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17 November 2021

Chris Higgins
CMOC-Northparkes Mines
PO Box 995
Parkes NSW 2870

Re: Northparkes Mines Modification 6 - air quality impact assessment

Dear Chris,

1 Introduction

CMOC-Northparkes Mines (CMOC) own and operate the Northparkes Mines (Northparkes), an existing copper-gold mine located approximately 27 kilometres (km) north-west of Parkes in the central west region of New South Wales (NSW). Northparkes has been operational since 1993 and has included the development of open cut and underground mining operations targeting a number of ore bodies, as well as associated ore processing and tailings storage infrastructure.

In 2019, Project Approval 11_0060 (PA 11_0060) was gazetted as a State Significant Development (hereafter SSD) under section 4 of the *Environmental Planning and Assessment Act 1979 No 203* (EP&A Act) and is now referred to as Development Consent 11_0060.

CMOC is seeking approval for a modification to PA 11_0060 (hereafter the Proposed Modification). The Proposed Modification includes:

- construction and use of a new underground portal access (including associated drive, conveyor and other ancillary infrastructure) for E22 underground mining operations;
- TSF2 embankment buttressing (including associated amendments to the approved disturbance area);
- changes to TSF construction within the approved disturbance footprint associated with increased safety requirements for TSFs since first approved;
- minor changes to the E31 and E31N open cut pits to reflect updated geological data and improved resource recovery, including:
  - minor adjustments to disturbance areas for the approved pits and associated infrastructure (roads, safety bunds, water management etc);
  - minor increases to maximum approved mining depths;
- establishment of temporary waste rock stockpile areas for the E31 and E31N pits to avoid unnecessary material re-handling in the future due to the proposed Rocklands TSF;
- additional detail regarding the approved methods and locations of rehabilitation material (soils and vegetation);

- establishment of additional clay and filter material borrow pits for TSF construction and lifts;
- relocation of the Contractor area facilities (eg site offices, crib huts and a workshop) which would also service the E31 and E31 mining operations;
- relocation of the main water supply pipeline and Rosedale (TSF3) tailings pipeline; and
- clarification regarding approved disturbance boundaries and the location of ancillary infrastructure within the E31 Precinct.

Key areas of the Northparkes and Proposed Modification are illustrated in Figure 1.1.

CMOC has engaged EMM Consulting Pty Ltd (hereafter, EMM) to complete an air quality impact assessment (AQIA) report for the Proposed Modification.

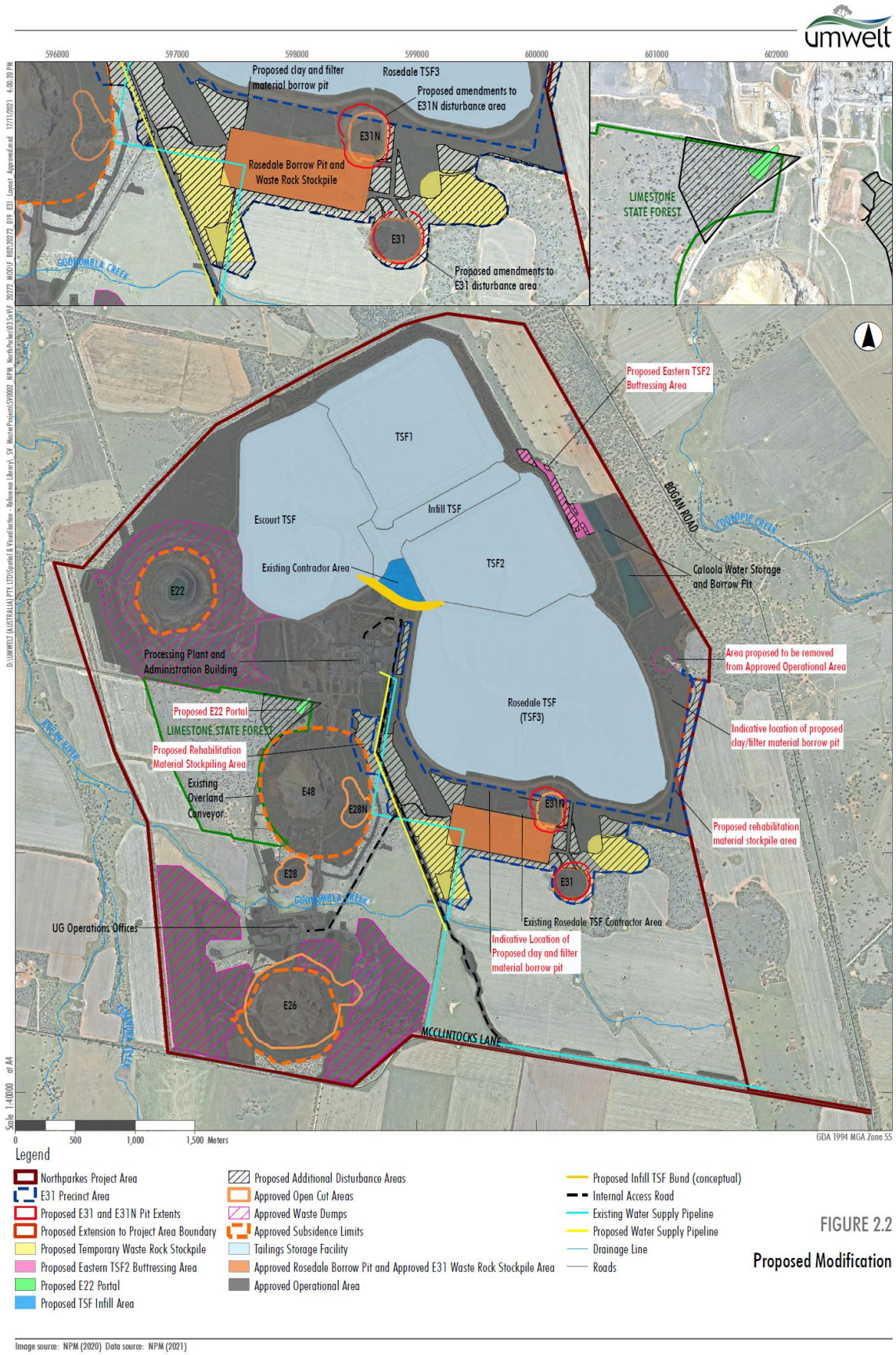

Figure 1.1 Proposed modification

Source: Umwelt (2021)

2 Project description

A new portal and associated decline to the existing approved E22 access heading is proposed to improve operational efficiencies and reduce overland ore transport. The new portal would be located in the north-eastern corner of Limestone National Forest (see Figure 1.1). This area is not currently approved for disturbance. The portal would be primarily used for ore transport to the surface, however it may also be used for personnel/vehicle/equipment access in the future. The new portal would also incorporate an associated conveyor (connecting into the mine's existing conveyor system) and water management infrastructure (eg surge dams, dewatering sumps etc).

In addition, CMOC has identified that the walls of TSF2 require additional buttressing to meet relevant safety standards and to enable the approved future lifts of the TSF wall to occur. This buttressing will require an adjustment to the approved disturbance boundary to the east of TSF2. The general location of this buttressing area is shown in Figure 1.1.

The Proposed Modification also includes an extension to the approved Infill TSF area (refer to Figure 1.1). This extension is required as a result of increased safety design standards for tailings storage facilities. The proposed infill extension area is located wholly within existing approved disturbance areas.

A review of the mine design for E31 and E31N has identified that minor adjustments to the approved disturbance boundaries of the two pits are required. Figure 1.1 provides a comparison of the approved and proposed disturbance boundaries for the E31 and E31N pits. In addition, CMOC is seeking to marginally increase the approved mining depths in both pits to approximately:

- 110 m below ground level in the E31 pit (an increase of 30 m); and
- 95 m below ground level in the E31N pit (an increase of 25 m).

CMOC has also identified the potential to utilise waste rock from the E31 and E31N pits in the construction of the future Rocklands TSF, which will form part of the upcoming Northparkes E44 Rocklands Project. To avoid rehandling of this waste rock in the future (and associated noise and air quality impacts), alternate stockpiling locations have been identified within the E31 Precinct which would improve integration of these approved mining operations with the proposed Rocklands TSF construction.

CMOC also proposes to establish a new rehabilitation material stockpiling area for topsoil, subsoil and vegetative material to the west of the Access Road. The establishment of this area would facilitate the future construction of the proposed Rocklands TSF and avoid rehandling of rehabilitation materials within the E31 Precinct. The use of this area for stockpiling soil and vegetation material also avoids further impacts on actively managed farming land as this area is not presently farmed due to its proximity to active mining operations. The disturbance footprint identified for these activities to the west of the Access Road has minimised biodiversity impacts by avoiding remnant paddock trees (pre-1990) and an area of regrowth around some of these trees. This area is located in either currently approved operational areas or land assessed as being Category 1 – exempt land under the Local Land Services Act 2012.

