Appendix 6

Air Quality Impact Assessment
prepared by
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TODOROSKI
AIR SCIENCES

AIR QUALITY IMPACT ASSESSMENT
TRITTON COPPER MINE MOD 9

RW Corkery & Co Pty Ltd

17 December 2024

Job Number 24061732

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Air Quality Impact Assessment
Tritton Copper Mine MOD 9

DOCUMENT CONTROL

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GLOSSARY OF TERMS

AWS	Automatic Weather Station
Background levels	Existing concentration of pollutants in the ambient air
BoM	Bureau of Meteorology
Cumulative impact	The impact due to all emission sources including background levels.
DPE	NSW Department of Planning and Environment
EPA	Environmental Protection Authority
g/m^2/month	Grams per metre squared per month
Incremental impact	The impact due to an emission source (or group of sources) in isolation, i.e. without including background levels.
NSW Government	State Government for NSW
PM_{10}	Particulate matter less than 10 µm in aerodynamic equivalent diameter
$PM_{2.5}$	Particulate matter less than 2.5 µm in aerodynamic equivalent diameter
SEARs	Secretary's Environmental Assessment Requirements
Sensitive receptor	A location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area
TSP	Total Suspended Particulates
$\mu g/m^3$	micrograms per cubic metre

1 INTRODUCTION

Todoroski Air Sciences has prepared this report for RW Corkery & Co on behalf of Tritton Resources Pty Ltd (Tritton). The report presents an assessment of potential air quality impacts associated with the proposed modifications to the Tritton Copper Mine (hereafter referred to as the Project).

The Project is located in the 'Bogan Shire' local government area (LGA) of central-western New South Wales. The Project site is located approximately 47 kilometres (km) northwest of Nyngan and approximately 85km east-northeast of Cobar.

The Tritton Copper Mine is an existing copper ore underground mining operation with associated processing infrastructure including a Tailings Storage Facility (TSF) and waste rock emplacement. The Project seeks to optimise existing operations and further integrate with other operations in the region, including Murrawombie Copper Mine, North East Copper Mine, Avoca Tank Project and the (separately) proposed Constellation Copper Mine. This would be achieved by the following key elements of the Project.

- Increase to the annual processing rate from 1.4 million (M) tonnes per annum (tpa) to 1.8Mtpa.
- Increase to the maximum elevation of the existing TSF from 272 meters (m) Australian Hight Datum (AHD) to 278mAHD via three 2m raises.
- Importation of up to 1.8Mtpa of mined materials (ore material and waste rock).
- Increase in the total area used for stockpiling of Non-acid-forming (NAF) waste rock through extension of the existing NAF Waste Rock Emplacement.
- An extension to the Mine life to allow for ongoing mining operations until 31 December 2036 which would effectively extend the existing approved Mine life by a further eight years to allow for the processing of ore sourced from the (separately) proposed Constellation Copper Mine.

The Project would also facilitate further integration with surrounding approved and proposed mining operations owned and operated by Tritton through the following.

- The export of tailing material to all mines within the Tritton Copper Operations (currently only permitted to the Murrawombie Copper Mine) and increase to the limit on export to 500,000tpa.
- Inclusion of additional sources of waste material to be received at the Mine Site for disposal in the existing Tritton landfill.

This air quality impact assessment has been prepared in general accordance with the New South Wales (NSW) Environment Protection Authority (EPA) document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2022**).

To assess the potential air quality impacts associated with the Project, this report comprises:

- A background to the Project and description of the proposed site and operations;
- An outline of the applicable criteria to assess air quality impacts from the Project;

- A review of the existing meteorological and air quality environment surrounding the site;
- A description of the dispersion modelling approach and emission estimation used to assess potential air quality impacts; and,
- Presentation of the predicted results and discussion of the potential air quality impacts and associated mitigation and management measures.

2 PROJECT BACKGROUND

2.1 Project setting

The area surrounding the Project site is predominately comprised of rural agricultural land with scattered residential dwellings identified in the surrounding area, with the closest residential dwelling to the site being identified as R1, located approximately 4.1km to the south.

The nearest residential dwellings to the Project are identified in **Table 2-1** and have been assessed as discrete assessment locations in this assessment.

Table 2-1: Residential receptor locations for the Project

Receiver ID	Easting (m)	Northing (m)	Approximate distance from Project site (km)
R1	472815	6531518	4.5
R2	476224	6523212	4.1
R3	476789	6520466	6.6
R4	485244	6528947	10.6
R5	479465	6533729	7.4

Figure 2-1 presents the location of the Project with reference to the residential dwellings considered in this assessment.

Figure 2-2 presents a pseudo three-dimensional visualisation of the topography in the general vicinity of the Project. The Project site can be characterised as primarily gently undulating hills with elevation becoming more level in the northwestern region.

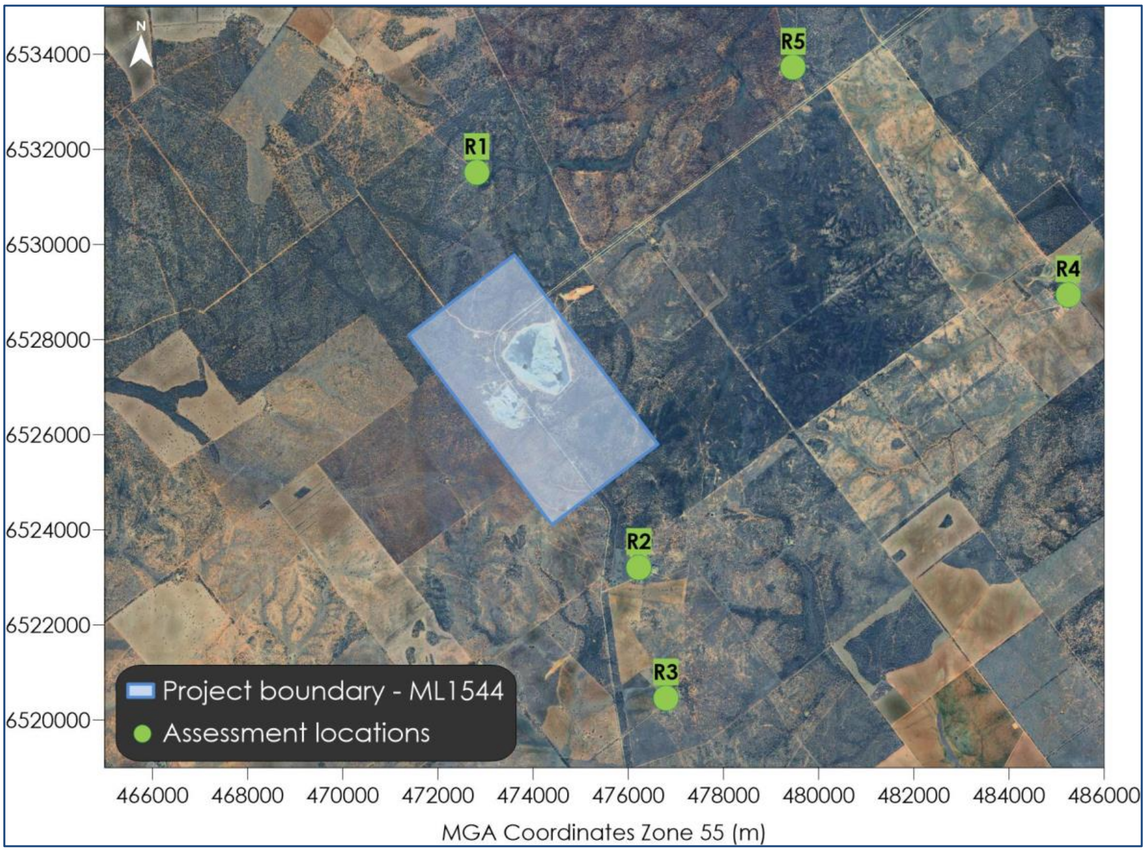

Figure 2-1: Project setting

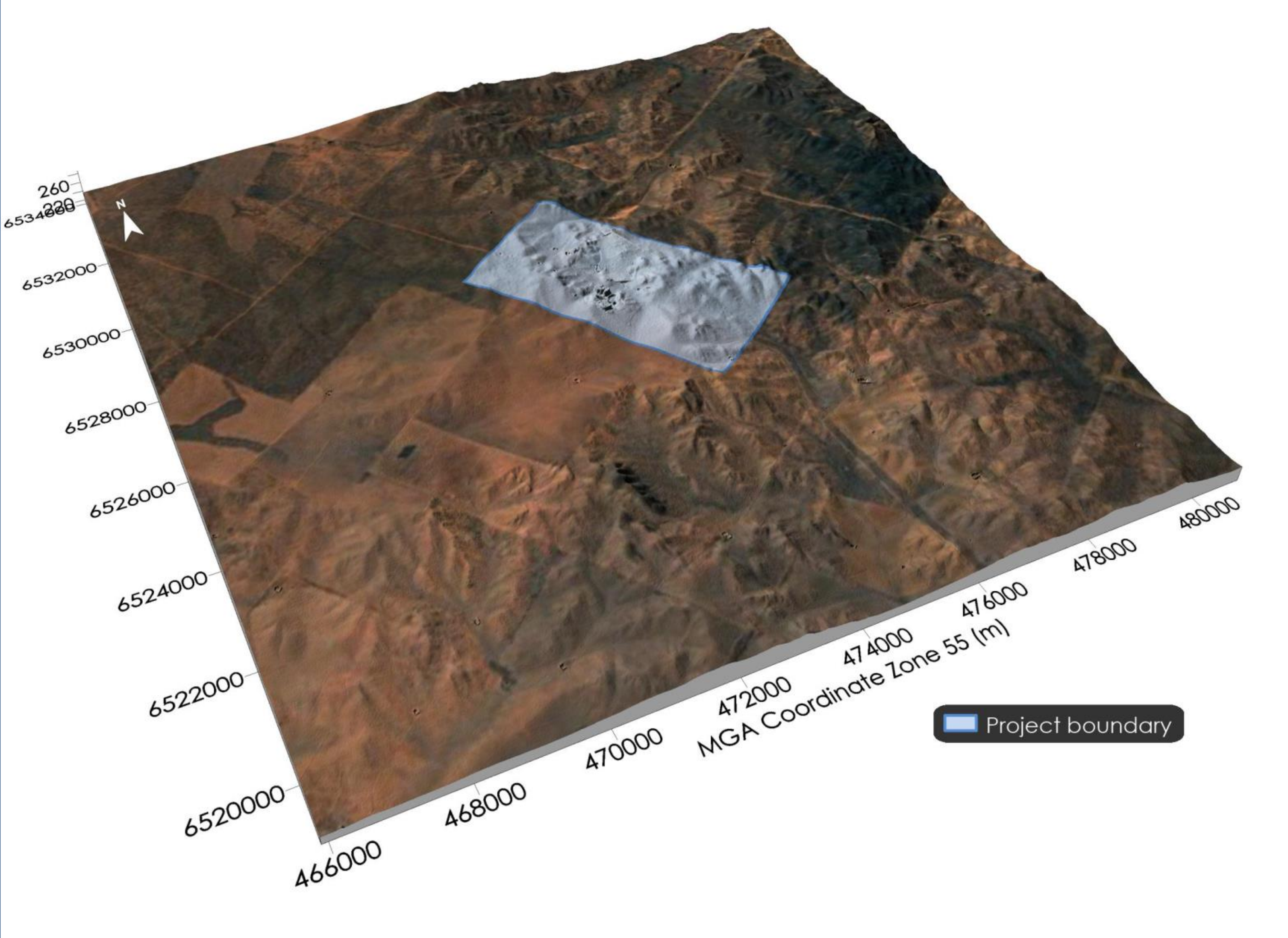

Figure 2-2: Representative visualisation of topography in the area surrounding the Project

2.2 Existing operations

Development Consent (DA) 41/98 for Tritton Copper Mine was approved on 1 September 1999 and has since been modified eight times with the approved operations comprising the following principal activities:

- Extraction of a total of approximately 12.8 million tonnes (Mt) of ore using underground mining techniques;
- Construction and use of a Non-acid Forming Waste Rock Emplacement to a maximum height of 30 metres (m) above the natural surface or approximately 301mAHD;
- Importation of no more than 1Mt of ore in a calendar year for processing at the Mine;
- Processing of up to 1.4Mtpa on-site and imported ore to produce a mineral concentrate;
- Export of no more than 30,000 tonnes of waste rock from the Mine in a calendar year, generally for the purposes of local road construction and maintenance;
- Transportation of the mineral concentrate in shipping containers to the Hermidale rail siding, located approximately 19km to the south of the Mine, and transportation of that material by train to port for export;
- Export of tailings for paste fill operations at the Murrawombie Copper Mine;
- Construction and use of a Tailings Storage Facility; and,
- Construction and use of a landfill for disposal of solid and inert wastes generated onsite and/or at other TCO mines.

The Tritton Copper Mine is one of four approved mining operations owned and operated by Tritton, others include the Murrawombie Copper Mine, North East Copper Mine and Avoca Tank Project.

2.3 Proposed operations

The Project is seeking to optimise aspects of the Tritton Copper Mine operations and integrate the proposed Constellation Copper Mine. Key aspects of the Project relevant to this AQIA include:

- Increasing the maximum elevation of the TSF by 6m to 278mAHD via three 2m lifts;
- Increasing the annual processing rate from 1.4Mtpa to 1.8Mtpa;
- Extending the mine life by an additional eight years to 2036;
- Including additional receivers for the export of tailings material and increase to the limit on export to 500,000tpa.
- Including additional sources for the receipt of waste material;
- Increase in the total area used for stockpiling of NAF waste rock through extension of the existing NAF Waste Rock Emplacement; and,

- Increasing the importation of mined materials (ore material and waste rock to 1.8Mtpa), requiring an additional Waste Rock Emplacement.

Figure 2-3 presents an indicative site layout for the approved operations and the Project.

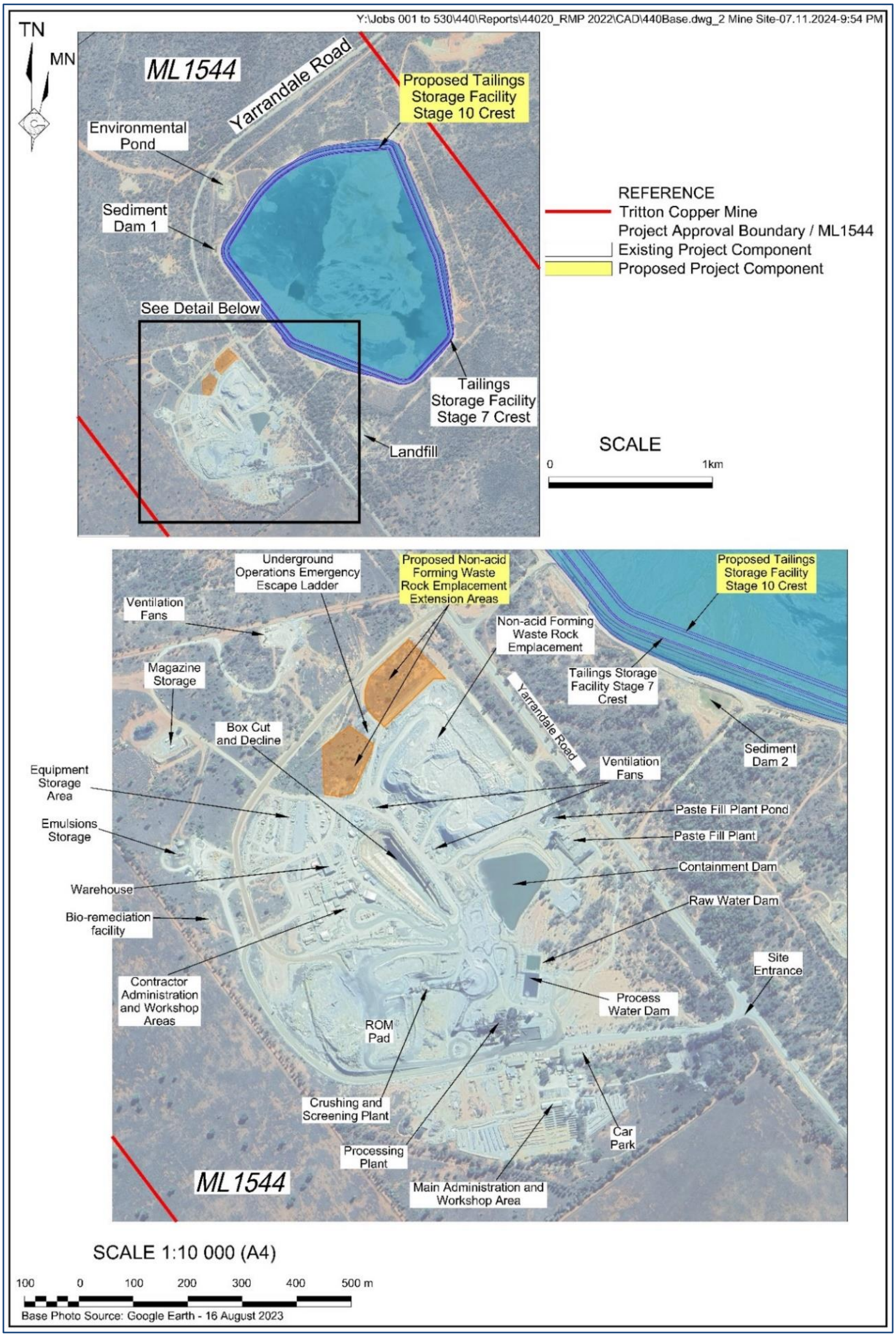

Figure 2-3: Existing operations and Project site layout

3 AIR QUALITY CRITERIA

Air quality criteria are benchmarks set to protect the general health and amenity of the community in relation to air quality. The sections below identify the potential air emissions generated by the Project and the applicable air quality criteria.

