# Appendix 12

# Air Quality Impact Assessment

prepared by

Northstar Air Quality Pty Ltd

(Total No. of pages including blank pages = 121)

This document has been prepared for **R. W. Corkery & Co. Pty. Limited** on behalf of **RZ Resources Limited** by:

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# Copi Mineral Sands Project

# Air Quality Impact Assessment

| | |
|---|---|
| Addressee(s): | R. W. Corkery & Co. Pty. Limited |
| Site Address: | Exploration Licence Areas 8385, 8865, 8312 & 8769 |
| Report Reference: | 20.1066.FR5V3 |
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## Quality Control

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| Copi Mineral Sands Project - Air Quality Impact Assessment | 20.1066.FR5V3 | Final | Northstar | DA, GCG | MD |

## Report Status

| Northstar References | | Report Status | Report Reference | Version |
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| Year | Job Number | (Draft: Final) | (R*x*) | (V*x*) |
| 2020 | 1066 | Revised Final | R5 | V3 |
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## Final Authority

This report must by regarded as draft until the above study components have been each marked as final, and the document has been signed and dated below.

**Martin Doyle** **7 August 2025**

## Non-Technical Summary

R.W Corkery and Co Pty Limited has engaged Northstar Air Quality Pty Ltd on behalf of RZ Resources Limited, to perform an updated air quality impact assessment for an amendment report for the proposed Copi Mineral Sands Project, which is located northwest of Wentworth NSW.

This assessment forms part of the amendment report prepared to accompany the development application for the Project under Part 4 of the *Environmental Planning and Assessment Act* 1979 and has been performed in accordance with the requirements of the NSW Approved Methods document, in association with NSW Planning Secretary Environmental Assessment Requirements.

The air quality assessment report previously submitted in support of the Environmental Impact Statement was dated 23 April 2024 (ref: 20.1066.FR3V4). On 24 June 2024, advice was received from NSW Environment Protection Authority identifying the following issues:

> *The EPA have reviewed the Air Quality Impact Assessment and have identified the following issues:*
> *1. Emissions inventory is not sufficiently transparent;*
> *2. Emissions inventory lacks detail regarding wind erosion of exposed areas;*
> *3. Control factors outlined within the AQIA may be difficult to achieve in practice; and*
> *4. Proposed silt content of haul roads does not reflect figures outlined in the AQIA.*

In addition, NSW Department of Planning, Housing and Infrastructure has provided a request for further information, replicated below:

- *Was heavy metal exposure assessed and modelled in the EIS at each stage/step (yes/how or no/why?);*
- *What are the proposed mitigation and management measures relating to heavy metal exposure in the EIS for each stage/step?;*
- *Was exposure to radiative dust assessed and modelled in the EIS at each stage/step (yes/how or no/why?);*
- *What are the proposed mitigation and management measures relating to radiative dust exposure in the EIS for each stage/step?; and*
- *Provide a technical note prepared by your air quality consultant for dust exposure, including a quantitative assessment of heavy metals and radiative dust based on the available concentrations measured in the collected samples. Compare the results against the current/existing criteria.*

This revised air quality assessment report is an update of the previous submission with additions to address the comments listed above.

Two separate scenarios were subject to assessment, reflecting activities during mining operations. Results of the assessment indicate that predicted incremental concentrations associated with the operation of the Project at non-Project related receptors are minor, and exceedances of the annual average $PM_{10}$ and $PM_{2.5}$ criteria are dominated by the already exceeding background conditions. The contribution of the Project to those exceedances is predicted to be minimal.

A small number of additional exceedances of the 24-hour $PM_{10}$ and $PM_{2.5}$ criteria are predicted, although the background concentrations on those days are either just below, or at the criterion, and the addition of the minimal incremental contribution from the Project results in marginal exceedances. The adopted control measures adopted result in minimal incremental contributions on these days.

In conclusion, the Project can be constructed and operated in accordance with best management practice, to minimise the concentrations of air pollutants on the surrounding environment.

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# 1. INTRODUCTION

R. W. Corkery & Co. Pty. Limited (RWC) has engaged Northstar Air Quality Pty Ltd (Northstar) on behalf of RZ Resources Limited (the Applicant) to perform an air quality impact assessment (AQIA) for the proposed Copi Mineral Sands Project (the Project or Mine Site) which is located approximately 75 kilometres (km) northwest of Wentworth, NSW.

This AQIA forms part of the amendment report prepared to accompany the State Significant Development application for the Project (SSD 41294067) under Division 4.7 of the *Environmental Planning and Assessment Act* 1979.

The AQIA presents an assessment of the impacts of activities associated with the operational phases of the Project. The AQIA has used a quantitative dispersion modelling approach, performed in accordance with the relevant NSW guidelines. The results of the assessment are presented as predicted incremental change, and as a cumulative impact accounting for the prevailing background air quality conditions.

## 1.1. Assessment Requirements

Planning Secretary's Environmental Assessment Requirements (SEARs) for SSD 41294067 have been provided for the Project by the NSW Department of Planning & Environment (DPE) (now NSW Department of Planning, Housing and Infrastructure [NSW DPHI]) on 19 May 2022. The SEARs included input from NSW Environment Protection Authority (NSW EPA).

Table 1 provides a summary of the SEARs relevant to this AQIA.

Table 1 Coverage of SEARs and other Government Agency Requirements relevant to air quality

| Authority | Requirement | Relevant section |
| --- | --- | --- |
| SEARs (December 2023) | An assessment of the likely air quality impacts of the development, including cumulative impacts from nearby developments, in accordance with the *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW* and having regard to the NSW Government's *Voluntary Land Acquisition and Mitigation Policy.* | Section 6 |
| | Ability to comply with the relevant regulatory framework, specifically the *Protection of the Environment Operations Act 1997* and the *Protection of the Environment Operations (Clean Air) Regulation 2010.* | Section 3, Section 6 |
| | A description of the air pollution control techniques from any air emission sources of the development that would be implemented to manage and monitor efficiency and performance (including fugitive dust, particulates, emissions from vehicle movements and greenhouse gases). | Section 7 |
| NSW EPA (4 May 2022)(A) | Details would need to be provided on the proposed measures to manage dust and particulates from all sources. | Section 5.4 |
| | Measures to prevent or control the emission of dust from vehicle movements and particulates from mining activities must be detailed based on the outcome of an assessment for undertaken in accordance with our guidelines the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales'* (EPA, 2016). | Section 6 |
| | The assessment must identify all sensitive receptors in proximity to the proposed development and present the potential impacts on those receptors including worst case scenarios. | Section 6 |

**Note:** (A) NSW EPA advice received for previous SEARs, not available for the most recent (December 2023) SEARs.

It is noted that the SEARs also require:

> *An assessment of the likely greenhouse gas impacts of the development including measures to minimise emissions having regard to the targets set in Climate Change (Net Zero Future) Act 2023 and the EPA's Climate Change Policy and Climate Action Plan, and Commonwealth Safeguard Mechanism reforms.*

This has been provided in a separate document (20.1066.FR6V1, dated 26 June 2025).

Further to the above, the policies, guidelines and plans which have been referenced during the performance of the AQIA include:

- *Protection of the Environment Operations Act* 1997.
- Protection of the Environment Operations (Clean Air) Regulation 2022.
- Approved Methods for the Modelling and Assessment of Air Quality in NSW (NSW EPA, 2022a)
- Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (NSW EPA, 2022b).

## 1.2. Report Revisions

The AQIA report submitted in support of the original EIS was dated 23 April 2024 (Northstar, April 2024). On 24 June 2024 advice was received from NSW EPA (NSW EPA, 24 June 2024) identifying the following issues:

> *The EPA have reviewed the Air Quality Impact Assessment and have identified the following issues:*
>
> *1. Emissions inventory is not sufficiently transparent;*
>
> *2. Emissions inventory lacks detail regarding wind erosion of exposed areas;*
>
> *3. Control factors outlined within the AQIA may be difficult to achieve in practice; and*
>
> *4. Proposed silt content of haul roads does not reflect figures outlined in the AQIA.*

The NSW EPA response includes additional information in an appendix of that advice letter and a recommendation for AQIA revisions. This revised AQIA report is an update of the previous AQIA with the additions outlined in Table 2 to address NSW EPA comments and respond to the recommendations offered.

Table 2 Report revisions to address NSW EPA issues

| Issue | NSW EPA Recommendation | Revisions to the AQIA |
|---|---|---|
| The emissions inventory is not sufficiently transparent | The AQIA be revised to include additional detailed information in the emissions inventory to enable emission estimates to be assessed and replicated. | Appendix C |
| Emissions inventory lacks detail regarding wind erosion of exposed areas | The AQIA be revised to enable emission estimates to be assessed and replicated for exposed areas susceptible to wind erosion. Further specific detail should be provided regarding the calculation of all exposed areas (including rehabilitated/revegetated areas and the off-path storage facility) to ensure the emissions inventory is accurate, transparent, and able to be replicated. The updated AQIA should include consideration regarding the anticipated level of rehabilitation achieved for each scenario. | Section 5.2<br>Appendix C |
| Control factors outlined within the AQIA may be difficult to achieve in practice. | The AQIA be revised to include additional detail of how control efficiencies will be met throughout the lifetime of the project. This includes (but is not limited to) the availability of water/chemical suppressants and the proposed application rates of water/chemical suppressants. The revised AQIA should include the viability of the adopted level of controls to reduce expected emissions. The updated AQIA should confirm whether there are any additional practicable mitigation controls or measures that could be implemented to minimise air emissions or reduce future impacts once the site is operational. | Section 7.1<br>Appendix C |
| Proposed silt content of haul roads does not reflect figures outlined in the AQIA | The AQIA be revised to include specific details of how haul roads will be constructed of low-silt materials and how such material will be sourced. | Section 7.1<br>Appendix C |

In addition, NSW DPHI has provided a request for further information, replicated in Table 3, which also includes where these items have been addressed in this AQIA.

Table 3 Report revisions to address NSW DPHI comments

| NSW DPHI comment | Revisions to the AQIA |
|---|---|
| Was heavy metal exposure assessed and modelled in the EIS at each stage/step (yes/how or no/why?); | Principal and toxic pollutants (including metals) concentrations have been predicted based on site sampling. The methodology is presented in Section 5.3.2 and results are presented in Section 6. |
| What are the proposed mitigation and management measures relating to heavy metal exposure in the EIS for each stage/step?; | Control measures are presented in Section 7. |
| Was exposure to radiative dust assessed and modelled in the EIS at each stage/step (yes/how or no/why?); | Radioactive dust impacts have been considered in a separate report. |
| What are the proposed mitigation and management measures relating to radiative dust exposure in the EIS for each stage/step?; and | Radioactive dust impacts have been considered in a separate report. Control of radioactive dust emissions is considered in Section 7. |
| Provide a technical note prepared by your air quality consultant for dust exposure, including a quantitative assessment of heavy metals and radiative dust based on the available concentrations measured in the collected samples. Compare the results against the current/existing criteria. | This report, and radioactive dust report. |

# 2. PROJECT DESCRIPTION

## 2.1. Overview

The Applicant is proposing to develop and operate an open cut mineral sands mine operation approximately 75 km northwest of Wentworth NSW, to extract and process heavy mineral ore and produce a heavy mineral concentrate (refer Figure 1).

The Copi Mineral Sands deposit occupies land within the following Exploration Licenses (EL) held by the Applicant (refer Figure 1):

- EL8385;
- EL8865;
- EL8312;
- EL9496; and
- EL8769.

The Project would comprise progressive development of an extraction area with capacity to extract up to approximately 27.1 million tonnes per year ($Mt \cdot yr^{-1}$) of ore, and an infrastructure area including:

- Mine Camp and associated infrastructure for up to 220 personnel;
- Offices and Administration Area;
- Workshops, Stores and Laydown Areas;
- A Water Storage Dam and Off-path Storage Facility;
- Stockpile areas; and
- A site access road (approximately 27 km) would be constructed from Anabranch Mail Road to the Infrastructure Area.

Power for the Mine Site would be provided by a combination of diesel generators during construction, and grid power sourced via a 66 kV powerline. A minimum 30 % of the Project's power would be sourced from renewable sources, including the onsite solar farm and/or externally contracted and certified renewable sources.

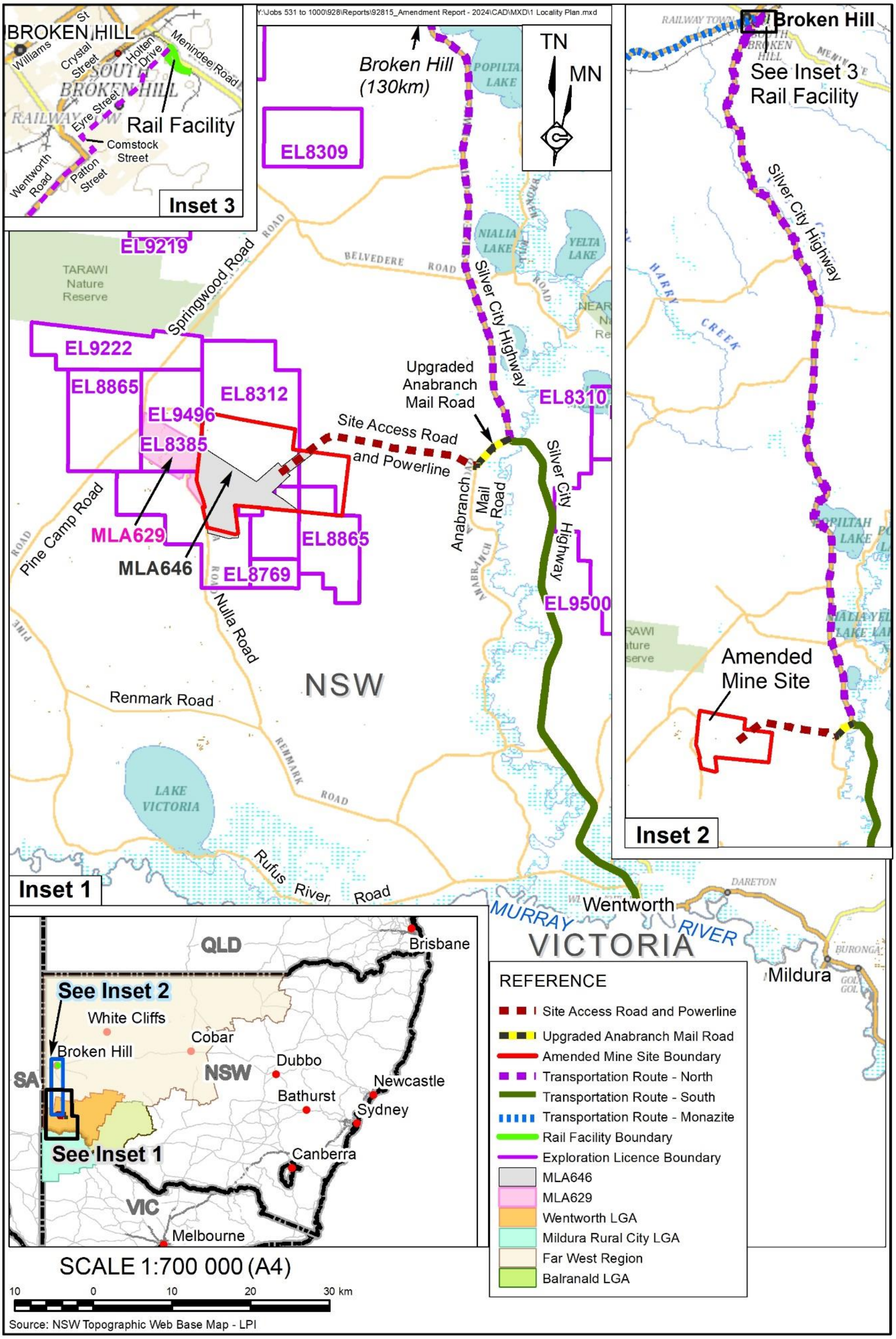
An indicative layout of the Mine Site is illustrated in Figure 2. Mining operations associated with the Project are anticipated to comprise the following:

- Dredge mining from an Extraction Area approximately 9.5 km long and up to approximately 3.0 km wide.
- Mining would commence with a starter pond at the at the southern extent of the deposit. The starter pond would be extracted using conventional free dig, load and haul mining techniques. Extracted overburden, namely material located above the water table with no heavy mineral, would

be used to construct infrastructure within the Mine Site or stockpiled for later use during rehabilitation operations.

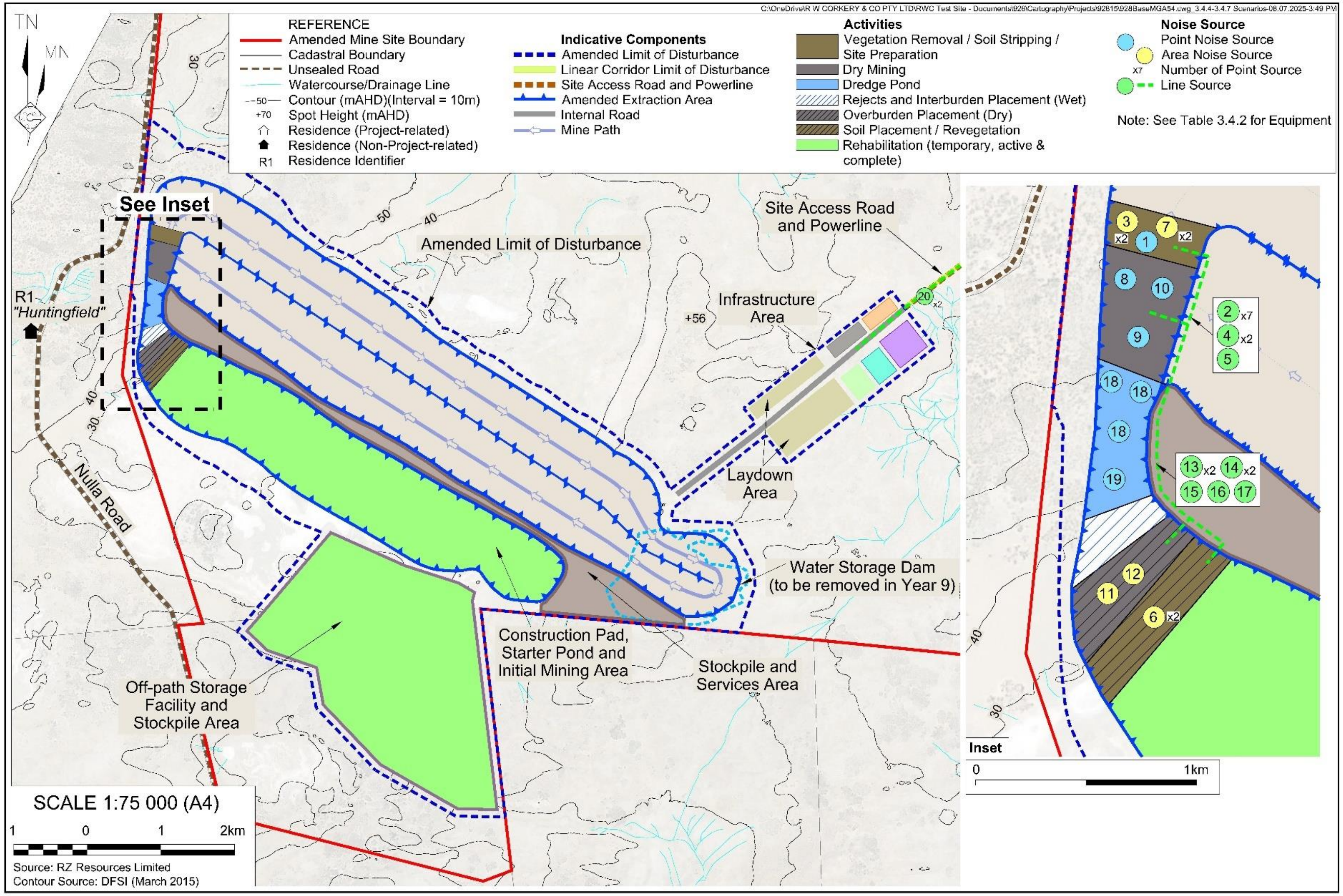
- Following establishment of the starter pond, the dredges would be installed, followed by the floating Wet Concentration Plant.
- Interburden, namely material located below the water table with uneconomic heavy mineral, would be extracted using floating dredges. Interburden would initially be transferred to the Off Path Storage Facility. Once the dredge pond has achieved its full operational size, extracted interburden would be used to backfill completed sections of the Extraction Area.
- Ore, namely material with sufficient heavy mineral to justify processing, would be extracted using a floating dredge. The ore would be transferred to the floating Wet Concentration Plant for processing.
- Reject from the Wet Concentration Plant would initially be transferred to the Off Path Storage Facility. Once the dredge pond has achieved its full operational size, reject would be combined with the extracted interburden to backfill completed sections of the Extraction Area.
- The placed reject and interburden would be covered by overburden and soil before being rehabilitated.

Figure 1 Locality plan




**Source**: RWC

Figure 2 Indicative mine layout




**Source**: RWC

The Project is expected to operate for approximately 26 years, including:

- Construction period of approximately three years;
- Mining operations of up to approximately 18 years; and
- A post-mining rehabilitation period of approximately five years following cessation of mining activities.

### 2.1.1. Proposed Mining Operations

The proposed mining and processing methods associated with the amended project are unchanged from the original project, although a description of the proposed mining and processing operations is presented below for completeness.

#### Dry Mining Operations

Mining operations would commence with removal of vegetation and soil. This would be followed by extraction of overburden using conventional free dig, load and haul open cut mining methods. The thickness of overburden to be removed using this method would vary depending on the depth from surface to the water table. Where required, multiple benches would be established to ensure safe operation of the mining plant. Extracted overburden would be used to cap the Off-path Storage Facility and construct the final landform.

Overburden placed in-pit would typically be placed close to the advancing face of the landform under construction before being pushed over the face using a bulldozer. Placed material would be compacted through the action of laden and unladen haul trucks passing and repassing over the placed material, as well as dozing. The overburden backfilling process may be carried out in benches to ensure geotechnical stability.

No drilling or blasting is required to facilitate mining.

#### Dredge Mining Operations

Once the overburden has been extracted, dredge mining operations would extract interburden and ore. The Applicant anticipates commissioning and operating two jet suction dredges and one cutter suction dredge. These dredges would use high pressure water jets and a rotating cutter head to extract material which would then be removed using a suction pipe.

The Applicant would initially excavate a starter pond and would install a small, temporary dredge to deepen and enlarge the pond sufficiently to allow the first dredge to be launched.

During construction of the dredges and Wet Concentration Plant, water would be pumped from the starter pond to the Water Storage Dam. Once the first dredge has been assembled, stored water within the Water Storage Dam would be returned to the construction pond, flooding the construction pad and allowing the first dredge to be floated off. Once complete, the process would be repeated for the second and third dredges and the Wet Concentration Plant.

Typically, two dredges would extract interburden while one dredge would extract ore once the floating Wet Concentration Plant has been installed. Each dredge would extract material to be pumped to the Wet Concentration Plant, with material from the interburden dredges passing directly to the reject circuit.

A full description of the material movement schedule is presented in Section 3 of the main amendment report.

## Processing and Rejects Management

The Wet Concentration Plant would be established on a floating platform located within the dredge pond. The Plant would include the following circuits:

- A Feed Preparation Circuit:
  - Feed from the ore dredge would be pumped to a rotating trommel. The trommel would progressively separate sand from oversize material greater that 2 mm in size, with the oversize material placed directly back into the dredge pond.
  - Undersize material would then pass through a series of cyclones that would separate the sand from the very fine material, or slimes, less than 53 µm in size. The coarser material, or cyclone underflow, would be pumped to the spiral circuit, while the finer material or cyclone overflow would be treated with flocculant and settled within a thickener. Thickened fines would be transferred to the Reject Circuit, with recovered water directed to the dredge pond.
- A Spiral Circuit:
  - Following removal of oversize and slimes, the ore would be passed to the spiral circuit where it would be processed through a series of spiral separators and fine screens to separate the denser heavy mineral, namely ilmenite, zircon, rutile, leucoxene, monazite and xenotime, from the less dense gangue or quartz and aluminium silicate minerals. The material would be processed in stages, with a series of recycle loops consisting of roughing, middlings, fine screening, cleaning, scavenging and recleaning stages to maximise the heavy mineral concentration within the concentrate while minimising loss of heavy mineral to rejects.
- Heavy Mineral Concentrate Washing and Stockpiling Circuit:
  - Heavy mineral concentrate from the spiral circuit would be transferred to a land-based dewatering cyclone which would dewater the concentrate. The concentrate would then be

transferred as a damp concentrate to the Rare Earth Concentrate Plant and the water would be returned to the dredge pond.

- A Reject Circuit:
  - Reject (including thickened slimes) from the feed preparation and spiral circuits and interburden from the interburden dredges would be pumped to a rejects circuit. Flocculant will be added to the rejects and thickened slimes, before being co-disposed sub-aquas. Interburden will be disposed sub-aquas without any treatment. Land based stackers or cyclones could also be used if and when required to dispose of the interburden.
  - The reject and interburden would comprise primarily coarse to fine sand. This material would settle relatively quickly, with the water component returning to the dredge pond. The reject and interburden would naturally consolidate to form a beach, with an underwater face that would slope back into the dredge pond. Once sufficiently consolidated and stabilised, overburden would be placed over the reject and interburden to further promote consolidation and compaction of the material prior to shaping the final landform and rehabilitation.
  - Following the commencement of dredge mining, there would be a period during which the dredge pond would not have sufficient capacity to accept rejects and interburden. Until sufficient capacity has been established, rejects and interburden would be placed into the Off Path Storage Facility.
  - The final design of the Off-path Storage Facility would be prepared by a suitably qualified and experienced engineering consultancy.
  - Following commencement of material placement into the dredge pond, placement of interburden and reject material into the Off-path Storage Facility would cease and the Applicant would complete the landform with overburden material, capping the wet placed material. The resultant landform would then be contoured to design, topsoil placed and rehabilitated.

### 2.1.2. Mine Site Road Network

The internal road network, namely those roads inside the security gate that would not be publicly accessible, would provide access for light and heavy vehicles to the operational areas of the Mine Site. These roads may be classified as:

- Heavy vehicle roads, suitable for use by the mine haulage fleet and other heavy vehicles: and,
- Light vehicle roads, suitable for use by the light vehicle fleet.

Internal roads would be constructed adjacent to the proposed Extraction Area and would be relocated and reconstructed as necessary. Heavy vehicle roads would generally have the following design criteria.

- A width sufficient to allow two laden haul trucks to pass.
- An unsealed pavement suitable for all weather heavy vehicle use.
- Culverts and under road and roadside drainage as required.

Light vehicle roads would typically be narrower than the proposed heavy vehicle roads and their use would be restricted to particular classes of vehicles.

Where practicable, the pavement of internal roads would be constructed of low-silt materials to minimise dust lift off and the volume of water required for dust suppression. Polymer-based dust suppressants may be used to minimise dust lift-off. Water for mixing the dust suppressants would typically be sourced from sediment basins and clean water storage facilities. When water from those sources is not available, low salinity treated groundwater would be used for dust suppression. Untreated groundwater with elevated salt levels would only be used in exceptional circumstances. This would minimise the potential for salt accumulation in soils underlying or adjacent to the internal roads.

Finally, all roads would be delineated using guideposts at suitable intervals and all vehicles would be required to remain on the marked roads or within defined work areas. This would limit the formation of unplanned and unnecessary tracks.

Where roads are no longer required for an operational purpose, they would be barricaded to prevent vehicular access and rehabilitated during progressive rehabilitation.

### 2.1.3. Offsite Transportation

Heavy mineral concentrate would be transported off-site by heavy vehicles (AB-quad [Type 2] road train,) north to a rail facility at Broken Hill via the Silver City Highway and Anabranch Mail Road, or south to Wentworth, also via Anabranch Mail Road and Silver City Highway. All material would be sealed in containers prior to leaving the Mine Site, and emissions to air associated with the Broken Hill or Wentworth facilities would be limited to those associated with vehicle movements.

### 2.1.4. Power Generation

Power for construction and emergency backup during operations would be provided by modular silenced diesel-powered generators located within the Power Station area.

The generators would have a maximum combined capacity of 30 MW (likely substantially less). Diesel for the power station would be sourced commercially and transported to site by road.

Power for the operational phase of the Project would be provided via a proposed 66 kV transmission from the 220 kV Buronga to Broken Hill Transmission Line. Following connection of the 66 kV power line, the majority of diesel generators would be removed from site, with sufficient generation capacity retained for emergency operations only.

The Applicant has committed to ensure that following commissioning of the 66 kV transmission line the Project would source a minimum of 30 % of the electricity used from renewable sources, with a intention of increasing that proportion with time. The Applicant would contract the required renewably sourced power from third-party suppliers.

### 2.1.5. Hours of Operation

Presented in Table 4 is a summary of the proposed hours of operation of the Project.

**Table 4 Proposed hours of operation**

| Activity | Proposed days of operation | Proposed hours of operation |
|---|---|---|
| Land preparation | 7 days per week | 7:00 am to 6:00 pm |
| Construction operation:<br>- Road construction within Broken Hill LGA<br>- All other construction | 7 days per week[1]<br>7 days per week | 7:00 am to 10:00 pm[1]<br>24 hours per day |
| Mining operations | 7 days per week | 24 hours per day |
| Processing operations | 7 days per week | 24 hours per day |
| Transportation operations:<br>- Heavy mineral concentrate transportation within Broken Hill LGA<br>- All other transportation | 7 days per week<br>7 days per week | 7:00 am to 10:00 pm<br>24 hours per day |
| Maintenance operations | 7 days per week | 24 hours per day |
| Rehabilitation operations | 7 days per week | 7:00 am to 6:00 pm |

**Notes**: [1] Or as instructed by the relevant road authority

### 2.1.6. Equipment

Presented in Table 5 is a summary of the indicative mining fleet proposed for the Project.

Table 5 Indicative mining fleet

| Equipment | Indicative make and model | Number |
|---|---|---|
| **Concentrate management** | | |
| Excavator | Komatsu PC300 or equivalent | 2 |
| Bulldozer | CAT D9 | 1 |
| Haul truck | CAT 745 or equivalent | 3 |
| Wheel Loader | CAT 966 or equivalent | 1 |
| **Overburden Management** | | |
| Excavator | EX2600 | 1 to 3 |
| Haul Truck | CAT 785 | 3 to 8 |
| Bulldozer | CAT D10 | 1 to 3 |
| Grader | CAT 16K | 1 to 2 |
| Bulldozer | CAT D9 | 1 to 2 |
| Scraper | CAT Scraper | 2 |
| Excavator | CAT390 | 1 |
| Excavator | CAT349 | 1 |
| Excavator | CAT336 | 1 |
| Wheel Loader | CAT992G | 1 |
| Wheel Loader | CAT980K | 1 |
| Articulated Haul Truck | Volvo A60H | 2 to 3 |
| Articulated Haul Truck | Bell Moxy B50D | 2 to 3 |
| Grader | CAT14M Grader | 1 to 2 |
| Water Truck | CAT773 Water truck | 1 |
| Water Cart | Moxi Watercart | 1 |
| Water Cart | CAT777 WC | 1 |

**Note:** Not including Dredges and Wet Concentration Plant

In addition to the mining fleet outlined in Table 5, road trucks (AB-quad road train) would be used, and diesel fired generators are also proposed to be used during construction.

## 2.2. Identified Potential for Emissions to Air

The processes which may result in the emission of pollutants to air during mine establishment and mining operations may include:

- Vegetation and topsoil removal;
- Overburden and interburden removal;
- Ore extraction;
- Ore processing;
- Loading, movement, and unloading of haul trucks on-site;
- On and off-site movement of trucks carrying heavy mineral concentrate;
- Wind erosion of disturbed areas; and

- Emissions from vehicle and equipment exhaust.

The specific pollutants of interest associated with those activities are:

- Total suspended particulate (TSP) assessed as TSP and deposited dust;
- Particulate matter with an aerodynamic diameter of 10 microns ($PM_{10}$) or less;
- Particulate matter with an aerodynamic diameter of 2.5 microns ($PM_{2.5}$) or less;
- Silica (Si); and
- A range of toxic metals and principal toxic air pollutants.

The removal of interburden and ore by wet dredging, the processing of ore in the Wet Concentration Plant, and pumping of rejects and slimes are all wet processes and will correspondingly not generate emissions of particulate matter.

Emissions of $NO_X$, carbon monoxide (CO) and sulphur dioxide ($SO_2$) related to diesel combustion in plant and machinery, power generation during construction, and LPG use during operations in dryers, would also be experienced (in addition to particulates considered above). Given the distances between the Project (Infrastructure Area) and nearest non-Project related sensitive receptors (approximately 11 km), and the quantity of equipment operating on site, it is not anticipated that emissions associated with diesel combustion would be a significant contributor to total site emissions and have not been addressed further.

A range of soil and material sampling has been performed at the Project Site and results provided by the Applicant to assist in the performance of the AQIA. Detailed results are provided in Section 5.3.2, but a summary of toxic metals, and principal and individual toxic air pollutants with an associated criterion measured within material at the Project Site are:

- Antimony (Sb);
- Arsenic (As);
- Barium (Ba);
- Beryllium (Be);
- Cadmium (Cd);
- Chromium (Cr);
- Copper (Cu);
- Manganese (Mn);
- Mercury (Hg);
- Nickel (Ni);
- Silver (Ag); and
- Thallium (Tl).

The potential impacts associated with these pollutants have been quantified within this AQIA.

# 3. LEGISLATION, REGULATION AND GUIDANCE

## 3.1. NSW EPA Air Quality Criteria

### 3.1.1. Criteria Air Pollutants

State air quality guidelines adopted by the NSW EPA are published in the *'Approved Methods for the Modelling and Assessment of Air Quality in NSW'* (NSW EPA, 2022a) (the Approved Methods) which has been consulted during the preparation of this assessment report.

The Approved Methods lists the statutory methods that are to be used to model and assess emissions of criteria air pollutants from stationary sources in NSW. Section 7.1 of the Approved Methods clearly outlines the impact assessment criteria to be applied.

