



APPENDIX B AIR QUALITY IMPACT ASSESSMENT





AIR QUALITY IMPACT ASSESSMENT WILPINJONG COAL MINE MODIFICATION

Wilpinjong Coal Pty Ltd

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Air Quality Impact Assessment

Wilpinjong Coal Project Modification

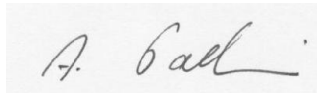
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1 INTRODUCTION

Todoroski Air Sciences has prepared this report for Wilpinjong Coal Pty Ltd (hereafter referred to as WCPL). It provides an assessment of the potential air quality impacts associated with the proposed modifications to the Wilpinjong Coal Mine (WCM) (hereafter referred to as the Modification).

The Modification involves the development of six minor open cut extension areas that immediately adjoin existing approved open cut limits to recover approximately 3 million tonnes (Mt) of additional run-of-mine (ROM) coal.

To assess the potential air quality impacts associated with the proposed Modification, this report incorporates the following aspects:

- ✦ a background to the WCM and description of the Modification;
- ✦ a review of the existing meteorological and air quality environment surrounding the WCM site;
- ✦ a description of the dispersion modelling approach used to assess potential air quality impacts;
- ✦ presentation of the predicted results;
- ✦ discussion of the potential air quality impacts as a result of the Modification; and
- ✦ an assessment of greenhouse gas emissions (GHG) expected to be generated by the WCM incorporating the Modification.

2 LOCAL SETTING

The WCM is located in the Western Coalfields of New South Wales (NSW), approximately 40 kilometres (km) northeast of Mudgee and 4km west-northwest of Wollar (see **Figure 2-1**). Coal mining operations and agricultural activities dominate the land use (**Figure 2-1**) in the surrounding area. The mine is bounded by the Goulburn River National Park to the north, the Munghorn Gap Nature Reserve to the southwest and Moolarben Coal mine to west. To the east and southeast of the mine, land use is predominantly agricultural properties and areas of Crown Land.

Figure 2-1 also presents the location of the WCM in relation to privately-owned and mine-owned sensitive receptors of relevance to this assessment. **Appendix A** provides a detailed list of all the privately-owned sensitive receptors assessed in this report.



