

Trap Gully Overburden Emplacement Extension Project: Air Quality Assessment

Prepared for:

**Hansen Environmental Consulting on behalf of
Batchfire Resources**

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Abbreviation, Units and Glossary

Term	Definition
$\mu\text{g}/\text{m}^3$	micrograms per cubic metre
BCM	bank cubic metre
$^{\circ}\text{C}$	degrees Celsius
g/s	grams per second
ha	hectare
km	kilometre
km/hr	kilometre per hour
m	metre
m/s	metres per second
m^2	square metres
$\text{mg}/\text{m}^2/\text{day}$	milligrams per square metre per day
Mtpa	million tonnes per annum
Nomenclature	Definition
CO	carbon monoxide
NO_x	oxides of nitrogen
PM_{10}	particulate matter with a diameter less than 10 micrometres
$\text{PM}_{2.5}$	particulate matter with a diameter less than 2.5 micrometres
SO_x	sulfur oxide
TSP	Total suspended particulate
Abbreviations	Definition
AHD	Australian Height Datum
Air EPP	<i>Environmental Protection (Air) Policy 2019 and Environmental Protection (Air) Amendment Policy 2024</i> (Qld)
AAQ NEPM	<i>National Environment Protection (Ambient Air Quality) Measure</i>
CPP	Coal Processing Plant
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DETSI	Department of Environment, Tourism, Science and Innovation (Qld)
EA	Environmental Authority
EAR	Environmental Assessment Report
EF	Emission factor
EP Act	<i>Environmental Protection Act 1994</i> (Qld)
ML	Mining Lease
NEPC	National Environment Protection Council
NPI	National Pollutant Inventory
ROM	Run of Mine
TAPM	The Air Pollution Model
USEPA	United States Environmental Protection Agency

Term	Definition
Ambient Air	Ambient air is the outdoor air in which humans and other organisms live and breathe.
Averaging period	Length of time over which an average of that data is taken. For example; if temperatures are measured once every minute over a day, a 1-hour averaging period is obtained by averaging sixty consecutive 1-minute measurements.
Background levels	Existing concentrations of pollutants in ambient air.

Term	Definition
CALMET	Meteorological model used in conjunction with the CALPUFF dispersion model. CALMET produces 1-hour average wind and temperature fields on a three-dimensional gridded domain.
CALPUFF	A model that characterises the dispersion and deposition of air pollutants in the atmosphere.
Concentration	Concentration is the mass of a pollutant such as particulate matter that is suspended per unit volume of air. Suspended particulate matter in ambient air is usually measured in micrograms per cubic metre ($\mu\text{g}/\text{m}^3$).
Dispersion modelling	Computer based software package used to mathematically simulate plume dispersion under varying atmospheric conditions; used to calculate spatial and temporal fields of concentrations due to emissions from various source types.
Dust deposition rate	Deposition is the mass of particulate matter that settles per unit surface area. Deposited particulate matter is usually measured in grams per square metre per month ($\text{g}/\text{m}^2/\text{month}$) or milligrams per square metre per day ($\text{mg}/\text{m}^2/\text{day}$).
Dust or particulate matter	Dust or particulate matter are terms used to define solid or liquid particles that may be suspended in the atmosphere. Particulate matter is a generic term that is commonly used interchangeably with other terms such as smoke, soot, haze and dust. The potential effect of particulate matter on the environment, human health and amenity depends on the size of the particles, the concentration of particulate matter in the atmosphere and the rate of deposition.
Mixing height	The layer of air through which pollutants are presumed to be mixed, due to convection caused by daytime heating of the earth's surface. The height of this layer of air is measured from the ground to the height of the lowest inversion.
Relative humidity	The amount of water vapour present in air (measured as vapour density or pressure) as a percentage of the maximum amount of vapour that the air could hold at the same temperature. Its maximum value is 100%.
Stability class	Stability is a term applied to the properties of the atmosphere that govern the acceleration of the vertical motion of an air parcel. The acceleration is positive in an unstable atmosphere (turbulence increases), zero when the atmosphere is neutral and negative (deceleration) when the atmosphere is stable (turbulence is suppressed). Atmospheric stability is typically classified under the Pasquill-Gifford scheme, with six main categories designated as A (highly unstable or convective), B (moderately unstable), C (slightly unstable), D (neutral), E (slightly stable) and F (stable).
Wind speed	The rate of movement of wind in distance per unit of time. When measured by an anemometer, this is a short-term average reading of horizontal wind vector magnitude, usually cited for measurement heights of 10 m.
Wind direction	Australian convention is to report wind direction by the direction from which it originates. For example, wind from the east is reported with a wind direction = 90° .

1. INTRODUCTION

1.1 Project description

Katestone Environmental Pty Ltd (Katestone) was commissioned by Hansen Environmental Consulting, on behalf of Batchfire Resources (Batchfire), to complete an air quality impact assessment as part of the Environmental Assessment Report (EAR) for the Trap Gully Overburden Emplacement Extension Project (the project).

Callide Mine is an operating open cut coal mine producing approximately 11 million tonnes per annum (Mtpa) of product coal. The mine has been operating since 1944 and is located approximately 20 km north of Biloela in Central Queensland (Figure 1). Callide Mine produces thermal coal for the domestic and export markets. Callide Mine includes mining in four discrete mining areas: Dunn Creek, Trap Gully, The Hut and Boundary Hill. The project is located at the Trap Gully mining area.

The project involves an extension of the existing Trap Gully overburden emplacement to the west, including the realignment of the existing Link Road, and the construction and operation of ancillary mine infrastructure to support the existing Trap Gully mining operations (Figure 2). The overburden emplacement extension and ancillary mine infrastructure will be located on new mining lease (ML) areas adjoining the existing Trap Gully ML's (Figure 2).

The project ancillary infrastructure will include the following:

- haul road connection, run of mine (ROM) coal stockpile area and heavy vehicle parking area, to the south of the existing open cut pit;
- new mine access road off Forestry Road;
- mine administration area, to the west of the overburden emplacement extension area, including office buildings (including new demountables and use of existing buildings) and car parks;
- incorporation of an existing off-site heavy mobile equipment assembly and major rebuild/shut down area into the new ML area; and
- drainage infrastructure for the overburden emplacement extension and ancillary infrastructure areas including catch drains, diversion drains and sediment dams.

The project will not involve any additional mining, increase in production, extension of the mine life or any other changes to the existing approved mining operations.

1.2 Scope of works

This study addresses the aspects of the project that may result in emissions to the atmosphere, as well as the legislation, policies and guidelines that are relevant to the management of air emissions in Queensland and Australia.

The key emissions to the atmosphere likely to be generated by the project are dust emissions.

Dust emissions would occur as a result of the operation of the project. Elevated levels of dust have the potential to adversely impact the amenity and health of any people living nearby. Dispersion modelling has been conducted to estimate the ground-level concentrations of dust associated with the project for assessment against amenity and health objectives.

The report also describes the measures that would be in place to mitigate dust emissions from the project.

2. CONSIDERATIONS FOR ASSESSING EMISSIONS TO AIR

Particulate matter (i.e. dust) would be the key air emission generated by activities on the project site. Particulate matter is discussed further in Section 2.1, and other potential pollutants are discussed in Section 2.2. The legislative context, and air quality standards and criteria used in the assessment are presented in Section 2.3.

2.1 Particulate matter

Elevated concentrations of dust have the potential to cause adverse impacts on the amenity and health of people living in the vicinity of the mine.

Dust can affect communities in various ways, depending upon the source and size of particles present. Dust typically emitted as a result of mining operations is assessed in terms of total suspended particulates (TSP), dust deposition and particulate matter with an aerodynamic diameter less than 10 micrometres (PM₁₀).

Dust from mining consists primarily of larger particles generated through the handling of rock and soil, as well as through wind erosion of stockpiles and exposed ground. Larger particles (measured as dust deposition) are mostly associated with dust nuisance or amenity impacts in residential areas, through settling or deposition of the particles. Elevated dust deposition rates can reduce public amenity, through soiling of clothes (drying on clothes lines), buildings and other surfaces in the area.

Smaller particles such as PM₁₀ and PM_{2.5} can also be generated through mining activities. Elevated levels of PM₁₀ or PM_{2.5} have the potential to affect human health as these particles can be trapped in the nose, mouth or throat, or be drawn into the lungs.

2.2 Other pollutants

Trace emissions of other pollutants such as oxides of nitrogen (NO_x), oxides of sulfur (SO_x), carbon monoxide (CO), and particulates would also occur due to the combustion of fuels in vehicles on the project site. The emission rates of these air pollutants are low compared to the emission rates of particulate matter from mining activities and are likely to have negligible impacts. Hence, particulate matter is the critical air pollutant that determines the feasibility of the activity from an air quality perspective. Compliance with air quality objectives for particulate matter at the nearest sensitive receptors will, as a consequence, demonstrate compliance with air quality standards for nitrogen dioxide, carbon monoxide and sulphur dioxide. Therefore, these air pollutants do not require further assessment.

2.3 Air quality objectives and criteria

Callide Mine currently operates under Environmental Authority (EA) EPML00720413. Schedule B of EA EPML00720413 contains the air quality criteria that are applicable to the existing Callide mining operations.

The *Environmental Protection Act 1994* (EP Act) provides for the management of the air environment in Queensland. The EP Act gives the Department of the Environment, Tourism, Science and Innovation (DETSI) the power to create Environmental Protection Policies that identify, and aim to protect, environmental values of the atmosphere that are conducive to the health and well-being of humans and biological integrity. The *Environmental Protection (Air) Policy* (Air EPP) was made under the EP Act and gazetted in 1997; the Air EPP was revised and reissued in 2019. The *Environmental Protection (Air) Amendment Policy 2024* (Air EPP Amendment 2024) commenced on 29 August 2024 and makes amendments to the [Environmental Protection \(Air\) Policy 2019](#) to ensure Queensland remains consistent with the *National Environment Protection (Ambient Air Quality) Measure* (AAQ NEPM).

The objective of the Air EPP is:

...to identify the environmental values of the air environment to be enhanced or protected and to achieve the objective of the Environmental Protection Act 1994, i.e. ecologically sustainable development.

The environmental values to be enhanced or protected under the Air EPP are the qualities of the environment that are conducive to:

- protecting health and biodiversity of ecosystems;
- human health and wellbeing;
- protecting the aesthetics of the environment, including the appearance of building structures and other property; and
- protecting agricultural use of the environment.

The administering authority must consider the requirements of the Air EPP when it decides an application for an environmental authority, amendment of a licence or approval of a draft environmental management plan. Schedule 1 of the Air EPP specifies air quality indicators and objectives for specific air pollutants.

The National Environment Protection Council (NEPC) defines national ambient air quality standards and goals in consultation, and with agreement from all Australian state and territory governments. These were first published in 1998 in the *National Environment Protection (Ambient Air Quality) Measure* (AAQ NEPM) and last varied in 2021. The NEPM contains, amongst other parameters, standards for particulates and combustion products. Compliance with the Air NEPM standards is determined by ambient air quality monitoring undertaken at locations prescribed by the Air NEPM and that are representative of large urban populations. The goal of the Air NEPM is to monitor and improve ambient air quality. Whilst the Air NEPM is relevant to ambient air quality levels rather than the assessment of emissions from individual facilities, a number of Australian states have adopted the Air NEPM standards as assessment criteria for air quality objectives. The air quality objectives contained in Queensland's Air EPP are mostly consistent with those in the AAQ NEPM for dust, with the exception of the annual and 24-hour average PM_{2.5} objectives. The 2021 amendment to the AAQ NEPM included the goal of reaching further reductions in maximum PM_{2.5} concentrations from 1 January 2025.

Also relevant is DETSI's *Application requirements for activities with impacts to air*, which outlines the information to be provided as part of the application process for environmentally relevant activities and how the information is used. This outlines how the proposed activity will be assessed by comparison with the requirements stipulated in the EP Act. In particular, this requires an application to include, if applicable:

- description of the site and surrounding areas, including topography, prevailing winds and ambient air quality (Section 4);
- identification of any nearby sensitive places must be identified and assessed appropriately (Section 4.2);
- identification and evaluation of possible impacts on air quality (Section 6); and
- Proposed management (Section 6.2).

This air quality assessment has been conducted in accordance with these requirements.

The air quality objectives relevant to dust that may be generated from the project are presented in Table 1, and have been derived from EPML00720413, as well as from the Air EPP and AAQ NEPM, where appropriate.

Table 1 **Air quality criteria and objectives used in the assessment**

Pollutant	Environmental value	Averaging period	Air quality objective (µg/m³)	Source
TSP	Health and wellbeing	1-year	90	EA / Air EPP
PM ₁₀	Health and wellbeing	24-hour	50	EA / Air EPP
		1-year	25	Air EPP / AAQ NEPM
PM _{2.5}	Health and wellbeing	24-hour	20	Air EPP / AAQ NEPM
		1-year	7	Air EPP / AAQ NEPM
Deposited dust	Amenity	1-month	120 mg/m²/day	EA

3. AIR QUALITY ASSESSMENT METHODOLOGY

3.1 Meteorology

The prognostic model TAPM (The Air Pollution Model) (CSIRO, 2006) was used in conjunction with local observations of meteorological data to represent wind flows in the region. The CALMET model was then used to generate a finer resolution dataset for use in the dispersion modelling.

Appendix A1 provides details of the generation of the site-specific meteorological dataset, including:

1. Selection of a modelling time period;
2. TAPM and CALMET model configurations; and
3. Discussion of meteorological parameters that drive the dispersion model (i.e. wind speed and direction, mixing heights, atmospheric stability).

3.2 Emission rates

Emission rates of dust associated with mining activities have been estimated, accounting for proposed emission controls, using emission factors published in authoritative sources including the National Pollutant Inventory (NPI) Handbooks or the USEPA AP42 Emission Estimation Manuals (NPI, 2012; USEPA, 1998, 2006a, 2006b, 2006c).

Operating parameters such as throughputs, location of equipment and utilisation rates, were based on information provided by the proponent, as detailed in Appendix B. Details of the methodology and the emission factors used for estimating dust emissions are provided in Appendix C.

Section 5 provides a comprehensive discussion of the sources of dust that were included in the assessment.

3.3 Dispersion modelling

Source characteristics and dust emission rates were incorporated into a dispersion modelling study. This was conducted using the CALPUFF dispersion model.

CALPUFF is an advanced non-steady-state air quality modelling system that is approved by DETSI for dispersion modelling. The TAPM/CALMET models were used to simulate meteorological conditions in the region around the project site. The data generated by these models was used as input for the dispersion model in order to include all weather conditions likely to be experienced in the region during a typical year. The modelling has been used to predict maximum ground-level concentrations and deposition rates of dust across a Cartesian grid of the project region and at the locations of the identified sensitive receptors.

Details of the CALPUFF model configuration are provided in Appendix A2.

3.4 Limitations of dispersion modelling

This study relies on the accuracy of a number of datasets including, but not limited to:

- Meteorological information; and
- Calculation of emission rates from mining activities.

It is important to note that numerical models are based on an approximation of governing equations and will inherently be associated with some degree of uncertainty. The more complex the model, the greater the number of physical processes that must be included.

There will be physical processes that are not explicitly accounted for in the model and, in general, these approximations tend to lead to an over-prediction of air pollutant levels. For example, in the real world when a plume of dust reaches an area of sloping terrain, mass from the plume will be removed through impaction on the surface. However, in a dust model, the dust plume is treated as a gas and the plume will pass over or around the obstacle with no loss of mass. This difference in characterisation can lead to an over-prediction of dust levels downwind from the source.

3.5 Model calibration for dust control

Additional dispersion modelling was undertaken to compare model predictions for existing operations at Trap Gully with on-site monitoring data of PM₁₀ for 2024. The results show that the model generally overpredicted 24-hour average concentrations of PM₁₀ and that standard mitigation measures are suitably calibrated using an emission reduction of 90% for haul activity. Further details are provided in Appendix D.

3.6 Cumulative impact assessment

Batchfire conducts PM₁₀ and dust deposition monitoring within the vicinity of the existing Trap Gully mining operations. Representative ambient background concentrations for use in the cumulative assessment of air quality impacts from the project have been determined using available on-site monitoring data.

The existing mining operations at the Callide Mine complex are the main source of anthropogenic emissions of dust in the vicinity of the project along with agricultural activities. Therefore, it was determined that the monitoring network established by Batchfire is suitable for establishing background concentrations of dust. A detailed review of the existing air quality in the region as well as data from the onsite monitoring network data is presented in Section 4.3, with the background concentrations used in the cumulative assessment presented in Section 4.3.3.

The mining operations at Trap Gully mine have been explicitly included in the dispersion modelling.

3.7 Presentation of results

Modelling results have been presented as ground-level concentrations or dust deposition rates at the closest sensitive receptors to the project and existing Trap Gully mining activities, as well as contours across the modelling domain.

4. EXISTING ENVIRONMENT

4.1 Local terrain and land-use

Figure 3 illustrates terrain in the vicinity of the project. The terrain rises gently from approximately 150 m Australian Height Datum (AHD) in the southwest of the modelling domain to approximately 265 m AHD in the centre of the modelling domain, where the project is situated. The terrain rises more steeply to the north, northeast and east of the project due to the Callide Range, with a maximum elevation of approximately 580 m AHD within the domain.

The area surrounding the project site is used for cattle grazing, coal mining, agriculture and timber harvesting.

4.2 Sensitive receptors

The closest sensitive receptors to the project site have been included as discrete receptors in the dispersion modelling. The locations of the sensitive receptors are displayed in Figure 4. Tabulated results have been presented for the key receptors nearest to the project area only, which are listed in Table 2. Predicted air quality at all other receptors are shown in the contour plates (Plate 1 to Plate 12).

Table 2 **Nearest sensitive receptors to the project**

ID	Description / Resident	Easting (m)	Northing (m)	Distance and direction from project ML boundary
SR1	Brosnan 1	250,682	7,312,545	0.3 km W
SR2	Durnsford	251,430	7,310,217	0.07 km S
SR3	P & D Scoleri	251,186	7,310,172	0.2 km S
SR4	B & D Johnston	250,753	7,310,457	0.1 km W
SR5	Brosnan 3	250,349	7,310,970	0.5 km W
SR6	Brosnan 2	250,439	7,311,064	0.4 km W

4.3 Existing air quality

4.3.1 Existing sources of emissions

Ambient dust levels across the area will be influenced by natural sources of dust such as wind erosion and fires, as well as dust emissions from existing anthropogenic sources in the area, including existing mining operations, power generation activities and agriculture activities.

The National Pollution Inventory (NPI) is a public database of annual emissions of 93 substances reported by industries across Australia. A review of emissions of PM₁₀ and PM_{2.5} reported to the NPI database for the 2023/2024 reporting year identified four facilities within 30 km of the project (NPI, 2025).

NPI reporting facilities within the modelling domain are summarised in Table 3 and presented spatially in Figure 5. The assessment of existing facilities has considered facilities reporting emissions of PM₁₀ and PM_{2.5} for the 2023/2024 reporting period. The closest facilities reporting to the NPI program are the Callide Power Plant and Callide Power Station (A & B) which are approximately 6.2 km southeast of the project ML. It is important to note that the distance from the project ML boundary is the shortest distance between the boundary of the ML associated with the project and the site latitude and longitude point of the reporting facility.

