Culcairn to Wagga Wagga Gas Pipeline

MOD 1 Uranquinty Compressor Station – Air Quality Impact Assessment

APA Group

06 August 2025

The Power of Commitment

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Glossary and acronyms

Term	Definition
Air NEPM	*National Environment Protection (Ambient Air Quality) Measure 2021*
APA	East Australian Pipeline Ltd, part of APA Group
Approved Methods	Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales
AQMS	Air quality monitoring station
AWS	Automatic weather station
BoM	Bureau of Meteorology
GHD	GHD Pty Ltd
NSW DCCEEW	NSW Department of Climate Change, Energy, the Environment and Water
NSW EPA	New South Wales Environment Protection Authority
US EPA	United States Environmental Protection Agency
IAQM	Institute of Air Quality Management
LGA	Local government area
POEO Act	*Protection of the Environment Operations Act 1997*
SSI	State Significant Infrastructure
TSP	Total suspended particulate
UCS	Uranquinty Compressor Station
VOC	Volatile Organic Compounds

1. Introduction

1.1 Background

East Australian Pipeline Pty Ltd, part of APA Group (APA), own and operate the Culcairn to Wagga Wagga Pipeline, an 88 km natural gas pipeline extending from Wagga Wagga in the Wagga Wagga local government area (LGA) to Culcairn in the Greater Hume Shire LGA in NSW. The Culcairn to Wagga Wagga pipeline interconnects with the Moomba to Wilton Pipeline which extends approximately 1,300 km between Moomba in South Australia to Wilton in NSW.

The Culcairn to Wagga Wagga Pipeline is authorised by Pipeline Licence No. 23 and SSI-65512969. The pipeline forms part of APA's East Coast Grid of gas transmission pipelines.

APA is proposing an expansion of gas transportation capacity within its East Coast Grid linking Queensland to southern states of Australia. This is in response to forecasted potential supply issues during the winter months. To achieve expansion of the East Coast Grid and build capacity to move more gas to address shortfalls, the construction of a compressor station on the Culcairn to Wagga Wagga Pipeline is proposed.

APA seeks to construct the Uranquinty Compressor Station (UCS) as part of Stage 3 of APA's East Coast Grid Expansion Plan (the proposed modification). The UCS would be located in Uranquinty, NSW along Uranquinty Cross Road within the Wagga Wagga LGA on land owned by APA (Lot 781 DP 878179).

GHD Pty Ltd (GHD) has been engaged by APA to undertake an air quality assessment of construction and operation of the Uranquinty Compressor Station. Construction of the UCS is scheduled to begin in the second half of 2026, subject to approval of Modification 1.

1.2 Overview of the proposed modification

1.2.1 Modification location

The modification site is located approximately 3.4 km west of Uranquinty Township within the Wagga Wagga LGA on land owned by APA (Lot 781 DP 878179) (the site) (refer Figure 1.1). The major access to the site is via Uranquinty Cross Road.

The closest residential dwellings are located about 880 m and 1.1 km south-east of the site. There is also one residential dwelling located about 1.3 km north-west of the proposed site. The town of Uranquinty is located about 3.2 km south-east of the proposed site. There are no schools, conservation areas and places of worship within 2 km of the proposed site. The nearest watercourse is Sandy Creek located approximately 1.9 km to the north-east. There is one commercial receiver located 1 km south-east of the site. Further details off surrounding land use are outlined in Section 3.1 and are shown in Figure 1.1.

LEGEND

- Proposed site
- Easement
- Lot
- Culcairn to Wagga Wagga pipeline
- Railway
- Waterway

Sensitive receivers

- Industrial
- Residential
- Shed

Paper Size ISO A4

0 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

East Australian Pipeline Pty Ltd
Culcairn to Wagga Wagga Gas Pipeline – MOD 1 Uranquinty Compressor Station

Project No. 12614690
Revision No. 0
Date 10/06/2025

Location of proposed modification

FIGURE 1.1

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Print date: 10 Jun 2025 - 15:06

Data source: DCS: DTDB\DCDB, 2023: World Topographic Map: Vicmap, Esri, TomTom, Garmin, FAO, METI/NASA, USGS
World Hillshade: Esri, CGIAR
World Topographic Map: Esri Community Maps Contributors, Vicmap, Esri, TomTom, Garmin, METI/NASA, USGS

World Hillshade: Esri, Geoscience Australia, NASA, NGA, USGS\ Metromap: Aerial imagery, . Created by: pfernandes

1.2.2 Key features of the modification

This modification seeks approval to establish and operate a compressor station and ancillary infrastructure.

The proposed modification will include the following elements:

- An electric driven compressor unit
- Lubricating oil system (inclusive of lube oil cooler)
- Compressor inlet / scrubber
- Air cooled heat exchangers
- Electrical house for high voltage switchgear
- Variable Frequency Drive (VFD)
- VFD cooler
- Isolation transformer
- Air compressors and receivers
- Associated piping, electrical equipment, instrumentation and controls
- Station attenuated vent
- Control building housing the automated control systems and communications
- Back up diesel generator
- Septic tank system
- Security fences
- Noise walls
- Access and support facilities.

Once constructed, the compressor station will have an average design life of approximately 25 years. APA will continue to monitor the condition of equipment up to, and beyond, the end of life to assess equipment is sound and fit for further service. Ongoing maintenance of plant and equipment would be undertaken as part of the operations.

Further details of the modification are provided in Section 3 of the Modification Report.

1.2.3 Modification timing

Construction of UCS is scheduled to begin in the first half of 2026, subject to approval of the proposed modification. The construction of UCS will take about twelve months, followed by about three months of commissioning.

1.3 Purpose and scope of this document

This report has been prepared GHD on behalf of APA as part of the Modification Report to support the proposed modification.

The purpose of this report is to assess potential air quality issues from the construction and operation of the proposed modification. Where required, feasible and reasonable mitigation and management measures have been identified.

This Air Quality Assessment:

- describes the existing environment with respect to air quality
- assesses the impacts of the construction and operation of the modification on air quality
- recommends measures to mitigate and manage the impacts identified.

1.4 Limitations

This report has been prepared by GHD for APA and may only be used and relied on by APA for the purpose agreed between GHD and APA as set out in section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than APA arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described throughout report. GHD disclaims liability arising from any of the assumptions being incorrect.

2. Methodology

2.1 Study area

The study area for the assessment has been defined as a 15 km buffer around the site. This buffer distance is considered sufficient to capture potential air quality impacts on sensitive receivers.

2.2 Assessment requirements and guidance

Guidelines and regulations relevant to the assessment are listed in Table 2.1.

Table 2.1 Guidelines and regulations relevant to the air quality

Guidelines and regulations	Description
Protection of the Environment Operations Act 1997 (NSW) (POEO Act)	The POEO Act provides the statutory framework for managing pollution in NSW, including the procedures for issuing licences for environmental protection on aspects such as waste, air, water and noise pollution control. The POEO Act requires that an occupier of any premises not cause air pollution (including odour) through a failure to maintain or operate equipment or deal with materials in a proper and efficient manner. An operator must also take all practicable means to minimise and prevent air pollution (sections 124, 125, 126 and 128 of the POEO Act). The POEO Act includes the concept of ‘offensive odour’ (section 129) and states it is an offence for scheduled activities to emit ‘offensive odour’.
Protection of the Environment Operations (Clean Air) Regulation 2022 (NSW)	The Protection of the Environment Operations (Clean Air) Regulation 2022 provides regulatory measures to control emissions from motor vehicles, fuels, and industry.
National Environment Protection Council National Environment Protection (Ambient Air Quality) Measure 2021 (the Air NEPM)	The National Environment Protection Council set uniform national standards for ambient air quality, known as the Air NEPM. The Air NEPM contains goals for the identified relevant pollutants inclusive of particulates and concentration limits, averaging periods and number of allowed exceedances for each of the identified pollutants.
Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (NSW EPA, 2022) (the Approved Methods)	The Approved Methods lists the statutory methods for modelling and assessing emissions of air pollutants from stationary sources in NSW. It considers the above-mentioned legislation and guidance to provide pollutant assessment criteria, and assessment methodologies, including for dispersion modelling. The assessment conducted for the proposed modification has considered the assessment criteria provided in the Approved Methods (see Section 2.3).
Guidance on the assessment of dust from demolition and construction (Institute of Air Quality Management, 2024) (IAQM Guidance)	This document is designed to provide guidance for developers, their consultants and environmental health practitioners on how to undertake a construction dust impact assessment (including demolition and earthworks as appropriate). It is an industry-accepted contemporary guidance which has been used for a number of large projects across Australia. The approach described in the IAQM Guidance has been used for the construction assessment (see Section 2.4.1). This guidance takes into account background PM_{10} concentrations when defining the sensitivity of an area. As this is a UK-based guidance, the annual average increments provided are not considered applicable in an Australian setting. Adjusted increments for an Australian setting have been considered (ARTC, 2020).

2.3 Assessment criteria

The *Approved Methods* lists the statutory methods for modelling and assessing air pollutants from stationary sources and specifies criteria which reflect the environmental outcomes adopted by the EPA. The *Approved Methods* are referred to in the Protection of the Environment Operations (Clean Air) Regulation 2022 for assessment of impacts of air pollutants. The air quality impact assessment criteria set out in the Approved Methods relevant to the pollutants identified in Section 2.2 are reproduced and discussed in Table 2.2.

Table 2.2 Air quality impact assessment criteria

Pollutant	Averaging period	Concentration	Unit
CO	15 minutes	100,000	mg/m^3
	1 hour	30,000	mg/m^3
	8 hours	10,000	mg/m^3
NO_2	1 hour	164	µg/m^3
	Annual	31	µg/m^3
SO_2	1 hour	286	µg/m^3
	24 hours	57	µg/m^3
$PM_{2.5}$[1]	24 hours	25	µg/m^3
	Annual	8	µg/m^3
PM_{10}	24 hours	50	µg/m^3
	Annual	25	µg/m^3
TSP	Annual	90	µg/m^3
Dust deposition	proposal contribution	2	g/m^2/month
	cumulative	4	g/m^2/month
PAH[2]	1 hour	0.4	µg/m^3
TVOCs (Benzene)[3]	1 hour	29	µg/m^3

1. Dust emissions from the operation of the project have been assessed against $PM_{2.5}$ criteria as a measure of conservatism.
2. PAH criteria are derived from the criteria for Benzene, which was selected as the lowest and therefore most conservative
3. These compounds are classed as VOCs, as a measure of conservatism, the lowest criteria (Formaldehyde) has been adopted for TVOCs in this assessment.

Guidance on the application of these criteria is outlined in section 7.1.2 and section 7.2.2 of the Approved Methods (NSW EPA, 2022) as follows:

– The assessment criteria for deposited dust, particulates, and products of combustion must be applied:
  - at the nearest existing or likely future off-site sensitive receivers
  - the incremental impact (predicted impacts due to the pollutant source alone) for each pollutant must be reported in units and averaging periods consistent with the impact assessment criteria
  - background concentrations must be included using the procedures specified in Section 5 of the *Approved Methods*
  - total impact (incremental impact plus background) must be reported as the 100th percentile in concentration or deposition units consistent with the impact assessment criteria and compared with the relevant impact assessment criteria.

– The impact assessment criteria for individual toxic air pollutants must be applied:
  - at and beyond the boundary of the facility
  - the incremental impact for each pollutant must be reported in concentration units consistent with the criteria, for an averaging period of 1 hour and as the 99.9th percentile of dispersion model predictions.

2.4 Assessment methodology

2.4.1 Construction phase

The main source of potential air quality impacts for the modification is a result of dust emissions during construction. Conducting a quantitative modelling assessment to estimate potential dust emissions from construction activities requires numerous assumptions to calculate particulate emission rates for model inputs. However, the inherent uncertainties in such analyses limit their practical value, as they do not directly aid in identifying air quality control measures for effective risk management.

Given this, a qualitative, risk-based assessment has been conducted using available information to determine which construction activities could lead to off-site air quality impacts if not properly controlled. This approach ensures that suitable mitigation measures can be identified and integrated into the project design and relevant environmental management plans.

To assess construction-phase impacts, the methodology outlined in the IAQM Guidance (Institute of Air Quality Management, 2024) has been applied. Developed by the IAQM in the United Kingdom, this framework provides a structured qualitative assessment method, detailed in Appendix A. The IAQM approach follows a four-step process to evaluate potential dust impacts from construction activities.

– Step 1 is to screen the requirement for an assessment. No further assessment is required if there are no receivers within a certain distance of the works.
– Step 2 is to assess the risk of dust impacts. This is done separately for each of the four activities (demolition, earthworks, construction, and track out) and take account of:
  - Potential dust emission magnitude (Step 2A)
  - The sensitivity of the area (Step 2B).
– Step 3 is to determine site-specific mitigation (in addition to basic project controls) for each of the four potential activities in Step 2.
– Step 4 is to examine the residual effects and to determine whether these are significant.

The primary air quality concerns associated with construction activities are from emissions of fugitive dust, which is directly influenced by the specific activities taking place at any given time. Typically, the activities most likely to result in short-term dust emissions include:

– Grading
– Loading and unloading of materials
– Combustion emissions from construction equipment
– Dust from trucks traveling on unpaved surfaces
– Wind erosion of exposed areas
– Material handling operations on-site.

Temporary increases in local dust levels are most probable during dry periods with low rainfall and/or windy conditions. The impact of elevated dust emissions depends on the ability of particulates to remain airborne before settling as dust or contributing to ambient particulate concentrations.

Several environmental factors can affect dust generation and dispersion, including:

– Wind Direction: Determines the transport of dust and suspended particles towards sensitive receivers.
– Wind Speed: Influences the suspension and drift potential of particles.
– Surface Type: More erodible materials, for example erodible soil types, are more prone to soil or dust erosion.
– Surface Moisture: Higher moisture levels in surface materials reduce the potential for erosion.
– Rainfall or Dew: Precipitation or heavy dew can moisten soil surfaces, decreasing the likelihood of dust generation.

In cases where diesel-powered machinery and vehicles are utilised, localised increases in ambient concentrations of combustion-related pollutants may occur. However, the risk of exceeding relevant impact assessment criteria for these pollutants in nearby sensitive areas is considered low due to the lack of other sources with potential to give rise to combustion-related pollutants emissions. Overall, fugitive dust emissions are generally regarded as the most significant contributors to downwind air quality impacts at construction sites and is also the case for this modification.

2.4.2 Operation phase

2.4.2.1 Meteorological modelling

Meteorological processes significantly influence the dispersion, transformation, and removal of pollutants in the atmosphere. Vertical dispersion depends on atmospheric stability and surface mixing layer depth, while horizontal dispersion is driven by wind speed and direction. Wind speed affects pollutant transport and dilution, with mechanical turbulence, influenced by surface roughness, further aiding dispersion. Wind direction determines pollutant pathways and crosswind spreading, causing concentrations to fluctuate with changes in stability, mixing depth, and wind patterns (Oke, 2002).

For this study, a site-specific three-dimensional meteorological dataset was developed using TAPM (v4.0.4) with meteorological observations from the Wagga Wagga automatic weather station (AWS). This meteorological dataset was incorporated into CALPUFF using 'no-ob's mode. Details of meteorological modelling configuration are provided in Appendix B-3.

2.4.2.2 Selection of representative year

Meteorological data taken at the Wagga Wagga AWS, located approximately 22 km northeast of the site, from 2020 – 2024 was reviewed to identify a representative year for air quality assessment. Using these data, it was determined meteorological data from 2022 was the most appropriate data to adopt as a representative year for the purpose of meteorological modelling. A full review of the local meteorology is available in Section 3.3.

2.4.2.3 Meteorological modelling

CALMET is a meteorological modelling tool that generates hourly wind and other meteorological fields within a three-dimensional gridded domain, which serve as inputs for the CALPUFF dispersion model. The output from CALMET also includes associated two-dimensional fields, such as mixing height, surface characteristics, and dispersion properties.

Within CALMET, the interpolated wind field is adjusted to incorporate the effects of topography, sea breezes, and variations in heating and surface roughness due to diverse land uses throughout the modelling domain. These adjustments are applied at each grid point to produce a final wind field that accurately reflects local influences.

Meteorological conditions were modelled using TAPM and CALMET utilising data collected from the Bureau of Meteorology (BoM) AWS located at Wagga Wagga North. A review of the past five full years of weather data from this station was undertaken and is outlined in Section 3.3 and it was determined that 2022 was the most representative year for modelling.

2.4.2.4 Plume Dispersion Model

Emissions from the proposed modification were assessed using the CALPUFF modelling system, a transport and dispersion model that tracks "puffs" of material from emission sources, accounting for their dispersion and transformation over time. The model utilises meteorological data generated by the CALMET pre-processor, which incorporates temporal and spatial variations in weather conditions.

The CALPUFF model was configured with reference to NSW Environment Protection Authority (NSW EPA) guidance on optimum settings for CALPUFF, using the Ozone Limiting Method (OLM) in order to predict speciation of NO_x to NO_2. Full details of dispersion model settings are outlined in Appendix B-4.

2.4.2.5 Emissions inventory

The key potential air emission sources associated with the operation of the project will be products of diesel combustion from one backup generator that is expected to provide up to 320 kW of power. The backup generator will not be used during standard operations and will only be used during emergency situations. The backup generator is the only major emitter of air pollutants for the UCS and has been conservatively included in the cumulative air quality assessment.

