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APPENDIX S.1 – Environmental Impact Statement

Air quality impact assessment

Prepared for Lake Lyell Project Pty Ltd

Lake Lyell Pumped Hydro Energy Storage Project

Air quality impact assessment

Lake Lyell Project Pty Ltd

E221111 RP12.1

November 2025

Version	Date	Prepared by	Reviewed by	Comments
1	6 September 2024	Amie Gilbert, Francine Manansala	Francine Manansala	Draft report
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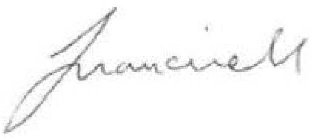
Approved by



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Executive summary

This air quality impact assessment (AQIA) supports the environmental impact statement (EIS) for the proposed Lake Lyell Pumped Hydro Energy Storage (PHES) Project (the project), located approximately 5 kilometres (km) west of Lithgow and 110 km west of the Sydney central business district in New South Wales (NSW). It documents the existing air quality and meteorological environment, applicable impact assessment criteria, air pollutant emission calculations, dispersion modelling of calculated emissions and assessment of predicted impacts relative to the criteria.

The AQIA addresses the Secretary's environmental assessment requirements (SEARs) issued for the project. The air quality assessment has been prepared in general accordance with the guidelines specified by the NSW Environment Protection Authority (EPA) in the A*pproved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*.

Local meteorological conditions were quantified from the Bureau of Meteorology (BoM) Marrangaroo automatic weather station (AWS). Background air quality was characterised using data from the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) Bathurst air quality monitoring station (AQMS).

Emissions estimation and dispersion modelling was completed for one worst-case construction scenario corresponding to peak construction activities at the project. Emissions of total suspended particulates (TSP), particulate matter less than 10 micrometres (µm) in aerodynamic diameter (PM_{10}) and particulate matter less than 2.5 µm in aerodynamic diameter ($PM_{2.5}$) were estimated and modelled.

Atmospheric dispersion modelling was completed using the TAPM and CALMET/CALPUFF models.

The results of the modelling showed that the predicted concentrations and deposition rates for incremental TSP, PM_{10}, $PM_{2.5}$ and dust deposition during the project's construction phase were below the NSW EPA's impact assessment criteria at all assessment locations, with the exception of one. Annual average dust deposition was exceeded at assessment location R2000 as a result of construction activities related to the construction of the Lakeside accommodation camp. It is noted however that R2000 represents the Lakeside accommodation camp itself and therefore would not exist as an assessment location at the time of the construction of the accommodation camp. The accommodation camp however may exist simultaneously with the construction activities occurring at the main project area which is the reason it was included in the dispersion model.

Cumulative impacts were assessed by combining the adopted background concentrations with the predicted incremental concentrations from the project. The cumulative results showed that during the project's construction phase, compliance with NSW EPA impact assessment criteria was predicted at all assessment locations.

A range of best practice dust mitigation measures are proposed for the project. These include the use of water sprays and measures to reduce emissions from diesel combustion.

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1 Introduction

1.1 Background

EnergyAustralia Portfolio Holdings Pty Ltd (EnergyAustralia) in partnership with EDF power solutions Australia (EDFA), referred to as Lake Lyell Project Pty Ltd (LLP) as trustee, is developing the Lake Lyell Pumped Hydro Energy Storage (PHES) Project (the project). The project will have the capacity to store up to 3,080 megawatt hours (MWh) of energy and generate at 385 megawatts (MW) for 8 hours or generate up to around 440 MW for a shorter period. At a basic level, it will consist of upper and lower water reservoirs, a pipeline connecting them, and a hydro-electric power station connected to the national energy grid that is capable of generating or consuming electricity.

The project is located approximately 5 kilometres (km) west of Lithgow and 110 km west of the Sydney central business district, shown in Figure 1.1 and Figure 1.2. The project takes advantage of existing infrastructure (i.e. Lake Lyell) associated with Mt Piper power station which will be decommissioned in the coming decades and allows Lake Lyell to continue to serve a specific purpose in electricity generation (consistent with its existing use).

In June 2024, the Minister for Planning and Public Spaces declared the project to be Critical State Significant Infrastructure (CSSI). Accordingly, approval for the project is required under Part 5, Division 5.2 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). This requires the preparation of an environmental impact statement (EIS) for the project in accordance with Secretary's environmental assessment requirements (SEARs) and the approval of the Minister. EMM Consulting Pty Limited (EMM) has been engaged by LLP to prepare the EIS.

This air quality impact assessment (AQIA) is an appendix to the project's EIS and should be read in conjunction with it. The AQIA addresses the SEARs issued for the project.

This AQIA report comprises:

- a description of the local setting and surroundings of the project site
- relevant pollutants for assessment and applicable impact assessment criteria
- a description of baseline inputs, specifically:
  - meteorology and climate
  - existing air quality environment
- a detailed air pollution emissions inventory for one worst-case construction scenario

  N.B: The volume of traffic, fuel use and emissions during the operation of the project will be substantially lower than during its construction. The construction phase therefore represents the more significant phase of the project in terms of potential air quality impacts and is the focus of this report. The operational phase of the project has not been considered further in this assessment.
- results of atmospheric dispersion modelling including an analysis of project-only and cumulative impacts accounting for background air quality
- management and mitigation measures proposed during the construction of the project.

1.2 Assessment guidelines and requirements

This AQIA report has been conducted in general accordance with the guidelines specified by the NSW Environment Protection Authority (EPA) in the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (NSW EPA 2022), hereafter referred to as the 'Approved Methods for Modelling'. Consistent with section 2.1 of the Approved Methods for Modelling, this AQIA is classed as a Level 2 assessment and implements a refined dispersion modelling approach using the site-specific/representative input.

1.2.1 Secretary's environmental assessment requirements

This AQIA has been prepared in accordance with the requirements of the NSW Department of Planning, Housing and Infrastructure (DPHI) and relevant agencies, which are set out in the SEARs for the project, issued on 17 November 2025. The SEARs identify matters which must be addressed in the EIS. Individual requirements relevant to this AQIA and where they are addressed in this report are listed in Table 1.1.

Table 1.1 Air quality related SEARs

Requirements	Section addressed
Air – including:	
• an assessment of the particulate matter and greenhouse gas emissions of the project[(a)]	This report and the Greenhouse Gas (GHG) assessment (Appendix S2 to the EIS)
• an assessment of the likely greenhouse gas impacts of the project including measures to minimise emissions, having regard to the targets set in the Climate Change (Net Zero Future) Act 2023, and in accordance with the EPA's NSW Guide for Large Emitters if required if emissions trigger the threshold as a large emitter.	GHG assessment (Appendix S2 to the EIS)

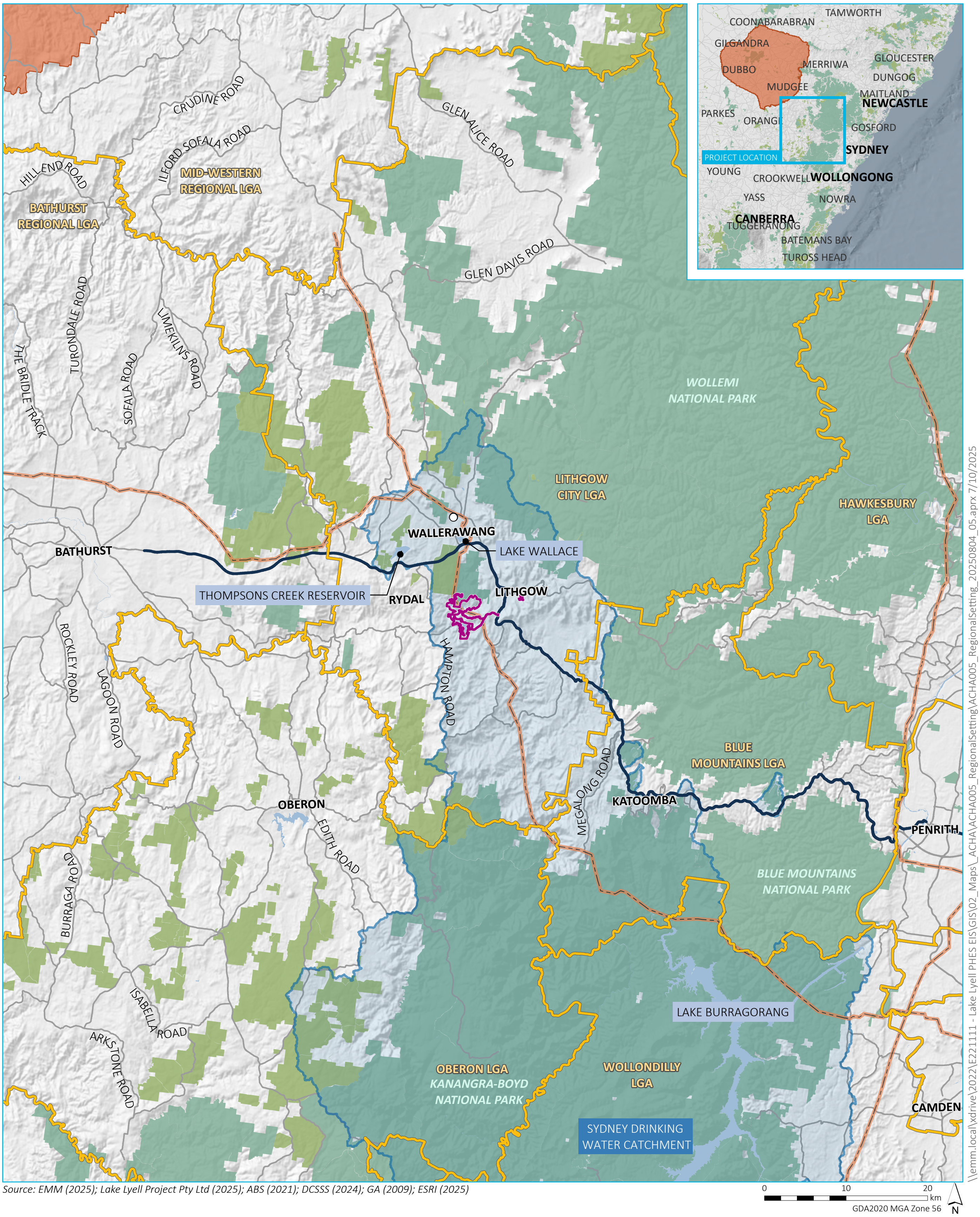
Note: (a) other requirements relating to greenhouse gases have been assessed separately and do not form part of this report.

1.2.2 Agency engagement

DPHI invited government agencies, including Lithgow City Council, to recommend matters to be addressed in the EIS. These matters were considered by the Secretary for DPHI when preparing the SEARs. Comments made by agencies relating to the assessment of air quality impacts and where they are addressed in this report are listed in Table 1.2.

Table 1.2 Agency comments on SEARs

Agency	Comments	Section addressed
Lithgow City Council	Council is satisfied that a quantitative air quality assessment detailing mitigation measures will be implemented and detailed within the EIS.	Chapter 10



Source: EMM (2025); Lake Lyell Project Pty Ltd (2025); ABS (2021); DCSSS (2024); GA (2009); ESRI (2025)

KEY

Project area

Existing environment

- Mt Piper Power Station
- Major road
- Great Western Highway
- 330 kV transmission line
- Named waterbody
- NPWS reserve
- State forest
- Local government area
- Sydney Drinking Water Catchment
- Central West Orana Renewable Energy Zone

INSET KEY

- Major road
- NPWS reserve
- State forest
- Central West Orana Renewable Energy Zone

Regional context

Lake Lyell PHES
Air Quality Impact Assessment
Figure 1.1

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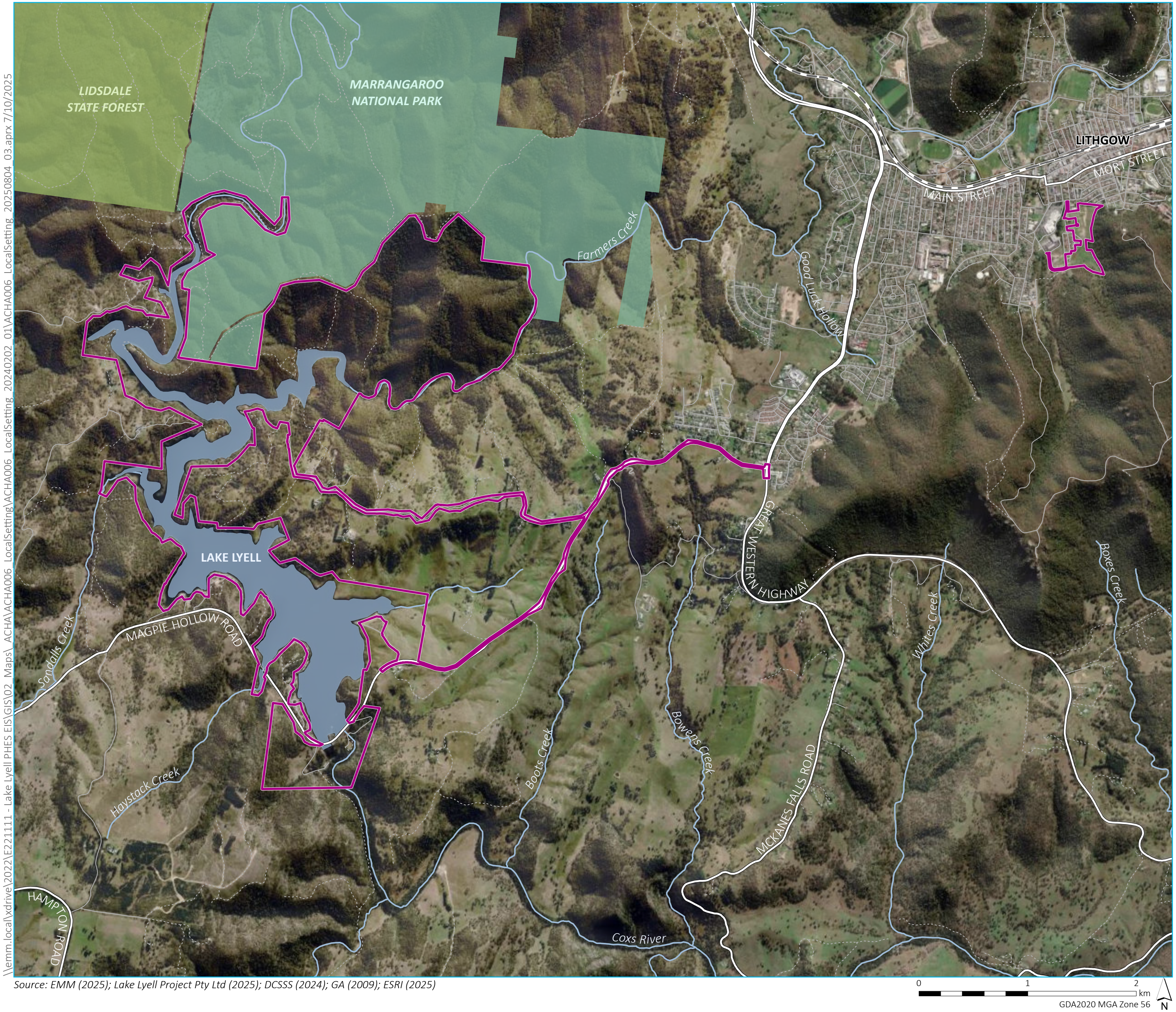

Source: EMM (2025); Lake Lyell Project Pty Ltd (2025); DCSSS (2024); GA (2009); ESRI (2025)

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KEY

Project area

Existing environment

Rail line

Major road

Minor road

Vehicular track

Named watercourse

Named waterbody

NPWS reserve

State forest

Local context

Lake Lyell PHES
Air Quality Impact Assessment
Figure 1.2

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2 Project description

A detailed description of the project, including an overview of its design, construction and operation is provided in the project's EIS. The EIS (specifically Chapter 3 and Appendix B) should be read in conjunction with this report. A summary of the project's key elements is provided below.

The project design, as shown in Figure 2.1, can be broadly categorised into:

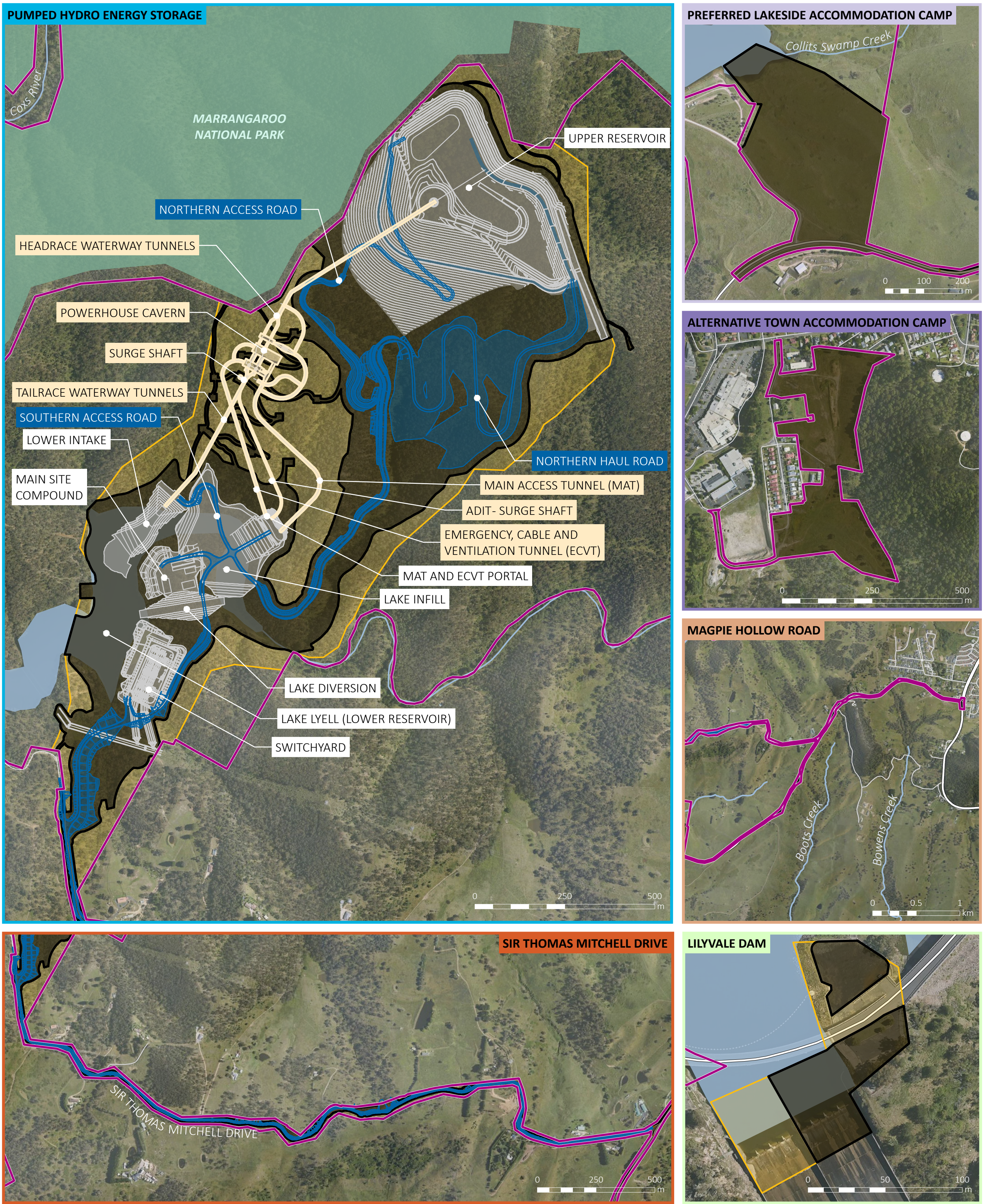
- pumped hydro generation components – including a 5.3 gigalitre (GL) upper reservoir to be constructed behind the southern ridge of Mount Walker, a 33.5 GL lower reservoir (existing Lake Lyell), inlet/outlet structures, and an underground powerhouse, surge shaft and waterway tunnels
- transmission connection components – including a new high voltage switchyard and connection to the existing 330 kilovolt (kV) transmission line that runs through the site
- site access and ancillary facilities – including upgrade of existing and construction of new access roads and bridges, a diversion and infill of a section of Lake Lyell, administration and utilities
- other construction components or works – including geotechnical investigations, temporary workforce accommodation, site work pads, laydown areas and facilities, and spoil management.

Construction will be completed in stages, including:

- pre-construction / enabling works – consisting of initial access works (internal and external roads), geotechnical investigations, site establishment and preparation of the worker's accommodation camp
- main works – consisting of all other construction activities needed to enable operation of the project.

During operation, the project will act as an electrical energy storage system through the conversion of electrical to kinetic energy to gravitational energy and back via water as it is transferred from the elevated upper reservoir to a lower reservoir. The project will provide services to the wholesale 'spot' market on the National Electricity Market (NEM), and support ancillary services used to manage the power system reliably.

After the 80 to 100-year design life of the project, the asset may remain viable for a plant refurbishment and extension of life as has been seen for other older assets globally. Following the plants final refurbishment or once it has reached the end of its serviceable life then the project would look to return the site to a more natural state and encourage community beneficial use.



Source: EMM (2025); Lake Lyell Project Pty Ltd (2025); DCSSS (2024); GA (2009); MetroMap (2025)

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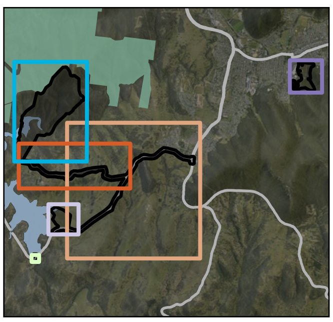

KEY

- Project area
- Permanent road
- Above ground design
- Underground design
- Construction envelope
- Disturbance footprint

Existing environment

- Major road
- Minor road
- Named watercourse
- Named waterbody
- NPWS reserve

Project overview

Lake Lyell PHES
Air Quality Impact Assessment
Figure 2.1

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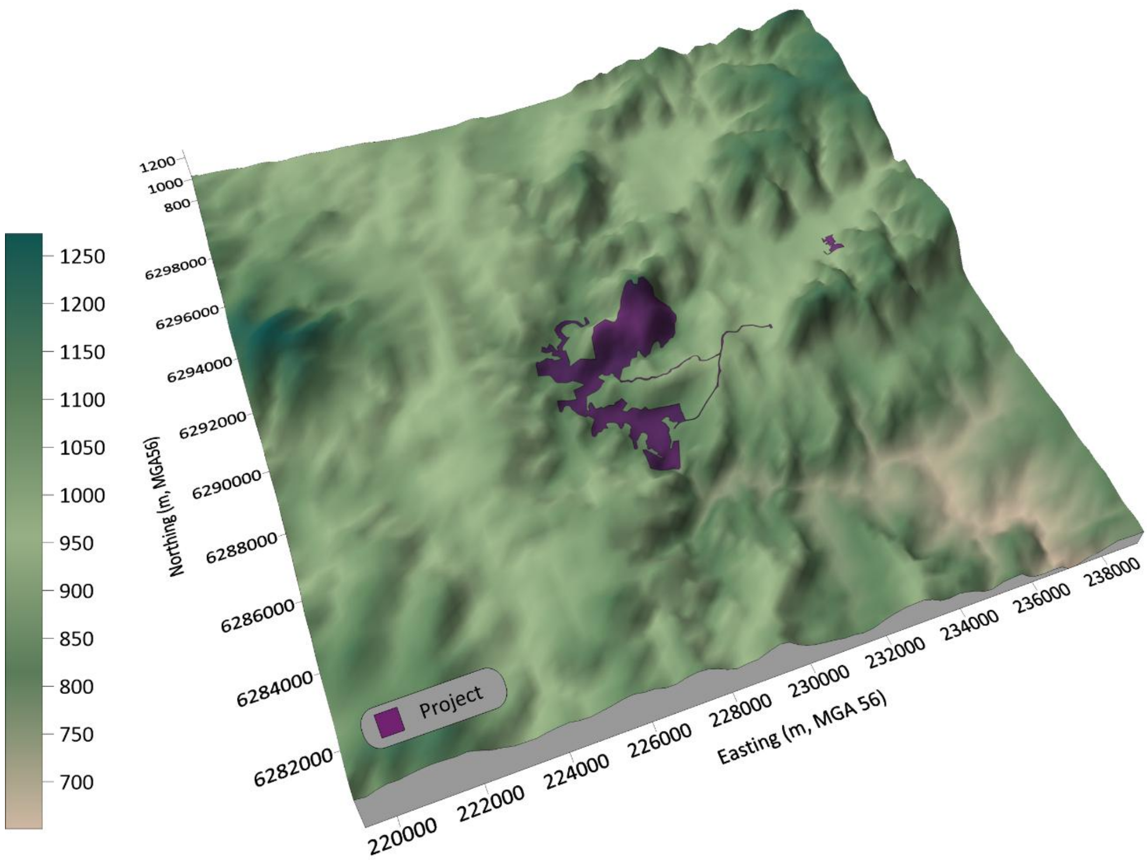
3 Site and surrounding area

3.1 Terrain and topography

The project is located in the Central Tablelands region of NSW within the City of Lithgow local government area (LGA), approximately 5 km west of Lithgow and 48 km east of Bathurst. The project is zoned as SP2 infrastructure (‘Electricity Generating Works’), with land classifications in the surrounding area including C1 National Parks and Nature Reserves, RE1 Public Recreation, RU2 Rural Landscape and RU1 Primary Production. The nearest residential zones are two areas of R2 Low Density Residential and R5 Large Lot Residential, each approximately 1.5 km from the main works area of the project.

Significant terrain features and areas of significance close to the project include Mount Walker, Marrangaroo National Park, and Lidsdale State Forest. Terrain is generally undulating across most of the project and surrounding area. Elevation ranges from approximately 1,170 metres Australian Height Datum (mAHD) to 785 mAHD within approximately 2 km of the project. A three-dimensional representation of the local topography is shown in Figure 3.1.