The existing mining operations at the Callide Mine complex are the main source of anthropogenic emissions of PM₁₀ and PM_{2.5} in the vicinity of the project. Therefore, it is expected that the monitoring network established by Batchfire will be suitable for establishing background concentrations of dust, including contributions from the existing mine and each of the closest reporting facilities.

Table 3 2023/2024 annual NPI dust emissions due to facilities within 30 km of the project

Facility		Approximate distance and direction from project ML boundary	Emissions (kg/year)	
			PM ₁₀	PM _{2.5} ¹
Batchfire Resources - Callide Mine complex	Boundary Hill mining area	4.6 km NW	10,526,987	189,510
	Hut mining area	3.9 km NE		
	Trap Gully mining area	Adjacent, E		
	Dunn Creek mining area	2.2 km SE		
Callide Power Plant		6.2 km SE	11,130	3,168
Callide Power Station (A & B)		6.3 km SE	740,900	301,886
Biloela Meat Plant		8.3 km SW	25,590	7,830
Table note: ¹ NPI reporting only considers PM _{2.5} due to combustion and does not include PM _{2.5} due to fugitive sources, including mining activities.				

4.3.2 Existing ambient air quality

Batchfire currently conducts monitoring of dust deposition and particulate matter (PM₁₀) in the vicinity of the Trap Gully mining area.

Dust deposition is monitored in accordance with the most recent version of Australian Standard AS3580.10.1 Methods for sampling and analysis of ambient air—Determination of particulate matter—Deposited matter – Gravimetric method. The monitoring of PM₁₀ is conducted using a Beta Attenuation Monitor (E-BAM). The EBAM monitoring is not conducted in accordance with the Australian standards, however it provides an indication of PM₁₀ concentrations.

A summary of the Batchfire monitoring stations relevant to the project area is presented in Figure 6 and Table 4.

Table 4 Monitoring stations relevant to the project area

Monitoring Station	Method	Monitoring Period	Parameters Monitored	Approximate distance and direction from project ML boundary
Trap Gully 1	Electronic - Beta attenuation monitor (E-BAM)	April 2022 – December 2024	PM ₁₀	0.24 km W
Kington				5.4 km W

Monitoring Station	Method	Monitoring Period	Parameters Monitored	Approximate distance and direction from project ML boundary
Gladstone Road	Dust deposition gauge	September 2021 – December 2024	Deposited dust	1.5 km SW
Callide Road				8.6 km W

4.3.2.1 PM₁₀

Table 5 presents a summary of PM₁₀ data collected by Batchfire at the Trap Gully 1 site. The timeseries of 24-hour concentrations of PM₁₀ is presented in Figure 7.

The monitoring data show:

- The data capture rate for this monitor in 2024 was 80.6%, which is suitable for determining a representative background (PRC, 2001);
- Annual average concentrations of PM₁₀ complied with the Air EPP objective of 25 µg/m³ in 2022 to 2024;
- In 2022, 24-hour average concentrations of PM₁₀ complied with the Air EPP objective of 50 µg/m³; and
- In 2023 and 2024, there were three days and four days, respectively, when 24-hour average concentrations of PM₁₀ were above the Air EPP objective of 50 µg/m³. There were no records of bushfires and/or dust storms that may have contributed to these elevated levels. Winds were in the direction of the mine on three of the seven exceedances days and therefore existing Trap Gully mining activities may have contributed to some of these levels.

Table 5 Summary statistics for 24-hour average PM₁₀ as measured at Trap Gully 1 real-time PM₁₀ monitoring station

Site	Year	Data Capture (%)	Maximum PM ₁₀ (µg/m ³)	90 th percentile PM ₁₀ (µg/m ³)	70 th percentile PM ₁₀ (µg/m ³)	Annual Average PM ₁₀ (µg/m ³)	Days above 50 µg/m ³
Trap Gully 1	2022	52.3	22.7	12.6	9.8	8.2	0
	2023	64.4	85.6	26.1	12.1	12.7	3
	2024	80.6	97.6	22.7	15.3	14.3	4

4.3.2.2 Dust deposition

Table 6 presents the monthly dust deposition data, measured at the Callide Road, Gladstone and Kington monitors from September 2021 to June 2024. These dust gauges are considered to be the most suitable for the calculation of background levels of dust as the other monitors are in close proximity to the existing Callide mining operations, local agricultural activities or local dust sources such as unsealed roads and driveways. The maximum rolling annual average for each gauge is also presented.

Table 6 Dust deposition rates measured during the monitoring period (mg/m²/day)

Date	Callide Road	Gladstone Road	Kington
Sep-21	23	23	13

Date	Callide Road	Gladstone Road	Kington
Oct-21	43	23	50
Nov-21	50	47	43
Dec-21	80	33	17
Jan-22	57	37	20
Feb-22	43	13	33
Mar-22	37	20	20
Apr-22	37	10	17
May-22	10	7	13
Jun-22	20	7	10
Jul-22	20	17	13
Aug-22	20	17	20
Sep-22	20	33	17
Oct-22	20	20	20
Nov-22	23	27	20
Dec-22	20	33	60
Jan-23	27	30	37
Feb-23	20	27	53
Mar-23	33	23	37
Apr-23	17	23	10
May-23	30	37	27
Jun-23	13	27	17
Jul-23	13	23	13
Aug-23	10	23	0
Sep-23	17	27	17
Oct-23	20	23	27
Nov-23	37	67	0
Dec-23	76	30	63
Jan-24	130	86	0
Feb-24	30	27	76
Mar-24	3	27	96
Apr-24	23	23	30
May-24	13	30	17
Jun-24	7	23	30
Jul-24	23	23	20
Aug-24	10	17	13
Sep-24	13	37	23
Oct-24	27	103	23
Nov-24	40	40	33
Dec-24	23	30	20
Annual Rolling Average	36.7	41.1	35.3
Guideline	120 mg/m²/day		

4.3.3 Summary of ambient air quality

Ambient background concentrations selected for use in the air quality assessment are presented in Table 7.

Table 7 Ambient background concentrations selected for use in the air quality assessment

Pollutant	Averaging period	Ambient background ($\mu\text{g}/\text{m}^3$)	Source
PM ₁₀ ⁽¹⁾	24-hour	15.3	Maximum 24-hour 70 th percentile PM ₁₀ measurement in 2024 from the monitoring data at Trap Gully 1 EBAM
	Annual	14.3	Annual average PM ₁₀ measurement in 2024 from the monitoring data at Trap Gully 1 EBAM
PM _{2.5} ⁽²⁾	24-hour	4.6	Derived from PM ₁₀ using PM _{2.5} to PM ₁₀ ratio of 0.3 based on PM _{2.5} /PM ₁₀ in data collected by DETSI in Moranbah
	Annual	4.3	
TSP ⁽²⁾	Annual	28.6	Derived from PM ₁₀ using PM ₁₀ to TSP ratio of 0.5
Dust deposition	Monthly	41.1 mg/m ² /day	Maximum rolling annual average of monthly dust deposition data from Kington, Callide Road and Gladstone Road between September 2021 and December 2024

Table note:

⁽¹⁾ Adoption of these levels is conservative as these concentrations include the contribution from the existing Trap Gully operations and therefore there is the potential for double counting as the approved Trap Gully operations have been included in the modelling.

⁽²⁾ Assumed background concentrations of PM_{2.5} and TSP are likely to be conservative as they have been derived from PM₁₀ which includes the existing Trap Gully operations.

5. EMISSIONS TO THE ATMOSPHERE

5.1 Construction phase activities

The construction phase of the project has the potential to cause elevated levels of dust if not managed appropriately. Construction phase activities can be described broadly as:

- The realignment of a section of the existing Link Road; and
- The construction of ancillary mine infrastructure to support existing mining operations.

5.2 Operation phase activities

Emissions of dust to the atmosphere will be produced during the operational phase of the project. Key activities relevant to dust emissions include:

- Dozer operation during extension of the existing overburden emplacement area to the west; and
- Wind erosion from the overburden emplacement extension area.

Other activities that will be occurring at the same time relate to the approved Trap Gully mining operations and include:

- Overburden and coal excavation, dozing and handling;
- Wheel generated dust due to transport of material across the mine site on unsealed haul roads;
- Wind erosion of exposed areas, including the open cut pit, overburden emplacement areas and stockpiles; and
- Transfer of coal to stockpiles and the Coal Processing Plant (CPP).

The project will not involve any additional mining, increase in production, extension of the mine life or any other changes to the existing approved mining operations.

5.3 Emissions inventory

Emissions of dust to the atmosphere will be produced during the operation of the project. Dust emissions will be generated by the five dozers that will operate during daylight hours to create the emplacement extension area. Wind erosion may also occur from the overburden emplacement extension area under high winds.

The emissions inventory developed for the project is presented in Table 8. Also included are the emissions due to the ongoing approved mining operations at Trap Gully.

The key measures to control dust emissions include watering of active haul and access roads, dust curtains on drills and wet drilling. Consequently, the following control measures and reduction factors have been accounted for when estimating dust emissions:

- 90% reduction in wheel generated dust due to watering on all haul routes;
- 90% reduction in emissions generated from grading of haul routes due to watering on all haul routes; and
- 70% reduction in emissions generated from drilling due to dust curtains on drills and wet drilling.

The 90% reduction in wheel generated dust due to watering on haul routes was established through model evaluation work conducted. This work is detailed in Appendix D, whereby predicted concentrations of dust from existing mining activities were compared against monitoring data from Batchfire's monitoring network.

Operating parameters, such as extraction rates, equipment locations and utilisation rates were based on information provided by the proponent. These are detailed in Appendix B. Other factors that determine dust emissions are the coal and overburden moisture and silt contents as well as the mitigation measures that may be employed. These key factors have been accounted for in estimating the dust emissions for the project.

Further details of the methodology and the emission factors used for estimating dust emissions are provided in Appendix C.

Table 8 **Trap Gully Overburden Emplacement Extension Project and Trap Gully mine - estimated dust emission rates**

Activity	Emission Rate (g/s)		
	TSP	PM ₁₀	PM _{2.5}
TGOEEP			
<i>Overburden dozing</i>	2.1	0.2	0.1
<i>Exposed areas</i>	2.8	1.4	0.2
Trap Gully Pit			
<i>Drilling / Blasting</i>	8.6	4.4	0.3
<i>Overburden handling</i>	16.7	3.5	0.3
<i>Overburden dozing</i>	0.3	0.05	0.03
<i>ROM handling</i>	0.03	0.01	0.002
<i>ROM dozing</i>	0.9	0.31	0.02
Trap Gully In-Pit Dump			
<i>Overburden handling</i>	0.2	0.09	0.01
<i>Overburden dozing</i>	0.1	0.03	0.01
Trap Gully Western Dump			
<i>Overburden handling</i>	0.2	0.07	0.01
<i>Overburden dozing</i>	0.1	0.03	0.01
ROM Pad			
<i>ROM handling</i>	0.1	0.03	0.004
<i>ROM dozing</i>	0.9	0.3	0.02
Haulage			
<i>Overburden hauls to dumps</i>	106.7	30.4	3.0
<i>ROM haulage</i>	59.3	15.9	1.6
<i>Miscellaneous traffic (Link Road/Mixing Truck Route)</i>	13.1	3.4	0.3
Grading of haul routes	0.7	0.2	0.02
Wind erosion			
<i>Exposed areas – pits and dumps</i>	8.2	4.1	0.6
<i>Exposed areas</i>	6.1	3.1	0.5
<i>ROM Stockpile</i>	0.5	0.3	0.04
TOTAL	227.6	67.8	7.1

6. IMPACT ASSESSMENT

6.1 Project and ambient background

The CALPUFF dispersion model has been used to quantify dust emissions associated with the project during its operational phase.

Ground-level concentrations of dust during the operational phase of the project have been predicted at the sensitive receptors. The cumulative impacts of the project's operational phase and the approved Trap Gully mining operations in isolation, and including the ambient background levels (Section 4.3.3), have been calculated. Air pollutant levels have been assessed by comparing the predicted concentrations and dust deposition rates at the closest sensitive receptors with the relevant air quality objectives. Ground-level concentrations of dust and dust deposition rates were also predicted at a network of evenly spaced grid points covering the study area and are presented as contour plots.

When considering the results, it is important to note that the 24-hour average dispersion modelling results are based on the maximum concentration of each pollutant predicted at the receptors over the modelled one-year period and thus represent a peak-impact scenario. The contour plots are constructed such that the maximum value is obtained and stored from each point in the modelled domain. As these maximum values may occur at different times at different grid points, these figures do not represent a single snapshot of conditions at any given time.

Table 9 and Table 10 provide the predicted ground-level concentrations of dust and dust deposition rates at the key sensitive receptors due to the operational phase of the project and approved Trap Gully mining operations in isolation, and with the addition of ambient background concentrations, respectively.

Contour plots of the predicted ground-level concentrations of dust and dust deposition rates are presented in Plate 1 to Plate 6 for the operational phase of the project and approved Trap Gully mining operations in isolation and Plate 7 to Plate 12 for the operational phase of the project, approved Trap Gully mining operations and including ambient background levels.

The results show:

- For the operational phase of the project and approved Trap Gully mining operations:
 - Predicted annual average ground-level concentrations of TSP **comply** with the relevant air quality objective at all sensitive receptors.
 - Predicted annual average and 24-hour average ground-level concentrations of PM₁₀ **comply** with the relevant air quality objectives at all sensitive receptors.
 - Predicted annual and 24-hour average ground-level concentrations of PM_{2.5} **comply** with the relevant air quality objectives at all sensitive receptors.
 - Predicted maximum monthly dust deposition rates **comply** with the relevant air quality objective at all sensitive receptors.
- For cumulative impacts (operational phase of the project, approved Trap Gully mining operations and including ambient background levels):
 - Predicted annual average ground-level concentrations of TSP **comply** with the relevant air quality objectives at all sensitive receptors.
 - Predicted annual average ground-level concentrations of PM₁₀ **comply** with the relevant air quality objectives at all sensitive receptors with the exception of SR1. This exceedance is likely to be due to the conservative adopted background levels and the conservatism in the model predictions as demonstrated in Appendix D. It should be noted that the annual average

concentration of PM₁₀ measured in 2024 at Trap Gully 1, which is located in close proximity to SR1 (Figure 6), was only 14.3 µg/m³.

- Predicted 24-hour average ground-level concentrations of PM₁₀ comply with the relevant air quality objective at all sensitive receptors with the exception of two sensitive receptors:
 - Six days of exceedances are predicted at SR1, located west of the project ML. These exceedances are generally consistent with monitoring data at Trap Gully 1 from 2024 (Table D2, Appendix D)
 - One day of exceedance is predicted at SR2, located south of the project ML. Concentrations are marginally higher (50.7 µg/m³) than the objective (50 µg/m³).
- Predicted annual average and 24-hour average ground-level concentrations of PM_{2.5} **comply** with the relevant air quality objectives at all sensitive receptors.
- Predicted maximum monthly dust deposition rates **comply** with the relevant air quality objective at all sensitive receptor with the exception of 1 month at SR1. This exceedance is consistent with the number of months the dust deposition data was above 120 mg/m²/month at this receptor from 2024 (Table D2, Appendix D).

Predicted concentrations and dust deposition rates at all other sensitive receptors further afield will be less than those presented here, and comply with all of the relevant air quality objectives.

Table 9 Predicted ground-level concentrations of dust due to the project and approved mining operations in isolation

Receptor	TSP ($\mu\text{g}/\text{m}^3$)	PM ₁₀ ($\mu\text{g}/\text{m}^3$)		PM _{2.5} ($\mu\text{g}/\text{m}^3$)		Dust deposition ($\text{mg}/\text{m}^2/\text{day}$)
	Annual average	Maximum 24-hour	Annual Average	Maximum 24-hour	Annual Average	Maximum Monthly
SR1	26.7	45.4	12.0	5.8	1.4	96.3
SR2	20.2	35.4	8.6	6.2	1.0	70.8
SR3	15	33.1	6.5	5.9	0.8	56.9
SR4	12.2	26.5	5.3	4.6	0.7	38.8
SR5	14.5	23.4	6.5	3.0	0.8	37.8
SR6	15.5	22.5	6.9	3.2	0.8	43.7
Air quality criteria	90	50	25	20	7	120

Table 10 Predicted ground-level concentrations of dust due to the project, approved mining operations plus ambient background concentrations

Receptor	TSP ($\mu\text{g}/\text{m}^3$)	PM ₁₀ ($\mu\text{g}/\text{m}^3$)		PM _{2.5} ($\mu\text{g}/\text{m}^3$)		Dust deposition ($\text{mg}/\text{m}^2/\text{day}$)
	Annual average	Maximum 24-hour	Annual Average	Maximum 24-hour	Annual Average	Maximum Monthly
SR1	55.3	60.7	26.3	10.4	5.7	137.4
SR2	48.8	50.7	22.9	10.8	5.3	111.9
SR3	43.6	48.4	20.8	10.4	5.1	98
SR4	40.8	41.8	19.6	9.2	4.9	79.9
SR5	43.1	38.7	20.8	7.6	5.1	78.9
SR6	44.1	37.8	21.2	7.8	5.1	84.8
Air quality criteria	90	50	25	20	7	120
Table note: Shaded cells depict values above the criteria						

6.2 Monitoring, mitigation and management

Batchfire currently manages dust from existing operations in the following ways:

- Implements routine control measures to minimise dust from mining activities including:
 - Watering on all mine truck haul roads and access roads; and
 - The use of dust curtains and water injection when drilling.
- Undertakes ambient monitoring of PM₁₀ and dust deposition within the vicinity of the Trap Gully mining area; and
- Has a protocol for managing potential dust impacts at Trap Gully that includes:
 - Review of depositional data monthly;
 - Senior Community Advisor liaises with all landholders and receives community complaints via text message;
 - Any complaints in relation to dust are recorded within the database “Consultation Manager” and are reviewed against monitored dust results; and
 - Any non-compliances are reported and investigated in accordance with EA conditions.

Batchfire will continue to implement the above practices throughout the duration of the project in order to adequately manage dust emissions from the project and to prevent adverse impacts at sensitive receptors.

In order to ensure monitoring of dust impacts at all potentially impacted sensitive receptors, Batchfire will establish a second PM₁₀ BAM monitor (Trap Gully 2 EBAM) and relocate the Byrd dust deposition gauge to a location in the vicinity of SR2. These monitors will be sited in accordance with AS/NZS 3580.1.1:2016 to ensure the monitors are not measuring local dust sources, prior to the commencement of the project.

7. CONCLUSIONS

An air quality assessment of the Trap Gully Overburden Emplacement Extension Project has been prepared.

This assessment was conducted in accordance with recognised techniques for dispersion modelling and emission estimation in order to determine potential impacts to identified sensitive receptors and the surrounding environment.

The project involves an extension of the existing Trap Gully overburden emplacement to the west, including the realignment of the existing Link Road, and the construction and operation of ancillary mine infrastructure to support the existing Trap Gully mining operations. Emissions from construction of ancillary infrastructure will be negligible in comparison with emissions from the operational phase of the project, and thus emissions from construction activities have not been quantified.