The relocation of contractor facilities currently located to the west of TSF2 is required as a consequence of the works required for buttressing the western side of TSF2 and construction of the Infill TSF (covered by existing approvals). These contractor facilities will be relocated within the existing Approved Operational Area, in the general vicinity of the current Northparkes admin and processing facilities outside the Infill TSF area. These works will include construction of crib rooms, bath house, carparking and workshop facilities similar to those which require relocation. The relocated contractor facilities will also service the E31 mining operations, and would also be used for the construction of the Rocklands TSF when approved.

It is noted that all of the above activities are likely to be completed within a 24-30 month period commencing early in 2022. Importantly, these operations would not coincide with approved open cut mining operations

at either E26 or E28 open cut pits and the bulk earthworks associated with the approved Rosedale TSF has already been completed.

The proposed modification will also include a minor adjustment to the PA 11_0060 disturbance area to align this boundary with the existing lease boundary and provide additional space for soil stockpiling in areas. This change does not involve any additional impacts on native vegetation.

A comparison between the approved development under PA 11_0060 and the Proposed Modification is provided in Table 1.

Table 1 Proposed Modification

Aspect	Approved Operations	Proposed Modification
Mine life	Mining operations until 31 December 2032	No change
Annual Ore Processing	No more than 8.5 million tonnes of ore per annum	No change
Operating hours	24 hours per day, 7 days per week	No change
Project boundary	As per Appendix 2 of PA 11_0060	No change
Mine plan	As per PA 11_0060	Addition of proposed E22 Portal, modifications to TSFs (TSF2 buttressing and extension of TSF infill area) and minor adjustments to the E31 and E31 pit areas as shown in Figure 1.1
Mining method	Open cut and underground mining (including block cave and sub-level caving)	No change
Approximate Open Cut Mining Depth	E26 – 300 m below ground level (mbgl) E28/E28N – 60 mbgl E31 – 80 mbgl E31N – 70 mbgl	No change to E26, E28 and E28N E31 – 110 mbgl (increase of 30 m) E31N – 95 mbgl (increase of 25 m)
Surface infrastructure	As per PA 11_0060	Construction and use of new E22 portal access with associated conveyor and water management infrastructure Minor changes to the location of internal access roads and water management associated with TSF2 and Infill TSF works and changes to E31 precinct activities Realignment of Rosedale TSF tailings pipeline Realignment of part of the Main Water Supply Pipeline Relocation of Contractor Area within existing Approved Operational Area
Ore Handling and Processing	As per PA 11_0060	No change
Materials Handling	As per PA 11_0060	Development of temporary waste rock stockpiles for E31 Pits Improved definition of clay and filter material stockpiles associated with TSF construction. Improved definition of soil and other rehabilitation material stockpiling requirements and locations
Product Transportation	Copper concentrate is transported by truck to the Goonumbla rail siding (or, for the duration of the Goonumbla rail siding upgrade, the Parkes National Logistics Terminal) for dispatch	No change
Workforce numbers	Approximately 700 people	No change

3 Existing environment

3.1 Meteorology

CMOC maintains a meteorological station at Northparkes recording continuous weather conditions, including wind speed and direction, temperature, solar radiation, rainfall and atmospheric pressure.

Data from the Northparkes meteorological station recorded between January 2016 and December 2020 inclusive, were collated and processed by EMM. The dataset featured a high level of data completeness for the entire five-year period, with each year featuring at least 99.2% hourly data completeness. Further, the analysis demonstrated a similarity across all years for the most important parameters for pollutant dispersion, such as wind speed and direction, temperature and relative humidity.

The recorded winds across all five years were predominately aligned along the north-south axis, with a spread of air flow between northwest to northeast and southeast to southwest. Limited winds are experienced from the eastern and western quadrants. Across the five years of data, the annual average recorded wind speed ranged from 3.1 m/s to 3.5 m/s, while the frequency of calm conditions (ie wind speeds less than 0.5 m/s) occurred between 3.3% and 6.5% of the time. Annual wind roses recorded between 2016 and 2020 are presented in Figure 3.1.

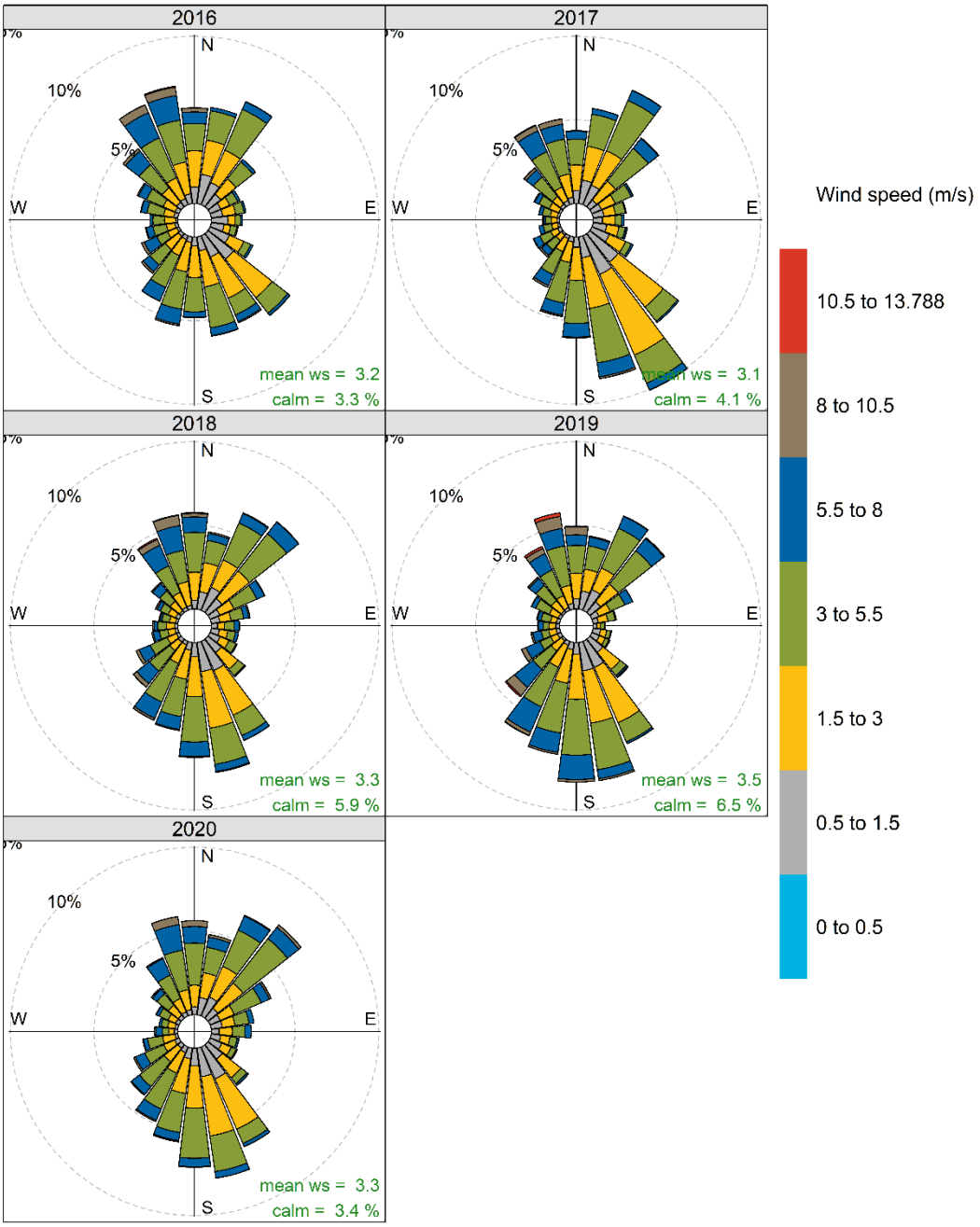

Figure 3.1 Inter-annual wind roses – Northparkes meteorological monitoring station – 2016 to 2020

3.2 Air quality

CMOC maintains an air quality monitoring network in the vicinity of Northparkes. The network includes three beta attenuation monitor (BAM) units for recording PM_{10}[1] concentrations on a continuous basis. These three sites are illustrated in Figure 3.2.

