Appendix J – Air Quality Impact Assessment

Mandalong Road Upgrade

Air Quality Impact Assessment

Transport for NSW

Document control

Rev	Date
First Draft	30/08/2024
First Draft (revised)	02/10/2024
Second Draft	30/10/2024
Final	15/11/2024
Final (revised)	07/02/2025

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Transport for NSW (Transport) proposes to provide upgrades to Mandalong Road between Gimberts Road and Ourimbah Street (the proposal). The proposal is located within the suburb of Morisset in the Lake Macquarie local government area.

Mandalong Road is a critical link within the B53 Morisset to Wallsend transport corridor that connects the Morisset town centre and surrounding urban areas to the M1 Pacific Motorway. A key aim of the proposal is to improve traffic flow and road safety for all road users by increasing the capacity of Mandalong Road and active and public transport improvements, which would support future economic and residential growth in the surrounding area. Key features of the proposal would include upgrades to the Mandalong Road/Freemans Drive/Dora Street/Wyee Road intersection.

Methodology

This technical report assesses the potential impacts to air quality from the construction and operation of the proposed road upgrade and has been prepared to support and inform the Review of Environmental Impacts (REF) for the proposal.

The assessment of potential impacts of dust and gas emissions associated with the construction of the proposal was assessed in accordance with the *Guidance on the assessment of dust from demolition and construction* published by the Institute of Air Quality Management (IAQM) and the *Good Practice Guide for the Assessment and Management of Air Pollution from Road Transport Projects* published by the Clean Air Society of Australia and New Zealand (CASANZ). The assessment of potential impacts of vehicle emissions associated with the operation of the proposal was assessed based on the Transport for NSW Roadside Air Quality Screening Tool (RAQST).

Potential construction impacts on air quality

The dust emission magnitudes for demolition, earthworks and construction and trackout (defined as dirt, mud or other materials tracked onto a paved public roadway by a vehicle leaving a construction site) activities were combined with the sensitivity of the area to determine the risk of air quality impacts for the construction of the proposal.

Based on the dust emission magnitudes determined and the sensitivity of the surrounding areas:

- demolition, earthworks and construction and trackout activities are considered to have a **medium** risk of dust soiling and human health impacts
- demolition and earthworks and construction activities are considered to have a **medium** risk of ecological impacts, whereas trackout activities are considered to have a **low** risk of ecological impacts.

Gaseous emissions from the construction works were assessed qualitatively by IAQM and would be adequately manageable through the implementation of mitigation measures.

Potential operational impacts on air quality

The operational impacts on air quality were calculated for two scenarios:

- baseline year of the proposal, assumed to be 2023
- design year of the proposal, assumed to be 2039.

A screening assessment was conducted using RAQST to provide estimated emissions rates for the criteria pollutant NO_2, $PM_{2.5}$ and PM_{10}. The results from the screening emissions show that the roadside contribution from the proposal in 2023 and 2039 scenarios combined with the background levels would be well below current criteria levels for all three pollutants.

The results from the screening assessment indicate that the emissions from the operation of the proposal would not lead to exceedances of current air quality guidelines for the fleet characteristics considered.

Safeguards and management measures

Air quality management measures would form part of the Construction Environmental Management Plan (CEMP). Mitigation measures are recommended in in this REF to minimise potential air quality impact during construction of the proposal.

With further site-specific mitigation measures in place, the residual dust impacts would be further reduced and not be of significance. Gaseous emissions generated from vehicles and fugitive sources during construction would be minimised with mitigation measures in place, and air quality impacts would not be of significance.

1 Introduction

1.1 Proposal identification

Transport for New South Wales (NSW) (Transport) proposes to provide upgrades to Mandalong Road between Gimberts Road and Ourimbah Street (the proposal). The proposal is located within the suburb of Morisset in the Lake Macquarie local government area (LGA).

Mandalong Road is a critical link within the B53 Morisset to Wallsend transport corridor, that connects the Morisset town centre and surrounding urban areas to the M1 Pacific Motorway. A key aim of the proposal is to improve traffic flow and road safety for all road users through increasing the capacity of Mandalong Road and active and public transport improvements, which would support future economic and residential growth in the surrounding area.

The locality of the proposal is shown in Figure 1-1.

1.2 Key features of the proposal

Key features of the proposal include:

- upgrading the Mandalong Road/Freemans Drive/Dora Street/Wyee Road intersection, including:
  - replacing the existing roundabout with new traffic lights
  - providing additional through and turning lanes on all approaches of the intersection
  - providing a central raised median on all approaches of the intersection
- providing active transport connections, including:
  - a shared user path along the length of the proposal on Mandalong Road and Dora Street
  - a shared user path on the eastern side of Wyee Road
  - a footpath on the north-eastern corner of Dora Street and Freemans Drive
- providing two new bus stop facilities on Dora Street
- installing and/or relocating fauna connectivity structures, such as glider poles
- full and partial property acquisitions, leases and adjustments, including relocating and adjusting property access and private utility connections
- ancillary work for the proposal, including, but not limited to, vegetation clearing, earthworks, landscaping and tie-in works
- relocating and/or adjusting existing public utilities, including electrical, gas, water, sewer and telecommunications
- roadworks, including pavement, line marking, lighting and road furniture (e.g. signs and safety barriers)
- upgrading drainage infrastructure, including culverts, pits, pipes, kerbs and gutters
- temporary ancillary facilities, including site compounds, material storage and laydown areas.

The key features of the proposal are shown in Figure 1-2 and described in detail in Chapter 3 of the REF. The ‘proposal area’ refers to the area that would be directly impacted by the proposal. This comprises the construction area of the proposal and any other areas that would be temporarily disturbed, including ancillary facilities. The proposal area is shown in Figure 1-2.

1.3 Purpose of this report

This air quality impact assessment supports the environmental assessment for the proposal. The proposal is subject to assessment by a Review of Environmental Factors (REF) under Division 5.1 of *Environmental Planning and Assessment Act 1979* (EP&A Act).

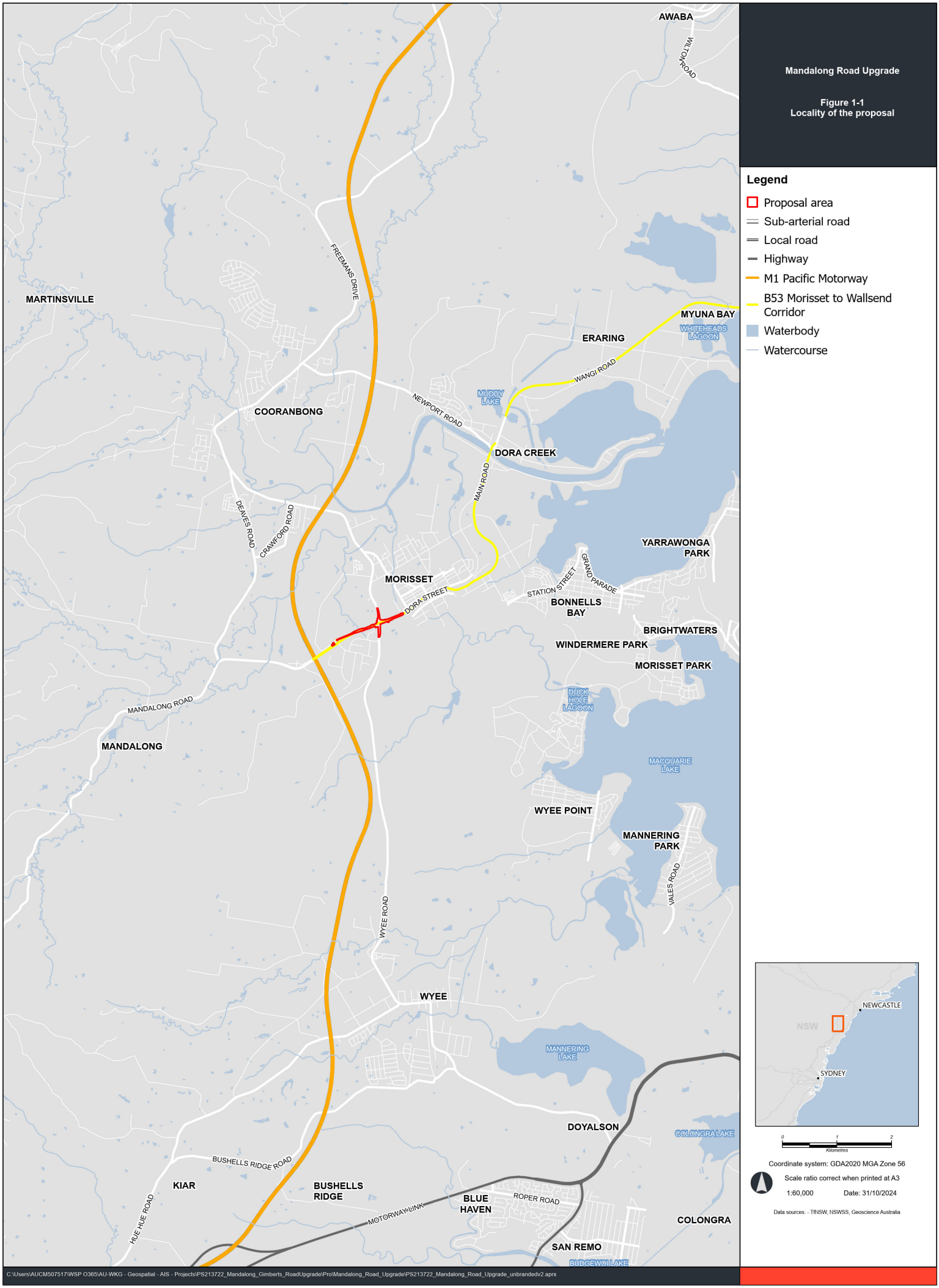
The purpose of this report is to assess the potential impacts to air quality from the construction and operation of the proposal. Specifically, this report has the following objectives:

- establish the existing environment as it pertains to air quality
- assess the potential air quality impacts during the construction of the proposal
- assess the potential air quality impacts during the operation of the proposal
- propose mitigation measures, if required.

1.4 Report outline

This report contains the following information and is structured as outlined below:

- Chapter 1 provides an overview of the proposal and assessment purpose
- Chapter 2 describes the legislative and policy context
- Chapter 3 describes the methodology employed for the assessment
- Chapter 4 describes the existing environment of proposal area with respect to air quality
- Chapter 5 identifies and describes risks associated with construction of the proposal
- Chapter 6 identifies and describes risks associated with operation of the proposal
- Chapter 7 details how the proposal would be managed to reduce potential environmental impacts throughout construction and operation
- Chapter 8 provides references of information used throughout the assessment
- Chapter 9 provides definitions for abbreviations used in the assessment.