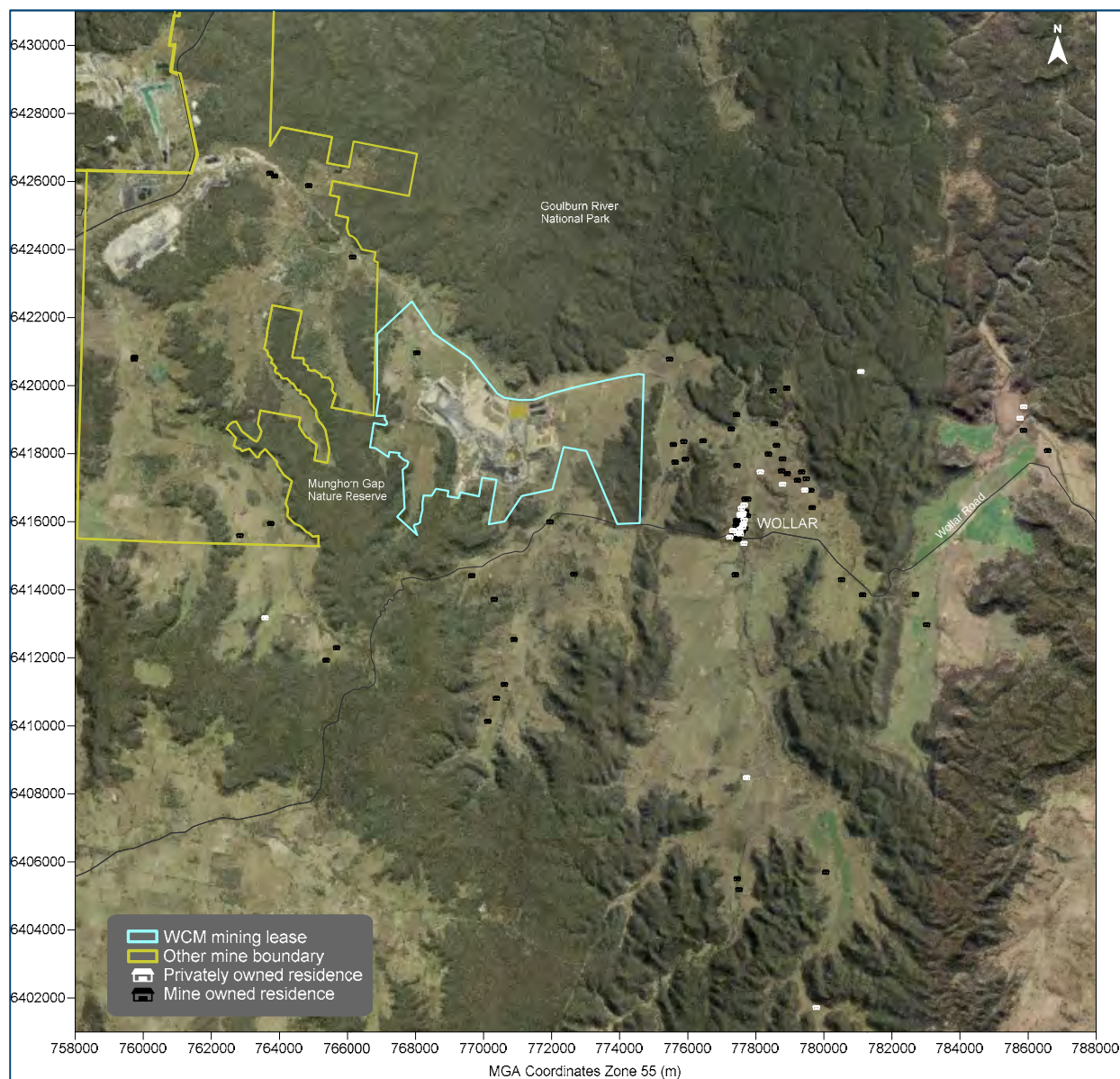


Figure 2-1: WCM location

Figure 2-2 presents a representative three-dimensional (3D) visualisation of the topography in the general vicinity of the WCM area. The area can be characterised as complex hilly terrain with the majority of the elevated areas forming the Goulburn River National Park and the Munghorn Gap Nature Reserve. To the east and southeast of the site, steep sided valleys open to flat agricultural land. Notable ridgelines separate the mine from sensitive receptors in Wollarr. The presence of the complex local terrain would have a significant effect on the distribution of wind patterns for the area.