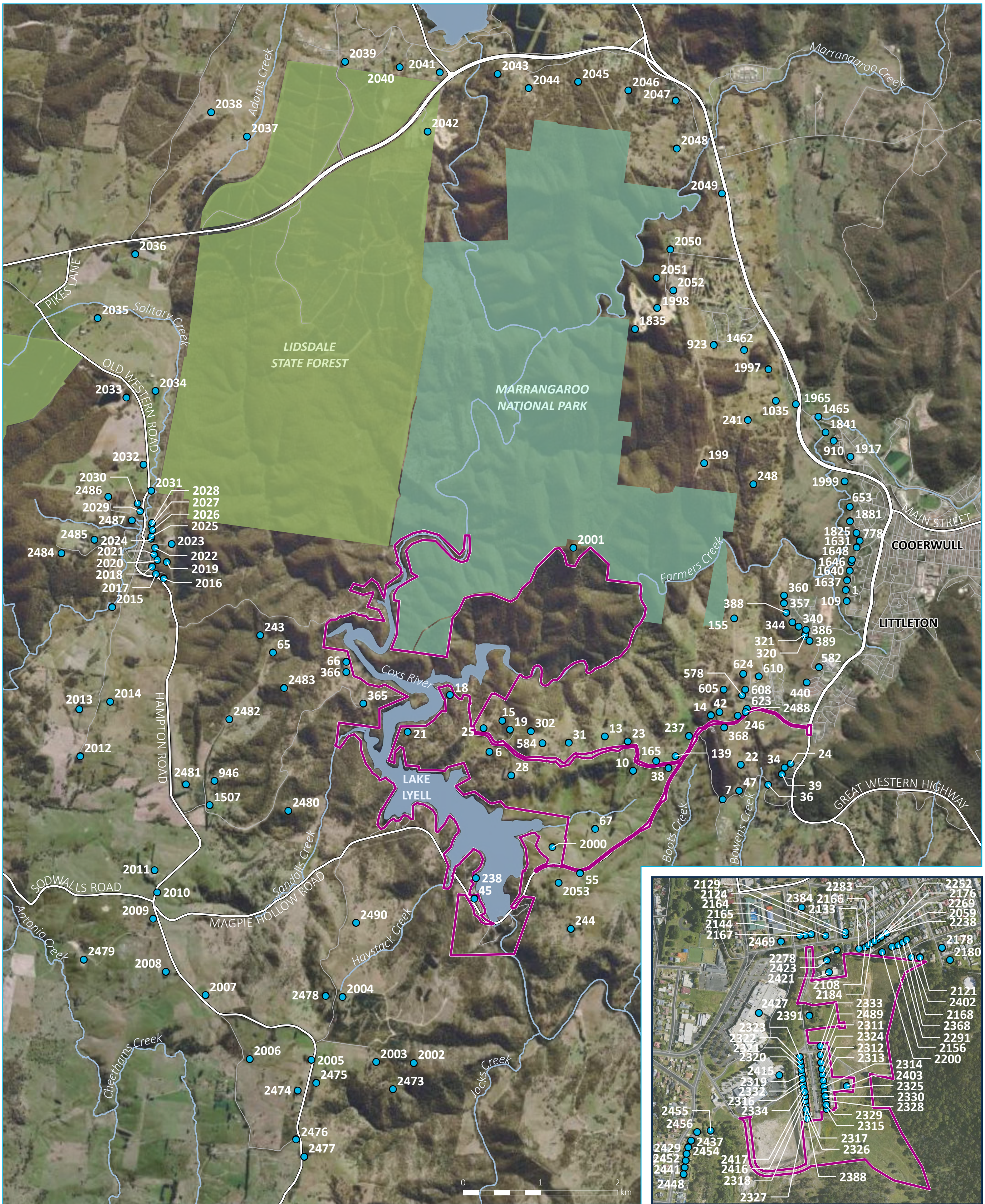
Source: NASA Shuttle Radar Topography Mission data

Figure 3.1 Three-dimensional topography surrounding the project area

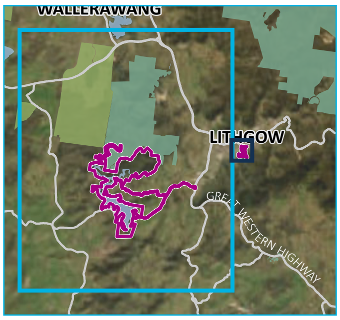
3.2 Assessment locations

The nearest representative sensitive locations to the project have been identified for the purpose of assessing potential air quality impacts. These are referred to in this report as 'assessment locations'.

A selection of representative residential, commercial, industrial, and recreational properties in the project area have been chosen as assessment locations for this study. The assessment locations are presented in Table A.1 of Annexure A and shown in Figure 3.2. It is noted that the IDs are non-consecutive in some cases as the locations are a sub-set of a larger list provided for the study. Locations excluded from the original list were a significant distance from the project. The original IDs have been retained for consistency.



Source: EMM (2025); Lake Lyell Project Pty Ltd (2025); ABS (2021); DCSSS (2024); GA (2009); ESRI (2024)



KEY
- Project area
- Assessment location

Existing environment
- Major road
- Minor road
- Named watercourse
- Named waterbody
- NPWS reserve
- State forest

Assessment locations

Lake Lyell PHES
Air Quality Impact Assessment
Figure 3.2

EMM creating opportunities

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4 Pollutants and assessment criteria

4.1 Potential air pollutants

The construction phase of the project will generate emissions of:

- particulate matter, specifically:
  - total suspended particulate matter (TSP)
  - particulate matter less than 10 micrometres (µm) in aerodynamic diameter (PM_{10})
  - particulate matter less than 2.5 µm in aerodynamic diameter ($PM_{2.5}$)
  - deposited dust.
- gaseous pollutants, specifically:
  - oxides of nitrogen (NO_x)[1], including nitrogen dioxide (NO_2)
  - sulfur dioxide (SO_2)
  - carbon monoxide (CO)
  - volatile organic compounds (VOCs).

A detailed description of the emission sources associated with the project's construction phase is presented in Chapter 8 of this report.

This assessment focusses on particulate matter (TSP, PM_{10} and $PM_{2.5}$), given that the main concern during construction is likely to be dust from fugitive emission sources. Particles less than 10 µm and 2.5 µm in diameter are small enough to enter the human respiratory system and can lead to adverse health impacts. TSP, which relates to airborne particles less than around 30 µm in diameter, is used as a metric for assessing amenity impacts (reduction in visibility, dust deposition and soiling of buildings and surfaces) rather than health impacts (NSW EPA 2013).

Although there will be emissions of NO_X from mobile and stationary construction equipment there are no measurements of existing NO_X concentrations within around 63 km of the project[2], which means that a cumulative assessment has little value. It is also worth noting that the prevailing concentrations are likely to be very low in the project area, given the absence of significant combustion sources. The other gaseous pollutants (SO_2, CO and VOCs) are unlikely to be a material concern during construction. Therefore, gaseous pollutants have not been included in the assessment.

1 By convention, NO_x = nitrous oxide (NO) + NO_2.

2 The closest NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) monitoring stations that measure NO_X are at Penrith and Richmond.

4.2 Applicable air quality assessment criteria

4.2.1 Airborne particulate matter

The air quality criteria that apply to the project are stated in the Approved Methods for Modelling (NSW EPA 2022).

The criteria for airborne particulate matter are presented in Table 4.1. The Approved Methods for Modelling classifies TSP, PM_{10} and $PM_{2.5}$ as criteria pollutants, for which the criteria apply at the nearest existing or likely future off-site sensitive receptor and compared against the 100th percentile (i.e. the highest) dispersion modelling prediction in the case of 24-hour impacts. Both the incremental (project only) and cumulative (project plus background) impacts need to be presented, the latter requiring consideration of existing ambient background concentrations for the criteria pollutants assessed.

Table 4.1 Impact assessment criteria for airborne particulate matter

Metric	Averaging period	Impact assessment criterion
TSP	Annual	90 µg/m^3
PM_{10}	24 hours	50 µg/m^3
	Annual	25 µg/m^3
$PM_{2.5}$	24 hours	25 µg/m^3
	Annual	8 µg/m^3

Note: µg/m^3: micrograms per cubic metre.

4.2.2 Dust deposition

The criteria for dust deposition in the Approved Methods for Modelling are given in Table 4.2. The criteria are for the project increment and cumulative dust deposition levels. Dust deposition impacts are derived from TSP emission rates and particle deposition calculations in the dispersion modelling process.

Table 4.2 Impact assessment criteria for dust deposition

Metric	Averaging period	Impact assessment criterion
Dust deposition	Annual	2 g/m^2/month (project increment only)
		4 g/m^2/month (cumulative)

Note: g/m^2/month: gram per square metre per month

5 Summary of assessment methodology

5.1 Overview

As noted earlier, the air quality assessment addresses the impacts of the project's main construction activities on airborne particulate matter (TSP, PM_{10}, $PM_{2.5}$) and dust deposition.

This chapter provides a summary of the methodology for the AQIA, with more detail provided in subsequent chapters.

Construction impacts were assessed based on emission estimates for key project sources and dispersion modelling to predict ground-level pollutant concentrations at assessment locations. Concentrations were also calculated for a nested grid domain to produce contour plots.

5.2 Characterisation of the existing environment

There are no meteorological stations in the vicinity of the project. Meteorological data recorded by the Bureau of Meteorology's (BoM) Marrangaroo (Defence) automatic weather station (AWS) from January 2019 to December 2023 were analysed for the purposes of selecting a representative year for dispersion modelling.

There are no air quality monitoring stations (AQMS) in the vicinity of the project. The closest AQMS to the project is the NSW DCCEEW Bathurst AQMS. Air quality monitoring data from the Bathurst AQMS were considered for the purposes of defining a background dataset to be used in the cumulative assessment.

Details of the meteorological and background air quality analysis are provided in Chapter 6, Chapter 7 and Annexure B.

5.3 Assessment scenario

This assessment has considered a single construction scenario, which was determined to be the 'worst-case' in terms of type and scale of the construction activities (defined as movement of spoil).

Spoil generated from the excavation of the upper reservoir, tunnelling and site establishing works, including earthworks for the two accommodation options, over the entire construction period was estimated to be 20,194,200 tonnes (t). A schedule of works for the construction period was analysed and it was determined that 2027 would be the year with the most dust-generating activities.

5.4 Emissions estimation

Emissions from fugitive dust sources associated with the construction emission scenario were quantified through the application of USEPA AP-42 emission factor equations. Particulate matter emissions were quantified for the three size fractions – TSP, PM_{10} and $PM_{2.5}$.

A description of the emission sources associated with the project, and an inventory of emissions, are presented in Chapter 8.

5.5 Meteorological and dispersion modelling

The dispersion modelling for this assessment involved the use of The Air Pollution Model (TAPM) and CALMET/CALPUFF.

Upper air profiles were generated by the Commonwealth Scientific and Industrial Research Organisation's (CSIRO) TAPM meteorological model. CALMET was used as the meteorological pre-processor for the dispersion model CALPUFF.

TAPM was used to generate required parameters that are not routinely measured, specifically mixing height and vertical wind/temperature profile.

The CALMET/CALPUFF model suite is commonly used in NSW for applications where non-steady state conditions may occur (i.e. complex terrain or coastal locations) or when calm wind conditions are important (i.e. for odour assessment). CALMET is endorsed by the USEPA and recommended by the NSW EPA for these conditions.

The modelling system worked as follows:

- TAPM was used to generate gridded three-dimensional meteorological data for each hour of the model run period.
- CALMET was used to calculate fine-resolution, three-dimensional meteorological data based upon observed surface data, as well as upper air data generated for example by TAPM. From this, a one-year representative meteorological dataset suitable for use in the three-dimensional plume dispersion model, CALPUFF, was compiled.
- CALPUFF was used to calculate the dispersion of air pollutants within the three-dimensional meteorological field.

Each emission source was represented in CALPUFF as a line-volume, volume source or area-polygon source, located according to the layout of the project’s main construction areas.

In addition to the 224 individual assessment locations (documented in Section 3.2) concentrations and deposition rates were predicted over a nested grid domain 18 km by 18 km with spacing ranging from 900 metres (m) to 100 m decreasing with proximity to the project area (totalling 2,617 receptor points). Simulations were undertaken for the 12-month period of 2023.

Further details of the meteorological and dispersion modelling are provided in Section 5.5 and Annexure B.

6 Meteorology

6.1 Meteorological monitoring data

Meteorological mechanisms govern the generation, dispersion, transformation, and eventual removal of pollutants from the atmosphere. To adequately characterise the dispersion meteorology of a region, information is needed on the prevailing wind regime, ambient temperature, rainfall, relative humidity, mixing depth and atmospheric stability.

There are no meteorological stations in the vicinity of the project. The closest meteorological station to the project is the BoM Marrangaroo (Defence) AWS (station 063308) located approximately 8 km to the north-east. Measurements of wind speed, wind direction, standard deviation of wind direction, temperature and relative humidity were analysed from this AWS.

6.2 Selection of a representative year and prevailing winds

The meteorological data recorded by the BoM Marrangaroo (Defence) AWS were analysed for the five-year period between 2019 and 2023 (refer to Annexure B) for the purposes of characterising the existing environment and selecting a representative year for dispersion modelling.

Inter-annual profiles for wind speed, wind direction and air temperature by hour of the day were analysed for the BoM Marrangaroo (Defence) AWS (refer to Figure B.1 to Figure B.5). Data for years 2019 to 2023 were considered generally comparable between years for all parameters. Hourly relative humidity in 2019 showed noticeable hourly variation when compared with the proceeding years, with generally lower levels of humidity, especially during the day. This is mostly likely due to the shift from drought like conditions felt across the region leading up to 2020 when cooler and wetter La Niña conditions set in.

Annual, seasonal and diurnal wind roses created from wind speed and direction data collected from the BoM Marrangaroo (Defence) AWS are presented in Figure B.6 to Figure B.8. Annually, the winds recorded by the BoM Marrangaroo (Defence) AWS showed a similarity across years for both wind speed and wind direction. Winds were predominately from the east and the west. On a seasonal basis, winds were also generally from the east and west, but there were also prominent westerlies in spring and winter. Diurnally, the dominant winds were again from the east and the west both during the day and night-time. Average wind speeds were higher during the day and the percentage of calms was higher at night-time.

As a result of the analysis provided above, the 2023 calendar year was adopted as the 12-month modelling period for the purpose of the AQIA. The modelling year was also chosen with regard to background air quality which is discussed in Section 7.4.

6.3 Meteorological modelling

6.3.1 Background

Meteorological modelling for this assessment was completed using the TAPM and CALMET meteorological models. Surface observations from the BoM Marrangaroo (Defence) AWS were included in the CALMET modelling (referred to as data assimilation) to provide real-world observations and improve the accuracy of the wind field.

The 2023 calendar year was adopted as the 12-month modelling period for the purpose of this AQIA for the reasons described in Section 6.2. Further details of the TAPM and CALMET meteorological modelling are presented in Annexure B.

6.3.2 Atmospheric stability and mixing depth

Atmospheric stability refers to the degree of turbulence or mixing that occurs within the atmosphere and is a controlling factor in the rate of atmospheric dispersion of pollutants.

The Monin-Obukhov length (L) provides a measure of the stability of the surface layer (i.e. the layer above the ground in which vertical variation of heat and momentum flux is negligible; typically about 10% of the mixing height). Negative L values correspond to unstable atmospheric conditions, while positive L values correspond to stable atmospheric conditions. Very large positive or negative L values correspond to neutral atmospheric conditions.

The diurnal variation of atmospheric stability predicted for the project is illustrated in Figure 6.1 and is derived from the Monin-Obukhov length calculated by CALMET. The diurnal profile presented illustrates that atmospheric instability increases during daylight hours as convective energy increases, whereas stable atmospheric conditions prevail during the night-time. This profile indicates that the potential for atmospheric dispersion of emissions would be greatest during daytime hours and lowest during evening through to early morning hours.

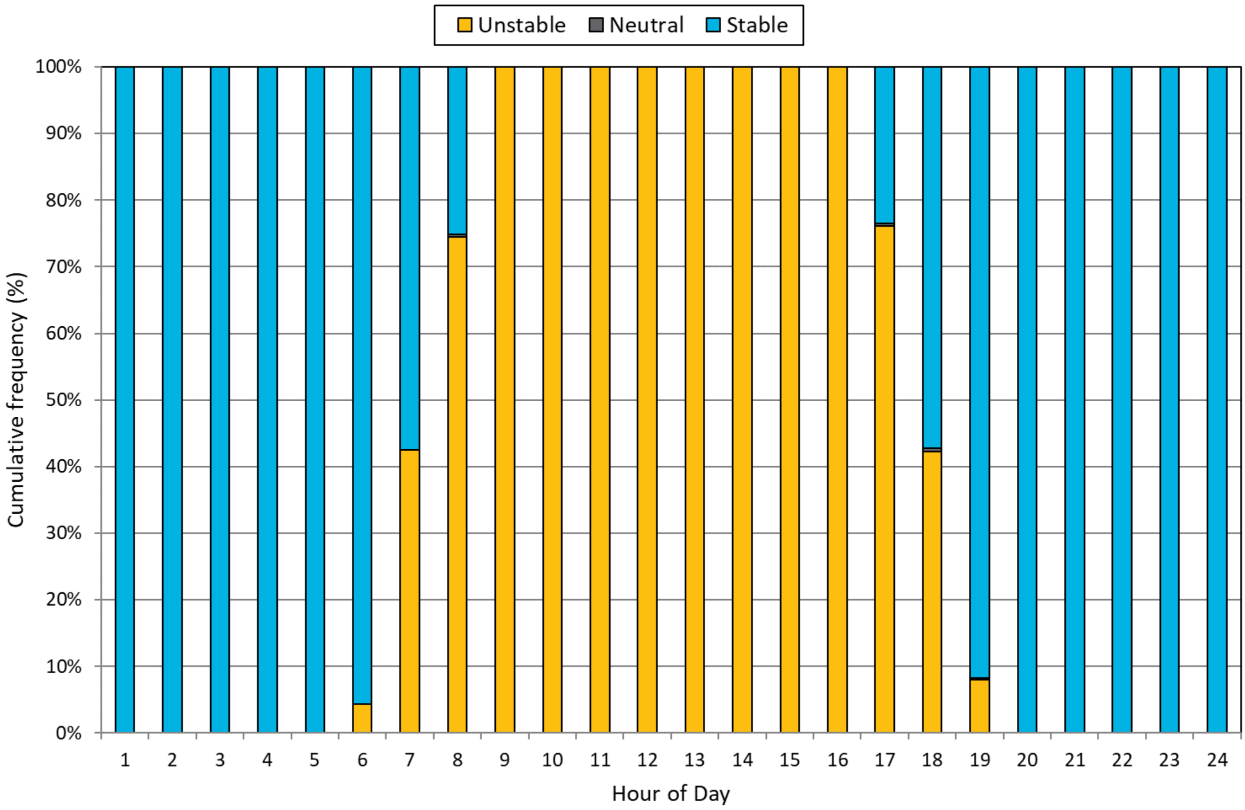
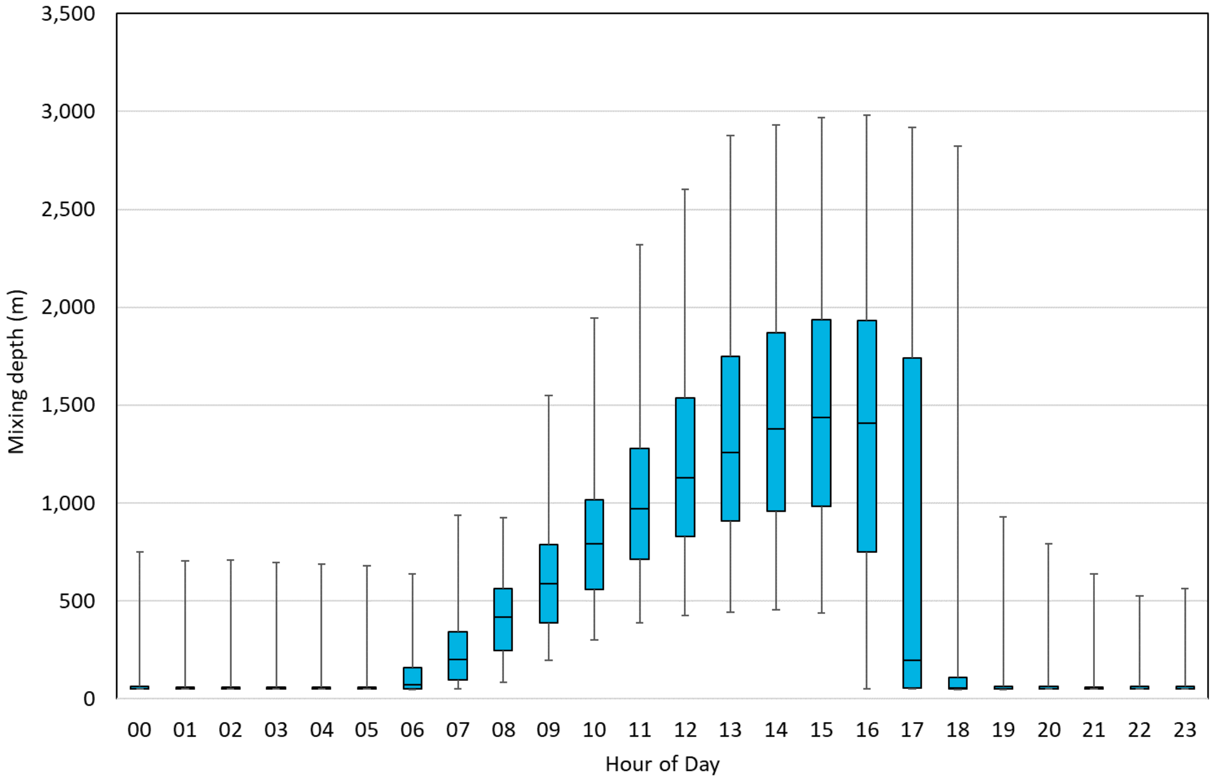


Figure 6.1 CALMET-predicted diurnal variation in atmospheric stability for the project in 2023

Mixing depth refers to the height of the atmosphere above ground level within which air pollution can be dispersed. The mixing depth of the atmosphere is influenced by mechanical (associated with wind speed) and thermal (associated with solar radiation) turbulence. Similar to the Monin-Obukhov L analysis above, higher daytime wind speeds and the onset of incoming solar radiation increase the amount of mechanical and convective turbulence in the atmosphere. As turbulence increases, so too does the depth of the boundary layer, generally contributing to higher mixing depths and greater potential for the atmospheric dispersion of pollutants.

Figure 6.2 presents the hourly-varying atmospheric boundary layer depths generated by CALMET. Greater boundary layer depths occur during the daytime hours, peaking in the mid to late afternoon.



Note: blue bars indicate the interquartile range (IQR), or middle 50% of the data, while the whiskers indicate highest and lowest values.

Figure 6.2 CALMET-predicted diurnal variation in atmospheric boundary layer depth for the project in 2023

7 Background air quality

7.1 Introduction

Apart from the project itself, air quality in the local airshed will be influenced by:

- agricultural practices
- wind generated dust from exposed areas
- dust entrainment and exhaust emissions from vehicle movements along unsealed and sealed roads
- seasonal emissions from household wood heaters
- long-range transport of fine particles into the region.

More remote sources which contribute episodically to suspended particulates in the region include dust storms and bushfires. It is considered that the above emission sources are accounted for in the monitoring data analysed in the following sections of this report.

7.2 Air quality monitoring resources

There are no air quality monitoring stations at or in the vicinity of the project. The NSW DCCEEW maintains an AQMS at Bathurst approximately 48.5 km north-west of the project. Daily average PM_{10} and $PM_{2.5}$ concentrations from the Bathurst AQMS were collated for the period between 2019 and 2023.

7.3 Summary of PM_{10} and $PM_{2.5}$ data

Summary statistics for PM_{10} and $PM_{2.5}$ at the Bathurst AQMS are given in Table 7.1, and a time series of 24-hour concentrations is shown in Figure 7.1.

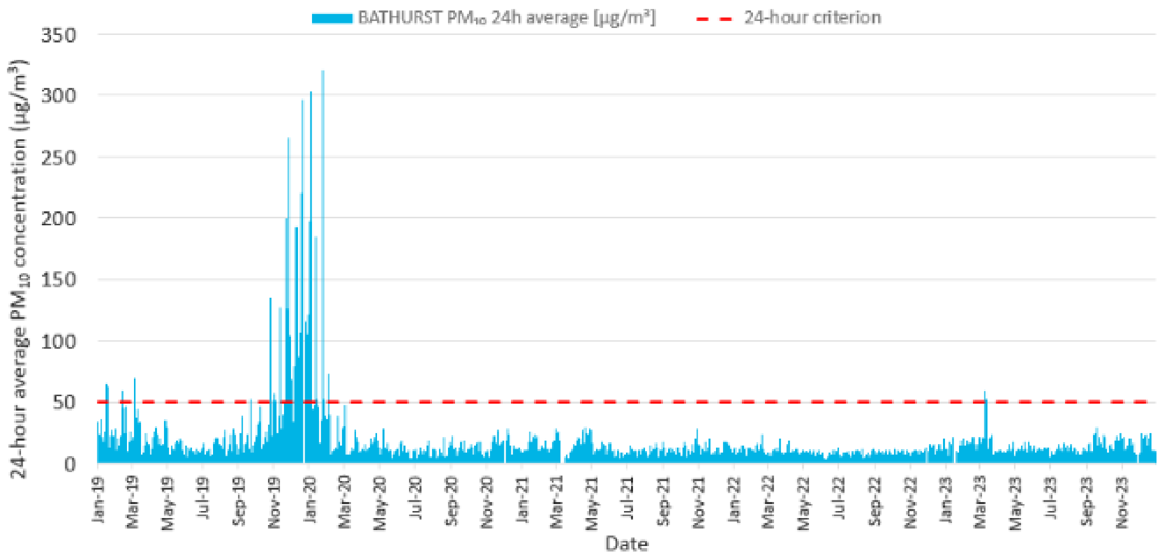
Measurements in 2019 to early 2020 were strongly influenced by the extensive 'Black Summer' bush fires, as shown in the time series plots. The fires had a large impact on annual mean and maximum PM_{10} and $PM_{2.5}$ concentrations in 2019, which were much higher than in other years. Maximum concentrations in 2020 were also elevated.

The NSW impact assessment criteria for annual mean PM_{10} (25 µg/m^3) and $PM_{2.5}$ (8 µg/m^3) were only exceeded in 2019. The 24-hour criteria PM_{10} (50 µg/m^3) and $PM_{2.5}$ (25 µg/m^3) were exceeded several times between 2018 and 2020, and again in 2023.