Mandalong Road Upgrade

Figure 1-1
Locality of the proposal

Legend

- Proposal area
- Sub-arterial road
- Local road
- Highway
- M1 Pacific Motorway
- B53 Morisset to Wallsend Corridor
- Waterbody
- Watercourse

Coordinate system: GDA2020 MGA Zone 56

Scale ratio correct when printed at A3

1:60,000 Date: 31/10/2024

Data sources: - TfNSW, NSWSS, Geoscience Australia

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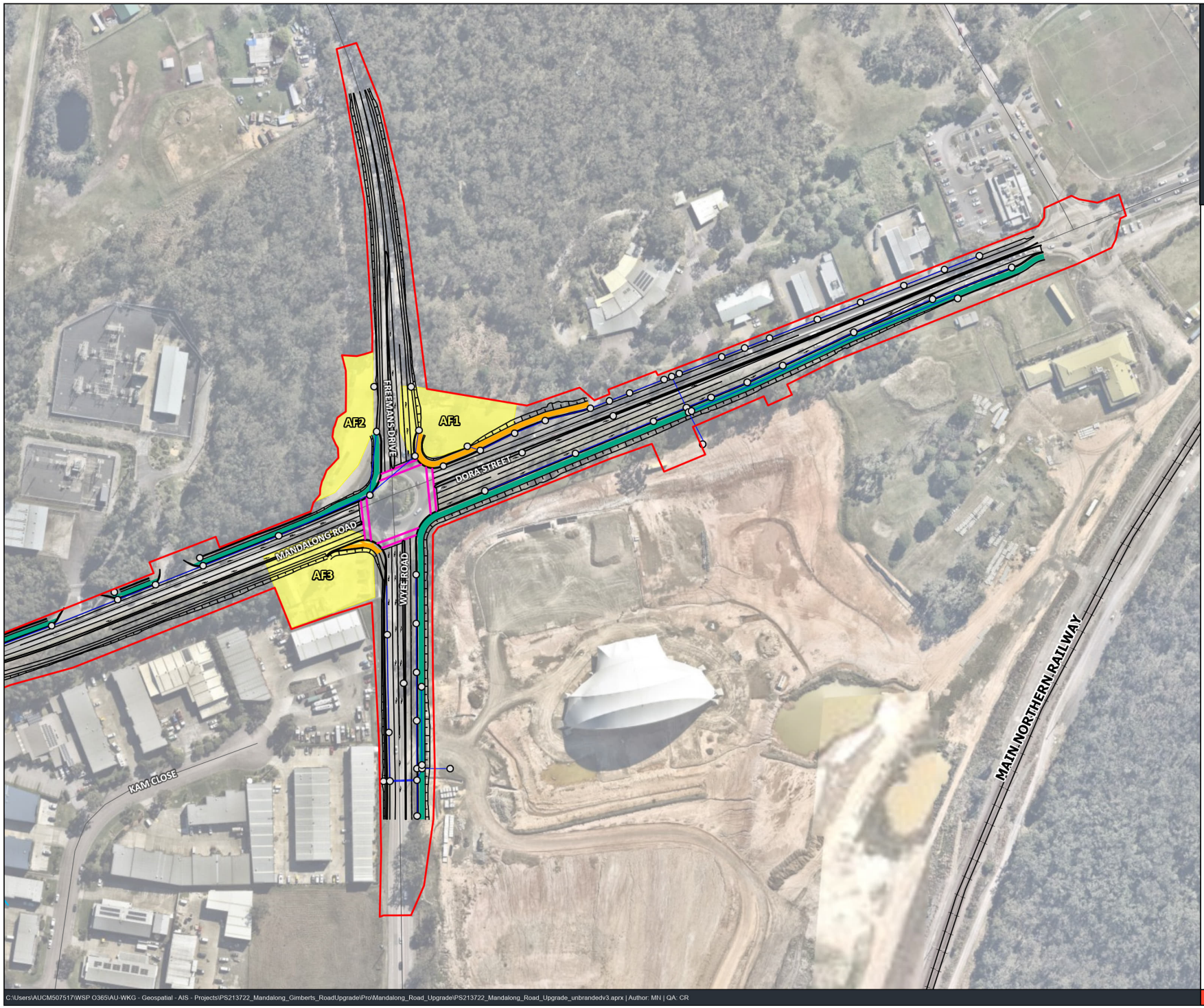


Mandalong Road Upgrade

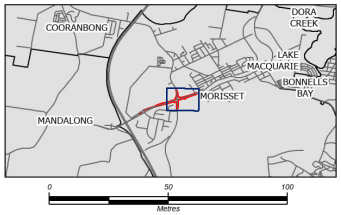
Figure 1-2
Proposal Design

Legend

- Proposal area
- Ancillary facility
- Road
- Railway
- Watercourse

Road design

- Drainage pit
- Road alignment
- Pedestrian crossing
- Drainage pipe
- Footpath
- Shared user path



Coordinate system: GDA2020 MGA Zone 56
Scale ratio correct when printed at A3

1:2,250 Date: 28/11/2024

GDA 2020

Data sources: WSP, Nearmap, NSWSS

Mandalong Road Upgrade

Figure 1-2
Proposal Design

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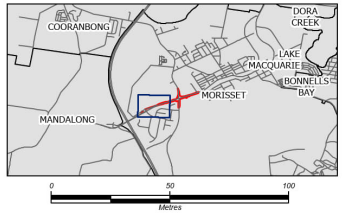

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Date: 28/11/2024

GDA 2020

Data sources: WSP, Nearmap, NSWSS

2 Legislative requirements

2.1 Legislative and Policy requirements

2.1.1 Commonwealth

2.1.1.1 National Environment Protection Council Act 1994

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

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

NEPMs are a special set of national objectives designed to assist in protecting or managing aspects of the environment e.g., air quality.

The NEPM relevant to air quality for the proposal is:

- National Environment Protection (Ambient Air Quality) Measure 2022 (Air NEPM).

2.1.1.2 National Environment Protection (Air Quality) Measure 2022

Key pollutants commonly found in ambient air are nationally regulated under the National Environment Protection (Ambient Air Quality) Measure (Air NEPM) and National Environment Protection (Air Toxics) Measure (Air Toxics NEPM).

The Air NEPM outlines standards and goals for key pollutants that are required to be achieved nationwide, with due regard to population exposure.

In addition, Commonwealth, State and Territory Environment Ministers have flagged an objective to move to a $PM_{2.5}$ goal of 20 micrograms per cubic metre air ($\mu g/m^3$) (1-day average) and 7 $\mu g/m^3$ (1-year average).

2.1.2 New South Wales

2.1.2.1 Protection of the Environment Operations Act 1997

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

Schedule 1 of the POEO Act lists the industrial activities that have the potential to have a significant impact on the environment. The NSW Environment Protection Authority (EPA) regulates these activities through environment protection licences, pollution reduction programs, load-based licensing (also applies to water pollution), and targeted policies.

The following scheduled activities set out in Schedule 1 are most relevant to the proposal:

- road construction if it results in four or more traffic lanes (not including bicycle lanes or lanes used for entry or exit), where the road is classified or proposed to be classified as a main road for at least 3 km of its length in the metropolitan area, and for at least 5 km in any other area (clause 35)
- extractive activities, where excavation required for the proposal is greater than 30,000 tonnes per year (clause 19)
- cement or lime handling, meaning the handling of cement, fly ash, powdered lime (other than agricultural lime) or any other similar dry cement products, but not if the handling occurs as part of the production of pre-mixed concrete (concrete batching), where more than 30,000 tonnes of cement or lime is handled per year (clause 6).

The overall proposal does not meet the trigger levels for activities listed in Schedule 1 of the POEO Act, therefore an environment protection licence (EPL) would not be required for the proposal. The licencing requirements will be reviewed at the detailed design stage and prior to construction.

2.1.2.2 Approved Methods for the Modelling and Assessment of Air Quality in NSW 2022

The NSW EPA's *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* 2022 (Approved Methods) prescribes the statutory methods for modelling and assessing emissions of air pollutants from stationary sources in the State. The Approved Methods describes a sensitive receptor as '*A location where people are likely to work or reside; this may include a dwelling, school, hospital, office, or public recreational area. An air quality impact assessment should also consider the location of any known or likely future sensitive receptors*'. This definition was used for this assessment.

The Approved Methods lists impact assessment criteria for a range of pollutants and the relevant criteria for this proposal are presented in Section 3.5.

2.1.3 Guidance and standards

2.1.3.1 Guidance on the assessment of dust from demolition and construction

Guidance on the assessment of dust from construction Version 2.2 (Institute of Air Quality Management (IAQM), 2024) (IAQM guidance) provides guidance for defining the significance of air quality impacts due to the construction of a new development based on the magnitude of change, i.e. the predicted increase or decrease in concentrations from the proposal, and the sensitivity of the receptor.

This guidance is widely used for the semi-quantitative assessment of the risk of air quality (primarily particulate matter) impacts from construction works. Gaseous emissions from the construction works and any construction works screened out by the IAQM guidance were assessed qualitatively.

2.1.3.2 Good practice guide for the assessment and management of air pollution from road transport projects

The *Good Practice Guide for the Assessment and Management of Air Pollution from Road Transport Projects* (Clean Air Society of Australia and New Zealand (CASANZ), 2023) (CASANZ Guide), provides guidance for defining the significance of air quality impacts due to construction of a new. For this assessment, the CASANZ Guide was used to assess the magnitude of change from the construction of roads in the layover. For this assessment, the CASANZ Guide was interpreted in light of the recent IAQM guidance, and in the event of discrepancies, the IAQM guidance assessment criteria were generally followed.

2.1.3.3 Air quality management guideline

The *Air quality management guideline* (Transport, 2022) provides guidance with regard to managing air quality and emissions on Transport project sites.

2.1.3.4 Roadside Air Quality screening tool (RAQST)

Transport developed the Roadside Air Quality screening tool (RAQST) in 2023 as a first-pass screening tool for determining the air quality impacts from vehicles using a new or existing roadway. The *Roadside air quality screening tool guideline* (Transport for NSW, 2023) summarises the methodology of the RAQST and provides a guide for users of the tool. The RAQST is designed to be consistent with the requirements of the CASANZ Guide. The RAQST is considered a conservative approach to estimate roadside pollutant levels, as worst-case scenarios are used to determine if a more detailed assessment is required. This approach is considered appropriate for this assessment as the proposal is for the upgrade of an existing road.

3 Methodology

3.1 Study area

The study area has been developed using a risk-based approach, adopted from and consistent with the IAQM and CASANZ Guide. The 'proposal area' refers to the area that would be directly impacted by the proposal. This comprises the construction area of the proposal and any other areas that would be temporarily disturbed, including ancillary facilities. To capture the potential air quality impacts from construction of the proposal, the study area for this assessment comprises the proposal area and a 250 metre (m) buffer around the proposal area.

3.2 Pollutants of interest

The construction of the proposal would generate dust from earthworks, vegetation clearing, surface grading and compaction, landscaping, transportation and handling of soil and materials. The combustion of engine fuel from vehicle movements during construction and operation, and the operation of diesel generators, on-site plant and machinery during construction also has the potential to generate air pollutants. Overall, the following key air pollutants were identified:

- dust associated pollutants including:
  - total suspended particulates (TSP)
  - particles with an aerodynamic diameter equal to or less than 10 micrometres (µm) in diameter (PM_{10})
  - particles with an aerodynamic diameter equal to or less than 2.5 µm in diameter ($PM_{2.5}$)
- deposited dust
- carbon monoxide (CO)
- oxides of nitrogen (NO_x)
- volatile organic compounds (VOCs) (e.g., benzene).

This screening-level assessment for the proposal construction considered primarily dust-associated pollution, while proposal operation considered PM_{10}, $PM_{2.5}$ and NO_2. The purpose of these screening-level assessments of the construction and operation of the proposal was to identify any potential exceedances of these key pollutants and determine if further assessment is required.

3.3 Sensitive receptors

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

3.4 Construction impacts

As stated in the CASANZ Guide, the risk of dust emissions from a construction site causing dust soling and health impacts is related to the quantity of dust emitted from construction operations is related to the area of land being worked, and the level of construction activity (nature, magnitude and duration).

