EnergyCo

September 2023

Central-West Orana Renewable Energy Zone Transmission project

Technical paper 18 – Air quality

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Central-West Orana Renewable Energy Zone Transmission project
Technical paper 18 – Air quality

EnergyCo

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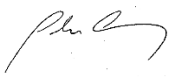
Prepared by:	John Conway	20/09/2023	
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WSP acknowledges that every project we work on takes place on First Peoples lands.
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

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Glossary

Term	Definition
Access roads	Permanent access roads to switching stations and energy hubs.
Access tracks	Temporary and permanent access tracks to transmission lines.
Air NEPM	National Environment Protection (Ambient Air Quality) Measure
Air Toxics NEPM	National Environment Protection (Air Toxics) Measure
Approved Methods	Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales 2022
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.
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, workforce accommodation camps, construction compounds and laydown and staging areas.
Construction compound	An area used as the base for construction activities, usually for the storage of plant, equipment and materials, and/or construction site offices and worker facilities. It can also comprise concrete batching plant, crushing, grinding and screening plant, testing laboratory and wastewater treatment plant.
Construction routes	Roads used by construction vehicles (light and heavy).
Enabling works	Activities that would be carried out before the start of substantial construction in order to make ready the key construction sites (including workforce accommodation camps and compounds), facilitate the commencement of substantial construction, manage specific features or issues and collect additional information required to finalise the final design and construction methodology.
EnergyCo	The Energy Corporation of New South Wales constituted by section 7 of the EUA Act as the NSW Government-controlled statutory authority responsible for the delivery of NSW's REZs.
Energy hub/s	An energy hub is a substation where energy exported from renewable energy generators or storage is aggregated, transformed to 500 kV (where required) and exported to the transmission network. For the project, this includes Merotherie Energy Hub and Elong Elong Energy Hub.
Renewable energy generators	A renewable energy provider to the CWO REZ.
Renewable energy generation and storage projects	The various renewable energy generation and storage projects within the CWO REZ that would be delivered by others, such as wind farms and solar farms.

Term	Definition
Essential Energy	The asset owner of multiple distribution lines below 132 kV in the region that cross the project at multiple locations.
IAQM guidance	Guidance on the Assessment of Dust from Demolition and Construction (Institute of Air Quality Management, 2014).
Impact	Influence or effect exerted by a project or other activity on the natural, built and community environment.
Operation area	The area that would be occupied by permanent components of the project, 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.
Renewable Energy Zone (REZ)	A geographic area identified and declared by the NSW Government as a REZ.
Separate works	Critical activities that are required to facilitate delivery of the transmission project, assessed, and determined by a separate planning approval process to the CSSI application.
Study area	For construction activities, the study area is within 350 metres (m) of the construction area and within 50 m of the construction routes used by construction vehicles on public roads up to 500 m from each construction area access point. For construction routes, the study area is 100 m of sealed roads and 200 m of unsealed roads. For operations, the study area considered is 100 m of the project.
Substation	A facility used to increase or decrease voltages between incoming and outgoing lines (e.g. 330 kV to 500 kV).
Switching station	A facility used to connect two or more distinct transmission lines of the same designated voltage.
Trackout	The dirt, mud or other materials tracked onto a sealed public roadway by a vehicle leaving a construction site.
Transmission line easement	An area surrounding and including the transmission lines which is a legal 'right of way' and allows for ongoing access and maintenance of the transmission lines. Landowners can typically continue to use most of the land within transmission line easements, subject to some restrictions for safety and operational reasons.
Twin transmission line	A pair of single or double circuit transmission lines running parallel.
Workforce accommodation camps	Areas that would be constructed and operated during construction to house the construction workforce.

Abbreviations

Acronym	Definition
AQIA	Air Quality Impact Assessment
AAQMS	Ambient Air Quality Monitoring Station
AWS	Automatic Weather Station
BoM	Bureau of Meteorology
CO	Carbon monoxide
CSSI	Critical State Significant Infrastructure
EIS	Environmental impact statement
EMF	Electromagnetic field
EP&A Act	*(NSW) Environmental Planning and Assessment Act 1979*
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DPE	NSW Department of Planning and Environment
DPIE	Department of Planning, Industry and Environment
EPL	Environment Protection Licence
FY	Financial year
HDV	Heavy duty vehicles defined as vehicles with a gross weight greater than 3.5 tonnes
HV	High voltage
HVAS	High volume air sampler
IAQM	Institute of Air Quality Management
LGA	Local Government Area
LNG	Liquefied natural gas
MCC	Moolarben Coal Complex
MCO	Moolarben Coal Operations
MWRC	Mid-Western Regional Council
NEM	National Energy Market
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NO_x	Oxides of nitrogen
NO	Nitrogen monoxide
NO_2	Nitrogen dioxide
NPI	National Pollutant Inventory

Acronym	Definition
NSW	New South Wales
PAHs	Polycyclic Aromatic Hydrocarbons
PEA	Peabody Energy Australia Pty Ltd
PM	Particulate matter
$PM_{2.5}$	Particles with an aerodynamic diameter of 2.5 micrometres or less
PM_{10}	Particles with an aerodynamic diameter of 10 micrometres or less
POEO Act	(NSW) *Protection of the Environment Operations Act 1997*
REZ	Renewable Energy Zones
SEARs	Secretary Environmental Assessment Requirements
SF_6	Sulphur hexafluoride
SO_2	Sulphur dioxide
SVOCs	Semi-volatile organic compounds
TEOM	Tapered Element Oscillating Meter
TSP	Total Suspended Particulates
UCML	Ulan Coal Mine Ltd
VOCs	Volatile Organic Compounds
WCPL	Wilpinjong Coal Pty Limited
WSP	WSP Australia Proprietary Limited
Units	
ºC	degree Celsius
Kg/m^3	kilograms per cubic metre
km	kilometre
km/h	kilometre per hour
kV	kilovolts
m	metre
mm	millimetres
Mtpa	million tonnes per annum
MW	megawatt
t/a	tonne per annum
$\mu g/m^3$	microgram per cubic metre
µm	micrometres

Executive summary

This technical paper assesses potential impacts to air quality 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 New South Wales (NSW) Department of Planning and Environment (DPE) and against the relevant legislation and guidelines as they apply to air quality.

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.

Legislative and policy context

Impacts to air quality from construction and operation of the project were assessed in accordance with the relevant legislation and guidelines as they apply to air quality. Key guidelines considered as part of this assessment included:

- National Environment Protection (Ambient Air Quality) Measure 2021
- Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales 2022
- Guidance on the assessment of dust from demolition and construction, 2014 published by the Institute of Air Quality Management (IAQM).

Methodology

The study area for this air quality impact assessment is within 350 metres (m) of the construction area of the project, or within 50 m of the construction routes extending up to 500 m from each construction area access point.

For construction routes used by construction vehicles on public roads beyond 500 m from construction area access points, the study area was 100 m from sealed roads and 200 m from unsealed roads.

The existing environment of the study area was characterised using publicly available information for:

- topography
- sensitive receivers
- meteorology
- air quality.

Potential air quality impacts associated with the construction of the project were assessed for particulate matter (dust), gaseous emissions and odour during construction works. Construction routes were qualitatively assessed for dust emissions.

Dust emissions were assessed in accordance with the *Guidance on the assessment of dust from demolition and construction* published by the Institute of Air Quality Management (IAQM) in 2014 (hereafter referred to as the IAQM guidance) for the following locations and activities:

- the New Wollar Switching Station
- energy hubs at Elong Elong
- thirteen switching stations (E1 to E5 and M1 to M9)
- construction compounds and laydown areas to be located at Elong Elong Energy Hub, and the New Wollar Switching Station
- transmission towers and lines
- construction accommodation camps to be located at 118 Neeleys Lane, Cassilis
- blasting activities at specific locations including near energy hubs, switching stations and small areas along the transmission line alignment)
- activities associated with borrow pits (e.g., material excavation and earth movements)
- crushing and screening plants at the New Wollar Switching Station, the Elong Elong Energy Hub
- concrete batching plants at the New Wollar Switching Station, the Elong Elong Energy Hub.

There are no sensitive receivers within 350 m of the Merotherie Energy Hub construction area and in accordance with the IAQM guidance, the risk of potential dust impact would not be of significance and therefore not further considered in this assessment.

Construction routes used by construction vehicles on public roads beyond 500 m of the construction area access points, were addressed qualitatively through the identification of sensitive receivers within 100 metres of sealed roads and 200 metres of unsealed roads. These construction routes are beyond those defined in the IAQM guidance.

Dust emissions from construction works and any dust related ancillary construction works ‘screened out’ by the IAQM guidance criteria was assessed qualitatively.

Gaseous emissions generated from vehicles, and plant and machinery were assessed qualitatively.

Odour potentially generated form the on-site wastewater treatment plants at the accommodation camps were also addressed qualitatively.

Air quality impacts of potential emissions from the operation phase of the project were assessed qualitatively.

Site-specific mitigation measures were developed for construction and operation of the project. Following implementation of mitigation measures, residual impacts for the project were discussed.

Existing environment

The topography of the study area is relatively flat ranging from 450 metres Australian Height Datum (AHD) at the western end to 700 metres (m) at the north-east. There are no local topographical features of distinction that may impact on the dispersal of pollutants within the study area. Twenty-eight sensitive receivers were identified within the study area.

Climate statistical data collected at the Mudgee Airport Automatic Weather Station (AWS), Merriwa (Roscommon) AWS, Gulgong Post Office, Dunedoo Post Office, Cassilis (Dalkeith) and Dubbo Airport AWS was reviewed to evaluate local meteorological conditions.

The air quality of the study area is predominantly influenced by rural activities including wind-blown dust from exposed land, agricultural activities and from vehicular traffic using the local road network. At the eastern end of the construction area lies Ulan and Wollar, small mining townships. Dust emissions from nearby mining operations are likely to contribute to the local airshed. Approximately 56 kilometres to the west of the construction area lies Dubbo, a large regional township. The air quality in Dubbo is more influenced by industrial emissions, higher levels of traffic emissions and other diffuse emission sources commonly associated with urban areas.

A review of the National Pollutant Inventory (NPI) database indicated that the airshed within the Local Government Areas (LGAs) of the study area is influenced by a number of industrial activities including mining, farming, concrete product manufacturing, gas supply and chemical wholesaling in addition to a range of diffuse sources including fuel combustion, sealed and unsealed roads, wind-blown dust from exposed land and rail freight.

There are two ambient air quality monitoring stations (AAQMS) located beyond the western and eastern extents of the study area. The nearest AAQMS is located at Merriwa, 46 kilometres to the east of the study area and Dubbo AAQMS situated 56 km to the west. The Merriwa AAQMS is an Air NEPM performance monitoring station. The instrument used at the Dubbo AAQMS is not a reference or reference equivalent method.

As such, the data collected is considered indicative of particulate matter concentrations in a regional area.

The latest five years (2017 to 2021) of monitoring data for particulate matter equal to or less than 10 micrometres in aerodynamic diameter (PM_{10}) and particulate matter equal to or less than 2.5 micrometres in aerodynamic diameter ($PM_{2.5}$) at Merriwa AAQMS was analysed and presented in this assessment. Data collected at the Merriwa AAQMS recorded the following exceedances:

- the annual PM_{10} concentration exceeded the Air NEPM standard in 2019
- the 24-hour PM_{10} concentrations exceeded the Air NEPM standard for the years 2018 to 2020. The exceedances were due to bushfire smoke and regional dust events
- the 24-hour $PM_{2.5}$ concentrations exceeded the Air NEPM standard in 2020.

Overall, the data collected at the Merriwa AAQMS is broadly representative of particulate levels in regional areas.

Particulate matter (PM) monitoring data collected at locations in the vicinity of the Moolarben, Wilpinjong and the Ulan coal mines were analysed for the years 2017 to 2021. All of the coal mines are located close to the transmission line that runs from the Merotherie Energy Hub to the New Wollar switching station and have the potential to influence the local airshed at the eastern end of the Project.

In summary, the existing environment of the study area is characterised by relatively flat terrain with large areas of exposed and agricultural land which is subject to dust generation during hot and windy conditions. The study area also contains a low number of sensitive receivers that may be impacted by emissions from construction works.

Potential construction impacts

The risk of dust impacts (dust soiling and human health) from earthworks and activities associated with construction works for the project were determined to be low to negligible at all locations assessed before mitigation measures are applied.

The risk of dust impacts (dust soiling) from trackout were assigned a low risk before the implementation of mitigation measures. With the implementation of mitigation measures detailed in Chapter 7, the risk of dust impacts (dust soiling and human health) from earthworks, construction activities and trackout would be further reduced.

Construction routes were addressed qualitatively through the identification of sensitive receivers within 100 metres of sealed roads and 200 metres of unsealed roads. There are 33 sensitive receivers within 200 metres of the identified construction routes. The impacts to these receivers would be intermittent, of short duration and would likely only impact a small number of receivers at any given time.

Potential gaseous and odour emissions during construction works were addressed qualitatively. Given the anticipated duration of construction at any given location, the likely numbers of emission sources, and scheduling of activities (i.e., not all machinery would be operating at the same location simultaneously), gaseous emissions are not anticipated to significantly influence local air quality. Potential odour emissions from the wastewater treatment plants at each of the accommodation camps would not be of significance.

Potential operational impacts

During operation, potential wind-blown dust emissions from unsealed tracks and roads would be negligible. No other air emissions would be generated either from the operation of transmission lines, the New Wollar Switching Station, the Elong Elong and Merotherie Energy Hubs, and the 13 switching stations.

During routine inspection, maintenance or emergency, potential gaseous and dust emissions are anticipated to be negligible, and the impacts of this on surrounding areas would not be of significance.

Recommended management measures

Air quality management measures would form part of the Construction Environmental Management Plan (CEMP). Mitigation measures are recommended in Chapter 7 to minimise potential air quality impact during construction and operation of the project.

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 (REZs) across NSW to deliver renewable energy generation and storage projects, supported by transmission infrastructure. A REZ connects renewable energy generation and energy storage systems to transmission infrastructure via energy hubs, 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 assesses the potential impacts to air quality from construction and operation of the project and has been prepared to support and inform the Environmental Impact Statement (EIS).

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

Table 1-1 SEARs relevant to this paper

Reference	Assessment requirement	Location where it is addressed
Key issue – Air	An assessment of the air quality impacts of the project	Chapters 5 and 6

1.2.1 Related technical papers

This technical paper is linked to the assessments completed in the following technical papers:

- Technical paper 13 – Traffic and transport: traffic volumes and construction routes
- Technical paper 16 – Contamination: areas of contamination.

1.3 Project overview

The project comprises the construction and operation of new electricity transmission infrastructure, energy hubs and switching stations within the Central-West Orana REZ. 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 National Electricity Market (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

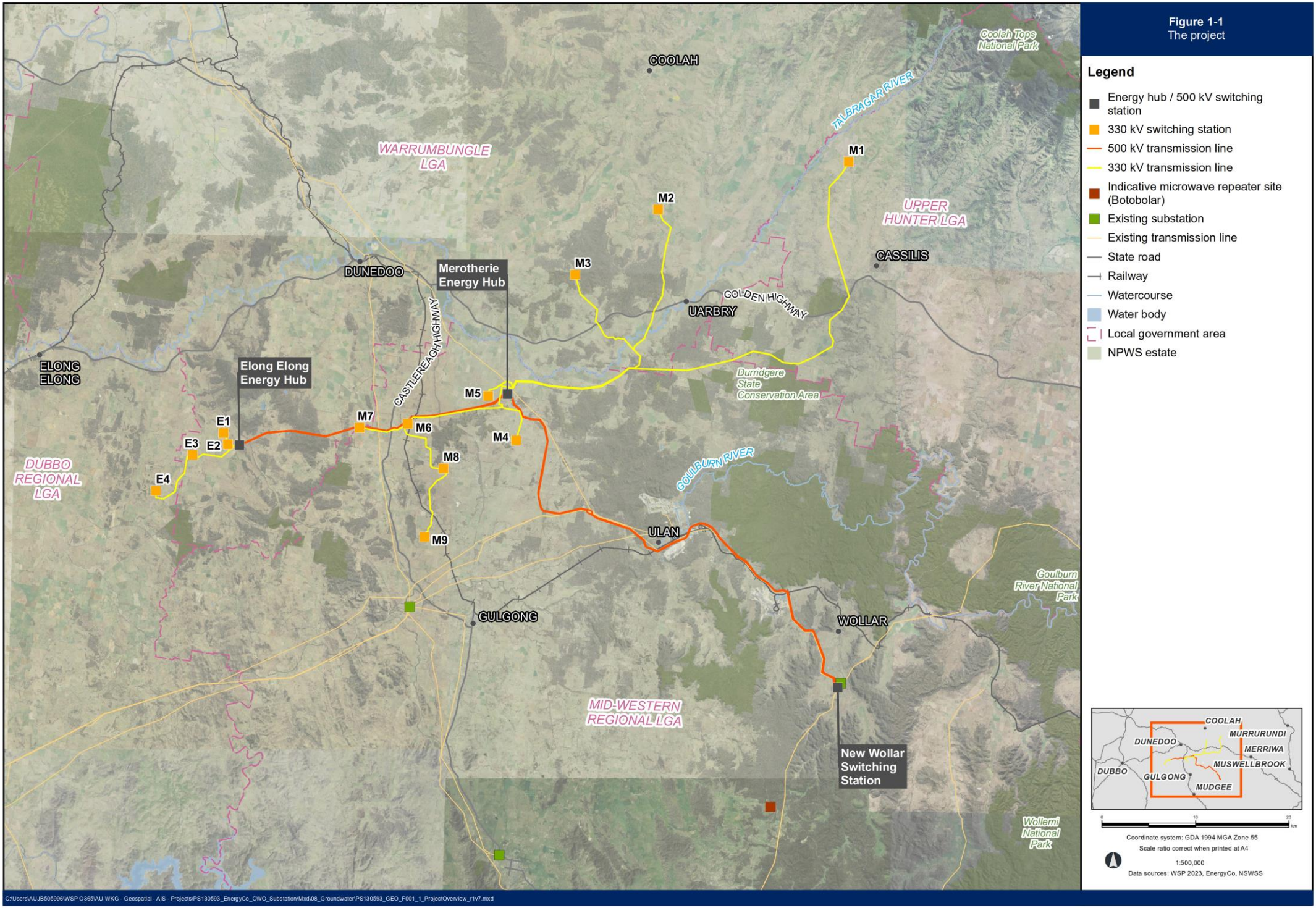
The project would comprise the following features:

- a new 500 kV 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 500 kV 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)
- property adjustment works to facilitate access to the transmission lines and switching stations. These works include the relocation of existing infrastructure on properties that are impacted by the project

- 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 500 kV transmission lines 5A3 (Bayswater to Mount Piper) and 5A5 (Wollar to Mount Piper) to provide 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 is shown in Figure 1-1.


COOLAH
Coolah Tops National Park
TALBRAGAR RIVER
WARRUMBUNGLE LGA
M1
M2
UPPER HUNTER LGA
CASSILIS
DUNEDOO
Merotherie Energy Hub
M3
GOLDEN HIGHWAY
UARBRY
ELONG ELONG
Elong Elong Energy Hub
CASTLEREAGH HIGHWAY
Durridgere State Conservation Area
M5
M7
M6
M4
E1
E3
E2
M8
DUBBO REGIONAL LGA
E4
GOULBURN RIVER
ULAN
M9
Goulburn River National Park
GULGONG
WOLLAR
MID-WESTERN REGIONAL LGA
New Wollar Switching Station
Wollemi National Park
Figure 1-1
The project
Legend
Energy hub / 500 kV switching station
330 kV switching station
500 kV transmission line
330 kV transmission line
Indicative microwave repeater site (Botobolar)
Existing substation
Existing transmission line
State road
Railway
Watercourse
Water body
Local government area
NPWS estate
COOLAH
MURRURUNDI
DUNEDOO
MERRIWA
MUSWELLBROOK
DUBBO
GULGONG
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Scale ratio correct when printed at A4
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Data sources: WSP 2023, EnergyCo, NSWSS
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1.3.3 Timing

Construction of the project would commence in the second half of 2024, subject to NSW Government and Commonwealth planning approvals, and is estimated to take about three 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
- earthwork material site activities
- 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 for the project 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 works and demobilised at the completion of construction. 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 1,800 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.

Operation of the project would require the establishment of transmission line easements. These easements would be around 60 metres for each 330 kV transmission lines and 70 metres for each 500 kV transmission lines. Where network infrastructure is collocated, easement widths would increase accordingly (for example, a twin double circuit 500 kV 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 vegetation types present.

1.4 Structure of the paper

The structure and content of this air quality technical paper is as follows:

- Chapter 1 – provides an introduction to this technical paper (this chapter)
- Chapter 2 – provides an overview of the regulatory context for this air quality assessment, including an overview of the legislation, policy, and guidelines relevant to air quality that apply to the project
- Chapter 3 – outlines the methodology adopted for this air quality impact assessment
- Chapter 4 – describes the existing environment of the project study area as it relates to air quality
- Chapter 5– describes the potential impacts to air quality from construction of the project
- Chapter 6 – describes the potential impacts to air quality from operation of the project
- Chapter 7 – provides recommended mitigation and management measures to avoid, minimise and manage any potential impacts to air quality from construction and/or operation of the project
- Chapter 8 – identifies the key reports and documents used to generate this paper.

The appendices to this paper are:

- Appendix A – Location of sensitive receivers within the study area around construction area
- Appendix B – Location of sensitive receivers along the construction routes.

2 Legislative and policy context

Environmental planning approval for the project is required in accordance with the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The project is also a controlled action and therefore requires Commonwealth assessment and approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Sections 5.12 and 5.13 of the EP&A Act provide for the declaration of State significant infrastructure (SSI) and Critical State Significant Infrastructure (CSSI). On 23 November 2020, the Minister for Planning made the Environmental Planning and Assessment Amendment (Central-West Orana Renewable Energy Zone Transmission Order) 2020. The Order declares the whole Central-West Orana REZ Transmission project to be CSSI.

This section describes the Commonwealth and State legislation and policies relevant to the assessment of air quality impacts.

2.1 Pollutants of interest relevant to the project

The key pollutants expected to be emitted during construction and operation of the project determine how relevant legislation, guidelines and standards are applied.

The construction of the project is expected to generate dust from activities including earthworks and ground disturbance activities, construction works and movement of vehicles on sealed and unsealed roads. The combustion of engine fuel from vehicle movements and the operation of on-site plant and machinery has the potential to generate particulate matter[1] (PM) and gaseous air pollutants. During operations, windblown dust may be generated from unsealed access tracks and easements along the transmission lines and any unsealed project roads, including at the energy hubs and switching stations. During routine inspection, maintenance or emergency works, light vehicles or light aircraft would be used to transport personnel to the various sites. This would generate emissions (gaseous and dust) due to fuel combustion from light vehicles, helicopters, and drones and dust emissions from light vehicles travelling on unsealed roads. Dust emissions may also be generated during vegetation clearing.

Overall, the following key air pollutants relevant to the project were identified:

- PM or dust associated pollutants, including:
  - total suspended particulates (TSP)
  - particulate matters equal to or less than 10 micrometres in aerodynamic diameter (PM_{10})
  - particulate matters equal to or less than 2.5 micrometres in aerodynamic diameter ($PM_{2.5}$)
  - deposited dust.
- Gaseous air pollutants, including:
  - carbon monoxide (CO)
  - oxides of nitrogen (NO_x) comprising of nitrogen dioxide (NO_2) and nitrogen monoxide (NO)
  - sulphur dioxide (SO_2)
  - volatile organic compounds (VOCs) e.g., benzene
  - semi-volatile organic compounds (SVOCs) e.g., polycyclic aromatic hydrocarbons (PAHs).

[1] The terms particulate matter and dust are used interchangeably. For the purposes of this assessment, the term ‘dust’ has been used to include particles that give rise to soiling and to human health effects.