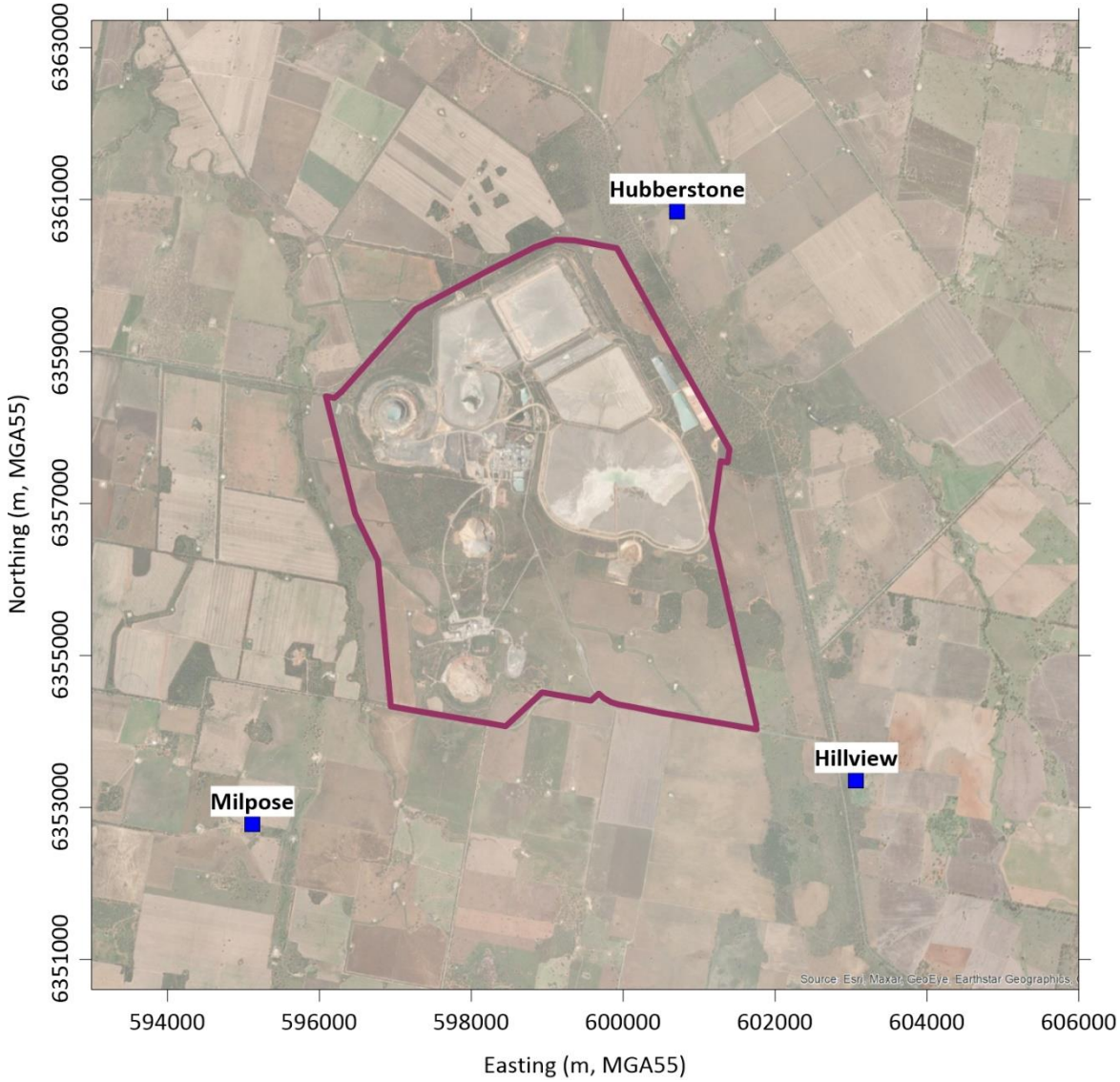

Figure 3.2 Northparkes BAM monitoring locations

In order to provide an illustration of existing air quality at Northparkes, a summary of key statistics for the most recent complete five years of analysed data from the three Northparkes BAM locations is presented in Table 3.1. Exceedances of the NSW Environment Protection Authority (EPA) 24-hour average criterion of 50 µg/m³ were recorded for all years except 2016. Exceedances of the criterion are shown in bold.

The data in Table 3.1 illustrates that PM_{10} concentrations increased notably from 2016 through to 2020. The increase is linked to intensifying drought conditions across eastern Australia with associated dust storm events, and the extensive bushfire emergency that occurred in NSW between July 2019 and February 2020.

[1] PM_{10} - particulate matter less than 10 micrometres (µm) in aerodynamic diameter

Table 3.1 Statistics for PM_{10} concentrations – Northparkes monitoring network – 2016 to 2020

Year	24-hour average PM_{10} concentration (µg/m³)						Days > 50 µg/m³	Data completeness
	Maximum	99th percentile	90th percentile	75th percentile	Median	Average		
				Hillview				
2016	38.6	33.6	20.7	13.7	4.7	7.6	0	55%
2017	**79.3**	34.7	17.2	12.1	7.7	8.5	**1**	77%
2018	**251.5**	**87.7**	35.9	23.1	15.0	19.9	**19**	99%
2019	**346.8**	**163.9**	40.2	25.0	14.4	**22.8**	**28**	94%
2020	**740.8**	**242.7**	55.6	22.0	11.4	**28.5**	**41**	97%
				Hubberstone				
2016	35.6	34.2	21.0	14.3	6.0	8.6	0	72%
2017	**95.4**	34.5	14.8	11.4	7.3	7.6	**1**	70%
2018	**197.8**	**109.0**	36.8	22.6	14.6	19.4	**24**	89%
2019	**693.2**	**582.6**	**124.9**	**63.2**	37.7	**60.9**	**119**	96%
2020	**740.8**	**252.0**	**58.1**	22.5	11.4	**29.2**	**42**	97%
				Milpose				
2016	**53.2**	34.3	16.4	10.8	6.9	8.1	**1**	83%
2017	**73.9**	34.3	15.2	10.9	6.0	7.0	**1**	69%
2018	**139.3**	**85.2**	30.4	18.5	11.8	15.8	**14**	95%
2019	**489.1**	**415.5**	**81.3**	42.6	23.8	**39.9**	**73**	100%
2020	**904.6**	**290.3**	**89.7**	27.9	14.8	**36.7**	**37**	84%

Note: bold text indicates an exceedance of the 24-hour average PM_{10} criterion of 50 µg/m³ or annual average PM_{10} criterion of 25 µg/m³

For the purpose of illustrating regional-scale elevated particulate matter events, concurrent 24-hour average PM_{10} concentrations from NSW Department of Planning, Industry and Environment (DPIE) air quality monitoring stations (AQMS) located at Wagga Wagga North (250 km south-southwest of Northparkes), Orange (105 km east-southeast of Northparkes), Bathurst (150 km east-southeast of Northparkes) and Merriwa (240 km northeast of Northparkes) were sourced from the DPIE monitoring portal (2021)[2].

A timeseries of 24-hour PM_{10} concentrations recorded at the three Northparkes BAM locations between 2016 and 2020 is presented in Figure 3.3. Additionally, the concurrent 24-hour PM_{10} concentrations recorded at the four regional DPIE AQMS locations are also presented in Figure 3.3.

[2] DPIE download facility - https://www.dpie.nsw.gov.au/air-quality/air-quality-data-services/data-download-facility