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

The air quality impact assessment undertaken for the construction phase adopted the following approach:

- reviewing the proposal scope, study area and construction activities
- reviewing the existing environment conditions, including local topography, climate and existing ambient air quality
- identifying sensitive receptors within the study area (i.e. 250 m of the proposal area)
- conducting a qualitative assessment of potential dust impacts associated with the proposal, consisting of a risk-based assessment in accordance with the CASANZ Guide:
  - Stage 1: characterising the proposal
  - Stage 3: completing a screening assessment to determine if a detailed assessment is required
  - Stage 4: assessing the dust impact risks. This stage is done separately for the four main types of construction activities, including demolition, earthwork, construction, and track out. This stage consists of the following steps:
    - step (i): reviewing the existing environment for receptors and air quality
    - step (ii): determining the potential dust emission magnitude
    - step (iii): determining the sensitivity of the area
    - step (iv): assessing the risk by combining the factors in step (ii) and step (iii)
  - Stage 5: determining site-specific mitigation and examining the residual effects and determining their significance
- qualitatively assessing gaseous emissions generated from vehicles and fugitive sources
- recommending site-specific mitigation measures for the construction of the proposal
- assessing residual impacts after the implementation of mitigation measures.

To adopt a conservative approach, potential emissions from construction activities deemed ‘negligible’, therefore, not requiring any further assessment, have been qualitatively assessed in accordance with CASANZ Guide to determine construction impacts would not be significant.

3.5 Operation impacts

The Transport RAQST was used for the assessment of the operational impacts of the proposal on air quality.

The air quality impact assessment undertaken for the operation phase adopted the following approach:

- proposal characterisation
- identify any sensitive receptors nearby the proposal boundary
- identify any special features of the proposal (e.g. complex topography etc.)
- if required, perform a screening assessment using an appropriate tool to provide a semi-quantitative estimate of air quality impacts of the proposal operation
- estimate concentrations of key criteria pollutants (NO_2, PM_{10} and $PM_{2.5}$) at receptors and compare to relevant air quality criteria (see Table 3-1)
- based on the outcomes of the screening assessment, determine the need for a detailed assessment, which would consider all pollutants of interest
- develop site-specific mitigation measures for the operation of the proposal, if required
- assess the residual impacts after the implementation of mitigation measures.

Table 3-1 Approved methods air quality impact assessment criteria

Pollutant	Averaging period	Assessment criterion
PM_{10}	24-hours	50 µg/m^3
	Annual	25 µg/m^3
$PM_{2.5}$	24-hours	25 µg/m^3
	Annual	8 µg/m^3
Deposited dust	Annual	2 grams per square meter per month (g/m^2/month) (incremental) 4 g/m^2/month (cumulative)
NO_2	1-hour	164 µg/m^3
	Annual	31 µg/m^3

3.5.1 Screening assessment tool

In NSW, the Approved Methods introduces a general overall approach to assessment, which has two 'Levels':

- Level 1: a simple 'screening' assessment using worst-case modelling assumptions.
- Level 2: a detailed assessment using refined modelling techniques and site-specific input data.

This approach is designed to ensure that the assessment effort is proportional to the potential scale of the impacts, with the impact estimates from Level 2 being more detailed than those from Level 1. If a Level 1 assessment demonstrates that adverse impacts will not occur, then there is no need to progress to Level 2. The Level 1 assessment, therefore, needs to be appropriately conservative. In other words, it needs to ensure that the predicted impacts are likely to be greater than the actual impacts but not so great that projects unnecessarily require the more expensive and time-consuming Level 2 process.

The RAQST was applied as a Level 1 assessment for the proposal, to determine the need for a Level 2 assessment.

4 Existing environment

4.1 Climate

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

The closest Bureau of Meteorology (BoM) station to the proposal is located at Lake Macquarie Automatic Weather Station (AWS) (BoM station ID: 061412). This station is located at -33.09 and 151.46 with an elevation of 6 m. Lake Macquarie AWS is located approximately 3 kilometres (km) north-northwest from the proposal, meaning this station is representative of the meteorology of the proposal.

Table 4-1 summarises the climatology between 2019 and 2023 at Lake Macquarie AWS, with wind speeds obtained from Mangrove Mountain AWS as described in Section 4.1.4.

Table 4-1 Summary statistics of the climate at Lake Macquarie AWS (2019–2023) by season

Parameter	Units	Summer (DJF)	Autumn (MAM)	Winter (JJA)	Spring (SON)
Max. temp	Degrees (°C)	27.2	23.3	18.6	23.6
Min. temp	Degrees (°C)	17.5	12.2	6.1	11.2
Relative humidity (9 am)	Per cent (%)	76	88	82	75
Relative humidity (3 pm)	Per cent (%)	92	95	88	90
Monthly rainfall	Millimetres (mm)	78	64	43	49
Days of rain	Number	8	7	4	6
Wind speed[1]	Metres per second (m/s)	2.3	2.2	2.5	2.5

(1) Wind speed statistics were obtained from Mangrove Mountain AWS as described in Section 4.1.4.

4.1.1 Temperature

Figure 4-1 presents the mean temperature at Lake Macquarie AWS over a year. The area is characterised by cool to mild winters and warm to hot summers, typical for this region in NSW. The mean maximum temperature is around 27°C and 18°C for summer and winter, respectively.

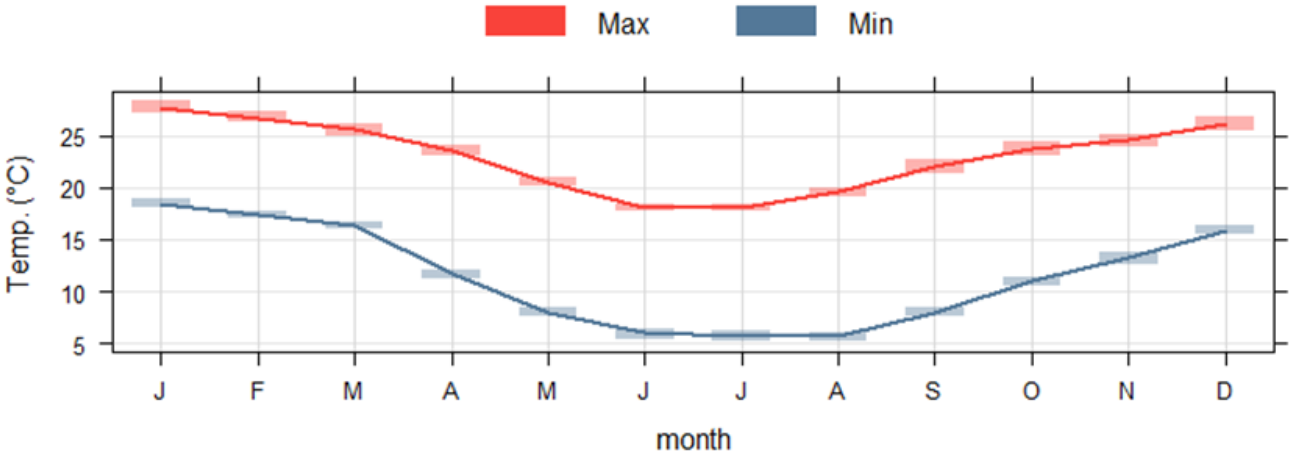


Figure 4-1 Mean monthly maximum and minimum temperature for 2019-2023 at Lake Macquarie AWS (the shaded bars indicate 95% confidence intervals)

4.1.2 Relative humidity

Figure 4-2 presents the mean monthly relative humidity (RH) at Lake Macquarie AWS and demonstrates the humid climate throughout the day, with the highest humidity observed in the afternoon.

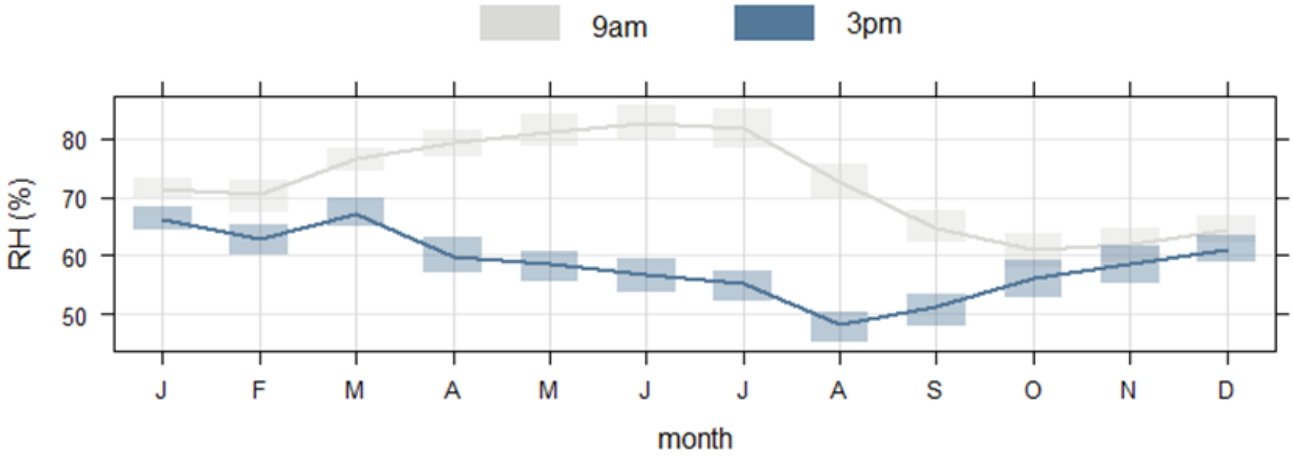


Figure 4-2 Mean monthly relative humidity (RH) for 2019–2023 at Lake Macquarie AWS (the shaded bars represent 95% confidence intervals)

4.1.3 Precipitation

The mean monthly precipitation at Lake Macquarie is presented in Figure 4-3, which indicates the humid subtropical typical of the region. The majority of the annual rain falls in the summer months, with only a few (4) significant rain events per month during winter (Figure 4-4).

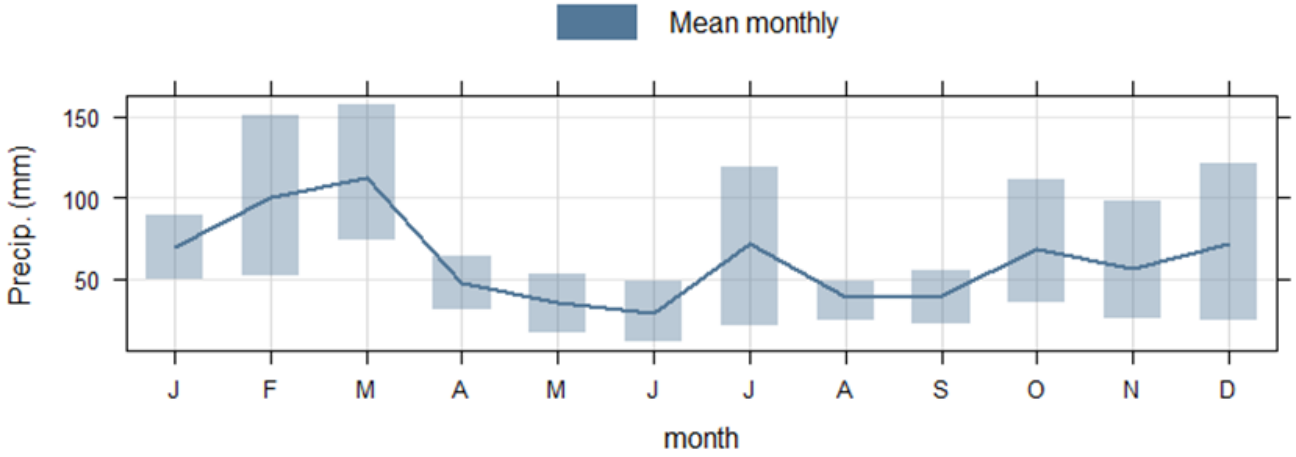


Figure 4-3 Mean monthly precipitation (mm) for 2019–2023 at Lake Macquarie AWS (the shaded bars represent 95% confidence intervals)