Expected pollutants from a backup diesel generator include:

– Nitrogen oxides (NO_x)
– Sulfur dioxide (SO_2)
– Carbon monoxide (CO)
– Particulate matter (PM_{10} and $PM_{2.5}$)
– Volatile organic compounds (VOCs)
– Polycyclic Aromatic Hydrocarbons (PAHs).

Vehicle exhaust emissions are deemed to have a minimal impact on overall air emissions, as they are considered negligible in comparison to other combustion sources. Consequently, vehicle exhaust emissions have not been included in the modelling analysis for this study.

To account for cumulative air quality impacts, emissions from the adjacent Uranquinty Power Station (UPS) were also modelled. Further discussion of this is presented in Section 3.5.2. Emissions from the compressor station were modelled using the assumptions and emission rates outlined Table 4.4. A full emissions inventory is presented in Appendix B.

2.4.3 Tasks

The following methodology was used to assess the potential for air quality impacts:

– reviewing the Modification site and study area to identify sensitive receivers (human and ecological receivers) in accordance with the IAQM Guidance and the Approved Methods.
– reviewing existing regional ambient air quality and meteorology, including data obtained by the BoM AWS, The Rural Air Quality Monitoring Network weather stations and the NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) air quality monitoring station (AQMS).
– establishing project-specific assessment criteria in accordance with the Approved Methods.
– reviewing emissions from typical construction activities associated with the proposed Modification and assessing the potential for air quality and odour impacts at sensitive receivers by undertaking:
  - a risk-based assessment of potential dust and particulate matter impacts in accordance with the IAQM Guidance (refer Section 2.2).
  - a qualitative assessment of exhaust emissions from vehicles, plant and machinery.
– air emission modelling and comparison to criteria identified in Section 2.3.
– recommending reasonable and feasible air quality mitigation and management measures.

2.5 Assumptions

The following assumptions have been used in the preparation of this report:

– Construction and operation of the compressor station has been assumed to be the same as other compressor stations that have been previously assessed by GHD (GHD, 2024).
– It has been assumed that air quality impacts from the decommissioning of the compressor station will be less than those of its construction. As such, no detailed assessment has been undertaken for this phase of the proposed modification.
– Where detailed information was not available, conservative assumptions have been made, such as:

- Background total suspended particles (TSP) data is not available within an acceptable distance of the site. It has been conservatively assumed that the background TSP concentration is twice that of the background PM_{10} concentration.
- Usage of the compressor station will vary significantly over time. The assessment assumes worst case scenario, with the proposed modification related emission sources operating at all hours.
- It has been assumed that 100 percent of unburned hydrocarbons are benzene, which is the VOC with the lowest criteria threshold.
- The width of the generator's exhaust pipe has been assumed to be 0.2 m diameter.

– Ambient air quality data and meteorological data was sourced from Wagga Wagga North AQMS and the Wagga Wagga AWS (ID 72150). These stations are approximately 14 m northwest of the site.

3. Existing environment

3.1 Terrain and land use

Topography plays a crucial role in air pollutant dispersion by influencing wind patterns, atmospheric stability, and temperature distributions. The site is generally flat, with little height variation between the proposed compressor station and nearby receivers. A terrain map is provided in Appendix B-4. Flat terrain can facilitate pollutant transport under suitable wind conditions but may also contribute to pollutant accumulation during periods of low wind speeds or atmospheric stagnation. Additionally, the higher elevations in the northeast could impact local airflow dynamics, potentially creating zones of air stagnation or turbulence. Land use surrounding the site is agricultural/primary production, with the exception of the adjacent UPS.

3.2 Sensitive receivers

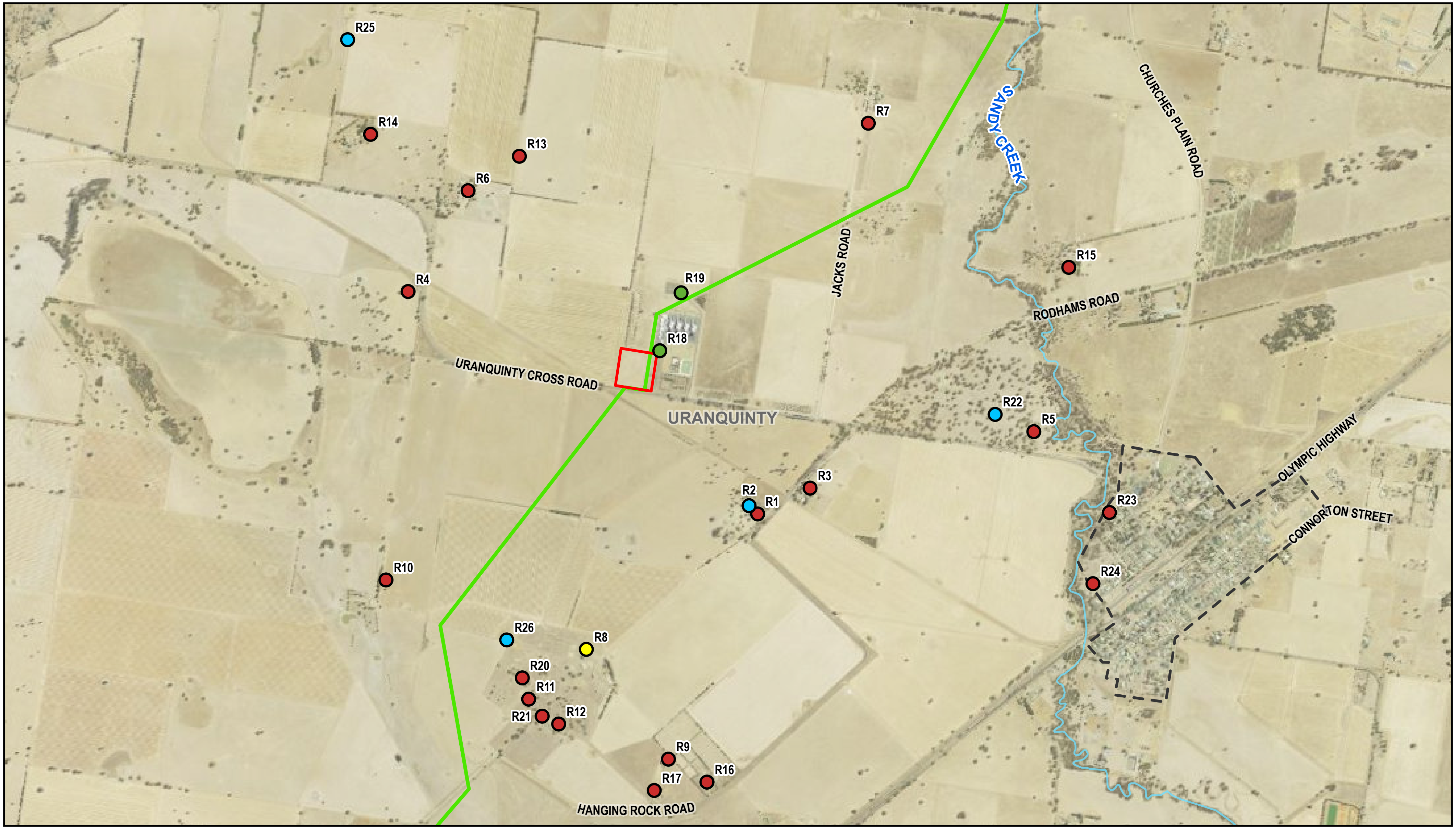
The Approved Methods defines a sensitive receiver as: ‘a location where people are likely to work or reside; this may include a dwelling, school, hospital, office, or public recreational area. An air quality impact assessment should also consider the location of known or likely future sensitive receivers.’

Existing receivers within 2.8 km of the site have been identified and are presented in Figure 1.1, Table 3.1 and Figure 3.1. This buffer distance was selected to include the closest receivers to the modification within Uranquinty township, while not extending too far for the assessment of a single generator.

Table 3.1 Identified receivers

ID	Coordinates (m)		Relative location to the site		Description
	Easting	Northing	Distance (m)	Direction	
R1	520,080	6,105,982	924	Southeast	Residential
R2	520,066	6,106,074	855	Southeast	Primary production (Shed)
R3	520,356	6,106,096	1,055	Southeast	Residential
R4	518,080	6,107,256	1,283	West	Residential
R5	521,665	6,106,468	2,197	East	Residential
R6	518,433	6,107,847	1,286	Northwest	Residential
R7	520,743	6,108,234	1,803	Northeast	Residential
R8	519,106	6,105,197	1,530	South	Commercial
R9	519,597	6,104,563	2,124	South	Residential
R10	517,975	6,105,576	1,738	Southwest	Residential
R11	518,787	6,104,909	1,880	South	Residential
R12	518,946	6,104,769	1,984	South	Residential
R13	518,722	6,108,036	1,274	Northwest	Residential
R14	517,888	6,108,172	1,920	Northwest	Residential
R15	521,848	6,107,434	2,414	Northeast	Residential
R16	519,787	6,104,484	2,276	South	Residential
R17	519,518	6,104,378	2,303	South	Residential
R18	519,532	6,106,907	29	North	Industrial
R19	519,658	6,107,241	383	North	Industrial
R20	518,709	6,105,059	1,773	South	Residential
R21	518,857	6,104,802	1,957	South	Residential

R22	521,476	6,106,548	1,961	East	Primary production (Shed)
R23	522,124	6,105,978	2,717	East	Residential
R24	522,028	6,105,562	2,765	East	Residential
R25	517,738	6,108,712	2,402	Northwest	Primary production (Shed)
R26	518,645	6,105,250	1,598	Southwest	Primary production (Shed)



LEGEND

- Proposed site
- Uranquinty township
- Waterway
- Culcairn to Wagga Wagga pipeline

Sensitive receivers

- Commercial
- Industrial
- Residential
- Shed

Paper Size ISO A4

0 200 400 600 800

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

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East Australian Pipeline Pty Ltd
Culcairn to Wagga Wagga Gas Pipeline
– MOD 1 Uranquinty Compressor Station

Sensitive receivers

Project No. 12614690
Revision No. 0
Date 10/06/2025

FIGURE 3.1

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Print date: 10 Jun 2025 - 15:07

Data source: DCS: DTDB\DCDB, 2023: NSW_Imagery: © Department of Customer Service 2020
World Hillshade: Esri, Geoscience Australia, NASA, NGA, USGS
World Topographic Map: Vicmap, Esri, TomTom, Garmin, METI/NASA, USGS\ Metromap: Aerial imagery, . Created by: pfernandes

3.3 Local meteorology

3.3.1 Available observations

The BoM operates a network of AWS across Australia. A BoM AWS typically measures critical meteorological parameters including wind speed, wind direction, temperature, relative humidity, and pressure, with some stations measuring cloud coverage.

The nearest AWS to the proposed modification is the BoM AWS Wagga Wagga North station (ID: 72150) approximately 22 km northeast of the site. This site is considered to be representative of the conditions at the site.

3.3.2 Wind speed and direction

The local climate and meteorology within the study area is of critical importance when assessing the potential for air quality impacts at sensitive receivers. The meteorological environment relevant to a project area is best understood through review of data collected from long-running monitoring weather stations, most commonly operated by the BoM.

The nearest such station to the site is the Wagga Wagga AWS (Station ID 072150), which is approximately 22 km northeast of the site measuring wind speed, wind direction, temperature, and relative humidity.

Figure 3.2 shows the average annual wind rose, Figure 3.3 shows the average diurnal wind roses and Figure 3.4 shows the average seasonal wind roses.

Figure 3.2 shows the following features:

– The average wind speed is moderate at 3.7 m/s, with a low percentage of calm conditions occurring 4 percent of the time.
– The predominant annual average direction is from the east. The second most frequent wind direction is from the west.

The average annual wind data are further supplemented by diurnal wind data. Diurnal wind data shown in Figure 3.3 demonstrate the following features:

– During the daytime period (6 am -- 6 pm):
  - Average windspeed ranges between 4 m/s to 4.2 m/s.
  - Calm conditions, which are defined as speeds less than 0.5 m/s and are associated with poor dispersion outcomes occur between 0.6 percent and 2.2 percent of the time.
  - Wind primarily occurs from the eastern quadrant in the early daytime period (6 am – 12 pm) and from the southwestern and northeastern quadrant during the late daytime period (12 pm – 6 pm).
– During the nighttime period (6 pm – 6 am):
  - Average windspeed is 3 m/s
  - Calm conditions occur between 7.3 percent and 9.1 percent of the time.
  - Wind occurs primarily from the east and northeast quadrants.

Figure 3.4 further extends average and diurnal observations showing that:

– In spring and summer, winds blow primarily from the northeastern quadrant. Calm conditions occur relatively infrequently in spring and summer months, occurring 2.9 percent and 2.4 percent of the time respectively.
– Wind during autumn and winter months winds blow primarily from the northeastern quadrant. Calm conditions occur relatively more frequently in autumn and winter months, occurring 5.7 percent and 6.7 percent of the time respectively.

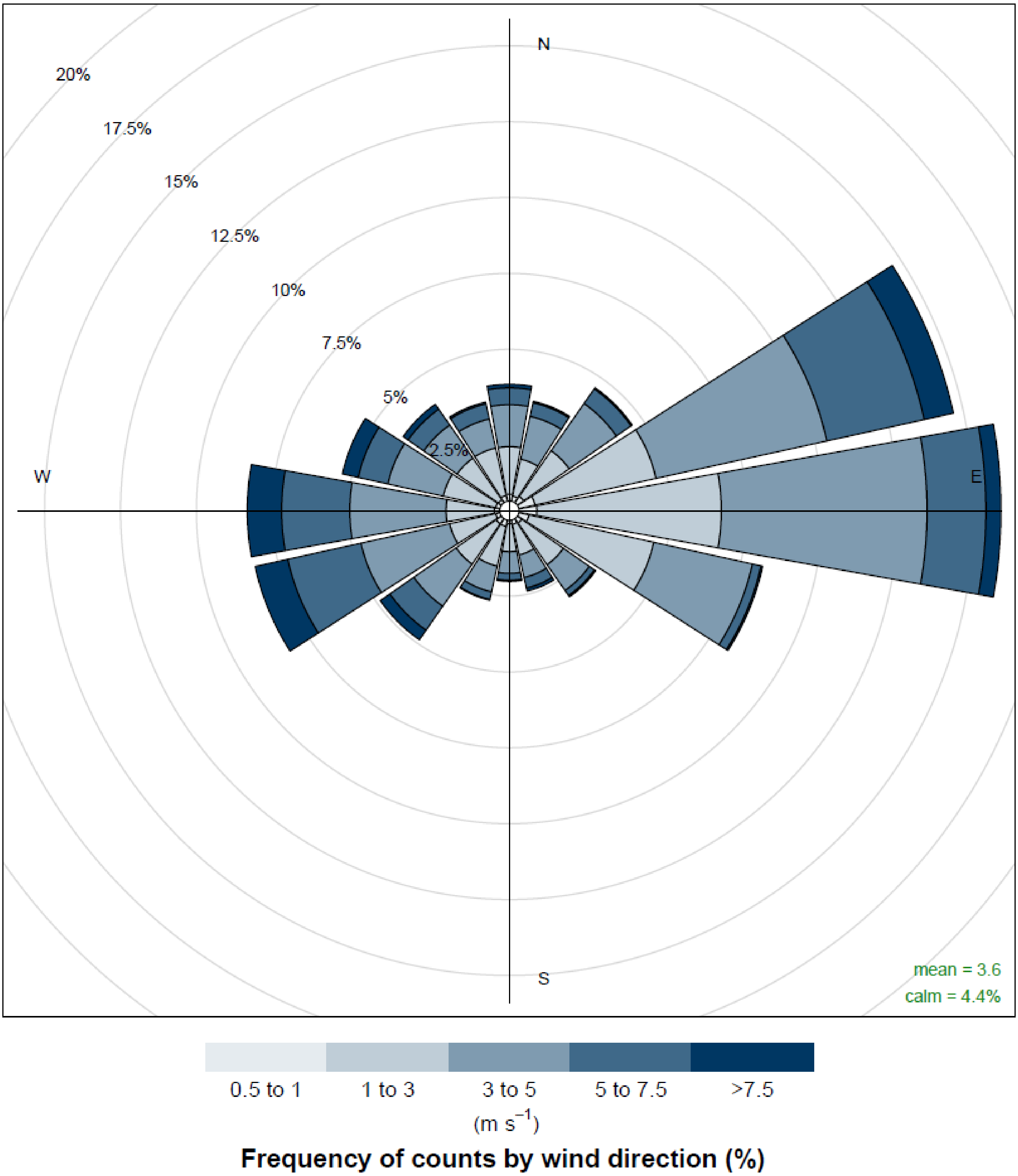

Figure 3.2 Average wind rose collected from Wagga Wagga AWS (2019-2023)