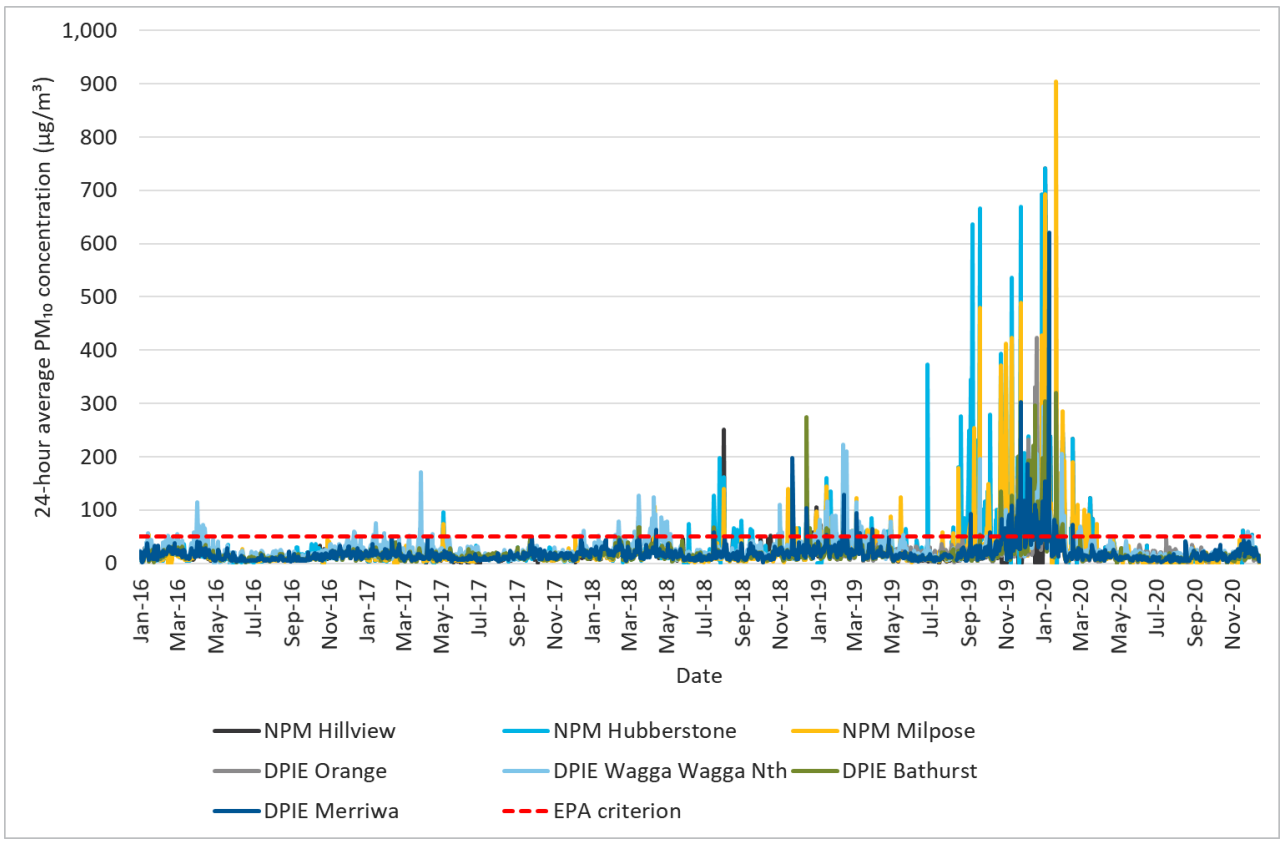

Figure 3.3 Timeseries of 24-hour average PM_{10} concentrations – Northparkes and regional DPIE monitoring stations - 2016 to 2020

The timeseries plots illustrate the following:

- the occurrence of elevated (greater than 50 µg/m³) PM_{10} concentrations increases from 2018 through to early 2020 across all monitoring stations (Northparkes and regional DPIE), which reflects the influence of the discussed state-wide drought and bushfire events;
- while often higher at the Northparkes monitoring stations, the recorded exceedances at Hillview, Hubberstone or Milpose coincide with exceedances at regional DPIE monitoring stations throughout the presented monitoring period;
- the Northparkes Hillview, Milpose and Hubberstone BAMs share a similar daily fluctuation in recorded PM_{10} concentrations throughout the analysed monitoring period; and
- following the end of the drought conditions in February 2020, the recorded PM_{10} concentrations reduce significantly across all presented monitoring stations (Northparkes and DPIE).

The annual average PM_{10} concentrations across the three Northparkes BAMs and four regional DPIE AQMS locations are presented in Figure 3.4. The increasing trend in annual average PM_{10} from 2016 to 2019 is further evidence of the increased intensity of drought conditions across NSW. It is considered that in general, the annual average PM_{10} concentrations, particularly between 2016 and 2018, are comparable between the Northparkes BAM and regional DPIE AQMS locations.

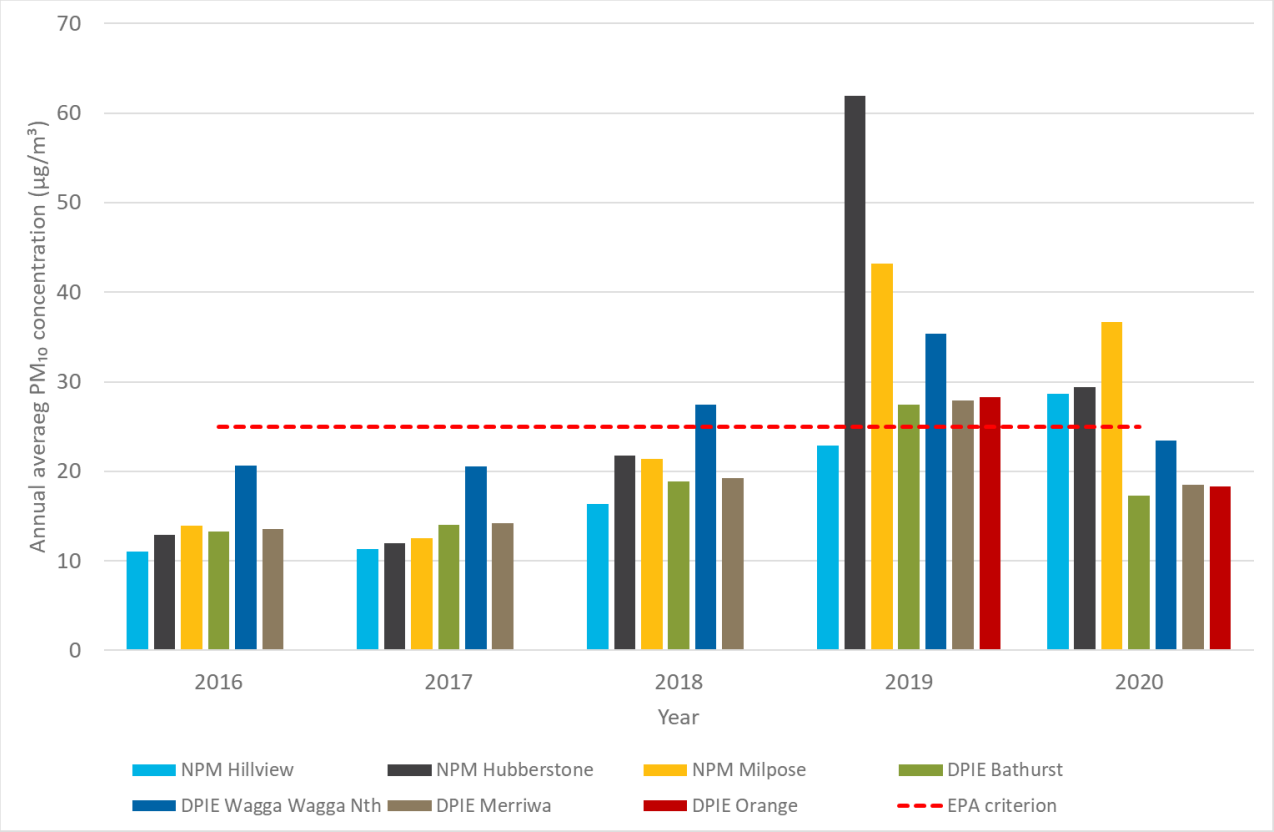

Figure 3.4 Annual average PM_{10} concentrations – Northparkes and regional DPIE monitoring stations - 2016 to 2020

The frequency of recorded PM_{10} concentrations at the Northparkes Hillview, Hubberstone and Milpose BAM locations by year for the period 2016 to 2020 is shown in Figure 3.5, Figure 3.6 and Figure 3.7 respectively. For all three monitoring locations, the distribution of recorded PM_{10} concentrations for 2018, 2019 and 2020 feature a notably higher occurrence of concentrations greater than 30 µg/m³ relative to 2016 and 2017. This again demonstrates the influence of drought and bushfire events on recorded PM_{10} concentrations at the Northparkes BAM network.