2.2 Commonwealth legislation

2.2.1 National Environment Protection Council Act 1994

The National Environment Protection Council (NEPC) was established under the *National Environment Protection Council Act 1994* (NEPC Act). The primary functions of the NEPC are to:

- prepare National Environment Protection Measures (NEPMs)
- assess and report on the implementation and effectiveness of the NEPMs in each state and territory.

NEPMs are a special set of national objectives designed to assist in protecting or managing aspects of the environment, including air quality. The NEPM relevant to air quality for the project is the National Environment Protection (Ambient Air Quality) Measure 2021 (Air NEPM), which is described in more detail in Section 2.2.2 below.

2.2.2 National Environment Protection (Ambient Air Quality) Measure, 2021

The Air NEPM outlines the standards and goals for key air pollutants that are required to be achieved nationwide, with due regard to population exposure. These national environment protection standards for ambient air quality, as included in the Air NEPM are presented in Table 2-1.

The Air NEPM sets health-based air quality standards for seven air pollutants. These standards are not relevant to air emissions from individual sources, specific industries, or roadside locations. Air NEPM standards are intended to be applied at performance monitoring locations that represent air quality for a region or sub-region of 25,000 people or more.

The Air NEPM is reviewed periodically based on the latest scientific understanding of the health effects of air pollutants which may lead to revised air quality standards. For example, the latest review led to the recent changes to the NO_2 and SO_2 standards and the future changes to the $PM_{2.5}$ standards in 2025.

Table 2-1 Ambient air quality standards from the Air NEPM

Pollutant	Averaging period	Standards[1]	Maximum allowable exceedances
PM_{10}	1 day	50 µg/m^3	None
	1 year	25 µg/m^3	None
$PM_{2.5}$[2]	1 day	25 µg/m^3	None
	1 year	8 µg/m^3	None
NO_2	1 hour	0.08 ppm	None
	1 year	0.015 ppm	
CO	8 hours	9.0 ppm	None
SO_2	1 hour	0.10 ppm	None
	1 day	0.02 ppm	

(1) 100th percentile

(2) Commonwealth, State and Territory Environment Ministers have flagged an objective to move to $PM_{2.5}$ standards of 20 µg/m^3 (1-day average) and 7 µg/m^3 (1-year average) by 2025.

2.3 NSW legislation

2.3.1 *Protection of the Environment Operations Act 1997*

The *Protection of the Environment Operations Act 1997* (POEO Act) provides the legislative framework for the protection and enhancement of air quality in NSW. Its primary objectives are to reduce human health risks to harmless levels through pollution prevention, cleaner production, application of waste management hierarchy, continual environmental improvement, and environmental monitoring.

Under Schedule 1, Scheduled activities, Part 1, Clause 16 prescribes the threshold for which an Environment Protection Licence (EPL) is required:

'***16 Crushing, grinding or separating***

*(1) This clause applies to "**crushing, grinding or separating**', meaning the processing of materials (including sand, gravel, rock or mineral, but not including waste of any description) by crushing, grinding or separating them into different sizes.*

……

(2) *The activity to which this cause applies is declared to be a scheduled activity if it has a capacity to process more than 150 tonnes of material per day or 30,000 tonnes of materials per year.*'

During construction of the project, crushing and screening may occur at several locations within the construction area, including the New Wollar Switching Station, the Elong Elong Energy Hub and the Merotherie Energy Hub. However, where crushing and screening occurs, the total estimated amount of material to be processed is not expected to exceed 150 tonnes of material per day or more than 30,000 tonnes per year and hence would not require an EPL to operate.

2.4 Policy, standards, and guidelines

2.4.1 *Approved Methods for the Modelling and Assessment of Air Quality in NSW, 2022*

The NSW EPA's *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales 2022* (Approved Methods) prescribes the statutory methods for modelling and assessing emissions of air pollutants from stationary sources in the state.

The Approved Methods lists impact assessment criteria for a range of pollutants and the relevant criteria of this project are presented in Table 2-2.

Table 2-2 Air quality impact assessment criteria in the Approved Methods

Pollutant	Averaging period	Standards
TSP	Annual	90 µg/m^3
PM_{10}	24 hours	50 µg/m^3
	Annual	25 µg/m^3
$PM_{2.5}$	24 hours	25 µg/m^3
	Annual	8 µg/m^3
Deposited dust	Annual	2 g/m^2/month (incremental) 4 g/m^2/month (cumulative)

Pollutant	Averaging period	Standards
NO_2	1 hour	164 µg/m^3
	Annual	31 µg/m^3
CO	15 minutes	100 mg/m^3
	1 hour	30 mg/m^3
	8 hours	10 mg/m^3
SO_2	1 hour[1]	286 µg/m^3
	1 hour[2]	215 µg/m^3
	24 hours	57 µg/m^3

(1) Criterion applies to impact assessments prepared before 1 January 2025

(2) Criterion applies to impact assessments prepared after 1 January 2025

2.4.2 *Guidance on the assessment of dust from demolition and construction 2014*

Guidance on the assessment of dust from demolition and construction Version 1.1, 2014, produced by the Institute of Air Quality Management (IAQM) [hereafter referred to as the IAQM guidance], provides guidance for defining the significance of air quality impacts due to construction of a new development based on the magnitude of change i.e., the predicted increase or decrease in concentrations from the project, and the sensitivity of the receivers.

This guidance is widely used in NSW for the semi-quantitative assessment of the risk of air quality (primarily particulate matter) impacts from construction works.

3 Methodology

3.1 Overview

This chapter describes the methods used to assess potential air quality impacts as a result of the construction and operation of project. As the nature and extent of activities during the construction and operation phase vary, the assessment methodology used for each phase were discussed separately.

The methodology applied to assess the potential impacts of the project on air quality include:

- determining the study area for the impact assessment
- establishment of the existing environment of the study area, including identification of air quality sensitive receivers within the study area that may be affected by construction and operation of the project
- identification of key air quality issues and potential sources of emissions generated by construction and operation of the project
- assessing potential impacts of the project on air quality during construction using a risk-based approach in accordance with the IAQM guidance
- assessing qualitatively potential air quality impacts during operations
- development of mitigation measures to avoid, minimise and manage any potential impacts identified.

The methodology for this air quality impact assessment is detailed in the sections below.

3.2 Study area

The study area has been developed using a risk-based approach and is adopted from, and consistent with the IAQM guidance. To capture the potential air quality impacts from construction of the project the project, the study area comprises:

- the construction area and areas within 350 metres
- construction routes extending up to 500 metres from each access point along the public road network and encompassing adjoining land by up to 50 metres from the route.

Along construction routes used by construction vehicles on public roads that are beyond 500 m from the construction area access points, potential air quality impacts would extend up to 100 m of sealed roads and 200 m of unsealed roads. Construction routes consist of roads used by construction traffic on a regular basis for movements between the construction area, construction compounds and workforce accommodation camps.

For operations, the potential air quality impacts would be within 100 m of the transmission lines and towers, energy hubs and switching stations. Beyond 100 m of these infrastructure components, air emissions are anticipated to have minimal impact on the receiving environment given the low level of activity during operations and are not expected to be of significance. Therefore operational impacts fall within the study area.

3.3 Existing environment

The existing environment relevant to air quality was characterised using the following aspects:

- topography
- sensitive receivers
- local meteorology
- ambient air quality.

The topography of the study area and surrounds was described and characterised using data obtained from Geoscience Australia.

The Approved Methods describes a sensitive receiver as '*A location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area. An air quality impact assessment should also consider the location of any known or likely future sensitive receptors*.'

Note sensitive receivers and sensitive receptors are interchangeable descriptors which describe locations that may be impacted by air emissions. They are referred to as sensitive receptors in the Approved Methods. For consistency with the EIS for the project and other technical papers being prepared, they are referred to as sensitive receivers in this Technical paper.

Twenty-seven sensitive receivers within the study area were identified using aerial imagery and information provided by the project team.

The type of soil in the study area was reviewed using information provided in Technical paper 16 – Contamination. The dust magnitude (increase or decrease) is dependent on the type of soil e.g., clay is considered to be a dusty soil type with a large dust magnitude and prone to suspension when dry due to small particle size. In contrast, sand is a soil type with a large grain size and small dust magnitude. The predominant soil types across the study area are typically loam and clay or a mix of the two.

The local climate and local meteorology were characterised using information obtained from the Bureau of Meteorology (BoM). The key meteorological parameters used include hourly records of wind speed, wind direction together with temperature, rainfall, and relative humidity. There are several meteorological stations near the study area that characterise the local climate using the most recent long-term datasets and are illustrated in Figure 4-2. These are:

- Mudgee Airport automatic weather station (AWS) [station number: 062101], located approximately 32 km south-west of the study area
- Merriwa (Roscommon) station (station number: 061287) located approximately 32 km east of the project
- Gulgong Post Office station (station number: 062013), located approximately 10 km to the south-east end of the project
- Dunedoo Post Office station (station number: 064009), located approximately 18 km to the north of the project
- Cassilis (Dalkeith) station (station number: 062009), located approximately 3.2 km to the west of the project
- Dubbo Airport AWS (station number: 065070), located approximately 55 km to the west of the project.

The recorded meteorological data has been analysed and is considered in further detail in Section 4.3. The data at all of the meteorological stations are broadly representative of the local climate given their proximity to the project, although there is likely to be variances due to location and local topography.

The air quality of the study area and surrounds (local airshed) were characterised using publicly available information obtained from the National Pollutant Inventory website and the NSW EPA website. The local airshed is influenced by rural activities including agricultural works. wind-blown dust from exposed land, and vehicular traffic using the local road network. Beyond the eastern extent of the study area lies several mines, the emissions of which are likely to contribute to the local airshed.

The National Pollutant Inventory (NPI), an online database providing public information on estimated emissions of 93 substances from industrial and non-industrial sources across Australia. The study area extends across four Local Government Areas (LGAs) for which emissions from industrial facilities are reported in the Financial Year (FY) 2020/2021.

Ambient air quality data at two NSW Government ambient air quality monitoring stations (AAQMS) were analysed for the tears 2017 to 2021. The nearest AAQMS to the study area are the Merriwa AAQMS and Dubbo AAQMS. The Merriwa AAQMS is a NEPM performance monitoring station and continuously monitors for PM_{10} and $PM_{2.5}$. The Dubbo AAQMS currently measures PM_{10} and $PM_{2.5}$ using a Dust Trak and provided indicative ambient dust concentrations in a regional environment.

PM monitoring data collected at locations in the vicinity of the Moolarben Coal Mine and the Wilpinjong Coal Mine were analysed for the years 2017 to 2021. Both coal mines are located close to the transmission line that runs from the Merotherie Energy Hub to the New Wollar Switching Station.

3.4 Impact assessment

3.4.1 Construction

The assessment of potential impacts to air quality during construction were assessed for particulate matter (dust), gaseous emissions and odour. Construction routes that extend outside of the construction area but included in the study area for this assessment were qualitatively assessed for dust emissions.

Potential air quality impacts associated with construction activities are dust soiling and increased PM_{10} concentrations. Dust soiling would arise from the deposition of dust in all particulate matter size fractions. For this project, dust relevant to health outcomes is considered as PM_{10}. Most of the dust generated during construction works would be present in the coarse ($PM_{2\text{-}5\text{-}10}$) fraction rather than the $PM_{2.5}$ fraction. Consequently, for the assessment of health outcomes for the project, only PM_{10} has been considered in this assessment.

Quantitative assessment i.e., dispersion modelling was not considered to be required for the project given the linear and varying nature of construction works, and its relatively small scale.

3.4.1.1 Construction works

Dust emissions associated with the construction of the project were assessed in accordance with the IAQM guidance which provides a risk-based approach to air quality impact assessment with the aim to identify risks and to recommend appropriate mitigation measures to minimise these risks.

The IAQM guidance considers the risk of dust emissions from a construction site causing amenity and health impacts is related to:

- the activities being undertaken (earthmoving, number of vehicles and plant)
- the duration of these activities
- the size of the site
- the meteorological conditions (wind speed, direction, and rainfall)
- the proximity of receivers to the activities
- the adequacy of the mitigation measures applied to reduce or eliminate dust
- the sensitivity of the receivers to dust.

The quantity of dust emitted from construction activities is related to the area of land being worked, and the level of construction activity (nature, magnitude, and duration).

The wind direction, wind speed and rainfall when construction activities are taking place will also influence the likelihood of dust impacts. Adverse air quality impacts can occur in any direction from a construction site. They are, however, more likely to occur downwind of the prevailing wind direction and/or close to the construction site. Local conditions including topography and natural barriers (e.g., woodland) can affect airborne concentrations of dust due to impaction. Furthermore, existing background concentrations can be used to determine whether ambient air quality standards are likely to be exceeded as a result of construction activities.

The IAQM guidance for assessing risk involves the following steps:

- Conduct a risk-based assessment in accordance with the IAQM guidance for potential dust impacts associated with the project construction:
  - Step 1: Screen the need for a more detailed assessment. The IAQM guidance document recommends that a risk assessment is undertaken where sensitive receivers are located within 350 metres of the construction area, or 50 metres of the construction route (s) used by construction vehicles on public roads up to 500 metres from the construction area site access. For construction activities 'screened out' (i.e. excluded as they are expected to have minimal impacts on the receiving environment) a detailed risk assessment is not required. For these activities, the IAQM guidance indicates it can be concluded that the level of risk is 'negligible' and any effects would not be of significance.
  - Step 2: Assess the risk of dust impacts at the locations identified in Step 1. The risk assessment is completed separately for each type of construction activity identified as potentially generating dust including demolition, earthworks, general construction and track out[2] by heavy vehicles (i.e., haulage activities).
    - Step 2A: Determine the potential dust emission magnitude (large, medium, or small) of the works depending on the type of activity (see Table 3-1).
    - Step 2B: Determine the sensitivity (high, medium, or low) of the location to dust soiling and human health (see Table 3-2 and Table 3-3). Several factors are considered including the number of receivers and their proximity to the works, specific receiver sensitivities, existing PM_{10} background concentrations in the study area and site-specific factors that may reduce impacts (e.g. trees that may reduce wind-blown dust).
    - Step 2C: Define the risk of dust impacts on dust soiling and human health (see Table 3-4 and Table 3-5) by combining the dust emission magnitudes (large, medium or small) for demolition, earthworks, general construction and track out (Step 2A) with the sensitivity of the area (high, medium or low) (Step 2B).
  - Step 3: Determine the site-specific mitigation measures, where required/applicable.
  - Step 4: Examine the residual effects and determine whether or not these are significant.

Table 3-1 Example definitions for large, medium, and small dust emission magnitude

Activities	Large	Medium	Small
Demolition	— Total building volume >50,000 cubic metres (m^3) — Potentially dusty construction material e.g., concrete — On-site crushing/screening — Height of demolition activities (>20 m above ground level).	— Total building volume 20,000–50,000 m^3 — Potentially dusty construction material — Height of demolition activities (10–20 m above ground level).	— Total building volume <20,000 m^3 — Low potential for dust release e.g., metal — Height of demolition activities (<20 m above ground level) — Demolition during wetter months.

[2] Track out is dirt, mud or other materials tracked onto a sealed public roadway by a vehicle leaving a construction site

Activities	Large	Medium	Small
Earthworks	— Total site area >10,000 square metres — Potential dusty soil type (e.g., clay) — >10 heavy earth moving vehicles active at any one time — Formation of bounds >8 metres in height — Total material moved >100,000 tonnes (t).	— Total site area 2,500–10,000 square metres (m^2) — Moderately dusty soil type (e.g., silt) — 5–10 heavy earth moving vehicles active at any one time — Formation of bounds 4–8 m in height — Total material moved 20,000 t – 100,000 t.	— Total site area <2,500 m^2 — Soil type with large grain size (e.g., sand) — <5 heavy earth moving vehicles active at any one time — Formation of bounds <4 m in height — Total material moved <20,000 t — Earthworks during wetter months.
Construction	— Total building volume >100,000m^3 — On-site concrete batching — Sandblasting.	— Total building volume 25,000–100,000 m^3 — On-site concrete batching — Potentially dusty construction material (e.g., concrete).	— Total building volume <25,000 m^3 — Construction material with low potential for dust release (e.g., metal cladding or timber).
Track out	— >50 heavy duty vehicles (HDV>3.5t) outward movements in any one day — Potential dusty surface material (e.g., high clay content) — Unsealed road length >100 m.	— 10–50 HDV (>3.5t) outward movements in any one day — Moderately dusty surface material (e.g., high clay content) — Unsealed road length 50–100 m.	— <10 HDV (>3.5 t) outward movements in any one day — Surface material with low potential for dust release — Unsealed road length <50 m.

Table 3-2 Sensitivity of the area to dust soiling

Receiver sensitivity	Number of receivers	Distance from the source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10–100	High	Medium	Low	Low
	1–10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	<1	Low	Low	Low	Low

The annual mean PM_{10} concentration was conservatively assumed to be the Air NEPM standard of 25 µg/m^3 for the purposes of establishing the sensitivity of the study area to human health impacts.

Table 3-3 Sensitivity of the area to human health impacts

Receiver sensitivity	Annual mean PM_{10} concentration[1]	Number of receivers	Distance from the source (m)				
			<20	<50	<100	<200	<350
High	>25µg/m^3	>100	High	High	High	Medium	Low
		10–100	High	High	Medium	Low	Low
		1–10	High	Medium	Low	Low	Low
	<25µg/m^3	>100	High	Medium	Low	Low	Low
		10–100	High	Medium	Low	Low	Low
		1–10	Medium	Low	Low	Low	Low
Medium	>25µg/m^3	>10	High	Medium	Low	Low	Low
		1–10	Medium	Low	Low	Low	Low
Low	<25µg/m^3	≥1	Low	Low	Low	Low	Low

(1) The annual mean PM_{10} concentration ranges were adjusted to reflect the annual mean Air NEPM standard of 25 µg/m^3

Table 3-4 Risk of dust impacts for earthworks and construction

Sensitivity of area	Dust emission magnitude		
	Large	Medium	Small
High	High risk	Medium risk	Low risk
Medium	Medium risk	Medium risk	Low risk
Low	Low risk	Low risk	Negligible

Table 3-5 Risk of dust impact from track out from trucks

Sensitivity of area	Dust emission magnitude		
	Large	Medium	Small
High	High risk	Medium risk	Low risk
Medium	Medium risk	Low risk	Negligible
Low	Low risk	Low risk	Negligible

3.4.1.2 Construction routes

Construction routes (sealed and unsealed) external to the construction area would also be used to transport material by trucks to and from energy hubs, construction compounds and workforce accommodation camps. Amenity impacts associated with dust potentially generated from trucks was also assessed qualitatively as part of this assessment.

3.4.1.3 Ancillary activities

Dust emissions from construction works and any dust related ancillary construction works ‘screened out’ by the IAQM guidance criteria were assessed qualitatively. Operation of ancillary facilities such as workforce accommodation camps and construction compounds and, generation of traffic along construction routes were assessed qualitatively.

3.4.1.4 Gaseous emissions

Gaseous emissions generated from vehicles and fugitive sources and construction activities not included in the IAQM guidance were assessed qualitatively.

3.4.1.5 Odour

Wastewater treatment facilities are proposed to be constructed at the following workforce accommodation camps:

- Merotherie workforce accommodation camp
- Neeleys Lane workforce accommodation camp.

Where possible, it is proposed to reuse the greywater generated on-site and to minimise water usage during construction. Some associated odour may be generated on-site and hence a qualitative assessment was undertaken.

3.4.2 Operation

Gaseous emissions due to vehicle fuel combustion and wheel-generated dust on unsealed roads have the potential to be generated during routine inspection, maintenance, or emergency. The low frequency of these events and numbers of vehicles required are addressed qualitatively to assess the potential impact to air quality.

Low levels of sulphur hexafluoride gas (SF_6) would also be used as a high voltage insulating gas at energy hubs and switching stations and expected to be emitted at trace levels and potential impacts assessed qualitatively.

3.5 Mitigation measures

Site-specific mitigation measures were developed for construction and operation of the project in Chapter 7 for aspects of the risk assessment where a potential air quality impact has been identified as part of the risk assessment.

Following implementation of mitigation measures, residual impacts for the project were assessed.

4 Existing environment

4.1 Topography

The topography of the study area is relatively flat ranging from approximately 450 m Australian Height Datum (AHD) at the western end of the study area to 350 mAHD near the south-east (New Wollar Switching Station) and 700 mAHD at the north-east. The Goulburn River National Park lies at lower elevations directly east of the construction area. Except for the Coolah Tops National Park (highest elevation of 1,266 mAHD at East Bluff) and Towarri National Park, located approximately 23 km and 75 km respectively to the north-east of the construction area, there are no other major topographical features of significance.

Given the type and nature of the potential emission sources in the construction area, the local topography is not expected to significantly influence the dispersal of pollutants that may be generated during construction. Figure 4-1 presents the topography of the construction area and surrounds.

4.2 Sensitive receivers

There are 28 air quality sensitive receivers within the study area consisting of 24 residences, three unoccupied properties and one property with approved development application (DA) to build a house. There are no identified sensitive receivers within 350 m of the M1, M2, M3, M4, M6, M7, M8, M9, E1 to E4 switching stations or any of the workforce accommodation camps. Table 4-1 presents the identified air quality sensitive receivers in the study area. Appendix A presents the locations of the sensitive receivers within the study area.

It is noted that at the time of finalising the air quality assessment, it became known there was a newly constructed dwelling at 121 Cliffdale Road, Uarbry in proximity to the construction area. As this was identified in the final stages of the preparation of this Technical paper, it has not been included. To address this issue a revised assessment will be carried out and the results presented in the submissions report. This will include conducting a search to confirm if any there are any newly approved DA's for properties in the study area that need to be included in the assessment.