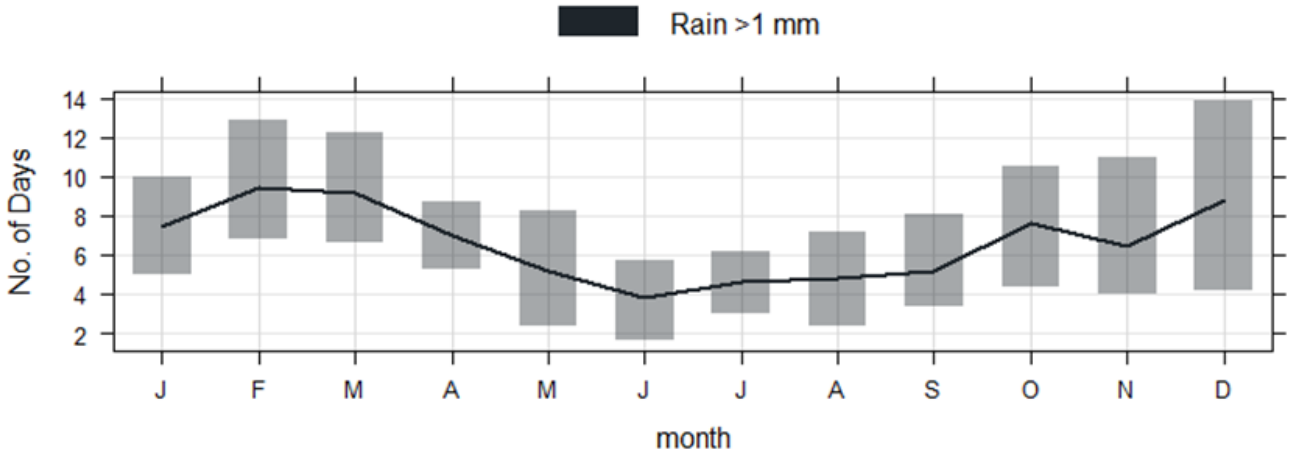


Figure 4-4 Mean number of days per month when rainfall was greater than 1 mm for 2019–2023 at Lake Macquarie AWS (the shaded bars represent 95 per cent confidence intervals)

4.1.4 Typical wind conditions

Analysis of the wind speed and wind direction data at Lake Macquarie AWS between 2019 and 2023 indicated a very high proportion of calm conditions (<0.5 m/s) and may indicate unreliable wind data. Therefore, wind data was obtained from the closest BoM station with a similar topography: Mangrove Mountain AWS (BoM station ID: 061375). This station is approximately 33 km southwest of the proposal (-33.29, 151.21).

The average annual wind rose plot for 2018 to 2022 is presented in Figure 4-5 for Mangrove Mountain, while wind rose plots for each season between 2018 and 2022 are shown in Figure 4-6.

There should be minimal interference from large buildings at this BoM station, and the wind rose plots should broadly represent the regional wind direction. Figure 4-5 indicates that the predominant wind direction is from the west-northwest for all seasons. Figure 4-6 indicates that lower wind speeds are typically observed in autumn, while wind speeds are typically the highest in summer.

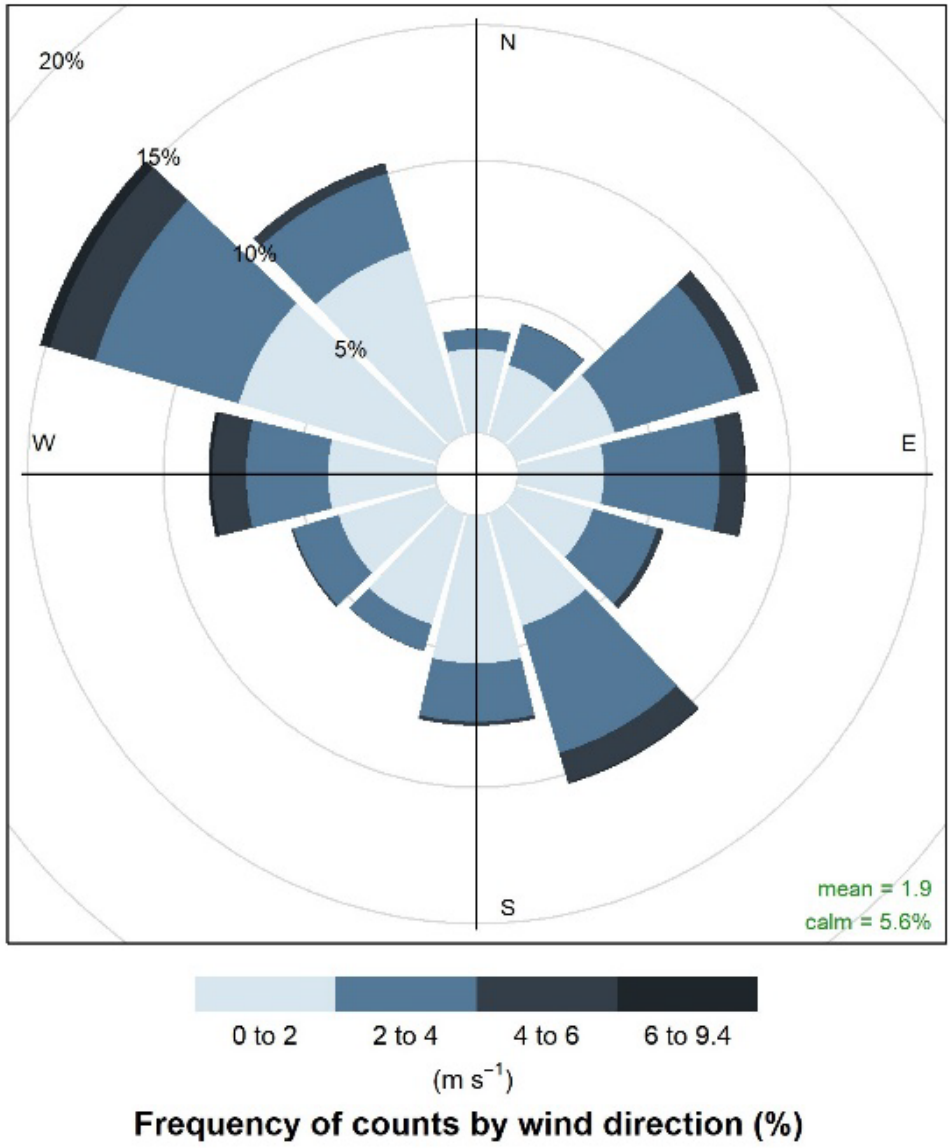


Figure 4-5 Annual average wind rose plot at Mangrove Mountain AWS for 2018–2022

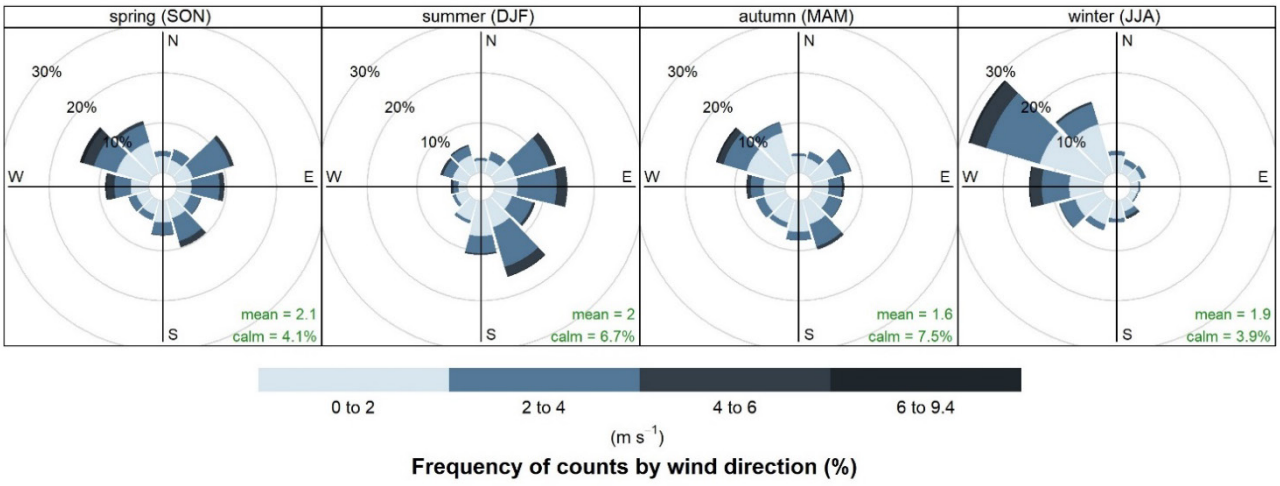


Figure 4-6 Seasonal average wind rose plots at Mangrove Mountain AWS for 2018–2022

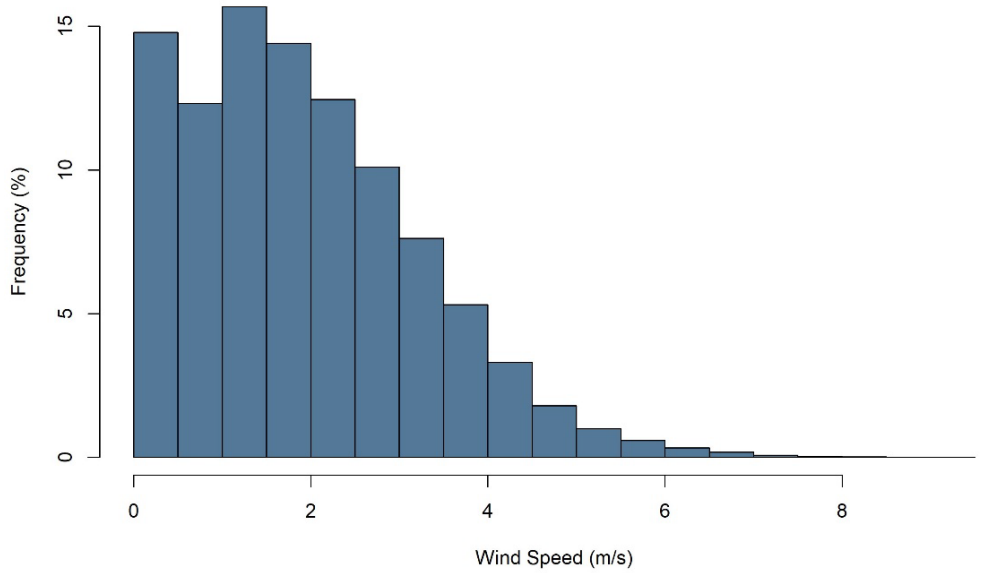


Figure 4-7 Histogram of wind speed frequency at Mangrove Mountain AWS for 2018–2022

4.2 Ambient air quality

4.2.1 Existing air emissions sources

The proposal consists of an existing road corridor located in a suburban area with a mix of residential, commercial and light industrial activities. The main existing emissions are exhaust emissions from traffic using the proposal area and the surrounding road network and wind-blown dust from bare land. A National Pollutant Inventory (NPI) database review was conducted to identify existing emission sources in the vicinity of the study area. Three facilities within 5 km of the study area have reported to the NPI for the 2022/2023 reporting period. A summary of the NPI facilities that reported emissions to air in the NPI in 2022/2023 within a 5 km radius of the proposal are presented in Table 4-2.