The air quality assessment has shown that predicted ground-level concentrations of all air pollutants and dust deposition rates due to the operational phase of the project and approved Trap Gully mining operations in isolation are predicted to **comply** with the relevant air quality objectives at all sensitive receptors.

The cumulative assessment of the operational phase of the project and approved Trap Gully mining operations with the inclusion of ambient background levels has shown that:

- Predicted annual average ground-level concentrations of TSP, PM₁₀, PM_{2.5}, as well as 24-hour concentrations of PM_{2.5}, are predicted to **comply** with the relevant air quality objectives at all sensitive receptors.
- Predicted 24-hour average ground-level concentrations of PM₁₀ comply with the relevant air quality objective at all sensitive receptors with the exception of two sensitive receptors:
 - Six days of exceedance are predicted at SR1, located west of the project ML. These exceedances are generally consistent with monitoring data at this receptor from 2024 (Table D2, Appendix D)
 - One day of exceedance is predicted at SR2, located south of the project ML. Concentrations are marginally higher (50.7 µg/m³) than the objective (50 µg/m³).
- Predicted maximum monthly dust deposition rates over a 12 month period **comply** with the relevant air quality objective at all sensitive receptors with the exception of 1 month at SR1. This exceedance is consistent with the number of months the dust deposition data was above 120 mg/m²/month at this receptor from 2024 (Table D2, Appendix D).

Batchfire will continue to implement the existing dust mitigation measures and dust management protocol for managing dust impacts throughout the duration of the project in order to adequately manage dust emissions from the project and to prevent adverse impacts at sensitive receptors.

8. REFERENCES

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USEPA, 2006b, *Aggregate Handling and Storage Piles*, AP42 Chapter 13.2.4, USEPA Office of Air Quality Planning and Standards.

USEPA, 2006c, *Industrial Wind Erosion*, AP42 Chapter 13.2.5, USEPA Office of Air Quality Planning and Standards.

9. FIGURES

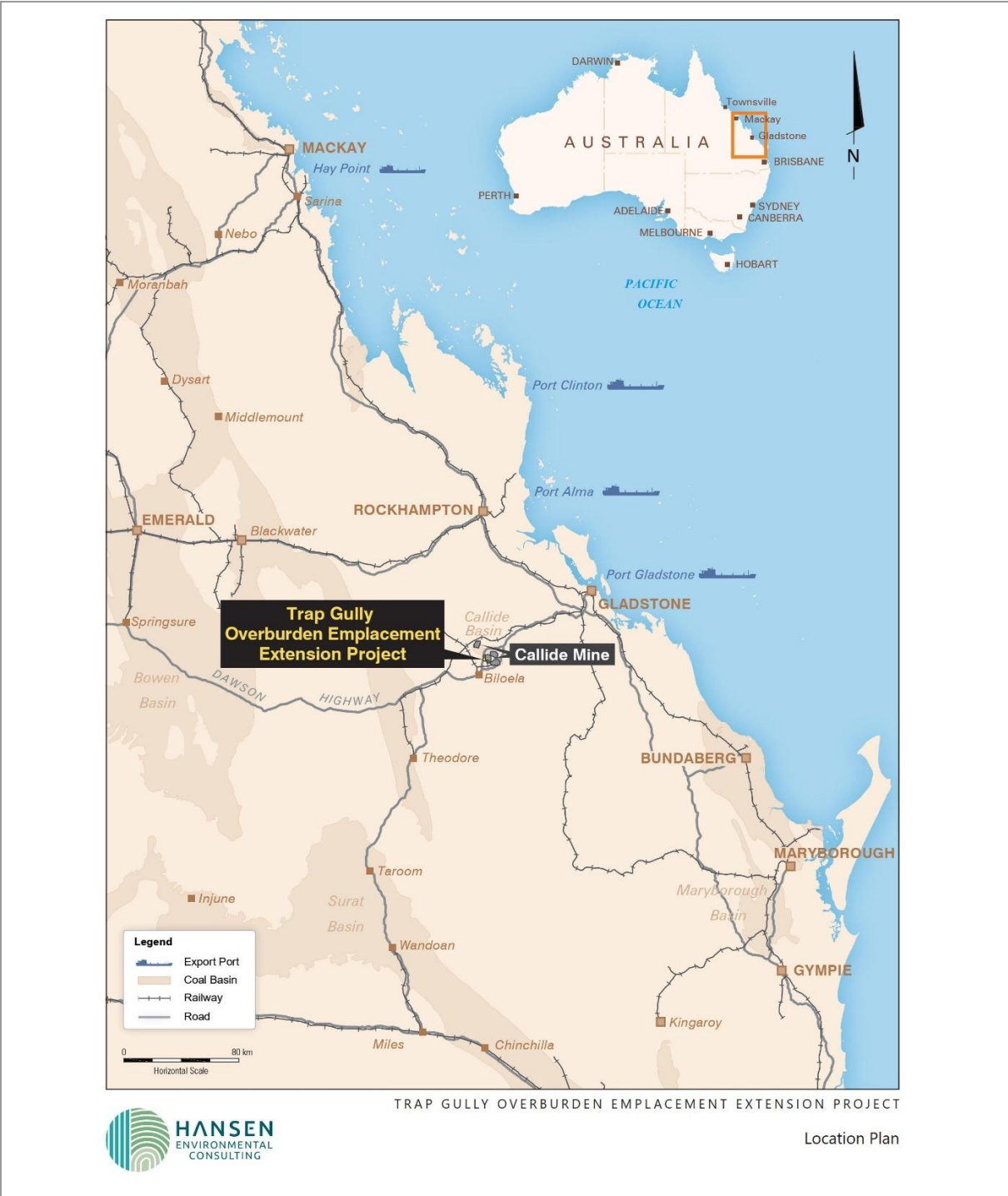
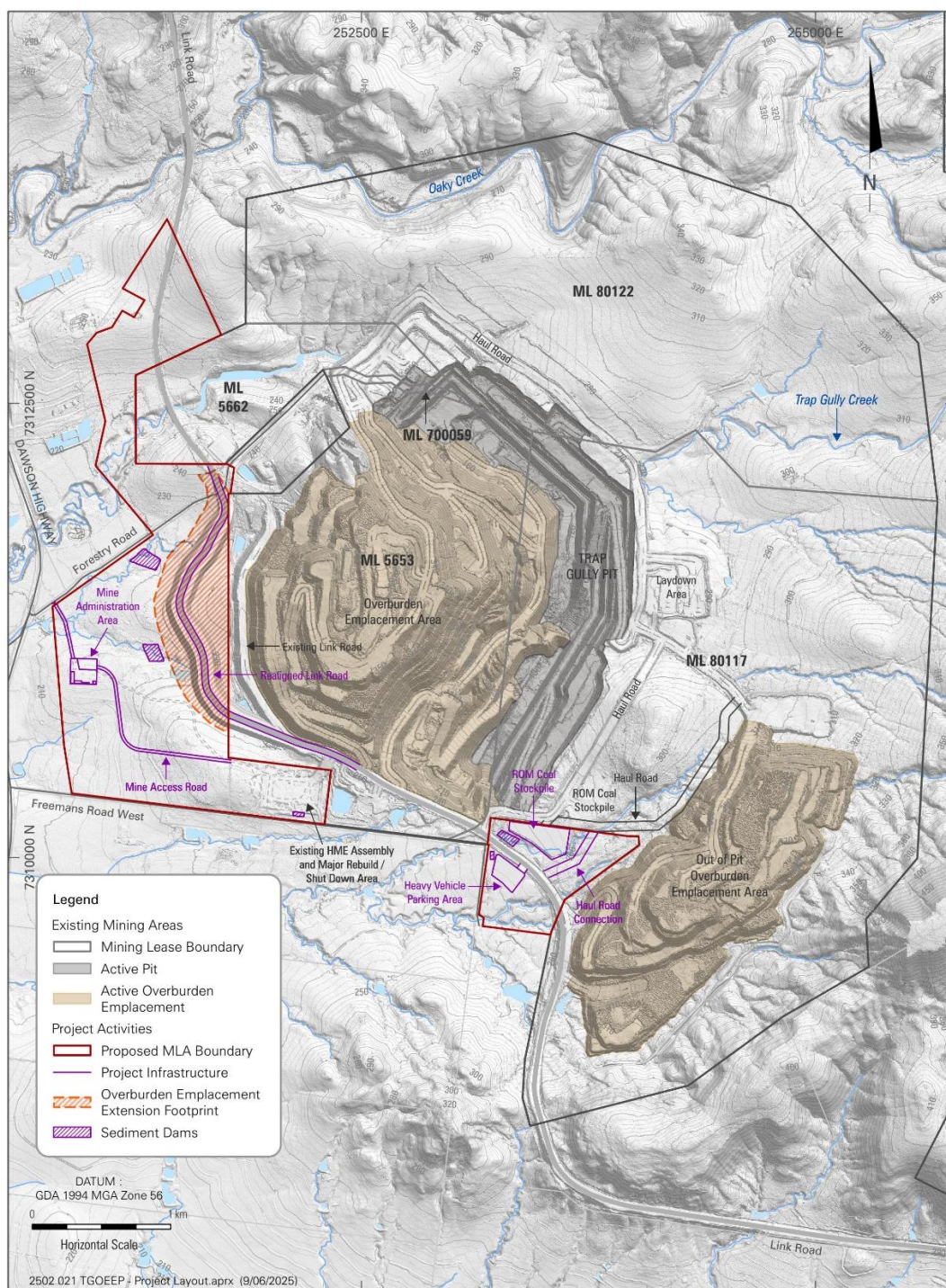


Figure 1 **Trap Gully Overburden Emplacement Extension Project – Location Plan**

Location: Queensland	Data source: Hansen Environmental Consulting	Date: July 2025
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TRAP GULLY OVERBURDEN EMPLACEMENT EXTENSION PROJECT

Project Layout



Figure 2 Trap Gully Overburden Emplacement Extension Project – Conceptual Project Layout

Location:
Callide, QLD

Data source:
Hansen Environmental Consulting

Date:
July 2025

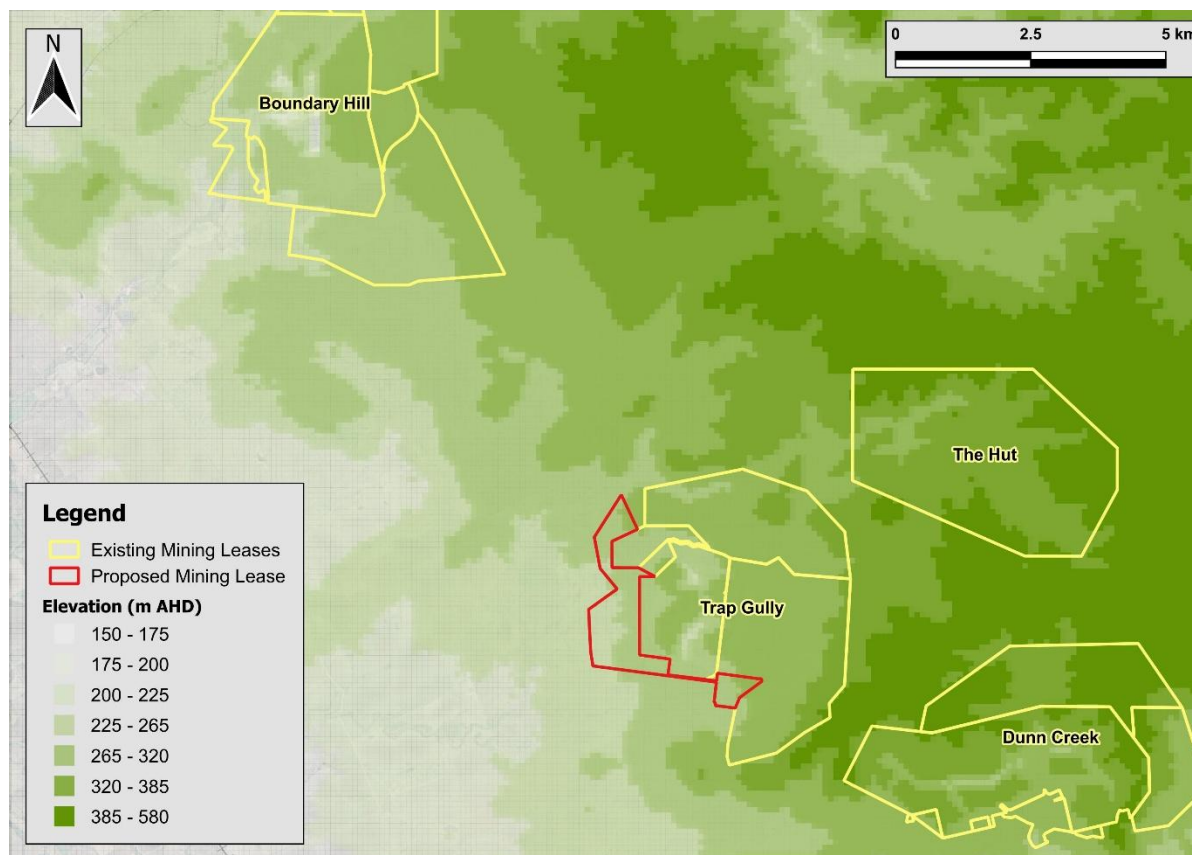


Figure 3 Terrain surrounding the project

Location: Callide, QLD	Data source: SRTM1 database	Units: Metres AHD, GDA-20 zone 56S
Type: Contour map	Prepared by: Sathya Roysmith	Date: July 2025

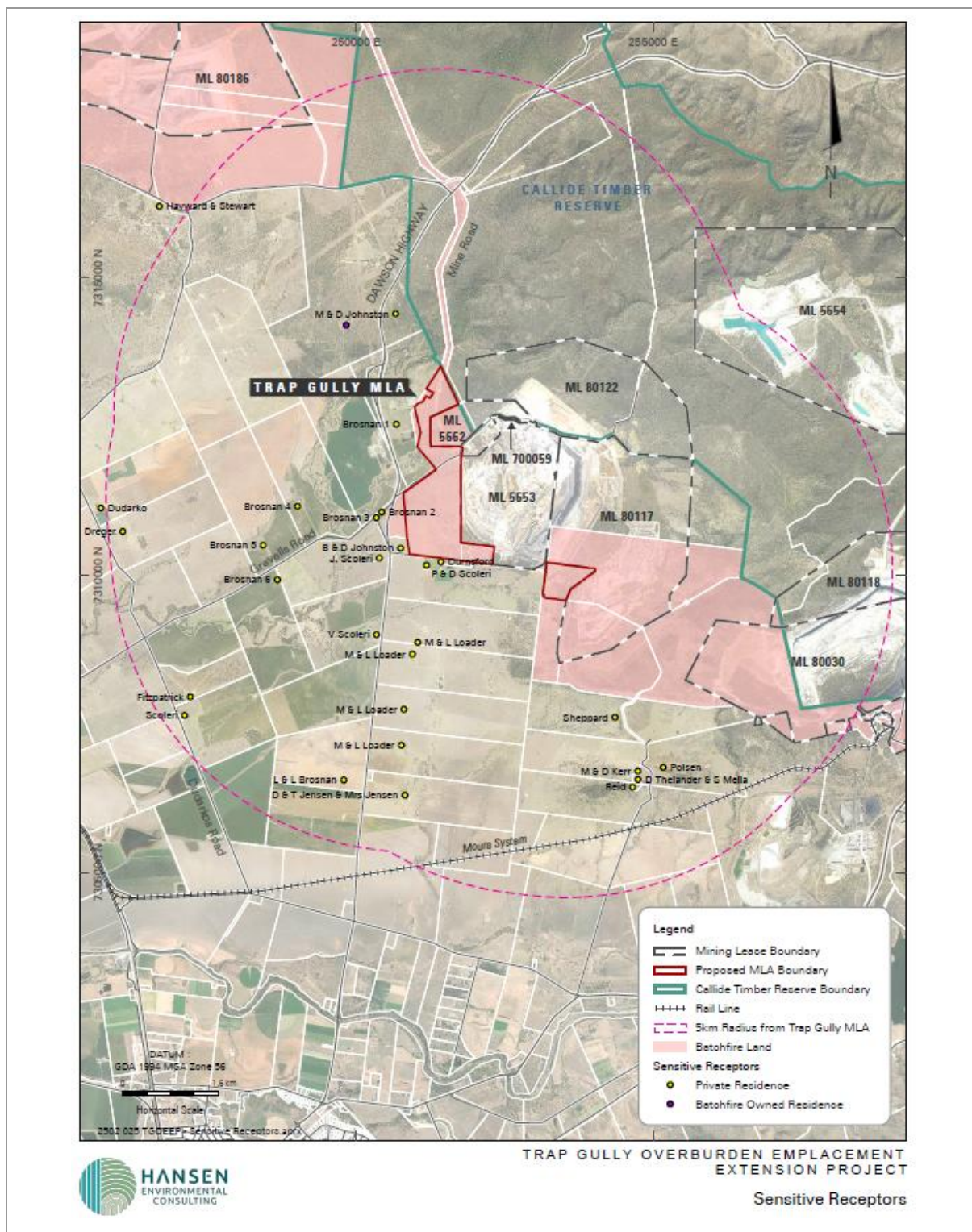


Figure 4 Sensitive receptors

Location:
Callide, QLD

Data source:
Hansen Environmental Consulting

Date:
July 2025

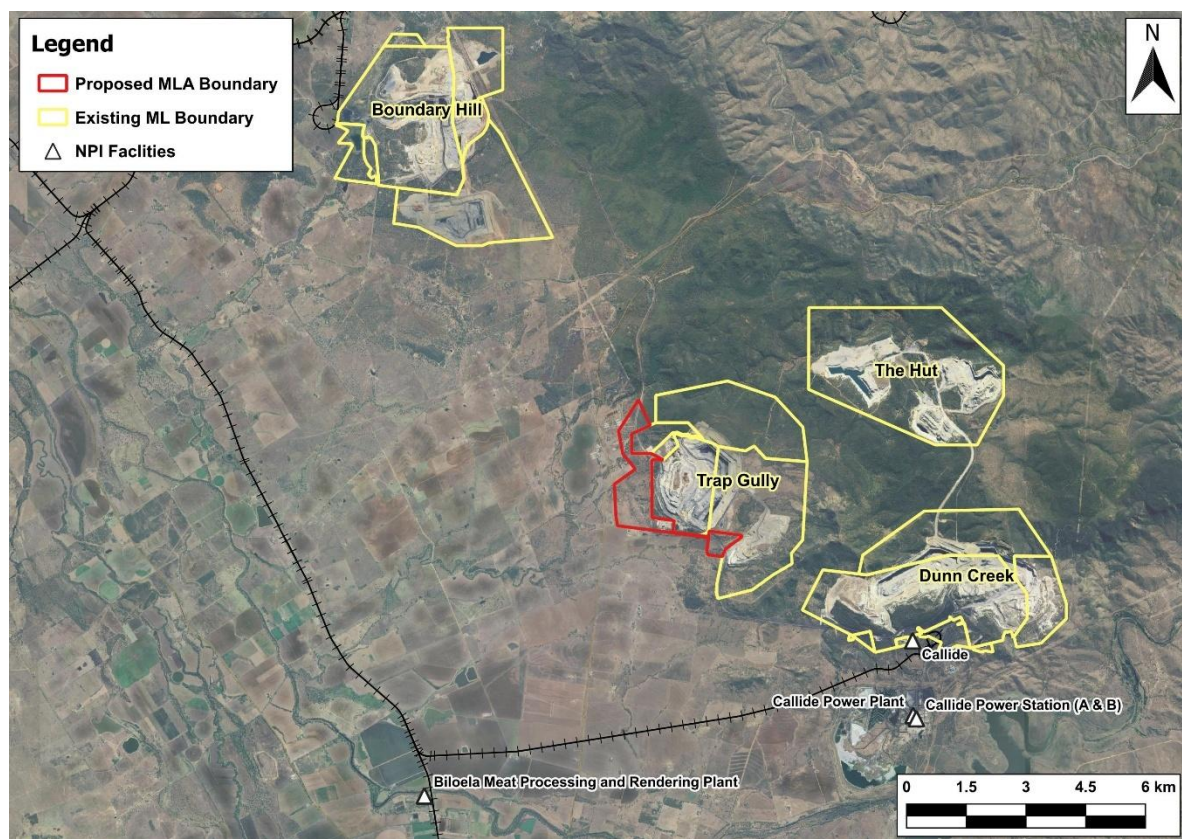


Figure 5 Location of facilities reporting to the NPI in the vicinity of the project