3.1 Particulate matter

Particulate matter consists of dust particles of varying size and composition. Air quality goals refer to measures of the total mass of all particles suspended in air defined as the Total Suspended Particulate matter (TSP). The upper size range for TSP is nominally taken to be 30 micrometres (µm) as in practice particles larger than 30 to 50µm will settle out of the atmosphere too quickly to be regarded as air pollutants.

Two sub-classes of TSP are also included in the air quality goals, namely PM_{10}, particulate matter with equivalent aerodynamic diameters of 10µm or less, and $PM_{2.5}$, particulate matter with equivalent aerodynamic diameters of 2.5µm or less.

Particulate matter, typically in the upper size range, that settles from the atmosphere and deposits on surfaces is characterised as deposited dust. The deposition of dust on surfaces may be considered a nuisance and can adversely affect the amenity of an area by soiling property in the vicinity.

3.2 Metals

Potential metals arising from the operations include copper (Cu), iron (Fe), Lead (Pb) and Zinc (Zn). Each of these metals occur naturally as mineral deposits in the Earth's crust.

Copper is a reddish-orange metal commonly used in electrical wiring due to its excellent electrical conductivity. Iron is a strong, silver-grey metal commonly used in the production of steel, which is extensively used in construction and manufacturing. Lead (Pb) is a soft, malleable metal primarily used in lead-acid batteries. Zinc (Zn) is a bluish-white, lustrous metal commonly used for galvanization as an anti-corrosion agent and is also utilised in alloys.

3.3 NSW EPA impact assessment criteria

Table 3-1 summarises the air quality goals that are relevant to this assessment as outlined in the NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2022**).

The air quality goals for total impact relate to the total pollutant burden in the air and not just the contribution from the Project. Consideration of background pollutant levels needs to be made when using these goals to assess potential impacts.

Table 3-1: NSW EPA air quality impact assessment criteria

Pollutant	Averaging Period	Impact	Criterion
TSP	Annual	Total	90 $\mu g/m^3$
PM_{10}	Annual	Total	25 $\mu g/m^3$
	24 hour	Total	50 $\mu g/m^3$
$PM_{2.5}$	Annual	Total	8$\mu g/m^3$
	24 hour	Total	25 $\mu g/m^3$
Deposited dust	Annual	Incremental	2 g/m^2/month
		Total	4 g/m^2/month
Copper dusts and mists	1 hour	Incremental	18 $\mu g/m^3$
Copper fumes	1 hour	Incremental	3.7 $\mu g/m^3$
Iron oxide fumes	1 hour	Incremental	90 $\mu g/m^3$
Lead	Annual	Total	0.5 $\mu g/m^3$
Zinc oxide fumes	1 hour	Incremental	90 $\mu g/m^3$

Source: **NSW EPA, 2022**

$\mu g/m^3$ = micrograms per cubic metre

g/m^2/month = grams per square metre per month

3.4 NSW Voluntary Land Acquisition and Mitigation Policy

Part of the NSW *Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments* (VLAMP) (**NSW Government, 2018**) describes the NSW Government's policy for voluntary mitigation and land acquisition to address particulate matter impacts from state significant mining, petroleum and extractive industry developments.

Voluntary mitigation rights (such as air conditioning at sensitive receptors [including heating]) may apply per the VLAMP where, even with best practice management, the development contributes to exceedances of the criteria in **Table 3-2** at any residence on privately owned land or workplace on privately owned land. [1]

Table 3-2: Particulate matter mitigation criteria

<table>
<tr><th>Pollutant</th><th>Averaging period</th><th colspan="2">Mitigation criterion</th><th>Impact type</th></tr>
<tr><td>$PM_{2.5}$</td><td>Annual</td><td colspan="2">8 $\mu g/m^3$*</td><td>Human health</td></tr>
<tr><td>$PM_{2.5}$</td><td>24 hour</td><td colspan="2">25 $\mu g/m^3$**</td><td>Human health</td></tr>
<tr><td>PM_{10}</td><td>Annual</td><td colspan="2">25 $\mu g/m^3$*</td><td>Human health</td></tr>
<tr><td>PM_{10}</td><td>24 hour</td><td colspan="2">50 $\mu g/m^3$**</td><td>Human health</td></tr>
<tr><td>TSP</td><td>Annual</td><td colspan="2">90 $\mu g/m^3$*</td><td>Amenity</td></tr>
<tr><td>Deposited dust</td><td>Annual</td><td>2 g/m^2/month**</td><td>4 g/m^2/month*</td><td>Amenity</td></tr>
</table>

Source: **NSW Government (2018)**

*Cumulative impact (i.e. increase in concentration due to the development plus background concentrations due to all other sources).

**Incremental impact (i.e. increase in concentrations due to the development alone), with zero allowable exceedances of the criteria over the life of the development.

Voluntary acquisition rights may apply as per the VLAMP where, even with best practice management, the development contributes to exceedances of the criteria in **Table 3-3** at any residence on privately owned land, workplace on privately-owned land or on more than 25% of any privately-owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls (vacant land).

1 Where any exceedance would be unreasonably detrimental to workers health or carrying out of the business at that workplace.

Table 3-3: Particulate matter acquisition criteria

Pollutant	Averaging period	Acquisition criterion		Impact type
$PM_{2.5}$	Annual	8 µg/m³*		Human health
$PM_{2.5}$	24 hour	25 µg/m³**		Human health
PM_{10}	Annual	25 µg/m³*		Human health
PM_{10}	24-hour	50 µg/m³**		Human health
TSP	Annual	90 µg/m³*		Amenity
Deposited dust	Annual	2 g/m²/month**	4 g/m²/month*	Amenity

Source: **NSW Government (2018)**

*Cumulative impact (i.e. increase in concentration due to the development plus background concentrations due to all other sources).

**Incremental impact (i.e. increase in concentrations due to the development alone), with up to five allowable exceedances of the criteria over the life of the development.

Table 3-2 and **Table 3-3** share identical criteria, with the exception of the footnotes for 24-hour average $PM_{2.5}$ and PM_{10}. It should be noted that the mitigation criteria strictly prohibit any exceedances of the criteria over the life of the development, while the acquisition criteria allow up to five exceedances over the life of the development. Another notable distinction between the two sets of criteria is that they apply to existing residences or, in the case of the acquisition criteria, land where a residence can be built.

4 EXISTING ENVIRONMENT

This section describes the existing environment including the climate and ambient air quality in the area surrounding the Project.

4.1 Local climatic conditions

Long-term climatic data from the closest Bureau of Meteorology (BoM) weather station at Cobar Airport Automatic Weather Station (AWS) (Site No. 048237) were analysed to characterise the local climate in the proximity of the Project. Cobar Airport AWS is located approximately 90km west of the Project.

Table 4-1 and **Figure 4-1** present a summary of data from the Cobar Airport AWS collected over a 16-to-30-year period for the various meteorological parameters.

The data indicate that January is the hottest month with a mean maximum temperature of 35.7 degrees Celsius (°C) and July is the coldest month with a mean minimum temperature of 3.3°C.

Rainfall is lowest during the cooler months, with an annual average rainfall of 351.7 millimetres (mm) over 40.7 days. The data indicate that February and November are the wettest months with an average rainfall of 37.2mm over 3.4 and 4.2 days respectively. August is the driest month with an average rainfall of 19.2mm over 2.9 days.

Relative humidity levels exhibit variability over the day and seasonal fluctuations. Mean 9am relative humidity ranges from 40% in December to 80% in June. Mean 3pm relative humidity levels range from 23% in December to 51% in June.

Wind speeds during the cooler months have a greater spread between the 9am and 3pm conditions compared to the warmer months. Mean 9am wind speeds range from 9.8 kilometres per hour (km/h) in July to 18.2km/h in January. Mean 3pm wind speeds range from 14.8km/h in May to 18.3km/h in October.

Table 4-1: Monthly climate statistics summary – Cobar Airport AWS

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Temperature													
Mean max. temp. (°C)	35.7	33.8	30.6	25.8	20.5	16.9	16.4	19.0	23.1	26.8	30.3	33.5	26.0
Mean min. temp. (°C)	21.0	19.9	16.6	11.4	6.8	4.7	3.3	4.3	7.8	11.6	15.6	18.2	11.8
Rainfall													
Rainfall (mm)	36.5	37.2	30.2	21.3	28.4	33.0	21.7	19.2	28.7	31.9	37.2	25.8	351.7
No. of rain days (≥1mm)	3.7	3.4	3.1	2.2	3.2	4.2	3.4	2.9	3.4	3.8	4.2	3.2	40.7
9am conditions													
Mean temp. (°C)	25.9	24.3	21.1	18.4	13.4	9.8	8.6	11.5	16.0	19.6	22.2	24.6	18.0
Mean R.H. (%)	43.0	51.0	54.0	55.0	68.0	80.0	79.0	64.0	55.0	44.0	46.0	40.0	57.0
Mean W.S. (km/h)	18.2	16.5	14.9	14.4	10.7	10.3	9.8	12.5	15.8	17.0	17.2	17.7	14.6
3pm conditions													
Mean temp. (°C)	33.3	31.8	29.3	24.8	19.8	16.4	15.5	18.0	22.0	25.1	28.6	31.6	24.7
Mean R.H. (%)	24.0	31.0	30.0	33.0	43.0	51.0	50.0	38.0	34.0	29.0	28.0	23.0	34.0
Mean W.S. (km/h)	17.0	16.6	15.8	15.1	14.8	15.2	15.6	17.1	17.9	18.3	18.0	18.0	16.6

Source: **Bureau of Meteorology, 2024 (2024)**

R.H. – Relative Humidity, W.S. – wind speed

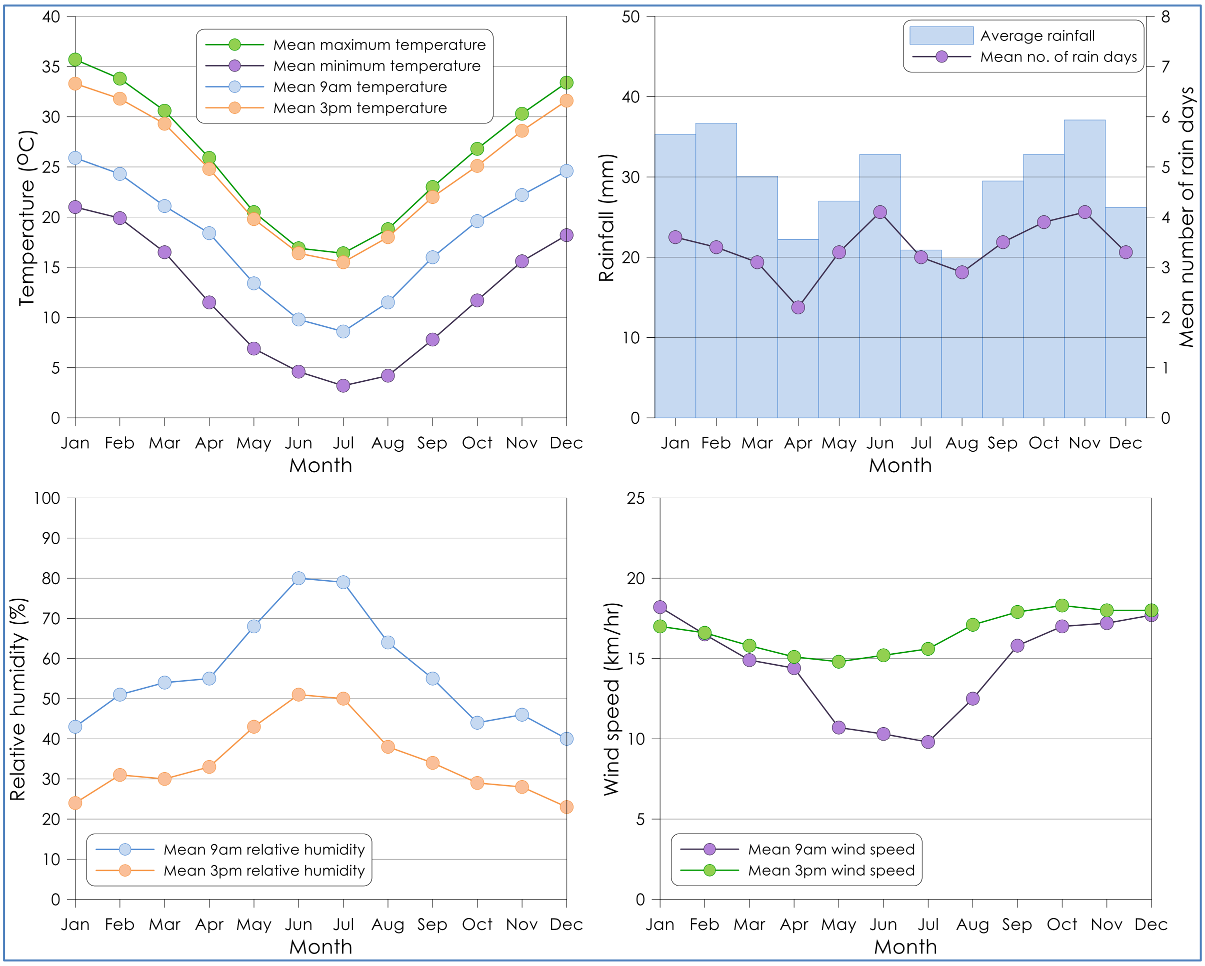

Figure 4-1: Monthly climate statistics summary – Cobar Airport AWS

4.2 Local meteorological conditions

Annual and seasonal windroses for the Cobar Airport AWS during the 2021 calendar period are presented in **Figure 4-2**.

The 2021 calendar year was selected as the meteorological year for the dispersion modelling based on an analysis of long-term data trends in meteorological data recorded and appropriate monitoring data for the area as outlined in **Appendix A**.

On an annual basis, winds predominantly follow a northeast to southwest axis. In summer, winds from the northeast to the east and the south-southwest are most prominent. The autumn windrose follows a similar pattern to the annual windrose with winds following a northeast to southwest axis. During winter and spring, winds primarily occur from the northeast with varied winds from other directions.