The Mandalong Mine is less than 1 km from the proposal and has reported emissions of pollutants listed as pollutants of interest in this assessment. The proposal is likely to be affected by the emissions from the operation of this facility. Due to the distance, the proposal is not likely affected by the emissions from the operation of the manufacturing facility Yates Australia Wyee, as listed in Table 4-2.

Table 4-2 Facilities reporting to NPI for 2022/2023 within a 5 km radius of the study area

Facility name, Company name	Type of activity	Distance and direction from study area	Reported emissions to air	
			Substance	Air total (kilograms (kg))
Mandalong Mine, Centennial Mandalong Pty Ltd [(1)]	Underground coal mining and coal handling	0.9 km to the west southwest	PM_{10}	9,800
			$PM_{2.5}$	5,400
			NO_X	80,000
			SO_2	40
			VOCs	8,000
			CO	94,000

Facility name, Company name	Type of activity	Distance and direction from study area	Reported emissions to air	
			Substance	Air total (kilograms (kg))
Yates Australia Wyee, Duluxgroup Pty Ltd	Manufacture of manure and mineral blend fertilisers and potting mix	3.6 km to the northeast	Ammonia	2,000

(1) Only pollutants of interest were listed in this table; Mandalong Mine reported other substances to NPI for 2022/2023.

4.2.2 Background air quality

The closest NSW EPA air quality monitoring station (AQMS) is Morisset, located approximately 7 km east of the proposal area. Morisset AQMS is located within a residential and light industrial area and is therefore considered as being representative of the proposal. Morisset AQMS was commissioned in November 2020; therefore, less than five years of air quality data is available from this AQMS. As such, data from the Wyong AQMS, located 18 km to the south-west of the study area, was obtained for the period between 2019 and 2023 to analyse the long-term trends. Data were obtained and analysed at both AQMS, CO, NO_2, PM_{10} and $PM_{2.5}$ to assess the background air quality at the proposal. The results of this analysis are summarised in Figure 4-8, Figure 4-9, Figure 4-10 and Table 4-3, Table 4-4.

Morisset and Wyong AQMS display similar PM_{10}, $PM_{2.5}$ and NO_2 trends. Between late 2020 and late 2022, the measured PM_{10} and $PM_{2.5}$ at Morisset AQMS were slightly lower than the Wyong AQMS. In late 2022, a step change in the measured PM_{10} and $PM_{2.5}$ at the Morisset AQMS was observed; this may indicate a change in the instrument at this AQMS. However, no information was available on the NSW EPA website to explain this step change. After this event, the Morisset and Wyong PM_{10} and $PM_{2.5}$ measurements become similar.

Due to the potential uncertainty related to the $PM_{2.5}$ and PM_{10} measurements at the Morisset station, measurements from the Wyong AQMS have been used to estimate background air quality for the proposal.

Between 2019 and 2023, the 70th percentile 24-hr average concentrations of $PM_{2.5}$ and PM_{10} at Wyong AQMS were 5.9 and 15.3 µg/m^3, respectively, which are below the respective 24-hr NSW standards specified in the Approved Methods ($PM_{2.5}$ = 25 µg/m^3; PM_{10} = 50 µg/m^3). A total of 27 and 26 exceedance days for $PM_{2.5}$ and $PM_{10,}$ respectively, were recorded, primarily in the summer of 2019-2020. NSW experienced an unusually extreme bushfire season, with several large bushfires in southern NSW, and these were the cause of the high air pollution during this period. For NO_2 and CO, no exceedances were observed at Wyong AQMS (See Figure 4-10 and Figure 4-11, respectively). The annual average concentration for CO and NO_2 was 0.034 and 0.003 ppm, respectively.

The results presented in Figure 4-8, Figure 4-9 and Table 4-3, Table 4-4 indicate that air quality in the study area is rated good to very good. As seen in data for late 2019 to early 2020, regional-scale air quality events, such as bushfires, occasionally impact the study area.

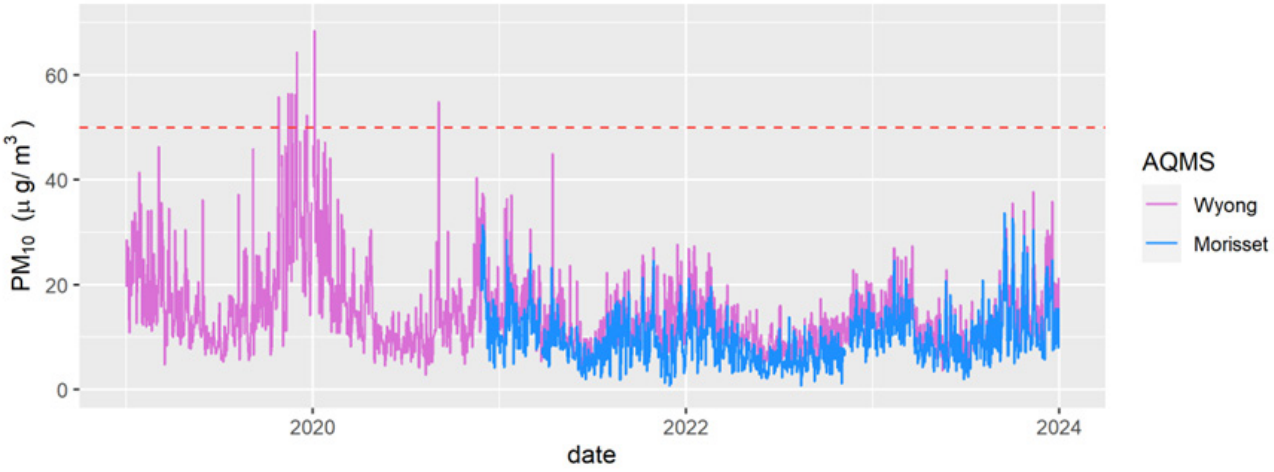


Figure 4-8 Time series of PM_{10} mass concentrations at Morisset and Wyong AQMS between 2019 and 2023. The dashed line indicates the 24-hr average standard (50 µg/m^3)

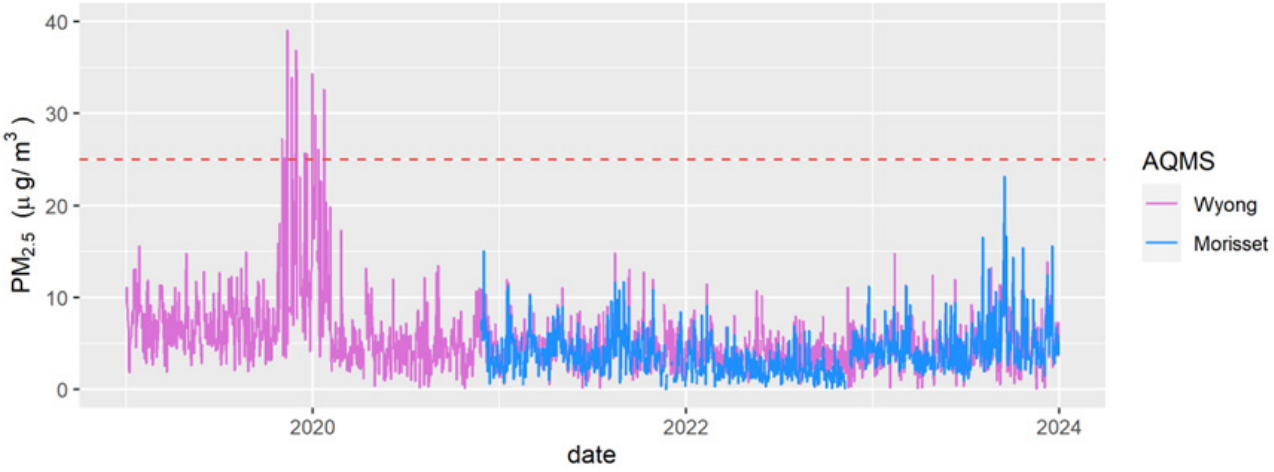


Figure 4-9 Time series of $PM_{2.5}$ mass concentrations at Morisset and Wyong AQMS between 2019 and 2023. The dashed line indicates the 24-hr average standard (25 µg/m^3)

Table 4-3 Summary statistics of $PM_{2.5}$ and PM_{10} observations at Wyong AQMS between 2019 and 2023

Averaging period	Statistic	$PM_{2.5}$	PM_{10}
24-hr	Data coverage (%)	98.7	99.3
	Maximum concentration (µg/m^3)	202.1	285.9
	70th percentile (µg/m^3)	6.2	16.2
	Criteria (µg/m^3)	***25***	***50***
	Exceedances (days)	27	26
Annual	Average concentration (µg/m^3)	5.9	15.3
	Criteria (µg/m^3)	***8***	***25***

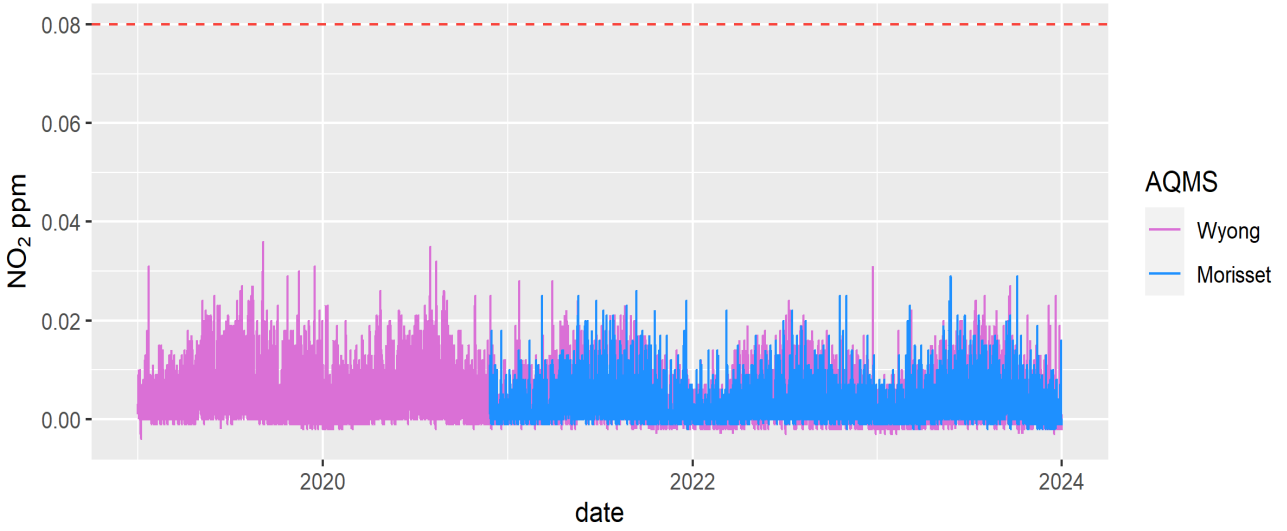


Figure 4-10 Time series of NO_2 mixing rations at Morisset and Wyong AQMS between 2019 and 2023. The dashed line indicates the 1-hr average standard (0.08 ppm)