The criteria listed in the Approved Methods are derived from a range of sources (including National Health and Medical Research Council [NHMRC], National Environment Protection Council [NEPC], Department of Environment [DoE], and World Health Organisation [WHO]).

The criteria specified in the Approved Methods are the defining ambient air quality criteria for NSW. The standards adopted to protect members of the community from health impacts in NSW are found in Table 6.

**Table 6 NSW EPA impact assessment criteria**

| Pollutant | Averaging period | Units | Criterion | Notes |
|---|---|---|---|---|
| Particulates (as $PM_{10}$) | 24 hours | $\mu g \cdot m^{-3}$ [(a)] | 50 | Numerically equivalent to the Ambient Air Quality National Environment Protection Measure (AAQ NEPM)[(b)] standards and goals. |
| | 1 year | $\mu g \cdot m^{-3}$ | 25 | |
| Particulates (as $PM_{2.5}$) | 24 hours | $\mu g \cdot m^{-3}$ | 25 | |
| | 1 year | $\mu g \cdot m^{-3}$ | 8 | |
| Particulates (as total suspended particulate [TSP]) | 1 year | $\mu g \cdot m^{-3}$ | 90 | |
| Deposited dust | 1 year | $g \cdot m^{-2} \cdot month^{-1}$ [(c)] | 2 | Assessed as insoluble solids as defined by AS 3580.10.1 |
| | | $g \cdot m^{-2} \cdot month^{-1}$ [(d)] | 4 | |
| Lead (Pb) | 1 year | $\mu g \cdot m^{-3}$ | 0.5 | Refer Section 5.3.2 |

**Notes:** (a): micrograms per cubic metre of air
(b): National Environment Protection (Ambient Air Quality) Measure
(c): Maximum increase in deposited dust level
(d): Maximum total deposited dust level

### 3.1.2. Respirable Crystalline Silica

Given the nature of the material to be extracted and processed at the Project Site, respirable crystalline silica (RCS) may be generated during those activities. NSW EPA do not provide air quality criteria for RCS, although Environment Protection Authority Victoria (EPA VIC) in their State Environmental Planning Policy (SEPP) Protocol for Environmental Management: Mining and Extractive Industries (PEM) (EPA VIC, 2007) do include an annual average criterion for RCS (assessed as $PM_{2.5}$) as 3 $\mu g{\cdot}m^{-3}$, which has been adopted from the California EPA Office for Environmental Health Hazard Assessment Reference Exposure Levels.

Furthermore, EPA South Australia (SA EPA) provide an interim criterion for RCS concentrations in ambient air associated with mining and extractive industries (EPA SA, 2022).

SA EPA, with input from SA Health, performed a literature review of the modern criteria for RCS in ambient air associated with mining and extractive industries. Based on that review, the SA EPA is adopting an interim respirable crystalline silica (RCS) criterion of 3 $\mu g{\cdot}m^{-3}$ (annual average) for the $PM_{10}$ size fraction of dust in ambient air.

It is noted that EPA VIC and SA EPA have adopted the same averaging period and concentration (3 $\mu g{\cdot}m^{-3}$, annual average) although the size fraction of particulate to which the criterion applied differs, with EPA VIC referencing the $PM_{2.5}$ size fraction, and SA EPA referencing the $PM_{10}$ fraction. $PM_{10}$ concentrations are shown to be greater than $PM_{2.5}$ concentrations (refer Section 6), and therefore this AQIA has adopted the SA EPA criterion which is a conservative assumption.

This criterion is referenced in this assessment and calculates RCS by adjusting annual average $PM_{10}$ modelling results on a *pro-rata* basis to account for the determined maximum free silica content of the extracted material (conservatively taken to be 100 % [w/w]). RCS is generally an occupational health and safety issue (i.e. on-site) rather than an environmental issue (i.e. off-site) when considering mining activities but has been presented within this AQIA for completeness.

### 3.1.3. Individual Toxic Air Pollutants

Section 7.2 of the Approved Methods outlines impact assessment criteria for toxic air pollutants. Principal toxic air pollutants are defined in the Approved Methods on the basis that they are carcinogenic, mutagenic, highly persistent, or highly toxic in the environment.

One principal and one individual toxic air pollutant are associated with the operations at the Mine Site including Barium (Ba) and Beryllium (Be). Table 7 below provides a summary of impact assessment criteria for the relevant toxic air pollutants as outlined in table 12 and table 13 of section 7.2 of (NSW EPA, 2022a). Although air quality criteria for a number of toxic metals are included in table 12 and table 13 of the Approved Methods, these are presented in Section 3.1.4.

Table 7 NSW EPA impact assessment criteria for principal and individual toxic pollutants

| Pollutant | Averaging period | Criterion ($mg \cdot m^{-3}$ (a)) |
|---|---|---|
| Barium (soluble compound) | 1 hour | 0.009 |
| Beryllium and beryllium compounds | 1 hour | 0.000004 |

**Note**: (a) milligrams per cubic metre of air

### 3.1.4. Air Quality Criteria Associated with Toxic Metals

There are 35 metals that can have an impact on human health due to exposure and of these, 23 are toxic metals (Jaishankar, Tseten, Anbalagan, Mathew, & Beeregowda, 2014). Of these 23 toxic metals, NSW Environment Protection Authority (EPA) provide air quality criteria for 12 in the Approved Methods.

The relevant criteria outlined in the Approved Methods are presented in Table 8 and represent the concentration of each toxic metal in the atmosphere not to be exceeded at a sensitive receptor location.

Toxic metals deposition criteria are not provided in the Approved Methods, although incremental and cumulative dust deposition criteria are provided, with these being subject to assessment within this AQIA.

A review of metals deposition criteria has been performed, with a report prepared for the NSW EPA (Project number: C03750-001, (University of Queensland, 2020)) providing several metal deposition guidelines referenced from the German regulation for air pollution control 'Technische Anleitung zur Reinhaltung der Luft' (TA LUFT, 1990, 1999). (TA LUFT, 1990, 1999) also provides additional metals deposition criteria which were not included in (University of Queensland, 2020) but have been reviewed and included in the summary of concentration and deposition criteria presented in Table 8 which, in lieu of NSW guidance, has been used as the basis for the assessment of toxic metals in this AQIA.

## 3.2. Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations* (POEO) *Act* (1997) sets the statutory framework for managing air quality in NSW, including establishing the licensing scheme for major industrial premises (scheduled activities) and a range of air pollution offences and penalties.

Should the Project gain approval the operations would be defined as a scheduled activity under the POEO Act. As such, an Environment Protection Licence (EPL) would be required to be obtained from NSW EPA and once issued would contain a range of conditions related to minimisation of emissions from the site.

Table 8 Toxic metals concentration and deposition criteria

| Heavy metal | Nomenclature in relevant source | Source | Averaging period | Criterion | Units |
|---|---|---|---|---|---|
| Antimony | Antimony and compounds | (NSW EPA, 2022a) | 1-hour | 0.009 | $mg \cdot m^{-3}$ |
| Arsenic | Arsenic and compounds | (NSW EPA, 2022a) | 1-hour | 0.00009 | $mg \cdot m^{-3}$ |
| | Arsenic (protection of human health) | (TA LUFT, 1990, 1999) | 1-year | 4 | $\mu g \cdot m^{-2} \cdot day^{-1}$ |
| | Arsenic (protection of crop land integrity) | | 1-year | 1 170 | $\mu g \cdot m^{-2} \cdot day^{-1}$ |
| | Arsenic (protection of grassland integrity) | | 1-year | 60 | $\mu g \cdot m^{-2} \cdot day^{-1}$ |
| Cadmium | Cadmium and compounds | (NSW EPA, 2022a) | 1-hour | 0.000018 | $mg \cdot m^{-3}$ |
| | Cadmium (protection of human health) | (TA LUFT, 1990, 1999) | 1-year | 2 | $\mu g \cdot m^{-2} \cdot day^{-1}$ |
| | Cadmium (protection of crop land integrity) | | 1-year | 2.5 | $\mu g \cdot m^{-2} \cdot day^{-1}$ |
| | Cadmium (protection of grassland integrity) | | 1-year | 32 | $\mu g \cdot m^{-2} \cdot day^{-1}$ |
| Chromium | Chromium (III) compounds | (NSW EPA, 2022a) | 1-hour | 0.009 | $mg \cdot m^{-3}$ |
| Copper | Copper dusts and mists | (NSW EPA, 2022a) | 1-hour | 0.018 | $mg \cdot m^{-3}$ |
| Lead | Lead | (NSW EPA, 2022a) | 1-year | 0.0005 | $mg \cdot m^{-3}$ |
| | Lead (protection of human health) | (TA LUFT, 1990, 1999) | 1-year | 100 | $\mu g \cdot m^{-2} \cdot day^{-1}$ |
| | Lead (protection of crop land integrity) | | 1-year | 185 | $\mu g \cdot m^{-2} \cdot day^{-1}$ |
| | Lead (protection of grassland integrity) | | 1-year | 1 900 | $\mu g \cdot m^{-2} \cdot day^{-1}$ |
| Manganese | Manganese and compounds | (NSW EPA, 2022a) | 1-hour | 0.018 | $mg \cdot m^{-3}$ |
| Mercury | Mercury (inorganic) | (NSW EPA, 2022a) | 1-hour | 0.0018 | $mg \cdot m^{-3}$ |
| | Mercury (protection of human health) | (TA LUFT, 1990, 1999) | 1-year | 1 | $\mu g \cdot m^{-2} \cdot day^{-1}$ |
| | Mercury (protection of crop land integrity) | | 1-year | 30 | $\mu g \cdot m^{-2} \cdot day^{-1}$ |
| | Mercury (protection of grassland integrity) | | 1-year | 3 | $\mu g \cdot m^{-2} \cdot day^{-1}$ |
| Nickel | Nickel and nickel compounds | (NSW EPA, 2022a) | 1-hour | 0.00018 | $mg \cdot m^{-3}$ |
| | Nickel | (TA LUFT, 1990, 1999) | 1-year | 15 | $\mu g \cdot m^{-2} \cdot day^{-1}$ |

| Heavy metal | Nomenclature in relevant source | Source | Averaging period | Criterion | Units |
|---|---|---|---|---|---|
| Silver | Silver metal | (NSW EPA, 2022a) | 1-hour | 0.0018 | $mg \cdot m^{-3}$ |
| Thallium | Thallium (protection of human health) | (TA LUFT, 1990, 1999) | 1-year | 2 | $\mu g \cdot m^{-2} \cdot day^{-1}$ |
| | Thallium (protection of crop land integrity) | | 1-year | 7 | $\mu g \cdot m^{-2} \cdot day^{-1}$ |
| | Thallium (protection of grassland integrity) | | 1-year | 25 | $\mu g \cdot m^{-2} \cdot day^{-1}$ |
| **Note**: no concentration or deposition criteria are outlined in (NSW EPA, 2022a) or (TA LUFT, 1990, 1999) for the heavy metals presented below: | | | | | |
| Bismuth, Cerium, Cobalt, Gallium, Gold, Iron, Platinum, Thallium (concentration), Tellurium, Tin, Uranium, Vanadium, Zinc | | | | | |

## 3.3. Protection of the Environment (Clean Air) Regulation 2022

The Protection of the Environment Operations (POEO) (Clean Air) Regulation (2022) sets standards of concentration for emissions to air from both scheduled and non-scheduled activities. For the activities performed at the Mine Site, the POEO (Clean Air) Regulation provides general standards of concentration for scheduled premises which are presented in Table 9 for the pollutants of relevance to this assessment.

Further to the requirements in Table 9, Part 4 Clause 15 of the POEO (Clean Air) Regulation requires that motor vehicles do not emit excessive air impurities which may be visible for a period of more than 10-seconds when determined in accordance with the relevant standard.

All vehicles, plant and equipment to be used either at the Mine Site or to transport personnel and materials to and from the Mine Site would be maintained regularly and in accordance with manufacturers' requirements, where these vehicles are under the operational control of the Applicant.

**Table 9 POEO (Clean Air) Regulation – General standards of concentration**

| Air Impurity | Activity | Standard of concentration (group 6)[1] |
|---|---|---|
| Solid particles (total) | Any activity or plant (except as listed below) | 50 $mg \cdot m^{-3}$ |
| | Any crushing, grinding, separating or materials handling activity | 20 $mg \cdot m^{-3}$ |
| Nitrogen dioxide ($NO_2$) or nitric oxide (NO) or both, as $NO_2$ equivalent | Any activity or plant (except boilers, gas turbines and stationary reciprocating internal combustion engines listed below) | 350 $mg \cdot m^{-3}$ |
| | Any turbine operating on gas, being a turbine used in connection with an electricity generation system with a capacity of 30 MW or more | 70 $mg \cdot m^{-3}$ |

**Note:** (1) Group 6 – pursuant to application made on or after 1 September 2005

## 3.4. NSW Voluntary Land Acquisition and Mitigation Policy

The NSW Government published the "*Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments*" (hereafter, the policy) in September 2018 (NSW Government, 2018). The policy is to be applied by consent authorities when assessing and determining applications for mining, petroleum and extractive industry developments that are subject to State Significant Development provisions of the *Environmental Planning and Assessment Act* 1979.

A number of policies and guidelines include Air Quality Assessment criteria to protect the amenity, health and safety of people, including those outlined in Section 3.1. They typically require applicants to implement all reasonable and feasible avoidance and/or mitigation measures to minimise the impacts of a development. In some circumstances however, it may not be possible to comply with these assessment criteria even with the implementation of all reasonable and feasible avoidance and/or mitigation measures. This can occur with large resource projects where the resources are fixed, and there is limited scope for avoiding and/or mitigating impacts. However, as outlined within the policy it is important to recognise that:

- Not all exceedances of the relevant assessment criteria equate to unacceptable impacts.
- Consent authorities may decide that it is in the public interest to allow the development to proceed, even though there would be exceedances of the relevant assessment criteria, because of the broader social and economic benefits of the development.
- Some landowners may be prepared to accept higher impacts on their land, subject to entering into suitable negotiated agreements with applicants, which may include the payment of compensation.

Consequently, the assessment process can lead to a range of possible outcomes.

In the application of the policy, the applicant must demonstrate that all viable alternatives have been considered, and all reasonable and feasible avoidance and mitigation measures have been incorporated into the project design. Should acquisition or mitigation criteria (see Table 10 and Table 11) be exceeded as a result of the project operation then the applicant should consider a negotiated agreement with the affected landowner or acquisition of the affected land. Full details of the negotiated agreement and acquisition process is provided in the policy (NSW Government, 2018).

In relation to air quality, the policy applies specifically to particulate matter (TSP, $PM_{10}$, $PM_{2.5}$ and dust deposition). Applicants are required to assess the impacts of the development in accordance with the Approved Methods guidance (NSW EPA, 2022a). Should exceedances of the relevant particulate matter criteria (refer Section 3.1) be predicted, then comparison with the mitigation and acquisition criteria is performed.

### 3.4.1. Voluntary Mitigation

As outlined in the policy, a consent authority should only apply voluntary mitigation rights where, even with the implementation of best practice management, the development contributes to exceedances of the mitigation criteria outlined in Table 10:

- At any residence on privately owned land; or
- At any workplace on privately owned land where the consequences of those exceedances in the opinion of the consent authority are unreasonably deleterious to worker health or the carrying out of business at that workplace, including consideration of the following factors:
  - The nature of the workplace;
  - The potential for exposure of workers to elevated levels of particulate matter;
  - The likely period of exposure; and,
  - The health and safety measures already employed in that workplace.

Table 10 Particulate matter mitigation criteria

| Pollutant | Averaging period | Units | Criterion | Impact type |
|---|---|---|---|---|
| $PM_{2.5}$ | Annual | $\mu g \cdot m^{-3}$ (a) | 8 | Human health |
| | 24 hour | $\mu g \cdot m^{-3}$ (b) | 25 | Human health |
| $PM_{10}$ | Annual | $\mu g \cdot m^{-3}$ (a) | 25 | Human health |
| | 24 hour | $\mu g \cdot m^{-3}$ (b) | 50 | Human health |
| Total suspended particulate (TSP) | Annual | $\mu g \cdot m^{-3}$ (a) | 90 | Amenity |
| Deposited dust | Annual | $g \cdot m^{-2} \cdot month^{-1}$ (b) | 2 | Amenity |
| | | $g \cdot m^{-2} \cdot month^{-1}$ (a) | 4 | Amenity |

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

Mitigation measures should be directed towards reducing the potential human health and amenity impacts of the development and must be directly relevant to the mitigation of those impacts.

### 3.4.2. Voluntary Acquisition

A consent authority should only apply voluntary acquisition rights where, even with the implementation of best practice management, the development is predicted to contribute to exceedances of the acquisition criteria in Table 11:

- At any residence on privately owned land; or
- At any workplace on privately owned land where the consequences of those exceedances in the opinion of the consent authority are unreasonably deleterious to worker health or the carrying out of business at that workplace, including consideration of the following factors:
  - The nature of the workplace;
  - The potential for exposure of workers to elevated levels of particulate matter;
  - The likely period of exposure; and
  - The health and safety measures already employed in that workplace.
- 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[1].

[1] Voluntary land acquisition rights should not be applied to address particulate matter levels on vacant land other than to vacant land specifically meeting these criteria.

Table 11 Particulate matter acquisition criteria

| Pollutant | Averaging period | Units | Criterion | Impact type |
|---|---|---|---|---|
| $PM_{2.5}$ | Annual | $\mu g \cdot m^{-3}$ (a) | 8 | Human health |
| | 24 hour | $\mu g \cdot m^{-3}$ (b) | 25 | Human health |
| $PM_{10}$ | Annual | $\mu g \cdot m^{-3}$ (a) | 25 | Human health |
| | 24 hour | $\mu g \cdot m^{-3}$ (b) | 50 | Human health |
| Total suspended particulate (TSP) | Annual | $\mu g \cdot m^{-3}$ (a) | 90 | Amenity |
| Deposited dust | Annual | $g \cdot m^{-2} \cdot month^{-1}$ (b) | 2 | Amenity |
| | | $g \cdot m^{-2} \cdot month^{-1}$ (a) | 4 | Amenity |

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

(b): 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.

# 4. EXISTING CONDITIONS

## 4.1. Surrounding Land Sensitivity

### 4.1.1. Discrete Receptor Locations

Air quality assessments typically use a desk-top mapping study to identify 'discrete receptor locations', which are intended to represent a selection of locations that may be susceptible to changes in air quality. In broad terms, the identification of sensitive receptors refers to places at which humans may be present for a period representative of the averaging period for the pollutant being assessed. Typically, these locations are identified as residential properties although other sensitive land uses may include schools, medical centres, places of employment, recreational areas or ecologically sensitive locations.

It is noted that in addition to the identified 'discrete' receptor locations, the entire modelling area is gridded with 'uniform' receptor locations (see Section 4.1.2) that are used to plot out the predicted impacts, and as such the accidental non-inclusion of a location sensitive to changes in air quality does not render the AQIA invalid, or otherwise incapable of assessing those potential risks.

To ensure that the selection of discrete receptors for the AQIA are reflective of the locations in which the population of the area surrounding the Mine Site reside, population density data has been examined. Population density data based on the 2016 census have been obtained from the Australian Bureau of Statistics (ABS) for a 1 square kilometre ($km^2$) grid, covering mainland Australia (ABS, 2017). Using a Geographical Information System (GIS), the locations of sensitive receptor locations have been confirmed with reference to their population densities.

Using ABS data in a GIS, the population density of the area surrounding the Mine Site has been reviewed. The Mine Site and surrounds is located in an area of very low population density (between zero and less than 500 persons·$km^{-2}$).

The Mine Site currently encompasses the five Western Land Leases as follows.

- Warwick – held by the Wentworth Pastoral Company, an entity associated with the Applicant and has been assessed as Project-related.
- Nulla Station – held by a private individual. The Applicant is in the final stages of negotiating a commercial agreement with the owners of this property.
- Huntingfield and Sunshine Stations – owned by a private individual. Mining operations were proposed within this property in the exhibited EIS.
- Belmore Station – owned by a private individual. No surface disturbance is proposed within Belmore.

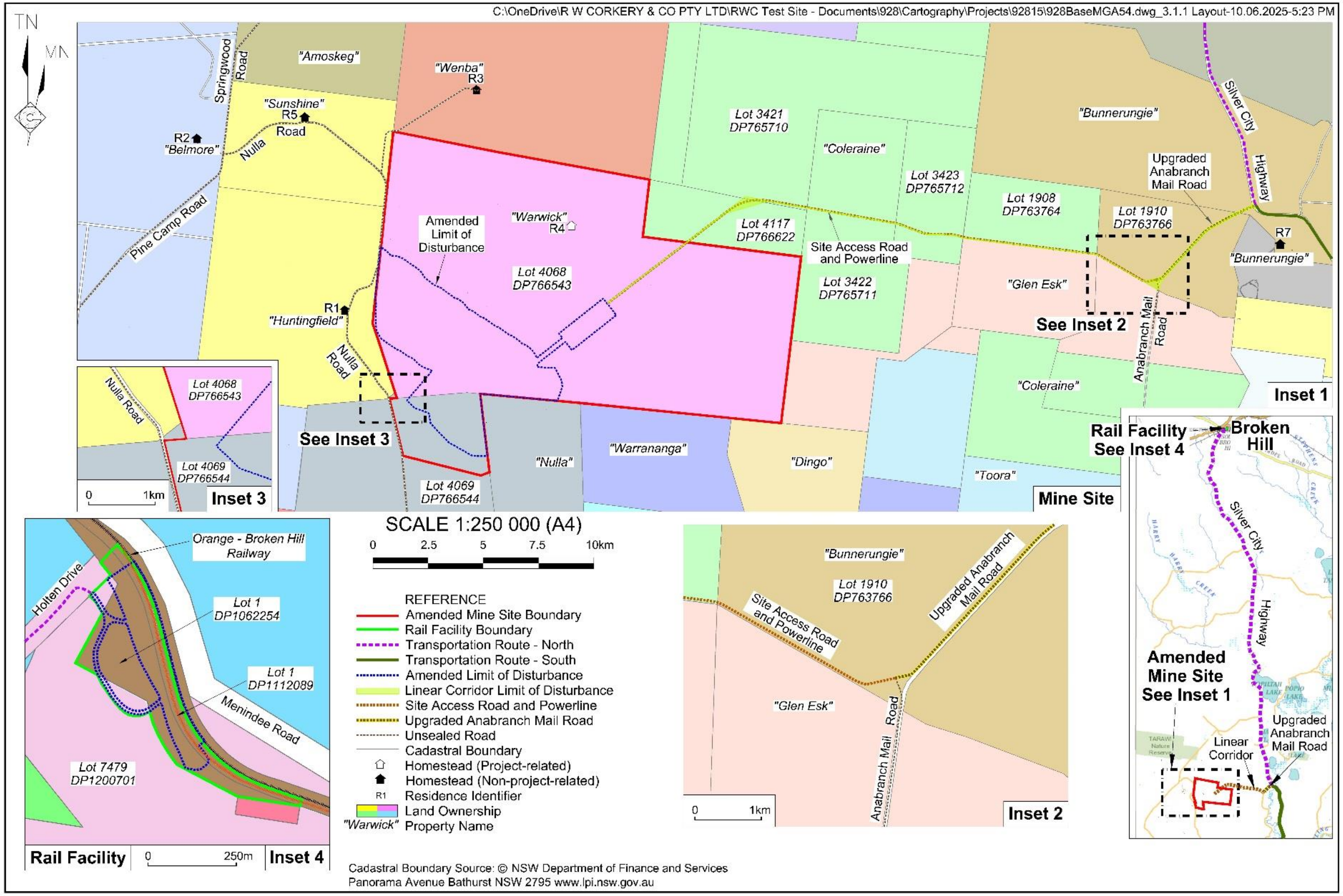
The receptors surrounding the Mine Site adopted for use within this AQIA as presented in Figure 3 and Table 12. It is noted that the nomenclature has been adopted to be consistent with the corresponding noise assessment for the Project.

**Table 12 Discrete sensitive receptor locations**

| Receptor ID | Type | Name | Location (m, UTM 54) | |
|---|---|---|---|---|
| | | | Eastings | Northings |
| R1 | Non-Project related | Huntingfield | 527 465 | 6 279 757 |
| R2 | Non-Project related | Belmore | 520 744 | 6 287 533 |
| R3 | Non-Project related | Wenba | 533 397 | 6 289 733 |
| R5 | Unoccupied | Sunshine | 525 628 | 6 288 406 |
| R6 | Non-Project related | Amoskeg | 524 562 | 6 296 514 |
| R7 | Non-Project related | Bunnerungee | 569 790 | 6 282 698 |
| R8 | Non-Project related | Coleraine | 566 775 | 6 271 855 |
| R9 | Non-Project related | Warranaga | 542 446 | 6 263 925 |
| R10 | Non-Project related | Toora | 566 554 | 6 269 159 |
| R11 | Non-Project related | Springwood | 555 583 | 6 318 366 |
| R12 | Non-Project related | Cooinda | 548 476 | 6 311 672 |
| R13 | Non-Project related | Belvedere | 542 090 | 6 309 887 |
| R4 | Project related | Warwick | 537 702 | 6 283 600 |
| Mine Camp | Project related | Mine Camp | 539 381 | 6 279 743 |

In addition to the assessment of potential air quality impacts at discrete locations, an assessment of impacts in accordance with the NSW Government's Voluntary Land Acquisition and Mitigation Policy (NSW Government, 2018) has been performed, as required by the SEARs.

## Figure 3 Sensitive receptors surrounding the Mine Site




**Source**: RWC

### 4.1.2. Uniform Receptor Locations

Additional to the sensitive receptors identified in Section 4.1.1, a grid of uniform receptor locations has been used in the AQIA to allow presentation of contour plots of predicted impacts.

## 4.2. Meteorology

The meteorology experienced within an area can govern the generation (in the case of wind-dependent emission sources), dispersion, transport and eventual fate of pollutants in the atmosphere. The meteorological conditions surrounding the Mine Site have been characterised using data collected by the Australian Government Bureau of Meteorology (BoM) at a number of surrounding Automatic Weather Stations (AWS), and specifically at Mildura Airport AWS, which is approximately 90 km southeast of the Mine Site. Given the lack of meteorological monitoring in the immediate area surrounding the Mine Site, this AWS is considered the most representative station for the area surrounding the Mine Site as it is significantly closer than others in the area (refer Appendix A). The meteorological conditions measured at Mildura Airport AWS are presented in Appendix A.

The wind roses presented in Appendix A indicate that from 2017 to 2021, winds at Mildura Airport AWS show similar wind distribution patterns across the years assessed, with predominant winds from southern vectors.

The majority of wind speeds experienced at the Mildura Airport AWS between 2017 and 2021 are generally in the range 0.5 meters per second ($m \cdot s^{-1}$) to 8 $m \cdot s^{-1}$ with the highest wind speeds (greater than 8 $m \cdot s^{-1}$) occurring from mostly north and north-easterly directions. Winds of this speed are rare and occur during 1.3 % of the observed hours during the years while calm winds (less than 0.5 $m \cdot s^{-1}$) occur during 4.2 % of hours on average across the years between 2017 and 2021.

To provide a characterisation of the meteorology which would be expected at the Mine Site, a meteorological modelling exercise has been performed.

Data from the year 2019 have been selected for use in the AQIA to provide an approximation of 'representative' conditions surrounding the Mine Site. This year has been selected through examination of meteorology for the five-year period between 2017 and 2021. The year 2019 was selected as being most representative as wind speed and direction measured at Mildura AWS in 2019 were considered to be most representative of the five-year period examined.

## 4.3. Background Air Quality

The air quality experienced at any location will be a result of emissions generated by natural and anthropogenic sources on a variety of scales (local, regional and global). The relative contributions of sources at each of these scales to the air quality at a location will vary based on a wide number of factors including the type, location, proximity and strength of the emission source(s), prevailing meteorology, land uses and other factors affecting the emission, dispersion and fate of those pollutants.

When assessing the impact of any particular source of emissions on the potential air quality at a location, the impact of all other sources of an individual pollutant should also be assessed. This 'background' (sometimes called 'baseline') air quality will vary depending on the pollutants to be assessed and can often be characterised by using representative air quality monitoring data.

The Mine Site is located at significant distance from any of the air quality monitoring stations (AQMS) operated by NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW). The locations of the nearest AQMS are briefly summarised in Table 13 and presented in Appendix B.

Given the location of the Mine Site, AQMS located in South Australia (SA) as operated by SA EPA have also been considered for use in this assessment.

The year 2019 is indicated in Table 13 as this is the year selected for assessment. Further information is provided below.

**Table 13 Closest AQMS to the Mine Site**

| AQMS Location | Source | Approximate distance to Project (km) | 2019 Data | Measurements | | |
|---|---|---|---|---|---|---|
| | | | | $PM_{10}$ | $PM_{2.5}$ | TSP |
| Wagga Wagga North | NSW DPE | 581 | ✓ | ✓ | ✓ | × |
| Albury | NSW DPE | 589 | ✓ | ✓ | ✓ | × |
| Elizabeth Downs | SA EPA | 259 | ✓ | ✓ | ✓ | × |

The closest representative AQMS with data available for the year 2019 (consistent with the meteorological modelling) is noted to be located at Wagga Wagga North and correspondingly, PM data collected at Wagga Wagga North AQMS has been adopted for use in this assessment. It is noted that the use of data from this AQMS is considered to represent a conservative approach to this assessment as there are a greater number of sources of PM surrounding the AQMS location as it is generally more suburban in nature.

The adoption of air quality monitoring data, often collected at significant distances from proposed projects, to represent conditions at those locations is a routinely adopted approach in NSW. NSW DCCEEW operates an extensive air quality monitoring network, generally reflective of the most populated areas of the State. Site specific air quality monitoring funded by applicants can sometimes be used, although for the purposes of use within an AQIA, at least a full year of continuous measurement is required.

Appendix B provides a detailed assessment of the background air quality monitoring data collected at the Wagga Wagga North AQMS.

It is noted that none of the AQMS identified in Table 13 measure concentrations of TSP. This pollutant is of relevance to the expected emissions from the Project. Other sources of data have been adopted to allow representation of the TSP environment in the area surrounding the Project, and a full discussion is provided in Appendix B.

Dust deposition rates are measured by the Applicant in the area surrounding the Mine Site for the assessment of current conditions, and these measurements would be adopted for ongoing air quality management purposes. There are currently two dust monitoring sites located on the boundary of Warwick Station, although historically, dust deposition rates have been measured at up to six locations, as shown in Table 14 and Figure 4. Results of the dust deposition monitoring (as total insoluble solids, $g{\cdot}m^{-2}{\cdot}month^{-1}$) over the most recent six complete years of monitoring (2019 to 2024), plus the most recent measurement for 2025 is presented in Table 14.

**Table 14 Dust deposition results**

| Year | Annual average total insoluble solids deposition rate ($g{\cdot}m^{-2}{\cdot}month^{-1}$) | | | | | | |
|---|---|---|---|---|---|---|---|
| | DMS1 | DMS2 | DMS3 | DMS4 | DMS5 | DMS6 | All sites |
| 2019 | 1.0 (5) | 0.9 (5) | 1.6 (5) | 1.6 (5) | 1.4 (5) | 0.8 (5) | 1.2 |
| 2020 | 2.8 (7) | 2.6 (7) | 8.7 (7) | 2.7 (7) | 0.4 (7) | 0.4 (7) | 2.9 |
| 2021 | 0.8 (5) | 0.9 (5) | 0.7 (5) | 1.5 (5) | 0.4 (5) | 0.3 (4) | 0.8 |
| 2022 | 1.9 (3) | 1.3 (3) | N/A | N/A | 0.3 (3) | 0.2 (3) | 0.9 |
| 2023 | 0.8 (9) | 1.0 (9) | N/A | N/A | 0.5 (5) | 0.5 (5) | 0.7 |
| 2024 | 0.4 (9) | 0.5 (9) | N/A | N/A | N/A | N/A | 0.5 |
| 2025 | 0.3 (3) | 0.4 (3) | N/A | N/A | N/A | N/A | 0.3 |

**Note:** Number of measurements shown in brackets.

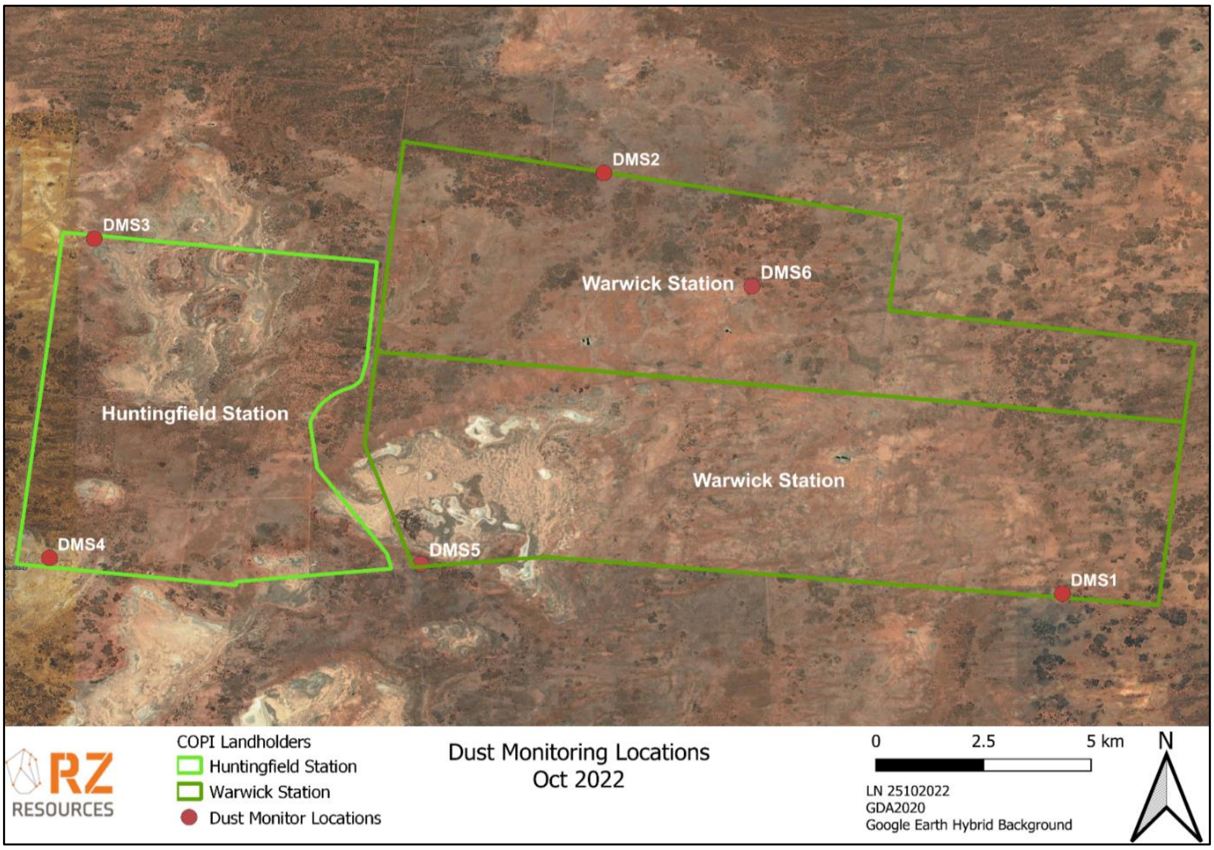
Given that the site average annual average total insoluble solids deposition rates have been measured to be below 2 $g{\cdot}m^{-2}{\cdot}month^{-1}$ over the last 4 complete years of monitoring, with the 2019 (representative year for modelling) rate being 1.2 $g{\cdot}m^{-2}{\cdot}month^{-1}$, the adopted annual average total insoluble solids deposition rate of 2 $g{\cdot}m^{-2}{\cdot}month^{-1}$ (the difference in NSW EPA maximum allowable and incremental impact criterion) is considered appropriate to allow the presentation of a conservative assessment.