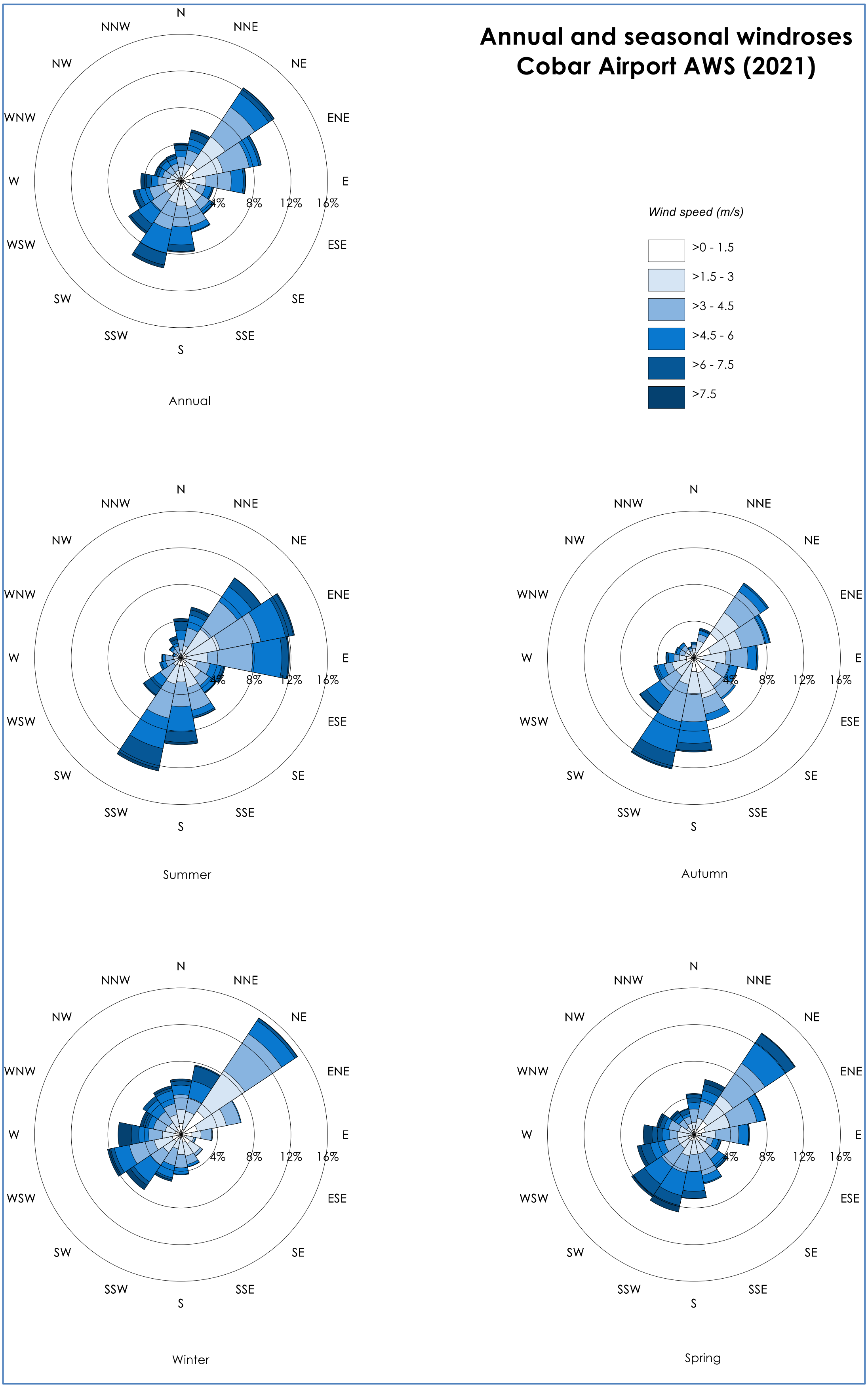

Figure 4-2 : Annual and seasonal windroses – Cobar Airport AWS (2021)

4.3 Local air quality monitoring

The main sources of air pollutants in the area surrounding the Project would include emissions from agricultural and mining activities, and anthropogenic activities such as motor vehicle exhaust, vehicles on unsealed roads and domestic wood heaters. Events such as bushfires and dust storms are also a potential source of air pollution in the surrounding area.

Ambient air quality monitoring data from the Project site are not available. Therefore, the available data from the nearest air quality monitors operated by the New South Wales (NSW) Department of Climate Change, Energy, the Environment and Water (DCCEEW) at Narrabri, Gunnedah and Orange, and dust deposition monitoring data conducted as part of the air quality monitoring for the Tritton Copper Mine were used to quantify the background levels for the Project site.

The Narrabri, Gunnedah and Orange monitoring stations are located approximately 318km northeast, 339km east, 306km southeast from the Project site, respectively. As per the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2022**), in the absence of site-specific monitoring data, data obtained from the closest monitoring station/s can be used to characterise the ambient background air quality levels for the Project location.

It is to be noted that all of the monitoring stations are located in generally more urban environments with potentially higher ubiquitous ambient air emissions sources such as traffic, domestic wood heater emissions, and nearby industrial and commercial activities. Orange is noted being more urbanised and significantly different topographically compared to the Narrabri and Gunnedah sites.

The monitoring data are expected to provide a conservative estimate of the underlying background levels in the locality.

4.3.1 PM_{10} monitoring

A summary of the available PM_{10} monitoring data from 2018 to 2023 for the Narrabri, Gunnedah and Orange monitoring stations are presented in **Table 4-2**. Recorded 24-hour average PM_{10} concentrations are presented in **Figure 4-3.**

A review of **Table 4-2** indicates that the annual average PM_{10} concentrations for all stations were below the relevant criterion of 25µg/m^3 for all years with the exception of Orange in 2019. It should be noted that annual periods which contain less than 75% data are excluded for estimating an annual average in **Table 4-2**. The maximum 24-hour average PM_{10} concentrations were found to exceed the relevant criterion of 50µg/m^3 during 2018, 2019, 2020, and 2023. Anomalously high PM_{10} concentrations were recorded in December 2018 at the monitor and have been attributed to regional dust storm events (**NSW DPIE 2020a**). The high PM_{10} concentration recorded in December 2019 and January 2020 are attributed to bushfires and the drought period (**NSW DPIE 2020b & NSW DPIE 2020c)**. The PM_{10} exceedances recorded in December 2023 at Narrabri and Gunnedah coincides with and is attributed to nearby bushfires.

Table 4-2: Summary of PM_{10} levels from monitoring stations ($\mu g/m^3$)

Year	Narrabri	Gunnedah	Orange	Criterion
	Annual average			
2018	14.3	18.9	ND	**25**
2019	23.2	24.8	**28.3**	**25**
2020	12.4	13.9	17.9	**25**
2021	7.0	11.2	11.3	**25**
2022	6.7	*	8.6	**25**
2023	9.4	12.9	11.8	**25**
Year	**Maximum 24-hour average**			**Criterion**
2018	**221.7**	**234.9**	-	**50**
2019	**232.6**	**205.2**	**423.7**	**50**
2020	**119.6**	**101.2**	**291.8**	**50**
2021	36.4	42.7	46.3	**50**
2022	17	36.4	43.1	**50**
2023	**53**	**61.3**	34.1	**50**

ND – No data **Bold** text exceeds criterion * - Less than 75% available data

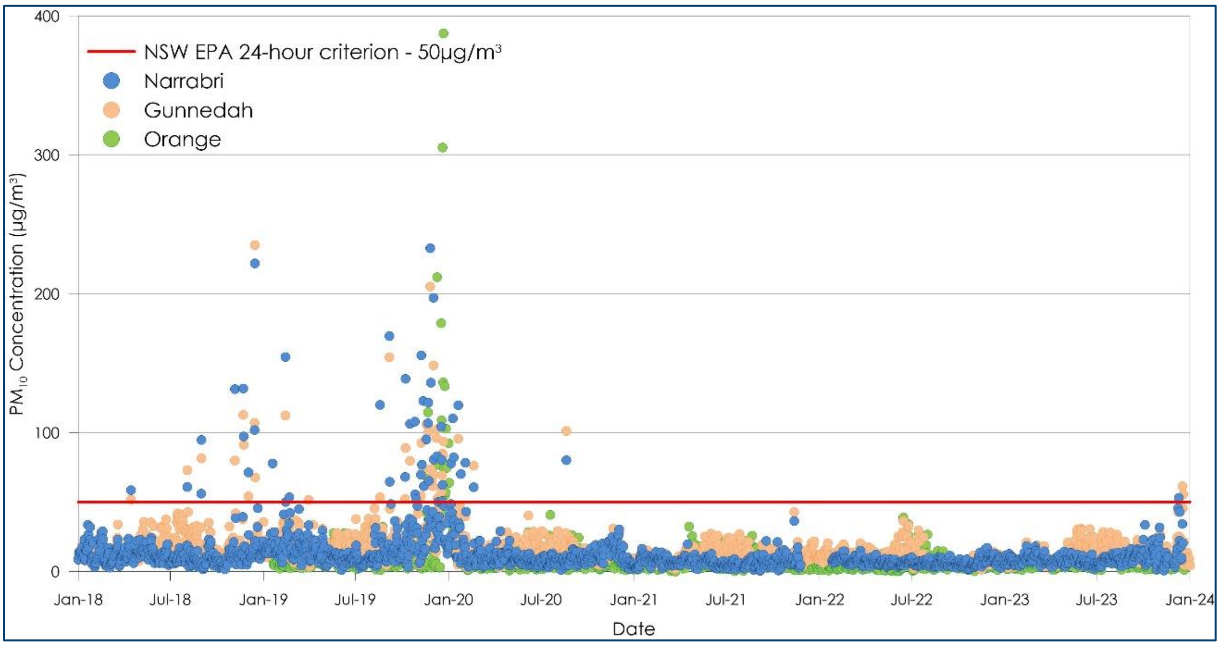

Figure 4-3: 24-hour average PM_{10} concentrations

4.3.2 $PM_{2.5}$ monitoring

A summary of the available data from 2018 to 2023 for the Narrabri, Gunnedah and Orange monitoring stations are presented in **Table 4-3**. Recorded 24-hour average $PM_{2.5}$ concentrations are presented in **Figure 4-4**.

Table 4-3 indicates that the annual average $PM_{2.5}$ concentrations for the monitoring stations were below the annual average criterion of 8µg/m³ for all years except for Gunnedah in 2018 and 2019, and Orange in 2019 and 2020. It should be noted that annual periods which contain less than 75% data are excluded for estimating an annual average in **Table 4-3**.

The maximum 24-hour average $PM_{2.5}$ concentrations at the monitoring stations were found to exceed the relevant criterion of 25µg/m^3 on occasion during the review period. Similar to the PM_{10} monitoring data, the mass bushfires affecting NSW in 2019 and 2020 are seen in the $PM_{2.5}$ monitoring data. Likewise, the bushfires in December 2023 seen in the PM_{10} monitoring data are also seen in the $PM_{2.5}$ monitoring data.

Table 4-3: Summary of $PM_{2.5}$ levels from monitoring stations (µg/m³)

Year	Narrabri	Gunnedah	Orange	Criterion
	Annual average			
2018	4.9	**9.0**	ND	**8**
2019	7.8	**11.2**	**15.8**	**8**
2020	5.5	7.7	**9.1**	**8**
2021	3.1	6.6	6.6	**8**
2022	3.6	*	5.2	**8**
2023	4.8	7.6	7.0	**8**
Year	**Maximum 24-hour average**			**Criterion**
2018	**26.3**	**50.7**	-	**25**
2019	**87.7**	**94.1**	**387.4**	**25**
2020	**42.4**	**34.7**	**92.3**	**25**
2021	11.8	23.9	**32.3**	**25**
2022	8.9	**28.2**	**38.9**	**25**
2023	**47**	**50.1**	24.9	**25**

ND – No data **Bold** text exceeds criterion * - Less than 75% available data

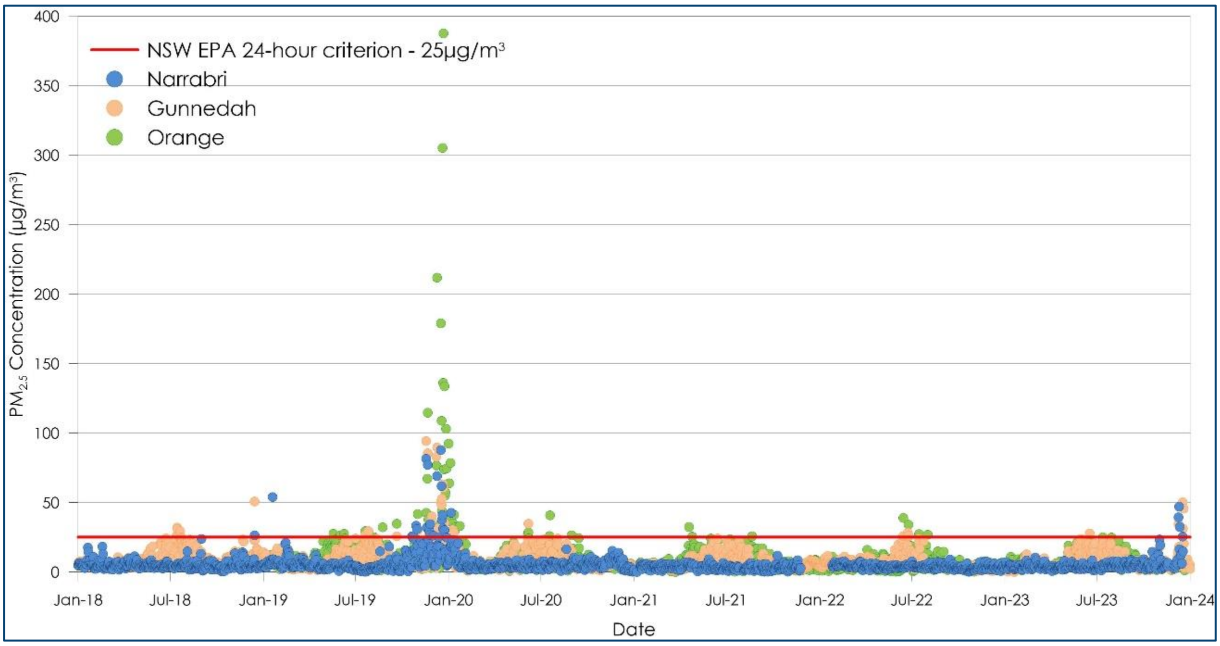

Figure 4-4: 24-hour average $PM_{2.5}$ concentrations

4.3.3 Deposited dust monitoring data

Annual average deposited dust levels recorded in the past six years are presented in **Figure 4-5**. The approximate location of each of the monitors relative to the Project are shown in **Figure 4-6**.

Figure 4-5 shows that deposited dust levels nearest sensitive receptor locations were generally equal to or below the NSW EPA criterion of 4g/m^2/month for all years at each monitor except for BG2 in 2019 which recorded 4.1g/m^2/month. The data indicate that deposited dust levels are elevated in 2019 and is likely attributed to the drought conditions during this period. Some of the deposited dust monitors located closer to mining activities, and not representative of the surrounding area, recorded levels above $4g/m^2/month$ on occasion as can be expected.

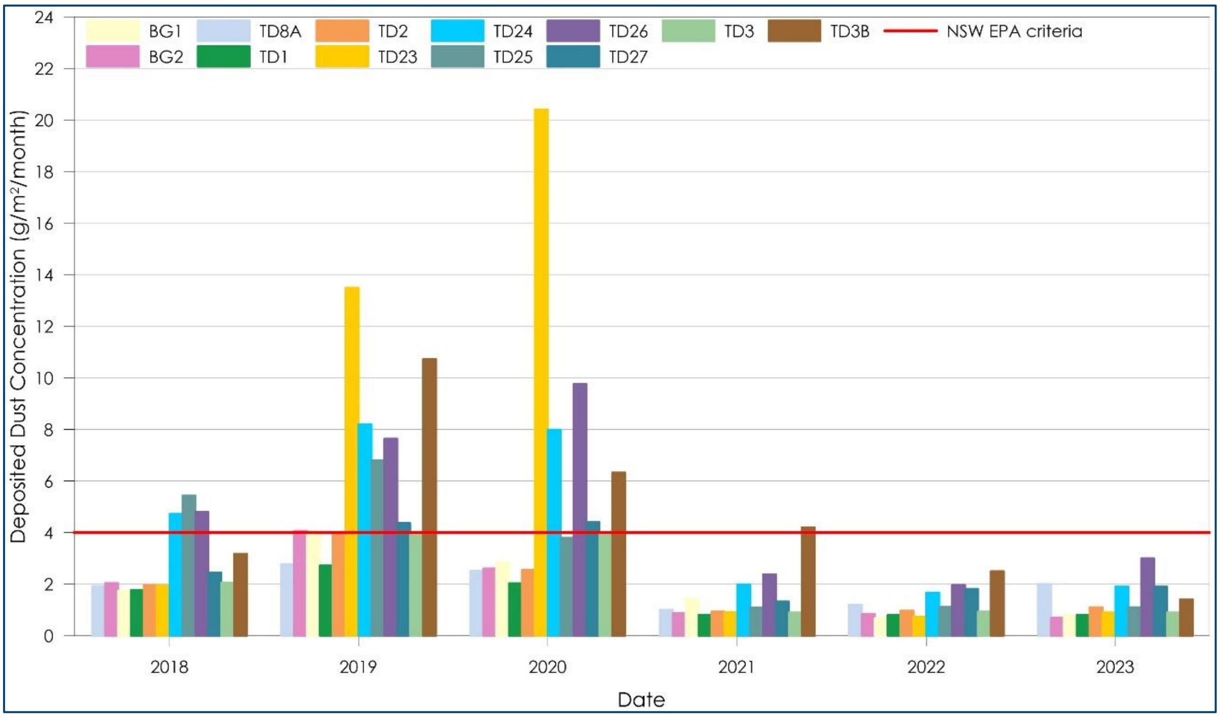

Figure 4-5: Annual average recorded deposited dust concentrations ($g/m^2/month$)

Metal deposition rates are also measured at the dust gauges. **Table 4-4** presents a summary of the metal and dust deposition rates for the 2023 period.