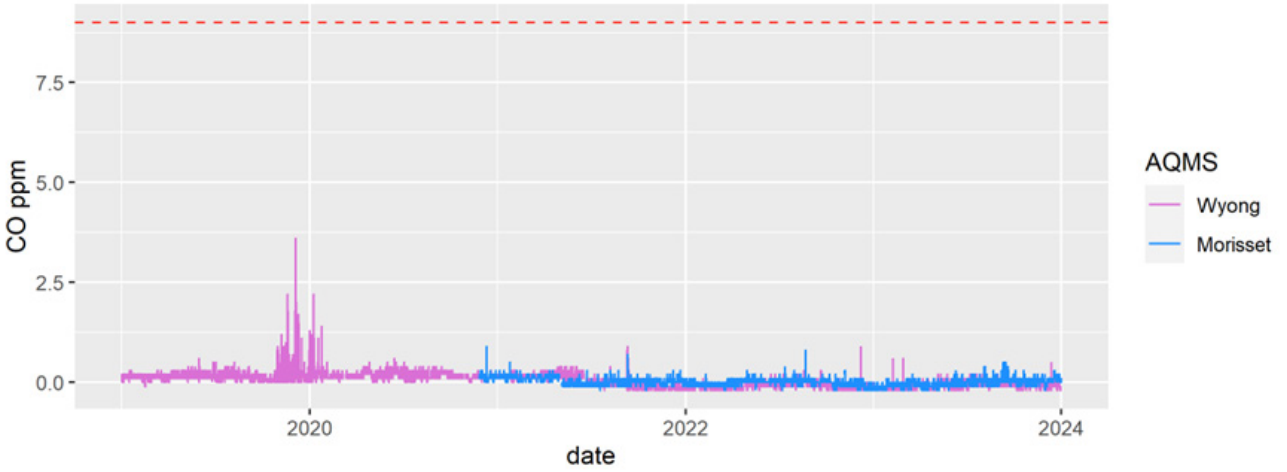


Figure 4-11 Time series of CO mixing ratios at Morisset and Wyong AQMS between 2019 and 2023. The dashed line indicates the 8-hr average standard (9 ppm)

Table 4-4 Summary statistics of NO_2 observations at Wyong station between 2019 and 2023

Averaging period	Statistic	NO_2
1-hr	Data coverage (%)	91.0
	Maximum concentration (ppm)	0.036
	Criteria (ppm)	0.08
	Exceedances (days)	0
Annual	Average concentration (ppm)	0.003
	Criteria (ppm)	0.015

5 Risk assessment

5.1 Construction dust risk assessment

5.1.1 Stage 1: Overview of proposal construction methods

The proposal is anticipated to be constructed in the following stages to ensure the safety of road users, maintain traffic flows and minimise impacts on the community:

- Early works – most utility and drainage adjustments and relocations, site preparation activities (e.g. implementation of environmental, traffic and pedestrian controls), site establishment activities (e.g. clearing and grubbing) and property adjustments that are required to be completed prior to the start of the main construction activities would be carried out.
- Main construction work is expected to be completed in four stages, as outlined in Table 5-1.

Construction of the proposal is expected to commence in 2026 and is estimated to take about 20 months to complete. The proposal is expected to commence operations in 2028. The construction staging and schedule are subject to change during the detailed design phase and construction.

Table 5-1 Indicative main construction stages of the proposal

Main construction stage	Time of day	Indicative activities
Stage 1	Night	— excavate and relocate utilities where impacted by the proposal, including temporary connections to maintain supply as required — demolish existing median and splitters islands — demolish roundabout island and construct pavement in former roundabout location — construct temporary road pavement along northern side of Mandalong Road and western side of Freemans Drive.
Stage 2	Day	— establish traffic control along the road to direct traffic along temporary traffic lanes along northern side of Mandalong Road and Dora Street and western side of Freemans Drive and Wyee Road — demolish part of the roundabout centre island and move island to allow traffic control during construction — excavate areas adjacent to the existing road and construct additional traffic lanes and upgrade existing road pavement along the southern side of Mandalong Road and Dora Street and the eastern side of Freemans Drive and Wyee Road — construct traffic signals at the Mandalong Road/Freemans Drive/ Dora Street/Wyee Road intersection.

Main construction stage	Time of day	Indicative activities
Stage 2A	Day	— excavate and move the roundabout centre island location to allow traffic control during construction — construct temporary road pavement on Dora Street and Wyee Road — excavate areas adjacent to the existing road and construct additional traffic lanes excavate areas adjacent to the existing road pavement and construct additional traffic lanes and upgrade existing road pavement along the northern side of Dora Street and western side of Wyee Road — complete traffic signal works at the Mandalong Road/Freemans Drive/ Dora Street/Wyee Road intersection.
Stage 3	Night	— excavate areas adjacent to the existing road and construct new pavement and upgrade existing road pavement along the northern side of Mandalong Road and western side of Freemans Drive — commission traffic signals at the Mandalong Road/Freemans Drive/ Dora Street/Wyee Road intersection — construct central medians and remaining traffic control signs.

5.1.2 Stage 3: Screening assessment

The CASANZ and IAQM guidance recommends that a detailed risk assessment of potential dust impacts from construction activities is undertaken when there are existing human sensitive receptors are located within:

- 250 m of the boundary of the proposal area
- 50 m of the routes used by construction vehicles on the public highway, up to 250 m from the proposal area entrances

and existing ecological receptors are located within:

- 50 m of the boundary of the proposal area
- 50 m of the routes used by construction vehicles on the public highway, up to 250 m from the proposal area entrances.

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

Sensitive receptors were identified within 250 m of the proposal area and a detailed risk assessment was triggered for the construction of the proposal refer to Figure 5-1).

5.1.3 Stage 4: Detailed assessment of the dust impacts risks

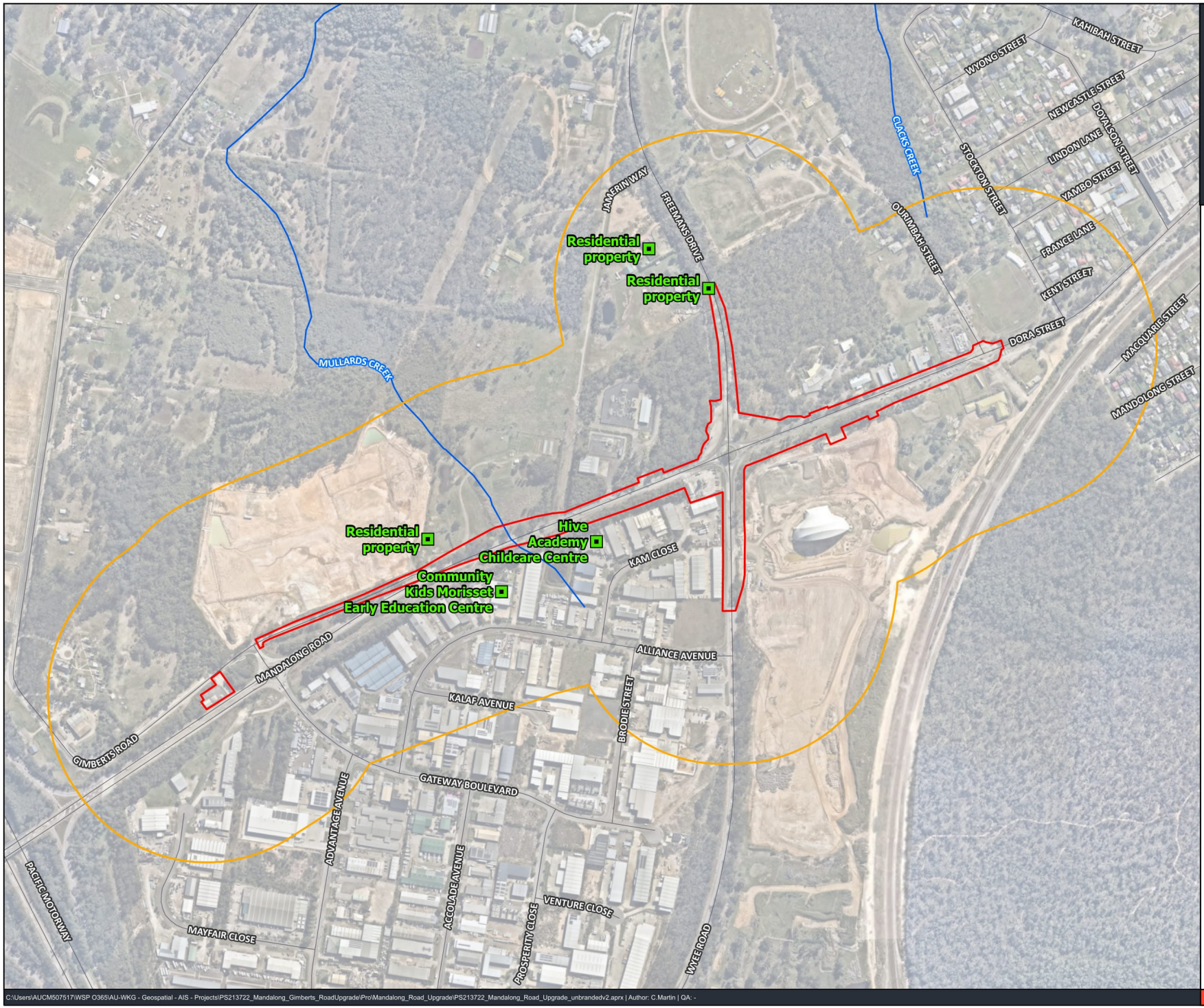
5.1.3.1 Step (i): Existing environment for receptors and air quality

The identified sensitive receptors within 250 m of the proposal area are shown in Figure 5-1.

Sensitive human receptors identified within 250 m of the proposal area include:

- Hive Academy Childcare Centre, at 47 Alliance Avenue, Morisset
- Community Kids Morisset Early Education Centre, at 9 Kam Close, Morisset
- three residential properties, at 50 Mandalong Road, 75 Freemans Drive and 77 Freemans Drive, Morisset.

Sensitive ecological receptors identified within 50 m of the proposal area include threatened ecological communities, fauna and flora listed under State and Commonwealth legislation (refer to Section 6.1 and Appendix D (Biodiversity Assessment Report) of the REF.

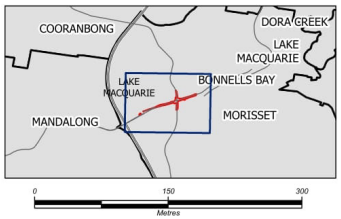


Mandalong Road Upgrade

Figure 5-1
Air quality sensitive receptors

Legend

- Proposal area
- Study area
- Watercourse
- Road
- Sensitive receptors



Coordinate system: GDA2020 MGA Zone 56
Scale ratio correct when printed at A3

1:6,000 Date: 2/10/2024

GDA 2020

Data sources: Geoscience Australia, Nearmap, NSWSS

5.1.3.2 Step (ii): Determine the potential dust emission magnitude

The potential dust emission magnitudes for demolition, earthworks, construction and vehicle track-out activities were evaluated in this section. Examples provided in the CASANZ Guide have been used to classify potential large, medium or small dust emission magnitude, as shown in Table 5-2.