Location:
Callide, QLD

Data source:
NPI database

Date:
July 2025

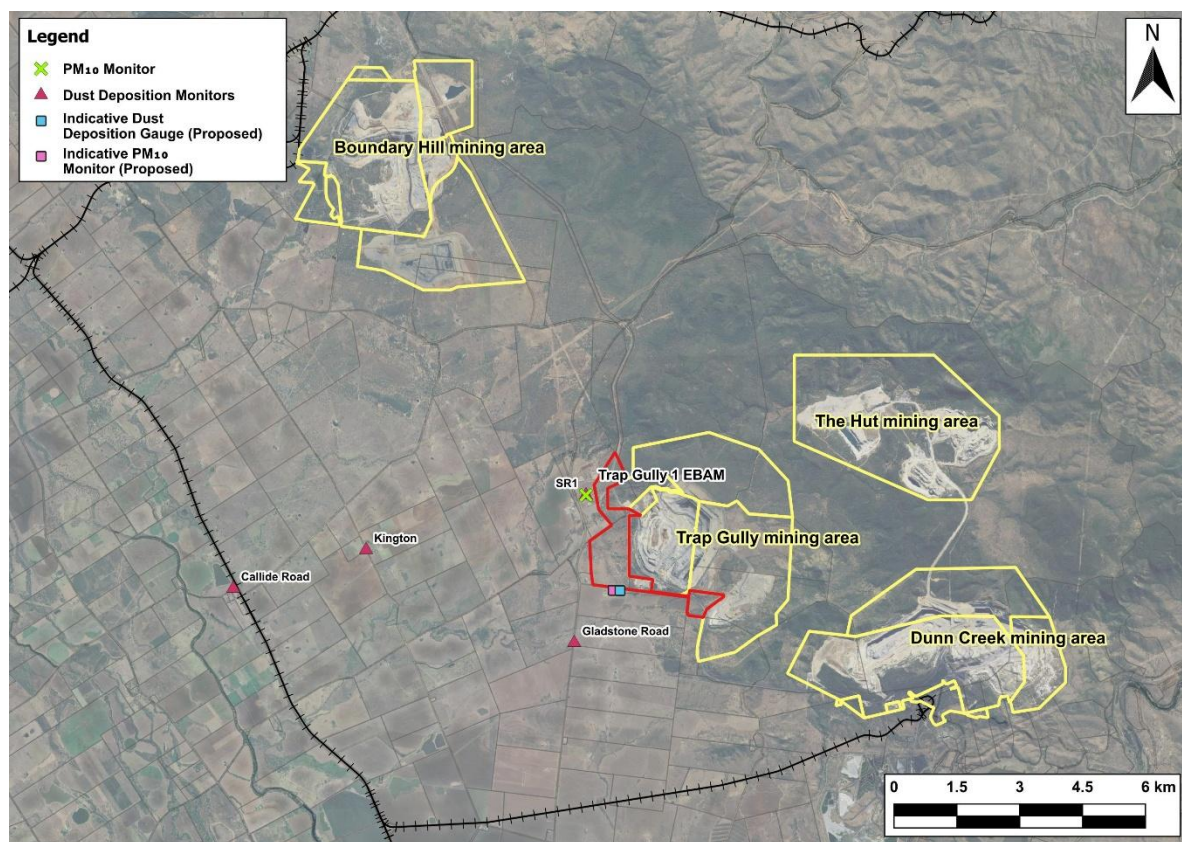


Figure 6 Existing monitoring network operated by Batchfire in the vicinity of the project

Location:
Callide, QLD

Data source:
Hansen Environmental Consulting

Date:
July 2025

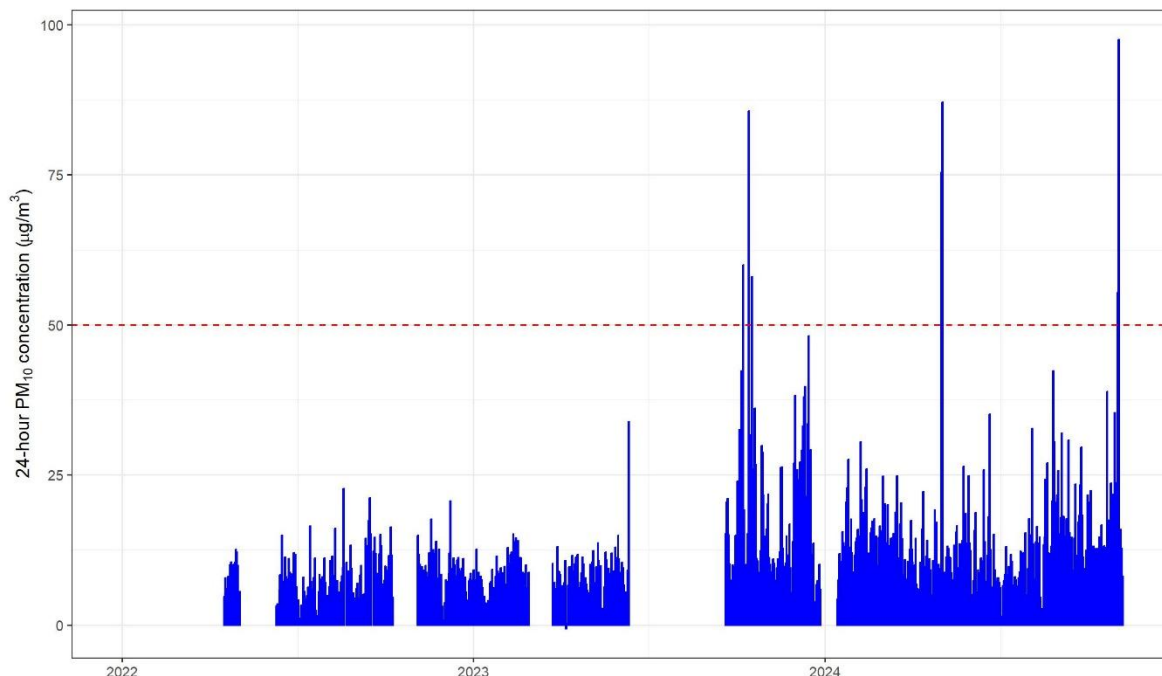
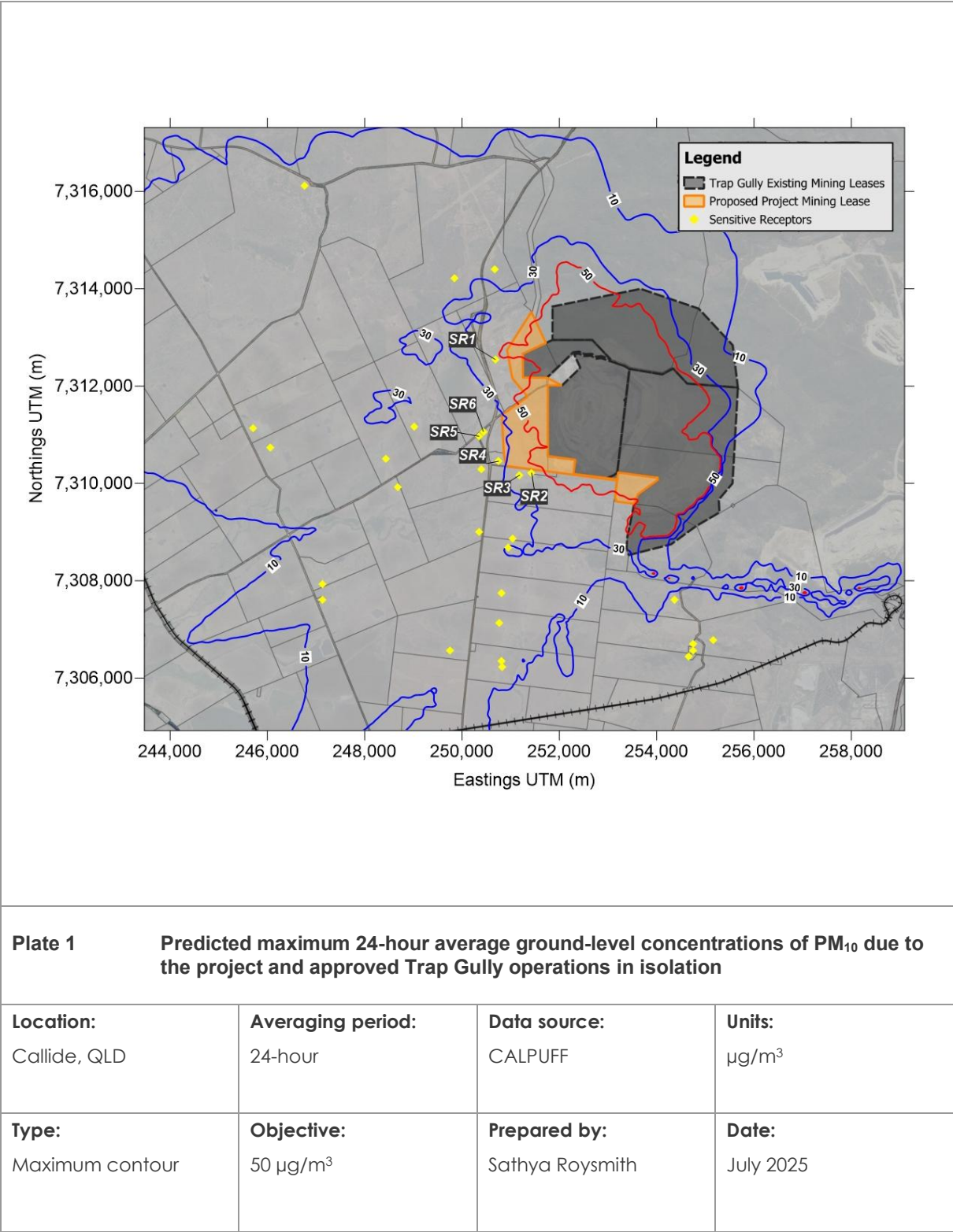


Figure 7 Timeseries of 24-hour average PM₁₀ as measured at the Trap Gully 1 monitoring station

Location: Callide, QLD	Data source: Batchfire Resources Monitoring Network	Units: µg/m ³
Type: Timeseries	Prepared by: Sathya Roysmith	Date: July 2025

10. CONTOUR PLATES



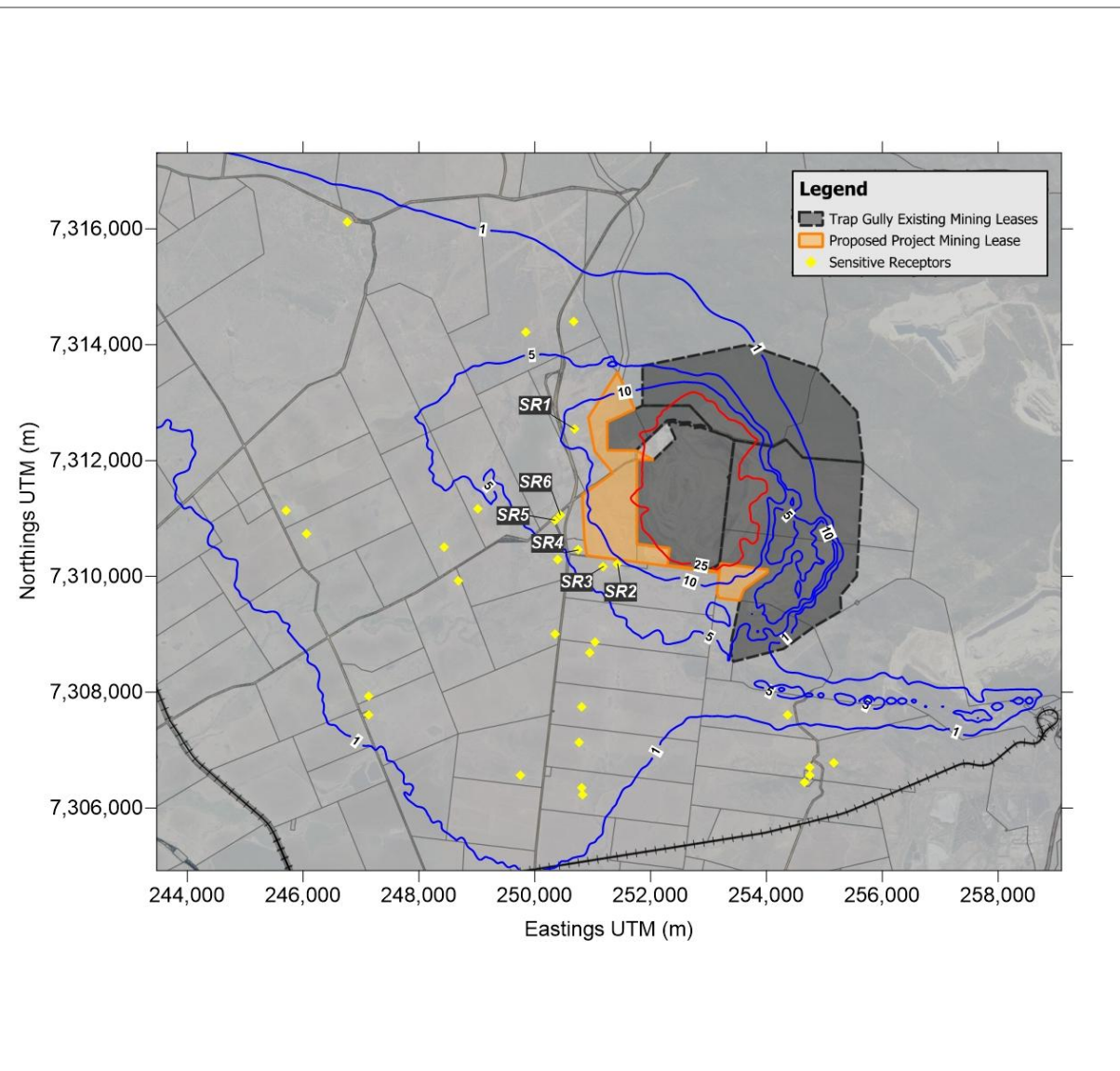


Plate 2 Predicted annual average ground-level concentrations of PM₁₀ due to the project and approved Trap Gully operations in isolation

Location: Callide, QLD	Averaging period: 1-year	Data source: CALPUFF	Units: µg/m ³
Type: Average contour	Objective: 25 µg/m ³	Prepared by: Sathya Roysmith	Date: July 2025

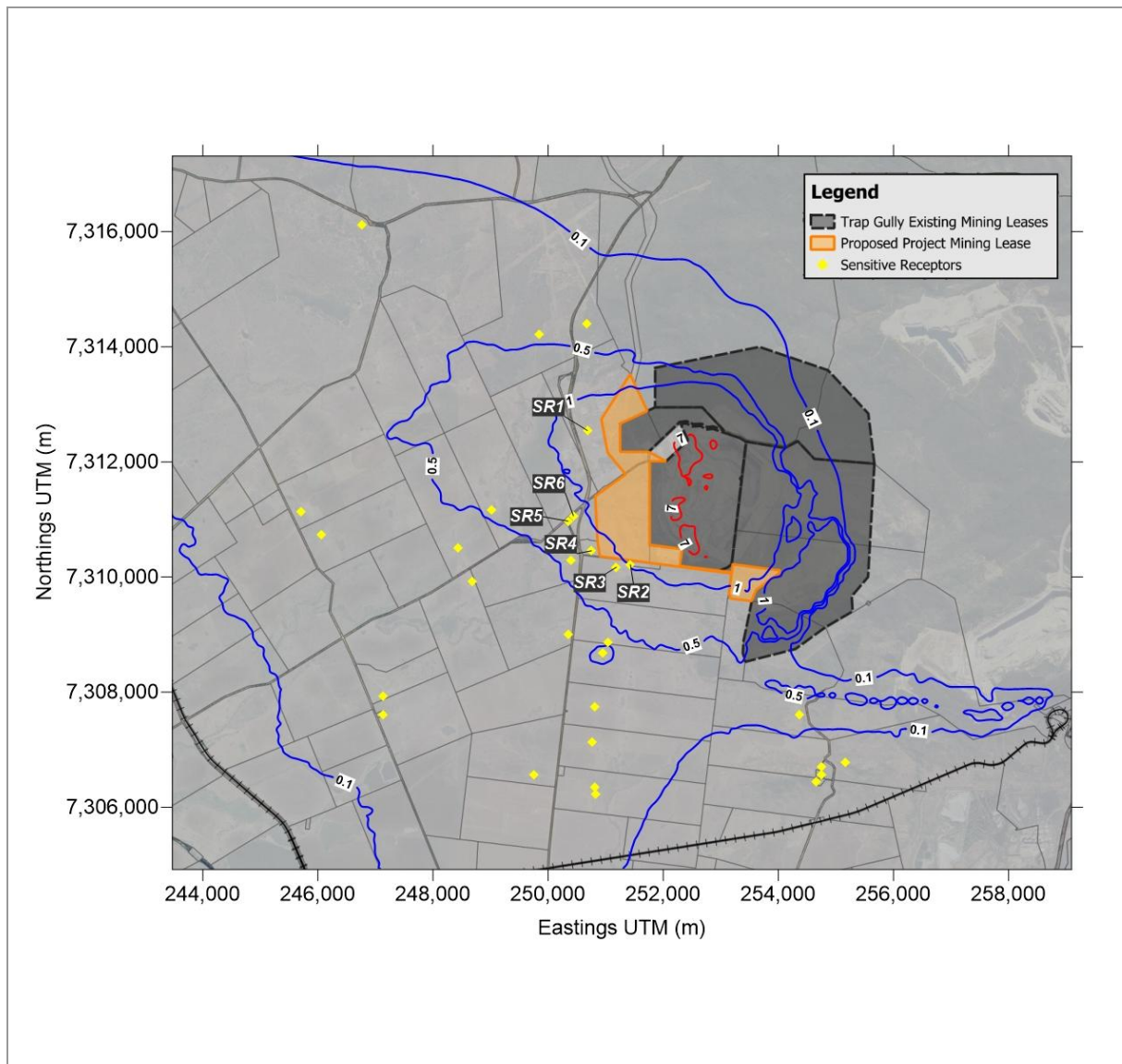


Plate 4 Predicted annual average ground-level concentrations of PM_{2.5} due to the project and approved Trap Gully operations in isolation

