Appendix 5

Air Quality Impact Assessment

prepared by
Northstar Air Quality Pty Ltd

(Total No. of pages including blank pages = 35)

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

Northstar Air Quality Pty Ltd,
Suite 1504, 275 Alfred Street, North Sydney, NSW 2060

www.northstarairquality.com | Tel: +61 (02) 9071 8600

Tomingley Gold Operations – MOD7

Air Quality Assessment

Addressee(s):	**Tomingley Gold Operations Pty Ltd**
Site Address:	**Tomingley, NSW**
Report Reference:	**20.1136.FR3V2**
Date:	**1 September 2022**
Status:	**Final**

Quality Control

Study	Status	Prepared by	Checked by	Authorised by
INTRODUCTION	Final	Northstar Air Quality	GCG	MD
THE PROPOSED MODIFICATION	Final	Northstar Air Quality	GCG	MD
EXISTING CONDITIONS	Final	Northstar Air Quality	GCG	MD
PREVIOUS ASSESSMENTS OF AIR QUALITY	Final	Northstar Air Quality	GCG	MD
ASSESSMENT	Final	Northstar Air Quality	GCG	MD
MITIGATION AND MONITORING	Final	Northstar Air Quality	GCG	MD
CONCLUSION	Final	Northstar Air Quality	GCG	MD

Report Status

Northstar References		Report Status	Report Reference	Version
Year	Job Number	(Draft: Final)	(R*x*)	(V*x*)
22	1136	Final	R3	V2
Based upon the above, the specific reference for this version of the report is:				20.1136.FR3V2

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 **1 September 2022**

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 support an application to modify State Significant Development Consent MP09_0155 for the Tomingley Gold Mine.

This assessment considers the potential emissions of particulate matter which might occur during both the construction and operation of a proposed alternative access point to the Wyoming 1 Open Cut at the Tomingley Gold Mine.

Emissions during construction phase activities are anticipated to be minor when compared to approved development and represent a decrease in TSP emissions of 7.2 % as an annual average, when compared to approved MOD5 activities (including all other approved activities occurring concurrently).

Assessment of the potential for short-term peaks in emissions (i.e. daily) indicates that when compared to proposed Tomingley Gold Extension Project activities (including all other approved Tomingley Gold Mine activities), MOD7 construction phase activities would result in either marginally greater (+2 %) or significantly lower than (up to -36 % lower) emissions. In the detailed air quality impact assessment for Tomingley Gold Extension Project, the impacts associated with those emissions were shown to be manageable through the continued implementation of the Air Quality and Greenhouse Gas Management Plan.

In relation to operation of MOD7 activities, no changes to the emissions associated with the current or approved development are anticipated.

It is concluded that any impacts associated with the construction and operational phase activities associated with MOD7 will be easily managed through the continued implementation of the Air Quality and Greenhouse Gas Management Plan.

CONTENTS

FIGURES

TABLES

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) to support an application to modify State Significant Development Consent MP09_0155 for the Tomingley Gold Mine (the TGO Mine).

The TGO Mine is located immediately to the south of the village of Tomingley in central western NSW. The TGO Mine is operated by the Applicant, which is a wholly owned subsidiary of Alkane Resources Ltd. MP09_0155 applies to, and the TGO Mine operates within, an area referred to for the purposes of this document as the TGO Mine Site.

MP09_0155 has been modified six times previously as follows.

- MOD1 (November 2013) - to adjust a range of commitments made during the original application which were no longer appropriate.
- MOD2 (April 2015) – to permit enhancement of the approved and constructed amenity bund and a cut back of the approved Caloma 1 Open Cut.
- MOD3 (July 2019) – to permit establishment of the Caloma 2 Open Cut, underground extraction from the Caloma 1 and 2 deposits and amendments to waste rock, surface water and soil management.
- MOD4 (May 2020) – to permit an increase the capacity of Residue Storage Facility 1 (RSF1) and a commensurate increase in the height and aerial extent of the facility.
- MOD5 (May 2021) – to permit the construction and use of Stages 1 and 2 of Residue Storage Facility 2 (RSF2), an extension of Mine Life from 31 December 2022 to 31 December 2025.; and an extension of the TGO Mine Site boundary to incorporate RSF2.
- MOD6 (June 2022) – to permit an increase in capacity of RSF1 and a commensurate increase in the height and adjustments to the approved final landform.

In addition to the above, the Applicant has recently submitted a development application for the Tomingley Gold Extension Project (TGEP), a State Significant extension of existing operations located immediately south of the TGO Mine Site (the SAR Mine Site). TGEP would involve surface and underground mining of the San Antonio and Roswell (SAR) deposits, including delivery of waste rock and ore to the TGO Mine Site for disposal, stockpiling and/or processing, and an extension in the Mine life beyond 31 December 2025. TGEP would also include the realignment of sections of the Newell Highway and Kyalite Road, including associated intersections. Determination of TGEP is expected to occur during Q3 2022.

2. THE PROPOSED MODIFICATION

The Wyoming 1 Open Cut is one of four approved open cuts for the TGO Mine and is the location of the Portal to the Wyoming 1 Underground Mine and San Antonio Roswell (SAR) Exploration Dive.

Localised and minor geotechnical unravelling and movement has occurred in north-eastern sections of the Wyoming 1 Open Cut, since mid-2017 (the "Ramp Failure"). A range of measures were successfully implemented to manage associated risks, including:

- steepening of the ramp and relocation of the associated switchback further from the failure;
- installation of surface water drainage structures to divert water away from the area; and
- installation of additional survey prisms and daily monitoring for further movement.

In January 2022, following more than 500 mm of rain in 10 weeks, further movement was identified.