Table 4-1 Identified air quality sensitive receivers within the study area

Receiver ID	Receiver type	Approximate distance to construction area (m)	Orientation from the project
New Wollar Switching Station			
ID: 19	Residence	265	North-west
Elong Elong Energy Hub			
ID: 719	Residence	85	North
M5 Switching Station			
ID: 876	Residence	230	East
ID: 880	Residence	230	East

Receiver ID	Receiver type	Approximate distance to construction area (m)	Orientation from the project
Transmission lines, towers, and access tracks			
ID: 181[1]	Residence	212	South-east
ID: 198	Residence	207	North-east
ID: 267	Residence	178	North-east
ID: 311	Residence	60	North-east
ID: 328	Residence	345	South
ID: 354	Residence	339	East
ID: 399	Residence	231	North
ID: 531	Residence	89	West
ID: 539	Residence	53	South
ID: 543	Residence (near access track)	25	North
ID: 580[1]	Residence	216	North-west
ID: 584	Residence	294	North-west
ID: 585	Residence	289	North-west
ID: 703	Residence	276	West
ID: 730[1]	Residence	350	North
ID: 927	Residence	314	North
ID: 929	Residence	204	North
ID: 979	Residence	272	North-west
ID: 1010	Residence	278	East
ID: 1015	Residence	260	East
ID: 1091	Residence	275	North
ID: 1351	Residence	205	South-east
ID: 1480	Residence	140	South-east
ID: 1483[2]	Residence	124	East

(1) Unoccupied residence

(2) Approval to develop a house

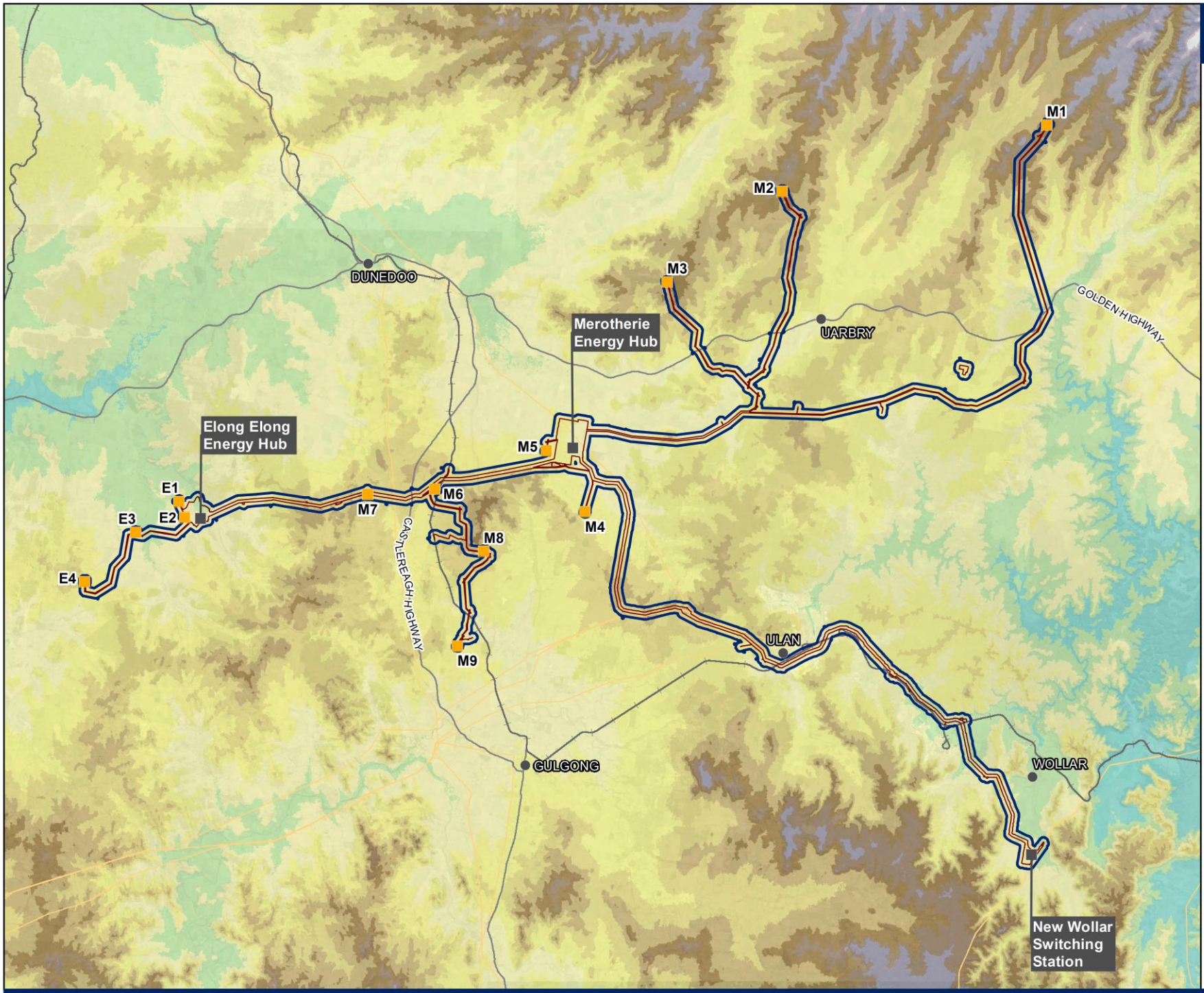


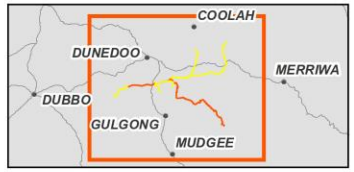
Figure 4.1
Local topography

Legend

- Study area
- Construction area
- Energy hub / 500 kV switching station
- 330 kV switching station
- Existing transmission line
- Road
- Railway

Surface Elevation (50m intervals)

- 180 - 350
- 350 - 400
- 400 - 450
- 450 - 500
- 500 - 550
- 550 - 600
- 600 - 650
- 650 - 700
- 700 - 800
- 800 - 850
- 850 - 900
- 900 - 950



Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A4

1:400,000

Data sources: WSP 2023

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4.3 Climate and meteorology

Meteorological conditions are important for determining the direction and rate at which emissions from a source disperse. The key meteorological parameters for air dispersion are wind speed, wind direction, temperature, rainfall, and relative humidity. Historical meteorological data in the vicinity of the study area was reviewed and the existing local meteorological conditions described below.

BoM collects meteorological data at Automatic Weather Stations (AWS) across Australia and can be used for determining climate statistics over a long period e.g. climate normals over a 30 year period.

Table 4-2 provides a summary of the nearest stations to the study area and Figure 4-2 illustrates these locations. As the terrain in the study area is undulating, the meteorological data presented in the following sections is considered representative of the local area.

Table 4-2 Summary of the meteorological stations near the project study area

Station name	Site number	Co-ordinates	Distance[1] (km) and direction	Station height (m)	Years operational	Notes
Mudgee Airport	062101	32.56ºS, 149.61ºE	32 km, south-west	471	1988 – to present	
Merriwa (Roscommon)	061287	32.19ºS, 150.17ºE	32 km, east	375	1969 – to present	Only rainfall and temperature recorded
Gulgong Post Office	062013	32.36ºS, 149.53ºE	10 km, south-east	475	1881 – to present	
Dunedoo Post Office	064009	32.02ºS, 149.40ºE	18 km, north	388	1912 – present	
Cassilis (Dalkeith)	062009	32.00ºS, 149.99ºE	3.2 km, east	420	1874 – present	Only rainfall data available
Dubbo Airport	065070	32.22ºS, 148.58ºE	56 km, west	284	1946 – present	

(1) Distance to nearest section of the construction area

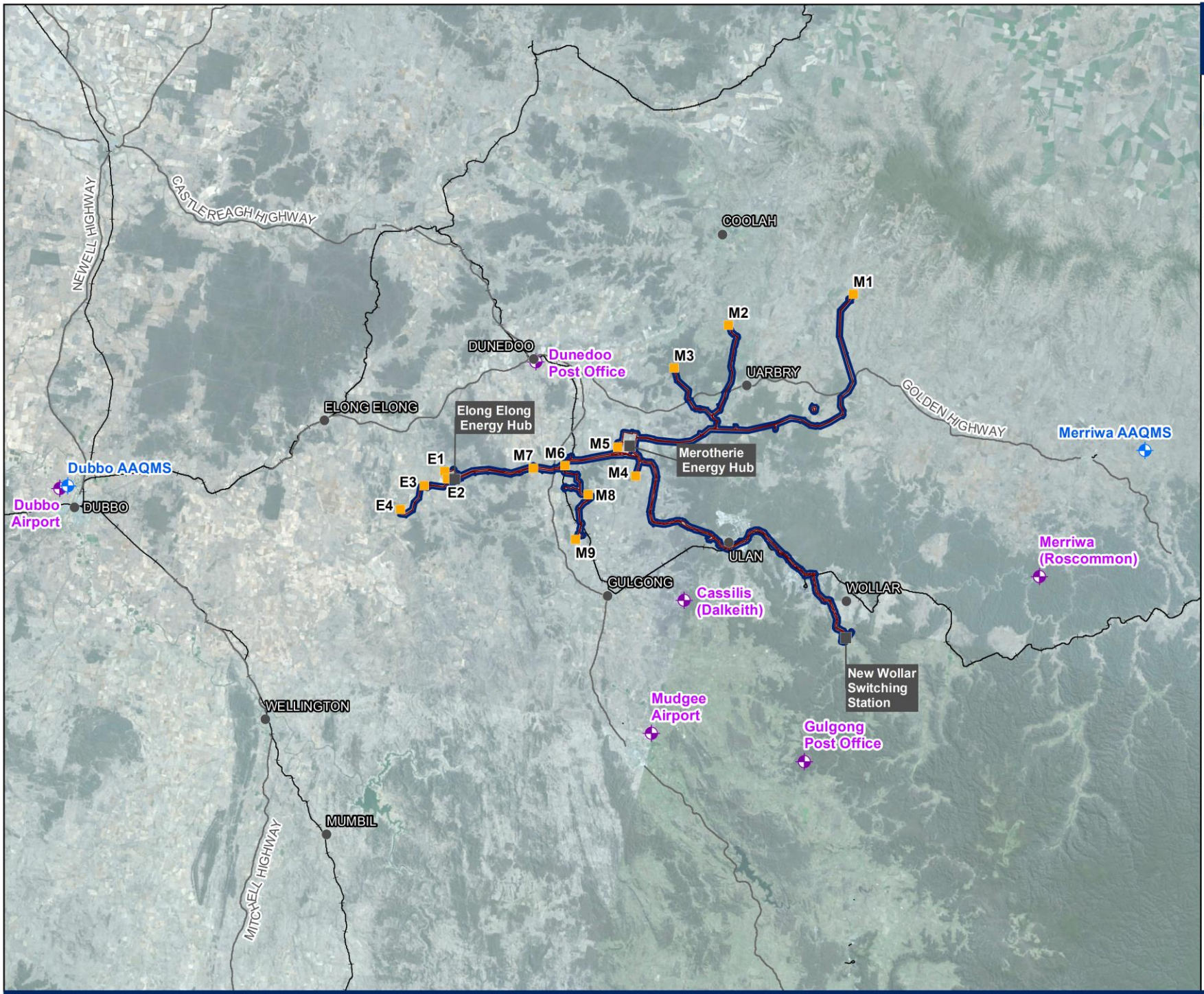

Figure 4.2
Location of meteorological and ambient air quality station

Legend

- Study area
- Construction area
- Energy hub / 500 kV switching station
- 330 kV switching station
- Road
- Railway
- Meteorological station
- Ambient air Quality monitoring station (AAQMS)

Coordinate system: GDA 1994 MGA Zone 55
Scale ratio correct when printed at A4

1:850,000

Data sources: WSP 2023

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4.3.1 Climate statistics

The climate statistical data recorded by BoM at each of the stations are presented in the following sections.

Given the extent of the study area, there are meteorological variations that have the potential to influence pollutant dispersal. The AWS at Mudgee Airport, Merriwa (Roscommon) and Dubbo Airport AWS have varying average wind speeds ranging from 3.1 m/s (Mudgee Airport AWS) to 4.3 m/s (Dubbo Airport AWS) with south-easterly winds a feature at each station. Temperatures are broadly similar across all three stations with Dubbo Airport AWS recording slightly higher monthly temperatures. The highest average annual rainfall of 643 millimetres (mm) is recorded in Mudgee.

4.3.1.1 Mudgee Airport AWS

Climate statistical data at the Mudgee Airport AWS are presented in Table 4-3.

The local climate at Mudgee Airport AWS is characterised by:

- an average maximum temperature of 31.1 degrees Celsius (°C) in January
- an average minimum temperature of 1.1°C in July
- an average annual rainfall of 642.9 millimetres (mm) and average of 60.2 rainy days
- an average maximum 9 am relative humidity of 87 per cent in June and July
- an average minimum 3 pm relative humidity of 37 per cent in December and January
- an average maximum 9 am wind speed of 17.3 kilometres per hour (km/hr) in October
- an average maximum 3 pm wind speed of 19.3 km/hr in September.

Table 4-3 Summary of climate statistics at Mudgee Airport AWS

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann[1]
Daily mean temperature (1991 to 2020)													
Max (°C)	31.1	29.4	26.8	23.0	18.6	15.0	14.6	16.3	19.7	23.2	26.5	28.9	22.8
Min (°C)	16.2	15.7	12.8	8.0	4.0	2.4	1.1	1.5	4.3	7.8	11.3	13.8	8.2
Rainfall (1994 to 2020)													
Mean rainfall (mm)	66.2	64.3	62.3	36.3	36.7	42.9	43.4	34.4	54.4	50.6	72.3	79.0	642.9
Mean days of rain (≥1 mm)	5.6	5.1	5.2	2.7	4.0	5.5	5.3	4.0	4.9	5.5	6.3	6.1	60.2
Mean 9 am conditions (1991 to 2020)													
Temperature (°C)	21.5	20.4	17.8	15.2	10.7	7.3	6.4	8.4	12.5	16.2	18.1	20.1	14.5
Relative humidity (per cent)	63	70	72	71	80	87	87	78	70	61	63	62	72
Wind speed (km/hr)	10.5	9.8	9.5	9.1	7.9	7.7	7.4	9.2	10.6	11.5	11.3	10.7	9.6
Mean 3 pm conditions (1991 to 2010)													
Temperature (°C)	29.1	27.9	25.4	21.8	17.6	14.0	13.5	15.3	18.4	21.5	24.6	27.1	21.4
Relative humidity (per cent)	37	42	42	41	49	57	55	47	44	41	40	37	44
Wind speed (km/hr)	16.7	15.9	15.2	15.1	14.8	15.6	16.2	18.4	18.7	18.6	18.1	17.3	16.7

(1) Ann: Annual

4.3.1.2 Merriwa (Roscommon)

Climate statistical data at the Merriwa (Roscommon) station are presented in Table 4-4.

The local climate at the Merriwa (Roscommon) station is characterised by:

- an average maximum temperature of 31.9ºC in January
- an average minimum temperature of 2.2ºC in July
- an average annual rainfall of 590.0 mm and average of 61.2 rainy days.

Table 4-4 Summary of climate statistics at Merriwa (Roscommon) station

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann[1]
Daily mean temperature (2007 to 2020)													
Max (ºC)	31.9	30.1	27.7	23.8	19.8	16.3	16.2	17.9	21.8	25.6	28.4	29.9	24.1
Min (ºC)	17.0	15.8	13.7	9.6	5.3	4.0	2.2	2.7	5.3	8.6	12.4	14.7	9.3
Rainfall (1991 to 2020)													
Mean rainfall (mm)	61.6	60.8	54.6	28.9	31.7	45.4	36.5	31.2	41.3	47.3	65.0	88.0	590.0
Mean days of rain (≥1 mm)	6.5	5.2	5.2	3.1	4.0	5.3	4.8	3.9	5.0	5.1	6.5	6.6	61.2

(1) Ann: Annual

4.3.1.3 Gulgong Post Office

Climate statistical data at the Gulgong Post Office station are presented in Table 4-5.

The local climate at the Gulgong Post Office station is characterised by:

- an average maximum temperature of 31.9ºC in January
- an average minimum temperature of 2.7ºC in July
- an average annual rainfall of 676.0 mm and average rainy days of 66.4
- an average maximum 9 am relative humidity of 85 per cent in June
- an average minimum 3 pm relative humidity of 37 per cent in December
- an average maximum 9 am wind speed of 9.1 km/hr in October
- an average maximum 3 pm wind speed of 12.5 km/hr in September.

Table 4-5 Summary of climate statistics at Gulgong Post Office station

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann[1]
Daily mean temperature (1991 to 2020)													
Max (ºC)	31.9	30.3	27.6	24.0	19.4	15.8	15.2	17.0	20.5	24.3	27.3	29.9	23.6
Min (ºC)	17.3	16.5	13.9	9.9	6.1	3.8	2.7	3.3	6.1	9.5	12.7	15.1	9.7
Rainfall (1991 to 2020)													
Mean rainfall (mm)	71.4	67.1	62.6	34.7	38.9	47.9	56.2	37.4	52.7	53.8	69.3	84.1	676
Mean days of rain (≥1 mm)	6.0	5.7	5.2	3.3	4.4	6.2	6.2	4.6	5.4	5.8	6.9	6.7	66.4

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann[1]
Mean 9 am conditions (1991 to 2010)													
Temperature (ºC)	21.6	20.4	18.0	15.6	11.2	7.8	6.8	8.6	12.6	16.5	18.2	20.4	14.8
Relative humidity (per cent)	64	71	72	71	79	85	84	76	70	62	63	63	72
Wind speed (km/hr)	8.5	7.0	5.8	5.8	5.2	4.3	4.3	6.5	8.1	9.1	8.6	8.5	6.8
Mean 3 pm conditions (1991 to 2010)													
Temperature (ºC)	29.8	28.7	26.2	22.7	18.4	14.6	13.9	15.8	19.2	22.5	25.4	27.9	22.1
Relative humidity (per cent)	38	42	41	41	48	57	54	46	43	40	39	37	44
Wind speed (km/hr)	10.0	9.6	8.3	8.2	9.8	9.8	9.6	12.4	12.5	11.8	10.9	10.4	10.3

(1) Ann: Annual

4.3.1.4 Dunedoo Post Office

Climate statistical data at the Dunedoo Post Office station are presented in Table 4-6.

The local climate at the Dunedoo Post Office station is characterised by:

- an average maximum temperature of 33.1ºC in January
- an average minimum temperature of 2.5ºC in July
- an average annual rainfall of 637.1 mm and average rainy days of 64.3
- an average maximum 9 am relative humidity of 86 per cent in June
- an average minimum 3 pm relative humidity of 38 per cent in November, December, and January
- an average maximum 9 am wind speed of 18 km/hr in December
- an average maximum 3 pm wind speed of 20.8 km/hr in December.

Table 4-6 Summary of climate statistics at Dunedoo Post Office station

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann[1]
Daily mean temperature (1991 to 2020)													
Max (ºC)	33.1	31.7	28.7	24.9	20.1	16.4	15.8	17.9	21.7	25.5	28.7	31.3	24.7
Min (ºC)	18.0	17.5	14.6	10.4	6.3	4.0	2.5	2.9	6.0	9.5	13.3	15.7	10.1
Rainfall (1994 to 2020)													
Mean rainfall (mm)	69.0	60.4	58.1	33.0	41.3	45.2	47.2	34.6	48.4	55.9	63.1	80.7	637.1
Mean days of rain (≥1 mm)	5.9	5.0	5.4	2.9	4.5	5.8	5.7	4.3	5.6	5.9	6.4	6.9	64.3
Mean 9 am conditions (1991 to 2010)													
Temperature (ºC)	22.9	21.8	19.2	16.6	12.0	8.5	7.2	9.4	13.9	17.9	19.6	21.9	15.9
Relative humidity (per cent)	63	68	70	70	79	86	85	76	68	60	61	60	71
Wind speed (km/hr)	17.9	16.3	16.6	13.6	10.6	9.4	8.3	11.5	14.1	16.5	17.6	18.0	14.2

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann[1]
Mean 3 pm conditions (1991 to 2010)													
Temperature (ºC)	30.9	29.9	27.3	23.4	18.9	15.2	14.5	20.1	23.3	26.5	28.7	22.9	20
Relative humidity (per cent)	38	40	41	42	50	57	56	57	43	41	38	38	44
Wind speed (km/hr)	19.1	17.7	18.2	16.4	16.1	16.5	15.8	18.5	19.1	20.1	20.4	20.8	18.2

(1) Ann: Annual

4.3.1.5 Cassilis (Dalkeith) station

Climate statistical data at the Cassilis (Dalkeith) station are presented in Table 4-7.

The local climate at the Cassilis (Dalkeith) station is characterised by an average annual rainfall of 634.1 mm and average of 60.3 rainy days.

Table 4-7 Summary of climate statistics at Cassilis (Dalkeith) station

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann[1]
Rainfall (1991 to 2020)													
Mean rainfall (mm)	65.8	68.2	62.1	32.9	33.0	47.6	43.6	34.3	43.5	49.2	66.9	89.1	634.1
Mean days of rain (≥1 mm)	5.7	5.3	5.2	3.1	4.1	5.3	4.9	4.5	4.7	4.9	6.4	6.2	60.3

(1) Ann: Annual

4.3.1.6 Dubbo Airport AWS

Climate statistical data at the Dubbo Airport AWS is characterised by:

- an average maximum temperature of 33.6ºC in January
- an average minimum temperature of 3.0ºC in July
- an average annual rainfall of 596.1 mm and average of 58.2 rainy days
- an average maximum 9 am relative humidity of 86 per cent in June and July
- an average minimum 3 pm relative humidity of 30 per cent in November
- an average maximum 9 am wind speed of 21.5 km/hr in January
- an average maximum 3 pm wind speed of 20.2 km/hr in November.

Table 4-8 Summary of climate statistics at Dubbo Airport AWS[2]

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann[1]
Daily mean temperature (1993 to 2022)													
Max (ºC)	33.6	32.0	29.0	24.9	20.1	16.4	15.7	17.5	21.4	25.2	28.7	31.5	24.7
Min (ºC)	18.4	17.6	14.8	10.4	6.5	4.4	3.0	3.2	6.0	9.5	13.5	16.0	10.3
Rainfall (1994 to 2020)													
Mean rainfall (mm)	58.7	45.0	68.0	36.4	39.5	48.6	43.9	37.1	41.5	45.8	61.8	61.7	569.6
Mean days of rain (≥1 mm)	5.2	4.8	5.2	3.1	4.1	5.6	5.3	4.3	5.0	4.9	5.7	5.0	58.2

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann[1]
Mean 9 am conditions (1993 to 2010)													
Temperature (ºC)	23.8	22.4	19.6	17.0	12.2	8.6	7.5	9.6	14.0	17.9	20.3	22.8	16.3
Relative humidity (per cent)	56	62	64	64	76	86	86	76	67	56	56	52	67
Wind speed (km/hr)	21.5	19.5	18.4	16.8	14.0	13.6	13.6	12.9	14.6	16.7	17.9	20.2	19.9
Mean 3 pm conditions (1993 to 2010)													
Temperature (ºC)	31.6	30.2	27.6	23.7	19.2	15.4	14.5	16.5	19.9	23.5	27.0	29.7	23.2
Relative humidity (per cent)	32	36	36	37	47	57	55	47	43	36	35	30	41
Wind speed (km/hr)	18.9	18.1	17.9	16.8	16.2	17.1	17.1	19.0	19.7	20.1	20.2	19.4	18.4

(1) Ann: Annual

4.3.2 Typical wind conditions

Detailed wind conditions were recorded at Mudgee Airport AWS, Merriwa (Roscommon) station and Dubbo AWS. Figure 4-3, Figure 4-4 and Figure 4-5 presents the annual and seasonal wind roses for these weather stations illustrating the frequency and direction of winds for the past five years (2017 to 2021).

The wind roses indicate that the typical winds at Mudgee Airport AWS are:

- mostly from the south-east, north-east and then south south-east over the five years (2017 to 2021) analysed with an average wind speed of 3.1 m/s and calm conditions (wind speeds of less than 0.5 m/s) of 8.6 per cent
- most frequently from the south-east during the summer with an average wind speed of 3.5 m/s and calm conditions of 4 per cent
- mostly from the south-east followed by the south south-east and north-east in the autumn with an average wind speed of 2.8 m/s and calm conditions of 10.4 per cent
- most frequently from the north-east and west during winter along with strong representation from other directions. An average wind speed of 2.8 m/s and calm conditions of 13.2 per cent were recorded
- mostly from the south-east and north-east and then the south south-east in spring with an average wind speed of 3.3 m/s and calm conditions of 6.8 per cent.

The wind roses indicate that the typical winds at the Merriwa (Roscommon) station are:

- mostly from the east south-east, west north-west followed by the west and east over the five years (2017 to 2021) analysed with an average wind speed of 3.7 m/s and calm conditions (wind speeds of less than 0.5 m/s) of 4.8 per cent
- most frequently from the east south-east and then east during the summer with an average wind speed of 4.2 m/s and calm conditions of 2.1 per cent
- mostly from the east south-east followed by the east, west north-west and west in the autumn with an average wind speed of 3.3 m/s and calm conditions of 6.8 per cent
- most frequently from the west north-west followed by the west and north-west during winter. An average wind speed of 3.3 m/s and calm conditions of 6.9 per cent were recorded
- mostly from the east south-east, west north-west, west, and east in spring with an average wind speed of 3.9 m/s and calm conditions of 3.5 per cent.

The wind roses indicate that the typical winds at the Dubbo Airport AWS station are:

- mostly from the east and then south-east over the five years (2017 to 2021) analysed with an average wind speed of 4.3 m/s and calm conditions (wind speeds of less than 0.5 m/s) of 2 per cent
- most frequently from the east and then east north-east during the summer with an average wind speed of 4.9 m/s and calm conditions of 1.2 per cent
- mostly from the east followed by the south-east in the autumn with an average wind speed of 4.1 m/s and calm conditions of 1.9 per cent
- most frequently from the east followed by the south south-east during winter with an average wind speed of 3.8 m/s and calm conditions of 3.4 per cent were recorded
- from a range of wind directions including the east, south-east, east north-east, and east south-east in spring with an average wind speed of 4.5 m/s and calm conditions of 1.8 per cent.