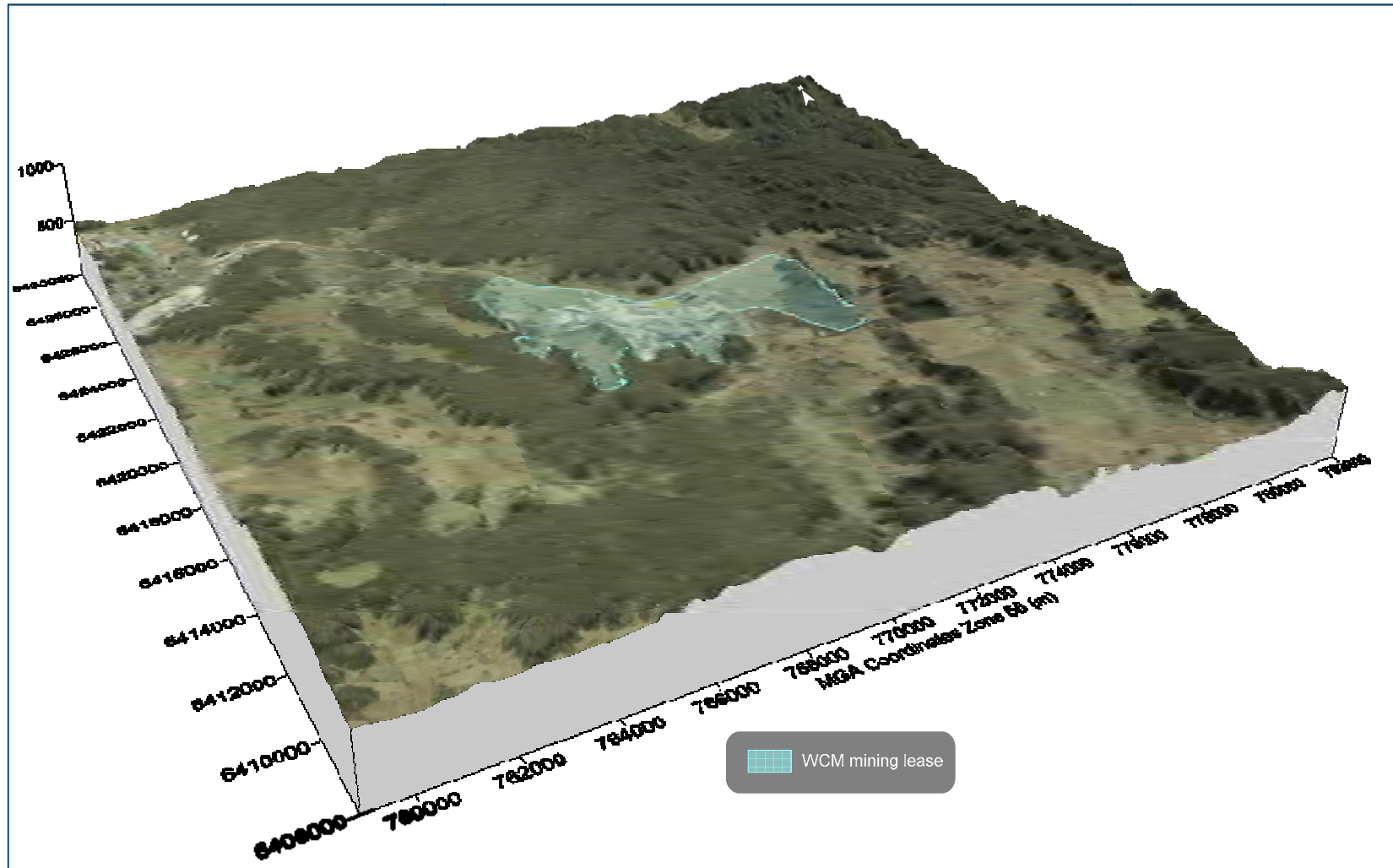


Figure 2-2: Topography of the WCM location



3 EXISTING OPERATIONS AND MODIFICATION DESCRIPTION

3.1 Existing operations

Mining at the WCM commenced in September 2006 as an approved open cut coal mining operation consisting of six open cuts and associated contained infrastructure area, comprising an area of approximately 1,920 hectares (ha). The mining operation utilises bulk push dozers and hydraulic excavators to mine coal and overburden in a strip mine configuration. ROM coal is mined 24 hours per day, seven days per week, at an approved rate of up to 15 million tonnes per annum (Mtpa). The WCM produces up to 12.5Mtpa of washed and unwashed (i.e. bypass) coal products.

The Coal Handling and Preparation Plant (CHPP) at the WCM operates up to 24 hours per day, seven days per week and the Project Approval (05_0021) currently allows for the beneficiation (i.e. washing) of up to 8.5Mt of ROM coal in the CHPP per year. Unwashed ROM is bypassed (i.e. crushed only). ROM coal stockpiles have a capacity of over 1.5Mt and product coal stockpiles have a combined capacity of approximately 500,000 tonnes for washed and unwashed coal products.

Tailings produced from the CHPP consist of fine rejects and slimes from the thickener. CHPP tailings are pumped as slurry and deposited in purpose-built tailing dams constructed within mined-out voids. CHPP coarse coal reject material is hauled back to the mining operation and deposited in the mined-out voids.