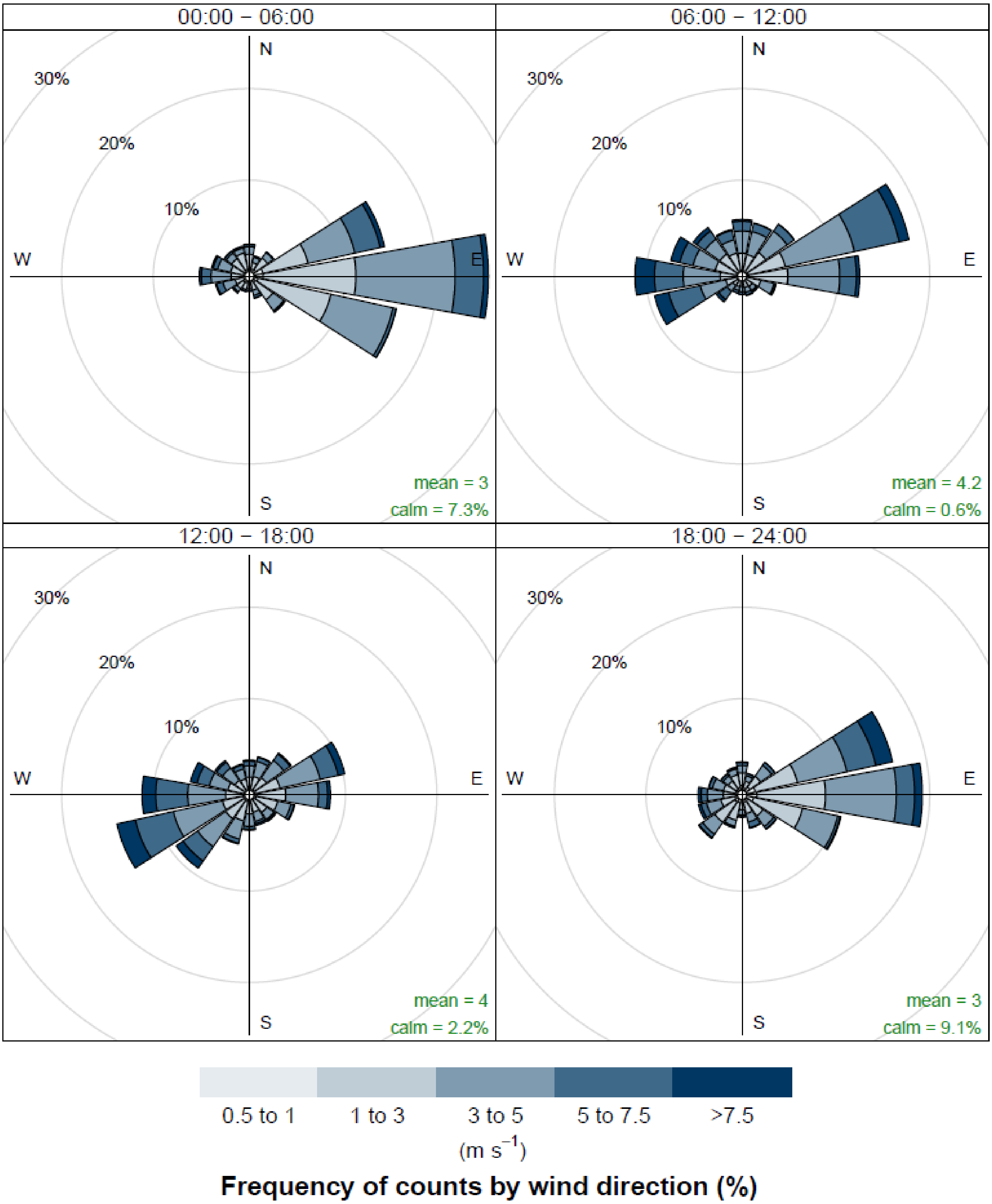

Figure 3.3 Average diurnal wind roses collected from Wagga Wagga AWS (2019-2023)

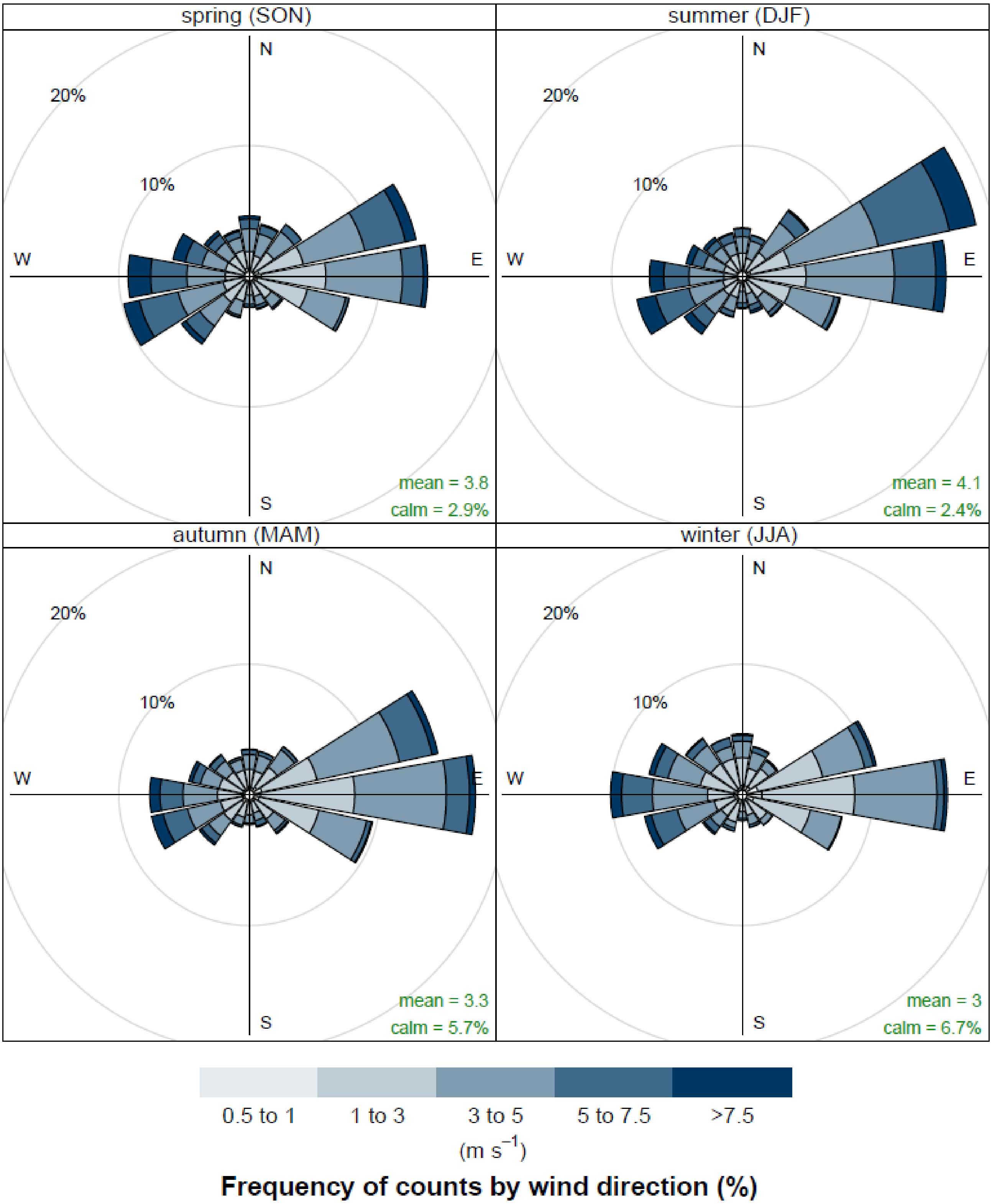

Figure 3.4 Average seasonal wind roses collected from Wagga Wagga AWS (2019-2023)

3.3.3 Temperature

Figure 3.5 shows monthly mean temperature statistics for data measured at BoM Wagga Wagga North AWS for the period 2019 through 2023. The 50th percentile monthly maximum and minimum temperatures are used to show the typical temperature range for each month of the year, as well as the monthly average temperature. Temperatures in the region have a wide range, with an average maximum of 32°C in January and an average minimum of 2.9°C in August. The mean temperature is approximately 29°C in January and 10°C in July.

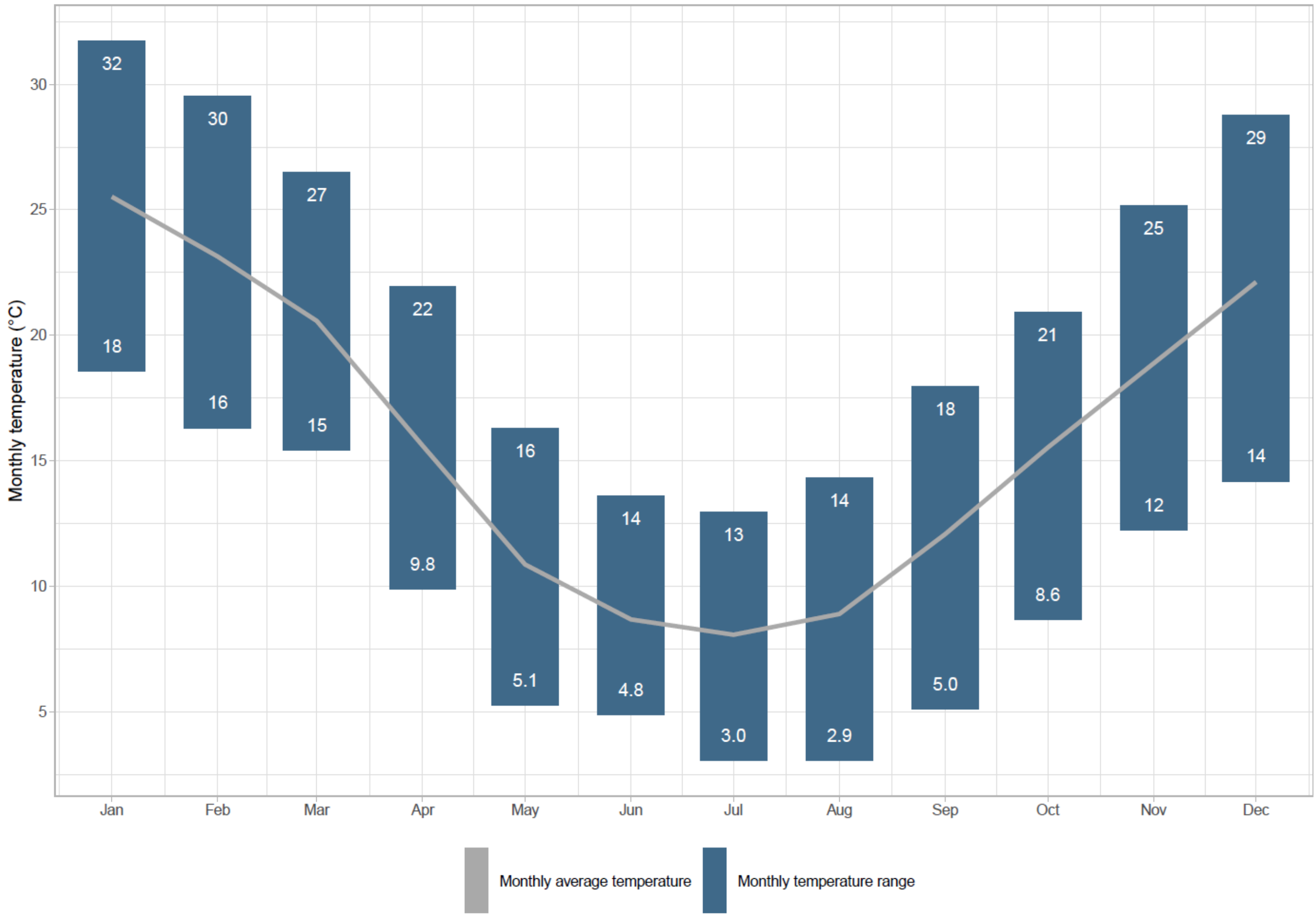

Figure 3.5 Monthly climate temperature statistics from BoM Wagga Wagga AWS (2019-2023)

3.3.4 Rainfall

Figure 3.6 shows monthly rainfall statistics for data measured at BoM AWS for the period 2019 through 2023. The statistics shown include average monthly rainfall amount (mm) and average number of days per month where rainfall is greater than 0.25 mm.

The data shows that total rainfall amounts are highest in November and march, with the most rainfall days occurring in June, July and August.

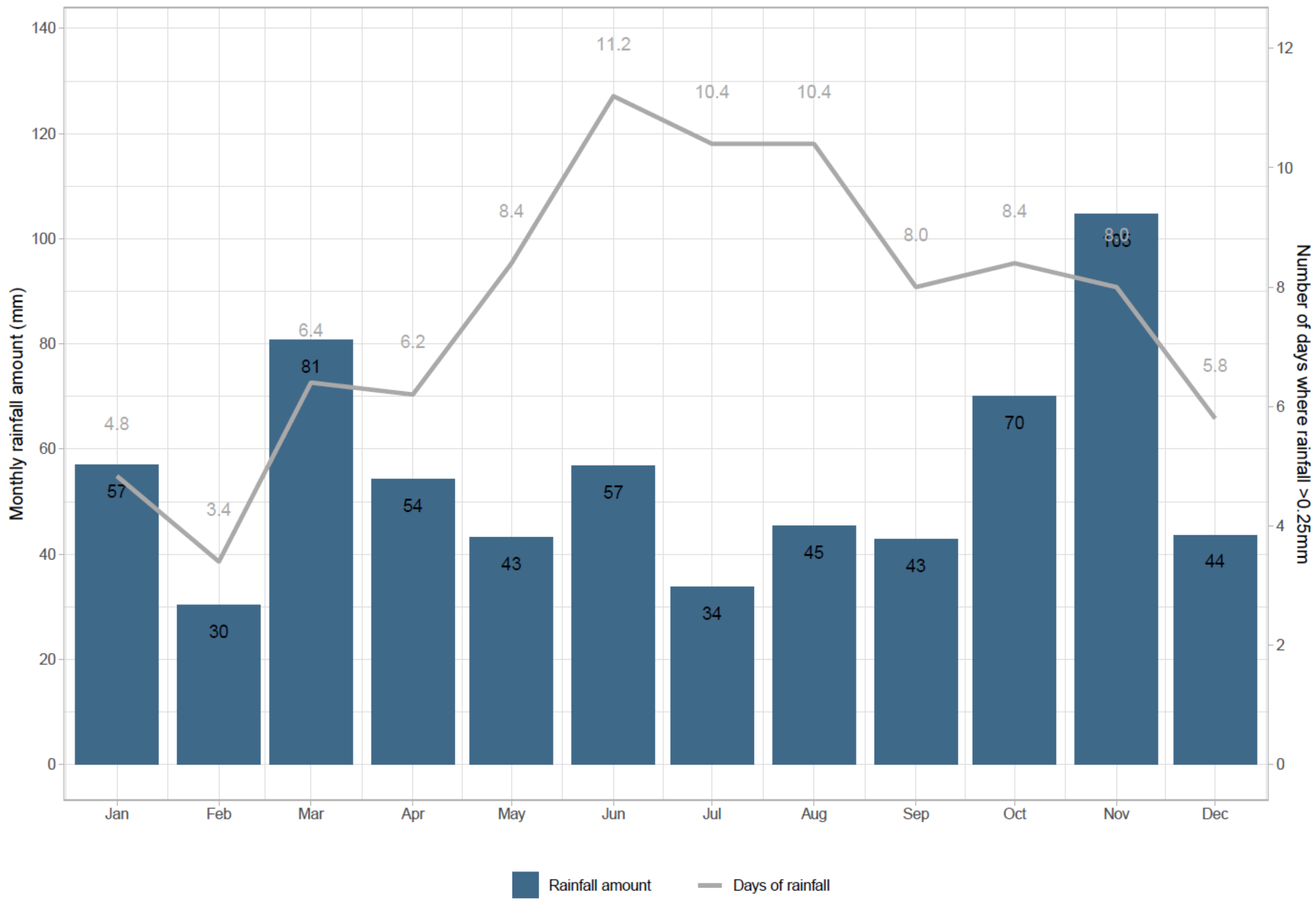

Figure 3.6 Average monthly rainfall collected from BoM Wagga Wagga North AWS (2019 - 2023)

3.3.5 Stability class

Atmospheric stability is a calculated metric that determines whether air will have a tendency to rise or will resist vertical motion. One method of determining the atmospheric stability is using the Pasquil-Gifford stability classes to categorise different atmospheric turbulence regimes. The categories range from A to F, where A is very unstable (air is very likely to rise) and F is stable (air has little vertical movement). The categories are determined according to the surface wind speed, incoming solar radiation, and night-time cloud cover.

Unstable conditions (Classes A-C) are characterised by strong solar heating of the ground that generates turbulent mixing in the atmosphere close to the ground. This turbulent mixing is the main driver of dispersion during unstable conditions. Dispersion under neutral conditions (Class D) are primarily driven by mechanical turbulence that occurs when air moves across the local terrain and is disturbed by land use (e.g., trees) or buildings in the area. Stable conditions (Classes E-F) typically occur during the overnight hours, when there is no incoming solar radiation and winds are light.

Stability classes calculated from measurements at the BoM Wagga Wagga North from 2019 – 2023 are presented in Figure 3.7. The figure shows that stable classes occur more frequently than unstable classes.