Location: Callide, QLD	Averaging period: 1-year	Data source: CALPUFF	Units: µg/m ³
Type: Average contour	Objective: 7 µg/m ³	Prepared by: Sathya Roysmith	Date: July 2025

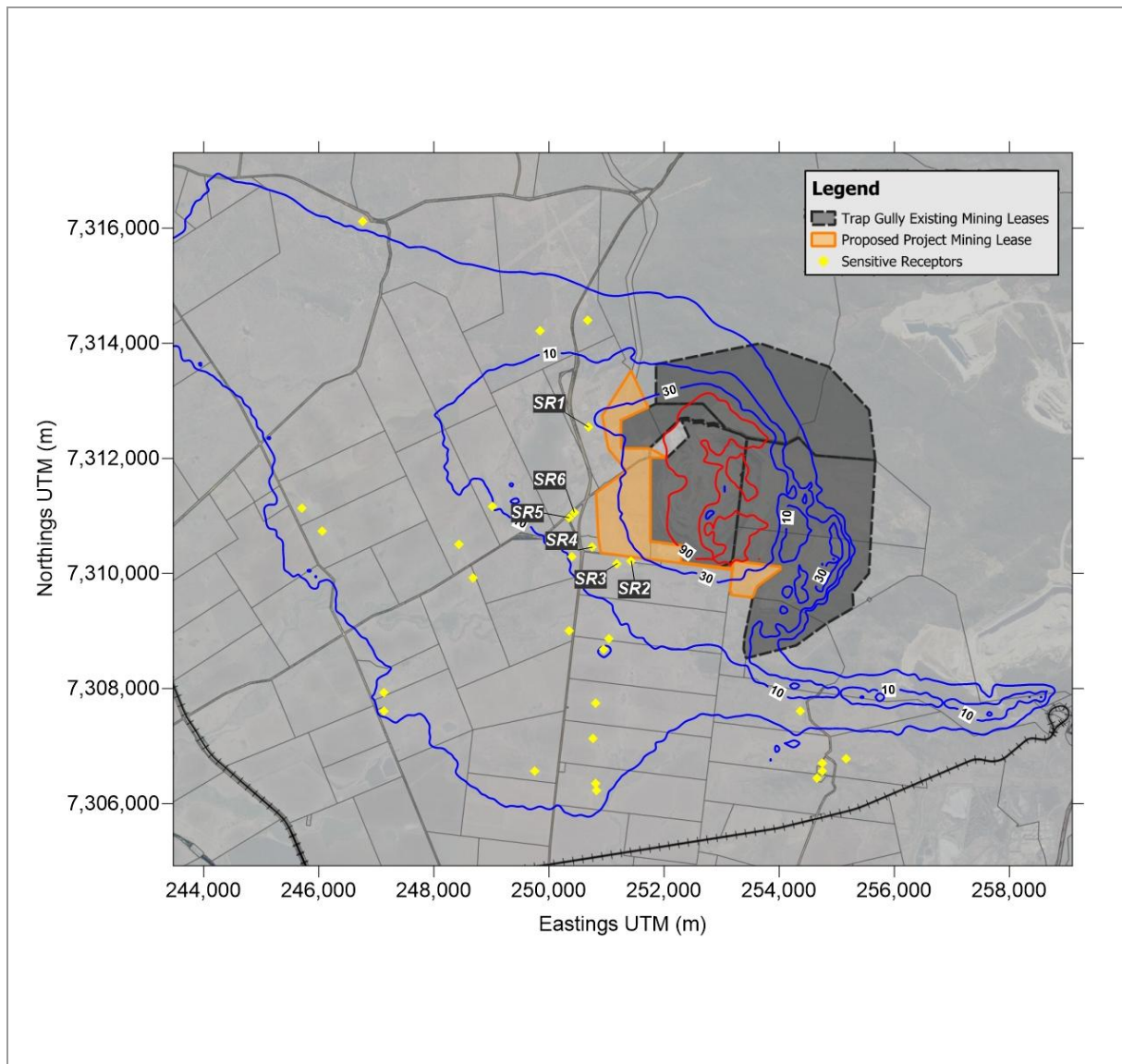


Plate 5 Predicted annual average ground-level concentrations of TSP due to the project and approved Trap Gully operations in isolation

Location: Callide, QLD	Averaging period: 1-year	Data source: CALPUFF	Units: µg/m ³
Type: Average contour	Objective: 90 µg/m ³	Prepared by: Sathya Roysmith	Date: July 2025

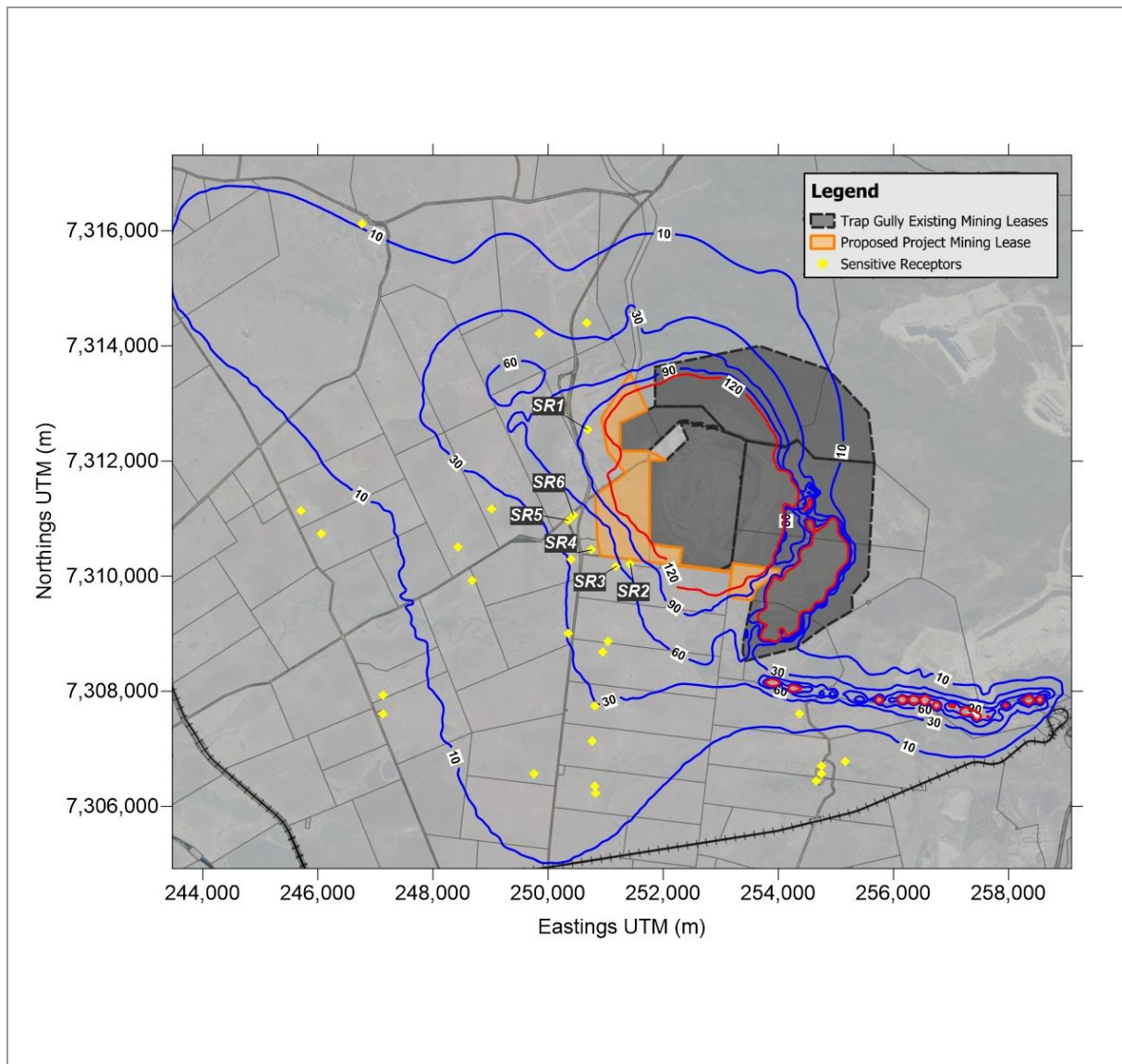


Plate 6 Predicted maximum monthly dust deposition rate due to the project and approved Trap Gully operations in isolation

Location: Callide, QLD	Averaging period: 1-month	Data source: CALPUFF	Units: mg/m ² /day
Type: Maximum contour	Objective: 120 mg/m ² /day	Prepared by: Sathya Roysmith	Date: July 2025

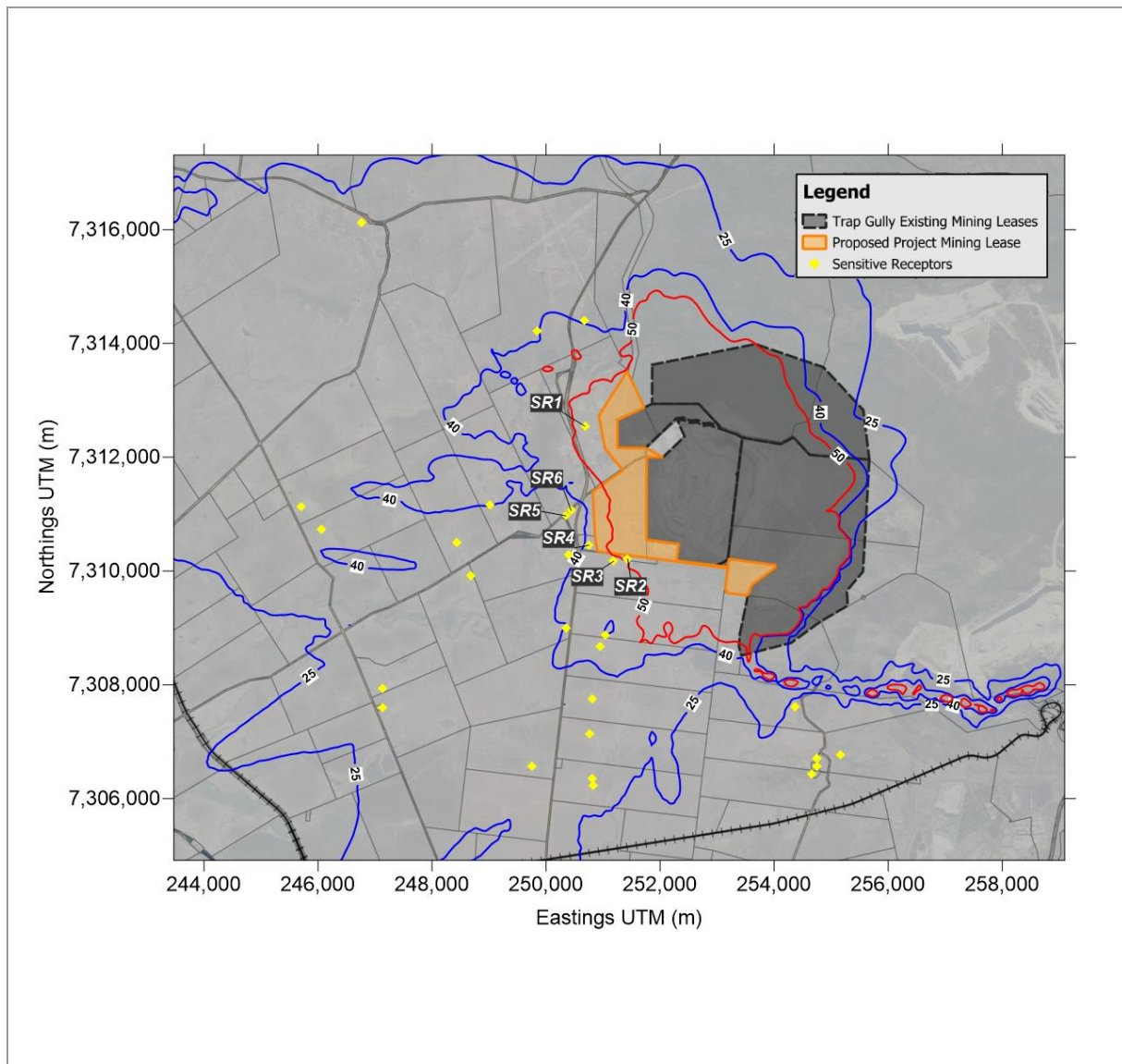


Plate 7 Predicted maximum 24-hour average ground-level concentrations of PM₁₀ due to the project, approved Trap Gully operations and including ambient background

Location: Callide, Qld	Averaging period: 24-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum contour	Objective: 50 µg/m ³	Prepared by: Sathya Roysmith	Date: July 2025

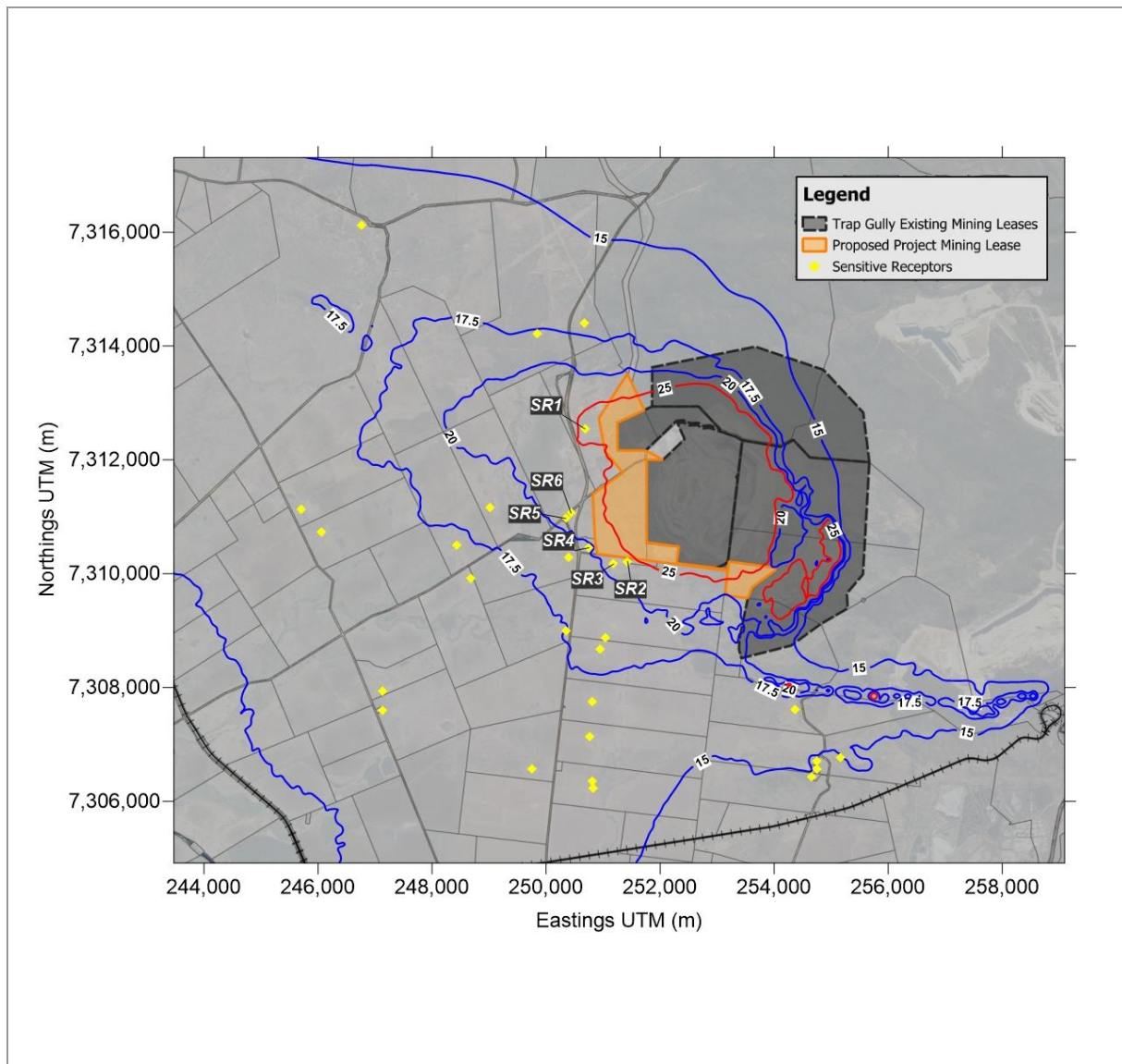


Plate 8 Predicted annual average ground-level concentrations of PM₁₀ due to the project, approved Trap Gully operations and including ambient background

Location: Callide, Qld	Averaging period: 1-year	Data source: CALPUFF	Units: µg/m ³
Type: Average contour	Objective: 25 µg/m ³	Prepared by: Sathya Roysmith	Date: July 2025