This has required further assessment of long-term management options to secure access to the Wyoming 1 Open Cut and Underground, as well as the SAR Exploration Drive.

Following extensive consultation, including with the Resources Regulator Mines Inspectorate and independent geotechnical engineers, the Applicant has determined to establish a new access ramp to the north of the existing Wyoming 1 Open Cut (the Northern Ramp). This would permit access to the Open Cut at a greater distance from the Ramp Failure and permit material above the failure to be removed, thereby reducing the potential for further movement, and reducing potential future operational and safety risks associated with possible further unravelling of the Ramp Failure.

The Proposed Modification (MOD7) seeks consent for the following:

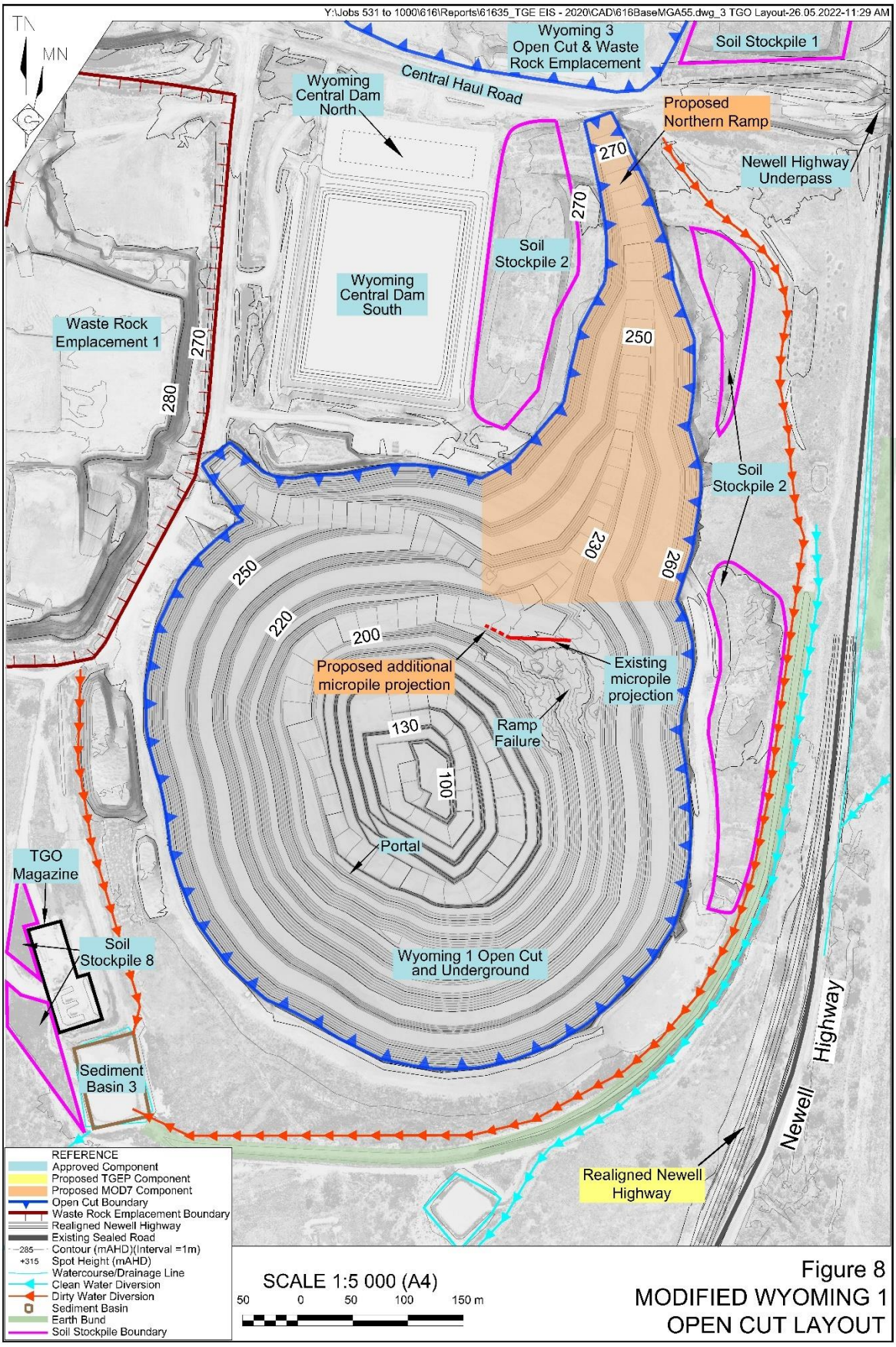
- Construction and use of the Northern Ramp for the Wyoming 1 Open Cut.

No other changes to the approved TGO Mine operations, or proposed TGEP operations, are proposed.

This Air Quality Impacts Assessment (AQIA) has been commissioned by the Applicant to assess the potential for any additional air quality impacts related to the Proposed Modification (MOD7).

Figure 1 presents the proposed layout of the Northern Ramp.

Figure 1 Proposed modification to the Wyoming 1 Open Cut



2.1. Construction

The proposed Northern Ramp would be constructed using the Applicant's existing open cut mining fleet. The following presents an overview of the proposed construction procedures. These are broadly consistent with the Applicant's current open cut mining procedures.