Table 4-4: Dust and metal deposition rates for the 2023 period

Dust Gauge ID	Average Analyte Concentrations ($\mu g/m^2/month$)				Insoluble Solids (g/m^2 month)
	Copper	Iron	Lead	Zinc	
Background					
TD8A	41.9	1,285.9	2.6	21.8	2.0
BG1	64.1	549.3	4.1	10.4	0.8
BG2	68.4	629.7	4.1	9.3	0.7
Tritton					
TD1	196.1	1,046.0	8.1	33.7	0.8
TD2	193.6	1,507.8	4.6	42.9	1.1
TD23	387.5	1,401.0	6.2	66.6	0.9
TD24	275.7	2,814.6	11.8	65.7	1.9
TD25	893.4	3,165.8	14.3	147.2	1.1
TD26	3,118.3	8,738.6	16.2	474.0	3.0
TD27	785.8	3,323.9	7.4	120.4	1.9
TD3	175.8	1,433.3	3.0	49.3	0.9
TD3B	249.8	2,288.0	4.1	73.9	1.4

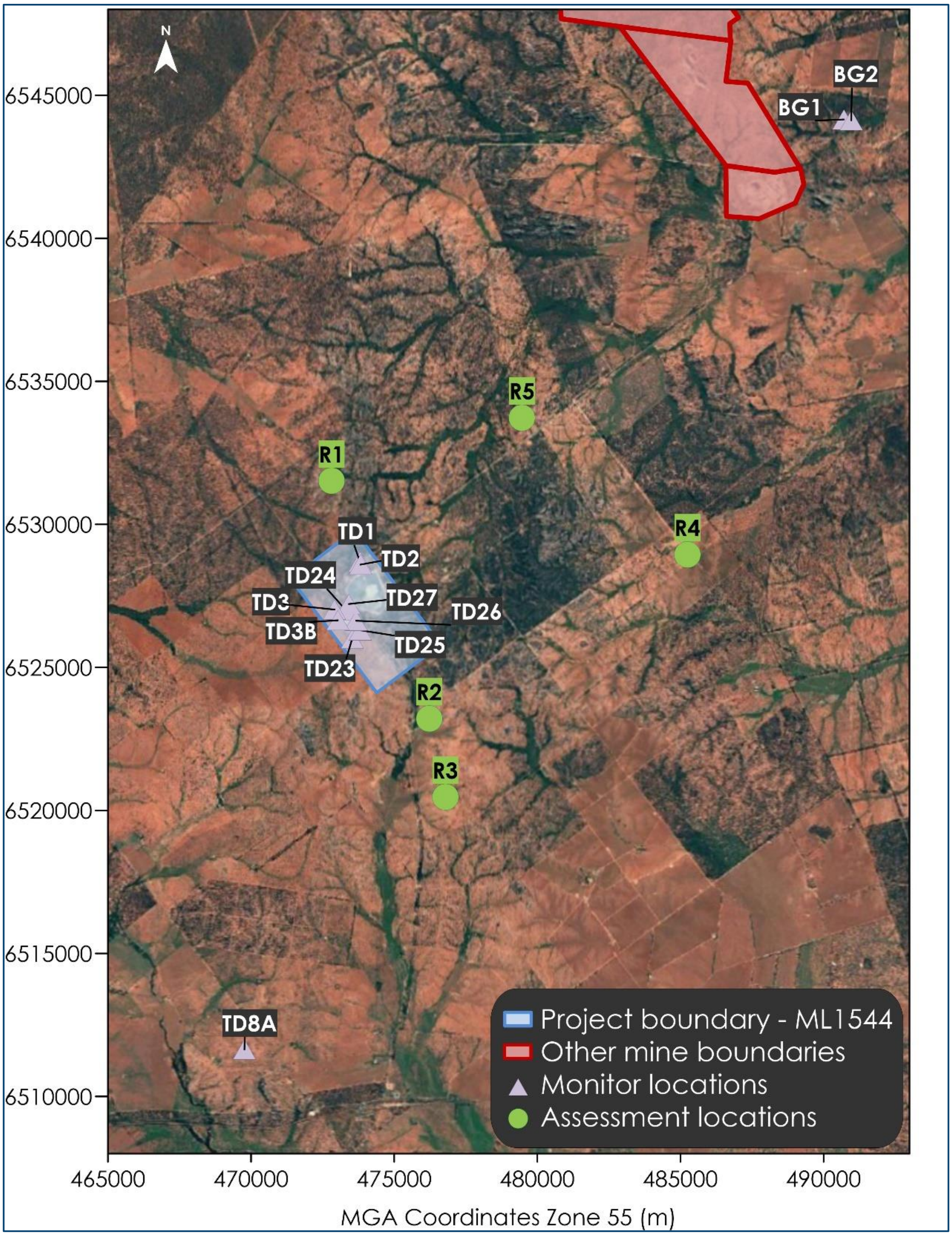

Figure 4-6: Deposited dust monitor locations

4.3.4 Estimated background levels

As outlined above, there are no readily available site-specific monitoring data and, in the absence, data obtained from the closest monitoring station/s can be used to characterise the ambient background air quality levels for the Project location.

Background air quality levels from the nearest DCCEEW monitor at Narrabri for the 2021 calendar year were used to represent the $PM_{2.5}$ and PM_{10} background levels for the Project. It is noted that the Narrabri monitoring station is located in generally more urban environments with potentially higher ubiquitous ambient air emissions sources and would be conservative for the Project.

Estimates of the annual average background TSP concentrations can be determined from a relationship between PM_{10} and TSP concentrations and the measured PM_{10} levels. This relationship assumes that an annual average PM_{10} concentration of 25µg/m^3 corresponds to a TSP concentration of 90µg/m^3. This assumption is based on the NSW EPA air quality impact criteria. Applying this relationship with the measured annual average PM_{10} concentration of 7.0µg/m^3 indicates an approximate annual average TSP concentration.

The annual average deposited dust level recorded at the BG2 monitor during 2021 was used to represent the background deposited dust level for the Project. The BG2 monitor was chosen as it recorded the median value out of the three monitors (BG1, BG2, TD8A) analysed that are outside any mining boundaries, which were placed for the purpose of characterizing background levels. The values recorded by this monitor include dust levels due to the nearby Murrawombie, North East and Avoca Tank mines. The BG2 monitor has also been used as the background metal deposition rates.

The background air quality levels applied in this assessment are summarised in **Table 4-5**.

Table 4-5: Summary of background levels

Pollutant	Background level	Units
Annual average TSP	25.1	µg/m^3
Maximum 24-hour average PM_{10}	36.4	µg/m^3
Annual average PM_{10}	7.0	µg/m^3
Maximum 24-hour average $PM_{2.5}$	11.8	µg/m^3
Annual average $PM_{2.5}$	3.1	µg/m^3
Annual average deposited dust	0.9	g/m^2/month

As mentioned, the meteorological year chosen for the dispersion modelling was the 2021 calendar year. This selection was based on an analysis of long-term data trends in meteorological conditions as outlined in **Appendix A**.

5 DISPERSION MODELLING APPROACH

The following sections are included to provide the reader with an understanding of the model and modelling approach applied for the assessment. The CALPUFF is an advanced air dispersion model which can deal with the effects of complex local terrain on the dispersion meteorology over the modelling domain in a three-dimensional, hourly varying time step.

Modelling was undertaken using a combination of the CALPUFF Modelling System and the Weather Research and Forecasting model (WRF). The CALPUFF Modelling System includes three main components: CALMET, CALPUFF and CALPOST and a large set of pre-processing programs designed to interface the model to standard, routinely available meteorological and geophysical datasets.

The model was setup in general accord with the methods provided in the NSW EPA document *Generic Guidance and Optimum Model Setting for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia'* (**TRC**, **2011**).

5.1 Meteorological modelling

The WRF model was applied to the available data to generate a three-dimensional upper air data file for use in CALMET. The centre of analysis for the WRF modelling used is 31.40deg south and 146.72deg east. The simulation involved an outer grid of 30km, with three nested grids of 10km, 3km, and 1km with 35 nested vertical levels.

The CALMET domain was run on a domain of 30 x 30km with a 0.3km grid resolution. The available meteorological data for the 2021 calendar year from the Cobar Airport AWS BoM meteorological monitoring site was included in the simulation. The 2021 calendar year was selected as the representative period for modelling the Project based on a statistical analysis of meteorological conditions from seven consecutive years, as outlined in **Appendix A**.

5.2 Meteorological modelling evaluation

The outputs of the CALMET modelling are evaluated using visual analysis of the wind fields and extract data. **Figure 5-1** presents a visualisation of the wind field generated by CALMET for a single hour of the modelling period (i.e. example only). The wind fields follow the terrain well and indicate the simulation produces realistic fine scale flow fields (such as terrain forced flows) in surrounding areas.

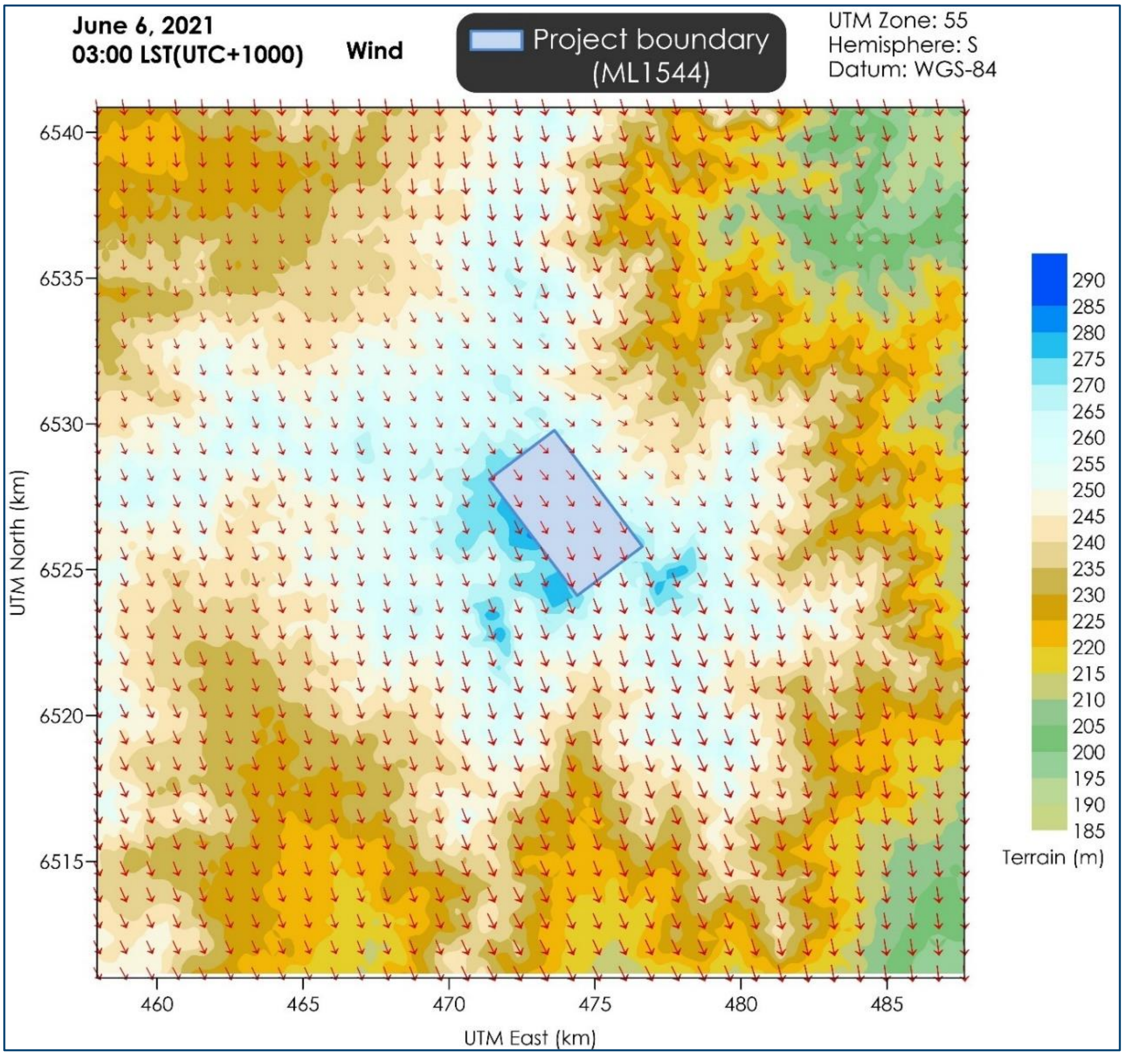

Figure 5-1: Representative 1-hour average snapshot of wind field for the Project

CALMET generated meteorological data were extracted from a point within the CALMET domain and are graphically represented in **Figure 5-2** and **Figure 5-3**.

Figure 5-2 presents the annual and seasonal windroses from the CALMET data. Overall, the windroses generated in the CALMET modelling reflect the expected wind distribution patterns of the area as determined based on the available measured data and the expected terrain effects on the prevailing winds.

It is noted that there is some variation in wind distributions between the Cobar Airport AWS and the CALMET extracted point. These disparities are likely attributed to variations in local terrain, vegetation and other factors that influence wind patterns. However, the resulting wind distribution generated by CALMET appears to be reasonable and aligned with expectations.

Figure 5-3 includes graphs of the temperature, wind speed, mixing height and stability classification over the modelling period and shows sensible trends considered to be representative of the area.

In conclusion, the CALMET generated meteorological data for the year 2021 are considered suitable for use in the air dispersion modelling for the Project.

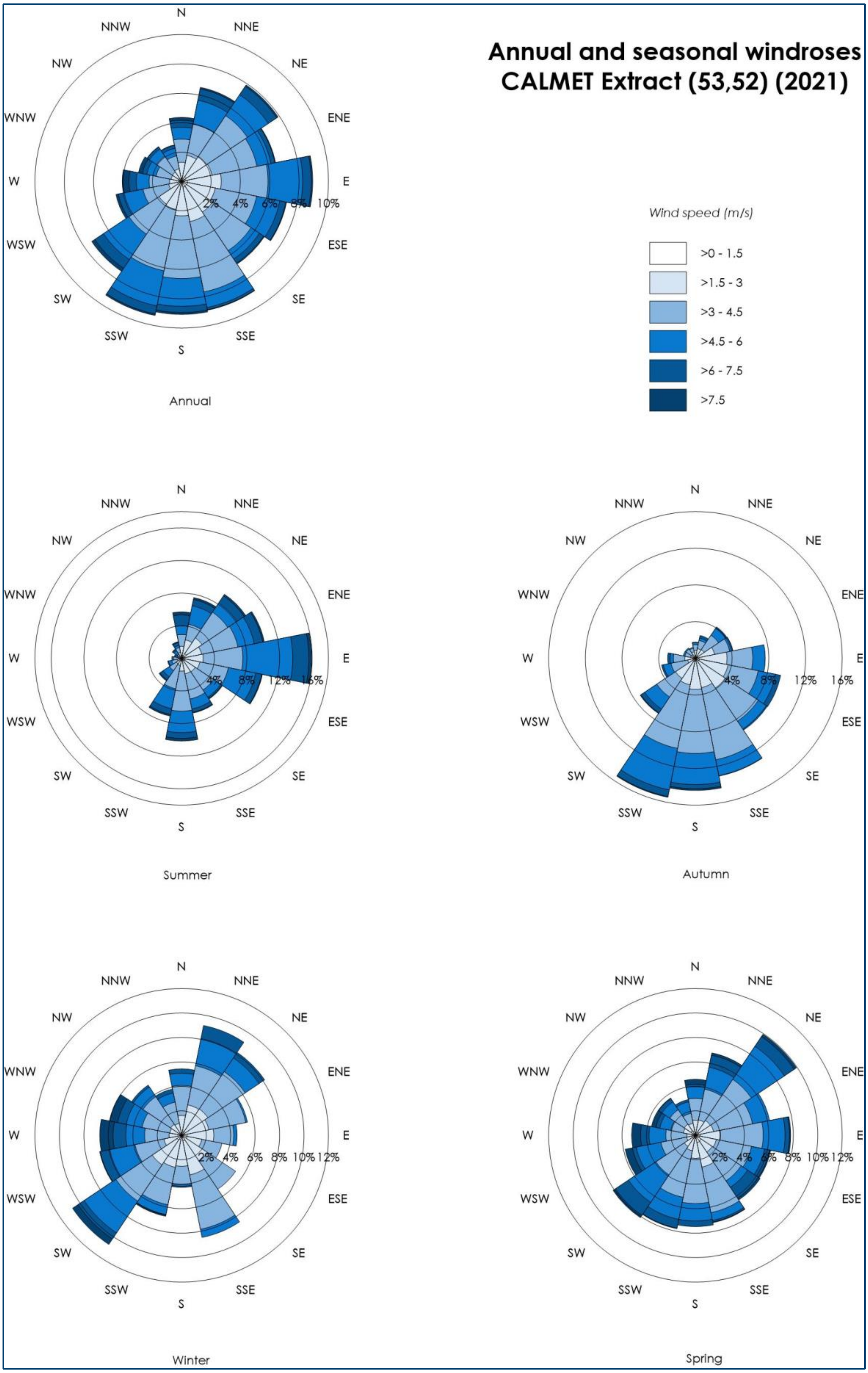

Figure 5-2: Annual and seasonal windroses from CALMET (Cell ref 5352)