Table 7.1 PM_{10} and $PM_{2.5}$ statistics for Bathurst AQMS

Year	Data availability (%)	Annual average	Maximum 24-hour average	
		Concentrations (µg/m³)	Concentrations (µg/m³)	Exceedances of 24-hour criterion
PM_{10}				
2019	99.2	27.2	296.6	40
2020	98.6	16.7	320.4	14
2021	96.2	10.9	29.2	0
2022	99.2	8.8	23.2	0
2023	97.0	12.1	59.7	2
Criterion	-	*25*	*50*	-
$PM_{2.5}$				
2019	98.6	11.2	199.5	24
2020	98.9	7.5	207.3	14
2021	99.2	5.0	13.8	0
2022	95.1	3.9	11.3	0
2023	97.8	5.5	35.3	1
Criterion	-	*8*	*25*	-

(a) PM_{10}



(b) $PM_{2.5}$

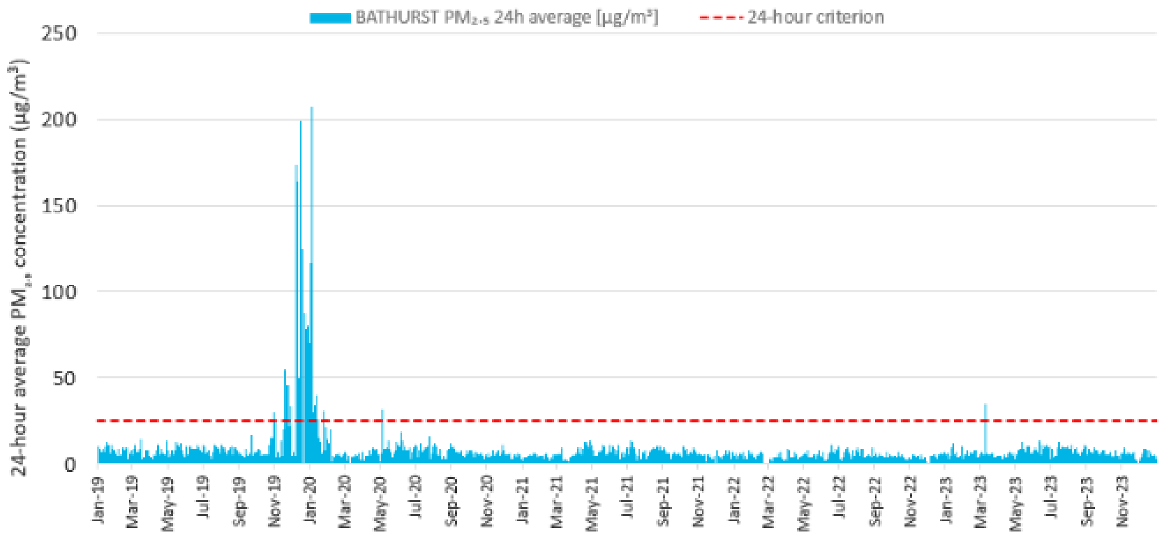


Figure 7.1 Time series of 24-hour PM_{10} and $PM_{2.5}$ concentrations - Bathurst AQMS – 2019 to 2023

7.4 Selection of a representative year

There are no criteria for selecting a representative year for modelling, but it is desirable to use a recent year that reflects 'typical' meteorology and air quality. At present, however, the concept of 'typical' is difficult to interpret, as the data for recent years (especially those for particulate matter) have been strongly affected by drought conditions, extensive bush fires and the La Niña phenomenon[3].

For this assessment, consistent with the adopted meteorological year, 2023 was selected as the representative year for PM_{10} and $PM_{2.5}$ concentrations. The reasons for this were as follows:

- The concentrations in 2018, 2019 and 2020 were severely affected by regional drought conditions and bush fires, with a high average value in 2019 and high maximum values across the three years.
- The concentrations in 2022 were below average, which was likely a consequence of the high rainfall in this year.

7.5 Assumed background concentrations

7.5.1 PM_{10} and $PM_{2.5}$

A time series of the 24-hour average PM_{10} concentrations dataset at Bathurst for 2023 is presented in Figure 7.2. This dataset was used to represent PM_{10} background data in the cumulative assessment. The maximum 24-hour average PM_{10} concentration was 59.7 µg/m³ and the annual average concentration was 12.4 µg/m³.

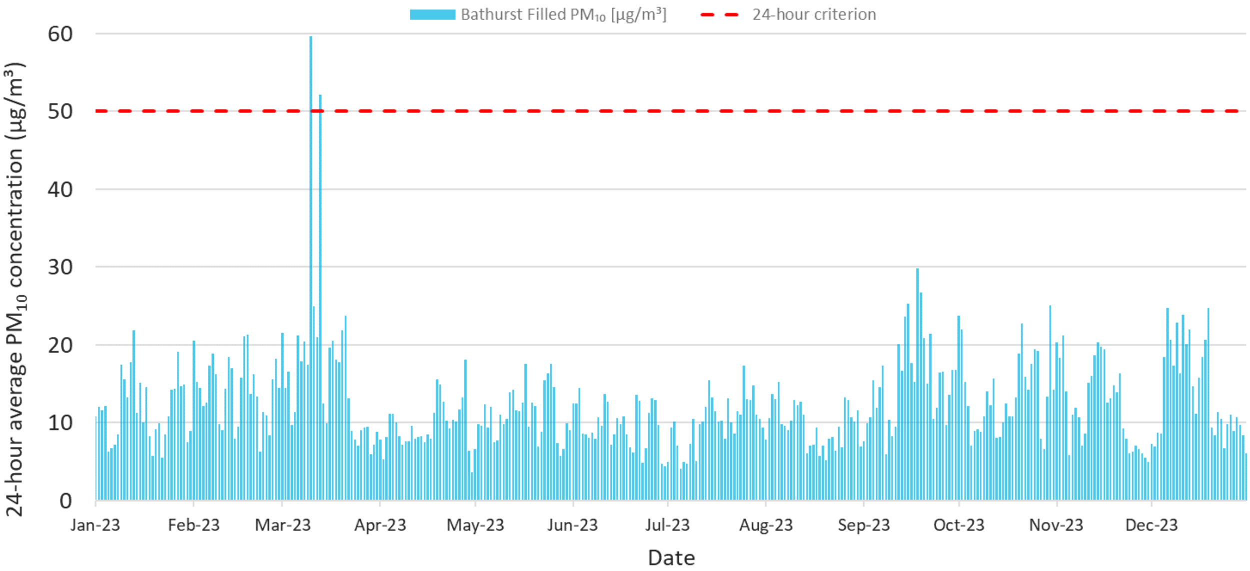


Figure 7.2 Time series of 24-hour average PM_{10} concentrations – Bathurst AQMS - 2023

[3] La Niña is the colder counterpart of El Niño and is part of the broader El Niño–Southern Oscillation (ENSO) climate pattern.

A time series of the 24-hour average $PM_{2.5}$ concentrations dataset at Bathurst for 2023 is presented in Figure 7.3. This dataset was used to represent $PM_{2.5}$ background data in the cumulative assessment. The maximum 24-hour average $PM_{2.5}$ concentration was 35.3 µg/m³ and the annual average concentration was 5.7 µg/m³.

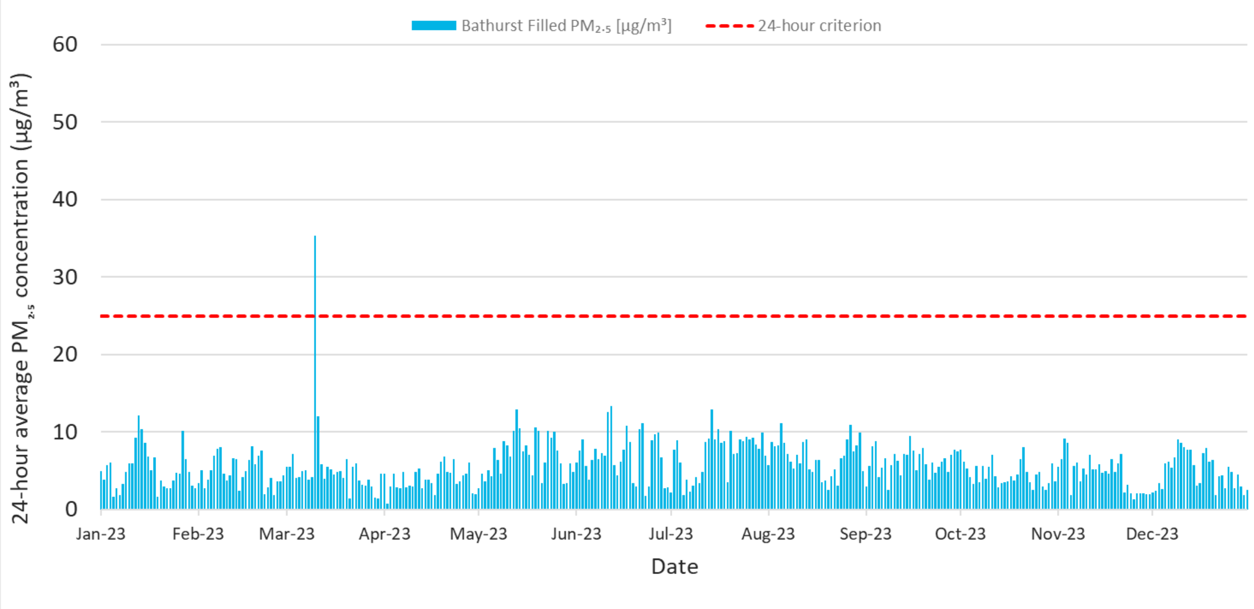


Figure 7.3 Time series of 24-hour average $PM_{2.5}$ concentrations – Bathurst AQMS – 2023

7.5.2 Total suspended particulate matter

TSP is not measured at the Bathurst AQMS. The percentage of PM_{10} in TSP for rural areas typically ranges from 40% to 50%. In the absence of appropriate local TSP monitoring data, the annual average TSP concentration has been derived by applying a PM_{10} to TSP ratio of 40% to the annual average PM_{10} concentration for 2023 (of 12.1 µg/m³). The resulting TSP background concentration was 30.3 µg/m³.

7.5.3 Dust deposition

Dust deposition is not recorded at the Bathurst AQMS. The AQIA therefore focuses on the incremental contribution from project emissions only.

7.5.4 All background values adopted for cumulative assessment

The background pollutant values adopted for cumulative assessment, based on the analysis presented in the preceding sections, are:

- 24-hour PM_{10} concentration – daily varying 2023 dataset with two days above the impact assessment criteria (existing exceedance)
- annual average PM_{10} concentration – 12.1 µg/m³
- 24-hour $PM_{2.5}$ concentration – daily varying 2023 dataset with one day above the impact assessment criteria (existing exceedance)
- annual average $PM_{2.5}$ concentration – 5.5 µg/m³
- annual average TSP concentration – 30.3 µg/m³.

8 Emissions inventory

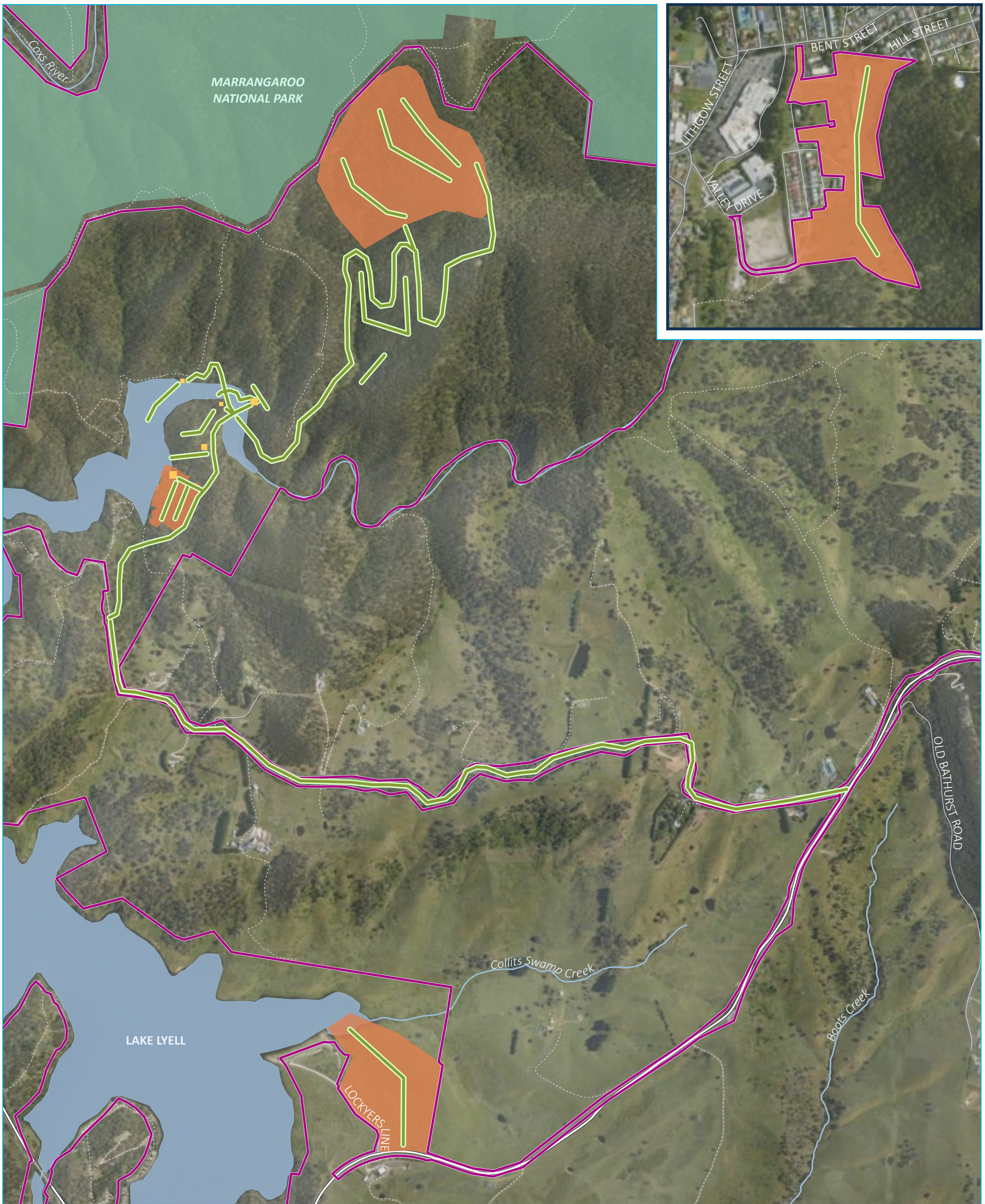
8.1 Sources of emissions

An emissions inventory was developed to quantify emissions from various pollutants resulting from the project. The main dust-generating sources included in the inventory were:

- hauling of spoil along unpaved and paved roads
- excavating spoil material, including drilling and blasting
- loading and unloading of spoil
- dozers working on spoil emplacement areas
- crushing and screening of spoil
- concrete and asphalt batching processes
- wind erosion from stockpiles and exposed surfaces
- diesel fuel combustion from construction plant, equipment and trucks.

Each activity has been represented in the model as either an area-polygon, volume, or line-volume source. The modelled source locations are shown in Figure 8.1.

It is noted that vegetation waste disposal will consist of two methods. Of the total vegetation removal for the project, approximately 20% of vegetation will be turned into mulch to be re-used on-site. The remaining 80% will be managed using specialised mobile biochar processing equipment (pyrolysis). This process involves burning organic matter at high temperatures and at low oxygen levels. This activity is not anticipated to have significant air quality impacts and as a result has not been included in this assessment.



Source: EMM (2025); Lake Lyell Project Pty Ltd (2025); DCSSS (2023); MetroMap (2025); GA (2009)

0 0.5 1 km
GDA2020 MGA Zone 56
N

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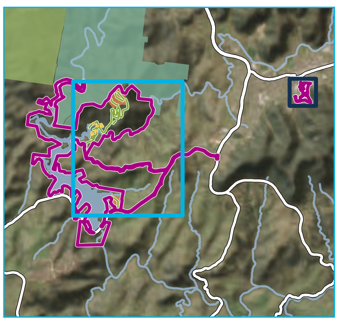

KEY

Project area
Line-volume source
Area source
Volume source

Existing environment
Major road
Minor road
Vehicular track
Named watercourse
Named waterbody
NPWS reserve
State forest

Model source locations

Lake Lyell PHES
Air Quality Impact Assessment
Figure 8.1

EMM
creating opportunities

8.2 Emissions scenarios

As previously mentioned, this assessment has considered a single 'worst-case' construction scenario, which was determined to be the 'worst-case' in terms of type and scale of the construction activities (defined as movements of spoil). Some activities, such as the construction of internal access roads, are projected to take six months to complete, while other activities, such as the excavation of tunnels, are projected to take 39 months. The dispersion modelling requires a full year assessment. As some construction activities in 2027 would be occurring for less than 12 months, spoil volumes related to these activities were scaled up in order to apportion the emissions over a 12-month period (e.g. spoil volumes for internal access roads occurring over six months were scaled up to 12 months).

In addition to the construction of the Lake Lyell PHES, emissions from the earthworks and construction of the lakeside and town accommodation camps were estimated.

Some construction activities will need to be completed before others can commence, (e.g. internal access roads will need to be established before construction works at the upper reservoir can begin). However, following a 'worst-case' approach, this AQIA has conservatively assumed that these activities would be occurring simultaneously.

Most works for the project are proposed to occur over normal construction hours between 6:00 am and 6:00 pm, Monday to Saturday. Underground excavating and tunnelling (including blasting) are proposed to occur over 24 hours, seven days a week. For dispersion modelling purposes, surface work activities (including spoil emplacement, concrete batching plant (CBP) activities, and asphalt batching activities) were modelled between 6:00 am and 6:00 pm, above ground drilling and blasting activities were modelled between 9:00 am and 6:00 pm, and truck deliveries along Sir Thomas Mitchell drive were modelled between 6:00 am and 10:00 pm.

8.3 Emission reduction factors

A range of particulate matter emission mitigation measures will be implemented during the construction of the project.

The following control factors were applied in the emissions inventory:

- Use of water carts of unpaved haul roads – 75% reduction for water application (Katestone 2011).
- Use of water sprays on drilling operations – 70% reduction for water application (Katestone 2011).
- Use of watering on dozer work area - 50% reduction for keeping travel routes and materials moist (Katestone 2011).
- Use of water sprays on stockpile loading – 50% reduction for water application (Katestone 2011).

While additional mitigation measures are proposed to be implemented for the project, such as lowering of speed limits, these measures have not been included in emissions estimation calculations for dispersion modelling. Further discussion on mitigation measures is presented in Chapter 10.

8.4 Emissions estimates

A summary of the calculated annual TSP, PM_{10} and $PM_{2.5}$ emissions rates by source type are presented in Table 8.1, while the significance of key source types by particle size is illustrated in Figure 8.2. Particulate matter control measures, as documented below, are accounted for in these annual emissions totals. The data shows that truck haulage on unpaved surfaces and dozer activities are the key contributing sources to total project emissions.

Further details regarding emission estimation factors and assumptions are provided in Annexure C.

Table 8.1 Calculated annual TSP, PM_{10} and $PM_{2.5}$ emissions

Emission source	Calculated annual emissions (kg/annum) by source		
	TSP	PM_{10}	$PM_{2.5}$
Portal pad			
Drilling	2,713	1,411	814
Blasting	1	<1	<1
Loading blasted spoil to trucks	466	220	33
Hauling spoil from main access tunnel to infill area (unpaved)	2,110	603	60
Unloading spoil from trucks to infill area	117	55	8
Hauling spoil from Portal pad for transfer off-site (unpaved)	6,179	1,765	177
Hauling spoil from Portal pad for transfer off-site (paved)	2,550	490	118
Main access tunnel (MAT) & construction adits			
Truck unloading spoil from tunnel portal to surface stockpile	237	112	17
Loading spoil from stockpile to trucks	237	112	17
Hauling spoil from main access tunnel to infill area (unpaved)	1,930	552	55
Unloading spoil from trucks to infill area	107	50	8
Hauling spoil from main access tunnel for transfer offsite (unpaved)	628	179	18
Hauling spoil from main access tunnel for transfer offsite (paved)	259	50	12
Upper reservoir			
Drilling	22,125	11,505	6,638
Blasting	88	46	26
Loading spoil to trucks	3,802	1,798	272
Dozer at excavation area	101,258	20,993	10,632
Hauling spoil from upper reservoir to emplacement area	163,203	46,631	4,663
Unloading spoil from trucks at emplacement area	1,901	899	136
Dozer at emplacement area	50,629	10,496	5,316
Crushing rock - upper reservoir	1,832	814	55
Screening rock - upper reservoir	8,483	2,918	197
Powerhouse, caverns and surge shaft			
Truck unloading spoil from tunnel portal to surface stockpile	175	83	13
Loading spoil from stockpile to trucks	175	83	13
Hauling spoil from main access tunnel to infill area (unpaved)	1,174	335	34
Unloading spoil from trucks to infill area	58	27	4

Emission source	Calculated annual emissions (kg/annum) by source		
	TSP	PM_{10}	$PM_{2.5}$
Hauling spoil from powerhouse and caverns for transfer offsite (unpaved)	1,192	340	34
Hauling spoil from powerhouse and caverns for transfer offsite (paved)	492	94	23
Tailrace tunnels			
Truck unloading spoil from tunnel portal to surface stockpile	118	56	8
Loading spoil from stockpile to trucks	118	56	8
Hauling spoil from tailrace tunnel to infill area (unpaved)	1,609	460	46
Unloading spoil from trucks to infill area	53	25	4
Hauling spoil from tailrace tunnel for transfer offsite (unpaved)	393	112	11
Hauling spoil from tailrace tunnel for transfer offsite (paved)	130	25	6
Lower reservoir inlet/outlet and channel			
Drilling	2,674	1,390	802
Blasting	1	<1	<1
Loading spoil to trucks	459	217	33
Hauling spoil from lower intake tunnel to infill area (unpaved)	6,931	1,980	198
Unloading spoil from trucks to infill area	230	109	16
Lake diversion			
Drilling	1,950	1,014	585
Blasting	<1	<1	<1
Loading spoil to trucks	335	158	24
Hauling spoil from lake diversion to infill area (unpaved)	2,022	578	58
Unloading spoil from trucks to infill area	101	48	7
Hauling spoil from lake diversion for transfer offsite (unpaved)	2,656	759	76
Hauling spoil from lake diversion for transfer offsite (paved)	1,466	281	68
Access roads			
Drilling (northern)	26,037	13,539	7,811
Blasting (northern)	125	65	38
Loading spoil to trucks (north)	4,474	2,116	320
Hauling spoil from access roads to emplacement pads (north)	562,471	160,710	16,071
Unloading spoil from trucks at emplacement pads	2,237	1,058	160
Excavating access road (south)	497	235	36
Loading spoil to trucks (south)	497	235	36

Emission source	Calculated annual emissions (kg/annum) by source		
	TSP	PM_{10}	$PM_{2.5}$
Hauling spoil from access roads to emplacement pads (south)	43,748	12,500	1,250
Excavating Sir Thomas Mitchell Drive	7	3	1
Unloading spoil along Sir Thomas Mitchell Drive (general filling)	109	52	8
Switch yard, concrete batching plant (CBP) & deliveries			
Drilling	1,102	573	331
Blasting	<1	<1	<1
Excavator loading spoil to trucks	189	90	14
Transporting spoil across switchyard area	952	272	27
Unloading spoil from trucks at switchyard	95	45	7
CBP processing activities (Switchyard)	440	176	56
Hauling construction materials along access road to the CBP (unpaved)	4,335	1,239	124
Hauling construction materials along access road to the CBP (paved)	1,405	270	65
Site compound			
Dozer heavy ripping	16,876	3,499	1,772
Dozer emplacement	33,753	6,998	3,544
Building pad			
CBP activities (building pad)	440	176	56
Asphalt plant activities	48	17	4
Accommodation camps			
Excavator at cut area - Lakeside	328	155	23
Excavator loading spoil to trucks - Lakeside	328	155	23
Transporting spoil from cut to fill area - Lakeside	4,944	1,413	141
Dozer at filling area - Lakeside	16,876	3,499	1,772
Excavator at cut area - Town	55	26	4
Excavator loading spoil to trucks - Town	55	26	4
Transporting spoil from cut to fill area - Town	824	235	24
Dozer at filling area – Town	16,876	3,499	1,772
Wind erosion			
Wind erosion from upper reservoir	497	248	37
Wind erosion from CBP stockpiles	55	27	4
Wind erosion from accommodation camp – lakeside	245	123	18

Emission source	Calculated annual emissions (kg/annum) by source		
	TSP	PM_{10}	$PM_{2.5}$
Wind erosion from accommodation camp - Town	224	112	17
Other			
Diesel combustion - Site operations	3,000	3,000	2,750
Diesel combustion – Off-site material haulage	6	6	6
Total	**1,139,518**	**326,323**	**69,669**

Note: Totals may not add up exactly due to rounding

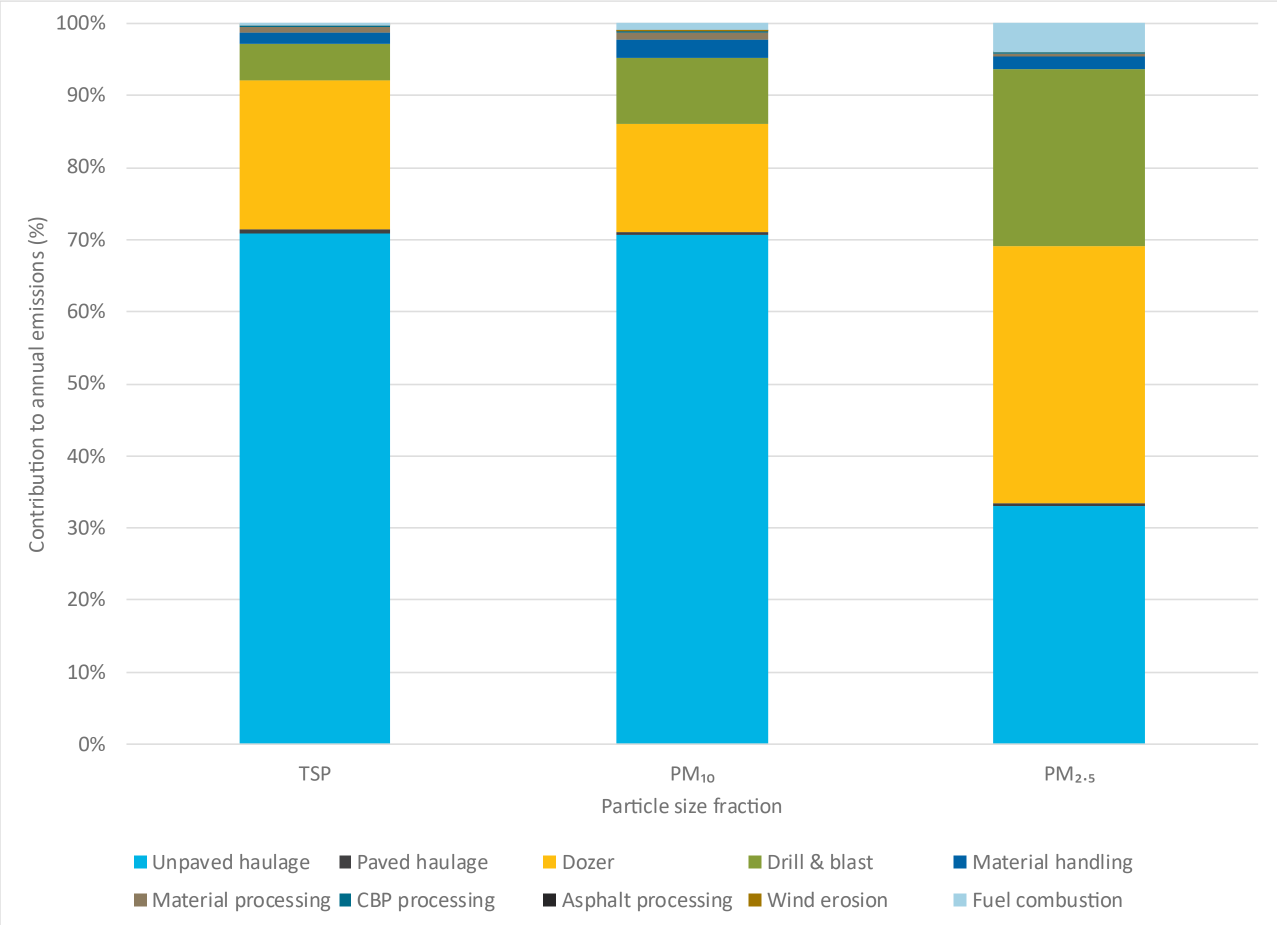

Figure 8.2 Contribution to annual emissions by source type and particle size

9 Air dispersion modelling

9.1 Incremental (project-only) results

Predicted incremental TSP, PM_{10}, $PM_{2.5}$, and dust deposition levels from the project are presented in Table 9.1 for each of the assessment locations. With the exception of dust deposition, the NSW EPA assessment criteria are applicable to cumulative concentrations. Analysis of cumulative impact compliance is presented in Section 9.2.

