TOMINGLEY
GOLD OPERATIONS PTY LTD
(A wholly owned subsidiary of Alkane Resources Ltd)
ABN 53 149 040 371

Tomingley Gold Extension Project

Air Quality Impact Assessment

Part 4

Major Project Application No. PA 09_0155





Prepared by northstar AIR QUALITY *Northstar Air Quality Pty Ltd*

December 2021

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This document has been prepared for **R.W. Corkery & Co. Pty Limited** on behalf of **Tomingley Gold Operations Pty Ltd** by:

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Tomingley Gold Extension Project

Air Quality Impact Assessment

Addressee(s):	Tomingley Gold Operations Pty Ltd
Site Address:	Tomingley NSW
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Quality Control

Study	Status	Prepared by	Checked by	Authorised by
INTRODUCTION	Final	Northstar Air Quality	MLN, GCG	MD
THE PROJECT	Final	Northstar Air Quality	MLN, GCG	MD
LEGISLATION, REGULATION AND GUIDANCE	Final	Northstar Air Quality	MLN, GCG	MD
EXISTING CONDITIONS	Final	Northstar Air Quality	MLN, GCG	MD
APPROACH TO ASSESSMENT	Final	Northstar Air Quality	MLN, GCG	MD
AIR QUALITY IMPACT ASSESSMENT	Final	Northstar Air Quality	MLN, GCG	MD
GREENHOUSE GAS ASSESSMENT	Final	Northstar Air Quality	MLN, GCG	MD
MITIGATION AND MONITORING	Final	Northstar Air Quality	MLN, GCG	MD
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Report Status

Northstar References		Report Status	Report Reference	Version
Year	Job Number	(Draft: Final)	(R*x*)	(V*x*)
20	1136	Final	R1	V1
Based upon the above, the specific reference for this version of the report is:				**20.1136.FR1V1**

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 **15th December 2021**

Non-Technical Summary

R. W. Corkery & Co. Pty Limited has engaged Northstar Air Quality Pty Ltd on behalf of Tomingley Gold Operations Pty Ltd to perform an Air Quality Impact Assessment for the proposed Tomingley Gold Extension Project.

The Air Quality Impact Assessment forms part of the Environmental Impact Statement prepared to accompany the development application for the Project under Part 4 of the *Environmental Planning and Assessment Act* 1979.

The Air Quality Impact Assessment has been performed in accordance with the requirements of the NSW Approved Methods for the Modelling and Assessment of Air Pollutants in NSW document and meets the requirements of the Planning Secretary's Environmental Assessment Requirements. The Air Quality Impact Assessment provides a detailed description of:

- the approved activities being performed by Tomingley Gold Operations Pty Ltd at the currently operating Tomingley Gold Mine;
- the proposed activities which form the Project, under three separate scenarios which reflect activities during site establishment and construction, and two mining scenarios.
- the legislative requirements which are required to be met, including existing conditions of consent, NSW Environment Protection Authority air quality criteria, *Protection of the Environment Operations Act* 1997, and *Protection of the Environment Operations (Clean Air) Regulations* 2010, and any policies and guidelines as they relate to air quality and greenhouse gas impacts of the Project.
- the existing conditions surrounding the Project Site, including the definition of sensitive receptor locations, prevailing meteorology and air quality, topography, and emissions of greenhouse gases in Australia and NSW in the year 2019.
- the approach to assessment, including justification for the approach adopted.
- emissions controls currently employed at the Mine, and proposed to be employed as part of the Project construction and operation.
- predicted air quality impacts during each of the three 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.
- how those measures would be triggered and implemented.
- predicted emissions of greenhouse gas during a year of operations representative of high activity.
- air quality mitigation measures which would be employed as part of the Project construction and operation, including air quality monitoring methods.
- greenhouse gas mitigation and monitoring measures which would be employed as part of Project construction and operation, with the aim of minimising those emissions.

In relation to air quality, the operational Trigger Action Response Plan would be updated to ensure that additional exceedances of the short-term (24-hour) particulate matter criteria are not experienced at a number of surrounding receptor locations. The Trigger Action Response Plan is currently operational and would be augmented by two additional real-time particulate monitors, located near to the Project activities. The detailed assessment presented in this report indicates that a range of management measures can be employed to ensure that additional exceedances do not generally occur at surrounding receptor locations. Where this assessment has indicated that further levels of control cannot be employed to ensure those criteria are achieved on rare occasions (i.e. best management practice is employed and exceedances are still predicted), this is a result of high background concentrations. Any exceedances would be minor.

Although the assessment has not predicted 'visibility' metrics, in relation to the Planning Secretary's Environmental Assessment Requirements regarding the 'function and integrity of all affected public roads', the concentrations of particulate matter predicted are not anticipated to result in visibility issues. Should visible dust be observed, this would cause a trigger of the Air Quality Management Plan, and measures would be immediately implemented to address that issue.

In relation to greenhouse gas, the assessment indicates that direct emissions associated with the Project are likely to be of the order of approximately 58.3 kilotonnes carbon dioxide equivalent per year. Indirect electricity emissions represent the largest source of total emissions at approximately 72.7 kilotonnes carbon dioxide equivalent per year. Tomingley Gold Operations Pty Ltd is currently reviewing options to install solar power generation to offset power consumption within the Tomingley Gold Operations Mine Site. Tomingley Gold Operations Pty Ltd is committed to continue to investigate ways to minimise the emission of greenhouse gas, and to reviewing any schemes which may provide opportunity to modernise plant and increase productivity, under the NSW Government Net Zero Plan Stage 1: 2020-2030.

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 Tomingley Gold Operations Pty Ltd (the Applicant), which is a wholly-owned subsidiary of Alkane Resources Limited, to perform an air quality impact assessment (AQIA) for the proposed Tomingley Gold Extension Project (the Project).

The AQIA forms part of the Environmental Impact Statement (EIS) prepared to accompany the development application for the Project under Part 4 of the *Environmental Planning and Assessment Act* (1979).

The AQIA presents an assessment of the impacts of activities associated with 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 changes to air quality concentrations and rates, and as a cumulative impact accounting for the prevailing background air quality conditions.

The AQIA includes an assessment of greenhouse gas (GHG) emissions associated with the Project and presents a comparison of these emissions with National and State GHG emissions totals to provide context and scale of those emissions. Opportunities for GHG emissions reduction are also provided.

1.1 Assessment Requirements

Planning Secretary's Environmental Assessment Requirements (SEARs) have been provided for the Project by the NSW Department of Planning, Industry & Environment (DPIE) on 22 July 2021. The SEARs included input from Narromine Shire Council and Transport for NSW. NSW Environment Protection Authority (EPA) provided general requirements for the assessment, which have been referenced. **Table 1** provides a summary of the SEARs relevant to this AQIA and provides reference to the key sections of this AQIA report that address those requirements.

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

Authority	Requirement	Relevant section(s)
SEARs (22 July 2021)	Air Quality – including: - an assessment of the likely air quality impacts of the development, including cumulative impacts from nearby developments, in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2016), and having regard to the NSW Government's Voluntary Land Acquisition and Mitigation Policy	Section 6
	- demonstrated 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

Authority	Requirement	Relevant section(s)
	- an assessment of the likely greenhouse gas impacts of the development; and	Section 7
	- a description of the feasibility of measures that would be implemented to monitor and report on the emissions (including fugitive dust and greenhouse gases) of the development;	Section 8
Narromine Shire Council (7 July 2021)	It is noted that sensitive receptors exist within close proximity to the proposed mine. As a result, an air quality assessment are required to be submitted which shall address the impacts of dust on sensitive receptors.	Section 6
	The EIS shall also address the potential cumulative impacts of the proposed development that is likely to occur as a result of dust, fumes.	Section 6
	Site dust control measures as a result of operations should also be implemented so that it is not a distraction nor interfere with a road user/ driver.	Section 6 Section 8
Transport for NSW (8 July 2021)	Identification and assessment of potential impacts of the project, such as blasting, lighting, visual, noise, dust and drainage on the function and integrity of all affected public roads	Section 6

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 (2010).
- Approved Methods for the Modelling and Assessment of Air Quality in NSW (NSW EPA, 2016).
- Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (NSW EPA, 2006).
- Voluntary Land Acquisition and Mitigation Policy, for State Significant Mining, Petroleum and Extractive Industry Developments (NSW Government, 2018).

As required by the SEARs, the GHG Assessment has been performed with reference to

- National Greenhouse Accounts Factors (DISER, 2021).

2. THE PROJECT

2.1 Approved Activities

The Applicant operates the Tomingley Gold Mine (the Mine), located immediately to the south of the village of Tomingley in central western NSW (see **Figure 1**).

Tomingley Gold Operations operates under State Significant Development Consent MP09_0155 originally granted on 24 July 2012. MP09_0155 has been modified five times, most recently on 5 May 2021. Approved activities include:

- Mining of four open cuts, with underground mining under three of the approved open cuts, namely Wyoming 1, Caloma 1 and Caloma 2 Open Cuts, until 31 December 2025.
- Placement of waste rock into three out-of-pit waste rock emplacements and two in-pit waste rock emplacement, namely the Wyoming 3 and Caloma 2 Open Cuts. It is noted that Waste Rock Emplacements 2 and 3 are complete, and with the exception of a small area on the upper surface of Waste Rock Emplacement 3, are under rehabilitation.
- Construction and use of a carbon-in-leach processing plant and associated infrastructure, including:
  - a run-of-mine (ROM) pad;
  - a crushing and screening circuit:
  - a ball mill and grinding circuit; and
  - a cyanide leaching and gold extraction circuit.

  The approved processing plant also includes workshops, ablutions facilities, stores, office area and car parking. The maximum approved rate of processing is 1.5 million tonnes per annum (Mtpa).
- Construction and use of Residue Storage Facility 1 (to Cell 1, Stage 9) for the storage of process residues, with a maximum approved elevation of 291.5 m AHD.
- Construction and use of Residue Storage Facility 2 (to Stage 2) for the storage of process residues, with a maximum approved elevation of 272.0 m AHD.
- Construction and use of infrastructure required for the TGO Mine, including:
  - dewatering ponds;
  - a water pipeline, from a licensed bore located approximately 7 km to the east of Narromine;
  - various internal and external roads, including an underpass beneath the Newell Highway and upgrades to Tomingley West Road and associated intersections;
  - a transformer and electrical distribution network within the TGO Mine Site;
  - various clean and dirty water management structures; and
  - fenced biodiversity offsets and vegetated amenity bunds.

Construction of the TGO Mine commenced in February 2013 with open cut mining commencing in November 2013. Underground mining development from a portal in the Wyoming 1 Open Cut commenced in January 2019, with ore production from stopes commencing in December 2019.

Underground development from a portal in the Wyoming 1 Open Cut commenced in January 2019, with ore production from stopes under the Wyoming 1 Open Cut commencing in December 2019. The Applicant continues to mine underground at Wyoming 1, Caloma 1 and Caloma 2.

Open cut mining recommenced within the Caloma 1 Open Cut in October 2020 and is expected to continue until December 2022. Processing operations recommenced in February 2020, initially on a reduced roster before full production was resumed in May 2020.

The approved Mine layout is presented in **Figure 2**.

Figure 1 Mine and Project location

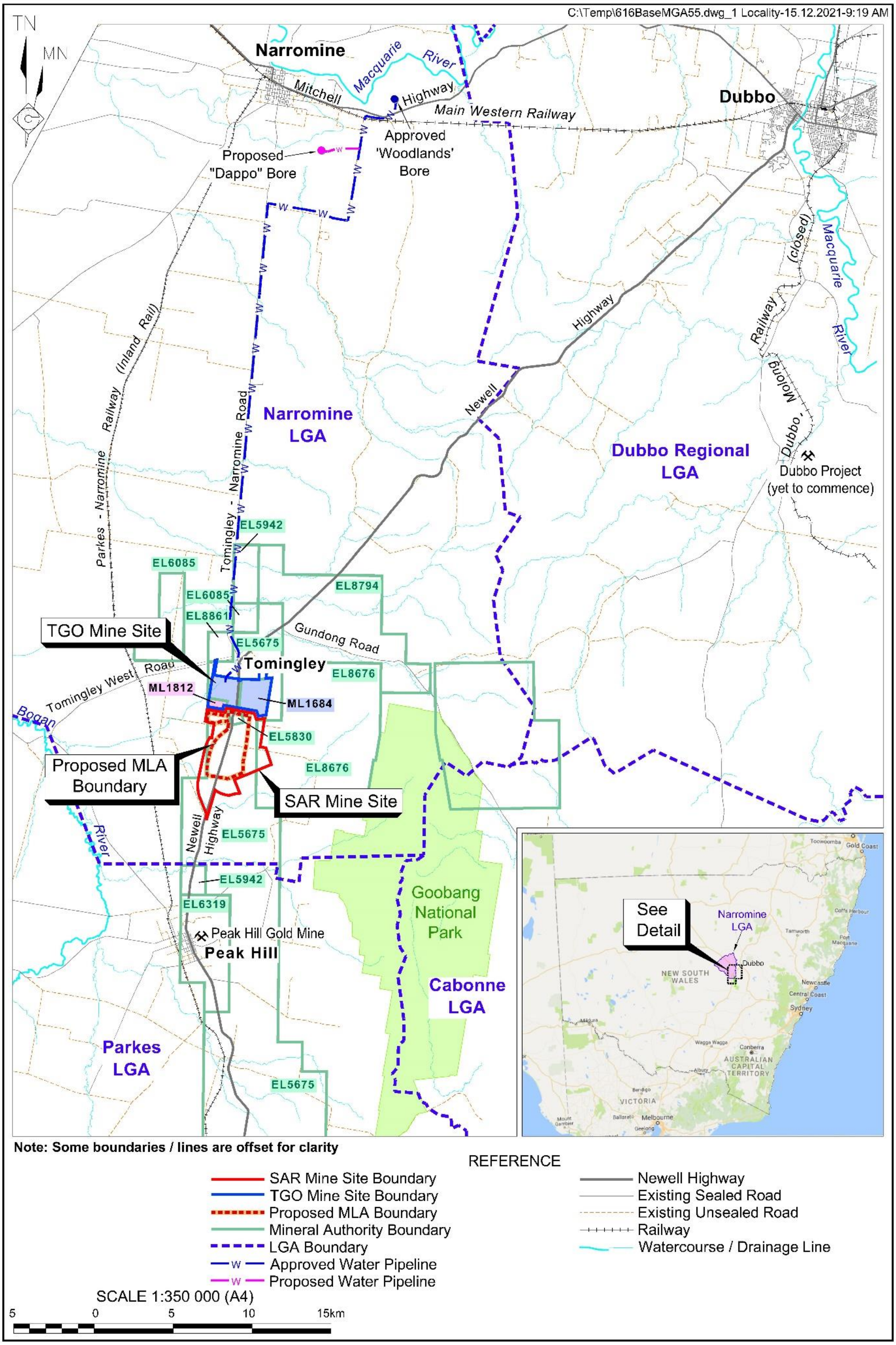


Figure 2 Existing TGO Mine Site layout

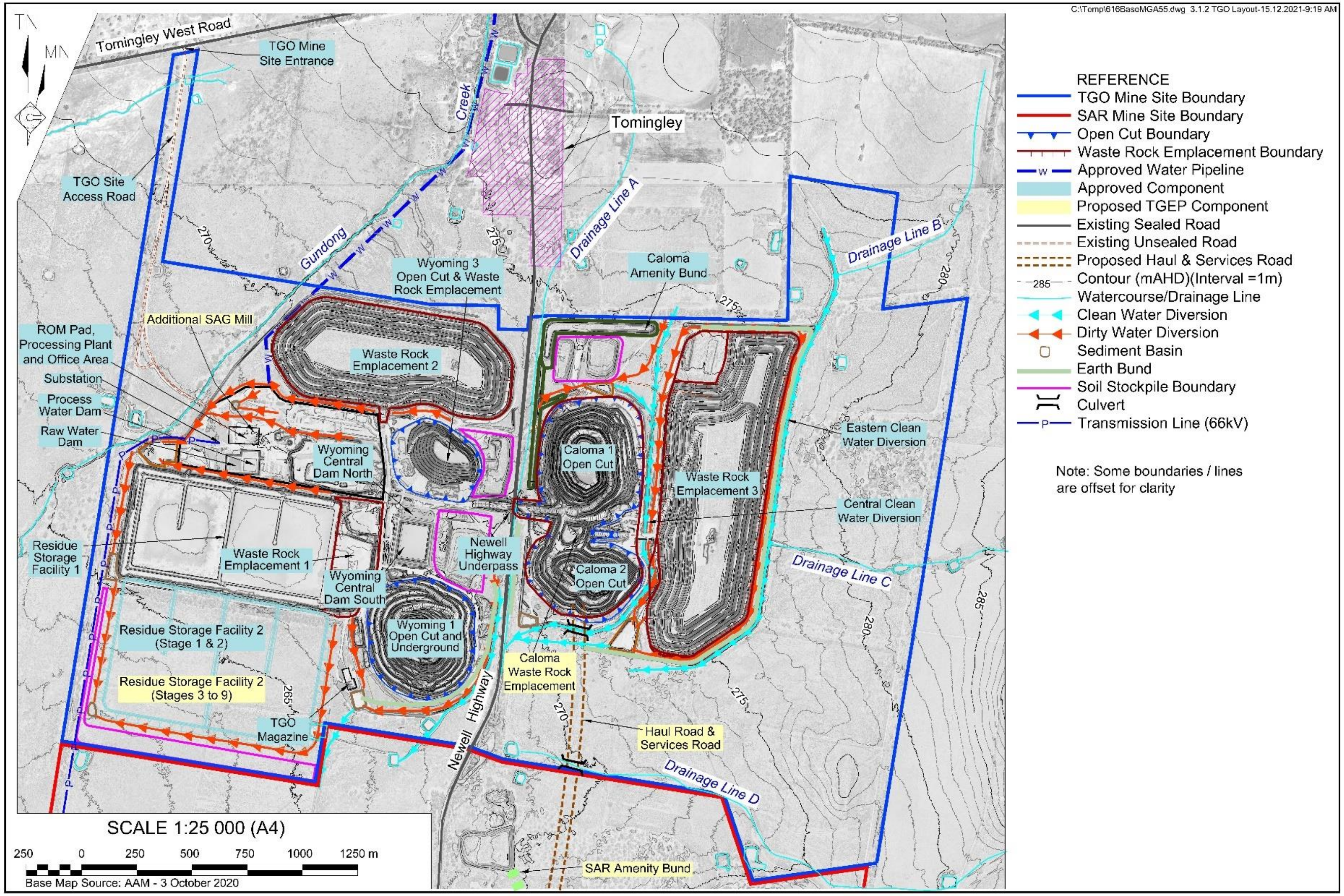


Table 2 presents the publicly available production figures for the Mine for each financial year to June 2021. In summary, approximately 7.5 million tonnes (Mt) of ore was processed ('ore milled') between the commencement of mining operations and 30 June 2021. The maximum annual rate of processing ('ore milled') was 1.14 Mt in 2015, less than the approved maximum rate of processing of 1.5 Mtpa. These data are presented visually in **Figure 3**.

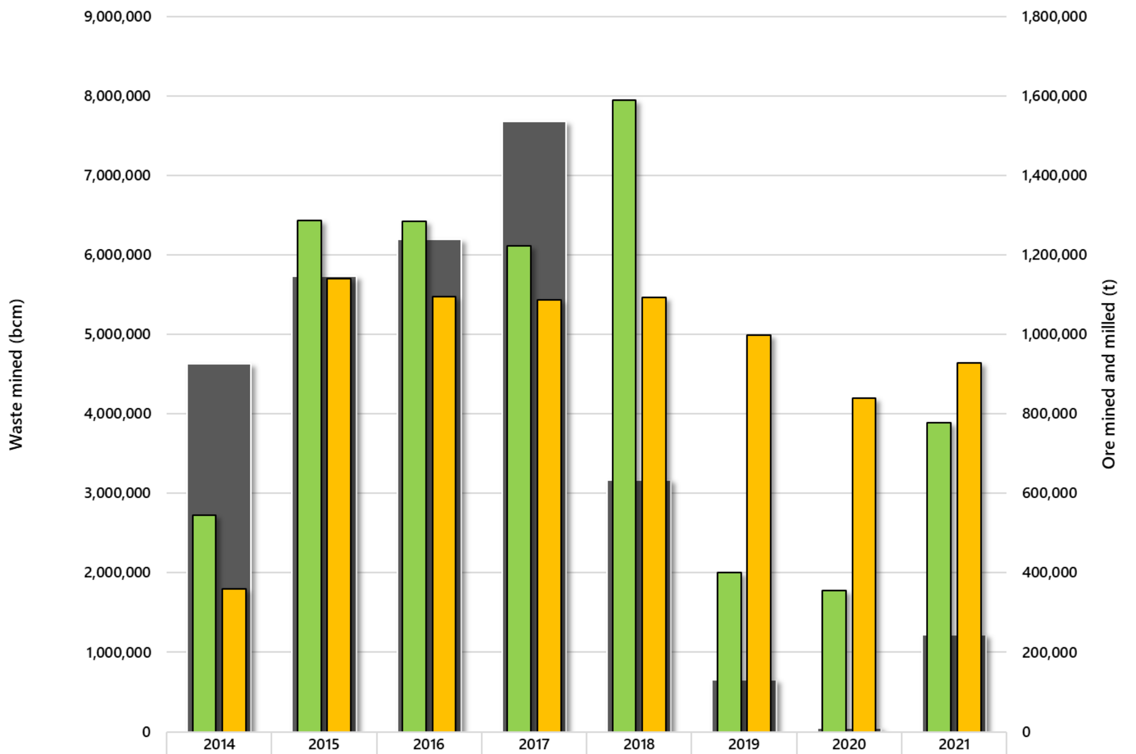
Table 2 Previous production statistics

Production	Units	Financial Year ending 30 June			
		2014	2015	2016	2017
Waste mined	bcm	4 635 684	5 730 661	6 199 820	7 679 110
Ore mined	t	545 550	1 286 291	1 285 454	1 222 868
Ore milled	t	359 096	1 140 704	1 096 105	1 087 983

Production	Units	Financial Year ending 30 June				Total
		2018	2019	2020	2021	
Waste mined	bcm	3 165 414	657 647	50 743	1 218 779	29 337 858
Ore mined	t	1 589 811	400 187	355 879	778 236	7 464 276
Ore milled	t	1 092 602	998 703	838 743	928 531	7 542 467

Notes: bcm: bank cubic metres, t: tonnes

Figure 3 Production data associated with the Mine FY2014 to FY2021



	2014	2015	2016	2017	2018	2019	2020	2021
Waste mined (bcm)	4,635,684	5,730,661	6,199,820	7,679,110	3,165,414	657,647	50,743	1,218,779
Ore mined (t)	545,550	1,286,291	1,285,454	1,222,868	1,589,811	400,187	355,879	778,236
Ore milled (t)	359,096	1,140,704	1,096,105	1,087,983	1,092,602	998,703	838,743	928,531

2.2 Previous Assessments of Air Quality

2.2.1 Tomingley Gold Project

An AQIA was performed to support the original EIS for the Tomingley Gold Project in 2011 (PAEHolmes, 2011). The AQIA quantified emissions associated with drilling, blasting, loading and hauling of waste rock and ore, emissions from processing activities, and wind erosion sources during three scenarios representative of operations at the end of year 1, 2 and 4. Dispersion modelling of those emissions was used to assess the impact that might arise from the project operations on a number of surrounding sensitive receptor locations, both with and without the effects of background air quality included.

The assessment criteria adopted for the project were those outlined in **Section 3.1**, although at that time, the annual average impact assessment criterion for PM_{10} was 30 µg·m^{-3}, and $PM_{2.5}$ criteria were not adopted in NSW.

PAEHolmes (2011) concluded that the annual average TSP, PM_{10} and deposited dust criteria were achieved in all modelled scenarios. A summary of the maximum incremental and cumulative impacts predicted in each of the three scenarios is presented in **Table 3**.

Table 3 Predicted incremental and cumulative annual average particulate (PAEHolmes, 2011)

Scenario	Annual average TSP µg·m^{-3}		Annual average PM_{10} µg·m^{-3}		Annual average dust deposition g·m^{-2}·month^{-1}	
	Maximum incremental	Maximum cumulative	Maximum incremental	Maximum cumulative	Maximum incremental	Maximum cumulative
Scenario 2 (Year 1)	6.0	57.0	5.0	25.0	0.2	2.2
Scenario 3 (Year 2)	6.0	57.0	5.0	25.0	0.2	2.2
Scenario 4 (Year 4)	4.0	55.0	3.0	23.0	0.3	2.3
Criterion	**90.0**		**30.0 (25.0)**		**4.0**	

Note: The criterion for annual average PM_{10} is presented as that applicable in 2011 (30 µg·m^{-3}), and presently (2021) (25 µg·m^{-3})

In relation to predicted maximum 24-hour PM_{10} impacts, PAEHolmes (2011) concluded that although the cumulative impact assessment criterion was exceeded at several receptor locations, the likelihood of these exceedances eventuating during any scenario modelled was low. This conclusion was reached through an assessment of the potential probability for the coincidence of background and incremental concentrations to result in exceedances of the relevant air quality criterion.

2.2.2 Modification 3 to MP 09_1055

MP 09_0155 was modified in November 2013 (MOD1) and in April 2015 (MOD2), which were considered not to materially impact upon air quality over and above that assessed in the original AQIA (PAEHolmes, 2011). A further modification application (MOD3) was submitted in November 2015 (PEL, 2015) which sought consent for the following:

- An additional cutback of the Caloma (Cal1) Open Cut;
- Establishment of the Caloma Two (Cal2) Open Cut;
- Construction of an alternative decline from the Cal1 Open Cut;
- Mining of additional underground resources below the Cal1 and Cal2 Open Cuts;
- Extension of Waste Rock Emplacement (WRE) 3;
- Backfill of the Wyoming Three (Wyo3) Open Cut with waste rock;
- Modifications to the Central Drainage Channel which diverts clean water runoff from the north through the Mine Site; and
- Minor modifications to soil management.

PEL (2015) quantified the additional emissions of TSP which would be anticipated should the above activities be approved. Emissions of TSP associated with MOD3 were calculated to increase by 10.9 % above those associated with Scenario 3 (Year 2) as reported in (PAEHolmes, 2011), (see **Section 2.2.1**). It was concluded that an increase in TSP emissions of less than 20 % would "*have a negligible impact on ground level particulate concentrations recorded at the assessed sensitive receptors*" (PEL, 2015). Furthermore PEL (2015) concluded that "*…it is anticipated that the air quality impacts resulting from MOD3 will be similar to those predicted in the original AQA*".

NSW EPA provided comments on the assessment and requested further information, including:

- a description of the temporal and spatial impacts of the proposed modification;
- a description of the on-site monitoring data and how it compared with predictions in the original AQIA (PAEHolmes, 2011); and
- details of additional management and mitigation measures to be implemented if required to ensure compliance with NSW EPA impact assessment criteria for particulates.

The additional information was provided in a Response to Submissions (PEL, 2016) which concluded that:

- activities associated with MOD3 would not be moving closer to receptors;
- the meteorological data used in the original AQIA included the more dominant wind conditions experienced at the site, as determined through on-site monitoring and was therefore representative;
- the annual average PM_{10} concentrations measured at the on-site PM_{10} monitor were close to those predicted in the original AQIA; and

- based on the annual average predictions, the model adopted as part of the original AQIA was considered to have performed well.

Modification 3 was approved in July 2016.

2.2.3 Tomingley Exploration Decline

In March 2020, an air quality assessment was performed to support a Review of Environmental Factors (REF) associated with exploration activities related to the San Antonio and Roswell (SAR) deposits. ERM (2020) performed a discrete dispersion modelling exercise to quantify likely particulate matter impacts at surrounding receptors, associated with emissions from one ventilation shaft located to the south of the Mine.

Incremental impacts associated with emissions from the ventilation shaft were predicted to be minor, with annual average concentrations of TSP < 0.2 $\mu g{\cdot}m^{-3}$, PM_{10} < 0.1 $\mu g{\cdot}m^{-3}$, and $PM_{2.5}$ < 0.1 $\mu g{\cdot}m^{-3}$, predicted at all surrounding sensitive receptor locations. Annual average dust deposition was also predicted to be minor with deposition rates of < 0.1 $g{\cdot}m^{-2}{\cdot}month^{-1}$ predicted.

Incremental maximum 24-hour PM_{10} and $PM_{2.5}$ concentrations were also predicted to be minor at all non-project related receptors, with increments being < 1.6 $\mu g{\cdot}m^{-3}$, and < 0.7 $\mu g{\cdot}m^{-3}$, respectively.

ERM (2020) concluded:

> ***"The results indicate that there are no sensitive receptors predicted to experience annual average PM concentrations or dust deposition rates above the relevant impact assessment criteria, either due to the Project alone or when including background concentrations.***
>
> ***When a contemporaneous assessment of 24-hour average PM_{10} is completed, combining background data with predicted project increment, one additional day of exceedance is observed at receptor R46. However, it is noted that receptor 46 is considered to be project-related.***
>
> ***Maximum predicted cumulative 24-hour average $PM_{2.5}$ concentrations are not predicted to exceed the EPA impact assessment criterion at any of the receptor locations.***
>
> ***Overall, this quantitative air quality assessment concludes that the operation of the proposed ventilation outlet is not anticipated to result in adverse air quality impacts under normal operating conditions."***

2.2.4 Modification 5 to MP 09_1055

Northstar (Northstar Air Quality, 2020) performed a dispersion modelling assessment to quantify the potential change in air quality at surrounding receptor locations during the construction of RSF2 (Modification 5 (MOD5) to MP 09_1055).

Modification 5 (MOD5) to PA 09_1055 was approved in May 2021. Activities approved under MOD5 included:

- Construction and use of Stages 1 and 2 of RSF2.
- An extension of Mine Life from 31 December 2022 to 31 December 2025.
- Extension of the Mine Site boundary to incorporate RSF2.

Construction of RSF2 will be performed in two stages, with both stages taking approximately 6 months to complete. Stage 1 is due to commence in early 2022, with construction of Stage 2 anticipated to commence 2 years after the completion of Stage 1. Impacts associated with the construction of Stage 2 of RSF2 have been considered within this AQIA.

2.3 The Project

The Applicant has identified a number of exploration prospects located to the south of the TGO Mine Site. The Applicant has been actively exploring the identified prospects, including in particular the San Antonio and Roswell (SAR) deposits.

Inferred Mineral Resource estimates have been released for the SAR deposits as follows:

- Roswell 10.1 Mt grading 2.04 grams gold per tonne ($g{\cdot}t^{-1}$) (660 000 ounces [oz])
- San Antonio 7.32 Mt grading 1.72 $g{\cdot}t^{-1}$ (406 000 oz)

The Applicant anticipates that the proposed site establishment activities and operation of the Project would include the following.

2.3.1 Site Establishment

Site establishment activities would include the following:

- Key boundaries and locations would be marked on the ground and recorded on relevant site construction plans and documents.
- Existing infrastructure within the disturbance area, including communication lines, powerlines, fences, buildings and sheds would be progressively demolished and/or relocated.
- Additional services required for the Project, including powerlines, communication lines and pipelines would be established.
- Erosion and sediment control structures, including clean and dirty water structures, would be established.
- Suitable fences, including warning signs, would be established to separate active mining areas from areas that would continue to be used for agricultural purposes.
- Construction laydown and equipment parking areas, as well as office/amenity buildings would be established.
- Vegetation clearing followed by stripping and stockpiling of soil would be undertaken.

- Borrow pits would be established within the footprint of the SAR Waste Rock Emplacement and / or SAR Open Cut for the supply of construction materials.
- Construction of the Haul Road, Services Road, SAR Amenity Bund, Administration Area (including offices, workshops, diesel store, equipment parking, vehicle washdown bay, etc), internal site roads, hard stands, explosives magazines, water storages, and other site infrastructure.

The Project would also require the realignment of the following public roads:

- Newell Highway and intersections with Kyalite Road, McNivens Lane and Back Tomingley West Road.
- Kyalite Road, including an overpass over the Haul Road and Services Road.

The current alignment of the Newell Highway is within the proposed SAR Open Cut. Open cut mining operations require that the Highway be realigned. The Applicant proposes to realign the Highway approximately 1 kilometre (km) to the west.

Kyalite Road is also within the footprint of the SAR Open Cut. As a result, the Applicant would realign Kyalite Road to the north and would construct an overpass over the Haul and Services Roads.

2.3.2 Mining Operations

Open cut mining operations would commence in the southern section of the SAR Open Cut. Mining of the near surface material would be undertaken using conventional free dig, load and haul techniques. Once more competent material is exposed, it would be extracted using conventional drill, blast, load and haul techniques. Open cut ore would be transported to the TGO Mine Site via the proposed Haul Road. Alternatively, ore may be stockpiled within the Run-in-Mine (RIM Pad) or Caloma Temporary Stockpile Area from where it would be transported to the TGO Mine Site via the proposed Haul Road.

Open cut waste rock would be placed into the SAR and Caloma Waste Rock Emplacements.

Underground mining operations would be undertaken using the approved SAR Exploration Drive (SARED). The drive would permit access from the Wyoming 1 underground workings to the SAR deposits. The drive and a single ventilation rise were approved under the *Mining Act* (1992) as exploration-related activities by the Resources Regulator on 7 May 2020.

Ore would initially be transported to the Mine Site via the underground drive and Wyoming 1 Portal. Ore transported via the Wyoming 1 Portal would be directly transferred to the ROM Pad using underground haul trucks. An additional portal may be established within the SAR Open Cut and ore may be bought to the surface via the SAR Portal and stockpiled within the RIM Pad from where it would be transported to the Mine Site.

Underground waste rock would be used to backfill completed stopes or would be transported to surface via the Wyoming 1 or SAR Portals and placed within surface waste rock emplacements.

Underground mining operations would be supported by the following surface infrastructure.

- The approved SARED Ventilation Rise.
- Proposed Roswell (ROS) Ventilation Rises.
- Additional ventilation rises as required within disturbed sections of the SAR Mine Site.
- A Paste Fill Plant.
- Services, including power, water and compressed air.

2.3.3 Transportation Operations

A Haul Road and Services Road would be constructed between the Caloma 2 and SAR Open Cuts. The Haul Road would permit surface haul trucks to transport ore and waste rock from the SAR Open Cut to the Mine Site. The road would be sufficiently wide to permit two-way use by haul trucks travelling in opposite directions.

Open Cut ore, including ore from any portal within the SAR Open Cut, would be transported to the ROM Pad via the Haul Road and existing Newell Highway Underpass using haul trucks or road trucks. Alternatively, ore including low grade ore, may be transported via the Haul Road and temporarily stockpiled within the footprint of the Caloma Waste Rock Emplacement.

Underground ore transported to surface via the Wyoming 1 Portal would be transported directly to the ROM Pad using underground haul trucks.

Waste rock from the SAR Open Cut would be transported via the Haul Road and placed within the Caloma Waste Rock Emplacement. Alternatively, waste rock from the SAR Open Cut would be transported to the SAR Waste Rock Emplacement, including in-pit and out-of-pit placement.

A Services Road would be constructed adjacent to the Haul Road and would permit use by smaller vehicles, including light vehicles, service vehicles and heavy vehicles transporting tailings/residue to the Pastefill Plant. The Services Road would be sufficiently wide to permit two-way use by vehicles travelling in opposite directions. The Services Road would be separated from the Haul Road by a bund that would prevent vehicles crossing between the two roads.

Where the Haul Road and Services Road cross the proposed realigned Kyalite Road, an overpass for vehicles using Kyalite Road would be constructed.

Finally, an amenity bund would be constructed on the western side of the Haul Road. The SAR Amenity Bund would be constructed in a manner that would ensure that views of active sections of the SAR Mine Site would, to the extent practicable, be limited for motorists using the Newell Highway to limit the potential for driver distraction on the Highway.

In addition to constructing the Haul Road and Services Road, the Applicant would realign Kyalite Road. SAR personnel and consumables required for the proposed SAR operations would access the SAR Mine Site via the Newell Highway, the realigned Kyalite Road and the proposed Site Access Road.

2.3.4 Waste Rock Management

Waste rock from the SAR Open Cut would initially be used for site establishment operations, including construction of the SAR Amenity Bund. Subsequently, waste rock would be transported either:

- to the TGO Mine Site via the Haul Road and placed into the Caloma 1 and Caloma 2 Open Cuts which would be completely backfilled; or
- to the SAR Waste Rock Emplacement, initially to an out-of-pit location, with in-pit placement of waste rock commencing following completion of the southern and central sections of the SAR Open Cut. The southern and central sections of the SAR Open Cut would also be completely backfilled to form an integrated SAR Waste Rock Emplacement.

During waste rock placement operations in the SAR Waste Rock Emplacement, the Applicant would construct, shape and rehabilitate the outer sections of the Waste Rock Emplacement initially to minimise noise emissions and ensure that operations are, to the extent practicable, not visible from locations to the west of the Project Site.

2.3.5 Processing Operations and Residue Management

Ore would be processed using the existing Processing Plant. The Applicant would add a semi-autogenous grinding (SAG) mill between the existing crushing circuit and the existing ball mill. This would permit the Processing Plant to achieve the approved production rate of 1.5 Mtpa when processing hard rock. However, the SAR deposits include a substantial proportion of oxide ore. As a result, production rates when processing this softer material would increase to 1.75 Mtpa.

The Project would require additional capacity to store residue/tailings. RSF2 was approved to Stage 2 or a maximum elevation of 272 m AHD. Development consent would be sought to increase the height of RSF2 to incorporate Stage 9 of RSF2, with a maximum elevation of 286 m AHD. This would result in RSF2 having approximately the same final elevation as the approved RSF1.

2.3.6 Hours of Operation and Project Life

The Project would operate 24 hours, 7 days per week.

The Applicant, in an announcement to the Australian Stock Exchange on 3 June 2021, identified that based on current known mineral resources, mining operations are likely to be undertaken until at least February 2031. Given that the San Antonio underground resource, additional ore likely to be identified down dip and along strike of the known SAR and Tomingley Gold Operations (TGO) sources has yet to be included in the mining schedule, the Applicant proposes to seek development consent for the Project until 31 December 2032.

2.3.7 Scenarios Assessed

To appropriately consider the potential impacts on air quality resulting from site establishment activities and operation of the Project, three scenarios have been selected for detailed assessment. These scenarios are summarised below:

- **Scenario 1** (indicative of activities in FY23, refer **Figure 4**) including:
  - SAR site establishment activities.
  - Road construction and realignment activities.
  - Exhaust ventilation from underground activities via the SARED Ventilation Rise.
  - Continued TGO Mine Operations.
- **Scenario 2** (indicative of activities in FY24, refer **Figure 5**) including:
  - Waste movement from Central and South Pits.
  - Waste transported either to the SAR or Caloma Waste Rock Emplacements.
  - Ore extraction activities in South Pit.
  - Construction of RSF2 Stage 2.
  - Exhaust ventilation from underground activities via the ROS Ventilation Rise, while the SARED Ventilation Rise would act as a fresh air intake.
  - Continued TGO Mine Operations.
- **Scenario 3** (indicative of activities in FY25, refer **Figure 6**) including:
  - Waste movement from Central, South and North Pits.
  - Waste transported either to the SAR or Caloma Waste Rock Emplacements.
  - Ore extraction activities in Central and South Pits.
  - Construction of RSF2 Stage 3.
  - Exhaust ventilation from underground activities via the ROS Ventilation Rise, while the SARED Ventilation Rise would act as a fresh air intake.
  - Continued TGO Mine Operations

As indicated above, approved TGO Operations as described in **Section 2.1** would continue under any new development consent issued for the Project.

These three scenarios were selected for assessment based on the quantities of waste and ore mined, the distance waste material would be transported, and the proximity of activities to sensitive receptor locations:

- **Scenario 1** represents site establishment and road realignment activities that would be in closest proximity to sensitive receptor locations to the south and west of the Project Site.
- **Scenario 2** represents the movement of over 30 Mt of waste rock, with 50 % being transported approximately 4 km from the SAR Open Cut, northwards to the Caloma Waste Rock Emplacement, with the remaining 50 % being transported to the SAR Waste Rock Emplacement. Scenario 2 also considers the extraction of 500 kt of ore from the SAR Open Cut.
- **Scenario 3** represents the movement of over 32 Mt of waste rock, with 50 % being transported approximately 4 km from the SAR Open Cut, northwards to the Caloma Waste Rock Emplacement, with the remaining 50 % being transported to the SAR Waste Rock Emplacement. Scenario 3 also considers the extraction of 2.3 Mt of ore from the SAR Open Cut. This represents the year of maximum waste rock and ore mining.