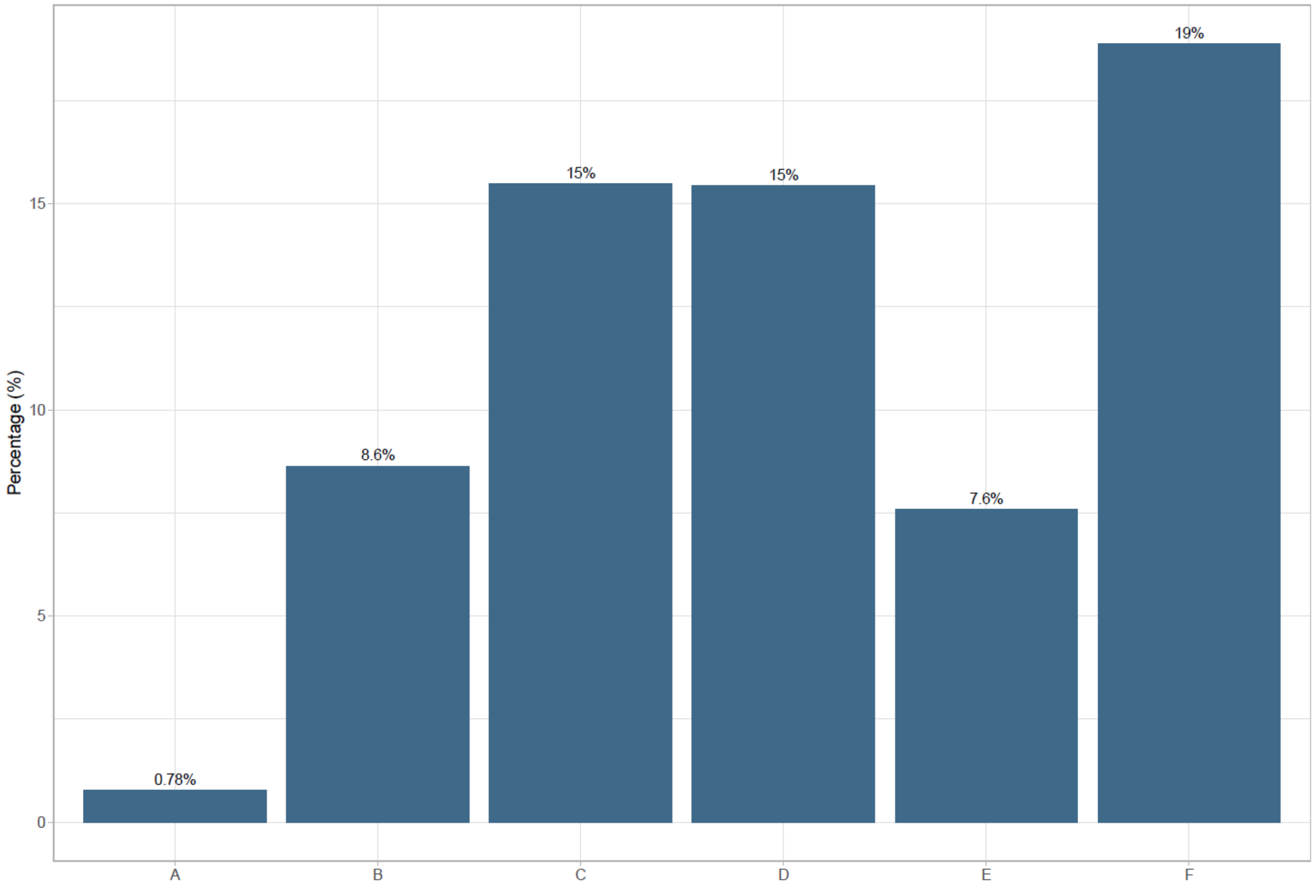

Figure 3.7 ***Stability class calculated from BoM Wagga Wagga North AWS (2019 - 2023)***

3.4 Background air quality

An assessment of the total impact, which includes the modification impact as well as the background concentrations, is required for air quality impact assessments. The NSW DCCEEW maintain AQMS across NSW. The closest DCCEEW AQMS is Wagga Wagga North is located approximately 16 km northeast of the site.

The AQMS at Wagga Wagga North has been measuring PM_{10} and $PM_{2.5}$ concentrations since 2011. The AQMS began reporting ozone concentrations in 2020 and NO_2 and NO_x concentrations in 2021. This data has been adopted for the purposes of the total impact assessment. Measured $PM_{2.5}$ and PM_{10} fractions are presented graphically in Figure 3.8 and Figure 3.9 respectively.

Background $PM_{2.5}$ and PM_{10} frequently exceeded the criteria prior to 2021. This was likely due to the 2019-2020 Australian bushfire season known as “Black Summer ” and was one of the largest bushfire seasons in NSW History. The fires were responsible for burning over 18 million hectares of land and significantly impacted air quality across regional NSW.

Figure 3.10 shows the available measured NO_2 data. NO_2 concentrations have not exceeded the criteria at any time. Ozone has only been included in this assessment for the purpose of determining NO_x speciation using the OLM and as such is presented without a criteria value in Figure 3.11.

No meteorological station near the site measures SO_2 concentrations.

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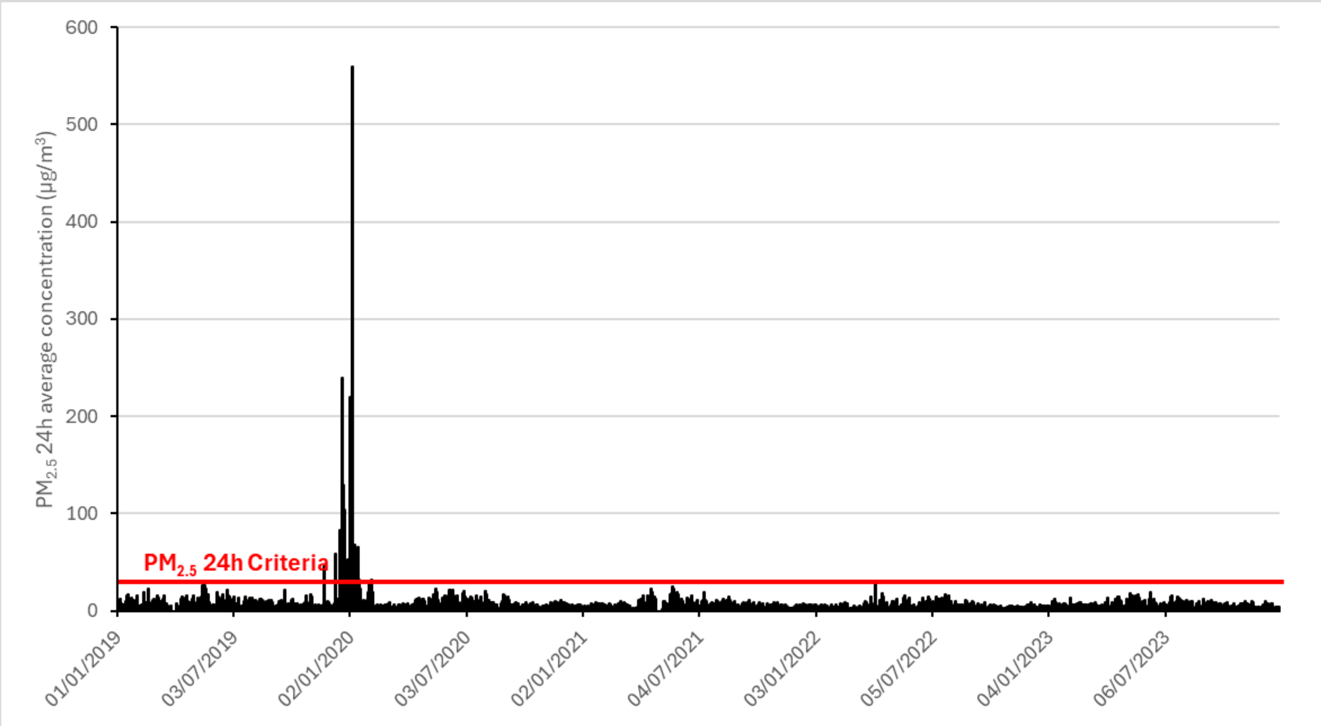

Figure 3.8 *$PM_{2.5}$ data taken from the Wagga Wagga North AQMS between 2019 and 2023*

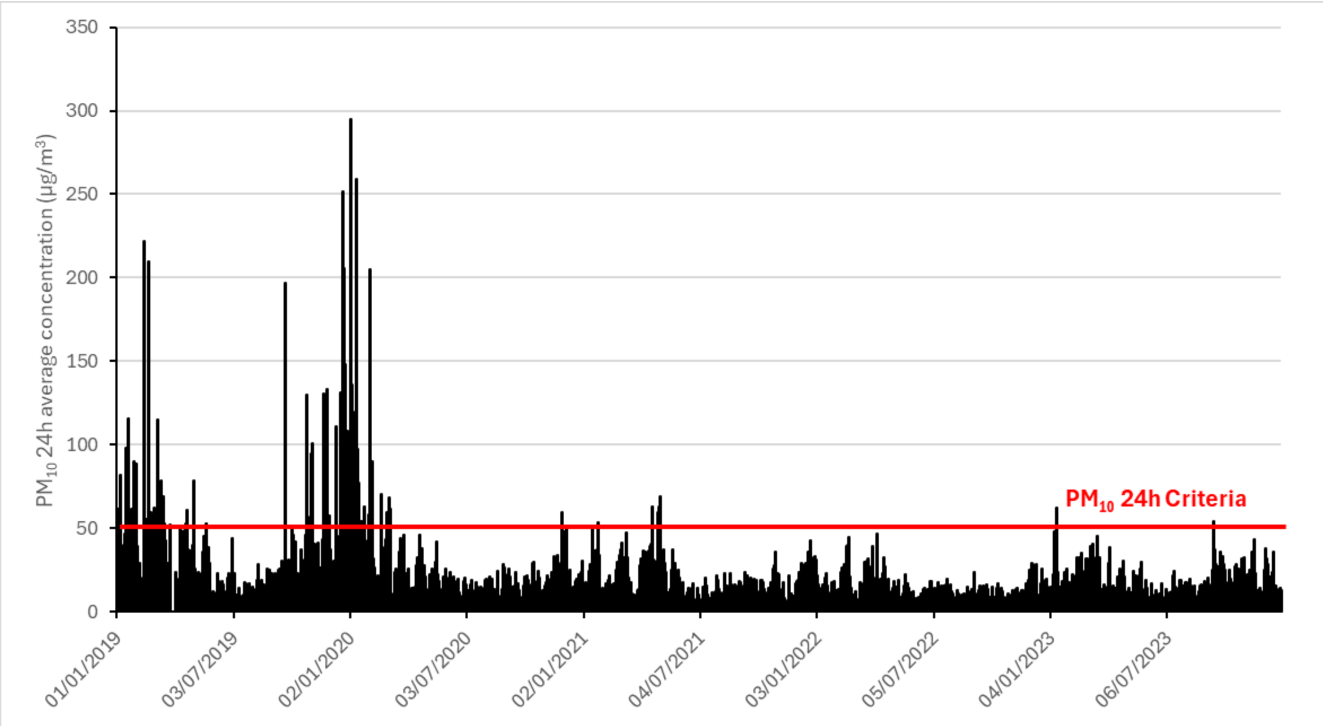

Figure 3.9 *PM_{10} data taken from the Wagga Wagga North AQMS between 2019 and 2023*

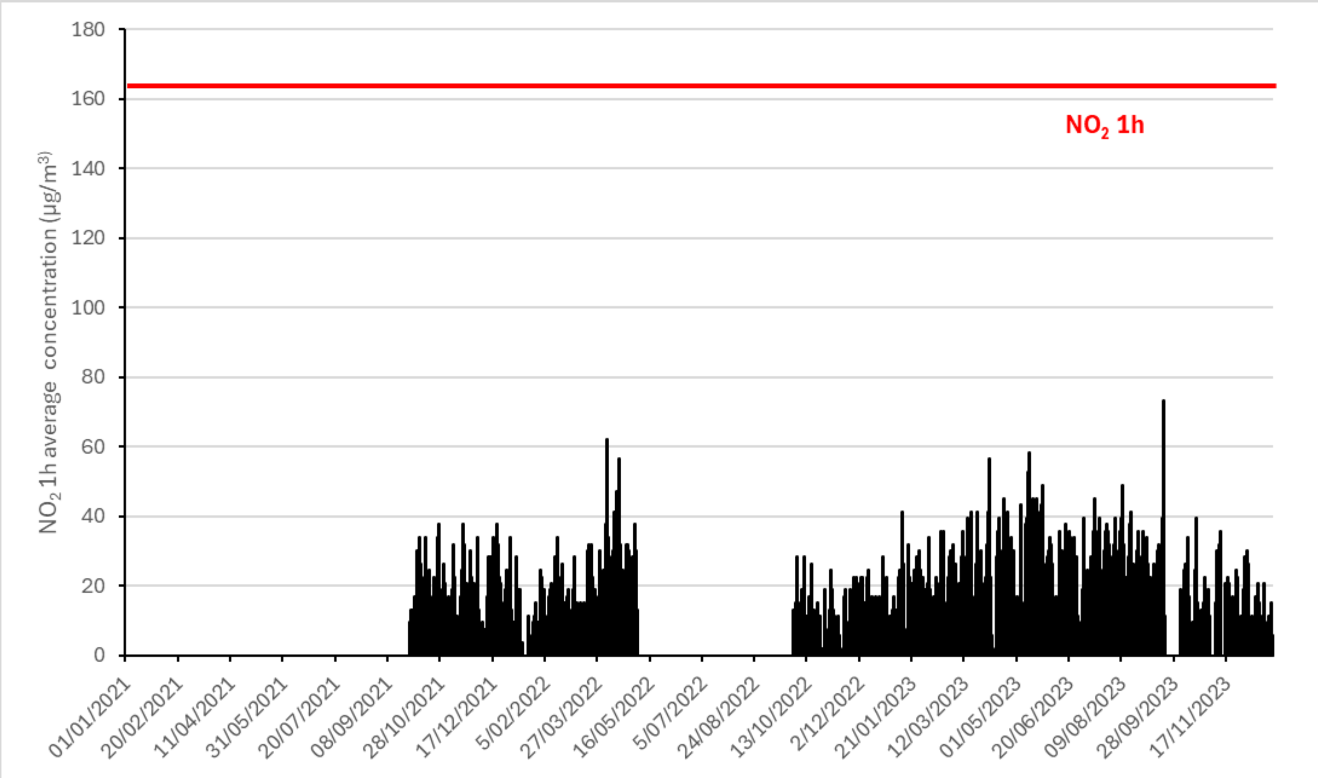

Figure 3.10 ***NO_2 data taken from the Wagga Wagga North AQMS between 2019 and 2023***

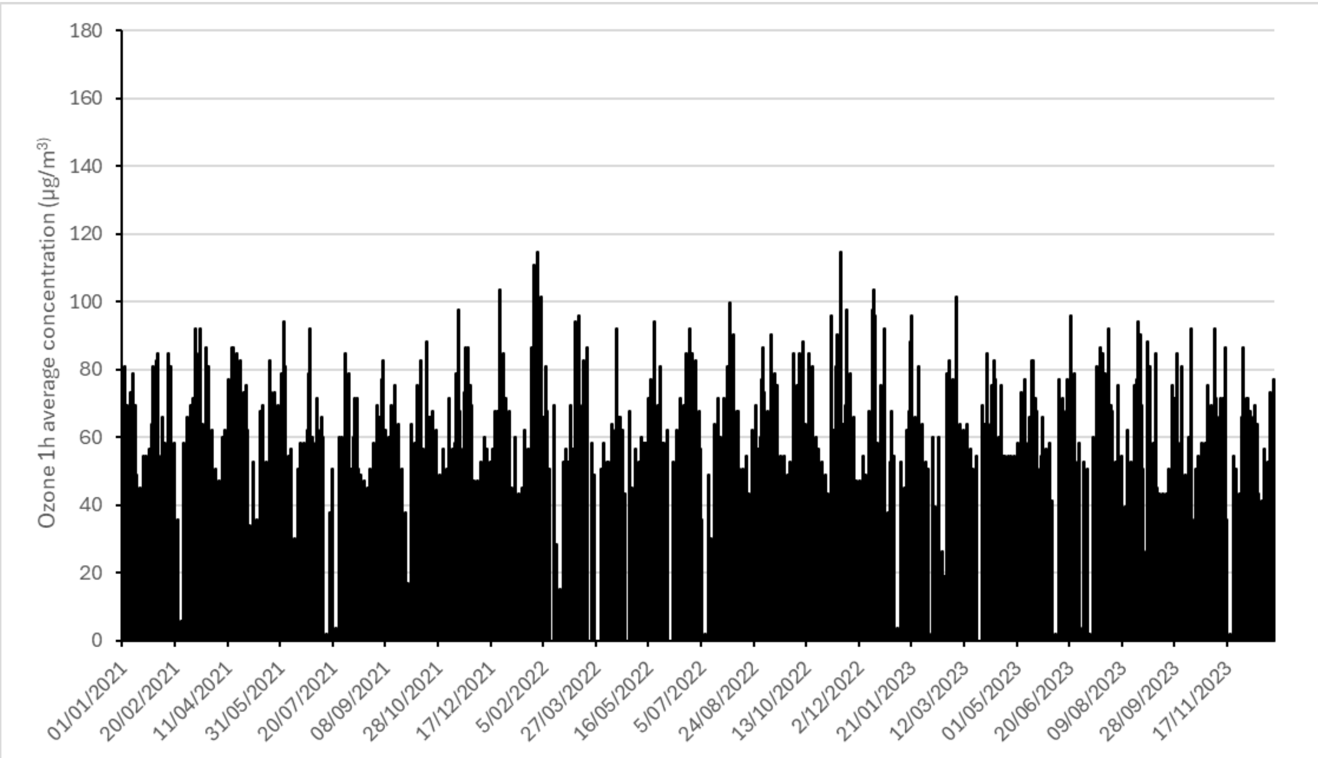

Figure 3.11 ***Ozone data taken from the Wagga Wagga North AQMS between 2019 and 2023***

As seen in Table 3.2, annual average PM concentrations show a reduction from 2019 to 2023. Ozone, NO_2 and NO annual averages are consistently low in the years where they were measured. The 5 year mean PM_{10}

concentration was 19.2 µg/m^3 and the 5 year mean $PM_{2.5}$ concentration was 8 µg/m^3. Background data in the representative year 2022 exceeded the 24 hour $PM_{2.5}$ and PM_{10} criteria on 1 day and 22 days of the year respectively. For the purpose of the contemporaneous assessment, background data which was above the criteria level was excluded from the analysis of modelling results and the highest concentration, which was beneath the criteria was adopted.