No data is available to allow the background silica (Si) concentrations experienced in areas surrounding the Mine Site. In the absence of any information, the background concentration has been assumed to be negligible. This assumption is considered to be reasonable, given the general absence of other sources in close proximity to the Mine Site.

In relation to the principal and toxic air pollutants, and toxic metals outlined in Section 3.1.3, the Approved Methods requires incremental impacts to be assessed, and no background concentrations are required to be included. Nonetheless, background concentrations of those pollutants in the area surrounding the Mine Site would be anticipated to be negligible.

A summary of the air quality monitoring data for the year 2019 is presented in Table 15.

Figure 4 Locations of dust deposition monitoring at the Mine Site




**Source:** RZ Resources

Table 15 Summary of background air quality used in the AQIA

| Pollutant | Ave Period | Units | Measured Value | Notes |
|---|---|---|---|---|
| Particles (as TSP) | Annual | µg·m$^{-3}$ | 82.7 | Estimated on a TSP:$PM_{10}$ ratio of 2.3404 : 1 |
| Particles (as $PM_{10}$) | 24-hour | µg·m$^{-3}$ | Daily Varying | The 24-hour maximum $PM_{10}$ in 2019 at Wagga Wagga North was measured to be 251.7 µg.m$^{-3}$ |
| | Annual | µg·m$^{-3}$ | 35.3 | |
| Particles (as $PM_{2.5}$) | 24-hour | µg.m$^{-3}$ | Daily Varying | The 24-hour maximum $PM_{2.5}$ in 2019 at Wagga Wagga North was measured to be 239.6 µg.m$^{-3}$ |
| | Annual | µg.m$^{-3}$ | 11.3 | |
| Dust deposition | Annual | g·m$^{-2}$·month$^{-1}$ | 2 | Difference in NSW EPA maximum allowable and incremental impact criterion |
| Silica | Annual | µg·m$^{-3}$ | N/A | Assumed to be negligible |

**Note:** Reference should be made to Appendix B

It is noted that the maximum 24-hour $PM_{10}$ and 24-hour $PM_{2.5}$ concentrations measured at Wagga Wagga North exceed the relevant criteria. Discussion is provided in Appendix B is to the sources of those elevated background concentration measurement.

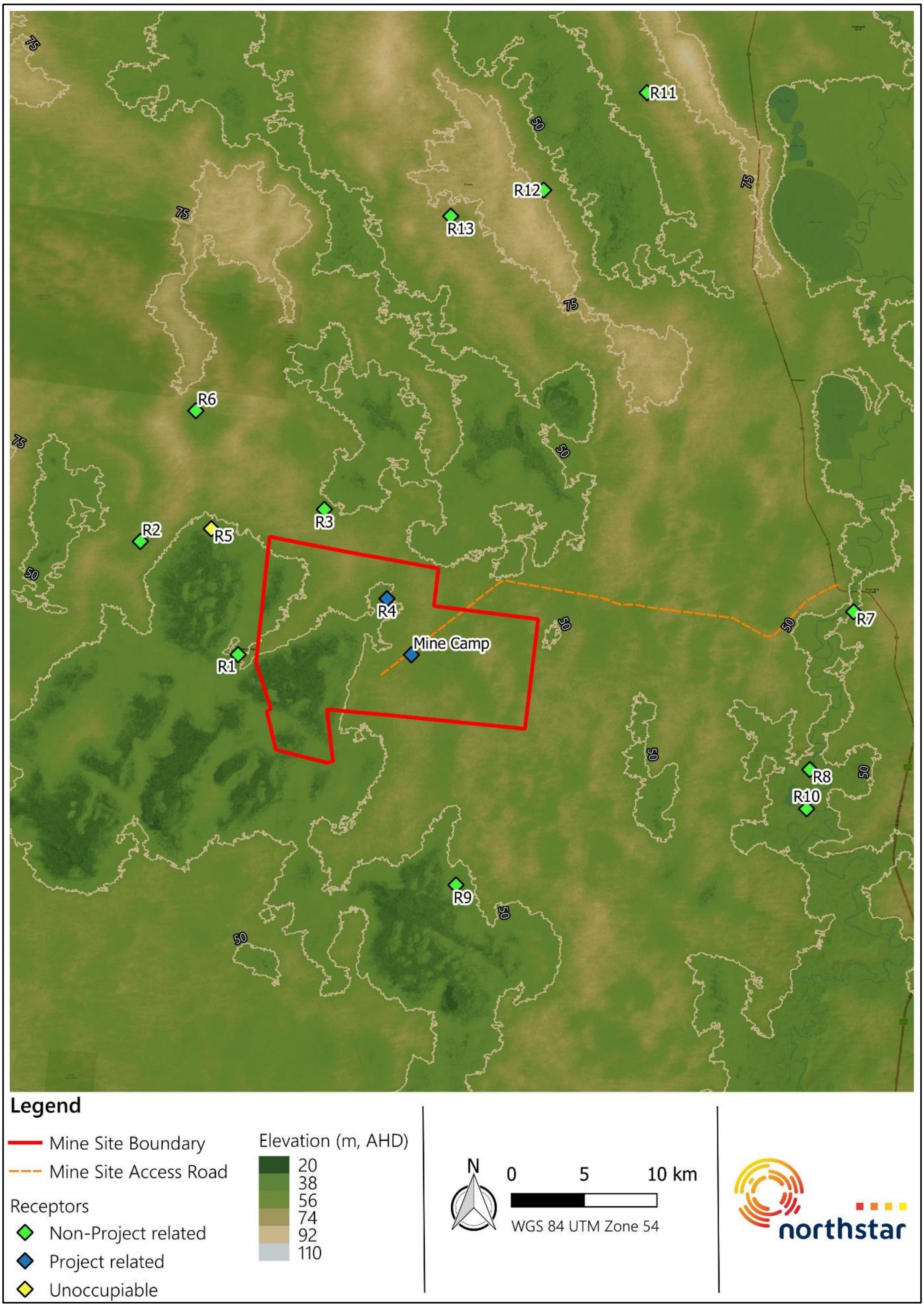
## 4.4. Topography

The elevation of the Mine Site is between approximately 40 m and 55 m Australian Height Datum (AHD). Surface geology within the Mine Site is dominated by aeolian sediments, comprising a series of discontinuous, east-west orientated sand dunes separated by broad swales and sand plains. The topography of the Mine Site and surrounds is presented in Figure 5. The topography of the area, and the locations of surrounding receptors in relation to the Project and surrounding topography has informed the approach to meteorological modelling (refer Section 5.1).

## 4.5. Potential for Cumulative Impacts

The area surrounding the Mine Site is generally rural in nature, with no significant anthropogenic sources of particulate matter that may impact cumulatively with the Project on nearby sensitive receptors. The inclusion of the background air quality data as described in Section 4.3 would appropriately account for any potential cumulative impacts associated with surrounding land uses.

Figure 5 Topography surrounding the Mine Site




**Source**: Northstar

# 5. APPROACH TO ASSESSMENT

## 5.1. Dispersion Modelling

A dispersion modelling assessment has been performed using the NSW EPA approved CALPUFF atmospheric dispersion model. The modelling has been performed in CALPUFF 2-dimensional (2-D) mode. Given the distance between the Mine Site and receptors, and the generally uncomplicated terrain (in air quality impact assessment terms) in the area, the performance of a full 3-D modelling assessment is not considered to be warranted.

An assessment of the impacts of the operation of activities at the Project has been performed which characterises the likely day-to-day operations, approximating average operational characteristics which are appropriate to assess against longer term (annual average) criteria for particulate matter. The likely peak activities at the Mine Site have also been characterised to allow comparison of potential impacts against shorter term (24-hour) criteria for particulate matter.

The modelling scenarios provide an indication of the air quality impacts of the operation of activities at the Mine Site. Added to these impacts are regional background air quality concentrations (as discussed in Section 4.3 and Appendix B) which represent the air quality which may be expected within the area surrounding the Mine Site, without the impacts of the Project itself.

Predicted impacts associated with each modelled pollutant are presented as per the requirements of the Approved Methods. Specifically, for the criteria air pollutants presented in Table 6, impacts are predicted at '*the nearest existing or likely future off-site receptor locations*' (and whilst not required by the Approved Methods, at the Project-related receptors on-site). The incremental, background, and cumulative impact (increment plus background) is presented as per section 7.1.2 of the Approved Methods.

For the criteria presented in Table 7 and Table 8 (excluding non-NSW EPA deposition criteria), the 99.9$^{th}$ percentile of dispersion model predictions are presented as per section 7.2.2 of the Approved Methods, specifically '*at and beyond the boundary of the facility*'.

## 5.2. Modelling Scenarios

Two modelling scenarios have been developed to provide an indication of the air quality impacts of the operation of activities at the Mine Site at the nearest sensitive receptors:

- Scenario 1 - Year five operations; and
- Scenario 2 – Year 16 operations;

These scenarios would both include the following activities:

- Vegetation and topsoil stripping;
- Removal of overburden and interburden;
- Extraction and processing of ore; and
- Transport of heavy mineral concentrate from the Mine Site and along Anabranch Mail Road.

Construction activities would occur at the commencement of the Project which would include:

- Vegetation and topsoil stripping;
- Removal of overburden and interburden;
- Transport of construction materials to the Mine Site; and
- Operation of diesel-powered generators.

The activity rates and emissions are anticipated to be greater during the operational scenarios than during construction, and impacts are therefore likely to be correspondingly greater. Impacts associated with construction activities have therefore not been quantitatively assessed.

The relevant activity rates associated with the two operational scenarios are presented in Table 16.

**Table 16 Mining schedule associated with modelled scenarios**

| Parameter | Scenario 1<br>Year 5 | Scenario 2<br>Year 16 |
|---|---|---|
| Vegetation clearing | 83.2 ha | 14.2 ha |
| Soil stripped | 1.1 $Mt{\cdot}yr^{-1}$ | 0.3 $Mt{\cdot}yr^{-1}$ |
| Overburden removed | 35.1 $Mt{\cdot}yr^{-1}$ | 27.9 $Mt{\cdot}yr^{-1}$ |
| Interburden removed (wet process) | 34.7 $Mt{\cdot}yr^{-1}$ | 20.6 $Mt{\cdot}yr^{-1}$ |
| Ore extracted | 20.3 $Mt{\cdot}yr^{-1}$ | 27.0 $Mt{\cdot}yr^{-1}$ |
| HMC transported | 437 000 $t{\cdot}yr^{-1}$ | 292 000 $t{\cdot}yr^{-1}$ |
| **Average daily heavy vehicle movements[a]** | | |
| Type 1 and Type 2 Road Train | 26 (Type 1 -3 trailers)<br>20 (Type 2-4 trailers) | 26 (Type 1 -3 trailers)<br>20 (Type 2-4 trailers) |
| B-Double / Semi Trailer Truck / other heavy vehicle | 10 | 10 |
| 22 seater bus | 2 | 2 |
| **Peak daily heavy vehicle movements** | | |
| Type 1 and Type 2 Road Train[b] | 24 (Type 1 -3 trailers)<br>32 (Type 2-4 trailers) | 24 (Type 1 -3 trailers)<br>32 (Type 2-4 trailers) |
| B-Double / Semi Trailer Truck / other heavy vehicle | 20 | 20 |
| 22 seater bus | 4 | 4 |

**Notes:** (a): one return trip = two movements

(b): Particulate matter emissions associated with the use of Type 1 (up to 24 movements per day) and Type 2 (up to 32 movements per day) road trains have been assessed, and it has been determined that there would be no material difference in predicted impacts at sensitive receptors between the vehicle types. As a result, Type 2 road trains have been assessed.

Layouts of both scenarios are presented in Figure 6 and Figure 7.

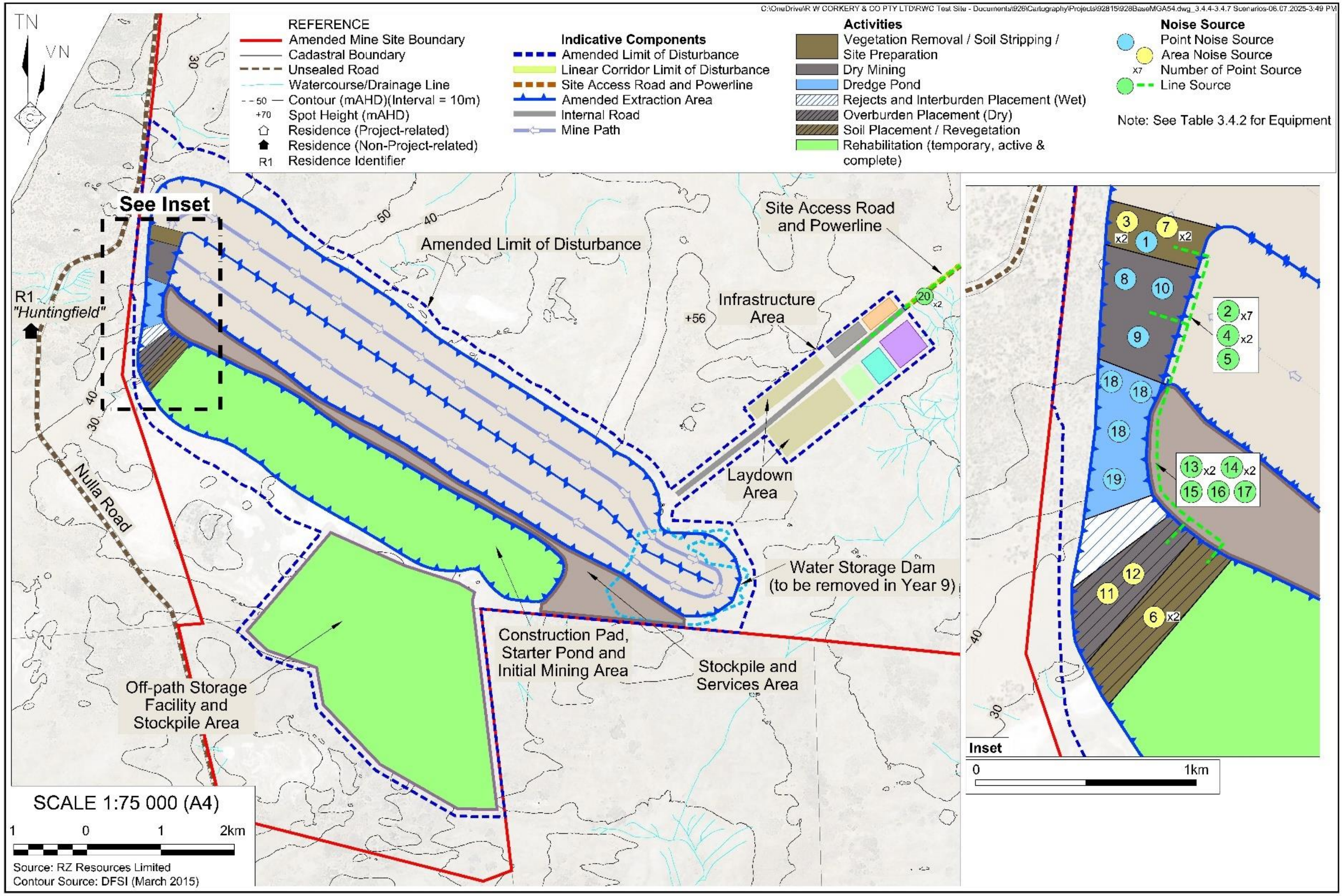
In relation to peak daily material extraction and on-site haulage rates, these are taken to be equal to the annual average, divided by 365 days of operation. Given the limitation of available equipment, on certain days those rates may increase, although it is anticipated that when the rate of certain activities increases, rates of others may decrease. The average daily extraction rate is therefore anticipated to be the maximum daily extraction rate in any year of operation.

In relation to wind erosion, and to respond to comments by NSW EPA (refer Section 1.2), the areas considered to represent significant sources of wind erosion are identified as (and shown in Figure 6 and Figure 7):

- Vegetation cleared (referenced as WE1 in Appendix C);
- Overburden removal area (referenced as WE2 in Appendix C);
- Overburden backfill area (referenced as WE3 in Appendix C);
- Soil spreading and revegetation area (referenced as WE4 in Appendix C); and
- Product drying stockpiles (referenced as WE5 in Appendix C).

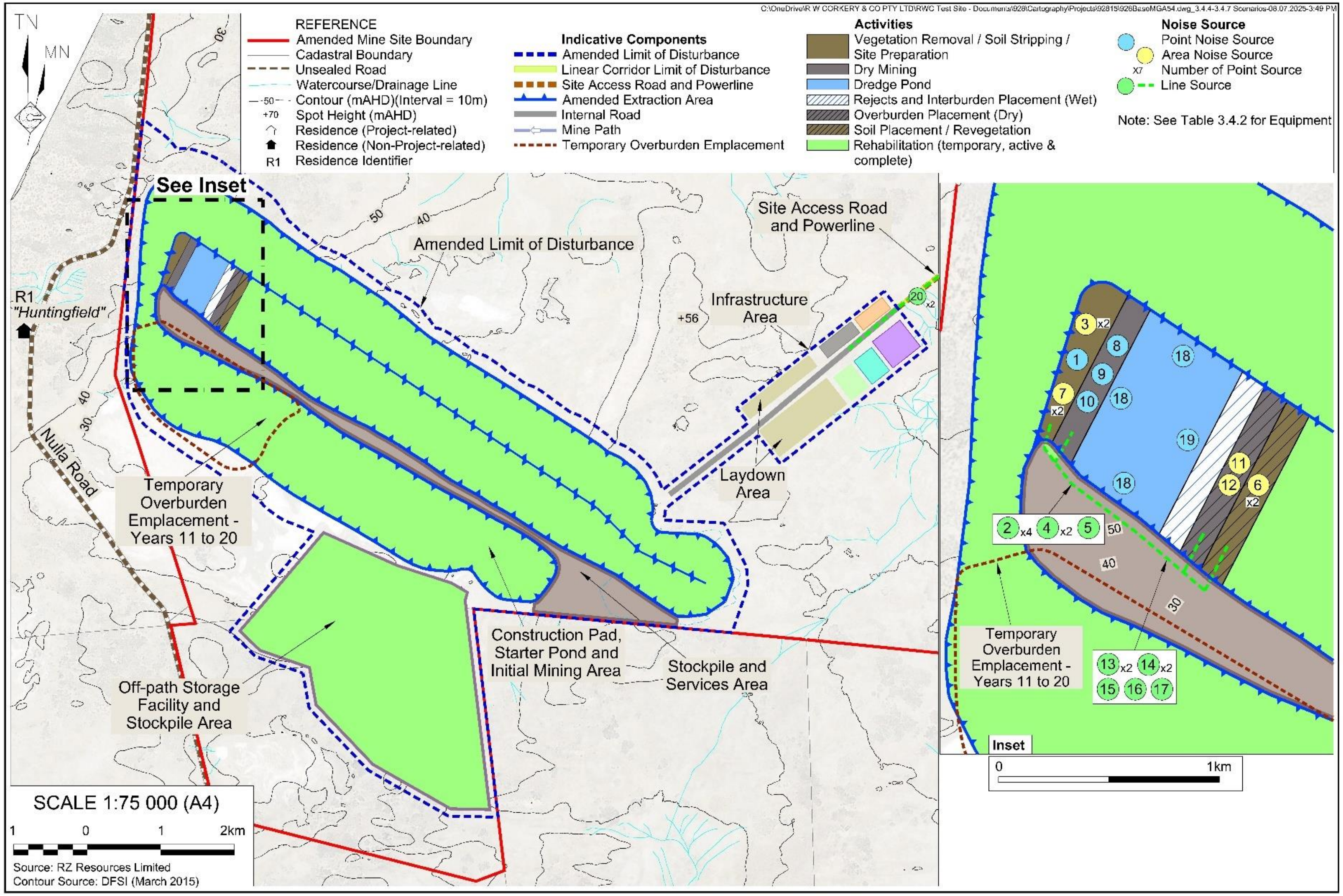
The active area of exposed areas, with the exception of the product drying stockpiles, is taken to be 10 % of the total area as stated in Appendix C, which is a commonly applied assumption. This assumption considers that only freshly disturbed materials/surfaces are likely to be sources of wind erosion, as once readily available particulate matter has been transported by the wind, refreshment of that source takes place after the surface is disturbed.

## Figure 6 Scenario 1 layout – year 5 operations




**Source:** RWC

Figure 7 Scenario 2 layout – year 16 operations




Source: RWC

## 5.3. Emissions Estimation

### 5.3.1. Particulate Matter

The estimation of emissions from a process is typically performed using direct measurement or through the application of factors which appropriately represent the processes under assessment. This assessment has adopted emission factors for materials handling processes, movement of trucks on unpaved site roads, screening, and wind erosion contained within the US EPA AP-42 emission factor compendium (US EPA, 1995 and updates) to represent the emission of particulate matter resulting from the operations occurring at the Mine Site as described in Section 2. These factors are appropriate for adoption in Australia and are routinely adopted in the assessment of operations of this nature.

Potential emissions of particulate matter during operations have been quantified, with an emissions inventory associated with the average operational characteristics, and peak characteristics during each stage calculated.

A full description of the emission sources included in the assessment, and the emission factors and assumptions adopted are presented in Appendix C.

In relation to potential impacts associated with materials transport along Anabranch Mail Road, an assessment of the potential for discrete impacts at distances away from the road has been performed. A nominal 5 km stretch of Anabranch Mail Road has been subject to dispersion modelling, and the inputs to that assessment are presented in Appendix C.

### 5.3.2. Toxic Metals and Individual Toxic Air Pollutants

The Applicant has provided a report which outlines a range of geochemical test results associated with 12 soil samples taken on 5 September and 18 September 2023 from proposed overburden and tailings areas at the Mine Site (RGS, 2023). The results of that testing, expressed as the soil concentration of toxic metal or individual toxic air pollutant in units of mg per kilogram of sample [$mg \cdot kg^{-1}$]) are presented in Table 17 for the metals with an associated criterion as presented in Table 8. The maximum measured concentration for each pollutant is highlighted.

Table 17 Geochemical test results – toxic metals and individual toxic air pollutants

| Heavy metal | Overburden | | | | | | | | | | Tailings | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | RZ079560 | RZ079573 | RZ079650 | RZ080009 | RZ080137 | RZ080154 | RZ081509 | RZ081522 | RZ081889 | RZ081903 W | PS120 PSD 16 DW | PS120 PSD 16 W e |
| | mg·kg$^{-1}$ | | | | | | | | | | | |
| Antimony | 0.12 | 0.08 | 0.11 | 0.25 | 0.19 | 0.17 | 0.14 | 0.12 | 0.09 | 0.09 | 0.09 | 0.09 |
| Arsenic | 4.8 | 1.4 | 2.2 | 1.6 | 3.4 | 5.4 | 3.9 | 5.4 | 4.6 | 1.4 | 1.00 | 4.1 |
| Cadmium | 0.05 | 0.01 | 0.27 | 0.01 | 0.02 | 0.01 | 0.04 | 0.04 | 0.01 | 0.01 | < 0.01 | < 0.01 |
| Chromium | 53 | 6 | 7 | 6 | 18 | 18 | 51 | 12 | 51 | 8 | 4.00 | 3 |
| Copper | 28.8 | 1.8 | 2.8 | 2.4 | 12.2 | 2.7 | 31.0 | 3.6 | 14.8 | 3.0 | 1.90 | 2.5 |
| Lead | 10.8 | 0.8 | 0.8 | 0.9 | 5.3 | 1.1 | 11.4 | 1.3 | 5.4 | 1.4 | 1.7 | 2.2 |
| Manganese | 600 | 35 | 48 | 46 | 310 | 41 | 1 275 | 153 | 86 | 55 | 16 | 23 |
| Mercury | < 0.01 | < 0.01 | 0.01 | < 0.01 | 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 | <0 .01 | 0.01 | 0.01 |
| Nickel | 39.6 | 2.4 | 3.0 | 1.5 | 13.4 | 3.0 | 52.1 | 3.4 | 13.0 | 4.0 | 1.8 | 1.2 |
| Silver | 0.01 | 0.01 | 0.53 | 0.01 | < 0.01 | 0.02 | < 0.01 | 0.03 | 0.01 | 0.03 | 0.03 | 0.03 |
| Thallium | 0.18 | < 0.02 | < 0.02 | 0.06 | 0.12 | < 0.02 | 0.19 | 0.03 | 0.11 | < 0.02 | 0.02 | 0.02 |
| Barium | 220 | 20 | 30 | 40 | 100 | 30 | 230 | 50 | 240 | 50 | 50 | 60 |
| Beryllium | 1.27 | < 0.05 | < 0.05 | < 0.05 | 0.53 | < 0.05 | 1.34 | 0.08 | 0.29 | 0.05 | <0.05 | < 0.05 |

**Source**: Acquired from table B2 of (RGS, 2023)

The approach to assessment of the pollutants identified in Table 17 has adopted a worst-case method which is intended to identify whether an air quality impact is likely to be a significant issue.

For each pollutant, the maximum measured concentration in sampled material at the Project Site has been applied to the predicted 99.9th percentile 1-hour TSP concentrations and annual average dust deposition rates at each receptor location, and at locations at and beyond the boundary of the Mine Site, as required. For example, for manganese, the modelled outputs are multiplied by 0.1275 % (equivalent to a manganese concentration of 1 275 $mg \cdot kg^{-1}$). This essentially assumes that the concentration of each pollutant in all material at the Mine Site is at the highest measured rate, which as shown by the sampling results in Table 17 is highly conservative.

Furthermore, applying the toxic pollutants concentrations to the modelled TSP concentration is also likely to represent a highly conservative assessment, with those toxic pollutants most likely to be an issue when associated with the more inhalable fraction of particulate matter (i.e. $PM_{10}$ and $PM_{2.5}$).

## 5.4. Emissions Controls

Emissions controls will be employed at the Mine Site. The application of these controls results in quantifiable reductions in the quantity of particulate matter being emitted as part of the Project operation.

A summary of the emissions reductions measures that would be adopted as part of the Project operation is presented in Table 18. These emission reductions are outlined in the NPI EETM for Mining (NPI, 2012) and relevant AP-42 documentation (US EPA, 1995).

**Table 18 Summary of emission reduction methods adopted as part of Project operation**

| Emission control method | Control efficiency (%) |
|---|---|
| Application of water and/or chemical suppressants on unpaved haulage routes | 90 |
| Limiting of on-site vehicle speeds to less than or equal to 50 $km \cdot hr^{-1}$ | 75 |
| Ore extraction, dredge mining, wet concentrator plant – wet processes | 100 |
| Retention of particulate matter in sub-ground level areas (pit retention) | 95 (TSP)<br>5 ($PM_{10}$ and $PM_{2.5}$) |
| Storage of heavy mineral concentrate in 3-sided bins prior to load-out | 75 |
| Movement of heavy mineral concentrate in sealed containers | Not quantified |

An emission control factor of 90 % has been adopted for the implementation of controls on unpaved haulage routes. As outlined in the literature (summarised in (Katestone, 2011)), the effectiveness of emissions controls can vary widely (30 % to 95 %) and is dependent upon the measures implemented. Recent studies performed at coal mines in NSW as part of the 'Dust Stop' program (under an EPA Pollution Reduction Program) provided data relating to the levels of dust control achieved through the implementation of controls (water, chemical suppressant). The average level of control achieved across 16 sites was 92 %, with the minimum being 80 % and the maximum 99 %.

The Applicant commits to achieving a particulate control efficiency of 90 % at the Mine Site and based on the findings of other mine sites across NSW, this is achievable. Further discussion of these control measures is presented in Section 7.1.

Material moisture contents have been measured to be high (SSM, 2020) (10 % for topsoil, and 17.5 % for overburden and ore). Silt contents as measured (SSM, 2020) of 6.2 % for topsoil, and 10 % for overburden and ore have been adopted in the calculation of emissions as outlined in Appendix C. Silt content of the unpaved haulage routes on site have been assumed to be 4.8 %, taken from section 13.2.2 of USEPA AP-42 emissions estimation documentation (USEPA, 2006c) which is the measured mean for plant roads at sand and gravel processing sites. For clarity, road surfaces will not be constructed of topsoil or subsoil. They will be constructed from locally sourced gravel, including oversize material removed during initial processing operations and imported material backloaded from Broken Hill or other locations.

Based on the foregoing, and the information provided in Appendix C, the distribution of uncontrolled and controlled particulate emissions in each year subject to assessment is presented in Figure 8 and Figure 9.

**Figure 8 Calculated uncontrolled & controlled annual $PM_{10}$ emissions – Scenario 1**

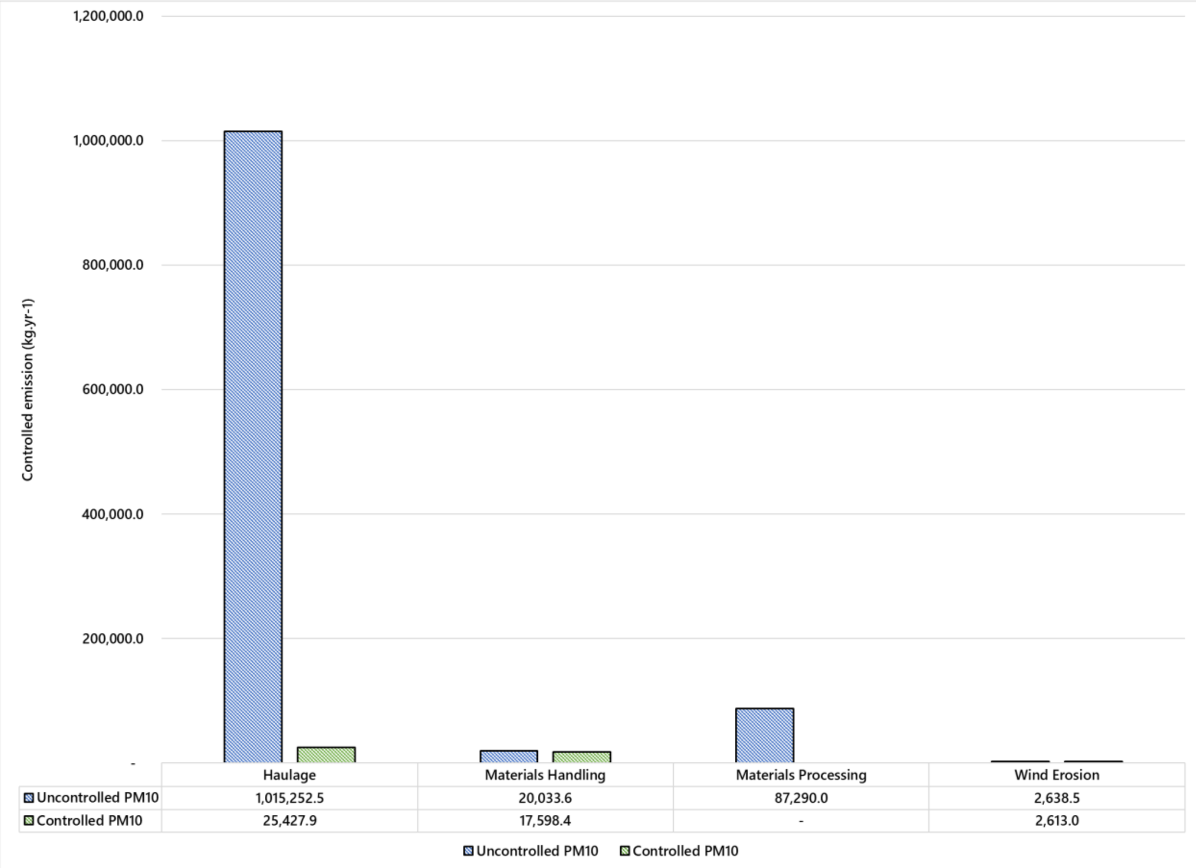
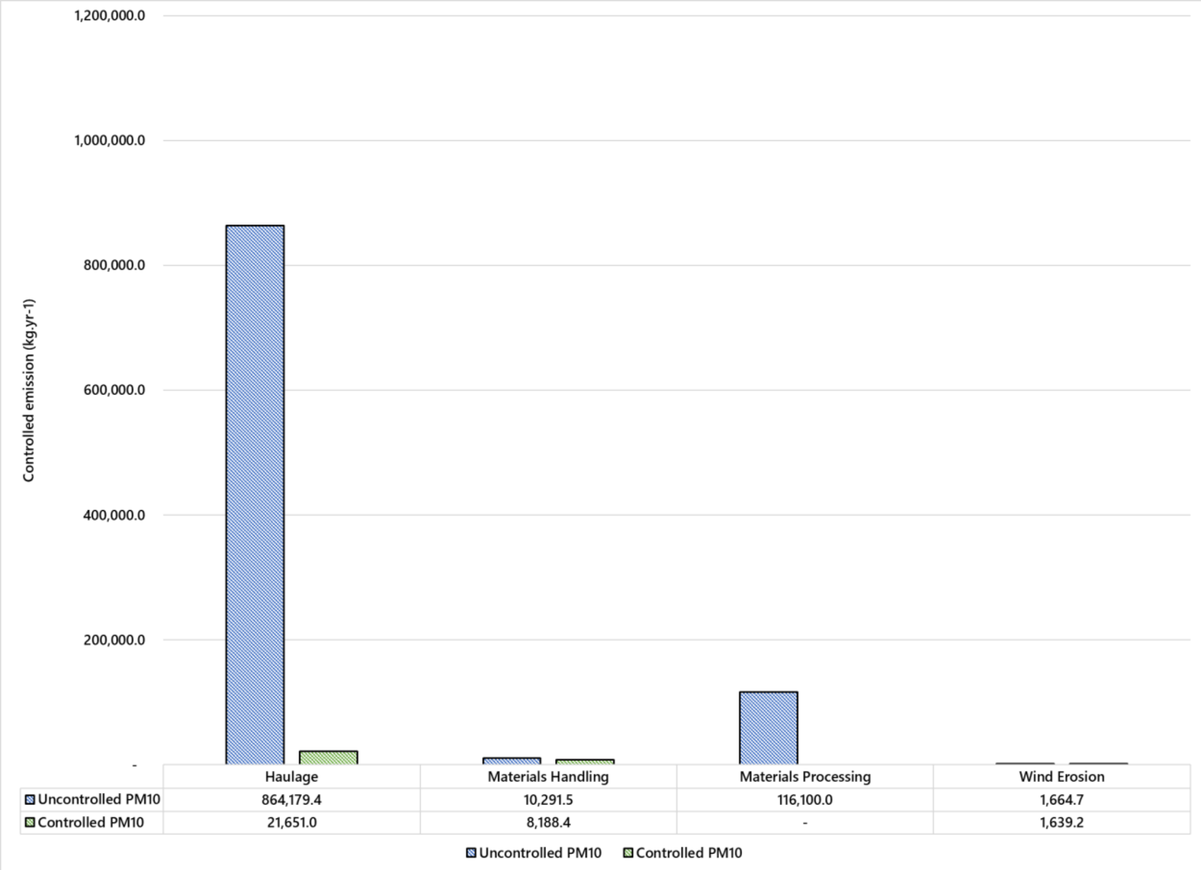


Figure 9 Calculated uncontrolled & controlled annual $PM_{10}$ emissions – Scenario 2



# 6. AIR QUALITY IMPACT ASSESSMENT

This section presents the results of the dispersion modelling assessment and uses the following terminology:

- Incremental impact – relates to the concentrations predicted as a result of the operation of the Project in isolation.
- Cumulative impact – relates to the incremental concentrations predicted as a result of the operation of the Project PLUS the background air quality concentrations discussed in Section 4.3.