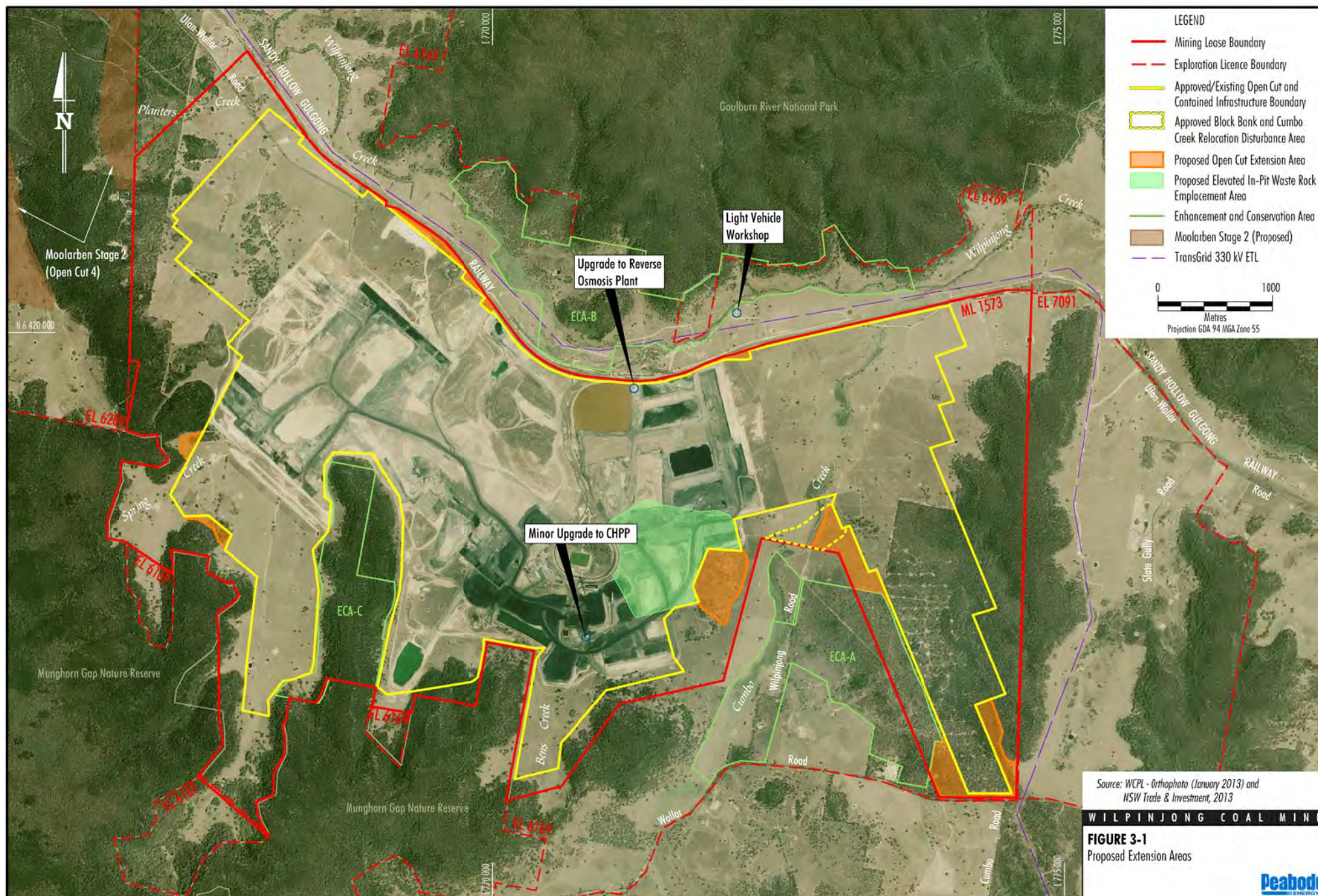
A train loading facility is located at the head of the rail loop within the mine infrastructure area and is capable of loading coal at a rate of 4,000 tonnes per hour. Coal is reclaimed from two alternative product feed conveyors that run the length of the product coal stockpiles. Product coal is loaded onto trains 24 hours per day, seven days per week. An average of six trains is loaded each day and a maximum of 10 trains per day are loaded during peak coal transport periods. Coal is railed east to domestic power generation customers and the Port of Newcastle for export. No coal is railed west of the WCM.

3.2 Proposed modifications

Following a review of mine planning, CHPP capacity, waste rock bulking factors, planned building and demolition works and light vehicle servicing requirements, WCPL has determined that a number of minor alterations to the approved WCM are required, including:

- ✦ development of incremental extensions to the existing open cut pits (**Figure 3-1**) that would extend the open cuts by approximately 70ha and would result in the recovery of approximately 3Mt of additional ROM coal;
- ✦ higher rates of annual waste rock production (from 28 million bank cubic metres [Mbcm] up to approximately 33.3Mbcm) in order to maintain approved ROM coal production;
- ✦ minor CHPP upgrades to improve fine coal reject management (installation of a belt press filter) and an increase in the rate of ROM coal beneficiation in the CHPP to approximately 9Mtpa;





- ✦ amendment of the waste emplacement strategy to include:
 - development of an elevated waste rock emplacement landform (up to approximately 450 metres Australian Height Datum) within the footprint of Pit 2;
 - disposal of some inert building and demolition waste that is produced from off-site building demolition in the approved mine waste rock emplacements;
 - co-disposal of fine coal reject material produced by the belt press filter with coarse rejects; and
- ✦ operation of a light vehicle servicing workshop at an existing farm shed that is located in the north of the Project area.

These variations to the WCM are being sought via a Modification under section 75W of the NSW *Environmental Planning and Assessment Act, 1979*.