Figure 4 Proposed Project layout – Scenario 1

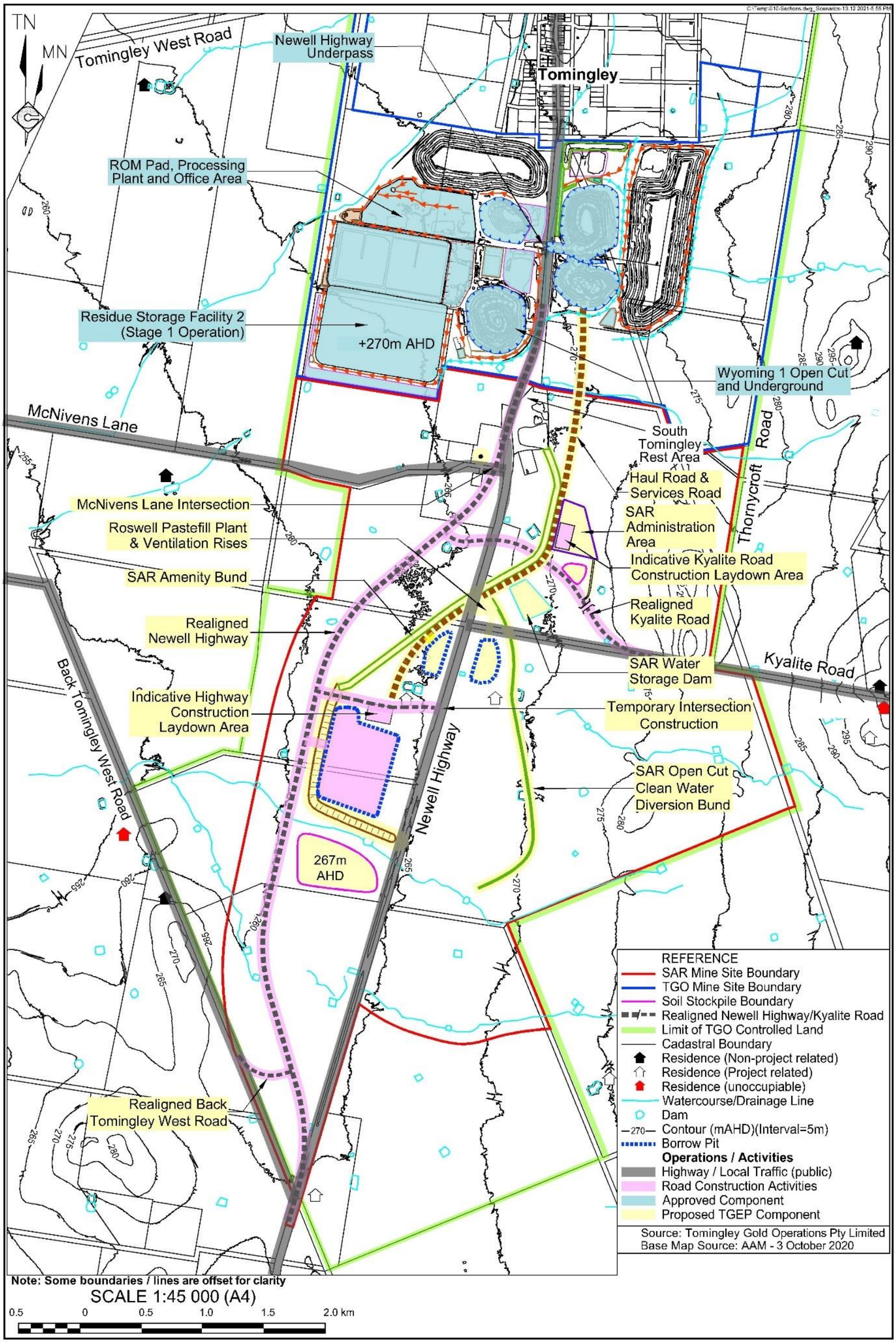


Figure 5 Proposed Project layout – Scenario 2

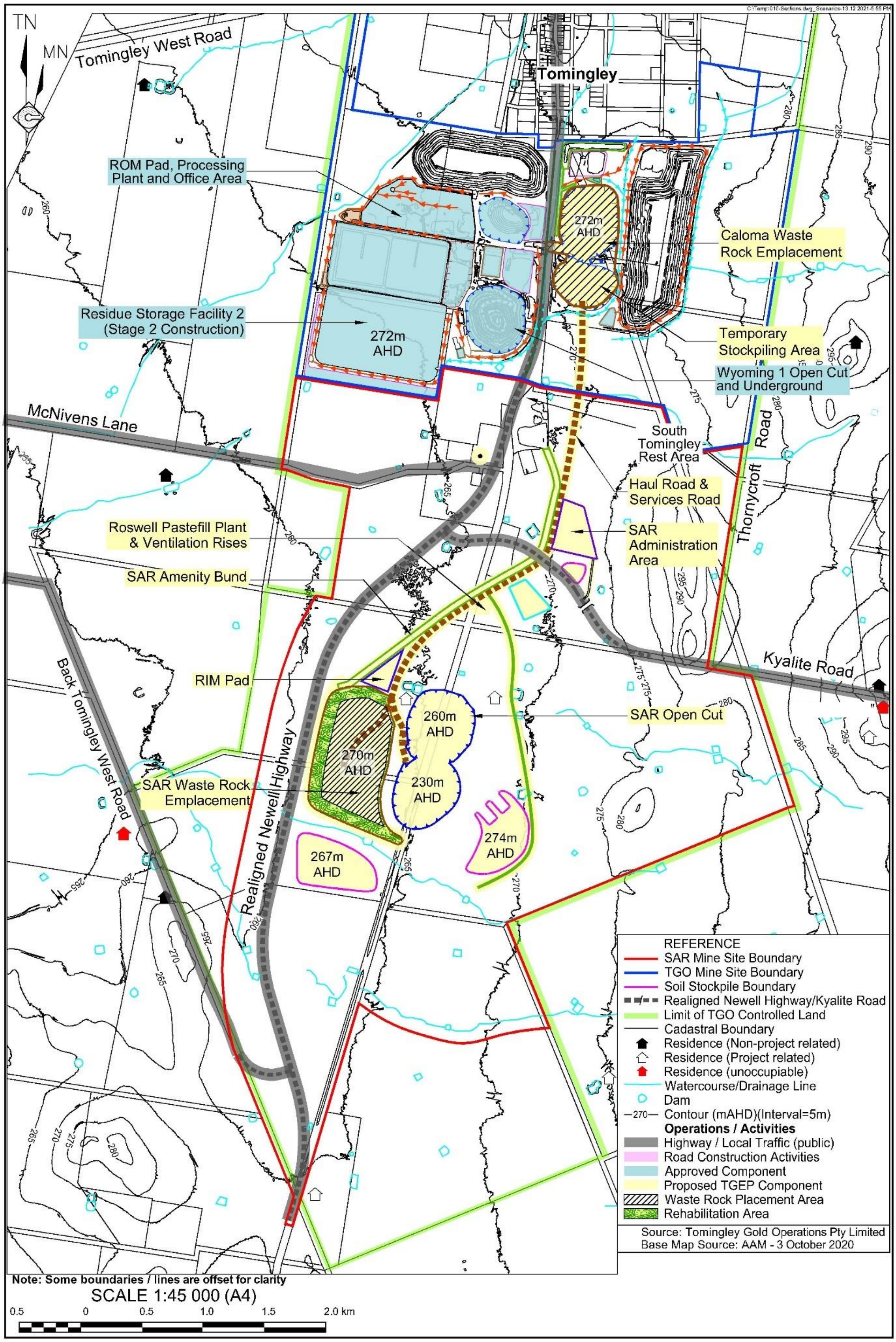
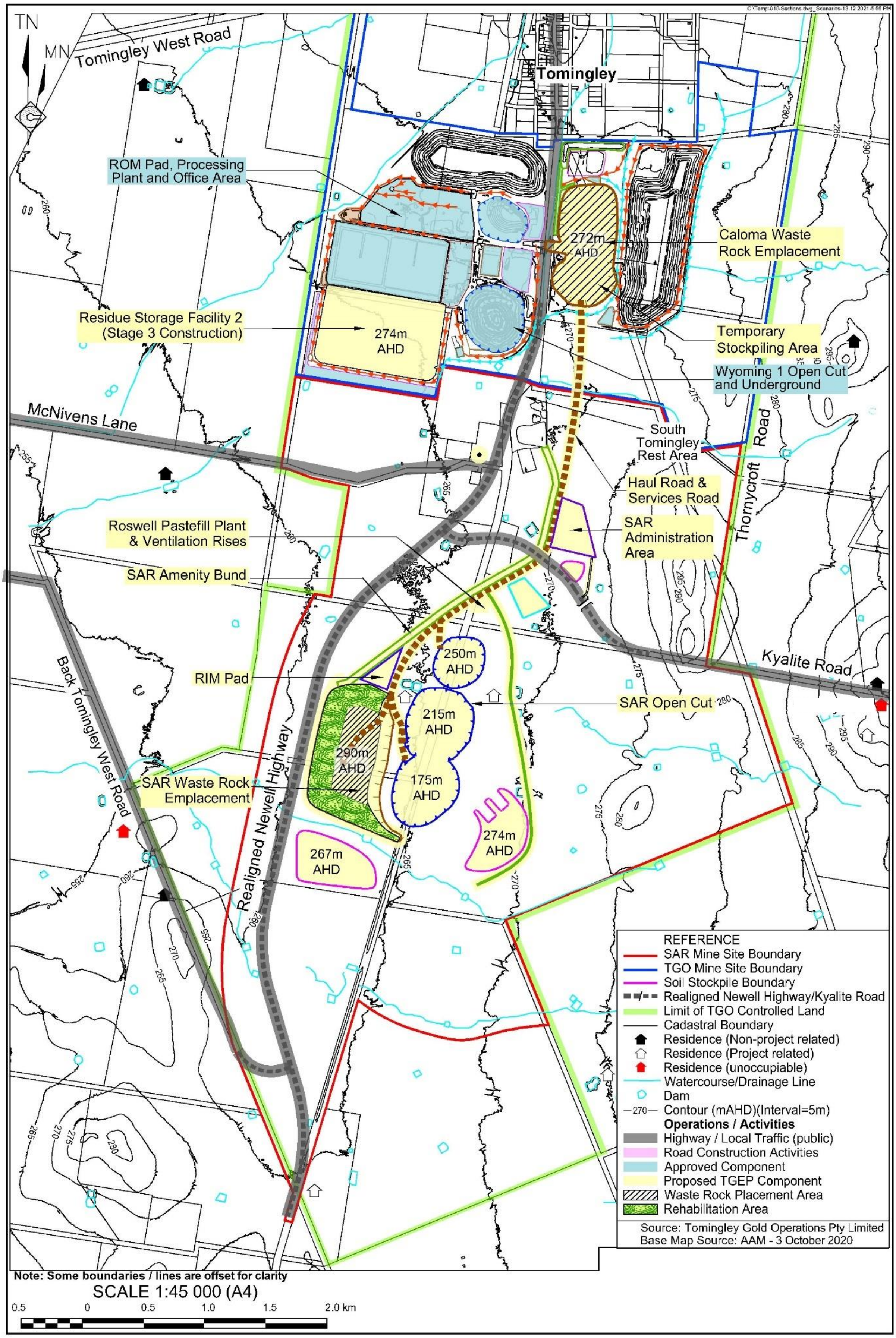


Figure 6 Proposed Project layout – Scenario 3



2.4 Identified Potential for Emissions to Air

The processes which may result in the emission of pollutants to air during the scenarios assessed would include:

- Digging material in borrow pit, loading to haul trucks and transporting to construction sites including the Newell Highway and Kyalite Road realignments, and internal haul roads;
- Stripping and loading soil from SAR disturbance areas and transporting to soil stockpiles;
- Shaping placed material on amenity bund, roads, and other areas;
- Construction of RSF2;
- Drilling and blasting;
- Loading of waste material to haul trucks, hauling to, unloading and moving at waste rock emplacements;
- Loading of ore to haul trucks, hauling to and unloading at the ROM and RIM stockpiles;
- Loading of soil to haul trucks, hauling to and unloading at soil stockpiles;
- Maintenance activities including grading of road surfaces, cleaning up of pit floor, trimming pit faces;
- Processing of ore;
- Wind erosion of disturbed areas;
- Emissions from vehicle and equipment exhaust; and
- Emissions from underground mine ventilation risers.

The specific pollutants of interest associated with those activities are:

- Total suspended particulate (TSP);
- Deposited dust;
- Particulate matter with an aerodynamic diameter of 10 microns (PM_{10});
- Particulate matter with an aerodynamic diameter of 2.5 microns ($PM_{2.5}$); and,
- Oxides of nitrogen (NO_X).

Emissions of NO_X have been considered in relation to blast fume. Emissions of NO_X, carbon monoxide (CO) and sulphur dioxide (SO_2) related to diesel combustion in plant and machinery would also be experienced (in addition to particulates considered above), however given the quantity of equipment operating on site it is not anticipated that emissions associated with diesel combustion (other than particulate matter which have been assessed) would be a significant contributor to total site emissions and have not been addressed further.

Detailed activity rates associated with the activities identified above are presented for each modelled scenario, in **Appendix B**.

Emissions of cyanide associated with the storage of processing residues in the RSF have not been considered quantitatively within this AQIA. In submissions to the original AQIA for the Tomingley Gold Project (PAEHolmes, 2011), NSW EPA raised the issue of cyanide emissions from the Tailings Storage Facility (TSF, now termed the RSF). In the Response to Submissions (RWC, 2012), the following discussion was provided:

> *Whilst the TSF will contain cyanide, as detailed in Section 2.6.3.3 of the Environmental Assessment, in order to ensure protection of fauna, the plant cyanide levels will be managed to reduce concentrations of WAD cyanide in the residue at low concentrations (90th percentile of 20mg/L and maximum of 30mg/L).*
>
> *Cyanide emissions (cyanide gas - HCN) from tailings dams accepting residues at these or even greater concentrations are normally very low to non-detectable. This is due to the fact that most of the cyanide in the residue is weak acid dissociable (WAD), i.e. attached to metals such as zinc, cadmium or copper and only dissociates under acidic conditions. In order to generate cyanide gas (HCN), the cyanide ion CN^- must dissociate from the metal ion. Due to the alkaline environment of the tailings slurry (pH 9 to 9.5), the WAD cyanide remains bound to the metals, and generally lodges within the solid material during the evaporation phase of the residue deposit cycle.*
>
> *It is only the dissolved HCN component of the much smaller proportion of free cyanide within the residue (CN^- ion or HCN) that has the potential to be released as cyanide vapour. The free cyanide within the liquid residue is vulnerable to UV radiation (broken down to Carbon and Nitrogen by), as is any HCN gas which evaporates from solution. In the pH range of 9 to 9.5, the free cyanide is split approximately 50:50 between the CN^- ion and dissolved HCN.*
>
> *Considering the above physical and chemical properties of the discharged residue (low cyanide concentration with the majority to remain bound to metal ions), it is concluded that the available HCN in solution on discharge and within the decant pond will be very low, and likely to be destroyed by UV radiation before it can vaporise. Should any HCN gas be emitted, it will quickly be dispersed by wind and destroyed by UV radiation. Given the large size of the RSF cells, any HCN gas is quickly diluted to undetectable levels.*
>
> *Further advice is provided with respect to the possible accumulation of cyanide within the RSF by the United Nations Environment Program fact sheet on cyanide (ASTDR, 2010):*
>
>> *"Cyanides are not persistent in water or soil. Cyanides may accumulate in bottom sediments, but residues are generally as low as 1 mg/kg even near polluting sources. Majority of accidental release of cyanide is volatilised to the atmosphere where it is quickly diluted and degraded by ultra violet. Other factors, such as biological oxidation, precipitation and the effects of sunlight also contribute to cyanide degradation. There is no evidence of bioaccumulation in the food chain, and hence, secondary poisoning does not occur".*
>
> *As such, there is limited potential for any adverse air quality impacts due to cyanide emissions from the TSF.*

In submissions to the original AQIA, NSW EPA also raised the issue of metal emissions during ore crushing and screening. The Response to Submissions (RWC, 2012) provided the following:

> *Whilst low levels of metals may be present in the ore,…. the levels of trace element concentrations (including metals) are very low, typically less than 0.01%.*
>
> *In addition, crushing and screening activities will take place inside purpose built enclosures (nominally constructed to reduce noise emissions but which will also function to prevent dust emissions). On the basis of the preceding, the potential for any adverse air quality impacts due to metal emissions is considered to be negligible.*

A public health assessment by the Colorado Department of Public Health and Environment (CDHPE) monitored on-site levels of lead, cadmium, chromium and arsenic in TSP from 1993 to 1996 at the Cripple Creek and Victor Gold Mining Company. The monitoring results showed that the maximum levels detected were all at least 1000 times below the lowest levels known to cause adverse health impacts in humans and not significantly different from samples collected at other similar operations. As a result, monitoring was discontinued and the CDHPE concluded that no adverse health impacts were expected to occur to people living near the mining activities (ASTDR, 2010).

Emissions of cyanide and metals have not been considered within this AQIA.

3. LEGISLATION, REGULATION AND GUIDANCE

3.1 NSW EPA Approved Methods

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, 2016) (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 presented in **Table 4**.

Table 4 NSW EPA air quality standards and goals

Pollutant	Averaging period	Units	Criterion	Notes
Nitrogen dioxide (NO_2)	1 hour	$\mu g \cdot m^{-3}$ (a)	246	Numerically equivalent to the Ambient Air Quality National Environment Protection Measure (AAQ NEPM)(b) standards and goals.
	Annual	$\mu g \cdot m^{-3}$	62	
Particulates (as PM_{10})	24 hours	$\mu g \cdot m^{-3}$	50	
	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	

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

3.2 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 and a range of air pollution offences and penalties.

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

3.3 Protection of the Environment (Clean Air) Regulation 2010

The Protection of the Environment Operations (POEO) (Clean Air) Regulation (2010) sets standards of concentration for emissions to air from both scheduled and non-scheduled activities. For the activities performed at the Project Site, the POEO (Clean Air) Regulation provides general standards of concentration for scheduled premises which are presented in **Table 5** for the pollutants of relevance to this assessment.

Table 5 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·m^{-3}
	Any crushing, grinding, separating or materials handling activity	20 mg·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·m^{-3}

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

Further to the requirements in **Table 5** 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.

Schedule 8 of the POEO (Clean Air) Regulation indicates that burning of vegetation is prohibited, except with approval, or in relation to certain domestic waste in the Narromine Shire Council LGA. No burning of materials would be performed as part of the Project operations.

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

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 6** and **Table 7**) 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, 2016). Should exceedances of the relevant particulate matter criteria (refer **Table 4**) 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 6**.

- 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 6 Particulate matter mitigation criteria

Pollutant	Averaging period	Units	Criterion	Impact type
Particulates (as $PM_{2.5}$)	Annual	$\mu g \cdot m^{-3}$ (a)	8	Human health
	24 hour	$\mu g \cdot m^{-3}$ (b)	25	Human health
Particulates (as 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 (as 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. Of note, a number of mitigation agreements have been entered into, primarily in response to noise levels, which include the installation of air conditioning units and payment of any additional power costs.

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 7**:

- 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].

Table 7 Particulate matter acquisition criteria

Pollutant	Averaging period	Units	Criterion	Impact type
Particulates (as $PM_{2.5}$)	Annual	$\mu g \cdot m^{-3}$ (a)	8	Human health
	24 hour	$\mu g \cdot m^{-3}$ (b)	25	Human health
Particulates (as 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 (as 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**.

The difference between the voluntary mitigation and voluntary acquisition criteria are the allowable number of exceedances of the incremental short-term (24 hour) particulate matter criteria, and the incremental dust deposition criterion. The voluntary mitigation criteria allow zero exceedances of those air quality criteria over the life of the development, where the voluntary acquisition criteria allow five exceedances over the life of the development. Additionally, the voluntary acquisition criteria are applied not only at residential locations, but over privately owned land where residential properties exist, or could be developed.

[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.

3.5 Project Approval Conditions

3.5.1 Air Quality Criteria

Condition 17 of Schedule 3 of the Project Approval conditions, as modified most recently in May 2021, include air quality criteria for the project which are to be achieved at any residence on privately owned land, or on more than 25 % of any privately-owned land.

The project specific air quality criteria are presented in a format consistent with MP 09_0155 in **Table 8**, **Table 9** and **Table 10**. Notes to those tables are presented below **Table 10**.

Table 8 Long term impact assessment criteria for particulate matter (MP 09_0155)

Pollutant	Averaging period	[d]Criterion
Total suspended particulate (TSP) matter	Annual	[a]90 $\mu g \cdot m^{-3}$
Particulate matter < 10 µm (PM_{10})	Annual	[a]30 $\mu g \cdot m^{-3}$

Table 9 Short term impact assessment criteria for particulate matter (MP 09_0155)

Pollutant	Averaging period	[d]Criterion
Particulate matter < 10 µm (PM_{10})	24 hour	[a]50 $\mu g \cdot m^{-3}$

Table 10 Long term impact assessment criteria for deposited dust (MP 09_0155)

Pollutant	Averaging period	Maximum increase in deposited dust level	Maximum total deposited dust level
[c]Deposited dust	Annual	[b]2 $g \cdot m^{-2} \cdot month^{-1}$	[a,d]4 $g \cdot m^{-2} \cdot month^{-1}$

Notes to tables:

a Total impact (i.e. incremental increase in concentrations due to the project plus background concentrations due to all other sources);

b Incremental impact (i.e. incremental increase in concentrations due to the project on its own);

c Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2016: Methods for Sampling and Analysis of Ambient Air – Determination of Particulate Matter – Deposited Matter – Gravimetric Method, or its latest version; and

d Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents or any other activity agreed by the Secretary.

Note that there are discrepancies between the air quality criteria presented in **Section 3.1** (NSW EPA, 2016) and those outlined above (MP 09_0155). Specifically:

- The annual average PM_{10} criterion is numerically different
  - 25 $\mu g \cdot m^{-3}$ (NSW EPA, 2016)
  - 30 $\mu g \cdot m^{-3}$ (MP 09_0155)
- The 24-hour average PM_{10} criterion reference different contributors

  - The criteria are numerically identical although NSW EPA (2016) is a cumulative criterion, where the criterion in MP 09_0155 references incremental impacts
- No $PM_{2.5}$ criteria (annual average or maximum 24-hour) included in MP 09_0155

As part of this AQIA, the air quality criteria as referenced in **Section 3.1** have been adopted as they are more stringent than the criteria applied to the currently approved project.

3.5.2 Operating Conditions

Condition 18 of Schedule 3 of the Project Approval conditions, as modified most recently in May 2021, include requirements associated with operating conditions to minimise air quality impacts:

The Proponent shall:

a) *implement best management practice, including all reasonable and feasible measures to minimise the off-site odour, fume and dust emissions from the project;*

b) *regularly assess the predictive meteorological forecasting data and real-time air quality monitoring data to guide the day-to-day planning of mining operations and implementation of both proactive and reactive air quality mitigation measures to ensure compliance with the relevant conditions of this approval;*

c) *minimise the air quality impacts of the project during adverse meteorological conditions and extraordinary events* (see Note [in **Section 3.5.1**]);

d) *monitor and report on compliance with the relevant air quality conditions in this approval; and*

e) *take all practical measures to minimise dust emissions from the residue storage facility, to the satisfaction of the Secretary.*

3.5.3 Air Quality and Greenhouse Gas Management Plan

Condition 19 of Schedule 3 of the Project Approval conditions, as modified most recently in May 2021, include requirements associated with the preparation and implementation of an Air Quality and Greenhouse Gas Management Plan (AQMP) for the project.

The most recent version of the AQMP was updated in December 2018 and outlines a range of air quality management measures to be implemented during operations, and also includes management measures to be implemented during adverse weather conditions. The AQMP would be updated to ensure that management and mitigation measures are in place to control emissions in all stages of the Project life, including construction and enabling works.

Details of the management measures are presented in **Section 5.1.3** and **Section 8.1** (air quality) and **Section 8.2** (greenhouse gas).

3.6 Greenhouse Gas Legislation and Guidance

The Australian Government Clean Energy Regulator administers schemes legislated by the Australian Government for measuring, managing, reducing or offsetting Australia's carbon emissions.

Schemes administered by the Clean Energy Regulator include:

- National Greenhouse and Energy Reporting Scheme, under the *National Greenhouse and Energy Reporting Act* (2007).
- Emissions Reduction Fund, under the *Carbon Credits (Carbon Farming Initiative) Act* (2011).
- Renewable Energy Target, under the *Renewable Energy (Electricity) Act* (2000).
- Australian National Registry of Emissions Units, under the *Australian National Registry of Emissions Units Act* (2011).

3.6.1 National Greenhouse and Energy Reporting Scheme

The National Greenhouse and Energy Reporting (NGER) scheme, established by the *National Greenhouse and Energy Reporting Act* (2007) (NGER Act), is a national framework for reporting and disseminating company information about greenhouse gas emissions, energy production, energy consumption and other information specified under NGER legislation.

The objectives of the NGER scheme are to:

- inform government policy.
- inform the Australian public.
- help meet Australia's international reporting obligations.
- assist Commonwealth, state and territory government programmes and activities.
- avoid duplication of similar reporting requirements in the states and territories.

Further information on the NGER scheme, specifically the definitions of various scopes and types of GHG emissions which have also been adopted for the purposes of this assessment, is provided in **Section 5.2**.

3.6.2 Relevant NSW Legislation

There is no specific GHG legislation administered within NSW. The NGER scheme (and other identified Commonwealth schemes in **Section 3.6.1**) forms the applicable legislation within NSW.

3.6.3 Relevant NSW Policy Framework

The NSW Government Net Zero Plan Stage 1: 2020-2030 (NSW DPIE, 2020) is the foundation for NSW's action on climate change and goal to reach net zero emissions by 2050. It outlines the NSW Government's plan to grow the economy, create jobs and reduce emissions over the next decade.

The plan aims to enhance the prosperity and quality of life of the people of NSW, while helping the state to deliver a 35 % reduction in emissions by 2030 compared to 2005 levels. The plan supports a range of initiatives targeting electricity and energy efficiency, electric vehicles, hydrogen, primary industries, coal innovation, organic waste and carbon financing.

Under the plan, businesses will be supported to modernise their plant and increase productivity.

3.6.4 Guidance

The GHG accounting and reporting principles adopted within this GHG assessment are based on the following financial accounting and reporting standards:

- Australian Government Department of the Environment, Australian National Greenhouse Accounts, National Greenhouse Accounts Factors, August 2021 (DISER, 2021).
- The World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) GHG Protocol: A Corporate Accounting and Report Standard (WRI, 2004).
- ISO 14064-1:2006 (Greenhouse Gases – Part 1: Specification with guidance at the organisation level for quantification and reporting of GHG emissions and removal).
- ISO 14064-2:2006 (Greenhouse Gases – Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of GHG emission reductions or removal enhancements).
- ISO 14064-3:2006 (Greenhouse Gases – Part 3: Specification with guidance for the validation and verification of GHG assertions) guidelines (internationally accepted best practice).

4. EXISTING CONDITIONS

4.1 Surrounding Land Sensitivity

4.1.1 Discrete Receptor Locations

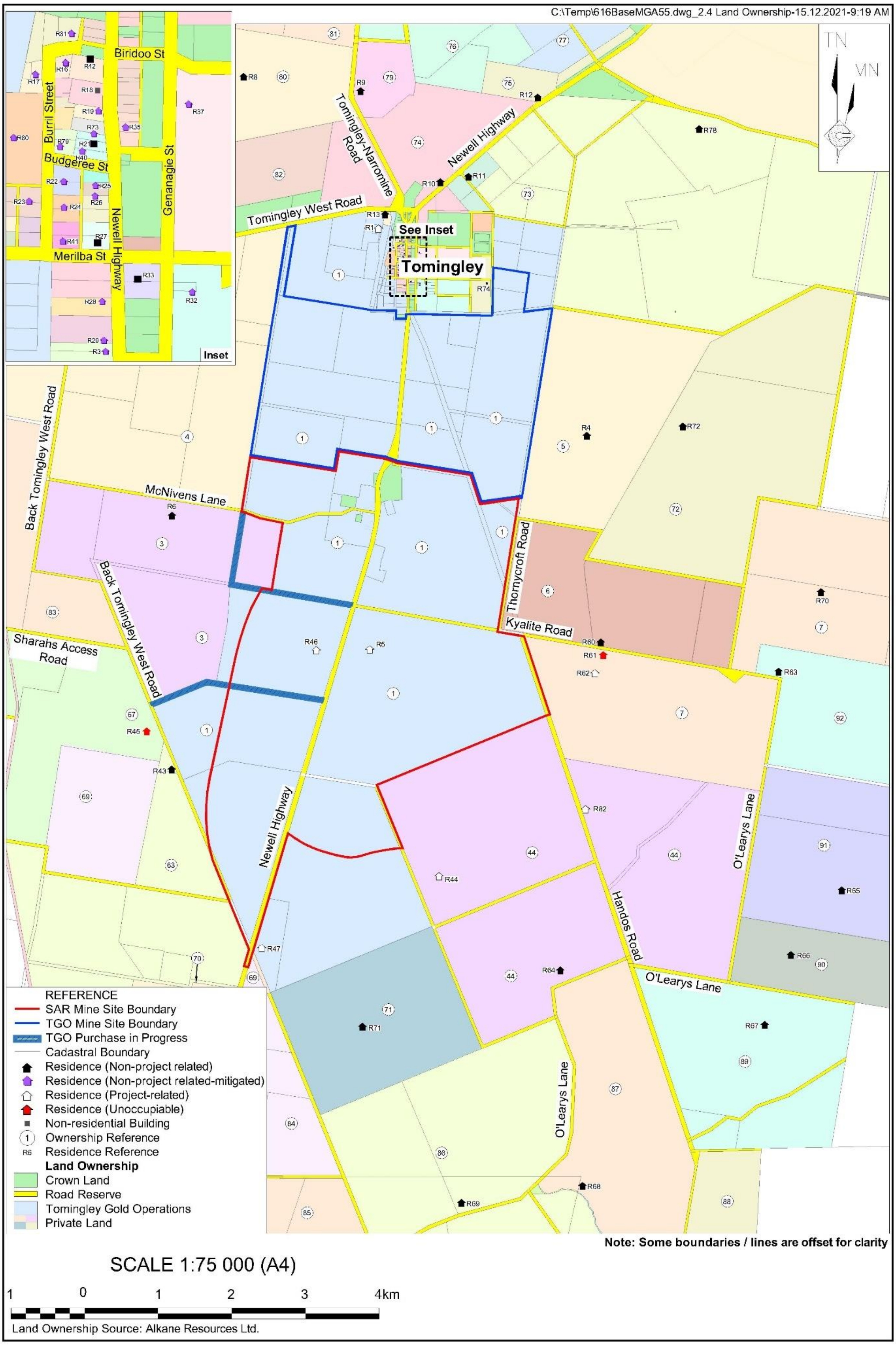
Air quality assessments typically use a desk-top mapping study to identify 'discrete receptor locations', which are intended to represent a selection of locations that may be susceptible to changes in air quality. In broad terms, the identification of sensitive receptors refers to places at which humans 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.

For the purposes of this assessment, 59 discrete receptors have been identified, with five of those receptors being Project-related (R5, R44, R46, R47 and R82), two as unoccupiable residences (R45 and R61), two as non-operational commercial locations (R27 and R33) with the remaining 50 receptors identified as non-Project related. Project related receptors R5 and R46 would be removed prior to mining operations commencing, and results are not presented for these receptors. All locations are presented in **Figure 7** and **Appendix C**.

4.1.2 Uniform Receptor Locations

In addition to the identified 'discrete' receptor locations, the entire modelling area is gridded with 'uniform' receptor locations 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. This uniform receptor grid also allows the presentation of contour plots of predicted impacts, and allows the assessment of particulate concentrations across privately owned land, in accordance with the NSW Voluntary Land Acquisition and Mitigation Policy (NSW Government, 2018), refer **Section 3.4**.

Figure 7 Sensitive receptors surrounding the Project Site

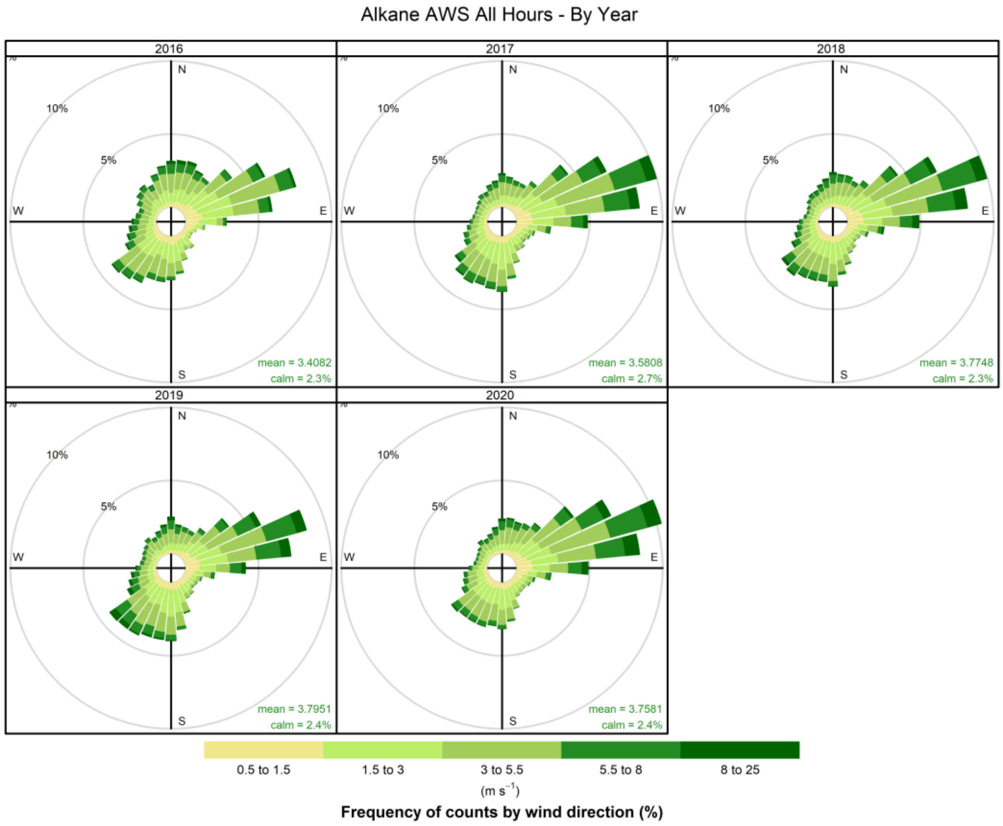


4.2 Meteorology

As previously discussed, meteorological monitoring is performed at the Mine. Annual wind roses for the period 2016 to 2020 as measured at the Mine, are presented in **Figure 8**.

Further discussion regarding the observed meteorology, meteorology adopted in previous AQIA for the Mine, and that adopted in the focussed quantitative assessment presented within this report, is provided in **Appendix D**.

Figure 8 Alkane AWS wind-roses (2016-2020)

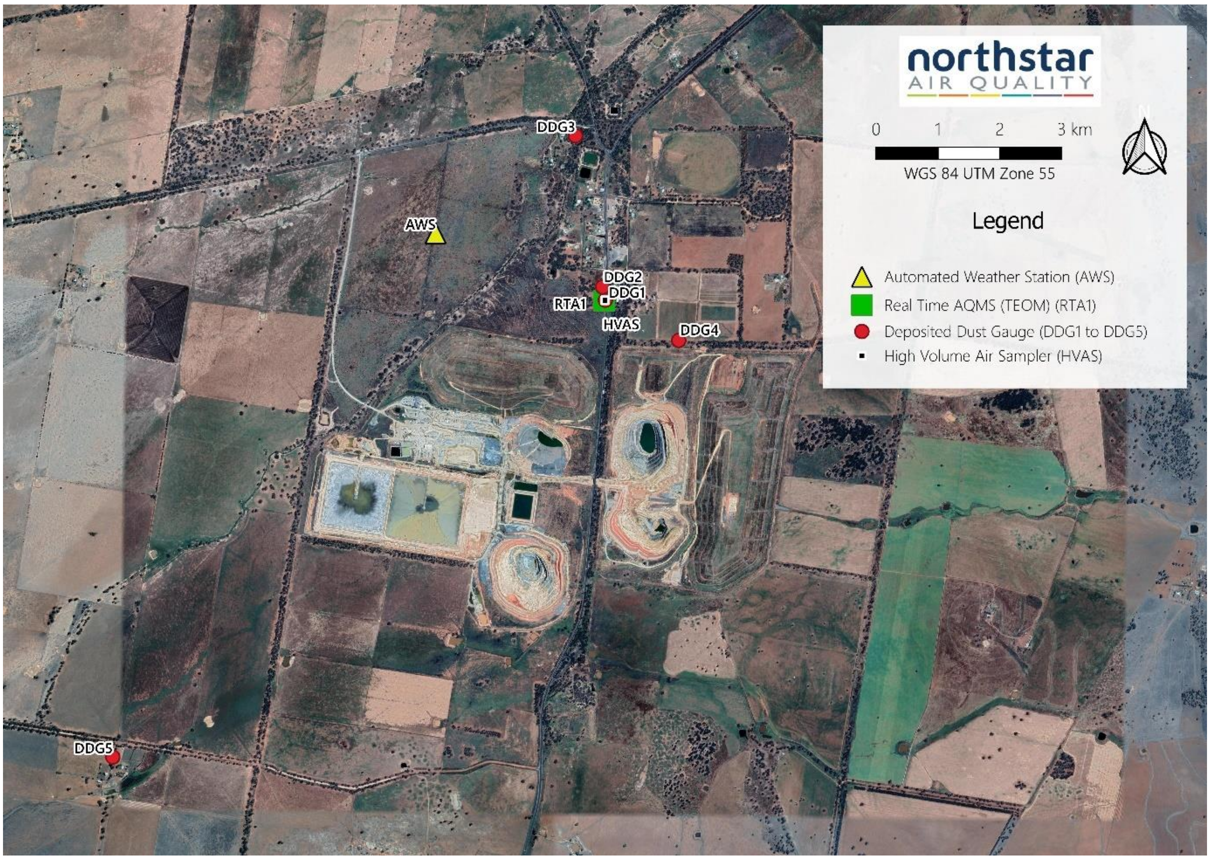


4.3 Air Quality

Air quality monitoring (including ambient concentrations of TSP and PM_{10}, and the rate of dust deposition) is performed at the Mine by the Applicant.

A Tapered Element Oscillating Microbalance (TEOM), which continuously measures particulate matter (PM_{10}) has been operated in the village of Tomingley since May 2014. Total Suspended Particulate (TSP) is measured by a High-Volume Air Sampler (HVAS) at the same location as the TEOM. There are also five dust deposition gauges (DDG) at various locations around the perimeter of the Mine. The locations of the air quality and meteorological monitoring equipment operated at the Mine are presented in **Figure 9**.

Figure 9 Meteorological and air quality monitoring at the Mine



Typically, air quality studies may also use historical air quality monitoring data generated by other operators, particularly the NSW DPIE. It is noted that the Mine is located at significant distance from any of the air quality monitoring stations (AQMS) operated by DPIE with the closest being at Bathurst, approximately 150 km to the southeast.

PM_{10} data collected at the TEOM operated by the Applicant in Tomingley village during the year 2017 has been used as a proxy for approved activities being performed at the Mine, to which the impacts associated with all Project activities are added to represent a potential cumulative impact. This is considered to be an appropriate, and even conservative approach, as PM_{10} data collected in 2017 at the Mine operated TEOM already represents the mining of approximately 7.6 Mbcm (approximately 18 Mt) of waste material and the processing of over 1 Mt of ore. By contrast, during the life of the Project, it is anticipated that surface mining activities within the TGO Mine Site will have largely ceased, resulting in considerably reduced particulate emissions compared to those in 2017. A more detailed discussion of the Project and Mine activities which either have been modelled or are assumed to be represented in that background dataset, is presented in **Section 5.1.1**.

Ambient concentrations of $PM_{2.5}$ and NO_X are not measured at the Mine and have been derived as outlined in **Appendix E**.

A detailed summary of the background air quality as measured at the Mine Site is presented in **Appendix E**, and a summary of the air quality monitoring data used in this assessment is presented in **Table 11**.

Table 11 Summary of background air quality used in the AQIA

Pollutant	Averaging Period	Value	Data Source
PM_{10}	24-hour	Daily varying	TGO Mine Site 2017 Maximum measured 24-hour average PM_{10} in 2017 – 77.6 $\mu g{\cdot}m^{-3}$
	Annual	19.9 $\mu g{\cdot}m^{-3}$	TGO Mine Site 2017
$PM_{2.5}$	24-hour	Daily varying	Bathurst 2017 Maximum measured 24-hour average $PM_{2.5}$ in 2017 – 17.5 $\mu g{\cdot}m^{-3}$
	Annual	6.1 $\mu g{\cdot}m^{-3}$	Bathurst 2017
TSP	Annual	46.8 $\mu g{\cdot}m^{-3}$	TGO Mine Site 2017
Dust Dep.	Monthly	2.0 $g{\cdot}m^{-2}{\cdot}month^{-1}$	Maximum measured at the Mine DDG network in 2017
NO_2	1-hour	Hourly varying	Richmond 2017 Maximum measured 1-hour NO_2 in 2017 – 53.3 $\mu g{\cdot}m^{-3}$
	Annual	9.6 $\mu g{\cdot}m^{-3}$	Richmond 2017

It is noted that the Approved Methods (NSW EPA, 2016) requires that background air pollutant concentrations (as summarised above) are aggregated with the dispersion model predictions to determine a 'cumulative' impact.

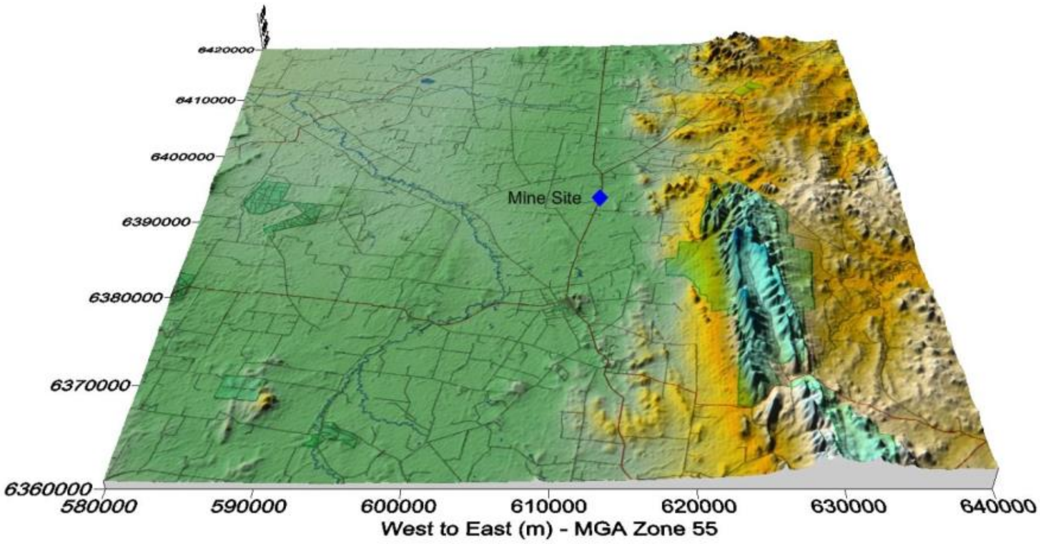
The AQIA has been performed to assess the contribution of the Project to the air quality of the surrounding area. A full discussion of how the Project is predicted to impact upon air quality is presented in **Section 6**.

4.4 Topography

The elevation of the Project Site is between approximately 260 m and 270 m AHD. The topography of the area, and the locations of surrounding receptors in relation to the Project Site and surrounding topography was provided in (PAEHolmes, 2011) and is replicated in **Figure 10**.

Topography has been considered in the generation of the meteorological file used in modelling (refer **Appendix D**).

Figure 10 Topography surrounding the Mine site



Source: (PAEHolmes, 2011)

4.5 Potential for Cumulative Impacts

The area surrounding the Project Site is generally agricultural in nature (consisting primarily of cropping and grazing operations), with no significant 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 **Appendix E** would appropriately account for any potential cumulative impacts associated with surrounding land uses.

4.6 Greenhouse Gas

Emissions of GHG are tracked by the Commonwealth of Australia through the Australian National Greenhouse Accounts program. This program, and the reports and data submitted as part of the program, fulfils Australia's international and domestic reporting requirements. Carbon emission totals by State and Territory by year and by sector are reported in the 'State and Territory Greenhouse Gas Inventories' report for each reporting year and provided online[2].

These data are used to:

- Meet Australia's reporting commitments under the United Nations Framework Convention on Climate Change (UNFCCC);

[2] https://www.industry.gov.au/data-and-publications/national-greenhouse-accounts-2019/state-and-territory-greenhouse-gas-inventories-2019-emissions

- Track progress against Australia's emission reduction commitments; and
- Inform policy makers and the public.

Data for 2019 have been obtained for the purposes of this GHG assessment. These data are the most recent available at the time of reporting.

Emissions of GHG from Australia in 2019 across all economic sectors were 529.9×10^6 tonnes (Mt) carbon dioxide equivalent (CO_2-e) and in NSW were 136.5 Mt CO_2-e.

5. APPROACH TO ASSESSMENT

5.1 Air Quality Impact Assessment

5.1.1 Dispersion Modelling

A dispersion modelling assessment has been performed using the NSW EPA approved CALPUFF atmospheric dispersion model in 3-dimensional (3D) mode.

The CALPUFF modelling system includes three main components: CALMET, CALPUFF and CALPOST and a large set of pre-processing programs designed to interface the model to routinely available meteorological and geophysical datasets.

In the simplest terms, CALMET is a meteorological model that develops hourly wind and temperature fields on a three-dimensional gridded domain. Associated two-dimensional fields such as mixing height, surface characteristics, and dispersion properties are also included in the file produced by CALMET (refer to **Section 4.2** and **Appendix D**).

CALPUFF is a transport and dispersion model that advects "puffs" of material emitted from modelled sources (refer **Appendix B**), simulating dispersion and transformation processes along the way. In doing so, it typically uses the fields generated by CALMET. Temporal and spatial variations in the meteorological fields are explicitly incorporated into the resulting distribution of puffs throughout a simulation period. The primary output files from CALPUFF contain either hourly concentrations or deposition fluxes evaluated at selected receptor locations.

CALPOST is used to process the CALPUFF output files, producing tabulations that summarise the results of the simulation (Scire, Strimaitis, & Yamartino, 2000).

In March 2011, NSW OEH (now DPIE) published generic guidance and optimal settings associated with the CALPUFF modelling system for inclusion in the Approved Methods (Barclay & Scire, 2011). These guidelines and settings have been considered in the performance of this assessment.

An assessment of the impacts of the operation of activities at the Project Site 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 within the Project Site are not anticipated to fluctuate significantly given the nature of mining operations, and these average activity rates are also suitable to allow comparison of potential impacts against shorter term (24-hour) criteria for particulate matter.

The three modelling scenarios (refer **Section 2.3**) provide an indication of the air quality impacts of the operation of activities within the Project Site. Added to these impacts are regional background air quality concentrations (as discussed in **Section 4.3** and **Appendix E**) which represent the air quality which may be expected within the area surrounding the Project Site, without the impacts of the Project itself.