- The approved boundaries of areas to be disturbed would be surveyed and marked out prior to commencement.
- Stockpiled soil within Soil Stockpile 2 would be extracted, transported and used immediately for rehabilitation of sections of Residue Storage Facility 1 or placed into other existing and approved Soil Stockpile locations within the TGO Mine Site. Adequate capacity exists within existing, approved soil stockpile areas within the TGO Mine Site to store all soil not used immediately for rehabilitation operations.
- Appropriate safety bunds and surface water controls would be constructed around the perimeter of the ramp to prevent inadvertent access and surface water inflows.
- Alluvium within the Northern Ramp would be extracted using an excavator and loaded into haul trucks to be transported to Residue Storage Facility 2 or Waste Rock Emplacement 1 (approximately 50 % of total material) or the Caloma Waste Rock Emplacement (approximately 50 % of total material). Approximately 0.75 Mm^3 of material would be extracted from the Northern Ramp. Adequate capacity exists within Residue Storage Facility 2, Waste Rock Emplacement 1 or the Caloma Waste Rock Emplacement to store all extracted material.

No drill and blast would be required during construction of the proposed Northern Ramp.

Construction of the Northern Ramp is anticipated to be completed in the last quarter of CY 2022. No overlap with the construction / major earthworks or operational activities associated with the proposed TGEP activities are therefore expected.

2.2. Operation

Once commissioned, the Northern Ramp would permit access from the existing ramp to the west of the Ramp Failure to the Central Haul Road which would become the primary transportation route for ore from the TGO Underground Mine to the ROM Pad.

The Northern Ramp would continue to be managed to minimise further possible development of the Ramp Failure.

The use of the Northern Ramp will coincide with TGEP activities (once approved), including construction / major earthworks, and operation.

2.3. Potential for Emissions to Air

In relation to air quality, impacts associated with the construction and operation of the Northern Ramp would be associated with:

- emissions associated with the extraction, loading, haulage, and unloading of materials associated with the construction of the Northern Ramp, including extracted alluvium and soil; and
- changes in emissions associated with the operation of the Northern Ramp, principally vehicle movements, when compared to the current situation.

Any emissions associated with the operation of the Northern Ramp would not be wholly additional to those resulting from the current operations of the TGO Mine. The current access route to the Wyoming 1 Open Cut would be redirected to the Northern Ramp, and therefore any emissions would be relocated. This assessment considers that potential change in anticipated emissions.

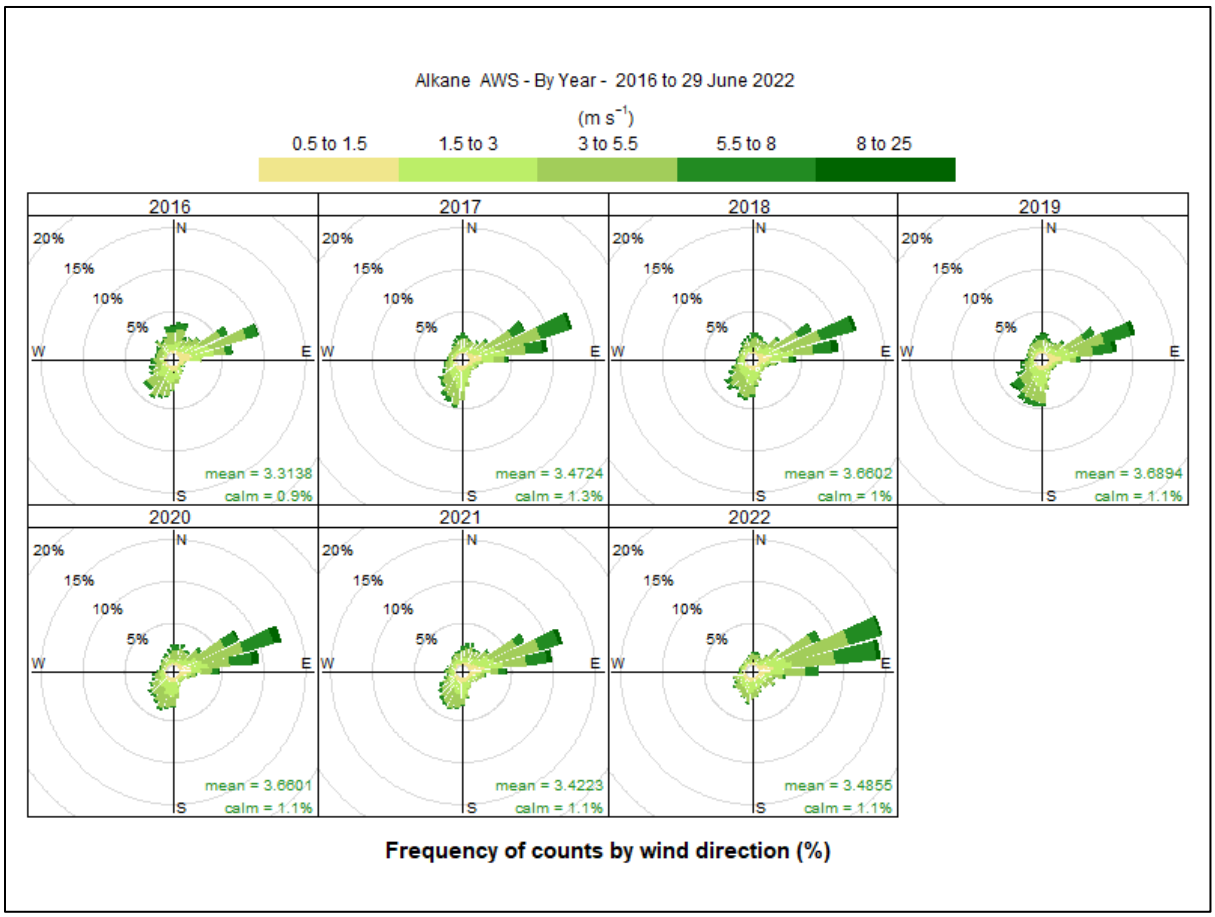
3. EXISTING CONDITIONS

A full and detailed summary of the existing air quality and meteorological environment surrounding the TGO Mine Site is presented in the air quality impact assessment (AQIA) which supported TGEP. That information has been updated below to include the most recent 12 months of data.