The results are presented in this manner to allow examination of the likely impact of the Project in isolation and the contribution to air quality impacts in a broader sense.

In the presentation of results, the tables included shaded cells which represent the following:

| Model prediction | Pollutant concentration / deposition rate less than the relevant criterion | Pollutant concentration / deposition rate equal to, or greater than the relevant criterion |
|---|---|---|

Predicted impacts are presented at all receptors, with those Project related receptors (R4, and the Mine Camp) being greyed out. The statistics related to the contribution of the Project to incremental and cumulative impacts (% of criterion) are shown only for non-Project related receptors.

## 6.1. Scenario 1

The following presents the results of the modelling assessment under the assumptions of Scenario 1 (refer Section 5.2).

### 6.1.1. Particulate Matter – Annual Average $PM_{10}$ and $PM_{2.5}$

The predicted annual average particulate matter concentrations (as TSP, $PM_{10}$ and $PM_{2.5}$) resulting from the operation of the Project under Scenario 1 are presented in Table 19.

The results indicate that incremental concentrations of TSP, $PM_{10}$ and $PM_{2.5}$ at surrounding receptor locations are all below the relevant criteria. It is noted that cumulative concentrations for $PM_{10}$ and $PM_{2.5}$ are shown to be above the relevant criteria at all receptor locations, driven by elevated background concentrations that are already in exceedance of the criteria (refer Appendix B).

Table 19 Predicted annual average TSP, $PM_{10}$ and $PM_{2.5}$ concentrations – Scenario 1

| Receptor | Annual Average Concentration ($\mu g{\cdot}m^{-3}$) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | TSP | | | $PM_{10}$ | | | $PM_{2.5}$ | | |
| | Incr. | Bg. | Cumul. | Incr. | Bg. | Cumul. | Incr. | Bg. | Cumul. |
| Criterion | 90 | | | 25 | | | 8 | | |
| Max. % of criterion | 1.5 | 91.9 | 93.4 | 2.4 | 141.3 | 143.6 | < 0.1 | 140.7 | 141.3 |
| R1 | 1.4 | 82.7 | 84.1 | 0.6 | 35.3 | 35.9 | < 0.1 | 11.3 | 11.3 |
| R2 | 0.1 | 82.7 | 82.8 | 0.1 | 35.3 | 35.4 | < 0.1 | 11.3 | 11.3 |
| R3 | 0.3 | 82.7 | 83.0 | 0.2 | 35.3 | 35.5 | < 0.1 | 11.3 | 11.3 |
| R5 | 0.3 | 82.7 | 83.0 | 0.2 | 35.3 | 35.5 | < 0.1 | 11.3 | 11.3 |
| R6 | 0.1 | 82.7 | 82.8 | 0.1 | 35.3 | 35.4 | < 0.1 | 11.3 | 11.3 |
| R7 | < 0.1 | 82.7 | 82.8 | < 0.1 | 35.3 | 35.4 | < 0.1 | 11.3 | 11.3 |
| R8 | < 0.1 | 82.7 | 82.8 | < 0.1 | 35.3 | 35.4 | < 0.1 | 11.3 | 11.3 |
| R9 | < 0.1 | 82.7 | 82.8 | < 0.1 | 35.3 | 35.4 | < 0.1 | 11.3 | 11.3 |
| R10 | < 0.1 | 82.7 | 82.8 | < 0.1 | 35.3 | 35.4 | < 0.1 | 11.3 | 11.3 |
| R11 | < 0.1 | 82.7 | 82.8 | < 0.1 | 35.3 | 35.4 | < 0.1 | 11.3 | 11.3 |
| R12 | < 0.1 | 82.7 | 82.8 | < 0.1 | 35.3 | 35.4 | < 0.1 | 11.3 | 11.3 |
| R13 | < 0.1 | 82.7 | 82.8 | < 0.1 | 35.3 | 35.4 | < 0.1 | 11.3 | 11.3 |
| R4 | 0.3 | 82.7 | 83.0 | 0.2 | 35.3 | 35.5 | < 0.1 | 11.3 | 11.3 |
| Mine Camp | 0.4 | 82.7 | 83.1 | 0.2 | 35.3 | 35.5 | < 0.1 | 11.3 | 11.3 |

**Note**: Incr = Incremental impact, Bg = Background, Cumul = Cumulative Impact

### 6.1.2. Respirable Crystalline Silica – Annual Average

As outlined in Section 3.1.2, RCS concentrations have been taken to be 100 % of the annual average $PM_{10}$ concentration. This is applied to the incremental impact only and assumes that the background air quality environment is not impacted by RCS, which is considered to be a reasonable assumption. The maximum predicted incremental annual average $PM_{10}$ concentration at any non-Project related receptor under Scenario 1 operations is 0.6 $\mu g{\cdot}m^{-3}$ which results in a predicted impact of 0.6 $\mu g{\cdot}m^{-3}$ of RCS (0.6 $\mu g{\cdot}m^{-3}$ × 100 %). This is significantly below the adopted annual average RCS criterion of 3 $\mu g{\cdot}m^{-3}$.

### 6.1.3. Particulate Matter – Annual Average Dust Deposition Rates

Table 20 presents the annual average dust deposition predicted as a result of the operation of the Project under Scenario 1.

The results indicate minor incremental impacts at all surrounding receptor locations, and compliance with the relevant criterion.

Table 20 Predicted annual average dust deposition – Scenario 1

| Receptor | Annual Average Dust Deposition ($g \cdot m^{-2} \cdot month^{-1}$) | | |
|---|---|---|---|
| | Incr. | Bg. | Cumul. |
| Criterion | 2 | - | 4 |
| Max. % of criterion | < 5.0 | - | 52.5 |
| R1 | < 0.1 | 2.0 | 2.1 |
| R2 | < 0.1 | 2.0 | 2.1 |
| R3 | < 0.1 | 2.0 | 2.1 |
| R5 | < 0.1 | 2.0 | 2.1 |
| R6 | < 0.1 | 2.0 | 2.1 |
| R7 | < 0.1 | 2.0 | 2.1 |
| R8 | < 0.1 | 2.0 | 2.1 |
| R9 | < 0.1 | 2.0 | 2.1 |
| R10 | < 0.1 | 2.0 | 2.1 |
| R11 | < 0.1 | 2.0 | 2.1 |
| R12 | < 0.1 | 2.0 | 2.1 |
| R13 | < 0.1 | 2.0 | 2.1 |
| R4 | < 0.1 | 2.0 | 2.1 |
| Mine Camp | < 0.1 | 2.0 | 2.1 |

**Note**: Incr = Incremental impact, Bg = Background, Cumul = Cumulative Impact

### 6.1.4. Particulate Matter – Maximum 24-hour Average

Presented in Table 21 are the maximum 24-hour average $PM_{10}$ and $PM_{2.5}$ concentrations predicted to occur at the nearest sensitive receptors as a result of the operation of the Project under Scenario 1. No background concentrations are included within this table. The highest incremental impacts are predicted at non-project related receptor R1 for $PM_{10}$ and $PM_{2.5}$.

Table 21 Predicted maximum incremental 24-hour $PM_{10}$ and $PM_{2.5}$ concentrations – Scenario 1

| Receptor | Maximum 24-hour average concentration (µg·m$^{-3}$) | |
|---|---|---|
| | $PM_{10}$ | $PM_{2.5}$ |
| Criterion | 50 | 25 |
| Max. % of criterion | 16.1 | 4.8 |
| R1 | 8.0 | 1.2 |
| R2 | 1.7 | 0.3 |
| R3 | 1.6 | 0.2 |
| R5 | 2.2 | 0.3 |
| R6 | 0.8 | 0.1 |
| R7 | 0.2 | < 0.1 |
| R8 | 0.2 | < 0.1 |
| R9 | 0.4 | < 0.1 |
| R10 | 0.2 | < 0.1 |
| R11 | 0.1 | < 0.1 |
| R12 | 0.2 | < 0.1 |
| R13 | 0.3 | < 0.1 |
| R4 | 1.3 | 0.2 |
| Mine Camp | 1.4 | 0.2 |

Table 23 and Table 24 present the predicted maximum 24-hour average $PM_{10}$ and $PM_{2.5}$ concentrations resulting from the operation of the Project under Scenario 1, with background included.

Results are presented for the non-project related receptor at which the highest incremental $PM_{10}$ and $PM_{2.5}$ impacts have been predicted, and also for the non-project related receptors at which the highest cumulative impacts (increment plus background) have been predicted. These may be different receptors than those at which the highest incremental impacts are predicted.

The left side of the tables show the predicted concentration on days with the highest cumulative impact (principally driven by the highest background concentrations), and the right side shows the total predicted concentration on days with the highest predicted incremental concentrations with the contemporaneous background values to derive the respective cumulative predictions.

It is noted that there is a high number of background concentrations already in exceedance of the relevant criteria. Correspondingly, Table 23 and Table 24 present the top ten highest ranking cumulative concentrations, followed by non-exceeding background concentrations to highlight any additional exceedances resulting from the Project. Their associated ranks are also shown in those tables. This approach has also been adopted for Scenario 2.

It is noted that less significant additional exceedances of the 24-hour $PM_{10}$ and $PM_{2.5}$ criteria are predicted at various receptors resulting from the operation of the Project. The number of predicted additional exceedances at those receptors is presented in Table 22, while the analysis of contemporaneous 24-hour data for those receptors is provided in Appendix D.

Contour plots of the incremental contribution of the proposed operation of the Project under Scenario 1 to the 24-hour average $PM_{10}$ concentrations are presented in Figure 10.

As shown in Table 23 and Table 24, 24-hour PM concentrations with background included indicate that the cumulative impacts are all driven by background conditions. For example, the addition of the predicted 24-hour $PM_{2.5}$ increments results in one minor additional exceedance of the criterion at receptors R3 and R6, although this represents 0.4 % of the criterion, with the increment already being less than 0.1 $\mu g \cdot m^{-3}$ (i.e. cannot realistically be controlled further).

**Table 22 Predicted additional exceedances of 24-hour $PM_{10}$ and $PM_{2.5}$ concentrations – Scenario 1**

| Receptor | Maximum 24-hour average concentration ($\mu g \cdot m^{-3}$) | |
|---|---|---|
| | $PM_{10}$ | $PM_{2.5}$ |
| R1 | 1 | 0 |
| R2 | 0 | 0 |
| R3 | 0 | 1 |
| R5 | 0 | 0 |
| R6 | 1 | 1 |
| R7 | 0 | 0 |
| R8 | 0 | 0 |
| R9 | 0 | 0 |
| R10 | 0 | 0 |
| R11 | 0 | 0 |
| R12 | 0 | 0 |
| R13 | 0 | 0 |
| R4 | 0 | 1 |
| Mine Camp | 0 | 1 |

Table 23 Summary of contemporaneous impact and background – $PM_{10}$ – Receptor R1, Scenario 1

| Cumul. Impact Rank | Date | 24-hour average $PM_{10}$ concentration ($\mu g \cdot m^{-3}$) – Receptor R1 | | | Inc. Impact Rank | Date | 24-hour average $PM_{10}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R1 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Incremental Impact | Background | Cumulative Impact | | | Incremental Impact | Background | Cumulative Impact |
| | Criterion | 50 | | | | Criterion | 50 | | |
| 1 | 20/12/2019 | 1.5 | 251.7 | 253.2 | 1 | 22/05/2019 | 8.0 | 30.7 | 38.7 |
| 2 | 12/02/2019 | < 0.1 | 221.9 | 222.0 | 2 | 25/06/2019 | 6.1 | 21.1 | 27.2 |
| 3 | 18/02/2019 | 0.5 | 209.7 | 210.2 | 3 | 07/06/2019 | 5.5 | 23.0 | 28.5 |
| 4 | 22/12/2019 | < 0.1 | 205.5 | 205.6 | 4 | 16/06/2019 | 4.9 | 15.4 | 20.3 |
| 5 | 21/09/2019 | < 0.1 | 196.8 | 196.9 | 5 | 28/07/2019 | 4.6 | 14.5 | 19.1 |
| 6 | 24/12/2019 | < 0.1 | 148.3 | 148.4 | 6 | 18/05/2019 | 4.4 | 34.2 | 38.6 |
| 7 | 23/12/2019 | < 0.1 | 145.8 | 145.9 | 7 | 26/06/2019 | 4.4 | 19.4 | 23.8 |
| 8 | 17/12/2019 | 2.4 | 131.5 | 133.9 | 8 | 24/06/2019 | 4.4 | 23.3 | 27.7 |
| 9 | 26/11/2019 | < 0.1 | 133.0 | 133.1 | 9 | 26/02/2019 | 4.1 | 55.6 | 59.7 |
| 10 | 21/11/2019 | < 0.1 | 130.5 | 130.6 | 10 | 05/07/2019 | 3.8 | 9.7 | 13.5 |
| 63 | 12/04/2019 | 2.5 | 48.1 | 50.6 | 35 | 12/04/2019 | 2.5 | 48.1 | 50.6 |
| These data represent the highest Cumulative Impact 24-hour $PM_{10}$ predictions (outlined in red) due to the operation of the project. | | | | | These data represent the highest Incremental Impact 24-hour $PM_{10}$ predictions (outlined in blue) due to the operation of the project. | | | | |

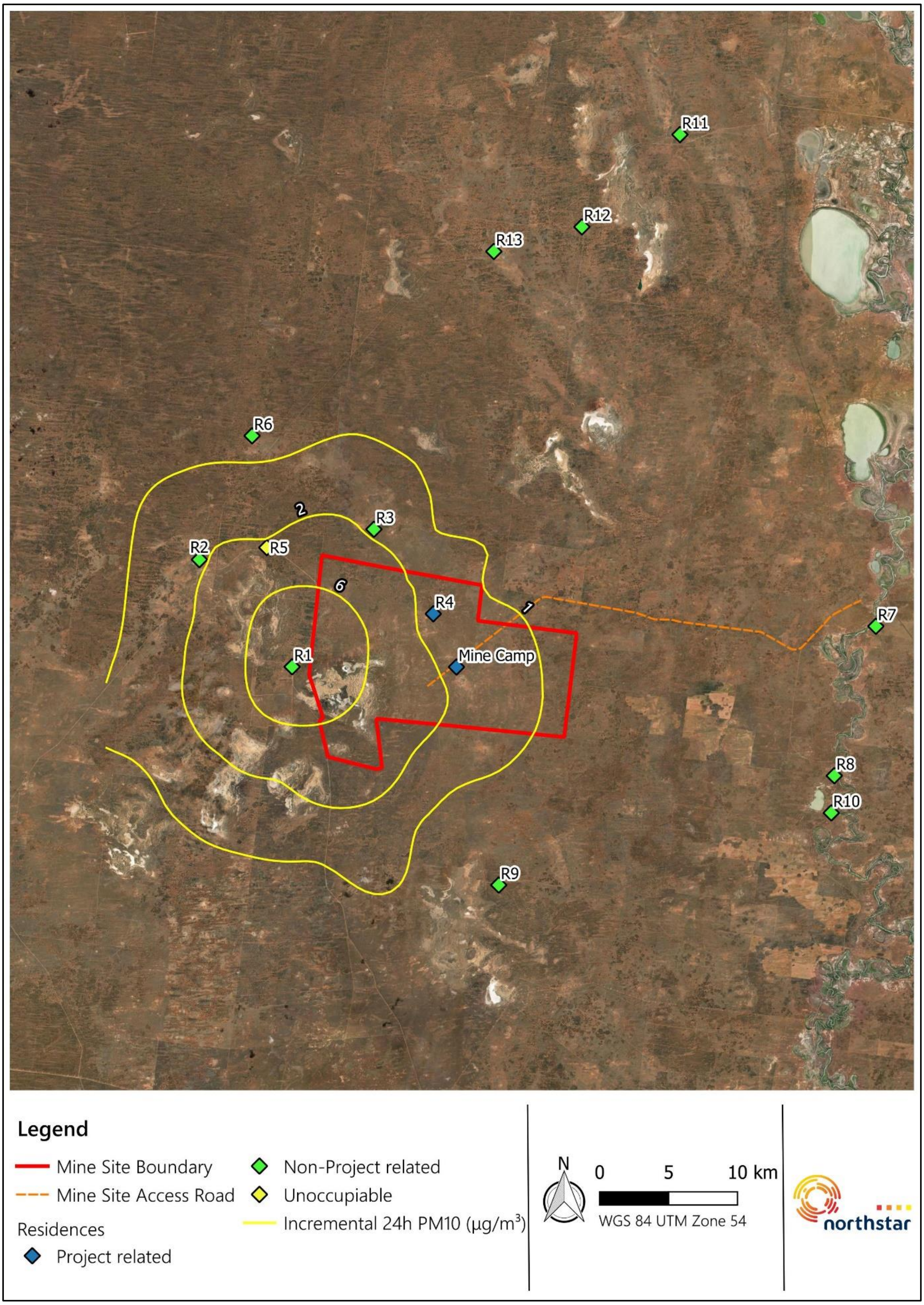
**Note**: Cumul. = Cumulative, Inc. = Incremental

Table 24 Summary of contemporaneous impact and background – $PM_{2.5}$ – Receptor R3, Scenario 1

| Cumul. Impact Rank | Date | 24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R3 | | | Inc. Impact Rank | Date | 24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Incremental Impact | Background | Cumulative Impact | | | Incremental Impact | Background | Cumulative Impact |
| | Criterion | 25 | | | | Criterion | 25 | | |
| 1 | 20/12/2019 | < 0.1 | 239.6 | 239.7 | 1 | 27/08/2019 | 0.2 | 11.3 | 11.5 |
| 2 | 22/12/2019 | < 0.1 | 129.4 | 129.5 | 2 | 25/08/2019 | 0.2 | 9.6 | 9.8 |
| 3 | 23/12/2019 | < 0.1 | 103.6 | 103.7 | 3 | 12/08/2019 | 0.2 | 5.6 | 5.8 |
| 4 | 24/12/2019 | < 0.1 | 87.5 | 87.6 | 4 | 03/08/2019 | 0.2 | 5.9 | 6.1 |
| 5 | 17/12/2019 | < 0.1 | 83.2 | 83.3 | 5 | 02/08/2019 | 0.2 | 10.6 | 10.8 |
| 6 | 18/12/2019 | < 0.1 | 71.6 | 71.7 | 6 | 26/08/2019 | 0.2 | 8.2 | 8.4 |
| 7 | 09/12/2019 | < 0.1 | 58.8 | 58.9 | 7 | 24/04/2019 | 0.2 | 7.3 | 7.5 |
| 8 | 28/12/2019 | < 0.1 | 53.2 | 53.3 | 8 | 04/05/2019 | 0.2 | 3.1 | 3.3 |
| 9 | 21/12/2019 | < 0.1 | 50.5 | 50.6 | 9 | 31/07/2019 | 0.2 | 13.5 | 13.7 |
| 10 | 21/11/2019 | < 0.1 | 45.5 | 45.6 | 10 | 05/05/2019 | 0.1 | 4.7 | 4.8 |
| 18 | 10/12/2019 | < 0.1 | 25.0 | 25.1 | 63 | 10/12/2019 | < 0.1 | 25.0 | 25.1 |
| These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) due to the operation of the Project. | | | | | These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) due to the operation of the project. | | | | |

**Note**: Cumul. = Cumulative, Inc. = Incremental

Figure 10 Predicted incremental 24-hour $PM_{10}$ concentrations – Scenario 1




**Source**: Northstar

### 6.1.5. Toxic Metals and Individual and Toxic Air Pollutants

Presented in Table 25 are the predicted toxic metals deposition rates associated with the relevant pollutants. Multiple criteria for each pollutant (except nickel) are adopted, and the calculation of the 'maximum percentage of criterion' relates to the most stringent of the criteria adopted, which are highlighted in the table.

Presented in Table 26 and Table 27 are the predicted toxic metal and principal individual and toxic air pollutant concentrations associated with the operation of the Project under Scenario 1. As previously noted in Section 5.3.2, the assessment has adopted highly conservative assumptions.

**Table 25 Predicted toxic metal deposition rates – Scenario 1**

| Receptor | Annual average deposition rate (µg·m$^{-2}$·day$^{-1}$) | | | | | |
|---|---|---|---|---|---|---|
| | Arsenic | Cadmium | Lead | Mercury | Nickel | Thallium |
| Health | 4 | 2 | 100 | 1 | 15 | 2 |
| Crops | 4.0E+00 | 2.0E+00 | 1.0E+02 | 1.0E+00 | 1.5E+01 | 2.0E+00 |
| Grassland | 1.17E+03 | 2.5E+00 | 1.85E+02 | 3.0E+01 | - | 7.0E+00 |
| Max % of criterion | 6.0E+01 | 3.2E+01 | 1.9E+03 | 3.0E+00 | - | 2.5E+01 |
| R1 | 2.40E-01 | 1.20E-02 | 5.08E-01 | 4.45E-04 | 1.76E+00 | 8.46E-03 |
| R2 | 1.42E-02 | 7.11E-04 | 3.00E-02 | 2.63E-05 | 1.04E-01 | 5.00E-04 |
| R3 | 4.56E-02 | 2.28E-03 | 9.63E-02 | 8.45E-05 | 3.35E-01 | 1.61E-03 |
| R5 | 4.04E-02 | 2.02E-03 | 8.52E-02 | 7.48E-05 | 2.96E-01 | 1.42E-03 |
| R6 | 1.15E-02 | 5.77E-04 | 2.44E-02 | 2.14E-05 | 8.46E-02 | 4.06E-04 |
| R7 | 1.39E-03 | 6.93E-05 | 2.93E-03 | 2.57E-06 | 1.02E-02 | 4.88E-05 |
| R8 | 1.08E-03 | 5.42E-05 | 2.29E-03 | 2.01E-06 | 7.95E-03 | 3.82E-05 |
| R9 | 2.85E-03 | 1.42E-04 | 6.01E-03 | 5.28E-06 | 2.09E-02 | 1.00E-04 |
| R10 | 9.80E-04 | 4.90E-05 | 2.07E-03 | 1.81E-06 | 7.19E-03 | 3.45E-05 |
| R11 | 1.34E-03 | 6.71E-05 | 2.83E-03 | 2.49E-06 | 9.84E-03 | 4.72E-05 |
| R12 | 2.49E-03 | 1.25E-04 | 5.26E-03 | 4.62E-06 | 1.83E-02 | 8.77E-05 |
| R13 | 3.82E-03 | 1.91E-04 | 8.05E-03 | 7.07E-06 | 2.80E-02 | 1.34E-04 |
| R4 | 4.81E-02 | 2.40E-03 | 1.01E-01 | 8.90E-05 | 3.52E-01 | 1.69E-03 |
| Mine Camp | 9.77E-02 | 4.89E-03 | 2.06E-01 | 1.81E-04 | 7.17E-01 | 3.44E-03 |

Table 26 Predicted 99.9th percentile principal and toxic air pollutant concentrations – Scenario 1 (part 1)

| Receptor | 99.9th percentile 1-hour average concentration (mg·m$^{-3}$) | | | | | |
|---|---|---|---|---|---|---|
| | Barium | Beryllium | Antimony | Arsenic | Cadmium | Chromium (III) |
| Criterion | 9.00E-03 | 4.00E-06 | 9.00E-03 | 9.00E-05 | 1.80E-05 | 9.00E-03 |
| Max % of criterion | 0.1 | 1.6 | < 0.1 | 0.3 | 0.1 | < 0.1 |
| R1 | 9.58E-06 | 5.35E-08 | 9.98E-09 | 2.16E-07 | 1.08E-08 | 2.12E-06 |
| R2 | 9.79E-07 | 5.47E-09 | 1.02E-09 | 2.20E-08 | 1.10E-09 | 2.16E-07 |
| R3 | 1.13E-06 | 6.31E-09 | 1.18E-09 | 2.54E-08 | 1.27E-09 | 2.50E-07 |
| R5 | 1.58E-06 | 8.82E-09 | 1.64E-09 | 3.55E-08 | 1.78E-09 | 3.49E-07 |
| R6 | 5.13E-07 | 2.86E-09 | 5.34E-10 | 1.15E-08 | 5.77E-10 | 1.13E-07 |
| R7 | 1.12E-07 | 6.23E-10 | 1.16E-10 | 2.51E-09 | 1.26E-10 | 2.46E-08 |
| R8 | 1.21E-07 | 6.74E-10 | 1.26E-10 | 2.71E-09 | 1.36E-10 | 2.66E-08 |
| R9 | 2.89E-07 | 1.61E-09 | 3.01E-10 | 6.50E-09 | 3.25E-10 | 6.38E-08 |
| R10 | 1.15E-07 | 6.43E-10 | 1.20E-10 | 2.59E-09 | 1.30E-10 | 2.54E-08 |
| R11 | 8.18E-08 | 4.57E-10 | 8.53E-11 | 1.84E-09 | 9.21E-11 | 1.81E-08 |
| R12 | 1.16E-07 | 6.48E-10 | 1.21E-10 | 2.61E-09 | 1.31E-10 | 2.56E-08 |
| R13 | 1.45E-07 | 8.11E-10 | 1.51E-10 | 3.27E-09 | 1.63E-10 | 3.21E-08 |
| Max. at and beyond boundary | 1.17E-05 | 6.51E-08 | 1.21E-08 | 2.62E-07 | 1.31E-08 | 2.57E-06 |
| R4 | 1.35E-06 | 7.53E-09 | 1.41E-09 | 3.03E-08 | 1.52E-09 | 2.98E-07 |
| Mine Camp | 1.17E-06 | 6.55E-09 | 1.22E-09 | 2.64E-08 | 1.32E-09 | 2.59E-07 |

Table 27 Predicted 99.9th percentile principal and toxic air pollutant concentrations – Scenario 1 (part 2)

| Receptor | 99.9th percentile 1-hour average concentration ($mg \cdot m^{-3}$) | | | | | Annual average ($mg \cdot m^{-3}$) |
|---|---|---|---|---|---|---|
| | Copper | Manganese | Mercury (inorganic) | Nickel | Silver | Lead |
| Criterion | 1.80E-02 | 1.80E-02 | 1.80E-03 | 1.80E-04 | 1.80E-03 | 5.00E-04 |
| Max % of criterion | <0.1 | 0.3 | <0.1 | 1.1 | <0.1 | <0.1 |
| R1 | 1.24E-06 | 5.09E-05 | 3.99E-10 | 1.58E-06 | 2.12E-08 | 1.58E-08 |
| R2 | 1.26E-07 | 5.20E-06 | 4.08E-11 | 1.62E-07 | 2.16E-09 | 1.69E-09 |
| R3 | 1.46E-07 | 6.01E-06 | 4.71E-11 | 1.87E-07 | 2.50E-09 | 3.52E-09 |
| R5 | 2.04E-07 | 8.39E-06 | 6.58E-11 | 2.61E-07 | 3.49E-09 | 3.94E-09 |
| R6 | 6.62E-08 | 2.72E-06 | 2.14E-11 | 8.46E-08 | 1.13E-09 | 1.55E-09 |
| R7 | 1.44E-08 | 5.93E-07 | 4.65E-12 | 1.84E-08 | 2.46E-10 | 1.73E-10 |
| R8 | 1.56E-08 | 6.41E-07 | 5.03E-12 | 1.99E-08 | 2.66E-10 | 1.60E-10 |
| R9 | 3.73E-08 | 1.54E-06 | 1.20E-11 | 4.77E-08 | 6.38E-10 | 3.39E-10 |
| R10 | 1.49E-08 | 6.12E-07 | 4.80E-12 | 1.90E-08 | 2.54E-10 | 1.51E-10 |
| R11 | 1.06E-08 | 4.35E-07 | 3.41E-12 | 1.35E-08 | 1.81E-10 | 1.88E-10 |
| R12 | 1.50E-08 | 6.16E-07 | 4.83E-12 | 1.91E-08 | 2.56E-10 | 3.29E-10 |
| R13 | 1.88E-08 | 7.71E-07 | 6.05E-12 | 2.40E-08 | 3.21E-10 | 4.99E-10 |
| Max. at and beyond boundary | 1.51E-06 | 6.19E-05 | 4.86E-10 | 1.92E-06 | 2.57E-08 | - |
| R4 | 1.74E-07 | 7.17E-06 | 5.62E-11 | 2.23E-07 | 2.98E-09 | 3.09E-09 |
| Mine Camp | 1.52E-07 | 6.23E-06 | 4.89E-11 | 1.94E-07 | 2.59E-09 | 4.03E-09 |

## 6.2. Scenario 2

The following presents the results of the modelling assessment under the assumptions of Scenario 2 (refer Section 5.2).

### 6.2.1. Particulate Matter – Annual Average $PM_{10}$ and $PM_{2.5}$

The predicted annual average particulate matter concentrations (as TSP, $PM_{10}$ and $PM_{2.5}$) resulting from the Project under Scenario 2 operations are presented in Table 28. Table 28 shows that predicted incremental concentrations of TSP, $PM_{10}$ and $PM_{2.5}$ at all receptor locations are significantly below the annual average TSP, $PM_{10}$ and $PM_{2.5}$ criteria.

The annual average TSP criterion is predicted to be achieved, although the annual average $PM_{10}$ and $PM_{2.5}$ criteria are shown to be exceeded, given the already exceeding background conditions. It is noted that the Project operation under Scenario 2 does not result in any significant increases in those concentrations.

**Table 28 Predicted annual average TSP, $PM_{10}$ and $PM_{2.5}$ concentrations – Scenario 2**

| Receptor | Annual Average Concentration ($\mu g \cdot m^{-3}$) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | TSP | | | $PM_{10}$ | | | $PM_{2.5}$ | | |
| | Incr. | Bg. | Cumul. | Incr. | Bg. | Cumul. | Incr. | Bg. | Cumul. |
| Criterion | 90 | | | 25 | | | 8 | | |
| Max. % of criterion | 0.8 | 91.9 | 92.7 | 1.3 | 141. | 142. | < 0.1 | 140.7 | 141.3 |
| R1 | 0.8 | 82.7 | 83.5 | 0.3 | 35.3 | 35.6 | < 0.1 | 11.3 | 11.3 |
| R2 | < 0.1 | 82.7 | 82.8 | < 0.1 | 35.3 | 35.4 | < 0.1 | 11.3 | 11.3 |
| R3 | 0.2 | 82.7 | 82.9 | 0.1 | 35.3 | 35.5 | < 0.1 | 11.3 | 11.3 |
| R5 | 0.2 | 82.7 | 82.9 | 0.1 | 35.3 | 35.5 | < 0.1 | 11.3 | 11.3 |
| R6 | < 0.1 | 82.7 | 82.8 | < 0.1 | 35.3 | 35.4 | < 0.1 | 11.3 | 11.3 |
| R7 | < 0.1 | 82.7 | 82.8 | < 0.1 | 35.3 | 35.4 | < 0.1 | 11.3 | 11.3 |
| R8 | < 0.1 | 82.7 | 82.8 | < 0.1 | 35.3 | 35.4 | < 0.1 | 11.3 | 11.3 |
| R9 | < 0.1 | 82.7 | 82.8 | < 0.1 | 35.3 | 35.4 | < 0.1 | 11.3 | 11.3 |
| R10 | < 0.1 | 82.7 | 82.8 | < 0.1 | 35.3 | 35.4 | < 0.1 | 11.3 | 11.3 |
| R11 | < 0.1 | 82.7 | 82.8 | < 0.1 | 35.3 | 35.4 | < 0.1 | 11.3 | 11.3 |
| R12 | < 0.1 | 82.7 | 82.8 | < 0.1 | 35.3 | 35.4 | < 0.1 | 11.3 | 11.3 |
| R13 | < 0.1 | 82.7 | 82.8 | < 0.1 | 35.3 | 35.4 | < 0.1 | 11.3 | 11.3 |
| R4 | 0.2 | 82.7 | 82.9 | 0.1 | 35.3 | 35.4 | < 0.1 | 11.3 | 11.3 |
| Mine Camp | 0.3 | 82.7 | 83.0 | 0.1 | 35.3 | 35.4 | < 0.1 | 11.3 | 11.3 |

**Note**: Incr = Incremental impact, Bg = Background, Cumul = Cumulative Impact

### 6.2.2. Respirable Crystalline Silica – Annual Average

As outlined in Section 3.1.2, RCS concentrations have been taken to be 100 % of the annual average $PM_{10}$ concentration. This is applied to the incremental impact only and assumes that the background air quality environment is not impacted by RCS, which is considered to be a reasonable assumption. The maximum predicted incremental annual average $PM_{10}$ concentration at any non-Project related receptor under Scenario 2 operations is 0.3 $\mu g \cdot m^{-3}$ which results in a predicted impact of 0.3 $\mu g \cdot m^{-3}$ of RCS (0.3 $\mu g \cdot m^{-3}$ × 100 %). This is significantly below the adopted annual average RCS criterion of 3 $\mu g \cdot m^{-3}$.