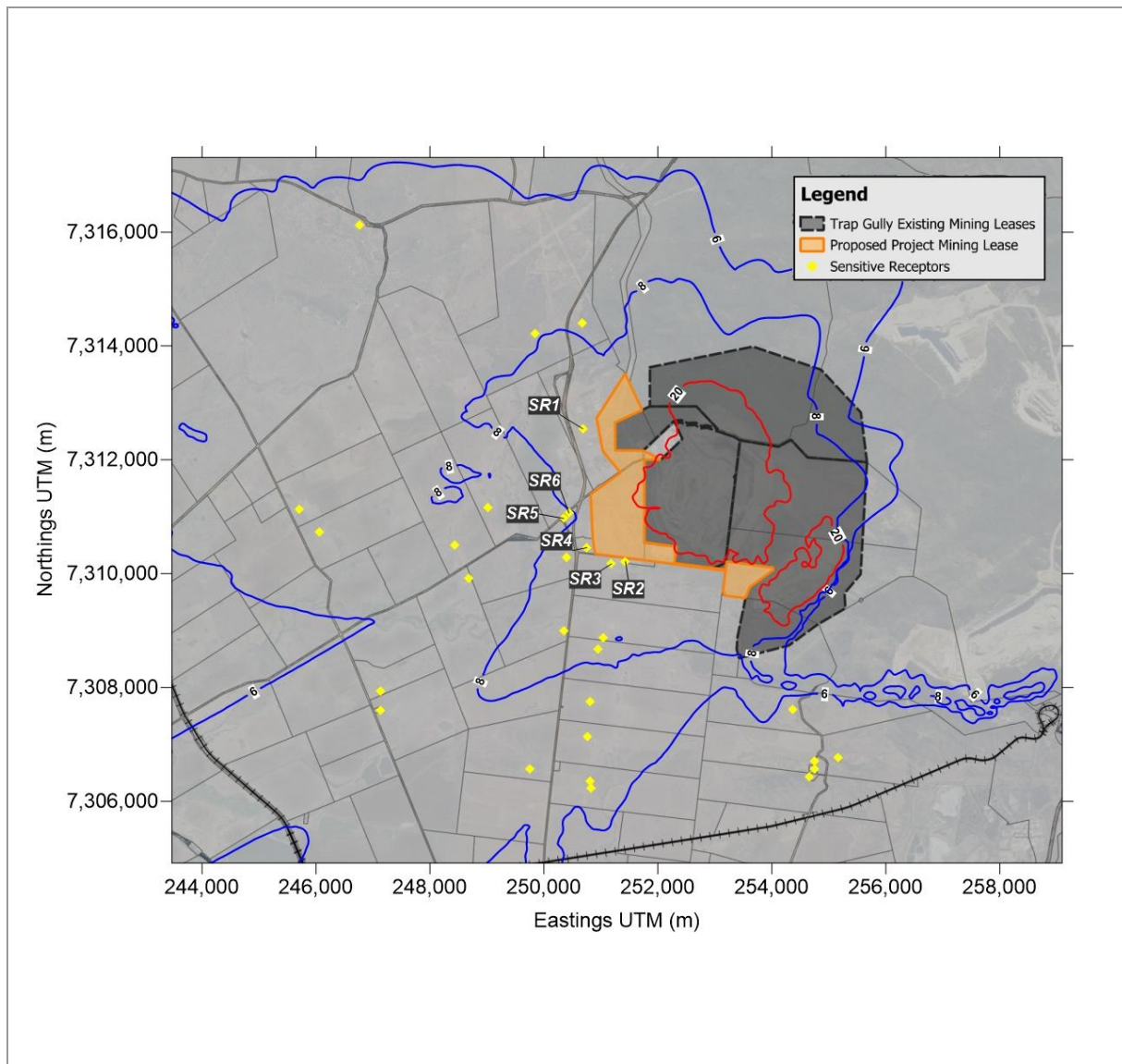


Plate 9 Predicted maximum 24-hour average ground-level concentrations of PM_{2.5} due to the project, approved Trap Gully operations and including ambient background

Location: Callide, QLD	Averaging period: 24-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum contour	Objective: 20 µg/m ³	Prepared by: Sathya Roysmith	Date: July 2025

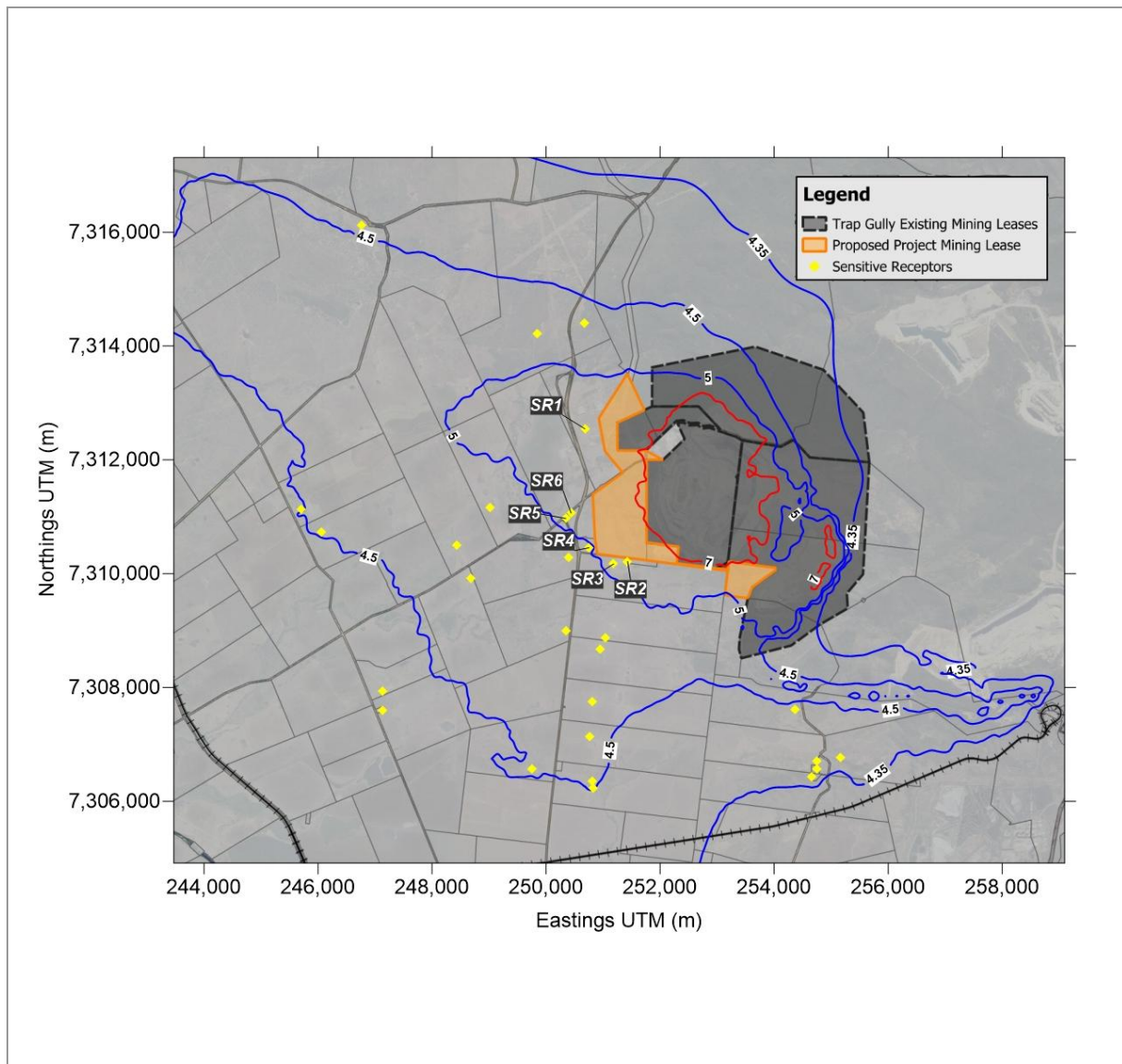


Plate 10 Predicted annual average ground-level concentrations of PM_{2.5} due to Year 1 of the project, approved Trap Gully operations and including background

Location: Callide, Qld	Averaging period: 1-year	Data source: CALPUFF	Units: µg/m ³
Type: Average contour	Objective: 7 µg/m ³	Prepared by: Sathya Roysmith	Date: July 2025

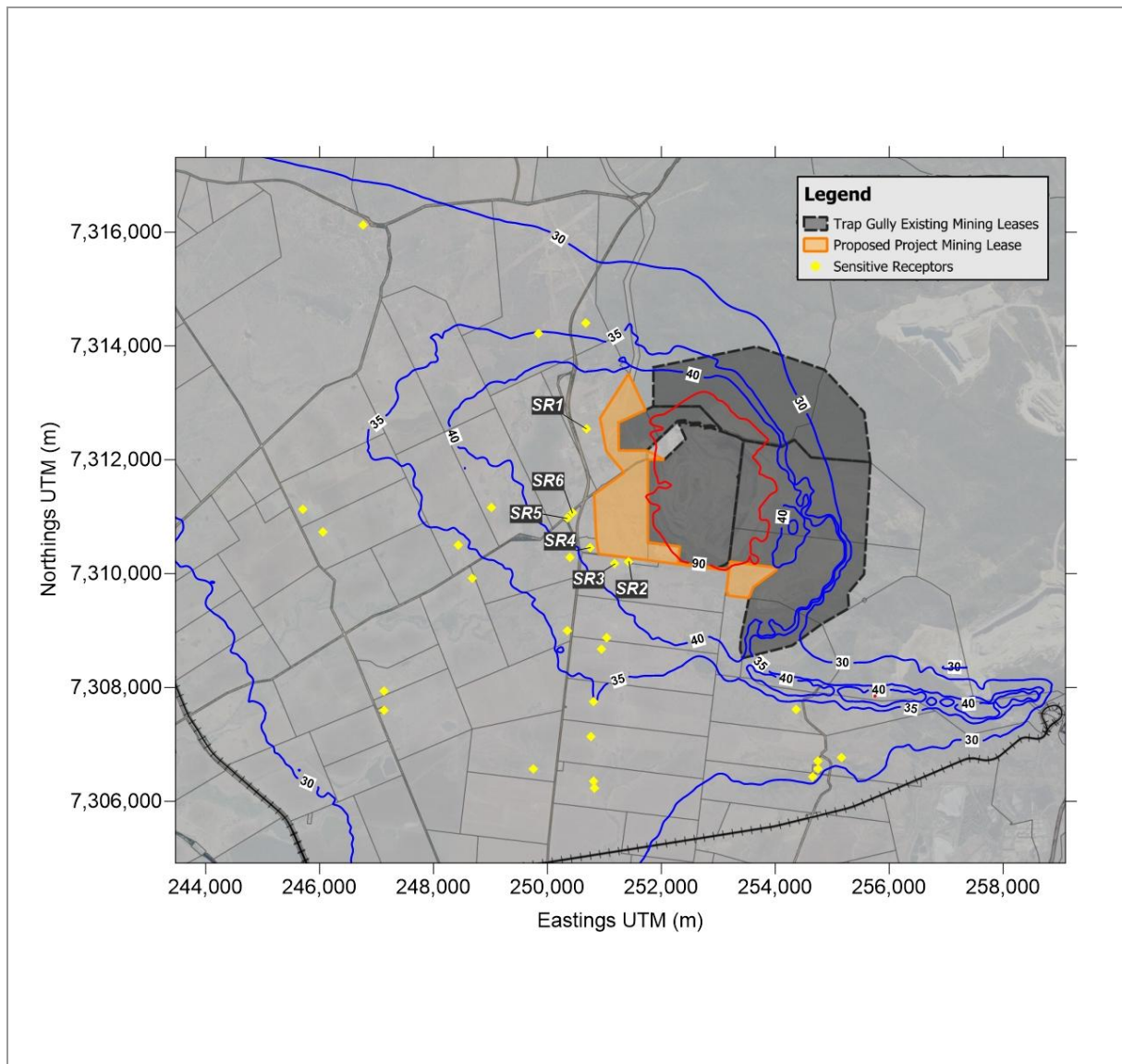


Plate 11 Predicted annual average ground-level concentrations of TSP due to the project, approved Trap Gully operations and including ambient background

Location: Callide, Qld	Averaging period: 1-year	Data source: CALPUFF	Units: µg/m ³
Type: Average contour	Objective: 90 µg/m ³	Prepared by: Sathya Roysmith	Date: July 2025

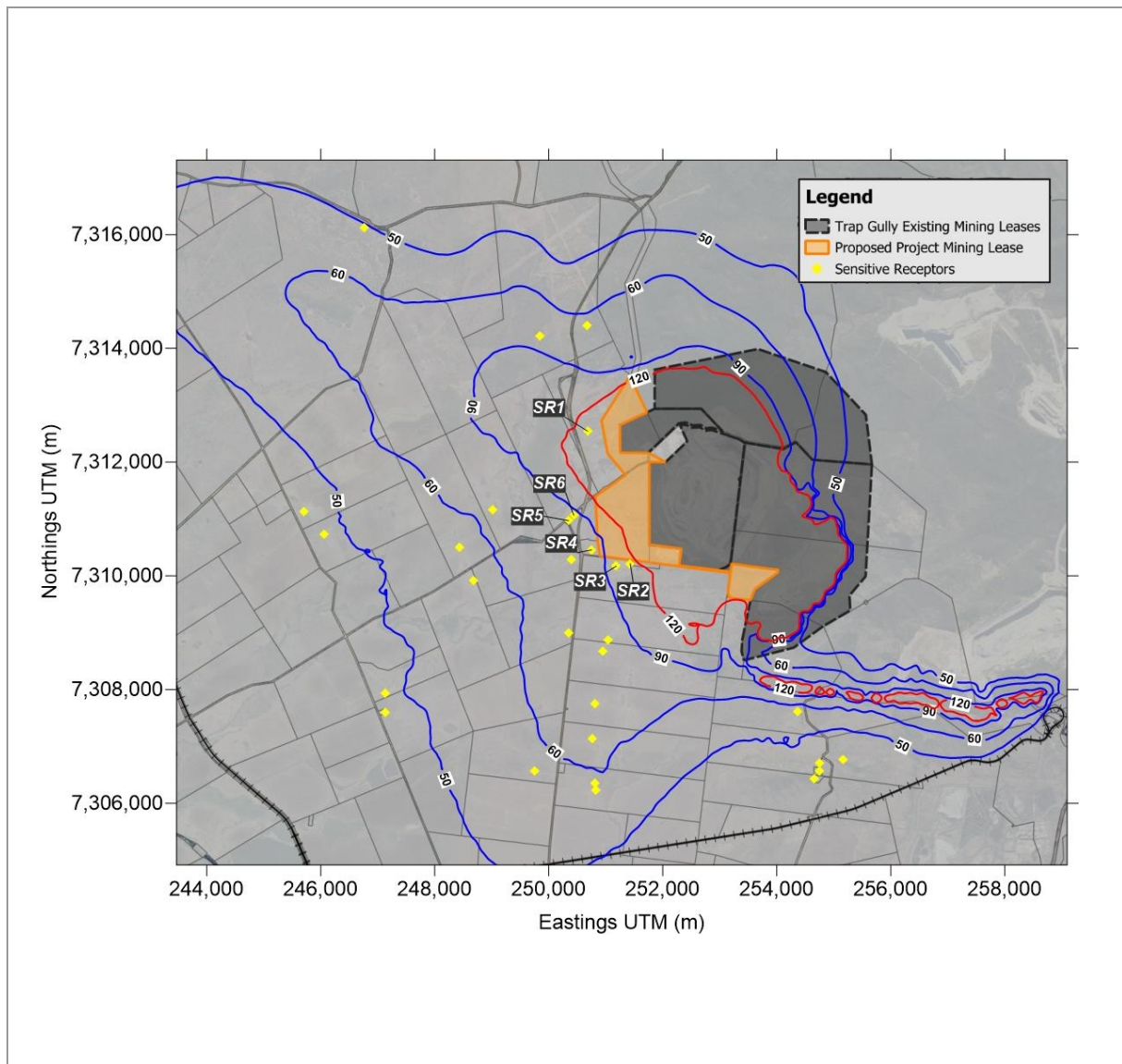


Plate 12 Predicted maximum monthly dust deposition rate due to the project, approved Trap Gully operations and including ambient background

Location: Callide, Qld	Averaging period: 1-month	Data source: CALPUFF	Units: mg/m ² /day
Type: Maximum contour	Objective: 120 mg/m ² /day	Prepared by: Sathya Roysmith	Date: July 2025

APPENDIX A METEOROLOGICAL AND DISPERSION MODELLING METHODOLOGY

A1 METEOROLOGY

A1.1 Selection of modelling time period

Meteorological data measured between 2019 and 2024 at the Bureau of Meteorology's (the Bureau's) Thangool Airport weather station was analysed to determine a representative year. Figure A1 presents probability distribution functions of meteorology conditions for each of the five years from 2019 to 2024.

All years displayed a wind direction probability distribution similar to the average. The year 2024 was selected as the most recent of the years that is generally representative of the wind speed, wind direction, humidity and temperature over the period.

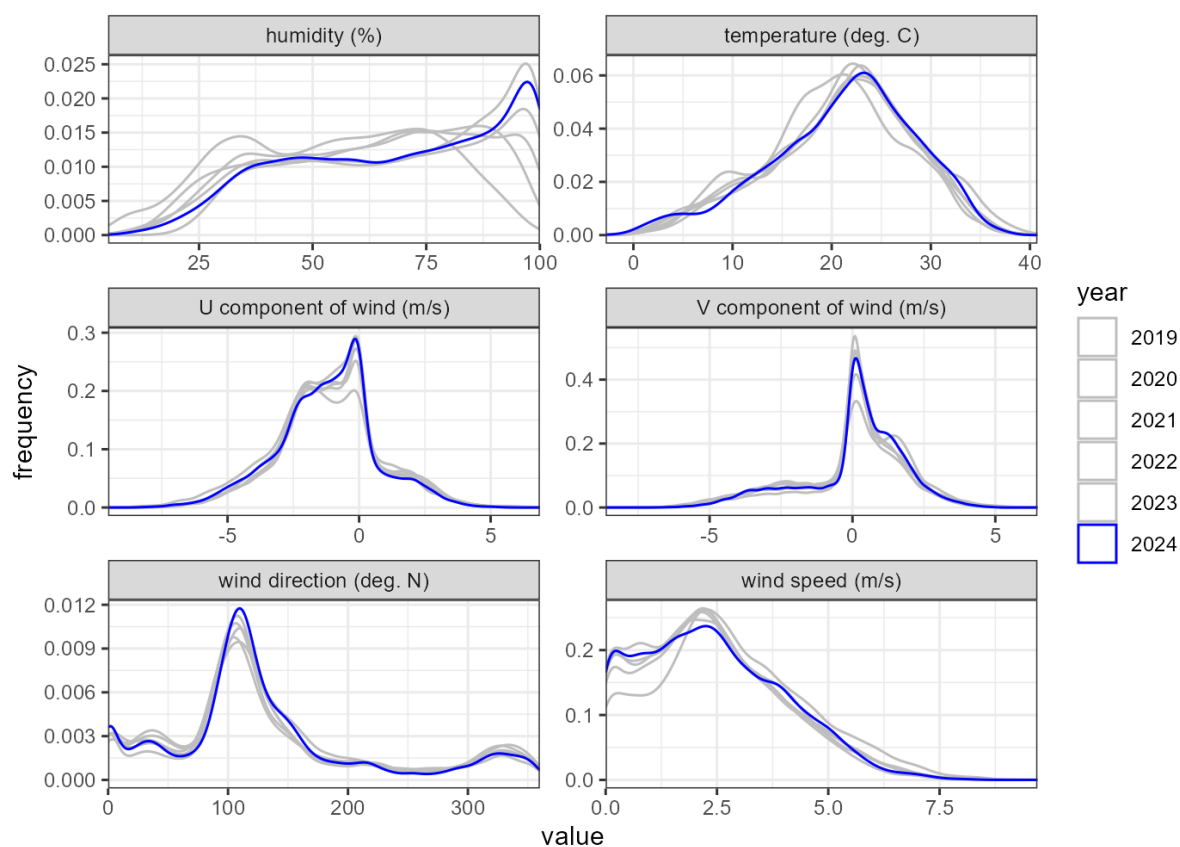


Figure A1 Probability distribution functions of the meteorology at the Bureau's Thangool Airport weather station between 2019 and 2024

A1.2 TAPM meteorology

TAPM (The Air Pollution Model) was developed by the CSIRO and has been validated by the CSIRO, Katestone and others for many locations in Australia, in south-east Asia and in North America (CSIRO, 2008). Katestone has extensive experience with TAPM for sites throughout Australia and in parts of America, Bangladesh, New Caledonia, Thailand and Vietnam. The model performs well in simulating regional wind patterns and has proven to be a useful tool for simulating meteorology in locations where monitoring data is unavailable.