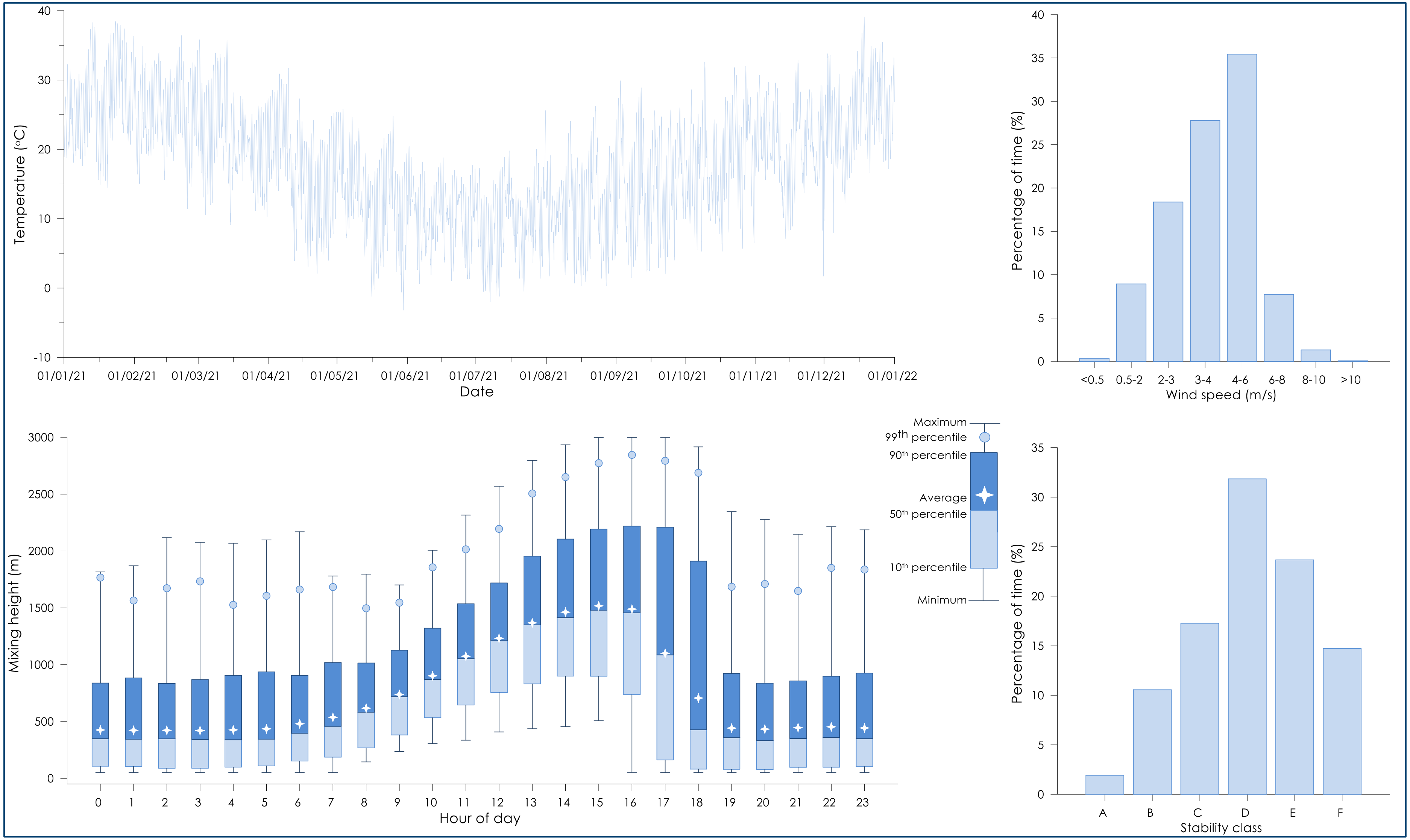

Figure 5-3: Meteorological analysis of CALMET (Cell Ref 5352)

5.3 Dispersion modelling

Dust emissions from each operational activity of the Project were represented by a series of volume sources and were included in the CALPUFF model via an hourly varying emission file. Meteorological conditions associated with dust generation (such as wind speed) and levels of dust generating activity were considered in calculating the hourly varying emission rate for each source.

It should be noted that as a conservative measure, the effect of the precipitation rate (rainfall) in reducing dust emissions has not been considered in this assessment.

5.4 Modelling scenarios

The assessment considered two scenarios, one for the Approved Operations, and one for the Proposed Operations, as described in **Section 2.2** and **Section 2.3**.

The Proposed Operations scenario represents a reasonable worst-case operating scenario in terms of air quality for the Project. The scenario assumes all 1.8Mtpa of imported mined material is ore material (a portion of it is planned to be waste rock), this assumption results in all the ore that is processed coming from imports, resulting in a longer haul route and more emissions.

The 24-hour average dust impacts (the peak scenario) have been assessed based on a maximum of 288 daily vehicle movement for material importation. The peak scenario is the same for the Proposed and Approved Operations as peak operations would not change under the proposed operations and both are based on a maximum of 288 daily vehicle movements for material importation.

Additionally, both scenarios conservatively assume that the entire TSF is subject to wind erosion, whereas in reality the high moisture content in it will dramatically limit the wind erosion.

Figure 5-4 presents the source locations used in the modelling and some of the relevant areas.

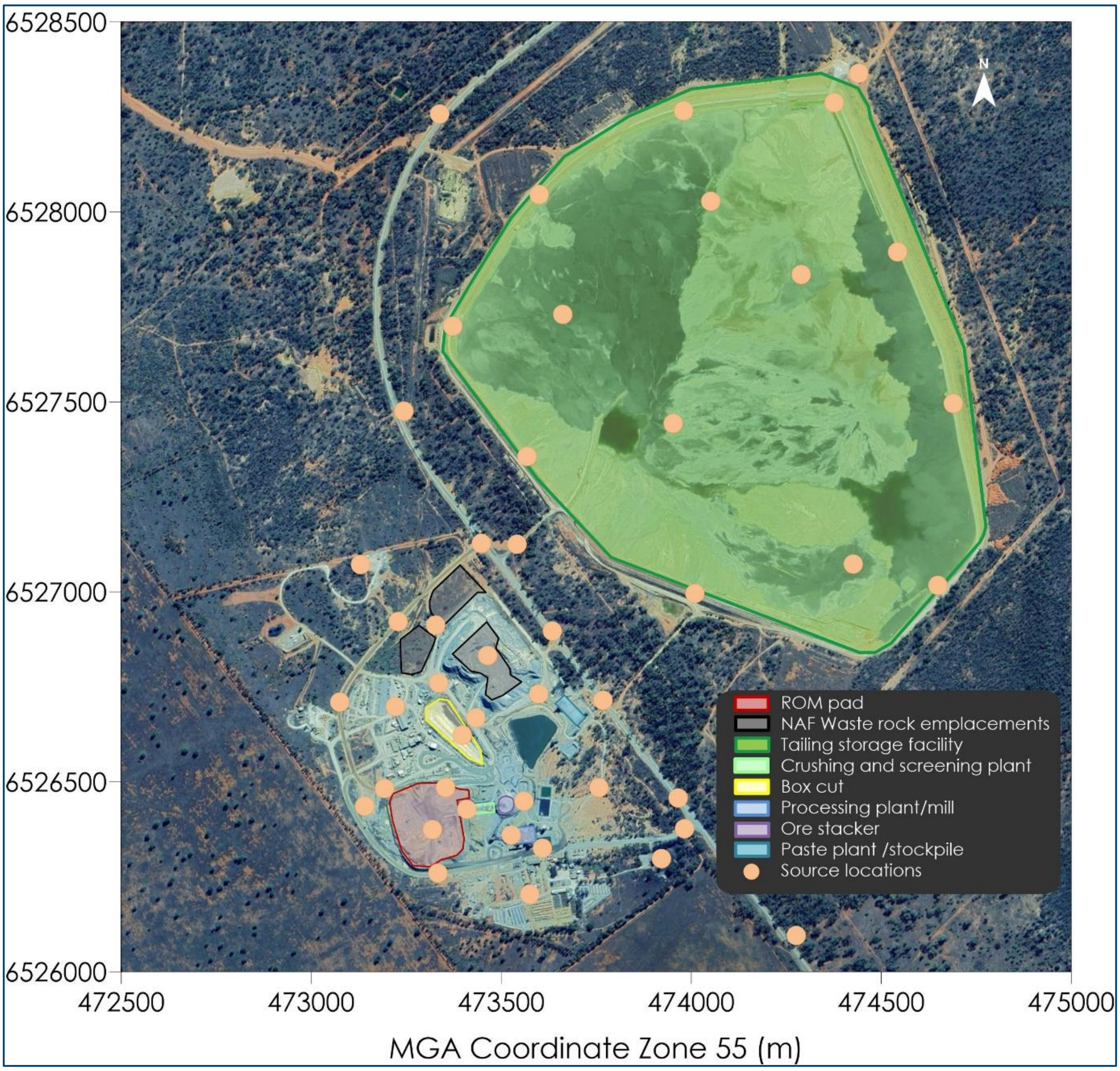

Figure 5-4: Indicative mine plan – Project site

5.4.1 Emission estimation

The significant dust generating activities associated with the operation of the Project are identified as the loading/unloading of material, vehicles travelling on-site (including material imports, exports and material transportation involved in the raising of the TSF), windblown dust from exposed areas and stockpiles, vent shaft emissions, and crushing, screening and grinding processes. The vehicle and plant equipment also have the potential to generate particulate emissions from the diesel exhaust.

The main increases in emissions in the Proposed Operations scenario comes from the increased loading/unloading of material and increased vehicle travelling on site associated with the increased quantity of materials processed, imported and exported.

Dust emission estimates have been calculated by analysing the various types of dust generating activities taking place and utilising suitable emissions sourced from both locally developed and United States Environmental Protection Agency (US EPA) developed documentation.

A summary of the estimated average TSP emissions for the Approved and Proposed Operations is presented in **Table 5-1**. Detailed calculations of the dust emission estimates with dust control factors considered in the model are provided in **Appendix B**. Some examples of existing dust mitigation measures are presented in **Section 7**.

As noted, the Proposed Operations scenario represents a reasonable worst-case operating scenario, assuming the maximum amount of ore material (1.8Mtpa) processed at the site is imported. This would result in more dust generation, as the haul distance for imported material is longer compared to hauling from the underground mine, which would produce less dust. Dust emission estimates for the peak scenario assessing 24-hour average dust impacts associated with the maximum daily vehicle movements is presented in **Appendix B**.

The estimated emissions are commensurate with utilising reasonable best practice dust mitigation applied where feasible. Further detail on the specific dust control measures applied for the Project are outlined in **Appendix B**.

Table 5-1: Summary of estimated TSP dust emissions for the Project (kg/year)

Activity	Approved Operations	Proposed Operations
Waste rock		
Hauling mined WR to NAF emplacement areas (unpaved)	3,755	4,828
Unloading WR at emplacement areas	558	717
Rehandle WR material	558	717
Load WR exports to trucks	77	77
Haul WR exports to boundary	741	741
Dozer shaping	6,694	6,694
Drill cuttings import		
import Hauling to tailings (unpaved)	274	274
unloading material from trucks	1	1
re handling material	2	2
re handling material	2	2
Tailings exports		
loading material to trucks	682	1,286
export - hauling to boundary	19,205	36,236
Tailings construction		
Loading material to trucks	473	473
Hauling to tailings bund (unpaved)	12,877	12,877
Unloading material at tailings bund	473	473
Rehandle material during construction	473	473
Dozer shaping	13,054	13,054
Main process		
Hauling mined ore to ROM pad	4,659	-
Hauling imports to Rom pad (unpaved)	23,447	42,205
Unloading ROM material at stockpile area	2,573	4,631
Rehandle material (FEL loading from ROM pad)	3,602	4,631
Loading ROM material to crusher	3,602	4,631
Crushing	840	1,080
Grinding	8,484	10,908
Screening	2,100	2,700
Unloading material to stockpile	3,602	4,631

Activity	Approved Operations	Proposed Operations
FEL loading export material to Road Truck (excluding WR)	147	244
Hauling export to boundary (unpaved)	577	961
Other		
Grader	17,430	17,430
Wind erosion - infrastructure + stockpiles	82,117	82,117
Diesel exhaust emission	3,192	5,720
Vent Shaft emissions	237,908	237,908
Total TSP emissions	**453,649**	**498,194**

5.4.2 Emissions from other mining operations

In addition to the estimated dust emissions from the Project, emissions from nearby approved mining operations would also contribute to the ambient dust levels in the surrounding environment. The approved mining operations include the Murrawombie, North East and Avoca Tank mines. The location of these mines relative to the Project is shown in **Figure 5-5**.

The latest air quality assessments for Avoca Tank (**RW Corkery, 2014**) mine was a qualitative assessment. They determined that due to the isolated nature of the operations, distance to surrounding residences and the application of best practice management measures and operation controls the potential for any air quality impacts are unlikely.

Based on the dust deposition monitoring data presented in **Section 4.3.4** the existing air quality levels in the surrounding area are considered good and generally below the criteria near the sensitive receptor locations. The measured levels include the contribution from the existing mining operations (i.e. Avoca Tank, Murrawombie and North East mines) and when applied to the incremental contribution from the Project would represent the potential cumulative contribution.

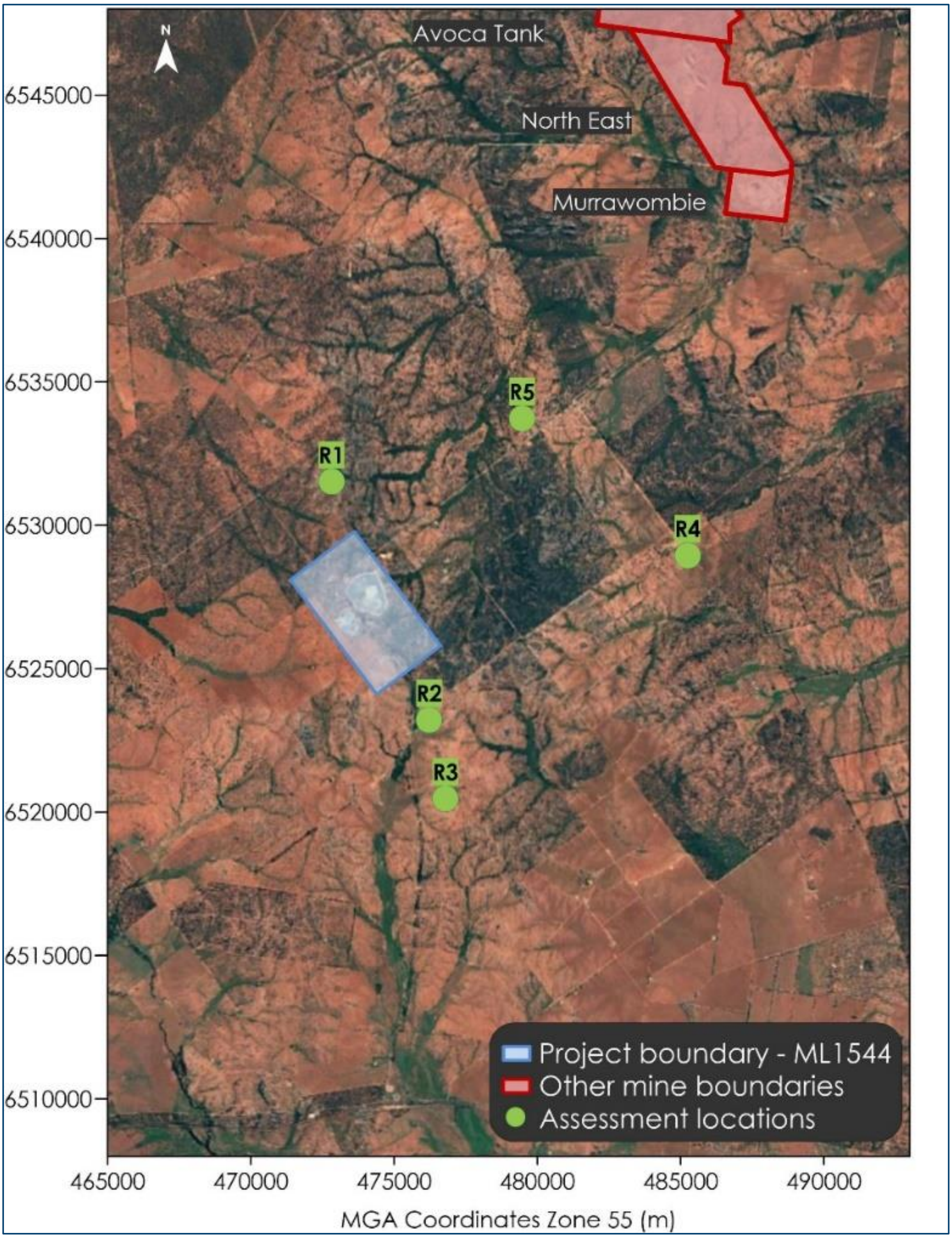

Figure 5-5: Other mining operations

6 DISPERSION MODELLING RESULTS

This section presents the predicted air quality levels which may arise from air emissions generated by the Project.