### 6.2.3. Particulate Matter – Annual Average Dust Deposition Rates

Table 29 presents the annual average dust deposition predicted as a result of the assumptions under Scenario 2.

Annual average dust deposition is predicted to meet the criterion at all identified receptors where the predicted impacts are less than 5 % of the incremental criterion.

**Table 29 Predicted annual average dust deposition – Scenario 2**

| Receptor | Annual Average Dust Deposition ($g \cdot m^{-2} \cdot month^{-1}$) | | |
|---|---|---|---|
| | Incr. | Bg. | Cumul. |
| Criterion | 2 | - | 4 |
| Max. % of criterion | < 5.0 | - | 52.5 |
| R1 | < 0.1 | 2.0 | 2.1 |
| R2 | < 0.1 | 2.0 | 2.1 |
| R3 | < 0.1 | 2.0 | 2.1 |
| R5 | < 0.1 | 2.0 | 2.1 |
| R6 | < 0.1 | 2.0 | 2.1 |
| R7 | < 0.1 | 2.0 | 2.1 |
| R8 | < 0.1 | 2.0 | 2.1 |
| R9 | < 0.1 | 2.0 | 2.1 |
| R10 | < 0.1 | 2.0 | 2.1 |
| R11 | < 0.1 | 2.0 | 2.1 |
| R12 | < 0.1 | 2.0 | 2.1 |
| R13 | < 0.1 | 2.0 | 2.1 |
| R4 | < 0.1 | 2.0 | 2.1 |
| Mine Camp | < 0.1 | 2.0 | 2.1 |

**Note**: Incr = Incremental impact, Bg = Background, Cumul = Cumulative Impact

### 6.2.4. Particulate Matter – Maximum 24-hour Average

Table 30 presents the maximum 24-hour average $PM_{10}$ and $PM_{2.5}$ concentrations predicted to occur at the nearest receptors, as a result of the Project operations under Scenario 2. No background concentrations are included within this table.

**Table 30 Predicted maximum incremental 24-hour $PM_{10}$ and $PM_{2.5}$ concentrations – Scenario 2**

| Receptor | Maximum 24-hour average concentration (µg·m$^{-3}$) | |
|---|---|---|
| | $PM_{10}$ | $PM_{2.5}$ |
| Criterion | 50 | 25 |
| Max. % of criterion | 9.6 | 2.7 |
| R1 | 4.8 | 0.7 |
| R2 | 1.1 | 0.2 |
| R3 | 1.0 | 0.2 |
| R5 | 1.5 | 0.2 |
| R6 | 0.6 | < 0.1 |
| R7 | 0.1 | < 0.1 |
| R8 | 0.2 | < 0.1 |
| R9 | 0.3 | < 0.1 |
| R10 | 0.2 | <0.1 |
| R11 | 0.1 | < 0.1 |
| R12 | 0.1 | < 0.1 |
| R13 | 0.2 | < 0.1 |
| R4 | 0.9 | 0.1 |
| Mine Camp | 1.2 | 0.2 |

The predicted incremental concentrations of $PM_{10}$ and $PM_{2.5}$ are demonstrated to represent less than 10 % of the relevant criteria for $PM_{10}$ and less than 3% for $PM_{2.5}$ at all non-Project related receptor locations.

As shown in Table 32 and Table 33, 24-hour $PM_{10}$ and $PM_{2.5}$ concentrations with background included at indicate that the concentrations are all driven by background conditions. However, no additional exceedances of the criterion are predicted at any receptor.

As shown in Table 33, 24-hour $PM_{2.5}$ concentrations with background included indicate that the cumulative impacts are also all driven by background conditions. The addition of the predicted increments does result in one minor additional exceedance of the criterion at five receptors (R3, R6, R11, R12, and R13) although again, this represents 0.4 % of the criterion, with the increment already being less than 0.1 µg·m$^{-3}$ (i.e. cannot realistically be controlled further).

The number of additional exceedances of the 24-hour $PM_{10}$ and $PM_{2.5}$ criteria predicted at various receptors is presented in Table 31, while the contemporaneous analysis for those additional receptors is provided in Appendix D.

Contour plots of the predicted incremental 24-hour $PM_{10}$ concentrations associated with the Project under Scenario 2 are presented in Figure 11 to allow examination of the distribution of particulate matter in the area surrounding the Mine Site.

**Table 31 Predicted additional exceedances of 24-hour $PM_{10}$ and $PM_{2.5}$ concentrations – Scenario 2**

| Receptor | Maximum 24-hour average concentration (µg·m$^{-3}$) | |
|---|---|---|
| | $PM_{10}$ | $PM_{2.5}$ |
| R1 | 0 | 0 |
| R2 | 0 | 0 |
| R3 | 0 | 1 |
| R5 | 0 | 0 |
| R6 | 0 | 1 |
| R7 | 0 | 0 |
| R8 | 0 | 0 |
| R9 | 0 | 0 |
| R10 | 0 | 0 |
| R11 | 0 | 1 |
| R12 | 0 | 1 |
| R13 | 0 | 1 |
| R4 | 0 | 1 |
| Mine Camp | 0 | 1 |

Table 32 Summary of contemporaneous impact and background – $PM_{10}$ – Receptor 6, Scenario 2

| Cumul. Impact Rank | Date | 24-hour average $PM_{10}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R6 | | | Inc. Impact Rank | Date | 24-hour average $PM_{10}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R6 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Incremental Impact | Background | Cumulative Impact | | | Incremental Impact | Background | Cumulative Impact |
| | Criterion | 50 | | | | Criterion | 50 | | |
| 1 | 20/12/2019 | < 0.1 | 251.7 | 251.8 | 1 | 21/06/2019 | 0.6 | 10.7 | 11.3 |
| 2 | 12/02/2019 | < 0.1 | 221.9 | 222.0 | 2 | 03/07/2019 | 0.5 | 23.1 | 23.6 |
| 3 | 18/02/2019 | < 0.1 | 209.7 | 209.8 | 3 | 11/04/2019 | 0.5 | 44.7 | 45.2 |
| 4 | 22/12/2019 | < 0.1 | 205.5 | 205.6 | 4 | 23/06/2019 | 0.4 | 20.1 | 20.5 |
| 5 | 21/09/2019 | < 0.1 | 196.8 | 196.9 | 5 | 10/04/2019 | 0.4 | 50.2 | 50.6 |
| 6 | 24/12/2019 | 0.3 | 148.3 | 148.6 | 6 | 19/03/2019 | 0.4 | 21.4 | 21.8 |
| 7 | 23/12/2019 | 0.3 | 145.8 | 146.1 | 7 | 16/03/2019 | 0.4 | 27.3 | 27.7 |
| 8 | 26/11/2019 | < 0.1 | 133.0 | 133.1 | 8 | 19/06/2019 | 0.4 | 9.0 | 9.4 |
| 9 | 17/12/2019 | < 0.1 | 131.5 | 131.6 | 9 | 17/02/2019 | 0.4 | 48.0 | 48.4 |
| 10 | 21/11/2019 | < 0.1 | 130.5 | 130.6 | 10 | 22/02/2019 | 0.3 | 30.6 | 30.9 |
| 65 | 21/02/2019 | 0.1 | 49.9 | 50.0 | 89 | 21/02/2019 | 0.1 | 49.9 | 50.0 |
| These data represent the highest Cumulative Impact 24-hour $PM_{10}$ predictions (outlined in red) due to the operation of the Project. | | | | | These data represent the highest Incremental Impact 24-hour $PM_{10}$ predictions (outlined in blue) due to the operation of the Project. | | | | |

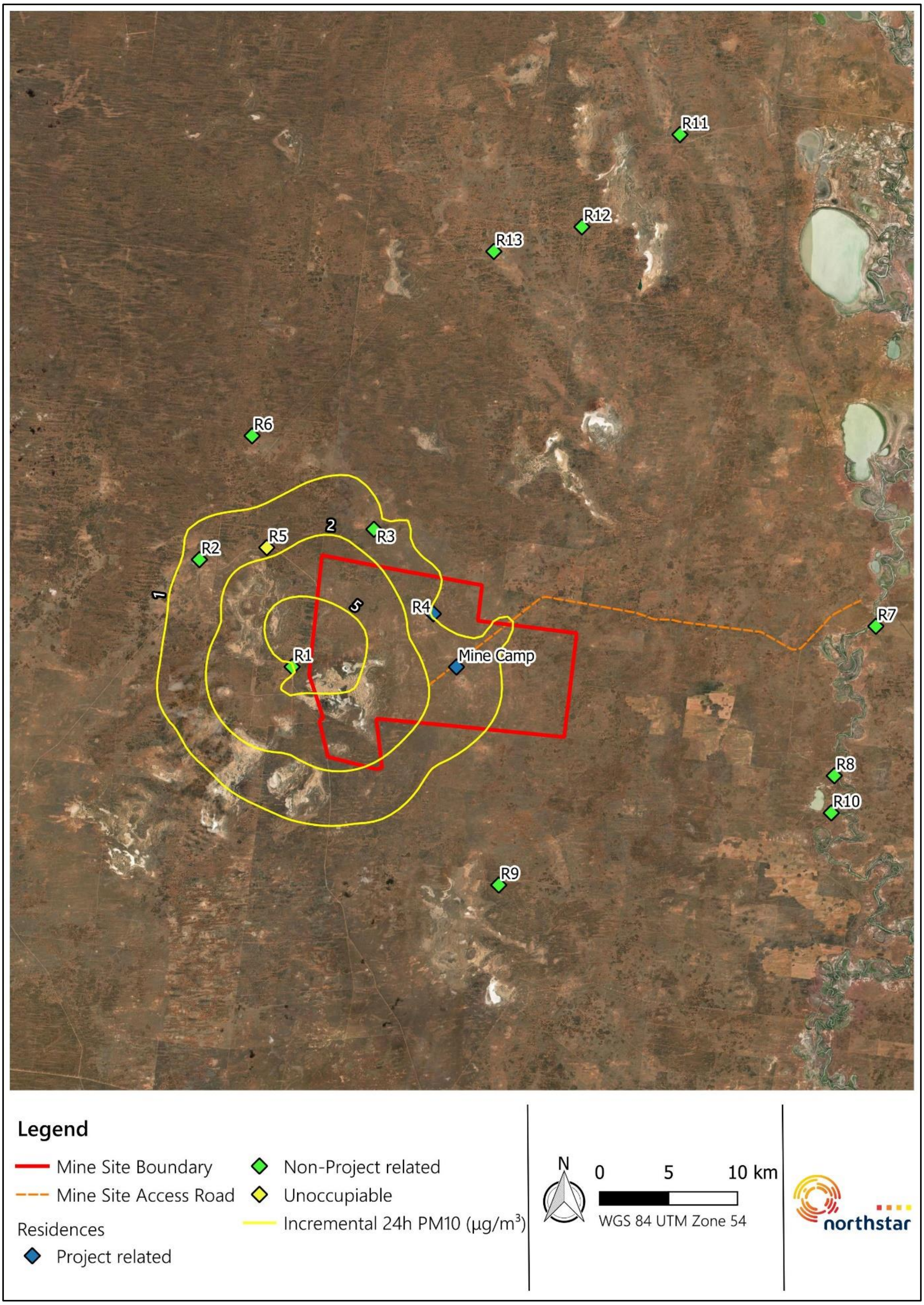
**Note**: Cumul. = Cumulative, Inc. = Incremental

Table 33 Summary of contemporaneous impact and background – $PM_{2.5}$ – Receptor R3, Scenario 2

| Cumul. Impact Rank | Date | 24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R3 | | | Inc. Impact Rank | Date | 24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Incremental Impact | Background | Cumulative Impact | | | Incremental Impact | Background | Cumulative Impact |
| | Criterion | 25 | | | | Criterion | 25 | | |
| 1 | 20/12/2019 | < 0.1 | 239.6 | 239.7 | 1 | 27/08/2019 | 0.2 | 11.3 | 11.5 |
| 2 | 22/12/2019 | < 0.1 | 129.4 | 129.5 | 2 | 25/08/2019 | 0.1 | 9.6 | 9.7 |
| 3 | 23/12/2019 | < 0.1 | 103.6 | 103.7 | 3 | 26/08/2019 | 0.1 | 8.2 | 8.3 |
| 4 | 24/12/2019 | < 0.1 | 87.5 | 87.6 | 4 | 03/08/2019 | 0.1 | 5.9 | 6.0 |
| 5 | 17/12/2019 | < 0.1 | 83.2 | 83.3 | 5 | 12/08/2019 | 0.1 | 5.6 | 5.7 |
| 6 | 18/12/2019 | < 0.1 | 71.6 | 71.7 | 6 | 24/04/2019 | 0.1 | 7.3 | 7.4 |
| 7 | 09/12/2019 | < 0.1 | 58.8 | 58.9 | 7 | 02/08/2019 | 0.1 | 10.6 | 10.7 |
| 8 | 28/12/2019 | < 0.1 | 53.2 | 53.3 | 8 | 05/05/2019 | 0.1 | 4.7 | 4.8 |
| 9 | 21/12/2019 | < 0.1 | 50.5 | 50.6 | 9 | 31/07/2019 | 0.1 | 13.5 | 13.6 |
| 10 | 21/11/2019 | < 0.1 | 45.5 | 45.6 | 10 | 18/03/2019 | 0.1 | 7.5 | 7.6 |
| 18 | 10/12/2019 | < 0.1 | 25.0 | 25.1 | 62 | 10/12/2019 | < 0.1 | 25.0 | 25.1 |
| These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) due to the operation of the Project. | | | | | These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) due to the operation of the Project. | | | | |

**Note**: Cumul. = Cumulative, Inc. = Incremental

Figure 11 Predicted incremental 24-hour $PM_{10}$ concentrations – Scenario 2




**Source**: Northstar

### 6.2.5. Toxic Metals and Individual and Toxic Air Pollutants

Presented in Table 34 are the predicted toxic metals deposition rates associated with the relevant pollutants. Multiple criteria for each pollutant (except nickel) are adopted, and the calculation of the 'maximum percentage of criterion' relates to the most stringent of the criteria adopted, which are highlighted in the table.

Presented in Table 26 and Table 27 are the predicted toxic metal and principal individual and toxic air pollutant concentrations associated with the operation of the Project under Scenario 2. As previously noted in Section 5.3.2, the assessment has adopted highly conservative assumptions.

**Table 34 Predicted toxic metal deposition rates – Scenario 2**

| Receptor | Annual average deposition rate (µg·m$^{-2}$·day$^{-1}$) | | | | | |
|---|---|---|---|---|---|---|
| | Arsenic | Cadmium | Lead | Mercury | Nickel | Thallium |
| Health | 4.0E+00 | 2.0E+00 | 1.0E+02 | 1.0E+00 | 1.5E+01 | 2.0E+00 |
| Crops | 1.17E+03 | 2.5E+00 | 1.85E+02 | 3.0E+01 | - | 7.0E+00 |
| Grassland | 6.0E+01 | 3.2E+01 | 1.9E+03 | 3.0E+00 | - | 2.5E+01 |
| Max % of criterion | 3.2 | 0.3 | 0.3 | < 0.1 | 6.3 | 0.2 |
| R1 | 1.28E-01 | 6.41E-03 | 2.71E-01 | 2.38E-04 | 9.41E-01 | 4.51E-03 |
| R2 | 9.23E-03 | 4.62E-04 | 1.95E-02 | 1.71E-05 | 6.77E-02 | 3.25E-04 |
| R3 | 3.41E-02 | 1.71E-03 | 7.20E-02 | 6.32E-05 | 2.50E-01 | 1.20E-03 |
| R5 | 2.71E-02 | 1.36E-03 | 5.72E-02 | 5.02E-05 | 1.99E-01 | 9.54E-04 |
| R6 | 8.01E-03 | 4.01E-04 | 1.69E-02 | 1.48E-05 | 5.88E-02 | 2.82E-04 |
| R7 | 9.80E-04 | 4.90E-05 | 2.07E-03 | 1.82E-06 | 7.19E-03 | 3.45E-05 |
| R8 | 7.58E-04 | 3.79E-05 | 1.60E-03 | 1.40E-06 | 5.56E-03 | 2.67E-05 |
| R9 | 2.05E-03 | 1.03E-04 | 4.33E-03 | 3.80E-06 | 1.50E-02 | 7.22E-05 |
| R10 | 6.78E-04 | 3.39E-05 | 1.43E-03 | 1.26E-06 | 4.97E-03 | 2.39E-05 |
| R11 | 9.08E-04 | 4.54E-05 | 1.92E-03 | 1.68E-06 | 6.66E-03 | 3.19E-05 |
| R12 | 1.73E-03 | 8.63E-05 | 3.64E-03 | 3.20E-06 | 1.27E-02 | 6.07E-05 |
| R13 | 2.63E-03 | 1.31E-04 | 5.55E-03 | 4.87E-06 | 1.93E-02 | 9.25E-05 |
| R4 | 3.85E-02 | 1.93E-03 | 8.13E-02 | 7.13E-05 | 2.82E-01 | 1.36E-03 |
| Mine Camp | 9.04E-02 | 4.52E-03 | 1.91E-01 | 1.67E-04 | 6.63E-01 | 3.18E-03 |

Table 35 Predicted 99.9th percentile principal and toxic air pollutant concentrations – Scenario 2 (part 1)

| Receptor | 99.9th percentile 1-hour average concentration (mg·m$^{-3}$) | | | | | |
|---|---|---|---|---|---|---|
| | Barium | Beryllium | Antimony | Arsenic | Cadmium | Chromium (III) |
| Criterion | 9.00E-03 | 4.00E-06 | 9.00E-03 | 9.00E-05 | 1.80E-05 | 9.00E-03 |
| Max % of criterion | 0.1 | 1.2 | < 0.1 | 0.2 | 0.1 | < 0.1 |
| R1 | 6.83E-06 | 3.81E-08 | 7.11E-09 | 1.54E-07 | 7.68E-09 | 1.51E-06 |
| R2 | 6.97E-07 | 3.89E-09 | 7.26E-10 | 1.57E-08 | 7.84E-10 | 1.54E-07 |
| R3 | 8.63E-07 | 4.82E-09 | 8.99E-10 | 1.94E-08 | 9.71E-10 | 1.91E-07 |
| R5 | 1.14E-06 | 6.38E-09 | 1.19E-09 | 2.57E-08 | 1.29E-09 | 2.52E-07 |
| R6 | 3.75E-07 | 2.09E-09 | 3.91E-10 | 8.44E-09 | 4.22E-10 | 8.28E-08 |
| R7 | 8.53E-08 | 4.76E-10 | 8.89E-11 | 1.92E-09 | 9.60E-11 | 1.88E-08 |
| R8 | 8.90E-08 | 4.97E-10 | 9.27E-11 | 2.00E-09 | 1.00E-10 | 1.97E-08 |
| R9 | 2.14E-07 | 1.19E-09 | 2.22E-10 | 4.80E-09 | 2.40E-10 | 4.71E-08 |
| R10 | 8.55E-08 | 4.77E-10 | 8.90E-11 | 1.92E-09 | 9.61E-11 | 1.89E-08 |
| R11 | 6.03E-08 | 3.37E-10 | 6.29E-11 | 1.36E-09 | 6.79E-11 | 1.33E-08 |
| R12 | 8.58E-08 | 4.79E-10 | 8.94E-11 | 1.93E-09 | 9.65E-11 | 1.89E-08 |
| R13 | 1.08E-07 | 6.04E-10 | 1.13E-10 | 2.43E-09 | 1.22E-10 | 2.39E-08 |
| Max. at and beyond boundary | 1.08E-07 | 6.04E-10 | 1.13E-10 | 2.43E-09 | 1.22E-10 | 2.39E-08 |
| R4 | 1.19E-06 | 6.63E-09 | 1.24E-09 | 2.67E-08 | 1.34E-09 | 2.62E-07 |
| Mine Camp | 1.02E-06 | 5.72E-09 | 1.07E-09 | 2.30E-08 | 1.15E-09 | 2.26E-07 |

Table 36 Predicted 99.9th percentile principal and toxic air pollutant concentrations – Scenario 2 (part 2)

| Receptor | 99.9th percentile 1-hour average concentration ($mg \cdot m^{-3}$) | | | | | Annual average ($mg \cdot m^{-3}$) |
|---|---|---|---|---|---|---|
| | Copper | Manganese | Mercury (inorganic) | Nickel | Silver | Lead |
| Criterion | 0.018 | 0.018 | 0.0018 | 0.00018 | 0.0018 | 0.0005 |
| Max % of criterion | < 0.1 | 0.3 | < 0.1 | 0.8 | < 0.1 | < 0.1 |
| R1 | 8.82E-07 | 3.63E-05 | 2.85E-10 | 1.13E-06 | 1.51E-08 | 8.62E-09 |
| R2 | 9.00E-08 | 3.70E-06 | 2.90E-11 | 1.15E-07 | 1.54E-09 | 1.13E-09 |
| R3 | 1.12E-07 | 4.59E-06 | 3.60E-11 | 1.42E-07 | 1.91E-09 | 2.72E-09 |
| R5 | 1.48E-07 | 6.07E-06 | 4.76E-11 | 1.88E-07 | 2.52E-09 | 2.67E-09 |
| R6 | 4.85E-08 | 1.99E-06 | 1.56E-11 | 6.19E-08 | 8.28E-10 | 1.10E-09 |
| R7 | 1.10E-08 | 4.53E-07 | 3.55E-12 | 1.41E-08 | 1.88E-10 | 1.26E-10 |
| R8 | 1.15E-08 | 4.73E-07 | 3.71E-12 | 1.47E-08 | 1.97E-10 | 1.16E-10 |
| R9 | 2.76E-08 | 1.13E-06 | 8.90E-12 | 3.52E-08 | 4.71E-10 | 2.47E-10 |
| R10 | 1.10E-08 | 4.54E-07 | 3.56E-12 | 1.41E-08 | 1.89E-10 | 1.09E-10 |
| R11 | 7.79E-09 | 3.21E-07 | 2.51E-12 | 9.96E-09 | 1.33E-10 | 1.35E-10 |
| R12 | 1.11E-08 | 4.56E-07 | 3.57E-12 | 1.42E-08 | 1.89E-10 | 2.40E-10 |
| R13 | 1.40E-08 | 5.74E-07 | 4.51E-12 | 1.78E-08 | 2.39E-10 | 3.64E-10 |
| Maximum at and beyond boundary | 1.12E-06 | 4.59E-05 | 3.60E-10 | 1.42E-06 | 1.91E-08 | - |
| R4 | 1.53E-07 | 6.31E-06 | 4.95E-11 | 1.96E-07 | 2.62E-09 | 2.51E-09 |
| Mine Camp | 1.32E-07 | 5.44E-06 | 4.27E-11 | 1.69E-07 | 2.26E-09 | 3.54E-09 |

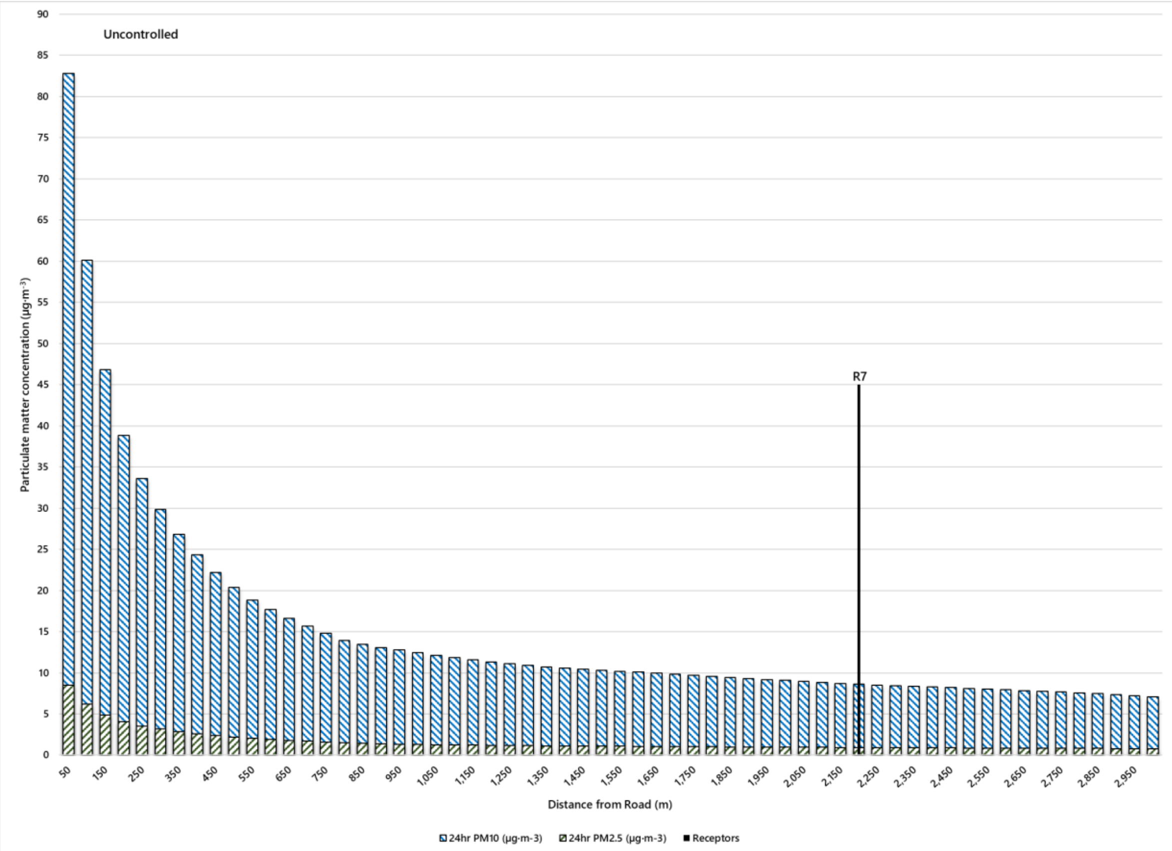
## 6.3. Off-site Transportation

The assessment of off-site transportation along Anabranch Mail Road during operation of the Project has been performed as described in Section 5.3.

Results are presented in Figure 12 for predicted maximum uncontrolled 24-hour $PM_{10}$ and $PM_{2.5}$ impacts at distance from the centre of Anabranch Mail Road, under the worst-case conditions associated with the operational phase of the Project.

The results indicate that particulate matter concentrations reduce rapidly away from the road as would be expected, and without any emissions control, maximum 24-hour $PM_{10}$ and $PM_{2.5}$ concentrations are predicted to be up to 8.5 µg·m$^{-3}$ and 0.9 µg·m$^{-3}$ respectively, at receptor R7 located approximately 2.2 km from Anabranch Road. It is noted that this is the closest receptor to the proposed transport route along Anabranch Road.

**Figure 12 Uncontrolled maximum 24-hour particulate matter impacts at distance from road**



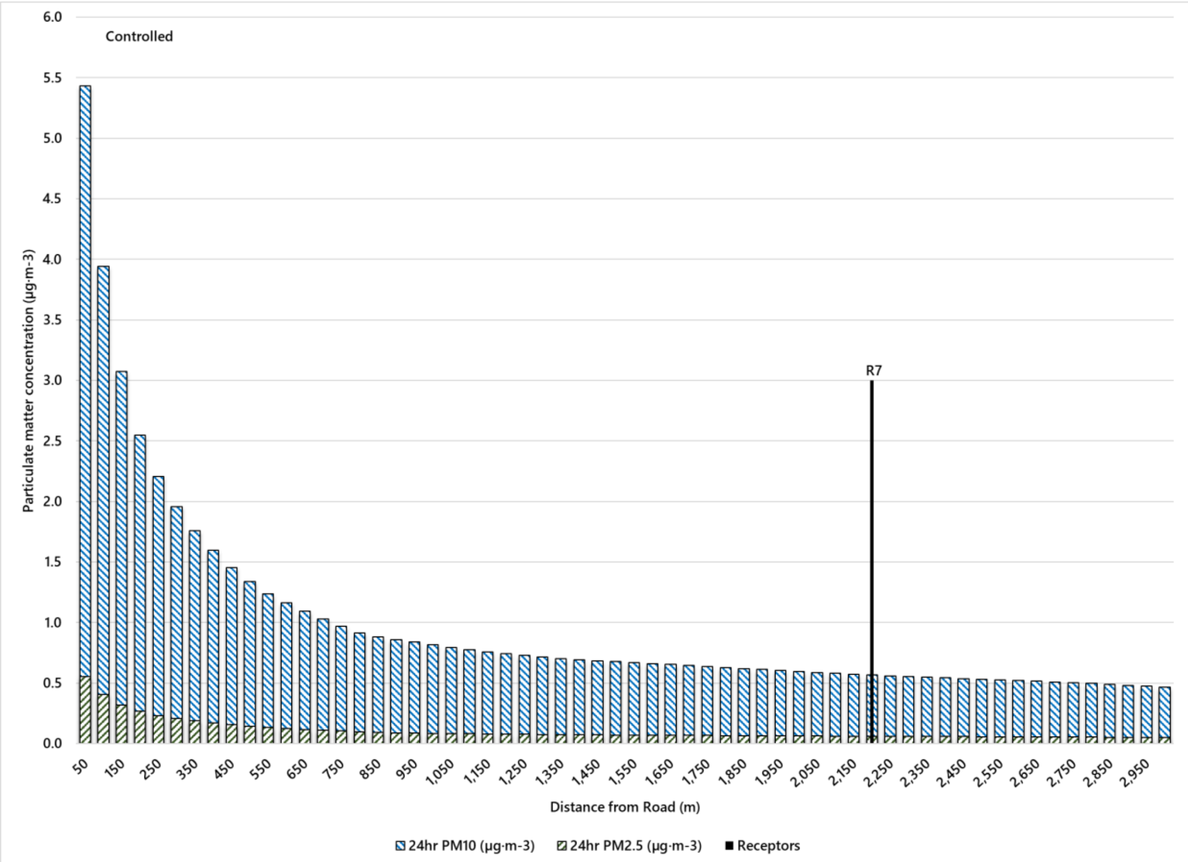

Further assessment has been performed to determine the potential particulate matter impacts at distance from Anabranch Mail Road, should emissions controls be applied. For the purposes of this assessment, those controls included the application of water and/or equivalent chemical dust suppressants to achieve a 75 % control efficiency. A 75 % control efficiency is associated with the use of water application at a rate of

2 L·m$^{-2}$·hr$^{-1}$, although as previously discussed, the use of chemical suppressants is likely to result in 90 % control. The results presented below therefore assume the lower of those control efficiencies and can be viewed as conservative.

Figure 13 presents the results of that assessment, which indicates that impacts can be significantly reduced through the adoption of those control measures, which are likely to result in predicted 24-hour $PM_{10}$ and $PM_{2.5}$ impacts at receptor R7 of 0.6 µg·m$^{-3}$ and less than 0.1 µg·m$^{-3}$, when controlled.

Should emission controls be employed along Anabranch Mail Road during construction and operational phase activities, cumulative impacts at all receptor locations should be minor.

**Figure 13 Controlled maximum 24-hour particulate matter impacts at distance from road**




Further discussion regarding emission control measures along Anabranch Mail Road is provided in Section 7.1.

## 6.4. Voluntary Land Acquisition and Mitigation Policy

The previous sections confirm that the relevant criteria associated with the NSW Voluntary Land Acquisition and Mitigation Policy are generally not exceeded at any surrounding privately-owned residence, under any of the scenarios assessed.

Background annual average $PM_{10}$ and $PM_{2.5}$ concentrations adopted in modelling are already in exceedance of the relevant criteria, and the incremental impacts associated with the operation of the Project are demonstrated to be low. In years with a lower number of exceptional events (i.e. dust storms and bushfires), it is anticipated that these low incremental impacts would not result in exceedance of the annual average $PM_{10}$ and $PM_{2.5}$ criteria.

Two minor exceedances of the 24-hour $PM_{10}$ criterion are predicted under Scenario 1, although the background $PM_{10}$ concentration driving those exceedances is high (either 49.9 $\mu g \cdot m^{-3}$ [99.8 % of the criterion], or 48.1 $\mu g \cdot m^{-3}$ [96.2% of the criterion]). The mitigation measures adopted as part of the Project will act to minimise particulate emissions.

Similarly, voluntary acquisition criteria are all achieved, with the exception of cumulative annual average $PM_{10}$ and $PM_{2.5}$ concentrations, which are due to the already exceeding background conditions.