Table 3.2 Background air quality data obtained from Wagga Wagga North AQMS

Pollutant	Averaging period	Year				
		2019	2020	2021	2022	2023
$PM_{2.5}$ (µg/m^3)	24-hour maximum	239.6	559.5	25.4	27.1	24.5
	Max 24 hour (below assessment criteria)	22.8	23.2	22.8	22.4	24.5
	Number of days above assessment criteria	17	13	1	1	0
	Annual (average)	11.3	10.7	6.3	5.3	7
PM_{10} (µg/m^3)	24-hour maximum	251.7	295.3	69.1	46.8	68.1
	Max 24 hour (below assessment criteria)	49.9	48.9	49.4	46.8	49.1
	Number of days above assessment criteria	63	25	78	22	183
	Annual (average)	35.3	23.2	17.7	13.1	7
TSP (µg/m^3) (calculated)[1]	24-hour maximum	503.4	590.6	138.2	93.6	136.2
	Annual (average)	24.8	24.8	24.9	24.8	24.5
Ozone (µg/m^3)	1-hour maximum	-	-	103.4	101.5	99.6
	Annual (average)	-		45	37	37
NO_2 (µg/m^3)	1-hour maximum	-	-	37.6	62	73.3
	Annual (average)	-	-	7.1	8	11
NO (µg/m^3)	1-hour maximum)	-	-	25.8	54.1	84.9
	Annual (average)	-	-	2.8	3.3	6.8

1. TSP Data was not available for any period. As a conservative assumption, TSP concentration has been estimated by multiplying PM_{10} concentrations by two.

3.5 Nearby industrial emissions

3.5.1 Facilities reporting to National Pollutant Inventory

The National Pollutant Inventory, operated under the National Environment Protection (National Pollutant Inventory) Measure 1998, provides publicly available information of 93 pollutants emitted by industrial facilities throughout Australia. Facilities that exceed prescribed threshold values are required to report their emissions to the National Pollutant Inventory on an annual basis.

Facilities within the 15 km radius of the site with potential to give rise to the pollutants from the proposed modification were identified. A summary of the emissions report of surrounding National Pollutant Inventory facilities is provided in Table 3.3.

Table 3.3 Industrial emissions nearby to the project site

Facility	Distance and direction from site	Compound (kg/year)	Year				
			2017-2018	2018-2019	2020-2021	2021-2022	2022-2023
Uranquinty Power Station	Directly adjacent on the northeastern boundary of the modification	PM_{10}	17,778	11,125	5,504	10,434	4,598
		$PM_{2.5}$	18,437	11,538	5,708	10,821	4,769
		CO	85,600	53,567	26,502	50,238	22,140
		NO_x	283,137	177,184	87,660	166,173	73,233
		SO_2	1,646	1,030	510	966	426
		VOCs	5,992	3,750	1,855	3,517	1,550
Uranquinty Meter Station	Directly Adjacent to site on the eastern boundary of the modification	VOCs	3,136	3,750	1,855	3,007	1,550
Hanson Construction Materials	Located 12 km Northeast of site	VOCs	-	-	-	796	804

3.5.2 Uranquinty Power Station

The proposed modification site is directly adjacent to the Origin Energy owned UPS, which is the largest emitter of similar pollutants in vicinity of the site. As part of the UPS operations, compliance reports and air quality monitoring reports are issued by Origin Energy periodically. The most recent compliance assessment was prepared by e2m (e2m, 2024) and operation of the station was found to be compliant with all applicable air quality requirements. Despite the power station's compliance, a conservative assessment approach has been implemented to assess cumulative impacts from the concurrent operation of the proposed modification and UPS. As such concurrent emissions from the UPS have been incorporated into the assessment modelling approach. A modelling scenario for the UPS was developed as outlined in Section 2.4.2 using the assumptions provided in Appendix B.

It should be noted that the UPS operates periodically based on demand. The UPS in this assessment has been modelled, assuming continuous operation, which is conservative.

4. Impact assessment

4.1 Construction

Step 1 – Screen the need for an assessment

The IAQM Guidance states that an assessment is required where there is:

– a human receiver within:
  - 250 m of the site boundary; or
  - 50 m of the route(s) used by construction vehicles on the public highway, up to 250 m from the site entrance(s)

– an ecological receiver within:
  - 50 m of the site boundary; or
  - 50 m of the route(s) used by construction vehicles on the public highway, up to 250 m from the site entrance(s).

For the purpose of this assessment, a sensitive receiver is a location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area. As presented in Figure 1.1 the Uranquinty Power Station site office is located 30 m north of the modification site, necessitating further evaluation.

The site is also bordered with undeveloped semi-arid rangeland, which is classed as an ecological receiver under the IAQM Guidance.

Step 2a – Define the potential dust emission magnitude

Based on the IAQM Guidance definitions provided in Appendix A, dust emission magnitudes for each phase of the construction activities have been categorised as detailed in Table 4.1. Given that no demolition is planned as part of the construction process, demolition-related emissions are not included in this assessment.

Table 4.1 Dust emission magnitude categorisation

Construction activity	Dust emission magnitude	Basis
Earthworks	Medium	**IAQM Guidance definition:** Total site area 18,000 m^2 – 110,000 m^2, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 3 m – 6 m in height **The modification:** The site covers an area of approximately 39,000 m^2, and the soil is prone to dust.
Construction	Medium	**IAQM Guidance definition:** Total building volume 12,000 m^3 – 75,000 m^3, potentially dusty construction material (e.g., concrete), on site concrete batching **The modification:** The total building volume is of a medium size (less than 75,000 m^3), and dusty materials are likely to be used (e.g., concrete for pouring pads). .
Track-out (the movement of site material onto public roads by vehicles)	Medium	**IAQM Guidance definition:** 20-50 HDV (>3.5t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50– 100 m **The modification:** The road surface is potentially dusty. The site is to be accessed using Uranquinty Cross Road, which is sealed. The road is surrounded by agricultural land use, which could result in dusty conditions on the road. There are expected to be 20 – 50 heavy vehicle (>3.5 t) outward movements per day as part of this modification.

Step 2b – Define the sensitivity of the area

Receiver sensitivity

The IAQM guidelines provide a method for categorising receiver sensitivity as high, medium or low, which applies:

– clear definitions on identified individual receivers relevant to the study area
– the proximity (distance) of receivers
– the number of receivers – background PM_{10} concentrations
– other relevant site-specific factors.

Based on the criteria listed in Table A1 in Appendix A (IAQM guidance), the sensitivity of the Uranquinty Power Station site office in this study is concluded to be **medium** for both health impacts and dust soiling.

Sensitivity of an area

According to the IAQM Guidance, for non-residential receivers, professional judgement is applied to estimate the number of sensitive receivers. For instance, the Uranquinty Power Station site office has seven full time employees as of 2024, however it is likely that additional contractors are brought in as necessary for maintenance and repair activities. As such it is conservatively categorised as having "10 to 100 persons".

The sensitivity of each area to dust deposition effects (as outlined in Appendix A, Table A.2) is determined by receiver sensitivity and the number of sensitive receivers located within 20 m, 50 m, 100 m, and 250 m of the site. The closest receiver to the construction site is the Uranquinty Power Station site office, which is directly adjacent to the site and is classified as medium sensitivity. There are no other receivers within 50 m, 100 m or 250 m of the site.

To assess sensitivity to health effects, the analysis also considers the 5-year mean background PM_{10} concentration data from the nearest air quality monitoring station in addition to the number of sensitive receivers within the same distances (refer Appendix A, Table A.3). As outlined in section 3.4, the 5-year mean background PM_{10} concentration data is 19.2 $\mu g/m^3$.

According to IAQM Guidance, only the highest area sensitivity level from Table A.2 and Table A.3 is applicable. For example, if there are 12 high-sensitivity receivers within 20 m of the source and 45 between 20 m and 50 m, the total number of receivers beyond 50 m is 57. In this scenario, the area sensitivity would be medium.

To inform the Modification Report, a biodiversity assessment was undertaken which involved survey of the site. It was determined that there are no known threatened ecological communities or threatened flora present in or near the site and as such, the proposed construction works are not likely to directly or indirectly affect the life cycle of any local populations of threatened plants.

Based on the above and according to IAQM Guidance, the sensitivity of the mentioned ecological receivers is classified to be low. Table 4.2 summarises the number of identified sensitive receivers and the corresponding sensitivity levels for dust deposition and health effects.

Table 4.2 Categorisation of sensitivity of area to dust deposition, human health and ecological effects

Distance from the site (metres)	Number of sensitive receivers	Sensitivity of area to dust deposition effects	Sensitivity of area to human health effects	Sensitivity of area to ecological impacts
UPS (medium sensitivity)				
< 20	More than 100	Medium	Low	N/A
< 50	More than 100	Medium	Low	N/A
< 100	More than 100	Medium	Low	N/A
< 250	More than 100	Medium	Low	N/A
Ecological Receivers (low sensitivity)				
< 20	N/A	N/A	N/A	Low
< 50	N/A	N/A	N/A	Low

Step 3 – Define the risk of impacts

The risk of air quality impacts is shown in Table 4.3. The risk is assessed based on the following key aspects:

- Sensitivity of the general area classified as **medium** to dust soiling and **low** to health effects and ecological impacts.
- Dust emission magnitudes being **medium** for the various construction activities as shown in Table 4.1.

Table 4.3 Uncontrolled risk assessment of air quality impacts from construction activities

Impact	Area Sensitivity	Dust Emission Magnitude			Uncontrolled Risk		
		Earthworks	Construction	Track-out	Earthworks	Construction	Track-out
Dust Soiling	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Human Health	Low				Low	Low	Low
Ecological Impacts	Low				Low	Low	Low

The results show that the unmitigated risk of dust soiling is classified as **medium**, while the risk to human health and ecological impacts are classified as **low** during all construction activities. According to the IAQM Guidance methodology, the **overall air quality risk** associated with these construction activities is assessed as **medium** for all surrounding receivers.

Given that the priority in construction activities is to ensure that the surrounding sensitive receivers are not significantly impacted by dust, the implementation of effective mitigation measures is essential. As outlined in the IAQM Guidance, such measures are generally sufficient to achieve this goal.

With the application of strategies detailed in Section 5, dust deposition, human health effects, and ecological impacts are anticipated to be managed to acceptable levels such that there is **low** risk of adverse air quality effects on nearby receivers.

4.1.1 Cumulative impacts

Cumulative air quality and dust impacts may occur where the construction or operation of a nearby project coincides with that of the construction or operation of the proposed modification.

To assess whether there is a potential for cumulative impacts, a review of projects within 3 km of the site on the Major Projects Website and Council Development Application registers has been undertaken. No relevant developments were identified that would cause cumulative impacts.

4.2 Operation

Emissions from the UCS and the UPS were modelled using CALPUFF dispersion modelling software. Ground level concentrations were predicted at each receiver location for each identified pollutant.

4.2.1 Emissions Inventory

Emissions from the UCS and the UPS were modelled using emission rates outlined in Table 4.4 below. A full emissions inventory, outlining assumptions, source characteristics and relevant modelling parameters is presented in Appendix B. Predicted concentrations at receiver locations are presented for each pollutant are presented in Sections 4.2.2 and 4.2.3.

Table 4.4 Summary emissions inventory

Description	Value	Units
UCS		
Emission factors		
NO_x	1.88×10^{-2}	kg/kWh
CO	4.06×10^{-3}	kg/kWh
SO_2	4.28×10^{-6}	kg/kWh
$PM_{2.5}$	1.31×10^{-3}	kg/kWh
PM_{10}	1.34×10^{-3}	kg/kWh
PAH	6.00×10^{-11}	kg/kWh
TVOCs (assessed against benzene criteria as a conservative assumption)	1.37×10^{-3}	kg/kWh
Emission Rates		
No_x	8.36×10^{-1}	g/s
CO	7.00×10^{-4}	g/s
SO_2	2.00×10^{-4}	g/s
$PM_{2.5}$	5.82×10^{-2}	g/s
PM_{10}	5.96×10^{-2}	g/s
PAH	3.00×10^{-9}	g/s
NO_x	6.09×10^{-2}	g/s
UPS		
Emission factors		
TVOC	9.10×10^{2}	kg/PJ
PAHs	9.50×10^{-1}	kg/PJ
PM_{10}	2.80×10^{3}	kg/PJ
$PM_{2.5}$	2.70×10^{3}	kg/PJ
NO_2/NO_x ratio	0.1	
Emission rates		
CO	5.1	g/s
SO_2	0.7	g/s
PM_{10}	4.1	g/s
NO_x	21	g/s
NO_2	2.1	g/s

Description	Value	Units
$PM_{2.5}$	3.95	g/s
VOCs	0.15	g/s
PAHs	1.58×10^{-4}	g/s
NO_x	21	g/s
NO_2	2.1	g/s

4.2.2 Particulate matter

4.2.2.1 $PM_{2.5}$

As shown in Table 4.5 24-hour average $PM_{2.5}$ concentrations are below the criteria at all identified sensitive receptor locations. The maximum predicted Table 4.6 demonstrates that the predicted annual $PM_{2.5}$ concentrations remain below the assessment criterion at all identified sensitive receiver locations.

The maximum predicted incremental 24-hour average $PM_{2.5}$ concentration is 2.9 µg/m^3, observed at R18 with the corresponding maximum annual average concentration of 0.2 µg/m^3, both well within allowable criteria.

Table 4.5 Predicted maximum 24-hour average $PM_{2.5}$ concentrations

Receiver ID	Predicted 24-hour average $PM_{2.5}$ concentrations			
	Background		Maximum predicted UCS backup generator incremental impact	Maximum predicted cumulative impact
	Maximum regional background	Maximum predicted UPS impact		
R1	22.4	0.4	0.5	22.4
R2	22.4	0.4	0.4	22.4
R3	22.4	0.4	0.3	22.4
R4	22.4	0.3	0.4	22.4
R5	22.4	0.3	0.2	22.4
R6	22.4	0.3	0.3	22.4
R7	22.4	0.4	0.3	22.5
R8	22.4	0.3	0.3	22.4
R9	22.4	0.2	0.4	22.4
R10	22.4	0.3	0.3	22.4
R11	22.4	0.3	0.2	22.4
R12	22.4	0.3	0.2	22.4
R13	22.4	0.3	0.4	22.4
R14	22.4	0.3	0.5	22.4
R15	22.4	0.2	0.1	22.4
R16	22.4	0.2	0.5	22.4
R17	22.4	0.2	0.2	22.4
R18	22.4	0.6	2.9	23
R19	22.4	0.4	0.7	22.7
R20	22.4	0.3	0.2	22.4
R21	22.4	0.3	0.3	22.4
R22	22.4	0.3	0.2	22.4

R23	22.4	0.2	0.2	22.4
R24	22.4	0.3	0.4	22.4
R25	22.4	0.2	0.4	22.4
R26	22.4	0.3	0.3	22.4
Criterion				25

Table 4.6 Predicted maximum annual average $PM_{2.5}$ concentrations

Receiver ID	Annual average $PM_{2.5}$ concentrations (μg/m^3)			
	Background		Maximum predicted UCS backup generator incremental impact	Maximum predicted cumulative impact
	Maximum regional background	Maximum predicted UPS impact		
R1	5.3	0.01	0.02	5.4
R2	5.3	0.01	0.02	5.4
R3	5.3	0.01	0.01	5.3
R4	5.3	0.02	0.02	5.4
R5	5.3	0.01	0.01	5.3
R6	5.3	0.01	0.01	5.3
R7	5.3	0.01	0.01	5.3
R8	5.3	0.01	0.01	5.3
R9	5.3	0.01	0.01	5.3
R10	5.3	0.01	0.02	5.4
R11	5.3	0.01	0.01	5.3
R12	5.3	0.01	0.01	5.3
R13	5.3	0.01	0.01	5.3
R14	5.3	0.01	0.01	5.3
R15	5.3	0.01	0.01	5.3
R16	5.3	0.01	0.01	5.3
R17	5.3	0.01	0.00	5.3
R18	5.3	0.04	0.20	5.6
R19	5.3	0.02	0.03	5.4
R20	5.3	0.01	0.01	5.3
R21	5.3	0.01	0.01	5.3
R22	5.3	0.01	0.01	5.3
R23	5.3	0.01	0.01	5.3
R24	5.3	0.01	0.01	5.3
R25	5.3	0.01	0.01	5.3
R26	5.3	0.01	0.01	5.3
Criterion				8

4.2.2.2 PM_{10}

As detailed in Table 4.7 and Table 4.8, both the predicted 24-hour average and annual average PM_{10} concentrations remain below their relevant assessment criteria at all receiver locations. The maximum predicted

Incremental 24-hour average concentration is 2.9 μg/m^3, recorded at R18. Similarly, the highest predicted annual average incremental concentration is 0.04 μg/m^3, also occurring at R18.

