Environment Effects Statement

VHM Limited
Goschen Rare Earths and Mineral Sands Project

Chapter 12 Air Quality

November 2023

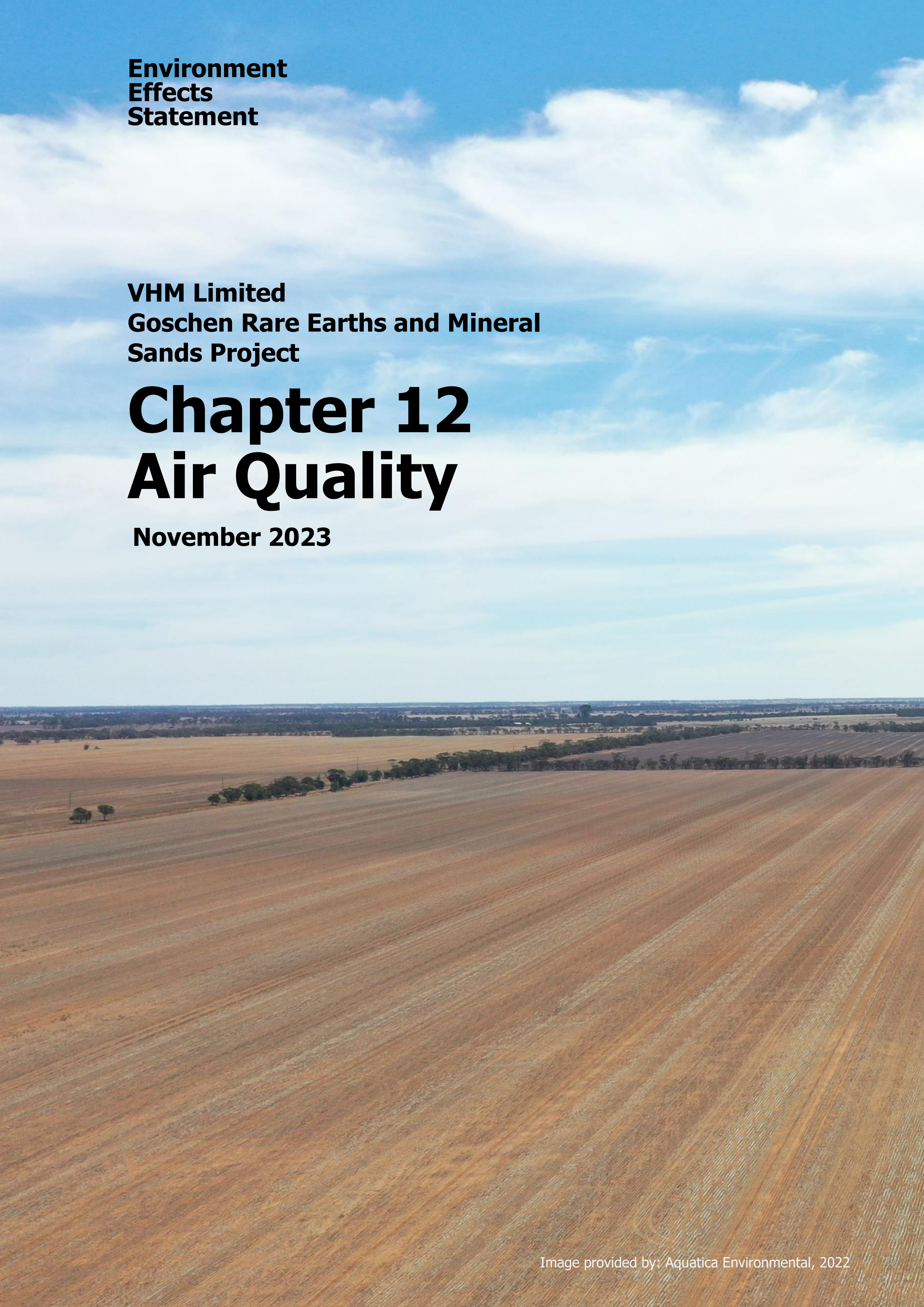

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Table of Contents

12. Air Quality

This chapter provides an assessment of the air quality impacts associated with the construction and operation of the Goschen Rare Earths and Mineral Sands Project (the Project).

This chapter summarises the outcomes of EES Technical Report G: Air Quality Impact Assessment prepared in support of the Environment Effects Statement (EES). This technical report is shown in EES Technical Report G: Air Quality Impact Assessment. This assessment informed the development of mitigation and management measures for the Project to avoid, minimise and manage air quality impacts.

Overview

Air quality is characterised by concentrations of substances in the ambient air (that is, atmospheric air in its natural state), including gases and particles. Air pollution can affect people's health, lifestyles and their enjoyment of outdoor spaces.

The Project is located within flat farmland, with several rural residences surrounding the Project area. Winds from the south and southwest are predominant, with few winds from the east.

Ambient air quality monitoring undertaken between January 2019 and September 2020 indicates that like any Victorian rural area with little anthropogenic activity, the area may be subject to periods of elevated concentrations of particulate with equivalent aerodynamic diameters of less than 10 microns (PM_{10}) and less than 2.5 microns ($PM_{2.5}$) due to regional bushfire and backburning impacts, and dust storms. Bushfires across Victoria in January 2020 were clearly evident in the data with elevated $PM_{2.5}$, and to a lesser extent PM_{10}, concentrations. However, the non-bushfire impacted year 2019 demonstrates elevated concentrations in the summer months such that the distinction between the years representing normal and bushfire conditions is not significant. Both years include periods of elevated background PM_{10} and $PM_{2.5}$ concentrations which exceed the relevant 24-hour average criteria. Monitored concentrations of respirable crystalline silica (RCS) were well below the annual average criterion. In the absence of NO_x monitoring in the Project area, with little anthropogenic activity, the background concentrations of NO_x are likely to be low, approaching zero.

Results of the assessment presented in EES Technical Report G: Air Quality Impact Assessment indicate that in general, exceedances of the PM_{10} criterion are predicted at all sensitive receptors due to the maximum background concentration exceeding the criterion before the Project contribution is added. The Project is not predicted to contribute significantly to existing conditions and with a few exceptions the contributions are a small fraction of the criterion.

Worst-case power station and pumping station dual-fuel generator emissions are predicted to result in exceedances of the 1-hour average NO_2 concentration beyond the Project boundaries when using diesel fuel. However, due to the rural and relatively remote nature of these Project locations, the likelihood of a third party occupying these impacted areas for more than a few minutes at a time is low. While impacts of NO_2 from the power station are predicted to exceed the annual average criterion relating to terrestrial vegetation beyond the Project boundary, the extent to which the exceedance is predicted is limited to approximately 50 m from the boundary, covering and an area of approximately 2.5 hectares. $PM_{2.5}$ ground level concentrations resulting from pumping station emissions to air are predicted to be negligible at sensitive receptors such that cumulative concentrations are unlikely to be increased by a measurable amount. These findings indicate that the risk of impacts from other products of diesel combustion (e.g. sulphur dioxide, volatile organic compounds, PAHs etc) would also be low. Use of liquified petroleum gas (LPG) instead of diesel would result in significantly lower emissions of NO_X (and $PM_{2.5}$), likely negating impacts predicted for diesel in these areas.

This assessment informed the development of mitigation measures for the Project to avoid or minimise and manage potential impacts on air quality. Best practice dust emission mitigation measures would be employed for all aspects of the Project operations including use of water sprays, misting systems and water trucks. Wheel generated dust from haul roads has been identified as the primary potential source of dust emissions, therefore preparing and maintaining level and well finished haul road surfaces would be considered a priority. Contingency measures may include reducing the site speed limit for haul trucks during periods of hot and dry weather coupled with increased water truck application.

EES evaluation objective

The scoping requirements for the Project Environment Effects Statement ('scoping requirements') by the Minister for Planning, set out the specific environmental matters the Project must address in order to satisfy the Victorian assessment and approval requirements.

The scoping requirements include a set of evaluation objectives for investigating and assessing the Project's environmental effects. These objectives identify the desired outcomes to be achieved in managing the potential impacts of constructing, operating and decommissioning / closure of the Project in accordance with the Ministerial guidelines for assessment of environmental effects under the Environment Effects Act 1978.

The following evaluation objective is relevant to the air quality assessment:

To protect the health and wellbeing of residents and local communities, and minimise effects on air quality, noise and the social amenity of the area, having regard to relevant limits, targets or standards.

A stated requirement of the Minister is for the EES is to address the effects of Project construction and operation on air quality and noise on nearby sensitive receptors (particularly residences).

The aspects from the scoping requirements relevant to the evaluation objective are shown in Table 1 of EES Technical Report G: Air Quality Impact Assessment.

The risk of impacts to health and the environment from the construction, operation and decommissioning of the Project were assessed to be low, or in some cases negligible. With the application of the proposed management and mitigation strategies, potential impacts on air quality due to the Project would be avoided, minimised or managed to required standards such that the health and wellbeing of residents and the local community would be protected.

12.1 Methodology

The air quality assessment as presented in EES Technical Report G: Air Quality Impact Assessment was undertaken according to the following steps:

- Review of the scoping requirements and evaluation criteria to define the key technical components of the study.
- Establishment of the study area.
- Review of relevant policy and legislation at Commonwealth, state and local level.
- Desktop review of relevant databases and a review of previous assessments.
- Characterisation of the existing ambient air concentration of air quality indicators and local meteorological conditions using Environment Protection Authority (EPA) Victoria and Bureau of Meteorology (BoM) monitoring data.
- A risk assessment to inform the impact assessment and development of additional mitigation measures.
- Assessment of impacts using relevant air quality criteria sourced from the Guideline for Assessing and Minimising Air Pollution in Victoria, EPA 2022 (the Air Guideline – Publication 1961) which lists numerous air pollution assessment criteria (APACs). The APACs are risk-based concentrations that help identify when or if an activity is likely to pose an unacceptable risk to human health and/or the environment and are not to be considered concentrations below which no management and/or mitigation of emissions to air is required.
- Assessment of air quality impacts due to construction of the Project using semi-quantitative methodologies provided in the UK Institute of Air Quality Management (IAQM) document, Guidance on the assessment of dust from demolition and construction (IAQM, 2014).
- Modelling of air pollutants from the operation of the Project using AERMOD (American Meteorological Society/Environment Protection Agency Regulatory Model), an atmospheric dispersion modelling system endorsed by the EPA Victoria as the regulatory model for use in air quality assessments in Victoria. AERMOD is a steady-state plume modelling system with three components: AERMOD (dispersion model), AERMAP (terrain data pre-processor) and AERMET (meteorological data pre-processor). The dispersal of pollutant emissions of PM10 and PM2.5 to air from the Project were modelled using AERMOD. The dispersal and deposition of pollutant emissions of TSP were also modelled using AERMOD. AERMOD was also used to predict maximum cumulative pollutant ground level concentrations (GLCs) resulting from the Project emissions to air and existing background concentrations.
- Development of mitigation and management measures in response to identified air quality impacts.
- Evaluating the residual human health and/or environmental impacts once mitigation has been implemented.

The relevant air quality criteria provided in Table 3 of EES Technical Report G: Air Quality Impact Assessment. The full methodology is also shown in Section 7.0 of EES Technical Report G: Air Quality Impact Assessment.

12.1.1 Air Quality Indicators

Mining

The primary air pollutants of concern from the proposed mining activities are related to fugitive dust generation from activities common to mining operations:

- Land clearing and exposure of dusty surfaces (further exacerbated by windy conditions).
- Removal of topsoil and overburden.
- Construction of landforms.
- Mining of the ore body.
- Loading and transport of ore to the Mining Unit Plant.
- Transportation of the product for export.
- Mobile plant and vehicles on unsealed roads.

The ore processing is for the most part a wet process and therefore dust emissions are likely to be limited relative to the mining activities. No drilling/blasting is proposed.

Particulate matter are the emissions of most concern caused my mining activities. Particulate matter has the capacity to affect human health and to cause nuisance effects and is categorised by size and/or by chemical composition. Particulate size ranges are commonly described as:

- TSP – refers to all (total) suspended particles in the air. In practice, the upper size range is typically 30 micrometres (μm) to 50 μm.
- PM_{10} – refers to all particles with equivalent aerodynamic diameters of less than 10 μm.
- $PM_{2.5}$ – refers to all particles with equivalent aerodynamic diameters of less than 2.5 μm diameter. These are often referred to as 'fine' particles and are a sub-component of $PM_{10.}$
- Deposited dust – refers to particulate matter that has settled out of the air. It is measured to assess if an emission source is causing a nuisance, such as soiling of property and materials, including rainwater tanks.

Respirable Crystalline Silica

Silica is one of the most abundant minerals found in the earth's crust. Crystalline silica is most dangerous to health when dust is generated, becomes airborne and is then inhaled. Respirable crystalline silica (RCS) dust particles are small enough to penetrate deep into the lungs and can cause irreversible lung damage.