The predicted concentrations for all pollutants and averaging periods for the project were below the applicable NSW EPA assessment criteria at all assessment locations with the exception of one. Annual average dust deposition was exceeded at assessment location R2000 as a result of activities related to the construction of the Lakeside accommodation camp. It is noted however that R2000 represents the Lakeside accommodation camp itself and therefore would not exist as an assessment location at the time of the construction of the accommodation camp. The accommodation camp however may exist simultaneously with the construction activities occurring at the main project area which is the reason it was included in the dispersion model.

Contour plots, illustrating spatial variations in incremental TSP, PM_{10} and $PM_{2.5}$ concentrations and dust deposition rates are provided in Annexure D. Contour plots of the maximum 24-hour average concentrations presented do not represent the dispersion pattern on any day, but rather the maximum daily concentration that was predicted to occur at each model calculation point given the range of meteorological conditions occurring over the 2023 modelling period.

Table 9.1 Incremental (project only) concentration and deposition results

Assessment location ID	Predicted incremental concentrations (µg/m³) and dust deposition rates (g/m²/month)					
	TSP	PM_{10}		$PM_{2.5}$		Dust deposition
	Annual	24-hour maximum	Annual	24-hour maximum	Annual	Annual
Criterion	**90**	**50**	**25**	**25**	**8**	**2**
R1	0.3	1.5	0.2	0.6	0.1	0.1
R6	0.7	8.5	0.5	2.9	0.2	<0.1
R7	0.5	3.0	0.3	0.9	0.1	<0.1
R10	0.7	5.3	0.5	1.6	0.2	0.1
R13	1.4	11.4	1.0	3.3	0.3	0.1
R14	0.8	4.1	0.5	1.1	0.2	0.1
R15	1.8	14.2	1.2	5.0	0.3	0.2
R18	0.4	13.3	0.3	4.8	0.1	<0.1
R19	1.2	12.2	0.8	3.8	0.2	0.1
R21	0.1	7.8	0.1	2.4	<0.1	<0.1
R22	0.5	2.5	0.3	0.8	0.1	<0.1
R23	1.5	8.4	0.9	2.7	0.3	0.2
R24	0.4	2.2	0.3	0.6	0.1	<0.1
R25	2.3	13.8	1.4	4.6	0.4	0.2
R28	0.4	6.2	0.3	2.1	0.1	<0.1

Assessment location ID	Predicted incremental concentrations (µg/m³) and dust deposition rates (g/m²/month)					
	TSP	PM_{10}		$PM_{2.5}$		Dust deposition
	Annual	24-hour maximum	Annual	24-hour maximum	Annual	Annual
Criterion	**90**	**50**	**25**	**25**	**8**	**2**
R31	1.1	10.2	0.7	3.8	0.2	0.1
R34	0.4	2.1	0.3	0.6	0.1	<0.1
R36	0.4	1.9	0.3	0.7	0.1	<0.1
R38	1.5	5.9	0.7	2.1	0.2	0.2
R39	0.4	2.0	0.3	0.6	0.1	<0.1
R42	0.7	3.9	0.5	1.0	0.1	0.1
R45	<0.1	1.1	<0.1	0.5	<0.1	<0.1
R47	0.5	2.2	0.3	0.7	0.1	<0.1
R55	0.7	3.5	0.5	1.6	0.2	0.1
R65	<0.1	4.2	<0.1	1.9	<0.1	<0.1
R66	0.1	5.1	0.1	1.9	<0.1	<0.1
R67	0.8	3.0	0.6	1.3	0.2	0.1
R109	0.3	1.4	0.2	0.4	0.1	0.1
R139	1.1	5.2	0.7	1.7	0.2	0.1
R155	0.8	3.0	0.5	1.1	0.2	0.1
R165	1.3	6.1	0.7	2.2	0.2	0.2
R199	0.3	3.4	0.2	1.5	0.1	<0.1
R237	0.9	4.3	0.6	1.4	0.2	0.1
R238	0.1	1.4	<0.1	0.6	<0.1	<0.1
R241	0.2	2.0	0.1	0.7	0.1	<0.1
R243	<0.1	3.8	<0.1	2.0	<0.1	<0.1
R244	0.2	3.2	0.1	1.2	0.1	<0.1
R246	0.6	3.2	0.4	0.9	0.1	0.1
R248	0.3	2.5	0.2	0.9	0.1	<0.1
R302	1.1	16.1	0.8	3.9	0.2	0.1
R320	0.5	2.3	0.3	0.6	0.1	0.1
R321	0.5	2.3	0.3	0.6	0.1	0.1
R340	0.5	2.2	0.3	0.6	0.1	0.1
R344	0.5	2.1	0.3	0.6	0.1	0.1
R357	0.5	2.4	0.4	0.8	0.1	0.1

Assessment location ID	Predicted incremental concentrations (µg/m³) and dust deposition rates (g/m²/month)					
	TSP	PM_{10}		$PM_{2.5}$		Dust deposition
	Annual	24-hour maximum	Annual	24-hour maximum	Annual	Annual
Criterion	**90**	**50**	**25**	**25**	**8**	**2**
R360	0.5	3.0	0.4	1.1	0.1	0.1
R365	0.1	4.5	0.1	1.6	<0.1	<0.1
R366	0.1	5.5	0.1	2.0	<0.1	<0.1
R368	0.6	3.4	0.4	0.9	0.1	0.1
R386	0.5	2.2	0.3	0.6	0.1	0.1
R388	0.5	2.1	0.4	0.7	0.1	0.1
R389	0.5	2.3	0.3	0.6	0.1	0.1
R440	0.4	2.4	0.3	0.9	0.1	0.1
R578	0.7	3.0	0.4	1.0	0.1	0.1
R582	0.4	2.3	0.3	0.8	0.1	0.1
R584	0.9	12.0	0.6	3.0	0.2	0.1
R605	0.8	3.5	0.5	1.2	0.2	0.1
R608	0.7	2.9	0.4	1.0	0.1	0.1
R610	0.6	2.9	0.4	1.0	0.1	0.1
R623	0.6	2.7	0.4	0.8	0.1	0.1
R624	0.7	3.4	0.5	1.1	0.1	0.1
R653	0.2	1.6	0.2	0.9	0.1	<0.1
R778	0.3	2.4	0.2	0.9	0.1	<0.1
R910	0.2	1.3	0.1	0.7	<0.1	<0.1
R923	0.1	2.0	0.1	0.7	<0.1	<0.1
R946	<0.1	2.4	<0.1	0.7	<0.1	<0.1
R1035	0.1	1.3	0.1	0.5	<0.1	<0.1
R1462	0.1	1.5	0.1	0.7	<0.1	<0.1
R1465	0.1	1.2	0.1	0.7	<0.1	<0.1
R1507	<0.1	1.7	<0.1	0.5	<0.1	<0.1
R1631	0.3	2.5	0.2	0.9	0.1	<0.1
R1637	0.3	1.9	0.2	0.8	0.1	0.1
R1640	0.3	2.3	0.2	0.9	0.1	0.1
R1646	0.3	2.5	0.2	0.9	0.1	0.1
R1648	0.3	2.5	0.2	1.0	0.1	0.1

Assessment location ID	Predicted incremental concentrations (μg/m³) and dust deposition rates (g/m²/month)					
	TSP	PM_{10}		$PM_{2.5}$		Dust deposition
	Annual	24-hour maximum	Annual	24-hour maximum	Annual	Annual
Criterion	**90**	**50**	**25**	**25**	**8**	**2**
R1825	0.3	2.3	0.2	0.7	0.1	<0.1
R1835	0.1	2.0	0.1	1.1	<0.1	<0.1
R1841	0.2	1.1	0.1	0.7	<0.1	<0.1
R1881	0.3	1.8	0.2	0.8	0.1	<0.1
R1917	0.2	1.6	0.1	0.8	0.1	<0.1
R1965	0.1	1.2	0.1	0.6	<0.1	<0.1
R1997	0.1	1.9	0.1	0.7	<0.1	<0.1
R1998	0.1	2.3	0.1	1.3	<0.1	<0.1
R1999	0.2	1.2	0.1	0.9	0.1	<0.1
R2000	17.3	16.1	5.3	6.7	2.1	**2.7**
R2001	4.6	24.1	2.6	11.3	1.2	1.0
R2002	<0.1	0.5	<0.1	0.4	<0.1	<0.1
R2003	<0.1	0.5	<0.1	0.3	<0.1	<0.1
R2004	<0.1	0.7	<0.1	0.5	<0.1	<0.1
R2005	<0.1	0.5	<0.1	0.4	<0.1	<0.1
R2006	<0.1	0.8	<0.1	0.6	<0.1	<0.1
R2007	<0.1	1.0	<0.1	0.7	<0.1	<0.1
R2008	<0.1	0.9	<0.1	0.6	<0.1	<0.1
R2009	<0.1	0.9	<0.1	0.4	<0.1	<0.1
R2010	<0.1	1.0	<0.1	0.4	<0.1	<0.1
R2011	<0.1	0.8	<0.1	0.3	<0.1	<0.1
R2012	<0.1	0.7	<0.1	0.3	<0.1	<0.1
R2013	<0.1	0.5	<0.1	0.4	<0.1	<0.1
R2014	<0.1	0.6	<0.1	0.4	<0.1	<0.1
R2015	<0.1	3.0	<0.1	2.2	<0.1	<0.1
R2016	<0.1	2.5	<0.1	1.9	<0.1	<0.1
R2017	<0.1	2.4	<0.1	1.8	<0.1	<0.1
R2018	<0.1	2.1	<0.1	1.6	<0.1	<0.1
R2019	<0.1	1.8	<0.1	1.4	<0.1	<0.1
R2020	<0.1	1.8	<0.1	1.4	<0.1	<0.1

Assessment location ID	Predicted incremental concentrations (µg/m³) and dust deposition rates (g/m²/month)					
	TSP	PM_{10}		$PM_{2.5}$		Dust deposition
	Annual	24-hour maximum	Annual	24-hour maximum	Annual	Annual
Criterion	**90**	**50**	**25**	**25**	**8**	**2**
R2021	<0.1	1.6	<0.1	1.2	<0.1	<0.1
R2022	<0.1	1.3	<0.1	1.0	<0.1	<0.1
R2023	<0.1	1.3	<0.1	0.8	<0.1	<0.1
R2024	<0.1	1.1	<0.1	0.8	<0.1	<0.1
R2025	<0.1	1.1	<0.1	0.7	<0.1	<0.1
R2026	<0.1	1.1	<0.1	0.6	<0.1	<0.1
R2027	<0.1	1.0	<0.1	0.5	<0.1	<0.1
R2028	<0.1	1.0	<0.1	0.5	<0.1	<0.1
R2029	<0.1	0.9	<0.1	0.5	<0.1	<0.1
R2030	<0.1	0.9	<0.1	0.4	<0.1	<0.1
R2031	<0.1	0.9	<0.1	0.4	<0.1	<0.1
R2032	<0.1	0.8	<0.1	0.5	<0.1	<0.1
R2033	<0.1	0.6	<0.1	0.3	<0.1	<0.1
R2034	<0.1	0.7	<0.1	0.3	<0.1	<0.1
R2035	<0.1	0.8	<0.1	0.3	<0.1	<0.1
R2036	<0.1	0.8	<0.1	0.3	<0.1	<0.1
R2037	<0.1	0.4	<0.1	0.1	<0.1	<0.1
R2038	<0.1	0.4	<0.1	0.1	<0.1	<0.1
R2039	<0.1	0.4	<0.1	0.2	<0.1	<0.1
R2040	<0.1	0.8	<0.1	0.3	<0.1	<0.1
R2041	<0.1	0.7	<0.1	0.3	<0.1	<0.1
R2042	<0.1	0.9	<0.1	0.4	<0.1	<0.1
R2043	<0.1	0.7	<0.1	0.4	<0.1	<0.1
R2044	<0.1	0.7	<0.1	0.3	<0.1	<0.1
R2045	<0.1	0.5	<0.1	0.2	<0.1	<0.1
R2046	<0.1	1.1	<0.1	0.4	<0.1	<0.1
R2047	<0.1	1.1	<0.1	0.7	<0.1	<0.1
R2048	0.1	1.4	<0.1	1.2	<0.1	<0.1
R2049	0.1	2.1	0.1	1.8	<0.1	<0.1
R2050	0.1	2.0	0.1	1.4	<0.1	<0.1

Assessment location ID	Predicted incremental concentrations (µg/m³) and dust deposition rates (g/m²/month)					
	TSP	PM_{10}		$PM_{2.5}$		Dust deposition
	Annual	24-hour maximum	Annual	24-hour maximum	Annual	Annual
Criterion	**90**	**50**	**25**	**25**	**8**	**2**
R2051	0.1	1.9	0.1	1.2	<0.1	<0.1
R2052	0.1	2.2	0.1	1.2	<0.1	<0.1
R2053	0.5	5.7	0.4	2.3	0.2	<0.1
R2059	1.3	5.8	0.5	4.0	0.3	0.3
R2108	1.5	6.4	0.6	4.3	0.3	0.3
R2121	1.1	2.7	0.5	1.7	0.2	0.3
R2124	0.6	4.5	0.3	3.2	0.2	0.1
R2129	0.5	4.3	0.3	3.1	0.2	0.1
R2133	1.3	6.4	0.5	4.2	0.3	0.3
R2144	0.2	1.2	0.2	0.9	0.1	<0.1
R2156	2.1	6.1	0.8	4.0	0.4	0.5
R2164	0.3	2.3	0.2	1.8	0.1	0.1
R2165	0.3	1.4	0.2	1.1	0.1	<0.1
R2166	1.6	6.5	0.6	4.4	0.3	0.3
R2167	0.2	1.0	0.1	0.8	0.1	<0.1
R2168	1.6	3.4	0.6	2.2	0.3	0.5
R2176	1.4	6.1	0.6	4.1	0.3	0.3
R2178	0.5	1.4	0.3	0.9	0.1	0.1
R2180	0.5	1.3	0.3	0.8	0.1	0.1
R2184	1.5	6.5	0.6	4.4	0.3	0.3
R2200	3.5	8.6	1.1	5.3	0.6	0.9
R2238	1.2	5.4	0.5	3.7	0.3	0.2
R2252	1.5	6.2	0.6	4.2	0.3	0.3
R2269	1.4	5.9	0.5	4.1	0.3	0.3
R2278	0.6	3.8	0.3	2.7	0.2	0.1
R2283	1.5	6.4	0.6	4.3	0.3	0.3
R2291	1.6	4.7	0.6	3.2	0.3	0.4
R2311	0.8	3.2	0.4	2.0	0.2	0.2
R2312	1.0	3.5	0.4	2.2	0.2	0.2
R2313	1.0	3.5	0.4	2.2	0.2	0.2

Assessment location ID	Predicted incremental concentrations (µg/m³) and dust deposition rates (g/m²/month)					
	TSP	PM_{10}		$PM_{2.5}$		Dust deposition
	Annual	24-hour maximum	Annual	24-hour maximum	Annual	Annual
Criterion	**90**	**50**	**25**	**25**	**8**	**2**
R2314	1.0	3.4	0.4	2.2	0.2	0.2
R2315	1.3	3.6	0.6	2.3	0.3	0.3
R2316	0.4	2.0	0.2	1.3	0.1	0.1
R2317	0.4	1.9	0.2	1.2	0.1	0.1
R2318	0.4	1.9	0.2	1.3	0.1	0.1
R2319	0.4	2.0	0.2	1.3	0.1	0.1
R2320	0.4	2.0	0.2	1.3	0.1	0.1
R2321	0.4	2.0	0.2	1.3	0.1	0.1
R2322	0.4	1.9	0.2	1.2	0.1	0.1
R2323	0.4	1.9	0.2	1.2	0.1	0.1
R2324	1.0	3.4	0.4	2.2	0.2	0.2
R2325	1.0	3.5	0.4	2.2	0.2	0.2
R2326	0.4	1.8	0.2	1.2	0.1	0.1
R2327	0.4	1.8	0.2	1.2	0.1	0.1
R2328	1.1	3.5	0.5	2.2	0.2	0.2
R2329	1.1	3.6	0.5	2.3	0.2	0.2
R2330	1.1	3.5	0.5	2.2	0.2	0.2
R2332	0.4	2.0	0.2	1.3	0.1	0.1
R2333	0.8	3.2	0.4	2.0	0.2	0.2
R2334	0.4	2.0	0.2	1.3	0.1	0.1
R2368	1.3	3.9	0.5	2.6	0.3	0.3
R2384	0.2	1.1	0.1	0.9	0.1	<0.1
R2388	0.5	1.9	0.3	1.3	0.1	0.1
R2391	0.4	2.0	0.2	1.3	0.1	0.1
R2402	1.0	3.4	0.4	2.2	0.2	0.3
R2403	3.8	8.1	1.2	4.8	0.6	0.9
R2415	0.2	1.2	0.2	0.8	0.1	<0.1
R2416	0.4	2.0	0.2	1.3	0.1	0.1
R2417	0.4	2.0	0.2	1.3	0.1	0.1
R2421	0.7	3.1	0.3	2.2	0.2	0.1

Assessment location ID	Predicted incremental concentrations (μg/m³) and dust deposition rates (g/m²/month)					
	TSP	PM_{10}		$PM_{2.5}$		Dust deposition
	Annual	24-hour maximum	Annual	24-hour maximum	Annual	Annual
Criterion	**90**	**50**	**25**	**25**	**8**	**2**
R2423	0.5	2.7	0.2	2.0	0.1	0.1
R2427	0.2	0.8	0.1	0.5	0.1	<0.1
R2429	0.2	0.9	0.1	0.6	<0.1	<0.1
R2437	0.2	0.9	0.1	0.6	<0.1	<0.1
R2441	0.2	1.0	0.1	0.7	<0.1	<0.1
R2448	0.2	1.0	0.1	0.7	<0.1	<0.1
R2452	0.2	1.0	0.1	0.6	<0.1	<0.1
R2454	0.2	0.9	0.1	0.6	<0.1	<0.1
R2455	0.2	0.9	0.1	0.6	<0.1	<0.1
R2456	0.2	0.8	0.1	0.6	<0.1	<0.1
R2469	0.2	0.7	0.1	0.5	0.1	<0.1
R2473	<0.1	0.4	<0.1	0.3	<0.1	<0.1
R2474	<0.1	0.6	<0.1	0.5	<0.1	<0.1
R2475	<0.1	0.5	<0.1	0.4	<0.1	<0.1
R2476	<0.1	0.4	<0.1	0.3	<0.1	<0.1
R2477	<0.1	0.3	<0.1	0.2	<0.1	<0.1
R2478	<0.1	0.7	<0.1	0.5	<0.1	<0.1
R2479	<0.1	0.6	<0.1	0.3	<0.1	<0.1
R2480	<0.1	3.1	<0.1	1.0	<0.1	<0.1
R2481	<0.1	2.4	<0.1	0.7	<0.1	<0.1
R2482	<0.1	1.4	<0.1	0.8	<0.1	<0.1
R2483	<0.1	2.5	<0.1	1.6	<0.1	<0.1
R2484	<0.1	1.0	<0.1	0.8	<0.1	<0.1
R2485	<0.1	0.9	<0.1	0.7	<0.1	<0.1
R2486	<0.1	0.8	<0.1	0.4	<0.1	<0.1
R2487	<0.1	0.9	<0.1	0.5	<0.1	<0.1
R2488	0.6	2.8	0.4	0.8	0.1	0.1
R2489	0.8	3.2	0.3	2.0	0.2	0.1
R2490	<0.1	0.7	<0.1	0.3	<0.1	<0.1

Note: Criteria for TSP, PM_{10} and $PM_{2.5}$ are applicable to cumulative (increment + background). Criteria are provided for comparison purposes only. Exceedance of dust deposition criteria marked by bold and grey shading.

9.2 Cumulative (project + background) results

Cumulative impacts at each of the assessment locations surrounding the site have been assessed in the following ways:

- For 24-hour average concentrations – each daily varying predicted 24-hour concentration for PM_{10} and $PM_{2.5}$ from the project were combined with the corresponding concentrations from the adopted assessment period background concentration datasets (refer to Section 7.5).
- For annual average concentrations – the predicted annual concentrations from the project were paired with the corresponding background annual average concentrations (refer to Section 7.5).

As detailed in Section 7.3, there were two exceedances of the 24-hour average PM_{10} criterion and one exceedances of the 24-hour $PM_{2.5}$ criterion in the Bathurst AQMS background dataset. For cumulative impact assessment purposes, these are classed as existing exceedances.

Section 5.1.3 of the Approved Methods for Modelling states that in the event of existing ambient air pollutant concentration in exceedance of applicable impact assessment the criteria, the assessment must:

> …demonstrate that no additional exceedances of the impact assessment criteria will occur as a result of the proposed activity and that best management practices will be implemented to minimise emissions of air pollutants as far as is practical.

To demonstrate that no additional exceedances of the applicable criteria will occur as a result of emissions from the project, the 3rd highest cumulative PM_{10} concentrations and 2nd highest $PM_{2.5}$ concentrations at each assessment location are reported in Table 9.2. Data has not been removed from the analysis but simply, the next highest result not affected by background above the criterion is shown in this section.

The predicted cumulative concentrations and deposition rates for all pollutants and averaging periods were below the applicable NSW EPA assessment criteria at all assessment locations.

Table 9.2 Cumulative (project + background) concentration results

Assessment location ID	Predicted cumulative concentrations (µg/m³)				
	TSP	PM_{10}		$PM_{2.5}$	
	Annual	3rd highest 24-hour	Annual	2nd highest 24-hour	Annual
Criterion	**90**	**50**	**25**	**25**	**8**
R1	31.4	29.8	12.7	13.3	5.7
R6	31.8	31.5	12.9	14.9	5.8
R7	31.6	31.0	12.8	13.6	5.8
R10	31.8	31.5	12.9	14.2	5.8
R13	32.5	32.7	13.4	15.4	5.9
R14	31.9	30.7	12.9	13.4	5.8
R15	32.9	33.0	13.6	14.6	6.0
R18	31.5	29.8	12.8	13.7	5.8
R19	32.2	31.6	13.2	13.8	5.9
R21	31.2	29.8	12.5	13.3	5.7

Assessment location ID	Predicted cumulative concentrations (µg/m³)				
	TSP	PM_{10}		$PM_{2.5}$	
	Annual	3rd highest 24-hour	Annual	2nd highest 24-hour	Annual
Criterion	**90**	**50**	**25**	**25**	**8**
R22	31.6	30.5	12.8	13.4	5.8
R23	32.6	32.3	13.3	14.5	5.9
R24	31.5	30.3	12.7	13.3	5.7
R25	33.3	35.3	13.8	17.4	6.0
R28	31.5	30.5	12.7	13.6	5.8
R31	32.1	34.3	13.2	15.2	5.9
R34	31.5	30.3	12.7	13.3	5.8
R36	31.5	30.4	12.7	13.4	5.8
R38	32.5	32.2	13.1	14.3	5.9
R39	31.5	30.3	12.7	13.4	5.8
R42	31.8	30.6	12.9	13.4	5.8
R45	31.1	29.8	12.5	13.3	5.7
R47	31.5	30.7	12.8	13.5	5.8
R55	31.8	31.1	12.9	13.9	5.9
R65	31.1	29.8	12.5	13.4	5.7
R66	31.2	29.8	12.5	13.5	5.7
R67	31.9	30.6	13.0	13.8	5.9
R109	31.4	29.8	12.7	13.3	5.7
R139	32.2	31.7	13.1	14.1	5.9
R155	31.9	30.0	13.0	13.3	5.8
R165	32.4	32.1	13.1	14.2	5.9
R199	31.4	29.8	12.6	13.3	5.7
R237	31.9	31.2	13.0	13.7	5.8
R238	31.1	29.8	12.5	13.3	5.7
R241	31.3	29.8	12.6	13.3	5.7
R243	31.1	29.8	12.5	13.4	5.7
R244	31.3	30.1	12.6	13.4	5.7
R246	31.7	30.5	12.8	13.3	5.8
R248	31.4	29.8	12.6	13.3	5.7
R302	32.2	31.5	13.2	14.1	5.9

Assessment location ID	Predicted cumulative concentrations (µg/m³)				
	TSP	PM_{10}		$PM_{2.5}$	
	Annual	3rd highest 24-hour	Annual	2nd highest 24-hour	Annual
Criterion	**90**	**50**	**25**	**25**	**8**
R320	31.6	29.9	12.7	13.3	5.8
R321	31.6	29.9	12.7	13.3	5.8
R340	31.6	29.9	12.8	13.3	5.8
R344	31.6	29.9	12.8	13.3	5.8
R357	31.6	29.9	12.8	13.3	5.8
R360	31.6	29.8	12.8	13.3	5.8
R365	31.2	29.8	12.5	13.4	5.7
R366	31.2	29.8	12.5	13.4	5.7
R368	31.7	30.6	12.9	13.4	5.8
R386	31.6	29.9	12.7	13.3	5.8
R388	31.6	29.9	12.8	13.3	5.8
R389	31.5	29.9	12.7	13.3	5.8
R440	31.5	30.1	12.7	13.3	5.8
R578	31.7	30.4	12.9	13.3	5.8
R582	31.5	30.0	12.7	13.3	5.8
R584	32.0	31.3	13.0	14.1	5.8
R605	31.9	30.5	13.0	13.3	5.8
R608	31.7	30.4	12.9	13.3	5.8
R610	31.7	30.2	12.8	13.3	5.8
R623	31.7	30.4	12.8	13.3	5.8
R624	31.8	30.3	12.9	13.3	5.8
R653	31.3	29.8	12.6	13.3	5.7
R778	31.4	29.8	12.6	13.3	5.7
R910	31.3	29.8	12.6	13.3	5.7
R923	31.2	29.8	12.5	13.3	5.7
R946	31.1	29.8	12.5	13.3	5.7
R1035	31.2	29.8	12.5	13.3	5.7
R1462	31.2	29.8	12.5	13.3	5.7
R1465	31.2	29.8	12.5	13.3	5.7
R1507	31.1	29.8	12.4	13.3	5.7