3.1. Meteorology

Meteorological monitoring is performed at the TGO Mine Site. Annual wind roses for the period 2016 to 29 June 2022 are presented in Figure 2 which indicate that the predominant wind direction experienced at the TGO Mine Site is from an east north-easterly direction. This observation is consistent across the period of observation.

Figure 2 TGO Mine AWS wind-roses (2016- 29 June 2022)



3.2. Air Quality

Air quality monitoring (including ambient concentrations of TSP and PM_{10}, and the rate of dust deposition) is performed at the TGO 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 results of continuous measurements of PM_{10} collected at the TGO Mine between 13 May 2014 and 30 June 2022 are summarised in Table 1.

The annual average PM_{10} concentration as measured within the TGO 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 1 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	14.4	0	14.4
2022 (to June 30)	12.4	1	12.1

As discussed in Northstar (2021), 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 3 and Figure 4 presents a summary of the concentrations of PM_{10} measured at the TGO Mine, and at the NSW DPE AQMS at Bathurst (approximately 150 km to the southeast of the TGO Mine) for the years 2014 to 2022. 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 3.

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 2021 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 2.

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 TGO Mine can be attributed to non-Mine sources.

Figure 3 Trend in PM_{10} at the Mine 2014 to 30 June 2022

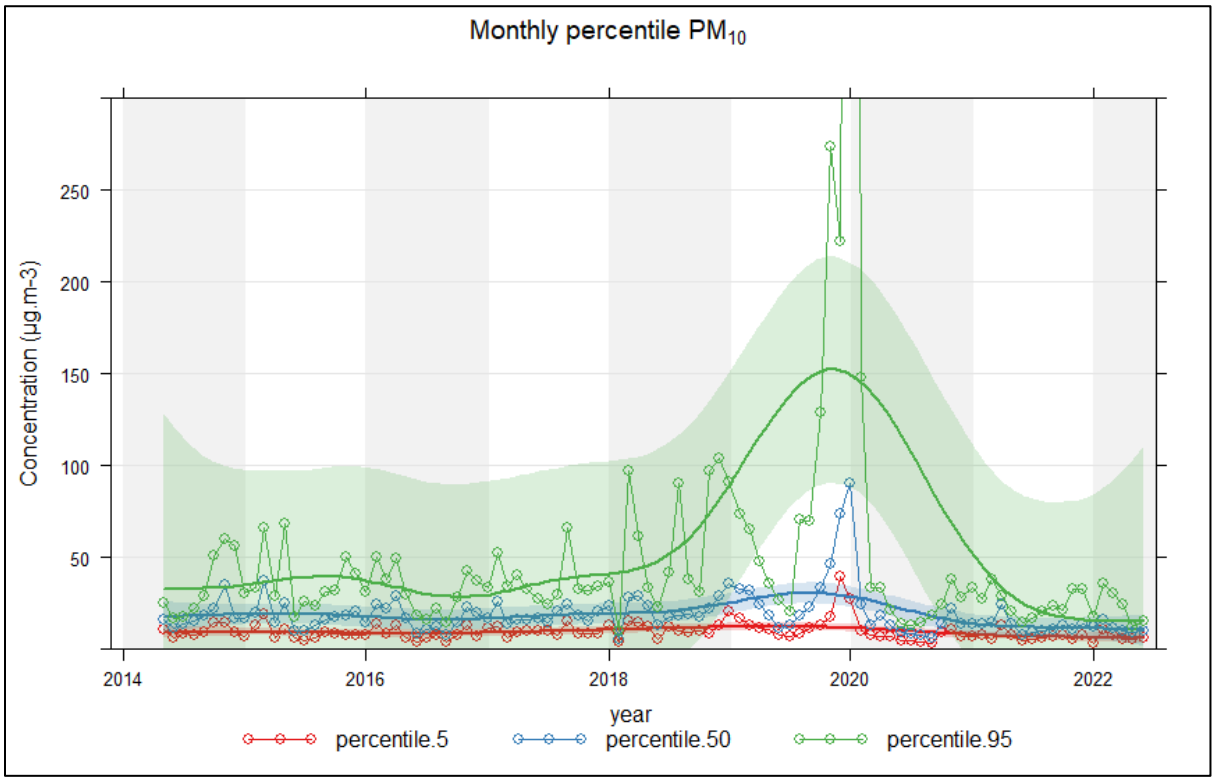


Figure 4 Trend in PM_{10} at Bathurst AQMS 2014 to 30 June 2022

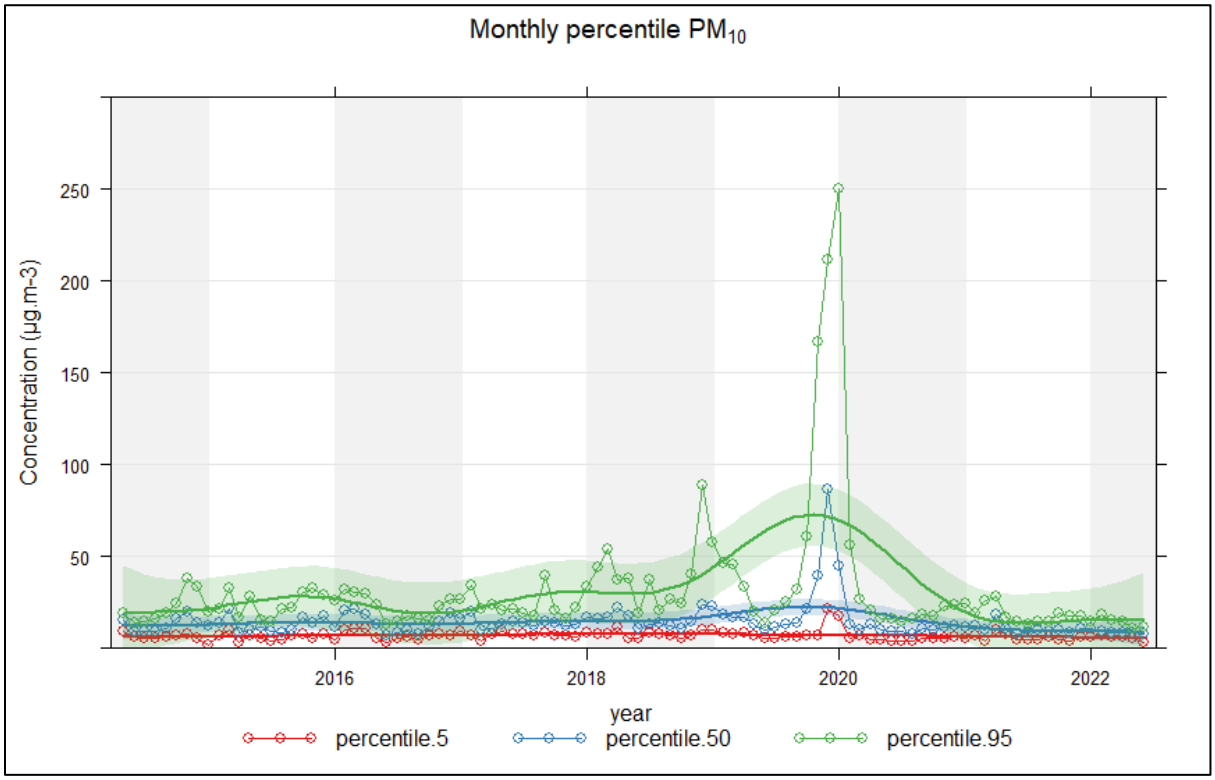


Table 2 Measured exceedances of the 24-hour PM_{10} criterion

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	No exceedances were recorded at the mine during the reporting period, and no complaints were received. (Tomingley Gold Operations Pty Ltd, 2022)
2022	1	2022 Annual Review not published yet.

The results of TSP measurements performed at the Mine between 2014 and 20 May 2021 are presented in Table 3. 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 TGO 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 3 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	33.6
2022 (to May)	38.8

The results of dust deposition monitoring performed at five locations around the TGO Mine between 2014 and May 2022 are presented in Table 4. Exceedances of the NSW EPA impact assessment criterion are highlighted.

Table 4 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
2021	1.4	0.8	0.9	1.8	0.7
2022 (to May)	1.2	1.1	0.9	2.1	1.1

Based on the foregoing description of meteorology and air quality as measured at and surrounding the TGO Mine Site, air quality criteria are generally achieved, and when significant elevations in concentrations occur, they can be attributed to regional rather than project-related influences. This indicates that the air quality management measures in place as part of the ongoing TGO Mine operations are acting to ensure that environmental objectives are achieved. In the case of meteorology, the data indicates that no significant variation in wind speed and direction are evident from year to year, and therefore no changes to air quality impacts related to meteorological conditions would be anticipated.