Heavy Metals and Radionuclides

Dust emissions from mineral sands mining can include heavy metals and radionuclides such as uranium (U) and thorium (Th). Heavy metals that have been considered as a fraction of PM_{10} and deposited dust include:

- Arsenic (As).
- Cadmium (Cd).
- Chromium (Cr).
- Copper (Cu).
- Lead (Pb).
- Manganese (Mn).
- Mercury (Hg).
- Nickel (Ni).
- Vanadium (V).
- Zinc (Zn).

Other air Quality Indicators Potentially Relevant to the Project

It is intended that Area 1 operations would be powered from a standalone 12-megawatt (MW) dual-fuel (diesel/LPG) power station until alternate renewable energy supplies are established in the district. The power station and adjacent fuel farm would be located close to the primary consumer points (namely the processing plant).

In addition, the water pumping station located at Kangaroo Lake, approximately 30 km east of the Project, would be powered, at least temporarily, by diesel powered generators (approx. 1.5 MW). For the purposes of the EES, it was conservatively assumed that these generators would be powered by diesel and would be required for the life of mine.

Potential air pollutants of interest associated with the operation of the power station and the pumping station include:

- Carbon monoxide (CO).
- Oxides of nitrogen (NO_x).
- PM_{10} and $PM_{2.5.}$
- Sulfur dioxide (SO_2).
- Volatile organic compounds (VOCs).
- Polycyclic aromatic hydrocarbons (PAHs).

More information on each of these pollutants is presented in Section 3.2 of EES Technical Report G: Air Quality Impact Assessment.

12.2 Study area

For significant surface-based fugitive emissions such as those that may be expected from the Project activities, a study area of approximately 10 km by 10 km (100 km^2) approximately centred on the Project would generally be considered sufficient to meet the definition of an appropriate study area. Due to the geographical spread of the Project Areas (Area 1 and Area 3) and the distribution of nearby sensitive receptors around the Project, a study area of 15 km by 15 km (225 km^2), centred towards the south-eastern corner of Area 3 was chosen for the purpose of the air quality assessment.

It should be noted that the water supply pipeline and the pumping station are considered separately. It should also be noted that the transport of product by road truck to Ultima was identified as a low-risk activity due to the relatively low frequency of trips (1 or 2 per hour) along public roads) and is therefore not specifically included in the impact assessment.

12.3 Existing conditions

12.3.1 Local setting

The majority of the Project would occur on farmland, with remnant native vegetation existing principally along road reserves. Rural residences are located over the Project area and surrounds, which are identified and discussed below.

12.3.2 Sensitive Receptors

Sensitive receptors include houses, schools, kindergartens, recreation areas and sporting ovals, however, sensitive receptors identified in the vicinity of the Project comprise only a number of nearby rural/farming residences. Lalbert is the nearest community to the Project and includes several residences, recreation areas and a post-office, and a more than 4.5km to the southwest of the Project, is unlikely to experience any measurable impacts as a result of the Project.

In accordance with the Air Guideline, the potential impacts at these residences have been assessed as part of the Air Quality Impact Assessment (AQIA) as presented in EES Technical Report G. The two closest sensitive receptors to the Project site boundaries are at a distance of 200 metres and 1000 metres. The nearest existing sensitive receptors to the Project and the pumping station by are listed in **Table 12-1** and **Table 12-2** and **Figure 12-1** and **Figure 12-2**.

It should be noted that Receptor R14 is not considered a sensitive receptor in the EES as the proponent has a land acquisition contract for the freehold. Impacts predicted at this locations would therefore be of little consequence. Furthermore, the proponent also has a land acquisition contract for the freehold of R09 which would not be considered a sensitive receptor once operations begin in Area 3.

Table 12-1 Identified Nearest Sensitive Receptors

ID	Description	UTM Coordinates (Zone 54)		Distance and Direction from Project Boundary
		(m East)	(m South)	
R1	Residence	728,695	6,057,913	4.9 km E (Area 3)
R2	Residence	724,850	6,053,261	3.2 km E (Area 1)
R3	Residence	720,945	6,050,305	2.0 km S (Area 1)
R4	Residence	725,900	6,064,002	5.0 km NNE (Area 3)
R5	Residence	725,979	6,063,658	4.0 km NNE (Area 3)
R6	Residence	727,086	6,061,550	4.0 km NE (Area 3)
R7	Residence	724,968	6,060,540	1.6 km NE (Area 3)
R8	Residence	718,405	6,060,955	2.3 km NW (Area 3)
R9*	Residence	721,880	6,058,420	0.0 km (Area 3)
R10	Residence	717,293	6,057,603	3.0 km SWS (Area 3)
R11	Residence	717,489	6,055,795	2.6 km WNW (Area 1)
R12	Residence	720,623	6,051,214	1.0 km S
R13	Residence	718,485	6,054,126	0.6 km NW (Area 1)
*R14**	*Residence*	*721,779*	*6,053,064*	*0.2 km E (Area 1)*
R15	Residence	718,344	6,051,555	1.0 km SW (Area 1)
R16	Residence	715,051	6,051,041	4.2 km SWS (Area 1)
R17	Residence	723,762	6,049,984	3.1 km SE (Area 1)

*Receptor R09 would not be considered a sensitive receptor during Project phase in Area 3.

*Receptor R14 would not be considered a sensitive receptor during Project.

Several other sensitive receptors are located in the vicinity of, but further away from the furthest receptors form the Project mining area listed in Table 12-1. These receptors will be impacted by Project emissions to a lesser degree due to their increased separation from the Project.

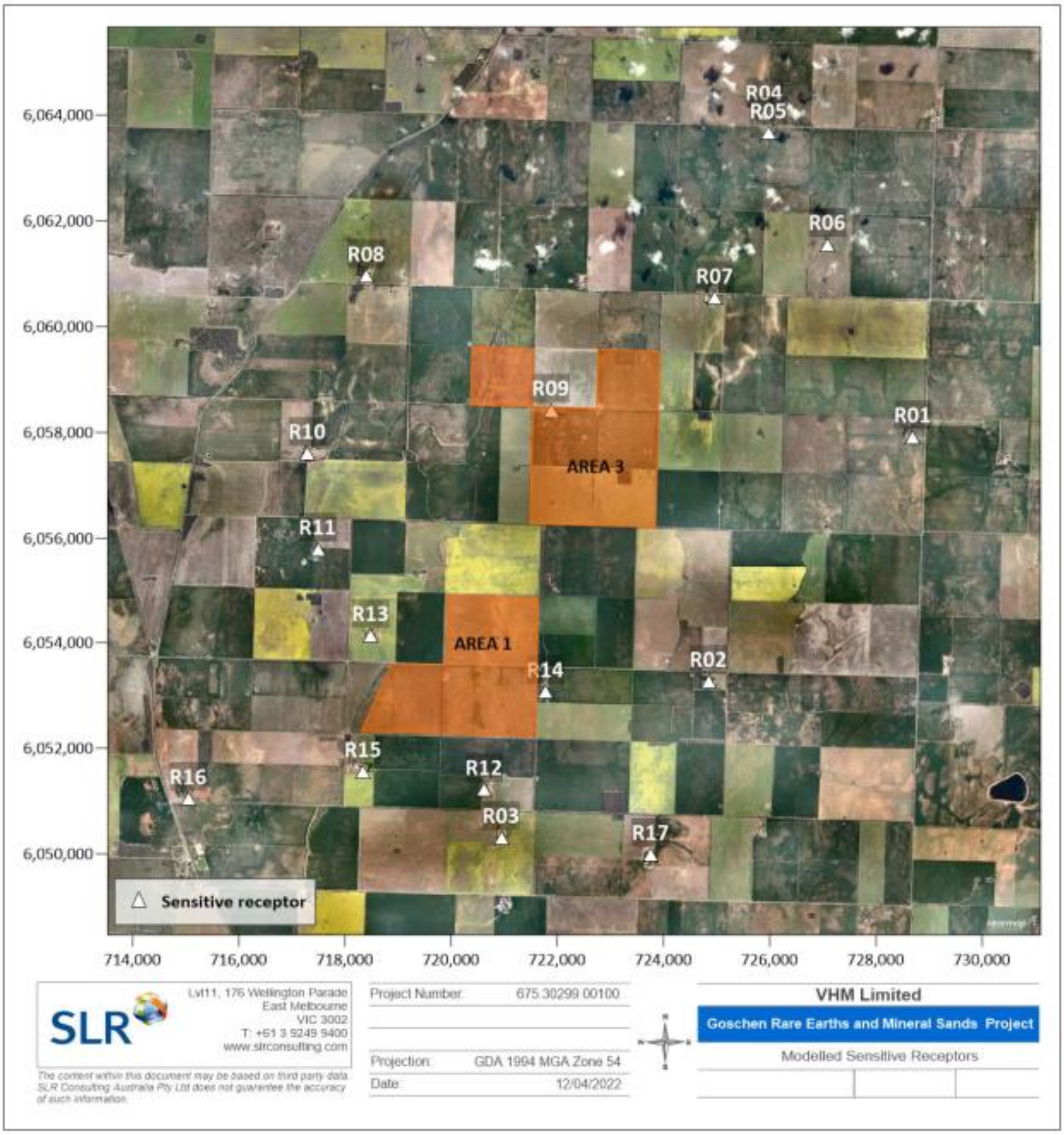

Figure 12-1 Identified Nearest Sensitive Receptors

Table 12-2 Identified Nearest Sensitive Receptors to Pumping Station

ID	Description	UTM Coordinates (Zone 54)		Distance and Direction from Project Boundary
		(m East)	(m South)	
R18	Residence	750,316	6,061,809	0.3 km NNE
R19	Residence	750,498	6,061,913	0.5 km NE
R20	Residence	750,317	6,060,709	0.8 km S

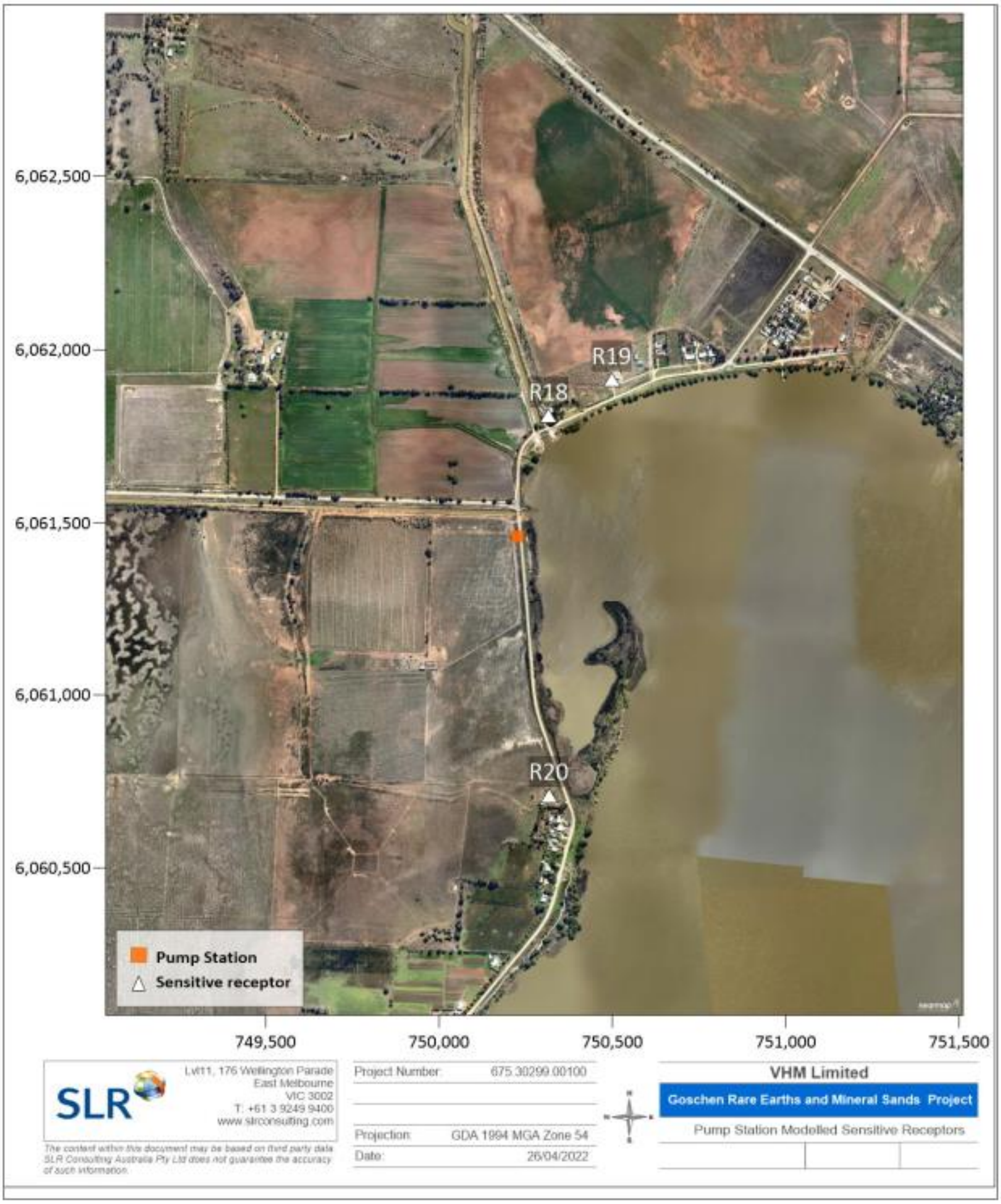

Figure 12-2 Identified Nearest Sensitive Receptors to Pumping Station

12.3.3 Topography

The Project area and surrounds are generally flat with less than 50 metres elevation change over 50 kilometres from the Project in any direction.