Voluntary acquisition criteria are also to be applied across privately owned land (rather than just residences). Specifically, voluntary acquisition rights may be applied by the consent authority *"where the development is predicted to result in exceedances of the relevant criteria 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."*

The relevant air quality criteria related to voluntary acquisition or mitigation are not predicted to be exceeded on private landholdings under either of the scenarios assessed.

# 7. MITIGATION AND MONITORING

## 7.1. Air Quality Mitigation

Based on the findings of the assessment, it is considered that the particulate control measures proposed to be implemented will be more than sufficient to ensure that air quality impacts at surrounding non-Project related receptor locations are minimised.

The control measures associated with particulate matter are relevant to all potential constituents of 'dust', and the control of particulate matter would result in equivalent control of principal and toxic components of material handled at the Mine Site.

### 7.1.1. Committed Mitigation Measures

A number of mitigation measures are proposed to be implemented as part of the Project operation. Where defensible quantification of the control efficiencies afforded by these measures can be determined, these have been applied within the assessment.

The mitigation measures which will be used as part of the Project activities are summarised in Table 37. Additional details in relation to particular mitigation measures are presented in Section 7.1.2 to Section 7.1.7.

**Table 37 Summary of emission reduction methods adopted**

| Emission control method | Control efficiency (%) |
|---|---|
| Application of water and/or chemical suppressants on unpaved haulage routes | 90 |
| Limiting of on-site vehicle speeds to less than or equal to 50 $km \cdot hr^{-1}$ | 75 |
| Ore extraction, dredge mining, wet concentrator plant – wet processes | 100 |
| Retention of particulate matter in sub-ground level areas (pit retention) | 95 (TSP)<br>5 ($PM_{10}$ and $PM_{2.5}$) |
| Storage of heavy mineral concentrate in 3-sided bins prior to load-out | 75 |
| Movement of heavy mineral concentrate in sealed containers | Not quantified |

### 7.1.2. Construction of Haulage Routes

In response to raised issues by NSW EPA, further detail regarding the construction, maintenance and control of dust emissions from the haul roads has been provided in this AQIA. The importance of the control of dust emissions from the haul roads is noted and agreed.

The haul roads will be constructed of low-silt materials, including low-clay/silt content interburden and overburden, and/or, washed coarse reject from the floating Wet Concentration Plant depending upon the structural capacity and availability of that material to form road materials. Those materials will be supplemented with internally sourced or imported gravel, including hard, low-silt gravel backloaded from Broken Hill, to form the internal haul roads.

NSW EPA provided comments comparing the assumed haul road silt content of 4.8 %(w/w) with the that of topsoil / subsoil of 6.2 %(w/w) and overburden / interburden of assumed average silt content of 10 %(w/w). It is noted that the haul roads will not be constructed with those materials.

### 7.1.3. Mitigation of Unpaved Haulage Routes

The control of dust from the haul roads will be achieved through a multi-faceted approach including the use of water suppression (using low-salt concentration water), chemical suppressants, and speed reduction as outlined in Section 5.4. Section 5.4 also discusses recent on-site evaluation of the identified controls and notes that control efficiencies greater than those adopted in the AQIA have been measured in NSW making the emission estimation conservative in this regard. All of the committed controls are routinely applied to control wheel generated dust from haul roads at mine / quarry sites.

An emission control factor of 90 % has been adopted for the implementation of emission controls using water / chemical suppressants on unpaved haulage routes. As outlined in the literature (summarised in (Katestone, 2011)), the effectiveness of emissions controls can vary widely (30 % to 95 %) and is dependent upon the measures implemented. Recent studies performed at coal mines in NSW as part of the 'Dust Stop' program (under an EPA Pollution Reduction Program) provided data relating to the levels of dust control achieved through the implementation of controls (water, chemical suppressant). The average level of control achieved across 16 sites was 92 %, with the minimum being 80 % and the maximum 99 %.

The Applicant commits to achieving a particulate control efficiency of 90 % at the Mine Site and based on the findings of other mine sites across NSW, this is achievable.

The effective on-going dust control will be achieved through regular and routine (i.e. daily) inspection of the haul roads, the provision of on-site reverse osmosis treatment plants to produce low-salt concentration water for dust suppression, the provision of water trucks to apply polymer binding agents at the recommended application rates, the regular application of chemical suppressants (e.g. Dustloc(C) or equivalent), the provision of suitable and adequate speed reduction signs, and the enforcement of vehicle speeds.

### 7.1.4. Mitigation of Off-site Transportation

In relation to emissions controls applied along Anabranch Mail Road during materials transportation, the assessment in Section 6.3 has assumed that watering / application of chemical controls resulting in an equivalent of 75 % control efficiency, would result in minor maximum 24-hour particulate matter impacts at all receptors. Given that Anabranch Mail Road is located over 2 km from the closest receptor, these measures are considered appropriate.

### 7.1.5. Mitigation of Other Emissions Sources

In relation to emissions sources other than unpaved road surfaces, emissions controls are associated with the retention of particulate matter in sub-ground level areas (i.e. pit retention), storage of product material in three-sided enclosures, movement of heavy mineral concentrate in sealed containers, and the adoption of a wet process during ore extraction, dredge mining, and in the wet concentrator plant.

The adopted emission control factors are sourced from referenced literature and are considered to be appropriate. The control efficiencies would be met throughout the lifetime of the Project through the implementation of an Air Quality Management Plan (refer Section 7.1.7), which would include daily site inspections to ensure that the emission control measures are implemented and effective.

### 7.1.6. Rehabilitation Plan

In relation to rehabilitation, and as outlined in section 3.12.5 of the EIS, the final landform would be progressively constructed behind the dredge pond using reject material and overburden. Once complete the landform would be shaped and growth medium would be spread prior to seeding the area to be revegetated using a textured roller and, where required, polymer spray to stabilise the soil and prevent wind erosion. Fencing would be erected to prevent grazing by feral and over abundant native fauna. In the event that climatic conditions or other factors prevent vegetation becoming established in the short-term, further polymer spray would be applied prior to the previous application becoming ineffective.

### 7.1.7. Air Quality Management Plan

The Air Quality Management Plan for the Project will include the measures identified above. The site manager will be responsible for ensuring that no operations are performed without the inclusion of the relevant controls.

It is recommended that Air Quality Management Plan identifies relevant controls and sections of Anabranch Mail Road where those controls are to be applied. The Plan would also identify the requirements to consult with owners/occupiers of residences along Anabranch Mail Road and a procedure to respond to and manage complaints.

It is considered that particulate matter generation during offsite transportation of product can be adequately managed through the above controls.

## 7.2. Monitoring

The predictions presented in this AQIA indicate that there would be no significant predicted exceedances of the adopted air quality criteria as a result of the Project operation. Additionally, given the distances between the Project and the receptor locations, the incremental impacts associated with the Project operation are predicted to be relatively small in comparison to background concentrations. Therefore, it is not anticipated that any air quality monitoring would be required to be performed, although it is recommended that regular audits are performed to ensure that the Project is implementing the air quality control measures appropriately, as outlined within this report.

# 8. CONCLUSION

RWC has engaged Northstar on behalf of the Applicant to perform an AQIA for the proposed Project.

The AQIA forms part of the amendment report prepared to accompany the development application for the Project under Part 4 of the *Environmental Planning and Assessment Act* 1979.

The AQIA has been performed in accordance with the requirements of the NSW Approved Methods document and meets the requirements of the SEARs. The AQIA provides a detailed description of:

- Proposed activities which form the Project, under two separate scenarios which reflect activities during site operation.
- Legislative requirements which are required to be met, including NSW EPA air quality criteria, POEO Act, and POEO (Clean Air) Regulations, and any policies and guidelines as they relate to air quality impacts of the Project.
- Existing conditions surrounding the Mine Site, including the definition of sensitive receptor locations, prevailing meteorology and air quality, and topography.
- The approach to assessment, including justification for the approach adopted.
- Emissions controls proposed to be employed as part of the Project operation.
- Predicted air quality impacts during each of the two scenarios modelled.
- Additional air quality management and mitigation measures which may need to be employed to ensure that the environmental objectives associated with the Project are achieved.
- Air quality mitigation measures which would be employed as part of the Project operation.

The results of the AQIA indicate that predicted incremental concentrations associated with the operation of the Project at non-Project related receptors are minor, and exceedances of the annual average $PM_{10}$ and $PM_{2.5}$ criteria are dominated by the already exceeding background conditions. The contribution of the Project to those exceedances is minimal.

Additional exceedances of the 24-hour $PM_{10}$ and $PM_{2.5}$ criteria are predicted at non-Project related receptors over the Scenarios modelled. Again, all of these exceedances are dominated by high background concentrations, representing more than 95 % of the $PM_{10}$ criterion and 100 % of the $PM_{2.5}$ criterion. The emission controls measures adopted result in the incremental concentrations contributing to the exceedances on those day being insignificant, and at concentrations which could not practically be controlled further.

Impacts associated with principal and toxic air pollutants (including metals) are shown to be minor at all surrounding receptor locations, and at locations at and beyond the Mine Site boundary. A worst-case assessment was adopted which provides confidence that actual concentrations would be anticipated to be significantly lower than presented in this AQIA. In conclusion, the Project can be constructed and operated in accordance with best management practice, to minimise the concentrations of air pollutants on the surrounding environment.

# 9. REFERENCES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# APPENDIX A

## Meteorology

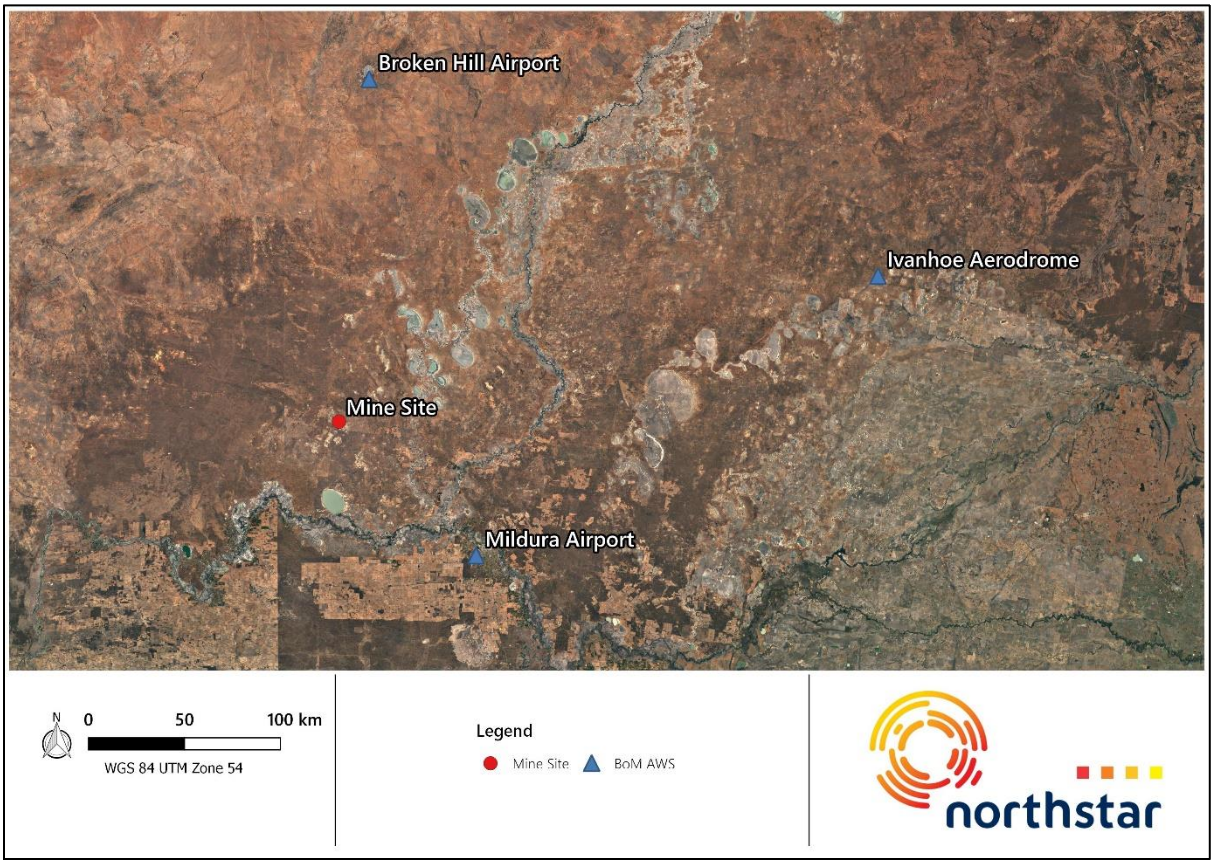
As discussed in Section 4.2 a meteorological modelling exercise has been performed to characterise the meteorology of the Mine Site in the absence of site-specific measurements covering the year 2019. The meteorological modelling has been based on measurements taken at a number of surrounding automatic weather stations (AWS).

A summary of the relevant AWS is provided in Table A1 and also displayed in Figure A1.

**Table A1 Details of the meteorological monitoring surrounding the Mine Site**

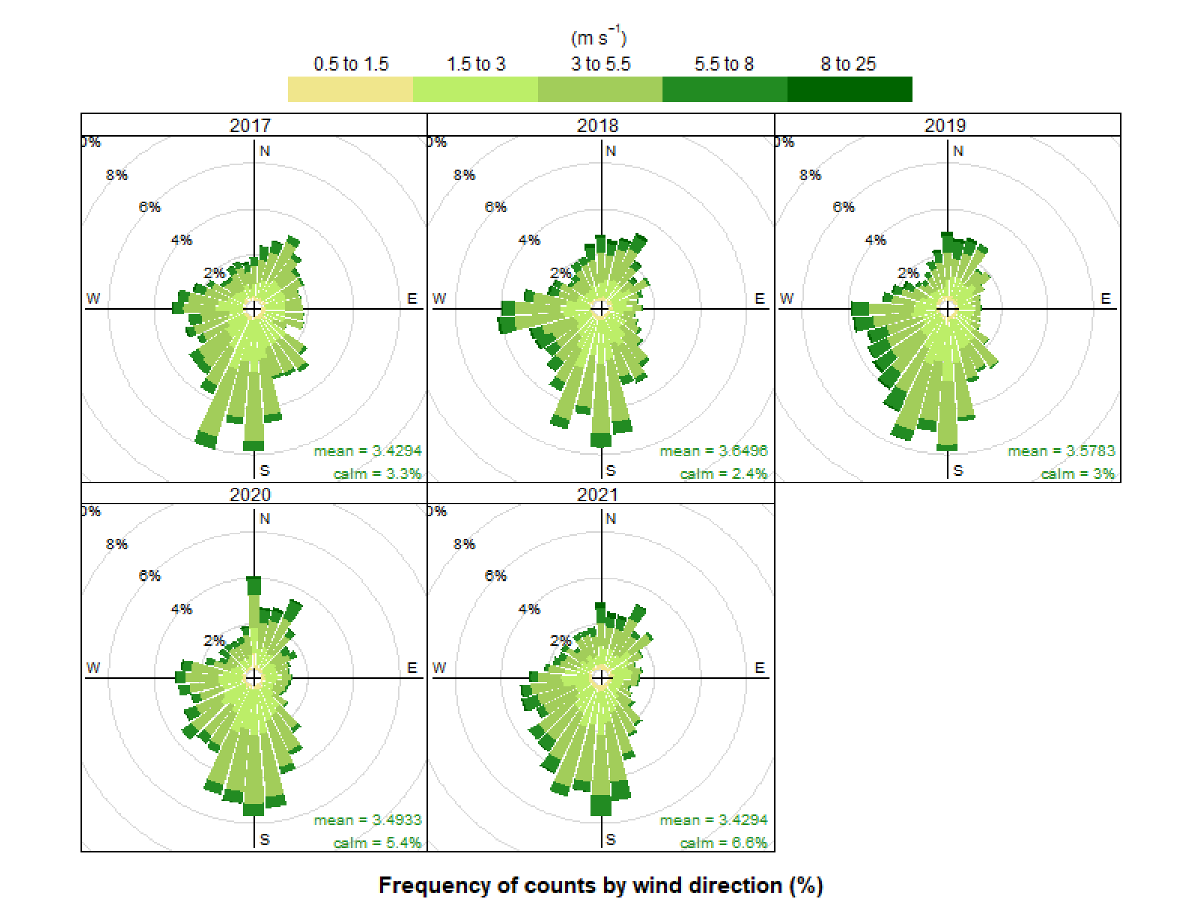
| Site Name | Source | Approximate Location (UTM) | | Approximate distance (km) | Availability |
|---|---|---|---|---|---|
| | | mE | mS | | |
| Mildura Airport AWS #076031 | BoM | 600 074 | 6 211 157 | 90 | From 2010 |
| Broken Hill Airport AWS #047048 | BoM | 544 337 | 6 459 335 | 186 | From 2009 |
| Ivanhoe Aerodrome AWS #049000 | BoM | 248 268 | 6 358 440 | 280 | From 2012 |
| On-Site AWS | - | 550 020 | 6 285 480 | 2 | 9 Mar – 31 Dec 2017<br>1 Jan – 3 Dec 2018<br>26 Feb – 31 Dec 2019 |

**Figure A1 Meteorological and air quality monitoring surrounding the Mine Site**



Given the proximity of the AWS in relation to the Mine Site, meteorological data measured at Mildura Airport AWS are considered to be most representative of the meteorological conditions surrounding the Mine Site. Correspondingly, meteorological data from Mildura Airport AWS have been examined to determine a 'typical' or representative dataset for use in dispersion modelling. Annual wind roses for the years 2017-2021 are presented in Figure A2.

**Figure A2 Annual wind roses - Mildura Airport AWS (2017-2021)**




The wind roses indicate that from 2017 to 2021, winds at Mildura Airport AWS shows predominant southerly and south-westerly wind directions with a westerly component evident.

The majority of wind speeds experienced at the Mildura Airport AWS between 2017 and 2021 are generally in the range 0.5 meters per second ($m \cdot s^{-1}$) to 8 $m \cdot s^{-1}$ with the highest wind speeds (greater than 8 $m \cdot s^{-1}$) occurring from mostly north and north-easterly directions. Winds of this speed are rare and occur during 1.3 % of the observed hours during the years while calm winds (less than 0.5 $m \cdot s^{-1}$) occur during 4.2 % of hours on average across the years from 2017 to 2021.

Given the wind distributions across the years examined, data for the year 2019 has been selected as being appropriate for further assessment, as it best represents the general trend across the five-year period studied.

Presented in Figure A3 are the annual wind rose for the 2017 to 2021 period and the year 2019 and in Figure A4 the annual wind speed distribution for Mildura Airport AWS. These figures indicate that the distribution of wind speed and direction in 2019 is very similar to that experienced across the longer-term period.

**Figure A3 Annual wind roses - Mildura Airport AWS (2017 to 2021, and 2019)**

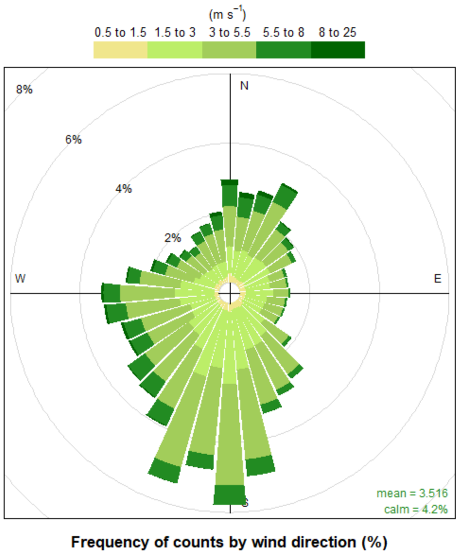
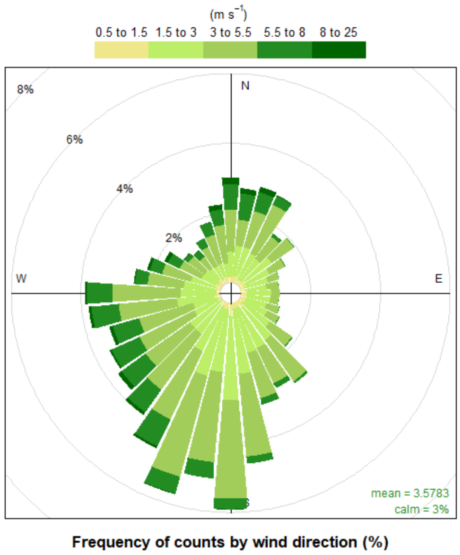
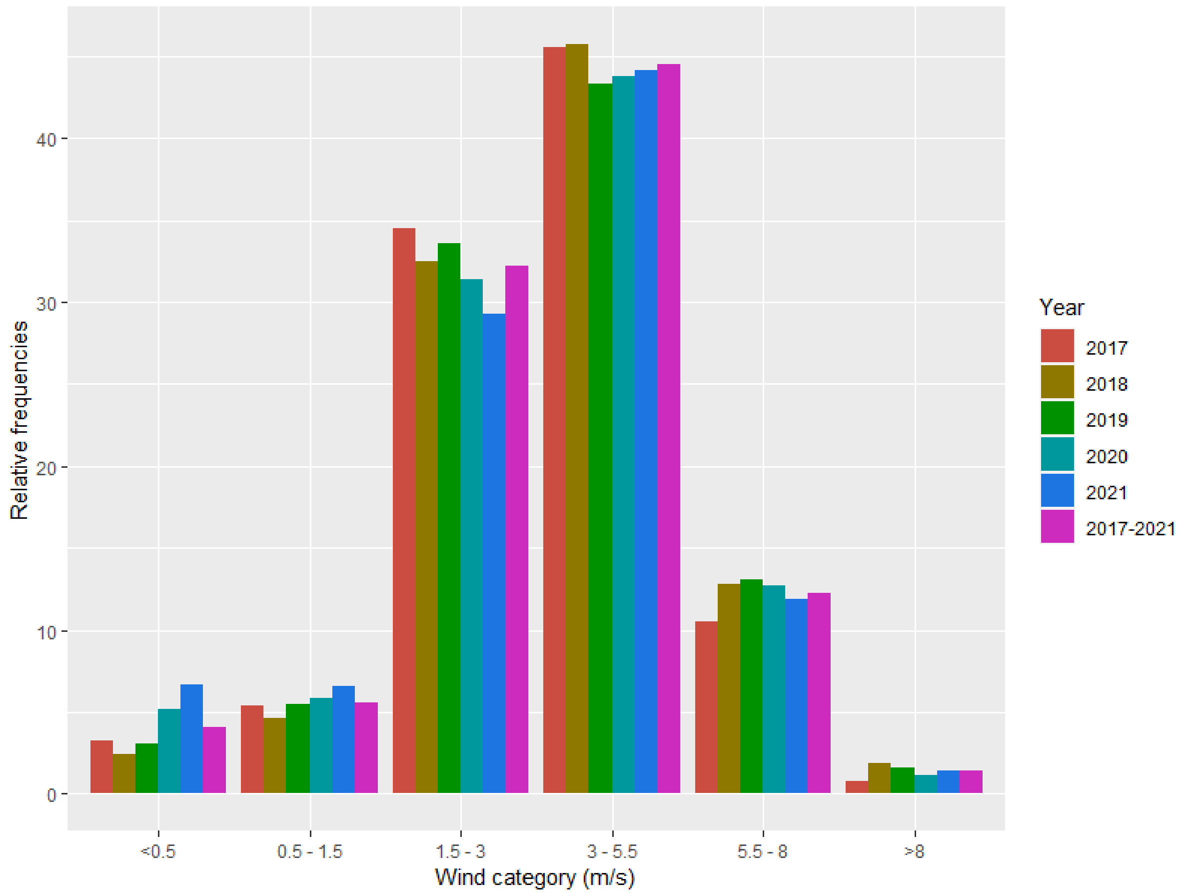
| 2017-2021 | 2019 |
|---|---|
|  |  |

**Figure A4 Annual wind speed distribution – Mildura Airport AWS**



# APPENDIX B

## Background Air Quality Data

Air quality is not monitored at the Mine Site and therefore air quality monitoring data measured at a representative location has been adopted for the purposes of this assessment. Determination of data to be used as a location representative of the Mine Site and during a representative year can be complicated by factors which include:

- The sources of air pollutant emissions around the Mine Site and representative air quality monitoring station(s); and,
- The variability of particulate matter concentrations (often impacted by natural climate variability).

Air quality monitoring is performed by the NSW Department of Planning and Environment (DPE) at two air quality monitoring station (AQMS) within a 590 km radius of the Mine Site. Details of the monitoring performed at these AQMS is presented in Table B1 and Figure A1. As discussed in Section 4.2 and Section 4.3, the year 2019 was selected for assessment based upon an analysis of meteorological and background air quality data.

**Table B1 Details of closest AQMS surrounding the Mine Site**

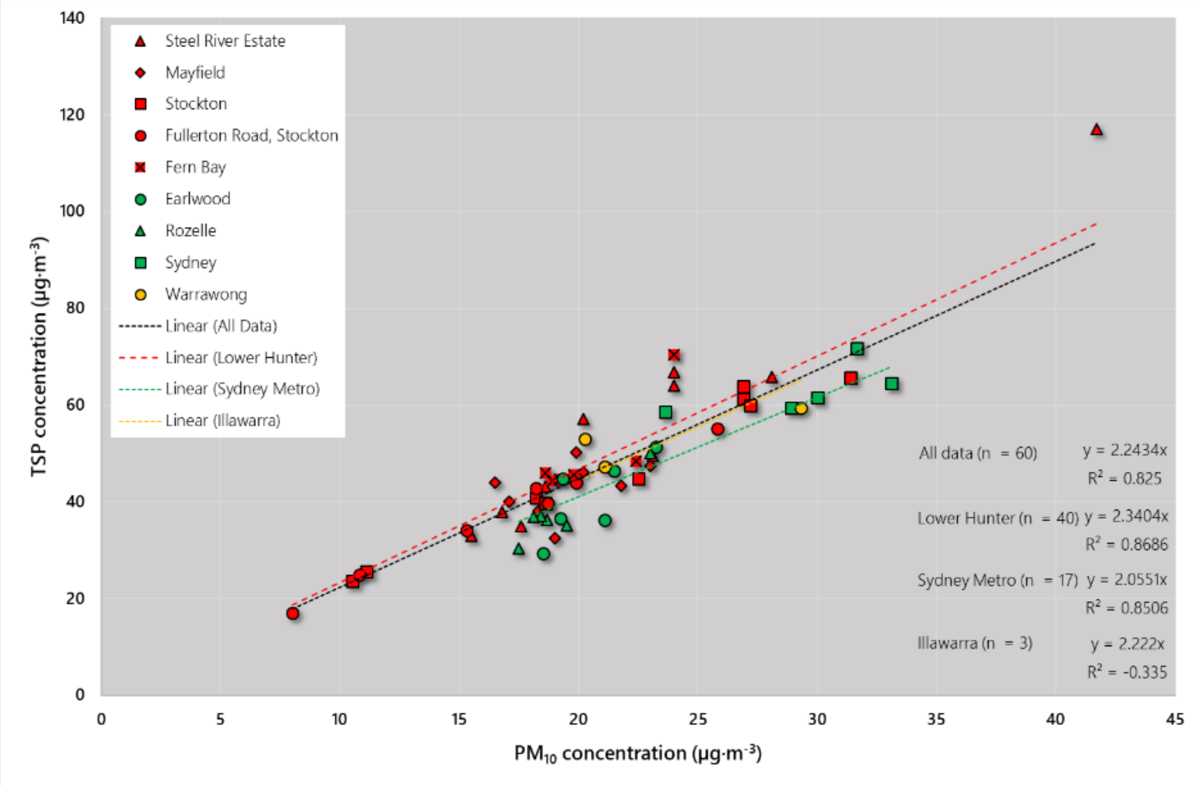
| AQMS Location | Source | Approximate distance to Project (km) | 2019 Data | Measurements | | |
|---|---|---|---|---|---|---|
| | | | | $PM_{10}$ | $PM_{2.5}$ | TSP |
| Wagga Wagga North | NSW DPE | 581 | ✓ | ✓ | ✓ | × |
| Albury | NSW DPE | 589 | ✓ | ✓ | ✓ | × |
| Elizabeth Downs | SA EPA | 259 | ✓ | ✓ | ✓ | × |

The closest representative NSW DPE AQMS with data available for the year 2019 (consistent with the meteorological modelling) is noted to be located at Wagga Wagga North and correspondingly, PM data collected at Wagga Wagga North AQMS has been adopted for use in this assessment.

Concentrations of TSP are not available from any AQMS identified in Table B1. An analysis of co-located measurements of TSP and $PM_{10}$ in the Lower Hunter (1999 to 2011), Illawarra (2002 to 2004), and Sydney Metropolitan (1999 to 2004) regions is presented in Figure B1.

The analysis concludes that, on the basis of the measurements collected in all regions between 1999 to 2011, the derivation of a broad TSP:$PM_{10}$ ratio of 2.3404 : 1 (i.e. $PM_{10}$ represents ~43 % of TSP) from the Lower Hunter is appropriate, and the most conservative of all the relationships assessed. In the absence of any more specific information, this ratio has been adopted within this AQIA, resulting in a background annual average TSP concentration of 82.7 $\mu g{\cdot}m^{-3}$ being adopted.

**Figure B1 Co-located TSP and $PM_{10}$ measurements, Lower Hunter, Sydney Metro and Illawarra**




Dust deposition rates are measured by the Applicant in the area surrounding the Mine Site for the assessment of current conditions, and these measurements would be adopted for ongoing air quality management purposes. There are currently two dust monitoring sites located on the boundary of Warwick Station, although historically, dust deposition rates have been measured at up to six locations, as shown in Table B2 and Figure 4. Results of the dust deposition monitoring (as total insoluble solids, $g{\cdot}m^{-2}{\cdot}month^{-1}$) over the most recent six complete years of monitoring (2019 to 2024), plus the most recent measurement for 2025 is presented in Table 14.

**Table B2 Dust deposition results**

| Year | Annual average total insoluble solids deposition rate ($g{\cdot}m^{-2}{\cdot}month^{-1}$) | | | | | | |
|---|---|---|---|---|---|---|---|
| | DMS1 | DMS2 | DMS3 | DMS4 | DMS5 | DMS6 | All sites |
| 2019 | 1.0 (5) | 0.9 (5) | 1.6 (5) | 1.6 (5) | 1.4 (5) | 0.8 (5) | 1.2 |
| 2020 | 2.8 (7) | 2.6 (7) | 8.7 (7) | 2.7 (7) | 0.4 (7) | 0.4 (7) | 2.9 |
| 2021 | 0.8 (5) | 0.9 (5) | 0.7 (5) | 1.5 (5) | 0.4 (5) | 0.3 (4) | 0.8 |
| 2022 | 1.9 (3) | 1.3 (3) | N/A | N/A | 0.3 (3) | 0.2 (3) | 0.9 |
| 2023 | 0.8 (9) | 1.0 (9) | N/A | N/A | 0.5 (5) | 0.5 (5) | 0.7 |
| 2024 | 0.4 (9) | 0.5 (9) | N/A | N/A | N/A | N/A | 0.5 |
| 2025 | 0.3 (3) | 0.4 (3) | N/A | N/A | N/A | N/A | 0.3 |

**Note:** Number of measurements shown in brackets.

Given that the site average annual average total insoluble solids deposition rates have been measured to be below 2 $g{\cdot}m^{-2}{\cdot}month^{-1}$ over the last 4 complete years of monitoring, with the 2019 (representative year for modelling) rate being 1.2 g·m$^{-2}$·month$^{-1}$, the adopted annual average total insoluble solids deposition rate of 2 g·m$^{-2}$·month$^{-1}$ (the difference in NSW EPA maximum allowable and incremental impact criterion) is considered appropriate to allow the presentation of a conservative assessment.

Summary statistics for the pollutants assessed are presented in Table B3.

**Table B3 Background air quality statistics**

| Pollutant | TSP | $PM_{10}$ | $PM_{2.5}$ |
|---|---|---|---|
| Units | µg·m$^{-3}$ | µg·m$^{-3}$ | µg·m$^{-3}$ |
| **Averaging Period** | **Annual** | **24-Hour** | **24-Hour** |
| **Statistics** | | | |
| Data Points (number) | 346 | 346 | 346 |
| Mean | 82.7 | 35.3 | 11.3 |
| Standard Deviation | - | 34.4 | 17.8 |
| *Skew*[1] | - | 3.0 | 8.2 |
| *Kurtosis*[2] | - | 11.6 | 88.0 |
| Minimum | - | 4.3 | 1.5 |
| **Percentiles** | | | |
| 25th | - | 14.8 | 5.3 |
| 50th | - | 24.4 | 7.6 |
| 75th | - | 42.9 | 11.4 |
| 90th | - | 68.5 | 15.9 |
| 95th | - | 100.0 | 24.5 |
| 97th | - | 129.1 | 41.9 |
| 98th | - | 134.3 | 53.8 |
| 99th | - | 201.6 | 85.6 |
| **Maximum** | **82.7** | **251.7** | **239.6** |
| **Data capture (%)** | **94.8** | **94.8** | **94.8** |

Graphs presenting the daily varying $PM_{10}$ and $PM_{2.5}$ data recorded at Wagga Wagga North are presented in Figure B2 and Figure B3, respectively.