These results confirm that modification-related PM_{10} contributions are minor and well within acceptable regulatory thresholds.

Table 4.7 Predicted maximum 24-hour average PM_{10} concentrations

Receiver ID	24-hour average PM_{10} concentrations (μg/m^3)			
	Background		**Maximum predicted UCS backup generator incremental impact**	**Maximum predicted cumulative impact**
	Maximum regional background	**Maximum predicted UPS impact**		
R1	46.8	0.4	0.5	46.8
R2	46.8	0.4	0.4	46.8
R3	46.8	0.4	0.3	46.8
R4	46.8	0.4	0.5	46.8
R5	46.8	0.3	0.2	46.8
R6	46.8	0.3	0.3	46.8
R7	46.8	0.4	0.3	46.9
R8	46.8	0.3	0.3	46.8
R9	46.8	0.3	0.4	46.8
R10	46.8	0.4	0.3	46.8
R11	46.8	0.3	0.2	46.8
R12	46.8	0.3	0.2	46.8
R13	46.8	0.3	0.4	46.9
R14	46.8	0.3	0.5	46.8
R15	46.8	0.2	0.1	46.8
R16	46.8	0.3	0.5	46.8
R17	46.8	0.2	0.2	46.8
R18	46.8	0.6	2.9	46.8
R19	46.8	0.5	0.7	46.9
R20	46.8	0.3	0.2	46.8
R21	46.8	0.3	0.3	46.8
R22	46.8	0.3	0.2	46.8
R23	46.8	0.2	0.2	46.8
R24	46.8	0.3	0.4	46.8
R25	46.8	0.2	0.4	46.8
R26	46.8	0.3	0.3	46.8
Criterion				50

Table 4.8 Predicted maximum annual average PM_{10} concentrations

Receiver ID	Annual average PM_{10} concentrations (µg/m^3)			
	Background		UCS backup generator incremental impact	Cumulative
	Maximum regional background	Maximum predicted UPS impact		
R1	13.1	0.01	0.02	13.1
R2	13.1	0.01	0.02	13.1
R3	13.1	0.01	0.02	13.1
R4	13.1	0.02	0.02	13.1
R5	13.1	0.01	0.01	13.1
R6	13.1	0.01	0.01	13.1
R7	13.1	0.01	0.01	13.1
R8	13.1	0.01	0.01	13.1
R9	13.1	0.01	0.01	13.1
R10	13.1	0.01	0.02	13.1
R11	13.1	0.01	0.01	13.1
R12	13.1	0.01	0.01	13.1
R13	13.1	0.01	0.01	13.1
R14	13.1	0.01	0.01	13.1
R15	13.1	0.01	0.01	13.1
R16	13.1	0.01	0.01	13.1
R17	13.1	0.01	0.00	13.1
R18	13.1	0.04	0.21	13.3
R19	13.1	0.03	0.03	13.1
R20	13.1	0.01	0.01	13.1
R21	13.1	0.01	0.01	13.1
R22	13.1	0.01	0.01	13.1
R23	13.1	0.01	0.01	13.1
R24	13.1	0.01	0.01	13.1
R25	13.1	0.01	0.01	13.1
R26	13.1	0.01	0.01	13.1
Criterion				25

4.2.3 Gases

All predicted gas concentrations are expected to comply with relevant criteria. Results are further specified below.

4.2.3.1 Carbon monoxide

As presented in Table 4.9, predicted maximum 1-hour average and 8-hour average CO concentrations are well below the relevant assessment criteria at all sensitive receiver locations.

Table 4.9 Predicted maximum 1-hour and 8-hour average CO concentrations

Receiver ID	Maximum 1-hour CO concentrations (mg/m^3)			Maximum 8-hour CO concentrations (mg/m^3)		
	Background Maximum predicted UPS impact	UCS backup generator incremental impact	Cumulative	Background Maximum predicted UPS impact	UCS backup generator incremental impact	Cumulative
1	0.007	0.0001	0.01	0.002	0.0000	0.002
2	0.007	0.0001	0.01	0.002	0.0000	0.002
3	0.007	0.0000	0.01	0.001	0.0000	0.001
4	0.007	0.0000	0.01	0.001	0.0000	0.001
5	0.006	0.0000	0.01	0.001	0.0000	0.001
6	0.006	0.0000	0.01	0.001	0.0000	0.001
7	0.004	0.0000	0.00	0.001	0.0000	0.001
8	0.004	0.0000	0.00	0.001	0.0000	0.001
9	0.004	0.0000	0.00	0.001	0.0000	0.001
10	0.004	0.0000	0.00	0.001	0.0000	0.001
11	0.003	0.0000	0.00	0.001	0.0000	0.001
12	0.003	0.0000	0.00	0.001	0.0000	0.001
13	0.006	0.0000	0.01	0.001	0.0000	0.001
14	0.004	0.0000	0.00	0.001	0.0000	0.001
15	0.005	0.0000	0.01	0.001	0.0000	0.001
16	0.004	0.0000	0.00	0.001	0.0000	0.001
17	0.004	0.0000	0.00	0.001	0.0000	0.001
18	0.007	0.0002	0.01	0.002	0.0001	0.002
19	0.007	0.0000	0.01	0.002	0.0000	0.002
20	0.003	0.0000	0.00	0.001	0.0000	0.001
21	0.003	0.0000	0.00	0.001	0.0000	0.001
22	0.006	0.0000	0.01	0.001	0.0000	0.001
23	0.004	0.0000	0.00	0.001	0.0000	0.001
24	0.003	0.0000	0.00	0.001	0.0000	0.001
25	0.003	0.0000	0.00	0.001	0.0000	0.001
26	0.004	0.0000	0.00	0.001	0.0000	0.001
Criterion			**30**			**10**

4.2.3.2 Sulfur dioxide

As shown in Table 4.10, the predicted maximum 1-hour average and 24-hour average SO_2 concentrations are well below the relevant assessment criteria at all receiver locations.

It is important to note, as outlined in Section 3.4, that the Wagga Wagga North AQMS does not record ambient SO_2 concentrations. Given this data gap and the role of the Uranquinty Power Station as a significant local source of SO_2 emissions, its contribution has been conservatively adopted as the background concentration for the assessment.

Table 4.10 Predicted maximum 1-hour and 24-hour SO_2 concentrations

Receiver ID	Maximum 1-hour SO_2 concentrations (µg/m^3)			Maximum 24-hour SO_2 concentrations (µg/m^3)		
	Background	UCS backup generator incremental impact	Cumulative	Background	UCS backup generator incremental impact	Cumulative
	Maximum predicted UPS impact			Maximum predicted UPS impact		
R1	0.98	0.02	0.98	0.070	0.00	0.07
R2	1.02	0.02	1.02	0.071	0.00	0.07
R3	1.03	0.01	1.03	0.065	0.00	0.07
R4	0.94	0.01	0.94	0.062	0.00	0.06
R5	0.78	0.01	0.78	0.050	0.00	0.05
R6	0.76	0.01	0.76	0.056	0.00	0.06
R7	0.61	0.01	0.61	0.068	0.00	0.07
R8	0.52	0.01	0.52	0.052	0.00	0.05
R9	0.52	0.01	0.52	0.044	0.00	0.04
R10	0.61	0.01	0.61	0.061	0.00	0.06
R11	0.46	0.01	0.46	0.047	0.00	0.05
R12	0.47	0.01	0.47	0.046	0.00	0.05
R13	0.81	0.01	0.81	0.060	0.00	0.06
R14	0.60	0.01	0.60	0.046	0.00	0.05
R15	0.71	0.00	0.71	0.041	0.00	0.04
R16	0.54	0.01	0.54	0.044	0.00	0.04
R17	0.52	0.01	0.52	0.042	0.00	0.04
R18	0.98	0.05	0.98	0.104	0.01	0.10
R19	1.00	0.01	1.00	0.078	0.00	0.08
R20	0.48	0.01	0.48	0.049	0.00	0.05
R21	0.46	0.01	0.46	0.046	0.00	0.05
R22	0.86	0.01	0.86	0.053	0.00	0.05
R23	0.51	0.00	0.51	0.041	0.00	0.04
R24	0.44	0.01	0.44	0.049	0.00	0.05
R25	0.46	0.01	0.46	0.042	0.00	0.04
R26	0.54	0.01	0.54	0.051	0.00	0.05
Criterion			215			57

4.2.3.3 Nitrogen dioxide

Table 4.11 and Table 4.12 displays the cumulative maximum 1-hour and annual average NO_2 concentrations predicted at all sensitive receiver locations for all modelled scenarios. These predictions are based on hourly NO_2 concentrations recorded by the Wagga Wagga North AQMS in 2022, which were contemporaneous with the meteorological data used in the modelling. The NO_2 concentrations were derived from the NO_x predictions generated by the model, using Method 2 from the Approved Methods (detailed in Section 2.4.2.4 and Appendix B-4-3). The modelling results indicate that the predicted cumulative maximum 1-hour and annual average NO_2 concentrations remain below the relevant ambient air quality criteria at all receiver locations analysed.

Table 4.11 Predicted maximum 1-hour NO_2 concentrations

Receiver ID	Maximum 1-hour NO_2 concentrations						
	Background		Incremental – UCS backup Generator				Cumulative NO_2 (µg/m^3)
	Maximum regional background	Maximum predicted UPS impact	Maximum 1-hour NO_2 (µg/m^3)	Corresponding 1-hour			
				NO_x (µg/m^3)	O_3 (µg/m^3)	Background NO_2 (µg/m^3)	
R1	62.0	27.4	54.6	54.6	56.8	3.4	62.0
R2	62.0	27.5	29.3	29.3	45.1	3.4	62.0
R3	62.0	27.5	34.5	34.5	35.3	3.4	62.0
R4	62.0	28.3	25.2	26.5	23.5	5.6	62.0
R5	62.0	23.5	9.5	9.5	35.3	3.4	62.0
R6	62.0	22.9	42.5	42.5	60.8	11.3	62.0
R7	62.0	18.2	36.2	36.2	58.8	18.8	62.0
R8	62.0	15.5	20.8	20.8	31.4	5.6	62.0
R9	62.0	15.6	16.5	16.5	19.6	7.5	62.0
R10	62.0	18.4	27.7	27.7	47.0	3.8	62.9
R11	62.0	13.7	25.0	25.0	60.8	16.9	62.0
R12	62.0	14.1	17.6	17.6	60.8	16.9	62.0
R13	62.0	23.1	28.7	61.2	23.5	3.8	75.0
R14	62.0	17.9	33.0	33.0	54.9	13.2	62.0
R15	62.0	21.4	17.7	17.7	49.0	3.4	62.0
R16	62.0	16.1	13.8	13.8	49.0	24.4	62.0
R17	62.0	15.5	13.2	19.1	11.8	24.4	62.0
R18	62.0	24.1	59.2	59.2	58.8	3.4	62.6
R19	62.0	23.7	40.6	40.6	47.0	3.4	62.3
R20	62.0	14.3	30.5	30.5	51.0	28.2	62.0
R21	62.0	13.8	25.7	25.7	60.8	16.9	62.0
R22	62.0	25.7	10.7	10.7	23.5	24.4	62.0
R23	62.0	15.3	14.8	14.8	35.3	24.4	62.0
R24	62.0	13.2	14.5	14.5	37.2	24.4	62.0
R25	62.0	13.9	24.8	24.8	43.1	24.4	62.0
R26	62.0	16.3	38.6	38.6	51.0	28.2	62.0
Criterion							**164**

Table 4.12 Predicted maximum annual NO_2 concentrations

Receiver ID	Annual average NO_2 concentrations (µg/m^3)			
	Background		Incremental UCS backup generator impact	Cumulative
	Maximum regional background	Maximum predicted UPS impact		
R1	4.6	0.05	0.2	4.8
R2	4.6	0.05	0.2	4.8
R3	4.6	0.05	0.2	4.8
R4	4.6	0.08	0.3	4.9
R5	4.6	0.04	0.1	4.7
R6	4.6	0.06	0.1	4.8
R7	4.6	0.06	0.1	4.8
R8	4.6	0.05	0.1	4.7
R9	4.6	0.05	0.1	4.7
R10	4.6	0.07	0.2	4.9
R11	4.6	0.05	0.1	4.7
R12	4.6	0.05	0.1	4.7
R13	4.6	0.05	0.1	4.8
R14	4.6	0.05	0.1	4.8
R15	4.6	0.05	0.1	4.7
R16	4.6	0.05	0.1	4.7
R17	4.6	0.05	0.1	4.7
R18	4.6	0.22	1.5	6.4
R19	4.6	0.13	0.4	5.1
R20	4.6	0.06	0.1	4.7
R21	4.6	0.05	0.1	4.7
R22	4.6	0.04	0.1	4.7
R23	4.6	0.03	0.1	4.7
R24	4.6	0.04	0.1	4.7
R25	4.6	0.04	0.1	4.7
R26	4.6	0.06	0.1	4.8
Criteria				31

4.2.3.4 TVOCs and PAHs

This report presents the projected incremental annual average concentrations of PAHs and VOCs at designated sensitive receiver locations. The modelling was conducted based on a worst-case scenario, assuming continuous 24 hours/7 days a week operation of the power generation system.

Per Table 4.13 the 99.9th percentile incremental 1-hour average PAH concentrations predicted at and beyond the project boundary are significantly less (<0.0001% for the offsite receivers and <0.0004% for the boundary receivers) than the criterion of 0.0004 mg/m^3. For the purposes of modelling, background PAH concentrations were assumed to be negligible. Regardless, the addition of the incremental impacts from the UCS backup generator to a background concentration are not predicted to cause an exceedance.

Table 4.13 Predicted 99.9th percentile PAH concentrations

Receiver ID	99.9th percentile PAHs (mg/m^3)
Maximum at the site boundary	**1.49×10^{-9}**
Maximum beyond the site boundary	**4.19×10^{-10}**
Impact assessment criteria	**0.0004**
R1	1.3×10^{-10}
R2	1.5×10^{-10}
R3	6.8×10^{-11}
R4	6.5×10^{-11}
R5	4.1×10^{-11}
R6	6.4×10^{-11}
R7	4.5×10^{-11}
R8	5.6×10^{-11}
R9	5.4×10^{-11}
R10	7.1×10^{-11}
R11	5.2×10^{-11}
R12	4.8×10^{-11}
R13	7.1×10^{-11}
R14	9.1×10^{-11}
R15	3.7×10^{-11}
R16	4.6×10^{-11}
R17	3.5×10^{-11}
R18	4.2×10^{-10}
R19	9.5×10^{-11}
R20	4.9×10^{-11}
R21	5.3×10^{-11}
R22	3.8×10^{-11}
R23	3.7×10^{-11}
R24	4.5×10^{-11}
R25	7.4×10^{-11}
R26	6.4×10^{-11}
B1	4.3×10^{-10}
B2	4.9×10^{-10}
B3	5.1×10^{-10}
B4	5.1×10^{-10}
B5	5.6×10^{-10}

Receiver ID	99.9th percentile PAHs (mg/m^3)
B6	4.9×10^{-10}
B7	5.9×10^{-10}
B8	7.5×10^{-10}
B9	1.5×10^{-9}
B10	1.2×10^{-9}
B11	9.1×10^{-10}
B12	5.8×10^{-10}

Table 4.14 presents the predicted 99.9th percentile incremental concentrations of VOCs represented as benzene, which has the most stringent assessment criteria among all VOC species, at surrounding residential and boundary receiver locations.

Based on the modelling outcomes presented in Table 4.14, it is concluded that modification-related air emissions are unlikely to result in exceedances of the relevant ambient air quality criteria for the VOCs at any off-site sensitive receiver locations.

While predicted VOCs concentrations marginally exceed the assessment criterion at the site boundary, this exceedance occurs under highly conservative modelling assumptions. Boundary receivers were positioned in close proximity to emission sources, and the applied criterion represents the most stringent regulatory threshold. Taking these factors into account, it is considered highly unlikely that the proposed modification would result in adverse air quality impacts, even at the site boundary.

Table 4.14 Predicted 99.9th percentile TVOCs (as benzene) concentrations

Receiver ID	TVOCs (as Benzene) ($\mu g/m^3$)
Maximum at site boundary	**34.0**
Maximum beyond the site boundary	**9.6**
Impact assessment criteria (benzene)	**29.0**
R1	3.0
R2	3.3
R3	1.6
R4	1.5
R5	0.9
R6	1.5
R7	1.0
R8	1.3
R9	1.2
R10	1.6
R11	1.2
R12	1.1
R13	1.6
R14	2.1
R15	0.9
R16	1.1
R17	0.8
R18	9.6

Receiver ID	TVOCs (as Benzene) (μg/m^3)
R19	2.2
R20	1.1
R21	1.2
R22	0.9
R23	0.8
R24	1.0
R25	1.7
R26	1.5
B1	9.9
B2	11.2
B3	11.6
B4	11.6
B5	12.7
B6	11.1
B7	13.5
B8	17.2
B9	34.0
B10	26.9
B11	20.8
B12	13.2

5. Mitigation measures

Standard mitigation measures to reduce impacts from construction and operation of the proposed modification are provided in Table 5.1. Decommissioning of the modification and rehabilitation of the proposed modification is expected to result in lower dust emissions than construction scenarios assessed in this report. However, the following dust mitigation measures are still recommended during decommissioning and rehabilitation to minimise risk of impacts.