TAPM is a prognostic meteorological model which predicts the flows important to regional and local scale meteorology, such as sea breezes and terrain-induced flows from the larger-scale meteorology provided by the synoptic analyses. TAPM solves the fundamental fluid dynamics equations to predict meteorology at a mesoscale (20 km to 200 km) and at a local scale (down to a few hundred metres). TAPM includes parameterisations for cloud/rain micro-physical processes, urban/vegetation canopy and soil, and radiative fluxes.

TAPM requires synoptic meteorological information for the region. This information is generated by a global model similar to the large-scale models used to forecast the weather. The data were supplied on a grid resolution of approximately 75km, and at elevations of 100m to 5km above the ground. TAPM uses this synoptic information, along with specific details of the location such as surrounding terrain, land-use, soil moisture content and soil type to simulate the meteorology of a region as well as at a specific location.

TAPM version 4.0.5 was configured with the following parameters:

- 41 x 41 grid point domain with an outer grid of 30 kilometres and nesting grids of 10 kilometres, 3 kilometres and 1 kilometre;
- 366 days modelled (from 1 January 2024 to 31 December 2024);
- Grid centred near the project site at latitude -24° 17.5' and longitude 150° 33.5';
- Geoscience Australia 9-second digital elevation model terrain data;
- Land use edited to be consistent with aerial imagery; and
- 25 vertical grid levels.
- Observation data from the Bureau's Thangool Airport weather station assimilated.

The TAPM configuration is consistent with the guidance provided in the TAPM user manual and the NSW Environment Protection Authority's (EPA) *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (2022).

A1.3 CALMET meteorological modelling

CALMET is an advanced non-steady-state diagnostic 3D meteorological model with micro-meteorological modules for overwater and overland boundary layers. The model is the meteorological pre-processor for the CALPUFF modelling system. CALMET is capable of reading hourly meteorological data as data assimilation from multiple sites within the modelling domain; it can also be initialised with the gridded three-dimensional prognostic output from other meteorological models such as TAPM. This can improve dispersion model output, particularly over complex terrain as the near surface meteorological conditions are calculated for each grid point.

CALMET version 6.5.0 was used to simulate meteorological conditions in the region. The CALMET simulation was initialised with the gridded TAPM 3D wind field data from the 1km grid. CALMET treats the prognostic model output as the initial guess field for the CALMET diagnostic model wind fields. The initial guess field is then adjusted for the kinematic effects of terrain, slope flows, blocking effects and 3D divergence minimisation.

CALMET was configured in accordance with *Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into The Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia* (TRC, 2011). This includes default options and parameters, with the following exceptions:

- Modelling period from 1 January 2024 to 31 December 2024;

- 225 x 200 grid point domain with 0.1 km resolution, nested within the TAPM inner domain;
- 12 vertical levels at heights of 20, 60, 100, 150, 200, 250, 350, 500, 800, 1600, 2600 and 4600 metres;
- Prognostic wind fields generated by TAPM input as MM5/3D.DAT at surface and upper air for “initial guess” field (no-observations mode);
- Gridded cloud cover from prognostic relative humidity at all levels;
- No extrapolation of surface wind observations to upper layers; and
- Terrain radius of influence of 1 km.

The geophysical data (land use) was generated to be consistent with the geophysical dataset for TAPM. Terrain data was generated from the SRTM1 dataset.

A1.4 Site-specific meteorology

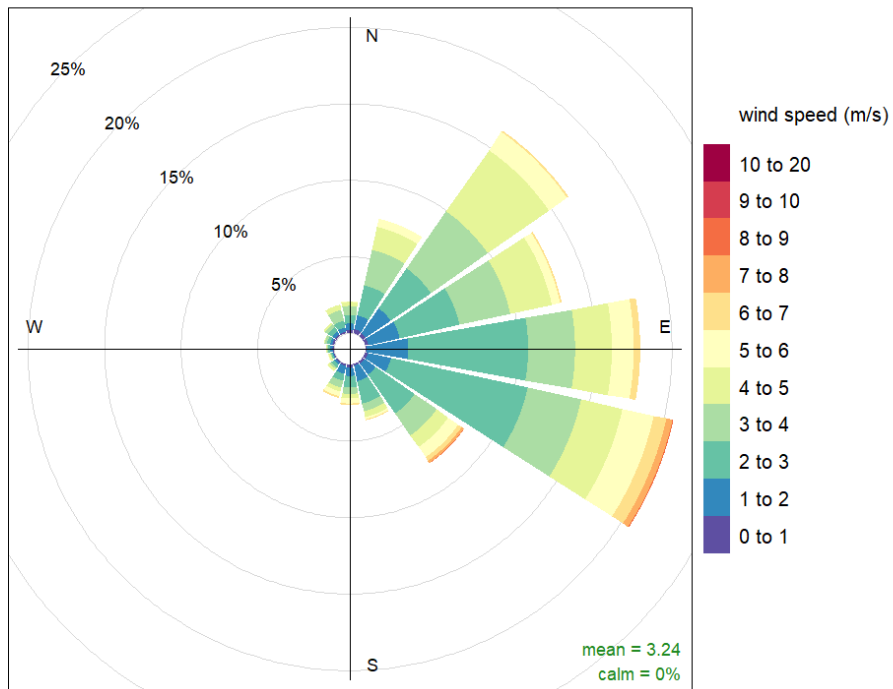
A1.4.1 Wind speed and direction

Wind speed and wind direction can determine the rate of dispersion of dust emissions from sources such as material transfers, material processing and wind erosion. Wind speed also determines the amount of dust lifted into the air by wind erosion. The annual, seasonal and diurnal frequency of winds at the project site is shown as wind roses in Figure A2, Figure A3 and Figure A4, respectively.

Northeasterly to southeasterly winds are dominant at the project site. The winds are generally light to moderate with an average wind speed of 3.2 m/s.

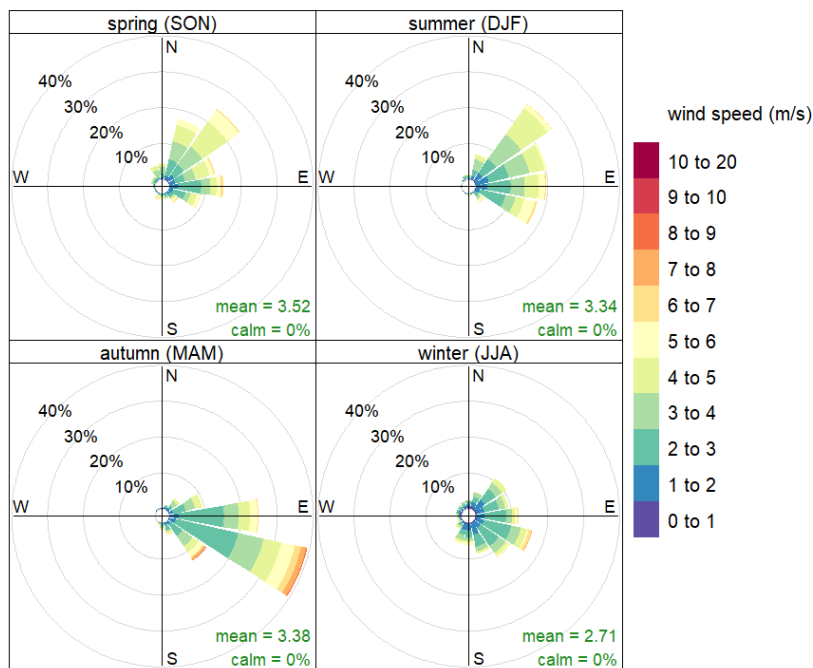
There is a variation in wind direction throughout the seasons of the year, spring and summer being characterised by winds from the northeast through east, and winter and autumn being characterised by predominantly southeast through east.

There is little diurnal variation in wind direction at the project site. From midnight through to midday, winds from the southeast through east occur frequently, with northeasterlies also present. During the period from midday to midnight, winds from the northeast through to east are primarily seen. Slightly stronger winds are also seen from midday – 6pm from the southeast.



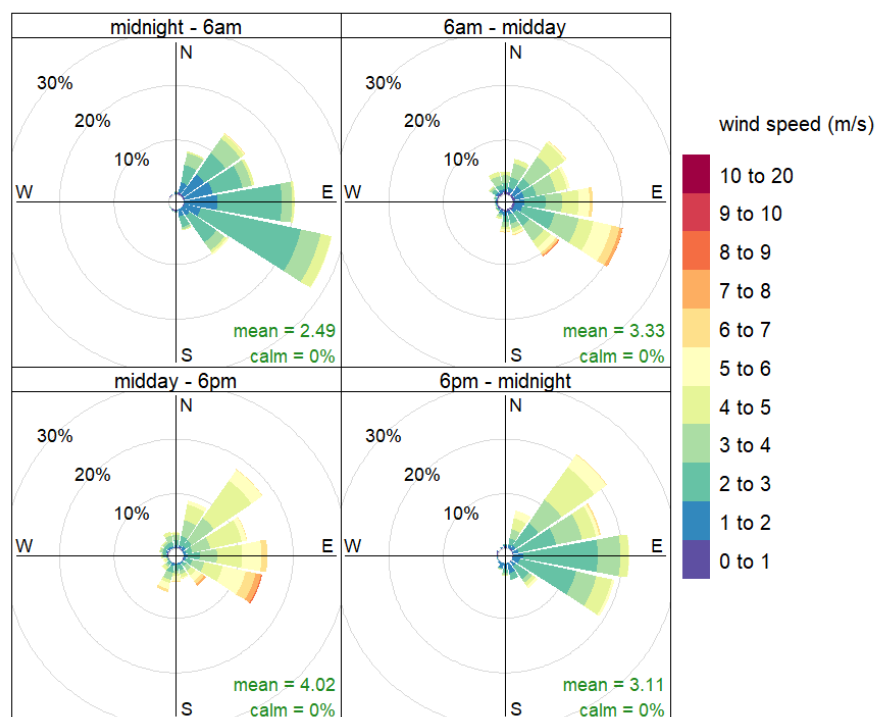
Frequency of counts by wind direction (%)

Figure A2 Annual wind distribution predicted by TAPM/CALMET at the project site (2024)



Frequency of counts by wind direction (%)

Figure A3 Seasonal wind distribution predicted by TAPM/CALMET at the project site (2024)



Frequency of counts by wind direction (%)

Figure A4 Diurnal wind distribution predicted by TAPM/CALMET at the project site (2024)

A1.4.2 Mixing height

The mixing height refers to the height above ground within which particulates or other pollutants released at or near ground can mix with ambient air. During stable atmospheric conditions, the mixing height is often quite low and particulate dispersion is limited to within this layer. During the day, solar radiation heats the air at the ground level and causes the mixing height to rise. This results in the better dispersion as pollutants can travel longer distances before reaching ground-level, and lower ground-level concentrations typically occur. The air above the mixing height during the day is generally cooler. The growth of the mixing height is dependent on how well the air can mix with the cooler upper level air and therefore depends on meteorological factors such as the intensity of solar radiation and wind speed. During strong wind speed conditions the air will be well mixed, resulting in a high mixing height.

Mixing height information for the project has been extracted from CALMET and is presented in Figure A5. The data shows that the mixing height develops around 6 am, increases to a peak around 3pm - 4 pm before descending rapidly between 5 pm and 6 pm.

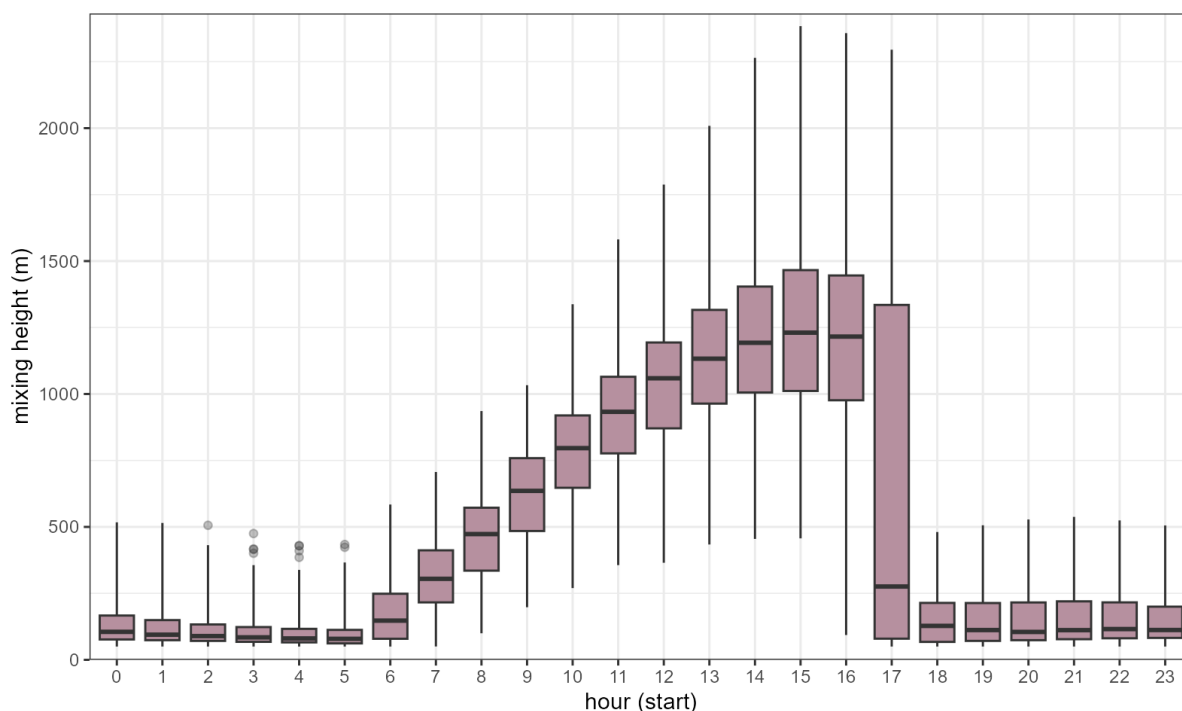


Figure A5 Diurnal profile of mixing height predicted by TAPM/CALMET at the project site (2024)

A1.4.3 Atmospheric stability

Atmospheric stability is classified under the Pasquill-Gifford scheme and ranges from Class A, which represents very unstable atmospheric conditions that may typically occur on a sunny day, to Class F which represents very stable atmospheric conditions that typically occur during light wind conditions at night. Unstable conditions (Class A-C) are characterised by strong solar heating of the ground that induces turbulent mixing in the atmosphere close to the ground, which usually results in material from a plume reaching the ground closer to the source than it does for neutral conditions or stable conditions.

This turbulent mixing is the main driver of dispersion during unstable conditions. Dispersion processes for stable conditions (Class F), which are most frequent at the project site, tend to suppress vertical updrafts and reduce turbulence intensity. During night time, the atmospheric conditions are generally neutral or stable (Class D, E and F) with cloud cover reducing solar heating and enhancing stability. Stability refers to the vertical movement of the atmosphere and is therefore an important factor in the dispersion and transport of particulates within the boundary layer.

Stability class is calculated by CALMET and has been extracted at the site and presented in Figure A6. Table A1 shows the distribution of stability classes for the site.

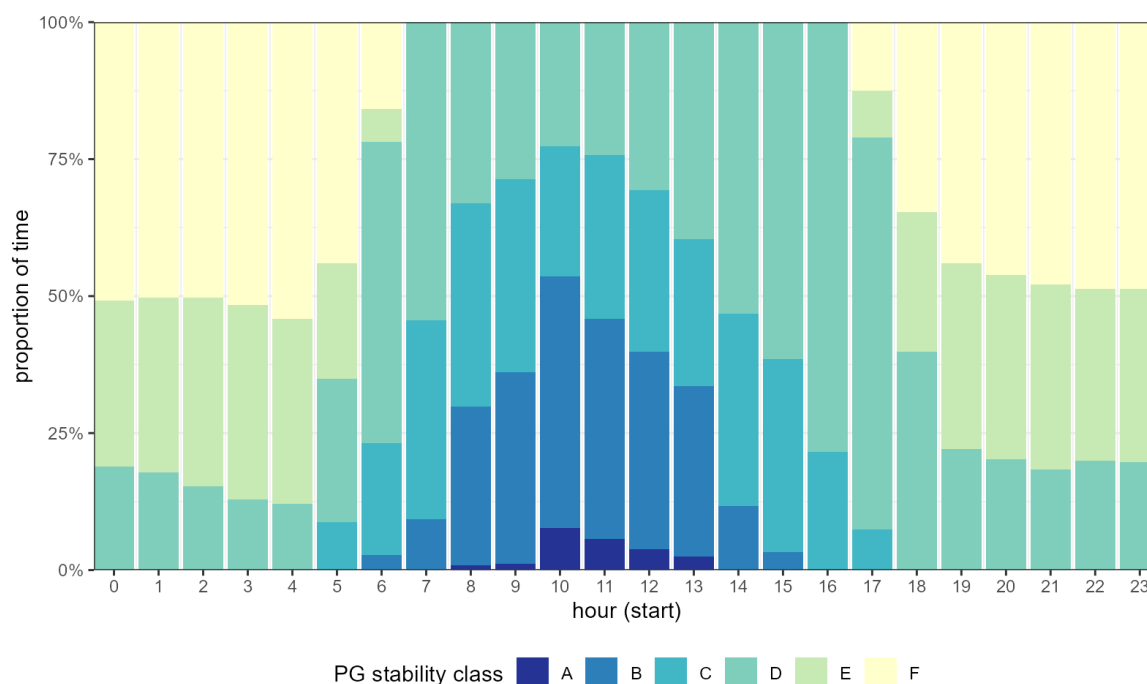


Figure A6 Proportion of stability class predicted by TAPM/CALMET at the project site by hour of day (2024)

Table A1 Frequency distribution of surface atmospheric stability conditions at the project site

Pasquil-Gifford Stability Class	Frequency (%)	Classification
A	1%	Extremely unstable
B	10%	Unstable
C	14%	Slightly unstable
D	33%	Neutral
E	16%	Slightly stable
F	25%	Stable

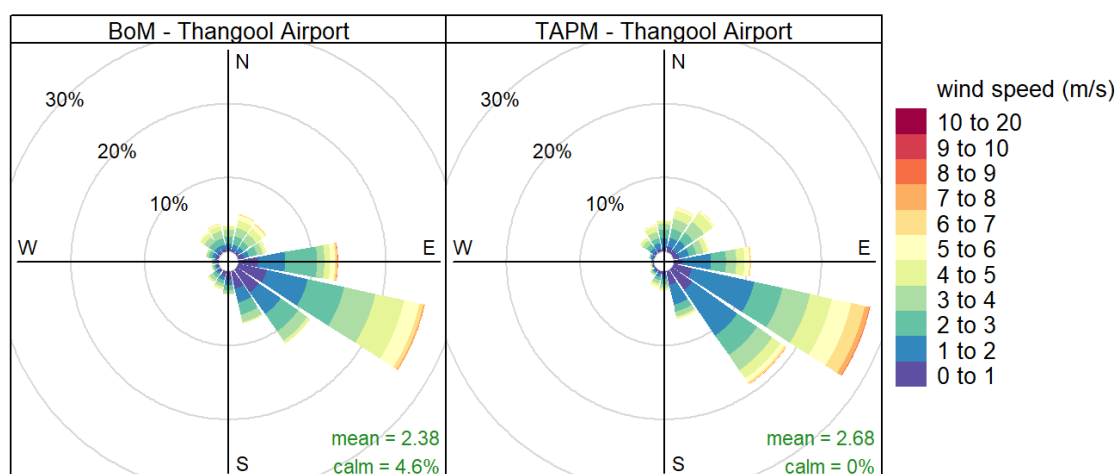
A1.5 Model evaluation

The model validation in this section compares observational meteorological data from the Bureau's Thangool Airport weather station with data derived from running TAPM/CALMET.