12.3.4 Meteorology

Data relevant to the dispersion modelling such as wind speed, wind direction, temperature and cloud cover were obtained from the Swan Hill Aerodrome automatic weather station (AWS) which is located approximately 25 kilometres to the northeast of the Project. A detailed analysis of the meteorological data from the Swan Hill AWS, available from 1996 to present, is presented in Section 8.4 of EES Technical Report G: Air Quality Impact Assessment and has been summarised as follows:

- **Temperature:** Mean maximum temperatures range from 14.8°C in winter to 33.3°C in summer, while mean minimum temperatures range from 3.6°C in winter to around 16.2°C in summer.
- **Rainfall:** Mean annual rainfall is 301 millimetres, with the highest average monthly rainfall of 40.5 mm/month in November and an average of 6.3 rain days recorded in this month. The average monthly rainfall is highest in winter, reducing from spring through to early autumn, with the lowest average of 16.2 mm/month recorded in March. This month also recorded an average of around 3.6 rain days per month.
- **Relative Humidity:** Morning humidity levels range from an average of around 85% in winter to around 50% in summer. Afternoon humidity levels are lower, at around 55% in winter dropping to around 25% in summer.
- **Wind**: Winds from the south and southwest are predominant, with very few winds from the east. Spring and autumn winds are similar to the annual distribution. Summer is more dominated by winds from the southern quadrant, while winter has more winds from the western quadrant.
- **Evaporation**: Approximate total annual average evaporation rate: 1800 mm, or 0.41 mm/h assuming evaporation occurs during daytime (12 hours) only. Approximate total summer average evaporation rate: 800 mm, or 0.73 mm/h assuming evaporation occurs during daytime (12 hours) only.
- **Meteorological Modelling**: A summary of the AERMET modelling options and parameters used for the assessment is provided in **Table 12-3** and a summary of the AERMOD meteorological files is provided in **Table 12-4**.

Table 12-3 AERMET Model Parameters

Parameter	Option / Source			
Adjusted U* (surface friction velocity)	Yes			
Threshold wind speed (m/s)	0.28			
Wind speed and direction	WRF			
Temperature	WRF			
Upper air data	WRF			
Scalar Parameters	**Summer**	**Autumn**	**Winter**	**Spring**
Albedo	0.18	0.18	0.20	0.18
Bowen ratio	0.80	1.0	1.0	0.40
Surface roughness 0° – 180° (m)	0.1	0.1	0.01	0.05

Table 12-4 AERMOD Meteorological Input Data

Meteorological Year	Available Hours	Calms [a] and Missing Data	Valid Hours [b]
2016	8,784	9	8775
2017	8,760	2	8758
2018	87,60	2	8758
2019	87,60	8	8752
2020	87,84	3	8781

a <0.28 m/s

b AERMOD does not predict GLCs during calms

12.3.5 Background Air Quality

To inform the AQIA, as presented in EES Technical Report G, for the Project, and specifically to establish appropriate existing background concentrations with which to predict cumulative (Project plus background) concentrations, a baseline ambient air quality monitoring programme (AAQMP) was undertaken at the Project site. The monitoring program was conducted between January 2019 and September 2020 and, in consultation with EPA, included the following:

- Continues monitoring of PM_{10} and $PM_{2.5}$ at one location.
- Batch monitoring of respirable crystalline silica (as $PM_{2.5}$) and heavy metals (as PM_{10}) at one location.
- Dust deposition monitoring at five locations.

The results indicated that like any Victorian rural area with little anthropogenic activity, the area may be subject to periods of elevated concentrations of particulate with equivalent aerodynamic diameters (PM_{10} $PM_{2.5}$ due to regional bushfire and backburning impacts, and dust storms. Bushfires across Victoria in January 2020 were clearly evident in the data with elevated $PM_{2.5}$, and to a lesser extent PM_{10}, concentrations. However, the non-bushfire impacted year 2019 demonstrates elevated concentrations in the summer months such that the distinction between the years representing normal and bushfire conditions is not significant. Both years include periods of elevated background PM_{10} and $PM_{2.5}$ concentrations which exceed the relevant 24-hour average criteria. Monitored concentrations of respirable crystalline silica (RCS) were well below the annual average criterion. In the absence of NO_X monitoring in the Project area, with little anthropogenic activity, the background concentrations of NO_X are likely to be low, approaching zero. However for assessment purposes, alternative data is sourced to conservatively represent potential background concentration. The results are presented in Section 8.5 of EES Technical Report G: Air Quality Impact Assessment.

It should be noted that no background monitoring was undertaken at proposed location of the pumping station. The concentrations monitored within the Project area are considered to be representative of regional background conditions during the monitoring period such that they are also considered generally representative of, for example, the Kangaroo Lake pumping station location and the water supply pipeline route.

12.4 Construction impact assessment

This section discusses the potential impacts of the Project as a result of the following construction activities:

- **Early Works:** Early works would consist of some vegetation removal and topsoil stripping. While there would be establishment of contractor facilities, a construction accommodation camp would not be required as construction personnel would be housed within the local services centres. Scrapers, dozers, excavators and trucks used for topsoil stripping and stockpiling have the potential to generate dust. Exposed areas resulting from the works would be susceptible to wind erosion. The emission of dust and products of combustion associated with diesel engines during early works has the potential to adversely affect nearby sensitive receptors.
- **Processing Plant and Power Station Construction:** Process plant construction would occur in a staged approach, starting at the Wet Concentrator Plant and progressing to the Mineral Separation Plant (Dry Plant). Construction equipment would be as per typical industry usage, and may include cranes and mobile lifting plant, service vehicles, welding plant, lighting towers, assembly workshops, etc. The construction contractor would provide all temporary construction power, administration and services buildings, ablutions, waste management and site security.
- **Pipeline and Pumping Station Construction**: The water supply pipeline construction would progress linearly with the corresponding potential for emissions to air moving along the pipeline route as the work progresses. Therefore any sensitive receptors along the route would only be exposed to these emissions for a relatively short period of time. The active footprint of the pipeline construction site is assumed to be 200 m long at any one time for the purpose of this assessment. Being geographically separate from the Project site for the most part, the pipeline construction and the pumping station are assessed separately.

As noted in **Table 12-1**, the nearest sensitive receptor (R14) is located approximately 200 metres from the nearest Site boundary, however Project construction activities, or the construction site, would be located approximately 900 metres from the nearest sensitive receptor. The Project site construction assessment is therefore limited to ecological receptors.

The closest sensitive receptors to the pipeline route were identified to be within 50 m of the pipeline at the intersection of Mystic Park East Road. Surrounding farmland is also within 50 metres of the route and therefore the pipeline construction assessment includes consideration of both human and ecological receptors.

The pumping station would be located adjacent to farmland with the closest sensitive receptor, R18 (refer **Table 12-2**), approximately 300 metres to the north. Therefore the pumping station construction assessment considers of both human and ecological receptors.

The results as presented in Section 10 of EES Technical Report G: Air Quality Impact Assessment indicate that the impacts to health and the environment due to dust soiling from construction and closure/rehabilitation works of the Project site, the pipeline corridor and the pumping station were assessed to be minor, or in some cases negligible, with the application of the proposed dust management and mitigation strategies presented in **Section 12.8**.

12.5 Operation impact assessment

The proposed mining activities in Area 1 and Area 3 are scheduled to move around the extraction area, block by block. As such, the extent of potential impacts to air quality beyond the extraction boundary and at nearby sensitive receptors would change as the locations of the emission sources change. The mining scenarios representative of worst-case emissions with respect to nearby sensitive receptors were based on:

- Amount of material handled (greater mining intensity means an increased emissions from all sources).
- Amount of material to be taken to stockpiles and not just moved a short distance to another block for backfilling.
- Distance between mining blocks and stockpiles.
- Location on site relative to nearest residences.

The mining scenarios include:

- **Scenario 1: Area 1, Year 1, Quarter 1:**
  - Moderate combined topsoil, clay and overburden and ore extraction rate.
  - High haulage (vehicle kilometres travelled) rate of topsoil, clay and overburden to temporary stockpiles.
  - No haulage between blocks.
  - Activities assumed:
    - Block 101: ore mining.
    - Block 102: clearing/overburden removal.

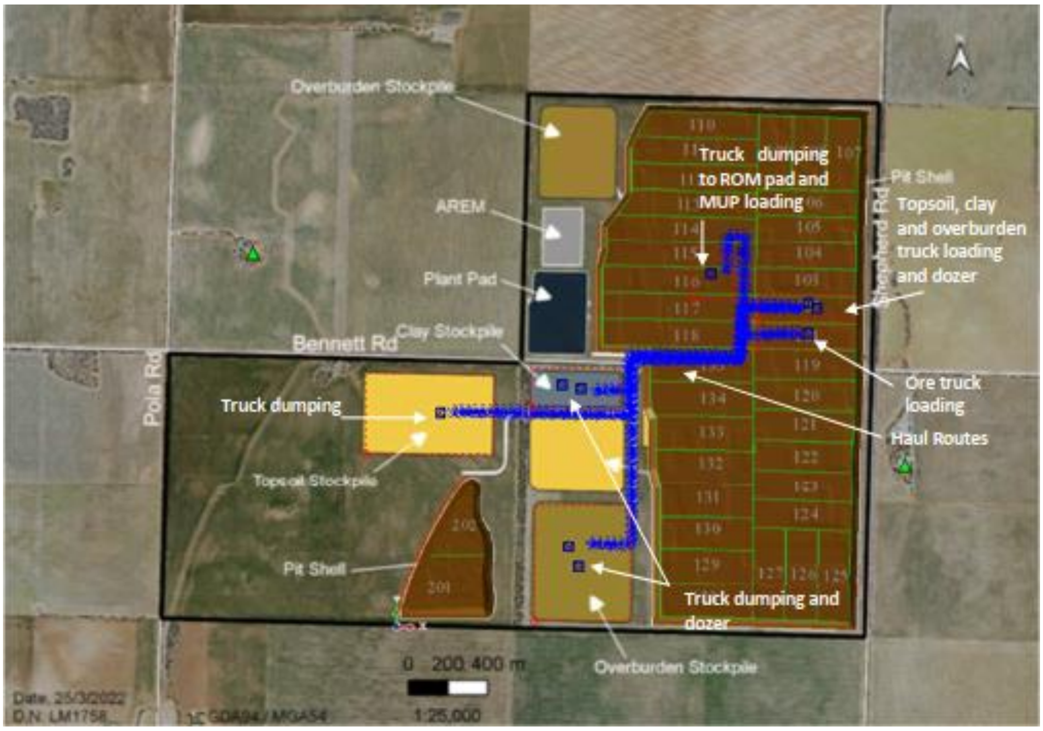

Figure 12-3 Scenario 1, Area 1, Year 1, Quarter 1

- **Scenario 2: Area 1, Year 6, Quarter 2:**
  - High combined topsoil, clay and overburden and ore extraction rate.
  - Moderate haulage (vehicle kilometres travelled) rate of topsoil, clay and overburden to temporary stockpiles.
  - Moderate haulage between mining blocks.
  - Close to receptor 13 – daytime operations only (7:00 am – 6:00 pm).
  - Activities assumed:
    - Block 125: backfilling.
    - Block 126: ore mining.
    - Block 127: clearing/overburden removal.

Figure 12-4 Scenario 2, Area 1, Year 6, Quarter 2

- **Scenario 3: Area 3, Year 11, Quarter 3:**
  - High combined topsoil, clay and overburden and ore extraction rate.
  - High haulage (vehicle kilometres travelled) rate of topsoil, clay and overburden to temporary stockpiles.
  - Moderate haulage between mining blocks.
  - Close to receptor 7 – daytime operations only (7:00am – 6:00pm).
  - Activities assumed:
    - Block 110: backfilling.
    - Block 111: ore mining.
    - Block 112: clearing/overburden removal.