6.1 Dust concentrations

The dispersion model predictions presented in this section include those for the operation of the Project in isolation (incremental impact) and the operation of the Project with consideration of other sources (total cumulative impact). The results show the predicted:

- Maximum 24-hour average $PM_{2.5}$ and PM_{10} concentrations;
- Annual average $PM_{2.5}$, PM_{10} and TSP concentrations; and,
- Annual average dust (insoluble solids) deposition rates.

It is important to note that when assessing impacts per the maximum 24-hour average levels, these predictions are based on the highest predicted 24-hour average concentrations which were modelled at each point within the modelling domain for the worst day (i.e. a 24-hour period) during the one year long modelling period.

Associated isopleth diagrams of the dispersion modelling results for the Approved Operations and Proposed Operations scenarios are presented in **Appendix C**.

The predicted incremental and cumulative particulate dispersion modelling results at each of the assessed receptor locations are presented in **Table 6-1** for the Approved Operations scenario and **Table 6-2** for the Proposed Operations scenario.

The cumulative (total) impact is defined as the modelling impact associated with the operation of the Project combined with the estimated ambient background levels in **Section 4.3.4**.

The predicted incremental results show that minimal incremental effects would arise at the residential receptor locations due to the Project. The predicted cumulative results indicate that all the assessed receptors are predicted to experience levels below the relevant criteria for each of the assessed dust metrics.

It can be seen in **Table 6-1** and **Table 6-2**, the greatest incremental effects are predicted to be experienced at receptors located close to the Project's activities (e.g. R1 and R2) as expected.

Furthermore, the isopleth diagrams presented in **Appendix C** illustrate the predicted dust levels in the surrounding environment and the contribution from the Project.

As required by the VLAMP, any impacts due to the Project must not extend over more than 25% of any privately-owned land, in addition to there being no impacts at any residences. The isopleth diagrams show that the only dust levels that extend beyond the site boundary at levels mentioned in the VLAMP is the maximum 24-hour average PM_{10}, the relevant concentration for which is 50µg/m^3. The 24-hour average PM_{10} only extends beyond the site by a small amount, covering less than 3% of the neighbouring property, less than 25% of the privately owned land, so the VLAMP criteria are met.

The difference in annual average dust levels between the Approved Operations scenario and the Proposed Operations scenario is small, since there is only a 10% increase in modelled TSP emissions between the scenarios. Due to the small incremental levels relative to the criteria, the difference between the scenarios at the assessment locations is even smaller relative to the criteria, as summarised in **Table 6-1** and **Table 6-2**. **Table 6-1** and **Table 6-2** both show the same 24hr average results, as the modelled peak emissions were the same for both scenarios.

Overall, the predicted dust levels associated with the Project would be below the relevant criteria for the various dust metrics.

Table 6-1: Dust dispersion modelling results for residential receptors – Approved Operations

Receptor ID	$PM_{2.5}$ ($\mu g/m^3$)		PM_{10} ($\mu g/m^3$)		TSP ($\mu g/m^3$)	DD* ($g/m^2/mth$)	$PM_{2.5}$ ($\mu g/m^3$)		PM_{10} ($\mu g/m^3$)		TSP ($\mu g/m^3$)	DD* ($g/m^2/mth$)
	Incremental						Cumulative					
	24-hr ave.	Ann. ave.	24-hr ave.	Ann. ave.	Ann. ave.	Ann. ave.	24-hr ave.	Ann. ave.	24-hr ave.	Ann. ave.	Ann. ave.	Ann. ave.
	Air quality impact criteria											
	-	-	-	-	-	2	25	8	50	25	90	4
R1	1.4	<0.1	6.2	0.2	0.3	<0.1	13.2	3.1	42.6	7.2	25.4	0.9
R2	1.1	<0.1	4.7	0.1	0.2	<0.1	12.9	3.1	41.1	7.1	25.3	0.9
R3	0.5	<0.1	2.0	<0.1	<0.1	<0.1	12.3	3.1	38.4	7.1	25.2	0.9
R4	0.2	<0.1	0.8	<0.1	<0.1	<0.1	12.0	3.1	37.2	7.0	25.1	0.9
R5	0.6	<0.1	2.9	<0.1	<0.1	<0.1	12.4	3.1	39.3	7.1	25.2	0.9

*Deposited dust

Table 6-2: Dust dispersion modelling results for residential receptors – Proposed Operations

Receptor ID	$PM_{2.5}$ ($\mu g/m^3$)		PM_{10} ($\mu g/m^3$)		TSP ($\mu g/m^3$)	DD* ($g/m^2/mth$)	$PM_{2.5}$ ($\mu g/m^3$)		PM_{10} ($\mu g/m^3$)		TSP ($\mu g/m^3$)	DD* ($g/m^2/mth$)
	Incremental						Cumulative					
	24-hr ave.	Ann. ave.	24-hr ave.	Ann. ave.	Ann. ave.	Ann. ave.	24-hr ave.	Ann. ave.	24-hr ave.	Ann. ave.	Ann. ave.	Ann. ave.
	Air quality impact criteria											
	-	-	-	-	-	2	25	8	50	25	90	4
R1	1.4	<0.1	6.2	0.2	0.4	<0.1	13.2	3.2	42.6	7.2	25.5	0.9
R2	1.1	<0.1	4.7	0.1	0.2	<0.1	12.9	3.1	41.1	7.1	25.3	0.9
R3	0.5	<0.1	2.0	<0.1	<0.1	<0.1	12.3	3.1	38.4	7.1	25.2	0.9
R4	0.2	<0.1	0.8	<0.1	<0.1	<0.1	12.0	3.1	37.2	7.0	25.1	0.9
R5	0.6	<0.1	2.9	<0.1	<0.1	<0.1	12.4	3.1	39.3	7.1	25.2	0.9

*Deposited dust

6.2 Metals concentrations

An estimate of the metals concentrations can be made by applying the ratio of the Project related measured deposited metal and dust deposition in **Section 4.3.3** to the modelling predictions for TSP in the Proposed Peak Operations scenario. From all the onsite dust gauges that could be used to develop a ratio, the dust gauge that resulted in the most conservative ratio was used for each metal. Where criteria apply to metal oxides, the metal oxide mass has been calculated assuming all the metal is converted into the metal oxide.

Table 6-3 presents the predicted maximum 1-hour average metal and metal oxide concentrations from the Project at the boundary and at the assessment location with the highest predicted level (Receptor R2). For copper, **Table 6-3**, shows the criteria for both copper fumes and dust, with predicted levels below both criteria. The results show the concentrations at the boundary are below the criteria, with the concentration at assessment locations at least 25 times below the criteria.

Table 6-3: Maximum Incremental 1-hour average metal concentrations (µg/m³)

Pollutant	Concentration at most affected assessment location (R2)	Maximum concentration at boundary	Criteria	
Copper	0.1	1.8	**3.7 (fumes)**	**18 (dust)**
Iron oxide	0.6	8.1	**90**	
Zinc oxide	0.03	0.4	**90**	

Table 6-4 presents the cumulative annual average lead concentrations at the boundary and at the assessment location with the highest predicted level (Receptor R1). The table shows the predicted lead levels are negligible compared to the criterion.

Table 6-4: Cumulative annual average lead concentrations

Pollutant	Concentration at most affected assessment location (R1)	Maximum concentration at boundary	Criterion
Lead	2.8×10^{-5}	1.3×10^{-3}	0.5

7 DUST MITIGATION AND MANAGEMENT

The proposed operations at the Project have the potential to generate dust emissions. To ensure that activities associated with the Project have a minimal effect on the surrounding environment and at residential receptor locations, it is recommended that all reasonable and practicable dust mitigation measures be utilised.

The site currently employs a number of air quality control measures such as the use of a water cart and ensuring that all trucks transporting drill cuttings and mill trash to the TSF have their loads covered. These measures are included within *Modification Report for the Tritton Copper Mine: Modification 8* **(RW Corkery, 2022)**. It is recommended that existing air quality control measures continue to be applied as they appear to be effective based on the available air quality monitoring data reviewed (see **Section 4.3**).

8 SUMMARY AND CONCLUSIONS

This report outlines the assessment of the potential air quality impacts associated with the proposed modifications to the Tritton Copper Mine.

Air dispersion modelling using the CALPUFF model was applied to predict the potential for off-site dust and metals impacts in the surrounding area due to the operation of the Project.

The predicted dust and metals levels in the surrounding environment associated with the Project, are low and would comply with the applicable assessment criteria at the assessed receivers and therefore would not lead to any unacceptable level of environmental harm or impact in the surrounding area.

The dispersion modelling predictions in **Table 6-1** and **Table 6-2** show that receptors located nearest to the Project's activities are expected to experience the greatest incremental effects, although these still represent less than 4% of the average cumulative dust levels. This is further reflected in the isopleth diagrams in **Appendix C**, depicting the contributions from the Project activities. The predicted dust levels associated with the Project are below the relevant criteria for the various incremental and cumulative dust metrics. The potential cumulative impacts include the contribution from the existing mining operations in the surrounding vicinity as based on the actual measured deposited dust levels in the surrounding environment.

Nevertheless, the site would apply appropriate dust management measures to ensure it minimises the potential occurrence of excessive air emissions from the site. Overall, the assessment demonstrates that the Project can operate without causing any significant air quality impact at sensitive receptor locations in the surrounding environment.

9 REFERENCES

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US EPA (1985 and update)

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Appendix A

Selection of Meteorological Year

Selection of meteorological year

A statistical analysis of the latest five contiguous years of meteorological data from the nearest BoM weather station with suitable available data, Cobar Airport weather station, is presented in **Table A-1**.

The standard deviation of the latest five years of meteorological data spanning 2019 to 2023 was analysed against the available measured wind speed, temperature and relative humidity. The analysis indicates that 2020, 2021 and 2022 datasets are closest to the mean for wind speed, the 2021 dataset is closes to the mean for temperature and 2020 is closest to the long-term average for relative humidity.

A score weighting analysis was performed to consider the deviation from the average for each of the meteorological data. The score value is based on the weighting of the different parameters as considered most relevant for the purposes of air dispersion modelling and assessment based on our experience.

On the basis of a score weighting analysis, both 2020 and 2021 were found to be most representative; however, given the beginning of 2020 was subject to mass bushfires which significantly affected numerous DPE air quality monitors within NSW resulting in anomalously high particulate concentrations, 2021 was selected for modelling.

Table A-1: Statistical analysis results for Cobar Airport AWS

Year	Wind speed	Temperature	Relative humidity	Score
2019	0.3	1.3	6.4	7.9
2020	0.2	1.2	3.8	5.2
2021	0.2	0.8	4.2	5.2
2022	0.2	1.2	6.6	8.0
2023	0.3	1.1	4.0	5.4

Figure A-1 shows the frequency distributions for wind speed, temperature and relative humidity for the 2021 year compared with the mean of the 2019 to 2023 data set. The 2021 year data appear to be well aligned with the mean data.

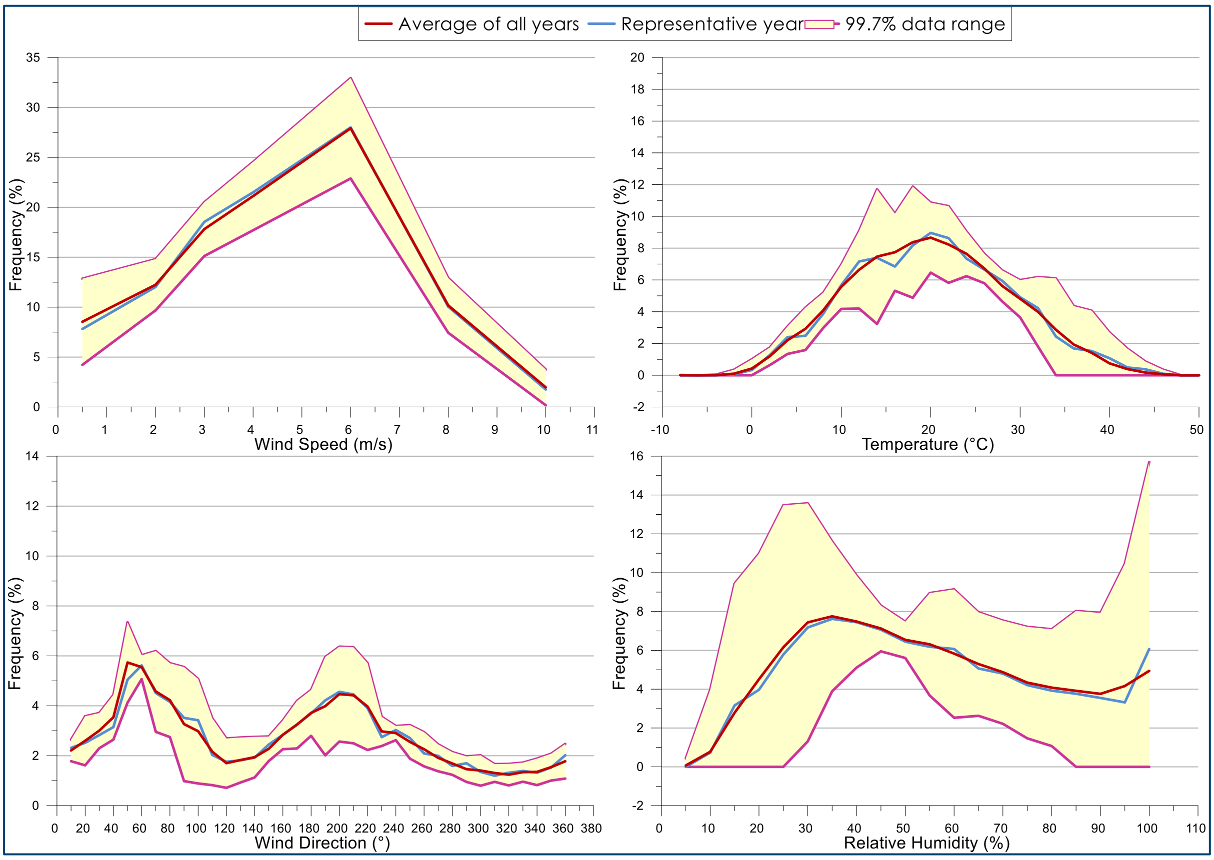

Figure A-1: Frequency distributions for wind speed, wind direction, temperature and relative humidity

Appendix B

Emission Calculations

Emission Calculation

The dust emissions from the Project have been estimated from the operational description of the proposed activities provided by the Proponent and have been combined with emissions factor equations and utilising suitable emission and load factors that relate to the quantity of dust emitted from particular activities based on intensity, the prevailing meteorological conditions and composition of the material being handled.

Emission factors and associated controls have been sourced from:

- United States (US) EPA AP42 Emission Factors (**US EPA, 1985 and Updates**);
- Office of Environment and Heritage document, "NSW Coal Mining Benchmarking Study: Best Practise Measures for Reducing Non-Road Diesel Exhaust Emissions, Final Report" (**NSW EPA, 2015**).

The emission factor equations used for each dust generating activity are outlined in **Table B-1** below. A detailed dust emission inventory for the different scenarios is presented in **Table B-2** to **Table B-4.**

Control factors include the following:

- Hauling on unpaved surfaces – 75% control for watering of trafficked areas;
- Wind erosion from exposed areas – 50% control for watering of exposed areas.