4. PREVIOUS ASSESSMENTS OF AIR QUALITY

4.1. 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.

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 5.

Table 5 Predicted incremental and cumulative annual average particulate (PAEHolmes, 2011)

Scenario	Annual average TSP $\mu g \cdot m^{-3}$		Annual average PM_{10} $\mu g \cdot m^{-3}$		Annual average dust deposition $g \cdot m^{-2} \cdot month^{-1}$	
	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 $\mu g \cdot m^{-3}$), and presently (2021) (25 $\mu g \cdot m^{-3}$)

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.

4.2. 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 1 Open Cut;
- Establishment of the Caloma 2 Open Cut;
- Construction of an alternative decline from the Caloma 1 Open Cut;
- Mining of additional underground resources below the Caloma 1 and Caloma 2 Open Cuts;
- Extension of Waste Rock Emplacement (WRE) 3;
- Backfill of the Wyoming 3 Open Cut with waste rock;
- Modifications to the Central Drainage Channel which diverts clean water runoff from the north through the TGO 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 4.1). 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.

4.3. SAR Exploration Drive

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, namely the establishment of an exploration drive (the SAR Exploration Drive). The SAR Exploration Drive commences within the Wyoming 1 Underground and is progressing south towards the 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 TGO Mine Site.

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."*

4.4. 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 MP 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 currently under construction, with construction of Stage 2 anticipated to commence 2 years after the completion of Stage 1.

4.5. Tomingley Gold Extension Project

Northstar (Northstar Air Quality, 2021) performed a dispersion modelling assessment to quantify the potential air quality impacts at surrounding sensitive receptor locations associated with the construction and mining phases of the TGEP.

The measures implemented through the existing Air Quality and Greenhouse Gas Management Plan were shown to be appropriate to manage impacts of all modelled pollutants at all surrounding receptor locations during the construction phase activities.

During operation of the TGEP, the dispersion modelling assessment indicated that a number of additional exceedances of short-term particulate matter air quality criteria would be avoided through the implementation of a modified Trigger Action Response Plan (TARP). The modified TARP includes the installation and operation of two additional real-time particulate monitors (in addition to the one currently installed and operated by the Applicant near Tomingley Village). Various air quality management measures were adopted to respond to any occurrences of elevated particulate matter concentrations, to ensure that any exceedances would be managed so as to not occur.