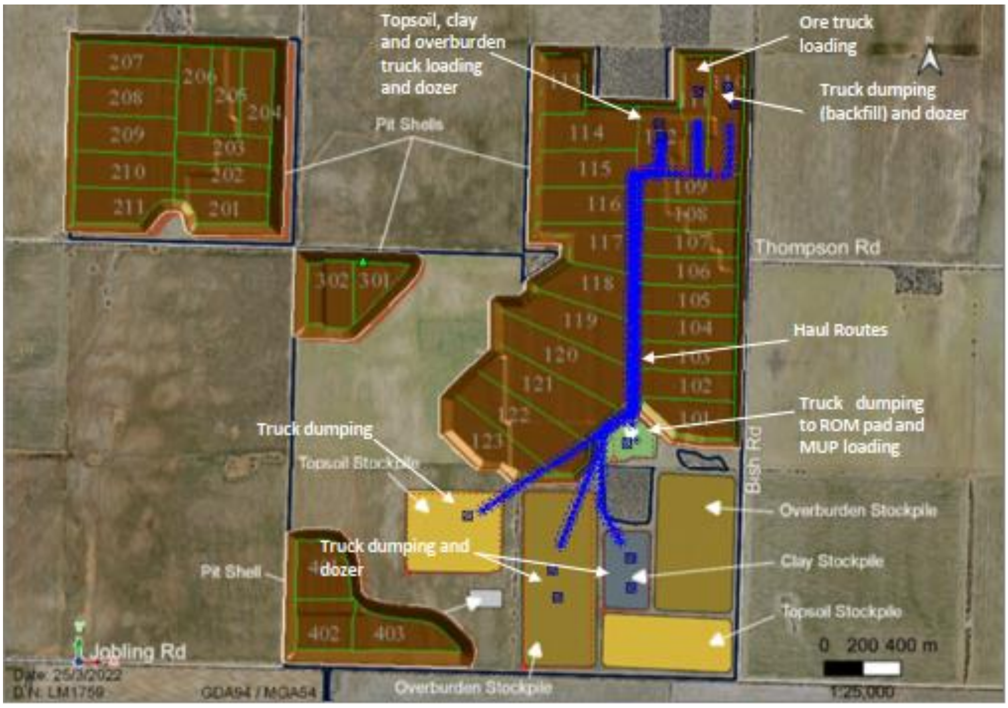

Figure 12-5 Scenario 3, Area 3, Year 11, Quarter 3

- **Scenario 4: Area 3, Year 15, Quarter 2:**
  - High combined topsoil, clay and overburden and ore extraction rate.
  - High haulage (vehicle kilometres travelled) rate of topsoil, clay and overburden to temporary stockpiles.
  - No haulage between mining blocks – all to stockpiles.
  - Activities assumed:
    - Block 101: clearing/overburden removal.

Figure 12-6 Scenario 4, Area 3, Year 15, Quarter 2

12.5.1 Modelled scenarios

The mining schedule for the Project indicates that the focus of activities would progress across the site extracting and backfilling the mining blocks systematically. A plume dispersion model can only represent one period in time in the mining schedule. A review of the material movement schedule and mining block layouts established that two mining scenarios for each area would represent potential worst-case emission profiles based on:

- The amount of material (topsoil, clay, overburden and ore) extracted.
- The amount of material taken to stockpiles (versus amount used to backfill nearby mining block).
- The distance between mining blocks and stockpiles.
- The separation distance between the mining activities and nearby sensitive receptors.

Scenario 1 – Area1 Y1Q1

Although the amount of material to be mined during the initial stages of the mining schedule in Area 1 (year 1, quarter 1 (Y1Q1)) is relatively moderate, all of the material is required to be transported by truck to the topsoil, clay and overburden stockpiles or to the Mining Unit Plant. The distance between the mining blocks (101 and 102) and the stockpiles is relatively far, which together with the intensity of haulage required has the potential to generate the most dust emissions due to wheel generated dust.

Scenario 2: Area 1 Y6Q2

The mining schedule indicates that the maximum amount of material to be mined in Area 1 would occur during year 6. During year 6, quarter 2 (Y6Q2) the distance between the mining blocks (127 and 126) and the stockpiles is relatively far, increasing the potential for the generation of wheel generated dust, however the percentage of material sent to stockpile is reduced as a significant amount is used to backfill block 125. Being near the southern boundary of Area 1, the distance to the nearest sensitive receptors is reduced and the activities in this area would therefore be limited to daytime hours only to manage noise impacts. This would require increased intensity of mining activities during daytime hours to achieve the necessary material movement rates.

Scenario 3: Area 3 Y11Q3

The amount of material to be mined during the initial stages of the mining schedule in Area 3 (year 11, quarter 3 (Y11Q3)) is relatively moderate, however the distance between the mining blocks (112 and 111) and the stockpiles and Mining Unit Plant is relatively far, increasing the potential for the generation of wheel generated dust. The percentage of material used to backfill block 110 is relatively low (approximately 20%). Being near the northern boundary of Area 3, the distance to the nearest sensitive receptors is reduced and activities in this area would therefore be limited to daytime hours only to manage noise impacts. This would require increased intensity of mining activities during daytime hours to achieve the necessary material movement rates. The increased intensity has been accounted for in this Scenario.

Scenario 4: Area 3 Y15 Q2

The amount of material to be mined during the year 15, quarter 2 (Y15Q2) is relatively high and all of it is to be transported by truck to the topsoil, clay and overburden stockpiles or to the Mining Unit Plant. The distance between the mining blocks (101 and 102) and the stockpiles is relatively far, which together with the intensity of haulage required, has the potential to generate the most dust emissions due to wheel generated dust.

Power Station

The power station assessment is based on proposed diesel generator exhaust stack parameters and emission rates for NO_X and $PM_{2.5}$

Pumping Station

The pumping station assessment is based on proposed diesel generator exhaust stack parameters and emission rates for NO_X and $PM_{2.5}$.

12.5.2 Estimated emissions

The estimated particulate emission distributions by activity for Scenario 1 to 4 are presented in **Figure 12-7** to **Figure 12-10**. A summary of the total average daily emissions for each scenario is provided in **Table 12-5**.

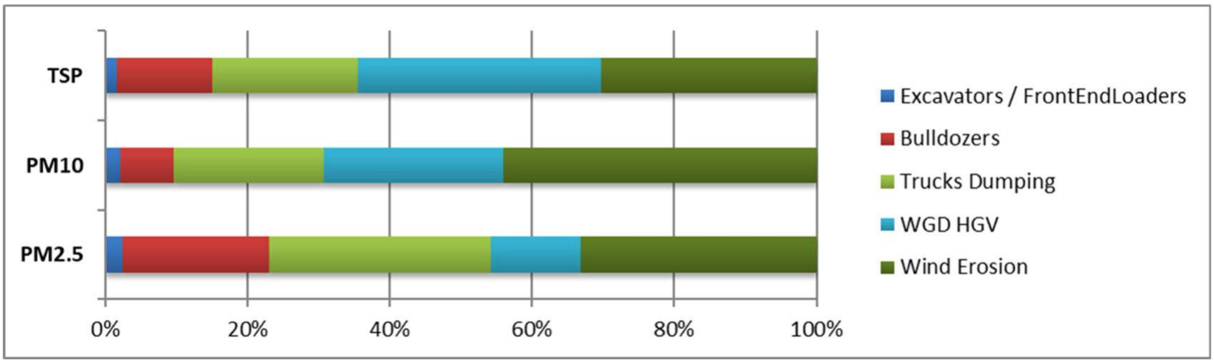

Figure 12-7 Estimated Particulate Emission Source Distribution: Scenario 1 - Area 1 Y1Q1

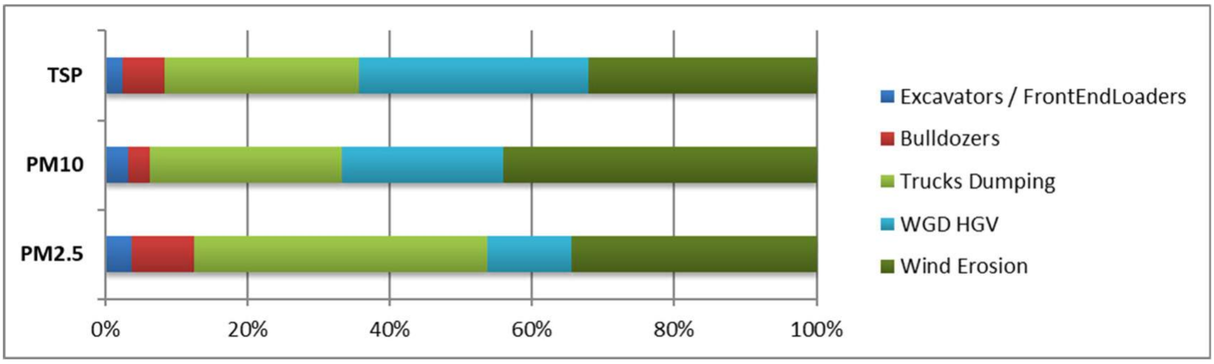

Figure 12-8 Estimated Particulate Emission Source Distribution: Scenario 2 - Area 2 Y6Q2

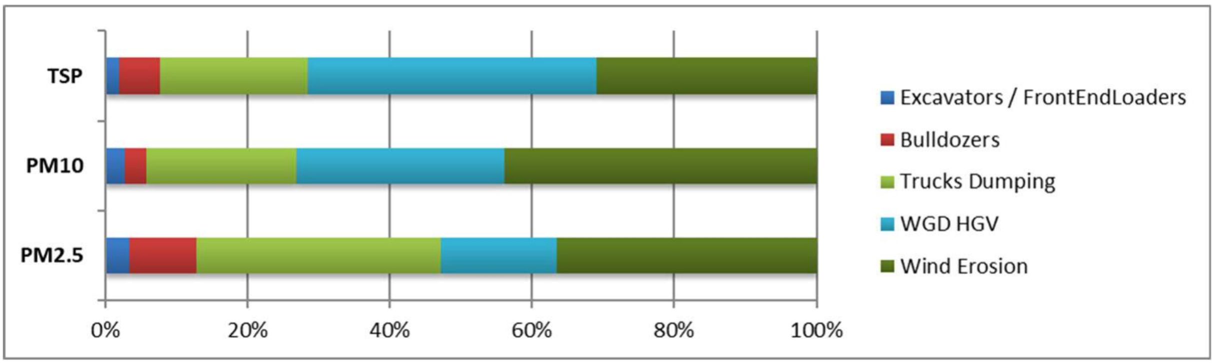

Figure 12-9 Estimated Particulate Emission Source Distribution: Scenario 3 - Area 3 Y11Q3

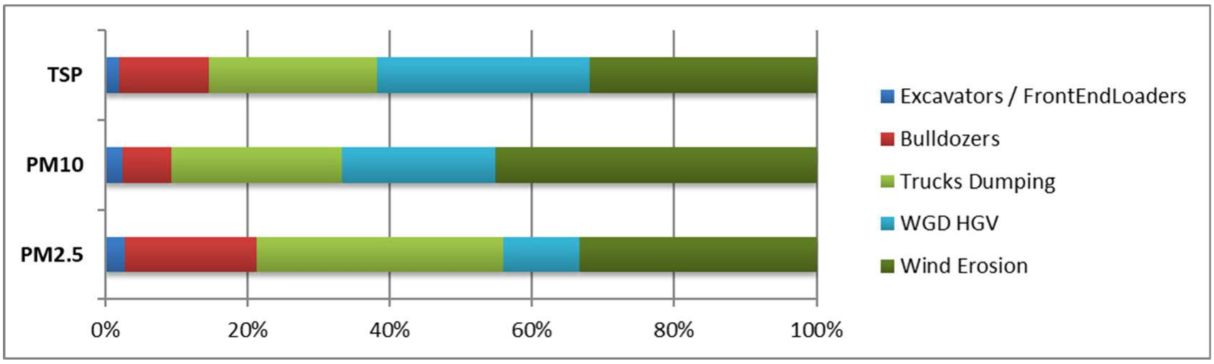

Figure 12-10 Estimated Particulate Emission Source Distribution: Scenario 4 - Area 3 Y15Q2

Table 12-5 Total Emission Summary

Scenario	Extraction Rate (t/day)	Emissions Rate (kg/day)		
		TSP	PM_{10}	$PM_{2.5}$
Scenario 1 – Area 1_Y1Q1	54,000	951	328	65
Scenario 2 – Area 2 Y6Q2	75,000	831	276	56
Scenario 3 – Area 3 Y11Q3	60,000	868	279	52
Scenario 4 – Area 3 Y15Q2	67,000	1014	357	72

12.5.3 Impact Assessment - Scenario 1 – Area 1, Year 1, Quarter 1

Maximum Predicted 24-hour Average Ground Level Concentrations (GLCs)

The maximum predicted 24-hour average Project-only PM_{10} GLCs at each receptor, along with the corresponding background and resulting cumulative concentrations, are provided in **Table 12-6**. The results have been summarised as follows:

- A maximum cumulative concentration that is within 20% of the criterion is predicted at sensitive receptor R5 during a bushfire impacted background year, with the Project contribution equivalent to 3% of the criterion.
- A maximum cumulative concentration that exceeds the criterion is predicted at sensitive receptor R1 during a bushfire impacted background year, with the Project contribution equivalent to 8% of the criterion.
- A maximum cumulative concentration that is within 20% of the criterion is predicted at receptor R12 during a normal background year, with the Project contribution equivalent to 50% of the criterion.
- A maximum cumulative concentration that exceeds the criterion is predicted at receptor R5 during a normal background year, with the Project contribution equivalent to 3% of the criterion.

Table 12-6 Scenario 1 Maximum Predicted Project 24-Hour Average PM_{10} GLCs.