Assessment location ID	Predicted cumulative concentrations (µg/m³)				
	TSP	PM_{10}		$PM_{2.5}$	
	Annual	3rd highest 24-hour	Annual	2nd highest 24-hour	Annual
Criterion	**90**	**50**	**25**	**25**	**8**
R1631	31.4	29.8	12.6	13.3	5.7
R1637	31.4	29.8	12.7	13.3	5.7
R1640	31.4	29.8	12.7	13.3	5.7
R1646	31.4	29.8	12.7	13.3	5.7
R1648	31.4	29.8	12.7	13.3	5.7
R1825	31.4	29.8	12.6	13.3	5.7
R1835	31.2	29.8	12.5	13.3	5.7
R1841	31.3	29.8	12.6	13.3	5.7
R1881	31.4	29.8	12.6	13.3	5.7
R1917	31.3	29.8	12.6	13.3	5.7
R1965	31.2	29.8	12.5	13.3	5.7
R1997	31.2	29.8	12.5	13.3	5.7
R1998	31.2	29.8	12.5	13.3	5.7
R1999	31.3	29.8	12.6	13.3	5.7
R2000	48.4	36.9	17.7	18.4	7.7
R2001	35.7	37.7	15.0	21.7	6.8
R2002	31.1	29.8	12.4	13.3	5.7
R2003	31.1	29.8	12.4	13.3	5.7
R2004	31.1	29.8	12.4	13.3	5.7
R2005	31.1	29.8	12.4	13.3	5.7
R2006	31.1	29.8	12.4	13.3	5.7
R2007	31.1	29.8	12.4	13.3	5.7
R2008	31.1	29.8	12.4	13.3	5.7
R2009	31.1	29.8	12.4	13.3	5.7
R2010	31.1	29.8	12.4	13.3	5.7
R2011	31.1	29.8	12.4	13.3	5.7
R2012	31.1	29.8	12.4	13.3	5.7
R2013	31.1	29.8	12.4	13.3	5.7
R2014	31.1	29.8	12.4	13.3	5.7
R2015	31.1	29.8	12.5	13.3	5.7

Assessment location ID	Predicted cumulative concentrations (µg/m³)				
	TSP	PM_{10}		$PM_{2.5}$	
	Annual	3rd highest 24-hour	Annual	2nd highest 24-hour	Annual
Criterion	**90**	**50**	**25**	**25**	**8**
R2016	31.1	29.8	12.5	13.3	5.7
R2017	31.1	29.8	12.5	13.3	5.7
R2018	31.1	29.8	12.5	13.3	5.7
R2019	31.1	29.8	12.5	13.3	5.7
R2020	31.1	29.8	12.5	13.3	5.7
R2021	31.1	29.8	12.5	13.3	5.7
R2022	31.1	29.8	12.5	13.3	5.7
R2023	31.1	29.8	12.5	13.3	5.7
R2024	31.1	29.8	12.4	13.3	5.7
R2025	31.1	29.8	12.4	13.3	5.7
R2026	31.1	29.8	12.4	13.3	5.7
R2027	31.1	29.8	12.4	13.3	5.7
R2028	31.1	29.8	12.4	13.3	5.7
R2029	31.1	29.8	12.4	13.3	5.7
R2030	31.1	29.8	12.4	13.3	5.7
R2031	31.1	29.8	12.4	13.3	5.7
R2032	31.1	29.8	12.4	13.3	5.7
R2033	31.1	29.8	12.4	13.3	5.7
R2034	31.1	29.8	12.4	13.3	5.7
R2035	31.1	29.8	12.4	13.3	5.7
R2036	31.1	29.8	12.4	13.3	5.7
R2037	31.1	29.8	12.5	13.3	5.7
R2038	31.1	29.8	12.4	13.3	5.7
R2039	31.1	29.8	12.5	13.3	5.7
R2040	31.1	29.8	12.5	13.3	5.7
R2041	31.1	29.8	12.5	13.3	5.7
R2042	31.1	29.8	12.5	13.3	5.7
R2043	31.1	29.8	12.5	13.3	5.7
R2044	31.1	29.8	12.5	13.3	5.7
R2045	31.1	29.8	12.5	13.3	5.7

Assessment location ID	Predicted cumulative concentrations (µg/m³)				
	TSP	PM_{10}		$PM_{2.5}$	
	Annual	3rd highest 24-hour	Annual	2nd highest 24-hour	Annual
Criterion	**90**	**50**	**25**	**25**	**8**
R2046	31.1	29.8	12.5	13.3	5.7
R2047	31.1	29.8	12.5	13.3	5.7
R2048	31.1	29.8	12.5	13.3	5.7
R2049	31.2	29.8	12.5	13.3	5.7
R2050	31.2	29.8	12.5	13.3	5.7
R2051	31.2	29.8	12.5	13.3	5.7
R2052	31.2	29.8	12.5	13.3	5.7
R2053	31.6	30.4	12.8	13.7	5.8
R2059	32.4	29.8	13.0	13.7	6.0
R2108	32.6	29.8	13.0	13.4	6.0
R2121	32.2	29.9	12.9	13.3	5.9
R2124	31.6	29.8	12.7	13.3	5.8
R2129	31.6	29.8	12.7	13.3	5.8
R2133	32.3	29.8	12.9	13.3	5.9
R2144	31.3	29.8	12.6	13.3	5.7
R2156	33.2	29.8	13.2	13.8	6.1
R2164	31.4	29.8	12.6	13.3	5.8
R2165	31.3	29.8	12.6	13.3	5.7
R2166	32.7	29.8	13.0	13.7	6.0
R2167	31.3	29.8	12.6	13.3	5.7
R2168	32.7	29.9	13.0	13.3	6.0
R2176	32.5	29.8	13.0	13.9	6.0
R2178	31.6	29.8	12.7	13.3	5.8
R2180	31.6	29.8	12.7	13.3	5.8
R2184	32.6	29.8	13.0	13.8	6.0
R2200	34.5	29.8	13.5	15.4	6.2
R2238	32.3	29.8	12.9	13.5	5.9
R2252	32.5	29.8	13.0	13.9	6.0
R2269	32.4	29.8	13.0	13.8	6.0
R2278	31.7	29.8	12.7	13.3	5.8

Assessment location ID	Predicted cumulative concentrations (µg/m³)				
	TSP	PM_{10}		$PM_{2.5}$	
	Annual	3rd highest 24-hour	Annual	2nd highest 24-hour	Annual
Criterion	**90**	**50**	**25**	**25**	**8**
R2283	32.6	29.8	13.0	13.9	6.0
R2291	32.7	29.8	13.1	13.3	6.0
R2311	31.9	29.9	12.8	13.8	5.9
R2312	32.1	29.9	12.9	14.0	5.9
R2313	32.1	29.9	12.9	14.0	5.9
R2314	32.1	29.9	12.9	14.0	5.9
R2315	32.4	30.0	13.0	14.1	5.9
R2316	31.5	29.9	12.7	13.6	5.8
R2317	31.5	29.9	12.7	13.7	5.8
R2318	31.5	29.9	12.7	13.7	5.8
R2319	31.5	29.8	12.7	13.6	5.8
R2320	31.5	29.8	12.6	13.5	5.8
R2321	31.5	29.8	12.6	13.5	5.8
R2322	31.5	29.8	12.6	13.5	5.8
R2323	31.5	29.8	12.6	13.5	5.8
R2324	32.1	29.9	12.8	13.9	5.9
R2325	32.1	29.9	12.9	14.0	5.9
R2326	31.5	29.9	12.7	13.7	5.8
R2327	31.5	29.9	12.7	13.7	5.8
R2328	32.2	30.0	12.9	14.1	5.9
R2329	32.2	30.0	12.9	14.1	5.9
R2330	32.1	29.9	12.9	14.1	5.9
R2332	31.5	29.8	12.7	13.6	5.8
R2333	31.9	29.9	12.8	13.8	5.8
R2334	31.5	29.9	12.7	13.6	5.8
R2368	32.4	29.8	12.9	13.3	5.9
R2384	31.3	29.8	12.6	13.3	5.7
R2388	31.5	29.9	12.7	13.7	5.8
R2391	31.5	29.8	12.7	13.5	5.8
R2402	32.1	29.8	12.9	13.3	5.9

Assessment location ID	Predicted cumulative concentrations (µg/m³)				
	TSP	PM_{10}		$PM_{2.5}$	
	Annual	3rd highest 24-hour	Annual	2nd highest 24-hour	Annual
Criterion	**90**	**50**	**25**	**25**	**8**
R2403	34.9	30.2	13.7	15.2	6.3
R2415	31.3	29.8	12.6	13.4	5.7
R2416	31.5	29.9	12.7	13.7	5.8
R2417	31.5	29.9	12.7	13.7	5.8
R2421	31.7	29.8	12.7	13.5	5.8
R2423	31.6	29.8	12.7	13.3	5.8
R2427	31.3	29.8	12.6	13.3	5.7
R2429	31.2	29.8	12.6	13.3	5.7
R2437	31.2	29.8	12.6	13.3	5.7
R2441	31.2	29.8	12.6	13.3	5.7
R2448	31.3	29.8	12.6	13.3	5.7
R2452	31.2	29.8	12.6	13.3	5.7
R2454	31.2	29.8	12.6	13.3	5.7
R2455	31.3	29.8	12.6	13.3	5.7
R2456	31.2	29.8	12.6	13.3	5.7
R2469	31.3	29.8	12.6	13.3	5.7
R2473	31.1	29.8	12.4	13.3	5.7
R2474	31.1	29.8	12.4	13.3	5.7
R2475	31.1	29.8	12.4	13.3	5.7
R2476	31.1	29.8	12.4	13.3	5.7
R2477	31.1	29.8	12.4	13.3	5.7
R2478	31.1	29.8	12.4	13.3	5.7
R2479	31.1	29.8	12.4	13.3	5.7
R2480	31.1	29.8	12.5	13.3	5.7
R2481	31.1	29.8	12.4	13.3	5.7
R2482	31.1	29.8	12.5	13.3	5.7
R2483	31.1	29.8	12.5	13.3	5.7
R2484	31.1	29.8	12.4	13.3	5.7
R2485	31.1	29.8	12.4	13.3	5.7
R2486	31.1	29.8	12.4	13.3	5.7

Assessment location ID	Predicted cumulative concentrations (µg/m³)				
	TSP	PM_{10}		$PM_{2.5}$	
	Annual	3rd highest 24-hour	Annual	2nd highest 24-hour	Annual
Criterion	**90**	**50**	**25**	**25**	**8**
R2487	31.1	29.8	12.4	13.3	5.7
R2488	31.7	30.4	12.8	13.3	5.8
R2489	31.9	29.9	12.8	13.8	5.9
R2490	31.1	29.8	12.4	13.3	5.7

10 Management and mitigation

10.1 Fugitive particulate matter emissions

LLP is committing to the management of particulate matter emissions from the project's construction and operation.

Table 10.1 provides an overview of the relevant applicable best practice dust control management measures as listed in the NSW Coal Benchmarking Study: *International Best Practice to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining* (Katestone 2011) (The Best Practice Report). The Best Practice Report was a study prepared by Katestone Environmental Pty Ltd in 2011 and was commissioned by the NSW EPA.

Whilst the project is not a coal mine, similar practices are employed between coal mines and the construction of the project, therefore, a comparison of the proposed dust control measures for the project with the Best Practice Report management techniques, has been undertaken.

Table 10.1 also includes the percentage control factor applied in the dispersion modelling.

Measures to be implemented at the project and included in the emissions estimation (where emission reduction factors exist) include:

- minimising vehicle travel speeds
- ensuring internal routes are kept moist with the use of water carts
- watering of exposed areas where practical
- watering during unloading of spoil
- watering unpaved haul routes
- water injection through drill holes.

Table 10.1 Overview of best practice measures for the project

Emissions source category	Best practice control measures (Katestone 2011)	Proposed implementation	Comments	Effectiveness of reduction in emissions inventory
Blasting & drilling	Fabric filter	No	-	-
	Cyclone	No	-	-
	Water injection	Yes	-	70%
	Delay shot to avoid unfavourable weather conditions	Yes	-	Not quantified in emissions estimates
	Minimise area blasted in design phase	Yes	-	Not quantified in emissions estimates
Dozers	Minimise travel speed and distance	Yes	-	Not quantified in emissions estimates
	Keep travel routes and materials moist	Yes	-	50%
Haul roads and grading	Surface treatment – watering	Yes	-	75%
	Surface treatment - chemical suppressants	Yes	Only if required	Not quantified in emissions estimates
	Surface treatment - hygroscopic salts	No	-	-
	Surface treatment – lignosulphonates	No	-	-
	Surface treatment - polymer emulsions	No	-	-
	Surface treatment - tar and bitumen emulsions	No	-	-
	Surface improvements - low silt aggregate	No	-	-
	Surface improvements - pave the surface	No	Permeant internal haul roads will be paved following the completion of construction	-
	Surface improvements - oil and double chip surface	No	-	-
	Reduction in vehicle travel speed	No	Vehicles will be travelling relatively slow due to steep grades	-
	Use larger vehicles rather than smaller vehicles to minimise number of trips	Yes	Using largest vehicles possible	Haul truck weight included. No specific control applied.

Emissions source category	Best practice control measures (Katestone 2011)	Proposed implementation	Comments	Effectiveness of reduction in emissions inventory
	Use conveyors in place of haul roads	No	-	-
	Grader speed reduction from 16 kilometres per hour (km/h) to 8 km/h	No	Unsafe for plant to travel at different speeds	-
	Watering grader routes	Yes	Watering vehicle has been allocated to every fleet	-
Wind erosion from exposed areas (e.g. spoil emplacement)	Avoidance - bypassing stockpiles	Yes	-	Not quantified in emissions estimates
	Surface stabilisation - watering	Yes	-	Not quantified in emissions estimates
	Surface stabilisation - chemical suppressants	Yes	Only if required	Not quantified in emissions estimates
	Surface stabilisation - surface crusting agent	No	-	-
	Surface stabilisation - carry over wetting from load in	No	-	-
	Enclosure - silo with bag house	No	-	-
	Enclosure - cover storage pile with a tarp during high wind speeds	No	-	-
	Wind speed reduction - vegetative wind breaks	No	-	-
	Wind speed reduction - reduced pile height	Yes	-	Not quantified in emissions estimates
	Wind speed reduction - wind screens/wind fences	No	-	-
	Wind speed reduction - pile shaping/orientation	Yes	-	Not quantified in emissions estimates
	Wind speed reduction - three-sided enclosure around storage piles	No	-	-
Loading and dumping spoil	Truck and excavator/FEL dumping - minimise drop height (from 3 m to 1.5 m)	No	Majority of material will be blasted rockfill	-
	Truck dumping - water application	Yes	-	50%
	Truck dumping - modify activities in windy conditions	Yes	-	Not quantified in emissions estimates

Emissions source category	Best practice control measures (Katestone 2011)	Proposed implementation	Comments	Effectiveness of reduction in emissions inventory
	Dumping to a bin (if applicable) - three sided and roofed enclosure	No	-	-
	Dumping to a bin (if applicable) - three sided and roofed enclosure with water sprays	No	-	-
	Dumping to a bin (if applicable) - enclosure with control device	No	-	-
Crushing/screening	Water spays	No	-	-
	Enclosed building	No	-	-

10.2 Diesel combustion emissions

The following management practices will be implemented where feasible to minimise emissions from the combustion of diesel during the project's construction and operational phases:

- where feasible, mobile and stationary equipment compliant with a more recent emission standard than USEPA Tier 2 will be sourced
- unpaved roads will be routinely maintained to reduce truck tyre rolling resistance
- all equipment will be routinely serviced to maintain manufacturers' emission specifications
- idling of diesel equipment will be minimised wherever feasible
- low-sulphur diesel fuels and lubricants will be used where feasible.

11 Conclusions

EMM was engaged by LLP to undertake an AQIA for the project. The AQIA has been conducted following the methods prescribed in the *Approved Methods for Modelling* (NSW EPA 2022).

Background concentrations were adopted for the 2023 calendar year using data collected at the NSW DCCEEW Bathurst AQMS. Meteorological modelling was completed using TAPM and CALMET, with real-world observations incorporated from the BoM Marrangaroo AWS.

Emissions of TSP, PM_{10} and $PM_{2.5}$ associated with the project were quantified using publicly available emission estimation techniques. Atmospheric dispersion model predictions for the proposed activities were undertaken using the CALPUFF dispersion modelling system.

The results of the modelling show that the predicted concentrations and deposition rates for incremental TSP, PM_{10}, $PM_{2.5}$ and dust deposition during the project's construction phase were below the NSW EPA impact assessment criterion at all assessment locations, with the exception of one. Annual average dust deposition was exceeded at assessment location R2000 as a result of construction activities related to the construction of the Lakeside accommodation camp. It is noted however that R2000 represents the Lakeside accommodation camp itself and therefore would not exist as an assessment location at the time of the construction of the accommodation camp. The accommodation camp however may exist simultaneously with the construction activities occurring at the main project area which is the reason it was included in the dispersion model.

Cumulative impacts were assessed by combining the adopted background concentrations with the predicted incremental concentrations from the project. The cumulative results showed that during the project's construction phase, compliance with NSW EPA impact assessment criterion was predicted at all assessment locations.

A range of best practice dust mitigation measures are proposed for the project. These include the use water sprays, and measures to reduce diesel combustion.

References

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NSW EPA 2022, *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*. New South Wales Environment Protection Authority, Parramatta.

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US-EPA 1998, AP-42 Chapter 11.9.9 – Western surface coal mining.

US-EPA 2004, AP-42 Chapter 11.19.2 – Crushed Stone Processing and Pulverized Mineral Processing

US-EPA 2006, AP-42 Chapter 13.2.2 – Unpaved Roads.

US-EPA 2006b, AP-42 Chapter 13.2.4 – Aggregate Handling and Storage Piles.

US-EPA 2016, Nonroad Compression-Ignition Engines: Exhaust Emission Standards (EPA-420-B-16-022, March 2016).

Abbreviations

AAQNEPM	Ambient Air Quality National Environment Protection Measure
AHD	Australian Height Datum
AQIA	air quality impact assessment
AQMS	air quality monitoring station
AWS	automatic weather station
BoM	Bureau of Meteorology
CBP	concrete batching plant
CO	carbon monoxide
CO_2	carbon dioxide
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EIS	environmental impact statement
EMM	EMM Consulting Pty Limited
km	kilometre
km/h	kilometre per hour
LGA	local government area
m	metre
NSW DCCEEW	NSW Department of Climate Change, Energy, the Environment and Water
NSW EPA	NSW Environment Protection Authority
NO_x	oxides of nitrogen
NO_2	nitrogen dioxide
NPI	National Pollution Inventory
PHES	pumped hydro energy storage
PM_{10}	Particulate matter less than 10 micrometres in aerodynamic diameter
$PM_{2.5}$	Particulate matter less than 2.5 micrometres in aerodynamic diameter
SEARs	Secretary's environmental assessment requirements
SO_2	sulfur dioxide
TAPM	The Air Pollution Model
tpa	tonnes per annum
TSP	total suspected particulate
US-EPA	United States Environmental Protection Agency
VKT	vehicle kilometres travelled
VOC	volatile organic compounds

Annexure A
Assessment locations

EMM
creating opportunities

Table A.1 Assessment locations

ID	Classification	Coordinates (MGA 56)	
		Easting (m)	Northing (m)
R1	Residential	233359	6290667
R6	Residential	228746	6288572
R7	Residential	231765	6287957
R10	Residential	230605	6288326
R13	Residential	230240	6288771
R14	Residential	231613	6289046
R15	Residential	228913	6288974
R18	Residential	228234	6289307
R19	Residential	229012	6288858
R21	Residential	227688	6288830
R22	Residential	231999	6288404
R23	Residential	230537	6288706
R24	Residential	232644	6288419
R25	Residential	228671	6288878
R28	Commercial	229028	6288267
R31	Residential	229773	6288690
R34	Residential	232567	6288369
R36	Residential	232354	6288146
R38	Residential	231063	6288361
R39	Residential	232531	6288283
R42	Residential	231723	6289085
R45	Commercial	228551	6286670
R47	Residential	231978	6288067
R55	Residential	229919	6287000
R65	Residential	225945	6289856
R66	Residential	226893	6289736
R67	Residential	230114	6287574
R109	Residential	233370	6290522
R139	Residential	231153	6288517
R155	Residential	231914	6290299
R165	Residential	230903	6288455

ID	Classification	Coordinates (MGA 56)	
		Easting (m)	Northing (m)
R199	Residential	231525	6292310
R237	Residential	231328	6288778
R238	Passive Recreation	228572	6286936
R241	Residential	232090	6292867
R243	Residential	225779	6290081
R244	Residential	229800	6286280
R246	Residential	231959	6289041
R248	Residential	232162	6292036
R302	Residential	229282	6288838
R320	Residential	232828	6290065
R321	Residential	232832	6290093
R340	Residential	232748	6290191
R344	Residential	232666	6290247
R357	Residential	232558	6290496
R360	Residential	232559	6290595
R365	Accommodation	227114	6289196
R366	Accommodation	226893	6289604
R368	Residential	231784	6288885
R386	Residential	232843	6290151
R388	Residential	232588	6290373
R389	Residential	232889	6290006
R440	Residential	232853	6289471
R578	Residential	232016	6289304
R582	Hospital/Classroom	233011	6289667
R584	Residential	229433	6288684
R605	Residential	231777	6289375
R608	Residential	232057	6289378
R610	Residential	232232	6289548
R623	Residential	232079	6289127
R624	Residential	232030	6289583
R653	Residential	233409	6291745
R778	Residential	233538	6291307

ID	Classification	Coordinates (MGA 56)	
		Easting (m)	Northing (m)
R910	Accommodation	233202	6292598
R923	Residential	231650	6293838
R946	Residential	225188	6288195
R1035	Residential	232453	6293112
R1462	Residential	232042	6293773
R1465	Residential	233003	6292909
R1507	Residential	225125	6287880
R1631	Residential	233499	6291218
R1637	Residential	233375	6290792
R1640	Residential	233409	6290917
R1646	Residential	233430	6291027
R1648	Residential	233438	6291058
R1825	Residential	233496	6291405
R1835	Industrial	230630	6294045
R1841	Accommodation	233096	6292708
R1881	Residential	233412	6291556
R1917	Commercial	233418	6292391
R1965	Residential	232712	6293072
R1997	Residential	232358	6293523
R1998	Industrial	230916	6294318
R1999	Residential	233344	6292074
R2000	Accommodation (Lakeside accommodation camp)	229561	6287337
R2001	Passive Recreation	229832	6291213
R2002	Residential	227767	6284544
R2003	Residential	227281	6284558
R2004	Residential	226845	6285397
R2005	Residential	226442	6284584
R2006	Residential	225644	6284596
R2007	Residential	225072	6285422
R2008	Residential	224558	6285726
R2009	Residential	224393	6286412
R2010	Residential	224446	6286750

ID	Classification	Coordinates (MGA 56)	
		Easting (m)	Northing (m)
R2011	Residential	224413	6287038
R2012	Residential	223450	6288514
R2013	Residential	223438	6289124
R2014	Residential	223837	6289221
R2015	Residential	223864	6290445
R2016	Residential	224531	6290814
R2017	Residential	224430	6290873
R2018	Residential	224380	6290968
R2019	Residential	224571	6291028
R2020	Residential	224450	6291052
R2021	Residential	224406	6291125
R2022	Residential	224418	6291212
R2023	Active Recreation	224633	6291263
R2024	Residential	224366	6291330
R2025	Residential	224372	6291360
R2026	Residential	224384	6291441
R2027	Residential	224372	6291499
R2028	Residential	224381	6291537
R2029	Residential	224227	6291686
R2030	Residential	224192	6291787
R2031	Residential	224370	6291952
R2032	Residential	224269	6292290
R2033	Residential	224047	6293158
R2034	Residential	224424	6293244
R2035	Residential	223676	6294187
R2036	Residential	224162	6295015
R2037	Residential	225608	6296536
R2038	Residential	225144	6296852
R2039	Residential	226877	6297504
R2040	Residential	227585	6297436
R2041	Residential	228103	6297367
R2042	Industrial	227946	6296601

ID	Classification	Coordinates (MGA 56)	
		Easting (m)	Northing (m)
R2043	Residential	228853	6297348
R2044	Residential	229253	6297164
R2045	Residential	229893	6297243
R2046	Residential	230543	6297133
R2047	Residential	231158	6297000
R2048	Residential	231171	6296380
R2049	Industrial	231756	6295798
R2050	Residential	231087	6295076
R2051	Residential	230908	6294708
R2052	Commercial	231125	6294544
R2053	Residential	229641	6286875
R2059	Residential	235855	6291368
R2108	Residential	235804	6291334
R2121	Residential	235956	6291307
R2124	Residential	235749	6291368
R2129	Residential	235749	6291376
R2133	Residential	235787	6291331
R2144	Residential	235638	6291369
R2156	Residential	235878	6291335
R2164	Residential	235694	6291367
R2165	Residential	235654	6291371
R2166	Residential	235812	6291339
R2167	Residential	235623	6291367
R2168	Residential	235932	6291307
R2176	Residential	235844	6291360
R2178	Residential	236017	6291333
R2180	Residential	236039	6291298
R2184	Residential	235821	6291346
R2200	Residential	235851	6291320
R2238	Residential	235863	6291374
R2252	Residential	235838	6291356
R2269	Residential	235848	6291363

ID	Classification	Coordinates (MGA 56)	
		Easting (m)	Northing (m)
R2278	Residential	235726	6291328
R2283	Residential	235830	6291352
R2291	Residential	235895	6291339
R2311	Residential	235681	6291014
R2312	Residential	235685	6290980
R2313	Residential	235687	6290964
R2314	Residential	235689	6290947
R2315	Residential	235697	6290884
R2316	Residential	235631	6290956
R2317	Residential	235639	6290896
R2318	Residential	235637	6290909
R2319	Residential	235628	6290981
R2320	Residential	235627	6290994
R2321	Residential	235625	6291005
R2322	Residential	235624	6291018
R2323	Residential	235622	6291029
R2324	Residential	235683	6290997
R2325	Residential	235691	6290934
R2326	Residential	235642	6290872
R2327	Residential	235640	6290883
R2328	Residential	235694	6290910
R2329	Residential	235696	6290897
R2330	Residential	235693	6290921
R2332	Residential	235630	6290968
R2333	Residential	235680	6291060
R2334	Residential	235633	6290943
R2368	Residential	235908	6291348
R2384	Community	235628	6291444
R2388	Residential	235643	6290858
R2391	Commercial	235649	6291145
R2402	Residential	235919	6291354
R2403	Residential	235753	6290950