The meteorology at the study area is expected to similar to that presented in the previous sections with variances dependent upon location and topography.

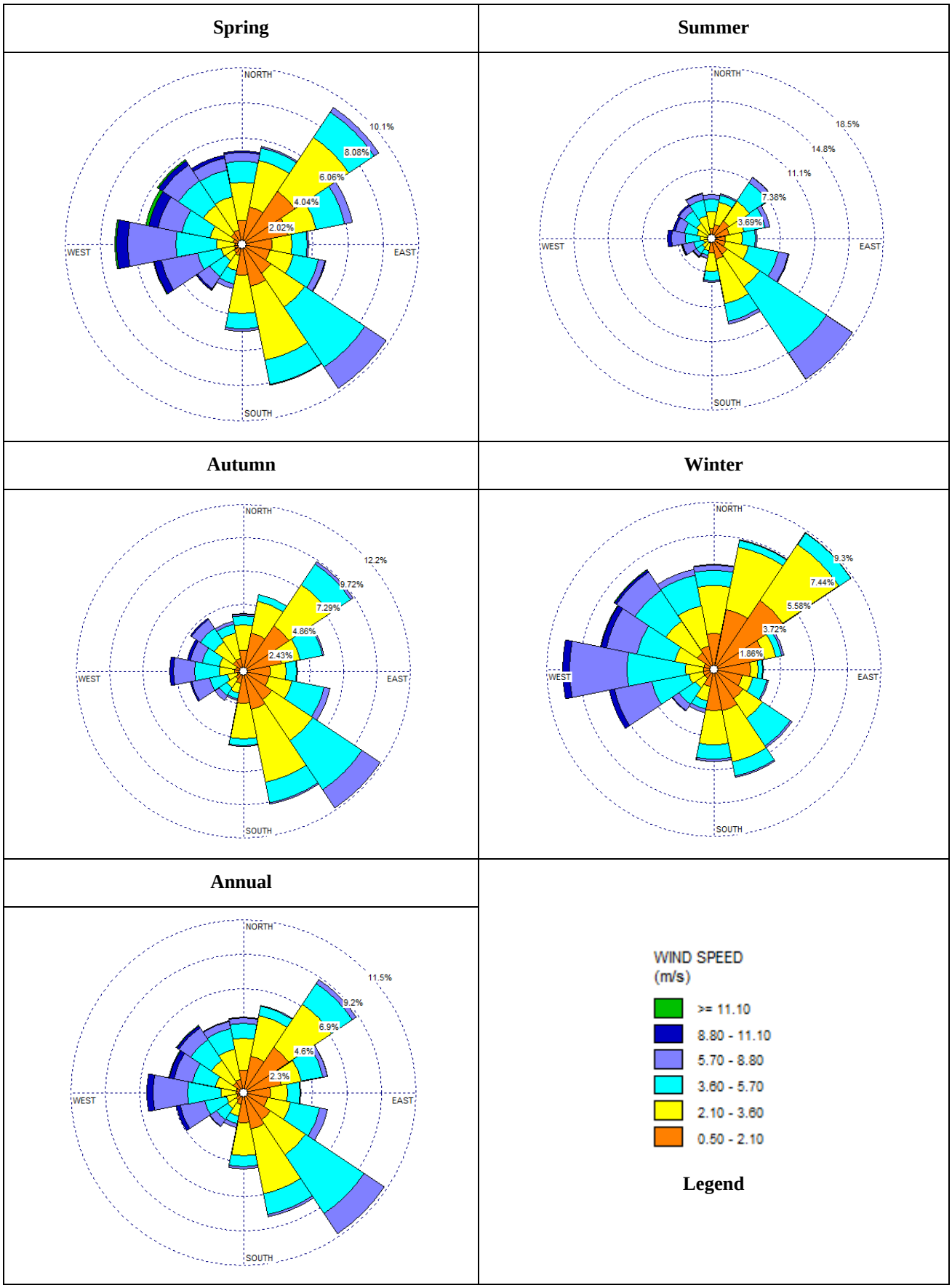


Figure 4-3 Annual and seasonal wind roses at Mudgee Airport AWS

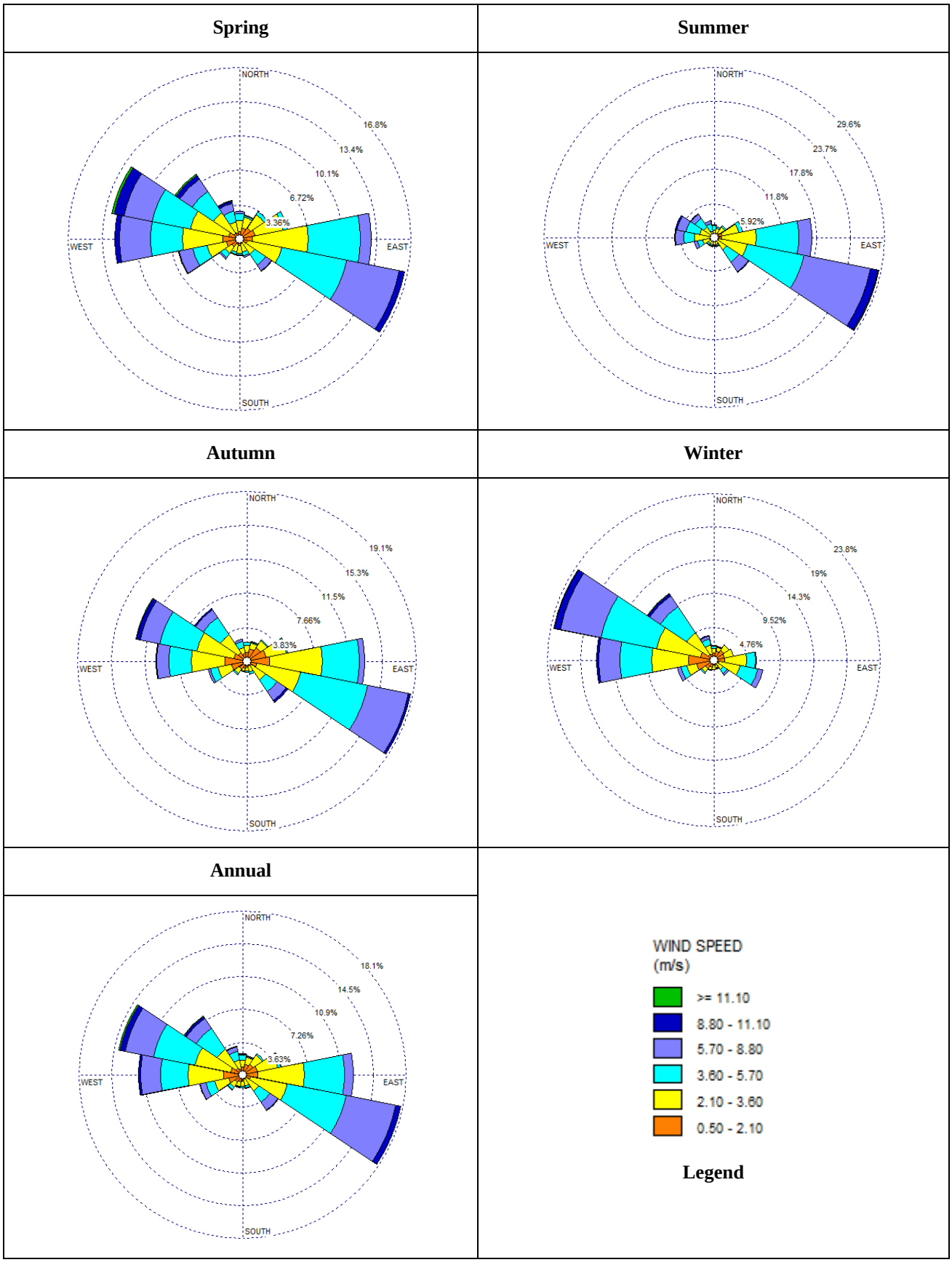


Figure 4-4 Annual and seasonal wind roses at Merriwa (Roscommon) station

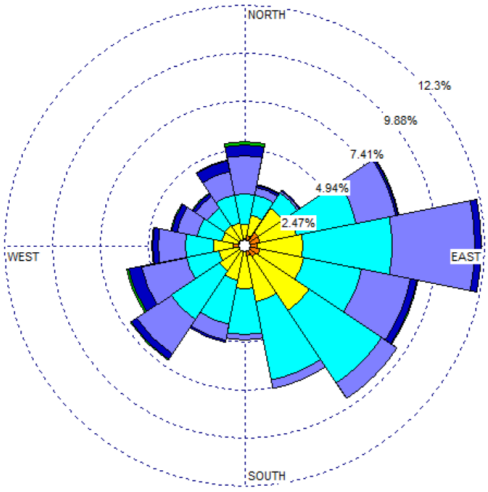
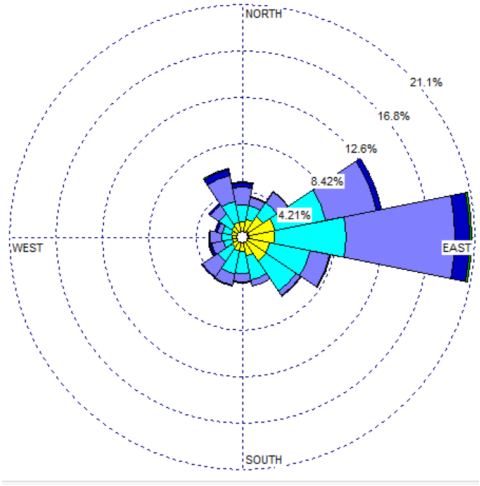
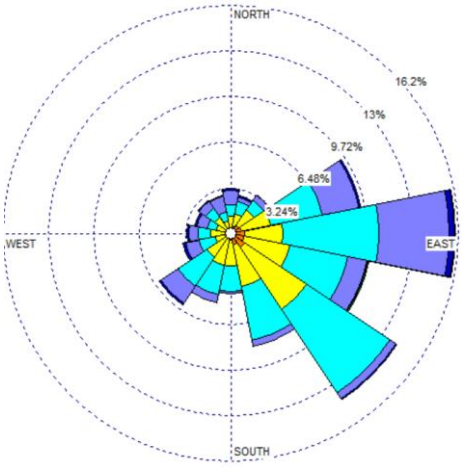
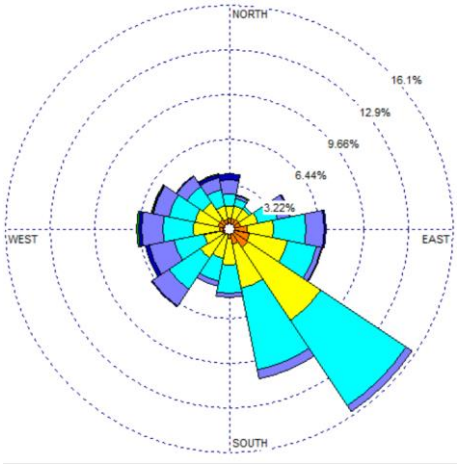
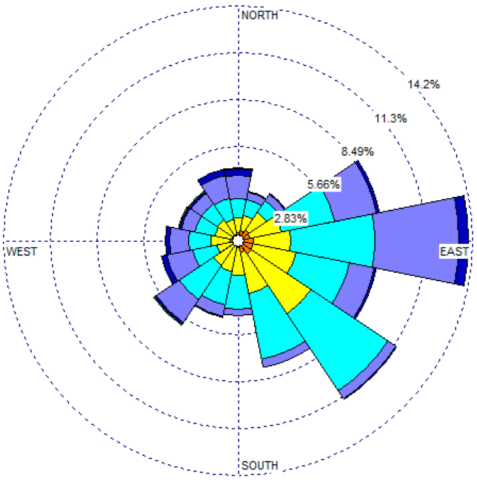
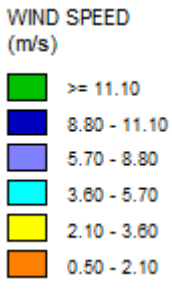
Spring	Summer
	
Autumn	**Winter**
	
Annual	
	 **Legend**

Figure 4-5 Annual and seasonal wind roses at Dubbo Airport AWS

4.4 Ambient air quality

4.4.1 Existing air emission sources

The air quality of the study area and surrounds are predominantly influenced by rural activities including wind-blown dust from exposed land, agricultural activities and from vehicular traffic using the local road network. At the eastern end of the construction area lies the small mining townships of Ulan and Wollar. Dust emissions from mining operations are likely to contribute to the local airshed at this section of the study area. Approximately 56 kilometres to the west of the construction area lies Dubbo, a large regional township. Compared to the eastern end of the study area, the air quality in Dubbo is more influenced by industrial emissions, higher levels of traffic emissions and other diffuse emission sources commonly associated with urban areas.

The main industrial and non-industrial air emission sources contributing to the local airshed of the study area include:

- agricultural activities
- traffic using the local road networks
- domestic solid and liquid fuel burning
- residential activities (e.g. lawn mowers and barbecues)
- railway operations
- industrial manufacturing
- extractive and associated industries.

These sources give rise to emissions of pollutants relevant to the project including:

- total suspended particulates (TSP), deposited dust, PM_{10} and $PM_{2.5}$
- oxides of nitrogen, carbon, and sulphur (NO_x, CO and SO_2)
- VOCs e.g., benzene, toluene, xylenes
- SVOCs e.g., polycyclic aromatic hydrocarbons (PAHs).

Local air emission sources are collated in the National Pollutant Inventory (NPI). It is an online database that provides public information regarding estimated emissions of 93 substances in Australia, together with the sources and location of these emissions. The NPI also includes estimated emissions data for non-industrial (diffuse) sources such as motor vehicle exhausts, wood heaters, lawn mowers and barbecues.

A review of the NPI database for the 2020/2021 reporting year was conducted to identify and quantify industrial emission and diffuse sources in the LGAs listed in Section 1.3.2 of this report.

The NPI analysis for industrial, diffuse motor vehicle emissions and all emission sources in the identified LGAs are presented in the following sections.

4.4.1.1 Industrial air emission sources

The industrial facilities that reported to the NPI in the financial year (FY) 2020/2021 for the four LGAs within which the study area is located are presented in Table 4-9. There were no facilities within the Warrumbungle LGA that reported emissions to the NPI for the FY 2020/2021.

Table 4-9 NPI industrial emission summary for each LGA in FY 2020/2021

LGA	Number of facilities	Number of pollutants reported
Warrumbungle	0	0
Mid-Western Regional	7	35
Dubbo	13	30
Upper Hunter	3	24

The types of industrial facilities in the three LGAs reporting to the NPI include:

- meat product manufacturing
- sheep, beef cattle and grain farming
- water supply, sewerage, and drainage services
- mineral, metal, and chemical wholesaling
- construction material mining
- gas supply
- coal mining
- cement, lime, plaster, and concrete product manufacturing.

Table 4-10 presents industrial emissions of the key pollutants for the above facilities.

Table 4-10 NPI reported industrial emission sources for FY 2020/2021

Pollutant	Emissions to air (kg) for FY 2020/2021		
	Mid-Western Regional LGA	Dubbo LGA	Upper Hunter LGA
PM_{10}	6,207,193	107,863	652
$PM_{2.5}$	202,266	14,201	646
NO_x	3,353,407	195,493	7,689
CO	2,747,043	85,397	9,698
SO_2	2,874	152	78
Total VOCs	252,866	32,124	3,194
PAHs [B(a)P TEQ]	91	7	0.05

4.4.1.2 All sources

Air emissions from all sources (industrial and diffuse) within the three LGAs reporting to the NPI for the FY 2020/2021 (www.npi.gov.au) reporting period (where information was available) are summarised in Table 4-11. In addition to emissions from motor vehicles and industrial reporting facilities, emissions from a range of other sources are included. These are:

- fuel combustion from all sources
- service stations
- domestic solid and liquid fuel burning
- domestic/commercial solvents/aerosols
- architectural surface coatings
- lawn mowing
- barbeques
- sealed and unsealed roads
- railways and rail freight transport
- agricultural activities
- wind-blown dust from exposed land.

It is noted that the reported air emissions for the Dubbo LGA are underestimated as diffuse (fugitive) emissions were not reported for the FY 2020/2021 reporting year.

Table 4-11 NPI reported total emission sources for FY2020/2021

Pollutant	Emissions to air (kg) for FY 2020/2021		
	Mid-Western Regional	Dubbo[1]	Upper Hunter
PM_{10}	6,508,291	107,863	6,276
$PM_{2.5}$	202,266	14,201	646
NO_x	3,531,035	195,493	12,521
CO	4,317,874	85,397	27,736
SO_2	21,334	152	731
Total VOCs	511,277	32,124	8,868
PAHs [B(a)P TEQ]	317	7	9

(1) Fugitive emissions were not included for the FY 2020/2021 reporting year

(2) Polycyclic aromatic hydrocarbons [Benzo[a]pyrene toxic equivalency quotient]

4.4.2 Background air quality

The NSW Government monitors ambient air quality at 47 AAQMS in metropolitan and regional centres and 36 rural and regional AAQMS.

The nearest AAQMS to the study area are:

- Merriwa AAQMS located at Lot 3, Merriwa, Scone Road, approximately 46 km east of the construction area
- Dubbo AAQMS located at Dubbo Airport, approximately 56 km west of the construction area.

The locations of these AAQMS are presented in Figure 4-2.

4.4.2.1 Merriwa AAQMS

The closest AAQMS to the project is located at Merriwa AAQMS. It is a NEPM performance monitoring station and continuously records PM_{10} and $PM_{2.5}$ data. Overall, the data collected at the station is broadly representative of particulate levels in regional urban settings.

Ambient air quality monitoring data for the Merriwa AAQMS listed were analysed and the maximum concentrations reported for the period 2017 to 2021 (DPE, 2022). The data is presented in Table 4-12 and the Air NEPM exceedances are highlighted in bold.

The monitoring data is summarised as follows:

- the annual PM_{10} concentration exceeded the Air NEPM standard in 2019
- the annual $PM_{2.5}$ concentration exceeded the Air NEPM standard in 2020. It is noted that $PM_{2.5}$ monitoring only commenced on 31 July 2020
- the 24-hour PM_{10} concentrations exceeded the Air NEPM standard for the years 2018 to 2020. The exceedances were due to bushfire smoke and regional dust events
- the 24-hour $PM_{2.5}$ concentrations exceeded the Air NEPM standard in 2020
- no $PM_{2.5}$ data was available for 2017 to 2019.

Table 4-12 Ambient air quality monitoring data at Merriwa AAQMS (2017–2021)

Year	Annual average (µg/m³)		Maximum 24-hour average (µg/m³)		
	PM_{10}	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**	**Number and date of exceedances**
2017	14.2	ND[1]	14.2	ND	No exceedances
2018	19.2	ND	**197.1**	ND	PM_{10}: 6 (maximum on 22 November)
2019	**27.9**	ND	**302.1**	ND	PM_{10}: 42 (maximum on 26 November)
2020[2]	18	**14.9**	**620.7**	**43.1**	PM_{10}: 12 (maximum on 11 January) $PM_{2.5}$: 0
2021	11.3	4.2	35.4	14.7	PM_{10}: 0 $PM_{2.5}$: 0
Air NEPM standard	***25***	***8***	***50***	***25***	

(1) ND: No data available

(2) Continuous $PM_{2.5}$ monitoring commenced on 31 July 2020

4.4.2.2 Dubbo AAQMS

Dust (i.e., total dust, PM_{10} and $PM_{2.5}$) is measured at rural and regional AAQMS using an Environmental Dust Monitor (EDT) or DRX DustTraks. These instruments are not reference or reference equivalence methods. As such, the monitoring data at the Dubbo AAQMS was considered indicative of particulate matter concentrations in a rural area and compliance assessment against the Air NEPM standards was not conducted. All the data presented in this section were to provide a context of indicative background air quality concentrations.

The latest five years (2017 to 2021 inclusive) monitoring data of PM_{10} and $PM_{2.5}$ at the Dubbo AAQMS was analysed (DPE, 2022).

The indicative annual and 24-hour PM_{10} concentrations, and the number of days with elevated PM_{10} concentrations (i.e., above Air NEPM standard of 25 µg/m^3) are presented in Table 4-13. There were 48 days across the last five years of monitoring (equivalent to 2.6 per cent of days) with elevated PM_{10} concentrations due to a range of events including dust storms, bushfire smoke, fog, or other dust events in the region. During late spring/early summer 2019 (September to December) and summer 2020, the elevated PM_{10} and $PM_{2.5}$ concentrations were due to widespread bushfire smoke.

Table 4-13 Ambient air quality monitoring data at Dubbo AAQMS (2017 – 2021)

Year	Annual average (µg/m^3)			Maximum 24-hour concentration (µg/m^3)			Number and date of elevated concentrations
	Total dust	PM_{10}	$PM_{2.5}$	Total dust	PM_{10}	$PM_{2.5}$	Number and date of exceedances
2017	8.7[2] 7.9[3]	ND[1] 7.8[3]	ND 6.7[3]	33.9[2] 43.6[3]	ND 43.5[3]	ND 27.2[3]	None None
2018	12.1[4]	12[4]	9.6[4]	113[4]	115[4]	69[4]	PM_{10}: 4 (maximum on 29 June) $PM_{2.5}$: 13 (maximum on 29 June)
2019	11[5] 51[6]	11[5] 44[6]	9[5] 14[6]	30[5] 517[6]	30[5] 419[6]	27[5] 215[6]	PM_{10}: 0, $PM_{2.5}$: 2 (max. on 1 June) PM_{10}: 36 (max on 21 September) $PM_{2.5}$: 11 (max. on 20 December)
2020	13[7]	12[7]	3.8[7]	427[7]	399[7]	58[7]	PM_{10}: 8 (maximum on 5 January) $PM_{2.5}$: 13 (maximum on 23 January
2021	5.4[7]	4.6[7]	1.9[7]	20[7]	18[7]	12[7]	PM_{10}: None $PM_{2.5}$: None

(1) ND: Not determined

(2) Monitoring conducted using a DRX DustTrak from 1 January to 6 August 2017

(3) Monitoring conducted using an EDT from 5 August to 31 December 2017

(4) Monitoring conducted using an EDT from 1 January to 31 December 2018

(5) Monitoring conducted using an EDT from 1 January 2019 to 29 July 2019

(6) Monitoring conducted using a DRX DustTrak from 5 August to 31 December 2019

(7) Monitoring conducted using a DRX DustTrak from 1 January 2020 to 31 December 2020

4.4.2.3 Ambient air monitoring data at local mine sites

Regular monitoring of air quality conditions is undertaken at Moolarben Coal Mine, Wilpinjong Coal Mine and Ulan Coal Mine. The monitoring data collected in the vicinity of these mine sites recorded exceedances of particulate matter, in particular 24-hour PM_{10} concentrations. The majority of these exceedances were due to regional and state-wide dust events and bushfire smoke. Towards the end of 2019 and the beginning of 2020, the local air quality was heavily influenced by bushfire smoke from the Black Summer fires. Outside of these exceptional events, the recorded PM concentrations at the mine sites show general compliance. However, given the nature of the works at open-cut coal mines and the proximity of the Ulan and Wollar townships, there is the potential for PM impacts to occur during unfavourable meteorological conditions.

Moolarben Coal Mine

Moolarben Coal Operations Pty Ltd (MCO) is the operator of the Moolarben Coal Complex (MCC), which are wholly owned subsidiaries of Yancoal Australia Ltd (Yancoal). MCC operates 24 hours a day and comprises four approved open cut mining areas (OC1 to OC4), three approved underground mining areas (UG1, UG2 and UG4) and other mining related infrastructure (including coal processing and transport facilities). Mining operations at the Moolarben Coal Complex are currently approved until 31 December 2038 and will continue to be carried out in accordance with Project Approval (05_0117) (Moolarben Coal Project Stage 1) as modified and Project Approval (08_0135) (Moolarben Coal Project Stage 2) as modified.