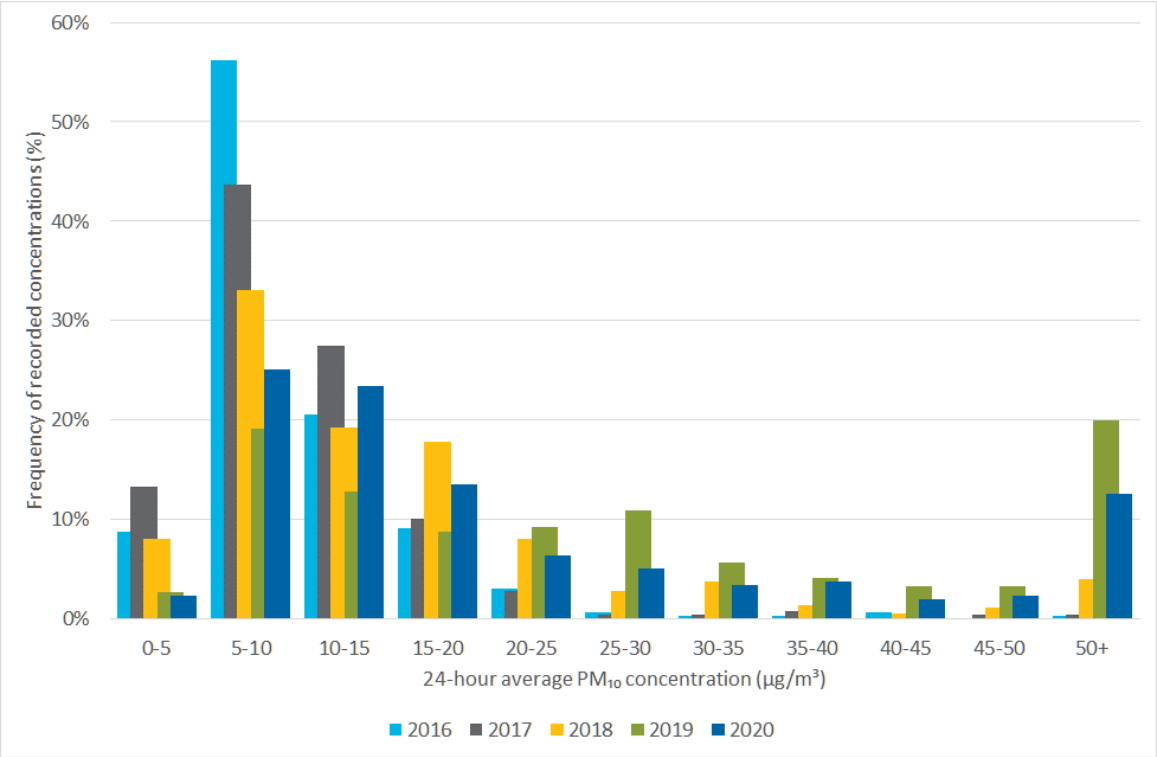

Figure 3.5 **Frequency distribution of PM_{10} monitoring data – Northparkes Hillview - 2016 to 2020**

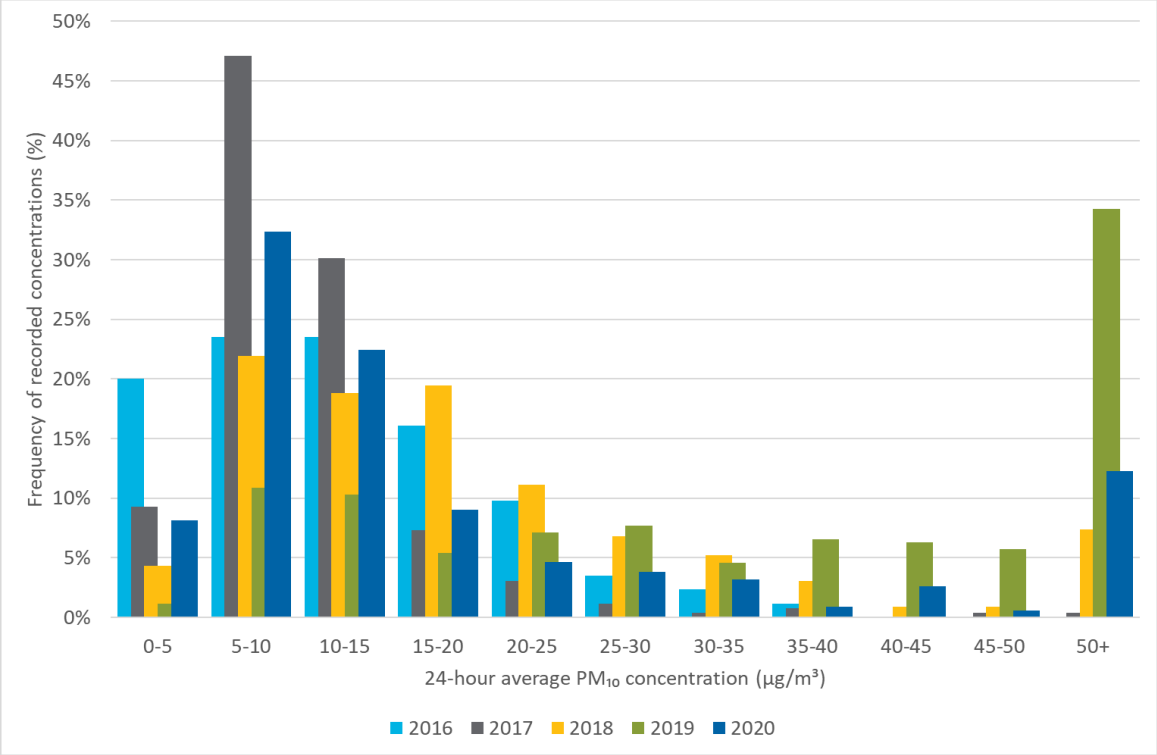

Figure 3.6 **Frequency distribution of PM_{10} monitoring data – Northparkes Hubberstone - 2016 to 2020**

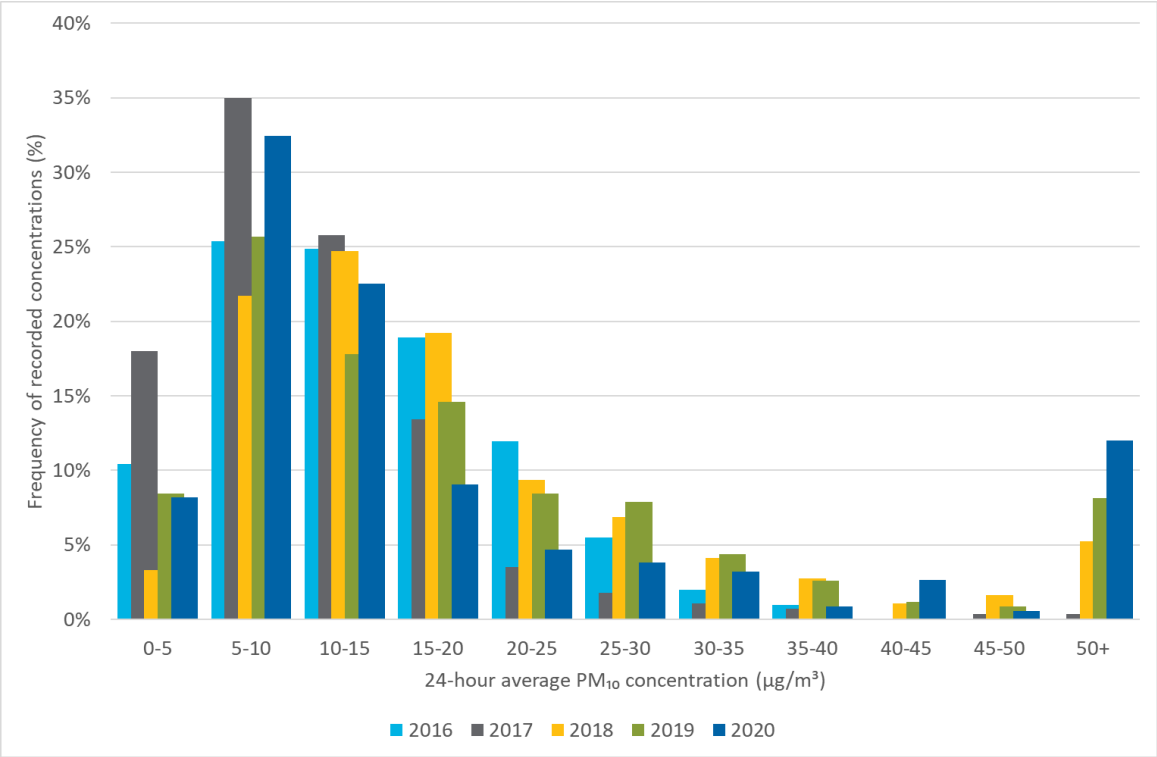

Figure 3.7 Frequency distribution of PM_{10} monitoring data – Northparkes Milpose - 2016 to 2020

The recorded hourly average wind speed and direction data from the Northparkes meteorological monitoring station were paired with the corresponding hourly average PM_{10} concentrations from each of the three Northparkes BAM locations to analyse the likely source of recorded concentrations. Using the PM_{10} concentration, wind speed and wind direction data, bivariate polar plots have been generated for each year and Northparkes BAM location and presented in Figure 3.8.

Some observations regarding the bivariate polar plots (PM_{10} concentration vs wind speed and wind direction) are as follows:

- For 2016 and 2017, the concentration range displayed is notably lower (0 µg/m³ - >30 µg/m³) relative to the plots for 2018 to 2020. The Hillview BAM features an elevated concentration signal under high winds from the northeast and south, neither of which are conditions when Northparkes operations are upwind of the BAM. The 2017 Hubberstone plot shows an elevated concentration signal when winds are elevated and from the south. This signal may be associated with emissions from the Northparkes (the tailings storage facilities are located southwest of the Hubberstone BAM) or neighbouring agricultural practices (ie a sheep and goat paddock is located immediately south of the Hubberstone BAM).