5. ASSESSMENT

5.1. Construction

Construction of the Northern Ramp is not anticipated to coincide with the construction or operational phases of the proposed TGEP but is anticipated to coincide with the construction of RSF2 Stage 1 (as assessed under MOD5).

An assessment of the potential particulate emissions anticipated as a result of the construction of the Northern Ramp, in conjunction with the activities approved under MOD5, including the ongoing operation of the TGO Mine, is presented in Table 6. The annual TSP emissions associated with the AQIA submitted in support of the original approval (PAEHolmes, 2011), the MOD3 AQIA (PEL, 2015), and the MOD5 AQIA (Northstar Air Quality, 2020) are presented in Table 6, along with those anticipated as part of MOD7.

A summary of emissions calculations associated with the construction phase of MOD7 are presented in Appendix A. Approximately 50 % of the material removed as part of the Northern Ramp construction is assumed to be loaded and transported to the RSF, with the remaining 50 % loaded and taken to WRE1.

The emissions presented in column 2 of Table 6 are those which were subject to dispersion modelling to support the original approval for the TGO Mine. Changes to those operations have occurred over time, either through modifications to the approval which have been assessed by DPE and EPA, or through changes in mine operations within the boundaries of the approvals e.g. change in activity location and intensity as the Mine has progressed.

This assessment seeks to provide comfort that the level of emissions change associated with MOD7 lies within the original approval and subsequent modifications. Where significant changes in the TGO Mine operations have been experienced (e.g. the significant reduction in open cut mining and associated waste management activities), these have been reflected in the modified emissions inventory by removal or modification of those sources (highlighted). Some activities have changed in intensity, although the emissions values associated with the original approval have been retained in this instance, as they reflect those activities at their maximum throughput. It is considered that this is an appropriate approach.

Emissions associated with TGEP are not presented here, as they will not be performed concurrently.

Table 6 Annual TSP emissions – Original, MOD3, MOD5 and current (MOD7) activities

Activity	Annual TSP emissions (kg·yr^{-1})			
	Original AQIA	MOD3	MOD5	MOD7
Waste – Drilling	66 050	37 170	37 170	-
Waste - Blasting	15 775	20	20	-
Waste - Excavator loading Waste to haul truck	3 977	1 649	1 649	-
Waste - Hauling from Caloma 1 OC to WRE3	69 137	22 745	22 745	-
Waste - Hauling from Wyoming 1 OC to WRE1	4 749	6 203	6 203	-
Waste - Hauling from Wyoming 3 OC to WRE2	15 922	310	310	-
Waste - Hauling from Caloma 2 OC to WRE3	-	5 686	5 686	-
Waste - Emplacing at WRE3	1 790	589	589	-
Waste - Emplacing at WRE1	676	883	883	-
Waste - Emplacing at WRE2	1 511	29	29	-
Waste- Emplacing at WRE3	-	147	147	-
Waste- Dozers on Waste	36 640	24 131	24 131	-
ORE- Drilling	928	700	700	700
ORE- Blasting	589	-	-	-
ORE - Dozers ripping/pushing/clean-up	109 963	282 439	282 439	282 439 *
ORE - Excavators/FELs loading open pit ore to trucks	106 550	105 955	105 955	82 648 *
ORE - Hauling open pit ore from Caloma 1 to ROM pad	12 352	9 748	9 748	9 748 *
ORE - Hauling open pit ore from Wyoming 1 to ROM pad	6 575	20 604	20 604	20 604 †
ORE- Hauling open pit ore from Wyoming 3 to ROM pad	5 689	266	266	266 †
ORE- Hauling open pit ore from Caloma 2 to ROM pad	-	2 437	2 437	2 437 †
ORE - Unloading ROM to ROM stockpiles	355	353	353	353
ORE- FEL unloading ROM from stockpiles to ROM bin	355	353	353	353
ORE- Primary Crushing	24 135	24 000	24 000	24 000
ORE - Conveying to Screen Building	46	46	46	46
ORE - Unloading ore from conveyor to Screen Building	355	353	353	353
ORE - Screening	1 508	1 500	1 500	1 500
ORE - Conveying oversized material to Crushing Building	46	46	46	46
ORE - Unloading oversized ore from conveyor to Crushing Building	101	101	101	101
ORE - Secondary Crushing	68 784	68 400	68 400	68 400
ORE - Conveying oversized material to Screen Building	46	46	46	46
ORE - Conveying undersized material to Surge Bin	27	27	27	27
ORE - Unloading undersized ore from conveyor to Surge Bin	5	5	5	5
ORE - Conveying undersized material from Surge Bin to ball mill	44	44	44	44
ORE - Unloading undersized ore from conveyor to ball mill	18	18	18	18
REHAB - Dozers on rehab	3 861	3 861	3 861	3 861
WE - Waste dump areas	223 730	230 901	230 901	230 901
WE - Residue Storage	51 824	51 824	51 824	51 824

Activity	Annual TSP emissions (kg·yr^{-1})			
	Original AQIA	MOD3	MOD5	MOD7
WE - Open pit	198 677	225 663	225 663	225 663
WE - ROM stockpiles	1 402	27 349	27 349	27 349
Grading roads	86 264	86 264	86 264	86 264
Stage 1 RSF2 Construction	-	-	29 961	29 961
Construction of the Northern Ramp	-	-	-	30 735
Total	1 120 456	1 242 865	1 272 826	1 180 692
% change compared to Original AQIA	-	+ 10.9 %	+ 13.6 %	+ 5.4 %
% change compared to MOD3 AQIA	-	-	+ 13.6 %	- 5.0%
% change compared to MOD5 AQIA	-	-	-	- 7.2 %

Note: * Emissions likely to be lower given that the same fleet of vehicles/equipment would be used in the construction of MOD7
† All indicated is now ore extracted from underground, not open cut. Emissions retained to reflect emissions associated with movement of that ore to the ROM pad.