Table 5-2 Example definitions for large, medium, and small dust emission magnitude from CASANZ Guide

Activities	Large	Medium	Small
Demolition	Total building volume >50,000 cubic metres (m^3) Potentially dusty construction material On-site crushing and screening Demolition activities >20 m above ground level	Total building volume 20,000–50,000 m^3 Potentially dusty construction material Demolition activities 10–20 m above ground level	Total building volume <20,000 m^3 Construction material with low potential for dust release Demolition activities <10 m above ground level
Earthworks	Total site area >10,000 square metres (m^2) Fines material content >10% >10 heavy earth-moving vehicles active at any one time Formation of bounds >8 m in height Total material moved >100,000 tonnes (T)	Total site area 2,500–10,000 m^2 Fines material content 5–10% 5–10 heavy earth moving vehicles active at any one time Formation of bounds 4–8 m in height Total material moved 20,000–100,000 T	Total site area <2,500 m^2 Fines material content <5% <5 heavy earth moving vehicles active at any one time Formation of bounds <4 m in height Total material moved <20,000 T Earthworks during wetter months
Construction	Total site area >10,000 m^2 Road length >2 km Construction duration >12 months >10 heavy earth-moving vehicles active at any one time Length of unpaved access roads >100 m Stockpile volume >10,000 m^3	Total site area 2,500–10,000 m^2 Road length 1–2 km Construction duration 3–12 months 5–10 heavy earth moving vehicles active at any one time Length of unpaved access roads 50–100 m Stockpile volume 1,000–10,000 m^3	Total site area <2,500 m^2 Road length <1 km Construction duration <3 months <5 heavy earth moving vehicles active at any one time Length of unpaved access roads <50 m Stockpile volume <1,000 m^3
Trackout[1]	>50 heavy duty vehicles (HDV>3.5 T) outward movements in any one day Fines material content >10% Unpaved road length >100 m	10–50 HDV (>3.5 T) outward movements in any one day Fines material content 5–10% Unpaved road length 50–100 m	<10 HDV (>3.5 T) outward movements in any one day Fines material content <5% Unpaved road length <50 m

(1) Trackout is dirt, mud or other materials tracked onto a paved public roadway by a vehicle leaving a construction site.

5.1.3.3 Demolition

The construction of the proposal would involve the demolition of road pavement, roundabout, median and splitter islands, pedestrian footpaths and one property, the Hanson concrete batching plant at 9 Mandalong Road, Morisset. All structures and concrete slabs relating to the batching plant will be demolished except for one shed and the precast concrete blocks forming the material bays.

Based on the above assumptions, the demolition dust emission magnitude was conservatively determined to be **medium** due to the potentially dusty material to be demolished (e.g. concrete slabs) combined with the demolition of a one shed.

5.1.3.4 Earthworks

During the proposal construction, the main earthworks are expected to include clearing and grubbing, stripping of topsoil, excavation, and disposal of unsuitable material. The total site area is approximately 80,000 m^2, and indicative earthwork quantities for the proposal are listed in Table 5-3. The total estimated volume of material moved is 14,630 m^3. Assuming an average soil density of 1.6 tonnes per cubic metre (T/m^3), this equates to a total mass of 23,400 T of excavated material. The earth working vehicles expected to be used include excavators, dump trucks, graders, bulldozers and rollers.

Overall, the earthworks dust emission magnitude is determined to be **medium** as the site area is large (around 80,000 m^2), and the total amount of material being moved is 23,400 T.

Table 5-3 Indicative earthworks quantities

Material	Estimated volumes (m^3)
Top soil	2,000
Excavation (cut)	4,430
Fill	6,200
Imported	2,000

5.1.3.5 Construction

The main construction activities during the proposal are expected to include road upgrades and widening and the installation of new traffic signals and central median. The construction is expected to take place over three stages. The expected total earthworks areas are 21,000 m^2, 25,000 m^2 and 6,000 m^2 for Stages 1, 2 and 3, respectively. The expected total construction duration are 12 months, 5 months and 2 months for Stages 1, 2 and 3, respectively. The total length of the road to be widened across the three stages of construction is expected to be 1,300 m, with an additional 700 m of shared user path.

Overall, while the earthworks areas for Stages 1 and 2 are large, as the total length of road to be widened over the three construction stages is less than 2 km and the longest construction duration is 12 months (Stage 1), the construction dust emission magnitude is determined to be **medium**.

5.1.3.6 Trackout

Trackout is dirt, mud or other materials tracked onto a paved public roadway by a vehicle leaving a construction site. Heavy vehicles (gross weight greater than 3.5 tonnes) involved in the construction include excavators, loaders, graders, articulated dump trucks, asphalt pavers and dozers. Up to 30 heavy vehicles would be required per day across the proposal area during the peak construction period.

Therefore, the dust emission magnitude for trackout is considered in the **medium** category as 10–50 heavy vehicles will be leaving the site onto a paved public roadway on average daily.

5.1.3.7 Step (iii): Determine the sensitivity of the area

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

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

Dust soiling and human health

The human sensitive receptors identified included:

- Hive Academy Childcare Centre, at 47 Alliance Avenue, Morisset
- Community Kids Morisset Early Education Centre, at 9 Kam Close, Morisset
- three residential properties, at 50 Mandalong Road, 75 Freemans Drive, and 77 Freemans Drive in Morisset.

The matrices for determining surrounding area sensitivity to dust soiling and human health are presented in Table 5-4 and Table 5-5.

From Table 5-4, the sensitivity of the area to dust soiling impacts is **high** as there are more than 100 identified receptors within 20 m of the proposal area (located at the Hive Academy Childcare Centre, Community Kids Morisset Early Education Centre and residential properties).

From Table 5-5, the sensitivity of the area to human health impacts remains **high** as the annual mean PM_{10} mass concentration at the site is expected to be 15.3 µg/m^3 (Table 4-3)

Table 5-4 Sensitivity of the area to dust soiling

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

Table 5-5 Sensitivity of the area to human health impacts

Receptor sensitivity	Annual mean PM_{10} concentration[1]	Number of receptors	Distance from the source (m)				
			<20	<50	<100	<200	<350
High	>20 µg/m^3	>100	High	High	High	Medium	Low
		10–100	High	High	Medium	Low	Low
		1–10	High	Medium	Low	Low	Low
	17.5–20 µg/m^3	>100	High	High	Medium	Low	Low
		10–100	High	Medium	Low	Low	Low
		1–10	High	Medium	Low	Low	Low

Receptor sensitivity	Annual mean PM_{10} concentration[1]	Number of receptors	Distance from the source (m)				
			<20	<50	<100	<200	<350
	15–17.5 µg/m^3	>100	High	Medium	Low	Low	Low
		10–100	High	Medium	Low	Low	Low
		1–10	Medium	Low	Low	Low	Low
	<15 µg/m^3	>100	Medium	Low	Low	Low	Low
		10–100	Low	Low	Low	Low	Low
		1–10	Low	Low	Low	Low	Low

Ecological

The sensitivity of ecological receptors around the proposal area considers the specific sensitivity and presence of receptors. Table 5-6 lists the classification from the CASANZ Guide, and based on this guidance, threatened ecological communities, flora and fauna identified within the study area (refer to Section 5.1.3.1) have been classified as sensitive ecological receptors. As the dust sensitivity of these areas is not known, the sensitivity was set to **medium.**

Table 5-6 Sensitivity of receptors to ecological impacts

Classification	Definition	Examples
High	Expectation of significant areas with a national or international ecological designation or crops with features that may be affected by dust soiling.	RAMSAR sites (internationally significant wetlands), farms, and vineyards.
Medium	Expectation of locations with particularly important species with unknown or uncertain dust sensitivity.	Significant natural areas.
Low	Expectation of local designation areas with features that may be affected by dust deposition.	Areas identified in regional planning maps (e.g. local nature reserves).

Screening summary

In summary, the areas surrounding the proposal study have:

- a **high** sensitivity to dust soiling impacts
- a **high** sensitivity to human health impacts
- a **medium** sensitivity to ecological impacts.

The outcome of defining the sensitivity of the surrounding areas to dust soiling, human health and ecological impacts is summarised in Table 5-7.

Table 5-7 Summary of sensitivity of the surrounding areas to the proposal construction

Potential impact	Receptor	Determining factors	Sensitivity of the surrounding areas
Dust Soiling	Childcare Centre	Receptor sensitivity: **high** >100 within 20 m	**High**
Human Health	Childcare Centre	Receptor sensitivity: **high** >100 within 20 m	**High**
Ecological	Bushland	Unknown dust sensitivity	**Medium**

5.1.3.8 Step (iv) – Define the risk of impacts

The dust emission magnitudes for earthworks, construction and track out during the proposal construction were combined with the sensitivity of the area to determine the risk of impacts. The matrices for the risk of dust impacts are presented in Table 5-8, Table 5-9 and Table 5-10.

Table 5-8 Risk of dust impacts from demolition

Sensitivity of the 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 5-9 Risk of dust impacts during earthworks and construction

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

Table 5-10 Risk of dust impacts for trackout

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

The potential risk of dust impacts during construction, based on the dust emission magnitudes determined in the previous section, the sensitivity of the surrounding areas in Table 5-7 and the risk of dust impacts matrices above, include:

- demolition, earthworks and construction and trackout activities associated with the proposal construction are considered to have a **medium** risk of dust soiling impacts and human health impacts
- demolition and earthworks and construction activities associated with the proposal construction are considered to have a **medium** risk of ecological impacts, whereas trackout activities are considered to have a **low** risk of ecological impacts.

A summary of dust risks at the sensitive receptor locations is presented in Table 5-11.

Table 5-11 Summary of dust risks for construction of the proposal (without mitigation)

Potential impact	Site location	Risk			
		Demolition	Earthworks	Construction	Trackout
Dust soiling	Childcare Centre	**Medium**	**Medium**	**Medium**	**Medium**
Human health	Childcare Centre	**Medium**	**Medium**	**Medium**	**Medium**
Ecological	Bushland surrounding proposal area	**Medium**	**Medium**	**Medium**	**Low**

5.1.4 Stage 5: Site-specific mitigation

As stated in Section 5.1.3.8, risk of dust impacts is described in terms of negligible, low, medium or high risk. Site-specific mitigation will be required when there are low, medium or high risks of an impact. For cases where the risk category is negligible, no mitigation measures beyond those required by legislation are required. For general mitigation measures, the highest risk category was applied. To minimise the dust impacts associated with the proposal, site-specific mitigation measures are presented in Section 7.

5.1.4.1 Determine significance of residual impacts

For almost all construction activities, the aim is to prevent significant effects on receptors using effective mitigation. According to the CASANZ Guide, this is normally possible. Therefore, with the implementation of site-specific mitigation measures detailed in Section 7, the residual dust impacts would not be of significance.

6 Operation impact assessment

6.1 Overview of the proposal operation

Roads that would be upgraded as part of the proposal include Freemans Drive, Dora Street (Freemans Drive to Ourimbah Street), Wyee Road and Mandalong Road West (Gimberts Road to Freemans Drive), as shown in Figure 1-2.

The location of sensitive receptors during the operation of the proposal will be unchanged from the construction of the proposal (Figure 5-1). These include single-house residential buildings, Hive Academy Childcare Centre and Community Kids Morisset Early Education Centre that border the updated sections of roads. The distance of the closest sensitive receptor was calculated from the property boundary to the edge of the road and is presented in Table 6-1.

6.2 Screening assessment

As the proposal is in the early stages of planning, a high-level comparison and evaluation of the relative impacts is sufficient. The screening assessment was carried out for emissions from traffic using the roads leading to the intersection. The assessment considered two scenarios:

- baseline year of the proposal, assumed to be 2023
- operation year of the proposal, assumed to be 2039.

The RAQST was used for this screening assessment.