For clarity, only 'new' emissions sources associated with the Project have been included within the dispersion modelling assessment. Those emissions sources determined to be represented in the air quality monitoring data measured at the Mine Site in 2017 have not been explicitly modelled ('existing' emissions sources). A summary of those sources is presented in **Table 12**.

Table 12 Summary of ''existing' and 'new' emissions sources

Existing emissions sources	New emissions sources	Comment
-	All SAR site establishment activities	-
-	Newell Highway and Kyalite Road realignment activities	-
-	All activities in the SAR Open Cut	-
-	Transport of waste material to the Caloma and SAR WRE	-
-	Transport of soil to soil stockpiles	-
-	Emissions through the SARED and ROS ventilation rises during Scenarios 1 and 2/3, respectively	Emissions through the SARED or ROS ventilation rises did not occur in 2017
Mining, transport and placement of approximately 18 Mt of waste material	Mining, transport and placement of up to an additional 32 Mt of waste material	The locations of waste extraction and placement were different in 2017 than proposed, although the impact of any placement and storage would be included in the existing air quality data and provide a conservative level of assessment
Processing of 1 087 983 t of ore	Processing of ore at tonnages > 1 087 983 t	Ore processing and handling at rates ≤ 1 087 983 t would be represented in the air quality data for 2017
All underground mining activities	-	-
-	RSF2 construction	-

The background air quality data for 2017 includes a component of particulate matter which is associated with the extraction, handling, transport and placement of waste material (approximately 18 Mt) in that year. The dispersion modelling assessment cannot be adjusted to take into account those movements (as is the case for ore processing), as the physical locations of those activities are different in 2017, when compared to those proposed as part of the Project.

Calculations suggest that those activities in 2017 may represent approximately 5 % to 10 % of the annual TSP emissions associated with Scenario 3, and therefore the total site emissions budget and consequently the predicted cumulative impacts, may be overestimated by a similar amount.

For clarity, the results of the assessment have not been adjusted to take into account that potential source of overestimation, but the results outlined in this AQIA should be viewed with that conservatism in mind.

5.1.2 Emissions Estimation

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 particulate matter emission factors for the activities being performed as part of the Project (refer **Section 2.3**) as contained within the US EPA AP-42 emission factor compendium (US EPA, 1995 and updates). These factors are appropriate for adoption in Australia and are routinely adopted in the assessment of operations of this nature.

Emissions of NO_X associated with blasting have been referenced from the National Pollutant Inventory Emission Estimation Technique for Mining (DSEWPC, 2010).

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

The AQMP (see **Section 3.5**) identifies that during certain wind conditions, activities at the Mine may be modified to ensure that excessive dust is not generated and transported to nearby sensitive receptors. These management measures would form a part of the updated AQMP which would cover all Project activities. However, the quantification of emissions for the Project does not (and cannot) take into account these modifications, and therefore the modelled increments may be viewed as being highly conservative, as operational controls implemented through the AQMP will have mitigated emissions and subsequent impacts. This is discussed in greater detail in **Section 6**.

5.1.3 Emissions Controls

Management of air quality is currently performed at the Mine with due reference to the AQMP (refer **Section 3.5.3**), which clearly outlines the management measures to be adopted as part of the ongoing operation of the Tomingley Gold Project. Following approval, those management measures would be adopted during the construction and operation of the Project, and the AQMP would be updated accordingly.

The AQMP includes:

- Pre-emptive measures for dust control, including:
  - Inductions

  - Weather condition monitoring
  - Visible dust monitoring and management
  - Water cart operations
  - Personnel Health Management

- Area specific controls for all open cut areas, waste rock emplacements, processing area and ROM pad.
- Proactive/reactive dust controls actions based on visual, climatic, predicted weather and operational triggers.

The AQMP includes a *Site Specific Procedure (SPP) for Dust Control* which is aimed at providing detailed operational guidance relating to the management of dust at the Mine, which would also be modified as required and adopted should the Project be approved.

A summary of those measures is provided in **Table 13**. For clarity, these measures would also be adopted during Project operation and where relevant, during any construction activities, following approval. The AQMP would be updated to cover all aspects of Project construction and operation.

Table 13 Summary of emission reduction methods adopted as part of Project operation

Activity	Emission control method
Wind erosion control	Disturb only the minimum area necessary. Review annually for potential improvement
	If exposed area is a potential source of dust emissions and is likely to be exposed for between 3-12 months a spray on erosion control product is to be applied. For any time greater than 12 months, revegetation should take place.
	Rehabilitate completed sections of the waste rock emplacement in accordance with the approved mine plan
	Fencing, shelterbelts or in-pit dump of waste emplacement shall be investigated as a possible mean to reduce surface wind speed of exposed areas, waste emplacement and stockpiles.
	Include information in the project induction on the requirement to drive only on designated haul roads, maintain site speed limits and notify a supervisor if visible dust generation is observed.
	Delineate haul roads, with marker posts or cones to control their locations.
	Rehabilitate roads as soon as possible once they are no longer in use.
	Limit the development of minor roads.
Drilling and Blasting	During portal development drilling operations use dust aprons, dust extraction and water injection where necessary to manage the dust.
	Monitor weather forecast to help plan blasting during portal development operations.
	Undertake blasting operations in appropriate wind conditions. Use data from the weather station and Weatherzone Mining Dashboard to gauge wind speed and direction to help guide blasting operations, for example a strong southerly wind may carry fugitive dust towards Tomingley village.
	Ensure adequate stemming is used during blasting operations
Conveyors	Enclose conveyor transfer points within the crushing and screening unit.

Activity	Emission control method
Ore Processing	Install and operate spray bars within the crushing and screening circuit of the processing operations to produce a fog of water to supress dust. Points at which this will be installed are as follows: • The ROM back bin and side walls, with a sensor that allows the system to be turned on when the loader approaches • The mouth of the primary crusher • The conveyor between the primary crusher and the secondary crusher • The discharge point to the head chute in the screening tower • The inlet to the screening tower • The oversize outlet to the screening tower • Loading points to the conveyors for the transfer of screened material to and from the screening tower and surge bin.
Material loading and dumping	Use of water sprays or water carts with boom spray or cease/modify activities on dry windy days.
	Use short tipping on ROM to minimise dust generation from material to avoid tipping material down a tip face.
	Wetting stockpiles when moving broken rock, loading trucks or dumping into bins or stockpiles
Haulage routes	Watering of roads
	In the circumstance where no water cart is available due to unplanned maintenance, water supply issues or the like, all activities that may generate dust are to be suspended immediately. Shift Supervisor (depending on responsibility for activity) is to notify the Area Superintendent immediately. In accordance with the EPL, works cannot re-commence until dust control measures are reinstated.
	When it is evident that the road surface or work area may generate dust, the area that is to be utilised during the shift is to be watered prior to works commencing. This includes access roads, haul roads, go-line and work areas.
	So as to ensure adequate moisture is retained in the trafficable surface; access roads, haul roads and work areas that are to be utilised by the oncoming shift should be watered at the end of the outgoing shift. This is particularly important for the night shift.

Emission control factors associated with all of the controls employed at the Project Site (see **Table 13**) are not available in the literature, although those that are available are presented in **Table 14**. These emission reductions are outlined in the NPI EETM for Mining (NPI, 2012), (Katestone, 2011) and relevant AP-42 documentation (US EPA, 1995).

Table 14 Summary of emission reduction methods adopted as part of Project operation

Emission control method	Control efficiency (%)
Use of water injection on drill rig	96
Application of water when loading materials to haul trucks It is also assumed that this material remains moist when unloaded and handled	50
Loading ore to crusher, crushing, and screening in enclosed building	90
Application of water during ore processing	50

Emission control method	Control efficiency (%)
Retention of particulate matter in sub-ground level areas (pit retention)	95 (TSP) 5 (PM_{10} and $PM_{2.5}$)
Application of water and/or chemical suppressants on unpaved haulage routes and/or limiting of site vehicle speeds	90 (see below)

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 Project Site and based on the findings of other mine sites across NSW, this is achievable.

Trigger Action Response Plan

The AQMP *SSP for Dust Control* includes a number of area specific controls which are based on wind direction, weather conditions, and the task being performed. These area specific controls will be updated to encompass the Project activities in the SAR Open Cut, SAR Waste Rock Emplacement, and new haulage routes.

The Mine implements a proactive dust management program, sometimes termed a Trigger Action Response Plan (TARP), to manage dust impacts at nearby sensitive receptors.

A proactive dust management system has been implemented to manage dust issues during the Mine operation according to real-time meteorological conditions and air quality observations. The goal is to ensure the 24-hour average PM_{10} concentrations remain below the assessment criterion, which is in accordance with Condition 18 (b) of the Project Approval conditions:

> ***'Regularly assess the predictive meteorological forecasting data and real-time air quality monitoring data, and relocate, modify and/or stop operations on site to ensure compliance with the relevant conditions of this approval'.***

The following provides a summary of the current TARP. This will be modified following Project approval and is discussed further in **Section 6** and **Section 8**.

The proactive air quality management system operates as follows.

- The continuous TEOM PM_{10} monitor relays data in near-real-time to a website.
- This website is accessible to the relevant mine personnel on a continuous basis.
- An SMS alarm is sent to relevant mine personnel when pre-determined concentrations are breached, which would in turn indicate what action and when is required.
- Two PM_{10} concentration trigger levels are applicable for the Mine.
  - Trigger Level 1 – Investigation Level

Current instantaneous PM_{10} concentrations indicate that dust levels are elevated and activities from the Mine may be contributing to these elevated levels. If Trigger Level 1 is exceeded, Mine personnel investigate prevailing winds, determine what activities are occurring on site that may be contributing to elevated dust levels. Site personnel are then informed that dust emissions are increasing and action(s) may be required.

- Trigger Level 2 – Action Level

  Rolling 24-hour average PM_{10} concentrations continue to be elevated and activities from the Mine are identified as contributing to these levels. If Trigger Level 2 is breached, remedial action is required, and additional dust control measures are implemented.

  Interim trigger values are presented in section 8.2 of the AQMP. It is proposed that trigger levels would be reviewed regularly to ensure they are working appropriately i.e. they are ensuring that dust levels remain below ambient air quality goals.

In the event that air quality monitoring identifies an exceedance of the air quality criteria identified in Schedule 3 Condition 17 of the approval, the exceedance is investigated to determine the likely cause(s). All corrective and preventative actions are entered into the Online Reporting Database. An investigation will then follow to determine:

- what immediate action(s) need to be taken to fix the problem in the short term, if applicable;
- the root causes of the problem (e.g. management system, equipment design / performance, human factors/behaviour, work environment or training);
- corrective actions required to eliminate the root cause(s);
- action(s) taken to verify effectiveness of corrective action(s) (i.e. what measures and checks are taken to ensure the corrective actions that are in place are effective to prevent any further exceedance); and
- on completion of the investigation, an electronic copy will be forwarded to Regional Manager for review/approval of corrective and preventative actions.

During dry conditions, and high wind speeds at the Mine, especially when the wind is blowing toward the village (that is when winds are blowing from the south/south-west), the following additional dust control measure are currently implemented:

- Activities capable of generating dust will be curtailed in the higher exposed areas.
- Additional water will be applied to internal roads in use by haul trucks.
- Any other open areas capable of generating dust will be watered by the water truck.
- Activities capable of generating dust will be curtailed or ceased across the Mine.

Preparatory measures that can be put in place for adverse weather include:

- Aim to have surface moist before the on-set of windy conditions. The area of focus should be where significant site work will be taking place for that day.
- Prepare for water cart spraying or sprinkler system during high winds.

- Prepare to cease certain activities or reduce activity level.
- Schedule maintenance for plant and equipment to reduce dust generating activities.

Six-day site specific forecasts are available from Weatherzone - miningzone[3]. This data is reviewed daily by the Environment Manager who will check weather conditions for coming days and plan accordingly for adverse weather.

Adverse weather, in terms of dust impacts, relates to hot, dry and gusty / windy conditions and specifically in relation to this Project is:

- Little or no rainfall forecast and little or no rainfall in past 48 hours; and
- High wind speeds (> 30 $km \cdot hr^{-1}$) from the south/south-west and towards nearest sensitive receptors.

The management measures defined in section 6.1.3 of the AQMP to be implemented during adverse weather conditions are:

- Activities capable of generating dust will be curtailed in the higher exposed areas;
- Additional water will be applied to internal roads in use by haul trucks;
- Any other open areas capable of generating dust will be watered by the water truck and potentially with the water truck's water cannon; and
- Activities capable of generating dust will be curtailed or ceased across the Mine.

Preparatory measures that can be put in place for adverse weather include:

- Aim to have surface moist before the on-set of windy conditions. The area of focus should be where significant site work will be taking place for that day;
- Prepare for the instigation of the water cart spraying or sprinkler system during high winds;
- Prepare to cease certain activities or reduce activity level; and
- Schedule maintenance for plant and equipment to reduce dust generating activities.

The Applicant should update the AQMP to incorporate each of the above measures, including (but not limited to) the triggers and corrective actions as required (section 8.3 of the AQMP), and the ongoing implementation of real time dust management (section 8.2 of the AQMP), should the Project be approved.

The TARP is proposed to be updated to include two additional real-time particulate monitors, with one located (i) at or near Receptor 43, and (ii) one located at or near Receptor 4. The existing real-time monitor between the Mine and Tomingley Village will be retained. Further discussion relating to the operation of the TARP during Project operations is presented in **Section 6** and **Section 8**.

3 https://business.weatherzone.com.au/industries/mining/

5.1.4 NO to NO_2 Conversion

The conversion of NO to NO_2 has been assumed to be in accordance with Method 2 of the NSW EPA Approved Methods (section 8.1.2 of (NSW EPA, 2016)). This is termed the Ozone Limiting Method (OLM). This method assumes that all the available ozone in the atmosphere will react with NO in the plume until either all the ozone (O_3) or all the nitrous oxide (NO) is depleted. This approach assumes that the atmospheric reaction is instant, although in reality the reaction takes place over a number of hours.

A level 2 assessment has been performed which uses the contemporaneous hourly model predictions of NO_X and measured hourly NO_2 and O_3 concentrations at the Richmond AQMS in 2017.

$$[NO_2]_{total} = \{0.1 \times [NO_x]_{pred}\} + MIN\left\{(0.9 \times [NO_x]_{pred} \; or \; \left(\frac{46}{48}\right) \times [O_3]_{bkgrd}\right\} + [NO_2]_{bkgrd}$$

where:

$[NO_2]_{total}$ = the predicted concentration of NO_2 in $\mu g{\cdot}m^{-3}$

$[NO_x]_{pred}$ = the dispersion model prediction of the ground level concentration of NO_X in $\mu g{\cdot}m^{-3}$

$[O_3]_{bkgrd}$ = the background ambient O_3 concentration in $\mu g{\cdot}m^{-3}$

$\left(\frac{46}{48}\right)$ = the ratio of molar mass of NO_2 and O_3

$[NO_2]_{bkgrd}$ = the background ambient NO_2 concentration in $\mu g{\cdot}m^{-3}$

5.2 Greenhouse Gas Assessment

The purpose of the GHG assessment is to examine the potential impacts of the operation of the Project relating to emissions of GHG. A quantitative assessment of emissions is performed with direct emissions compared with total national and NSW GHG emissions for context (refer **Section 4.6**).

The scope of the GHG assessment is to provide a quantitative assessment of GHG emissions arising from the operation of the Project. This report does not provide a definitive quantification of GHG emissions arising from the Project operation but provides the general context of the likely quantum of emissions.

Opportunities for reduction of GHG emissions are discussed.

5.2.1 Emission Types

The Australian Government Department of the Environment (DoE) document, "National Greenhouse Accounts Factors" Workbook (NGA Factors) (DISER, 2021) defines two types of GHG emissions (see **Table 15**), namely 'direct' and 'indirect'. This assessment considers both direct emissions and indirect emissions resulting from the Project operation.

Table 15 Greenhouse gas emission types

Emission Type	Definition
Direct	Produced from sources within the boundary of an organisation and as a result of that organisation's activities (e.g. consumption of fuel in on-site vehicles)
Indirect	Generated in the wider economy as a consequence of an organisation's activities (particularly from its demand for goods and services), but which are physically produced by the activities of another organisation (e.g. consumption of purchased electricity).

Note: Adapted from NGA Factors Workbook (DISER, 2021)

5.2.2 Emission Scopes

The NGA Factors (DISER, 2021) identifies three 'scopes' of emissions for GHG accounting and reporting purposes as shown in **Table 16**.

Table 16 Greenhouse gas emission scopes

Emission Scope	Definition
Scope 1	Direct (or point-source) emission factors give the kilograms of carbon dioxide equivalent (CO_2-e) emitted per unit of activity at the point of emission release (i.e. fuel use, energy use, manufacturing process activity, mining activity, on-site waste disposal, etc.). These factors are used to calculate Scope 1 emissions.
Scope 2	Indirect emission factors are used to calculate Scope 2 emissions from the generation of the electricity purchased and consumed by an organisation as kilograms of CO_2-e per unit of electricity consumed. Scope 2 emissions are physically produced by the burning of fuels (coal, natural gas, etc.) at the power station.
Scope 3	Indirect emissions which are not included in scope 2, occurring within an organisation's value chain. The majority of a company's value chain greenhouse gas emissions may lie outside their own operations. Emissions from a company's value chain occurring externally to their operations within Australia may be estimated using the available scope 3 emission factors

Note: Adapted from NGA Factors Workbook (DISER, 2021)

5.2.3 Source Identification and Boundary Definition

The geographical boundary set for the GHG assessment covers the Project Site (i.e. encompassing current activities at the TGO Mine Site and those proposed as part of the Project) but also includes the transport of personnel to/from the Project Site. Emissions associated with product transport have not been included, given the sensitive nature of the assumptions required to underlie that calculation. Given the anticipated low number of vehicles used to transport product from the Project Site, GHG emissions are anticipated to be negligible.

All Scope 1, 2 and Scope 3 emissions within the defined boundary have been identified and reported as far as possible.

5.2.4 Emission Source Identification

The activities/operations being performed as part of the Project which have the potential to result in emissions of GHG are presented in **Table 17**. Emissions of GHG resulting from land clearance have not been estimated, given that the site will be rehabilitated at the end of the extraction period.

Table 17 Greenhouse gas emission sources

Project Component	Scope	Emission Source Description
Consumption of diesel fuel in mobile plant and equipment	1,3	Emissions from combustion of fuel (scope 1) Emissions associated with extraction and processing of fuel (scope 3)
Consumption of LPG in processing operations	1,3	Emissions from combustion of fuel (scope 1) Emissions associated with extraction and processing of fuel (scope 3)
Consumption of electricity	2	Emissions associated with electricity generation
Consumption of diesel fuel / unleaded fuel for employee transport purposes	3	Emissions associated with the extraction and processing of fuels
Consumption of diesel fuel in the transport of materials to the Project Site	3	Emissions associated with the extraction and processing of fuels

5.2.5 Emissions Estimations

Emissions of GHG from each of the sources identified in **Table 17** have been calculated using activity data for each source per annum (e.g. kL diesel fuel) and the relevant emission factor for each source.

The assumptions used in the calculation of activity data for each emissions source are presented below. Emission factors are presented in the following section.

5.2.6 Activity Data

Information relating to the quantities of LPG, electricity, and diesel fuel used at the Mine, or anticipated as a result of the Project, have been provided by the Applicant. In the calculation of certain values, assumptions have been made based on the levels of activity at the Site. These data and assumptions are outlined in **Table** 18.

Table 18 Calculated activity data

Project Component	Assumptions	Activity	Units
Consumption of diesel fuel in mobile plant and equipment at the Project Site	Information provided by the Applicant indicates the diesel fuel use to be 21 224.33 kL per annum in FY25 (year of maximum ore extraction and processing)	21 224.33	$kL{\cdot}annum^{-1}$
Consumption of LPG in processing operations	Information provided by the Applicant indicates the LPG use to be 441.8 kL per annum (pro-rata to FY25 value from FY21 LPG consumption and ore tonnage milled)	441.8	$kL{\cdot}annum^{-1}$
Consumption of electricity	Information provided by the Applicant indicates the electricity use to be 93.2 GWh per annum (pro-rata to FY25 value from FY21 electricity consumption and ore tonnage milled)	93.2	$GWh{\cdot}annum^{-1}$
Consumption of diesel fuel / unleaded fuel for employee transport purposes	Up to 250 personnel to be employed at the Project Site on a full-time equivalent basis Assume employees reside in each of: - Peak Hill (36 km as a two-way journey) – 10 % - Narromine (76 km as a two-way journey) – 20 % - Dubbo (108 km as a two-way journey) – 60 % - Parkes (132 km as a two-way journey)- 10 % 11.1 L per 100 km fuel efficiency (ABS, 2020)	970.3	$kL{\cdot}annum^{-1}$
Consumption of diesel fuel in the transport of materials to the Project Site	Up to 10 heavy vehicles per day, assuming: - 9 from Dubbo (107 km as a two-way journey) - 1 from Bogan Gate (180 km as a two-way journey) 53.1 L per 100km fuel efficiency (ABS, 2020)	221.5	$kL{\cdot}annum^{-1}$

5.2.7 Emission Factors

Emissions factors used for the assessment of GHG emissions associated with the operation of the Project have been sourced from the NGA Factors (DISER, 2021) (refer to **Table 19**).

Table 19 Greenhouse gas emission factors

Emission Scope	Emission Source	Emission Factor (per unit energy)	Energy Content Factor	Emission Factor (per unit activity)
Scope 1	Diesel fuel for mobile plant and equipment	70.2 kg CO_2-e GJ^{-1}	38.6 $GJ \cdot kL^{-1}$	2 709.7 $kg \cdot kL^{-1}$
	Diesel fuel for material transport	70.4 kg CO_2-e GJ^{-1}	38.6 $GJ \cdot kL^{-1}$	2 717.4 $kg \cdot kL^{-1}$
	Liquified petroleum gas	51.53 kg CO_2-e GJ^{-1}	25.3 $GJ \cdot kL^{-1}$	1 303.7 $kg \cdot kL^{-1}$
Scope 2	Electricity consumption (NSW)	0.78 kg CO_2-e kWh^{-1}	-	0.78 kg CO_2-e kWh^{-1}
Scope 3	Diesel fuel for mobile plant and equipment	3.6 kg CO_2-e GJ^{-1}	38.6 $GJ \cdot kL^{-1}$	139.0 $kg \cdot kL^{-1}$
	Diesel fuel for material transport	3.6 kg CO_2-e GJ^{-1}	38.6 $GJ \cdot kL^{-1}$	139.0 $kg \cdot kL^{-1}$
	Liquified petroleum gas	3.6 kg CO_2-e GJ^{-1}	25.3 $GJ \cdot kL^{-1}$	91.1 $kg \cdot kL^{-1}$
	Electricity consumption (NSW)	0.07 kg CO_2-e kWh^{-1}	-	0.07 kg CO_2-e kWh^{-1}
	Unleaded fuel for employee transport	3.6 kg CO_2-e GJ^{-1}	34.2 $GJ \cdot kL^{-1}$	123.1 $kg \cdot kL^{-1}$

Emission factors for the combustion of diesel fuel in mobile plant and equipment, and for material transport differ slightly. Given that a definitive split between fuel combusted for mobile plant and material movements purposes in unknown at this time, a conservative approach has been taken which assumes all emissions are associated with material transport. Given the nature of the development, this is a reasonable assumption for the purposes of this assessment.

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 construction and operation of the Project in isolation.
- Cumulative impact – relates to the incremental concentrations predicted as a result of the construction and operation of the Project PLUS the background air quality concentrations discussed in **Appendix E**.

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.

Project related (R44, R47, R62 and R82) and unoccupiable receptors (R45 and R61) are presented at the bottom of each table of results, and also highlighted in gray text. Project related receptors R5 and R46 would be removed prior to mining operations commencing and results are not presented for these receptors.

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**

6.1 Scenario 1

As outlined in **Section 2.3.7**, Scenario 1 (indicative of activities in FY23, refer **Figure 4**) includes:

- SAR site establishment activities.
- Road construction and realignment activities.
- Ventilation from underground activities via the SARED Ventilation Rise.
- Continued TGO Mine Operations.

Scenario 1 represents site establishment and road realignment activities that would be in closest proximity to sensitive receptor locations to the south and west of the Project Site.

6.1.1 Scenario 1 - Particulate Matter - Annual Average TSP, PM_{10} and $PM_{2.5}$

The predicted annual average particulate matter concentrations (as TSP, PM_{10} and $PM_{2.5}$) resulting from Project operations in Scenario 1 are presented in **Table 20**. Project related (R44, R47, R62 and R82) and unoccupiable receptors (R45 and R61) are presented at the bottom of the table and highlighted in gray text.

The results indicate that predicted incremental concentrations of TSP, PM_{10} and $PM_{2.5}$ at all non-Project related receptor locations are minor, and represent as a maximum:

- 1.7 % of the annual average TSP criterion;
- 3.7 % of the annual average PM_{10} criterion; and
- 1.9 % of the annual average $PM_{2.5}$ criterion.

The addition of existing background concentrations (refer **Appendix E**) results in predicted cumulative concentrations representing, as a maximum:

- 53.7 % of the annual average TSP criterion;
- 83.3 % of the annual average PM_{10} criterion; and
- 78.2 % of the annual average $PM_{2.5}$ criterion.

Table 20 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}			$PM_{2.5}$		
	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact
Criterion	-	90		-	25		-	8	
R01	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R02	<0.1	46.8	46.9	<0.1	19.9	20.0	<0.1	6.1	6.2
R03	0.3	46.8	47.1	0.2	19.9	20.1	<0.1	6.1	6.2
R04	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R06	0.3	46.8	47.1	0.2	19.9	20.1	<0.1	6.1	6.2
R08	<0.1	46.8	46.9	<0.1	19.9	20.0	<0.1	6.1	6.2
R09	0.1	46.8	46.9	<0.1	19.9	20.0	<0.1	6.1	6.2
R10	0.2	46.8	47.0	<0.1	19.9	20.0	<0.1	6.1	6.2
R11	0.2	46.8	47.0	<0.1	19.9	20.0	<0.1	6.1	6.2
R12	<0.1	46.8	46.9	<0.1	19.9	20.0	<0.1	6.1	6.2
R13	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R16	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R17	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R18	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R19	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R21	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R22	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R23	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R24	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R25	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R26	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R27	0.3	46.8	47.1	0.1	19.9	20.0	<0.1	6.1	6.2

Receptor	Annual Average Concentration (µg·m^{-3})								
	TSP			PM_{10}			$PM_{2.5}$		
	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact
Criterion	-	90		-	25		-	8	
R28	0.3	46.8	47.1	0.1	19.9	20.0	<0.1	6.1	6.2
R29	0.3	46.8	47.1	0.2	19.9	20.1	<0.1	6.1	6.2
R32	0.3	46.8	47.1	0.1	19.9	20.0	<0.1	6.1	6.2
R33	0.3	46.8	47.1	0.1	19.9	20.0	<0.1	6.1	6.2
R35	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R37	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R40	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R41	0.3	46.8	47.1	0.1	19.9	20.0	<0.1	6.1	6.2
R42	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R43	1.5	46.8	48.3	0.9	19.9	20.8	0.2	6.1	6.3
R60	0.2	46.8	47.0	<0.1	19.9	20.0	<0.1	6.1	6.2
R63	<0.1	46.8	46.9	<0.1	19.9	20.0	<0.1	6.1	6.2
R64	<0.1	46.8	46.9	<0.1	19.9	20.0	<0.1	6.1	6.2
R65	<0.1	46.8	46.9	<0.1	19.9	20.0	<0.1	6.1	6.2
R66	<0.1	46.8	46.9	<0.1	19.9	20.0	<0.1	6.1	6.2
R67	<0.1	46.8	46.9	<0.1	19.9	20.0	<0.1	6.1	6.2
R68	<0.1	46.8	46.9	<0.1	19.9	20.0	<0.1	6.1	6.2
R69	<0.1	46.8	46.9	<0.1	19.9	20.0	<0.1	6.1	6.2
R70	<0.1	46.8	46.9	<0.1	19.9	20.0	<0.1	6.1	6.2
R71	0.1	46.8	46.9	<0.1	19.9	20.0	<0.1	6.1	6.2
R72	0.1	46.8	46.9	<0.1	19.9	20.0	<0.1	6.1	6.2
R73	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R74	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R75	<0.1	46.8	46.9	<0.1	19.9	20.0	<0.1	6.1	6.2
R78	<0.1	46.8	46.9	<0.1	19.9	20.0	<0.1	6.1	6.2
R79	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R80	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R81	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R44	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R45	0.9	46.8	47.7	0.5	19.9	20.4	<0.1	6.1	6.2
R47	0.5	46.8	47.3	0.2	19.9	20.1	<0.1	6.1	6.2
R61	0.2	46.8	47.0	<0.1	19.9	20.0	<0.1	6.1	6.2
R62	0.2	46.8	47.0	<0.1	19.9	20.0	<0.1	6.1	6.2
R82	0.1	46.8	46.9	<0.1	19.9	20.0	<0.1	6.1	6.2

Contour plots of incremental annual average TSP, PM_{10} and $PM_{2.5}$ are presented in **Appendix F**.

6.1.2 Scenario 1 - Particulate Matter – Annual Average Dust Deposition Rates

Table 21 presents the annual average dust deposition rates predicted as a result of Project operations during Scenario 1.

The results indicate that predicted incremental dust deposition rates at all non-Project related receptor locations are minor, and represent as a maximum:

- 5.0 % of the annual average criterion of 2 $g \cdot m^{-2} \cdot month^{-1}$.

The addition of the adopted background dust deposition rate (refer **Appendix E**) results in predicted cumulative rates representing, as a maximum:

- 52.5 % of the annual average criterion of 4 $g \cdot m^{-2} \cdot month^{-1}$.

No contour plot of annual average dust deposition is presented, given the minor predicted contribution from the Project operations at the nearest sensitive receptors.

Table 21 Predicted annual average dust deposition – Scenario 1

Receptor	Annual Average Dust Deposition ($g \cdot m^{-2} \cdot month^{-1}$)		
	Incremental Impact	Background	Cumulative Impact
Criterion	2.0	-	4.0
R01	<0.1	2.0	2.1
R02	<0.1	2.0	2.1
R03	<0.1	2.0	2.1
R04	<0.1	2.0	2.1
R06	<0.1	2.0	2.1
R08	<0.1	2.0	2.1
R09	<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
R16	<0.1	2.0	2.1
R17	<0.1	2.0	2.1
R18	<0.1	2.0	2.1
R19	<0.1	2.0	2.1
R21	<0.1	2.0	2.1
R22	<0.1	2.0	2.1
R23	<0.1	2.0	2.1
R24	<0.1	2.0	2.1
R25	<0.1	2.0	2.1

Receptor	Annual Average Dust Deposition ($g \cdot m^{-2} \cdot month^{-1}$)		
	Incremental Impact	Background	Cumulative Impact
Criterion	2.0	-	4.0
R26	<0.1	2.0	2.1
R27	<0.1	2.0	2.1
R28	<0.1	2.0	2.1
R29	<0.1	2.0	2.1
R32	<0.1	2.0	2.1
R33	<0.1	2.0	2.1
R35	<0.1	2.0	2.1
R37	<0.1	2.0	2.1
R40	<0.1	2.0	2.1
R41	<0.1	2.0	2.1
R42	<0.1	2.0	2.1
R43	<0.1	2.0	2.1
R60	<0.1	2.0	2.1
R63	<0.1	2.0	2.1
R64	<0.1	2.0	2.1
R65	<0.1	2.0	2.1
R66	<0.1	2.0	2.1
R67	<0.1	2.0	2.1
R68	<0.1	2.0	2.1
R69	<0.1	2.0	2.1
R70	<0.1	2.0	2.1
R71	<0.1	2.0	2.1
R72	<0.1	2.0	2.1
R73	<0.1	2.0	2.1
R74	<0.1	2.0	2.1
R75	<0.1	2.0	2.1
R78	<0.1	2.0	2.1
R79	<0.1	2.0	2.1
R80	<0.1	2.0	2.1
R81	<0.1	2.0	2.1
R44	<0.1	2.0	2.1
R45	<0.1	2.0	2.1
R47	<0.1	2.0	2.1
R61	<0.1	2.0	2.1
R62	<0.1	2.0	2.1
R82	<0.1	2.0	2.1

6.1.3 Scenario 1 - Particulate Matter - Maximum 24-hour Average

Presented in **Table 22** are the maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations predicted to occur at the nearest non-Project related sensitive receptors as a result of activities at the Project during Scenario 1. No background concentrations are included within this table. Maximum concentrations at non-Project related receptors are highlighted in bold.

Table 22 Predicted maximum incremental 24-hour PM_{10} and $PM_{2.5}$ concentrations – Scenario 1

Receptor	Maximum incremental 24-hour average concentration ($\mu g \cdot m^{-3}$)	
	PM_{10}	$PM_{2.5}$
Criterion	50	25
R01	1.4	0.2
R02	0.7	0.1
R03	1.4	0.3
R04	1.6	0.3
R06	1.4	0.2
R08	0.8	0.1
R09	0.8	0.1
R10	1.2	0.2
R11	1.1	0.2
R12	0.8	0.1
R13	1.4	0.2
R16	1.5	0.2
R17	1.5	0.2
R18	1.4	0.2
R19	1.4	0.2
R21	1.4	0.2
R22	1.5	0.2
R23	1.5	0.2
R24	1.5	0.2
R25	1.4	0.2
R26	1.4	0.2
R27	1.4	0.2
R28	1.4	0.2
R29	1.4	0.3
R32	1.5	0.3
R33	1.4	0.3
R35	1.4	0.2
R37	1.3	0.2
R40	1.4	0.2
R41	1.5	0.2
R42	1.4	0.2

Receptor	Maximum incremental 24-hour average concentration ($\mu g \cdot m^{-3}$)	
	PM_{10}	$PM_{2.5}$
Criterion	50	25
R43	**7.4**	**1.2**
R60	1.2	0.2
R63	0.8	0.1
R64	0.9	0.2
R65	0.5	<0.1
R66	0.7	0.1
R67	0.5	<0.1
R68	0.5	0.1
R69	0.7	0.2
R70	0.5	<0.1
R71	1.1	0.3
R72	1.0	0.2
R73	1.4	0.2
R74	1.3	0.2
R75	0.8	0.1
R78	0.9	0.2
R79	1.5	0.2
R80	1.5	0.2
R81	1.5	0.2
R44	3.0	0.7
R45	4.0	0.7
R47	2.3	0.5
R61	1.1	0.2
R62	1.1	0.2
R82	1.2	0.2

The predicted incremental concentration of PM_{10} and $PM_{2.5}$ are demonstrated to be generally minor, with the maximum concentrations predicted at Receptor 43, to the southwest of the Project Site, and in closest proximity to the Newell Highway realignment activities.

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

Results are presented for the receptor at which the highest incremental PM_{10} and $PM_{2.5}$ impacts have been predicted, and also for the receptors at which the highest cumulative impacts (increment plus background) have been predicted. These may often 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 background concentrations, and the right side shows the total predicted concentration on days with the highest predicted incremental concentrations. The results are presented in this way to be consistent with the requirements of section 11.2 of the Approved Methods (NSW EPA, 2016).

The maximum cumulative impacts (shown on the left side of the table) are generally driven by the highest background concentrations, and similar results are experienced at all receptors. The results are presented for the receptor at which the highest total cumulative impacts were predicted.

Model predictions presented in **Table 23** indicate that the Project activities occurring as part of Scenario 1 are not likely to result in any additional exceedances of the 24-hour PM_{10} criterion at any surrounding non-Project related receptor. The five existing exceedances of the criterion are presented, and no further exceedances are anticipated. The control measures implemented during Scenario 1 activities are shown to be appropriate to manage impacts of PM_{10} at all non-Project related receptors.

Table 23 Summary of contemporaneous impact and background – PM_{10} - Scenario 1

Date	24-hour average PM_{10} concentration ($\mu g{\cdot}m^{-3}$) Receptor R4			Date	24-hour average PM_{10} concentration ($\mu g{\cdot}m^{-3}$) Receptor R43		
	Incremental Impact	Background	Cumulative Impact		Incremental Impact	Background	Cumulative Impact
Criterion	50			Criterion	50		
3/09/2017	0.2	76.2	76.4	23/04/2017	7.4	16.7	24.1
12/02/2017	0.2	73.5	73.7	1/07/2017	6.8	14.3	21.2
23/09/2017	<0.1	72.8	72.9	27/06/2017	6.4	18.9	25.4
24/09/2017	0.2	57.4	57.6	22/06/2017	5.4	14.1	19.6
21/02/2017	<0.1	53.2	53.3	22/04/2017	4.6	21.6	26.2
24/02/2017	0.1	49.6	49.8	13/08/2017	4.1	12.8	16.9
17/02/2017	0.2	49.2	49.4	16/07/2017	4.1	14.8	18.9
10/04/2017	0.5	48.5	49.0	22/05/2017	4.0	12.5	16.5
9/04/2017	0.2	47.0	47.2	17/05/2017	4.0	36.6	40.6
6/10/2017	<0.1	46.5	46.6	4/10/2017	3.7	26.6	30.3
These data represent the highest Cumulative Impact 24-hour PM_{10} predictions (outlined in red) as a result of the operation of the project.				These data represent the highest Incremental Impact 24-hour PM_{10} predictions (outlined in blue) as a result of the operation of the project.			

Model predictions presented in **Table 24** indicate that the Project activities occurring as part of Scenario 1 are not likely to result in any exceedances of the 24-hour $PM_{2.5}$ criterion at any surrounding non-Project related receptor. The control measures implemented during Scenario 1 activities are shown to be appropriate to manage impacts of $PM_{2.5}$ at all non-Project related receptors.

Contour plots of the incremental contribution of the proposed Scenario 1 operations of the Project to the 24-hour average PM_{10} and $PM_{2.5}$ concentrations are presented in **Appendix F**.

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

Date	24-hour average $PM_{2.5}$ concentration ($\mu g{\cdot}m^{-3}$) Receptor R43			Date	24-hour average $PM_{2.5}$ concentration ($\mu g{\cdot}m^{-3}$) Receptor R43		
	Incremental Impact	Background	Cumulative Impact		Incremental Impact	Background	Cumulative Impact
Criterion	25			Criterion	25		
16/06/2017	0.4	17.5	17.9	23/04/2017	1.2	8.4	9.6
17/06/2017	<0.1	16.0	16.1	1/07/2017	1.2	9.9	11.1
17/05/2017	0.6	15.3	15.9	27/06/2017	1.1	9.3	10.4
3/07/2017	<0.1	12.8	12.9	22/06/2017	0.9	9.0	9.9
2/07/2017	0.3	12.3	12.6	22/04/2017	0.7	4.3	5.0
28/06/2017	0.6	12.0	12.6	16/07/2017	0.7	8.0	8.7
5/06/2017	<0.1	12.3	12.4	13/08/2017	0.7	8.5	9.2
15/01/2017	<0.1	12.0	12.1	22/05/2017	0.7	9.3	10.0
18/06/2017	<0.1	12.0	12.1	17/05/2017	0.6	15.3	15.9
24/06/2017	<0.1	11.6	11.7	4/10/2017	0.6	9.2	9.8
These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) as a result of the operation of the Proposal.				These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) as a result of the operation of the Proposal.			

6.1.4 Scenario 1 - Nitrogen Dioxide

Impacts associated with blast fume (NO_2) have been considered in Scenario 3. No blasting is proposed in Scenario 1.

6.1.5 Scenario 1 - 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 not exceeded at any surrounding privately-owned residence.

The previous sections also confirm that the Voluntary Acquisition criteria are not exceeded at any surrounding sensitive receptor location, however the 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 any parts of private landholdings in Scenario 1.

6.1.6 Scenario 1 – Trigger Action Response Plan

The predicted air quality impacts associated with operations under Scenario 1 are not predicted to result in any additional exceedances of the relevant air quality criteria, and therefore no additional requirements for air quality management are anticipated to be required. The currently operational TARP is described in **Section 5.1.3** and this will remain the primary mechanism for day-to-day air quality management.

6.2 Scenario 2

As outlined in **Section 2.3.7**, Scenario 2 (indicative of activities in FY24, refer **Figure 5**) includes:

- Waste movement from Central and South Pits.
- Waste transported either to the SAR or Caloma Waste Rock Emplacements.
- Ore extraction activities in South Pit.
- Construction of RSF2 Stage 2.
- Exhaust ventilation from underground activities via the ROS Ventilation Rise, while the SARED Ventilation Rise would act a fresh air intake.
- Continued TGO Mine Operations.

Scenario 2 represents the movement of over 30 Mt of waste rock, with 50 % being transported approximately 4 km from the SAR Open Cut, northwards to the Caloma Waste Rock Emplacement, with the remaining 50 % being transported to the SAR Waste Rock Emplacement. Scenario 2 also considers the extraction of 500 000 t of ore from the SAR Open Cut.

6.2.1 Scenario 2 - Particulate Matter - Annual Average TSP, PM_{10} and $PM_{2.5}$

The predicted annual average particulate matter concentrations (as TSP, PM_{10} and $PM_{2.5}$) resulting from Project operations in Scenario 2 are presented in **Table 25**. Project related (R44, R47, R62 and R82) and unoccupiable receptors (R45 and R61) are presented at the bottom of the table and highlighted in gray text. Receptors R5 and R46 would be removed from site or demolished prior to mining operations commencing, and results are not presented for these receptors.

The results indicate that predicted <u>incremental</u> concentrations of TSP, PM_{10} and $PM_{2.5}$ at all non-Project related receptor locations are minor, and represent as a maximum:

- 7.8 % of the annual average TSP criterion;
- 16.3% of the annual average PM_{10} criterion; and
- 8.8 % of the annual average $PM_{2.5}$ criterion.

The addition of existing background concentrations (refer **Appendix E**) results in predicted cumulative concentrations representing, as a maximum:

- 59.8 % of the annual average TSP criterion;
- 95.9 % of the annual average PM_{10} criterion; and
- 85.1 % of the annual average $PM_{2.5}$ criterion.

The predicted annual average particulate concentrations presented in **Table 25** include the effects of the emissions control measures as outlined in **Section 5.1.3**, but do not include the effect of the Trigger Action Response Plan (TARP) which would continue to be operated as part of Project activities. That TARP would be modified, as described in detail in **Section 6.2.6**.