Surface mining operations (including open cut mining) within the Moolarben Coal Mine area are located directly south of the proposed 500 kV transmission line that would run between the Merotherie Energy Hub and the New Wollar Switching Station. The construction area is generally located along the northern and eastern perimeter of the coal mine. The township of Ulan is approximately 680 m directly north of the proposed transmission line and approximately 860 m to the mining lease boundary within the Mid-Western Regional (MWRC) LGA, in central NSW.

As part of its operating conditions, ambient air monitoring is required to be undertaken. Details of the monitoring program are presented in Table 4-14. The monitoring locations are presented in Figure 4-6. MCO monitors for deposited dust, TSP, PM_{10} and $PM_{2.5}$.

Table 4-14 Monitoring details at Moolarben Coal Mine

Pollutant	Number of monitoring locations	Location ID	Monitoring technique	Frequency
Deposited dust	11	DG01, DG04, DG05, DG06, DG07, DG08, DG09, DG11, DG12, DG13, DG14	Deposition gauges	Monthly
TSP	6	TEOM1, TEOM4, TEOM6, TEOM7 PM01, PM02	TEOM High volume Air Sampler (HVAS)	Continuous 1 in 6 days
PM_{10}	6	TEOM1, TEOM4, TEOM6, TEOM7 PM01, PM02	TEOM HVAS	Continuous 1 in 6 days
$PM_{2.5}$	1	TEOM7	TEOM	Continuous

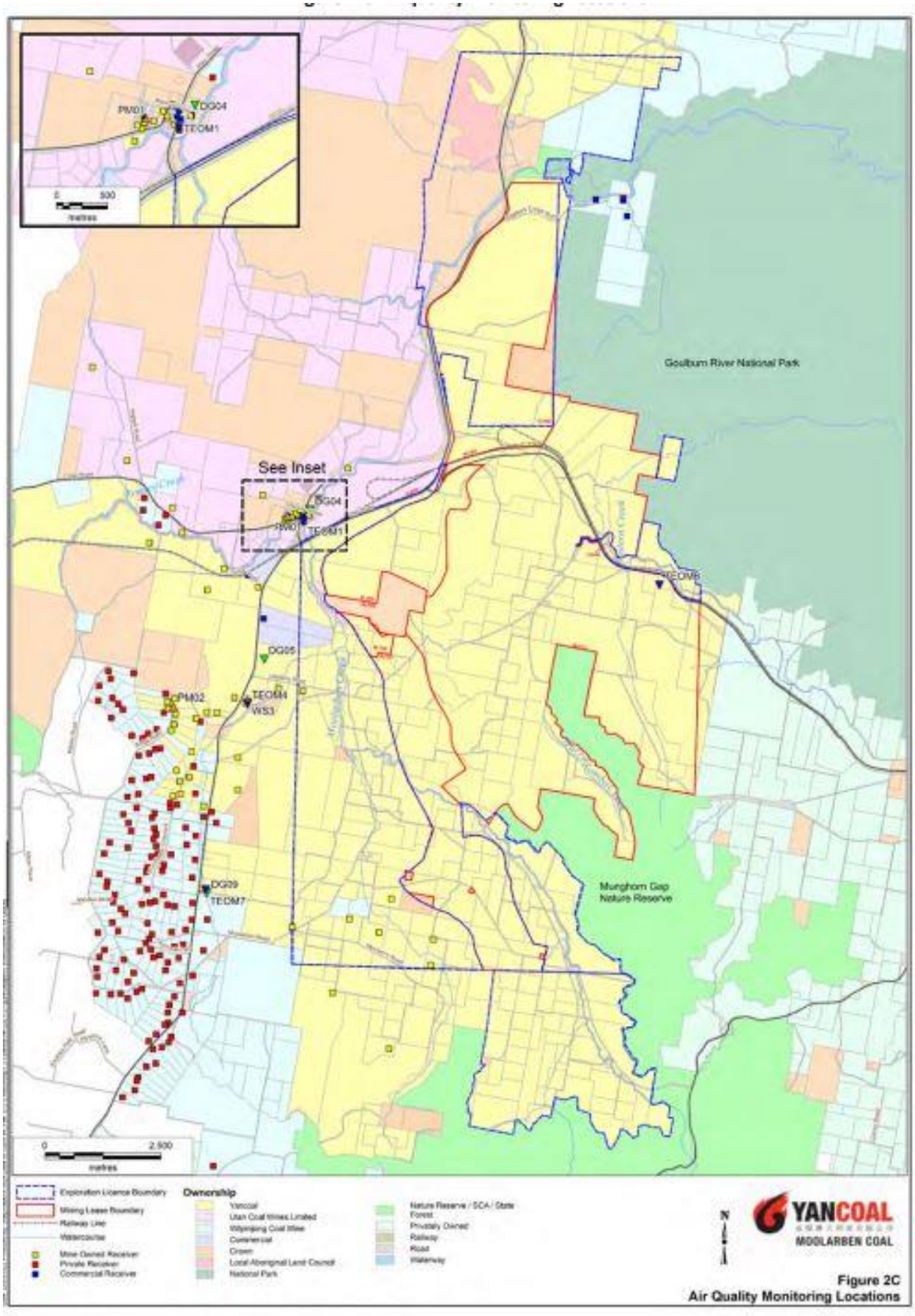


Figure 4-6 Monitoring locations at Moolarben Coal Mine

Ambient air concentrations of deposited dust, TSP, PM_{10} and $PM_{2.5}$ are presented in Table 4-15 to Table 4-20 for the years 2017 to 2021. The data can be summarised as follows:

- Deposited dust levels at all of the monitoring locations and for all years are below the 4g/m^2/month criterion. No data was available at DG06 to DG08 and DG11 to DG14 in 2020 and 2021.
- Annual TSP concentrations are below the 90 µg/m^3 criterion for all years analysed at all locations.
- Except for the monitoring location at Ulan Road (TEOM05/07) in 2017, the maximum 24-hour PM_{10} concentrations in 2017 and 2021 are below the 50 µg/m^3 at all locations. A concentration of 172.8 µg/m^3 was recorded at Ulan Road (TEOM05/07) due to fires on Moolarben Road at this time.
- In 2018, 2019 and 2021, the 24-hour PM_{10} criterion is exceeded at all monitoring locations due to regional dust events and bushfires. A large number of exceedances were recorded at all locations due to the widespread Black Summer bushfires in late 2019 and early 2020.
- Annual average PM_{10} concentrations are below the criterion of 30 µg/m^3 at all locations and for all years of data analysed.
- The 24-hour $PM_{2.5}$ criterion of 25 µg/m^3 is exceeded at the only monitoring location for 2019, 2020 and 2021. Monitoring of $PM_{2.5}$ was not undertaken in 2017 and 2018.
- Annual average $PM_{2.5}$ concentrations are below the 8 µg/m^3 criterion for 2019, 2020 and 2021. Monitoring of $PM_{2.5}$ was not undertaken in 2017 and 2018.

Table 4-15 Dust deposition levels at Moolarben Coal Mine (2017 to 2021)

Dust gauge ID and monitoring location	**Annual deposited dust level (g/m^2/month)[6]**				
	2017[1]	**2018[2]**	**2019[3]**	**2020[4]**	**2021[5]**
DG01	0.6	0.9	1.3	0.9	0.5
DG04	1.0	1.4	1.8	1.0	0.5
DG05	1.5	1.8	1.5	1.3	0.9
DG06	0.7	1.7	1.5	No data presented	
DG07	0.7	1.4	1.3		
DG08	0.9	1.7	1.8		
DG09	0.9	1.9	1.5	1.3	0.4
DG11	1.1	1.7	2.0	No data presented	
DG12	1.2	2.1	1.7		
DG13	1.7	1.6	1.6		
DG14	1.2	1.9	2.7		
Criterion	**4 g/m^2/month**				

(1) Moolarben Coal Complex – Annual Review 2017, June 2018

(2) Moolarben Coal Complex – Annual Review 2018, March 2019

(3) Moolarben Coal Complex – Annual Review 2019, April 2020

(4) Moolarben Coal Complex – Annual Review 2020, March 2021

(5) Moolarben Coal Complex – Annual Review 2021, March 2022

(6) Maximum total deposited dust level

Table 4-16 Annual average TSP concentrations at Moolarben Coal Mine (2017 to 2021)

Monitoring location	Annual average TSP (µg/m³)[1,2]					
	2017	2018	2019	2020	2021	Number and date of exceedances
Ulan School (TEOM01)	30.7	37.7	43.2	37.8	30.8	None
Ulan Road (TEOM04)	37.9	46.8	50.1	35.3	28.5	None
Ulan-Wollar Road (TEOM06)	31.4	39.3	49.3	41.5	30.0	None
Ulan Road (TEOM07)	27.9	41.3	39.0	28.5	20.0	None
Ulan Village HVAS (PM01)	32.4	53.6	47.3	29.5	29.8	None
Ridge Road HVAS (PM02)	33.7	57.4	46.7	31.0	21.3	None
Criterion	**90**					

(1) See notes in Table 4-15 for data references

(2) Annual TSP concentrations calculated based on annual PM_{10} concentrations

Table 4-17 Maximum 24-hour PM_{10} concentrations at Moolarben Coal Mine (2017 to 2021)

Monitoring location	Maximum 24-hour average PM_{10} (µg/m³)[1]					
	2017	2018	2019	2020	2021	Number and date of exceedances
Ulan School (TEOM01)	39.5	**234.5**	**309.4**	**585.5**	29.2	2018: 9 (maximum on 15 December). All due to bushfires or regional dust events. 2019: 38 (maximum on 26 November) 2020: 16 (maximum on 11 January)
Ulan Road (TEOM04)	41.3	**253.6**	**307.9**	**581.9**	36.1	2018: 10 (maximum on 15 December). All due to bushfires or regional dust events. 2019: 39 (maximum on 26 November) 2020: 15 (maximum on 11 January)
Ulan-Wollar Road (TEOM06)	49.4	**200.8**	**391.8**	**581.3**	33.6	2018: 12 (maximum on 15 December). All due to bushfires or regional dust events. 2019: 50 (maximum on 26 November) 2020: 17 (maximum on 11 January)
Ulan Road (TEOM05/07)[2]	**172.8**	**268.7**	**253.4**	**437.9**	36.6	2017: 2 (maximum on 7 February). Bushfire on Moolarben Road. 2018: 11 (maximum on 15 December). All due to bushfires or regional dust events. 2019: 40 (maximum on 26 November). 2020: 10 maximum on 11 January
Ulan Village HVAS (PM01)[3]	34	**251**	**229**	**60**	21.6	2018: 2, maximum on 15 December. All due to bushfires or regional dust events. 2019: 6 (maximum on 22 December). All due to bushfires 2020: 3 (maximum on 1 January)

Monitoring location	Maximum 24-hour average PM_{10} ($\mu g/m^3$)[1]					
	2017	2018	2019	2020	2021	Number and date of exceedances
Ridge Road HVAS (PM02)[3]	38	**271**	**239**	**66**	23.5	2018: 2, maximum on 15 December. All due to bushfires or regional dust events. 2019: 6 (maximum on 22 December). All due to bushfires. 2020: 4 (maximum on 15 January)
Criterion	**50**					

(1) See notes in Table 4-15 for data references

(2) TEOM05 relocated to TEOM07 location during monitoring period

(3) 1 in 6-day monitoring frequency

Table 4-18 Annual average PM_{10} concentrations at Moolarben Coal Mine (2017 to 2021)

Monitoring location	Annual average PM_{10} ($\mu g/m^3$)[1]					
	2017	2018	2019	2020	2021	Number and date of exceedances
Ulan School (TEOM01)	12.3	15.1	17.2	15.1	12.3	None
Ulan Road (TEOM04)	15.2	18.7	20.0	14.1	11.4	None
Ulan-Wollar Road (TEOM06)	12.5	15.7	19.7	16.6	12.0	None
Ulan Road (TEOM07)	11.2[2]	16.5	15.6	11.4	8.0	None
Ulan Village HVAS (PM01)	13.0	21.4	18.9	11.8	7.9	None
Ridge Road HVAS (PM02)	13.5	22.9	18.7	12.4	8.5	None
Criterion	**25**					

(1) See notes in Table 4-15 for data references

(2) Calculated using 5 months of data

Table 4-19 Maximum 24-hour $PM_{2.5}$ concentrations at Moolarben Coal Mine (2017 to 2021)

Monitoring location	Maximum 24-hour average $PM_{2.5}$ ($\mu g/m^3$)[1]					
	2017	2018	2019	2020	2021	Number and date of exceedances
Ulan School (TEOM07)	No $PM_{2.5}$ monitoring undertaken		**195.3**	**72.7**	**30.6**	2019: 28 (maximum on 11 December). Due to bushfires. 2020: 7 (maximum on 1 January) 2021: 10 (maximum on 1 January)
Criterion	**25**					

(1) See notes in Table 4-15 for data references

Table 4-20 Annual average $PM_{2.5}$ concentrations at Moolarben Coal Mine (2017 to 2021)

Monitoring location	Annual average $PM_{2.5}$ (µg/m^3)[1]					
	2017	2018	2019	2020	2021	Number and date of exceedances
Ulan School (TEOM07)	No $PM_{2.5}$ monitoring undertaken		5.8[2]	5.6	4.4	None
Criterion	**8**					

(1) See notes in Table 4-15 for data references

(2) Calculated based on 6 months of data

Wilpinjong Coal Mine

The Wilpinjong Coal Mine is owned and operated by Wilpinjong Coal Pty Limited (WCPL), a wholly owned subsidiary of Peabody Energy Australia Pty Ltd (PEA). The Wilpinjong Coal Mine is an existing open cut coal mining operation situated approximately 40 km north-east of Mudgee, near the village of Wollar, within the MWRC LGA, in central NSW. The mine produces thermal coal products which are transported by rail to domestic customers for use in electricity generation and to port for export. Open cut mining operations are undertaken 24 hours per day, seven days per week.

WCPL was granted Development Consent (SSD-6764) for the Wilpinjong Extension Project (WEP) that provides for the continued operation of the Mine at rates of up to 16 million tonnes per annum (Mtpa) of run-of-mine (ROM) out to 2033, and access to approximately 800 hectares (ha) of open cut extensions. The project 500 kV transmission line that would run between the Merotherie Energy Hub and the New Wollar switching station intersects the Wilpinjong Coal Mine. The transmission line borders the northern and north-eastern perimeter of the coal mine, then directly cuts through the mine heading south. The township of Wollar is approximately 2.6 km to the east of the transmission line and approximately 2.9 km to the active section of the mine.

As part of its operating licence conditions, ambient air monitoring is required to be undertaken. Details of the monitoring program are presented in Table 4-21. The monitoring locations are presented in Figure 4-7. MCO monitors for deposited dust, TSP, PM_{10} and $PM_{2.5}$.

Table 4-21 Monitoring details at Wilpinjong Coal Mine

Pollutant	Number of monitoring locations	Location ID	Monitoring technique	Frequency
Deposited dust	9	DG4, DG5, DG8, DG10, DG11, DG12, DG13, DG14, DG15	Deposition gauges	Monthly
TSP	1	HV3	HVAS	1 in 6 days
PM_{10}	6	TEOM1, TEOM3, TEOM 4 HV1, HV4, HV5	TEOM HVAS	Continuous 1 in 6 days
$PM_{2.5}$	1	TEOM5	TEOM	Continuous

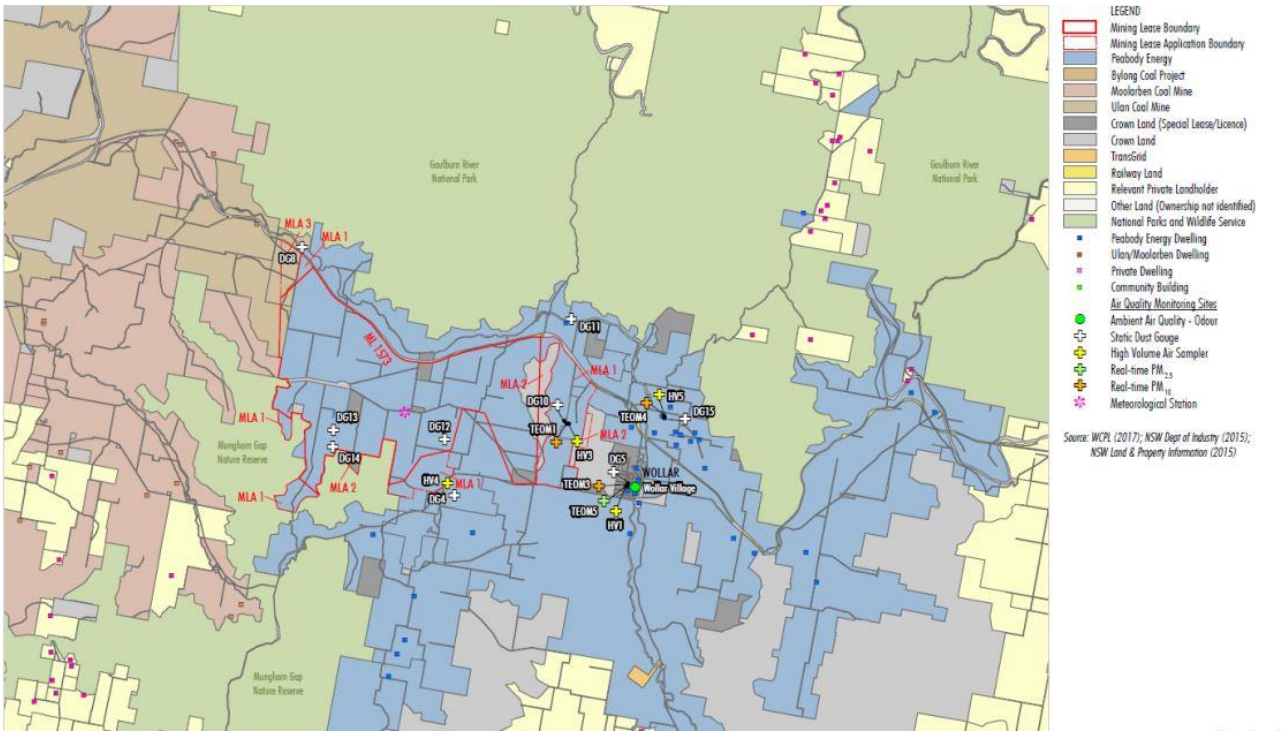


Figure 4-7 Monitoring locations at Wilpinjong Coal Mine

Ambient air concentrations of deposited dust, TSP, PM_{10} and $PM_{2.5}$ are presented in Table 4-22 to Table 4-27 for the years 2017 to 2021. The data can be summarised as follows:

- Deposited dust levels at monitoring locations DG5, DG8 and DG15 for all years analysed are below the 4 g/m^2/month criterion. One exceedance was recorded at DG4 (2019). Two exceedances were recorded at DG10 (2017, 2019), DG12 (2018, 2019) and DG13 (2017, 2018). Three exceedances were recorded at DG14 (2017 to 2019). No sampling was undertaken at DG10 in 2020 and 2021.
- Annual TSP concentrations are below the 90 $\mu g/m^3$ criterion in 2017 and 2018. HV3 was decommissioned in 2019.
- The 24-hour PM_{10} criterion is exceeded at monitoring locations TEOM3 and TEOM4 for all years analysed (2017 to 2021). At TEOM1, exceedances were recorded in 2017 to 2019. The TEOM1 was decommissioned in 2019 and therefore no data is available for 2020 and 2021. HV1 showed exceedances for the years 2018 to 2020. Hv4 and HV5 recorded exceedances for the years 2018 to 2020. Information was not provided on the number and source of these exceedances. Regional dust storms and bushfires are the likely causes of the exceedances.
- Annual average PM_{10} concentrations are below the criterion of 30 $\mu g/m^3$ at all locations and for all years of data analysed. The TEOM1 was decommissioned in 2019 and therefore no data is available for 2020 and 2021.
- The 24-hour $PM_{2.5}$ criterion of 25 $\mu g/m^3$ is exceeded at the only monitoring location (TEOM5) for 2019 to 2021. Monitoring of $PM_{2.5}$ was not undertaken in 2017 and 2018.
- Annual average $PM_{2.5}$ concentrations are below the 8 $\mu g/m^3$ criterion for 2019, 2020 and 2021. Monitoring of $PM_{2.5}$ was not undertaken in 2017 and 2018.

Table 4-22 Dust deposition levels at Wilpinjong Coal Mine (2017 to 2021)

Dust gauge ID and monitoring location	Annual deposited dust level (g/m^2/month)[6]				
	2017[1]	2018[2]	2019[3]	2020[4]	2021[5]
DG4	1.1	3.2	**5.3**	1.7	2.9
DG5	1.5	2	2.7	1.9	1.7
DG8	1.5	1.7	2.3	2.9	1.1
DG10	**4.2**	3.7	**4.6**	Note 7	
DG11	2.9	2.2	3.1	2.3	1.7
DG12	3.4	**5.2**	**5.9**	4.1	3.0
DG13	**27.2**	**4.1**	3.3	2.6	1.4
DG14	**13.9**	**6.6**	**5.5**	3.8	1.5
DG15	1.4	1.3	1.6	1.7	1.0
Criterion	**4 g/m^2/month**				

(1) 2017 Annual Review – Wilpinjong Coal Mine

(2) 2018 Annual Review – Wilpinjong Coal Mine

(3) 2019 Annual Review – Wilpinjong Coal Mine

(4) 2020 Annual Review – Wilpinjong Coal Mine

(5) 2021 Annual Review – Wilpinjong Coal Mine

(6) Maximum total deposited dust level

(7) DG10 decommissioned in 2020

Table 4-23 Annual average TSP concentrations at Wilpinjong Coal Mine (2017 to 2021)

Monitoring location	Annual average TSP ($\mu g/m^3$)[1,2]					
	2017	2018	2019[3]	2020	2021	Number and date of exceedances
HV3	38.1	45.7	Note 2			None
Criterion	**90**					

(1) See notes in Table 4-22 for data references

(2) Data is not for compliance but for management purposes only

(3) Monitoring station decommissioned in 2019. No data available from 22 August 2019.

Table 4-24 Maximum 24-hour PM_{10} concentrations Wilpinjong Coal Mine (2017 to 2021)

Monitoring location	Maximum 24-hour average PM_{10} ($\mu g/m^3$)[1]					
	2017	2018	2019	2020	2021	Number and date of exceedances
TEOM1	**86.7**	**206.6**	**107.8**[2]	**Note 2**		Information not available
TEOM3	**52.2**	**143.3**	**242.8**	**331.0**	**86.6**	
TEOM4	**50.9**	**156.8**	**273.1**	**416.2**	**139.5**	
HV1[3]	28.2	**168.0**	**196**	**59.1**	30.3	
HV4[3]	**69.1**	**208.0**	**207**	**106**	38.6	
HV5[3]	**55.4**	**167.0**	**195**	**66.2**	38.6	
Criterion	**50**					

(1) See notes in Table 4-22 for data references

(2) Monitoring station decommissioned in 2019. No data available from 22 August 2019.

(3) 1 in 6-day monitoring frequency

Table 4-25 Annual average PM_{10} concentrations at Wilpinjong Coal Mine (2017 to 2021)

Monitoring location	Annual average PM_{10} ($\mu g/m^3$)[1]					
	2017	2018	2019	2020	2021	Number and date of exceedances
TEOM1	18.4	22.1	Note 2			None
TEOM3	9.5	14.4	14.4	26.5	8.6	None
TEOM4	12.8	18.0	18.0	19.6	11.9	None
HV1	12.2	23.3	16.1	13.5	9.5	None
HV4	16.7	24.8	17.8	18.7	14.7	None
HV5	16.6	16.9	23.8	17.4	8.6	None
Criterion	**30**[3]					

(1) See notes in Table 4-22 for data references

(2) Monitoring station decommissioned in 2019. No data available from 22 August 2019

(3) Approved criterion.