Table B-1: Emission factor equations

Activity	Emission factor equation		
	TSP	PM_{10}	$PM_{2.5}$
Loading / emplacing material	$EF = 0.74 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right) kg/tonne$	$EF = 0.35 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right) kg/tonne$	$EF = 0.053 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right) kg/tonne$
Hauling on unsealed surfaces	$EF = \left(\frac{0.4536}{1.6093}\right) \times 4.9 \times (s/12)^{0.7} \times (1.1023 \times M/3)^{0.45} kg/VKT$	$EF = \left(\frac{0.4536}{1.6093}\right) \times 1.5 \times (s/12)^{0.9} \times (1.1023 \times M/3)^{0.45} kg/VKT$	$EF = \left(\frac{0.4536}{1.6093}\right) \times 0.15 \times (s/12)^{0.9} \times (1.1023 \times M/3)^{0.45} kg/VKT$
Hauling on sealed surfaces	$EF = 3.23 \times s.L.^{0.91} \times (1.1023 \times W)^{1.02} kg/VKT$	$EF = 0.62 \times s.L.^{0.91} \times (1.1023 \times W)^{1.02} kg/VKT$	$EF = 0.15 \times s.L.^{0.91} \times (1.1023 \times W)^{1.02} kg/VKT$
Drilling overburden	0.59	$0.30 \times TSP$	$0.04 \times TSP$
Tertiary crushing (controlled)	0.0006	0.00027	0.00005
Screening (controlled)	$EF = 0.0011\, kg/tonne$	$EF = 0.00037\, kg/tonne$	$EF = 0.000025\, kg/tonne$
Grinding	$EF = 0.0202\, kg/tonne$	$EF = 0.0169\, kg/tonne$	$EF = 0.006\, kg/tonne$
Wind erosion on exposed areas, stockpiles	$EF = 850\, kg/ha/year$	$0.5 \times TSP$	$0.075 \times TSP$
Grading	$EF = 0.0034 \times (S)^{2.5}$	$EF = 0.0056 \times (S)^{2} \times 0.6$	$EF = 0.0034 \times (S)^{2.5} \times 0.031$
Dozers	$EF = 2.6 \times s^{1.2} / M^{1.3}\ kg/hr$	$EF = (0.45 \times s^{1.5} / M^{1.4}) \times 0.75\ kg/hr$	$EF = (2.6 \times s^{1.2} / M^{1.3}) \times 0.105\ kg/hr$

EF = emission factor, U = wind speed (m/s), M = moisture content (%), s = silt content (%), s.L. = silt loading (g/m^2), W = average weight of vehicle (tonne), VKT = vehicle kilometres travelled (km).

Table B-2: Dust Emissions Inventory – Approved Operations

Activity	TSP emission (kg/y)	PM10 emission (kg/y)	PM25 emission (kg/y)	Intensity	Units	EF - TSP	EF - PM10	EF - PM25	Units	Var 1	Units	Var 2	Units	Var 3 - TSP	Var 3 - PM10	Var 3 - PM25	Units	Var 4	Units	Var 5	Units	Var 6	Units
Waste rock																							
Hauling mined WR to NAF emplacement areas (u	3,755	949	95	216,765	t/yr	0.069	0.018	0.002	kg/t	63	t/load	1.35	km/return	3.2	0.8	0.08	kg/VKT	4.6	S.C %	79.94	weight (t)	75	C %
Unloading WR at emplacement areas	558	264	40	216,765	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m/s)	2	M.C %										
Rehandle WR material	558	264	40	216,765	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m/s)	2	M.C %										
Load WR exports to trucks	77	37	6	30,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m/s)	2	M.C %										
Haul WR exports to boundary	705	178	18	30,000	t/yr	0.094	0.024	0.002	kg/t	52	t/load	2.01	km/return	2.4	0.6	0.06	kg/VKT	4.6	S.C %	42.5	weight (t)	75	C %
Dozer shaping	6,694	1,618	703	400	hr/yr	16.7353	4.0442	1.7572	kg/h	10	S.C. %	2	M.C. %										
drill cuttings import																							
import Hauling to tailings (unpaved)	274	69	7	800	t/yr	1.372	0.347	0.035	kg/t	8	t/load	6.20	km/return	1.8	0.4	0.04	kg/VKT	4.6	S.C %	21	weight (t)	75	C %
unloading material from trucks	1	0	0	800	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m/s)	2	M.C %									75	C %
re handling material	2	1	0	800	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m/s)	2	M.C %										
re handling material	2	1	0	800	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m/s)	2	M.C %										
Tailings exports																							
loading material to trucks	682	322	49	265,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m/s)	2	M.C %										
export - hauling to boundary	19,205	4,853	485	265,000	t/yr	0.290	0.073	0.007	kg/t	52	t/load	6.20	km/return	2.4	0.6	0.06	kg/VKT	4.6	S.C %	42.5	weight (t)	75	C %
Tailings construction																							
loading material to trucks	473	224	34	184,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m/s)	2	M.C %										
Hauling to tailings bund (unpaved)	12,382	3,129	313	184,000	t/yr	0.269	0.068	0.007	kg/t	52	t/load	4.33	km/return	3.2	0.8	0.08	kg/VKT	4.6	S.C %	79.94	weight (t)	75	C %
Unloading material at tailings bund	473	224	34	184,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m/s)	2	M.C %										
Rehandle material during construction	473	224	34	184,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m/s)	2	M.C %										
Dozer shaping	13,054	3,154	1,371	780	hr/yr	16.7353	4.0442	1.7572	kg/h	10	S.C. %	2	M.C. %										
Main process																							
Hauling mined ore to ROM pad	4,659	1,177	118	400,000	t/yr	0.047	0.012	0.001	kg/t	63	t/load	0.9	km/return	3.2	0.8	0.08	kg/VKT	4.6	S.C %	79.94	weight (t)	75	C %
Hauling imports to Rom pad (unpaved)	23,447	5,925	593	1,000,000	t/yr	0.094	0.024	0.002	kg/t	52	t/load	2.0	km/return	2.4	0.6	0.06	kg/VKT	4.6	S.C %	42.5	weight (t)	75	C %
Unloading ROM material at stockpile area	2,573	1,217	184	1,000,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m/s)	2	M.C %										
Rehandle material (FEL loading from ROM pad)	3,602	1,704	258	1,400,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m/s)	2	M.C %										
Loading ROM material to crusher	3,602	1,704	258	1,400,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m/s)	2	M.C %										
Crushing	840	378	70	1,400,000	t/yr	0.0006	0.0003	0.0001	kg/t														
Grinding	8,484	7,098	2,520	1,400,000	t/yr	0.0202	0.0169	0.0060	kg/t													70	C %
Screening	2,100	840	49	1,400,000	t/yr	0.0015	0.0006	0.0000	kg/t														
Unloading material to stockpile	3,602	1,704	258	1,400,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m/s)	2	M.C %										
FEL loading export material to Road Truck (exclu	147	69	10	56,940	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m/s)	2	M.C %										
Hauling export to boundary (unpaved)	577	146	15	56,940	t/yr	0.041	0.010	0.001	kg/t	52	t/load	0.9	km/return	2.4	0.6	0.06	kg/VKT	4.6	S.C %	42.5	weight (t)	75	C %
Other																							
Grader	17,430	6,090	540	28,320	km	0.6155	0.2150	0.0191	kg/VKT	8	speed (km/hr)												
WE - infrastructure + stockpiles	82,117	41,059	6,159	193.2	ha	850	425	64	kg/ha/year													50	C %
Diesel exhaust emission	3,192	3,192	3,096																				
Vent Shaft emissions	237,908	92,974	11,134	31,536,000	sec/year	0.0075	0.0029	0.0004	kg/sec	4.72	mg/m3	1600	m3/s										
Total TSP emissions (kg/yr.)	**453,649**	**180,788**	**28,490**																				

Table B-3: Dust Emissions Inventory – Proposed Operations

Activity	TSP emission (kg/y)	PM10 emission (kg/y)	PM25 emission (kg/y)	Intensity	Units	EF - TSP	EF - PM10	EF - PM25	Units	Var 1	Units	Var 2	Units	Var 3 - TSP	Var 3 - PM10	Var 3 - PM25	Units	Var 4	Units	Var 5	Units	Var 6	Units
Waste rock																							
Hauling mined WR to NAF emplacement areas (u	4,828	1,220	122	278,698	t/yr	0.069	0.018	0.002	kg/t	63	t/load	1.35	km/return	3.2	0.8	0.08	kg/VKT	4.6	S.C %	80	weight (t)	75	C %
Unloading WR at emplacement areas	717	339	51	278,698	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
Rehandle WR material	717	339	51	278,698	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
Load WR exports to trucks	77	37	6	30,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
Haul WR exports to boundary	705	178	18	30,000	t/yr	0.094	0.024	0.002	kg/t	52	t/load	2.01	km/return	2.4	0.6	0.06	kg/VKT	4.6	S.C %	42.5	weight (t)	75	C %
Dozer shaping	6,694	1,618	703	400	hr/yr	16.7353	4.0442	1.7572	kg/h	10	S.C. %	2	M.C. %										
drill cuttings import																							
import - Hauling to tailings (unpaved)	274	69	7	800	t/yr	1.372	0.347	0.035	kg/t	8	t/load	6.20	km/return	1.8	0.4	0.04	kg/VKT	4.6	S.C %	21	weight (t)	75	C %
unloading material from trucks	1	0	0	800	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %									75	C %
re handling material	2	1	0	800	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
re handling material	2	1	0	800	t/yr	0	0	0	kg/t	2.17	(ws/2.2)^1.3 (r	2	M.C %										
Tailings exports																							
loading material to trucks	1,286	608	92	500,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
export - hauling to boundary	36,236	9,157	916	500,000	t/yr	0.290	0.073	0.007	kg/t	52	t/load	6.20	km/return	2.4	0.6	0.06	kg/VKT	4.6	S.C %	43	weight (t)	75	C %
Tailings construction																							
loading material to trucks	473	224	34	184,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
Hauling to tailings bund (unpaved)	12,382	3,129	313	184,000	t/yr	0.269	0.068	0.007	kg/t	52	t/load	4.33	km/return	3.2	0.8	0.08	kg/VKT	4.6	S.C %	80	weight (t)	75	C %
Unloading material at tailings bund	473	224	34	184,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
Rehandle material during construction	473	224	34	184,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
Dozer shaping	13,054	3,154	1,371	780	hr/yr	16.7353	4.0442	1.7572	kg/h	10	S.C. %	2	M.C. %										
Main process																							
Hauling mined ore to ROM pad	-	-	-	-	t/yr	0.047	0.012	0.001	kg/t	63	t/load	0.9	km/return	3.2	0.8	0.08	kg/VKT	4.6	S.C %	80	weight (t)	75	C %
Hauling imports to Rom pad (unpaved)	42,205	10,665	1,067	1,800,000	t/yr	0.094	0.024	0.002	kg/t	52	t/load	2.0	km/return	2.4	0.6	0.06	kg/VKT	4.6	S.C %	43	weight (t)	75	C %
Unloading ROM material at stockpile area	4,631	2,190	332	1,800,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
Rehandle material (FEL loading from ROM pad)	4,631	2,190	332	1,800,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
Loading ROM material to crusher	4,631	2,190	332	1,800,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
Crushing	1,080	486	90	1,800,000	t/yr	0.0006	0.0003	0.0001	kg/t														
Grinding	10,908	9,126	3,240	1,800,000	t/yr	0.0202	0.0169	0.0060	kg/t													70	C %
Screening	2,700	1,080	63	1,800,000	t/yr	0.0015	0.0006	0.0000	kg/t														
Unloading material to stockpile	4,631	2,190	332	1,800,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
FEL loading export material to Road Truck (excl	244	115	17	94,900	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
Hauling export to boundary (unpaved)	961	243	24	94,900	t/yr	0.041	0.010	0.001	kg/t	52	t/load	0.9	km/return	2.4	0.6	0.06	kg/VKT	4.6	S.C %	42.5	weight (t)	75	C %
Other																							
Grader	17,430	6,090	540	28,320	km	0.6155	0.2150	0.0191	kg/VKT	8	speed (km/hr)												
WE - infrastructure + stockpiles	82,117	41,059	6,159	193.2	ha	850	425	64	kg/ha/year													50	C %
Diesel exhaust emission	5,720	5,720	5,549																				
Vent Shaft emissions	237,908	92,974	11,134	31,536,000	sec/year	0.0075	0.0029	0.0004	kg/sec	4.72	mg/m3	1600	m3/s										
Total TSP emissions (kg/yr.)	**498,194**	**196,843**	**32,961**																				

Table B-4: Dust Emissions Inventory – Proposed Operations (peak scenario)

Activity	TSP emission (kg/y)	PM10 emission (kg/y)	PM25 emission (kg/y)	Intensity	Units	EF - TSP	EF - PM10	EF - PM25	Units	Var 1	Units	Var 2	Units	Var 3 - TSP	Var 3 - PM10	Var 3 - PM25	Units	Var 4	Units	Var 5	Units	Var 6	Units
Waste rock																							
Hauling mined WR to NAF emplacement areas (u	7,330	1,852	185	423,175	t/yr	0.069	0.018	0.002	kg/t	63	t/load	1.35	km/return	3.2	0.8	0.08	kg/VKT	4.6	S.C %	80	weight (t)	75	C %
Unloading WR at emplacement areas	1,089	515	78	423,175	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
Rehandle WR material	1,089	515	78	423,175	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
Load WR exports to trucks	117	55	8	45,552	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
Haul WR exports to boundary	1,071	271	27	45,552	t/yr	0.094	0.024	0.002	kg/t	52	t/load	2.01	km/return	2.4	0.6	0.06	kg/VKT	4.6	S.C %	42.5	weight (t)	75	C %
Dozer shaping	109,951	26,570	11,545	6,570	hr/yr	16.7353	4.0442	1.7572	kg/h	10	S.C. %	2	M.C. %										
drill cuttings import																							
import Hauling to tailings (unpaved)	2,003	506	51	5,840	t/yr	1.372	0.347	0.035	kg/t	8	t/load	6.20	km/return	1.8	0.4	0.04	kg/VKT	4.6	S.C %	21	weight (t)	75	C %
unloading material from trucks	4	2	0	5,840	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %									75	C %
re handling material	15	7	1	5,840	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
re handling material	15	7	1	5,840	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (r	2	M.C %										
Tailings exports																							
loading material to trucks	7,032	3,326	504	2,733,120	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
export - hauling to boundary	198,074	50,054	5,005	2,733,120	t/yr	0.290	0.073	0.007	kg/t	52	t/load	6.20	km/return	2.4	0.6	0.06	kg/VKT	4.6	S.C %	43	weight (t)	75	C %
Tailings construction																							
loading material to trucks	473	224	34	184,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
Hauling to tailings bund (unpaved)	12,382	3,129	313	184,000	t/yr	0.269	0.068	0.007	kg/t	52	t/load	4.33	km/return	3.2	0.8	0.08	kg/VKT	4.6	S.C %	80	weight (t)	75	C %
Unloading material at tailings bund	473	224	34	184,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
Rehandle material during construction	473	224	34	184,000	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
Dozer shaping	109,951	26,570	11,545	6,570	hr/yr	16.7353	4.0442	1.7572	kg/h	10	S.C. %	2	M.C. %										
Main process																							
Hauling mined ore to ROM pad	-	-	-	-	t/yr	0.047	0.012	0.001	kg/t	63	t/load	0.9	km/return	3.2	0.8	0.08	kg/VKT	4.6	S.C %	80	weight (t)	75	C %
Hauling imports to Rom pad (unpaved)	64,085	16,194	1,619	2,733,120	t/yr	0.094	0.024	0.002	kg/t	52	t/load	2.0	km/return	2.4	0.6	0.06	kg/VKT	4.6	S.C %	43	weight (t)	75	C %
Unloading ROM material at stockpile area	7,032	3,326	504	2,733,120	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
Rehandle material (FEL loading from ROM pad)	7,032	3,326	504	2,733,120	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
Loading ROM material to crusher	7,032	3,326	504	2,733,120	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
Crushing	1,640	738	137	2,733,120	t/yr	0.0006	0.0003	0.0001	kg/t														
Grinding	16,563	13,857	4,920	2,733,120	t/yr	0.0202	0.0169	0.0060	kg/t													70	C %
Screening	4,100	1,640	96	2,733,120	t/yr	0.0015	0.0006	0.0000	kg/t														
Unloading material to stockpile	7,032	3,326	504	2,733,120	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
FEL loading export material to Road Truck (excl	1,319	624	94	512,460	t/yr	0.00257	0.00122	0.00018	kg/t	2.17	(ws/2.2)^1.3 (m	2	M.C %										
Hauling export to boundary (unpaved)	5,189	1,311	131	512,460	t/yr	0.041	0.010	0.001	kg/t	52	t/load	0.9	km/return	2.4	0.6	0.06	kg/VKT	4.6	S.C %	42.5	weight (t)	75	C %
Other																							
Grader	97,047	33,908	3,008	157,680	km	0.6155	0.2150	0.0191	kg/VKT	8	speed (km/hr)												
WE - infrastructure + stockpiles	82,117	41,059	6,159	193.2	ha	850	425	64	kg/ha/year													50	C %
Diesel exhaust emission	5,720	5,720	5,549																				
Vent Shaft emissions	237,908	92,974	11,134	31,536,000	sec/year	0.0075	0.0029	0.0004	kg/sec	4.72	mg/m3	1600	m3/s										
Total TSP emissions (kg/yr.)	**995,359**	**335,381**	**64,305**																				