It should be noted that no changes are proposed to the approved rates of production of ROM coal (15Mtpa) or product coal (12.5Mtpa) and the current owner-operation mobile fleet would not require augmentation. In addition, the Modification would not require any significant alteration to the existing approved WCM mining operations and general supporting infrastructure, or current operational workforce of approximately 550 staff and contractors.

3.3 Purpose of this air quality impact assessment

It is relatively clear from the scale of the proposed changes described above that the Modification would only have limited capacity to greatly affect air emissions relative to the approved WCM.

However, some of the changes proposed would increase the annual intensity of mining activity in some areas, and would slightly increase the mine footprint in some areas that are in relatively close proximity to remaining private receptors. These changes have the potential to increase the level of dust at receptor locations that may arise from the mine.

Whilst the potential change in dust levels that may arise from the Modification is expected to be relatively small, it is important to examine in sufficient detail what the extent of the potential change may be and to also confirm whether or not any unacceptable impact could arise should the Modification proceed. This is the key purpose of this assessment.

The assessment applies advanced air dispersion modelling approaches which allow spatially varying winds and the interaction of the prevailing winds with the local terrain to be considered. In this way a secondary purpose of the assessment is to provide a more accurate estimate of the existing mine dust levels at receptor locations and to update the likely effect of the existing approved mine on air quality in the area.



4 AIR QUALITY ASSESSMENT CRITERIA

4.1 Preamble

Air quality criteria are benchmarks set to protect the general health and amenity of the community in relation to air quality. **Sections 4.2 to 4.4** below identify the potential air emissions generated by the Modification and the applicable air quality criteria.

4.2 Particulate matter

Particulate matter consists of dust particles of varying size and composition. Air quality goals refer to measures of the total mass of all particles suspended in air defined as the Total Suspended Particulate matter (TSP). The upper size range for TSP is nominally taken to be 30 micrometres (μm) as in practice particles larger than 30 to 50 μm will settle out of the atmosphere too quickly to be regarded as air pollutants.

The TSP is defined further into two sub-components. They are PM_{10} and $\text{PM}_{2.5}$ particles, particulate matter with aerodynamic diameters of 10 μm or 2.5 μm or less respectively.

Mining activities generate particles in all the above size categories. The great majority of the particles generated are due to the abrasion or crushing of rock and coal and general disturbance of dusty material. These particulate emissions will be generally larger than 2.5 μm as these fine particulates are often only generated through combustion processes.

Combustion particulates can be harmful to human health as the particles have the ability to penetrate deep into the human respiratory system and generally include acidic and carcinogenic substances.

A study of the distribution of particle sizes near mining dust sources in 1986 conducted by the State Pollution Control Commission (SPCC) found that the average of approximately 120 samples showed $\text{PM}_{2.5}$ comprised 4.7 percent (%) of the TSP, and PM_{10} comprised 39.1% of the TSP in the samples (**SPCC, 1986**). The emissions of $\text{PM}_{2.5}$ occurring from mining activities are small in comparison to the total dust emissions.

4.2.1 New South Wales Environment Protection Authority impact assessment criteria

Table 4-1 summarises the air quality goals that are relevant to this study as outlined in the NSW Environment Protection Authority (NSW EPA) document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**DEC, 2005**). The air quality goals for total impact relate to the total dust burden in the air and not just the dust from the Modification. Consideration of background dust levels needs to be made when using these goals to assess potential impacts.

Table 4-1: NSW EPA air quality impact assessment criteria

Pollutant	Averaging Period	Impact	Criterion
TSP	Annual	Total	90 $\mu\text{g}/\text{m}^3$
PM_{10}	Annual	Total	30 $\mu\text{g}/\text{m}^3$
	24-hour	Total	50 $\mu\text{g}/\text{m}^3$
Deposited dust	Annual	Incremental	2 $\text{g}/\text{m}^2/\text{month}$
		Total	4 $\text{g}/\text{m}^2/\text{month}$

Source: **DEC, 2005**

$\mu\text{g}/\text{m}^3$ = micrograms per cubic metre

$\text{g}/\text{m}^2/\text{month}$ = grams per square metre per month



The criteria for 24-hour average PM₁₀ originate from the National Environment Protection Measure (NEPM) goals (National Environmental Protection Council [NEPC, 1988]). These goals apply to the population as a whole, and are not recommended to be applied to "hot spots" such as locations near industry, busy roads or mining. However, in the absence of alternative measures, NSW EPA does apply the criteria to assess the potential for impacts to arise at such locations. The NEPM permits five days annually above the 24-hour average PM₁₀ criterion to allow for bush fires and similar events. Similarly, it is normally the case that on days where ambient dust levels are affected by such events they are excluded from assessment as per the NSW EPA criterion.