Table 4-26 Maximum 24-hour $PM_{2.5}$ concentrations at Wilpinjong Coal Mine (2017 to 2021)

Monitoring location	Maximum 24-hour average $PM_{2.5}$ ($\mu g/m^3$)[1]					
	2017	2018	2019	2020	2021	Number and date of exceedances
TEOM5	No $PM_{2.5}$ monitoring undertaken		**196.5**	**196.5**	**82.4**	Information not available
Criterion	**25**					

(1) See notes in Table 4-22 for data references

Table 4-27 Annual average $PM_{2.5}$ concentrations at Wilpinjong Coal Mine (2017 to 2021)

Monitoring location	Annual average $PM_{2.5}$ (µg/m³)[1]					
	2017	2018	2019	2020	2021	Number and date of exceedances
TEOM5	No $PM_{2.5}$ monitoring undertaken		6.8	5.8	4.4	None
Criterion	**8**					

(1) See notes in Table 4-22 for data references

Ulan Coal Mine

Ulan Coal Mines Limited (UCML) is a joint venture between Xstrata Coal Pty Ltd (90 per cent) and Mitsubishi Development (10 per cent). The UCML complex is located approximately 1.5 km from Ulan village within the MWRC LGA. The UCML complex is located approximately 28 km north north-east of Mudgee and 19 km north-west of Gulgong. The mine produces thermal coal for the export market with the higher ash content coal supplying the domestic market for power generation. The UCML complex operations 24 hours a day, 7 days a week.

Project Approval 08_0184 provides for continued simultaneous open-cut and underground mine activities for a period of 21 years. Modification of Project Approval 08_0184 allows for the underground mining in an area known as North 1 and the installation and operation of a concrete batching plant. The Modification also includes minor amendments to the Ulan No. 3 and Ulan West Mine Plans. The Moolarben Coal Project (MCP) is located immediately adjacent to the southern and eastern boundaries of the UCML complex. The Wilpinjong Coal Mine is situated approximately 7 km to the south-east of the UCML Project Approval Area. The UCML complex lies directly north of the project 500 kV transmission line that would run between the Merotherie energy hub to the New Wollar switching station. The transmission line borders part of the southern perimeter of the coal mine before veering south.

As part of its operating licence conditions, ambient air monitoring is required to be undertaken. Details of the monitoring program are presented in Table 4-28. The monitoring locations are presented in Figure 4-8. Ulan Coal Mine monitors for deposited dust, TSP, and PM_{10}.

Table 4-28 Monitoring details at Ulan Coal Mine

Pollutant	Number of monitoring locations	Location ID	Monitoring technique	Frequency
Deposited dust	8	DM1, DM4, DM5, DM8, DM9, DM11, DM12, DM13	Deposition gauges	Monthly
TSP	2	15 (Flannery), 29 (Merlene/Cope)	HVAS	1 in 6 days
PM_{10}	1	30	TEOM	Continuous

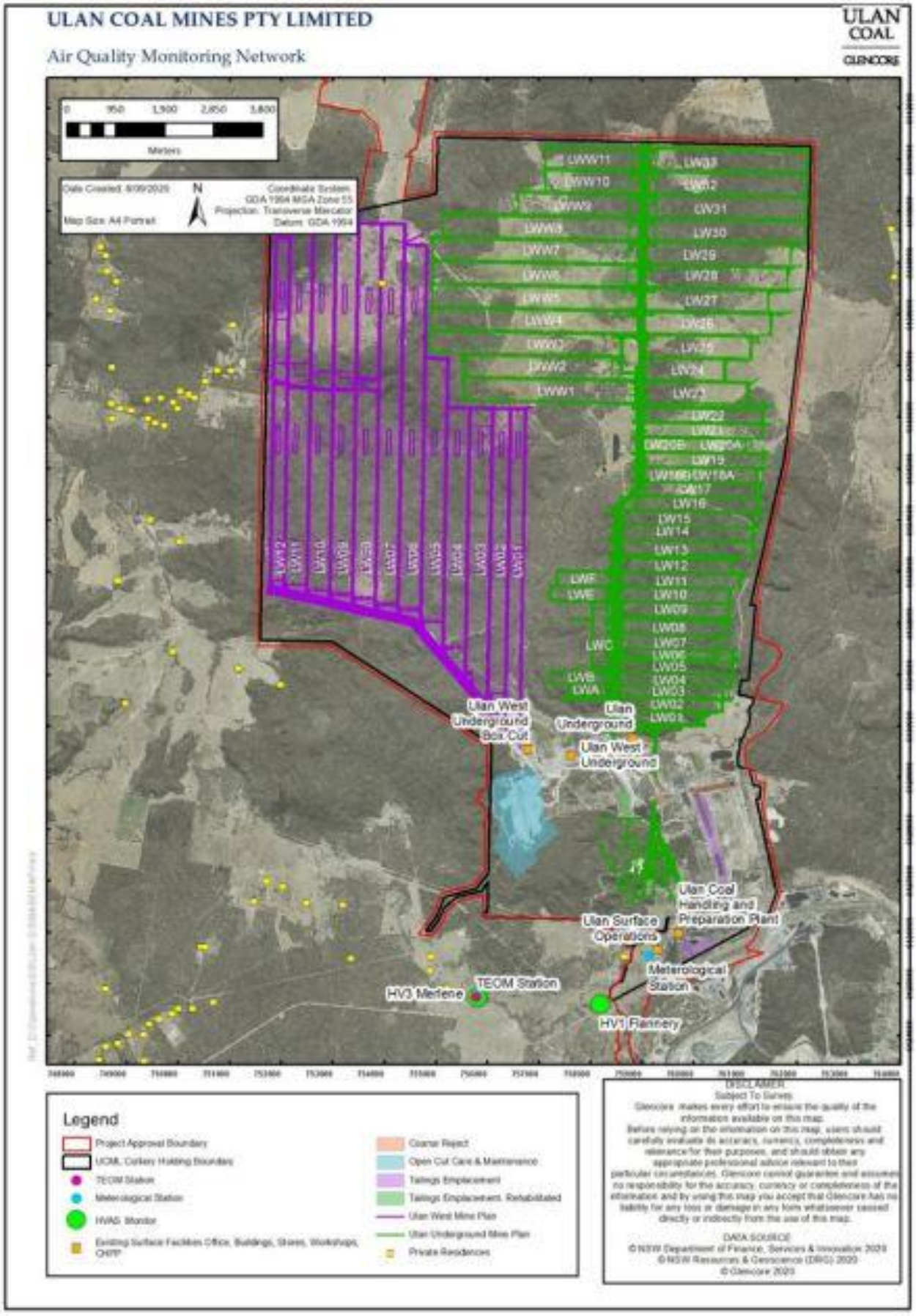


Figure 4-8 Monitoring locations at Ulan Coal Mine

Recorded ambient air concentrations at the Ulan Coal Mine for deposited dust, TSP, and PM_{10} are presented in Table 4-29 to Table 4-31 for the years 2017 to 2021. The data can be summarised as follows:

- Deposited dust levels at all monitoring locations for all years analysed (2017 to 2019) are below the 4g/m^2/month criterion. Dust deposition monitoring was not undertaken in 2020 or 2021.
- Except for 2017 and 2021, annual TSP concentrations exceeded the 90 µg/m^3 criterion. The majority of exceedances occurred due to regional dust events and bushfire smoke (2019 and 2020).
- Except for 2017, the 24-hour PM_{10} criterion is exceeded at monitoring location 30 for all years analysed (2017 to 2021). Exceedances were due to regional dust events and widespread bushfires in 2019 and 2020.

Table 4-29 Dust deposition levels at Ulan Coal Mine (2017 to 2021)

Dust gauge ID and monitoring locations	**Annual deposited dust level (g/m^2/month)[1]**				
	2017[2]	**2018[3]**	**2019[4]**	**2020[5]**	**2021[5]**
DM1	1.2	2.3	3.8	No data available	
DM4	0.9	1.5	2.5		
DM5	2.0	3.3	2.7		
DM8	1.0	1.2	1.9		
DM9	1.0	1.0	2.0		
DG11	0.9	1.6	2.2		
DG12	0.7	1.3	2.0		
DG13	0.9	1.0	1.0		
Criterion	**4 g/m^2/month**				

(1) Annual rolling average

(2) Monthly Pollution Monitoring Report, Ulan Coal Complex, January – December 2017

(3) Monthly Pollution Monitoring Report, Ulan Coal Complex, January – December 2018

(4) Environmental Monitoring Summary, Ulan Coal Complex, January – December 2019

(5) Dust deposition monitoring was not undertaken in 2020 and 2021

Table 4-30 Annual average TSP concentrations at Ulan Coal Mine (2017 to 2021)

Monitoring location	Annual average TSP (µg/m³)					
	2017[1]	2018[1]	2019[2]	2020[3]	2021[4]	Number and date of exceedances
15 (Flannery)	69.4	**337**	**317**	**117**	56.8	2018: 2, maximum occurred on 15 December due to regional dust event. 2019: 8, maximum occurred on 22 November to regional dust event. 2020: 2, maximum occurred on 15 January due to bushfires.
29 (Merlene/Cope)	56.4	**338**	**311**	**110**	53.4	2018: 1, maximum occurred on 15 December due to regional dust event. 2019: 6, maximum occurred on 22 November due to regional dust event. 2020: 2, maximum occurred on 15 January due to bushfires.

(1) See Notes 1 and 2 in Table 4-29 for data references

(2) Environmental Monitoring Summary, January – March 2019, April – June 2019, July – September 2019, October – December 2019

(3) Environmental Monitoring Summary, January – March 2020, April – June 2020, July – September 2020, October – December 2020

(4) Environmental Monitoring Summary, January – March 2021, April – June 2021, July – September 2021, October – December 2021

Table 4-31 Maximum 24-hour PM_{10} concentrations at Ulan Coal Mine (2017 to 2021)

Monitoring location	Maximum 24-hour average PM_{10} (µg/m³)					
	2017[1]	2018[1]	2019[1]	2020[1]	2021[1]	Number and date of exceedances
30	43.5	**264.8**	**291.4**	**556.4**	**65.4**	2018: Number and date of exceedances not provided 2019: 38, maximum occurred on 26 November. Due to regional dust events and bushfire smoke. 2020: 15, maximum occurred on 11 January. All due to bushfire smoke except for 1 day (regional dust event) 2020: 1, maximum occurred on 14 January.

(1) See notes in Table 4-30 for data references

5 Construction assessment

This Chapter presents an assessment of the potential impacts that are expected to occur during construction of the project.

Key construction activities for the project include:

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

5.1 Construction program

The indicative timeframe for the project is for construction to commence in the second half of 2024 with initial operations to commence by late-2027, subject to NSW Government and Commonwealth planning approvals.

The enabling works would take approximately 20 months to complete with the overall construction phase taking 52 months. Site decommissioning and rehabilitation is expected to extend 12 months beyond the project commissioning with an estimated completion time of early 2028.

Figure 5-1 presents the indicative construction program for all construction works.

Figure 5-1 Indicative construction program

5.2 Construction activities

Table 5-1 presents the proposed work phases and key construction activities of the project.

Table 5-1 Construction works phases and key construction activities

Work phase	Key construction activities
Enabling work	— Installation of fencing, gates, barricades, exclusion zones and other access controls — Property adjustment work, including adjustments to property fencing — Establishment of permanent and temporary environmental controls and monitoring equipment, where required — Minor clearance of vegetation (excluding threatened species and ecological communities) to facilitate other enabling works, and the relocation of salvaged habitat features — Establishment of construction compounds, interim workforce accommodation camps and laydown areas — Installation of temporary site sheds, amenities facilities and storage containers — Establishment of new access tracks and upgrades to existing access tracks where required, including widening and/or grading of existing access tracks and installation of drainage controls for new access tracks — Biodiversity, heritage and other investigations, including test excavation, protection, salvage, environmental monitoring and recordings — Establishment of new access tracks and upgrades to existing access tracks where required, including widening and/or grading of existing access tracks and installation of drainage controls for new access tracks — Utility works, connections, adjustments, relocations, and protection. This includes connections to construction compounds and/or workforce accommodation camps, where possible — Receiving construction plant and equipment on site and materials at laydown areas — Additional geotechnical and contamination investigations — Other survey work, such as road dilapidation surveys, and surveys of the general alignment and existing utilities, installing survey controls (including installation of global positioning systems), installing repeater stations, carrying out surveys of existing and future utilities — Installation of temporary site sheds, amenities facilities and storage containers — Removal of waste from the construction area and remediation of contaminated land (if present and required) — Installation of communication towers (other than those using microwave technology).
Transmission line construction	— Earthworks including excavation and bored in situ piles to establish the transmission line tower footings — Blasting where required to loosen and break up existing rock to establish transmission line tower footings — Assembly of tower structures — Erection of transmission line tower structure — Stringing of transmission line by either a ground pulled draw wire or a line stringing drone or by helicopter.

Work phase	Key construction activities
Energy hubs and switching station sites	— Removal of vegetation — Bulk earthworks to form the energy hub or switching station pad including the placement of fill, where required — Excavation and preparation of the site for concrete foundations — Installation of reinforced concrete and piled foundations for the electrical equipment — Excavation and installation of electrical equipment conduits, trenches and general site drainage works — Construction of new ancillary and equipment control buildings, as required — Erection of galvanised steel towers to support electrical equipment, using cranes — Installation of electrical equipment on foundations — Installation of site wiring and electrical control equipment within the control buildings — Erection of the boundary security fence, including site access gates — Surfacing and stabilising works for access, dust and vegetation suppression and drainage.
Pre-commissioning	— Testing and commissioning of the equipment at the new energy hubs and switching stations — Point to point testing of the connections of the new transmission lines, energy hubs and switching stations — Earthing testing — High voltage testing — High voltage equipment operational checks — Connection to the existing transmission network — Protection, control, and metering system and communication system testing.
Commissioning	— Transmission line cut in and connection to the electrical network — Protection, control, and metering checks — High voltage equipment operation and energisation — Audible noise, thermographic imaging, and electric and magnetic field testing.
Demobilisation and site rehabilitation	— Removal of all construction plant and equipment, and all materials not required during operation, including any remaining waste material — Removal of construction compounds and workforce accommodation camp sites — Removal of any temporary site buildings and temporary environmental controls — Rehabilitation works, including rehabilitation of construction areas, compounds and workforce accommodation camps fences, gates and other agricultural infrastructure which may have been damaged during construction.

5.2.1 *Construction compounds and workforce accommodation camps*

To support the construction of the project, three main construction compounds would be required, one at each of the energy hubs and one at the New Wollar Switching Station. The main construction compounds would be established as part of enabling works. Construction compounds would include the following components:

- staging and laydown areas
- concrete batching plant
- cement silo
- earthworks
- crushing, grinding and screening plant
- aggregate bins
- staff facilities (office, lunchroom and amenities)
- parking areas

- construction support facilities including vehicle, equipment and materials storage, maintenance sheds, generators, chemical and fuel stores (such as petroleum, diesel, liquefied natural gas, herbicide, pesticide, and mineral oils), waste disposal facilities and potential stockpile areas. Hazardous and dangerous good storage would be secured in purpose-built bunded and secure areas
- helicopter landing pad and support facilities
- testing laboratory
- potable water tanks
- wastewater treatment plant (only at the energy hub construction compounds).

Two workforce accommodation camps would be established to support the project, located at Merotherie Energy Hub and Neeleys Lane, Cassilis. The workforce accommodation camps would be established as part of enabling works and demobilised at the completion of construction. Each workforce accommodation camp would include a range of facilities, potentially including:

- demountable accommodation and office buildings
- staff amenities, include food and catering facilities, fitness, and recreational facilities (such as indoor and outdoor recreational spaces, gymnasium areas) and laundry, bathroom and first aid facilities
- utilities, including telecommunication services, electricity and water (including water tanks)
- waste bins
- refuelling tank
- parking area and bus stop
- equipment, materials, and gas storage
- generators
- potable water tanks
- wastewater treatment plant.

5.2.2 Vehicle movements

Construction traffic would include both heavy and light vehicles transporting materials, plant and equipment and the construction workforce to and from the construction area. These movements would occur daily across the whole of the project. Non-standard or oversized loads would also be required to deliver specialised construction plant and equipment, and project components for the energy hubs (such as synchronous condensers and transportation of transmission line tower materials). Maximum hourly trips generated to/from the respective sites are outlined in Table 5-2. These estimates are based on typical and peak construction period for the project and would be confirmed during detailed design.

Table 5-2 Traffic and transport peak-hour trip estimates (two-way combined per hour)

Location	Light vehicles (trips per hour)[1]	Heavy vehicles (trips)	Total (trips per hour)
New Wollar Switching Station	10	4	14
Elong Elong Energy Hub	4	20	24
Merotherie Energy Hub and Workforce Accommodation Camp	40	30	70
Neeleys Lane Workforce Accommodation Camp	32	24	56
Switching stations (typical)	12	1	13

(1) A trip is defined as a one-way vehicular movement from one point to another excluding the return journey

Construction vehicle traffic would be greatest during construction works associated with transmission lines/towers, energy hubs and switching stations. Worker vehicle movements would also be highest during both the morning and afternoon peak hour periods.

5.2.3 Construction routes

Local roads would form part of the construction routes for the project. Where possible, project construction traffic would use the public road network to access relevant locations within the construction areas. These routes would be used by both general construction traffic and for heavy vehicle haulage. Construction vehicles would travel along sealed and unsealed roads (construction routes).

5.3 Dust impacts

The project would generate dust during construction with impacts depending on the quantity and drift potential of the particles in the atmosphere. Larger particles (the larger particle fractions of TSP) settle out closer to the source due to their larger mass. The deposition of the particles can cause nuisance and aesthetic impacts on the receiving environment. Finer particles (PM_{10} and $PM_{2.5}$) remain entrained in the atmosphere for longer and therefore dispersed at greater distances from the source. The fine nature of these particles also has the potential for human health impacts if not adequately controlled.

5.3.1 Earthworks, construction and track out

This section assesses the potential dust impacts associated with construction activities at the following locations:

- the New Wollar Switching Station
- construction of the Elong Elong Energy Hub
- construction of 13 switching stations
- construction compounds and laydown areas
- workforce accommodation camps
- construction of transmission line and towers along the entire length of the project.

There are no sensitive receivers within 350 m of the Merotherie Energy Hub construction area and in accordance with the IAQM guidance the risk of potential dust impact was not of significance and not considered further in this assessment.

The dust assessment adopts a risked based approach outlined in the IAQM guidance was adopted in this assessment. Construction works included in the detailed risk assessment (‘screened in’) are evaluated in the following sections.

5.3.1.1 Step 1 – Screen the need for a detailed assessment

The IAQM guidance recommends that a risk assessment of potential dust impacts from construction activities is undertaken when sensitive receivers are located within:

- 350 metres of the boundary of the construction area
- 50 metres of the routes used by construction vehicles on the public highway up to 500 metres from the site entrance points.

In cases where there are no sensitive receivers identified within these locations, the need for a more detailed assessment is ‘screened out’. It can be concluded that the level of risk is negligible, and any impacts would not be of significance.

The location of identified sensitive receivers within the study area in relation to the project are:

- one near the New Wollar Switching Station
- one near the Elong Elong Energy Hub
- two near the M5 Switching Station
- 24 along the transmission line alignment.

Appendix A presents the locations of all sensitive receivers to the study area.

A detailed risk assessment was triggered for the locations listed above and are discussed further in Section 5.3.1.2 to 5.3.1.4.

5.3.1.2 Step 2A – Determine the potential dust emission magnitude

The potential dust emission magnitudes for demolition, earthworks, construction, and vehicle track out activities were evaluated in this section. Examples provided in the IAQM guidance were used to classify potential large, medium or dust emission magnitude as shown in Table 3-1 in Section 3.4.1.

Demolition

No demolition is proposed as part of the project. Minor structures such as fencing and disused agricultural infrastructure may be encountered during construction which would need to be removed.

Earthworks

For this project, earthworks would be required for excavating on-site material, movement of material on-site, importing fill material to each location, haulage tipping and stockpiling.

Earthworks would be required to construct the foundations of energy hubs and switching stations, with the most extensive earthworks required at the Elong Elong Energy Hub and New Wollar switching station due to the size of the infrastructure in those locations. Works would include:

- bulk earthworks to form the energy hub or switching station pad including the placement of fill, where required
- excavation and preparation of the site for concrete foundations
- installation of reinforced concrete and piled foundations for the electrical equipment
- excavation and installation of electrical equipment conduits, trenches and general site drainage works.

The transmission lines would be supported on a series of transmission line towers typically spaced at around 450 metres to 550 metres apart for the 500 kV network infrastructure and 250 metres to 450 metres apart for the 330 kV network infrastructure, though this would increase or decrease depending on constraints present along the corridor. The main earthworks associated with the construction of the transmission line towers would be structural excavations and piling. A self-supporting structure with four foundations per structure was conservatively assumed to estimate the volume of excavated material. Excavated material would be stockpiled and used for backfill around the foundations (where appropriate).

Given the distance between transmission line towers, each structure location is considered to be a separate site. Access tracks of around 600 metres in length on both sides of each structure were assumed to be part of each site.

Details of the indicative earthworks at each transmission line tower would be:

- disturbance of up to 60 by 120 metres of land, equivalent to 7,200 square metres (structural excavation area for four foundations would be approximately 13 square metres)
- the total material encountered at each tower site would be emplaced within the construction area. The volume of material would be approximately 200 cubic metres, equivalent to 1,102 tonnes (assuming soil density of 1,900 kilograms per cubic metre (kg/m^3)).

Access tracks along the transmission line alignment between towers would have an indicative area of about 4,400 square metres (eight metres in width and 550 metres in length).

Table 5-3 presents the dust emission magnitude at each of the project locations.

Table 5-3 Dust emission magnitude during earthworks

Project location	Indicative site area (m^2)	Soil type[1]	Number of HEMVs[2]	Total material handled		Emission magnitude
				m^3	Tonnes	
New Wollar Switching Station	525,000	Sand/Clay	5–10	–	>100,000	Large
Elong Elong Energy Hub	2,625,500	Sand/Clay	5–10	–	>100,000	Large
M5 Switching Station	54,000	Sand/Clay	5–10	–	<20,000	Medium
Transmission line tower sites and access tracks (per site)	11,600	Sandy/clay	<5	200	1,100	Small

(1) Loam and clay soil density ranges from 1,290 kg/m^3 to 1,900 kg/m^3

(2) HEMVs: Heavy earth moving vehicles

Construction

The key factors when determining the potential dust emission magnitude during the construction phase include the building volume, method of construction, construction materials, on-site concrete batching plant and blasting. Table 5-4 presents the dust emission magnitude for construction work at each project location. On-site concrete batching would potentially occur at the New Wollar Switching Station and the Elong Elong Energy Hub.

Controlled blasting may be required to loosen and break up existing rock at energy hubs, switching stations and small areas along the transmission line alignment where shallow bedrock or hard geological conditions are identified. This would most likely include the transmission line from Merotherie Energy Hub towards switching stations M1, M2 and M3, and the transmission line between the Merotherie, and Elong Elong energy hubs. Areas requiring blasting would be confirmed during detailed development of the construction methodology. Where possible, the excavated material from blasting would be used to construct the pads for the energy hubs, switching stations and transmission tower footings, to minimise the volume of imported fill material required.

Table 5-4 Dust emission magnitude for construction works

Project location	Building volume (m^3)	Construction material	On-site concrete batching	Blasting	Emission magnitude
New Wollar Switching Station	<25,000	Concrete/steel	Yes	Yes	Medium
Elong Elong Energy Hub	<25,000	Concrete/steel	Yes	Yes	Medium
M5 Switching Station	<25,000	Concrete/steel	No	Yes	Medium
Transmission line tower sites and access tracks (per site)	NA[1]	Steel	No	Yes	Small

(1) NA: Not applicable as a tower is not a building.