- The 2018 plots show high concentrations at both the Hubberstone and Milpose BAM locations under high winds from the southwest to northwest. Under a southwest airflow, the Hubberstone and Milpose BAMs are located upwind and downwind of Northparkes operational emission sources, therefore it is likely that the recorded PM_{10} concentrations are influenced by a regional emissions event such as a dust storm. Hubberstone and Milpose also experience a signal under high winds from the northeast. By comparison, only a north-westerly signal is evident at the Hillview BAM.

- For the 2019 plots in Figure 3.8, the three BAM sites each show similar patterns of elevated PM_{10} concentrations from high wind speeds from the northwest and southwest. Given that the three BAMs are located at different directions to Northparkes operations (ie Hubberstone to the northeast, Hillview to the southeast and Milpose to the southwest), the similarity in PM_{10} concentration by wind

direction would indicate that these northwest and southwest signals are associated with regionally transported particulate matter (ie dust storm events).

- However, the Hubberstone BAM bivariate polar plot for 2019 also shows an elevated PM_{10} concentration signal from the south that is not evident in the plots for the two other Northparkes BAMs. An investigation into these elevated PM_{10} concentrations indicated that the likely contributing source was neighbouring agricultural practices.

- The 2020 bivariate plots show a consistent signal from the south, northeast and northwest at all BAM locations under high wind conditions. It is likely that the signals are associated with particulate matter from regional dust storms and bush fire smoke (particularly the northeast signal).

While there may be some local emission source influences on the recorded PM_{10} concentrations (eg signal under southerly winds at Hubberstone), it is considered that the bivariate polar plots presented in Figure 3.8 demonstrate that elevated concentrations recorded by the Northparkes BAMs are primarily influenced by regional sources of particulate matter emissions.

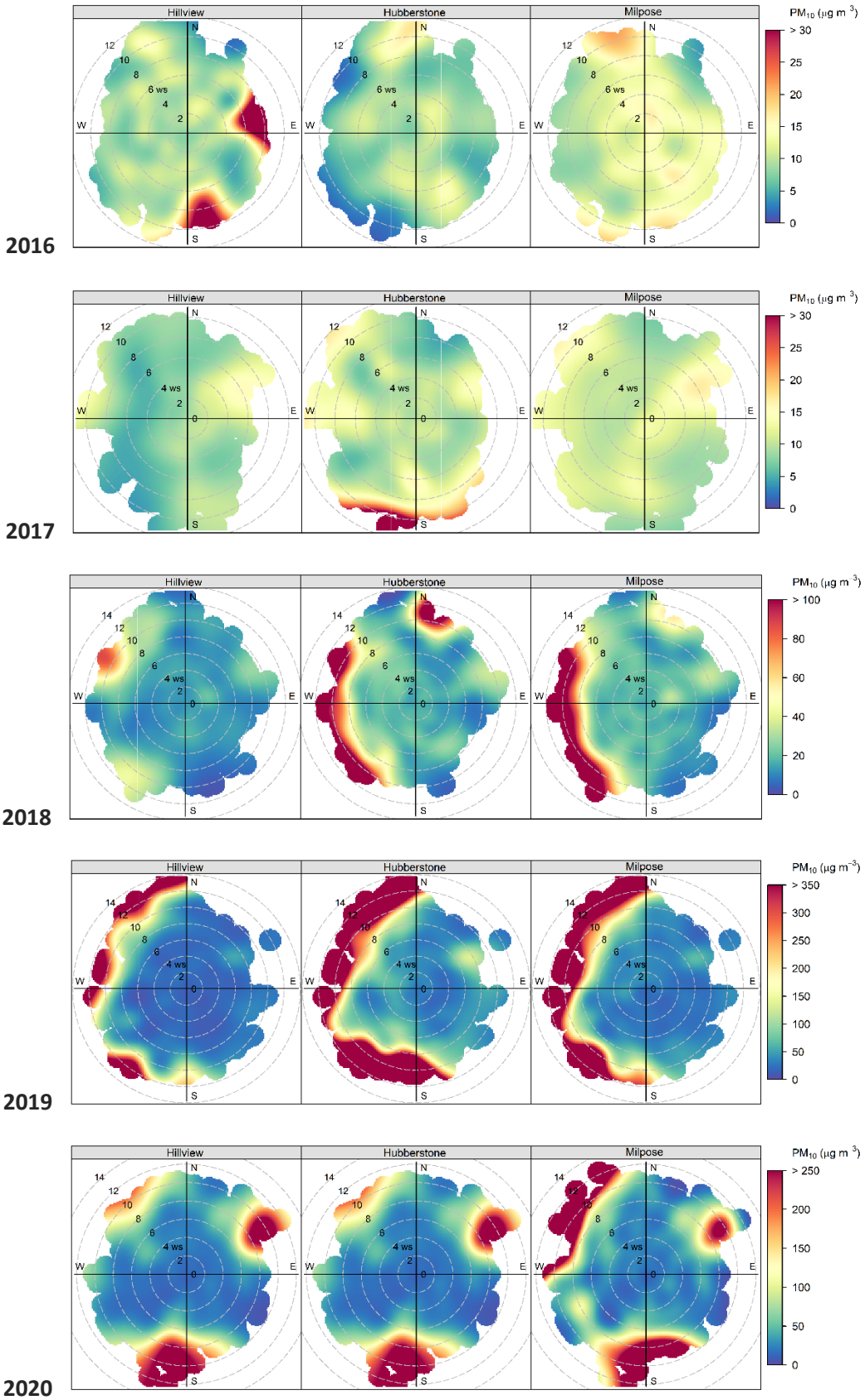

Figure 3.8 **Relationship between wind speed, wind direction and PM_{10} concentration – Northparkes BAM locations – 2016 to 2020**

4 Air quality impact assessment

The Proposed Modification has the potential to change emissions of air pollutants and associated air quality impacts to the surrounding environment from Northparkes relative to approved operations. The most recent quantitative air quality impact assessment (AQIA) of Northparkes was completed in 2013 by SKM for the Northparkes Extension Project Environmental Assessment.

The SKM 2013 AQIA quantified particulate matter emissions for a proposed operational scenario for Northparkes involving concurrent mining operations in the E26 open cut and E31/E31N open cuts along with TSF construction activities at the eastern extent of TSF2.

In order to understand the implications of the Proposed Modification for air pollutant emissions and air quality impacts, the emissions inventory developed in the SKM 2013 AQIA has been reviewed and amended to reflect the proposed changes to operations at Northparkes. The following changes to the SKM 2013 AQIA emissions inventory were made by EMM:

- no extractive operations at E26 or E28 open cut areas (these will not be undertaken concurrently with the E31 open cut pit, E22 construction and TSF bunding works);
- total combined annual ore extraction rate from E31 and E31N of 3.2 million tonnes per annum (Mtpa);
- total combined annual waste rock extraction rate from E31 and E31N of 5.9 Mtpa;
- waste rock from E31/E31N transported to two TSF construction areas (TSF2 East or Infill East) or two waste rock emplacement areas (eastern and western) in the E31 precinct, replacing the previous TSF construction activity emissions in the SKM 2013 AQIA;
    - waste rock from E31/E31N to TSF2 East construction area - 400,909 tpa;
    - waste rock from E31/E31N to Infill East TSF construction area - 373,468 tpa; and
    - the remaining waste rock from E31/E31N transported to eastern and western emplacement areas at a split of 25%/75% (1,271,406 tpa to eastern, 3,814,217 tpa to western).
- return haul distances from E31/E31N to emplacement areas as follows:
    - E31/E31N to TSF2 East construction area – 6.8 km;
    - E31/E31N to Infill East TSF construction area – 8.2 km;
    - E31/E31N to eastern emplacement area – 2 km; and
    - E31/E31N to eastern emplacement area – 4.8 km.
- E22 Portal box cut construction by truck and shovel activities, with an estimated excavated material of 87,000 tpa;
- return haul distance of 2 km assumed for excavated material from E22 Portal;
- no changes to the assumptions from the SKM 2013 AQIA for the following sources:
    - the total area for wind erosion calculation purposes for stockpiles, exposed surfaces and TSF;
    - ore processing rate (8.5 Mtpa);

- ventilation shaft emissions;
- drill/blast activities in E31/E31N; or
- dozer active hours at E31/E31N or TSF construction areas.

Wherever possible, particulate matter emission factors, key parameters and material characteristics were retained from the SKM 2013 AQIA with the following exceptions:

- update of wind speed conditions to a more recent monitoring year (2017), changing the average wind speed from 3.4 m/s to 3.2 m/s and the frequency of winds greater than 5.4 m/s from 14.3% to 13.5%;
- change from a default emission factor for emissions generated by truck movements on unpaved road to the equation listed in USEPA AP-42 2006 *13.2.2 - Unpaved roads*.