Based on the results presented in Table 6, the change in annual TSP emissions associated with the construction phase activities of the MOD7 development are calculated to be 7.2 % less than those associated with the approved MOD5 development, when taking into account operational changes in relation to waste generation and management across the TGO Mine Site. This reduction in TSP emissions is not anticipated to result in any material changes to the air quality impacts of the MOD7 construction phase activities, over and above those already assessed and approved as part of MOD5. The locations of the construction activities being performed as part of MOD7 are within the disturbance footprint of approved activities, and therefore no quantitative assessment is required to assess that minor level of change.

Given that the MOD7 construction activities will occur over a three-month period, peaks in short-term (24-hr) particulate emissions would be greater than the annual average rates. To provide an assessment of whether those elevated short-term emission rates may result in additional exceedances of the relevant particulate matter criteria, a comparison with peak daily emissions during the proposed TGEP activities has been performed.

As previously noted, these activities (TGEP and MOD7) are not likely to coincide (see Section 2.1), but this assessment is provided to allow the level of potential impact to be placed into context (i.e. for benchmarking purposes only). Specifically, potential particulate impacts associated with activities proposed as part of the construction and operational phases of the TGEP have been shown to be manageable through the implementation of the Air Quality and Greenhouse Gas Management Plan (AQMP), as identified by Northstar (2021). Table 7 shows that peak daily emissions associated with the MOD7 construction phase activities (including all other approved activities likely to be concurrent) are either marginally greater (+2 %) or significantly less (up to 36 % lower) than those proposed under TGEP and assessed by Northstar (2021). In addition, the construction of the Northern Ramp would require the use of the same fleet required for the construction of the SAR Mine Site.

The measures outlined in the AQMP would be more than sufficient to manage any potential short and longer-term impacts associated with the construction of the Northern Ramp. Furthermore, these construction activities are proposed to be located within the existing and approved areas of disturbance within the TGO Mine Site, and would not result in emissions sources moving closer to any receptors.

Table 7 Comparison of short-term emissions (MOD7 vs TGEP)

Development phase	Peak daily TSP emissions (kg·day^{-1})		
	Construction phase of TGEP (FY23)	Operational phase of TGEP (FY24)	Operational phase of TGEP (FY25)
Current approved TGO and proposed TGEP (incl. original approval, MOD3 and MOD5)	3 419	5 244	5 460
Proposed (incl. original approval, MOD3, MOD5 and construction phase of MOD7)	3 487	3 487	3 487
Comparison of TSP emissions (construction of MOD7) with TGEP	+2 %	-34 %	-36 %

5.2. Operation

The original AQIA and the AQIA submitted to support MOD3 assumed a transport distance from the Wyoming 1 Open Cut to the ROM Pad of 3.1 km (round trip). Review of plans and aerial imagery associated with the operation of the Northern Ramp indicates that the distance from the Wyoming 1 Open Cut to the ROM Pad remains at 3.1 km (round trip), and therefore no changes to emissions associated with ore transport are anticipated as a result of MOD7.

6. MITIGATION AND MONITORING

Management of air quality is currently undertaken by the Applicant with due reference to the AQMP which clearly outlines the management measures to be adopted as part of the ongoing operation of the TGO Mine. Those management measures would be adopted during the construction and operation of MOD7.

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.

Based upon the foregoing, and the benchmarked estimated estimate associated with MOD 7 against emission estimates for previously approved modifications and the approved management measures implemented through the AQMP, it is considered that those measures are sufficient to ensure that the construction or operational activities associated with MOD7 would not result in exceedances of the relevant air quality criteria.

7. CONCLUSION

RWC has engaged Northstar on behalf of the Applicant to support an application to modify SSD Consent MP09_0155 for the TGO Mine.

This assessment considers the potential emissions of particulate matter which might occur during both the construction and operation of a proposed alternative access point to the Wyoming 1 Open Cut at the TGO Mine.

Emissions during construction phase activities are anticipated to be minor when compared to approved development and represent a decrease in TSP emissions of 7.2 % as an annual average when compared to approved MOD5 activities (including all other approved activities occurring concurrently).

Assessment of the potential for short-term peaks in emissions (i.e. daily) indicates that when compared to proposed TGEP activities (including all other approved TGO Mine activities), MOD7 construction phase activities would result in either marginally greater (+2 %) or significantly lower than (up to -36 % lower) emissions. In the detailed AQIA for TGEP, the impacts associated with those emissions was shown to be manageable through the continued implementation of the AQMP.

In relation to operation of MOD7 activities, no changes to the emissions associated with the current or approved development are anticipated.

It is concluded that any impacts associated with the construction and operational phase activities associated with MOD7 will be easily managed through the continued implementation of the AQMP.