4.3 PM_{2.5} concentrations

The NSW EPA currently do not have impact assessment criteria for PM_{2.5} concentrations, however the NEPC has released a variation to the NEPM (NEPC, 2003) to include advisory reporting standards for PM_{2.5} (see **Table 4-2**). The advisory reporting standards for PM_{2.5} are a maximum 24-hour average of 25µg/m³ and an annual average of 8µg/m³, and as with the NEPM goals, apply to the average, or general exposure of a population, rather than to "hot spot" locations.

Predictions have been made as to the likely contribution that emissions from the Modification would make to ambient PM_{2.5} concentrations and are presented in **Section 7**.

Table 4-2: Advisory standard for PM_{2.5} concentrations

Pollutant	Averaging Period	Criterion
PM _{2.5}	Annual	8µg/m ³
	24-hour	25µg/m ³

Source: NEPC, 2003

4.4 Other air pollutants

Emissions of carbon monoxide, sulphur dioxide and nitrogen dioxide will also arise from mining activities. These emissions are generally too low to generate any significant off-site concentrations and have not been assessed further in this report.



5 EXISTING ENVIRONMENT AND AIR QUALITY MANAGEMENT

This section describes the existing climate and air quality in the general area surrounding the WCM.

5.1 Local climate

Long-term climatic data from the closest Bureau of Meteorology (BoM) weather station at Gulgong Post Office (Site No. 062013) were analysed to characterise the local climate in the proximity of the WCM. The Gulgong Post Office station is located approximately 30km west of WCM.

Table 5-1 and **Figure 5-1** present a summary of data from the Gulgong Post Office weather station collected over an approximate 38-year period.

The data indicate that January is the hottest month with a mean maximum temperature of 30.9°C and July as the coldest month with a mean minimum temperature of 2.6°C.

Humidity levels exhibit variability and seasonal flux across the year. Mean 9am humidity levels range from 61% in October to 84% in June and July. Mean 3pm humidity levels range from 36% in December to 57% in June.

Rainfall peaks during the months of spring and summer and declines during winter. The data indicate that January is the wettest month with an average rainfall of 70.5 millimetres (mm) over 5.9 days and April is the driest month with an average rainfall of 44.2mm over 4.6 days. The annual average rainfall at Gulgong is 654mm.

Mean 9am wind speeds range from 4.4 kilometres per hour (km/h) in June to 9.1km/h in October and November. Mean 3pm wind speeds range from 7.8km/h in April to 11.7m/h in August.

Table 5-1: Monthly climate statistics summary - Gulgong Post Office

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature												
Mean max. temperature (°C)	30.9	29.7	27.3	23.4	19.1	15.4	14.7	16.5	19.6	23.4	26.6	29.6
Mean min. temperature (°C)	16.7	16.3	13.7	9.8	6.3	3.6	2.6	3.4	6.1	9.3	12.3	14.8
Rainfall												
Rainfall (mm)	70.5	62.5	54.8	44.2	45.4	50.5	49.3	46.5	46.8	56.2	60.1	67.5
Mean No. of rain days (≥1mm)	5.9	5.5	5.2	4.6	5.7	7.2	7.6	6.9	6.7	6.7	6.3	6.3
9am conditions												
Mean temperature (°C)	21.7	20.6	18.9	15.8	11.3	7.7	6.7	8.5	12.6	16.5	18.3	20.8
Mean relative humidity (%)	64	71	71	70	79	84	84	76	70	61	63	62
Mean wind speed (km/h)	8.2	6.7	6.2	5.9	5.0	4.4	4.9	6.1	7.7	9.1	9.1	8.9
3pm conditions												
Mean temperature (°C)	29.5	28.4	26.2	22.3	18.0	14.3	13.5	15.3	18.5	22.1	25.1	28.2
Mean relative humidity (%)	37	42	41	42	49	57	54	46	44	40	39	36
Mean wind speed (km/h)	9.6	8.5	7.9	7.8	9.0	8.8	9.9	11.7	11.4	11.5	11.4	11.2