ID	Classification	Coordinates (MGA 56)	
		Easting (m)	Northing (m)
R2415	Commercial	235566	6290979
R2416	Residential	235638	6290921
R2417	Residential	235636	6290934
R2421	Services	235704	6291265
R2423	Community	235698	6291298
R2427	Commercial	235509	6291151
R2429	Residential	235309	6290760
R2437	Residential	235321	6290797
R2441	Residential	235303	6290724
R2448	Residential	235300	6290705
R2452	Residential	235306	6290743
R2454	Residential	235313	6290779
R2455	Residential	235375	6290826
R2456	Residential	235338	6290822
R2469	Residential	235570	6291351
R2473	Residential	227497	6284203
R2474	Residential	226265	6284185
R2475	Residential	226504	6284286
R2476	Residential	226243	6283555
R2477	Residential	226350	6283331
R2478	Residential	226627	6285411
R2479	Residential	223496	6285882
R2480	Residential	226143	6287808
R2481	Residential	224819	6288149
R2482	Residential	225380	6288991
R2483	Residential	226088	6289398
R2484	Residential	223207	6291142
R2485	Residential	223633	6291318
R2486	Residential	223813	6291871
R2487	Residential	224119	6291569
R2488	Residential	232060	6289085
R2489	Residential	235680	6291035

ID	Classification	Coordinates (MGA 56)	
		Easting (m)	Northing (m)
R2490	Residential	227020	6286357

Annexure B
Metrological analysis

EMM
creating opportunities

B.1 Meteorological data analysis for the BoM Marangaroo (Defence) AWS – 2019 to 2023

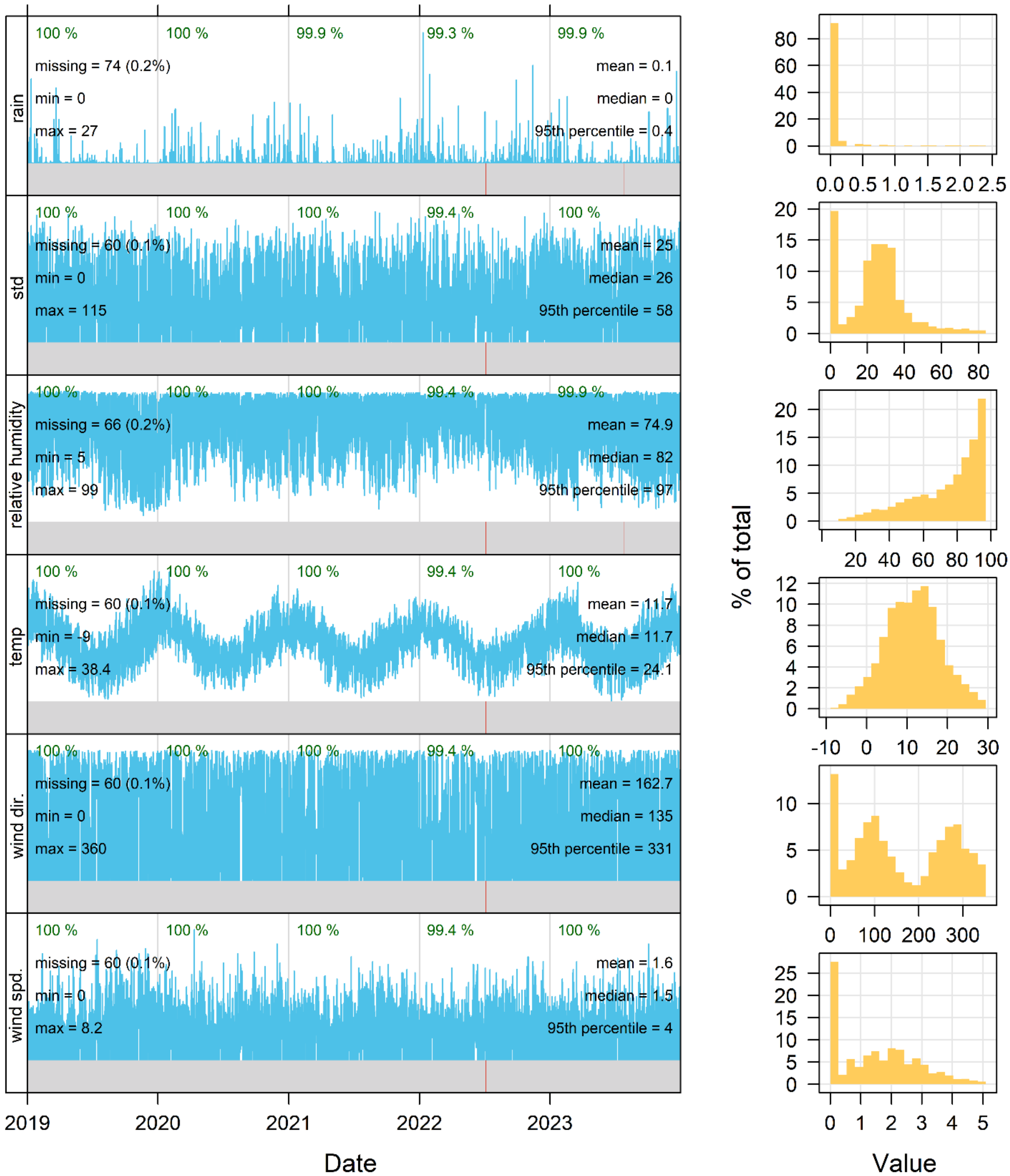


Figure B.1 Data completeness analysis plot – BoM Marangaroo (Defence) AWS – 2019 to 2023

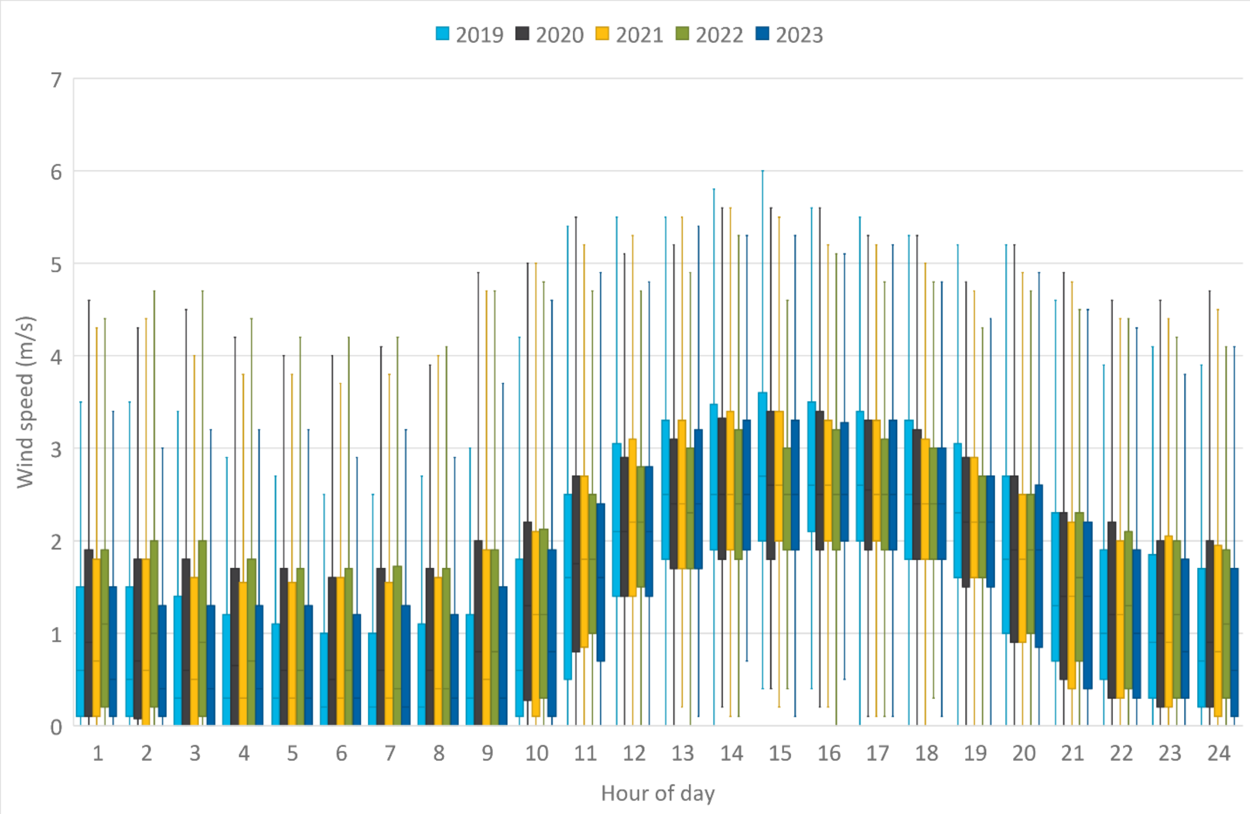


Figure B.2 **Inter-annual variability in diurnal wind speed – BoM Marangaroo (Defence) AWS – 2019 to 2023**

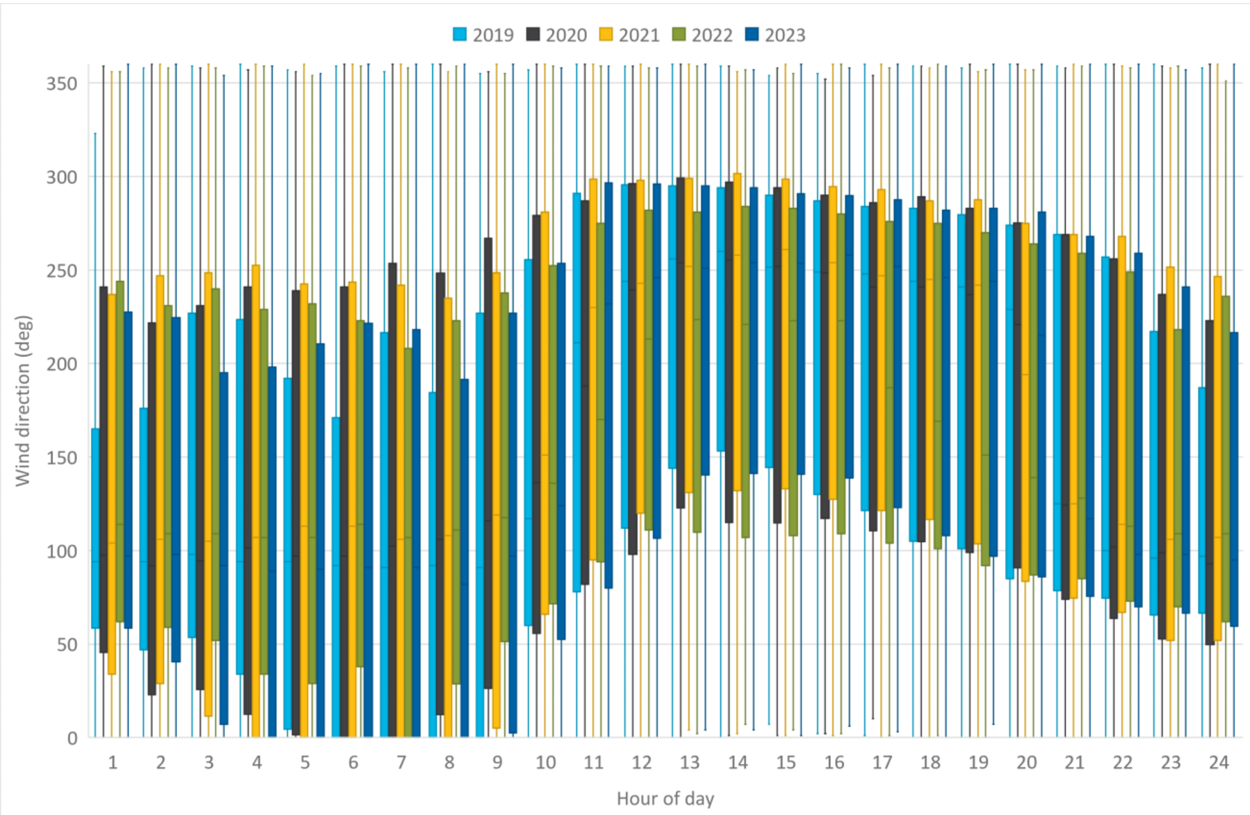


Figure B.3 **Inter-annual variability in diurnal wind direction – BoM Marangaroo (Defence) AWS – 2019 to 2023**

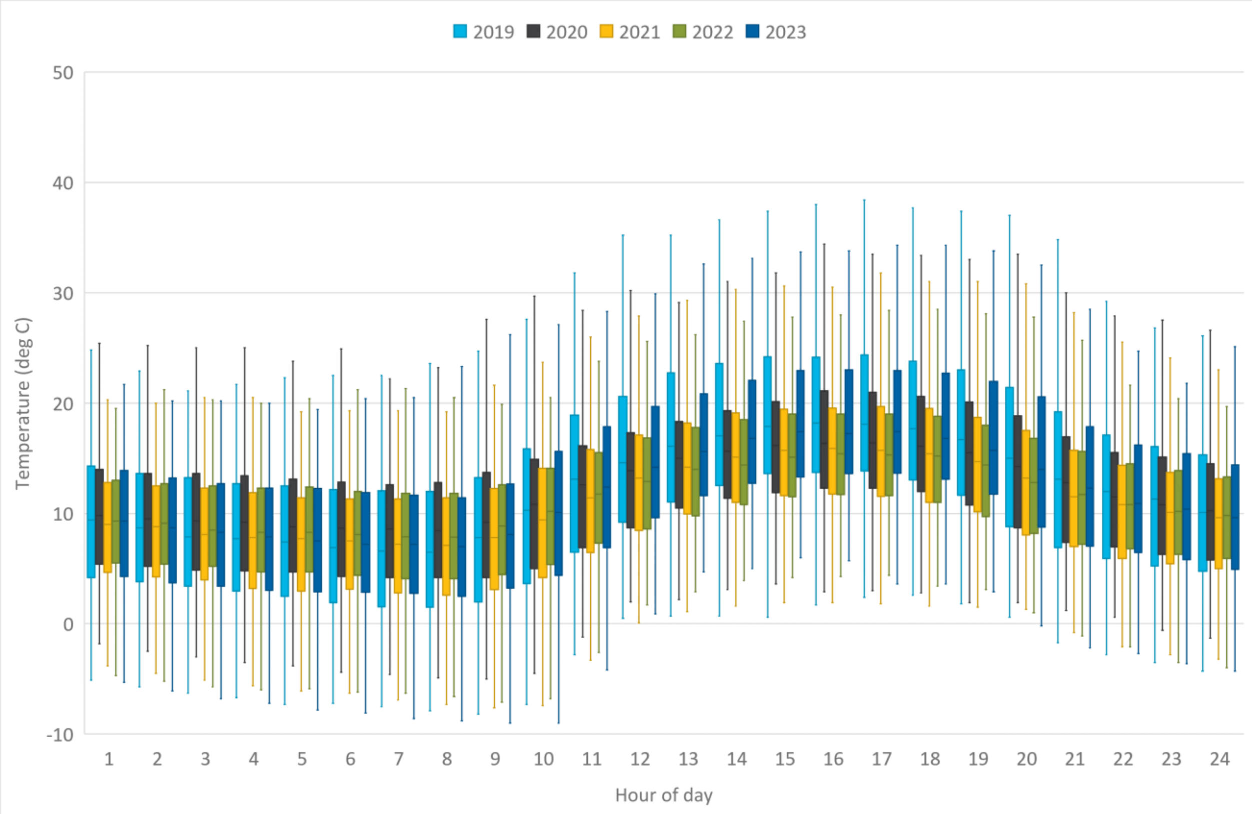


Figure B.4 **Inter-annual variability in diurnal air temperature – BoM Marangaroo (Defence) AWS – 2019 to 2023**

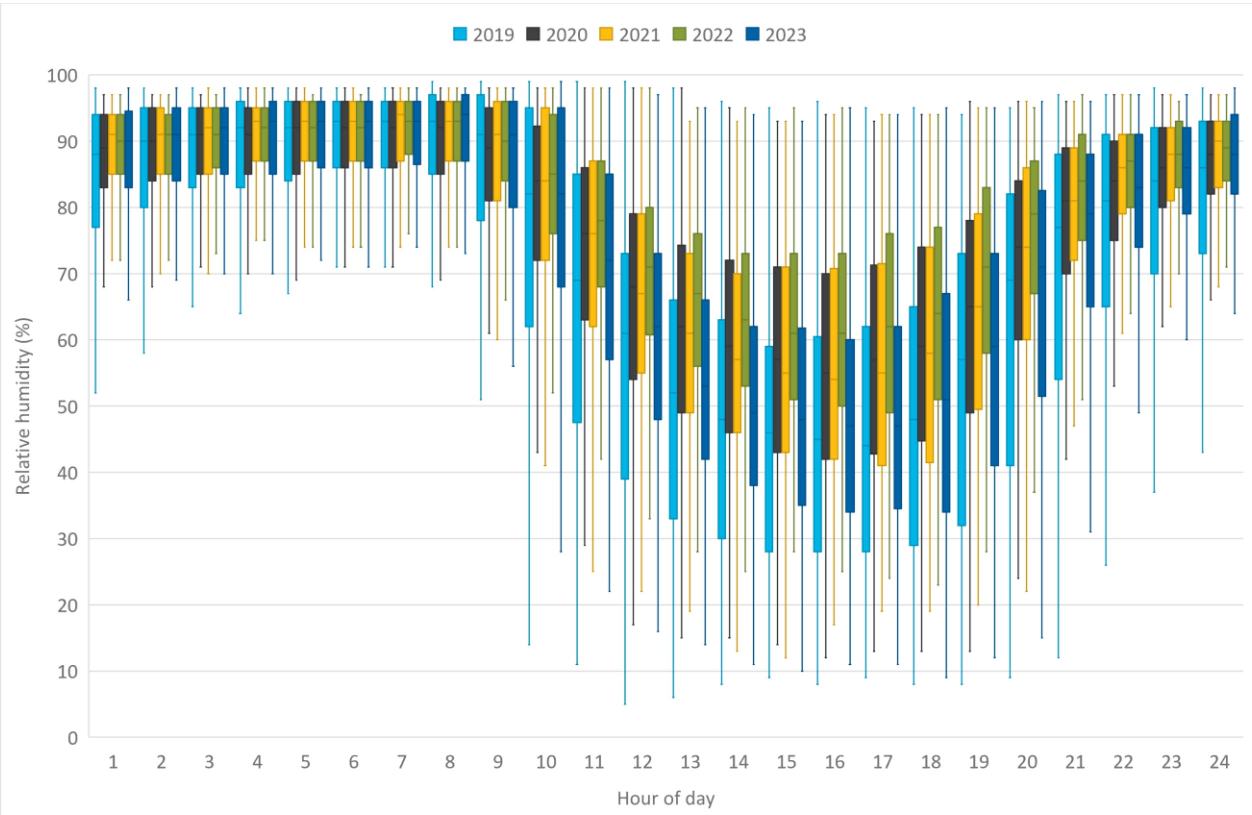


Figure B.5 **Inter-annual variability in diurnal relative humidity – BoM Marangaroo (Defence) AWS – 2019 to 2023**

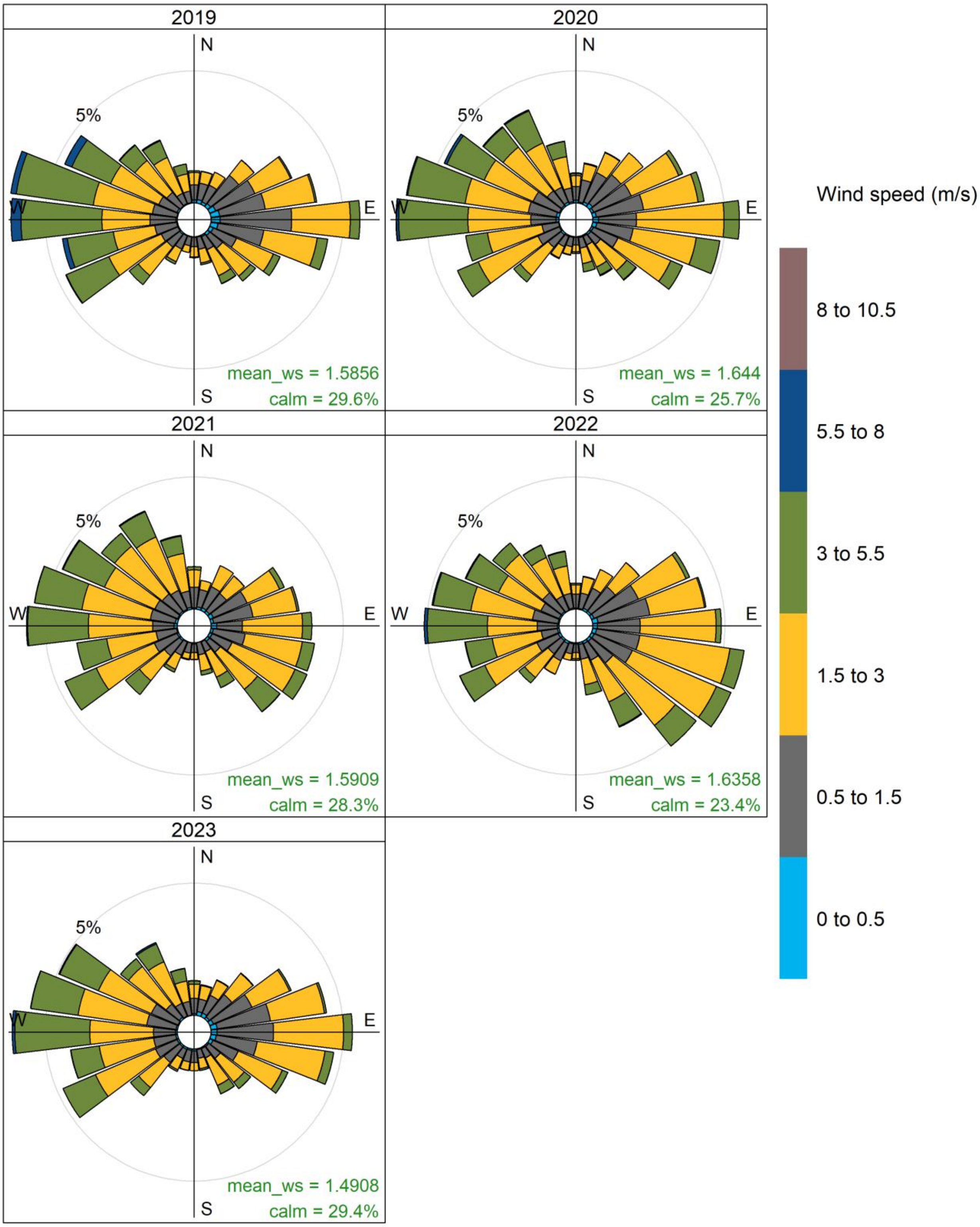


Figure B.6 Inter-annual comparison of recorded wind speed and direction – BoM Marangaroo (Defence) AWS – 2019 to 2023

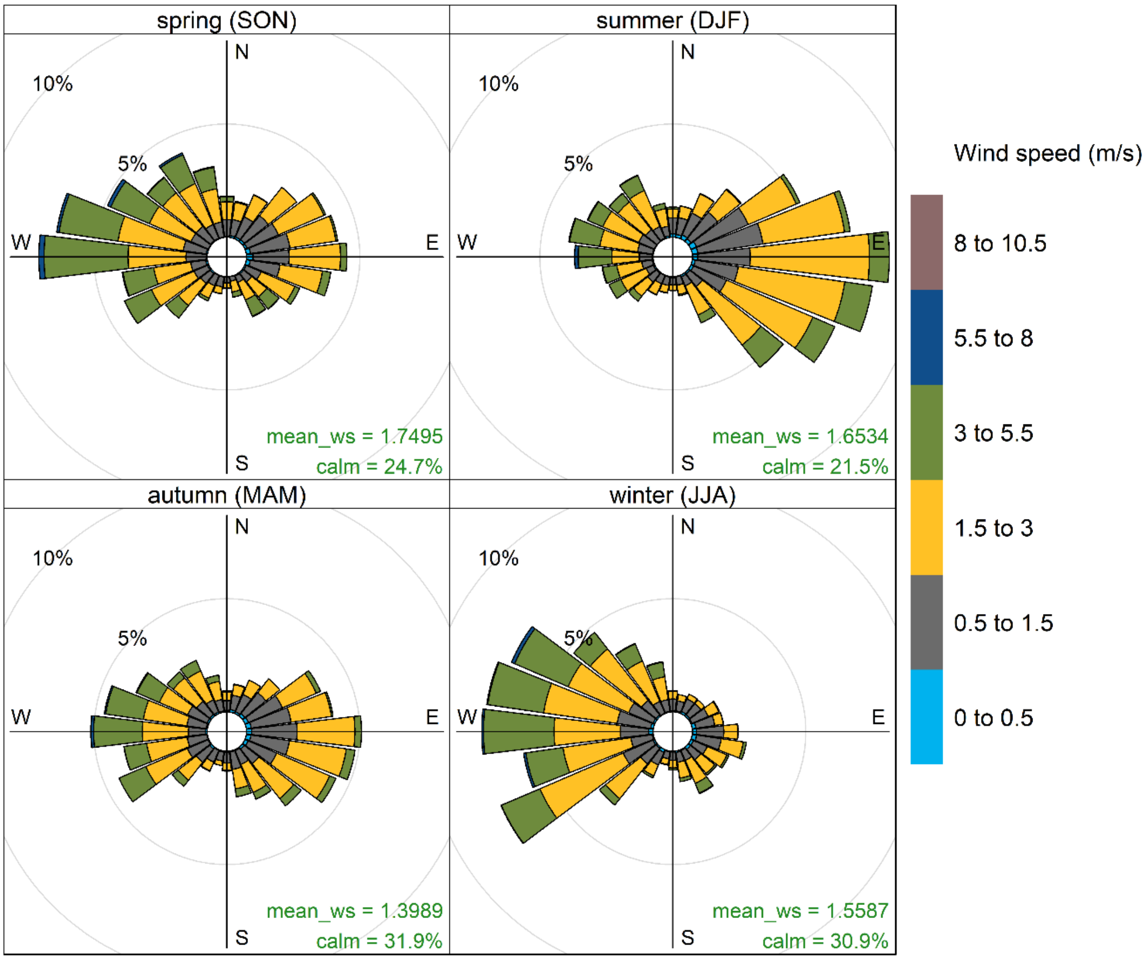


Figure B.7 Seasonal wind speed and direction – BoM Marangaroo (Defence) AWS – 2019 to 2023

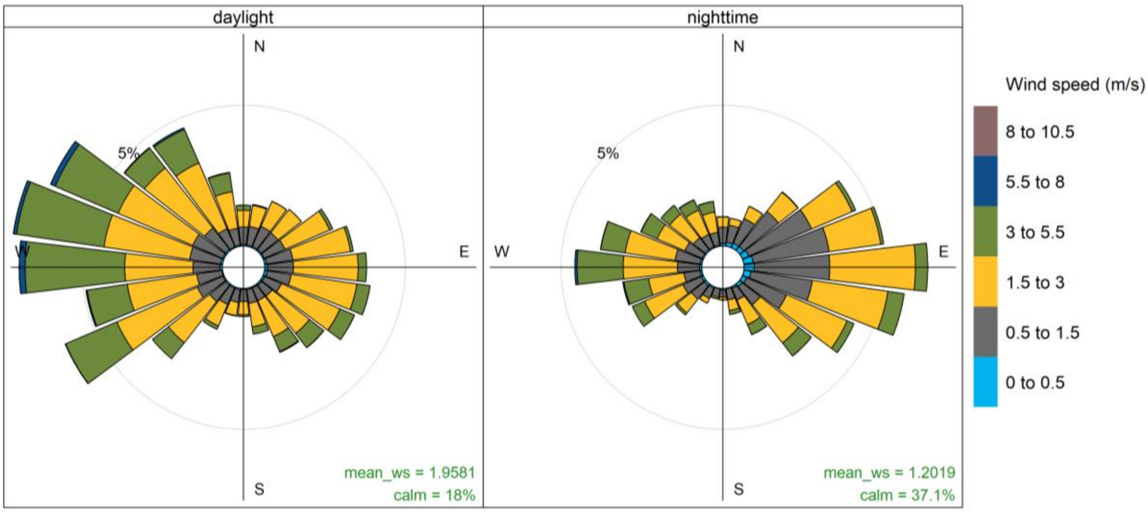


Figure B.8 Diurnal wind speed and direction – BoM Marangaroo (Defence) AWS – 2019 to 2023

B.2 Meteorological modelling

B.2.1 TAPM modelling

The CSIRO prognostic meteorology model TAPM was used to generate the required upper air prognostic dataset required for AERMET modelling.