ID	Maximum 24-Hour Average Concentration (µg/mg³)					Project Contribution Relative to APAC
	Project	Normal Background Year		Bushfire Impacted Background Year		
		Background	Cumulative	Background	Cumulative	
R1	4.0	7.1	11	65	**69**	8%
R2	4.8	1.8	6.6	2.9	7.7	10%
R3	15	22	37	8	22	30%
R4	2.8	4.3	7.1	9.0	12	6%
R5	1.6	56	**58**	43	45	3%
R6	2.6	3.5	6.1	5.6	8.2	5%
R7	7.5	3.5	11	5.6	13	15%
R8	4.6	12	17	5	10	9%
R9[a]	6.5	4.3	11	9.0	16	13%
R10	6.0	5.9	12	6.0	12	12%
R11	9.2	2.9	12	8.9	18	18%
R12	25	22	**47**	8	32	50%
R13	16	2.9	19	8.9	25	33%
R14[a]	*54*	*2.5*	*57*	*0.3*	*55*	*109%*
R15	15	4.4	20	4.3	20	31%
R16	9.1	2.9	12	8.9	18	18%
R17	11	2.5	14	0.3	12	23%
Criteria			**50**		**50**	

[a] Location would not be considered a sensitive receptor.

Red font indicates cumulative concentration exceeds the APAC. Orange font indicates cumulative concentrations is within 20% of the APAC

Maximum Predicted Annual Average GLCs

The predicted RCS GLCs at each receptor is provided in **Table 12-7** and the predicted metals GLCs at the most impacted receptor (R12) are provided in **Table 12-8**.

Table 12-7 Scenario 1 Maximum Predicted Cumulative Annual Average RCS GLCs

ID	Maximum 24-Hour Average Concentration (µg/mg^3)			Project Contribution Relative to APAC
	Project	Background	Cumulative	
R1	0.019	0.046	0.065	1%
R2	0.058	0.046	0.10	2%
R3	0.11	0.046	0.15	4%
R4	0.017	0.046	0.063	1%
R5	0.017	0.046	0.063	1%
R6	0.019	0.046	0.065	1%
R7	0.029	0.046	0.075	1%
R8	0.024	0.046	0.070	1%
R9a	0.061	0.046	0.11	2%
R10	0.041	0.046	0.087	1%
R11	0.062	0.046	0.11	2%
R12	0.21	0.046	0.26	7%
R13	0.16	0.046	0.21	5%
R14[a]	*0.41*	*0.046*	*0.45*	*14%*
R15	0.12	0.046	0.17	4%
R16	0.029	0.046	0.075	1%
R17	0.046	0.046	0.092	2%
Criteria			**3**	

[a] Location would not be considered a sensitive receptor during Project.

Table 12-8 Scenario 1 Maximum Predicted Cumulative Annual Average Metals GLCs.

Most Impacted Receptor: R12							
Maximum Annual Average PM10 Concentration (µg/m3): 1.1							
Metal	Fraction of PM10	Annual Average Concentration (µg/m3)			APAC (µg/m3)	Project Contribution	
		Project	Background	Cumulative		Relative to APAC	Relative to Background
As	0.011%	0.00011	0.0020	0.0021	0.007	1.6%	5.6%
Cd	0.021%	0.00022	0.0040	**0.0042**	0.005	4.5%	5.6%
Cr	0.13%	0.0014	0.025	**0.026**	0.005	28%	5.6%
Cy	0.079%	0.00084	0.015	0.016	-	-	5.6%
Pb	0.15%	0.0016	0.028	0.030	0.5	0.3%	5.6%
Mn	0.28%	0.0030	0.053	0.056	0.15	2.0%	5.6%
Hg	0.016%	0.00014	0.0030	0.0032	1	0.02%	5.6%
Ni	0.15%	0.0016	0.028	0.0030	0.09	1.7%	5.6%
V	0.042%	0.00045	0.0080	0.0084	-	-	5.6%
Zn	0.31%	0.058	0.058	0.061	2	0.2%	5.6%

Orange font indicates cumulative concentration is equal to or greater than 80% of the APAC. Red font indicates exceedance of the APAC

12.5.4 Impact Assessment - Scenario 2 – Area 1, Year 6, Quarter 2

Maximum Predicted 24-hour Average GLCs

The maximum predicted 24-hour average Project-only PM_{10} GLCs at each receptor, along with the corresponding background and resulting cumulative concentrations, are provided in **Table 12-9**. The results have been summarised as follows:

- A maximum cumulative concentration that exceeds the criterion is predicted at sensitive receptor R1, with the Project contribution equivalent to 4% of the criterion.

Table 12-9 Scenario 2 Maximum Predicted Project 24-Hour Average PM_{10} GLCs.

ID	Maximum 24-Hour Average Concentration (µg/mg3)					Project Contribution Relative to APAC
	Project	Normal Background Year		Bushfire Impacted Background Year		
		Background	Cumulative	Background	Cumulative	
R1	2.2	48	**50**	10	12	4%
R2	6.9	2.6	9.5	4.3	11	14%
R3	12	5.6	17	1.3	13	23%
R4	1.5	7.8	9.3	3.6	5.1	3%
R5	1.7	7.8	9.5	3.6	5.3	3%
R6	2.1	3.5	5.6	0.50	2.6	4%
R7	1.6	3.5	5.1	5.6	7.2	3%
R8	2.4	7.8	10	3.6	6.0	5%
R9a	5.0	2.2	7.2	9.3	14	10%
R10	6.7	11	18	5.3	12	13%
R11	4.2	2.2	6.4	13	17	8%
R12	19	5.3	24	7.0	26	38%
R13	14	5.5	19	6.8	21	28%
R14[a]	*36*	*8.5*	*45*	*9.7*	*46*	*73%*
R15	16	2.6	19	4.3	21	33%
R16	4.5	2.9	7.4	8.9	13	9%
R17	5.7	3.3	9.0	0.90	6.6	11%
Criteria			**50**		**50**	

- [a] Location would not be considered a sensitive receptor during Project.
- Red font indicates cumulative concentration exceeds the APAC. Orange font indicates cumulative concentration is equal to or greater than 80% of the APAC.

Maximum Predicted Annual Average GLCs

The predicted RCS GLCs at each receptor are provided in **Table 12-10** and the predicted metals GLCs at the most impacted receptor are provided in **Table 12-11**. No exceedances would be experienced at any sensitive receptor identified near the Project, with cumulative concentrations equal to less than 50% of the criterion.

Table 12-10 Scenario 2 Maximum Predicted Cumulative Annual Average RCS GLCs

ID	Maximum 24-Hour Average Concentration (µg/mg³)			Project Contribution Relative to APAC
	Project	Background	Cumulative	
R1	0.0086	0.046	0.055	0.3%
R2	0.032	0.046	0.078	1.1%
R3	0.069	0.046	0.11	2.3%

ID	Maximum 24-Hour Average Concentration (µg/mg³)			Project Contribution Relative to APAC
	Project	Background	Cumulative	
R4	0.0053	0.046	0.051	0.2%
R5	0.0062	0.046	0.052	0.2%
R6	0.0083	0.046	0.054	0.3%
R7	0.010	0.046	0.056	0.3%
R8	0.010	0.046	0.056	0.3%
R9a	0.021	0.046	0.067	0.7%
R10	0.016	0.046	0.062	0.5%
R11	0.016	0.046	0.062	0.5%
R12	0.13	0.046	0.18	4.3%
R13	0.036	0.046	0.082	1.2%
R14[a]	*0.53*	*0.046*	*0.58*	*18%*
R15	0.040	0.046	0.086	1.3%
R16	0.011	0.046	0.057	0.4%
R17	0.026	0.046	0.072	0.9%
Criteria			**3**	

[a] Location would not be considered a sensitive receptor during Project.

Table 12-11 Scenario 2 Maximum Predicted Cumulative Annual Average Metals GLCs.

Most Impacted Receptor: R12							
Maximum Annual Average PM_{10} Concentration (µg/m³): 0.79							
Metal	**Fraction of PM_{10}**	**Annual Average Concentration (µg/m³)**			**APAC (µg/m³)**	**Project Contribution**	
		Project	**Background**	**Cumulative**		**Relative to APAC**	**Relative to Background**
As	0.011%	0.000083	0.0020	0.0021	0.007	1.2%	4.1%
Cd	0.021%	0.00017	0.0040	**0.0042**	0.005	3.3%	4.1%
Cr	0.13%	0.0010	0.025	**0.026**	0.005	21%	4.1%
Cy	0.079%	0.00062	0.015	0.016	-	-	4.1%
Pb	0.15%	0.0012	0.028	0.029	0.5	0.2%	4.1%
Mn	0.28%	0.0022	0.053	0.055	0.15	1.5%	4.1%
Hg	0.016%	0.00012	0.0030	0.0031	1	0.01%	4.1%
Ni	0.15%	0.0012	0.028	0.029	0.09	1.3%	4.1%
V	0.042%	0.00033	0.0080	0.0083	-	-	4.1%
Zn	0.31%	0.0024	0.058	0.060	2	0.1%	4.1%

Orange font indicates cumulative concentration is equal to or greater than 80% of the APAC. Red font indicates exceedance of the APAC

12.5.5 Impact Assessment - Scenario 3 – Area 3, Year 11, Quarter 3

Maximum Predicted 24-hour Average GLCs

The maximum predicted 24-hour average Project-only PM_{10} GLCs at each receptor, along with the corresponding background and resulting cumulative concentrations, are provided in **Table 12-12**. The results show no exceedances of the criterion is predicted.

Table 12-12 Scenario 3 Maximum Predicted Project 24-Hour Average PM_{10} GLCs.

ID	Maximum 24-Hour Average Concentration (µg/mg³)					Project Contribution Relative to APAC
	Project	Normal Background Year		Bushfire Impacted Background Year		
		Background	Cumulative	Background	Cumulative	
R1	7.5	3.6	11	3.2	11	15%
R2	8.2	2.5	11	0.30	8.5	16%
R3	7.8	5.3	13	7.0	15	16%
R4	6.4	7.8	14	3.6	10	13%
R5	3.7	8	12	3.6	7.3	7%
R6	3.7	2.3	6.0	4.1	7.8	7%
R7	14	2.3	16	4.1	18	27%
R8	3.8	5.5	9.3	6.8	11	8%
R9[a]	*17*	*2.6*	*20*	*4.3*	*21*	*34%*
R10	2.9	3.8	6.7	18	21	6%
R11	5.0	2.6	7.6	4.3	9.3	10%
R12	5.0	2.6	7.6	1.5	6.5	10%
R13	3.6	3.8	7.4	6.9	11	7%
R14[b]	*16*	*5.3*	*21*	*7.0*	*23*	*32%*
R15	2.2	7.7	10	4.8	7.0	4%
R16	2.3	3.8	6.1	2.9	5.2	5%
R17	5.7	2.5	8.2	0.3	6.0	11%
Criteria			**50**		**50**	

[a] Location would not be considered a sensitive receptor during Project phase in Area 3.

[b] Location would not be considered a sensitive receptor during Project

Maximum Predicted Annual Average GLCs

The predicted RCS GLCs at each receptor are provided in **Table 12-13** and show that no exceedances would be experienced at any sensitive receptor identified near the Project. The predicted metals GLCs at the most impacted receptor (R7) are provided in **Table 12-14**.

Table 12-13 Scenario 3 Maximum Predicted Cumulative Annual Average RCS GLCs

ID	Maximum 24-Hour Average Concentration (µg/mg³)			Project Contribution Relative to APAC
	Project	Background	Cumulative	
R1	0.016	0.046	0.062	0.5%
R2	0.018	0.046	0.064	0.6%
R3	0.012	0.046	0.058	0.4%
R4	0.014	0.046	0.060	0.5%
R5	0.017	0.046	0.060	0.5%
R6	0.017	0.046	0.063	0.6%
R7	0.057	0.046	0.10	1.9%
R8	0.0088	0.046	0.055	0.3%
R9[a]	*0.072*	*0.046*	*0.12*	*2.4%*

ID	Maximum 24-Hour Average Concentration (µg/mg³)			Project Contribution Relative to APAC
	Project	Background	Cumulative	
R10	0.010	0.046	0.056	0.3%
R11	0.0092	0.046	0.055	0.3%
R12	0.011	0.046	0.057	0.4%
R13	0.011	0.046	0.057	0.4%
R14[b]	*0.026*	*0.046*	*0.072*	*0.9%*
R15	0.0091	0.046	0.055	0.3%
R16	0.0052	0.046	0.051	0.2%
R17	0.0089	0.046	0.055	0.3%
Criteria			**3**	

[a] Location would not be considered a sensitive receptor during Project phase in Area 3.

[b] Location would not be considered a sensitive receptor during Project

Table 12-14 Scenario 3 Maximum Predicted Cumulative Annual Average Metals GLCs.