8. REFERENCES

Katestone. (2011). *Katestone Environmental Pty Ltd, NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining. June 2011.*

Northstar Air Quality. (2020). *Tomingley Gold Operations - Modification 5, Air Quality Assessment, November 2020.*

Northstar Air Quality. (2021). *Tomingley Gold Extension Project, Air Quality Impact Assessment.*

NPI. (2012). *National Pollutant Inventory Emission Estimation Technique Manual for Mining, Version 3.1.*

PAEHolmes. (2011). *Tomingley Gold Project, Air Quality Assessment, September 2011.*

PEL. (2015). *Tomingley Gold Mine Modification - Air Quality, 9 November 2015, Pacific Environment Limited.*

PEL. (2016). *Tomingley Gold Mine Modification Response to EPA letter - Air Quality, 2 February 2016.*

Tomingley Gold Operations Pty Ltd. (2015). *Annual Environmental Management Report 1 January - 31 December 2014.*

Tomingley Gold Operations Pty Ltd. (2016). *Tomingley Gold Operations Annual Review 1 January - 31 December 2015.*

Tomingley Gold Operations Pty Ltd. (2017). *Tomingley Gold Operations Annual Review 1 January - 31 December 2016.*

Tomingley Gold Operations Pty Ltd. (2018). *Tomingley Gold Operations Annual Review 1 January - 31 December 2017.*

Tomingley Gold Operations Pty Ltd. (2019). *Tomingley Gold Operations Annual Review 1 January - 31 December 2018.*

Tomingley Gold Operations Pty Ltd. (2020). *Tomingley Gold Operations Annual Review 1 January - 31 December 2019.*

Tomingley Gold Operations Pty Ltd. (2021). *Tomingley Gold Operations Annual Review 1 January - 31 December 2020.*

Tomingley Gold Operations Pty Ltd. (2022). *Tomingley Gold Operations Annual Review 1 January - 31 December 2021.*

US EPA. (1995). *Compilation of Air Pollutant Emission Factors, January 1995.*

US EPA. (1998). *AP-42 Emission Factors Section 11.9 Western Surface Coal Mining.*

USEPA. (2006a). *AP-42 Compilation of Air Pollutant Emission Factors, Chapter 13.2.4 Aggregate Handling and Storage Piles.*

USEPA. (2006c). *AP42 Compilation of Air Pollutant Emission Factors, Chapter 13.2.2 Unpaved Roads.*

APPENDIX A

Emissions Estimation

As outlined in Section 2.3, 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 and waste material is taken to be 10%, and the moisture content of topsoil and waste material is taken to be 4.8 %, which are all consistent with the original AQIA (PAEHolmes, 2011) and subsequent modification assessments.

The activity data associated with each process under assessment has been provided by the Applicant, or calculated from those data. Importantly, the bulk density of the 0.7 Mm^3 of waste and soil material to be removed is assumed to be 2.75 $t \cdot m^{-3}$.

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).

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

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 the construction phase of MOD7 are presented in the following tables. The first table shows the annual emission anticipated, associated with the three-month construction period, and the second table shows the potential peak daily emissions.

Anticipated annual particulate emissions

Activity Description	Emission Factor	Emission Rate			Units	Activity Rate	Units	Emission Controls (% efficiency)	Controlled emissions (kg.year-1)		
		TSP	PM_{10}	$PM_{2.5}$					TSP	PM_{10}	$PM_{2.5}$
Excavator on alluvium, loading to trucks	AP-42 - Batch drop - Section 13.2.4.3	0.0006	0.0003	0.00004	kg/t	2,062,500	t	Water sprays (50%)	631.2	298.6	45.2
Transport of 50% of alluvium to RSF	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg/VKT	48,729	VKT	90% for haul road dust suppression	20,002.4	5,139.7	514.0
Transport of 50% of alluvium to WRE1	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg/VKT	21,532	VKT	90% for haul road dust suppression	8,838.3	2,271.0	227.1
Unloading of material at RSF	AP-42 - Batch drop - Section 13.2.4.3	0.0006	0.0003	0.00004	kg/t	1,031,250	t		631.2	298.6	45.2
Unloading of material at WRE1	AP-42 - Batch drop - Section 13.2.4.3	0.0006	0.0003	0.0000	kg/t	1,031,250	t		631.2	298.6	45.2
Wind erosion	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.0	425.0	63.8	kg/ha/yr	3.2	ha	Water sprays (50%)	0.2	0.1	0.0
								Total	**30,734.5**	**8,306.4**	**876.7**

Anticipated peak daily particulate emissions

Activity Description	Emission Factor	Emission Rate			Units	Activity Rate	Units	Emission Controls (% efficiency)	Controlled emissions (kg.year-1)		
		TSP	PM_{10}	$PM_{2.5}$					TSP	PM_{10}	$PM_{2.5}$
Excavator on alluvium, loading to trucks	AP-42 - Batch drop - Section 13.2.4.3	0.0006	0.0003	0.00004	kg/t	8,250,000	t	Water sprays (50%)	2,525.0	1,194.2	180.8
Transport of 50% of alluvium to RSF	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg/VKT	194,918	VKT	90% for haul road dust suppression	80,009.6	20,558.7	2,055.9
Transport of 50% of alluvium to WRE1	AP-42 Unpaved roads - Section 13.2.2	4.105	1.055	0.105	kg/VKT	86,126	VKT	90% for haul road dust suppression	35,353.1	9,084.1	908.4
Unloading of material at RSF	AP-42 - Batch drop - Section 13.2.4.3	0.0006	0.0003	0.00004	kg/t	4,125,000	t		2,525.0	1,194.2	180.8
Unloading of material at WRE1	AP-42 - Batch drop - Section 13.2.4.3	0.0006	0.0003	0.0000	kg/t	4,125,000	t		2,525.0	1,194.2	180.8
Wind erosion	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	850.0	425.0	63.8	kg/ha/yr	3	ha	Water sprays (50%)	0.2	0.1	0.0
								Total	**122,937.7**	**33,225.5**	**3,506.8**
								Peak Daily (kg.day-1)	**336.8**	**91.0**	**9.6**