Table 25 Predicted annual average TSP, PM_{10} and $PM_{2.5}$ concentrations – Scenario 2

Receptor	Annual Average Concentration (µg·m^{-3})								
	TSP			PM_{10}			$PM_{2.5}$		
	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact
Criterion	-	90		-	25		-	8	
R01	3.3	46.8	50.1	2.1	19.9	22.0	0.4	6.1	6.5
R02	1.5	46.8	48.3	1.1	19.9	21.0	0.2	6.1	6.3
R03	5.3	46.8	52.1	3.2	19.9	23.1	0.6	6.1	6.7
R04	1.8	46.8	48.6	1.1	19.9	21.0	0.2	6.1	6.3
R06	5.6	46.8	52.4	3.2	19.9	23.1	0.6	6.1	6.7
R08	1.1	46.8	47.9	0.8	19.9	20.7	0.1	6.1	6.2
R09	1.6	46.8	48.4	1.1	19.9	21.0	0.2	6.1	6.3
R10	2.6	46.8	49.4	1.6	19.9	21.5	0.3	6.1	6.4
R11	2.4	46.8	49.2	1.6	19.9	21.5	0.3	6.1	6.4
R12	1.1	46.8	47.9	0.7	19.9	20.6	0.1	6.1	6.2
R13	3.1	46.8	49.9	2.0	19.9	21.9	0.4	6.1	6.5
R16	3.8	46.8	50.6	2.4	19.9	22.3	0.4	6.1	6.5
R17	3.8	46.8	50.6	2.4	19.9	22.3	0.4	6.1	6.5
R18	3.8	46.8	50.6	2.4	19.9	22.3	0.4	6.1	6.5
R19	3.9	46.8	50.7	2.4	19.9	22.3	0.5	6.1	6.6
R21	4.1	46.8	50.9	2.5	19.9	22.4	0.5	6.1	6.6
R22	4.3	46.8	51.1	2.6	19.9	22.5	0.5	6.1	6.6
R23	4.4	46.8	51.2	2.7	19.9	22.6	0.5	6.1	6.6
R24	4.4	46.8	51.2	2.7	19.9	22.6	0.5	6.1	6.6
R25	4.3	46.8	51.1	2.6	19.9	22.5	0.5	6.1	6.6
R26	4.3	46.8	51.1	2.7	19.9	22.6	0.5	6.1	6.6
R27	4.6	46.8	51.4	2.8	19.9	22.7	0.5	6.1	6.6
R28	5.0	46.8	51.8	3.0	19.9	22.9	0.6	6.1	6.7

Receptor	Annual Average Concentration ($\mu g \cdot m^{-3}$)								
	TSP			PM_{10}			$PM_{2.5}$		
	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact
Criterion	-	90		-	25		-	8	
R29	5.3	46.8	52.1	3.2	19.9	23.1	0.6	6.1	6.7
R32	4.9	46.8	51.7	3.0	19.9	22.9	0.6	6.1	6.7
R33	4.8	46.8	51.6	2.9	19.9	22.8	0.5	6.1	6.6
R35	4.0	46.8	50.8	2.5	19.9	22.4	0.5	6.1	6.6
R37	3.8	46.8	50.6	2.4	19.9	22.3	0.4	6.1	6.5
R40	4.1	46.8	50.9	2.5	19.9	22.4	0.5	6.1	6.6
R41	4.6	46.8	51.4	2.8	19.9	22.7	0.5	6.1	6.6
R42	3.7	46.8	50.5	2.3	19.9	22.2	0.4	6.1	6.5
R43	7.0	46.8	53.8	4.1	19.9	24.0	0.7	6.1	6.8
R60	1.0	46.8	47.8	0.6	19.9	20.5	0.1	6.1	6.2
R63	0.3	46.8	47.1	0.2	19.9	20.1	<0.1	6.1	6.2
R64	0.4	46.8	47.2	0.3	19.9	20.2	<0.1	6.1	6.2
R65	0.2	46.8	47.0	0.2	19.9	20.1	<0.1	6.1	6.2
R66	0.2	46.8	47.0	0.2	19.9	20.1	<0.1	6.1	6.2
R67	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R68	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R69	0.2	46.8	47.0	0.2	19.9	20.1	<0.1	6.1	6.2
R70	0.3	46.8	47.1	0.2	19.9	20.1	<0.1	6.1	6.2
R71	0.6	46.8	47.4	0.4	19.9	20.3	<0.1	6.1	6.2
R72	0.8	46.8	47.6	0.6	19.9	20.5	0.1	6.1	6.2
R73	4.0	46.8	50.8	2.5	19.9	22.4	0.5	6.1	6.6
R74	2.8	46.8	49.6	1.7	19.9	21.6	0.3	6.1	6.4
R75	0.7	46.8	47.5	0.5	19.9	20.4	<0.1	6.1	6.2
R78	0.5	46.8	47.3	0.4	19.9	20.3	<0.1	6.1	6.2
R79	4.1	46.8	50.9	2.5	19.9	22.4	0.5	6.1	6.6
R80	4.1	46.8	50.9	2.5	19.9	22.4	0.5	6.1	6.6
R81	3.6	46.8	50.4	2.3	19.9	22.2	0.4	6.1	6.5
R44	0.9	46.8	47.7	0.6	19.9	20.5	0.1	6.1	6.2
R45	9.2	46.8	56.0	5.1	19.9	25.0	0.9	6.1	7.0
R47	1.9	46.8	48.7	1.3	19.9	21.2	0.2	6.1	6.3
R61	0.9	46.8	47.7	0.6	19.9	20.5	0.1	6.1	6.2
R62	0.9	46.8	47.7	0.6	19.9	20.5	0.1	6.1	6.2
R82	0.8	46.8	47.6	0.5	19.9	20.4	<0.1	6.1	6.2

Contour plots of incremental annual average TSP, PM_{10} and $PM_{2.5}$ are presented in **Appendix F**.

6.2.2 Scenario 2 - Particulate Matter – Annual Average Dust Deposition Rates

Table 26 presents the annual average dust deposition rates predicted as a result of Project operations during Scenario 2.

The results indicate that predicted incremental dust deposition rates at all non-Project related receptor locations are minor, and represent as a maximum:

- 10 % of the annual average criterion of 2 $g{\cdot}m^{-2}{\cdot}month^{-1}$.

The addition of the adopted background dust deposition rate (refer **Appendix E**) results in predicted cumulative rates representing, as a maximum:

- 55 % of the annual average criterion of 4 $g{\cdot}m^{-2}{\cdot}month^{-1}$.

No contour plot of annual average dust deposition is presented, given the minor predicted contribution from the Project operations at the nearest sensitive receptors.

Table 26 Predicted annual average dust deposition – Scenario 2

Receptor	Annual Average Dust Deposition ($g{\cdot}m^{-2}{\cdot}month^{-1}$)		
	Incremental Impact	Background	Cumulative Impact
Criterion	2.0	-	4.0
R01	<0.1	2.0	2.1
R02	<0.1	2.0	2.1
R03	<0.1	2.0	2.1
R04	<0.1	2.0	2.1
R06	0.1	2.0	2.1
R08	<0.1	2.0	2.1
R09	<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
R16	<0.1	2.0	2.1
R17	<0.1	2.0	2.1
R18	<0.1	2.0	2.1
R19	<0.1	2.0	2.1
R21	<0.1	2.0	2.1
R22	<0.1	2.0	2.1
R23	<0.1	2.0	2.1
R24	<0.1	2.0	2.1
R25	<0.1	2.0	2.1

Receptor	Annual Average Dust Deposition ($g \cdot m^{-2} \cdot month^{-1}$)		
	Incremental Impact	Background	Cumulative Impact
Criterion	2.0	-	4.0
R26	<0.1	2.0	2.1
R27	<0.1	2.0	2.1
R28	<0.1	2.0	2.1
R29	<0.1	2.0	2.1
R32	<0.1	2.0	2.1
R33	<0.1	2.0	2.1
R35	<0.1	2.0	2.1
R37	<0.1	2.0	2.1
R40	<0.1	2.0	2.1
R41	<0.1	2.0	2.1
R42	<0.1	2.0	2.1
R43	0.2	2.0	2.2
R60	<0.1	2.0	2.1
R63	<0.1	2.0	2.1
R64	<0.1	2.0	2.1
R65	<0.1	2.0	2.1
R66	<0.1	2.0	2.1
R67	<0.1	2.0	2.1
R68	<0.1	2.0	2.1
R69	<0.1	2.0	2.1
R70	<0.1	2.0	2.1
R71	<0.1	2.0	2.1
R72	<0.1	2.0	2.1
R73	<0.1	2.0	2.1
R74	<0.1	2.0	2.1
R75	<0.1	2.0	2.1
R78	<0.1	2.0	2.1
R79	<0.1	2.0	2.1
R80	<0.1	2.0	2.1
R81	<0.1	2.0	2.1
R44	<0.1	2.0	2.1
R45	0.3	2.0	2.3
R47	<0.1	2.0	2.1
R61	<0.1	2.0	2.1
R62	<0.1	2.0	2.1
R82	<0.1	2.0	2.1

6.2.3 Scenario 2 - Particulate Matter - Maximum 24-hour Average

Presented in **Table 27** are the maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations predicted to occur at the nearest non-Project related sensitive receptors as a result of activities at the Project during Scenario 2. No background concentrations are included within this table. Maximum concentrations at non-Project related receptors are highlighted in bold.

Table 27 Predicted maximum incremental 24-hour PM_{10} and $PM_{2.5}$ concentrations – Scenario 2

Receptor	Maximum incremental 24-hour average concentration ($\mu g \cdot m^{-3}$)	
	PM_{10}	$PM_{2.5}$
Criterion	50	25
R01	22.9	4.9
R02	11.7	2.1
R03	27.8	6.5
R04	14.7	2.8
R06	26.1	5.2
R08	13.5	2.5
R09	12.2	2.4
R10	19.6	3.1
R11	21.6	3.9
R12	12.6	2.3
R13	22.9	4.4
R16	24.2	5.0
R17	26.0	5.3
R18	21.7	4.3
R19	22.3	4.5
R21	22.8	4.7
R22	26.9	5.8
R23	28.1	**6.6**
R24	27.5	5.9
R25	23.6	5.0
R26	24.0	5.1
R27	25.0	5.5
R28	26.5	6.0
R29	27.6	6.4
R32	24.3	6.0
R33	25.8	5.5
R35	21.5	4.3
R37	20.1	4.5
R40	23.1	4.8
R41	28.4	6.1
R42	21.5	4.3

Receptor	Maximum incremental 24-hour average concentration ($\mu g \cdot m^{-3}$)	
	PM_{10}	$PM_{2.5}$
Criterion	50	25
R43	29.1	5.2
R60	16.2	3.1
R63	6.4	1.2
R64	9.1	1.7
R65	3.6	0.7
R66	4.8	1.0
R67	3.3	0.7
R68	4.5	0.9
R69	5.1	1.0
R70	7.1	1.5
R71	8.0	1.4
R72	7.3	1.2
R73	22.6	4.6
R74	**29.9**	5.5
R75	9.8	1.9
R78	9.1	1.7
R79	26.3	5.6
R80	27.2	6.0
R81	22.7	4.6
R44	11.1	2.6
R45	38.5	7.7
R47	24.7	4.5
R61	14.2	3.1
R62	12.0	2.4
R82	10.7	2.0

The predicted incremental concentration of PM_{10} and $PM_{2.5}$ are predicted to be at their maxima at Receptor 74 (PM_{10}) to the northeast of the Project, and Receptor 23 ($PM_{2.5}$) to the west of Tomingley Village.

The following tables present the predicted maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations resulting from the operation of the Project during Scenario 2, with background included.

Results are presented for the receptor at which the highest incremental PM_{10} and $PM_{2.5}$ impacts have been predicted, and also for the receptors at which the highest cumulative impacts (increment plus background) have been predicted. These may often 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 background concentrations, and the right side shows the total predicted concentration on days with the highest predicted incremental concentrations. The results are presented in this way to be consistent with the requirements of section 11.2 of the Approved Methods (NSW EPA, 2016).

The maximum cumulative impacts (shown on the left side of the table) are generally driven by the highest background concentrations, and similar results are experienced at all receptors. The results are presented for the receptor at which the highest total cumulative impacts were predicted.

Model predictions presented in **Table 28** indicate that the Project activities occurring as part of Scenario 2 are predicted to result in additional exceedances of the 24-hour PM_{10} criterion at surrounding non-Project related receptors. The five existing exceedances of the criterion are presented, although additional exceedances of the criterion are predicted at a number of receptor locations, also presented in **Figure 11** and **Figure 12**.

The predicted maximum 24-hour PM_{10} concentrations presented in **Table 28**, and the additional predicted exceedances in **Figure 11** and **Figure 12** include the effects of the emissions control measures as outlined in **Section 5.1.3**, but do not include the effect of the Trigger Action Response Plan (TARP) which would continue to be operated as part of Project activities. That TARP would be modified, as described in detail in **Section 6.2.6**.

Table 28 Summary of contemporaneous impact and background – PM_{10} - Scenario 2

Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$) Receptor R4			Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$) Receptor R74		
	Incremental Impact	Background	Cumulative Impact		Incremental Impact	Background	Cumulative Impact
Criterion	50			Criterion	50		
3/09/2017	5.9	76.2	82.0	6/06/2017	29.9	23.6	53.6
12/02/2017	0.6	73.5	74.1	29/06/2017	24.8	20.3	45.1
23/09/2017	<0.1	72.8	72.9	1/11/2017	22.5	34.1	56.6
24/09/2017	12.1	57.4	69.5	31/10/2017	21.4	19.9	41.3
10/04/2017	9.2	48.5	57.7	27/08/2017	19.8	29.9	49.7
21/02/2017	<0.1	53.2	53.3	7/06/2017	18.8	14.5	33.3
8/09/2017	10.9	40.8	51.7	20/02/2017	16.4	33.3	49.8
9/04/2017	3.4	47.0	50.4	19/02/2017	14.5	26.2	40.7
24/02/2017	0.5	49.6	50.1	11/04/2017	14.4	21.2	35.6
17/02/2017	0.7	49.2	49.9	30/06/2017	13.4	21.7	35.1
These data represent the highest Cumulative Impact 24-hour PM_{10} predictions (outlined in red) as a result of the operation of the project.				These data represent the highest Incremental Impact 24-hour PM_{10} predictions (outlined in blue) as a result of the operation of the project.			

Figure 11 Locations and dates on which additional exceedances of the 24-hr PM_{10} criterion are predicted – Scenario 2 (1 of 2)

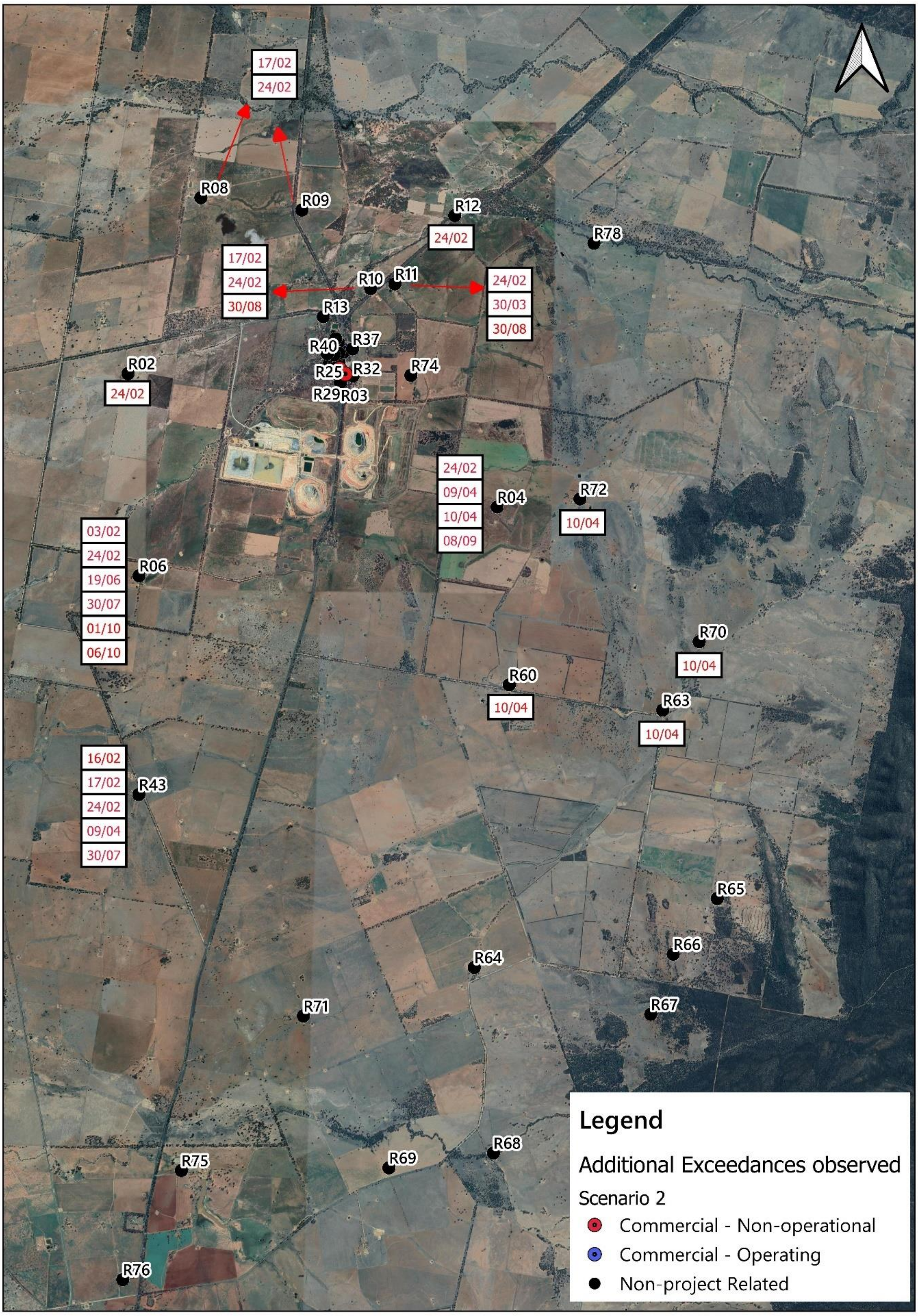


Figure 12 Locations and dates on which additional exceedances of the 24-hr PM_{10} criterion are predicted – Scenario 2 (2 of 2)

Model predictions presented in **Table 29** indicate that the Project activities occurring as part of Scenario 2 are not likely to result in any exceedances of the 24-hour $PM_{2.5}$ criterion at any surrounding non-Project related receptor. The control measures implemented during Scenario 2 activities are shown to be appropriate to manage impacts of $PM_{2.5}$ at all non-Project related receptors.

Contour plots of the incremental contribution of the proposed Scenario 2 operations of the Project to the 24-hour average PM_{10} and $PM_{2.5}$ concentrations are presented in **Appendix F**.

Table 29 Summary of contemporaneous impact and background – $PM_{2.5}$ – Scenario 2

Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) Receptor R6			Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) Receptor R23		
	Incremental Impact	Background	Cumulative Impact		Incremental Impact	Background	Cumulative Impact
Criterion	25			Criterion	25		
16/06/2017	3.2	17.5	20.7	2/06/2017	6.6	8.5	15.1
17/06/2017	0.6	16.0	16.6	28/04/2017	5.4	5.5	10.9
17/05/2017	0.3	15.3	15.6	1/06/2017	4.9	10.4	15.3
15/07/2017	5.2	9.6	14.8	25/05/2017	4.8	6.9	11.7
18/06/2017	2.7	12.0	14.7	5/12/2017	3.9	3.3	7.2
28/06/2017	2.6	12.0	14.6	21/07/2017	3.7	5.4	9.1
19/06/2017	4.1	9.7	13.8	8/06/2017	3.2	5.1	8.3
5/06/2017	0.6	12.3	12.9	29/04/2017	3.2	5.4	8.6
3/07/2017	0.1	12.8	12.9	24/08/2017	3.2	7.1	10.3
2/07/2017	0.4	12.3	12.7	28/08/2017	2.9	3.7	6.6
These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) as a result of the operation of the Proposal.				These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) as a result of the operation of the Proposal.			

6.2.4 Scenario 2 - Nitrogen Dioxide

Impacts associated with blast fume (NO_2) have been considered in Scenario 3.

6.2.5 Scenario 2 - 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 not exceeded at any surrounding privately-owned residence.

The previous sections also confirm that the Voluntary Acquisition criteria are not exceeded at any surrounding sensitive receptor location, however the 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 in Scenario 2.

6.2.6 Scenario 2 – Trigger Action Response Plan

As described in the preceding sections, the operation of the Project is anticipated to result in a number of additional exceedances of the 24-hour PM_{10} criterion in Scenario 2 across a total of 18 days, even with the adoption of emissions control measures as outlined in **Section 5.1.3**. Those emissions controls are applied in the modelling assessment on a regular basis across the entire modelling period and represent a commitment by the Applicant that those measures would continually be in place. However, on rare occasions, the implementation of those measures is shown not to be sufficient to ensure that the environmental objectives are achieved, and additional measures are required to be implemented.

It is important to note that there are a range of management and mitigation measures outlined in **Section 5.1.3** which cannot be justifiably included in the modelling assessment, either because the emission reduction efficiency afforded by their implementation is not well documented and therefore may be open to scrutiny, or they are applied on an 'as needs' basis rather than continually. Furthermore, the cumulative impacts predicted are likely to include a level of 'double-counting' associated with waste movements included in the 2017 background air quality dataset. The dispersion model predictions can be viewed as a conservative approximation of the anticipated impacts associated with the Project.

Importantly, the Applicant is not relying on unquantifiable emissions reductions to demonstrate achievement of the environmental objectives, and is committed to extending the coverage of the already operational proactive TARP as part of the ongoing Project operation to manage any risks associated with non-compliance with air quality criteria.

The currently operational TARP is described in **Section 5.1.3**. A real-time particulate monitor is located to the north of the Mine (to the south of Tomingley Village), and particulate monitoring data is continually recorded and is available to the Applicant's employees via an online Portal. If the concentrations of particulate matter are approaching criteria levels, then that 'trigger' sets off a range of management 'actions' as a response. The aim of those actions is to reduce emissions of particulate matter, and subsequently off-site concentrations, such that the exceedance that might have occurred, would be avoided.

The Applicant proposes to maintain the real-time monitoring equipment near Tomingley Village, and additionally install real-time particulate monitoring equipment (i) at or near Receptor 43, and (ii) one located at or near Receptor 4. The Applicant would then operate three real-time particulate monitoring which would cover the areas of likely increased impact, as presented within this AQIA.

To allow the determination of what operations might need to be managed to ensure compliance with the air quality criteria, dispersion model predictions associated with additional exceedances of the 24-hour PM_{10} criterion have been examined in detail.

For each day of additional exceedance, a receptor location considered to be representative of the impacted area has been selected (if multiple exceedances have been predicted), and the dispersion model re-run to provide information on the particular emission sources that make up the incremental PM_{10} concentration on that day. Where one receptor location is not considered to appropriately represent the number or range of affected locations, additional locations have been selected for analysis. The receptors selected are those at which the highest incremental concentrations are predicted on the day of interest and therefore, should additional measures be shown to be sufficient to remove that exceedance occurring at one receptor, it would be likely to remove the exceedance from all other receptors.

Through review of the source contribution analysis, the following cascade of management measures has been identified as generally providing sufficient reductions in incremental PM_{10} concentrations to remove the predicted additional exceedances:

1. Cease the transport of waste to, and unloading at the Caloma WRE
2. Cease the transport of ore to the ROM Pad
3. Modify or cease SAR in pit activities, including the transport and unloading of waste to the SAR WRE

The order of the measures has been determined through their relative contribution to the total increment (e.g. impacts associated with transport of waste to Caloma WRE, and unloading of that waste, were generally shown to result in the largest incremental contribution, and therefore provides the biggest opportunity for reduction in particulate emissions).

The effect of implementing that cascade of measures is presented in **Table 31**. A descriptive 'key' to facilitate the interpretation of the information presented in **Table 31** and **Table 38** for Scenario 2 and Scenario 3 respectively is provided in **Table 30**.

Table 30 Interpretive key to Table 31 and Table 38

Receptor		RX	The receptor number
Date	-	01/01/2017	The date of the additional exceedance
Background PM_{10}	µg·m^{-3}	48.6	The background PM_{10} concentration
Cumulative PM_{10}		55.0	The total (cumulative) PM_{10} concentration
Incremental PM_{10}		6.4	The incremental (Project) PM_{10} concentration
Is background >95% of the criterion?		YES	Is the background already approaching the criterion?
Transport of waste to Caloma	% of incr.	58%	The % contribution of the activity to the total incremental (Project) concentration If the box is orange, modification of that activity will not ensure compliance
Transport of ore to ROM pad		4%	If the box is green, modification of that activity (plus all others above) will ensure compliance
SAR in pit activities and transport of waste to SAR WRE		7%	If the box is yellow, modification of that activity is not required to ensure compliance, but may be implemented nonetheless

Notes:

'Transport of waste to Caloma' - Movement of waste to Caloma WRE, unloading and shaping of that waste at the WRE

'Transport of ore to ROM pad' - Movement of ore to ROM pad.

'SAR in pit activities' – A combination of all activities occurring in the SAR extraction area (drilling, blasting, loading haul trucks etc).

'Transport of waste to SAR WRE - Movement of waste to SAR WRE, unloading and shaping of that waste at the WRE

'Incr' – increment

The groupings of activities are not intended to suggest a binary approach to particulate emissions management (i.e. all on / all off), but are provided to allow stakeholders to appreciate that Project activities can be modified to result in achievement of the air quality criteria.

Table 31 Analysis of additional 24-hour PM_{10} exceedances and management options – Scenario 2

Receptor		R06	R43	R23	R03	R32	R74
Date	-	03/02/2017	16/02/2017	17/02/2017	17/02/2017	24/02/2017	28/03/2017
Background PM_{10}	$\mu g \cdot m^{-3}$	40.6	37.0	49.2	49.2	49.6	41.3
Cumulative PM_{10}		50.8	51.5	56.8	56.5	54.6	50.3
Incremental PM_{10}		10.2	14.5	7.6	7.3	5.0	9.0
Is background >95% of the criterion?		NO	NO	YES	YES	YES	NO
Transport of waste to Caloma	% of incr.	29%	13%	72%	70%	63%	55%
Transport of ore to ROM pad		2%	0%	3%	2%	4%	4%
SAR in pit activities and transport of waste to SAR WRE		41%	49%	3%	3%	12%	16%
Receptor		**R03**	**R74**	**R43**	**R04**	**R60**	**R04**
Date	-	30/03/2017	30/03/2017	09/04/2017	09/04/2017	10/04/2017	10/04/2017
Background PM_{10}	$\mu g \cdot m^{-3}$	45.6	45.6	47.0	47.0	48.5	48.5
Cumulative PM_{10}		50.2	51.1	50.2	50.4	53.0	57.7
Incremental PM_{10}		4.6	5.5	3.2	3.4	4.5	9.2
Is the background >95% of the criterion?		NO	NO	NO	NO	YES	YES
Transport of waste to Caloma WRE	% of incr.	23%	59%	33%	37%	33%	64%
Transport of ore to ROM pad		6%	3%	2%	2%	2%	3%
SAR in pit activities and transport of waste to SAR WRE		33%	15%	41%	38%	36%	14%

Table 31 - continued

Receptor		R74	R06	R43	R06	R32	R32
Date	-	06/06/2017	19/06/2017	30/07/2017	30/07/2017	24/08/2017	30/08/2017
Background PM_{10}	$\mu g \cdot m^{-3}$	23.6	26.4	43.5	43.5	27.2	37.8
Cumulative PM_{10}		53.6	50.6	56.9	51.7	51.4	56.3
Incremental PM_{10}		30.0	24.2	13.4	8.2	24.3	18.5
Is background >95% of the criterion?		NO	NO	NO	NO	NO	NO
Transport of waste to Caloma	% of incr.	58%	26%	16%	39%	39%	51%
Transport of ore to ROM pad		4%	1%	1%	3%	5%	5%
SAR in pit activities and transport of waste to SAR WRE		16%	44%	47%	24%	32%	23%
Receptor		**R04**	**R06**	**R74**	**R74**	**R03**	
Date	-	08/09/2017	01/10/2017	06/10/2017	01/11/2017	20/12/2017	
Background PM_{10}	$\mu g \cdot m^{-3}$	40.8	29.6	46.5	34.1	46.2	
Cumulative PM_{10}		51.7	52.2	54.9	56.6	52.2	
Incremental PM_{10}		10.9	22.6	8.4	22.5	6.0	
Is the background >95% of the criterion?		NO	NO	NO	NO	NO	
Transport of waste to Caloma WRE	% of incr.	39%	12%	62%	62%	69%	
Transport of ore to ROM pad		2%	1%	2%	3%	8%	
SAR in pit activities and transport of waste to SAR WRE		35%	58%	17%	16%	5%	

The analysis indicates that on all but three days (17 February, 24 February and 10 April), a range of measures can be implemented to ensure that the additional exceedances of the 24-hour PM_{10} criterion would not eventuate. On the majority of those days, further measures were also available but not required to be implemented, to ensure the criterion was achieved.

On the three days on which it is shown that the implementation of all cascading measures would still not be sufficient to ensure the 24-hour PM_{10} criterion would be achieved, it is shown that the background PM_{10} concentration is > 95 % of the criterion, even without the addition of the Project contribution. Implementation of all air quality management measures, and including the cascading measures outlined above would represent best practice emissions control and would minimise emissions from the Project as far as practicable.

The procedure implemented through the AQMP to pro-actively identify the potential for days of elevated background air pollution is discussed in **Section 5.1.3**.

6.3 Scenario 3

As outlined in **Section 2.3.7**, Scenario 3 (indicative of activities in FY25, refer **Figure 6**) includes:

- Waste movement from Central, South and North Pits.
- Waste transported either to the SAR or Caloma Waste Rock Emplacements.
- Ore extraction activities in Central and South Pits.
- Construction of RSF2 Stage 3.
- Exhaust ventilation from underground activities via the ROS Ventilation Rise, while the SARED Ventilation Rise would act a fresh air intake.
- Continued TGO Mine Operations

Scenario 3 represents the movement of over 32 Mt of waste rock, with 50 % being transported approximately 4 km from the SAR Open Cut, northwards to the Caloma Waste Rock Emplacement, with the remaining 50 % being transported to the SAR Waste Rock Emplacement. Scenario 3 also considers the extraction of 2.3 Mt of ore from the SAR Open Cut. This represents the year of maximum waste rock and ore mining.

6.3.1 Scenario 3 - Particulate Matter - Annual Average TSP, PM_{10} and $PM_{2.5}$

The predicted annual average particulate matter concentrations (as TSP, PM_{10} and $PM_{2.5}$) resulting from Project operations in Scenario 3 are presented in **Table 32**. Project related (R44, R47, R62 and R82) and unoccupiable receptors (R45 and R61) are presented at the bottom of the table and highlighted in gray text. Receptors R5 and R46 would be removed from site or demolished prior to mining operations commencing, and results are not presented for these receptors.

The results indicate that predicted <u>incremental</u> concentrations of TSP, PM_{10} and $PM_{2.5}$ at all non-Project related receptor locations are minor, and represent as a maximum:

- 8.1 % of the annual average TSP criterion;
- 16.2 % of the annual average PM_{10} criterion; and
- 11.3 % of the annual average $PM_{2.5}$ criterion.

The addition of existing background concentrations (refer **Appendix E**) results in predicted <u>cumulative</u> concentrations representing, as a maximum:

- 60.1 % of the annual average TSP criterion;
- 95.8 % of the annual average PM_{10} criterion; and
- 87.5 % of the annual average $PM_{2.5}$ criterion.

The predicted annual average particulate concentrations presented in **Table 25** include the effects of the emissions control measures as outlined in **Section 5.1.3**, but do not include the effect of the Trigger Action Response Plan (TARP) which would continue to be operated as part of Project activities. That TARP would be modified, as described in detail in **Section 6.2.6**.

Table 32 Predicted annual average TSP, PM_{10} and $PM_{2.5}$ concentrations – Scenario 3

Receptor	Annual Average Concentration (µg·m^{-3})								
	TSP			PM_{10}			$PM_{2.5}$		
	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact
Criterion	-	90		-	25		-	8	
R01	4.3	46.8	51.1	2.5	19.9	22.4	0.6	6.1	6.7
R02	1.9	46.8	48.7	1.2	19.9	21.1	0.3	6.1	6.4
R03	7.3	46.8	54.1	4.1	19.9	24.0	0.9	6.1	7.0
R04	2.1	46.8	48.9	1.2	19.9	21.1	0.3	6.1	6.4
R06	6.2	46.8	53.0	3.4	19.9	23.3	0.6	6.1	6.7
R08	1.2	46.8	48.0	0.9	19.9	20.8	0.2	6.1	6.3
R09	1.9	46.8	48.7	1.2	19.9	21.1	0.3	6.1	6.4
R10	3.2	46.8	50.0	1.9	19.9	21.8	0.4	6.1	6.5
R11	2.9	46.8	49.7	1.8	19.9	21.7	0.4	6.1	6.5
R12	1.3	46.8	48.1	0.8	19.9	20.7	0.2	6.1	6.3
R13	3.9	46.8	50.7	2.4	19.9	22.3	0.5	6.1	6.6
R16	4.8	46.8	51.6	2.9	19.9	22.8	0.6	6.1	6.7
R17	4.9	46.8	51.7	2.9	19.9	22.8	0.6	6.1	6.7
R18	5.0	46.8	51.8	2.9	19.9	22.8	0.6	6.1	6.7
R19	5.1	46.8	51.9	3.0	19.9	22.9	0.7	6.1	6.8
R21	5.3	46.8	52.1	3.1	19.9	23.0	0.7	6.1	6.8
R22	5.6	46.8	52.4	3.3	19.9	23.2	0.7	6.1	6.8
R23	5.8	46.8	52.6	3.4	19.9	23.3	0.8	6.1	6.9
R24	5.9	46.8	52.7	3.4	19.9	23.3	0.8	6.1	6.9
R25	5.6	46.8	52.4	3.2	19.9	23.1	0.7	6.1	6.8
R26	5.7	46.8	52.5	3.3	19.9	23.2	0.7	6.1	6.8
R27	6.1	46.8	52.9	3.5	19.9	23.4	0.8	6.1	6.9
R28	6.7	46.8	53.5	3.8	19.9	23.7	0.8	6.1	6.9
R29	7.1	46.8	53.9	4.0	19.9	23.9	0.9	6.1	7.0
R32	6.6	46.8	53.4	3.7	19.9	23.6	0.8	6.1	6.9
R33	6.4	46.8	53.2	3.6	19.9	23.5	0.8	6.1	6.9
R35	5.1	46.8	51.9	3.0	19.9	22.9	0.7	6.1	6.8
R37	4.9	46.8	51.7	2.9	19.9	22.8	0.6	6.1	6.7
R40	5.3	46.8	52.1	3.1	19.9	23.0	0.7	6.1	6.8
R41	6.2	46.8	53.0	3.5	19.9	23.4	0.8	6.1	6.9

Receptor	Annual Average Concentration (µg·m^{-3})								
	TSP			PM_{10}			$PM_{2.5}$		
	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact
Criterion	-	90		-	25		-	8	
R42	4.8	46.8	51.6	2.8	19.9	22.7	0.6	6.1	6.7
R43	6.1	46.8	52.9	3.4	19.9	23.3	0.6	6.1	6.7
R60	1.0	46.8	47.8	0.6	19.9	20.5	0.1	6.1	6.2
R63	0.4	46.8	47.2	0.2	19.9	20.1	<0.1	6.1	6.2
R64	0.4	46.8	47.2	0.3	19.9	20.2	<0.1	6.1	6.2
R65	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R66	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R67	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R68	0.2	46.8	47.0	0.1	19.9	20.0	<0.1	6.1	6.2
R69	0.2	46.8	47.0	0.2	19.9	20.1	<0.1	6.1	6.2
R70	0.4	46.8	47.2	0.2	19.9	20.1	<0.1	6.1	6.2
R71	0.6	46.8	47.4	0.4	19.9	20.3	<0.1	6.1	6.2
R72	0.9	46.8	47.7	0.6	19.9	20.5	0.1	6.1	6.2
R73	5.2	46.8	52.0	3.0	19.9	22.9	0.7	6.1	6.8
R74	3.6	46.8	50.4	2.0	19.9	21.9	0.4	6.1	6.5
R75	0.6	46.8	47.4	0.4	19.9	20.3	<0.1	6.1	6.2
R78	0.6	46.8	47.4	0.4	19.9	20.3	<0.1	6.1	6.2
R79	5.4	46.8	52.2	3.1	19.9	23.0	0.7	6.1	6.8
R80	5.3	46.8	52.1	3.1	19.9	23.0	0.7	6.1	6.8
R81	4.6	46.8	51.4	2.7	19.9	22.6	0.6	6.1	6.7
R44	0.9	46.8	47.7	0.6	19.9	20.5	0.1	6.1	6.2
R45	7.9	46.8	54.7	4.3	19.9	24.2	0.8	6.1	6.9
R47	1.7	46.8	48.5	1.1	19.9	21.0	0.2	6.1	6.3
R61	1.0	46.8	47.8	0.6	19.9	20.5	0.1	6.1	6.2
R62	1.0	46.8	47.8	0.6	19.9	20.5	0.1	6.1	6.2
R82	0.7	46.8	47.5	0.5	19.9	20.4	<0.1	6.1	6.2

Contour plots of incremental annual average TSP, PM_{10} and $PM_{2.5}$ are presented in **Appendix F**.

6.3.2 Scenario 3 - Particulate Matter – Annual Average Dust Deposition Rates

Table 33 presents the annual average dust deposition rates predicted as a result of Project operations during Scenario 3.

The results indicate that predicted incremental dust deposition rates at all non-Project related receptor locations are minor, and represent as a maximum:

- 10 % of the annual average criterion of 2 g·m^{-2}·month^{-1}.

The addition of the adopted background dust deposition rate (refer **Appendix E**) results in predicted cumulative rates representing, as a maximum:

- 55 % of the annual average criterion of 4 g·m^{-2}·month^{-1}.

No contour plot of annual average dust deposition is presented, given the minor predicted contribution from the Project operations at the nearest sensitive receptors.

Table 33 Predicted annual average dust deposition – Scenario 3

Receptor	Annual Average Dust Deposition (g·m^{-2}·month^{-1})		
	Incremental Impact	Background	Cumulative Impact
Criterion	2.0	-	4.0
R01	<0.1	2.0	2.1
R02	<0.1	2.0	2.1
R03	0.1	2.0	2.1
R04	<0.1	2.0	2.1
R06	0.1	2.0	2.1
R08	<0.1	2.0	2.1
R09	<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
R16	<0.1	2.0	2.1
R17	<0.1	2.0	2.1
R18	<0.1	2.0	2.1
R19	<0.1	2.0	2.1
R21	0.1	2.0	2.1
R22	0.1	2.0	2.1
R23	0.1	2.0	2.1
R24	0.1	2.0	2.1
R25	0.1	2.0	2.1
R26	0.1	2.0	2.1
R27	0.1	2.0	2.1
R28	0.1	2.0	2.1
R29	0.1	2.0	2.1
R32	0.1	2.0	2.1
R33	0.1	2.0	2.1
R35	<0.1	2.0	2.1

Receptor	Annual Average Dust Deposition ($g \cdot m^{-2} \cdot month^{-1}$)		
	Incremental Impact	Background	Cumulative Impact
Criterion	2.0	-	4.0
R37	<0.1	2.0	2.1
R40	0.1	2.0	2.1
R41	0.1	2.0	2.1
R42	<0.1	2.0	2.1
R43	0.2	2.0	2.2
R60	<0.1	2.0	2.1
R63	<0.1	2.0	2.1
R64	<0.1	2.0	2.1
R65	<0.1	2.0	2.1
R66	<0.1	2.0	2.1
R67	<0.1	2.0	2.1
R68	<0.1	2.0	2.1
R69	<0.1	2.0	2.1
R70	<0.1	2.0	2.1
R71	<0.1	2.0	2.1
R72	<0.1	2.0	2.1
R73	<0.1	2.0	2.1
R74	0.1	2.0	2.1
R75	<0.1	2.0	2.1
R78	<0.1	2.0	2.1
R79	0.1	2.0	2.1
R80	<0.1	2.0	2.1
R81	<0.1	2.0	2.1
R44	<0.1	2.0	2.1
R45	0.3	2.0	2.3
R47	<0.1	2.0	2.1
R61	<0.1	2.0	2.1
R62	<0.1	2.0	2.1
R82	<0.1	2.0	2.1

6.3.3 Scenario 3 - Particulate Matter - Maximum 24-hour Average

Presented in **Table 34** are the maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations predicted to occur at the nearest non-Project related sensitive receptors as a result of activities at the Project during Scenario 3. No background concentrations are included within this table. Maximum concentrations at non-Project related receptors are highlighted in bold.

Table 34 Predicted maximum incremental 24-hour PM_{10} and $PM_{2.5}$ concentrations – Scenario 3

Receptor	Maximum incremental 24-hour average concentration ($\mu g \cdot m^{-3}$)	
	PM_{10}	$PM_{2.5}$
Criterion	50	25
R01	25.1	7.4
R02	11.9	3.2
R03	32.7	8.8
R04	15.0	3.9
R06	23.1	4.5
R08	15.6	3.4
R09	12.8	3.1
R10	22.6	3.7
R11	24.1	4.8
R12	13.7	2.7
R13	24.4	5.2
R16	26.2	6.0
R17	28.2	6.4
R18	24.9	5.5
R19	25.5	5.6
R21	26.1	5.8
R22	29.9	7.3
R23	31.2	**10.3**
R24	30.9	7.6
R25	27.1	6.0
R26	27.4	6.2
R27	28.7	6.9
R28	30.6	7.8
R29	32.4	8.6
R32	30.2	9.5
R33	28.8	7.1
R35	25.0	5.3
R37	22.8	6.9
R40	26.3	5.8
R41	32.2	8.4
R42	24.1	5.2
R43	28.6	5.4
R60	15.0	3.0
R63	6.4	1.1
R64	5.8	1.0
R65	3.6	0.7
R66	3.3	0.6
R67	3.3	0.6

Receptor	Maximum incremental 24-hour average concentration ($\mu g \cdot m^{-3}$)	
	PM_{10}	$PM_{2.5}$
Criterion	50	25
R68	3.4	0.6
R69	4.1	0.8
R70	6.4	1.2
R71	6.4	1.3
R72	7.7	1.8
R73	25.8	5.7
R74	**34.9**	7.1
R75	8.7	1.7
R78	10.2	2.1
R79	29.0	6.9
R80	29.8	9.2
R81	24.2	5.3
R44	9.1	2.3
R45	35.4	7.3
R47	20.9	3.8
R61	12.1	2.4
R62	12.7	2.3
R82	9.0	1.9

The predicted incremental concentration of PM_{10} and $PM_{2.5}$ are predicted to be at their maxima at Receptor 74 (PM_{10}) to the northeast of the Project, and Receptor 23 ($PM_{2.5}$) to the west of Tomingley Village.

The following tables present the predicted maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations resulting from the operation of the Project during Scenario 3, with background included.

Results are presented for the receptor at which the highest incremental PM_{10} and $PM_{2.5}$ impacts have been predicted, and also for the receptors at which the highest cumulative impacts (increment plus background) have been predicted. These may often 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 background concentrations, and the right side shows the total predicted concentration on days with the highest predicted incremental concentrations. The results are presented in this way to be consistent with the requirements of section 11.2 of the Approved Methods (NSW EPA, 2016).

The maximum cumulative impacts (shown on the left side of the table) are generally driven by the highest background concentrations, and similar results are experienced at all receptors. The results are presented for the receptor at which the highest total cumulative impacts were predicted.

Model predictions presented in **Table 35** indicate that the Project activities occurring as part of Scenario 3 are predicted to result in additional exceedances of the 24-hour PM_{10} criterion at surrounding non-Project related receptors. The five existing exceedances of the criterion are presented, although additional exceedances of the criterion are predicted at a number of receptor locations, also presented in **Figure 13** and **Figure 14**.

Table 35 Summary of contemporaneous impact and background – PM_{10} - Scenario 3

Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$) Receptor R4			Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$) Receptor R74		
	Incremental Impact	Background	Cumulative Impact		Incremental Impact	Background	Cumulative Impact
Criterion	50			Criterion	50		
3/09/2017	5.7	76.2	81.8	6/06/2017	34.9	23.6	58.5
12/02/2017	0.7	73.5	74.2	29/06/2017	28.0	20.3	48.2
23/09/2017	<0.1	72.8	72.9	1/11/2017	25.1	34.1	59.3
24/09/2017	13.6	57.4	71.0	31/10/2017	24.7	19.9	44.6
10/04/2017	10.5	48.5	59.0	27/08/2017	22.5	29.9	52.4
21/02/2017	<0.1	53.2	53.3	7/06/2017	20.8	14.5	35.3
8/09/2017	10.6	40.8	51.4	20/02/2017	17.7	33.3	51.0
9/04/2017	3.6	47.0	50.6	19/02/2017	17.2	26.2	43.4
24/02/2017	0.4	49.6	50.0	11/04/2017	16.1	21.2	37.3
17/02/2017	0.8	49.2	50.0	30/06/2017	14.7	21.7	36.4
These data represent the highest Cumulative Impact 24-hour PM_{10} predictions (outlined in red) as a result of the operation of the project.				These data represent the highest Incremental Impact 24-hour PM_{10} predictions (outlined in blue) as a result of the operation of the project.			