Most Impacted Receptor: R7							
Maximum Annual Average PM_{10} Concentration (µg/m³): 038							
Metal	Fraction of PM_{10}	Annual Average Concentration (µg/m³)			APAC (µg/m³)	Project Contribution	
		Project	Background	Cumulative		Relative to APAC	Relative to Background
As	0.011%	0.000040	0.0020	0.0020	0.007	0.6%	2.0%
Cd	0.021%	0.000080	0.0040	**0.0041**	0.005	1.6%	2.0%
Cr	0.13%	0.00050	0.025	**0.026**	0.005	10%	2.0%
Cy	0.079%	0.00030	0.015	0.015	-	-	2.0%
Pb	0.15%	0.00056	0.028	0.029	0.5	0.1%	2.0%
Mn	0.28%	0.0011	0.053	0.054	0.15	0.7%	2.0%
Hg	0.016%	0.000060	0.0030	0.0031	1	0.01%	2.0%
Ni	0.15%	0.00056	0.028	0.029	0.09	0.6%	2.0%
V	0.042%	0.00016	0.0080	0.0082	-	-	2.0%
Zn	0.31%	0.0012	0.058	0.059	2	0.1%	2.0%

Red font indicates cumulative concentration exceeds the APAC. Orange font indicates cumulative concentration is equal to or greater than 80% of the APAC.

12.5.6 Impact Assessment - Scenario 4 – Area 4, Year 15, Quarter 2

Maximum Predicted 24-hour Average GLCs

The maximum predicted 24-hour average Project-only PM_{10} GLCs at each receptor, along with the corresponding background and resulting cumulative concentrations, are provided in **Table 12-15**. The results indicate that no exceedances of the criterion are predicted.

Table 12-15 Scenario 4 Maximum Predicted Project 24-Hour Average PM_{10} GLCs.

ID	Maximum 24-Hour Average Concentration (µg/mg³)					Project Contribution Relative to APAC
	Project	Normal Background Year		Bushfire Impacted Background Year		
		Background	Cumulative	Background	Cumulative	
R1	3.3	3.7	7.0	3.6	6.9	7%
R2	17	5.3	22	5.9	23	33%
R3	7.5	14	21	14	21	15%
R4	4.3	9.7	14	7.7	12	9%
R5	5.1	4.3	9.4	9.0	14	10%
R6	5.5	0.9	6.4	3.3	8.8	11%
R7	16	3.5	19	5.6	21	32%
R8	7.6	2.9	10	8.9	16	15%
R9[a]	*41*	*2.8*	*44*	*13*	*54*	*82%*
R10	6.3	2.2	8.5	9.3	16	13%
R11	5.2	2.6	7.8	4.3	9.5	10%
R12	8.6	2.6	11	4.3	13	17%
R13	5.1	33	38	5.7	11	10%
R14[b]	*14*	*14*	*28*	*14*	*28*	*27%*
R15	5.0	2.2	7.2	9.3	14	10%
R16	1.9	5.4	7.3	5.7	7.6	4%
R17	8.5	16	24	16	24	17%
Criteria			**50**		**50**	

[a] Location would not be considered a sensitive receptor during Project phase in Area 3.

[b] Location would not be considered a sensitive receptor during Project.

Maximum Predicted Annual Average GLCs

The predicted RCS GLCs are provided in **Table 12-16**. No exceedances would be experienced at any sensitive receptor identified near the Project. The predicted metals GLCs at the most impacted receptor (R7)

As stated in **Section 12.3.2**, R14 would be vacated for the duration of the entire Project and receptor R09 would be vacated when works begin in Area 3. Impacts predicted at these locations would therefore be of little consequence as they would no longer be sensitive receptors during the Project.

Table 12-16 Scenario 4 Maximum Predicted Cumulative Annual Average RCS GLCs

ID	Maximum 24-Hour Average Concentration (µg/mg³)			Project Contribution Relative to APAC
	Project	Background	Cumulative	
R1	0.036	0.046	0.082	1.2%
R2	0.062	0.046	0.11	2.1%
R3	0.034	0.046	0.080	1.1%
R4	0.035	0.046	0.081	1.2%
R5	0.038	0.046	0.084	1.3%
R6	0.045	0.046	0.091	1.5%
R7	0.11	0.046	0.16	3.7%

ID	Maximum 24-Hour Average Concentration (µg/mg³)			Project Contribution Relative to APAC
	Project	Background	Cumulative	
R8	0.032	0.046	0.078	1.1%
R9[a]	*0.29*	*0.046*	*0.34*	*9.7%*
R10	0.031	0.046	0.077	1.0%
R11	0.031	0.046	0.077	1.0%
R12	0.040	0.046	0.086	1.3%
R13	0.038	0.046	0.084	1.3%
R14[b]	*0.078*	*0.046*	*0.12*	*2.6%*
R15	0.028	0.046	0.074	0.9%
R16	0.013	0.046	0.059	0.4%
R17	0.034	0.046	0.080	1.1%
Criteria			**3**	

[a] Location would not be considered a sensitive receptor during Project phase in Area 3.

[b] Location would not be considered a sensitive receptor during Project.

Table 12-17 Scenario 4 Maximum Predicted Cumulative Annual Average Metals GLCs.

Most Impacted Receptor: R7							
Maximum Annual Average PM_{10} Concentration (µg/m³): 0.55							
Metal	Fraction of PM_{10}	Annual Average Concentration (µg/m³)			APAC (µg/m³)	Project Contribution	
		Project	Background	Cumulative		Relative to APAC	Relative to Background
As	0.011%	0.000057	0.0020	0.0021	0.007	0.8%	2.9%
Cd	0.021%	0.00011	0.0040	**0.0041**	0.005	2.3%	2.9%
Cr	0.13%	0.00072	0.025	**0.026**	0.005	14%	2.9%
Cy	0.079%	0.00043	0.015	0.015	-	-	2.9%
Pb	0.15%	0.00080	0.028	0.029	0.5	0.2%	2.9%
Mn	0.28%	0.0015	0.053	0.055	0.15	1.0%	2.9%
Hg	0.016%	0.000086	0.0030	0.0031	1	0.01%	2.9%
Ni	0.15%	0.00080	0.028	0.029	0.09	0.9%	2.9%
V	0.042%	0.00023	0.0080	0.0082	-	-	2.9%
Zn	0.31%	0.0017	0.058	0.060	2	0.1%	2.9%

Red font indicates cumulative concentration exceeds the APAC. Orange font indicates cumulative concentrations is within 80% of the APAC.

12.5.7 Predicted Indicative Dust Deposition Rates

The maximum predicted annual average (of five years) Project and cumulative dust deposition rates at each receptor for each Scenario are provided in **Table 12-18**.

Table 12-18 Maximum Annual Average Dust Deposition Rates

ID	Dust Deposition Rate (g/m³/month)								
	Project				Background	Cumulative			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4		Scenario 1	Scenario 2	Scenario 3	Scenario 4
R1	0.0094	0.010	0.019	0.021	2.8	2.8	2.8	2.8	2.8
R2	0.028	0.037	0.027	0.033	2.8	2.8	2.8	2.8	2.8
R3	0.053	0.071	0.010	0.012	2.8	2.8	2.9	2.8	2.8
R4	0.006	0.0066	0.018	0.013	2.8	2.8	2.8	2.8	2.8
R5	0.006	0.0069	0.020	0.015	2.8	2.8	2.8	2.8	2.8
R6	0.0066	0.008	0.026	0.020	2.8	2.8	2.8	2.8	2.8
R7	0.010	0.011	0.079	0.045	2.8	2.8	2.8	2.9	2.8
R8	0.010	0.008	0.011	0.013	2.8	2.8	2.8	2.8	2.8
R9[a]	*0.020*	*0.019*	*0.092*	*0.15*	*2.8*	*2.8*	*2.8*	*2.9*	*2.9*
R10	0.017	0.012	0.0094	0.010	2.8	2.8	2.8	2.8	2.8
R11	0.029	0.018	0.010	0.011	2.8	2.8	2.8	2.8	2.8
R12	0.12	0.14	0.012	0.013	2.8	2.9	2.9	2.8	2.8
R13	0.093	0.046	0.012	0.013	2.8	2.9	2.8	2.8	2.8
R14[b]	*0.26*	*0.65*	*0.023*	*0.030*	*2.8*	*3.1*	*3.4*	*2.8*	*2.8*
R15	0.055	0.040	0.0093	0.010	2.8	2.9	2.8	2.8	2.8
R16	0.012	0.010	0.0046	0.0042	2.8	2.8	2.8	2.8	2.8
R17	0.019	0.027	0.0095	0.010	2.8	2.8	2.8	2.8	2.8

*Receptor R09 would not be considered a sensitive receptor during Project phase in Area 3 (see **Section 12.3.2**).

*Receptor R14 would not be considered a sensitive receptor during Project (see **Section 12.3.2**).

Metals Deposition

It has been assumed that the identified sensitive receptors have rainwater tanks and use these as their primary source of drinking water. As outlined in **Section 12.3.3,** the average annual rainfall is 301 millimetres. A typical rural dwelling that uses the roof to collect rainwater into a tank might therefore collect approximately 300 litres/m^2/year (L/m^2/year) into which metals in dust deposited on the roof might mix.

As shown in **Table 12-18**, R12 is predicted to be the most impacted receptor with a maximum predicted annual average dust deposition rate of 0.14 g/m^2/month, or 1.7 g/m^2/year. The resulting indicative maximum annual average deposition rate of metals resulting from the Project for receptor R12, conservatively assuming that all deposited dust contains metals fractions based on those of the PM_{10} background monitoring data is provided in **Table 12-19**. The relatively low deposition rates predicted at sensitive receptors would result in corresponding low impacts to rainwater tanks, with deposition of metals unlikely to lead to exceedances of Australian drinking water guidelines.

Table 12-19 Maximum Predicted Annual Average Metals Deposition to Rainwater Tanks

Most Impacted Receptor: R12					
Maximum Annual Average Deposition Rate: 1.7 g/m^2/year					
Metal	**Fraction of Dust [a]**	**Maximum Annual Average Deposition Rate (mg/m2/year)**	**Average Rainfall (L/ m2/year)**	**Maximum Project Contribution to Rainwater Tank Concentration (mg/L)**	**Drinking Water Guideline (mg/L)**
As	0.011%	0.18	300	0.00060	0.010
Cd	0.021%	0.36	300	0.0012	0.002
Cr	0.13%	2.3	300	0.0075	0.05
Cy	0.079%	1.4	300	0.0045	2
Pb	0.15%	2.5	300	**0.0084**	0.01
Mn	0.28%	4.8	300	0.016	0.5
Hg	0.016%	0.27	300	**0.00090**	0.001
Ni	0.15%	2.5	300	0.0084	0.02
V	0.042%	0.72	300	0.0024	-
Zn	0.31%	5.3	300	0.017	3.0

[a] Based on estimated metals fraction in PM_{10}

Orange font indicates cumulative concentrations is within 80% of the APAC.

12.5.8 Impact Assessment – Power Station

NO_2

The maximum (99.9th percentile) predicted 1-hour average cumulative NO2 GLCs at and beyond the Project site boundary and at the sensitive receptors are provided in **Table 12-20**. Maximum predicted annual average (of five years) Project GLCS are also provided. Cumulative GLCs, including conservative background NO2 concentrations, comply with the NO2 1-hour average and annual average criteria at all sensitive receptors. Exceedances of the 1-hour and annual average criteria are predicted at or beyond the Project boundary.

Table 12-20 Maximum Predicted NO_2 GLCs at Sensitive Receptors (Power Station)

ID	Maximum (99.9th Percentile) 1 Hour Average NO_2 Concentration (µg/m^3)			Project Contribution Relative to APAC	Annual Average NO_2 Concentration (µg/m^3)			Project Contribution Relative to APAC
	Cumulative	Project [a]	Background		Project [a]	Background	Cumulative	
Project Boundary [b]	**957**	940	17	627%	44	19	**63**	157%
R1	77	0.015	77	51%	0.1	19	19	0.4%
R2	77	0.0033	77	51%	0.30	19	19	1.1%
R3	86	39	47	57%	0.31	19	19	1.1%
R4	77	39	38	51%	0.15	19	19	0.5%
R5	75	0.033	75	50%	0.15	19	19	0.5%
R6	76	4.5	71	51%	0.13	19	19	0.5%
R7	84	31.3	53	56%	0.23	19	19	0.8%
R8	77	0.008	77	51%	0.16	19	19	0.6%
R9	89	38	51	59%	0.43	19	19	1.5%

ID	Maximum (99.9th Percentile) 1 Hour Average NO_2 Concentration (µg/m³)			Project Contribution Relative to APAC	Annual Average NO_2 Concentration (µg/m³)			Project Contribution Relative to APAC
	Cumulative	Project [a]	Background		Project [a]	Background	Cumulative	
R10	80	29	51	53%	0.33	19	19	1.2%
R11	85	0.044	85	56%	0.51	19	19	1.8%
R12	97	74	23	64%	0.45	19	19	1.6%
R13	**126**	70	56	84%	1.3	19	20	4.7%
R14[c]	*106*	*74*	*32*	*71%*	*0.89*	*19*	*19*	*3.2%*
R15	100	38	62	67%	0.76	19	19	2.7%
R16	81	22	58	54%	0.25	19	19	0.9%
R17	79	45	34	53%	0.24	19	19	0.9%
Criteria	**150**					**Health** **Vegetation**	**28** **30**	

[a] Assumed NO2 to NOx ratio of 30%

[b] At or beyond the Project site boundary

[c,] Location would not be considered a sensitive receptor during Project.