6.2.1 Screening assessment inputs

This assessment considered current daily traffic in 2023 as the baseline, while 2039 was considered representative of the operation of the proposal. The following assumptions were used when calculating the proposal contribution from road emissions using the RAQST:

- Road type for each section of road was assigned based on the NSW GMR inventory road type. The proposal roads are all assumed to be arterial roads.
- Traffic composition (heavy vehicle vs light vehicle) was obtained from measured 2023 data provided in the *Mandalong Road Upgrade, Concept Design and REF - Traffic and Transport Assessment Report* (Arcadis, 2024a) (Traffic and Transport Assessment Report). The traffic composition was assumed to be unchanged between 2023 and 2039.
- 2023 Annual Average Daily Traffic (AADT) and 2023 peak traffic volume were provided in the *Mandalong Road Upgrade between the M1 Pacific Motorway and Ourimbah Street – Options Testing Report* (Arcadis, 2024b) (Options Testing Report) and Traffic and Transport Assessment Report Peak traffic volume percentage of AADT was calculated from 2023 data and assumed unchanged between 2023 and 2039.
- The traffic was assumed to be evenly split between the east and westbound lanes.
- Background levels are from Wyong AQMS for 2021 as per Section 4.2.2.
- Speed limits were provided in the Traffic and Transport Assessment Report, with 60 kilometres per hour (km/hr) used in this assessment for all four roads.
- The road gradient is specified in the direction of travel and near the receptor. These include single-house residential buildings and businesses that border the updated sections of roads.
- The distance to the receptor was measured from the property boundary to the edge of the kerb of the nearest traffic lane. The distance to receptor changed from 2023 to 2039 due to changes in the road design (e.g. road widening from two to four lanes).

Table 6-1 Summary of the road sections for the screening assessment by year

Road section	Road	Year	AADT	Peak hour traffic as % of AADT	% Heavy vehicles	Distance to receptor (1)
1	**Freemans Dr**	2023	6,640	19	11	30 m
		2039	8,179	19	11	26 m
2	**Dora St**	2023	22,900	17	10	6 m
		2039	26,166	17	10	5 m
3	**Wyee Rd**	2023	16,510	17	7	11 m
		2039	20,267	17	7	4 m
4	**Mandalong Rd**	2023	17,900	12	7	33 m
		2039	28,167	12	7	14 m

(1) Indicates the distance to the nearest sensitive receptor property boundary for the proposal design.

Table 6-2 Summary of the proposal's road conditions used in RAQST by direction

Road section	Direction	Gradient (2)
1	Northbound	-3.55 %
	Southbound	3.55 %
2	Eastbound	-0.38 %
	Westbound	0.38 %
3	Northbound	-0.71 %
	Southbound	0.71 %
4	Eastbound	5.47 %
	Westbound	-5.47 %

6.2.2 Screening assessment results

Table 6-3 and Table 6-4 summarise the estimated levels of NO_2, PM_{10}, and $PM_{2.5}$ using the RAQST for expected traffic conditions for the proposal operation. The calculated levels of NO_2, PM_{10}, and $PM_{2.5}$ by the RAQST exhibited the following trends:

For current road conditions (in 2023, refer to Table 6-3), the following conclusions were drawn:

- Calculated 1-hr and annual average NO_2 levels for all road sections are below criteria at the closest sensitive receptor. The calculated proposal contributions to the annual average NO_2 levels are 2.9–19.1 micrograms per cubic meter ($\mu g/m^3$) by the RAQST.
- Calculated 24-hr and annual average PM_{10} levels for all road sections are below criteria at the closest sensitive receptors. The calculated proposal contribution to the 24-hour average PM_{10} levels are 1.1–10.7 $\mu g/m^3$ by the RAQST.
- Calculated 24-hr and annual average $PM_{2.5}$ levels for all road sections are below criteria at the closest sensitive receptors. The calculated proposal contribution to the 24-hour average $PM_{2.5}$ levels are 0.7–6.9 $\mu g/m^3$ by the RAQST. The potential impacts are negligible for Freemans Dr, moderate for Dora St, moderate for Wyee Rd and slight for Mandalong Rd.

- The highest predicted NO_2, PM_{10}, and $PM_{2.5}$ levels by the RAQST were for the Dora St section, likely due to this section having the highest AADT. Overall, the potential impacts are negligible for Freemans Dr, slight for Mandalong Rd (except NO_2, which was moderate), and moderate for Dora St and Wyee Rd.

For the future traffic conditions (in 2039, refer to Table 6-4):

- Predicted 1-hr and annual average NO_2 levels for all road sections are below criteria at the closest sensitive receptors. The calculated proposal contributions to the annual average NO_2 levels are 2.2–13.2 µg/m^3 RAQST. The potential impacts are negligible for Freemans Drive, moderate for Dora Street, Wyee Road and Mandalong Road.
- Predicted 24-hr and annual average PM_{10} levels for all road sections are below criteria at the closest sensitive receptors. The calculated proposal contributions to the 24-hour average PM10 levels are 1.2–7.4 µg/m^3 by the RAQST. The potential impacts are negligible for Freemans Dr, moderate for Dora Street, moderate for Wyee Road and slight for Mandalong Road.
- Predicted 24-hr and annual average $PM_{2.5}$ levels for all road sections are below criteria at the closest sensitive receptors. The calculated proposal contributions to the 24-hour average $PM_{2.5}$ levels are 0.3–2.3 µg/m^3 by the RAQST. The potential impacts are negligible for Freemans Drive, moderate for Dora Street, moderate for Wyee Road and moderate for Mandalong Road.

Levels of NO_2, PM_{10}, and $PM_{2.5}$ due to the project operation are predicted to increase in 2039 due to the operational road design reducing the distance from the nearest sensitive receptor at Wyee Road and Mandalong Road sections (Table 6-2) and expected increase in road traffic but should not lead to exceedances of current guidelines. The levels of NO_2, PM_{10}, and $PM_{2.5}$ due to the project operation are predicted to decrease in 2039 for Freemans Drive and Dora Street sections despite the increase in expected road traffic, possibly due to the predicted decrease in future vehicle emissions rates. The overall potential impacts for all road sections are predicted to remain unchanged between 2023 and 2039.

Therefore, the results from the screening assessment indicate that a detailed assessment is not required for the proposal.

Table 6-3 Summary of air quality screening level assessment for the project contribution by road section in 2023

		NO_2 (µg/m^3)		**PM_{10} (µg/m^3)**		**$PM_{2.5}$ (µg/m^3)**	
Road Section	Avg. period	1-hr	Annual	24-hr	Annual	24-hr	Annual
	Unit	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3
	Criteria	**164**	**31**	**50**	**25**	**25**	**8**
	Background	15	8.7	21.5	13.5	7.7	4.7
Freemans Drive	Road section contribution	45.6	2.9	1.1	0.4	0.7	0.3
	Total	60.6	11.5	22.6	13.9	8.4	5.0
Dora Street	Road section contribution	127.5	19.1	10.7	4.3	6.9	2.7
	Total	142.5	27.8	32.2	17.8	14.6	7.4
Wyee Road	Road section contribution	100.3	10.0	4.9	1.9	3.1	1.2
	Total	115.3	18.7	26.4	15.4	10.8	5.9
Mandalong Road	Road section contribution	64.6	5.0	2.0	0.8	1.3	0.5
	Total	79.6	13.6	23.5	14.3	9.1	5.2

Table 6-4 Summary of air quality screening level assessment for the project contribution by road section in 2039

		NO_2 (µg/m^3)		PM_{10} (µg/m^3)		$PM_{2.5}$ (µg/m^3)	
Road Section	Avg. period	1-hr	Annual	24-hr	Annual	24-hr	Annual
	Unit	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3
	Criteria	**164**	**31**	**50**	**25**	**25**	**8**
	Background	15	8.7	21.5	13.5	7.7	4.7
Freemans Drive	Road section contribution	39.2	2.2	1.2	0.5	0.7	0.3
	Total	54.2	10.9	22.7	14.0	8.5	5.0
Dora Street	Road section contribution	114.4	13.2	9.5	3.8	5.8	2.3
	Total	129.4	21.8	31.0	17.3	13.5	7.0
Wyee Road	Road section contribution	100	10.0	7.4	3.0	4.5	1.8
	Total	115.0	18.7	28.9	16.5	12.2	6.5
Mandalong Road	Road section contribution	85.3	7.6	4.6	1.8	2.9	1.2
	Total	100.3	16.3	26.1	15.3	10.7	5.9

7 Mitigation measures

7.1 Construction

Site-specific mitigation measures have been proposed to minimise air quality impacts associated with the proposal construction. Mitigation measures for the proposal are presented in Table 7-1.

Table 7-1 Proposed mitigation measures during construction

Ref	Impact/ uncertainty	Environmental management measure	Responsibility	Timing
AQ1	Air quality impacts	Air quality management measures for the proposal area and any ancillary facilities will be implemented as part of the CEMP. The CEMP will identify: — all dust and odour sensitive receptors — potential sources of air pollution during construction, including dust, vehicles transporting waste, plant and equipment — air quality management objectives consistent with relevant published EPA and/or DPIE guidelines — mitigation and suppression measures to be implemented — methods to manage works during strong winds or other adverse weather conditions — a progressive rehabilitation strategy for exposed surfaces — community notification and complaint handling procedures. Measures will include (but not be limited to): — use of water sprays or dust suppression surfactants as required for dust suppression — adjusting the intensity of activities based on observed dust levels and weather forecasts — minimising the amount of materials stockpiled and position stockpiles away from surrounding sensitive receptors — limiting vehicle movements to designated entry/exit routes and parking areas, and implementing measures to minimise the tracking of material onto paved roads — covering of loads — stabilising disturbed areas as soon as practicable, including new access routes — minimising the extent of disturbance as far as practicable.	Contractor	Construction

Ref	Impact/ uncertainty	Environmental management measure	Responsibility	Timing
AQ2	Combustion emissions	Combustion emissions generated during construction will be minimised through: — ensuring all vehicles and machinery are fitted with appropriate emission control equipment and maintained in a proper and efficient manner — minimising the use of diesel- or petrol-powered generators by using mains electricity or battery-powered equipment where practicable — ensuring all vehicles are switch off engines when stationary, to prevent unnecessary idling of vehicles.	Contractor	Construction

8 References

Arcadis (2024a), Mandalong Road Upgrade, Concept Design and REF: Traffic and Transport Assessment Report. August 2024.

Arcadis (2024b), Mandalong Road Upgrade between the M1 Pacific Motorway and Ourimbah Street – Options Testing Report, May 2024.

CASANZ (2023), Good practice guide for the assessment and management of air pollution from road transport projects. Clean Air Society of Australia and New Zealand.

IAQM (2024), Guidance on the assessment of dust from demolition and construction. Institute of Air Quality Management.

Transport for NSW (2023), Roadside air quality screening tool guideline, October 2023.

9 Definitions

Term/acronym	Description
AADT	Annual Average Daily Traffic
Air NEPM	National Environment Protection (Ambient Air Quality) Measure 2021
AQMS	Air Quality Monitoring Stations
AWS	Automatic Weather Station
BoM	Bureau of Meteorology
CASANZ	Clean Air Society of Australia and New Zealand
CO	Carbon monoxide
EPA	Environment Protection Agency
HGV	Heavy duty vehicles defined as vehicles with a gross weight greater than 3.5 tonnes
IAQM	Institute of Air Quality Management
IAQM guidance	Guidance on the Assessment of Dust from Demolition and Construction
NEPM	National Environment Protection Measures
NO_2	Nitrogen dioxide
NOx	Oxides of Nitrogen
NPI	National Pollutant Inventory
NSW	New South Wales
O_3	Ozone
PAHs	Polycyclic Aromatic Hydrocarbons
PM	Particulate Matter
$PM_{2.5}$	Particles with an aerodynamic of 2.5 micrometres or less
PM_{10}	Particles with an aerodynamic of 10 micrometres or less
RH	Relative humidity
SO_2	Sulphur dioxide
TSP	Total suspended particulates
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
WSP	WSP Australia Pty Limited

Term/acronym	Description
Units	
ºC	Degree Celsius
km	kilometre
km/h	kilometre per hour
m	metre
m^2	square metre
m^3	cubic metre
mm	millimetres
µg/m^3	microgram per cubic metre