These changes have made only a minor difference to the emission factors applied in the SKM 2013 AQIA and are therefore considered immaterial for the purpose of this report.

Full details of emissions inventory calculations are presented in Appendix A.

A summary of calculated emissions of particulate matter by source/activity type and particulate matter size fraction (TSP, PM_{10} and $PM_{2.5}$) is presented in Table 2. Additionally, the total emissions presented in the SKM 2013 AQIA is included in Table 2 for comparison purposes.

It is noted that the SKM 2013 AQIA did not present annual emissions for PM_{10} or $PM_{2.5}$, instead applying a single particle size distribution to all quantified TSP emissions. Specifically, the SKM 2013 AQIA assumes that annual PM_{10} and $PM_{2.5}$ emissions are 34.4% and 4.7% of total annual TSP emissions respectively. This approach does not account for the variation in particle size distribution between source types (eg $PM_{2.5}$ is 7% of TSP for wind erosion emissions and 3% of TSP for unpaved road emissions).

In contrast, the emissions inventory prepared by EMM for the Proposed Modification has quantified emissions by particle size fraction based on source specific particle size distribution. Therefore, the primary point of comparison between the Proposed Modification and SKM 2013 AQIA emissions inventories presented in Table 2 are the annual TSP emission totals.

Table 2 Emissions inventory – Proposed Modification

Emission source	Annual emissions by source and particulate matter size fraction (kg/year))		
	TSP	PM_{10}	$PM_{2.5}$
E31/E31N - Stripping topsoil	5,110.0	1,234.9	536.6
E31/E31N - Drilling	1,076.8	565.8	84.9
E31/E31N - Blasting	5,032.5	2,616.9	151.0
E31/E31N - Loading overburden for eastern emplacement area	2,411.7	1,140.7	172.7
E31/E31N - Loading overburden for western emplacement area	7,235.1	3,422.0	518.2
E31/E31N - Loading overburden for TSF2 East	836.4	395.6	59.9
E31/E31N - Loading overburden for Infill East	708.4	335.1	50.7
E31/E31N - Hauling to eastern emplacement areas	27,401.2	6,924.4	692.4
E31/E31N - Hauling to western emplacement areas	197,288.9	49,855.5	4,985.6
E31/E31N - Hauling to TSF2 East	32,308.3	8,164.4	816.4
E31/E31N - Hauling to Infill East	33,000.7	8,339.4	833.9
E31/E31N - Emplacement at eastern dump	2,411.7	1,140.7	172.7
E31/E31N - Emplacement at western dump	7,235.1	3,422.0	518.2
E31/E31N - Emplacement at TSF2	836.4	395.6	59.9
E31/E31N - Emplacement at Infill East	708.4	335.1	50.7
E31/E31N - Dozers working in pit	134,384.7	32,474.9	14,110.4
E31/E31N - Loading ROM ore to trucks	6,070.0	2,871.0	434.7
E31/E31N - Hauling ROM ore to surface crusher from pit	268,967.9	67,969.0	6,796.9
Unloading ore underground/overland conveyor to surface crusher	16,123.5	7,626.0	1,154.8
Primary ore crushing	85,000.0	34,000.0	3,400.0
Transfer by conveyor to mill	16,123.5	7,626.0	1,154.8
Unloading ore to stockpile	16,123.5	7,626.0	1,154.8
Ore processing in mill	0.0	0.0	0.0
Transporting concentrate off site (pipeline)	0.0	0.0	0.0
Wind erosion - plant stockpiles and exposed areas	514,248.4	257,124.2	38,568.6
Wind erosion - tailings storage dams	646,822.3	323,411.1	48,511.7
Ventilation shaft emissions	97,761.6	48,880.8	4,888.1
Tailings construction - dozers working on tailings lifts (all)	11,182.8	2,048.0	1,174.2
Grading roads	7,477.9	2,643.8	264.4
E22 Portal - excavation of material	164.5	77.8	11.8
E22 Portal - haulage of material	98.9	25.0	2.5
E22 Portal - unloading of material	164.5	77.8	11.8
Total emissions	**2,144,315.6**	**882,769.2**	**131,343.3**
SKM 2013 AQIA total emissions	**2,343,000.0**	**916,113.0**	**110,121.0**

Note: SKM 2013 AQIA did not present annual emission totals for PM_{10} or $PM_{2.5}$. These totals were derived through the application of 39% for PM_{10} and 4.7% for $PM_{2.5}$.

From the results presented in Table 2, the annual TSP emissions quantified for the Proposed Modification are 8% lower than the annual TSP emissions quantified and modelled in the SKM 2013 AQIA. The annual PM_{10} and $PM_{2.5}$ totals for the Proposed Modification presented in Table 2 are 3% lower and 19% higher than the annual PM_{10} and $PM_{2.5}$ totals that were derived from the SKM 2013 AQIA annual TSP emissions.

However, if the fixed particle size distribution ratios from the SKM 2013 AQIA (ie 34.4% for PM_{10} and 4.7% for $PM_{2.5}$) are applied to the annual TSP total for the Proposed Modification, the following totals are returned:

- annual PM_{10} - 838,427.4 kg/year (an 8% reduction on the SKM 2013 AQIA PM_{10} total); and
- annual $PM_{2.5}$ - 100,782.8 kg/year (an 8% reduction on the SKM 2013 AQIA $PM_{2.5}$ total).

This analysis demonstrates that the changes to approved Northparkes construction and operational activities under the Proposed Modification will reduce particulate matter emissions relative to the proposed scenario that was quantified in the SKM 2013 AQIA.

5 Conclusions

The SKM 2013 AQIA made the following conclusions with regards to the dispersion modelling completed for the Northparkes Extension Project Environmental Assessment:

> - annual average PM_{10}, TSP and dust deposition levels will be in compliance with air quality criteria at sensitive receptors during Project operation;
>
> - proposed mining activities, on their own, will comply with the PM_{10} criterion (50 µg/m^3). However, there is a potential risk that existing and proposed activities will contribute to exceedances of the 24-hour average PM_{10} criterion (50 µg/m^3), especially if background levels are higher than average. Mining activities will need to be suitably managed to minimise or avoid these events;
>
> - the maximum 24-hour average PM_{10} concentrations due to proposed mining activities will be at levels that are unlikely to cause exceedances of the DP&I acquisition criterion (150 µg/m^3), taking account of background levels.[3]

On the basis of the emissions quantification exercise undertaken for the Proposed Modification and the comparison with the annual emissions inventory totals from the SKM 2013 AQIA, emissions from the Proposed Modification would be lower than the emissions modelled by SKM. Therefore, it is unlikely that associated air quality impacts from the Proposed Modification would be greater than those presented in the SKM 2013 AQIA, which are representative of current approved operations at Northparkes.

The Northparkes BAM monitoring data analysis presented in Section 3.2 indicates that while exceedance of applicable NSW EPA impact assessment criteria occurred between 2016 and 2020, the dominant influencing source of particulate matter emissions was likely regional scale transportation (eg dust storms) rather than emissions generated by Northparkes operations. This would continue to be the case under the Proposed Modification.

[3] It is noted that the DP&I (now DPIE) acquisition criterion referenced in the third point by SKM is now 50 µg/m^3 under the *Voluntary Land Acquisition and Mitigation Policy (VLAMP) for State Significant Mining, Petroleum and Extractive Industry Developments* (DPIE 2018).

Yours sincerely

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

SKM 2013, *Northparkes Step Change Project Air Quality Impact Assessment* 28 June 2013.

Pacific Environment Limited 2014, *Mobile Sampling Of Dust Emissions From Unsealed Roads*, ACARP Project number C20023, Pacific Environment Limited

US-EPA 2006, AP-42 Chapter 13.2.2 – *Unpaved Roads.*

Appendix A

Emissions inventory

A.1 Proposed Modification emissions inventory

Table A.1 provides a breakdown of emissions calculations for the Proposed Modification scenario. Wherever possible, the emission factors applied in the SKM 2013 AQIA were retained.

For the calculation of unpaved road emissions, the AP-42 (2006) emission factor for unpaved roads was adopted as follows:

$$Emission\ factor\ = k * \left(\frac{s}{12}\right)^{a} * \left(\frac{W}{3}\right)^{b} * \left(\frac{281.9}{1000}\right)$$

where:

k = 4.9 for TSP, 1.5 for PM_{10} and 0.15 for $PM_{2.5}$;

a = 0.7 for TSP, 0.9 for PM_{10} and $PM_{2.5}$; and

b = 0.45 for TSP, PM_{10} and $PM_{2.5}$.