Figure 13 Locations and dates on which additional exceedances of the 24-hr PM_{10} criterion are predicted – Scenario 3 (1 of 2)

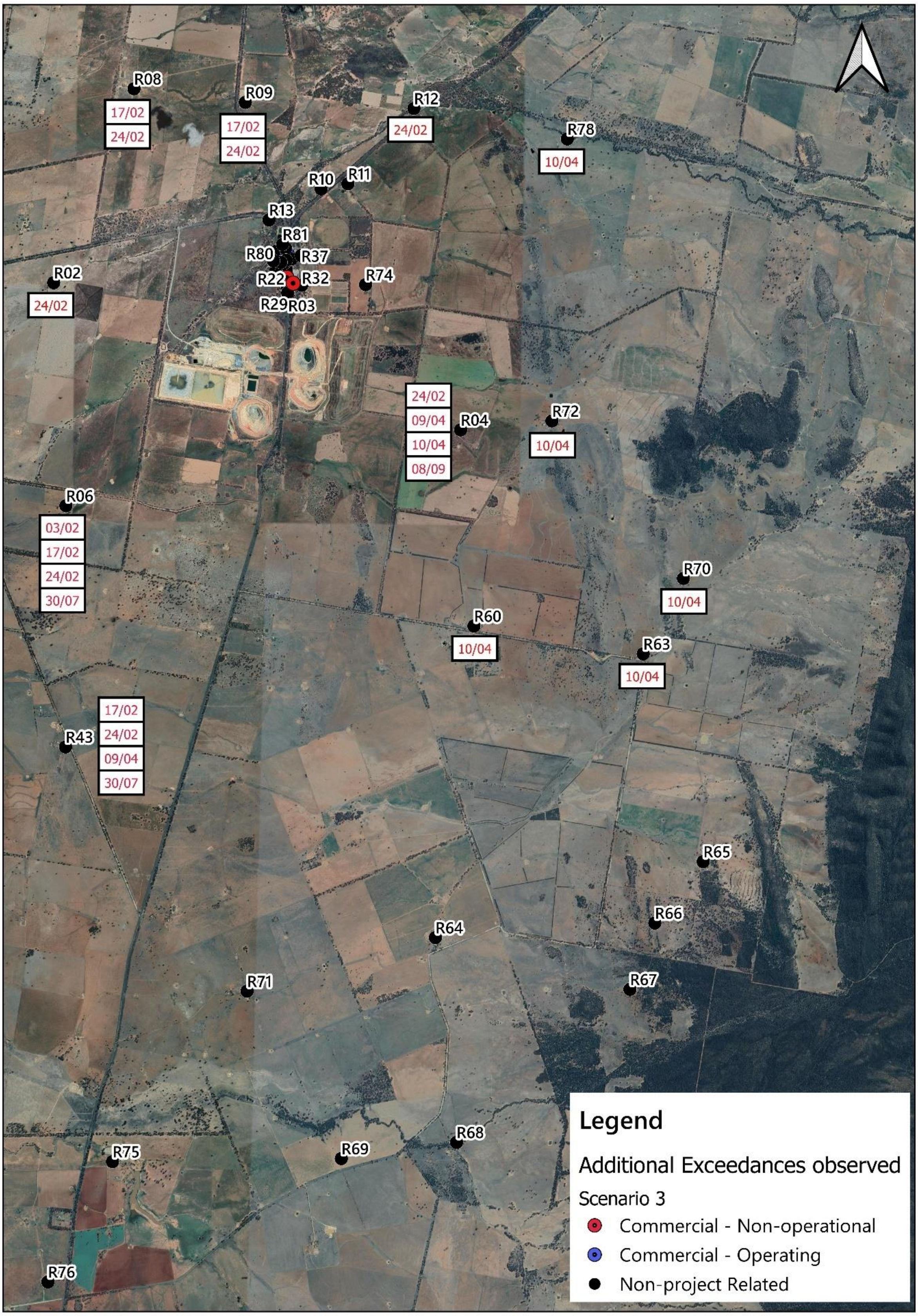


Figure 14 Locations and dates on which additional exceedances of the 24-hr PM_{10} criterion are predicted – Scenario 3 (2 of 2)

Model predictions presented in **Table 36** indicate that the Project activities occurring as part of Scenario 3 are not likely to result in any exceedances of the 24-hour $PM_{2.5}$ criterion at any surrounding non-Project related receptor.

The predicted maximum 24-hour PM_{10} concentrations presented in **Table 35**, and the additional predicted exceedances in **Figure 13** and **Figure 14** include the effects of the emissions control measures as outlined in **Section 5.1.3**, but do not include the effect of the Trigger Action Response Plan (TARP) which would continue to be operated as part of Project activities. That TARP would be modified, as described in detail in **Section 6.3.6**. The TARP would also act to minimise impacts of 24-hour $PM_{2.5}$ concentrations, as discussed further in **Section 6.3.6**.

Contour plots of the incremental contribution of the proposed Scenario 3 operations of the Project to the 24-hour average PM_{10} and $PM_{2.5}$ concentrations are presented in **Appendix F**.

Table 36 Summary of contemporaneous impact and background – $PM_{2.5}$ – Scenario 2

Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) Receptor R74			Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) Receptor R23		
	Incremental Impact	Background	Cumulative Impact		Incremental Impact	Background	Cumulative Impact
Criterion	25			Criterion	25		
16/06/2017	3.1	17.5	20.6	2/06/2017	10.3	8.5	18.8
17/06/2017	0.7	16.0	16.7	1/06/2017	7.1	10.4	17.5
17/05/2017	0.4	15.3	15.7	25/05/2017	7.0	6.9	13.9
28/06/2017	3.0	12.0	15.0	28/04/2017	6.6	5.5	12.1
15/07/2017	4.5	9.6	14.1	21/07/2017	5.5	5.4	10.9
18/06/2017	1.7	12.0	13.7	29/04/2017	4.7	5.4	10.1
19/06/2017	3.8	9.7	13.5	5/12/2017	4.6	3.3	7.9
10/07/2017	2.4	10.7	13.1	29/06/2017	4.3	8.3	12.6
5/06/2017	0.7	12.3	13.0	26/05/2017	3.8	4.2	8.0
3/07/2017	0.1	12.8	12.9	16/05/2017	3.8	8.6	12.4
These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) as a result of the operation of the Proposal.				These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) as a result of the operation of the Proposal.			

6.3.4 Scenario 3 - Nitrogen Dioxide

The predicted annual average and maximum 1-hour NO_2 concentrations resulting from blasting operations during Scenario 3 are presented in **Table 37**.

The conversion of NO_X to NO_2 has been assumed to be in accordance with Method 2 of the NSW EPA Approved Methods (section 8.1.2 of (NSW EPA, 2016), commonly known as the 'Ozone Limiting Method' (OLM) (refer **Section 5.1.4**).

The results indicate that predicted cumulative concentrations of NO_2 at all non-Project related receptor locations comply with both the 1-hour and annual average criteria.

The results presented in **Table 37** are based on emissions during every hour of the year during which blasting is permitted, and during all wind conditions during those periods.

Table 37 Predicted annual average and maximum 1-hour NO_2 concentrations

Receptor	Annual Average NO_2 Concentration ($\mu g \cdot m^{-3}$)			Max 1-hour NO_2 Concentration ($\mu g \cdot m^{-3}$)		
	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact
Criterion	62			246		
R01	1.5	9.6	11.1	116.1	10.3	126.4
R02	0.4	9.6	10.0	64.5	4.1	68.6
R03	1.9	9.6	11.5	120.6	8.2	128.8
R04	2.4	9.6	12.0	162.7	8.2	170.9
R06	0.8	9.6	10.4	120.3	2.1	122.3
R08	0.6	9.6	10.2	82.2	24.6	106.8
R09	0.9	9.6	10.5	83.8	14.4	98.1
R10	1.3	9.6	10.9	143.9	8.2	152.1
R11	1.3	9.6	10.9	124.2	8.2	132.4
R12	1.0	9.6	10.6	85.8	8.2	94.0
R13	1.4	9.6	11.1	112.7	8.2	120.9
R16	1.6	9.6	11.2	124.9	8.2	133.1
R17	1.6	9.6	11.2	128.1	8.2	136.3
R18	1.6	9.6	11.2	114.7	8.2	122.9
R19	1.6	9.6	11.2	114.1	8.2	122.3
R21	1.6	9.6	11.3	112.8	8.2	121.0
R22	1.7	9.6	11.3	120.9	8.2	129.1
R23	1.7	9.6	11.3	128.2	8.2	136.4
R24	1.7	9.6	11.3	119.7	8.2	127.9
R25	1.7	9.6	11.3	109.6	8.2	117.8
R26	1.7	9.6	11.3	109.0	8.2	117.2
R27	1.7	9.6	11.4	104.8	14.4	119.1
R28	1.8	9.6	11.4	109.7	14.4	124.1
R29	1.9	9.6	11.5	112.3	14.4	126.6
R32	1.8	9.6	11.5	163.8	8.2	172.0
R33	1.8	9.6	11.4	131.9	8.2	140.1
R35	1.6	9.6	11.2	105.0	14.4	119.4
R37	1.6	9.6	11.2	137.9	8.2	146.1
R40	1.7	9.6	11.3	112.6	8.2	120.8
R41	1.7	9.6	11.4	118.3	8.2	126.5

Receptor	Annual Average NO_2 Concentration (µg·m^{-3})			Max 1-hour NO_2 Concentration (µg·m^{-3})		
	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact
R42	1.6	9.6	11.2	118.3	8.2	126.5
R43	13.2	9.6	22.8	220.0	16.4	236.4
R60	2.1	9.6	11.7	125.5	8.2	133.7
R63	1.0	9.6	10.6	136.6	10.3	146.8
R64	1.3	9.6	11.0	126.0	4.1	130.1
R65	0.7	9.6	10.3	96.2	0.0	96.2
R66	0.5	9.6	10.1	84.6	4.1	88.7
R67	0.5	9.6	10.1	113.5	2.1	115.5
R68	0.9	9.6	10.5	121.0	4.1	125.1
R69	1.1	9.6	10.8	133.7	6.2	139.9
R70	0.6	9.6	10.3	106.4	8.2	114.6
R71	2.2	9.6	11.8	118.2	4.1	122.3
R72	1.7	9.6	11.4	120.9	8.2	129.1
R73	1.6	9.6	11.3	113.4	8.2	121.6
R74	1.7	9.6	11.3	106.1	8.2	114.3
R75	0.8	9.6	10.5	92.2	16.4	108.6
R78	0.8	9.6	10.4	89.0	4.1	93.1
R79	1.7	9.6	11.3	123.2	8.2	131.4
R80	1.7	9.6	11.3	129.0	8.2	137.2
R81	1.6	9.6	11.2	124.0	8.2	132.2
R44	4.1	9.6	13.7	215.6	10.3	225.9
R45	7.1	9.6	16.7	291.5	4.1	295.6
R47	3.4	9.6	13.0	147.5	10.3	157.8
R61	2.0	9.6	11.6	133.4	8.2	141.6
R62	2.2	9.6	11.9	140.0	10.3	150.3
R82	2.2	9.6	11.8	136.5	4.1	140.6

6.3.5 Scenario 3 - 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 not exceeded at any surrounding privately-owned residence.

The previous sections also confirm that the Voluntary Acquisition criteria are not exceeded at any surrounding sensitive receptor location, however the 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 in Scenario 3.

6.3.6 Scenario 3 – Trigger Action Response Plan

A number of additional exceedances of the 24-hour PM_{10} criterion are anticipated to occur during Scenario 3 across a total of 20 days. As for Scenario 2, a detailed analysis of the effect of a range of cascading mitigation measures has been performed to determine how those exceedances can be avoided.

The effect of implementing that cascade of measures is presented in **Table 38**. A descriptive 'key' to facilitate the interpretation of the information is presented in **Table 30** in **Section 6.2.6**.

Table 38 Analysis of additional 24-hour PM_{10} exceedances and management options – Scenario 3

Receptor		R06	R43	R23	R03	R32	R74
Date	-	03/02/2017	17/02/2017	17/02/2017	20/02/2017	24/02/2017	28/03/2017
Background PM_{10}	$\mu g{\cdot}m^{-3}$	40.6	49.2	49.2	33.3	49.6	41.3
Cumulative PM_{10}		50.4	59.1	58.1	51.0	55.6	51.9
Incremental PM_{10}		9.8	9.9	8.9	17.7	6.0	10.6
Is background >95% of the criterion?		NO	YES	YES	NO	YES	NO
Transport of waste to Caloma	% of incr.	25%	58%	59%	57%	53%	47%
Transport of ore to ROM pad		1%	2%	1%	3%	3%	3%
SAR in pit activities and transport of waste to SAR WRE		41%	2%	2%	13%	9%	13%
Receptor		**R03**	**R74**	**R43**	**R04**	**R04**	**R72**
Date	-	30/03/2017	30/03/2017	09/04/2017	09/04/2017	10/04/2017	10/04/2017
Background PM_{10}	$\mu g{\cdot}m^{-3}$	45.6	45.6	47.0	47.0	48.5	48.5
Cumulative PM_{10}		51.1	52.0	50.5	50.6	59.0	55.0
Incremental PM_{10}		5.5	6.4	3.5	3.6	10.5	6.5
Is the background >95% of the criterion?		NO	NO	NO	NO	YES	YES
Transport of waste to Caloma WRE	% of incr.	15%	51%	26%	31%	56%	45%
Transport of ore to ROM pad		5%	3%	2%	2%	3%	3%
SAR in pit activities and transport of waste to SAR WRE		26%	13%	42%	38%	12%	19%

Table 38- continued

Receptor		R03	R03	R23	R74	R43	R06
Date	-	07/05/2017	08/05/2017	02/06/2017	06/06/2017	30/07/2017	30/07/2017
Background PM_{10}	$\mu g \cdot m^{-3}$	20.7	30.8	22.0	23.6	43.5	43.5
Cumulative PM_{10}		50.7	54.6	51.9	58.5	54.6	52.2
Incremental PM_{10}		30.0	23.8	29.9	34.9	11.1	8.7
Is background >95% of the criterion?		NO	NO	NO	NO	NO	NO
Transport of waste to Caloma	% of incr.	39%	63%	62%	51%	13%	33%
Transport of ore to ROM pad		3%	5%	2%	3%	1%	3%
SAR in pit activities and transport of waste to SAR WRE		22%	0%	2%	13%	42%	22%
Receptor		**R32**	**R74**	**R32**	**R03**	**R04**	**R74**
Date	-	24/08/2017	27/08/2017	30/08/2017	30/08/2017	08/09/2017	08/09/2017
Background PM_{10}	$\mu g \cdot m^{-3}$	27.2	29.9	37.8	37.8	40.8	40.8
Cumulative PM_{10}		54.6	52.4	59.2	56.9	51.4	52.0
Incremental PM_{10}		27.5	22.5	21.4	19.1	10.6	11.2
Is the background >95% of the criterion?		NO	NO	NO	NO	NO	NO
Transport of waste to Caloma WRE	% of incr.	31%	55%	43%	32%	35%	28%
Transport of ore to ROM pad		4%	3%	4%	4%	2%	5%
SAR in pit activities and transport of waste to SAR WRE		28%	13%	19%	27%	34%	7%

Table 38- continued

Receptor		R74	R74	R03
Date	-	06/10/2017	01/11/2017	20/12/2017
Background PM_{10}	$\mu g \cdot m^{-3}$	46.5	34.1	46.2
Cumulative PM_{10}		55.8	59.3	54.0
Incremental PM_{10}		9.3	25.2	7.8
Is background >95% of the criterion?		NO	NO	NO
Transport of waste to Caloma	% of incr.	56%	56%	55%
Transport of ore to ROM pad		2%	3%	5%
SAR in pit activities and transport of waste to SAR WRE		15%	13%	4%

The analysis indicates that on all but three days (17 February, 24 February and 10 April), a range of measures can be implemented to ensure that the additional exceedances of the 24-hour PM_{10} criterion would not eventuate. On the majority of those days, further measures were also available but not required to be implemented, to ensure the criterion was achieved.

On the three days on which it is shown that the implementation of all cascading measures would still not be sufficient to ensure the 24-hour PM_{10} criterion would be achieved, it is shown that the background PM_{10} concentration is > 95 % of the criterion, even without the addition of the Project contribution. Implementation of all air quality management measures, and including the cascading measures outlined above would represent best practice emissions control and would minimise emissions from the Project as far as practicable.

The procedure implemented through the AQMP to pro-actively identify the potential for days of elevated background air pollution is discussed in **Section 5.1.3**.

7. GREENHOUSE GAS ASSESSMENT

This section presents the results of the GHG assessment and compares estimated direct emissions totals with NSW and Australian totals. Opportunities for GHG management and mitigation are presented in **Section 8.2**.

Based on the activity data for the operation of the Proposal and the emission factors outlined in **Section 5.2**, annual GHG emissions have been calculated and are presented in **Table 39**. The Proposal is calculated to result in direct (scope 1) GHG emissions of 58 251.9 t CO_2-e per annum.

Indirect (scope 2) emissions from the consumption of purchased electricity are shown to be higher than direct (scope 1) emissions, due to the quantity of electricity anticipated to be consumed. Indirect (scope 3) emissions are largely made of up of contributions from diesel combustion at the Project, and electricity consumption, as expected.

Table 39 Calculated Proposal GHG emissions

Scope		Activity Rate	Units	Emission Factor		CO_2-e ($t{\cdot}yr^{-1}$)
1	Diesel fuel in material transport	21 224.3	$kL{\cdot}year^{-1}$	2 717.4	kg CO_2-e·kL^{-1}	57 675.8
	Liquified petroleum gas	441.8	$kL{\cdot}year^{-1}$	1 303.7	kg CO_2-e·kL^{-1}	576.0
					Scope 1 (subtotal)	**58 251.9**
2	Electricity consumption	93.2	$GWh{\cdot}year^{-1}$	0.78	kg CO_2-e·kWh^{-1}	72 673.7
					Scope 2 (subtotal)	**72 673.7**
3	Diesel fuel in material transport[(A)]	21 445.9	$kL{\cdot}year^{-1}$	139.0	kg CO_2-e·kL^{-1}	2 980.1
	Liquified petroleum gas	441.8	$kL{\cdot}year^{-1}$	91.1	kg CO_2-e·kL^{-1}	40.2
	Electricity consumption	93.2	$GWh{\cdot}year^{-1}$	0.07	kg CO_2-e·kWh^{-1}	6 522.0
	Employee travel	970.3	$kL{\cdot}year^{-1}$	123.1	kg CO_2-e·kL^{-1}	119.5
					Scope 3 (subtotal)	**9 661.8**
					TOTAL	**140 587.4**

Note: (A) Includes the transport of materials to the Project Site

A comparison of the calculated direct (scope 1) GHG emissions associated with the Proposal against Australian and NSW total emissions in 2019 is presented in **Table 40**. Scope 2 and scope 3 emissions are not compared with Australian and NSW total emissions as this results in double counting of emissions (e.g. the electricity supplier would report emissions associated with energy production as a Scope 1 emission).

Opportunities for emission reductions across all emission scopes are presented in **Section 8**.

Table 40 Proposal GHG emissions in context

Proposal Phase	Emissions (t CO_2-e per annum)		
	Proposal	NSW (2019)	Australia (2019)
		Total 136 579 000	Total 529 298 000
Operation	58 251.9	0.04%	0.01 %

These data indicate that the operation of the Proposal would contribute 0.01 % of Australian total GHG emissions 0.04 % of NSW total GHG emissions in 2019.

8. MITIGATION AND MONITORING

8.1 Air Quality Mitigation and Monitoring

A detailed discussion of the particulate control measures to be employed as part of the Project is presented in **Section 5.1.3**. The measures included in the dispersion modelling assessment are presented in **Table 41**.

Table 41 Summary of emission reduction methods adopted as part of the Project

Emission control method	Control efficiency (%)
Use of water injection on drill rig	96
Application of water when loading materials to haul trucks It is also assumed that this material remains moist when unloaded and handled	50
Loading ore to crusher, crushing, and screening in enclosed building	90
Application of water during ore processing	50
Retention of particulate matter in sub-ground level areas (pit retention)	95 (TSP) 5 (PM_{10} and $PM_{2.5}$)
Application of water and/or chemical suppressants on unpaved haulage routes and/or limiting of site vehicle speeds	90

The measures presented in **Table 41** do not represent the full suite of management measures currently employed at the Mine, nor do they represent those which would be employed during the Project operation, but they are those which can be justifiably and defensibly included within the quantitative assessment.

The results of the air quality impact assessment are presented in **Section 6**, and based on the above, these results can be viewed as a conservative approximation of the likely impacts which may be experienced during the Project operation.

In Scenario 1, no additional exceedances of the adopted air quality criteria have been predicted, and the measures outlined in **Table 41** alone are demonstrated to be sufficient to ensure that the environmental objectives are achieved. The implementation of further measures through the ongoing adoption of the TARP (to be updated following Project approval) would ensure that any impacts associated with the Project are managed in accordance with best practice.

During Scenario 2 and Scenario 3 operations, the dispersion modelling assessment indicates that the measures outlined in **Table 41** may not be sufficient on their own to ensure that the relevant air quality criteria are achieved. Specifically, short-term elevations in PM_{10} (in Scenario 2 and 3), resulting in exceedances of the criterion are predicted at several locations surrounding the Project. A range of additional measures included within the TARP are likely to ensure that the air quality criteria would not be exceeded as a result of Project operations. However, the Applicant is not relying upon unquantifiable emissions reductions to demonstrate achievement of the environmental objectives, and a detailed assessment of the source contributions to those elevated Project increments has been performed.

Through review of the source contribution analysis, the following cascade of management measures has been identified as generally providing sufficient reductions in incremental PM_{10} concentrations to remove the predicted additional exceedances:

1. Cease the transport of waste to, and unloading at the Caloma WRE
2. Cease the transport of ore to the ROM Pad
3. Modify or cease SAR in pit activities, including the transport and unloading of waste to the SAR WRE

Those management measures would be included in the updated TARP.

The Applicant is committed to extending the coverage of the already operational proactive TARP as part of the ongoing Project operation to manage any risks associated with non-compliance with air quality criteria.

The Applicant proposes to maintain the real-time monitoring equipment near Tomingley Village, and additionally install real-time particulate monitoring equipment at or near to Receptor R43 (to the southwest of the Project) or Receptor R4 (to the northeast of the SAR Open Cut). The Applicant would then operate three real-time particulate monitoring which would cover the areas of likely increased impact, as presented within this AQIA.

The implementation of an updated TARP is demonstrated to result in the removal of the majority of exceedances at surrounding non-Project receptors with the exception of three days (17 February, 24 February and 10 April). On those days, it is shown that the background PM_{10} concentration was already > 95 % of the criterion, even without the addition of the Project contribution. Implementation of all air quality management measures, and including the cascading measures outlined above would represent best practice emissions control and would minimise emissions from the Project as far as practicable.

8.2 Greenhouse Gas Mitigation and Monitoring

The AQMP includes a section on the sources and management of GHG at the Mine. As previously stated, this AQMP would be updated to include any additional impacts associated with the Project.

The Applicant currently utilises the EnviroSuite system to track energy consumption and greenhouse gas emissions, establish targets for reduction and facilitate assessment and reporting against targets for reduction.

Light vehicles, dump trucks, loaders, drills, graders and any other mobile equipment all undergo regular maintenance on site. They are serviced by TGO's mobile maintenance department in the on-site workshop to ensure they are operating within required specifications.

The Applicant is committed to continue to investigate ways to minimise the emission of GHG, which may include:

- The use of solar powered lighting;
- The use of energy efficient pumps and motors; or
- Ongoing education via inductions and toolbox presentations on reporting energy wastage.

The Applicant is currently reviewing options to install solar power generation to offset power consumption within the TGO Mine Site. No decision has been made in relation to that proposal and subsequent approval under the NSW EP&A Act would be required prior to installation. Notwithstanding this, potential exists to further mitigate greenhouse gas emissions from the Project.

The Applicant is also committed to reviewing any schemes which may provide opportunity to modernise plant and increase productivity, under the NSW Government Net Zero Plan Stage 1: 2020-2030.

9. CONCLUSION

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

The AQIA forms part of the EIS 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:

- the approved activities being performed by the Applicant at the currently operating Tomingley Gold Mine;
- the proposed activities which form the Project, under three separate scenarios which reflect activities during site establishment and construction, and two mining scenarios.
- the legislative requirements which are required to met, including existing conditions of consent, NSW EPA air quality criteria, POEO Act, and POEO (Clean Air) Regulations, and any policies and guidelines as they relate to air quality and greenhouse gas impacts of the Project.
- the existing conditions surrounding the Project Site, including the definition of sensitive receptor locations, prevailing meteorology and air quality, topography, and emissions of GHG in Australia and NSW in the year 2019.
- the approach to assessment, including justification for the approach adopted.
- emissions controls currently employed at the Mine, and proposed to be employed as part of the Project construction and operation.
- predicted air quality impacts during each of the three 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.
- how those measures would be triggered and implemented.
- predicted emissions of GHG during a year of operations representative of high activity.
- air quality mitigation measures which would be employed as part of the Project construction and operation, including air quality monitoring methods.
- greenhouse gas mitigation and monitoring measures which would be employed as part of Project construction and operation, with the aim of minimising those emissions.

In relation to air quality, the operational Trigger Action Response Plan (TARP) would be updated to ensure that additional exceedances of the short-term (24-hour) particulate matter criteria are not experienced at a number of surrounding receptor locations. The TARP is currently operational and would be augmented by two additional real-time particulate monitors, located near to the Project activities. The detailed assessment presented in this report indicates that a range of management measures can be employed to ensure that additional exceedances do not generally occur at surrounding receptor locations. Where this assessment has indicated that further levels of control cannot be employed to ensure those criteria are achieved on rare occasions (i.e. best management practice is employed and exceedances are still predicted), this is a result of high background concentrations. Any exceedances would be minor.

Although the assessment has not predicted 'visibility' metrics, in relation to the SEARs requirement regarding the 'function and integrity of all affected public roads', the concentrations of particulate matter predicted are not anticipated to result in visibility issues. Should visible dust be observed, this would cause a trigger of the AQMP, and measures would be immediately implemented to address that issue.

In relation to greenhouse gas, the assessment indicates that direct emissions associated with the Project are likely to be of the order of approximately 58.3 kt CO_2-e per annum. Indirect electricity emissions represent the largest source of total emissions at approximately 72.7kt CO_2-e per annum. The Applicant is currently reviewing options to install solar power generation to offset power consumption within the TGO Mine Site. The Applicant is committed to continue to investigate ways to minimise the emission of GHG, and to reviewing any schemes which may provide opportunity to modernise plant and increase productivity, under the NSW Government Net Zero Plan Stage 1: 2020-2030.

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.

10. REFERENCES

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APPENDIX A

Report Units and Common Abbreviations

Units Used in the Report

All units presented in the report follow the International System of Units (SI) conventions, unless derived from references using non-SI units. In this report, units formed by the division of SI and non-SI units are expressed as a negative exponent, and do not use the solidus (/) symbol. For example:

- 50 micrograms per cubic metre would be presented as 50 $\mu g \cdot m^{-3}$ and not 50 $\mu g/m^3$; and
- 0.2 kilograms per hectare per hour would be presented as 0.2 $kg \cdot ha^{-1} \cdot hr^{-1}$ and not 0.2 kg/ha/hr.

Table A1 Common Abbreviations

Abbreviation	Term
ABS	Australian Bureau of Statistics
AHD	Australian Height Datum
AQIA	air quality impact assessment
AQMP	air quality management plan
AQMS	air quality monitoring station
AWS	automatic weather station
bcm	bank cubic metres
BoM	Bureau of Meteorology
°C	degrees Celsius
CO	carbon monoxide
CO_2	carbon dioxide
CO_2-e	carbon dioxide equivalent
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DPIE	NSW Department of Planning, Industry and Environment
EETM	emission estimation technique manual
EPA	Environmental Protection Authority
FEL	front end loader
g	gram
GDA	Geocentric Datum of Australia
GHG	greenhouse gas
GIS	geographical information system
$g \cdot m^{-2} \cdot month^{-1}$	gram per square metre per month
K	kelvin (-273°C = 0 K, ±1°C = ±1 K)
kW	kilowatt
MGA	Map Grid of Australia
Mtpa	million tonnes per annum
$\mu g \cdot m^{-3}$	microgram per cubic metre of air
NCAA	National Clean Air Agreement
NEPM	National Environment Protection Measure
NO	nitric oxide
NO_2	nitrogen dioxide
NO_X	total oxides of nitrogen

Abbreviation	Term
O_2	ozone
OEH	NSW Office of Environment and Heritage (now defunct)
oz	ounce
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 µm or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 µm or less
RIM	run-in-mine
ROM	run-of-mine
RSF	Residue Storage Facility
SAR	San Antonio and Roswell
SEARs	Secretary's Environmental Assessment Requirements
t	tonne
TAPM	The Air Pollution Model
TARP	trigger action response plan
TGO	Tomingley Gold Operations
TPM	total particulate matter
TSP	total suspended particulates
US EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
VKT	vehicle kilometres travelled

APPENDIX B

Emissions Inventory

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, and blasting has the potential to result in emissions of NO_X. A detailed outline of the emission estimation techniques adopted to derive total emissions from the sources identified are presented in this appendix.

A detailed summary and justification of all parameters adopted within the emissions estimation calculations is provided.

The silt content of topsoil, waste and ore material is taken to be 10%, the moisture content of topsoil is taken to be 8.4 % and the moisture content of waste and ore material is taken to be 4.8 %, which are all consistent with the original AQIA (PAEHolmes, 2011).

The activity data associated with each process under assessment has been provided by the Applicant, or calculated from those data, and is replicated in **Table B1** and **Table B2**.

Table B1 Activity data associated with Scenario 1, 2 and 3

Location	Material	Activity	Units	Scenario 1	Scenario 2	Scenario 3	Notes
Central Pit	Waste	Drilling	holes	-	2,940.0	35,700.0	
	Waste	Blasting	blasts	-	19.6	238.0	
	Waste	Excavator loading haul truck	t	-	15,425,000.0	16,050,000.0	Assumed 50/50 split, Central and South Pit (Scenario 2), 50/50 split Central and North Pit (Scenario 3)
	Waste	Hauling from Central Pit to Caloma 2 inpit WRE	VKT	-	See ROADS	See ROADS	50% to SAR WRE, 50% to Caloma inpit WRE
	Waste	Hauling from Central Pit to SAR out of pit WRE	VKT	-	See ROADS	See ROADS	50% to SAR WRE, 50% to Caloma inpit WRE
	Ore	Drilling	holes	-	-	10,200.0	
	Ore	Blasting	blasts	-	-	68.0	
	Ore	Excavator loading haul truck	t	-	-	1,840,000.0	
	Ore	Hauling from Central Pit to ROM pad	VKT	-	-	See ROADS	
	Other	Excavator timming faces	t	-	21,900.0	21,900.0	
	Other	Dozer cleaning up pit floor	hrs	-	6,311.0	6,742.0	
	Other	Grader in pit road maintenance	VKT	-	See ROADS	See ROADS	
	Other	Front end loader loading soil to haul trucks	t	-	35,532.0	-	
	Other	Articulated haul truck moving soil to soil stockpile to SE of SAR open cut	VKT	-	See ROADS	See ROADS	
	Other	Wind erosion of exposed area	ha	-	24.2	24.2	
South Pit	Waste	Drilling	holes	-	10,290.0	-	
	Waste	Blasting	blasts	-	68.6	-	
	Waste	Excavator loading haul truck	t	-	15,425,000.0	-	Assumed 50/50 split, Central and South Pit (Scenario 2), 50/50 split Central and North Pit (Scenario 3)
	Waste	Hauling from South Pit to Caloma 1 inpit WRE	VKT	-	See ROADS	-	50% to SAR WRE, 50% to Caloma inpit WRE
	Waste	Hauling from South Pit to SAR WRE	VKT	-	See ROADS	-	50% to SAR WRE, 50% to Caloma inpit WRE
	Ore	Drilling	holes	-	1,470.0	5,100.0	
	Ore	Blasting	blasts	-	9.8	34.0	
	Ore	Excavator loading haul truck	t	-	500,000.0	460,000.0	
	Ore	Hauling from South Pit to ROM pad	VKT	-	See ROADS	See ROADS	
	Other	Excavator timming faces	t	-	21,900.0	-	
	Other	Dozer cleaning up pit floor	hrs	-	6,311.0	-	
	Other	Grader in pit road maintenance	VKT	-	See ROADS	-	
	Other	Front end loader loading soil to haul trucks	t	-	16,800.0	-	
	Other	Articulated haul truck moving soil to soil stockpile to SW of MLA area	VKT	-	See ROADS	-	
	Other	Wind erosion of exposed area	ha	-	26.5	26.5	

Table B1 (continued)

Location	Material	Activity	Units	Scenario 1	Scenario 2	Scenario 3	Notes
North Pit	Waste	Drilling	holes	-	-	-	
	Waste	Blasting	blasts	-	-	-	
	Waste	Excavator loading haul truck	t	-	-	16,050,000.0	Assumed 50/50 split Central and North Pit (Scenario 3)
	Waste	Hauling from North Pit to SAR out of pit WRE	VKT	-	-	See ROADS	
	Waste	Hauling from North Pit to Caloma in pit WRE	VKT	-	-	See ROADS	
	Other	Excavator timming faces	t	-	-	-	
	Other	Dozer cleaning up pit floor	hrs	-	-	6,742.0	
	Other	Grader in pit road maintenance	VKT	-	-	See ROADS	
	Other	Front end loader loading soil to haul trucks	t	-	-	38,500.0	
	Other	Articulated haul truck moving soil to soil stockpile to E of SAR open cut North Pit	VKT	-	-	See ROADS	
	Other	Wind erosion of exposed area	ha	-	13.7	13.7	
	Other	0	0	-	-	-	
Caloma 1 & 2 WRE	Waste	Unloading waste from Central Pit, South Pit and/or North Pit	t	-	15,425,000.0	16,050,000.0	
	Waste	Dozer pushing waste	hrs	-	13,523.0	13,523.0	
	Waste	Shaping outer face of Caloma WRE	t	-	5,410.0	5,410.0	
	Waste	Wind erosion	ha	-	15.6	15.6	
	Waste	0	0	-	-	-	
SAR WRE	Waste	Unloading waste from Central Pit, South Pit and/or North Pit	t	-	15,425,000.0	16,050,000.0	
	Waste	Dozer pushing waste	hrs	-	13,484.0	13,484.0	
	Waste	Shaping outer face of SAR WRE	t	-	5,395.0	5,395.0	
	Waste	Wind erosion	ha	-	64.7	64.7	
	Waste	0	0	-	-	-	
Soil Stockpiles	Other	Unloading soil at soil stockpile SE of SAR open cut	t	-	52,332.0	-	
	Other	Front end loader moving soil at soil stockpile SE of SAR open cut	t	-	52,332.0	-	
	Other	Wind erosion of soil stockpile SE of SAR open cut	ha	-	19.8	-	
	Other	Unloading soil at soil stockpile at SW of MLA area	t	1,841,070.0	-	-	
	Other	Front end loader moving soil at soil stockpile at SW of MLA area	t	1,841,070.0	-	-	
	Other	Wind erosion of soil stockpile at SW of MLA area	ha	22.3	-	-	
	Other	Unloading soil at soil stockpile at E of SAR open cut North Pit	t	-	-	38,500.0	
	Other	Front end loader moving soil at soil stockpile at E of SAR open cut North Pit	t	-	-	38,500.0	
	Other	Wind erosion of soil stockpile at E of SAR open cut North Pit	ha	-	-	-	

Table B1 (continued)

Location	Material	Activity	Units	Scenario 1	Scenario 2	Scenario 3	Notes
Processing Plant	Ore	Unloading ore at ROM pad	t	-	262,017.0	662,017.0	
	Ore	Unloading ore at Temporary stockpile in Caloma 1	0	-	-	1,400,000.0	
	Ore	Loading ore to crusher	t	-	37,017.0	662,017.0	Additional to the 1,087,983 t milled in 2017, which is represented in the air quality data for that year
	Ore	Crushing	t	-	37,017.0	662,017.0	
	Ore	Conveying to Screen Building	ha	-	0.0	0.0	Conveyors equivalent to 132m2 (as per original AQIA)
	Ore	Unloading ore from conveyor to Screen Building	t	-	37,017.0	662,017.0	
	Ore	Screening	t	-	37,017.0	662,017.0	
	Ore	Conveying oversize material to Crushing Building	ha	-	0.0	0.0	Conveyors equivalent to 132m2 (as per original AQIA)
	Ore	Unloading oversized ore from conveyor to Crushing Building	t	-	35,166.2	628,916.2	95% of total (as per original AQIA)
	Ore	Secondary crushing	t	-	35,166.2	628,916.2	95% of total (as per original AQIA)
	Ore	Conveying oversized material to Screen Building	ha	-	0.0	0.0	Conveyors equivalent to 132m2 (as per original AQIA)
	Ore	Conveying undersized material to Surge Bin	ha	-	0.0	0.0	Conveyors equivalent to 132m2 (as per original AQIA)
	Ore	Unloading undersized ore from conveyor to Surge Bin	t	-	1,850.9	33,100.9	5% of total (as per original AQIA)
	Ore	Conveying undersized material fro Surge Bin to Ball Mill	ha	-	0.0	0.0	Conveyors equivalent to 132m2 (as per original AQIA)
	Ore	Unloading undersized ore from conveyor to Ball Mill	t	-	1,850.9	33,100.9	5% of total (as per original AQIA)
	Ore	Wind erosion of ROM stockpiles	0	-	-	-	
RSF Construction	Stage 2 and Stage 3	Scraper working on impoundment and embankment area	t	-	331,200.0	331,200.0	
	Stage 2 and Stage 3	Dozer on impoundment and embankment area	hrs	-	360.0	360.0	
	Stage 2 and Stage 3	Trench excavation and backfill	t	-	162,304.0	162,304.0	
	Stage 2 and Stage 3	Dozer on Embankment construction Zone 1	hrs	-	360.0	360.0	
	Stage 2 and Stage 3	Dozer on Embankment construction Zone 2	hrs	-	360.0	360.0	
	Stage 2 and Stage 3	Dozer on Embankment construction Zone 3	hrs	-	360.0	360.0	
	Stage 2 and Stage 3	Transport of material from WRE1	VKT	-	17,505.0	17,505.0	
	Stage 2 and Stage 3	Loading of material at WRE1	t	-	468,000.0	468,000.0	
	Stage 2 and Stage 3	Unloading material at RSF2	t	-	468,000.0	468,000.0	
	Stage 2 and Stage 3	Wind erosion	ha	-	54.0	54.0	

Table B1 (continued)

Location	Material	Activity	Units	Scenario 1	Scenario 2	Scenario 3	Notes
	Other	Digging material in borrow pit and loading to haul trucks	t	1,841,070.0	-	-	
	Other	Loading stripped soil from SAR area	t	520,800.0	-	-	
	Other	Transporting material from borrow pit to construction site	VKT	See ROADS	-	-	
SAR Site Establishment	Other	Transporting soil to soil stockpiles	VKT	See ROADS	-	-	
	Other	Dozer shaping placed material, stripping, pushing up soil	hrs	4,562.5	-	-	
	Other	Grader shaping placed material	VKT	See ROADS	-	-	
	Other	0	0	-	-	-	
	Other	Scraper stripping soil and surface material	t	145,320.0	-	-	
	Other	Digging material in borrow pit and loading to haul trucks	t	176,540.0	-	-	
	Other	Transporting material along new road alignment	VKT	See ROADS	-	-	
Road construction activities	Other	Unloading material along new road alignment	t	438,060.0	-	-	
	Other	FEL/excavator on material	t	438,060.0	-	-	
	Other	Grader shaping placed material	VKT	See ROADS	-	-	
	Other	Roller compacting placed material	VKT	See ROADS	-	-	
	Other	Piling for Kyalite Road overpass	t	700.0	-	-	
UG Ventilation	Other	SARED and ROS Ventilaton Rises	-	SARED	ROS	ROS	
	Other	Unloading material along amenity bund	t	792,400.0	-	-	
	Other	Dozer shaping placed material, stripping, pushing up soil	hrs	1,791.9	-	-	
	Other	Unloading material along Southern barrier	t	723,800.0	-	-	
	Other	Dozer shaping placed material, stripping, pushing up soil	hrs	1,636.8	-	-	
	Other	Unloading material along haul road	t	239,330.0	-	-	
	Other	Dozer shaping placed material, stripping, pushing up soil	hrs	304.7	-	-	
	Other	Unloading material at Admin Area	t	76,300.0	-	-	
SAR Site Establishment	Other	Dozer shaping placed material, stripping, pushing up soil	hrs	172.5	-	-	
	Other	Unloading material at Pastefill Plant	t	9,240.0	-	-	
	Other	Dozer shaping placed material, stripping, pushing up soil	hrs	20.9	-	-	
	Other	Unloading material at Kyalite Road E of Hwy	t	104,580.0	-	-	
	Other	Dozer shaping placed material, stripping, pushing up soil	hrs	236.5	-	-	
	Other	Unloading material W of Hwy	t	2,380.0	-	-	
	Other	Dozer shaping placed material, stripping, pushing up soil	hrs	5.4	-	-	

Table B2 Material transport activity data associated with Scenario 1, 2 and 3

			tonnes hauled/annum							Distance (km)
Location	Material type	Name	Scenario 1	Scenario 2	Scenario 3	Vehicle type	Hours	Payload (t)	Average weight (t)	
Central Pit	Waste	Hauling from Central Pit to Caloma 2 inpit WRE	-	7,712,500.0	8,025,000.0	CAT 789	24/7	183.0	190.6	4.3
Central Pit	Waste	Hauling from Central Pit to SAR out of pit WRE	-	7,712,500.0	8,025,000.0	CAT 777F	24/7	91.0	119.5	1.1
Central Pit	Ore	Hauling from Central Pit to ROM pad	-	-	1,840,000.0	CAT 777F	24/7	91.0	119.5	6.0
Central Pit	Other	Articulated haul truck moving soil to soil stockpile to SE of SAR open cut	-	35,532.0	-	CAT 740	Day	38.0	52.1	0.9
Central Pit	Other	Grader in pit road maintenance	-	-	-	-	Day	-	-	-
South Pit	Waste	Hauling from South Pit to Caloma 1 inpit WRE	-	7,712,500.0	-	CAT 789	24/7	183.0	190.6	4.4
South Pit	Ore	Hauling from South Pit to ROM pad	-	500,000.0	460,000.0	CAT 777F	24/7	91.0	119.5	6.2
South Pit	Other	Articulated haul truck moving soil to soil stockpile to SW of MLA area	-	16,800.0	-	CAT 740	Day	38.0	52.1	1.4
South Pit	Other	Grader in pit road maintenance	-	-	-	-	Day	-	-	-
South Pit	Waste	Hauling from South Pit to SAR WRE	-	7,712,500.0	-	CAT 777F	24/7	91.0	119.5	1.1
North Pit	Waste	Hauling from North Pit to SAR out of pit WRE	-	-	8,025,000.0	CAT 785	24/7	134.0	163.4	1.7
North Pit	Other	Articulated haul truck moving soil to soil stockpile to E of SAR open cut North Pit	-	-	38,500.0	CAT 740	Day	38.0	52.1	1.4
North Pit	Other	Grader in pit road maintenance	-	-	-	-	-	-	-	-
North Pit	Waste	Hauling from North Pit to Caloma in pit WRE	-	-	8,025,000.0	CAT 789	24/7	183.0	190.6	3.4
SAR Site Establishment	Other	Transporting material from borrow pit to construction site	1,841,070.0	-	-	CAT 777F	Day / Evening	91.0	119.5	2.3
SAR Site Establishment	Other	Transporting soil to soil stockpiles	520,800.0	-	-	CAT 777F	Day / Evening	91.0	119.5	1.7
SAR Site Establishment	Other	Grader shaping placed material	-	-	-	-	-	-	-	-
Road Construction Activities	Other	Transporting material along new road alignment	412,230.0	-	-	CAT 740	Day / Evening	38.0	52.1	4.1
Road Construction Activities	Other	Grader shaping placed material	-	-	-	CAT 140	Day / Evening	-	-	-
Road Construction Activities	Other	Roller compacting placed material	-	-	-	18t	Day / Evening	-	-	-

Table B2 (continued)

Location	Material type	Name	Loads/annum Scenario 1	Loads/annum Scenario 2	Loads/annum Scenario 3	VKT/annum - 2 way Scenario 1	VKT/annum - 2 way Scenario 2	VKT/annum - 2 way Scenario 3
Central Pit	Waste	Hauling from Central Pit to Caloma 2 inpit WRE	-	42,144.8	43,852.5	-	360,338.1	374,938.5
Central Pit	Waste	Hauling from Central Pit to SAR out of pit WRE	-	84,752.7	88,186.8	-	186,964.6	194,540.1
Central Pit	Ore	Hauling from Central Pit to ROM pad	-	-	20,219.8	-	-	243,891.0
Central Pit	Other	Articulated haul truck moving soil to soil stockpile to SE of SAR open cut	-	935.1	-	-	1,647.6	-
Central Pit	Other	Grader in pit road maintenance	-	-	-	-	17,520.0	-
South Pit	Waste	Hauling from South Pit to Caloma 1 inpit WRE	-	42,144.8	-	-	373,571.6	-
South Pit	Ore	Hauling from South Pit to ROM pad	-	5,494.5	5,054.9	-	68,241.8	62,782.4
South Pit	Other	Articulated haul truck moving soil to soil stockpile to SW of MLA area	-	442.1	-	-	1,225.5	-
South Pit	Other	Grader in pit road maintenance	-	-	-	-	17,520.0	-
South Pit	Waste	Hauling from South Pit to SAR WRE	-	84,752.7	-	-	186,456.0	-
North Pit	Waste	Hauling from North Pit to SAR out of pit WRE	-	-	59,888.1	-	-	200,385.4
North Pit	Other	Articulated haul truck moving soil to soil stockpile to E of SAR open cut North Pit	-	-	1,013.2	-	-	2,932.1
North Pit	Other	Grader in pit road maintenance	-	-	-	-	-	17,520.0
North Pit	Waste	Hauling from North Pit to Caloma in pit WRE	-	-	43,852.5	-	-	296,442.6
SAR Site Establishment	Other	Transporting material from borrow pit to construction site	20,231.5	-	-	94,279.0	-	-
SAR Site Establishment	Other	Transporting soil to soil stockpiles	5,723.1	-	-	19,458.5	-	-
SAR Site Establishment	Other	Grader shaping placed material	-	-	-	17,520.0	-	-
Road Construction Activities	Other	Transporting material along new road alignment	-	-	-	-	-	-
Road Construction Activities	Other	Grader shaping placed material	-	-	-	17,520.0	-	-
Road Construction Activities	Other	Roller compacting placed material	-	-	-	17,520.0	-	-

Blasting

The emissions of particulate matter from blasting operations have been estimated using emission factors presented in Section 11.9-2 of AP-42 (Western Surface Coal Mine)**Invalid source specified.**. The emission factors are:

$$EF_{TSP}\ (kg.blast^{-1}) = 0.00022 \times (A)^{1.5}$$

$$EF_{PM_{10}}\ (kg.blast^{-1}) = 0.52 \times (EF_{TSP})$$

$$EF_{PM_{2.5}}\ (kg.blast^{-1}) = 0.03 \times (EF_{TSP})$$

where:

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

A = horizontal area (m^2), with blasting depth ≤ 21 m.