Table 5.1 Mitigation measures

Impact	Number	Environmental safeguard	Responsibility
Construction			
Dust	AQ1	Vehicular speeds onsite will be limited to <20 km/hr and vehicle movements will be restricted to designated access tracks to minimise dust lift-off from roads.	APA / Contractor
	AQ2	On days with forecast and actual high winds (i.e., >10 m/s), work effort will be reduced accordingly if wind-blown dust is observed to be leaving site boundary.	APA / Contractor
	AQ3	Dust suppression will be undertaken as required (i.e., when dust is visible), including water sprays, water extension agents, or other suitable media on unpaved work areas subject to traffic or winds.	APA / Contractor
	AQ4	Detail all mitigation measures in the site Construction Environmental Management Plan and ensure site personnel carry out mitigation measures when necessary.	APA / Contractor
Combustion gases	AQ5	Vehicles, plant and equipment used on site (including generators) will: – comply with appropriate standards – not be used where they produce excessive emissions (based on a visual assessment) until service/maintenance can be undertaken to return them to normal working order – be turned off when not in use and not left to idle for prolonged periods – be regularly maintained in accordance with manufacturers specifications.	APA / Contractor
Operation			
Dust	AQ6	Vehicular speeds onsite will be limited to <20 km/hr and vehicle movements will be restricted to designated paved access roads or blue metal finished areas to minimise dust lift-off from roads.	APA / Contractor
Combustion gases	AQ7	Vehicles, plant and equipment used on site (including back-up generator) will: – comply with appropriate standards – not be used where they produce excessive emissions (based on a visual assessment) until service/maintenance can be undertaken to return them to normal working order – be turned off when not in use and not left to idle for prolonged periods – be regularly maintained in accordance with manufacturers specifications. – Implementation of a CobaDGS tandem gas seal with nitrogen gas seal system.	APA / Contractor

Emissions Reduction	AQ8	APA will be implementing an Emissions Reduction Strategy in line with the APA Group climate commitments. It should be noted that the selection of an electrically driven compressor, which will not result in increased emissions of pollutants to the air, was selected as part of APA groups existing climate commitments.	APA / Contractor

6. Conclusion

APA commissioned GHD to undertake an air quality assessment to accompany the Modification Report for the proposed modification. This included a construction dust assessment and an operational assessment for the compressor station.

– A qualitative construction dust assessment has been undertaken following the IAQM guidance focusing on activities planned for the construction stage of the modification. The assessment concluded that the construction stage poses a medium risk of dust soiling at the neighbouring Uranquinty Power Station site office across all construction phases, and a low risk for human health and ecological impacts. Mitigation measures have been recommended to manage potential construction dust emissions as a matter of best practice.
– A detailed air quality assessment was performed for combustion emissions from the compressor station, in accordance with the Approved Methods. Emission rates were estimated based on information representative of equipment provided by APA or from the NPI emissions estimation technique manual for combustion engines (version 3.0). The assessment utilised the NSW EPA approved dispersion modelling software CALPUFF.
  - Incremental VOC, NO_2, CO, SO_2, $PM_{2.5}$, and PAH are below the modification-specific criteria at all offsite receivers.
  - Incremental VOC concentrations are below the project-specific criteria at all boundary receivers.
  - Incremental VOC concentrations are marginally above the criteria for benzene at a single boundary receiver location.
    – This result is highly conservative, as it assumes 100 percent of VOC emissions are benzene, the compound with the most stringent criteria. In reality VOC emissions will encompass a large mixture of compounds, and as such it is highly unlikely that these compounds will exceed criteria at the boundary. Regardless mitigation measures have been specified in order to reduce risk of VOC impacts at the boundary during generator use.
  - Cumulative NO_2, CO and SO_2 are below the modification-specific criteria at all offsite receivers.
  - Cumulative $PM_{2.5}$ predictions were marginally above the criteria due to background data already exceeding the criteria on its own. Cumulative predictions using the background maximum 1-hour data, which was below the criteria stayed within the acceptable range.
  - Cumulative PM_{10} predictions were below the criteria at all receiver locations.

7. References

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Appendix A

Construction phase risk assessment methodology

This section outlines the assessment methodology for undertaking a construction dust impact assessment as per the IAQM.

Step 1 – Screen the Need for a Detailed Assessment

The Step 1 screening criteria provided by the IAQM guidance suggests screening out any assessment of impacts from construction activities where sensitive receivers (defined as receivers in this AQIA) are located more than 250 m from the boundary of the site, more than 50 m from the route used by construction vehicles on public roads up to 250 m from the site entrance. This step is noted as having deliberately been chosen to be conservative and will require assessments for most projects.

Step 2a – Define the Potential Dust Emission Magnitude

The dust emission magnitude is based on the scale of the anticipated works and should be classified as Small, Medium, or Large. The following are examples of how the potential dust emission magnitude for different activities can be defined. Note that, in each case, not all the criteria need to be met, and that other criteria may be used if justified in the assessment. Where relevant, multiple screening assessments may be completed for different development phases (or even sub-phases where demolition may be brief or there is a very short period of intense activity, for example). This may particularly be the case for linear schemes (i.e. new roads, railways).

Example definitions for demolition are as follows. Alternative screening values may be used here this is justified based on a particular scheme:

– ***Large***: Total building volume >75,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >12 m above ground level
– ***Medium***: Total building volume 12,000 m^3 – 75,000 m^3, potentially dusty construction material, demolition activities 6-12 m above ground level
– ***Small***: Total building volume <12,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <6 m above ground, demolition during wetter months.

Earthworks will primarily involve excavating material, haulage, tipping and stockpiling. This may also involve levelling the site and landscaping. Example definitions for earthworks are:

– ***Large***: Total site area >110,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >6 m in height
– ***Medium***: Total site area 18,000 m^2 – 110,000 m^2, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 3 m – 6 m in height
– ***Small***: Total site area <18,000 m^2, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4 m in height.

Construction: The key issues when determining the potential dust emission magnitude during the construction phase include the size of the building(s)/infrastructure, method of construction, construction materials, and duration of build. Example definitions for Construction are:

– ***Large:*** Total building volume >75,000 m^3, on site concrete batching, sandblasting
– ***Medium:*** Total building volume 12,000 m^3 – 75,000 m^3, potentially dusty construction material (e.g., concrete), on site concrete batching
– ***Small:*** Total building volume <12,000 m^3, construction material with low potential for dust release (e.g., metal cladding or timber).

Track-out: Factors which determine the dust emission magnitude are vehicle size, vehicle speed, vehicle numbers, geology and duration. As with all other potential sources, professional judgement must be applied when classifying track-out into one of the dust emission magnitude categories. Example definitions for track-out are:

– ***Large:*** >50 HDV (>3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m
– ***Medium:*** 20-50 HDV (>3.5t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 m – 100 m

– ***Small:*** <20 HDV (>3.5t) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50 m.

Step 2b – Define the Sensitivity of the Area

Step 2b of the assessment process requires the sensitivity of the area to be defined. The sensitivity of the area takes into account:

– the specific sensitivities of receivers in the area
– the proximity and number of those receivers
– in the case of PM_{10}, the local background concentration
– site-specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust.

The type of receivers at different distances from the site boundary or, if known, from the dust generating activities, should be included. Consideration also should be given to the number of ‘human receivers’. Exact counting of the number of ‘human receivers’, is not required. Instead, it is recommended that judgement is used to determine the approximate number of receivers (a residential unit is one receiver) within each distance band. For receivers which are not dwellings professional judgement should be used to determine the number of human receivers for use in the tables, for example a school is likely to be treated as being in the >100 receiver category.

The likely routes the construction traffic will use should also be included to enable the presence of track-out receivers to be included in the assessment. As general guidance, without site-specific mitigation, track-out may occur along the public highway up to 500 m from large sites (as defined in STEP 2A), 200 m from medium sites and 50 m from small sites, as measured from the site exit.

A number of attempts have been made to categorise receivers into high, medium and low sensitivity categories; however, there is no unified sensitivity classification scheme that covers the quite different potential effects on property, human health and ecological receivers.

Table A.1 provides guidance on the sensitivity of different types of receivers to dust soiling, health effects, and ecological effects.

Table A.1 IAQM guidance for categorising receiver sensitivity

Value	High sensitivity receiver	Medium sensitivity receiver	Low sensitivity receiver
Dust Soiling	Users can reasonably expect enjoyment of a high level of amenity; or The appearance, aesthetics or value of their property would be diminished by soiling; and The people or property would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land.	Users would expect a to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or The appearance, aesthetics or value of their property could be diminished by soiling; or The people or property wouldn’t reasonably be expected a to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land.	The enjoyment of amenity would not reasonably be expected; or Property would not reasonably be expected to be diminished in appearance, aesthetics, or value by soiling; or There is transient exposure, where the people or property would reasonably be expected a to be present only for limited periods of time as part of the normal pattern of use of the land.
	Indicative examples include dwellings, museums, and other culturally important collections, medium- and long-term car parks and car showrooms.	Indicative examples include parks and places of work.	Indicative examples include playing fields, farmland (unless commercially sensitive horticultural), footpaths, short term car parks and roads.

Value	High sensitivity receiver	Medium sensitivity receiver	Low sensitivity receiver
Health Effects	Locations where members of the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day).	Locations where the people exposed are workers, and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day).	Locations where human exposure is transient
	Indicative examples include residential properties. Hospitals, schools, and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.	Indicative examples include office and shop workers but will generally not include workers occupationally exposed to PM_{10}, as protection is covered by Health and Safety at Work legislation.	Indicative examples include public footpaths, playing fields, parks, and shopping streets.

According to the IAQM methods, the sensitivity of the identified individual receivers (as described above) is then used to assess the sensitivity of the area surrounding the active construction area, taking into account the proximity and number of those receivers, and the local background PM_{10} concentration (in the case of potential health impacts) and other site-specific factors. Additional factors to consider when determining the sensitivity of the area include:

– any history of dust generating activities in the area
– the likelihood of concurrent dust generating activity on nearby sites
– any pre-existing screening between the source and the receivers
– any conclusions drawn from analysing local meteorological data which accurately represent the area; and if relevant.
– the season during which the works will take place.
– any conclusions drawn from local topography.
– duration of the potential impact, as a receiver may become more sensitive over time.
– any known specific receiver sensitivities which go beyond the classifications given in this document.

The IAQM guidance for assessing the sensitivity of an area to dust soiling is shown in Table A.2. The sensitivity of the area should be derived for each of activity relevant to the modification (i.e. construction and earthworks).

Table A.2 IAQM guidance for categorising sensitivity of an area to dust soiling effects

Receiver Sensitivity	Number of receivers	Distance from the source (m)			
		<20	<50	<100	<250
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

Note: Estimate the total number of receivers within the stated distance. Only the *highest level* of area sensitivity from the table needs to be considered. For example, if there are 7 high sensitivity receivers < 20 m of the source and 95 high sensitivity receivers between 20 and 50 m, then the total of number of receivers < 50 m is 102. The sensitivity of the area in this case would be high.

The IAQM guidance for assessing the sensitivity of an area to health impacts is shown in Table A.3. The IAQM methods takes into account the PM_{10} background concentration for the receivers with high sensitivity. Given that the PM_{10} concentrations in the IAQM method is based on air quality objectives in the UK, these concentrations are slightly modified for application is the assessments performed in Australia.

Table A.3 IAQM guidance for categorising the sensitivity of an area to dust health effects

Receiver sensitivity	Annual mean PM_{10} Concentration	Number of receivers	Distance from the source (m)			
			<20	<50	<100	<250
High	>25 µg/m³	>100	High	High	High	Medium
		10-100	High	High	Medium	Low
		1-10	High	Medium	Low	Low
	21-25 µg/m³	>100	High	High	Medium	Low
		10-100	High	Medium	Low	Low
		1-10	High	Medium	Low	Low
	17-21 µg/m³	>100	High	Medium	Low	Low
		10-100	High	Medium	Low	Low
		1-10	Medium	Low	Low	Low
	<17 µg/m³	>100	Medium	Low	Low	Low
		10-100	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Medium	>25 µg/m³	>10	High	Medium	Low	Low
		1-10	Medium	Low	Low	Low
	21-25 µg/m³	>10	Medium	Low	Low	Low
		1-10	Low	Low	Low	Low
	17-21 µg/m³	>10	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
	<17 µg/m³	>10	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low

Step 2c – Define the Risk of Impacts

The dust emission magnitude determined at Step 2a should be combined with the sensitivity of the area determined at Step 2b to determine the risk of impacts with no mitigation applied. The matrices in Table A.4 (Demolition), Table A.5 (earthworks and construction) and Table A.6 (track-out) provide a method of assigning the level of risk for each activity.

Table A.4 Risk category from demolition activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table A.5 Risk Category from Earthworks and Construction Activities

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 A.6 Risk Category from Track-out Activities

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

Appendix B

Operational phase methodology

B-1 Uranquinty Compressor Station Emissions Inventory

The emissions inventory presented in Table B.1 was constructed using the following assumptions:

- The 200 kVA, 400V, 3 phase diesel generator is expected to be the primary emission source during operation of the modification. It will operate intermittently to supply power for critical loads and safe shutdown of the Compressor station during critical loads.
  - Emission rates from the generator have been modelled using a representative generator (Cummins C200 D5e 50 Hz Diesel generator). It should be noted that generator selection is not finalised and is likely to change. In the event that a smaller generator is selected, this assessment should be considered conservative. In the event that a larger generator is selected, an updated air quality impact assessment should be adopted.
  - Emission factors have been adopted from tables 49 and 50 (emission factors for stationary, small (less than 450 kW) diesel engines) of the National Pollutant Inventory emission estimation technique manual for Combustion Engines (version 3.0) (National Pollutant Inventory, 2008).
- It was assumed the compressor station will operate continuously, all year long. This is a conservative assumption as it is anticipated to only operate during periods of high end-user demand, such as during winter.
- Concentrations of NO_2 have been calculated using the ozone limiting method using ozone concentrations collected from the Wagga Wagga North AQMS in accordance with the approved methods (NSW EPA, 2022).
  - This method operates under the assumption that all available atmospheric O_3 will react with NO in the emission plume until either the O_3 or NO is fully depleted. It simplifies the atmospheric chemistry by treating the reaction as instantaneous, despite the fact that, in reality, this conversion occurs gradually over several hours. The OLM offers flexibility in its application, allowing for varying levels of refinement based on the scale of emissions and the potential environmental impact, as determined by the equation below.
    - $[NO_2]_{total} = \{0.1 \times [NO_x]_{pred.}\} + MIN\{(0.9) \times [NO_x]_{pred.}\ or\ \left({}^{46}/_{48}\right) \times [O_3]_{bkgd.}\} + [NO_2]_{bkgd}$
- The compressor station will be powered by the existing electricity grid and is not expected to result in emissions to air during regular operation.

Emission rates, alongside relevant equipment specifications are outlined in this appendix. Equipment specifications were sourced from a similar assessment undertaken for APA (GHD, 2024). It is expected that most combustion particulates would be the finer $PM_{2.5}$ fraction. Therefore, all PM emissions have been conservatively assumed to be $PM_{2.5}$.

Table B.1 Generator emissions inventory

Description	Value	Units	Note/Source
Generator – Power Generation			
Energy Generation	200	kVa	C200 D5e specification sheet
	160	kWh	C200 D5e specification sheet assuming all energy output in 1 hour as a worst-case scenario
Generator Exhaust Specifications			
Diameter	0.20	ø (m)	Assumed
Area	0.03	m^2	Calculated
Flow Velocity	18.99	m/s	Calculated
Stack height	2.5	M	C200 D5e specification sheet (0.3 m above the generator outlet as a conservative assumption)
Exhaust gas temp	561	C	C200 D5e specification sheet
Exhaust gas temp	834	K	Calculated
Exhaust gas density	0.4	kg/m^3	C200 D5e specification sheet

Emission factors			
NO_x	1.88×10^{-2}	kg/kWh	NPI Emission estimation technique manual combustion engines version 3.0 June 2008
CO	4.06×10^{-3}	kg/kWh	
SO_2	4.28×10^{-6}	kg/kWh	
$PM_{2.5}$	1.31×10^{-3}	kg/kWh	
PM_{10}	1.34×10^{-3}	kg/kWh	
PAH	6.00×10^{-11}	kg/kWh	
TVOCs (assessed against benzene criteria as a conservative assumption)	1.37×10^{-3}	kg/kWh	
Emission Rates			
No_x	8.36×10^{-1}	g/s	calculated
CO	7.00×10^{-4}	g/s	
SO_2	2.00×10^{-4}	g/s	
$PM_{2.5}$	5.82×10^{-2}	g/s	
PM_{10}	5.96×10^{-2}	g/s	
PAH	3.00×10^{-9}	g/s	
NO_x	6.09×10^{-2}	g/s	

B-2 Uranquinty Power Station Emissions Inventory

The emissions inventory in Table B-2 was constructed using the following assumptions:

– Stack parameters have been sourced from the previously undertaken EIS (Katestone Environmental, 2003)
  - Emission factors have been adopted from tables 49 and 50 (emission factors for stationary, small (less than 450 kW) diesel engines) of the National Pollutant Inventory emission estimation technique manual for Combustion Engines (version 3.0) (National Pollutant Inventory, 2008).