Table A.1 Emissions inventory – Proposed Modification

Emission source	Activity rate	Units	TSP emission factor	PM_{10} emission factor	$PM_{2.5}$ emission factor	Unit	Parameter 1	Unit	Parameter 2	Unit	Parameter 3	Unit	Parameter 4	Unit	Parameter 5	Unit	Reduction factor	Emission control
E31 - Stripping topsoil	365	hr/year	14.000	3.383	1.47	kg/h												
E31 - Drilling	1,825	Holes/year	0.590	0.310	0.0465	kg/hole												
E31 - Blasting	183	Blasts/year	27.500	14.300	0.825	kg/blast	2,500.0	Area of blast m2	183	Blasts per year								
E31 - Loading overburden for eastern emplacement area	1,271,406	t/y	0.002	0.001	0.000135858	kg/t	3.2	Average wind speed (m/s)	2	Moisture content (%)								
E31 - Loading overburden for western emplacement area	3,814,217	t/y	0.002	0.001	0.000135858	kg/t	3.2	Average wind speed (m/s)	2	Moisture content (%)								
E31 - Loading overburden for TSF2 East	440,909	t/y	0.002	0.001	0.000135858	kg/t	3.2	Average wind speed (m/s)	2	Moisture content (%)								
E31 - Loading overburden for Infill East	373,468	t/y	0.002	0.001	0.000135858	kg/t	3.2	Average wind speed (m/s)	2	Moisture content (%)								
E31 - Hauling to eastern emplacement areas	28,253	VKT/year	3.879	0.980	0.098032244	kg/VKT	4.6	Road silt content (%)	2	Return haul distance (km)	14,127	Loads/year	120	Average weight (t)	90	Load in truck (t)	0.75	Watering
E31 - Hauling to western emplacement areas	203,425	VKT/year	3.879	0.980	0.098032244	kg/VKT	4.6	Road silt content (%)	4.8	Return haul distance (km)	42,380	Loads/year	120	Average weight (t)	90	Load in truck (t)	0.75	Watering
E31 - Hauling to TSF2 East	33,313	VKT/year	3.879	0.980	0.098032244	kg/VKT	4.6	Road silt content (%)	6.8	Return haul distance (km)	4,899	Loads/year	120	Average weight (t)	90	Load in truck (t)	0.75	Watering

Table A.1 Emissions inventory – Proposed Modification

Emission source	Activity rate	Units	TSP emission factor	PM_{10} emission factor	$PM_{2.5}$ emission factor	Unit	Parameter 1	Unit	Parameter 2	Unit	Parameter 3	Unit	Parameter 4	Unit	Parameter 5	Unit	Reduction factor	Emission control
E31 - Hauling to Infill East	34,027	VKT/year	3.879	0.980	0.098032244	kg/VKT	4.6	Road silt content (%)	8.2	Return haul distance (km)	4,150	Loads/year	120	Average weight (t)	90	Load in truck (t)	0.75	Watering
E31 - Emplacement at eastern dump	1,271,406	t/y	0.002	0.001	0.000135858	kg/t	3.2	Average wind speed (m/s)	2	Moisture content (%)								
E31 - Emplacement at western dump	3,814,217	t/y	0.002	0.001	0.000135858	kg/t	3.2	Average wind speed (m/s)	2	Moisture content (%)								
E31 - Emplacement at TSF2	440,909	t/y	0.002	0.001	0.000135858	kg/t	3.2	Average wind speed (m/s)	2	Moisture content (%)								
E31 - Emplacement at Infill East	373,468	t/y	0.002	0.001	0.000135858	kg/t	3.2	Average wind speed (m/s)	2	Moisture content (%)								
E31 - Dozers working in pit	8,030	hr/year	16.735	4.044	1.757209946	kg/hr	2.0	Moisture content (%)	10	Silt content (%)								
E31 - Loading ROM ore to trucks	3,200,000	t/y	0.002	0.001	0.000135858	kg/t	3.2	Average wind speed (m/s)	2	Moisture content (%)								
E31 - Hauling ROM ore to surface crusher from pit	277,333	VKT/year	3.879	0.980	0.098032244	kg/VKT	4.6	Road silt content (%)	7.8	Return haul distance (km)	35,556	Loads/year	120	Average weight (t)	90	Load in truck (t)	0.75	Watering
Unloading ore underground/overland conveyor to surface crusher	8,500,000	t/y	0.002	0.001	0.000135858	kg/t	3.2	Average wind speed (m/s)	2	Moisture content (%)								
Primary ore crushing	8,500,000	t/y	0.010	0.004	0.0004	kg/t												

Table A.1 Emissions inventory – Proposed Modification

Emission source	Activity rate	Units	TSP emission factor	PM_{10} emission factor	$PM_{2.5}$ emission factor	Unit	Parameter 1	Unit	Parameter 2	Unit	Parameter 3	Unit	Parameter 4	Unit	Parameter 5	Unit	Reduction factor	Emission control
Transfer by conveyor to mill	8,500,000	t/y	0.002	0.001	0.000135858	kg/t	3.2	Average wind speed (m/s)	2	Moisture content (%)								
Unloading ore to stockpile	8,500,000	t/y	0.002	0.001	0.000135858	kg/t	3.2	Average wind speed (m/s)	2	Moisture content (%)								
Ore processing in mill	8,500,000	t/y	0.000	0.000	0	kg/t												
Transporting concentrate off site (pipeline)	8,500,000	t/y	0.000	0.000	0	kg/t												
Wind erosion - plant stockpiles and exposed areas	208	ha	2468.787	1234.394	185.1590426	kg/ha/year	5.0	Silt content (%)	86	Number of raindays	13	Percentage time winds > 5.4m/s						
Wind erosion - tailings storage dams	262	ha	2468.787	1234.394	185.1590426	kg/ha/year	5.0	Silt content (%)	86	Number of raindays	13	Percentage time winds > 5.4m/s						
Ventilation shaft emissions	8,760	hr/year	11.160	5.580	0.558	kg/hr	1,116,000.0	m3/hour	10	Concentration (mg/m3)								
Tailings construction - dozers working on tailings lifts (all)	3,780	hrs/year	2.958	0.542	0.310633767	kg/hr	4.0	Moisture content (%)	5	Silt content (%)								
Grading roads	24,300	km/year	0.615	0.218	0.02176	kg/VKT	8.0	travel speed (km/hr)									0.5	Watering
E22 Portal - excavation of material	86,716	t/y	0.002	0.001	0.000135858	kg/t	3.2	Average wind speed (m/s)	2	Moisture content (%)								
E22 Portal - haulage of material	151	VKT/year	2.616	0.661	0.066111024	kg/VKT	4.6	Road silt content (%)	2	Return haul distance (km)	76	Loads/year	50	Average weight (t)	50	Load in truck (t)	0.75	Watering

Table A.1 Emissions inventory – Proposed Modification

Emission source	Activity rate	Units	TSP emission factor	PM_{10} emission factor	$PM_{2.5}$ emission factor	Unit	Parameter 1	Unit	Parameter 2	Unit	Parameter 3	Unit	Parameter 4	Unit	Parameter 5	Unit	Reduction factor	Emission control
E22 Portal - unloading of material	86,716	t/y	0.002	0.001	0.000135858	kg/t	3.2	Average wind speed (m/s)	2	Moisture content (%)								

A.2 Haul road activity calculations

Table A.2 provides a specific breakdown on the activity rates (tonnes of material, haul truck capacity, haul route distance and annual kilometres travelled) for activities associated with the Proposed Modification. For other activities (eg ore transportation), the assumptions presented in the SKM 2013 AQIA have been retained.

Table A.2 Haulage calculations – Proposed Modification

Activity	Parameter	Unit	Activity rate by emplacement area				
			Eastern emplacement area	Western emplacement area	TSF2 East	Infill East	E22 Portal
Haulage of waste from E31/E31N	Annual material extracted	tonnes	1,271,406	3,814,217	440,909	373,468	86,716
	Capacity of haul truck	tonnes	90	90	90	90	50
	Loads per year	loads/year	14,127	42,380	4,899	4,150	76
	Two-way distance of haulage to emplacement area	km	2.0	4.8	6.8	8.2	2.0
	Annual vehicles kilometre travelled	km/year	28,253	203,425	33,313	34,027	151

A.4 Material specific input data

The material property inputs used in the emission estimates are summarised in Table A.3. Wherever possible, the assumptions made in SKM 2013 AQIA were retained in this study.

Table A.3 Material property inputs for emission estimation

Material properties	Units	Value	Source of information
Moisture content of waste and ore	%	2.0	NPI default – consistent with SKM (2013)
Silt content of waste and ore	%	10	NPI default – consistent with SKM (2013)
Moisture content of TSF construction dozer	%	5	SKM (2013)
Silt content of TSF construction dozer	%	4	SKM (2013)
Silt content of unpaved roads	%	4.6	ACARP Report C20023 (Pacific Environment 2014) - average of uncontrolled haul roads