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

For emissions of NO_X, data associated with the anticipated explosive usage during each year of the Project was provided by the Applicant, which indicated that the largest blast would use 188.6 t of explosive. Assuming the use of ANFO explosives, the emission rate of NO_X, referenced from (DEE, 2016) is 3.8 kg·t^{-1}. This results in 716.7 kg NO_X being emitted during the largest blast anticipated. The source of this blast has been assumed to be at the south of the South Pit, and in closest proximity to receptors to the southwest of the Project Site.

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) (USEPA, 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 $PM_{2.5}$.

Crushing (Primary and Secondary)

Emissions of particulate matter resulting from the processing of ore (primary and secondary crushing) have been estimated using the emission factors presented in Section 11.19.2 of AP-42 (Crushed Stone Processing and Pulverised Mineral Processing) (US EPA, 2004).

The emission factors within table 11.19.2-1 have been adopted for the operations outlined above. No emission factors associated with primary or secondary crushing are available within AP-42 although emission factors for tertiary crushers can be used as an upper limit for primary or secondary crushing (US EPA, 2004).

$PM_{2.5}$ emission factors are not available for uncontrolled crushing sources in AP-42 although have been taken to be 18% of PM10 as per controlled tertiary crushing in table 11.19.2-1 (US EPA, 2004).

For uncontrolled tertiary crushing (and uncontrolled primary and secondary crushing):

$$EF_{TSP}\ (kg.tonne^{-1}) = 0.0027$$

$$EF_{PM_{10}}\ (kg.tonne^{-1}) = 0.0012$$

$$EF_{PM_{2.5}}\ (kg.tonne^{-1}) = 0.00012$$

The quality rating for these emission factors is: Tertiary Crushing (uncontrolled) = E & C (TSP & PM10 respectively).

Drilling

Emissions of particulate matter resulting from drilling (overburden) operations have been estimated using the emission factors presented in Section 11.9-4 of AP-42 (Western Surface Coal Mining) (USEPA, 1998).

The emission factors within table 11.9-4 have been adopted for the operations outlined above. The emission factor is:

$$EF_{TSP}\ (kg.hole^{-1}) = 0.59$$

where:

EF_{TSP} = emission factor for total suspended particulate matter (kg per hole)

PM_{10} & $PM_{2.5}$ emission factors are not available in AP-42 although have been taken to be 52% of TSP for PM10 and, 3% of TSP for $PM_{2.5}$ as per AP-42 blasting (Table 11.9-2) (US EPA, 2004).

The quality rating for this emission factor is C.

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) (USEPA, 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 8 $km \cdot hr^{-1}$.

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.

Screening

Emissions of particulate matter resulting from the screening of material have been estimated using the emission factors presented in Section 11.19.2 of AP-42 (Crushed Stone Processing and Pulverised Mineral Processing) (US EPA, 2004).

The emission factors within table 11.19.2-1 have been adopted for the operations outlined above. PM2.5 emission factors are not available for uncontrolled screening sources in AP-42 although have been taken to be 7% of PM10 as per controlled screening activities in table 11.19.2-1 (US EPA, 2004).

For uncontrolled screening:

$$EF_{TSP}\ (kg.tonne^{-1}) = 0.0125$$

$$EF_{PM_{10}}\ (kg.tonne^{-1}) = 0.0043$$

$$EF_{PM_{2.5}}\ (kg.tonne^{-1}) = 0.00030$$

The quality rating for these emission factors is: screening (uncontrolled) = E & C (TSP & PM_{10} respectively).

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 Quarry site has been taken to be 5 % which is consistent with the assumption adopted in the original AQIA (PAEHolmes, 2011).

The mean weight of vehicles used on site is presented in **Table B2**.

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.

Emissions inventories for each of Scenario 1, Scenario 2 and Scenario 3 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.

Emissions associated with the construction of RSF2 are consistent with those presented in the MOD5 AQIA.

Table B3 TSP, PM_{10} and $PM_{2.5}$ emissions - Scenario 1

Description	Factor	Emission Rate			Units	Activity Rate	Units	Emission Controls	Controlled Emissions (kg·year-1)		
		TSP	PM_{10}	$PM_{2.5}$				(% efficiency)	TSP	PM10	PM2.5
Central Pit -Waste -Drilling	AP-42 - Drilling (Overburden) - Table 11.9-4	0.590	0.307	0.018	kg·hole-1	-	holes	Pit Retention	-	-	-
Central Pit -Waste -Blasting	AP-42 - Blasting (Coal or Overburden) - Table 11.9-2	14.080	7.322	0.422	kg·blast-1	-	blasts	Pit Retention	-	-	-
Central Pit -Waste -Excavator loading haul truck	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t	Pit Retention	-	-	-
Central Pit -Ore -Drilling	AP-42 - Drilling (Overburden) - Table 11.9-4	0.590	0.307	0.018	kg·hole-1	-	holes	Pit Retention	-	-	-
Central Pit -Ore -Blasting	AP-42 - Blasting (Coal or Overburden) - Table 11.9-2	14.080	7.322	0.422	kg·blast-1	-	blasts	Pit Retention	-	-	-
Central Pit -Ore -Excavator loading haul truck	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t	Pit Retention	-	-	-
Central Pit -Other -Excavator timming faces	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t	Pit Retention	-	-	-
Central Pit -Other -Dozer cleaning up pit floor	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	-	hr	Pit Retention	-	-	-
Central Pit -Other -Front end loader loading soil to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	-	t		-	-	-
South Pit -Waste -Drilling	AP-42 - Drilling (Overburden) - Table 11.9-4	0.590	0.307	0.018	kg·hole-1	-	holes	Pit Retention	-	-	-
South Pit -Waste -Blasting	AP-42 - Blasting (Coal or Overburden) - Table 11.9-2	14.080	7.322	0.422	kg·blast-1	-	blasts	Pit Retention	-	-	-
South Pit -Waste -Excavator loading haul truck	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t	Pit Retention	-	-	-
South Pit -Ore -Drilling	AP-42 - Drilling (Overburden) - Table 11.9-4	0.590	0.307	0.018	kg·hole-1	-	holes	Pit Retention	-	-	-
South Pit -Ore -Blasting	AP-42 - Blasting (Coal or Overburden) - Table 11.9-2	14.080	7.322	0.422	kg·blast-1	-	blasts	Pit Retention	-	-	-
South Pit -Ore -Excavator loading haul truck	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t	Pit Retention	-	-	-
South Pit -Other -Excavator timming faces	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t	Pit Retention	-	-	-
South Pit -Other -Dozer cleaning up pit floor	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	-	hr	Pit Retention	-	-	-
South Pit -Other -Front end loader loading soil to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	-	t		-	-	-
North Pit -Waste -Drilling	AP-42 - Drilling (Overburden) - Table 11.9-4	0.590	0.307	0.018	kg·hole-1	-	holes	Pit Retention	-	-	-
North Pit -Waste -Blasting	NPI - Blasting - Section 1.1.9	14.080	7.296	0.438	kg·blast-1	-	blasts	Pit Retention	-	-	-
North Pit -Ore -Excavator loading haul truck	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t	Pit Retention	-	-	-
North Pit -Other -Excavator timming faces	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t	Pit Retention	-	-	-
North Pit -Other -Dozer cleaning up pit floor	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	-	hr	Pit Retention	-	-	-
North Pit -Other -Front end loader loading soil to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	-	t		-	-	-
Caloma 1 & 2 WRE -Waste -Unloading waste from Central Pit, South Pit and/or North Pit	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t	Pit Retention	-	-	-
Caloma 1 & 2 WRE -Waste -Dozer pushing waste	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	-	hr	Pit Retention	-	-	-
Caloma 1 & 2 WRE -Waste -Shaping outer face of Caloma WRE	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-

Table B3 (continued)

Description	Factor	Emission Rate			Units	Activity Rate	Units	Emission Controls	Controlled Emissions (kg·year-1)		
		TSP	PM_{10}	$PM_{2.5}$				(% efficiency)	TSP	PM10	PM2.5
SAR WRE -Waste -Unloading waste from Central Pit, South Pit and/or North Pit	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
SAR WRE -Waste -Dozer pushing waste	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	-	hr		-	-	-
SAR WRE -Waste -Shaping outer face of SAR WRE	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Soil stockpiles -Other -Unloading soil at soil stockpile SE of SAR open cut	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	-	t		-	-	-
Soil stockpiles -Other -Front end loader moving soil at soil stockpile SE of SAR open cut	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	-	t		-	-	-
Soil stockpiles -Other -Unloading soil at soil stockpile at SW of MLA area	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	1,841,070.0	t		257.4	121.7	18.4
Soil stockpiles -Other -Front end loader moving soil at soil stockpile at SW of MLA area	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	1,841,070.0	t		514.8	243.5	36.9
Soil stockpiles -Other -Unloading soil at soil stockpile at E of SAR open cut North Pit	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	-	t		-	-	-
Soil stockpiles -Other -Front end loader moving soil at soil stockpile at E of SAR open cut North Pit	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	-	t		-	-	-
Processing Plant -Ore -Unloading ore at ROM pad	AP-42 - Batch drop - Section 13.2.4.3	0.004	0.002	0.002	kg·t-1	-	t		-	-	-
Processing Plant -Ore -Unloading ore at Temporary stockpile in Caloma 1	AP-42 - Batch drop - Section 13.2.4.3	0.004	0.002	0.002	kg·t-1	-	t		-	-	-
Processing Plant -Ore -Loading ore to crusher	AP-42 - Batch drop - Section 13.2.4.3	0.009	0.004	0.004	kg·t-1	-	t	Enclosed building	-	-	-
Processing Plant -Ore -Crushing	AP-42 - Primary crushing - Table 11.19.2.1	0.200	0.020	0.020	kg·t-1	-	tonnes	Enclosed building	-	-	-
Processing Plant -Ore -Unloading ore from conveyor to Screen Building	AP-42 - Batch drop - Section 13.2.4.3	0.009	0.004	0.004	kg·t-1	-	t		-	-	-
Processing Plant -Ore -Screening	AP-42 - Screening - Table 11.19.2.1	0.013	0.004	0.000	kg·t-1	-	tonnes	Enclosed building	-	-	-
Processing Plant -Ore -Unloading oversized ore from conveyor to Crushing Building	AP-42 - Batch drop - Section 13.2.4.3	0.009	0.004	0.004	kg·t-1	-	t		-	-	-
Processing Plant -Ore -Secondary crushing	AP-42 - Secondary crushing - Table 11.19.2.1	0.200	0.020	0.020	kg·t-1	-	tonnes	Enclosed building	-	-	-
Processing Plant -Ore -Unloading undersized ore from conveyor to Surge Bin	AP-42 - Batch drop - Section 13.2.4.3	0.009	0.004	0.004	kg·t-1	-	t		-	-	-
Processing Plant -Ore -Unloading undersized ore from conveyor to Ball Mill	AP-42 - Batch drop - Section 13.2.4.3	0.009	0.004	0.004	kg·t-1	-	t		-	-	-
SAR Site Establishment -Other -Digging material in borrow pit and loading to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	1,841,070.0	t		1,126.9	533.0	80.7
SAR Site Establishment -Other -Loading stripped soil from SAR area	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	520,800.0	t		145.6	68.9	10.4

Table B3 (continued)

Description	Factor	Emission Rate			Units	Activity Rate	Units	Emission Controls	Controlled Emissions (kg·year-1)		
		TSP	PM_{10}	$PM_{2.5}$				(% efficiency)	TSP	PM10	PM2.5
Road Construction Activities -Other -Scraper stripping soil and surface material	AP-42 - Topsoil removal by scraper - Table 11.9-4	0.029	0.007	0.001	kg·t-1	145,320.0	t		4,214.3	1,053.6	158.0
Road Construction Activities -Other -Digging material in borrow pit and loading to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	176,540.0	t		108.1	51.1	7.7
Road Construction Activities -Other -Unloading material along new road alignment	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	438,060.0	t		268.1	126.8	19.2
Road Construction Activities -Other -FEL/excavator on material	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	438,060.0	t		268.1	126.8	19.2
Road Construction Activities -Other -Piling for Kyalite Road overpass	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	700.0	t		0.4	0.2	0.0
Road Construction Activities -Other -Unloading material along amenity bund	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	792,400.0	t		485.0	229.4	34.7
Road Construction Activities -Other -Dozer shaping placed material, stripping, pushing up soil	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	1,791.9	hr		9,608.8	2,127.4	1,008.9
Road Construction Activities -Other -Unloading material along Southern barrier	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	723,800.0	t		443.0	209.5	31.7
Road Construction Activities -Other -Dozer shaping placed material, stripping, pushing up soil	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	1,636.8	hr		8,777.0	1,943.2	921.6
Road Construction Activities -Other -Unloading material along haul road	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	239,330.0	t		146.5	69.3	10.5
Road Construction Activities -Other -Dozer shaping placed material, stripping, pushing up soil	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	304.7	hr		1,634.0	361.8	171.6
Road Construction Activities -Other -Unloading material at Admin Area	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	76,300.0	t		46.7	22.1	3.3
Road Construction Activities -Other -Dozer shaping placed material, stripping, pushing up soil	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	172.5	hr		925.2	204.8	97.1
Road Construction Activities -Other -Unloading material at Pastefill Plant	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	9,240.0	t		5.7	2.7	0.4
Road Construction Activities -Other -Dozer shaping placed material, stripping, pushing up soil	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	20.9	hr		112.0	24.8	11.8
Road Construction Activities -Other -Unloading material at Kyalite Road E of Hwy	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	104,580.0	t		64.0	30.3	4.6
Central Pit -Waste -Hauling from Central Pit to Caloma 2 inpit WRE	AP-42 Unpaved roads - Section 13.2.2	5.064	1.301	0.130	kg·VKT-1	-	VKT	Control to 90%	-	-	-
Central Pit -Waste -Hauling from Central Pit to SAR out of pit WRE	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	-	VKT	Control to 90%	-	-	-
Central Pit -Ore -Hauling from Central Pit to ROM pad	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	-	VKT	Control to 90%	-	-	-
Central Pit -Other -Articulated haul truck moving soil to soil stockpile to SE of SAR open cut	AP-42 Unpaved roads - Section 13.2.2	2.825	0.726	0.073	kg·VKT-1	-	VKT	Control to 90%	-	-	-
Central Pit -Other -Grader in pit road maintenance	AP-42 - Grading - Table 11.9-2	0.615	0.215	0.019	kg·VKT-1	-	VKT	Control to 90%	-	-	-
South Pit -Waste -Hauling from South Pit to Caloma 1 inpit WRE	AP-42 Unpaved roads - Section 13.2.2	5.064	1.301	0.130	kg·VKT-1	-	VKT	Control to 90%	-	-	-
South Pit -Ore -Hauling from South Pit to ROM pad	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	-	VKT	Control to 90%	-	-	-
South Pit -Other -Articulated haul truck moving soil to soil stockpile to SW of MLA area	AP-42 Unpaved roads - Section 13.2.2	2.825	0.726	0.073	kg·VKT-1	-	VKT	Control to 90%	-	-	-
South Pit -Other -Grader in pit road maintenance	AP-42 - Grading - Table 11.9-2	0.615	0.215	0.019	kg·VKT-1	-	VKT	Control to 90%	-	-	-
South Pit -Waste -Hauling from South Pit to SAR WRE	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	-	VKT	Control to 90%	-	-	-
North Pit -Waste -Hauling from North Pit to SAR out of pit WRE	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	-	VKT	Control to 90%	-	-	-
North Pit -Other -Articulated haul truck moving soil to soil stockpile to E of SAR open cut North Pit	AP-42 Unpaved roads - Section 13.2.2	2.825	0.726	0.073	kg·VKT-1	-	VKT	Control to 90%	-	-	-
North Pit -Other -Grader in pit road maintenance	AP-42 - Grading - Table 11.9-2	0.615	0.215	0.019	kg·VKT-1	-	VKT	Control to 90%	-	-	-
North Pit -Waste -Hauling from North Pit to Caloma in pit WRE	AP-42 Unpaved roads - Section 13.2.2	5.064	1.301	0.130	kg·VKT-1	-	VKT	Control to 90%	-	-	-

Table B3 (continued)

Description	Factor	Emission Rate			Units	Activity Rate	Units	Emission Controls	Controlled Emissions (kg·year-1)		
		TSP	PM_{10}	$PM_{2.5}$				(% efficiency)	TSP	PM10	PM2.5
SAR Site Establishment -Other -Transporting material from borrow pit to construction site	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	94,279.0	VKT	Control to 90%	38,699.5	9,943.9	994.4
SAR Site Establishment -Other -Transporting soil to soil stockpiles	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	19,458.5	VKT	Control to 90%	7,987.3	2,052.4	205.2
SAR Site Establishment -Other -Grader shaping placed material	AP-42 - Grading - Table 11.9-2	0.615	0.215	0.019	kg·VKT-1	17,520.0	VKT	Control to 90%	1,078.3	376.8	33.4
Road Construction Activities -Other -Transporting material along new road alignment	AP-42 Unpaved roads - Section 13.2.2	2.825	0.726	0.073	kg·VKT-1	23,402.0	VKT	Control to 90%	6,611.9	1,698.9	169.9
Road Construction Activities -Other -Grader shaping placed material	AP-42 - Grading - Table 11.9-2	0.615	0.215	0.019	kg·VKT-1	17,520.0	VKT	Control to 90%	1,078.3	376.8	33.4
Road Construction Activities -Other -Roller compacting placed material	AP-42 - Grading - Table 11.9-2	0.615	0.215	0.019	kg·VKT-1	17,520.0	VKT	Control to 90%	1,078.3	376.8	33.4
Central Pit -Other -Wind erosion of exposed area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	-	ha	Pit retention	-	-	-
South Pit -Other -Wind erosion of exposed area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	-	ha	Pit retention	-	-	-
North Pit -Other -Wind erosion of exposed area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	-	ha	Pit retention	-	-	-
Caloma 1 & 2 WRE -Waste -Wind erosion	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	-	ha	Pit retention	-	-	-
SAR WRE -Waste -Wind erosion	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	-	ha		-	-	-
Soil Stockpiles -Other -Wind erosion of soil stockpile SE of SAR open cut	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	-	ha		-	-	-
Soil Stockpiles -Other -Wind erosion of soil stockpile at SW of MLA area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	22.3	ha		18,995.0	9,497.5	1,424.6
Soil Stockpiles -Other -Wind erosion of soil stockpile at E of SAR open cut North Pit	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	-	ha		-	-	-
								TOTAL	**104,680.4**	**31,873.9**	**5,541.4**

Table B4 TSP, PM_{10} and $PM_{2.5}$ emissions - Scenario 2

Description	Factor	Emission Rate			Units	Activity Rate	Units	Emission Controls	Controlled Emissions (kg·year-1)		
		TSP	PM_{10}	$PM_{2.5}$				(% efficiency)	TSP	PM10	PM2.5
Central Pit -Waste -Drilling	AP-42 - Drilling (Overburden) - Table 11.9-4	0.590	0.307	0.018	kg·hole-1	2,940.0	holes	Pit Retention	34.7	34.3	2.0
Central Pit -Waste -Blasting	AP-42 - Blasting (Coal or Overburden) - Table 11.9-2	14.080	7.322	0.422	kg·blast-1	19.6	blasts	Pit Retention	138.0	136.3	7.9
Central Pit -Waste -Excavator loading haul truck	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	15,425,000.0	t	Pit Retention	2,360.4	2,121.2	321.2
Central Pit -Ore -Drilling	AP-42 - Drilling (Overburden) - Table 11.9-4	0.590	0.307	0.018	kg·hole-1	-	holes	Pit Retention	-	-	-
Central Pit -Ore -Blasting	AP-42 - Blasting (Coal or Overburden) - Table 11.9-2	14.080	7.322	0.422	kg·blast-1	-	blasts	Pit Retention	-	-	-
Central Pit -Ore -Excavator loading haul truck	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t	Pit Retention	-	-	-
Central Pit -Other -Excavator timming faces	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	21,900.0	t	Pit Retention	6.7	6.0	0.9
Central Pit -Other -Dozer cleaning up pit floor	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	6,311.0	hr	Pit Retention	16,921.1	7,118.0	3,375.8
Central Pit -Other -Front end loader loading soil to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	35,532.0	t		9.9	4.7	0.7
South Pit -Waste -Drilling	AP-42 - Drilling (Overburden) - Table 11.9-4	0.590	0.307	0.018	kg·hole-1	10,290.0	holes	Pit Retention	121.4	120.0	6.9
South Pit -Waste -Blasting	AP-42 - Blasting (Coal or Overburden) - Table 11.9-2	14.080	7.322	0.422	kg·blast-1	68.6	blasts	Pit Retention	482.9	477.1	27.5
South Pit -Waste -Excavator loading haul truck	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	15,425,000.0	t	Pit Retention	2,360.4	2,121.2	321.2
South Pit -Ore -Drilling	AP-42 - Drilling (Overburden) - Table 11.9-4	0.590	0.307	0.018	kg·hole-1	1,470.0	holes	Pit Retention	17.3	17.1	1.0
South Pit -Ore -Blasting	AP-42 - Blasting (Coal or Overburden) - Table 11.9-2	14.080	7.322	0.422	kg·blast-1	9.8	blasts	Pit Retention	69.0	68.2	3.9
South Pit -Ore -Excavator loading haul truck	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	500,000.0	t	Pit Retention	76.5	68.8	10.4
South Pit -Other -Excavator timming faces	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	21,900.0	t	Pit Retention	6.7	6.0	0.9
South Pit -Other -Dozer cleaning up pit floor	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	6,311.0	hr	Pit Retention	16,921.1	7,118.0	3,375.8
South Pit -Other -Front end loader loading soil to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	16,800.0	t		4.7	2.2	0.3
North Pit -Waste -Drilling	AP-42 - Drilling (Overburden) - Table 11.9-4	0.590	0.307	0.018	kg·hole-1	-	holes	Pit Retention	-	-	-
North Pit -Waste -Blasting	NPI - Blasting - Section 1.1.9	14.080	7.296	0.438	kg·blast-1	-	blasts	Pit Retention	-	-	-
North Pit -Ore -Excavator loading haul truck	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t	Pit Retention	-	-	-
North Pit -Other -Excavator timming faces	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t	Pit Retention	-	-	-
North Pit -Other -Dozer cleaning up pit floor	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	-	hr	Pit Retention	-	-	-
North Pit -Other -Front end loader loading soil to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	-	t		-	-	-
Caloma 1 & 2 WRE -Waste -Unloading waste from Central Pit, South Pit and/or North Pit	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	15,425,000.0	t	Pit Retention	2,360.4	2,121.2	321.2
Caloma 1 & 2 WRE -Waste -Dozer pushing waste	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	13,523.0	hr	Pit Retention	18,129.0	7,626.1	3,616.7
Caloma 1 & 2 WRE -Waste -Shaping outer face of Caloma WRE	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	5,410.0	t		3.3	1.6	0.2

Table B4 (continued)

Description	Factor	Emission Rate			Units	Activity Rate	Units	Emission Controls	Controlled Emissions (kg·year-1)		
		TSP	PM_{10}	$PM_{2.5}$				(% efficiency)	TSP	PM10	PM2.5
SAR WRE -Waste -Unloading waste from Central Pit, South Pit and/or North Pit	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	15,425,000.0	t		4,720.9	2,232.9	338.1
SAR WRE -Waste -Dozer pushing waste	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	13,484.0	hr		36,153.3	8,004.3	3,796.1
SAR WRE -Waste -Shaping outer face of SAR WRE	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	5,395.0	t		3.3	1.6	0.2
Soil stockpiles -Other -Unloading soil at soil stockpile SE of SAR open cut	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	52,332.0	t		7.3	3.5	0.5
Soil stockpiles -Other -Front end loader moving soil at soil stockpile SE of SAR open cut	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	52,332.0	t		14.6	6.9	1.0
Soil stockpiles -Other -Unloading soil at soil stockpile at SW of MLA area	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	-	t		-	-	-
Soil stockpiles -Other -Front end loader moving soil at soil stockpile at SW of MLA area	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	-	t		-	-	-
Soil stockpiles -Other -Unloading soil at soil stockpile at E of SAR open cut North Pit	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	-	t		-	-	-
Soil stockpiles -Other -Front end loader moving soil at soil stockpile at E of SAR open cut North Pit	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	-	t		-	-	-
Processing Plant -Ore -Unloading ore at ROM pad	AP-42 - Batch drop - Section 13.2.4.3	0.004	0.002	0.002	kg·t-1	262,017.0	t		524.0	222.7	220.1
Processing Plant -Ore -Unloading ore at Temporary stockpile in Caloma 1	AP-42 - Batch drop - Section 13.2.4.3	0.004	0.002	0.002	kg·t-1	-	t		-	-	-
Processing Plant -Ore -Loading ore to crusher	AP-42 - Batch drop - Section 13.2.4.3	0.009	0.004	0.004	kg·t-1	37,017.0	t	Enclosed building	16.7	7.0	7.0
Processing Plant -Ore -Crushing	AP-42 - Primary crushing - Table 11.19.2.1	0.200	0.020	0.020	kg·t-1	37,017.0	tonnes	Enclosed building	370.2	37.0	37.0
Processing Plant -Ore -Unloading ore from conveyor to Screen Building	AP-42 - Batch drop - Section 13.2.4.3	0.009	0.004	0.004	kg·t-1	37,017.0	t		166.6	70.3	70.0
Processing Plant -Ore -Screening	AP-42 - Screening - Table 11.19.2.1	0.013	0.004	0.000	kg·t-1	37,017.0	tonnes	Enclosed building	23.1	8.0	0.6
Processing Plant -Ore -Unloading oversized ore from conveyor to Crushing Building	AP-42 - Batch drop - Section 13.2.4.3	0.009	0.004	0.004	kg·t-1	35,166.2	t		158.2	66.8	66.5
Processing Plant -Ore -Secondary crushing	AP-42 - Secondary crushing - Table 11.19.2.1	0.200	0.020	0.020	kg·t-1	35,166.2	tonnes	Enclosed building	351.7	35.2	35.2
Processing Plant -Ore -Unloading undersized ore from conveyor to Surge Bin	AP-42 - Batch drop - Section 13.2.4.3	0.009	0.004	0.004	kg·t-1	1,850.9	t		16.7	7.0	7.0
Processing Plant -Ore -Unloading undersized ore from conveyor to Ball Mill	AP-42 - Batch drop - Section 13.2.4.3	0.009	0.004	0.004	kg·t-1	1,850.9	t		16.7	7.0	7.0
SAR Site Establishment -Other -Digging material in borrow pit and loading to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
SAR Site Establishment -Other -Loading stripped soil from SAR area	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	-	t		-	-	-

Table B4 (continued)

Description	Factor	Emission Rate			Units	Activity Rate	Units	Emission Controls	Controlled Emissions (kg·year-1)		
		TSP	PM_{10}	$PM_{2.5}$				(% efficiency)	TSP	PM10	PM2.5
Road Construction Activities -Other -Scraper stripping soil and surface material	AP-42 - Topsoil removal by scraper - Table 11.9-4	0.029	0.007	0.001	kg·t-1	-	t		-	-	-
Road Construction Activities -Other -Digging material in borrow pit and loading to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Road Construction Activities -Other -Unloading material along new road alignment	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Road Construction Activities -Other -FEL/excavator on material	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Road Construction Activities -Other -Piling for Kyalite Road overpass	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Road Construction Activities -Other -Unloading material along amenity bund	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Road Construction Activities -Other -Dozer shaping placed material, stripping, pushing up soil	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	-	hr		-	-	-
Road Construction Activities -Other -Unloading material along Southern barrier	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Road Construction Activities -Other -Dozer shaping placed material, stripping, pushing up soil	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	-	hr		-	-	-
Road Construction Activities -Other -Unloading material along haul road	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Road Construction Activities -Other -Dozer shaping placed material, stripping, pushing up soil	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	-	hr		-	-	-
Road Construction Activities -Other -Unloading material at Admin Area	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Road Construction Activities -Other -Dozer shaping placed material, stripping, pushing up soil	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	-	hr		-	-	-
Road Construction Activities -Other -Unloading material at Pastefill Plant	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Road Construction Activities -Other -Dozer shaping placed material, stripping, pushing up soil	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	-	hr		-	-	-
Road Construction Activities -Other -Unloading material at Kyalite Road E of Hwy	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Central Pit -Waste -Hauling from Central Pit to Caloma 2 inpit WRE	AP-42 Unpaved roads - Section 13.2.2	5.064	1.301	0.130	kg·VKT-1	360,338.1	VKT	Control to 90%	182,490.8	46,891.5	4,689.1
Central Pit -Waste -Hauling from Central Pit to SAR out of pit WRE	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	186,964.6	VKT	Control to 90%	76,745.0	19,719.8	1,972.0
Central Pit -Ore -Hauling from Central Pit to ROM pad	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	-	VKT	Control to 90%	-	-	-
Central Pit -Other -Articulated haul truck moving soil to soil stockpile to SE of SAR open cut	AP-42 Unpaved roads - Section 13.2.2	2.825	0.726	0.073	kg·VKT-1	1,647.6	VKT	Control to 90%	465.5	119.6	12.0
Central Pit -Other -Grader in pit road maintenance	AP-42 - Grading - Table 11.9-2	0.615	0.215	0.019	kg·VKT-1	17,520.0	VKT	Control to 90%	1,078.3	376.8	33.4
South Pit -Waste -Hauling from South Pit to Caloma 1 inpit WRE	AP-42 Unpaved roads - Section 13.2.2	5.064	1.301	0.130	kg·VKT-1	373,571.6	VKT	Control to 90%	189,192.8	48,613.6	4,861.4
South Pit -Ore -Hauling from South Pit to ROM pad	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	68,241.8	VKT	Control to 90%	28,011.8	7,197.7	719.8
South Pit -Other -Articulated haul truck moving soil to soil stockpile to SW of MLA area	AP-42 Unpaved roads - Section 13.2.2	2.825	0.726	0.073	kg·VKT-1	1,225.5	VKT	Control to 90%	346.2	89.0	8.9
South Pit -Other -Grader in pit road maintenance	AP-42 - Grading - Table 11.9-2	0.615	0.215	0.019	kg·VKT-1	17,520.0	VKT	Control to 90%	1,078.3	376.8	33.4
South Pit -Waste -Hauling from South Pit to SAR WRE	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	186,456.0	VKT	Control to 90%	76,536.3	19,666.2	1,966.6
North Pit -Waste -Hauling from North Pit to SAR out of pit WRE	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	-	VKT	Control to 90%	-	-	-
North Pit -Other -Articulated haul truck moving soil to soil stockpile to E of SAR open cut North Pit	AP-42 Unpaved roads - Section 13.2.2	2.825	0.726	0.073	kg·VKT-1	-	VKT	Control to 90%	-	-	-
North Pit -Other -Grader in pit road maintenance	AP-42 - Grading - Table 11.9-2	0.615	0.215	0.019	kg·VKT-1	-	VKT	Control to 90%	-	-	-
North Pit -Waste -Hauling from North Pit to Caloma in pit WRE	AP-42 Unpaved roads - Section 13.2.2	5.064	1.301	0.130	kg·VKT-1	-	VKT	Control to 90%	-	-	-

Table B4 (continued)

Description	Factor	Emission Rate			Units	Activity Rate	Units	Emission Controls	Controlled Emissions (kg·year-1)		
		TSP	PM_{10}	$PM_{2.5}$				(% efficiency)	TSP	PM10	PM2.5
SAR Site Establishment -Other -Transporting material from borrow pit to construction site	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	-	VKT	Control to 90%	-	-	-
SAR Site Establishment -Other -Transporting soil to soil stockpiles	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	-	VKT	Control to 90%	-	-	-
SAR Site Establishment -Other -Grader shaping placed material	AP-42 - Grading - Table 11.9-2	0.615	0.215	0.019	kg·VKT-1	-	VKT	Control to 90%	-	-	-
Road Construction Activities -Other -Transporting material along new road alignment	AP-42 Unpaved roads - Section 13.2.2	2.825	0.726	0.073	kg·VKT-1	-	VKT	Control to 90%	-	-	-
Road Construction Activities -Other -Grader shaping placed material	AP-42 - Grading - Table 11.9-2	0.615	0.215	0.019	kg·VKT-1	-	VKT	Control to 90%	-	-	-
Road Construction Activities -Other -Roller compacting placed material	AP-42 - Grading - Table 11.9-2	0.615	0.215	0.019	kg·VKT-1	-	VKT	Control to 90%	-	-	-
Central Pit -Other -Wind erosion of exposed area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	24.2	ha	Pit retention	10,278.5	9,764.6	1,464.7
South Pit -Other -Wind erosion of exposed area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	26.5	ha	Pit retention	11,246.0	10,683.7	1,602.6
North Pit -Other -Wind erosion of exposed area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	13.7	ha	Pit retention	5,805.8	5,515.5	827.3
Caloma 1 & 2 WRE -Waste -Wind erosion	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	15.6	ha	Pit retention	6,624.4	6,293.2	944.0
SAR WRE -Waste -Wind erosion	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	64.7	ha		54,980.5	27,490.2	4,123.5
Soil Stockpiles -Other -Wind erosion of soil stockpile SE of SAR open cut	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	19.8	ha		16,830.8	8,415.4	1,262.3
Soil Stockpiles -Other -Wind erosion of soil stockpile at SW of MLA area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	-	ha		-	-	-
Soil Stockpiles -Other -Wind erosion of soil stockpile at E of SAR open cut North Pit	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	-	ha		-	-	-
								TOTAL	**764,278.0**	**251,091.8**	**40,501.9**

Table B5 TSP, PM_{10} and $PM_{2.5}$ emissions - Scenario 3

Description	Factor	Emission Rate			Units	Activity Rate	Units	Emission Controls	Controlled Emissions (kg·year-1)		
		TSP	PM_{10}	$PM_{2.5}$				(% efficiency)	TSP	PM10	PM2.5
Central Pit -Waste -Drilling	AP-42 - Drilling (Overburden) - Table 11.9-4	0.590	0.307	0.018	kg·hole-1	35,700.0	holes	Pit Retention	421.3	416.2	24.0
Central Pit -Waste -Blasting	AP-42 - Blasting (Coal or Overburden) - Table 11.9-2	14.080	7.322	0.422	kg·blast-1	238.0	blasts	Pit Retention	1,675.5	1,655.4	95.5
Central Pit -Waste -Excavator loading haul truck	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	16,050,000.0	t	Pit Retention	2,456.1	2,207.2	334.2
Central Pit -Ore -Drilling	AP-42 - Drilling (Overburden) - Table 11.9-4	0.590	0.307	0.018	kg·hole-1	10,200.0	holes	Pit Retention	120.4	118.9	6.9
Central Pit -Ore -Blasting	AP-42 - Blasting (Coal or Overburden) - Table 11.9-2	14.080	7.322	0.422	kg·blast-1	68.0	blasts	Pit Retention	478.7	473.0	27.3
Central Pit -Ore -Excavator loading haul truck	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	1,840,000.0	t	Pit Retention	281.6	253.0	38.3
Central Pit -Other -Excavator timming faces	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	21,900.0	t	Pit Retention	6.7	6.0	0.9
Central Pit -Other -Dozer cleaning up pit floor	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	6,742.0	hr	Pit Retention	18,076.7	7,604.1	3,606.3
Central Pit -Other -Front end loader loading soil to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	-	t		-	-	-
South Pit -Waste -Drilling	AP-42 - Drilling (Overburden) - Table 11.9-4	0.590	0.307	0.018	kg·hole-1	-	holes	Pit Retention	-	-	-
South Pit -Waste -Blasting	AP-42 - Blasting (Coal or Overburden) - Table 11.9-2	14.080	7.322	0.422	kg·blast-1	-	blasts	Pit Retention	-	-	-
South Pit -Waste -Excavator loading haul truck	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t	Pit Retention	-	-	-
South Pit -Ore -Drilling	AP-42 - Drilling (Overburden) - Table 11.9-4	0.590	0.307	0.018	kg·hole-1	5,100.0	holes	Pit Retention	60.2	59.5	3.4
South Pit -Ore -Blasting	AP-42 - Blasting (Coal or Overburden) - Table 11.9-2	14.080	7.322	0.422	kg·blast-1	34.0	blasts	Pit Retention	239.4	236.5	13.6
South Pit -Ore -Excavator loading haul truck	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	460,000.0	t	Pit Retention	70.4	63.3	9.6
South Pit -Other -Excavator timming faces	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t	Pit Retention	-	-	-
South Pit -Other -Dozer cleaning up pit floor	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	-	hr	Pit Retention	-	-	-
South Pit -Other -Front end loader loading soil to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	-	t		-	-	-
North Pit -Waste -Drilling	AP-42 - Drilling (Overburden) - Table 11.9-4	0.590	0.307	0.018	kg·hole-1	-	holes	Pit Retention	-	-	-
North Pit -Waste -Blasting	NPI - Blasting - Section 1.1.9	14.080	7.296	0.438	kg·blast-1	-	blasts	Pit Retention	-	-	-
North Pit -Ore -Excavator loading haul truck	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	16,050,000.0	t	Pit Retention	2,456.1	2,207.2	334.2
North Pit -Other -Excavator timming faces	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t	Pit Retention	-	-	-
North Pit -Other -Dozer cleaning up pit floor	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	6,742.0	hr	Pit Retention	9,038.3	3,802.1	1,803.1
North Pit -Other -Front end loader loading soil to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	38,500.0	t		10.8	5.1	0.8
Caloma 1 & 2 WRE -Waste -Unloading waste from Central Pit, South Pit and/or North Pit	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	16,050,000.0	t	Pit Retention	2,456.1	2,207.2	334.2
Caloma 1 & 2 WRE -Waste -Dozer pushing waste	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	13,523.0	hr	Pit Retention	18,129.0	7,626.1	3,616.7
Caloma 1 & 2 WRE -Waste -Shaping outer face of Caloma WRE	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	5,410.0	t		3.3	1.6	0.2

Table B5 (continued)

Description	Factor	Emission Rate			Units	Activity Rate	Units	Emission Controls	Controlled Emissions (kg·year-1)		
		TSP	PM_{10}	$PM_{2.5}$				(% efficiency)	TSP	PM10	PM2.5
SAR WRE -Waste -Unloading waste from Central Pit, South Pit and/or North Pit	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	16,050,000.0	t		4,912.2	2,323.3	351.8
SAR WRE -Waste -Dozer pushing waste	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	13,484.0	hr		36,153.3	8,004.3	3,796.1
SAR WRE -Waste -Shaping outer face of SAR WRE	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	5,395.0	t		3.3	1.6	0.2
Soil stockpiles -Other -Unloading soil at soil stockpile SE of SAR open cut	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	-	t		-	-	-
Soil stockpiles -Other -Front end loader moving soil at soil stockpile SE of SAR open cut	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	-	t		-	-	-
Soil stockpiles -Other -Unloading soil at soil stockpile at SW of MLA area	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	-	t		-	-	-
Soil stockpiles -Other -Front end loader moving soil at soil stockpile at SW of MLA area	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	-	t		-	-	-
Soil stockpiles -Other -Unloading soil at soil stockpile at E of SAR open cut North Pit	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	38,500.0	t		5.4	2.5	0.4
Soil stockpiles -Other -Front end loader moving soil at soil stockpile at E of SAR open cut North Pit	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	38,500.0	t		10.8	5.1	0.8
Processing Plant -Ore -Unloading ore at ROM pad	AP-42 - Batch drop - Section 13.2.4.3	0.004	0.002	0.002	kg·t-1	662,017.0	t		1,324.0	562.7	556.1
Processing Plant -Ore -Unloading ore at Temporary stockpile in Caloma 1	AP-42 - Batch drop - Section 13.2.4.3	0.004	0.002	0.002	kg·t-1	1,400,000.0	t		5,600.0	2,380.0	2,352.0
Processing Plant -Ore -Loading ore to crusher	AP-42 - Batch drop - Section 13.2.4.3	0.009	0.004	0.004	kg·t-1	662,017.0	t	Enclosed building	297.9	125.8	125.1
Processing Plant -Ore -Crushing	AP-42 - Primary crushing - Table 11.19.2.1	0.200	0.020	0.020	kg·t-1	662,017.0	tonnes	Enclosed building	6,620.2	662.0	662.0
Processing Plant -Ore -Unloading ore from conveyor to Screen Building	AP-42 - Batch drop - Section 13.2.4.3	0.009	0.004	0.004	kg·t-1	662,017.0	t		2,979.1	1,257.8	1,251.2
Processing Plant -Ore -Screening	AP-42 - Screening - Table 11.19.2.1	0.013	0.004	0.000	kg·t-1	662,017.0	tonnes	Enclosed building	413.8	142.3	10.0
Processing Plant -Ore -Unloading oversized ore from conveyor to Crushing Building	AP-42 - Batch drop - Section 13.2.4.3	0.009	0.004	0.004	kg·t-1	628,916.2	t		2,830.1	1,194.9	1,188.7
Processing Plant -Ore -Secondary crushing	AP-42 - Secondary crushing - Table 11.19.2.1	0.200	0.020	0.020	kg·t-1	628,916.2	tonnes	Enclosed building	6,289.2	628.9	628.9
Processing Plant -Ore -Unloading undersized ore from conveyor to Surge Bin	AP-42 - Batch drop - Section 13.2.4.3	0.009	0.004	0.004	kg·t-1	33,100.9	t		297.9	125.8	125.1
Processing Plant -Ore -Unloading undersized ore from conveyor to Ball Mill	AP-42 - Batch drop - Section 13.2.4.3	0.009	0.004	0.004	kg·t-1	33,100.9	t		297.9	125.8	125.1
SAR Site Establishment -Other -Digging material in borrow pit and loading to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
SAR Site Establishment -Other -Loading stripped soil from SAR area	AP-42 - Batch drop - Section 13.2.4.3	0.000	0.000	0.000	kg·t-1	-	t		-	-	-