TAPM was configured and run as follows:

- TAPM version 4.0.4.
- Inclusion of high resolution (90 m) regional topography (improvement over default 250 m resolution data).
- Grid domains with cell resolution of 30 km, 10 km and 3 km. Each grid domain features 25 x 25 horizontal grid points and 35 vertical levels.
- TAPM default databases for land use, synoptic analysis and asea surface temperature.
- TAPM defaults for advanced meteorological inputs.
- Two 'spin-up' days allowed at the beginning and end of the run.

B.2.2 CALMET

The CALMET/CALPUFF model suite was chosen for this study. CALMET was used to produce three-dimensional meteorological fields for use in the CALPUFF model.

In the absence of upper air measurements, CALMET can be run using prognostic upper air data (as a three-dimensional '3D.dat' file), which is used to derive an initial wind field (known as the Step 1 wind field in the CALMET model). The model then incorporates mesoscale and local scale effects, including surface observations, to adjust the wind field. This modelling approach is known as the 'hybrid' approach (TRC 2011) and is adopted for this assessment. TAPM was used to generate gridded upper air data for each hour of the model run period, for input into CALMET.

A CALMET modelling domain was configured with a modelling grid of 20 km (x axis) by 20 km (y axis) with a resolution of 250 m. Surface meteorological data from the BoM Marrangaroo (Defence) AWS were incorporated into the modelling. A TAPM-generated 3D.dat file with 3 km grid resolution was used as prognostic input file to Step 1 wind field calculations.

The observations at the surface stations provided the dominant influence on the derived wind field and the resultant dispersion meteorology within the model. The distance at which the observation influences the model (radius of influence) is determined by the CALMET setting 'RMAX'. The relative importance of the observation in the model (relative weighting of the Step 1 wind field and the observation) is determined by the CALMET setting 'R1'.

An RMAX value of 6 km was selected to allow for the influence of each meteorological observation stations on the surrounding area in CALMET calculations. A weighting value of 3 km was selected for R1 to enable the gradual decrease in influence of surface observations with distance from the monitoring location.

To resolve the local topography in wind field calculations, consistent with section 3.2.3 of TRC (2011), the radius of influence of terrain features (TERRAD) value was calculated based on the ridge-to-ridge dimension of the dominant terrain features in the modelling domain (measured at approximately between 4 km) divided by two plus 1 km. This returned a TERRAD value of 3 km.

The detailed CALMET model options used are presented in Table B.1. These were selected in accordance with recommendations in TRC (2011). Surface observations were included in the modelling (referred to as data assimilation) to provide real-world observations and improve accuracy of the wind fields.

Table B.1 CALMET model options used

Flag	Descriptor	Default	Value used
IEXTRP	Extrapolate surface wind observations to upper layers	Similarity theory	Similarity theory
BIAS (NZ)	Relative weighting given to vertically extrapolated surface observations versus upper air data	No default	-1, -0.5, -0.25, -0.1, 0, 0, 0, 0, 0, 0
TERRAD	Radius of influence of terrain	No default	3
RMAX1 and RMAX2	Maximum radius of influence over land observations in layer 1 and aloft	No default	6 (RMAX1) and 6 (RMAX2)
R1 and R2	Distance from observations in layer 1 and aloft at which observations and Step 1 wind field are weighted equally	No default	3 (R1) and 3 (R2)

Annexure C

Emissions inventory detail

C.1 Introduction

Particulate matter emissions were quantified through the application of accepted published emissions estimation factors, collated from a combination of United States Environmental Protection Agency (US-EPA) AP-42 Air Pollutant Emissions Factors and NPI emission estimation manuals, including:

- NPI Emissions Estimation Technique Manual for Combustion Engines (NPI 2008)
- NPI Emission Estimation Technique Manual for Mining (NPI 2012)
- US-EPA AP-41 Chapter 11.9, Table 11.9-4 – Drilling (US-EPA 1998)
- US-EPA AP-41 Chapter 11.9, Table 11.9-4 – Blasting (US-EPA 1998)
- US-EPA AP-42 Chapter 11.9, Table 11.9-4 – Wind erosion of exposed areas (US-EPA 1998)
- US-EPA AP-42 Chapter 11.9, Table 11.19.2-1 – Tertiary crushing (controlled) (US-EPA 2004)
- US-EPA AP-42 Chapter 11.9, Table 11.19.2-1 – Screening (controlled) (US-EPA 2004)
- US-EPA AP-41 Chapter 13.2.1 – Paved roads (US-EPA 2011)
- US-EPA AP-42 Chapter 13.2.2 – Unpaved roads (US-EPA 2006a)
- US-EPA AP-42 Chapter 13.2.4 – Aggregate handling and storage piles (US-EPA 2006b).

Particulate releases were quantified for TSP, PM_{10} and $PM_{2.5}$ as documented in subsequent sections.

C.2 Emissions inventory assumptions

Material parameters adopted within the emissions inventory are presented in Table C.1.

Table C.1 Assumed material parameters

Material / site area	Parameter	Value	Source
Topsoil/ overburden/ cut and fill	Moisture content (%)	2	Provided by LLP
	Silt content (%)	6	Provided by LLP
Material haulage unpaved roads	Silt content (%)	8.5	Default silt content for construction sites – Material storage area AP42 13.2.2
Material haulage paved roads	Silt loading (g/m^2)	0.6	Ubiquitous baseline paved roads <500 movements per day – AP42 13.2.1-2

C.3 Diesel combustion emissions

Diesel consumption was estimated for the project. Assumptions adopted for on-site diesel use were:

- annual diesel consumption for construction machinery, mobile equipment and vehicles, and diesel generators of approximately 5 million litres for the construction year of 2027
- emission factors from the NPI Emission Estimation Technique Manual for Combustion Engines (NPI 2008) – (diesel industrial vehicles - miscellaneous)

- the corresponding USEPA (USEPA 2016) Tier 2 emissions standards for PM of 0.2 g/kWh was selected
- the g/kWh emission standard was converted to g per litre of diesel by applying a scaling factor of 3, as per the notes for Table 35 in *NPI Emissions Estimation Technique Manual for Combustion Engines* (NPI 2008)
- the PM emission standard is assumed to correspond to PM_{10} with $PM_{2.5}$ emissions derived from the relationship between PM_{10} and $PM_{2.5}$ emission factors presented in Table 35 in NPI 2008 (91.7%).

Annual diesel combustion emissions from off-site spoil haulage and material delivery trucks were estimated using the following assumptions:

- Off-site spoil haulage and materials deliveries with annual VKT of 81,760 km for 2027 construction works along Sir Thomas Michell Drive to Magpie Hollow Road.
- Emissions from diesel combustion by road were quantified through the calculated annual VKT and the EPA PM Emissions Factor for road trucks (EPA 2012), based on specifications of 2011 ADR80/30.

C.4 Emissions inventory table

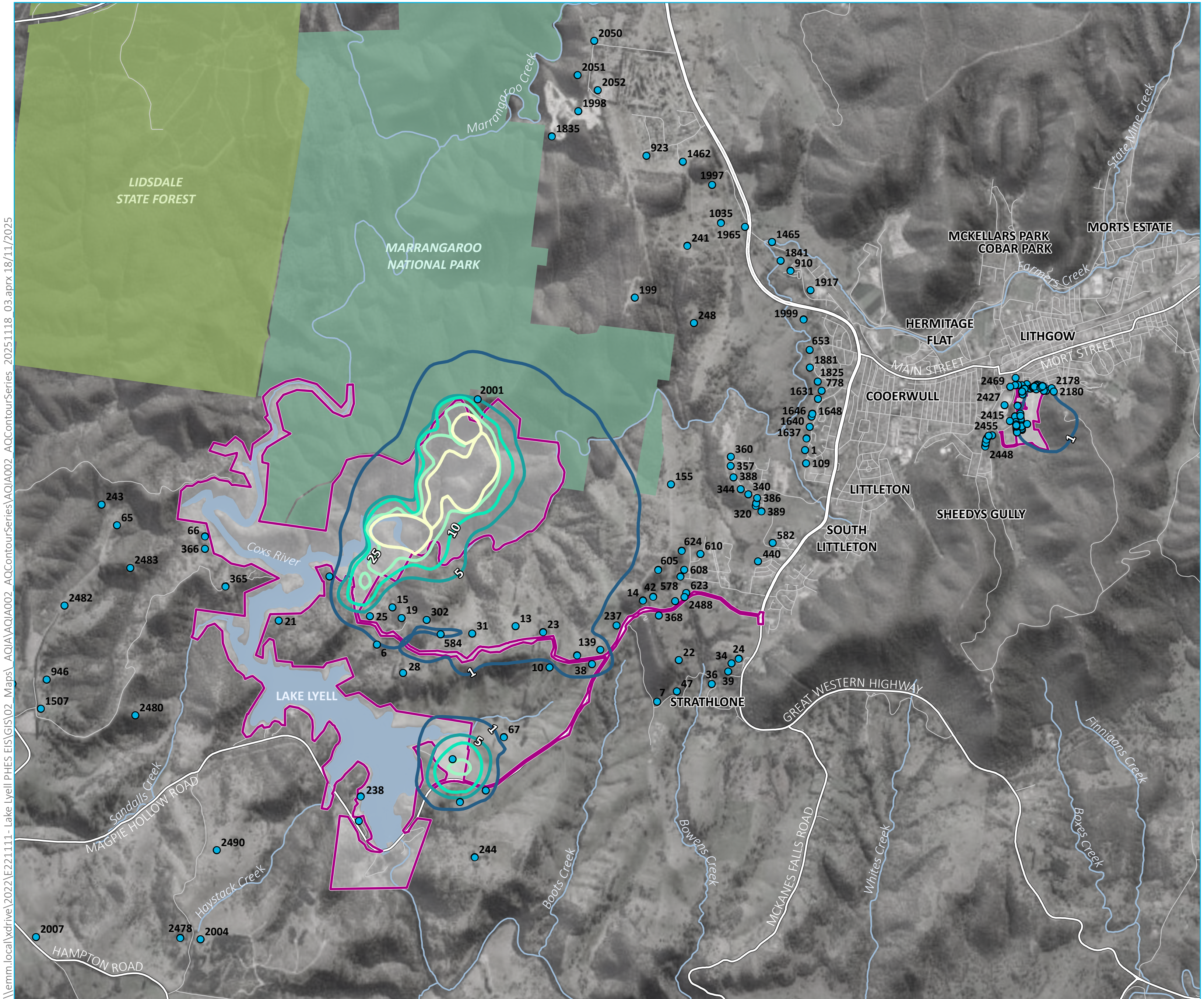
A summary of the emissions inventory for the project is presented in Table C.2.

Table C.2 Emissions inventory

Activity	Emission estimate TSP (kg/y)	Emission estimate PM_{10} (kg/y)	Emission estimate $PM_{2.5}$ (kg/y)	Activity rate	Units	TSP emission factor	PM_{10} emission factor	$PM_{2.5}$ emission factor	Unit	Parameter 1	Unit	Parameter 2	Unit	Parameter 3	Unit	Parameter 3	Unit	Reduction factor	Emission control	Emission factor source
Portal pad																				
Drilling	2,713	1,411	814	15,326	es per year	0.5900	0.3068	0.1770	kg/hole	1,268.2	holes per blast							0.7	Water injection	USEPA AP-42 11.9.4 - Drilling
Blasting	1	0	0	12	ast per year	0.0706	0.0367	0.0212	kg/blast	122.6	Area of blast (m2)									USEPA AP-42 11.9.4 - Blasting
Loading blasted spoil to trucks	466	220	33	416,000	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2.0	Moisture content (%)							USEPA AP-42 13.2.4 - Materials handling equation
Hauling spoil from main access tunnel to infill area (unpaved)	2,110	603	60	2,080	VKT/year	4.0569	1.1591	0.1159	kg/VKT	8.5	% silt content	0	Return haul distance (km)	5,778	Loads/year	51	Average weight (t)	0.75	Watering of travel routes	USEPA AP-42 13.2.2 - Unpaved roads
Unloading spoil from trucks to infill area	117	55	8	208,000	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)					0.5	Water sprays	USEPA AP-42 13.2.4 - Materials handling equation
Hauling spoil from Portal pad for transfer offsite (unpaved)	6,179	1,765	177	5,795	VKT/year	4.2651	1.2186	0.1219	kg/VKT	8.5	% silt content	2	Return haul distance (km)	2,708	Loads/year	57	Average weight (t)	0.75	Watering of travel routes	USEPA AP-42 13.2.2 - Unpaved roads
Hauling spoil from Portal pad for transfer offsite (paved)	2,550	490	118	18,413	VKT/year	0.1385	0.0266	0.0064	kg/VKT	0.6	Road silt loading (g/m²)	7	Return haul distance (km)	2,708	Loads/year	57	Average weight (t)			USEPA AP-42 13.2.1 - Paved roads
Main access tunnel (MAT) & construction adits																				
Truck unloading spoil from tunnel portal to surface stockpile	237	112	17	211,461	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)							USEPA AP-42 13.2.4 - Materials handling equation
Loading spoil from stockpile to trucks	237	112	17	211,461	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)							USEPA AP-42 13.2.4 - Materials handling equation
Hauling spoil from main access tunnel to infill area (unpaved)	1,930	552	55	1,903	VKT/year	4.0569	1.1591	0.1159	kg/VKT	8.5	% silt content	0.36	Return haul distance (km)	5,287	Loads/year	51	Average weight (t)	0.75	Watering of travel routes	USEPA AP-42 13.2.2 - Unpaved roads
Unloading spoil from trucks to infill area	107	50	8	190,315	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)					0.5	Water sprays	USEPA AP-42 13.2.4 - Materials handling equation
Hauling spoil from main access tunnel for transfer offsite (unpaved)	628	179	18	589	VKT/year	4.2651	1.2186	0.1219	kg/VKT	8.5	% silt content	2.14	Return haul distance (km)	275	Loads/year	57	Average weight (t)	0.75	Watering of travel routes	USEPA AP-42 13.2.2 - Unpaved roads
Hauling spoil from main access tunnel for transfer offsite (paved)	259	50	12	1,872	VKT/year	0.1385	0.0266	0.0064	kg/VKT	0.6	Road silt loading (g/m²)	6.8	Return haul distance (km)	275	Loads/year	57	Average weight (t)			USEPA AP-42 13.2.1 - Paved roads
Upper reservoir																				
Drilling	22,125	11,505	6,638	125,000	es per year	0.5900	0.3068	0.1770	kg/hole	1,250.0	holes per blast							0.7	Water injection	USEPA AP-42 11.9.4 - Drilling
Blasting	88	46	26	100	ast per year	0.8758	0.4554	0.2628	kg/blast	1,000.0	Area of blast (m2)									USEPA AP-42 11.9.4 - Blasting
Loading spoil to trucks	3,802	1,798	272	3,393,000	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)							USEPA AP-42 13.2.4 - Materials handling equation
Dozer at excavation area	101,258	20,993	10,632	22,338	h/y	9.0660	1.8796	0.9519	kg/h	6.0	Silt content (%)	2	Moisture content (%)					0.5	Watering of travel routes	USEPA AP-42 13.2.4 - Materials handling equation
Hauling spoil from upper reservoir to emplacement area	163,203	46,631	4,663	136,932	VKT/year	4.7674	1.3622	0.1362	kg/VKT	8.5	% silt content	2.26	Return haul distance (km)	60,589	Loads/year	73	Average weight (t)	0.75	Watering of travel routes	USEPA AP-42 13.2.2 - Unpaved roads
Unloading spoil from trucks at emplacement area	1,901	899	136	3,393,000	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)					0.5	Water sprays	USEPA AP-42 13.2.4 - Materials handling equation
Dozer at emplacement area	50,629	10,496	5,316	11,169	h/y	9.0660	1.8796	0.9519	kg/h	6.0	Silt content (%)	2	Moisture content (%)					0.5	Watering of travel routes	USEPA AP-42 13.2.4 - Materials handling equation
Crushing rock - upper reservoir	1,832	814	55	678,600	t/y	0.0027	0.0012	0.0001	kg/t											USEPA AP-42 11.19.2-1 - Tertiary crushing
Screening rock - upper reservoir	8,483	2,918	197	678,600	t/y	0.0125	0.0043	0.0003	kg/t											USEPA AP-42 11.19.2-1 - Screening
Powerhouse, caverns & surge shaft																				
Truck unloading spoil from tunnel portal to surface stockpile	175	83	13	155,888	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)							USEPA AP-42 13.2.4 - Materials handling equation
Loading spoil from stockpile to trucks	175	83	13	155,888	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2.0	Moisture content (%)							USEPA AP-42 13.2.4 - Materials handling equation
Hauling spoil from main access tunnel to infill area (unpaved)	1,174	335	34	1,158	VKT/year	4.0569	1.1591	0.1159	kg/VKT	8.5	% silt content	0.36	Return haul distance (km)	3,216	Loads/year	51	Average weight (t)	0.75	Watering of travel routes	USEPA AP-42 13.2.2 - Unpaved roads
Unloading spoil from trucks to infill area	58	27	4	102,886	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)					0.5	Water sprays	USEPA AP-42 13.2.4 - Materials handling equation
Hauling spoil from powerhouse and caverns for transfer offsite (unpaved)	1,192	340	34	1,118	VKT/year	4.2651	1.2186	0.1219	kg/VKT	8.5	% silt content	2.14	Return haul distance (km)	522	Loads/year	57	Average weight (t)	0.75	Watering of travel routes	USEPA AP-42 13.2.2 - Unpaved roads
Hauling spoil from powerhouse and caverns for transfer offsite (paved)	492	94	23	3,551	VKT/year	0.1385	0.0266	0.0064	kg/VKT	0.6	Road silt loading (g/m²)	6.8	Return haul distance (km)	522	Loads/year	57	Average weight (t)			USEPA AP-42 13.2.1 - Paved roads
Tailrace tunnels																				
Truck unloading spoil from tunnel portal to surface stockpile	118	56	8	105,730	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)							USEPA AP-42 13.2.4 - Materials handling equation
Loading spoil from stockpile to trucks	118	56	8	105,730	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)							USEPA AP-42 13.2.4 - Materials handling equation
Hauling spoil from tailrace tunnel to infill area (unpaved)	1,609	460	46	1,586	VKT/year	4.0569	1.1591	0.1159	kg/VKT	8.5	% silt content	0.6	Return haul distance (km)	2,643	Loads/year	51	Average weight (t)	0.75	Watering of travel routes	USEPA AP-42 13.2.2 - Unpaved roads
Unloading spoil from trucks to infill area	53	25	4	95,157	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)					0.5	Water sprays	USEPA AP-42 13.2.4 - Materials handling equation
Hauling spoil from tailrace tunnel for transfer offsite (unpaved)	393	112	11	369	VKT/year	4.2651	1.2186	0.1219	kg/VKT	8.5	% silt content	2.68	Return haul distance (km)	138	Loads/year	57	Average weight (t)	0.75	Watering of travel routes	USEPA AP-42 13.2.2 - Unpaved roads
Hauling spoil from tailrace tunnel for transfer offsite (paved)	130	25	6	936	VKT/year	0.1385	0.0266	0.0064	kg/VKT	0.6	Road silt loading (g/m²)	6.8	Return haul distance (km)	138	Loads/year	57	Average weight (t)			USEPA AP-42 13.2.1 - Paved roads
Lower reservoir Inlet/outlet & channel																				
Drilling	2,674	1,390	802	15,106	es per year	0.5900	0.3068	0.1770	kg/hole	1,250.0	holes per blast							0.7	Water injection	USEPA AP-42 11.9.4 - Drilling
Blasting	1	0	0	12	ast per year	0.0694	0.0361	0.0208	kg/blast	120.8	Area of blast (m2)									USEPA AP-42 11.9.4 - Blasting
Loading spoil to trucks	459	217	33	410,036	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)							USEPA AP-42 13.2.4 - Materials handling equation
Hauling spoil from lower intake tunnel to infill area (unpaved)	6,931	1,980	198	6,834	VKT/year	4.0569	1.1591	0.1159	kg/VKT	8.5	% silt content	0.6	Return haul distance (km)	11,390	Loads/year	51	Average weight (t)	0.75	Watering of travel routes	USEPA AP-42 13.2.2 - Unpaved roads
Unloading spoil from trucks to infill area	230	109	16	410,036	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2.0	Moisture content (%)					0.5	Water sprays	USEPA AP-42 13.2.4 - Materials handling equation
Lake diversion																				
Drilling	1,950	1,014	585	11,015	es per year	0.5900	0.3068	0.1770	kg/hole	1,250.0	holes per blast							0.7	Water injection	USEPA AP-42 11.9.4 - Drilling
Blasting	0	0	0	9	st per year	0.0475	0.0247	0.0142	kg/blast	88.1	Area of blast (m2)									USEPA AP-42 11.9.4 - Blasting
Loading spoil to trucks	335	158	24	299,000	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)							USEPA AP-42 13.2.4 - Materials handling equation
Hauling spoil from lake diversion to infill area (unpaved)	2,022	578	58	1,993	VKT/year	4.0569	1.1591	0.1159	kg/VKT	8.5	% silt content	0.4	Return haul distance (km)	11,390	Loads/year	51	Average weight (t)	0.75	Watering of travel routes	USEPA AP-42 13.2.2 - Unpaved roads
Unloading spoil from trucks to infill area	101	48	7	179,400	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)					0.5	Water sprays	USEPA AP-42 13.2.4 - Materials handling equation
Hauling spoil from lake diversion for transfer offsite (unpaved)	2,656	759	76	2,491	VKT/year	4.2651	1.2186	0.1219	kg/VKT	8.5	% silt content	1.6	Return haul distance (km)	1,557	Loads/year	57	Average weight (t)	0.75	Watering of travel routes	USEPA AP-42 13.2.2 - Unpaved roads
Hauling spoil from lake diversion for transfer offsite (paved)	1,466	281	68	10,588	VKT/year	0.1385	0.0266	0.0064	kg/VKT	0.6	Road silt loading (g/m²)	6.8	Return haul distance (km)	1,557	Loads/year	57	Average weight (t)			USEPA AP-42 13.2.1 - Paved roads
Access roads																				
Drilling (northern)	26,037	13,539	7,811	147,103	es per year	0.5900	0.3068	0.1770	kg/hole	1,250.0	holes per blast							0.7	Water injection	USEPA AP-42 11.9.4 - Drilling
Blasting (northern)	125	65	38	118	ast per year	1.0648	0.5537	0.3194	kg/blast	1,176.8	Area of blast (m2)									USEPA AP-42 11.9.4 - Blasting
Loading spoil to trucks (north)	4,474	2,116	320	3,992,970	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)							USEPA AP-42 13.2.4 - Materials handling equation
Hauling spoil from access roads to emplacement pads (north)	562,471	160,710	16,071	554,579	VKT/year	4.0569	1.1591	0.1159	kg/VKT	8.5	% silt content	5	Return haul distance (km)	110,916	Loads/year	51	Average weight (t)	0.75	Watering of travel routes	USEPA AP-42 13.2.2 - Unpaved roads
Unloading spoil from trucks at emplacement pads	2,237	1,058	160	3,992,970	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)					0.5	Water sprays	USEPA AP-42 13.2.4 - Materials handling equation
Excavating access road (south)	497	235	36	443,663	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)							USEPA AP-42 13.2.4 - Materials handling equation
Loading spoil to trucks (south)	497	235	36	443,663	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)							USEPA AP-42 13.2.4 - Materials handling equation
Hauling spoil from access roads to emplacement pads (south)	43,748	12,500	1,250	43,134	VKT/year	4.0569	1.1591	0.1159	kg/VKT	8.5	% silt content	3.5	Return haul distance (km)	12,324	Loads/year	51	Average weight (t)	0.75	Watering of travel routes	USEPA AP-42 13.2.2 - Unpaved roads
Excavating Sir Thomas Mitchell Drive	7	3	1	6,500	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)							USEPA AP-42 13.2.4 - Materials handling equation
Unloading spoil along Sir Thomas Mitchell Drive (general filling)	109	52	8	97,500	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)							USEPA AP-42 13.2.4 - Materials handling equation
Switch yard, concrete batching plant (CBP) & deliveries																				
Drilling	1,102	573	331	6,226	es per year	0.5900	0.3068	0.1770	kg/hole	1,250.0	holes per blast							0.7	Water injection	USEPA AP-42 11.9.4 - Drilling
Blasting	0	0	0	5	ast per year	0.0239	0.0125	0.0072	kg/blast	49.8	Area of blast (m2)									USEPA AP-42 11.9.4 - Blasting
Excavator loading spoil to trucks	189	90	14	169,000	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)							USEPA AP-42 13.2.4 - Materials handling equation
Transporting spoil across switchyard area	952	272	27	939	VKT/year	4.0569	1.1591	0.1159	kg/VKT	8.5	% silt content	0	Return haul distance (km)	4,694	Loads/year	51	Average weight (t)	0.75	Watering of travel routes	USEPA AP-42 13.2.2 - Unpaved roads
Unloading spoil from trucks at switchyard	95	45	7	169,000	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)					0.5	Water sprays	USEPA AP-42 13.2.4 - Materials handling equation
CBP processing activities (Switchyard)	440	176	56																	
Hauling construction materials along access road to the CBP (unpaved)	4,335	1,239	124	6,513	VKT/year	2.6623	0.7607	0.0761	kg/VKT	8.5	% silt content	1.5	Return haul distance (km)	4,342	Loads/year	20	Average weight (t)	0.75	Watering of travel routes	USEPA AP-42 13.2.2 - Unpaved roads
Hauling construction materials along access road to the CBP (paved)	1,405	270	65	29,526	VKT/year	0.0476	0.0091	0.0022	kg/VKT	0.6	Road silt loading (g/m²)	6.8	Return haul distance (km)	4,342	Loads/year	20	Average weight (t)			USEPA AP-42 13.2.1 - Paved roads
Site compound																				
Dozer heavy ripping	16,876	3,499	1,772	3,723	h/y	9.0660	1.8796	0.9519	kg/h	6.0	Silt content (%)	2	Moisture content (%)					0.5	Watering of travel routes	USEPA AP-42 13.2.4 - Materials handling equation
Dozer emplacement	33,753	6,998	3,544	7,446	h/y	9.0660	1.8796	0.9519	kg/h	6.0	Silt content (%)	2	Moisture content (%)					0.5	Watering of travel routes	USEPA AP-42 13.2.4 - Materials handling equation
Building pad																				
CBP processing activities (building pad)	440	176	56																	
Asphalt plant processing activities	48	17	4																	
Accomodation camps																				
Excavator at cut area - Lakeside	328	155	23	292,500	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)							USEPA AP-42 13.2.4 - Materials handling equation
Excavator loading spoil to trucks - Lakeside	328	155	23	292,500	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)							USEPA AP-42 13.2.4 - Materials handling equation
Transporting spoil from cut to fill area - Lakeside	4,944	1,413	141	4,875	VKT/year	4.0569	1.1591	0.1159	kg/VKT	8.5	% silt content	0.6	Return haul distance (km)	8,125	Loads/year	51	Average weight (t)	0.75	Watering of travel routes	USEPA AP-42 13.2.2 - Unpaved roads
Dozer at filling area - Lakeside	16,876	3,499	1,772	3,723	h/y	9.0660	1.8796	0.9519	kg/h	6.0	Silt content (%)	2	Moisture content (%)					0.5	Watering of travel routes	USEPA AP-42 13.2.4 - Materials handling equation
Excavator at cut area - Town	55	26	4	48,750	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)							USEPA AP-42 13.2.4 - Materials handling equation
Excavator loading spoil to trucks - Town	55	26	4	48,750	t/y	0.0011	0.0005	0.0001	kg/t	2.1	Average wind speed (m/s)	2	Moisture content (%)							USEPA AP-42 13.2.4 - Materials handling equation
Transporting spoil from cut to fill area - Town	824	235	24	813	VKT/year	4.0569	1.1591	0.1159	kg/VKT	8.5	% silt content	0.6	Return haul distance (km)	1,354	Loads/year	51	Average weight (t)	0.75	Watering of travel routes	USEPA AP-42 13.2.2 - Unpaved roads
Dozer at filling area - Town	16,876	3,499	1,772	3,723	h/y	9.0660	1.8796	0.9519	kg/h	6.0	Silt content (%)	2	Moisture content (%)					0.5	Watering of travel routes	USEPA AP-42 13.2.4 - Materials handling equation
Wind erosion																				
Wind erosion from upper reservoir	497	248	37	27	Area (ha)	0.0970	0.0485	0.0073	kg/ha/hour	192.0	Hours >5.4m/s									USEPA AP-42 11.9 - Wind erosion of exposed areas
Wind erosion from switchyard area	55	27	4	3	Area (ha)	0.0970	0.0485	0.0073	kg/ha/hour	192.0	Hours >5.4m/s									USEPA AP-42 11.9 - Wind erosion of exposed areas
Wind erosion from accomodation camp - lakeside	245	123	18	13	Area (ha)	0.0970	0.0485	0.0073	:g/ha/hour	192.0	Hours >5.4m/s									USEPA AP-42 11.9 - Wind erosion of exposed areas
Wind erosion from accomodation camp - town	224	112	17	12	Area (ha)	0.0970	0.0485	0.0073	:g/ha/hour	192.0	Hours >5.4m/s									USEPA AP-42 11.9 - Wind erosion of exposed areas
Other																				
Diesel combustion - Site operations	3,000	3,000	2,750																	USEPA Tier 2 non road diesel emission factor
Diesel combustion - Offsite material haulage (unpaved)	3	3	3																	NSW EPA GMR Emissions Inventory
Diesel combustion - Offsite material haulage (paved)	3	3	3																	NSW EPA GMR Emissions Inventory
Total	**1,139,518**	**326,323**	**69,669**																	