Orange font indicates cumulative concentration is equal to or greater than 80% of the APAC. Red font indicates cumulative concentration exceeds the APAC.

$PM_{2.5}$

The maximum predicted 24-hour average cumulative $PM_{2.5}$ GLCs resulting from power station emissions to air at each receptor are provided in **Table 12-21** for both normal and bushfire background concentrations years. Exceedances of the criterion are predicted at all receptors due to the maximum background concentration exceeding the criterion before the Project contribution is added.

The maximum predicted 24-hour average Project-only $PM_{2.5}$ GLCs at each receptor, along with the corresponding background and resulting cumulative concentrations, are provided in **Table 12-22** and corresponding annual average predictions are provided in **Table 12-23**. No exceedances would be experienced at any sensitive receptor identified near the Project.

Table 12-21 Maximum Predicted Cumulative 24-Hour Average $PM_{2.5}$ GLCs (Power Station)

ID	Normal Background Year — Maximum 24-Hour Average Concentration (µg/m³)			Additional Exceedances	Bushfire Impacted Background Year — Maximum 24-Hour Average Concentration (µg/m³)			Additional Exceedances
	Cumulative	Project	Background		Cumulative	Project	Background	
R1	**45**	0.0090	45	0	**81**	0.00035	81	0
R2	**45**	0.0088	45	0	**81**	0.00036	81	0
R3	**45**	0.0089	45	0	**81**	0.00048	81	0
R4	**45**	0.0023	45	0	**81**	0.011	81	0
R5	**45**	0.0030	45	0	**81**	0.011	81	0
R6	**45**	0.0041	45	0	**81**	0.0034	81	0
R7	**45**	0.0073	45	0	**81**	0.011	81	0

ID	Normal Background Year Maximum 24-Hour Average Concentration (µg/m³)			Additional Exceedances	Bushfire Impacted Background Year Maximum 24-Hour Average Concentration (µg/m³)			Additional Exceedances
	Cumulative	Project	Background		Cumulative	Project	Background	
R8	**45**	0.011	45	0	**81**	0.0056	81	0
R9	**45**	0.0063	45	0	**81**	0.031	81	0
R10	**45**	0.0075	45	0	**81**	0.024	81	0
R11	**45**	0.0047	45	0	**81**	0.0048	81	0
R12	**45**	0.020	45	0	**81**	0.0012	81	0
R13	**45**	0.022	45	0	**81**	0.0029	81	0
R14[a]	**45**	0.066	45	0	**81**	0.0013	81	0
R15	**45**	0.0019	45	0	**81**	0.0081	81	0
R16	**45**	0.00088	45	0	**81**	0.0040	81	0
R17	**45**	0.0060	45	0	**81**	0.00033	81	0
Criteria	**25**				**25**			

[a] Location would not be considered a sensitive receptor during Project

Red font indicates cumulative concentration exceeds the APAC

Table 12-22 Maximum Predicted Project 24-Hour Average $PM_{2.5}$ GLCs (Power Station)

ID	Maximum 24-Hour Average Concentration (µg/mg³) Project	Normal Background Year Background	Normal Background Year Cumulative	Bushfire Impacted Background Year Background	Bushfire Impacted Background Year Cumulative	Project Contribution Relative to APAC
R1	0.097	0.60	0.7	0.2	0.3	0.4%
R2	0.17	0.10	0.27	0.8	0.97	0.7%
R3	0.46	0.70	1.2	2.4	2.9	1.8%
R4	0.094	1.2	1.3	1.9	2	0.4%
R5	0.094	1.2	1.3	1.9	2	0.4%
R6	0.061	0.2	0.26	0	0.061	0.2%
R7	0.12	0.4	0.52	1.1	1.2	0.5%
R8	0.12	1.2	1.3	0.4	0.5	0.5%
R9	0.26	3.5	3.8	0.50	0.76	1.0%
R10	0.18	0	0.18	0	0.18	0.7%
R11	0.22	4.6	4.8	2.5	2.7	0.9%
R12	0.61	0.70	1.3	2.4	3	2.4%
R13	0.65	0	0.65	2.4	3.1	2.6%
R14[a]	*0.38*	*1.8*	*2.2*	*1.1*	*1.5*	*1.5%*
R15	0.38	2.6	3.0	0.5	0.88	1.5%
R16	0.22	0	0.22	0.8	1.0	0.9%
R17	0.20	1.1	1.3	1.9	2.1	0.8%
Criteria			**25**		**25**	

[a] Location would not be considered a sensitive receptor during Project.

Table 12-23 Maximum Predicted Cumulative Annual Average $PM_{2.5}$ GLCs (Power Station)

ID	Maximum 24-Hour Average Concentration (µg/mg³)					Project Contribution Relative to APAC
	Project	Normal Background Year		Bushfire Impacted Background Year		
		Background	Cumulative	Background	Cumulative	
R1	0.0027	2.7	2.7	3.5	3.5	<0.1%
R2	0.0061	2.7	2.7	3.5	3.5	0.1%
R3	0.0088	2.7	2.7	3.5	3.5	0.1%
R4	0.0038	2.7	2.7	3.5	3.5	<0.1%
R5	0.0027	2.7	2.7	3.5	3.5	<0.1%
R6	0.0027	2.7	2.7	3.5	3.5	<0.1%
R7	0.0055	2.7	2.7	3.5	3.5	0.1%
R8	0.0056	2.7	2.7	3.5	3.5	0.1%
R9	*0.011*	*2.7*	*2.7*	*3.5*	*3.5*	*0.1%*
R10	0.0066	2.7	2.7	3.5	3.5	0.1%
R11	0.011	2.7	2.7	3.5	3.5	0.1%
R12	0.012	2.7	2.7	3.5	3.5	0.2%
R13	0.026	2.7	2.8	3.5	3.6	0.3%
R14[a]	*0.020*	*2.7*	*2.8*	*3.5*	*3.6*	*0.3%*
R15	0.017	2.7	2.8	3.5	3.5	0.2%
R16	0.0046	2.7	2.7	3.5	3.5	0.1%
R17	0.0044	2.7	2.7	3.5	3.5	0.1%
Criteria			**8**		**8**	

[a] Location would not be considered a sensitive receptor during Project.

12.5.9 Impact Assessment – Pumping Station

NO_2

The maximum (99.9th percentile) predicted 1-hour average cumulative NO_2 GLCs at and beyond the pumping station site boundary and at the sensitive receptors are provided in **Table 12-24**. Maximum predicted annual average (of five years) Project GLCs are also provided. Cumulative GLCs, including conservative background NO_2 concentrations, comply with the NO_2 1-hour average and annual average criteria at all sensitive receptors. Exceedances of the 1-hour and annual average criteria are predicted at or beyond the pumping station site boundary.

Table 12-24 Maximum Predicted NO_2 GLCs at Sensitive Receptors (Pumping Station)

ID	Maximum (99.9th Percentile) 1 Hour Average NO_2 Concentration (µg/m³)			Project Contribution Relative to APAC	Annual Average NO_2 Concentration (µg/m³)			Project Contribution Relative to APAC
	Cumulative	Project[a]	Background		Project[a]	Background	Cumulative	
Site Boundary[b]	**448**	392	56	261%	8.0	20	**28**	29%
R18	94	33	60	62%	2.7	17	20	9.6%
R19	80	31	49	53%	1.5	17	19	5.4%
R20	73	8.7	64	48%	0.68	17	18	2.4%
Criteria	150					**Health** **Vegetation**	**28** **30**	

[a] Assumed NO2 to NOx ratio of 30%

[b] At or beyond the Project site boundary.

Red font indicates cumulative concentration exceeds the APAC.

$PM_{2.5}$

The maximum predicted 24-hour average cumulative $PM_{2.5}$ GLCs resulting from pumping station emissions to air at each receptor are provided in **Table 12-25** for both normal and bushfire background concentrations years. Exceedances of the criterion are predicted at all receptors due to the maximum background concentration exceeding the criterion before the Project contribution is added.

The maximum predicted 24-hour average Project-only $PM_{2.5}$ GLCs at each receptor, along with the corresponding background and resulting cumulative concentrations, are provided in **Table 12-26** and **Table 12-27**. No exceedances would be experienced at any sensitive receptor identified near the Pumping Station.

Table 12-25 Maximum Predicted Cumulative 24-Hour Average $PM_{2.5}$ GLCs (Pumping Station)

ID	Normal Background Year				Bushfire Impacted Background Year			
	Maximum (99.9th Percentile) 1 Hour Average NO2 Concentration (µg/m³)			Additional Exceedances	Annual Average NO2 Concentration (µg/m³)			Additional Exceedances
	Cumulative	Project	Background		Cumulative	Project	Background	
R18	**45**	0.11	45	0	**81**	0.17	81	0
R19	**45**	0.12	45	0	**81**	0.11	81	0
R20	**45**	0.066	45	0	**81**	0.019	81	0
Criteria	**25**				**25**			

Table 12-26 Maximum Predicted Project 24-Hour Average $PM_{2.5}$ GLCs (Pumping Station)

ID	Maximum 24-Hour Average Concentration (µg/mg³)					Project Contribution Relative to APAC
	Project	Normal Background Year		Bushfire Impacted Background Year		
		Background	Cumulative	Background	Cumulative	
R18	0.62	0	0.62	1	1.6	2.5%
R19	0.32	0	0.32	0.80	1.1	1.3%
R20	0.19	0.10	0.29	0	0.19	0.8%
Criteria			**25**		**25**	

Table 12-27 Maximum Predicted Cumulative Annual Average $PM_{2.5}$ GLCs (Pumping Station)

ID	Maximum 24-Hour Average Concentration (µg/mg³)					Project Contribution Relative to APAC
	Project	Normal Background Year		Bushfire Impacted Background Year		
		Background	Cumulative	Background	Cumulative	
R18	0.054	2.7	2.8	3.5	3.6	0.7%
R19	0.030	2.7	2.8	3.5	3.6	0.4%
R20	0.014	2.7	2.7	3.5	3.5	0.2%
Criteria			**8**		**8**	

12.6 Residual impacts

Residual impacts are those that remain once mitigation and management measures have been implemented. This section describes potential residual impacts during the operation phase of the Project once mitigation and management measures have been considered and applied.

12.6.1 Mining Activities

Elevated background concentrations of PM_{10} and $PM_{2.5}$ (representative of normal and bushfire years) result in exceedances of the 24-hour criteria at all receptors before the Project contribution is considered. Depending on the modelled scenario, there is one additional exceedances predicted at one or more of R1, R4, R7, R9, R12 and R15 under normal and bushfire background conditions.

Table 12-28 summarises the second highest predicted PM_{10} GLCs at valid sensitive receptors for each Scenario. The second and third highest predicted Project GLCs in any year are also provided and demonstrate that these are significantly lower than the 5-year maximum. Analysis of the model data indicates that the primary contributor to the predicted elevated impacts at these receptors is the wheel-generated dust associated with haulage of topsoil, overburden and ore. Watering of the haul routes has been assumed to provide a control of 95% on wheel generated dust emissions. The maintenance of haul road surfaces and use of chemical stabilisers could provide additional mitigation benefits reducing the emissions and potential impacts further.

Table 12-28 Maximum Predicted Project 24-Hour Average PM_{10} GLCs by Scenario

Modelled Scenario	Receptor ID	Criterion (µg/m³)	Maximum Concentration (µg/m3)	Project Contribution Relative to Criterion	Second Highest Predicted Concentration (µg/m3)
1	R12	25	50%	21	13
2	R12	19	38%	14	13
3	R2	8.2	16%	3.7	1.9
4	R2	17	34%	6.9	5.5

The annual average PM_{10} criterion, 24-hour and annual average $PM_{2.5}$ criteria, and annual average RCS criterion are met at all sensitive receptors under all modelled scenarios with the Project contributions generally being a relatively low percentage of the relevant criterion (maximum contribution of 50% for 24-hour average PM_{10} under Scenario 1).

The annual average metals (as PM_{10}) GLCs at the most impacted sensitive receptor meets the APACS for all metals, with the exception of chromium due to an assumed background concentration that exceeds the APAC before the Project contribution is added. The maximum predicted Project contribution of chromium is approximately 28% of the APAC, and 5.6% of the background concentration.

Regarding the potential for the Project to impact dust deposition rates, indicative modelling indicates that a maximum monthly deposition rate at a sensitive receptor of 0.14 g/m²/month, at receptor R12. When compared to the deposition rate guideline of 2 g/m²/month and baseline depositional dust monitoring results, no significant depositional impacts at sensitive receptors are indicated, such that nuisance impacts are deemed unlikely. Furthermore, the isopleths presented in EES Technical Report G: Air Quality Impact Assessment indicate that deposition rates of greater than 2 g/m²/month are generally limited to within the Project area boundaries, and therefore suggest that there is little risk of deposition rates approaching the 30 g/m2/month necessary to impact surrounding vegetated areas and crops. The relatively low deposition rates predicted at sensitive receptors would result in corresponding low impacts to rainwater tanks, with deposition of metals unlikely to lead to exceedances of Australian drinking water guidelines.