– The Uranquinty Power Station is operating at full capacity 7 days a week 24 hours a day. This is conservative as the Uranquinty Power Station fluctuates in activity throughout the year.

Table B.2 Uranquinty Power Station Emissions Inventory

Description	Value	Units	Note/Source
Uranquinty Power Station Power Generation			
Power output	166	MW	SGT-2000E Spec sheet
	1.66×10^{-7}	PJ/s	Calculated
Fuel	Natural Gas	-	SGT-2000E Spec sheet
Exit Velocity	40.6	m/s	Origin Energy, "Uranquinty Power Station Environmental Management Plan", Version 12, Dated 17 June 2022
Exit Temperature	552	°C	
	825	K	
Stack height	35	m	
Stack diameter	6.2	m	Kate Stone Environmental, "Air Quality Impact Assessment for a Proposed Power Station at Wagga Wagga, Dated December 2003
Emission factors			
TVOC	9.10×10^{2}	kg/PJ	NPI Emission estimation technique manual for Fossil Fuel Electric Power Generation Version 3.0, Dated 2012
PAHs	9.50×10^{-1}	kg/PJ	
PM_{10}	2.80×10^{3}	kg/PJ	
$PM_{2.5}$	2.70×10^{3}	kg/PJ	
NO_2/NO_x ratio	0.1		
Emission Rates			
CO	5.1	g/s	Origin Energy, "Uranquinty Power Station Environmental Management Plan", Version 12, Dated 17 June 2022
SO_2	0.7	g/s	
PM_{10}	4.1	g/s	
NO_x	21	g/s	Stack emission characteristics from Uranquinty Power Station Environmental Management Plan", Version 12, Dated 17 June 2022
NO_2	2.1	g/s	Calculated based on 10% No_x to NO_2 conversion
$PM_{2.5}$	3.95	g/s	Based on NPI ratio of PM_{10} to $PM_{2.5}$
VOCs	0.15	g/s	NPI Emission estimation technique manual for Fossil Fuel Electric Power Generation Version 3.0, Dated 2012
PAHs	1.58×10^{-4}	g/s	
NO_x	21	g/s	Stack emission characteristics from Uranquinty Power Station Environmental Management Plan", Version 12, Dated 17 June 2022
NO_2	2.1	g/s	Calculated based on 10% NO_x to NO_2 conversion
CO	5.1	g/s	Stack emission characteristics from Uranquinty Power Station Environmental Management Plan", Version 12, Dated 17 June 2022

B-3 Meteorological model inputs

Meteorological model inputs are outlined below.

B-3-1 TAPM Meteorological Modelling

TAPM (v4.0.4), developed by CSIRO, was used to generate site-specific meteorological data for dispersion modelling. The model predicts parameters such as wind, temperature, and turbulence using input from terrain, vegetation, and synoptic meteorological data. TAPM can assimilate actual local wind observations so that they can optionally be included in a model solution.

TAPM parameters used for this study are presented in Table B.3.

Table B.3 TAPM parameters

Parameter	Model Configuration
Modelling Period	01 January 2022 to 31 December 2022
Centre of analysis	509,079 mE 6,096,607 mS UTM Coordinates
Number of grid points	30 × 30 × 30
Number of grids (spacing)	5 (30 km, 10 km, 3 km, 1 km, 300 m)
Data Assimilation	Wagga Wagga AWS (Station ID: 72150)

B-3-2 CALMET

CALMET is a meteorological modelling tool that generates hourly wind and other meteorological fields within a three-dimensional gridded domain, which serve as inputs for the CALPUFF dispersion model. The output from CALMET also includes associated two-dimensional fields, such as mixing height, surface characteristics, and dispersion properties.

Within CALMET, the interpolated wind field is adjusted to incorporate the effects of topography, sea breezes, and variations in heating and surface roughness due to diverse land uses throughout the modelling domain. These adjustments are applied at each grid point to produce a final wind field that accurately reflects local influences.

The CALMET modelling was conducted using the ‘Hybrid’ approach across a 7.5 km by 7.5 km domain with a 100 m resolution. TAPM-generated three-dimensional meteorological data served as the initial wind field for both domains, while local topographical and land use data were utilised to enhance the wind field derived from TAPM outputs.

Table B.4 outlines the parameters employed in the meteorological modelling to drive the CALMET model.

Table B.4 Calmet modelling parameters

Parameter	Model Configuration
Modelling period	01 January 2022 to 31 December 2022
Meteorological grid resolution	500 m
Centre grid coordinates	509,079 mE 6,096,607 mS UTM Coordinates
Initial guess filed	TAPM output
Vertical resolution (cell heights)	10 (0 m, 20 m, 40 m, 80 m, 160 m, 320 m, 640 m, 1200 m, 2000 m, 3000 m, 4000 m)

B-4 Dispersion model inputs

B-4-1 Surrounding land zoning and modelled terrain

Figure 5 shows the site, surrounded by residential and industrial/commercial receivers. Residential receivers are located predominantly to the south and southwest of the site, in urban and suburban areas within approximately 800 m at their closest point. The site is primarily surrounded by rural/agricultural properties. The closest industrial/commercial receiver is approximately 400 m southwest of the site boundary.

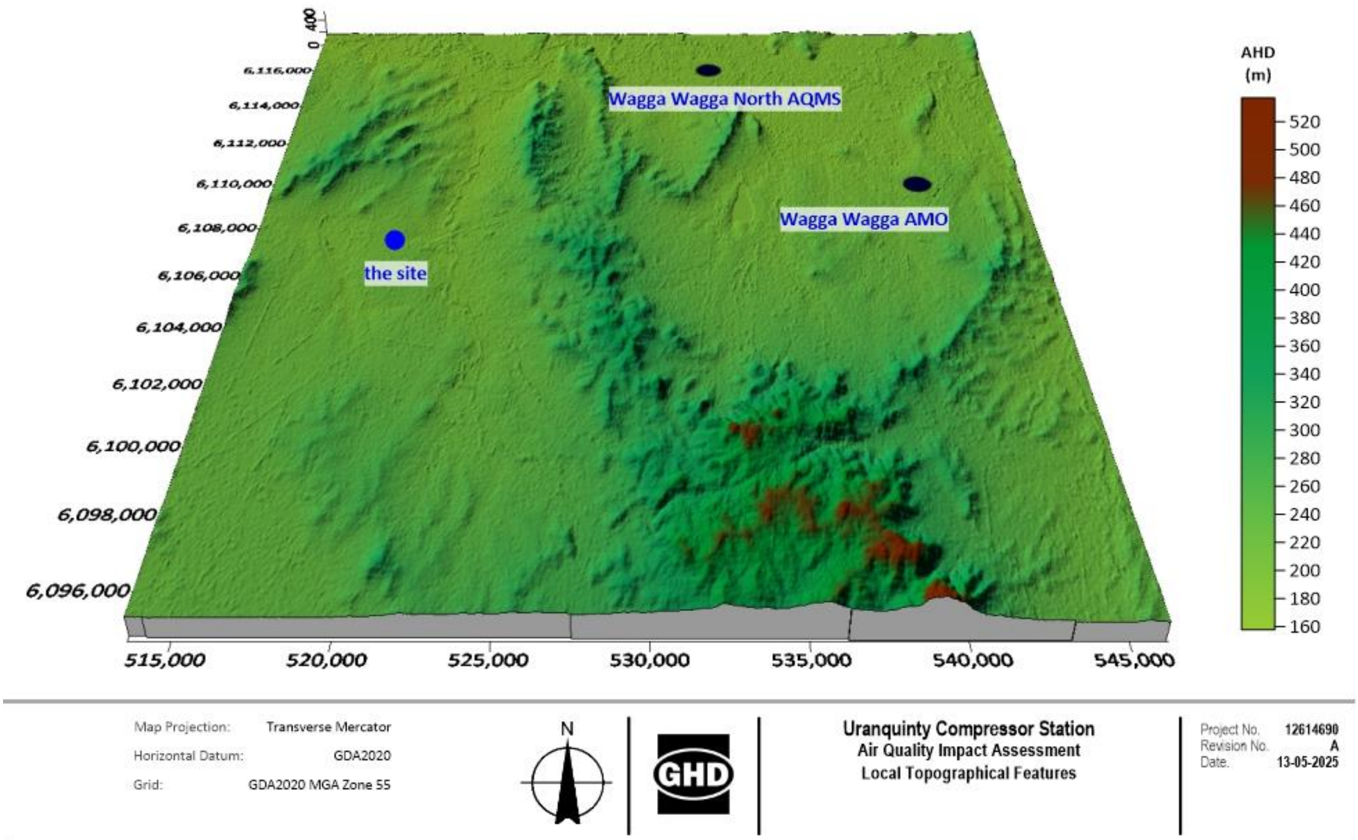

Figure B.1 Local topographic features

B-4-2 Building downwash

When air pollutant emissions occur near large structures, the natural dispersion of these emissions can be significantly disrupted. This disruption, known as building downwash, happens when wind flows around and over structures, creating turbulent air patterns. These patterns can force emissions from elevated sources downward, leading to increased pollutant concentrations at ground level. Turbulent wakes and areas of air stagnation often form behind buildings, intensifying this effect.

To reduce the risk of elevated pollutant concentrations due to downwash, United States Environmental Protection Agency has set guidelines for determining Good Engineering Practice (GEP) stack height. GEP stack height is designed to ensure that emissions disperse adequately and are not trapped near the ground by the influence of nearby structures. According to the United States Environmental Protection Agency (1985), GEP stack height is calculated as the height of the nearby building plus 1.5 times the smaller of either the building's height or its projected width.

A stack is considered susceptible to downwash effects if it is located within a distance less than five times the smaller dimension of the building's height or width.

In this assessment, CALPUFF uses its integrated PRIME algorithm to analyse the influence of buildings on pollutant dispersion. Building dimensions and profiles were determined using the USEPA's Building Profile Input Program (BPIP). The modelling incorporated the proposed generator structures to evaluate their effects on emissions.

Figure 7.1 illustrates the spatial arrangement of buildings included in the analysis which included the Uranquinty Power Station main generator buildings, as well as the emergency generator of the Uranquinty Compressor Station.

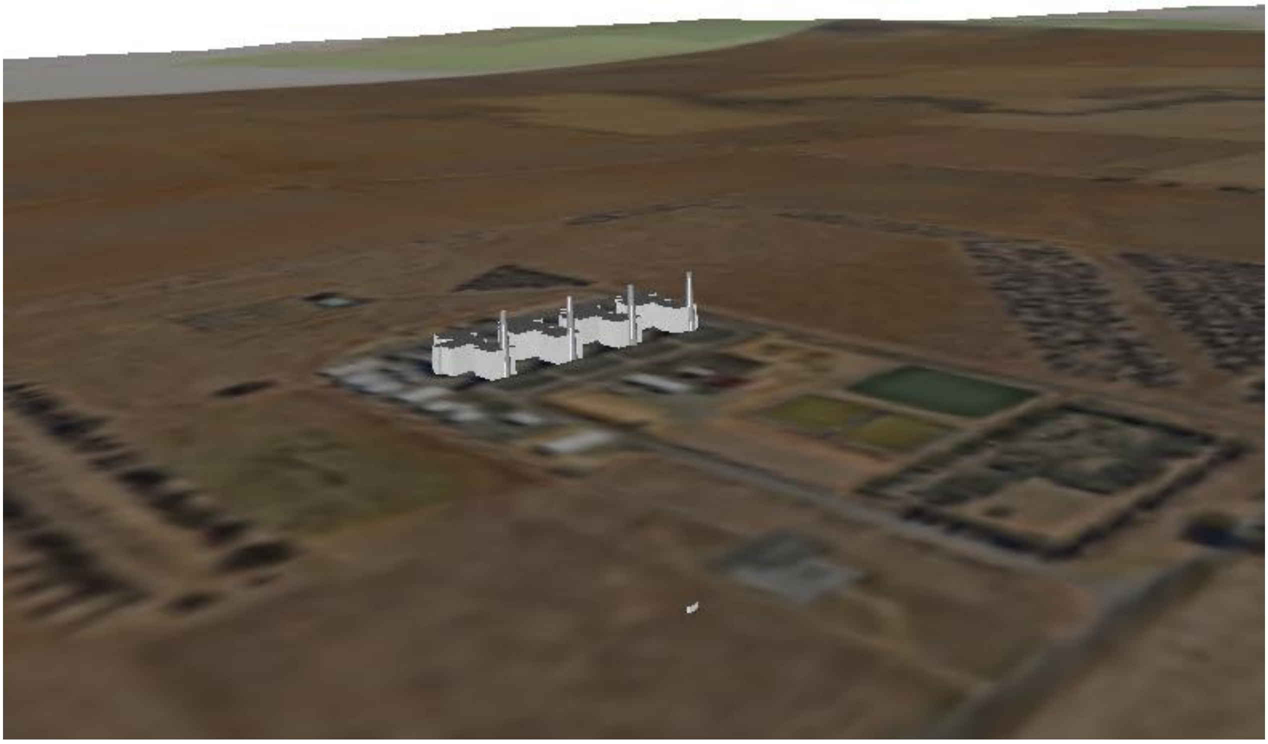

Figure 7.1 Modelled buildings and stacks

B-4-3 NO_x to NO_2 conversion

Nitrogen oxides (NO_x) emitted from combustion processes consist mainly of nitric oxide (NO), with a smaller fraction (approximately 10%) as nitrogen dioxide (NO_2). As NO disperses into the atmosphere, it undergoes oxidation to form NO_2, driven by reactions with ozone (O_3) in the presence of sunlight. This transformation occurs progressively as the plume travels away from the source, with the oxidation rate influenced by various factors, particularly ambient O_3 concentrations. This dynamic plays a key role in the formation and depletion of ozone, as NO reacts with O_3 to produce NO_2, which can then photolyze under sunlight to regenerate NO and create new ozone molecules. In environments rich in volatile organic compounds (VOCs), additional reactions can accelerate NO oxidation without consuming ozone, leading to net ozone accumulation and contributing to ground-level ozone pollution. To accurately estimate downwind NO_2 concentrations at receiver locations, the following techniques can be used to account for the atmospheric conversion of NO to NO_2 during dispersion modelling based on the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (NSW EPA, 2022).

Method 1 – 100% Conversion

This approach is typically applied as a preliminary screening tool, operating under the assumption that all emitted NO fully converts to nitrogen dioxide NO_2 before reaching the receiver. While this provides a conservative estimate, it often leads to substantial overestimations of NO_2 concentrations, particularly at receivers located close to the emission source.

Method 2 – Ambient Ozone Limiting Method

The United States Environmental Protection Agency Ozone Limiting Method (OLM) is a widely used approach for estimating ground-level concentrations of NO_2. This method operates under the assumption that all available atmospheric O_3 will react with NO in the emission plume until either the O_3 or NO is fully depleted. It simplifies the atmospheric chemistry by treating the reaction as instantaneous, despite the fact that, in reality, this conversion occurs gradually over several hours.

The OLM offers flexibility in its application, allowing for varying levels of refinement based on the scale of emissions and the potential environmental impact, as determined by the equation below.

$$[NO_2]_{total} = \{0.1 \times [NO_x]_{pred.}\} + MIN\{(0.9) \times [NO_x]_{pred.}\ or\ \left({}^{46}/_{48}\right) \times [O_3]_{bkgd.}\} + [NO_2]_{bkgd}$$

However, due to the lack of ozone data representative of conditions at the project site, this method was not applied for converting NO_x to NO_2 in this assessment.

Method 3 – NO to NO_2 conversion using empirical relationship

Janssen et al. (Janssen et. al., 1988) introduced an empirical formula to estimate the rate at which NO oxidises within power plant plumes. This equation relates the oxidation rate to the downwind distance from the emission source and incorporates the parameters A and α, as outlined in Table B.5. The equation is expressed as follows:

$$ {}^{NO_2}/_{NO_x} = A\left(1 - exp(-\alpha x)\right)$$

Table B.5 Classification of Values for A and α by Season

Season	Ozone (ppb)	Wind speed (m/s)					
		5		15		>15	
		A	α (km-1)	A	α (km-1)	A	α (km-1)
Winter	0	0.49	0.05	0.49	0.05	0.49	0.05
	10	0.49	0.05	0.49	0.05	0.49	0.05
	20	0.74	0.07	0.74	0.07	0.74	0.07
	30	0.83	0.07	0.83	0.07	0.83	0.1
	40	0.87	0.07	0.87	0.07	0.87	0.15
Spring/Autumn	0	0.635	0.1	0.635	0.1	0.635	0.1
	20	0.635	0.1	0.635	0.1	0.635	0.1
	30	0.74	0.1	0.74	0.1	0.74	0.15
	40	0.8	0.1	0.8	0.1	0.8	0.25
	60	0.85	0.1	0.85	0.15	0.85	0.3
Summer	0	0.67	0.1	0.67	0.1	0.67	0.1
	30	0.67	0.1	0.67	0.1	0.67	0.1
	40	0.74	0.1	0.74	0.15	0.74	0.25
	60	0.81	0.15	0.81	0.25	0.81	0.35
	120	0.88	0.2	0.88	0.35	0.88	0.45
	200	0.93	0.4	0.93	0.65	0.93	0.8