Table B5 (continued)

Description	Factor	Emission Rate			Units	Activity Rate	Units	Emission Controls	Controlled Emissions (kg·year-1)		
		TSP	PM_{10}	$PM_{2.5}$				(% efficiency)	TSP	PM10	PM2.5
Road Construction Activities -Other -Scraper stripping soil and surface material	AP-42 - Topsoil removal by scraper - Table 11.9-4	0.029	0.007	0.001	kg·t-1	-	t		-	-	-
Road Construction Activities -Other -Digging material in borrow pit and loading to haul trucks	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Road Construction Activities -Other -Unloading material along new road alignment	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Road Construction Activities -Other -FEL/excavator on material	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Road Construction Activities -Other -Piling for Kyalite Road overpass	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Road Construction Activities -Other -Unloading material along amenity bund	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Road Construction Activities -Other -Dozer shaping placed material, stripping, pushing up soil	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	-	hr		-	-	-
Road Construction Activities -Other -Unloading material along Southern barrier	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Road Construction Activities -Other -Dozer shaping placed material, stripping, pushing up soil	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	-	hr		-	-	-
Road Construction Activities -Other -Unloading material along haul road	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Road Construction Activities -Other -Dozer shaping placed material, stripping, pushing up soil	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	-	hr		-	-	-
Road Construction Activities -Other -Unloading material at Admin Area	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Road Construction Activities -Other -Dozer shaping placed material, stripping, pushing up soil	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	-	hr		-	-	-
Road Construction Activities -Other -Unloading material at Pastefill Plant	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Road Construction Activities -Other -Dozer shaping placed material, stripping, pushing up soil	AP-42 - Bulldozing (Overburden) - Table 11.9-2	5.362	1.187	0.563	kg·hr-1	-	hr		-	-	-
Road Construction Activities -Other -Unloading material at Kyalite Road E of Hwy	AP-42 - Batch drop - Section 13.2.4.3	0.001	0.000	0.000	kg·t-1	-	t		-	-	-
Central Pit -Waste -Hauling from Central Pit to Caloma 2 inpit WRE	AP-42 Unpaved roads - Section 13.2.2	5.064	1.301	0.130	kg·VKT-1	374,938.5	VKT	Control to 90%	189,885.1	48,791.4	4,879.1
Central Pit -Waste -Hauling from Central Pit to SAR out of pit WRE	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	194,540.1	VKT	Control to 90%	79,854.6	20,518.9	2,051.9
Central Pit -Ore -Hauling from Central Pit to ROM pad	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	243,891.0	VKT	Control to 90%	100,112.1	25,724.1	2,572.4
Central Pit -Other -Articulated haul truck moving soil to soil stockpile to SE of SAR open cut	AP-42 Unpaved roads - Section 13.2.2	2.825	0.726	0.073	kg·VKT-1	-	VKT	Control to 90%	-	-	-
Central Pit -Other -Grader in pit road maintenance	AP-42 - Grading - Table 11.9-2	0.615	0.215	0.019	kg·VKT-1	-	VKT	Control to 90%	-	-	-
South Pit -Waste -Hauling from South Pit to Caloma 1 inpit WRE	AP-42 Unpaved roads - Section 13.2.2	5.064	1.301	0.130	kg·VKT-1	-	VKT	Control to 90%	-	-	-
South Pit -Ore -Hauling from South Pit to ROM pad	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	62,782.4	VKT	Control to 90%	25,770.9	6,621.9	662.2
South Pit -Other -Articulated haul truck moving soil to soil stockpile to SW of MLA area	AP-42 Unpaved roads - Section 13.2.2	2.825	0.726	0.073	kg·VKT-1	-	VKT	Control to 90%	-	-	-
South Pit -Other -Grader in pit road maintenance	AP-42 - Grading - Table 11.9-2	0.615	0.215	0.019	kg·VKT-1	-	VKT	Control to 90%	-	-	-
South Pit -Waste -Hauling from South Pit to SAR WRE	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	-	VKT	Control to 90%	-	-	-
North Pit -Waste -Hauling from North Pit to SAR out of pit WRE	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	200,385.4	VKT	Control to 90%	82,254.0	21,135.4	2,113.5
North Pit -Other -Articulated haul truck moving soil to soil stockpile to E of SAR open cut North Pit	AP-42 Unpaved roads - Section 13.2.2	2.825	0.726	0.073	kg·VKT-1	2,932.1	VKT	Control to 90%	828.4	212.9	21.3
North Pit -Other -Grader in pit road maintenance	AP-42 - Grading - Table 11.9-2	0.615	0.215	0.019	kg·VKT-1	17,520.0	VKT	Control to 90%	1,078.3	376.8	33.4
North Pit -Waste -Hauling from North Pit to Caloma in pit WRE	AP-42 Unpaved roads - Section 13.2.2	5.064	1.301	0.130	kg·VKT-1	296,442.6	VKT	Control to 90%	150,131.3	38,576.6	3,857.7

Table B5 (continued)

Description	Factor	Emission Rate TSP	Emission Rate PM_{10}	Emission Rate $PM_{2.5}$	Units	Activity Rate	Units	Emission Controls (% efficiency)	Controlled Emissions (kg·year-1) TSP	Controlled Emissions (kg·year-1) PM10	Controlled Emissions (kg·year-1) PM2.5
SAR Site Establishment -Other -Transporting material from borrow pit to construction site	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	-	VKT	Control to 90%	-	-	-
SAR Site Establishment -Other -Transporting soil to soil stockpiles	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg·VKT-1	-	VKT	Control to 90%	-	-	-
SAR Site Establishment -Other -Grader shaping placed material	AP-42 - Grading - Table 11.9-2	0.615	0.215	0.019	kg·VKT-1	-	VKT	Control to 90%	-	-	-
Road Construction Activities -Other -Transporting material along new road alignment	AP-42 Unpaved roads - Section 13.2.2	2.825	0.726	0.073	kg·VKT-1	-	VKT	Control to 90%	-	-	-
Road Construction Activities -Other -Grader shaping placed material	AP-42 - Grading - Table 11.9-2	0.615	0.215	0.019	kg·VKT-1	-	VKT	Control to 90%	-	-	-
Road Construction Activities -Other -Roller compacting placed material	AP-42 - Grading - Table 11.9-2	0.615	0.215	0.019	kg·VKT-1	-	VKT	Control to 90%	-	-	-
Central Pit -Other -Wind erosion of exposed area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	24.2	ha	Pit retention	10,278.5	9,764.6	1,464.7
South Pit -Other -Wind erosion of exposed area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	26.5	ha	Pit retention	11,246.0	10,683.7	1,602.6
North Pit -Other -Wind erosion of exposed area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	13.7	ha	Pit retention	5,805.8	5,515.5	827.3
Caloma 1 & 2 WRE -Waste -Wind erosion	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	15.6	ha	Pit retention	6,624.4	6,293.2	944.0
SAR WRE -Waste -Wind erosion	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	64.7	ha		54,980.5	27,490.2	4,123.5
Soil Stockpiles -Other -Wind erosion of soil stockpile SE of SAR open cut	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	-	ha		-	-	-
Soil Stockpiles -Other -Wind erosion of soil stockpile at SW of MLA area	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	-	ha		-	-	-
Soil Stockpiles -Other -Wind erosion of soil stockpile at E of SAR open cut North Pit	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.00	425.00	63.75	kg·ha-1·yr-1	-	ha		-	-	-
								TOTAL	**842,865.4**	**268,190.3**	**46,576.6**

APPENDIX C

Sensitive Receptors

Discrete sensitive receptor locations used in the study

ID	Location (m, UTM 55)		Description
	Eastings	Northings	
R01	614 328	6 396 164	Project Related
R02	611 348	6 395 447	Non-project Related
R03	614 690	6 395 277	Non-project Related
R04	617 153	6 393 349	Non-project Related
R06	611 523	6 392 266	Non-project Related
R08	612 493	6 398 213	Non-project Related
R09	614 081	6 398 019	Non-project Related
R10	615 163	6 396 785	Non-project Related
R11	615 544	6 396 858	Non-project Related
R12	616 485	6 397 932	Non-project Related
R13	614 419	6 396 342	Non-project Related
R16	614 593	6 395 913	Non-project Related
R17	614 531	6 395 902	Non-project Related
R18	614 667	6 395 849	Commercial - Operating
R19	614 664	6 395 801	Non-project Related
R21	614 663	6 395 746	Commercial - Operating
R22	614 595	6 395 660	Non-project Related
R23	614 517	6 395 616	Non-project Related
R24	614 596	6 395 602	Non-project Related
R25	614 667	6 395 651	Non-project Related
R26	614 666	6 395 628	Non-project Related
R27	614 672	6 395 522	Commercial - Non-operational
R28	614 682	6 395 389	Non-project Related
R29	614 686	6 395 301	Non-project Related
R32	614 886	6 395 411	Non-project Related
R33	614 763	6 395 440	Commercial - Non-operational
R35	614 735	6 395 783	Non-project Related
R37	614 878	6 395 835	Non-project Related
R40	614 661	6 395 726	Non-project Related
R41	614 594	6 395 525	Non-project Related
R42	614 655	6 395 936	Non-project Related
R43	611 517	6 388 826	Non-project Related
R60	617 342	6 390 550	Non-project Related
R63	619 756	6 390 153	Non-project Related
R64	616 792	6 386 106	Non-project Related
R65	620 612	6 387 190	Non-project Related
R66	619 921	6 386 314	Non-project Related
R67	619 567	6 385 368	Non-project Related
R68	617 094	6 383 186	Non-project Related

ID	Location (m, UTM 55)		Description
	Eastings	Northings	
R69	615 450	6 382 954	Non-project Related
R70	620 330	6 391 230	Non-project Related
R71	614 106	6 385 342	Non-project Related
R72	618 454	6 393 476	Non-project Related
R73	614 663	6 395 768	Non-project Related
R74	615 796	6 395 420	Non-project Related
R75	612 187	6 382 911	Non-project Related
R78	618 673	6 397 498	Non-project Related
R79	614 588	6 395 739	Non-project Related
R80	614 482	6 395 759	Non-project Related
R81	614 613	6 395 994	Non-project Related
R44	615 140	6 387 358	Project Related
R45	611 176	6 389 342	Unoccupiable
R46	613 483	6 390 443	Project Related
R47	612 742	6 386 408	Project Related
R61	617 375	6 390 378	Unoccupiable
R62	617 262	6 390 132	Project Related
R05	614 208	6 390 455	Project Related
R82	617 148	6 388 305	Project Related

APPENDIX D

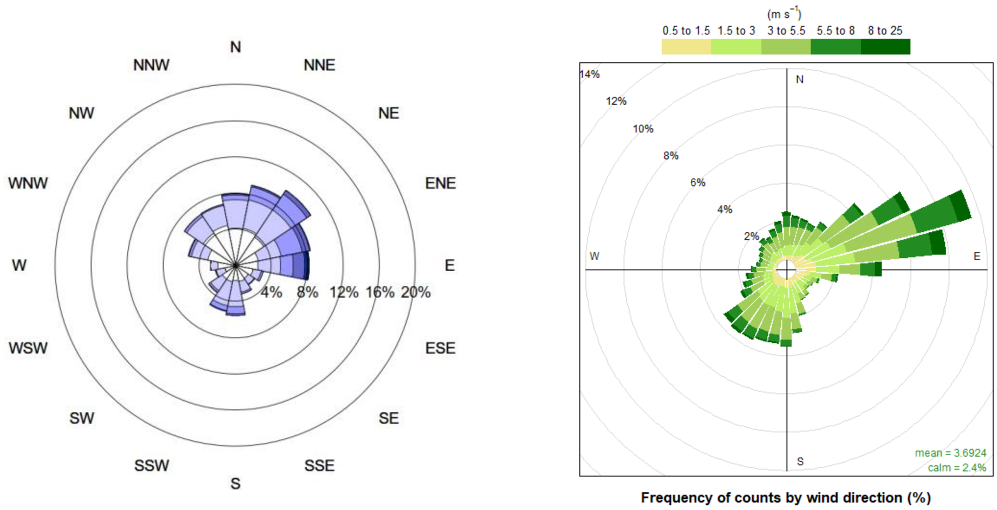
Meteorology

Previous Meteorological Assessment

As outlined in (PEL, 2016), the dispersion modelling for the original AQIA used 2003 meteorological data from the Peak Hill station (located approximately 15 km south of the Mine), integrated with site specific, synthetic meteorological data for the Tomingley site using TAPM. Since the performance of the original AQIA, on-site observations of meteorology have been collected by the Applicant. A comparison of the annual wind rose of data adopted in the original AQIA, and that collected at the Mine for the period 2016 to 2020 is presented in **Figure D1**.

As identified in (PEL, 2016), the meteorological data used in the original AQIA includes a much larger spread of winds from the entire north eastern sector as compared to site observations which show a larger influence of winds from the east northeast. This would act to transport particulate away from the receptors to the north of the Mine, and towards the more sparsely populated area to the west of the Mine. Winds from the south are shown to be well characterised in the meteorological data adopted in the original AQIA.

Figure D1 Comparison of modelled meteorology (PAEHolmes, 2011) and site observations



Meteorological Modelling

Site representative meteorological data was generated using the CALMET meteorological model in a format suitable for use in the CALPUFF dispersion model.

In this study, CALMET has been run in no-observations ("no-obs") mode using gridded prognostic data generated by The Air Pollution Model (TAPM, v 4.0.5), developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

The parameters used in TAPM and CALMET modelling are presented in **Table D1**. The year 2017 was adopted as it was shown to be representative of the period of available measurements and was also selected when considering the use of background air quality data to represent operations at the Mine Site.

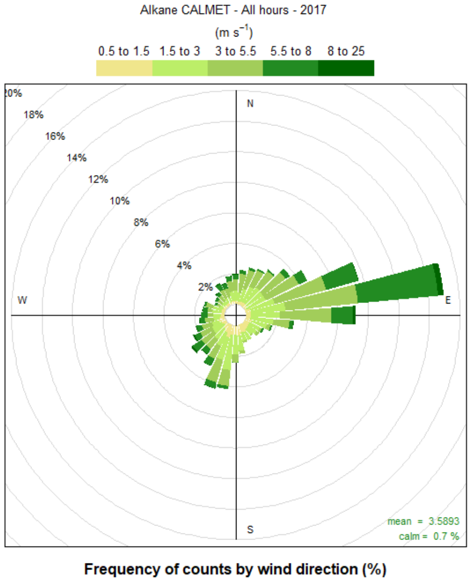
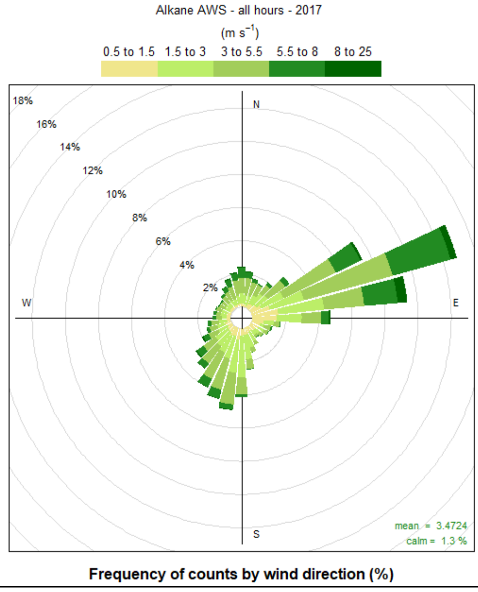
Table D1 Meteorological parameters adopted

TAPM v 4.0.5	
Modelling period	1 January 2017 to 31 December 2017
Centre of analysis	614 191 mE, 6 394 250 mN (UTM Coordinates)
Number of grid points	25 × 25 × 25
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Terrain	AUSLIG 9 second DEM
Data assimilation	-
CALMET	
Modelling period	1 January 2017 to 31 December 2017
South-West corner of analysis	604 500 mS, 6 383 000 mN (UTM Coordinates)
Meteorological grid domain (resolution)	20 km × 22.2 km (0.2 km)
Vertical resolution (cell heights)	10 (0 m, 20 m, 40 m, 80 m, 160 m, 320 m, 640 m, 1200 m, 2000 m, 3000 m, 4000 m)
Data assimilation	No-obs approach using TAPM – 3D.DAT file

A comparison of the CALMET generated meteorological data, and that observed at the on-site AWS is presented in **Figure D2**.

These data generally compare well which provides confidence that the meteorological conditions modelled as part of this assessment are appropriate.

Figure D2 Modelled and observed meteorological data – 2017

CALMET generated windrose	Observational data
	

APPENDIX E

Background Air Quality Data

As discussed in **Section 4.3** air quality parameters are measured at the Mine by the Applicant. A summary of the data collected onsite is outlined below.

PM_{10} Monitoring

The results of continuous measurements of PM_{10} collected at the Mine between 13 May 2014 and 30 April 2021 are summarised in **Table E1**.

The annual average PM_{10} concentration as measured within the Mine boundary is presented, as are the number of measured exceedances of the NSW EPA 24-hour PM_{10} criterion of 50 $\mu g \cdot m^{-3}$. The annual average calculated without the influence of those exceedances is also presented. Exceedances of the NSW EPA impact assessment criterion are highlighted.

Table E1 Measured annual average and 24-hour PM_{10} concentrations at the Mine

Year	Annual average PM_{10} $\mu g \cdot m^{-3}$	Number of exceedances of 24-hour PM_{10} criteria	Annual average PM_{10} $\mu g \cdot m^{-3}$ less exceedances
2014 (from 13 May)	19.9	10	18.1
2015	20.0	11	18.3
2016	18.2	5	17.7
2017	19.9	5	19.2
2018	26.1	31	20.0
2019	42.5	76	23.5
2020	39.2	32	14.5
2021 (to April 30)	18.5	0	18.5

It can be seen from **Table E1** that the measured annual average PM_{10} concentrations significantly increased in 2018 relative to the preceding years, and is a trend which continued in 2019 and also in 2020. The number of exceedances of the 24-hour PM_{10} criterion are also shown to increase significantly in those years, a trend which is replicated at many AQMS across NSW due to regional pollution episodes including bushfires and dust storms.

To illustrate this, **Figure E1** and **Figure E2** presents a summary of the concentrations of PM_{10} measured at the Mine, and at the NSW DPIE AQMS at Bathurst (approximately 150 km to the southeast of the Mine) for the years 2014 to 2021. These data indicate that increases in PM_{10} were experienced at both locations over the same time period, indicating a more regional (rather than local) influence. The graphs present the same data, but truncated on **Figure E1**.

Figure E1 Trend in PM_{10} at the Mine 2014 to 2021

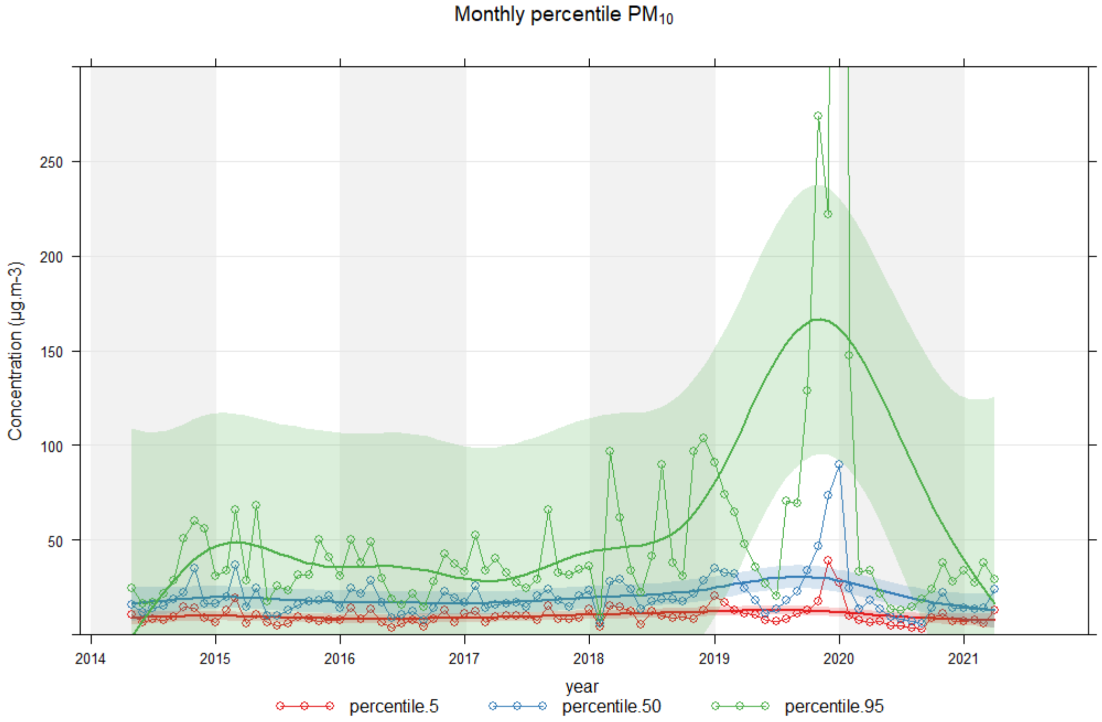
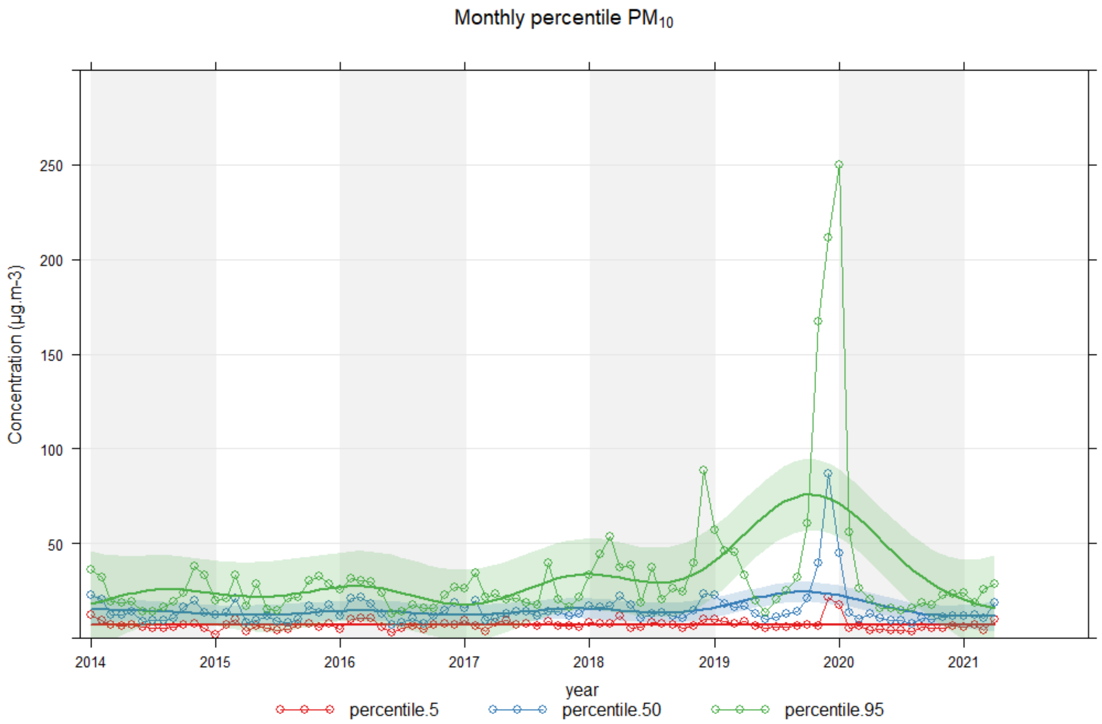


Figure E2 Trend in PM_{10} at Bathurst AQMS 2014 to 2021



It is widely acknowledged and reported that the impacts of drought related dust, hazard reduction burning and/or bushfire, were seen in the monitoring record across NSW in 2018, with impacts associated with the bushfire emergency of 2019/2020 significantly impacting air quality across NSW. The Annual Reviews compiled by the Applicant between 2014 and 2019 provide commentary on the exceedances of the 24-hour PM_{10} criterion as measured at the Mine. These, along with a comment on the exceedances measured in 2020, are presented in **Table E2**.

It is shown that with the exception of one event in 2016, caused by a non-conformance with established procedures, all exceedances of the 24-hour PM_{10} criterion as measured at the Mine can be attributed to non-Mine sources.

Table E2 Measured exceedances of the 24-hour PM_{10} criterion

Year	Number of exceedances of 24-hour PM_{10} criteria	Discussion relating to exceedances
2014	10	Numerous exceedances between October and December due to extended dry period (Tomingley Gold Operations Pty Ltd, 2015).
2015	11	Exceedances in March due to local meteorological conditions. Other exceedances due to regional smoke and dust vents (Tomingley Gold Operations Pty Ltd, 2016).
2016	5	Exceedance on 26 February due to non-conformance with TGO procedures. Other exceedances resulted from local meteorological conditions and non-mining activities (Tomingley Gold Operations Pty Ltd, 2017).
2017	5	Exceedances measured in February due to extreme heat and dry conditions. Other exceedances due to local meteorological conditions (Tomingley Gold Operations Pty Ltd, 2018).
2018	31	All exceedances due to local meteorological conditions and farming activities (Tomingley Gold Operations Pty Ltd, 2019).
2019	76	All exceedances attributed to extraordinary events such as dust storms and bushfires (Tomingley Gold Operations Pty Ltd, 2020).
2020	32	Ninety seven percent of exceedances were in January and the first week of February and could be attributed to extraordinary events including dust storms and severe bushfires (Tomingley Gold Operations Pty Ltd, 2021).
2021	0	2021 Annual Review not published however, there are currently no recorded exceedances.

TSP Monitoring

The results of TSP measurements performed at the Mine between 2014 and 20 May 2021 are presented in **Table E3**. These data generally reflect the increasing trend observed in the annual average PM_{10} concentration (see above), with significant increases observed in 2019 and 2020. Given the discussion provided above regarding regional particulate events, the influence of the Mine operations on these concentrations cannot be quantified but is likely to be minor. Exceedances of the NSW EPA impact assessment criterion are highlighted.

Table E3 Measured annual average TSP concentrations at the Mine

Year	Annual average TSP $\mu g \cdot m^{-3}$
2014	60.0
2015	49.5
2016	38.6
2017	46.8
2018	56.5
2019	94.1
2020	69.8
2021 (to May 20)	40.3

Deposited Dust Monitoring

The results of dust deposition monitoring performed at five locations around the Mine between 2014 and May 2021 are presented in **Table E4**. Exceedances of the NSW EPA impact assessment criterion are highlighted.

Table E4 Measured dust deposition

Year	Annual average dust deposition ($g \cdot m^{-2} \cdot month^{-1}$)				
	DDG 1	DDG 2	DDG 3	DDG 4	DDG 5
2014	1.2	1.2	1.2	8.7	1.7
2015	1.5	1.4	1.4	8.0	2.5
2016	1.2	1.0	1.3	1.3	1.1
2017	1.5	1.3	1.2	2.0	1.7
2018	1.9	2.0	1.9	2.1	2.0
2019	3.3	2.3	2.8	4.2	3.3
2020	3.3	2.0	2.3	3.4	4.3

The measured exceedances of the annual average dust deposition criterion occur at DDG 4 and DDG 5. DDG 4 is located close to the northern Mine site boundary, immediately north of the Caloma One open cut and DDG 5 is located to the southwest of the current Mine boundary. Refer to **Figure 9** for the location of DDG 4 and DDG 5, and **Figure 2** for the locations of current mining activities. The location of DDG 4 to mining activities makes it representative of dust deposition rates at that boundary, and highly likely to be prone to influence from heavy particulates that are typically settled from the air within, or close to the boundary. Previously measured rates at DDG 4 are higher than those of more recent years, with the exception of 2019 which is considered to be significantly influenced by the 2019/2020 regional bushfires, which can be seen as higher dust deposition rates at all DDG locations.

$PM_{2.5}$

$PM_{2.5}$ concentrations are not measured at the Mine and therefore a surrogate dataset is required. The closest DPIE AQMS to the Mine which measures $PM_{2.5}$ is located at Bathurst which is located approximately 150 km to the southeast. Measured 24-hour average $PM_{2.5}$ concentrations show a strong seasonal trend in Bathurst, due to various local factors including the prevalence of wood-fired heater usage in the winter months.

The use of data from Bathurst to represent the likely $PM_{2.5}$ environment of the area surrounding the Project Site is likely to be conservative, given that the population of Bathurst is much higher than Tomingley, and the use of wood heating is likely to be higher within Bathurst.

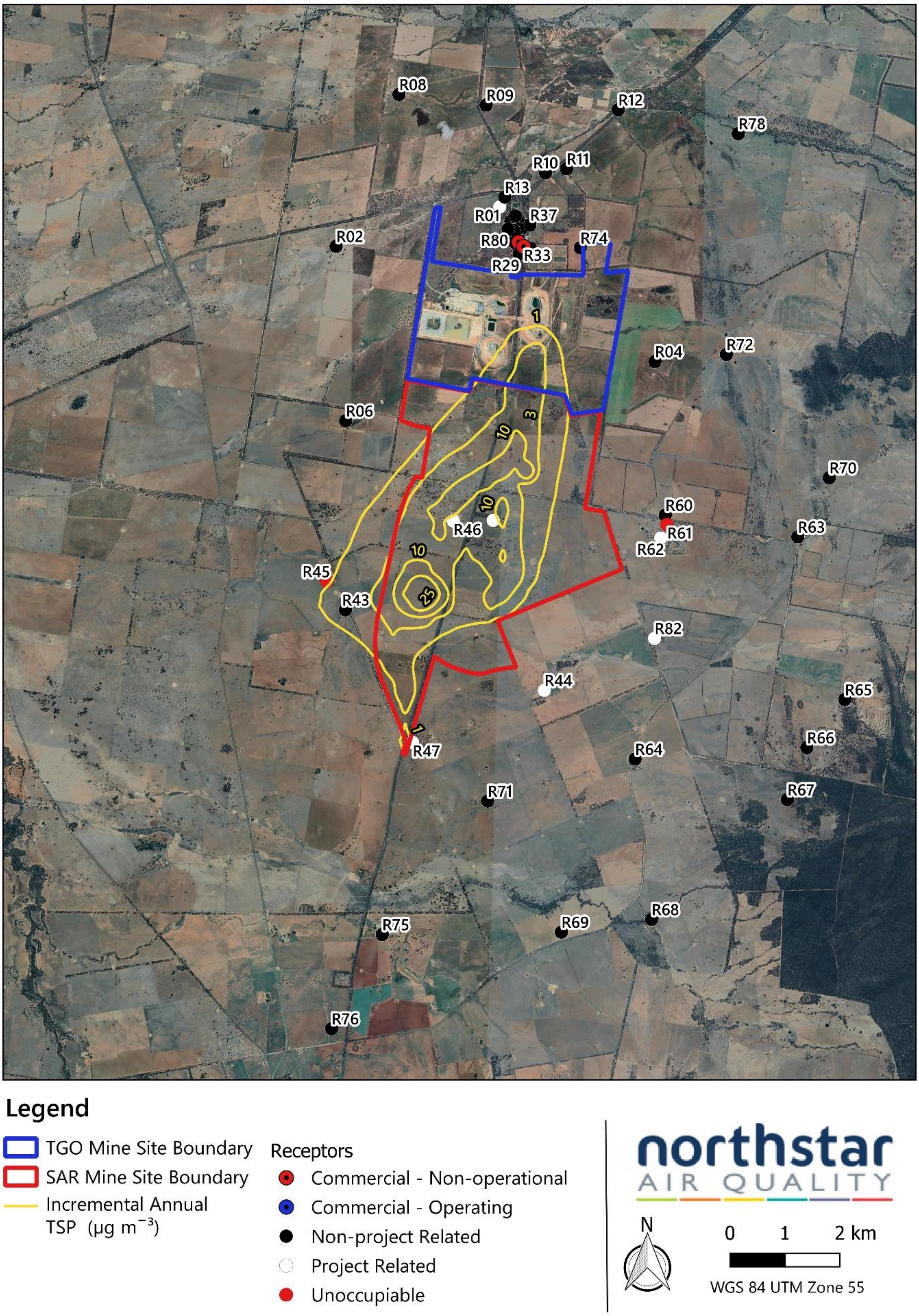
NO_2

NO_2 concentrations are not measured at the Mine and therefore a surrogate dataset is required. The closest DPIE AQMS to the Mine which measures NO_2 is located at Richmond which is located approximately 263 km to the southeast. Given that the Richmond AQMS is located in an urbanised area, with sources of emissions such as significant vehicular traffic and combustion emission sources associated with urbanised/industrialised areas, the adoption of the Richmond dataset to approximate NO_2 concentrations in the area surrounding the Project is considered to be conservative.

APPENDIX F

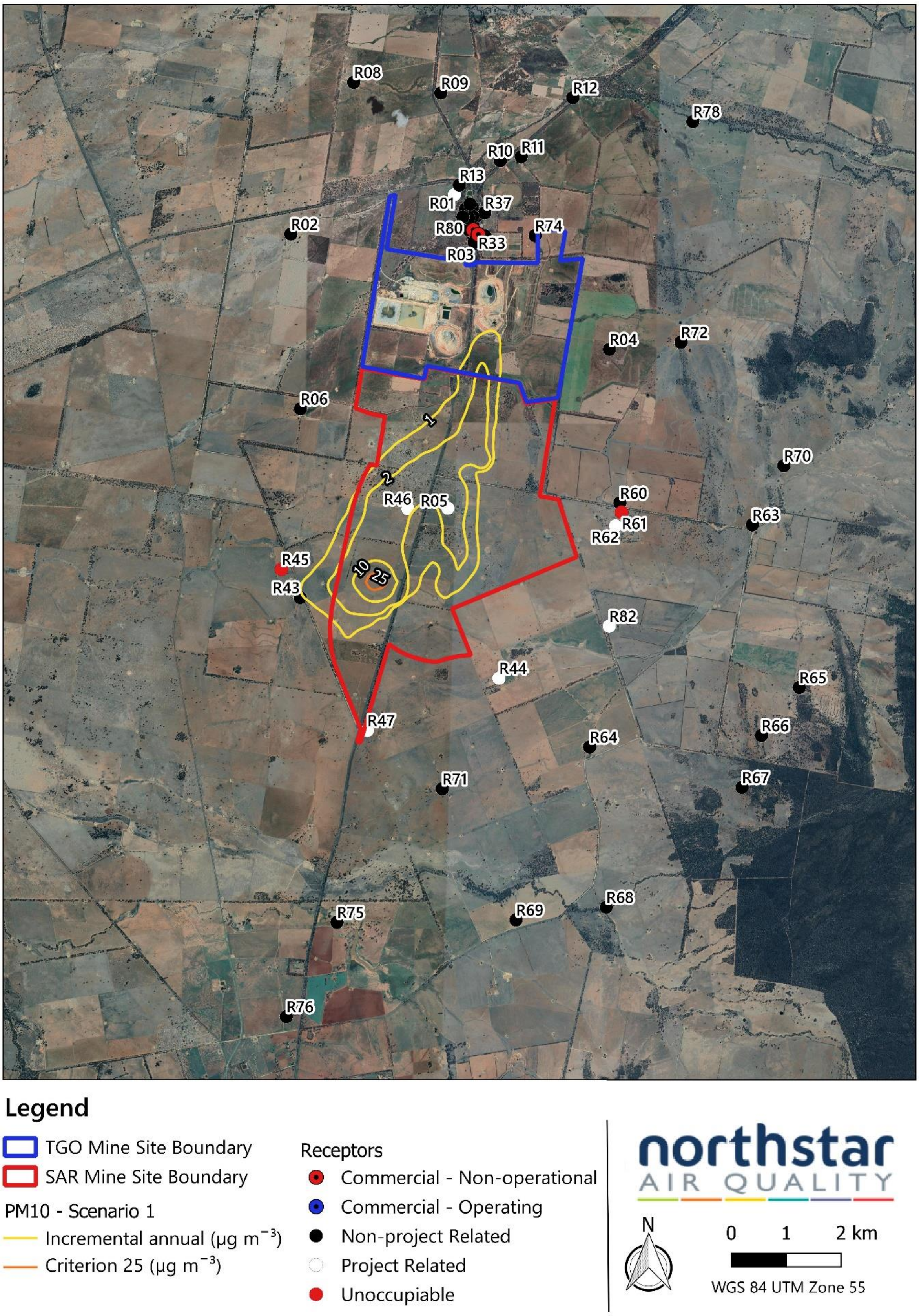
Pollutant Isopleth Plots

Scenario 1 – Incremental annual average TSP concentrations



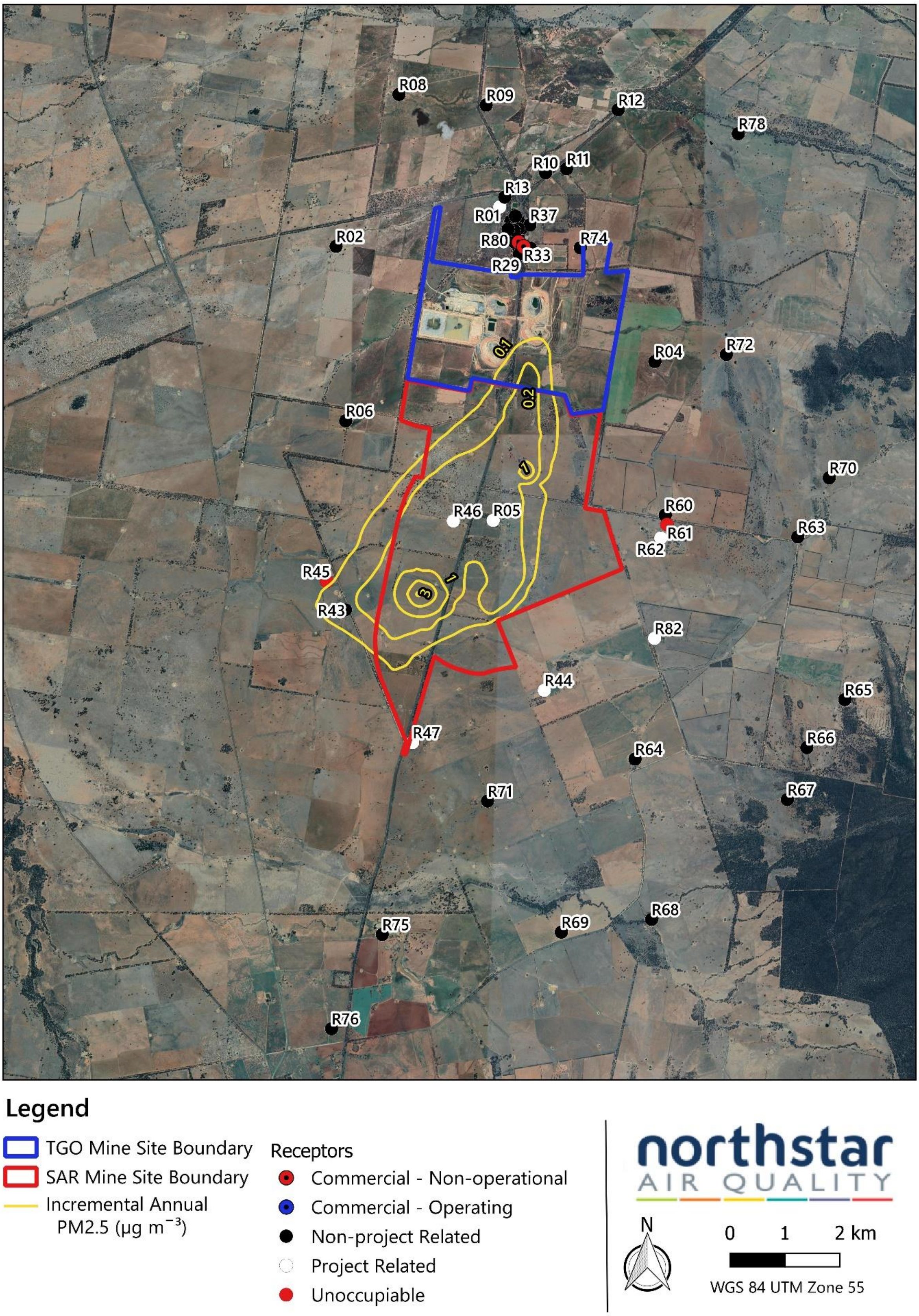
Criterion – 90 µg·m^{-3} (cumulative)

Scenario 1 – Incremental annual average PM_{10} concentrations



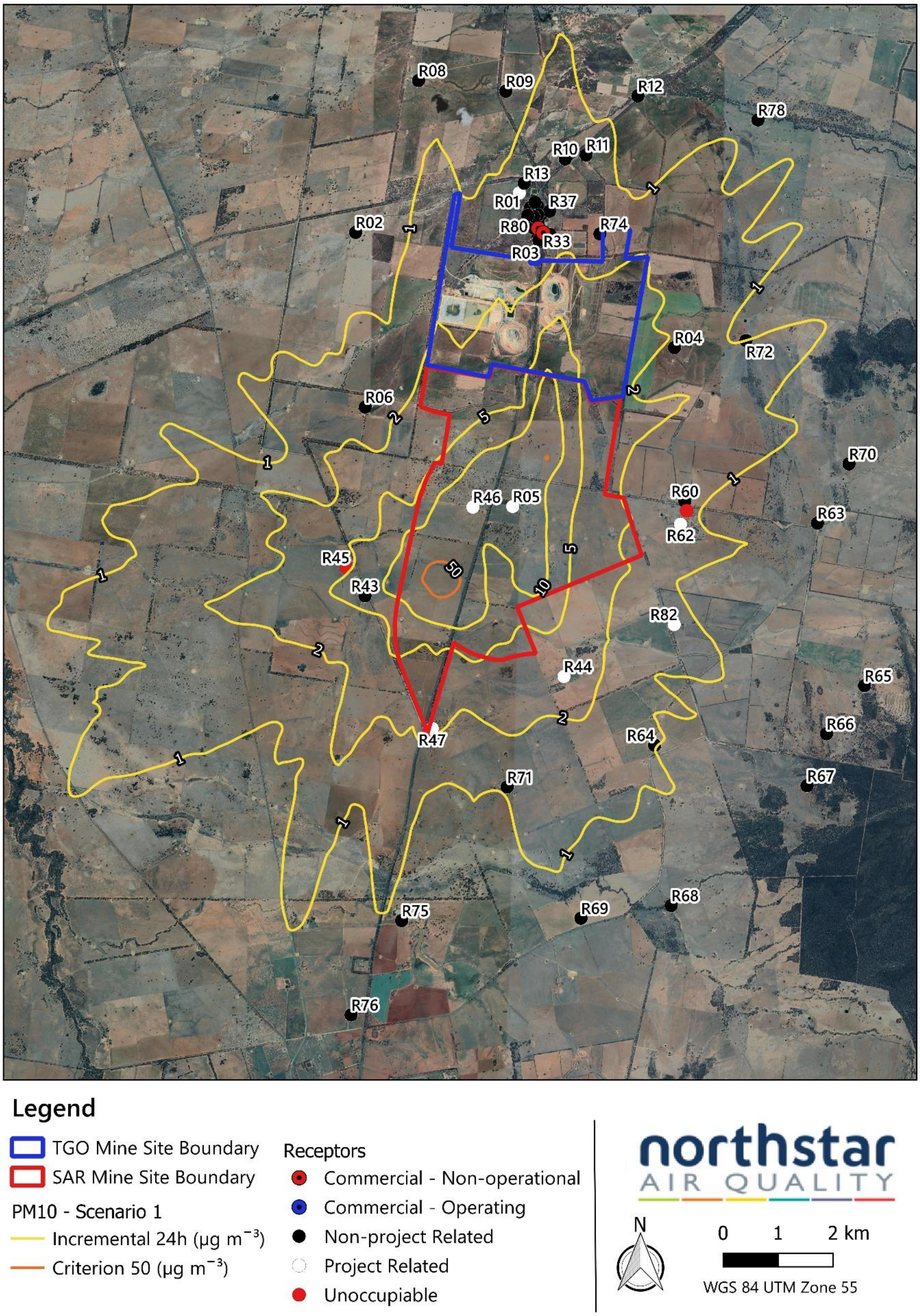
Criterion – 25 µg·m^{-3} (cumulative)