Track out

The IAQM Guidance, defines track out as '*the transport of dust and dirt from the construction/demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network. This arises when HDVs leave the construction/demolition site with dusty materials, which may then spill onto the road, and/or when HDVs transfer dust and dirt onto the road having travelled over muddy ground on site*'.

Heavy duty vehicles (HDVs) would travel from construction sites and onto public roads through access points shown in the sensitive receiver figure (refer to Appendix A). Outward movements of more than 50 HDVs at the M5 switching station and energy hubs are expected during a typical day and the dust emission magnitude is considered to be in the large category. At the new Wollar switching station and transmission line tower sites, the dust emission magnitude is in the medium category due to the lower number of outward daily HDV movements.

Table 5-5 Dust emission magnitude for track out

Project location	Daily HDV outward movements	Surface material	Unsealed road length (m)	Emission magnitude
New Wollar Switching Station	10–50	Sand/clay	>100	Medium
Elong Elong Energy Hub	>50	Sand/clay	>100	Large
M5 Switching Station	<10	Sand/clay	>100	Medium
Transmission line tower sites and access tracks (per site)	<10	Sand/clay	>100	Medium

5.3.1.3 Step 2B – Determine the sensitivity of the area

The sensitivity of the surrounding land uses takes account of several factors. These are:

- the specific sensitivities of receivers
- the number of receivers and their proximity to the site
- local background PM_{10} concentrations
- site-specific factors that may reduce the risk of wind-blown dust (e.g. trees).

The sensitive receivers that were identified within the study area (refer to Section 5.3.1.1) are residences. Some of these residences are unoccupied. Residences are considered to be 'high' sensitivity receivers to dust soiling and health effects. The matrices for determining the surrounding area sensitivity to dust soiling and human health are presented in Table 3-2 and Table 3-3 in Section 3.4.1.

Table 5-6 presents the sensitivity of the area to dust soiling and human health impacts. All receivers have a low sensitivity to dust soiling. Apart from two receivers, the sensitivity of the area to health impacts was low. ID: 543 and ID: 539 had a medium sensitivity to human health impacts due to its proximity to the construction route.

Table 5-6 Sensitivity of the area to dust soiling and human health impacts

Receiver ID	Type	Distance to construction area	Sensitivity of area to dust soiling	Sensitivity of area to human health impacts
New Wollar Switching Station				
ID: 19	Residence	263	Low	Low
Elong Elong Energy Hub				
ID: 719	Residence	85	Low	Low
M5 Switching Station				
ID: 876	Residence	230	Low	Low
ID: 880	Residence	230	Low	Low
Transmission lines towers and access tracks				
ID: 181[1]	Residence	212	Low	Low
ID: 198	Residence	207	Low	Low
ID: 267	Residence	178	Low	Low
ID: 311	Residence	143	Low	Low
ID: 328	Residence	345	Low	Low
ID: 354	Residence	339	Low	Low
ID: 399	Residence	231	Low	Low
ID: 531	Residence	89	Low	Low
ID: 539	Residence	53	Low	Medium
ID: 543	Residence (access track)	25	Low	Medium
ID: 580[1]	Residence	216	Low	Low
ID: 584	Residence	294	Low	Low
ID: 585	Residence	289	Low	Low
ID: 703	Residence	276	Low	Low
ID: 730[1]	Residence	350	Low	Low
ID: 927	Residence	314	Low	Low
ID: 929	Residence	204	Low	Low
ID: 979	Residence	272	Low	Low
ID: 1010	Residence	278	Low	Low
ID: 1015	Residence	249	Low	Low
ID: 1091	Residence	275	Low	Low
ID: 1351	Residence	205	Low	Low
ID: 1480	Residence	140	Low	Low
ID: 1483[2]	Residence	124	Low	Low

(1) Unoccupied property

(2) Approval to develop a house

5.3.1.4 Step 2C – Define the risk of impact

The dust emission magnitudes for earthworks, construction and track out were combined with the sensitivity of the area to determine the risk of dust impacts. The matrices for dust risk of impacts on dust soiling and human health are presented in Table 3-4 to Table 3-5 in Section 3.4.1.

Table 5-7 presents the summary of dust risk to dust soiling and human health impact at each sensitive receivers assessed for earthworks, construction works and trackout.

The outcomes of the risk assessment indicate that during earthworks and construction, the risk of dust soiling is low to negligible, and the risk of human health impacts is low at all sensitive receivers. During trackout, the overall risk to sensitive receivers from dust soiling is low.

Table 5-7 Summary of risk of air quality impact

Receiver ID	Earthworks		Construction		Trackout	
	DS[1]	HH[2]	DS[1]	HH[2]	DS[1]	HH[2]
New Wollar Switching Station						
ID: 19	Low	Low	Low	Low	Low	Low
Elong Elong Energy Hub						
ID: 719	Low	Low	Low	Low	Low	Low
M5 Switching Station						
ID: 876	Low	Low	Low	Low	Low	Low
ID: 880	Low	Low	Low	Low	Low	Low
Transmission line tower sites						
ID: 539	Negligible	Low	Negligible	Low	Low	Low
ID: 543	Negligible	Low	Negligible	Low	Low	Low
All other receiver locations[3]	Negligible	Negligible	Negligible	Negligible	Low	Low

(1) DS: Dust soiling

(2) HH: Human health

(3) See Table 5-6 for list of sensitive receivers.

5.3.1.5 Step 3 – Site specific mitigation

Risks are described in terms of a negligible, low, medium, or high risk. Where there are low, medium, or high risks of an impact, then site-specific mitigation is required based on the risk level. For cases where the risk category is negligible, no mitigation measures beyond those required by legislation is required.

All identified sensitive receivers were assigned a negligible or low risk for earthworks, construction activities and trackout. It is noted that these risk categories are assigned to identified sensitive receivers prior to on-site mitigation and management measures being applied. To ensure dust impacts associated with the project are minimised site-specific mitigation measures are presented in Chapter 7.

5.3.1.6 Step 4 – Determine the significance of residual impacts

For all construction activities, the aim is to prevent significant impacts on receivers through effective mitigation. As stated in the IAQM guidance, this is normally possible. With the implementation of site-specific mitigation and management measures detailed in Chapter 7, the residual impacts are expected to be minor.

5.3.1.7 Impacts from concurrent project activities

There are two receivers with the potential to be impacted in the event that project construction activities occur concurrently. These receivers include ID: 876 and ID: 880.

Table 5-8 presents the sensitive receivers that have the potential to be affected by construction activities i.e. those sensitive receivers within 350 m of the construction area.

The IAQM assessment indicated the risk of dust impact at each of these receivers from activities at the nearest construction area was low prior to the implementation of mitigation measures. The residual risk of construction activities at these sensitive receivers are expected to be minor with mitigation measures in place. It follows that the risk of dust impact from individual activities located further away, but within 350 m of the identified sensitive receivers, would also be low (Table 5-8).

Activities that may take place at both construction areas concurrently, within 350 m of the identified sensitive receivers have the potential to increase the risk of dust impact. However, given the risk from individual activities at each construction area is low, it is considered that concurrent activities at both construction areas would also be low. Mitigation measures would further reduce the risk of dust impact, where concurrent construction activities occur.

Table 5-8 Sensitive receivers potentially affected by concurrent construction activities

Receiver ID	Distance to construction area (m)	Direction	Initial risk rating
ID 876	230 m to transmission line	East	Low
	247 m to M5	North-east	Low
ID 880	230 m to transmission line	East	Low
	259 m to M5	North-east	Low

5.3.2 Construction routes

Potential amenity impacts from dust generated on sealed and unsealed roads forming part of the construction routes were considered in addition to trackout. These construction routes are used by construction vehicles on public roads beyond 500 m of construction area access points. Potential dust impacts from construction traffic travelling on these construction routes would extend up to 100 m of sealed roads and 200 m of unsealed roads.

There are 35 sealed and unsealed roads that have been identified as part of the construction routes for the project. Of these, there are approximately 22 roads used by construction traffic that are characterised as unsealed. There are 33 sensitive receivers within 200 metres of the identified construction routes. The local construction routes and sensitive receivers are presented on figures in Appendix B.

Construction vehicles travelling on sealed roads have the potential to generate dust by the force of the wheels on the road, the road surface and vehicle speed. The surface of most sealed roads is bitumen and would not in themselves generate dust. During dry conditions, dust present on the sealed roads may be generated in the wake of the construction vehicles potentially impacting sensitive receivers. Construction vehicles would be required to adhere to the posted speed limits in particular when passing through townships and villages where the majority of sensitive receivers are located, which would assist in reducing potential dust, and associate amenity, impacts. Additionally, impacts are expected to be of short duration and intermittent and occur infrequently.

Construction vehicles travelling on unsealed construction routes would also generate dust by the force of the wheels on the road surface, the road condition and vehicle speed. The extent of dispersion and the size of impact would be dependent on meteorological conditions including wind speed and wind direction. Notwithstanding, dust generated from trucks on unsealed roads has the potential to be high particularly under certain conditions (dry surface road and high winds). However, the impacts to these receivers would be intermittent, of short duration and would likely only impact a small number of receivers at any given time.

Recommended management measures presented in Chapter 7 would assist with reducing impacts at identified sensitive receivers.

5.3.3 Ancillary sites

Operation of ancillary facilities such as workforce accommodation camps and construction compounds are 'screened out' by the IAQM guidance criteria and therefore were assessed qualitatively. These include the following facilities located at the energy hubs, New Wollar Switching Station and the Neeleys Lane workforce accommodation camp:

- staging and laydown areas
- construction support facilities including vehicle, equipment and materials storage, maintenance sheds, generators, chemical and fuel stores, waste bins and potential stockpiles areas
- accommodation buildings
- staff facilities (office and amenities)
- parking areas
- potable water tanks
- helicopter landing and take off.

Staging and laydown areas would also be located along the transmission line alignment for the temporary storage of materials, plant and equipment required to construct the various elements of the project, and to facilitate assembly of the transmission line towers and stringing of the conductors.

These activities are not expected to generate dust emissions and are not considered to be of significance.

5.4 Gaseous emissions

Gaseous emissions such as CO, NO_x, SO_2, VOCs and SVOCs would be generated from vehicles and fugitive sources during the construction phase.

5.4.1 Vehicle emissions

Diesel fuel combustion from vehicle movements and on-site plant and machinery operation would generate CO, NOx, SO_2 and trace amounts of non-combustible hydrocarbons (i.e. VOCs and SVOCs). The emission rates and potential impact on surrounding areas would depend on the number and power output of the combustion engines, the quality of fuel used, the condition of the engines and the intensity of use.

Construction vehicle movements would be required along the length of the construction area on a daily basis. The majority of movements would comprise vehicles travelling on the local, State and national road network delivering materials to the project and removing spoil and waste. A smaller proportion of movements would comprise mini-buses and light vehicles associated with construction workers travelling on State and local roads and access tracks between the workforce accommodation camps and construction areas. Details of daily heavy vehicle movements are presented in Section 5.2.2.

Workers would be transported between construction areas and the accommodation camps via shuttle buses to minimise potential traffic impacts on local roads and also reduce combustion emissions. This would mainly occur at the start and end of the working day.

The plant and machinery involved in the project construction includes excavators, cranes, rigid tippers, semi-trailers, rollers, dozers, concrete batching plants, concrete agitators, watercarts, crusher/screener, graders, stringing winches, backhoes, dumper trucks, trenchers, transport trucks, generators, and air compressors. Fuel combustion emissions from plant and equipment operating in the construction area would be intermittent and transient as not all the plant and machinery would be operating simultaneously.

Given the anticipated duration of works at any given location, the likely numbers of emission sources, and scheduling of activities (i.e., not all machinery would be operating in the same location simultaneously), gaseous emissions are not anticipated to significantly influence local or regional air quality. Emissions would be adequately manageable through the implementation of mitigation measures (refer to Chapter 7).

5.4.2 Fugitive emissions

Chemicals and fuel such as petroleum, diesel, liquefied natural gas (LNG), herbicides, pesticides and mineral oils would be stored in the storage and laydown areas at the construction compounds and accommodation camp sites have the potential to generate fugitive emissions i.e. leaks or other irregular releases of gases and vapours from tanks or pressurised containers. These hazardous and dangerous goods would be secured in purpose built bunded and secure areas. These emissions are expected to be minor and readily dispersed within the construction area. With appropriate handling and storage, air quality impacts from these fugitive sources are considered to be negligible.

5.5 Odour

Wastewater treatment plants are proposed to be included at the workforce accommodation camps at Merotherie Energy Hub and Neeleys Lane, Cassilis. The proposed wastewater treatment plants are anticipated to consist of a generally contained system that would include biological and chemical treatment, filtration, and disinfection.

The treatment system would mainly comprise of enclosed tanks with the following potential odour sources:

- wastewater screening to remove inorganics
- screened material stored in waste bins (sludge storage).

In an event that inorganic materials accumulate on the screens, waste bins are not emptied regularly or not properly closed, or waste sludge is not appropriately stored before off-site removal to a licensed facility, odour emissions may potentially impact on the receiving environment. The most potentially affected receivers are on-site workers living within the workforce accommodation camp. In general, there is low potential for odour generation at the wastewater facilities, given the relatively small scale of the treatment plants with no large open sources.

If odour emissions do occur, they are likely to be infrequent, of short duration and of low intensity. Potential odour impacts on workers within the accommodation camp are anticipated to be of low significance. Off-site receivers are not expected to be adversely impacted by odour emissions given the approximate distance of the wastewater treatment plants. Potential odour emissions from the wastewater treatment plants at each of the accommodation camps would not be of significance.

6 Operational assessment

This Chapter presents an assessment of the potential impacts that are expected to occur during operation as a result of the project.

6.1 Infrastructure operations

During operations, windblown dust may be generated from unsealed access tracks and easements along the transmission lines and towers and any unsealed roads at the energy hubs and switching stations. These emissions are expected to be low and impacts minimal.

Sulphur hexafluoride (SF_6) may also be released at the energy hubs and switching stations. SF_6 would be used as a high voltage insulating gas and expected to be emitted at trace levels. Impacts on the receiving environment would be negligible from the release of SF_6.

6.2 Inspection, maintenance, or emergency works

During routine inspection, maintenance or emergency works, light vehicles to the various sections of the operation area. In an emergency, there is the potential for light aircraft to be used, which would be extremely infrequent. Small to medium sized equipment may also be used at times. This would generate emissions (gaseous and dust) due to fuel combustion from light vehicles, drones and helicopters and dust emissions from light vehicles travelling on unsealed roads. Dust emissions may also be generated during vegetation clearing.

The following maintenance activities would be required during operation of the project:

- regular inspection and maintenance of transmission lines, towers and poles
- routine/planned line maintenance using a light vehicle(s), an elevated work platform and a medium sized truck involving multiple maintenance crews to rectify any defects found from routine inspections. Generally, this would occur within the same maintenance cycles as the routine infrastructure inspections
- aerial inspections and LiDAR data gathering exercises of transmission lines would be completed every two years
- a vehicle-based patrol of access tracks and roads would occur every two years
- ad hoc fault and emergency fly over(s) to assess infrastructure condition should an unplanned outage occur (for example through a weather event or other failure of infrastructure). This maintenance would occur as required. The number of maintenance personnel and/or crews required to repair any damaged infrastructure would depend on the extent of repairs required
- vegetation removal to maintain appropriate clearances to the transmission lines.

Maintenance activities at the energy hubs and switching stations include:

- routine infrastructure inspection (of transformers and other electrical plant and equipment) throughout the year
- routine/planned maintenance of equipment, property, and switchyard areas on a scheduled basis
- ad hoc fault and emergency work for repair of any damaged infrastructure.

In summary, air quality impacts from operations, maintenance or emergency works on the receiving environment are expected to low and not of significance.

7 Recommended management and mitigation measures

This chapter describes how the project would be managed to reduce potential impacts to air quality throughout detailed design, construction, and operation. The approach to environmental management and mitigation of potential impacts for the project would be carried out through the development of a project specific construction and environment management plan (CEMP) for main construction works.

7.1 Environmental management

Air quality management measures would form part of the Construction Environmental Management Plan (CEMP) and incorporate the following components:

- identification of sensitive receivers with 350 m of the construction area
- assessment of impacts from all construction areas
- recommendation of management measures to reduce potential impacts during construction
- review and update the air quality management measures at regular intervals i.e. three months to reflect the changing nature of the construction works.

7.2 Recommended mitigation measures

Table 7-1 presents recommended mitigation measures for the project.

Table 7-1 Proposed mitigation measures

Reference	Impact	Mitigation measures	Timing	Applicable location(s)
AQ1	Dust generation – general	Management measures to prevent or minimise dust generation and impacts to the local community and environment will include (but not be limited to): — use of water sprays or dust suppression surfactants as required for dust suppression where required and appropriate — adjusting the intensity of activities based on observed dust levels and weather forecasts — minimising the amount of material stockpiled and position stockpiles away from surrounding receivers — project construction vehicle movements are to adhere to designated entry/exit routes and parking areas — implementation of measures to minimise the tracking of material onto sealed roads e.g., wheel wash — covering of loads — stabilising disturbed areas as soon as practicable, including new access routes — minimising the extent of disturbance as far as practicable — regularly conducting visual inspections of dust emissions and applying additional controls as required	Construction	All locations

Reference	Impact	Mitigation measures	Timing	Applicable location(s)
		— where possible minimise concurrent construction activities near sensitive receivers that have a greater potential of the risk of dust impact.		
AQ2	Vehicle and plant emissions	Where feasible, construction vehicles and machinery will be fitted with appropriate emission control equipment and maintained in a proper and efficient manner.	Construction	All locations
AQ3	Dust emissions from concrete batching plants	Measures will be implemented at concrete batching plants to minimise emissions to air as far as possible. The measures will be regularly inspected with additional controls implemented as required. Measures to minimise emissions to air from concrete batching plants may include: — all aggregate and sand will be stored appropriately in storage bins or bays to minimise dust generation, and material will not exceed the height of the bay — cement silos and hoppers will be fitted with dust filters — all inspection points and hatches will be fully sealed — all dry raw materials to be transferred into the bowl of an agitator via front end loaders by maintaining adequate moisture levels and/or an enclosed conveyor — cement silos will be fitted with an emergency pressure alert and automatic cut off protection to prevent overfill — transfer of cement from storage to batching will occur via sealed steel augers.	Construction	Concrete batching plant(s)
AQ4	Dust emissions from crushing and screening plant	To minimise dust emissions associated with the proposed crushing and screening activities, the following measures will be implemented: — ensure screen covers are fitted to the screening operations — control dust emissions from screening operations using water sprinklers, where required and appropriate — inspect the water sprinklers on a regular basis to ensure operational efficiency — where practicable, install wind breaks in appropriate locations adjacent to the dust generating equipment and processes — prior to screening, dampen the rocks during dry weather conditions.	Construction	Crushing and screening
AQ5	Emissions along construction routes	During high wind conditions (wind speeds greater than 5 metres per second), reduced speed limits for project heavy vehicles on unsealed roads will be implemented.	Construction	Construction routes

7.3 Effectiveness of the mitigation measures

7.3.1 Construction

The risk of dust impact from earthworks and construction works activities associated with the project are low to negligible prior to mitigation. For trackout, the risk of dust impacts is low except for two sensitive receivers where the risk was medium. With site-specific mitigation measures in place, the risk would be further reduced to low or negligible and would not be of significance.

Gaseous emissions generated from vehicles and fugitive sources during construction phase would be minimised with mitigation measures in place and air quality impacts would not be of significance.

Odour emissions from the on-site wastewater treatment plants would be low. The systems would be contained and managed to ensure odour generated is minimised.

7.3.2 Operation

During normal operations, potential wind-blown dust emissions from unsealed tracks and roads would be negligible. No other air emissions would be generated either from the operation of transmission lines, energy hubs or switching stations.

During routine inspection, maintenance or emergency, the potential gaseous emissions and dust emissions are anticipated to be negligible, and the impacts on surrounding areas would not be significant. Notwithstanding, proposed management measures would be implemented to ensure potential air quality impacts are minimised.

8 References

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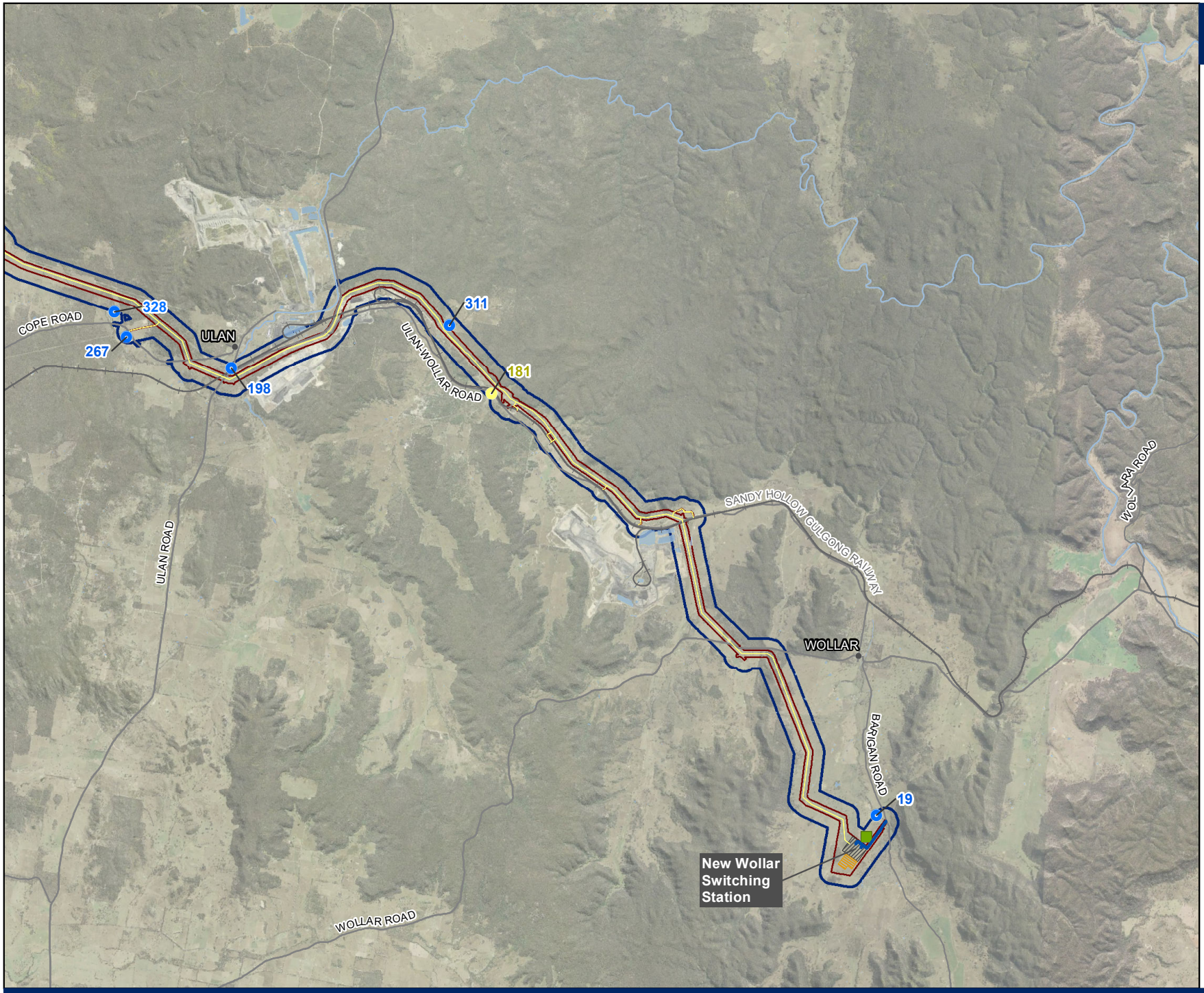
Ulan Coal, Glencore, Ulan Coal Mines Limited, Environmental Monitoring Summary reports, January – March 2021, April – June 2021, July – September 2021, October – December 2021.