Source: Bureau of Meteorology, 2013



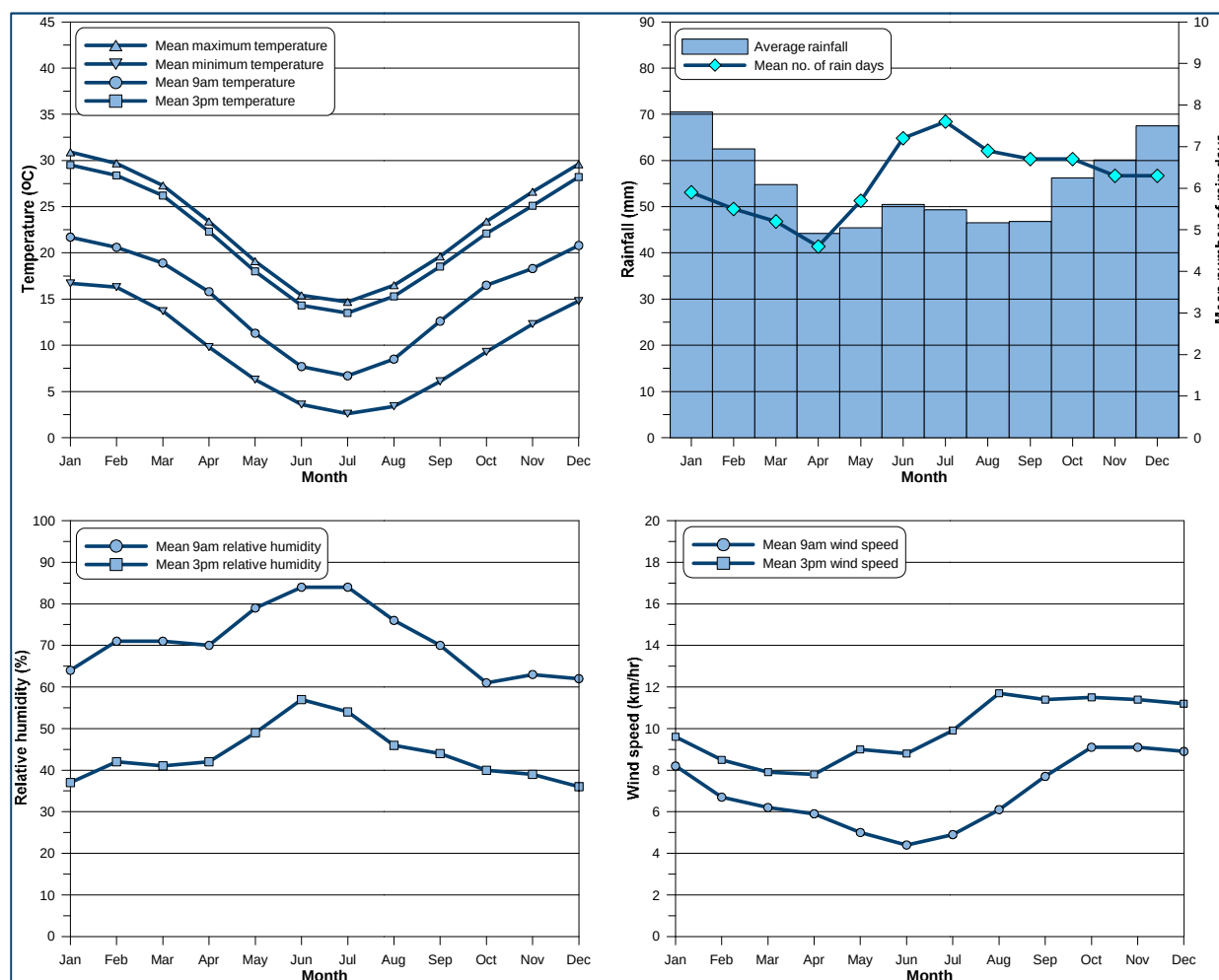


Figure 5-1: Monthly climate statistics summary - Gulgong Post Office

5.2 Local meteorological conditions

WCM operates a 10m weather station to assist with the environmental management of site operations. Annual and seasonal windroses prepared from data collected during the September 2011 to August 2012 period are presented in **Figure 5-2**.

Analysis of the windroses shows the most common winds on an annual basis are from the east-southeast and east with a lesser portion of winds from the northwest quadrant. Very few winds originate from the northeast and southwest sectors. This wind distribution pattern is as expected of the local area considering the location of the station in relation to the terrain features.

In the summertime the winds predominately occur from the east-southeast. During winter, winds are most frequent from the west-northwest and northwest sectors. The autumn and spring windroses share similar wind distribution patterns to the annual distribution.