Figure B2 PM$_{10}$ measurements – Wagga Wagga North (2019)

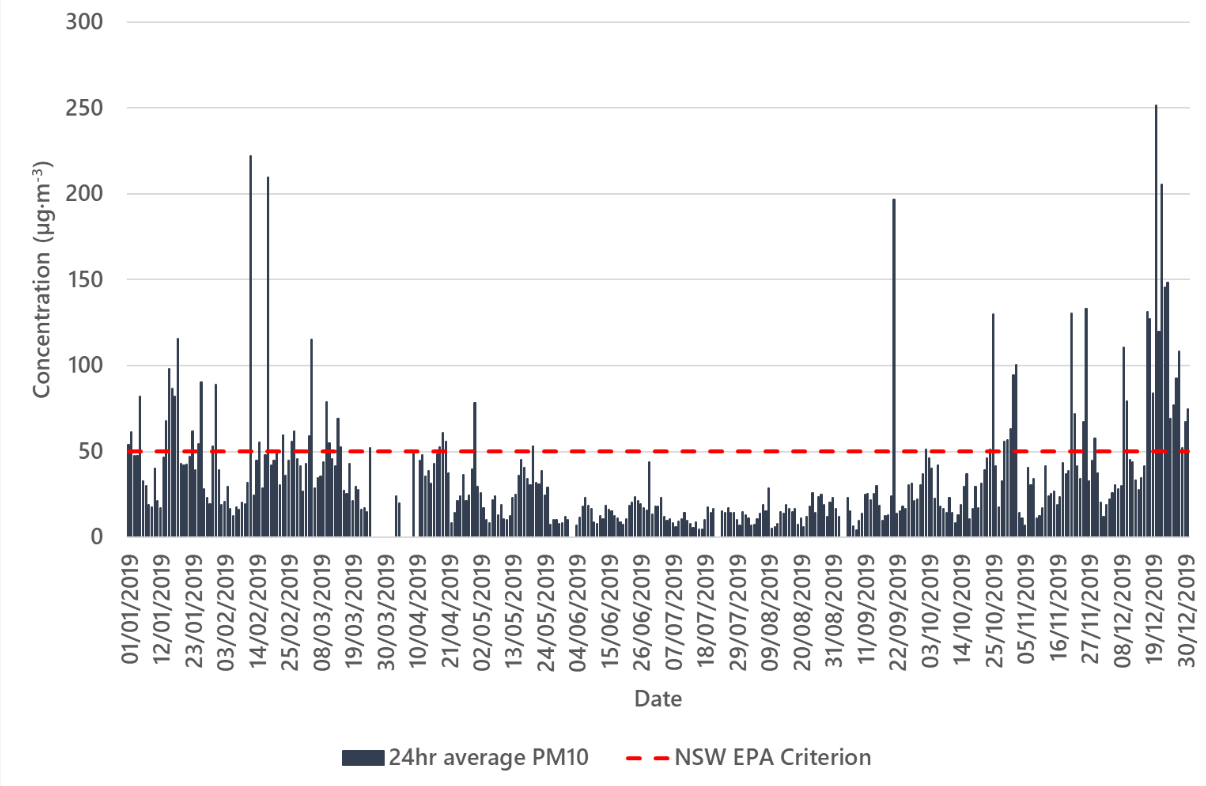
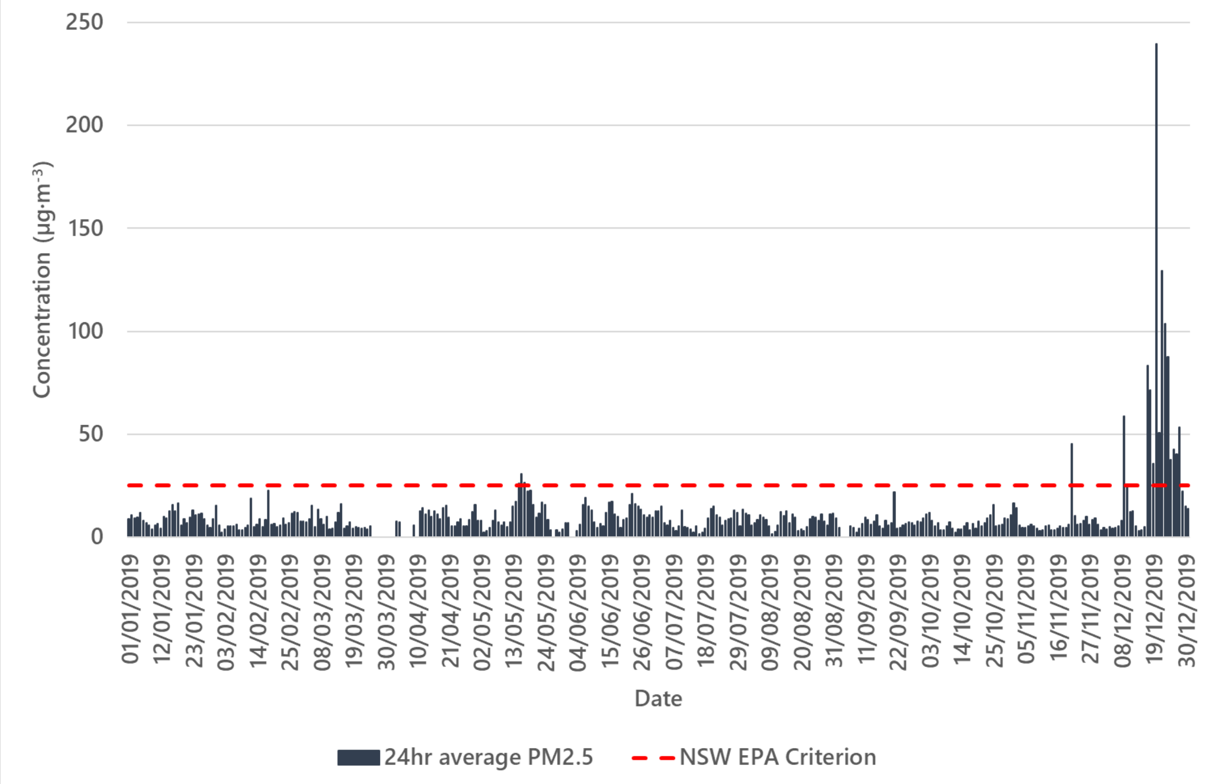


Figure B3 PM$_{2.5}$ measurements – Wagga Wagga North (2019)




Many exceedances of the NSW EPA maximum 24-hour average PM$_{10}$ and PM$_{2.5}$ criteria were measured at the Wagga Wagga North AQMS in late 2019. The NSW Annual Compliance Report for the National Environment Protection (Ambient Air Quality) Measure for 2019 (NSW DPE, 2021) provides commentary on the likely source of PM exceedances summarising that extensive drought conditions and bushfires were the primary source.

Given the likely source of particulates which influence measurements of particulate matter at the Wagga Wagga North AQMS, it is likely that measurements of particulate matter experienced in the area surrounding the Mine Site may be lower. The use of air quality data from Wagga Wagga North to characterise the air quality in the area surrounding Wentworth and the Mine Site is considered to be appropriate, if not conservative.

The AQIA considers all measured particulate concentrations within the background dataset (including exceedances) and provides discussion as to the potential impact of the Project on air quality. Impacts are discussed in terms of 'incremental' and 'cumulative' impact, and in relation to the number of 'additional exceedances' which may eventuate with the operation of the Project.

# APPENDIX C

## Emissions Estimation

## Section C1 Emission Factors

As outlined in Section 2.2, several operations to be performed as part of the Project have the potential to result in emissions of particulate matter. A detailed outline of the emission estimation techniques adopted to derive total emissions from the sources identified are presented in this appendix.

### Bulldozing (Overburden)

The emissions of particulate matter from the bulldozing (overburden [or material other than coal in the NPI]) process have been estimated using emission factors presented in Section 11.9-2 of AP-42 (Western Surface Coal Mining) (US EPA, 1998). The emission factor is:

$$EF_{TSP}\ (kg.hr^{-1}) = \frac{2.6 \times (s)^{1.2}}{(M)^{1.3}}$$

$$EF_{PM_{15}}\ (kg.hr^{-1}) = \frac{0.45 \times (s)^{1.5}}{(M)^{1.4}}$$

$$EF_{PM_{10}}(kg.hr^{-1}) = 0.75\ \times EF_{PM_{15}}$$

$$EF_{PM_{2.5}}\ (kg.hr^{-1}) = 0.105 \times EF_{TSP}$$

where:

$EF_{(kg \cdot hr^{-1})}$ = emission factor for particulate matter

$s_{(\%)}$ = silt content in %, by weight

$M_{(\%)}$ = moisture content of overburden in %, by weight

The quality rating for this emission factor is rated B for TSP, C for $PM_{15}$, D for $PM_{10}$, D for $PM_{2.5}$.

## Excavators/Frontend Loaders

Emissions associated with all loading and unloading operations have been characterised using the factor outlined in AP-42 for Batch Drop processes (Section 13.2.4.3) (USEPA, 2006a). This equation is consistent with that associated with the use of excavators, shovels and front-end loaders outlined in the NPI EETM for Mining (NPI, 2012):

$$EF\ (kg \cdot tonne^{-1}) = k(0.0016)\ \frac{\left(\frac{U\ (m \cdot s^{-1})}{2.2}\right)^{1.3}}{\left(\frac{M\ (\%)}{2}\right)^{1.4}}$$

where:

$EF_{TSP\ (kg \cdot tonne^{-1})}$ = emission factor for total suspended particles

$EF_{PM_{10}\ (kg \cdot tonne^{-1})}$ = emission factor for total suspended particles

$k_{TSP}$ = 0.74 for particles less than 30 micrometres aerodynamic diameter

$k_{PM_{10}}$ = 0.35 for particles less than 10 micrometres aerodynamic diameter

$k_{PM_{2.5}}$ = 0.053 for particles less than 2.5 micrometres aerodynamic diameter

$U$ = mean wind speed ($m \cdot s^{-1}$)

$M$ = material moisture content (% by weight)

The quality rating for this application is rated U (no rating).

## Grading

The emissions of particulate matter from grading operations have been estimated using emission factors presented in Section 11.9-2 of AP-42 (Western Surface Coal Mine) (US EPA, 1998). The emission factor is:

$$EF_{TSP}\ (kg.VKT^{-1}) = 0.0034 \times (S)^{2.5}$$

$$EF_{PM_{10}}\ (kg.VKT^{-1}) = 0.60 \times (EF_{PM_{15}})$$

$$EF_{PM_{2.5}}\ (kg.VKT^{-1}) = 0.031 \times (EF_{TSP})$$

where:

$EF_{(kg \cdot VKT^{-1})}$ = emission factor for particulate matter

$S$ = mean vehicle speed ($km \cdot hr^{-1}$), taken to be 2.5 $km \cdot hr^{-1}$.

The quality rating for this emission factor is rated C for TSP, D for $PM_{10}$, D for $PM_{2.5}$.

## Scraper

The emissions of particulate matter from the topsoil removal by scraper process have been estimated using emission factors presented in Section 11.9-4 of AP-42 (Western Surface Coal Mining) (US EPA, 1998). The emission factor is:

$$EF_{TSP}\ (kg.tonne^{-1}) = 0.029$$

where:

$EF_{(kg \cdot tonne^{-1})}$ = emission factor for particulate matter

$PM_{10}$ & $PM_{2.5}$ emission factors are not available in NPI although have been taken to be 25% of TSP for $PM_{10}$ and 15% of $PM_{10}$ for $PM_{2.5}$ as per MRI WRAPAIR ratio for Aggregate Handling & Storage Piles, consistent with AP-42 for Batch Drop (Section 13.2.4.3).

The quality rating for this emission factor is rated E.

## Unpaved Roads

Emissions of particulate matter resulting from the movement of materials on unpaved roads have been estimated using the emission factors presented in Section 13.2.2 (Unpaved Roads) of AP-42 (USEPA, 2006c).

The emission factor in section 13.2.2 of (USEPA, 2006c) has been adopted for the operations of vehicles on unpaved roads:

$$EF_{(kg.VKT^{-1})} = 0.2819 \times k \times (\frac{s}{12})^{a} \times (\frac{W \times 0.907185}{3})^{b}$$

where:

$EF_{(kg.VKT^{-1})}$ = emission factor (kg per vehicle kilometre travelled) multiplied by 0.2819 to convert from lb per vehicle mile travelled

$k$ = particle size multiplier (dimensionless)

$s$ = surface material silt content (%)

$W$ = mean vehicle weight (tons) multiplied by 0.907185 to convert from metric tonnes

The particle size multipliers for TSP, $PM_{10}$ and $PM_{2.5}$ ($k$) are provided in (US EPA, 2006a) as 4.9, 1.5 and 0.15, respectively.

The quality rating for this application is rated B for TSP, B for $PM_{10}$ and B for $PM_{2.5}$.

The silt content of unpaved haul roads at the Mine Site has been taken to be 4.8 % as outlined in USEPA AP-42 documentation, associated with unpaved plant roads sand and gravel processing facilities (range 4.1 % to 6 %, mean 4.8 %).

## Wind Erosion (Exposed Areas)

Emissions of particulate matter resulting from the wind erosion of exposed areas have been estimated using the emission factors presented in Section 11.9-4 of AP-42 (Western Surface Coal Mining) (US EPA, 1998).

The emission factors within table 11.9-4 have been adopted for the operations outlined above. The emission factor applies to the materials: seeded land, stripped overburden and graded overburden. The emission factor is:

$$EF_{TSP}\ (tonne.(hectare.year)^{-1}) = 0.85$$

where:

$EF_{TSP}\ (tonne.(hectare.year)^{-1})$ = emission factor for total suspended particulate matter

$PM_{10}$ and $PM_{2.5}$ emission factors are not available in AP-42 although have been taken to be 50% of TSP for $PM_{10}$ and, 7.5% of TSP for $PM_{2.5}$ as per AP-42 section (13.2.5) for industrial wind erosion.

The quality rating for this emission factors is C.

The active area of exposed areas, with the exception of the HMC storage area, is taken to be 10 % of the total area.

# Section C2 Project-Specific Data

## Material Silt and Moisture Content

The material silt and moisture contents assumed in the calculation of emissions is presented below.

**Table C1 Material silt and moisture content**

| Ref | Description | Silt content (%) | Moisture content (%) |
|---|---|---|---|
| Material 1 | Topsoil and subsoil | 6.2 | 10 |
| Material 2 | Overburden and interburden | 10 | 17.5 |
| Material 3 | Ore | 10 | 17.5 |
| Material 4 | Product | 10 | 5.5 |

The above silt and moisture contents are consistent with measured data presented in (SSM, 2020).

## Road Surface Silt and Average Vehicle Weights

**Table C2 Road surface silt and vehicle weight**

| Ref | Description | Paved / unpaved | Silt content (% or $g{\cdot}m^{-2}$) | Average vehicle weight (t) |
|---|---|---|---|---|
| Road 1 | Stripped topsoil and subsoil to revegetated area | Unpaved | 4.8 | 55.1 |
| Road 2 | Stripped overburden to placement area | Unpaved | 4.8 | 172.9 |
| Road 3 | Offsite transportation of product in containers, B-doubles plus buses | Unpaved | 4.8 | 72.5 |
| Road 4 | Grader on all roads | Unpaved | 4.8 | - |

## Vehicle Kilometre Travelled (VKT)

**Table C3 Vehicle kilometres travelled**

| Ref | Annual vehicle kilometres travelled (VKT) ($km{\cdot}yr^{-1}$) | | Daily vehicle kilometres travelled (VKT) ($km{\cdot}day^{-1}$) | |
|---|---|---|---|---|
| | Scenario 1 | Scenario 2 | Scenario 1 | Scenario 2 |
| Road 1 | 123 237 | 38 935 | 338 | 107 |
| Road 2 | 675 608 | 590 209 | 1 851 | 1 617 |
| Road 3 | 150 307 | 150 307 | 568 | 568 |
| Road 4 | 9,125 | 9 125 | 25 | 25 |

## Wind Erosion

The areas considered to represent significant sources of wind erosion are identified as:

- WE1 Vegetation cleared
- WE2 Overburden removal area
- WE3 Overburden backfill area
- WE4 Soil spreading and revegetation area
- WE5 Product drying stockpiles

Figure 6 and Figure 7 presented in Section 5.2 are provided by RZ Resources / RWC and show the locations for the above sources for the four assessment years:

- Scenario 1 Year 5 operations; and
- Scenario 2 Year 16 operations.

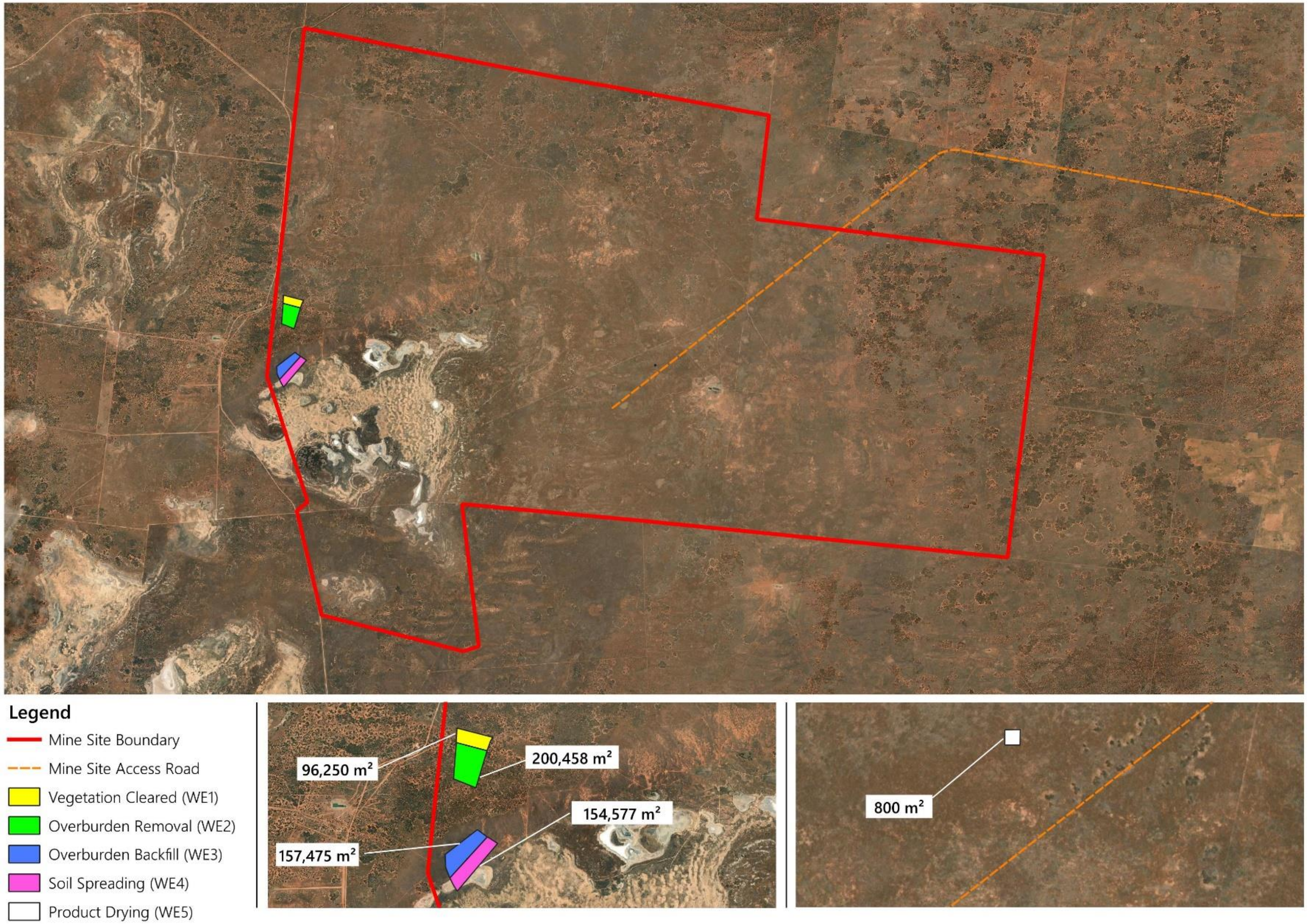
That information was imported into a GIS for mapping purposes, and the derived areas for each scenario are illustrated in Figure C1 and Figure C2 below and summarised in Table C4.

**Table C4 Wind erosion areas (ha)**

| Ref | Total area (ha) | | | Wind erosion area (ha) | |
|---|---|---|---|---|---|
| | Scenario 1 | Scenario 2 | Active Area | Scenario 1 | Scenario 2 |
| WE1 | 9.6250 | 9.1642 | 10% | 0.9625 | 0.91642 |
| WE2 | 20.0458 | 8.7961 | 10% | 2.04548 | 0.87961 |
| WE3 | 15.7475 | 9.9918 | 10% | 1.57475 | 0.99918 |
| WE4 | 15.4577 | 10.4163 | 10% | 1.54557 | 1.04163 |
| WE5 | 0.080 | 0.080 | 100% | 0.08 | 0.08 |

The active area of exposed areas, with the exception of the HMC storage area, is taken to be 10 % of the total area as presented in Figure C1 and Figure C2, and which is a commonly applied assumption. The area of HMC storage area available for wind erosion is taken to be 100 % of the area as it is frequently worked.

Figure C1 Estimated areas of wind erosion sources (Scenario 1)

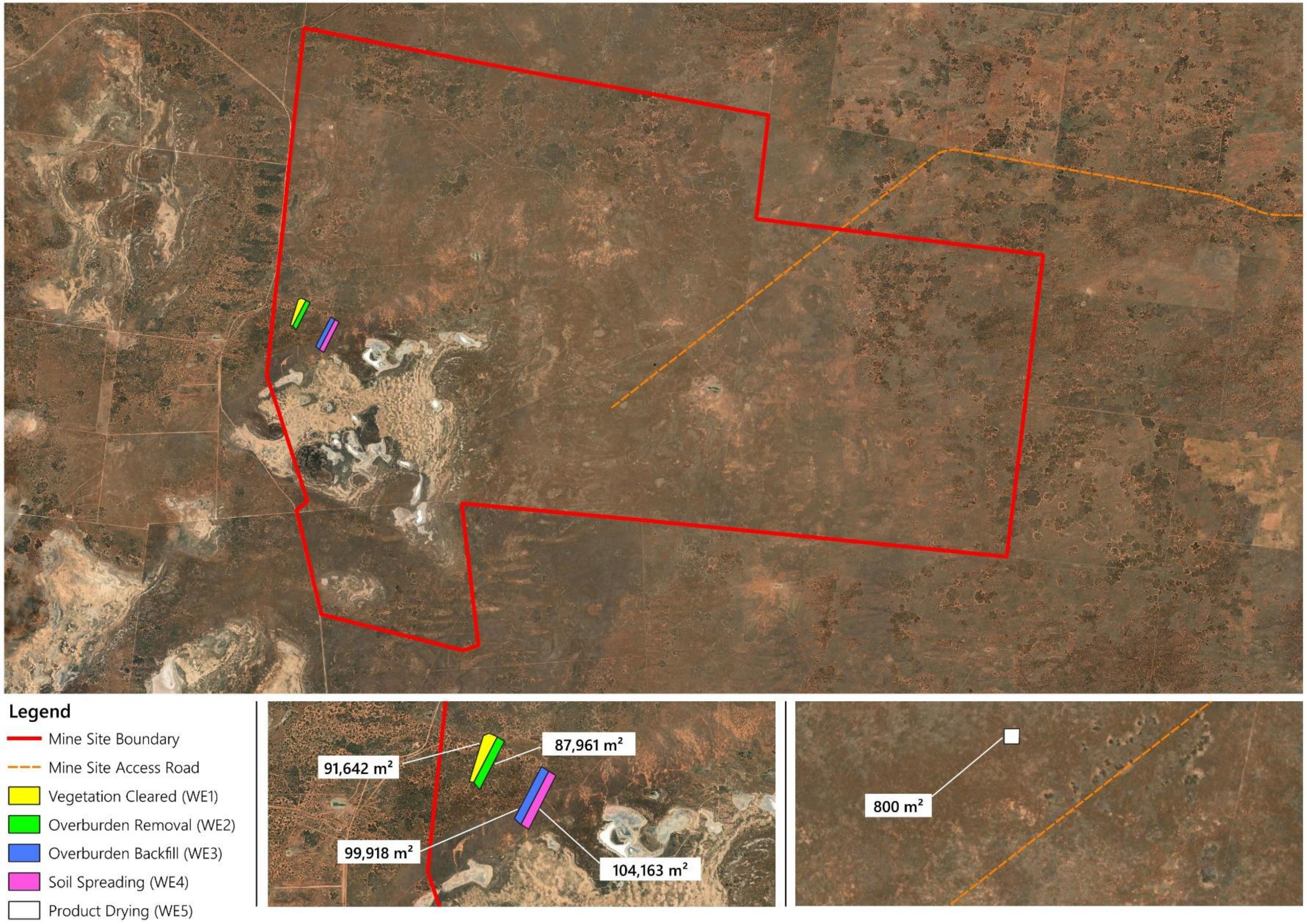



**Legend**

- Mine Site Boundary
- Mine Site Access Road
- Vegetation Cleared (WE1)
- Overburden Removal (WE2)
- Overburden Backfill (WE3)
- Soil Spreading (WE4)
- Product Drying (WE5)

**Source:** Northstar

Figure C2 Estimated areas of wind erosion sources (Scenario 2)




**Source:** Northstar

## Section C3 Emission Inventories

Annual and daily maximum emissions inventories for Scenario 1 and Scenario 2 are presented overleaf.

Inventories are presented in a consistent manner, to allow easy identification of the sources which are active or inactive in each modelled scenario.

## Table C5 Scenario 1 – annual emissions

| | | Emission rate | | | | | | | Controlled emission (kg.yr-1) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Description | Emission Factor | TSP | PM10 | PM2.5 | Units | Activity Rate | Units | Emission Controls | TSP | PM10 | PM2.5 |
| AVC - bulldozer clearing vegetation | AP-42 - Bulldozing (Overburden) - Table 11.9-2 | 1.2E+00 | 2.1E-01 | 1.2E-01 | kg·hr-1 | 913 | hr | | 1,061.9 | 189.3 | 111.5 |
| ASS - scraper on topsoil | AP-42 - Topsoil removal by scraper - Table 11.9-4 | 2.9E-02 | 7.3E-03 | 1.1E-03 | kg·t-1 | 1,103,124 | t | | 31,990.6 | 7,997.6 | 1,199.6 |
| DM - excavator loading overburden to haul trucks | AP-42 - Batch drop - Section 13.2.4.3 | 8.6E-05 | 4.1E-05 | 6.2E-06 | kg·t-1 | 35,100,000 | t | Pit retention | 1,517.4 | 1,363.6 | 206.5 |
| OBF - unloading of haul trucks at OBF area | AP-42 - Batch drop - Section 13.2.4.3 | 8.6E-05 | 4.1E-05 | 6.2E-06 | kg·t-1 | 35,100,000 | t | Pit retention | 1,517.4 | 1,363.6 | 206.5 |
| OBF - bulldozer push overburden | AP-42 - Bulldozing (Overburden) - Table 11.9-2 | 1.0E+00 | 1.9E-01 | 1.0E-01 | kg·hr-1 | 4,380 | hr | Pit retention | 2,185.1 | 807.6 | 435.9 |
| SSR - unloading of soil in reveg area | AP-42 - Scraper unloading (batch drop) - Table 11.9-4 | 2.0E-02 | 5.0E-03 | 7.5E-04 | kg·t-1 | 1,103,124 | t | | 22,062.5 | 5,515.6 | 827.3 |
| SSR - bulldozer spreading soil in reveg area | AP-42 - Bulldozing (Overburden) - Table 11.9-2 | 1.2E+00 | 2.1E-01 | 1.2E-01 | kg·hr-1 | 913 | hr | | 1,061.9 | 189.3 | 111.5 |
| DrM - Interburden removal, dredge mining | AP-42 - Batch drop - Section 13.2.4.3 | 8.6E-05 | 4.1E-05 | 6.2E-06 | kg·t-1 | 34,700,000 | t | Wet - 100% controlled | - | - | - |
| DrM - Ore extraction, dredge mining | AP-42 - Batch drop - Section 13.2.4.3 | 8.6E-05 | 4.1E-05 | 6.2E-06 | kg·t-1 | 20,300,000 | t | Wet - 100% controlled | - | - | - |
| Pr - wet concentration plant | AP-42 - Screening - Table 11.19.2.1 | 1.3E-02 | 4.3E-03 | 3.0E-04 | kg·t-1 | 20,300,000 | t | Wet - 100% controlled | - | - | - |
| Pr - HMC loaded to stockpiles for drying | AP-42 - Batch drop - Section 13.2.4.3 | 4.4E-04 | 2.1E-04 | 3.1E-05 | kg·t-1 | 437,000 | t | | 191.0 | 90.3 | 13.7 |
| Pr - HMC loaded to shipping containers | AP-42 - Batch drop - Section 13.2.4.3 | 4.4E-04 | 2.1E-04 | 3.1E-05 | kg·t-1 | 437,000 | t | | 191.0 | 90.3 | 13.7 |
| Stripped topsoil and subsoil to reveg area | AP-42 Unpaved roads - Section 13.2.2 | 2.8E+00 | 7.2E-01 | 7.2E-02 | kg·VKT-1 | 123,237 | VKT | Polymer application (90%), speed reduction (75%) | 8,674.9 | 2,210.9 | 221.1 |
| Stripped overburden to placement area | AP-42 Unpaved roads - Section 13.2.2 | 4.7E+00 | 1.2E+00 | 1.2E-01 | kg·VKT-1 | 669,882 | VKT | Polymer application (90%), speed reduction (75%) | 78,886.7 | 20,105.3 | 2,010.5 |
| Offsite transportation of product in containers, B-d | AP-42 Unpaved roads - Section 13.2.2 | 3.2E+00 | 8.1E-01 | 8.1E-02 | kg·VKT-1 | 150,307 | VKT | Polymer application (90%), speed reduction (75%) | 11,971.2 | 3,051.0 | 305.1 |
| Grader on all roads | AP-42 - Grading - Table 11.9-2 | 1.5E-01 | 6.8E-02 | 4.5E-03 | kg·VKT-1 | 9,125 | VKT | Polymer application (90%) | 133.3 | 62.1 | 4.1 |
| Vegetation cleared | AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4 | 8.5E+02 | 4.3E+02 | 6.4E+01 | kg·ha-1·yr-1 | 1.0 | ha | | 818.1 | 409.1 | 61.4 |
| Overburden removal area | AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4 | 8.5E+02 | 4.3E+02 | 6.4E+01 | kg·ha-1·yr-1 | 2.0 | ha | | 1,738.7 | 869.3 | 130.4 |
| Overburden backfill area | AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4 | 8.5E+02 | 4.3E+02 | 6.4E+01 | kg·ha-1·yr-1 | 1.6 | ha | | 1,338.5 | 669.3 | 100.4 |
| Soil spreading and reveg area | AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4 | 8.5E+02 | 4.3E+02 | 6.4E+01 | kg·ha-1·yr-1 | 1.5 | ha | | 1,313.7 | 656.9 | 98.5 |
| Product drying stockpiles | AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4 | 8.5E+02 | 4.3E+02 | 6.4E+01 | kg·ha-1·yr-1 | 0.1 | ha | 3 sided bins | 17.0 | 8.5 | 1.3 |
| | | | | | | | | TOTAL | **166,670.7** | **45,649.6** | **6,059.0** |

Table C6 Scenario 1 – peak daily emissions

| Description | Emission Factor | Emission rate | | | | Activity Rate | Units | Emission Controls | Controlled emissions (kg.day-1) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | TSP | PM10 | PM2.5 | Units | | | | TSP | PM10 | PM2.5 |
| AVC - bulldozer clearing vegetation | AP-42 - Bulldozing (Overburden) - Table 11.9-2 | 1.2E+00 | 2.1E-01 | 1.2E-01 | kg·hr-1 | 3 | hr | | 2.9 | 0.5 | 0.3 |
| ASS - scraper on topsoil | AP-42 - Topsoil removal by scraper - Table 11.9-4 | 2.9E-02 | 7.3E-03 | 1.1E-03 | kg·t-1 | 3,022 | t | | 87.6 | 21.9 | 3.3 |
| DM - excavator loading overburden to haul trucks | AP-42 - Batch drop - Section 13.2.4.3 | 8.6E-05 | 4.1E-05 | 6.2E-06 | kg·t-1 | 96,164 | t | Pit retention | 4.2 | 3.7 | 0.6 |
| OBF - unloading of haul trucks at OBF area | AP-42 - Batch drop - Section 13.2.4.3 | 8.6E-05 | 4.1E-05 | 6.2E-06 | kg·t-1 | 96,164 | t | Pit retention | 4.2 | 3.7 | 0.6 |
| OBF - bulldozer push overburden | AP-42 - Bulldozing (Overburden) - Table 11.9-2 | 1.0E+00 | 1.9E-01 | 1.0E-01 | kg·hr-1 | 12 | hr | Pit retention | 6.0 | 2.2 | 1.2 |
| SSR - unloading of soil in reveg area | AP-42 - Scraper unloading (batch drop) - Table 11.9-4 | 2.0E-02 | 5.0E-03 | 7.5E-04 | kg·t-1 | 3,022 | t | | 60.4 | 15.1 | 2.3 |
| SSR - bulldozer spreading soil in reveg area | AP-42 - Bulldozing (Overburden) - Table 11.9-2 | 1.2E+00 | 2.1E-01 | 1.2E-01 | kg·hr-1 | 3 | hr | | 2.9 | 0.5 | 0.3 |
| DrM - Interburden removal, dredge mining | AP-42 - Batch drop - Section 13.2.4.3 | 8.6E-05 | 4.1E-05 | 6.2E-06 | kg·t-1 | 95,068 | t | Wet - 100% controlled | - | - | - |
| DrM - Ore extraction, dredge mining | AP-42 - Batch drop - Section 13.2.4.3 | 8.6E-05 | 4.1E-05 | 6.2E-06 | kg·t-1 | 55,616 | t | Wet - 100% controlled | - | - | - |
| Pr - wet concentration plant | AP-42 - Screening - Table 11.19.2.1 | 1.3E-02 | 4.3E-03 | 3.0E-04 | kg·t-1 | 55,616 | t | Wet - 100% controlled | - | - | - |
| Pr - HMC loaded to stockpiles for drying | AP-42 - Batch drop - Section 13.2.4.3 | 4.4E-04 | 2.1E-04 | 3.1E-05 | kg·t-1 | 1,197 | t | | 0.5 | 0.2 | 0.0 |
| Pr - HMC loaded to shipping containers | AP-42 - Batch drop - Section 13.2.4.3 | 4.4E-04 | 2.1E-04 | 3.1E-05 | kg·t-1 | 1,197 | t | | 0.5 | 0.2 | 0.0 |
| Stripped topsoil and subsoil to reveg area | AP-42 Unpaved roads - Section 13.2.2 | 2.8E+00 | 7.2E-01 | 7.2E-02 | kg·VKT-1 | 338 | VKT | Polymer application (90%), speed reduction (75%) | 23.8 | 6.1 | 0.6 |
| Stripped overburden to placement area | AP-42 Unpaved roads - Section 13.2.2 | 4.7E+00 | 1.2E+00 | 1.2E-01 | kg·VKT-1 | 1,835 | VKT | Polymer application (90%), speed reduction (75%) | 216.1 | 55.1 | 5.5 |
| Offsite transportation of product in containers, B-d | AP-42 Unpaved roads - Section 13.2.2 | 3.2E+00 | 8.1E-01 | 8.1E-02 | kg·VKT-1 | 568 | VKT | Polymer application (90%), speed reduction (75%) | 45.2 | 11.5 | 1.2 |
| Grader on all roads | AP-42 - Grading - Table 11.9-2 | 1.5E-01 | 6.8E-02 | 4.5E-03 | kg·VKT-1 | 25 | VKT | Polymer application (90%) | 0.4 | 0.2 | 0.0 |
| Vegetation cleared | AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4 | 8.5E+02 | 4.3E+02 | 6.4E+01 | kg·ha-1·yr-1 | 1.0 | ha | | 2.2 | 1.1 | 0.2 |
| Overburden removal area | AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4 | 8.5E+02 | 4.3E+02 | 6.4E+01 | kg·ha-1·yr-1 | 2.0 | ha | | 4.8 | 2.4 | 0.4 |
| Overburden backfill area | AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4 | 8.5E+02 | 4.3E+02 | 6.4E+01 | kg·ha-1·yr-1 | 1.6 | ha | | 3.7 | 1.8 | 0.3 |
| Soil spreading and reveg area | AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4 | 8.5E+02 | 4.3E+02 | 6.4E+01 | kg·ha-1·yr-1 | 1.5 | ha | | 3.6 | 1.8 | 0.3 |
| Product drying stockpiles | AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4 | 8.5E+02 | 4.3E+02 | 6.4E+01 | kg·ha-1·yr-1 | 0.1 | ha | 3 sided bins | 0.0 | 0.0 | 0.0 |
| | | | | | | | | TOTAL | **469.1** | **128.2** | **16.9** |