Figure A7 compares the annual distribution of winds predicted by TAPM/CALMET with the observed annual wind distribution at the Thangool Airport station. Table A2 presents a statistical comparison of TAPM/CALMET output (wind speed and temperature) to meteorological data recorded at the Thangool Airport weather station. The statistical measures of model accuracy presented in the table are the mean bias, the root mean square error (RMSE) and the index of agreement (IOA). Relevant benchmarks for each measure are also presented.

The statistical measures of model accuracy for predicting wind speed are all within the benchmarks, and the wind rose comparison indicates good agreement between the observed and modelled distributions of winds. While the mean temperature bias is slightly outside the benchmark range, the index of agreement for temperature is high.

Therefore, the output from TAPM/CALMET can be said to be representative of meteorological conditions in the area.



Frequency of counts by wind direction (%)

Figure A7 Comparison of predicted annual distribution of TAPM/CALMET generated winds to observed annual distribution of winds at Thangool Airport

Table A2 Comparison of the observed meteorological data at the Thangool Airport weather station with the first-level output from TAPM/CALMET

Statistic	“Good” value	Wind speed			Temperature		
		Benchmark	Observational data	TAPM / CALMET	Benchmark	Observational data	TAPM / CALMET
Mean	-	-	2.38	2.68	-	21.19	21.79
Standard deviation	-	-	1.61	1.61	-	7.37	5.78
Minimum	-	-	0	0	-	-2.8	3.1
Maximum	-	-	8.26	8.70	-	38.75	37.70
Bias	0	<±0.5 m/s	0.30		<±0.5 °C	0.60	
Root mean square error (RMSE)	Close to 0	<2 m/s	0.91		-	2.86	
Index of agreement	Close to 1	>0.6	0.92		≥0.8	0.95	

A2 CALPUFF DISPERSION MODELLING

CALPUFF simulates the dispersion of air pollutants to predict ground-level concentration and deposition rates across a network of receptors spaced at regular intervals, and at identified discrete locations. CALPUFF is a non-steady-state Lagrangian Gaussian puff model containing parameterisations for complex terrain effects, overwater transport, coastal interaction effects, building downwash, wet and dry removal, and simple chemical transformation. CALPUFF employs the 3D meteorological fields generated from the CALMET model by simulating the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal. CALPUFF takes into account the geophysical features of the study area that affects dispersion of pollutants and ground-level concentrations of those pollutants in identified regions of interest. CALPUFF contains algorithms that can resolve near-source effects such as building downwash, transitional plume rise, partial plume penetration, sub-grid scale terrain interactions, as well as the long range effects of removal, transformation, vertical wind shear, overwater transport and coastal interactions. Emission sources can be characterised as arbitrarily-varying point, area, volume and lines or any combination of those sources within the modelling domain.

Key features of CALPUFF used to simulate dispersion:

- Domain area of 225 by 200 grids at 100 m spacing;
- 366 days modelled (1 January 2024 to 31 December 2024);
- Gridded 3D hourly-varying meteorological conditions generated by CALMET;
- Partial plume path adjustment for terrain modelled;
- Dispersion coefficients calculated internally from sigma v and sigma w using micrometeorological variables; and

All other options set to default.

APPENDIX B ACTIVITY DATA

The activity data that has been utilised to calculate the emissions is presented below in Table B1.

Table B1 Activity data for the Trap Gully Overburden Emplacement Extension project

Activity	Year 1	Units	Source
Operating hours			
Operating hours – Dozer push area	11	hrs/day	Proponent
Material characteristics			
Overburden - Silt content	6.9	%	AP42 Ch 11.9
Overburden - Moisture content	7.9	%	
Met parameters			
Ave wind speed	3.24	m/s	CALMET wind field
Dozers			
Total Dozers	5	#	Proponent
Hours of operation per dozer – dozer push operations in western emplacement	3,394	hrs.op/year	
Exposed Areas			
Dozer push area	103	ha	Measured from GIS

Table B2 Activity data for Trap Gully mine activities

Activity	Year 1	Units	Source
Operating hours			
Operating hours – mining	24	hrs/day	Proponent
Operating days – mining	363	Days/year	
Operating hours - blasting	12	hrs/day	
Operating days – drilling and blasting	150	Days/year	
Throughputs			
Overburden – truck/shovel	21,586	kBCM	Proponent
Overburden	47,488,778	tonnes (dry)	Calculated
ROM	4,780,422	tonnes	Proponent
Overburden distribution			
OB dumping in western emplacement	36	%	Proponent
Partings dumping in western emplacement	9	%	

Activity	Year 1	Units	Source
OB dumping in in-pit emplacement	46	%	
Partings dumping in in-pit emplacement	9	%	
ROM distribution			
ROM haulage direct to Dunn Creek CHPP	77	%	Proponent
ROM to stockpile storage prior to reclamation and haulage to Dunn Creek CHPP	23	%	
Material characteristics			
Overburden - Density	2.2	tonnes/BCM	Assumption
Overburden - Silt content	6.9	%	AP42 Ch 11.9
Overburden - Moisture content	7.9	%	
ROM - Silt content	8.6	%	
ROM - Moisture content	10.4	%	
Met parameters			
Ave wind speed	3.24	m/s	CALMET wind field
Haul characteristics			
Silt content on Unpaved Hauls	8.4	%	AP42 Ch13.2
Silt content on Plant Road	5.1	%	
Grader speed	8	km/hr	
Haulage Equipment			
ROM Haul Trucks			
Empty weight	131	tonnes	CAT 789
Payload	193	tonnes	
Average weight	251	tons	Calculated
OB Haul Trucks			
Empty weight	231	tonnes	Komatsu 930E
Payload	290	tonnes	
Average weight	415	tons	Calculated
Mixing Truck			
Empty weight	8.5	tonnes	18t tri-axle truck
Payload	9.5	tonnes	
Average weight	14.6	tons	Calculated
Link Road Vehicles			
Average weight	309.4	tons	5 x 930E haul trucks, 7 x 789 haul trucks.

Activity	Year 1	Units	Source
			2 x low loader (789 engine)
Haulage – trip length (one-way)			
OB Haul – Western emplacement	2,162	m	Measured from GIS
OB Haul – In-pit emplacement	3,158	m	
Partings Haul – Western emplacement	1,258	m	
Partings Haul – In-pit emplacement	1,377	m	
ROM Haul to stockpile	3,364	m	
ROM Haul to CHPP	7,949	m	
Link Road	13,137	m	
Mixing Truck route	3,929	m	
Haulage – No. of trips			
OB Haul – Western emplacement	58,901	#	Calculated
OB Haul – In-pit emplacement	75,262	#	
Partings Haul – Western emplacement	14,725	#	
Partings Haul – In-pit emplacement	14,725	#	
ROM Haul to stockpile	24,769	#	
ROM Haul to CHPP	24,769	#	
Link Road	5,082	#	
Mixing Truck route	150	#	
Haulage – VKT			
OB Haul – Western emplacement	254,721	VKT	Calculated
OB Haul – In-pit emplacement	475,316	VKT	
Partings Haul – Western emplacement	36,907	VKT	
Partings Haul – In-pit emplacement	40,553	VKT	
ROM Haul to stockpile	166,638	VKT	
ROM Haul to CHPP	393,784	VKT	
Link Road	133,525	VKT	
Mixing Truck route	1,179	VKT	
Grading	72,000	VKT	
Grader			
Total Graders	2	#	Proponent
Hours of operation per grader	9,000	hrs.op/yr	
OB Haul – Western emplacement	12,205	hrs.op/yr	Calculated

Activity	Year 1	Units	Source
OB Haul – In-pit emplacement	22,775	hrs.op/yr	
Partings Haul – Western emplacement	1,768	hrs.op/yr	
Partings Haul – In-pit emplacement	1,943	hrs.op/yr	
ROM Haul to stockpile	7,985	hrs.op/yr	
ROM Haul to CHPP	18,869	hrs.op/yr	
Link Road	6,398	hrs.op/yr	
Mixing Truck route	56	hrs.op/yr	
Dozers			
Total Dozers	13	#	Proponent
Hours of operation per dozer – mining operations	1,605	hrs.op/year	
Excavators			
Total Excavators	4	#	Proponent
Drilling and blasting			
Total blasts per year	50	blasts/yr	Proponent
Total holes drilled per blast	276	holes/blast	
Total holes drilled per year	13,800	holes/yr	
Area per blasts	27,330	m²	
Stockpile Areas			
ROM Stockpile base area	2.7	ha	Measured from GIS
ROM Stockpile height	6	m	Proponent
Exposed Areas			
Pit	132	ha	Measured from GIS
Western emplacement area	36	ha	
In-pit emplacement area	109	ha	
Exposed Area	228	ha	

APPENDIX C METHODOLOGIES FOR CALCULATING EMISSIONS

C1 MATERIAL HANDLING

Locations throughout the mining and processing areas involve the transfer of material from one location to another. Emissions are dependent on amount of materials transferred (kg/tonne of material).

Emission rates for material transfers were calculated using the following equation (US EPA, 2006):

$$EF = k \times 0.0016 \times \left(\frac{U}{2.2}\right)^{1.3} \left(\frac{2}{M}\right)^{1.4}$$

where:

- k : 0.74 for particles less than 30 μm
 0.35 for particles less than 10 μm
 0.053 for particles less than 2.5 μm
- U : Mean wind speed in m/s
- M : Material moisture content

C2 WHEEL GENERATED DUST FROM UNPAVED HAUL ROADS

Wheel-generated dust from haulage of material around the site along unpaved haul routes was estimated using the emission factor defined in AP42 for haulage of materials through unpaved roads. The emission factor for wheel-generated dust on haul roads is dependent on the size of the truck and the silt content of the road. In equation form, the emission factors (g/VKT) for dust are defined using the following equations:

$$EF_{TSP} = 281.9 \times 4.9 \times \left(\frac{S}{12}\right)^{0.7} \times \left(\frac{W}{3}\right)^{0.45}$$

$$EF_{PM10} = 281.9 \times 1.5 \times \left(\frac{S}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45}$$

$$EF_{PM2.5} = 281.9 \times 0.15 \times \left(\frac{S}{12}\right)^{0.9} \times \left(\frac{W}{3}\right)^{0.45}$$

where:

- s : Silt content of the road
- W : mean vehicle weight in tons

The total emissions are dependent on the total distance travelled by the truck, which is based on truck capacity and the length of the haul road to be travelled.

C3 GRADING

Maintenance of unpaved haul roads would be achieved with the use of a grader. Emissions of TSP during grading were estimated using the equation defined in AP42:

$$EF_{TSP} = 0.0034 \times (S)^{2.5}$$

$$EF_{PM10} = 0.0034 \times (S)^2$$

3.1% of TSP emissions are estimated to be PM_{2.5}.

C4 DRILLING

Dust emitted during drilling was estimated based on the emission factor defined in the NPI. The TSP emission factor is 0.59 kg/hole and the PM₁₀ emission factor is 0.31 kg/hole. The ratio of PM_{2.5} to TSP emissions is 3%.

C5 BLASTING

The emission rate for blasting has been calculated using the following equations (NPI, 2012):

$$EF_{TSP} = 0.00022 \times A^{1.5}$$

$$EF_{PM10} = 0.000114 \times A^{1.5}$$

where:

EF_{TSP} : TSP blasting emission factor (kg/blast)

EF_{PM10} : PM₁₀ blasting emission factor (kg/blast)

A: Area blasted (m²)

Blasting was assumed to occur during daylight hours and was modelled between 6am and 6pm. Of TSP emissions, 3.0% are estimated to be PM_{2.5}. The particulate matter distribution is based on size particle distribution for blasting as defined in the AP42.

C6 BULLDOZING

The TSP and PM₁₀ emission factors for bulldozing of overburden were calculated using the equation for materials other than coal, as defined in the NPI and AP42 (NPI, 2012):

$$EF_{TSP} = 2.6 \times \frac{s^{1.2}}{M^{1.3}}$$

$$EF_{PM10} = 0.34 \times \frac{s^{1.5}}{M^{1.4}}$$

where

s: Silt content

M: Moisture content

PM_{2.5} emissions were assumed to be 10.5% of TSP emissions, based on the PM_{2.5} to TSP ratio for dozing materials other than coal defined in AP42 Ch. 11.9.

The TSP and PM₁₀ emissions factors for bulldozing of ROM were calculated using the equation for coal, as defined in the NPI (NPI, 2012):

$$EF_{TSP} = 35.6 \times \frac{s^{1.2}}{M^{1.4}}$$

$$EF_{PM10} = 6.33 \times \frac{s^{1.5}}{M^{1.4}}$$

where

s: Silt content

M: Moisture content

PM_{2.5} emissions were assumed to be 10.5% of TSP emissions, based on the PM_{2.5} to TSP ratio for dozing materials other than coal defined in AP42 Ch. 11.9.

C7 WIND EROSION OF ACTIVE STOCKPILES

Emissions of dust from wind erosion of stockpiles are dependent on the surface area of the stockpiles (kg/ha/hr). The emission rate of dust from the ore and product stockpiles has been calculated using the emission factor for active storage piles from the AP42 Chapter 11.9. In equation form, the emission factor for TSP is defined as:

$$EF_{TSP} = 1.8 \times u$$

where

u: Wind speed (m/s)

Of TSP emissions, 50% are estimated to be PM₁₀ and 7.5% of TSP emissions are estimated to be PM_{2.5}. The particulate matter distribution is based on size particle distribution for wind erosion as defined in the AP42 and the NPI.

Emissions of dust from wind erosion of active stockpiles have been modelled as hourly varying, using a threshold wind speed of 5.4 m/s so that emissions occur during hours when the wind speed is greater than the threshold wind speed, and the magnitude of dust emissions is proportional to the square of the wind speed.

C8 WIND EROSION OF EXPOSED AREAS

Emissions of dust from wind erosion of exposed areas are dependent on the size of the exposed areas (Mg/ha/yr). The emission rate is based on the equation defined in the AP42 for estimating emissions of wind exposed areas. A rain factor was not applied. The TSP emission factor was estimated using the following equation:

$$EF_{TSP} = 0.85$$

Of TSP emissions, 50% are estimated to be PM₁₀ and 7.5% are estimated to be PM_{2.5}. The particulate matter distribution is based on the size particle distribution for wind erosion as defined in the AP42 and the NPI.

Emissions of dust from wind erosion of exposed areas have been modelled as hourly varying, using a threshold wind speed of 5.4 m/s so that emissions occur during hours when the wind speed is greater than the threshold wind speed, and the magnitude of dust emissions is proportional to the square of the wind speed.

APPENDIX D MODEL EVALUATION FOR DUST CONTROL

In order to determine the level of control that is being achieved through standard mitigation measures, a model evaluation study was undertaken whereby model predictions for the existing Trap Gully mining operations were compared with measured concentrations and dust deposition levels from Batchfire's monitoring network.

The model evaluation used the same methodologies as presenting in Section 3 in terms of development of wind field, estimation of emissions and dispersion modelling approach.

The model evaluation investigated the sensitivity of results to the level of emissions reduction assumed due to the application of water on haul roads. Two levels of emission reduction were investigated: 84% and 90% control.

Table D1 Standard mitigation measures and relative reduction in emissions

Activity	Mitigation measure	Emission reduction
Drilling	Cyclones	70%
ROM coal haulage	Watering	84% / 90%
Overburden haulage	Watering	84% / 90%

Table D2 presents the predicted ground-level concentrations of dust deposition rates for 2024. Figure D1 shows a timeseries of 24-hour concentrations of PM₁₀ observed (green line), modelled with 84% control on haul roads (blue line) and modelled with 90% control on haul roads (red line). The results show that the model tends to overpredict, in particular average concentrations and the number of days of exceedances. The magnitude of the exceedance events is not replicated, however, given that for two of these days, winds were not from the direction of the mine, it is likely that these events were attributed to non-mining events and therefore would not be captured in the modelling.

Given that the model evaluation has demonstrated that the model is conservative and the magnitude of predictions agrees with observations, the assessment was conducted using the emission reductions as specified in Table A4 with a reduction of 90% applied to haul activities.

Table D2 Model predictions at Trap Gully 1 compared with observations - 2024

	PM ₁₀			Dust deposition	
	Max 24-hour conc (µg/m ³)	No. exceedance days	Annual average	Maximum monthly	Number of exceedances
Observed	97.6	4	14.3	140.0	1
Modelled (assuming 84% control)	79.5	46	32.0	164.0	3
Modelled (assuming 90% control)	60.8	7	27.1	141.9	3

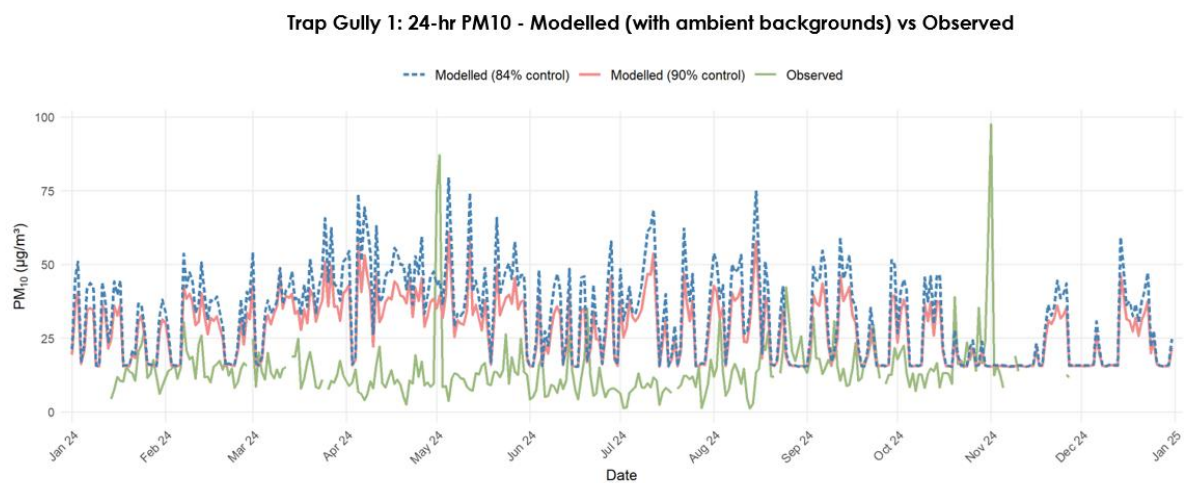


Figure D1 Timeseries comparing modelled and observed PM₁₀ concentrations at Trap Gully 1