Scenario 1 – Incremental annual average $PM_{2.5}$ concentrations



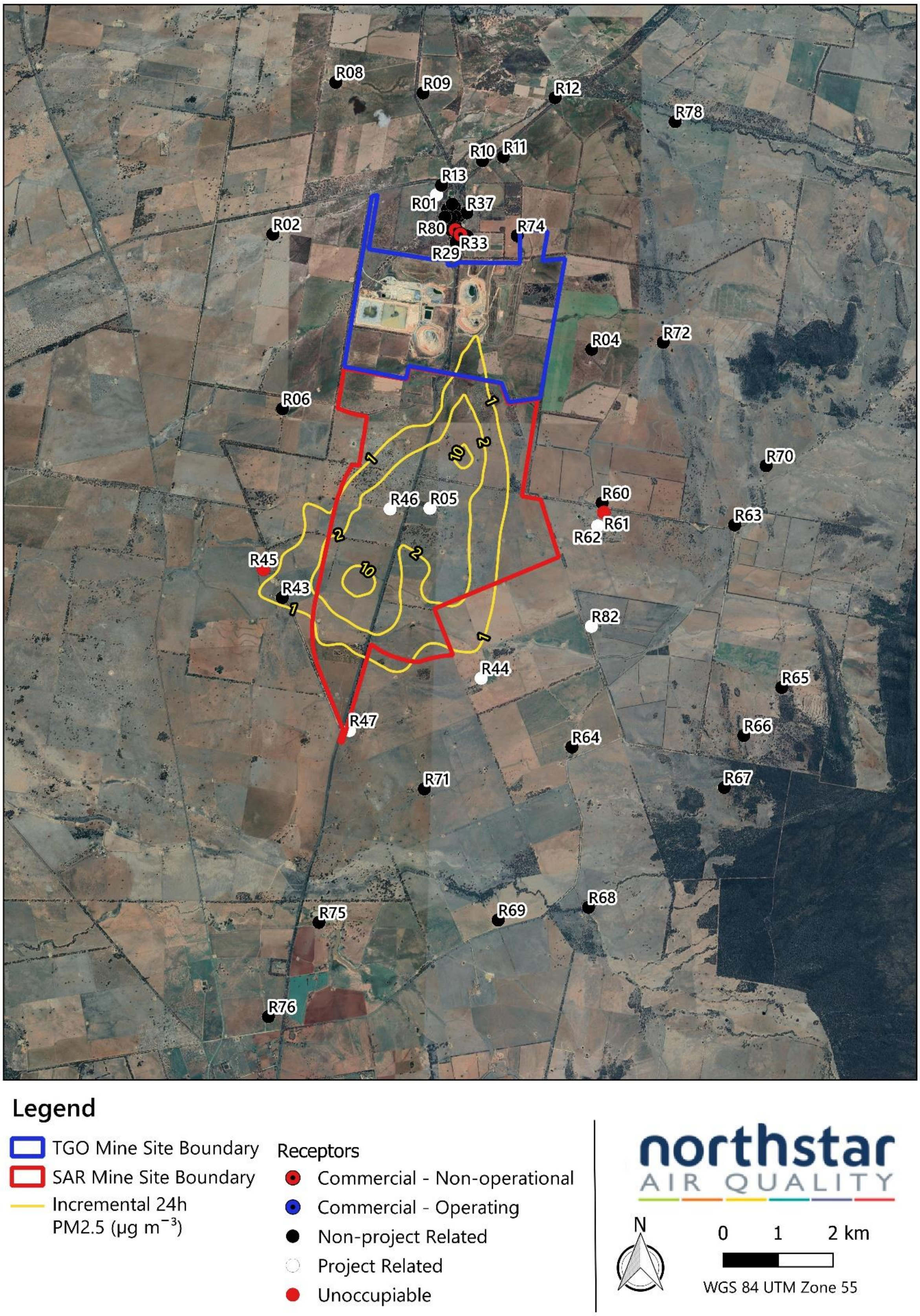
Criterion – 8 µg·m^{-3} (cumulative)

Scenario 1 – Incremental maximum 24-hour average PM_{10} concentrations



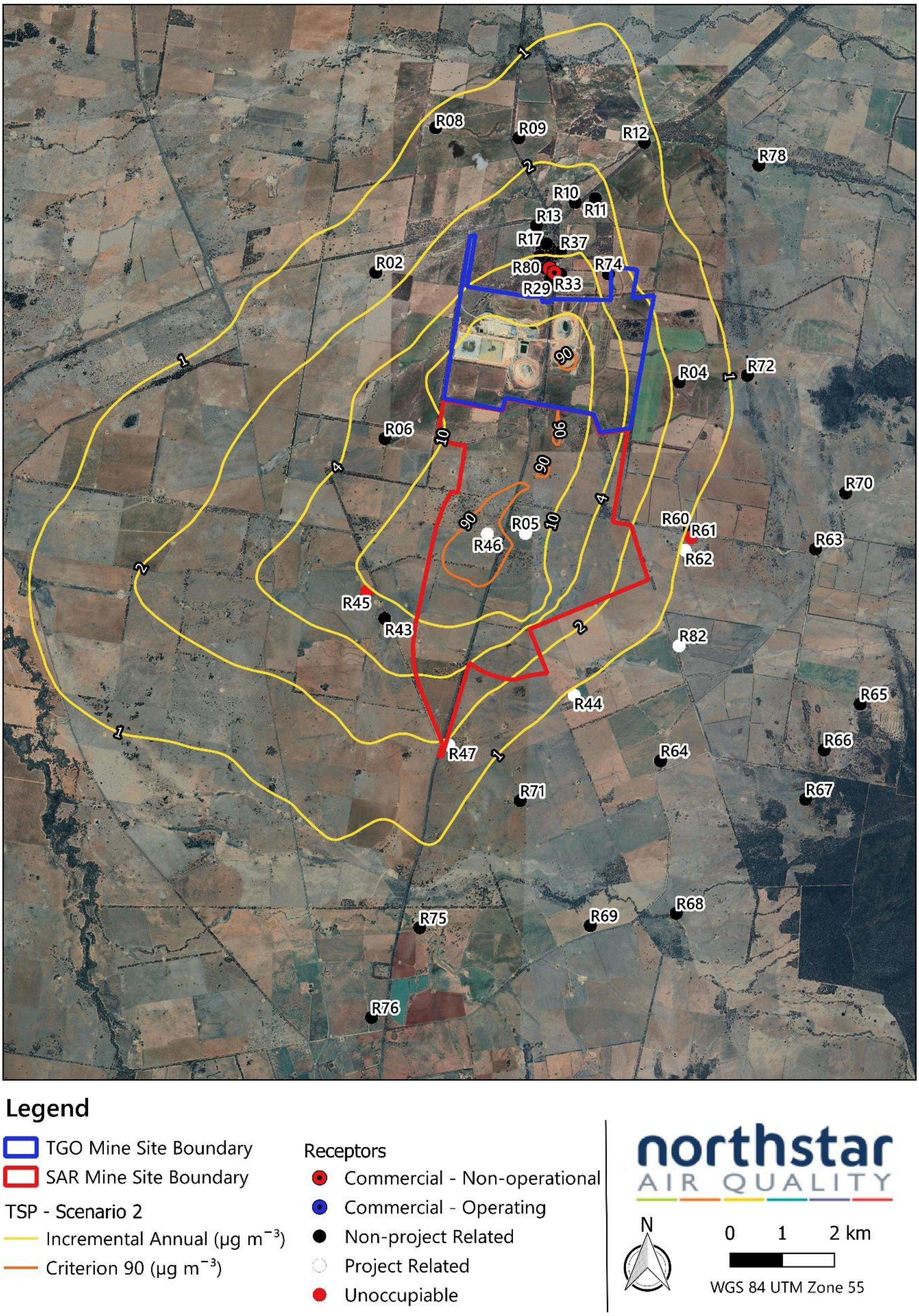
Criterion – 50 $\mu g \cdot m^{-3}$ (cumulative)

Scenario 1 – Incremental maximum 24-hour average $PM_{2.5}$ concentrations



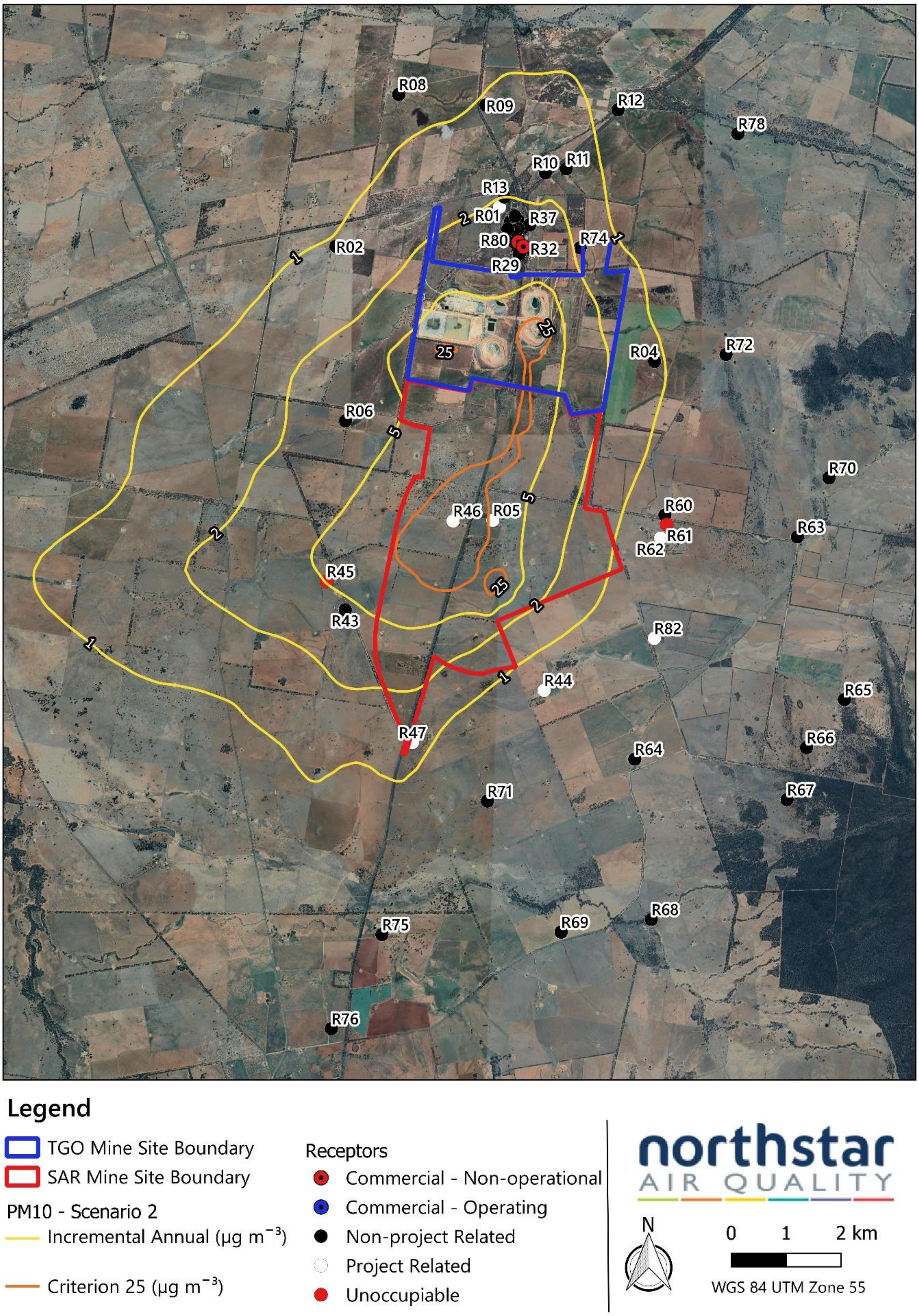
Criterion – 25 µg·m^{-3} (cumulative)

Scenario 2 – Incremental annual average TSP concentrations



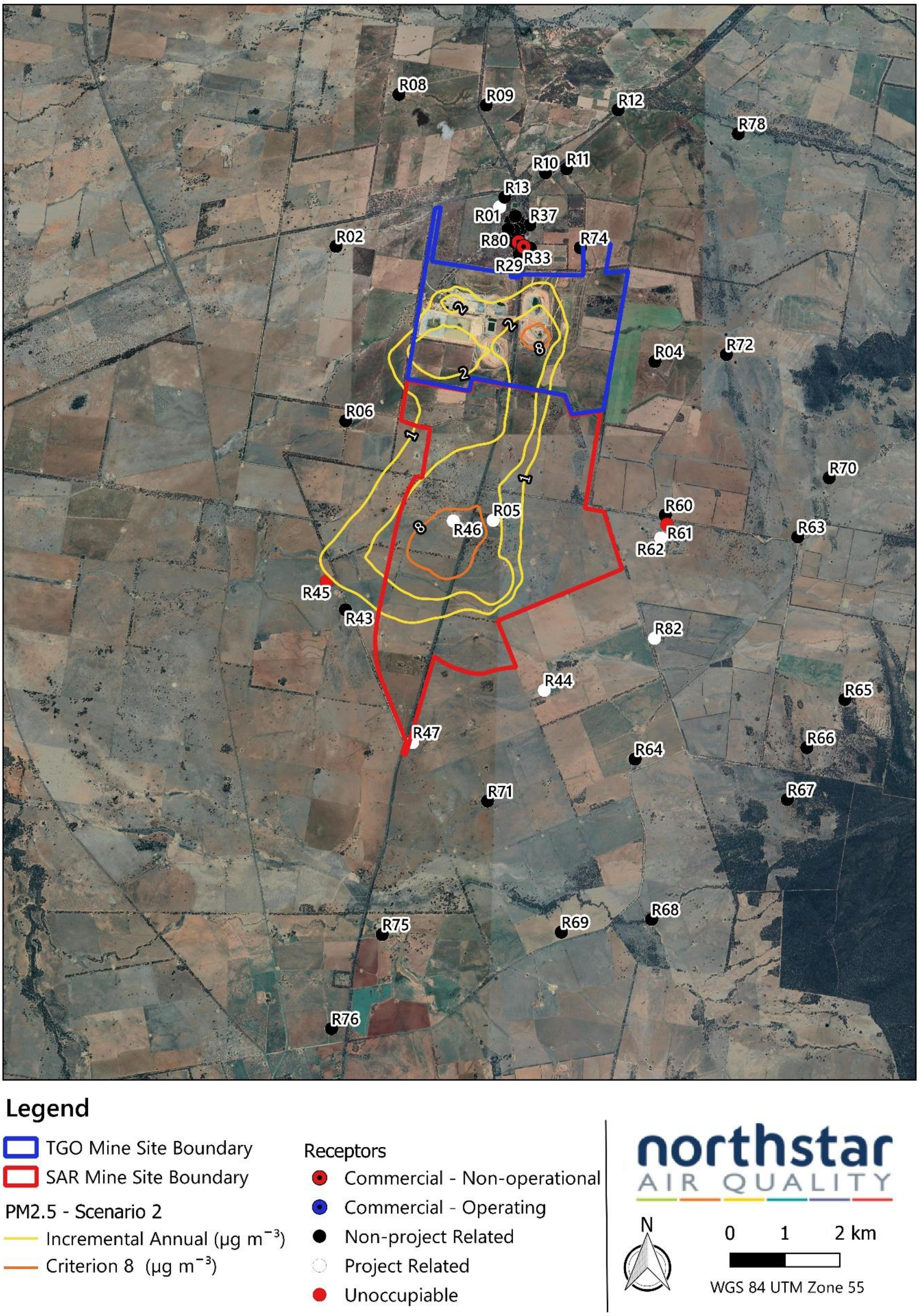
Criterion – 90 μg·m^{-3} (cumulative)

Scenario 2 – Incremental annual average PM_{10} concentrations



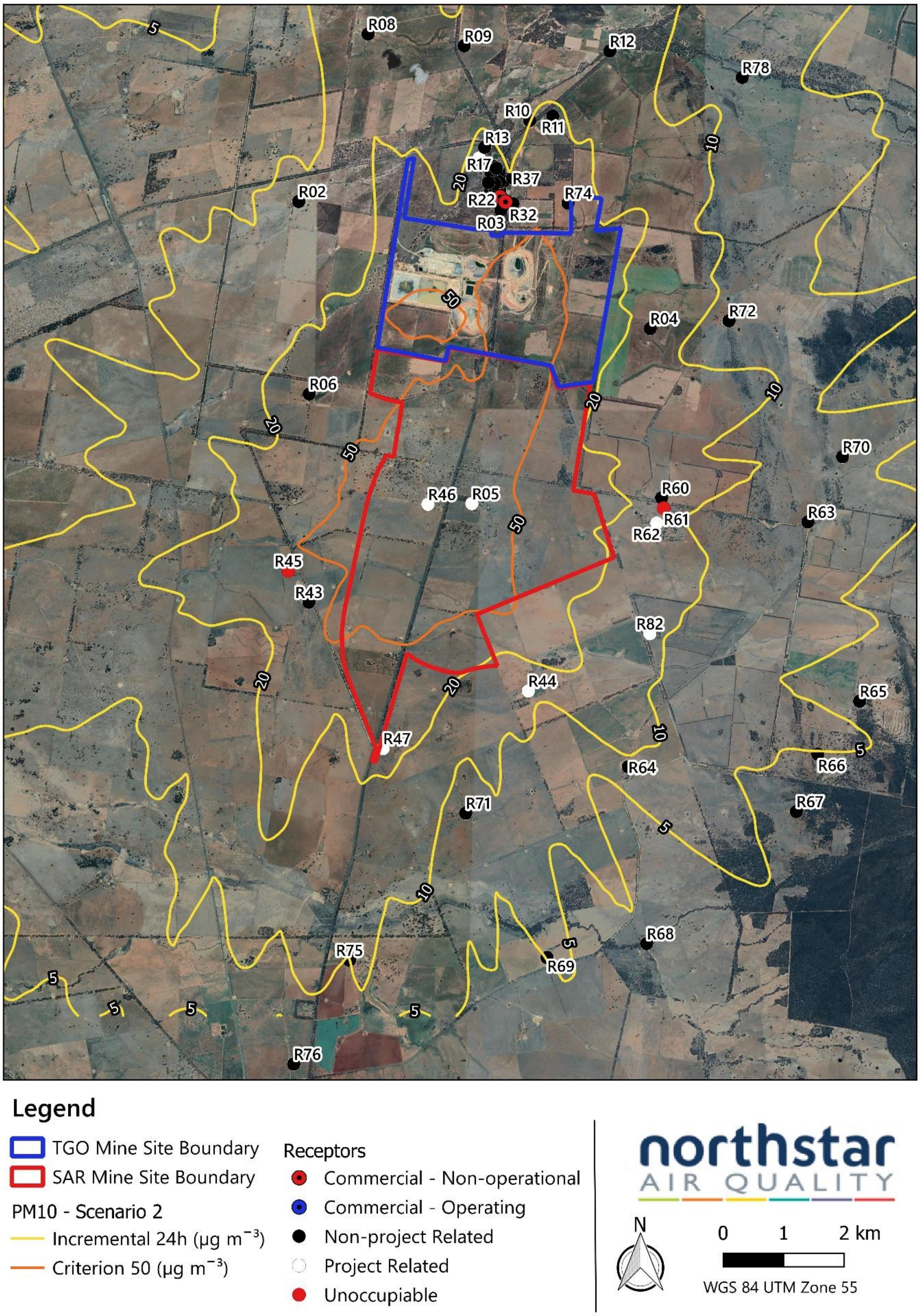
Criterion – 25 µg·m^{-3} (cumulative)

Scenario 2 – Incremental annual average $PM_{2.5}$ concentrations



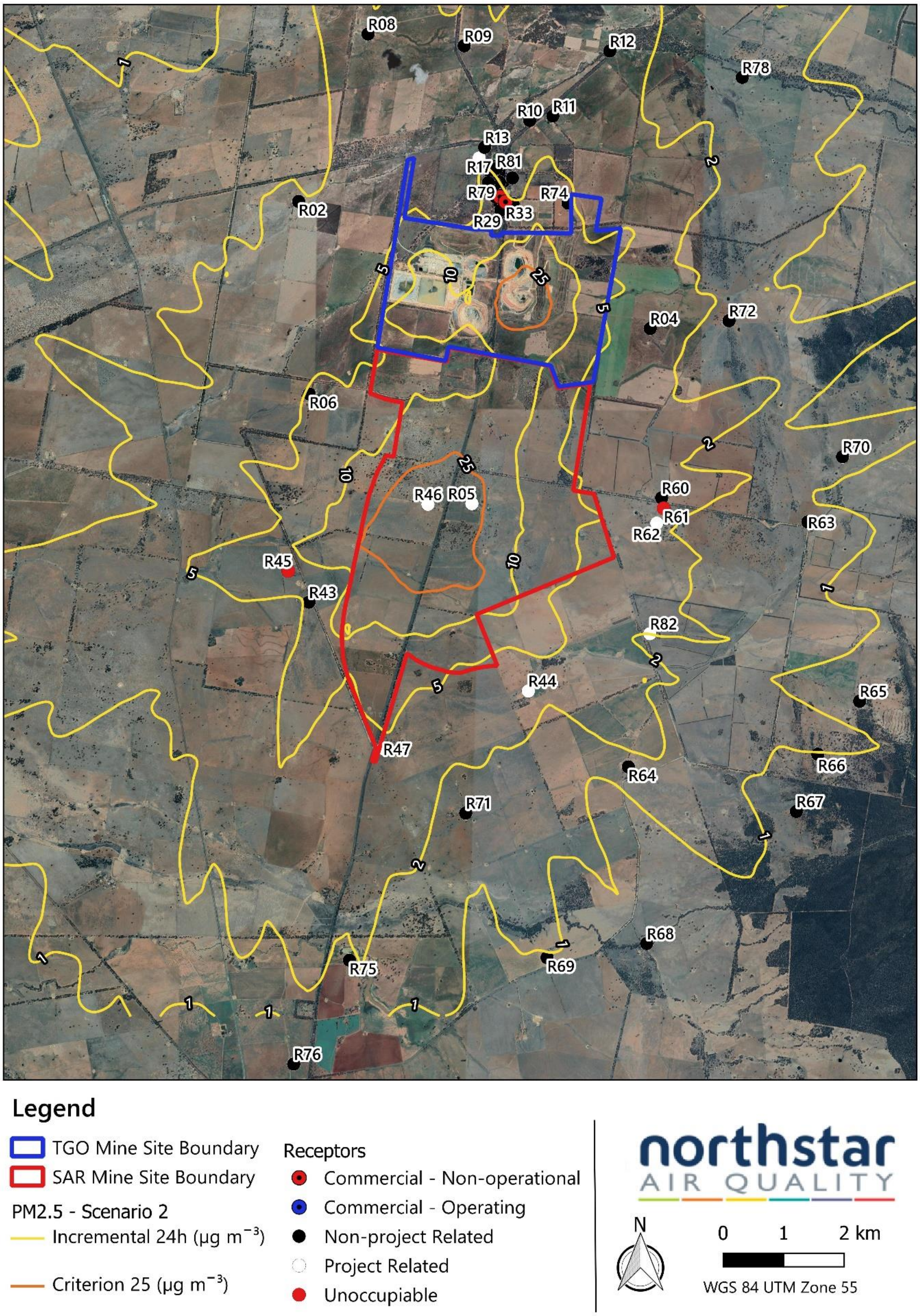
Criterion – 8 μg·m^{-3} (cumulative)

Scenario 2 – Incremental maximum 24-hour average PM_{10} concentrations



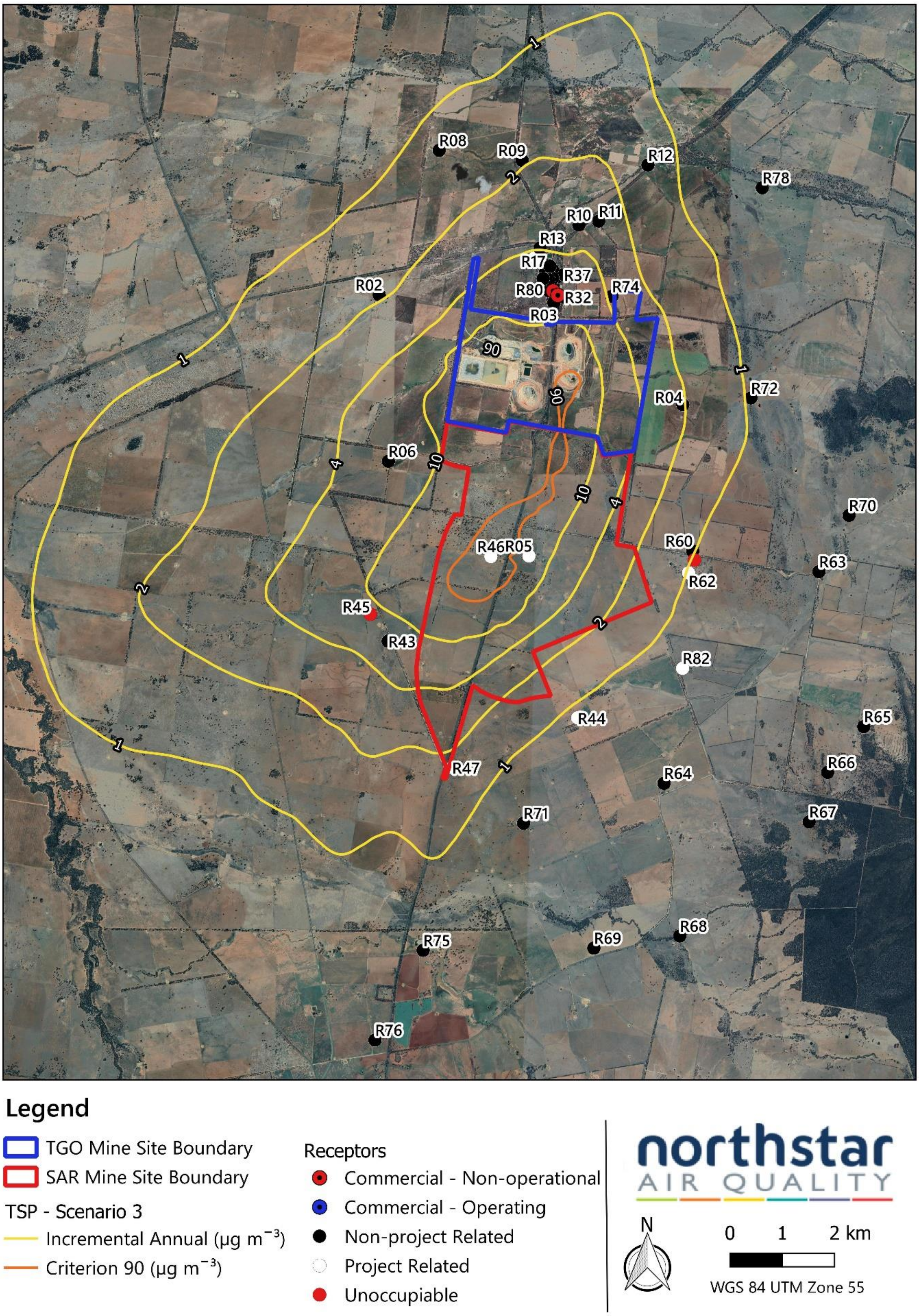
Criterion – 50 µg·m^{-3} (cumulative)

Scenario 2 – Incremental maximum 24-hour average $PM_{2.5}$ concentrations



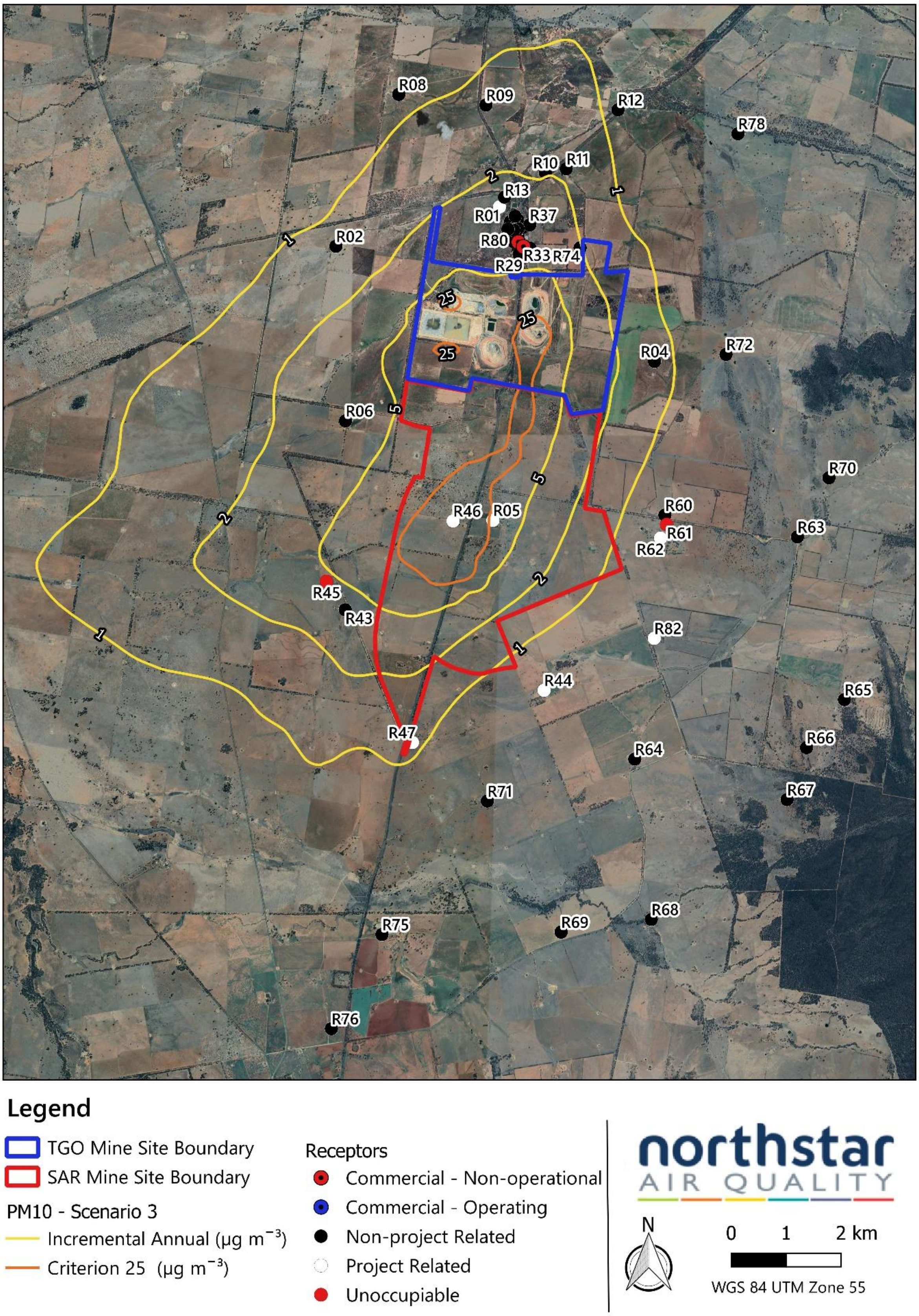
Criterion – 25 µg·m⁻³ (cumulative)

Scenario 3 – Incremental annual average TSP concentrations



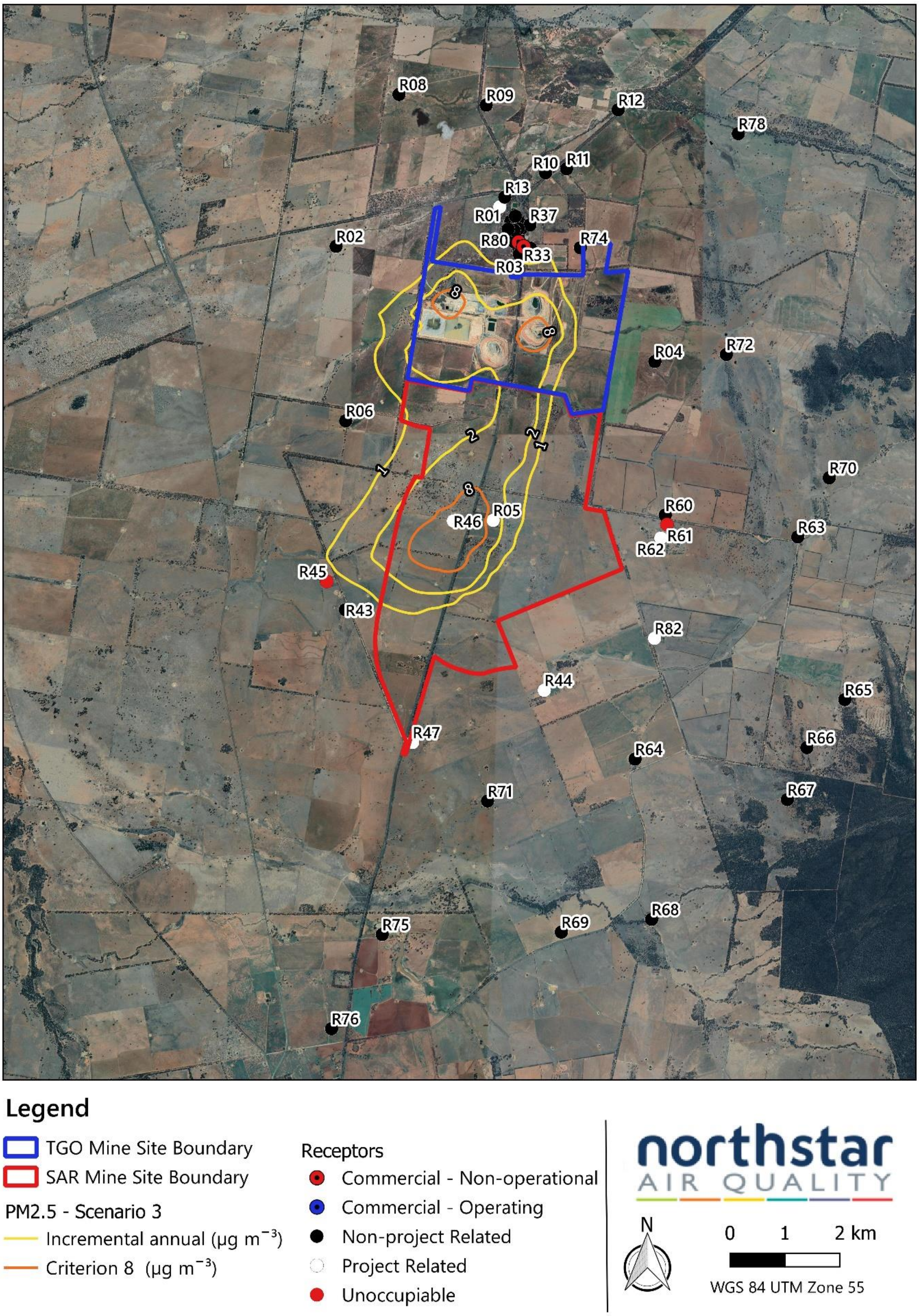
Criterion – 90 µg·m^{-3} (cumulative)

Scenario 3 – Incremental annual average PM_{10} concentrations



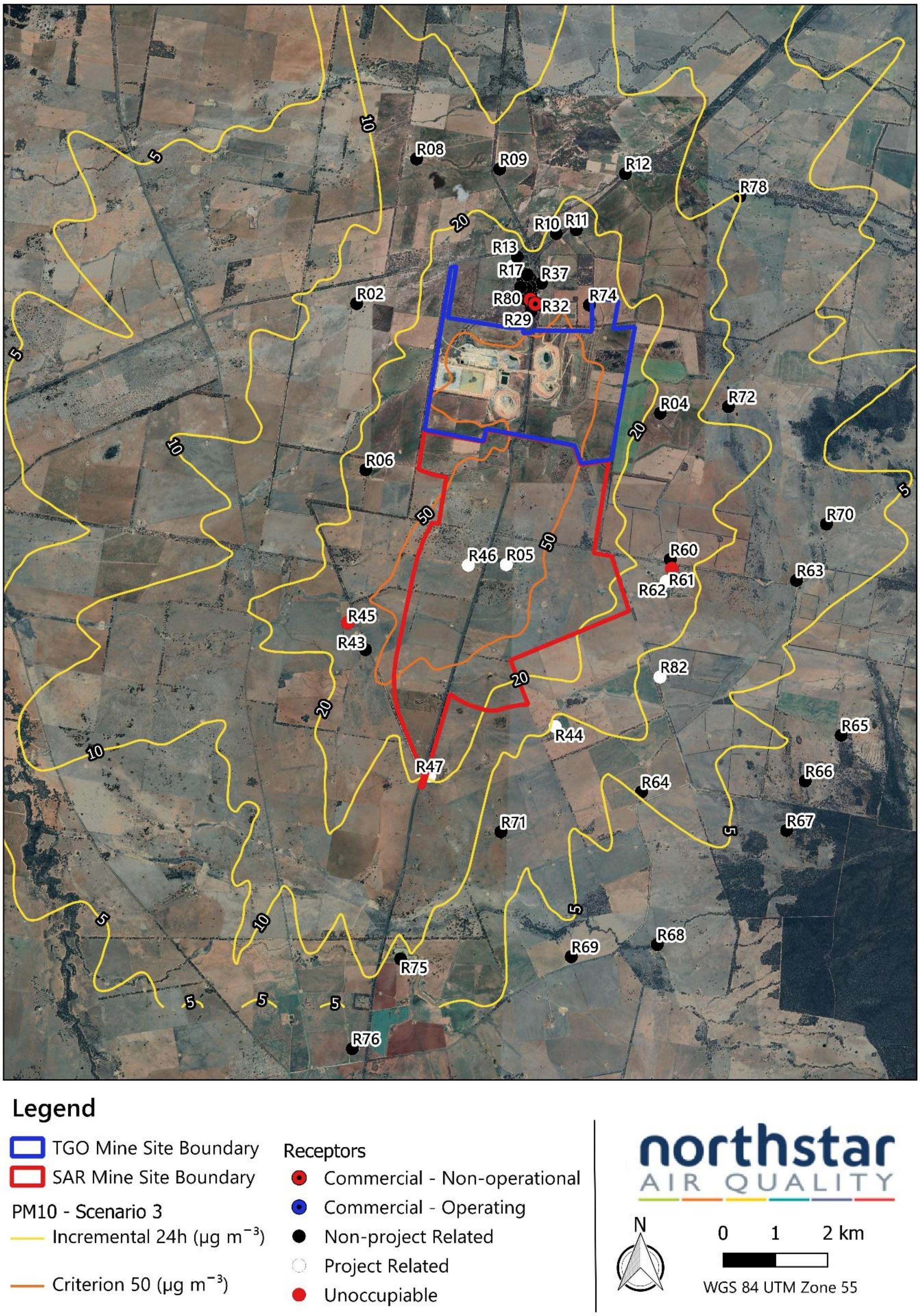
Criterion – 25 μg·m^{-3} (cumulative)

Scenario 3 – Incremental annual average $PM_{2.5}$ concentrations



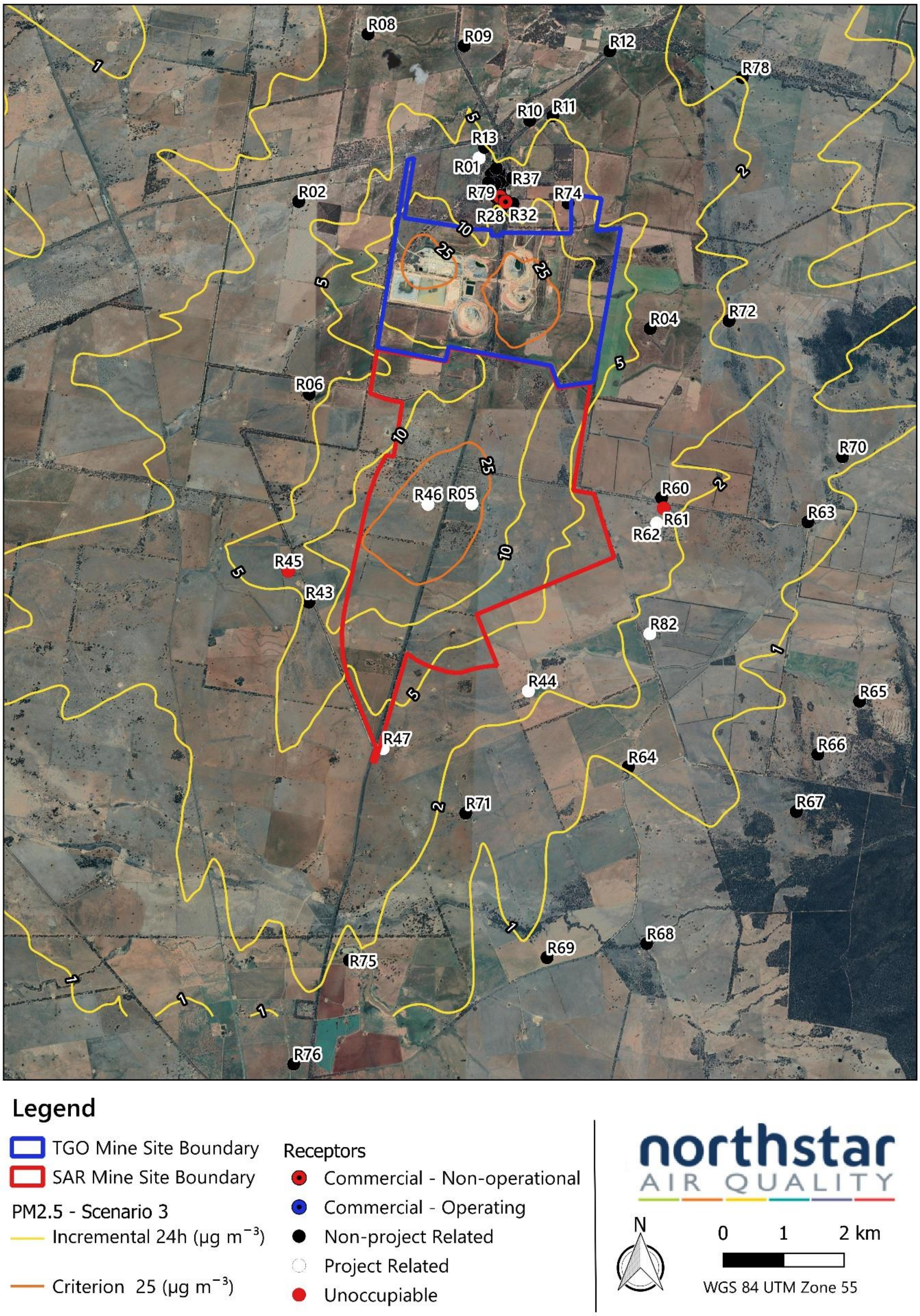
Criterion – 8 µg·m⁻³ (cumulative)

Scenario 3 – Incremental maximum 24-hour average PM_{10} concentrations



Criterion – 50 µg·m^{-3} (cumulative)

Scenario 3 – Incremental maximum 24-hour average $PM_{2.5}$ concentrations



Criterion – 25 µg·m^{-3} (cumulative)

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