9 Limitations

The existing environment study was conducted using publicly available data (e.g., Bureau of Meteorology) and consulting the DPE (i.e., ambient air quality monitoring data). Due to the remoteness of the project and the limited availability of information for the air quality study area, the most representative data was analysed to demonstrate the likely conditions of the existing environment.

Appendix A

Location of sensitive receivers



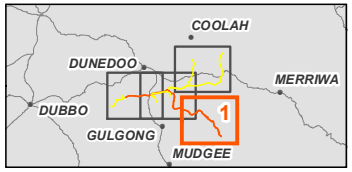
Appendix A
Location of sensitive receivers
Page 1 of 4

Legend

- Study area
- Construction area
- Construction compound
- Energy hub / 500 kV switching station
- Existing substation
- Access road
- Access track
- Road
- Railway
- Watercourse
- Water body

Sensitive receiver

- House
- Unoccupied house



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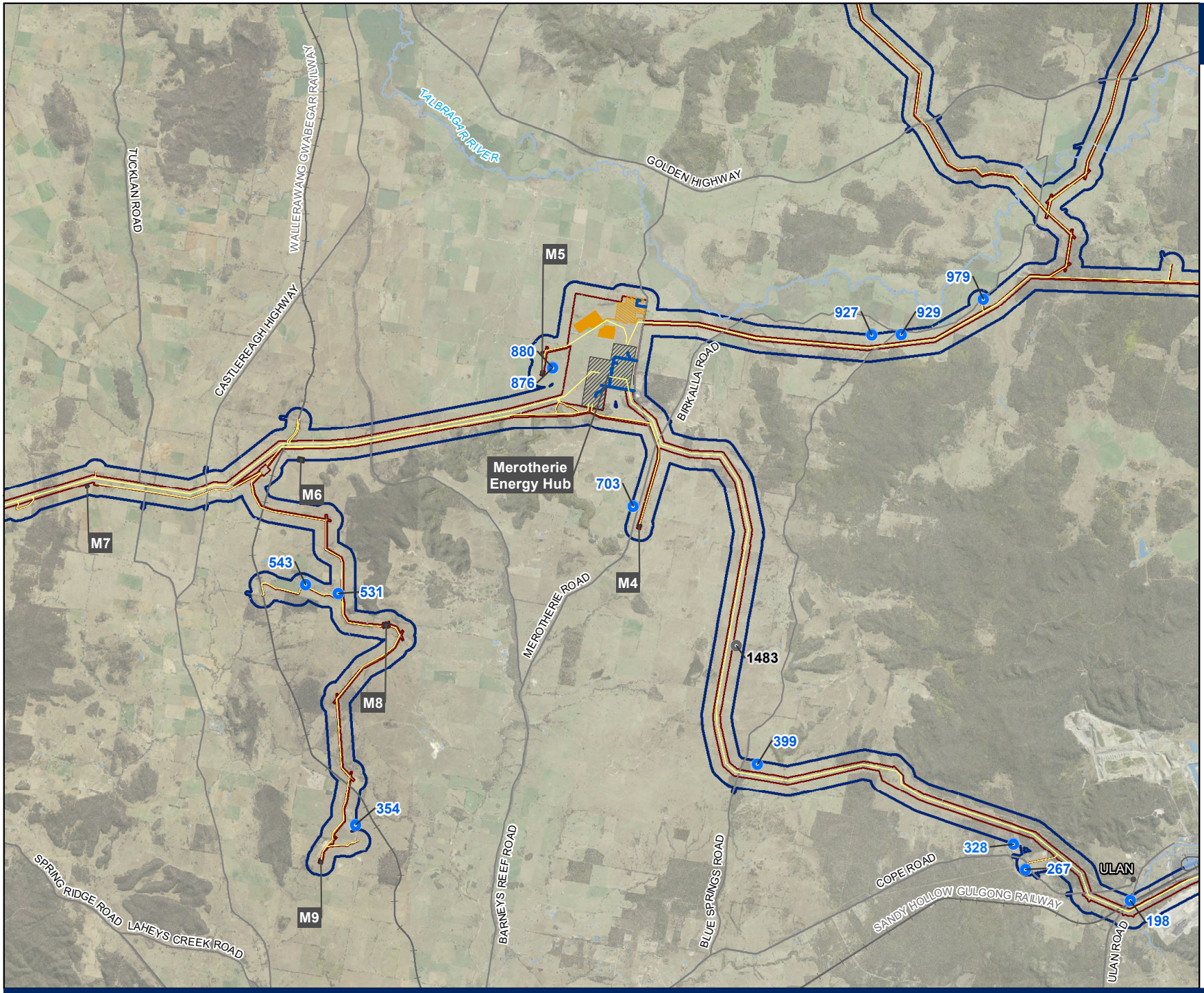


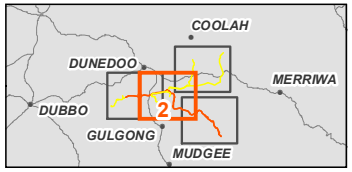
Appendix A
Location of sensitive receivers
Page 2 of 4

Legend

- Study area
- Construction area
- Construction compound
- Workforce accommodation camp
- Energy hub / 500 kV switching station
- 330 kV switching station
- Access road
- Access track
- Road
- Railway
- Watercourse
- Water body

Sensitive receiver

- House
- DA approved (no structure)



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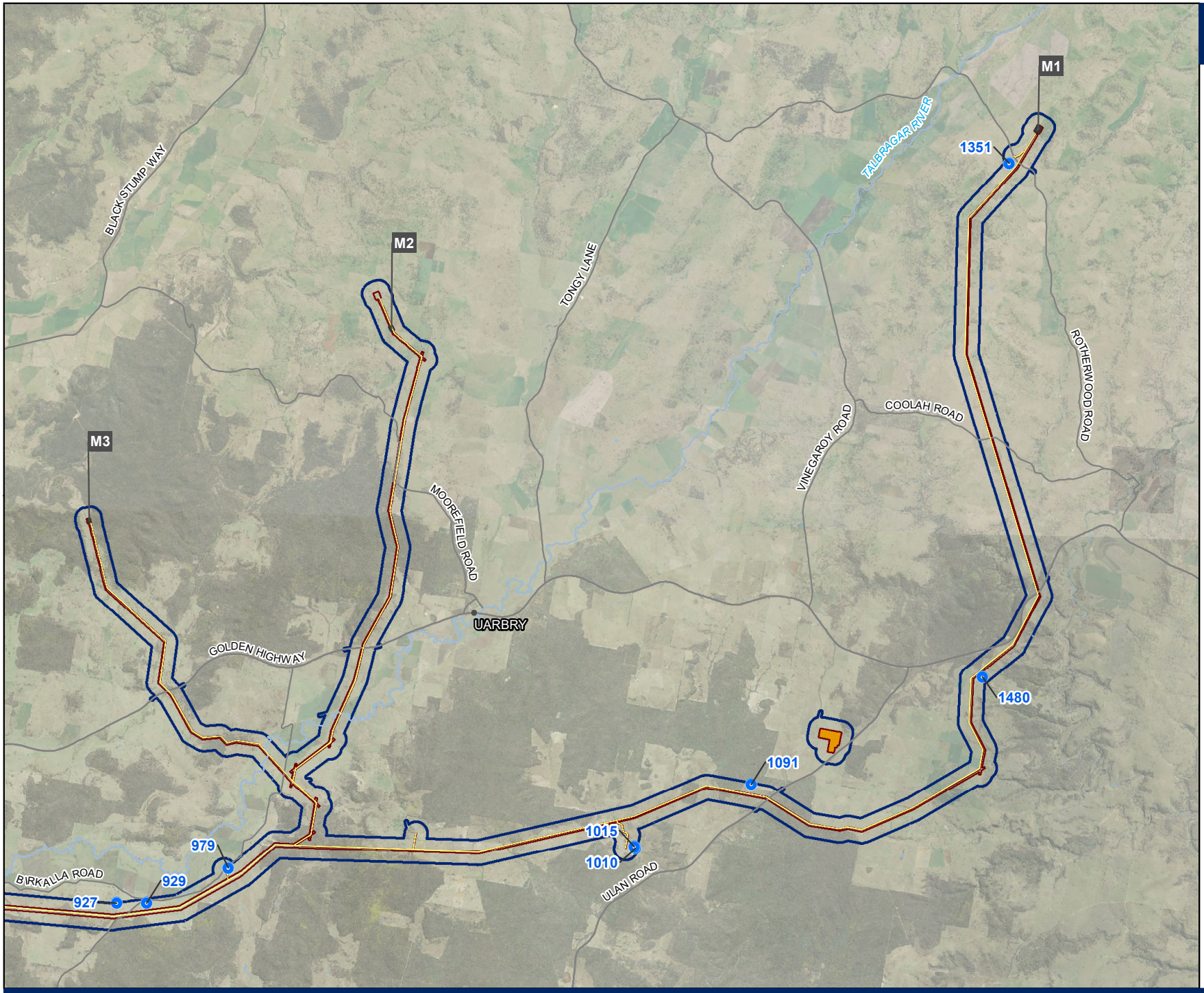
Appendix A
Location of sensitive receivers
Page 3 of 4

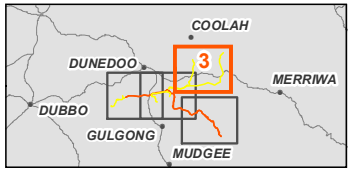


Legend

- Study area
- Construction area
- Workforce accommodation camp
- 330 kV switching station
- Access track
- Road
- Watercourse
- Water body

Sensitive receiver

- House



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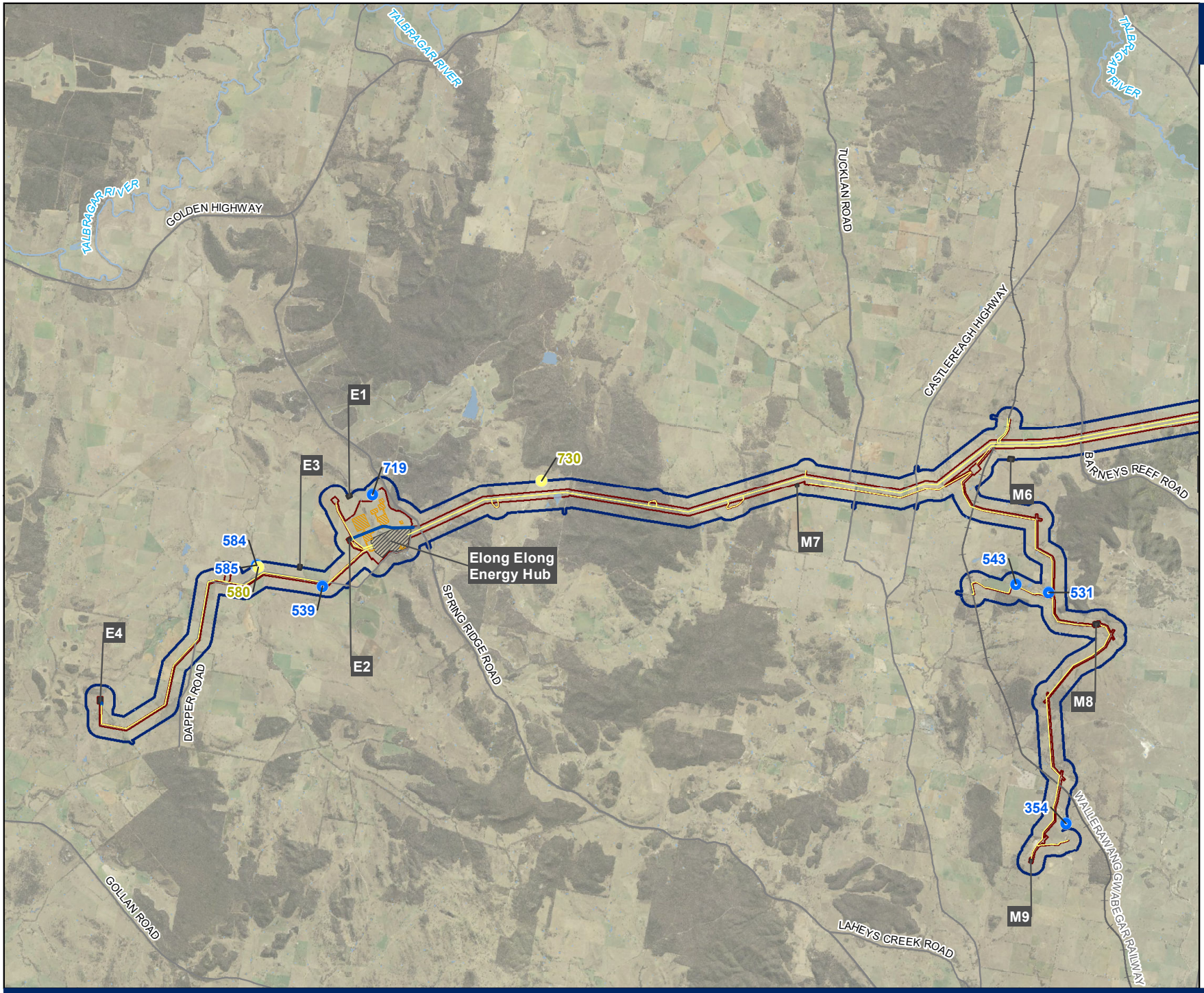


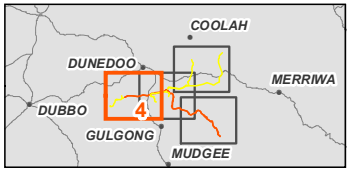
Appendix A
Location of sensitive receivers
Page 4 of 4

Legend

- Study area
- Construction area
- Construction compound
- Energy hub / 500 kV switching station
- 330 kV switching station
- Access road
- Access track
- Road
- Railway
- Watercourse
- Water body

Sensitive receiver

- House
- Unoccupied house



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Appendix B

Sensitive receivers along construction routes

Appendix B
Sensitive receivers on construction routes
Page 1 of 4

Legend

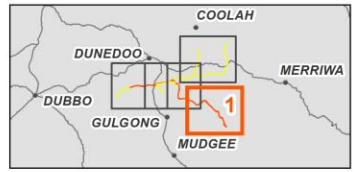
- Study area
- Construction area
- Construction compound
- Energy hub / 500 kV switching station
- Existing Substation

General construction route

- General construction route (light and heavy vehicles)

Sensitive receiver

- Sensitive receiver



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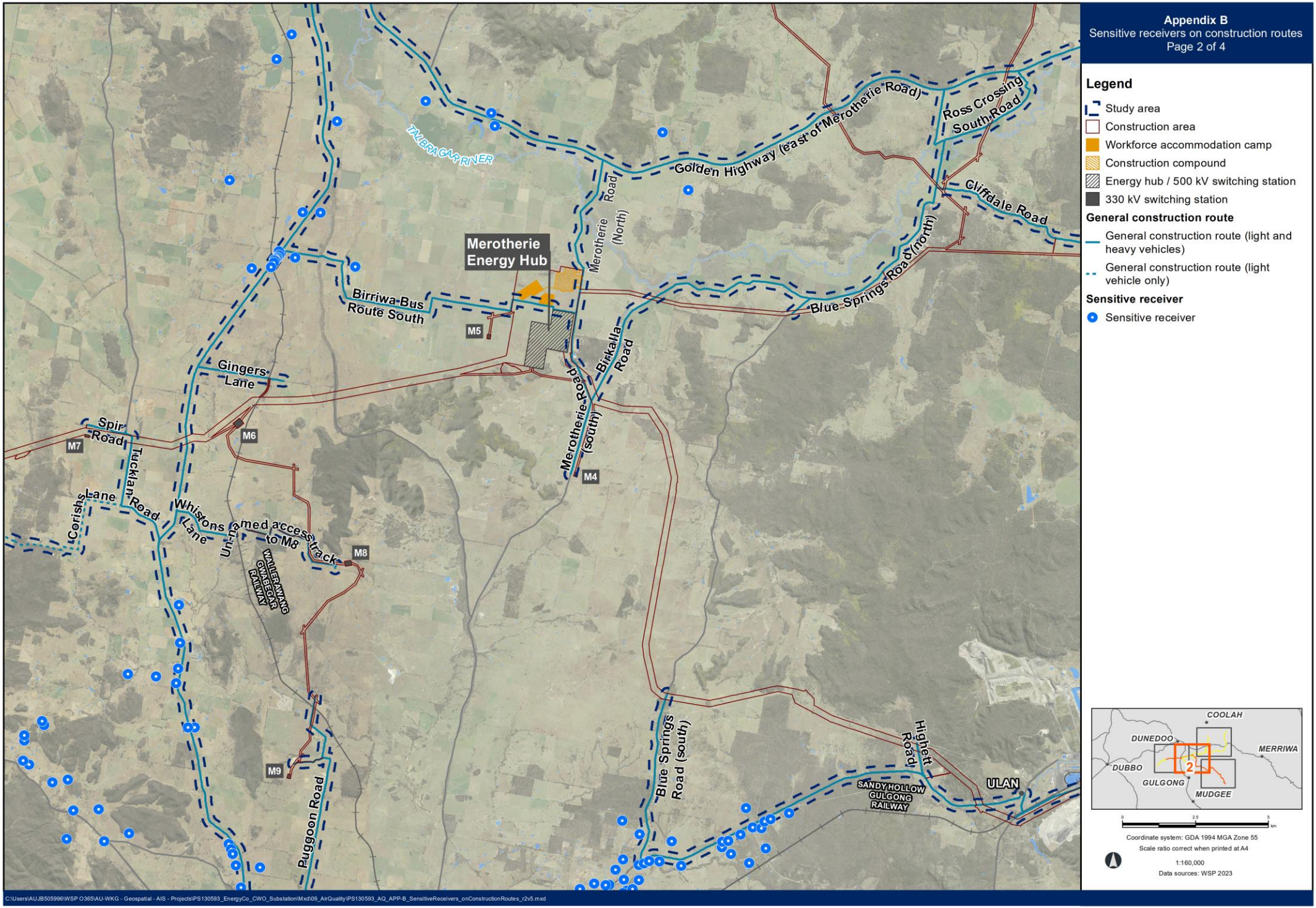
Merotherie Energy Hub
Golden Highway (east of Merotherie Road)
Ross Crossing South Road
Cliffdale Road
Blue Springs Road (north)
Merotherie Road (North)
Birriwa Bus Route South
Gingers Lane
Spir Road
Tucklan Road
Corishs Lane
Whistons Lane
Un-named access track to M8
Merotherie Road (south)
Birkalla Road
Blue Springs Road (south)
Highett Road
Puggoon Road
TALBRAGAR RIVER
WALLERAWANG GWABEGAR RAILWAY
SANDY HOLLOW GULGONG RAILWAY
ULAN
M4
M5
M6
M7
M8
M9
Appendix B
Sensitive receivers on construction routes
Page 2 of 4
Legend
Study area
Construction area
Workforce accommodation camp
Construction compound
Energy hub / 500 kV switching station
330 kV switching station
General construction route
General construction route (light and heavy vehicles)
General construction route (light vehicle only)
Sensitive receiver
Sensitive receiver
COOLAH
DUNEDOO
MERRIWA
DUBBO
GULGONG
MUDGEE
2
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Appendix B
Sensitive receivers on construction routes

Legend

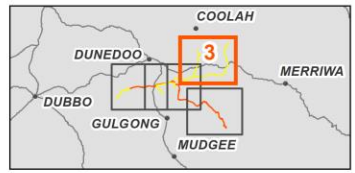
- Study area
- Construction area
- Workforce accommodation camp
- 330 kV switching station

General construction route

- General construction route (light and heavy vehicles)

Sensitive receiver

- Sensitive receiver



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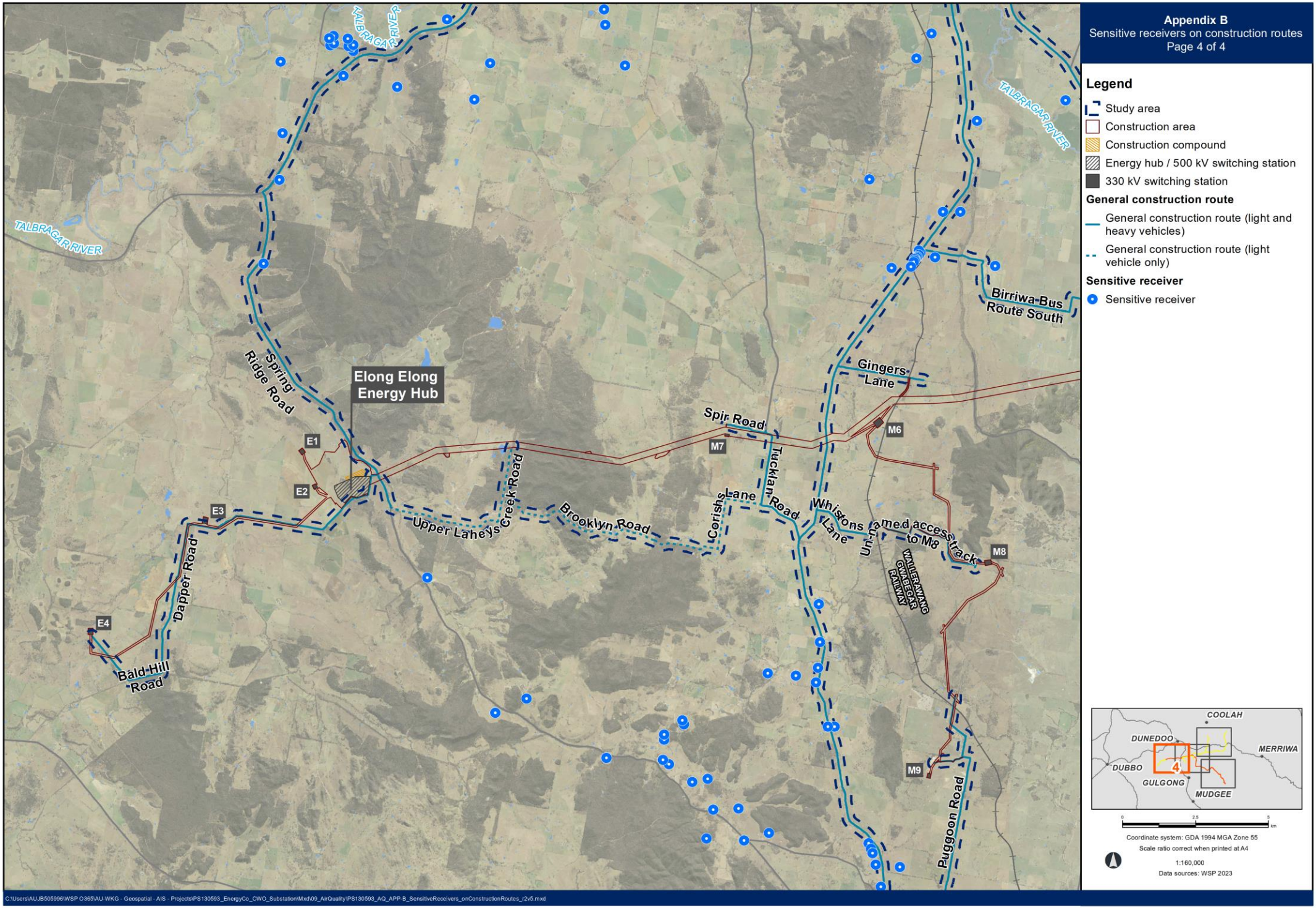

Appendix B
Sensitive receivers on construction routes

Legend

- Study area
- Construction area
- Construction compound
- Energy hub / 500 kV switching station
- 330 kV switching station

General construction route

- General construction route (light and heavy vehicles)
- General construction route (light vehicle only)

Sensitive receiver

- Sensitive receiver

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