Appendix C

Isopleth Diagrams

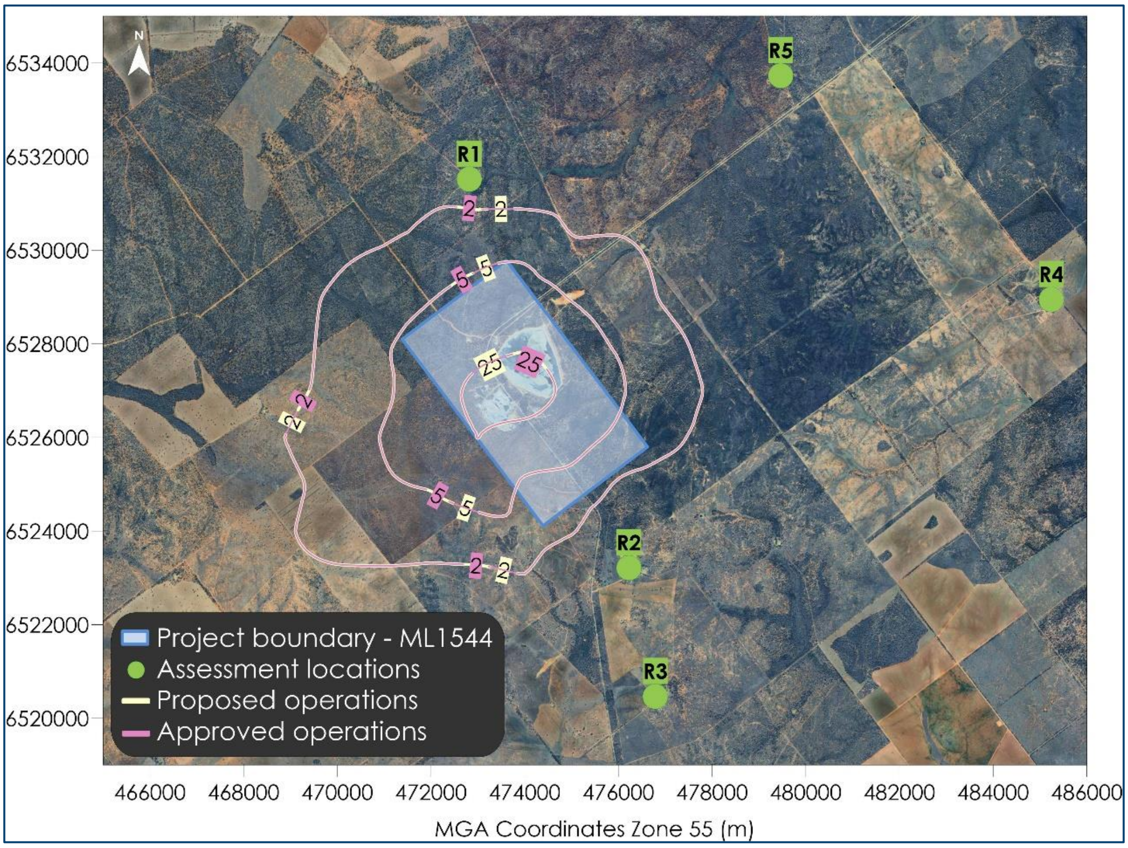

Figure C-1: Predicted incremental maximum 24-hour average $PM_{2.5}$ concentrations (µg/m³)

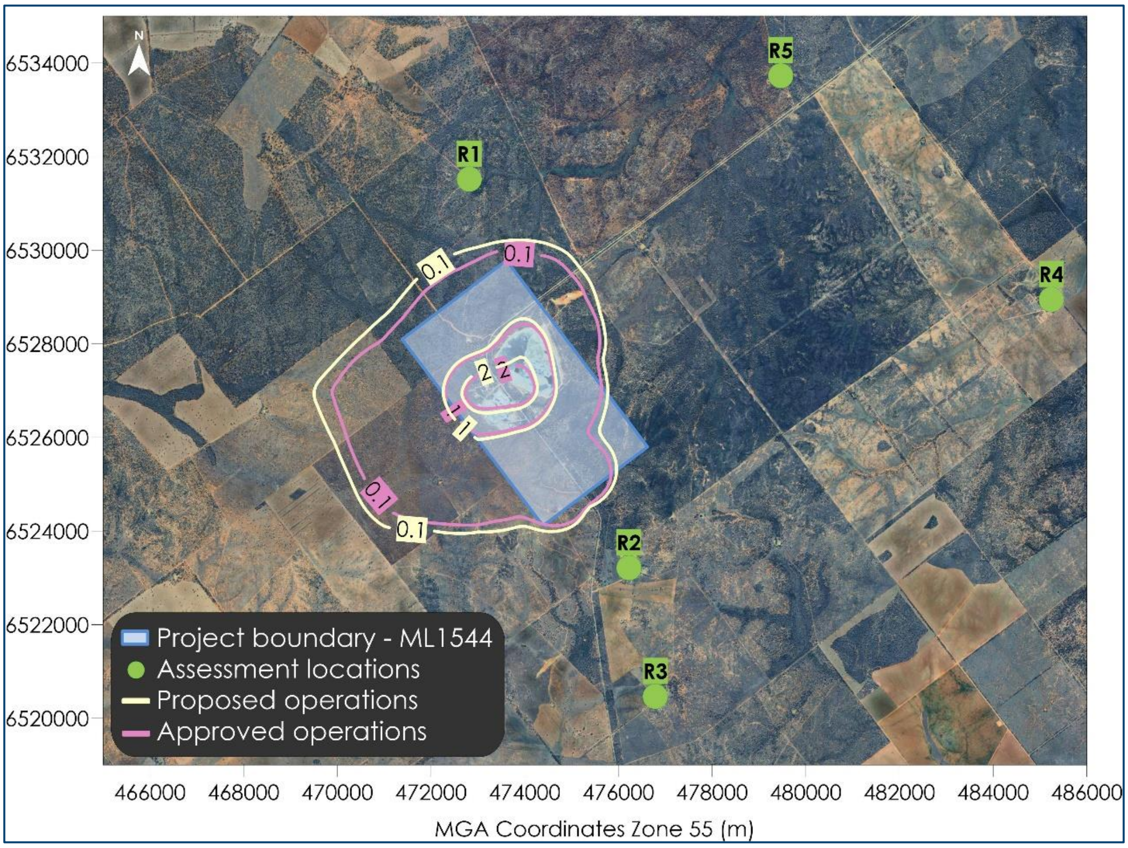

Figure C-2: Predicted incremental annual average $PM_{2.5}$ concentrations (µg/m³)

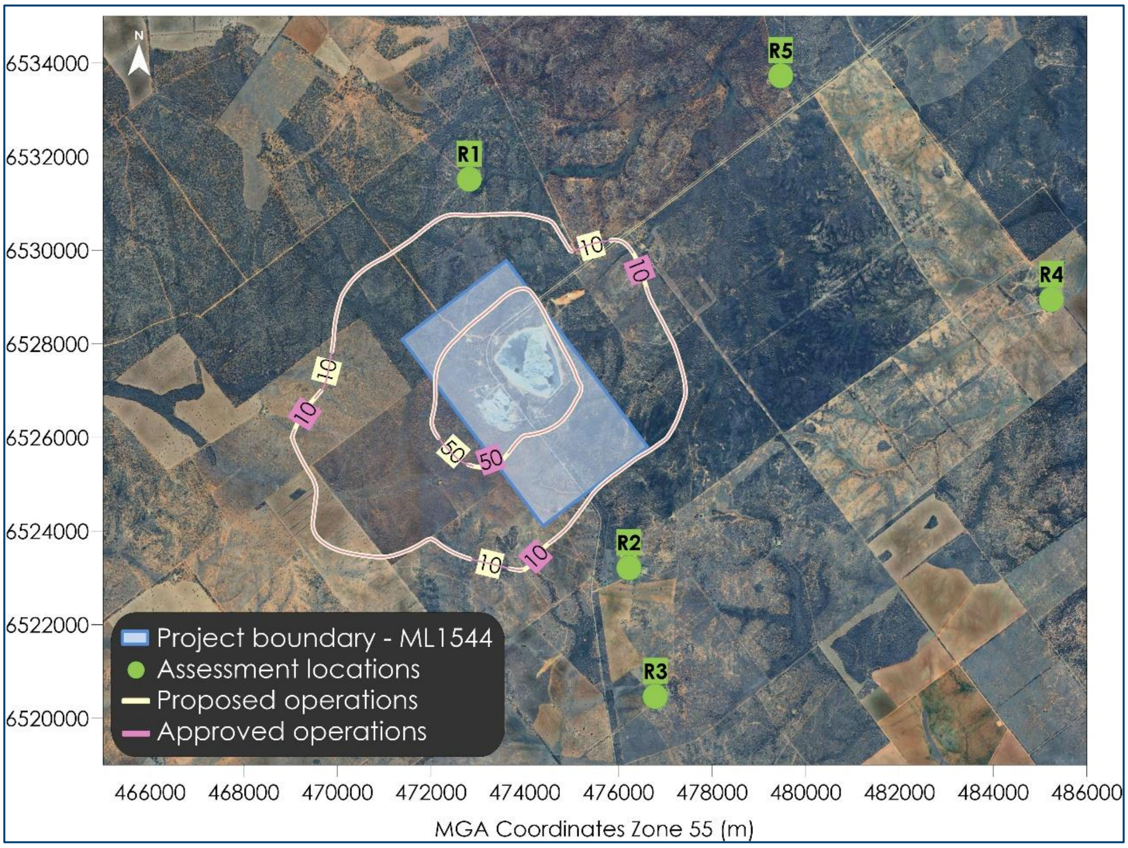

Figure C-3: Predicted incremental maximum 24-hour average PM_{10} concentrations (µg/m³)

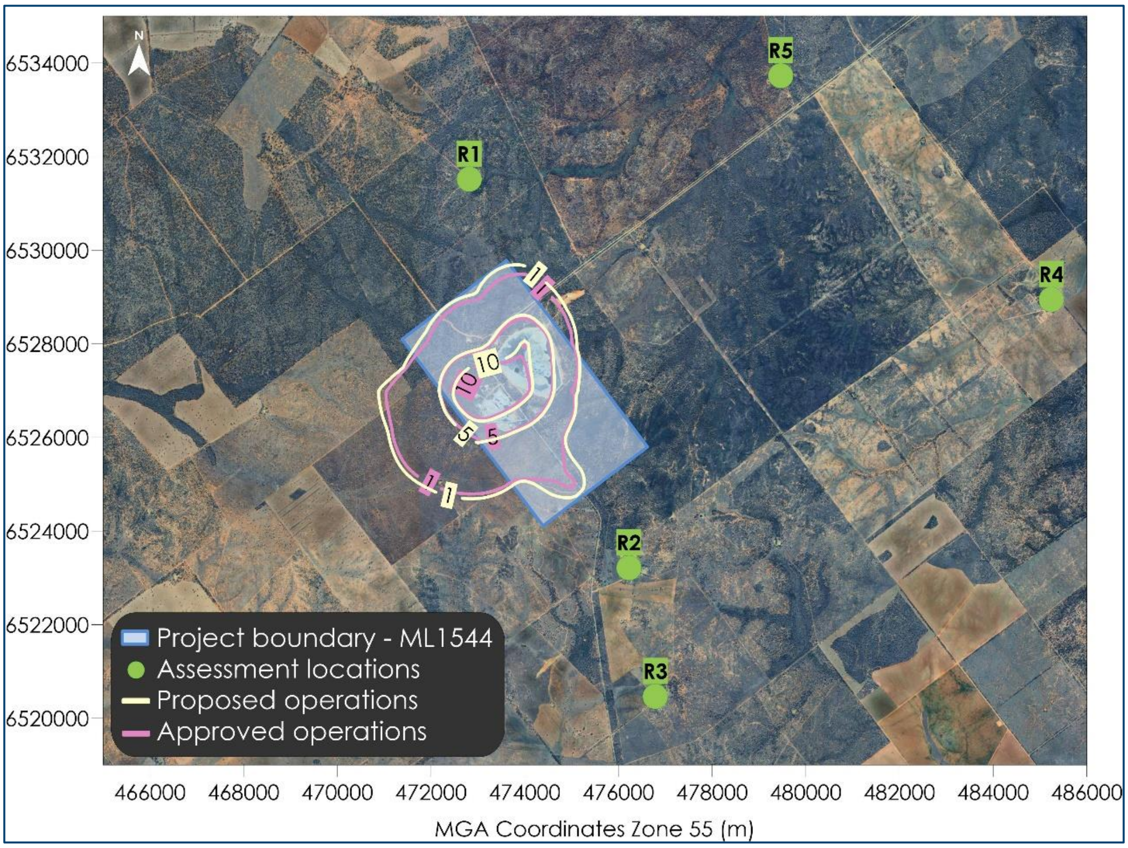

Figure C-4: Predicted incremental annual average PM_{10} concentrations (µg/m³)

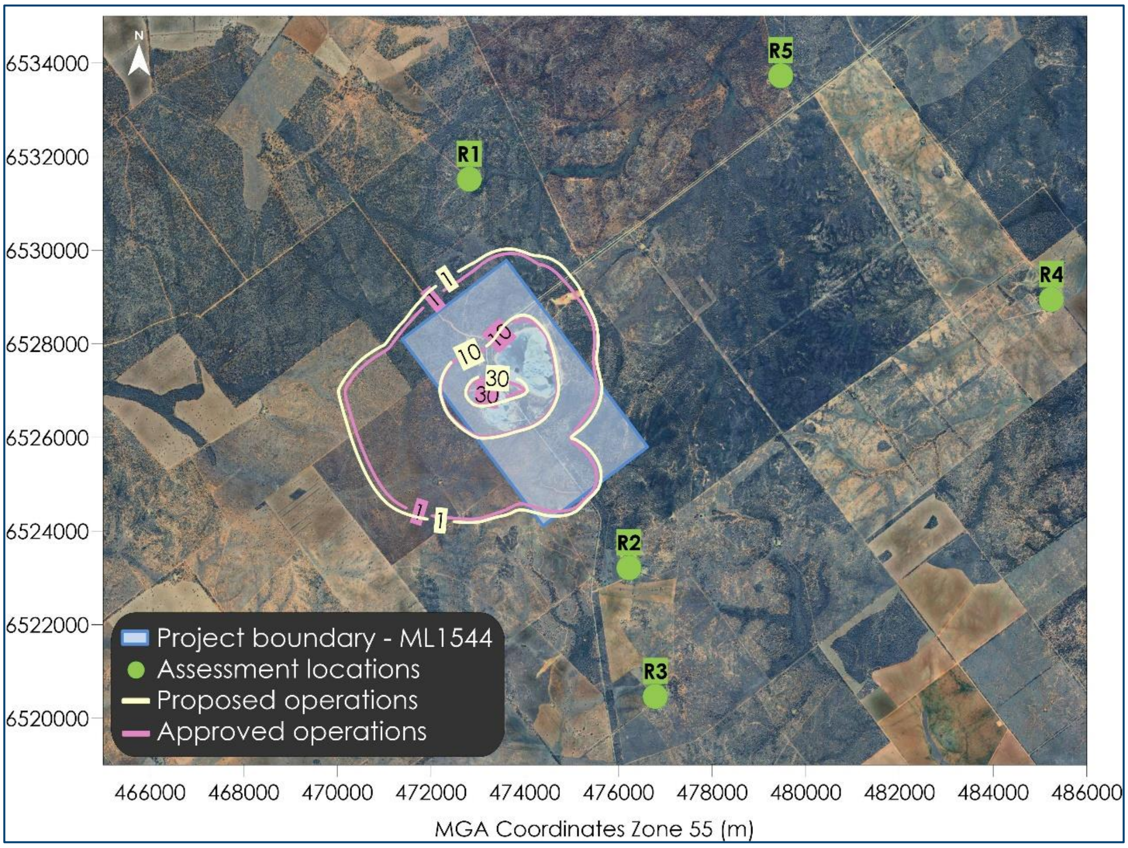

Figure C-5: Predicted incremental annual average TSP concentrations (µg/m³)

Figure C-6: Predicted incremental annual average dust deposition levels (g/m²/month)