## Table C7 Scenario 2 – annual emissions

| Description | Emission Factor | Emission rate | | | | | | Emission Controls | Controlled emission (kg.yr-1) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | TSP | PM10 | PM2.5 | Units | Activity Rate | Units | | TSP | PM10 | PM2.5 |
| AVC - bulldozer clearing vegetation | AP-42 - Bulldozing (Overburden) - Table 11.9-2 | 1.2E+00 | 2.1E-01 | 1.2E-01 | kg·hr-1 | 913 | hr | | 1,061.9 | 189.3 | 111.5 |
| ASS - scraper on topsoil | AP-42 - Topsoil removal by scraper - Table 11.9-4 | 2.9E-02 | 7.3E-03 | 1.1E-03 | kg·t-1 | 386,189 | t | | 11,199.5 | 2,799.9 | 420.0 |
| DM - excavator loading overburden to haul trucks | AP-42 - Batch drop - Section 13.2.4.3 | 8.6E-05 | 4.1E-05 | 6.2E-06 | kg·t-1 | 27,700,000 | t | Pit retention | 1,197.5 | 1,076.1 | 163.0 |
| OBF - unloading of haul trucks at OBF area | AP-42 - Batch drop - Section 13.2.4.3 | 8.6E-05 | 4.1E-05 | 6.2E-06 | kg·t-1 | 27,700,000 | t | Pit retention | 1,197.5 | 1,076.1 | 163.0 |
| OBF - bulldozer push overburden | AP-42 - Bulldozing (Overburden) - Table 11.9-2 | 1.0E+00 | 1.9E-01 | 1.0E-01 | kg·hr-1 | 4,380 | hr | Pit retention | 2,185.1 | 807.6 | 435.9 |
| SSR - unloading of soil in reveg area | AP-42 - Scraper unloading (batch drop) - Table 11.9-4 | 2.0E-02 | 5.0E-03 | 7.5E-04 | kg·t-1 | 386,189 | t | | 7,723.8 | 1,930.9 | 289.6 |
| SSR - bulldozer spreading soil in reveg area | AP-42 - Bulldozing (Overburden) - Table 11.9-2 | 1.2E+00 | 2.1E-01 | 1.2E-01 | kg·hr-1 | 913 | hr | | 1,061.9 | 189.3 | 111.5 |
| DrM - Interburden removal, dredge mining | AP-42 - Batch drop - Section 13.2.4.3 | 8.6E-05 | 4.1E-05 | 6.2E-06 | kg·t-1 | 20,600,000 | t | Wet - 100% controlled | - | - | - |
| DrM - Ore extraction, dredge mining | AP-42 - Batch drop - Section 13.2.4.3 | 8.6E-05 | 4.1E-05 | 6.2E-06 | kg·t-1 | 27,000,000 | t | Wet - 100% controlled | - | - | - |
| Pr - wet concentration plant | AP-42 - Screening - Table 11.19.2.1 | 1.3E-02 | 4.3E-03 | 3.0E-04 | kg·t-1 | 27,000,000 | t | Wet - 100% controlled | - | - | - |
| Pr - HMC loaded to stockpiles for drying | AP-42 - Batch drop - Section 13.2.4.3 | 4.4E-04 | 2.1E-04 | 3.1E-05 | kg·t-1 | 292,000 | t | | 127.6 | 60.4 | 9.1 |
| Pr - HMC loaded to shipping containers | AP-42 - Batch drop - Section 13.2.4.3 | 4.4E-04 | 2.1E-04 | 3.1E-05 | kg·t-1 | 292,000 | t | | 127.6 | 60.4 | 9.1 |
| Stripped topsoil and subsoil to reveg area | AP-42 Unpaved roads - Section 13.2.2 | 2.8E+00 | 7.2E-01 | 7.2E-02 | kg·VKT-1 | 38,935 | VKT | Polymer application (90%), speed reduction (75%) | 2,740.7 | 698.5 | 69.9 |
| Stripped overburden to placement area | AP-42 Unpaved roads - Section 13.2.2 | 4.7E+00 | 1.2E+00 | 1.2E-01 | kg·VKT-1 | 590,209 | VKT | Polymer application (90%), speed reduction (75%) | 69,504.2 | 17,714.1 | 1,771.4 |
| Offsite transportation of product in containers, B-d | AP-42 Unpaved roads - Section 13.2.2 | 3.2E+00 | 8.1E-01 | 8.1E-02 | kg·VKT-1 | 150,307 | VKT | Polymer application (90%), speed reduction (75%) | 11,971.2 | 3,051.0 | 305.1 |
| Grader on all roads | AP-42 - Grading - Table 11.9-2 | 1.5E-01 | 6.8E-02 | 4.5E-03 | kg·VKT-1 | 9,125 | VKT | Polymer application (90%) | 133.3 | 62.1 | 4.1 |
| Vegetation cleared | AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4 | 8.5E+02 | 4.3E+02 | 6.4E+01 | kg·ha-1·yr-1 | 0.9 | ha | | 779.0 | 389.5 | 58.4 |
| Overburden removal area | AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4 | 8.5E+02 | 4.3E+02 | 6.4E+01 | kg·ha-1·yr-1 | 0.9 | ha | | 747.7 | 373.8 | 56.1 |
| Overburden backfill area | AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4 | 8.5E+02 | 4.3E+02 | 6.4E+01 | kg·ha-1·yr-1 | 1.0 | ha | | 849.3 | 424.7 | 63.7 |
| Soil spreading and reveg area | AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4 | 8.5E+02 | 4.3E+02 | 6.4E+01 | kg·ha-1·yr-1 | 1.0 | ha | | 885.4 | 442.7 | 66.4 |
| Product drying stockpiles | AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4 | 8.5E+02 | 4.3E+02 | 6.4E+01 | kg·ha-1·yr-1 | 0.1 | ha | 3 sided bins | 17.0 | 8.5 | 1.3 |
| | | | | | | | | TOTAL | **113,509.9** | **31,354.7** | **4,109.1** |

## Table C8 Scenario 2 – peak daily emissions

| Description | Emission Factor | Emission rate | | | | | | Emission Controls | Controlled emissions (kg.day-1) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | TSP | PM10 | PM2.5 | Units | Activity Rate | Units | | TSP | PM10 | PM2.5 |
| AVC - bulldozer clearing vegetation | AP-42 - Bulldozing (Overburden) - Table 11.9-2 | 1.2E+00 | 2.1E-01 | 1.2E-01 | kg·hr-1 | 3 | hr | | 2.9 | 0.5 | 0.3 |
| ASS - scraper on topsoil | AP-42 - Topsoil removal by scraper - Table 11.9-4 | 2.9E-02 | 7.3E-03 | 1.1E-03 | kg·t-1 | 1,058 | t | | 30.7 | 7.7 | 1.2 |
| DM - excavator loading overburden to haul trucks | AP-42 - Batch drop - Section 13.2.4.3 | 8.6E-05 | 4.1E-05 | 6.2E-06 | kg·t-1 | 75,890 | t | Pit retention | 3.3 | 2.9 | 0.4 |
| OBF - unloading of haul trucks at OBF area | AP-42 - Batch drop - Section 13.2.4.3 | 8.6E-05 | 4.1E-05 | 6.2E-06 | kg·t-1 | 75,890 | t | Pit retention | 3.3 | 2.9 | 0.4 |
| OBF - bulldozer push overburden | AP-42 - Bulldozing (Overburden) - Table 11.9-2 | 1.0E+00 | 1.9E-01 | 1.0E-01 | kg·hr-1 | 12 | hr | Pit retention | 6.0 | 2.2 | 1.2 |
| SSR - unloading of soil in reveg area | AP-42 - Scraper unloading (batch drop) - Table 11.9-4 | 2.0E-02 | 5.0E-03 | 7.5E-04 | kg·t-1 | 1,058 | t | | 21.2 | 5.3 | 0.8 |
| SSR - bulldozer spreading soil in reveg area | AP-42 - Bulldozing (Overburden) - Table 11.9-2 | 1.2E+00 | 2.1E-01 | 1.2E-01 | kg·hr-1 | 3 | hr | | 2.9 | 0.5 | 0.3 |
| DrM - Interburden removal, dredge mining | AP-42 - Batch drop - Section 13.2.4.3 | 8.6E-05 | 4.1E-05 | 6.2E-06 | kg·t-1 | 56,438 | t | Wet - 100% controlled | - | - | - |
| DrM - Ore extraction, dredge mining | AP-42 - Batch drop - Section 13.2.4.3 | 8.6E-05 | 4.1E-05 | 6.2E-06 | kg·t-1 | 73,973 | t | Wet - 100% controlled | - | - | - |
| Pr - wet concentration plant | AP-42 - Screening - Table 11.19.2.1 | 1.3E-02 | 4.3E-03 | 3.0E-04 | kg·t-1 | 73,973 | t | Wet - 100% controlled | - | - | - |
| Pr - HMC loaded to stockpiles for drying | AP-42 - Batch drop - Section 13.2.4.3 | 4.4E-04 | 2.1E-04 | 3.1E-05 | kg·t-1 | 800 | t | | 0.3 | 0.2 | 0.0 |
| Pr - HMC loaded to shipping containers | AP-42 - Batch drop - Section 13.2.4.3 | 4.4E-04 | 2.1E-04 | 3.1E-05 | kg·t-1 | 800 | t | | 0.3 | 0.2 | 0.0 |
| Stripped topsoil and subsoil to reveg area | AP-42 Unpaved roads - Section 13.2.2 | 2.8E+00 | 7.2E-01 | 7.2E-02 | kg·VKT-1 | 107 | VKT | Polymer application (90%), speed reduction (75%) | 7.5 | 1.9 | 0.2 |
| Stripped overburden to placement area | AP-42 Unpaved roads - Section 13.2.2 | 4.7E+00 | 1.2E+00 | 1.2E-01 | kg·VKT-1 | 1,617 | VKT | Polymer application (90%), speed reduction (75%) | 190.4 | 48.5 | 4.9 |
| Offsite transportation of product in containers, B-d | AP-42 Unpaved roads - Section 13.2.2 | 3.2E+00 | 8.1E-01 | 8.1E-02 | kg·VKT-1 | 568 | VKT | Polymer application (90%), speed reduction (75%) | 45.2 | 11.5 | 1.2 |
| Grader on all roads | AP-42 - Grading - Table 11.9-2 | 1.5E-01 | 6.8E-02 | 4.5E-03 | kg·VKT-1 | 25 | VKT | Polymer application (90%) | 0.4 | 0.2 | 0.0 |
| Vegetation cleared | AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4 | 8.5E+02 | 4.3E+02 | 6.4E+01 | kg·ha-1·yr-1 | 0.9 | ha | | 2.1 | 1.1 | 0.2 |
| Overburden removal area | AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4 | 8.5E+02 | 4.3E+02 | 6.4E+01 | kg·ha-1·yr-1 | 0.9 | ha | | 2.0 | 1.0 | 0.2 |
| Overburden backfill area | AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4 | 8.5E+02 | 4.3E+02 | 6.4E+01 | kg·ha-1·yr-1 | 1.0 | ha | | 2.3 | 1.2 | 0.2 |
| Soil spreading and reveg area | AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4 | 8.5E+02 | 4.3E+02 | 6.4E+01 | kg·ha-1·yr-1 | 1.0 | ha | | 2.4 | 1.2 | 0.2 |
| Product drying stockpiles | AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4 | 8.5E+02 | 4.3E+02 | 6.4E+01 | kg·ha-1·yr-1 | 0.1 | ha | 3 sided bins | 0.0 | 0.0 | 0.0 |
| | | | | | | | | TOTAL | **323.4** | **89.1** | **11.6** |

# APPENDIX D

## 24-hour Average PM Additional Exceedances

Table D1 Summary of contemporaneous impact and background – $PM_{10}$ – Receptor R6, Scenario 1

| Cumul. Impact Rank | Date | 24-hour average $PM_{10}$ concentration ($\mu g{\cdot}m^{-3}$) - Receptor R6 | | | Inc. Impact Rank | Date | 24-hour average $PM_{10}$ concentration ($\mu g{\cdot}m^{-3}$) - Receptor R6 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Incremental Impact | Background | Cumulative Impact | | | Incremental Impact | Background | Cumulative Impact |
| | Criterion | 50 | | | | Criterion | 50 | | |
| 1 | 20/12/2019 | < 0.1 | 251.7 | 251.8 | 1 | 21/06/2019 | 0.8 | 10.7 | 11.5 |
| 2 | 12/02/2019 | < 0.1 | 221.9 | 222.0 | 2 | 03/07/2019 | 0.6 | 23.1 | 23.7 |
| 3 | 18/02/2019 | < 0.1 | 209.7 | 209.8 | 3 | 11/04/2019 | 0.6 | 44.7 | 45.3 |
| 4 | 22/12/2019 | 0.1 | 205.5 | 205.6 | 4 | 23/06/2019 | 0.6 | 20.1 | 20.7 |
| 5 | 21/09/2019 | < 0.1 | 196.8 | 196.9 | 5 | 10/04/2019 | 0.6 | 50.2 | 50.8 |
| 6 | 24/12/2019 | 0.4 | 148.3 | 148.7 | 6 | 19/06/2019 | 0.6 | 9.0 | 9.6 |
| 7 | 23/12/2019 | 0.4 | 145.8 | 146.2 | 7 | 19/03/2019 | 0.5 | 21.4 | 21.9 |
| 8 | 26/11/2019 | < 0.1 | 133.0 | 133.1 | 8 | 17/02/2019 | 0.5 | 48.0 | 48.5 |
| 9 | 17/12/2019 | < 0.1 | 131.5 | 131.6 | 9 | 15/03/2019 | 0.5 | 52.7 | 53.2 |
| 10 | 21/11/2019 | < 0.1 | 130.5 | 130.6 | 10 | 16/03/2019 | 0.5 | 27.3 | 27.8 |
| 65 | 21/02/2019 | 0.2 | 49.9 | 50.1 | 78 | 21/02/2019 | 0.2 | 49.9 | 50.1 |
| These data represent the highest Cumulative Impact 24-hour $PM_{10}$ predictions (outlined in red) due to the operation of the Project. | | | | | These data represent the highest Incremental Impact 24-hour $PM_{10}$ predictions (outlined in blue) due to the operation of the Project. | | | | |

Table D2 Summary of contemporaneous impact and background – $PM_{2.5}$ – Receptor R6, Scenario 1

| Cumul. Impact Rank | Date | 24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R6 | | | Inc. Impact Rank | Date | 24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R6 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Incremental Impact | Background | Cumulative Impact | | | Incremental Impact | Background | Cumulative Impact |
| | Criterion | 25 | | | | Criterion | 25 | | |
| 1 | 20/12/2019 | < 0.1 | 239.6 | 239.7 | 1 | 21/06/2019 | 0.1 | 9.3 | 9.4 |
| 2 | 22/12/2019 | < 0.1 | 129.4 | 129.5 | 2 | 03/07/2019 | < 0.1 | 15.0 | 15.1 |
| 3 | 23/12/2019 | < 0.1 | 103.6 | 103.7 | 3 | 11/04/2019 | < 0.1 | 12.8 | 12.9 |
| 4 | 24/12/2019 | < 0.1 | 87.5 | 87.6 | 4 | 23/06/2019 | < 0.1 | 21.1 | 21.2 |
| 5 | 17/12/2019 | < 0.1 | 83.2 | 83.3 | 5 | 19/06/2019 | < 0.1 | 4.8 | 4.9 |
| 6 | 18/12/2019 | < 0.1 | 71.6 | 71.7 | 6 | 10/04/2019 | < 0.1 | 5.7 | 5.8 |
| 7 | 09/12/2019 | < 0.1 | 58.8 | 58.9 | 7 | 19/03/2019 | < 0.1 | 4.3 | 4.4 |
| 8 | 28/12/2019 | < 0.1 | 53.2 | 53.3 | 8 | 17/02/2019 | < 0.1 | 8.4 | 8.5 |
| 9 | 21/12/2019 | < 0.1 | 50.5 | 50.6 | 9 | 15/03/2019 | < 0.1 | 16.3 | 16.4 |
| 10 | 21/11/2019 | < 0.1 | 45.5 | 45.6 | 10 | 14/01/2019 | < 0.1 | 9.2 | 9.3 |
| 18 | 10/12/2019 | < 0.1 | 25.0 | 25.1 | 265 | 10/12/2019 | < 0.1 | 25.0 | 25.1 |
| These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) as a result of the operation of the project. | | | | | These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) as a result of the operation of the project. | | | | |

Table D3 Summary of contemporaneous impact and background – $PM_{2.5}$ – Receptor R11, Scenario 1

| Cumul. Impact Rank | Date | 24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R11 | | | Inc. Impact Rank | Date | 24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R11 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Incremental Impact | Background | Cumulative Impact | | | Incremental Impact | Background | Cumulative Impact |
| | Criterion | 25 | | | | Criterion | 25 | | |
| 1 | 20/12/2019 | < 0.1 | 239.6 | 239.7 | 1 | 12/08/2019 | < 0.1 | 5.6 | 5.7 |
| 2 | 22/12/2019 | < 0.1 | 129.4 | 129.5 | 2 | 31/05/2019 | < 0.1 | 6.8 | 6.9 |
| 3 | 23/12/2019 | < 0.1 | 103.6 | 103.7 | 3 | 08/07/2019 | < 0.1 | 3.0 | 3.1 |
| 4 | 24/12/2019 | < 0.1 | 87.5 | 87.6 | 4 | 14/10/2019 | < 0.1 | 4.0 | 4.1 |
| 5 | 17/12/2019 | < 0.1 | 83.2 | 83.3 | 5 | 29/11/2019 | < 0.1 | 9.2 | 9.3 |
| 6 | 18/12/2019 | < 0.1 | 71.6 | 71.7 | 6 | 03/08/2019 | < 0.1 | 5.9 | 6.0 |
| 7 | 09/12/2019 | < 0.1 | 58.8 | 58.9 | 7 | 27/08/2019 | < 0.1 | 11.3 | 11.4 |
| 8 | 28/12/2019 | < 0.1 | 53.2 | 53.3 | 8 | 04/05/2019 | < 0.1 | 3.1 | 3.2 |
| 9 | 21/12/2019 | < 0.1 | 50.5 | 50.6 | 9 | 19/06/2019 | < 0.1 | 4.8 | 4.9 |
| 10 | 21/11/2019 | < 0.1 | 45.5 | 45.6 | 10 | 28/04/2019 | < 0.1 | 8.5 | 8.6 |
| 18 | 10/12/2019 | < 0.1 | 25.0 | 25.1 | 138 | 10/12/2019 | < 0.1 | 25.0 | 25.1 |
| These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) as a result of the operation of the project. | | | | | These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) as a result of the operation of the project. | | | | |

Table D4 Summary of contemporaneous impact and background – $PM_{2.5}$ – Receptor R12, Scenario 1

| Cumul. Impact Rank | Date | 24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R12 | | | Inc. Impact Rank | Date | 24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R12 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Incremental Impact | Background | Cumulative Impact | | | Incremental Impact | Background | Cumulative Impact |
| | Criterion | 25 | | | | Criterion | 25 | | |
| 1 | 20/12/2019 | < 0.1 | 239.6 | 239.7 | 1 | 27/08/2019 | < 0.1 | 11.3 | 11.4 |
| 2 | 22/12/2019 | < 0.1 | 129.4 | 129.5 | 2 | 12/08/2019 | < 0.1 | 5.6 | 5.7 |
| 3 | 23/12/2019 | < 0.1 | 103.6 | 103.7 | 3 | 03/08/2019 | < 0.1 | 5.9 | 6.0 |
| 4 | 24/12/2019 | < 0.1 | 87.5 | 87.6 | 4 | 31/05/2019 | < 0.1 | 6.8 | 6.9 |
| 5 | 17/12/2019 | < 0.1 | 83.2 | 83.3 | 5 | 04/05/2019 | < 0.1 | 3.1 | 3.2 |
| 6 | 18/12/2019 | < 0.1 | 71.6 | 71.7 | 6 | 29/11/2019 | < 0.1 | 9.2 | 9.3 |
| 7 | 09/12/2019 | < 0.1 | 58.8 | 58.9 | 7 | 08/07/2019 | < 0.1 | 3.0 | 3.1 |
| 8 | 28/12/2019 | < 0.1 | 53.2 | 53.3 | 8 | 02/08/2019 | < 0.1 | 10.6 | 10.7 |
| 9 | 21/12/2019 | < 0.1 | 50.5 | 50.6 | 9 | 26/08/2019 | < 0.1 | 8.2 | 8.3 |
| 10 | 21/11/2019 | < 0.1 | 45.5 | 45.6 | 10 | 19/06/2019 | < 0.1 | 4.8 | 4.9 |
| 18 | 10/12/2019 | < 0.1 | 25.0 | 25.1 | 120 | 10/12/2019 | < 0.1 | 25.0 | 25.1 |
| These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) as a result of the operation of the project. | | | | | These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) as a result of the operation of the project. | | | | |

Table D5 Summary of contemporaneous impact and background – $PM_{2.5}$ – Receptor R13, Scenario 1

| Cumul. Impact Rank | Date | 24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R13 | | | Inc. Impact Rank | Date | 24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R13 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Incremental Impact | Background | Cumulative Impact | | | Incremental Impact | Background | Cumulative Impact |
| | Criterion | 25 | | | | Criterion | 25 | | |
| 1 | 20/12/2019 | < 0.1 | 239.6 | 239.7 | 1 | 27/08/2019 | < 0.1 | 11.3 | 11.4 |
| 2 | 22/12/2019 | < 0.1 | 129.4 | 129.5 | 2 | 26/08/2019 | < 0.1 | 8.2 | 8.3 |
| 3 | 23/12/2019 | < 0.1 | 103.6 | 103.7 | 3 | 03/08/2019 | < 0.1 | 5.9 | 6.0 |
| 4 | 24/12/2019 | < 0.1 | 87.5 | 87.6 | 4 | 24/04/2019 | < 0.1 | 7.3 | 7.4 |
| 5 | 17/12/2019 | < 0.1 | 83.2 | 83.3 | 5 | 02/08/2019 | < 0.1 | 10.6 | 10.7 |
| 6 | 18/12/2019 | < 0.1 | 71.6 | 71.7 | 6 | 12/08/2019 | < 0.1 | 5.6 | 5.7 |
| 7 | 09/12/2019 | < 0.1 | 58.8 | 58.9 | 7 | 05/05/2019 | < 0.1 | 4.7 | 4.8 |
| 8 | 28/12/2019 | < 0.1 | 53.2 | 53.3 | 8 | 19/06/2019 | < 0.1 | 4.8 | 4.9 |
| 9 | 21/12/2019 | < 0.1 | 50.5 | 50.6 | 9 | 01/08/2019 | < 0.1 | 11.7 | 11.8 |
| 10 | 21/11/2019 | < 0.1 | 45.5 | 45.6 | 10 | 25/08/2019 | < 0.1 | 9.6 | 9.7 |
| 18 | 10/12/2019 | < 0.1 | 25.0 | 25.1 | 58 | 10/12/2019 | < 0.1 | 25.0 | 25.1 |
| These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) as a result of the operation of the project. | | | | | These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) as a result of the operation of the project. | | | | |

Table D6 Summary of contemporaneous impact and background – $PM_{2.5}$ – Receptor R6, Scenario 2

| Cumul. Impact Rank | Date | 24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R6 | | | Inc. Impact Rank | Date | 24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R6 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Incremental Impact | Background | Cumulative Impact | | | Incremental Impact | Background | Cumulative Impact |
| | Criterion | 25 | | | | Criterion | 25 | | |
| 1 | 20/12/2019 | < 0.1 | 239.6 | 239.7 | 1 | 21/06/2019 | < 0.1 | 9.3 | 9.4 |
| 2 | 22/12/2019 | <0.1 | 129.4 | 129.5 | 2 | 03/07/2019 | < 0.1 | 15.0 | 15.1 |
| 3 | 23/12/2019 | < 0.1 | 103.6 | 103.7 | 3 | 11/04/2019 | < 0.1 | 12.8 | 12.9 |
| 4 | 24/12/2019 | < 0.1 | 87.5 | 87.6 | 4 | 23/06/2019 | < 0.1 | 21.1 | 21.2 |
| 5 | 17/12/2019 | < 0.1 | 83.2 | 83.3 | 5 | 10/04/2019 | < 0.1 | 5.7 | 5.8 |
| 6 | 18/12/2019 | < 0.1 | 71.6 | 71.7 | 6 | 19/06/2019 | < 0.1 | 4.8 | 4.9 |
| 7 | 09/12/2019 | < 0.1 | 58.8 | 58.9 | 7 | 19/03/2019 | < 0.1 | 4.3 | 4.4 |
| 8 | 28/12/2019 | < 0.1 | 53.2 | 53.3 | 8 | 17/02/2019 | < 0.1 | 8.4 | 8.5 |
| 9 | 21/12/2019 | < 0.1 | 50.5 | 50.6 | 9 | 16/03/2019 | < 0.1 | 4.3 | 4.4 |
| 10 | 21/11/2019 | < 0.1 | 45.5 | 45.6 | 10 | 20/03/2019 | < 0.1 | 5.1 | 5.2 |
| 18 | 10/12/2019 | < 0.1 | 25.0 | 25.1 | 273 | 10/12/2019 | < 0.1 | 25.0 | 25.1 |
| These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) as a result of the operation of the project. | | | | | These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) as a result of the operation of the project. | | | | |

Table D7 Summary of contemporaneous impact and background – $PM_{2.5}$ – Receptor R11, Scenario 2

| Cumul. Impact Rank | Date | 24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R11 | | | Inc. Impact Rank | Date | 24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R11 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Incremental Impact | Background | Cumulative Impact | | | Incremental Impact | Background | Cumulative Impact |
| | Criterion | 25 | | | | Criterion | 25 | | |
| 1 | 20/12/2019 | < 0.1 | 239.6 | 239.7 | 1 | 12/08/2019 | < 0.1 | 5.6 | 5.7 |
| 2 | 22/12/2019 | < 0.1 | 129.4 | 129.5 | 2 | 31/05/2019 | < 0.1 | 6.8 | 6.9 |
| 3 | 23/12/2019 | < 0.1 | 103.6 | 103.7 | 3 | 29/11/2019 | < 0.1 | 9.2 | 9.3 |
| 4 | 24/12/2019 | < 0.1 | 87.5 | 87.6 | 4 | 14/10/2019 | < 0.1 | 4.0 | 4.1 |
| 5 | 17/12/2019 | < 0.1 | 83.2 | 83.3 | 5 | 27/08/2019 | < 0.1 | 11.3 | 11.4 |
| 6 | 18/12/2019 | < 0.1 | 71.6 | 71.7 | 6 | 03/08/2019 | < 0.1 | 5.9 | 6.0 |
| 7 | 09/12/2019 | < 0.1 | 58.8 | 58.9 | 7 | 08/07/2019 | < 0.1 | 3.0 | 3.1 |
| 8 | 28/12/2019 | < 0.1 | 53.2 | 53.3 | 8 | 04/05/2019 | < 0.1 | 3.1 | 3.2 |
| 9 | 21/12/2019 | < 0.1 | 50.5 | 50.6 | 9 | 28/04/2019 | < 0.1 | 8.5 | 8.6 |
| 10 | 21/11/2019 | < 0.1 | 45.5 | 45.6 | 10 | 19/06/2019 | < 0.1 | 4.8 | 4.9 |
| 18 | 10/12/2019 | < 0.1 | 25.0 | 25.1 | 138 | 10/12/2019 | < 0.1 | 25.0 | 25.1 |
| These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) as a result of the operation of the project. | | | | | These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) as a result of the operation of the project. | | | | |

Table D8 Summary of contemporaneous impact and background – $PM_{2.5}$ – Receptor R12, Scenario 2

| Cumul. Impact Rank | Date | 24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R12 | | | Inc. Impact Rank | Date | 24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R12 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Incremental Impact | Background | Cumulative Impact | | | Incremental Impact | Background | Cumulative Impact |
| | Criterion | 25 | | | | Criterion | 25 | | |
| 1 | 20/12/2019 | < 0.1 | 239.6 | 239.7 | 1 | 27/08/2019 | < 0.1 | 11.3 | 11.4 |
| 2 | 22/12/2019 | < 0.1 | 129.4 | 129.5 | 2 | 12/08/2019 | < 0.1 | 5.6 | 5.7 |
| 3 | 23/12/2019 | < 0.1 | 103.6 | 103.7 | 3 | 03/08/2019 | < 0.1 | 5.9 | 6.0 |
| 4 | 24/12/2019 | < 0.1 | 87.5 | 87.6 | 4 | 31/05/2019 | < 0.1 | 6.8 | 6.9 |
| 5 | 17/12/2019 | < 0.1 | 83.2 | 83.3 | 5 | 29/11/2019 | < 0.1 | 9.2 | 9.3 |
| 6 | 18/12/2019 | < 0.1 | 71.6 | 71.7 | 6 | 04/05/2019 | < 0.1 | 3.1 | 3.2 |
| 7 | 09/12/2019 | < 0.1 | 58.8 | 58.9 | 7 | 26/08/2019 | < 0.1 | 8.2 | 8.3 |
| 8 | 28/12/2019 | < 0.1 | 53.2 | 53.3 | 8 | 02/08/2019 | < 0.1 | 10.6 | 10.7 |
| 9 | 21/12/2019 | < 0.1 | 50.5 | 50.6 | 9 | 19/06/2019 | < 0.1 | 4.8 | 4.9 |
| 10 | 21/11/2019 | < 0.1 | 45.5 | 45.6 | 10 | 08/07/2019 | < 0.1 | 3.0 | 3.1 |
| 18 | 10/12/2019 | < 0.1 | 25.0 | 25.1 | 108 | 10/12/2019 | < 0.1 | 25.0 | 25.1 |
| These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) as a result of the operation of the project. | | | | | These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) as a result of the operation of the project. | | | | |

Table D9 Summary of contemporaneous impact and background – $PM_{2.5}$ – Receptor R13, Scenario 2

| Cumul. Impact Rank | Date | 24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R13 | | | Inc. Impact Rank | Date | 24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) - Receptor R13 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Incremental Impact | Background | Cumulative Impact | | | Incremental Impact | Background | Cumulative Impact |
| | Criterion | 25 | | | | Criterion | 25 | | |
| 1 | 20/12/2019 | < 0.1 | 239.6 | 239.7 | 1 | 27/08/2019 | < 0.1 | 11.3 | 11.4 |
| 2 | 22/12/2019 | < 0.1 | 129.4 | 129.5 | 2 | 26/08/2019 | < 0.1 | 8.2 | 8.3 |
| 3 | 23/12/2019 | < 0.1 | 103.6 | 103.7 | 3 | 24/04/2019 | < 0.1 | 7.3 | 7.4 |
| 4 | 24/12/2019 | < 0.1 | 87.5 | 87.6 | 4 | 05/05/2019 | < 0.1 | 4.7 | 4.8 |
| 5 | 17/12/2019 | < 0.1 | 83.2 | 83.3 | 5 | 03/08/2019 | < 0.1 | 5.9 | 6.0 |
| 6 | 18/12/2019 | < 0.1 | 71.6 | 71.7 | 6 | 02/08/2019 | < 0.1 | 10.6 | 10.7 |
| 7 | 09/12/2019 | < 0.1 | 58.8 | 58.9 | 7 | 12/08/2019 | < 0.1 | 5.6 | 5.7 |
| 8 | 28/12/2019 | < 0.1 | 53.2 | 53.3 | 8 | 19/06/2019 | < 0.1 | 4.8 | 4.9 |
| 9 | 21/12/2019 | < 0.1 | 50.5 | 50.6 | 9 | 01/08/2019 | < 0.1 | 11.7 | 11.8 |
| 10 | 21/11/2019 | < 0.1 | 45.5 | 45.6 | 10 | 25/08/2019 | < 0.1 | 9.6 | 9.7 |
| 18 | 10/12/2019 | < 0.1 | 25.0 | 25.1 | 51 | 10/12/2019 | < 0.1 | 25.0 | 25.1 |
| These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) as a result of the operation of the project. | | | | | These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) as a result of the operation of the project. | | | | |