It is anticipated that a combination of best practice haul route construction, maintenance and watering, including reactive dust management (e.g. reactive to visual inspection and real-time dust monitoring, refer **Section 12.7**) could reduce fugitive dust emissions such that impacts to air quality at these receptors could be further reduced.

12.6.2 Power Station and Pumping Station

Maximum predicted NO_2 GLCs at or beyond the site boundary resulting from the power station emissions exceed the 1-hour human health criterion and the annual average vegetation criterion. Isopleths (Figure 53 of EES Technical Report G: Air Quality Impact Assessment) indicate that exceedances of the health criterion extend to between 500 and 800 metres of the site boundary into the surrounding field. Similarly, isopleths (Figure 54 of EES Technical Report G: Air Quality Impact Assessment) indicate that exceedances of the vegetation criterion extend to approximately 50 metres from the site boundary.

$PM_{2.5}$ GLCs resulting from power station emissions to air are negligible at the receptors such that cumulative concentrations are unlikely to be increased by a measurable amount.

Likewise, the maximum predicted NO_2 GLCs at or beyond the site boundary resulting from the pumping station emissions exceed the 1-hour human health criterion and the annual average vegetation criterion. The isopleths (Figure 55 of EES Technical Report G: Air Quality Impact Assessment) indicate that exceedances of the health criterion extend to approximately 200 metres of the pumping station. The isopleths (Figure 56 of EES Technical Report G: Air Quality Impact Assessment) indicate that there are unlikely to be exceedances of the vegetation criterion extending beyond approximately 10-15 metres of the pumping station.

$PM_{2.5}$ GLCs resulting from pumping station emissions to air are negligible at the receptors such that cumulative concentrations are unlikely to be increased by a measurable amount.

The geographical extent that both the power station and pumping station GLCs are predicted to exceed the NO_2 1-hour criterion is limited to areas which would seldomly be occupied by members of the public, including farmers. In the case of the power station, the potentially impacted land is a neighbouring field with no public access. The potentially impacted area surrounding the pumping station includes fields, roadways and the lake. While third party access is possible to all of these areas, it is likely to be infrequent and for no more than a few minutes at a time.

While the geographical extent to which the emissions from the power station are predicted to exceed the annual average criterion relating to vegetation is not large, it does suggest that there may be some detrimental effects to those areas, especially in the case of the power station where the impacted may be to an area of cropland. The annual average criterion relating to human health is not applicable in this area due to the absence of human receptors over this length of time. A reduction of NO_x emissions, and therefore NO_2 impacts, could potentially be achieved by using emission reduction technology (refer to **Section 12.8.1**).

Several other sensitive receptors are located in the vicinity of, but further away from the furthest receptors form the Project mining area listed in Table 12-1. These receptors will be impacted by Project emissions to a lesser degree due to their increased separation from the Project.

12.7 Closure and Rehabilitation Impact Assessment

It is assumed that impacts to air quality associated with decommissioning would be approximately equal to or less than those associated with construction (refer **Section 12.4**). Mitigation and management that aim to reduce impacts to as low a level as is reasonably practicable are summarised in **Section 12.8**.

12.8 Summary of mitigation and management measures

12.8.1 Mitigation and management measures

The mitigation and management that are proposed to avoid, mitigate or manage air quality impacts associated with the Project are summarised in **Table 12-29**.

Table 12-29 Management and Mitigation Measures Relevant to Air Quality

Measure ID	Management or Mitigation Measure	Phase
General		
MM-AQ1	Minimise air emissions as far as reasonably practicable– General Practice: All staff to receive a site induction including details of the various ways dust can be generated, methods to minimise dust generation, requirement for speed restrictions across the site and on public unsealed roads particularly for road truck (below the posted speed limit) and their responsibility to minimise and report observed dust generation. A Dust Environmental Management and Monitoring Plan (DEMMP) will be prepared ahead of Project construction. The DEMMP would capture high risk activities, controls, management practices and would detail a dust monitoring program. The DEMMP would be prepared in accordance with: • EPA Publication 1961 Guideline for assessing and minimising air pollution. • EPA Publication 1823.1 Mining and quarrying - guide to preventing harm to people and the environment • EPA Victoria website How to control dust from your business.	All phases

Measure ID	Management or Mitigation Measure	Phase
MM-AQ2	Minimise air emissions as far as reasonably practicable– Mine planning: Employ best practice across all aspects of mining operations to minimise air emissions as much as possible, that will include as a minimum: • Consideration of weather conditions into weekly and daily mine plans. • Utilising water spray and misting systems to supress dust emissions in live active working areas. • Water spray systems will be utilised where dust from mobile plant material movements and stockpiles cannot otherwise be practically contained. • Excavator and loader operators will minimise the height from which material is dropped into trucks. • Trucks carrying uncovered loads of dry material on internal roads, if cannot be avoided, to be loaded below 300 mm of the freeboard. • Ensuring mobile fleet reduce speed as much as practical when and where necessary to aid in reducing dust generation and specifically during the following: – During hot and dry conditions; – where/when excessive wheel generated dust is observed; and – when mine haulage roads are within 500m of a sensitive receptor. • Preparing and maintaining level and well finished haul road surfaces to minimise dust emission from rolling wheeled vehicles. • Regular grading and gravelling of heavy traffic areas such as intersections as required with regular resurfacing of high traffic areas such as intersections to reduce silt build up. • Attentive monitoring and application of suppressants as surface dries out to avoid and minimise emissions as far as reasonably practicable • Progressive consolidation of and/or re-vegetation of exposed areas. • Compaction of stockpile batters (where viability of topsoils for rehabilitation is not impacted) will reduce the amount of loose material that can be eroded by wind. • Sustainable mulches or emulsions and polymers applied to stockpile surface on a periodic (nominally yearly) basis to reduce wind erosion.	Construction Operation
MM-AQ03	Minimise air emissions as far as reasonably practicable– Process plant: All trafficable areas within the process plant footprint will be sealed and would be kept clean through sweeping. Product stockpiles to be located within roofed and three-sided shelters to minimise wind erosion.	Operation
MM-AQ04	Minimise air emissions as far as reasonably practicable– Public roads: Regardless of posted speed limits, road trucks travelling to and from the Project site on unsealed public roads, will be advised to travel at reduced speed to reduce wheel generated dust, through contractual obligations, training and monitoring.	All phases
MM-AQ05	Minimise air emissions as far as reasonably practicable– General Practice: Employ best practice across all aspects to minimise air emissions as much as practicable, such as: • Turning off plant, equipment and vehicles when not in use for an extended period • All equipment/vehicles to be operated and maintained to manufacturer’s specifications in order to minimise exhaust emissions • Requirement under VHM policies to use low emission or solar powered equipment as much as possible to reduce air emissions.	All phases
MM-AQ06	Minimise air emissions as far as reasonably practicable- Equipment and Plant Exhaust Emissions: Select diesel generators employing emission reduction technology such as selective catalytic reduction (SCR; e.g. AdBlue) or use LNG/LPG. Use low emission or solar powered equipment as much as possible to reduce air emissions.	Operation

12.8.2 Monitoring and contingency measures

The monitoring and contingency measures that are proposed to assess air quality impacts associated with the Project are summarised **Table 12-30**.

Table 12-30 Mitigation Measures Relevant to air quality

Measure ID	Mitigation Measure	Phase
1. Project specific air quality monitoring plan	A Project specific Air Quality Monitoring plan will be prepared to: • Set out monitoring responsibilities of staff and contractors • Identify air quality indicators to be monitored • Establish monitoring criteria for the air quality indicators • Set out appropriate air quality monitoring methods, schedules and reporting requirements. (see below).	All phases
2. continuous air quality monitoring	Compliance continuous PM10 and PM2.5 monitoring will be conducted in accordance with relevant Australian Standards at a location representative of where a sensitive receptor(s) is likely to experience the highest particulate concentrations during the operational stage of the Project to demonstrate that dust emissions are being controlled adequately to meet relevant Air Pollution Assessment Criteria (APACs). Monitors will be used that are compliant with the relevant Australian Standards. Monitoring will be conducted by a suitably qualified person and reported on a quarterly frequency (or less if results necessitate more frequent reporting). The data will be reported to the regulators. The information from the data will be communicated to community members and other stakeholders during the construction, operation and closure (including rehabilitation and post-closure) phases of the project in accordance with the Community Engagement Plan.	All phases
3. Compliance monitoring of RCS	Compliance monitoring of RCS (as PM2.5) and heavy metals (as PM10) will be conducted monthly in accordance with relevant Australian Standards at a location representative of where a sensitive receptor(s) is likely to experience the highest particulate concentrations during the operational stage of the Project to demonstrate that dust emissions are being controlled adequately to meet relevant APACs. Monitors will be used that are compliant with the relevant Australian Standards. Monitoring will be conducted by a suitably qualified person and reported on a quarterly frequency (or less if results necessitate more frequent reporting). The data will be reported to the regulators. The information from the data will be communicated to community members and other stakeholders during the construction, operation and closure (including rehabilitation and post-closure) phases of the project in accordance with the Community Engagement Plan.	All phases
4. Monitoring of PM10	Indicative continuous PM10 monitoring will be conducted to provide near real-time feedback to site management with regard to potential dust emission across the site boundaries. Short-term average concentration trigger levels will be used so that site management are alerted (e.g. via SMS) to elevated concentrations such that additional management controls can be actioned to reduce dust levels to below the trigger level as defined by the applicable Trigger Action Response Plan (TARP).	All phases
5. Fugitive dust generation monitoring	A Dust Environmental Management and Monitoring Plan (DEMMP) will be prepared. Visual assessment of both fugitive dust generation, specially that leaving the site boundary, and dust deposition on the vegetation surrounding the site would be detailed as part of the DEMMP. All site personnel will have the responsibility to report observations of any excessive dust generation resulting from their own, or others work. The site manager will implement appropriate mitigation measures (e.g. increased haul road watering and/or further reduced speed limits for road trucks on unsealed site and public roads).	All phases

12.9 Conclusion

The assessment has shown that the construction, operation and decommissioning phases of the Project can be managed such that the objective of avoiding or minimising adverse effects for community amenity and wellbeing, with regard to Project air quality can be met.

The impacts to health and the environment due to dust soiling from construction and decommissioning works of the Project site and the water supply pipeline corridor were assessed to be low, or in some cases negligible, with the application of the proposed dust management and mitigation strategies.

During operation, exceedances of the criterion are predicted at all receptors due to the maximum background concentration exceeding the criterion before the Project contribution is added. The number of additional exceedances (over and above those of the background concentrations) predicted to be generated by the Project are few (between 0 and 3 depending on receptor and stage of mining).

While elevated background concentrations of PM_{10} and $PM_{2.5}$ result in exceedances of the 24-hour criteria at all receptors before the Project contribution is considered, there are no exceedances of the PM_{10} 24-hour APAC due to Project impacts alone with the greatest Project contribution equivalent to 50% of the criterion at nearby receptor R12 under Scenario 1, and 38% under Scenario 2. Over the 5 years of meteorological conditions assessed, the second and third highest predicted corresponding concentrations are significantly lower than these maximums, indicating that out of over 1800 meteorological condition scenarios, significantly elevated concentrations at nearby sensitive receptors are few. Annual average PM_{10}, $PM_{2.5}$ and RCS criteria are met at all receptors.

The power station and pumping station diesel generator emissions are predicted to result in exceedances of the 1-hour average NO_2 concentration beyond the Project boundaries. Due to the rural and relatively remote nature of these Project locations, however, the likelihood of a third party occupying these impacted areas for more than a few minutes at a time is low. While the geographical extent to which the emissions from the power station are predicted to exceed the annual average criterion relating to vegetation is not large, it does suggest that there may be some detrimental effects to those areas, especially in the case of the power station where the impacts may be to an area of cropland. The annual average criterion relating to human health is not applicable in this area due to the absence of human receptors over this length of time. $PM_{2.5}$ GLCs resulting from pumping station emissions to air are negligible at the receptors such that cumulative concentrations are unlikely to be increased by a measurable amount. These findings indicate that the risk of impacts from other products of diesel combustion (e.g. SO_2, VOCs, PAHs etc) would also be low.

The mining schedule, which would generally include only six active blocks at any one time would limit exposed areas subject to wind erosion, with surface consolidation and revegetation occurring throughout the mine life, rather than at the end.

Best practice dust emission mitigation measures would be employed for all aspects of the Project operations including use of water sprays and misting systems and water trucks. Wheel generated dust from haul roads has been identified as the primary potential source of dust emissions, therefore preparing and maintaining level and well finished haul road surfaces with low silt content material would be considered a priority. Contingency measures may include reducing the site speed limit for haul trucks during periods of hot and dry weather coupled with increased water truck application.

In response to the EES evaluation objective described at the beginning of this chapter, impacts of the Project on air quality have been assessed, and mitigation and measurement measures have been identified to avoid, minimise and manage adverse effects on community amenity and wellbeing.