Annexure D

Incremental (project-only) contour plots



KEY

Project area

Assessment location

Annual TSP concentrations (µg/m³)

1

5

10

25

50

Existing environment

Major road

Minor road

Named watercourse

Named waterbody

NPWS reserve

State forest

Predicted annual average TSP concentrations (µg/m³) – project only increment

Lake Lyell PHES
Air Quality Impact Assessment
Figure D.1

EMM
creating opportunities

Source: EMM (2025); Lake Lyell Project Pty Ltd (2025); DCSSS (2024); GA (2009); ESRI (2025)

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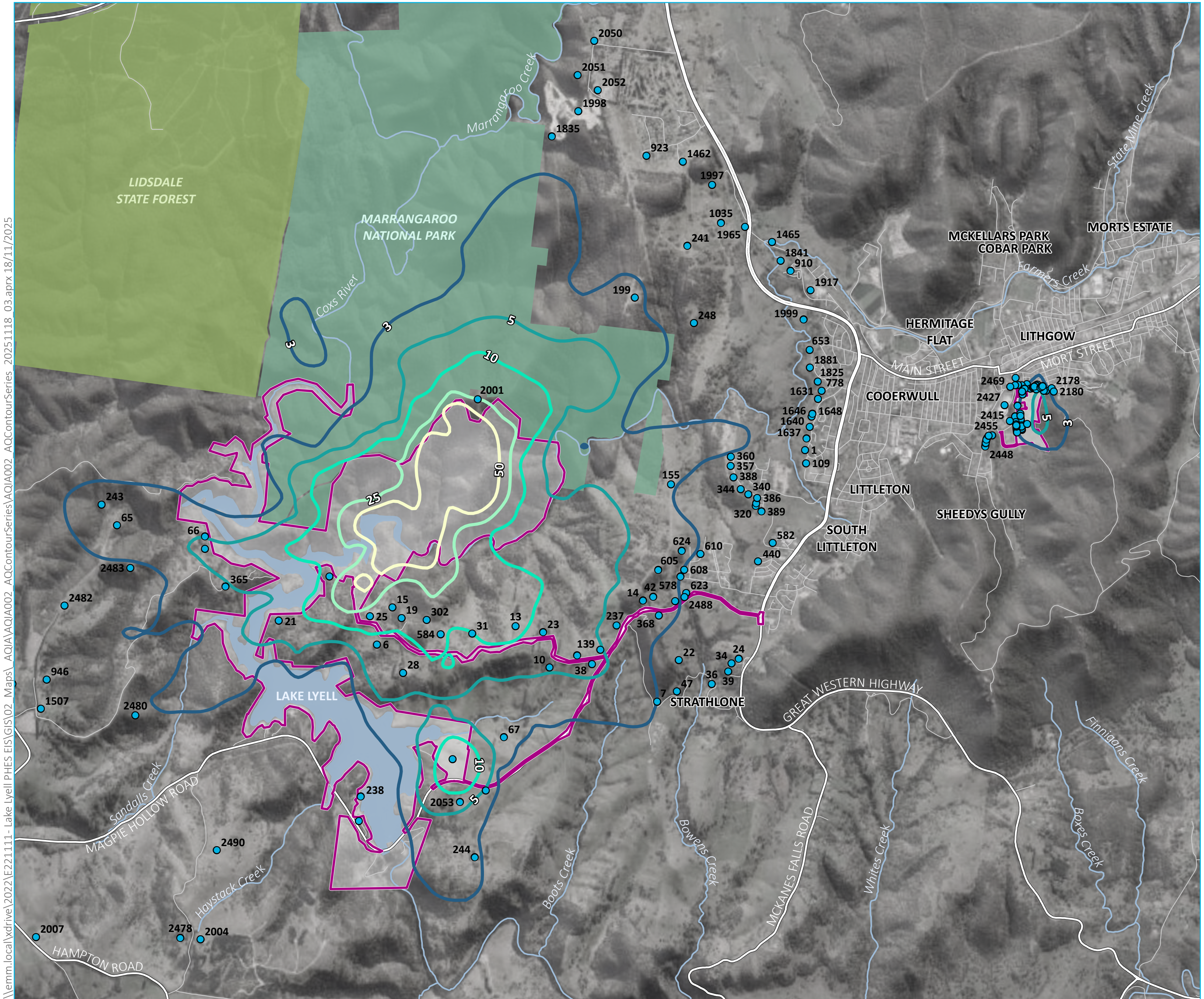

KEY

- Project area
- Assessment location

24-hour PM_{10} contour (µg/m³)

- 3
- 5
- 10
- 25
- 50

Existing environment

- Major road
- Minor road
- Named watercourse
- Named waterbody
- NPWS reserve
- State forest

Source: EMM (2025); Lake Lyell Project Pty Ltd (2025); DCSSS (2024); GA (2009); ESRI (2025)

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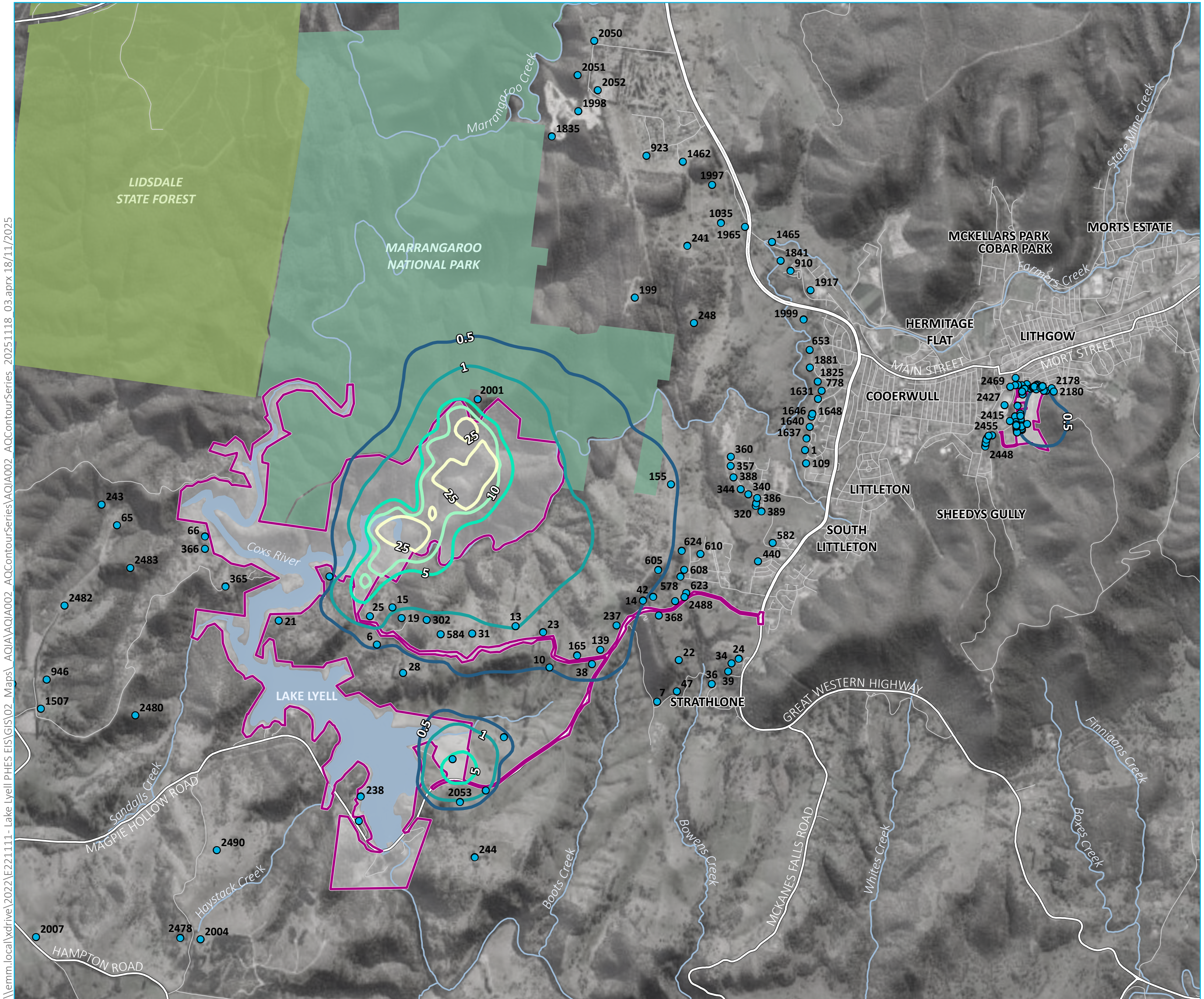
Maximum predicted 24-hour average PM_{10} concentrations (µg/m³) – project only increment

Lake Lyell PHES
Air Quality Impact Assessment
Figure D.2

EMM
creating opportunities



Source: EMM (2025); Lake Lyell Project Pty Ltd (2025); DCSSS (2024); GA (2009); ESRI (2025)

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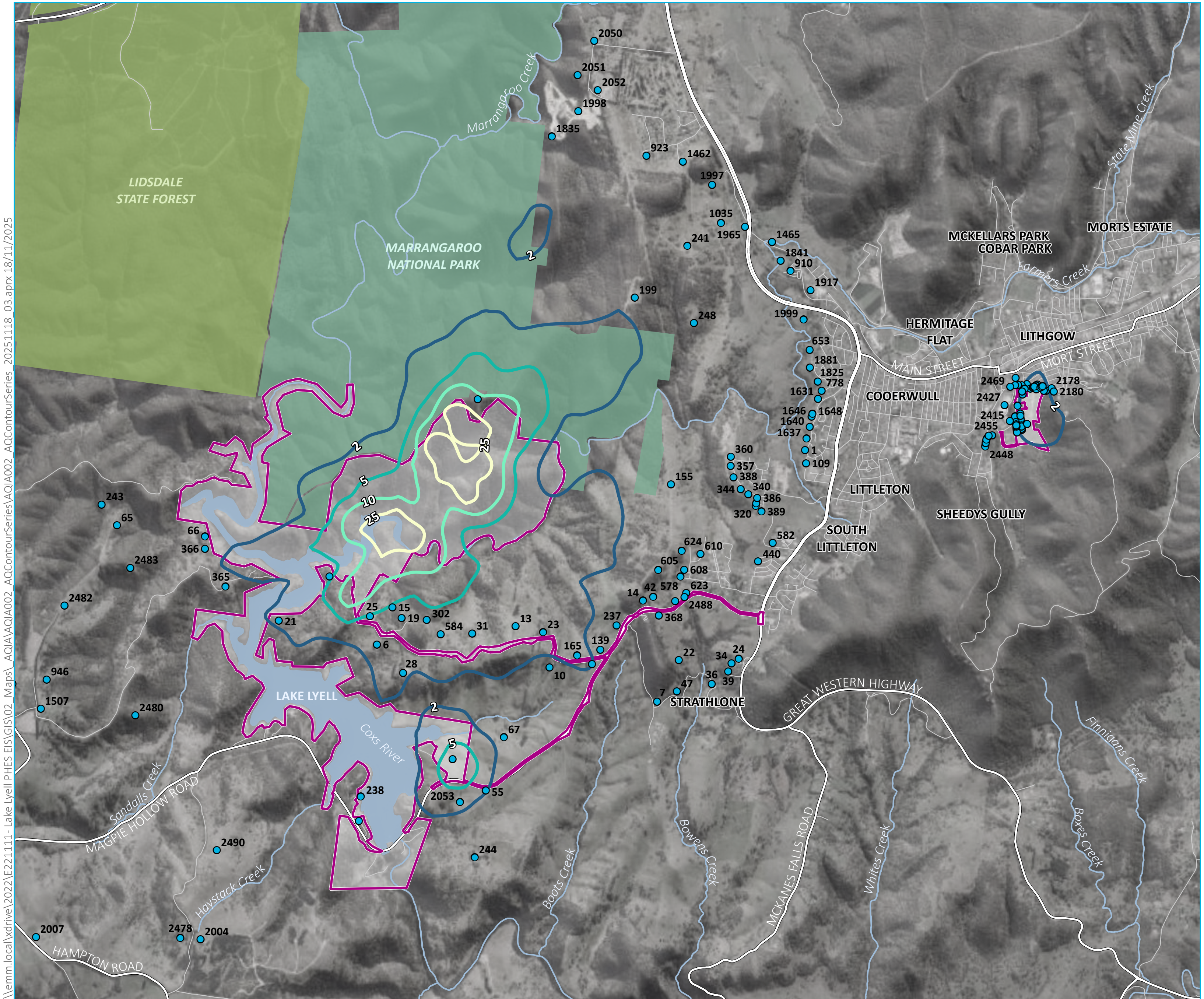
Predicted annual average PM_{10} concentrations (µg/m³) – project only increment

Lake Lyell PHES
Air Quality Impact Assessment
Figure D.3

EMM creating opportunities



KEY

- Project area
- Assessment location

24-hour $PM_{2.5}$ contour (µg/m³)

- 2
- 5
- 10
- 25

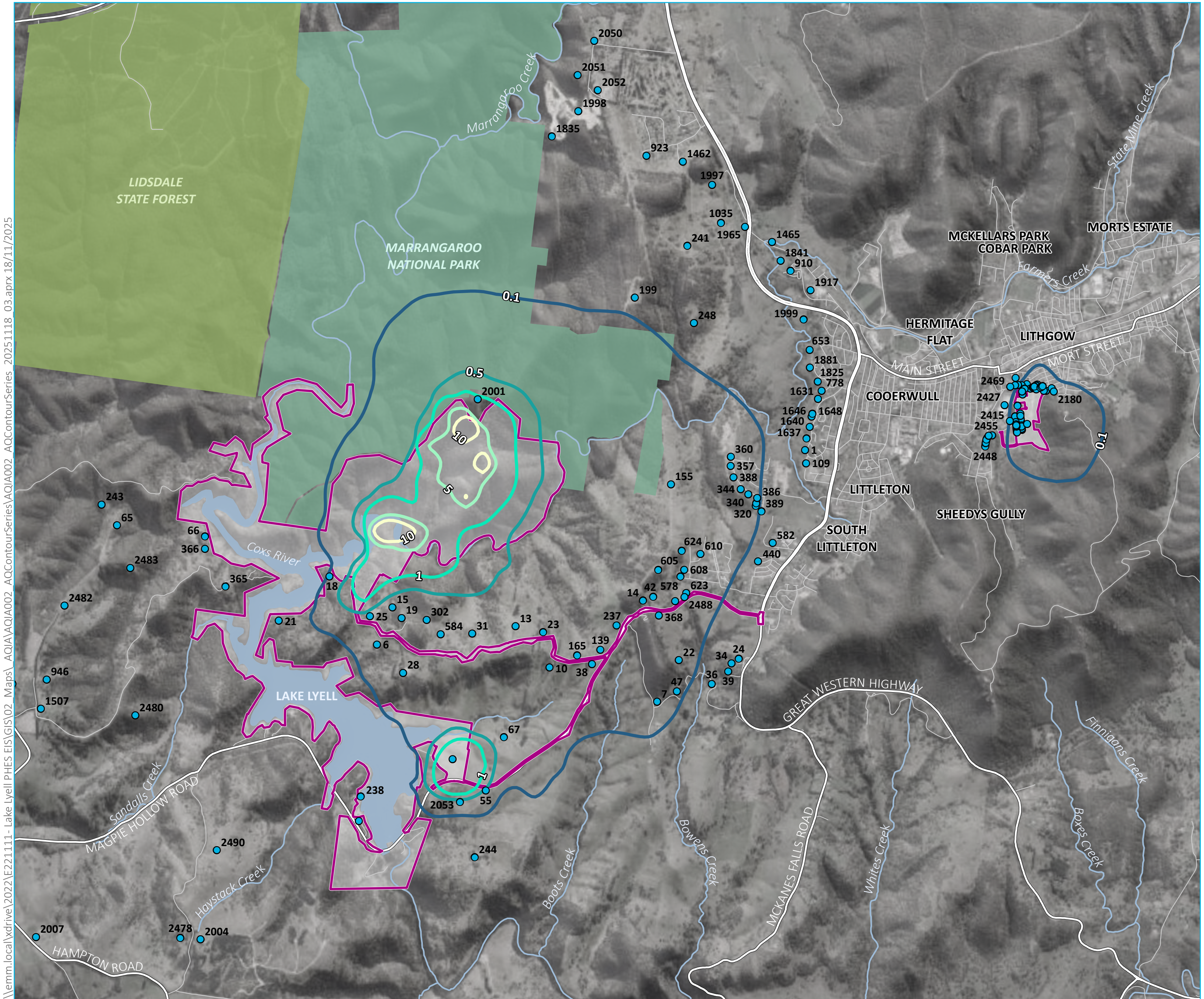
Existing environment

- Major road
- Minor road
- Named watercourse
- Named waterbody
- NPWS reserve
- State forest

Source: EMM (2025); Lake Lyell Project Pty Ltd (2025); DCSSS (2024); GA (2009); ESRI (2025)

Maximum predicted 24-hour average $PM_{2.5}$ concentrations (µg/m³) – project only increment

Lake Lyell PHES
Air Quality Impact Assessment
Figure D.4



KEY

- Project area
- Assessment location

Annual $PM_{2.5}$ contour (µg/m³)

- 0.1
- 0.5
- 1
- 5
- 10

Existing environment

- Major road
- Minor road
- Named watercourse
- Named waterbody
- NPWS reserve
- State forest

Source: EMM (2025); Lake Lyell Project Pty Ltd (2025); DCSSS (2024); GA (2009); ESRI (2025)

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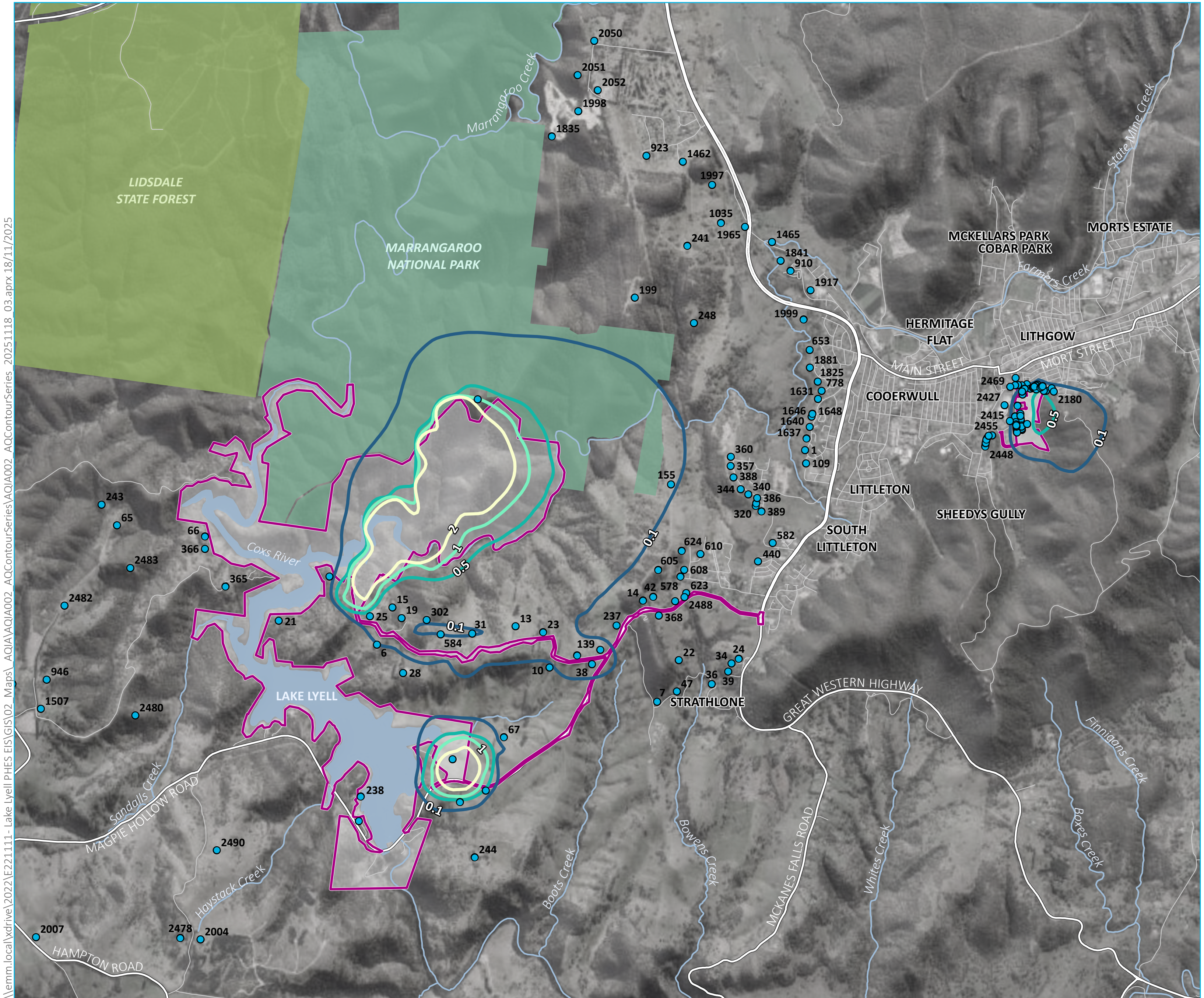
Predicted annual average $PM_{2.5}$ concentrations (µg/m³) – project only increment

Lake Lyell PHES
Air Quality Impact Assessment
Figure D.5

EMM creating opportunities



Source: EMM (2025); Lake Lyell Project Pty Ltd (2025); DCSSS (2024); GA (2009); ESRI (2025)

0 1 2 km
GDA2020 MGA Zone 56
N

KEY

- Project area
- Assessment location

Dust deposition contour (g/m²/month)

- 0.1
- 0.5
- 1
- 2

Existing environment

- Major road
- Minor road
- Named watercourse
- Named waterbody
- NPWS reserve
- State forest

Predicted annual average dust deposition levels (g/m²/month) – project only increment

Lake Lyell PHES
Air Quality Impact Assessment
Figure D.6

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