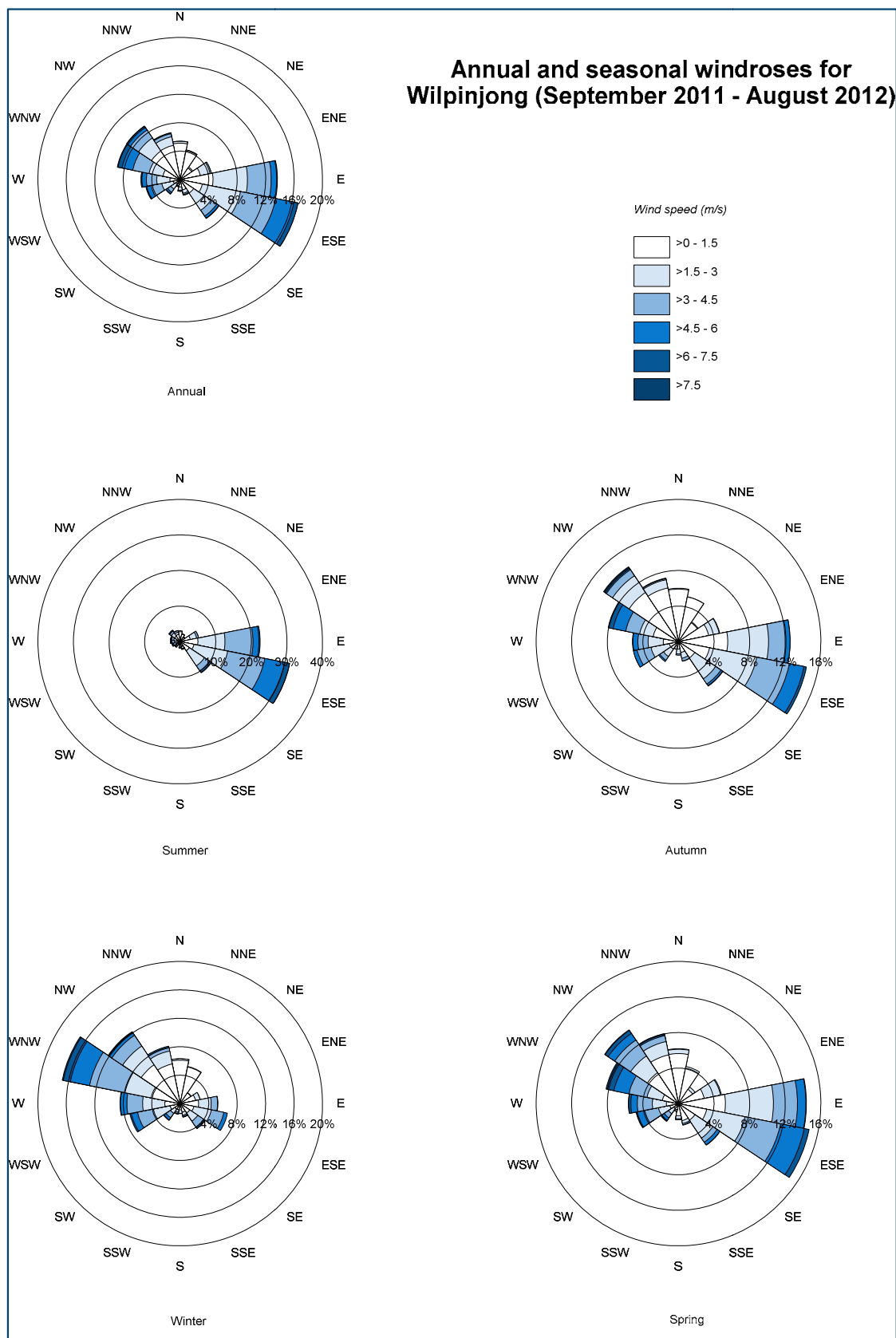


Figure 5-2: Annual and seasonal windroses for Wilpinjong (September 2011 - August 2012)



5.3 Local air quality monitoring

The main sources of particulate matter in the wider area of the WCM include active mining, agricultural activities, emissions from local anthropogenic activities (such as motor vehicle exhaust and domestic wood heaters) and various other industrial activities. This section reviews all available ambient monitoring data collected from the WCM ambient air quality monitoring program between 2006 and 2012 to characterise the existing background levels of the surrounding area.

5.3.1 Existing air quality monitoring network description

The air quality monitors operating in the WCM's air quality monitoring network include two Tapered Element Oscillating Microbalances (TEOMs), four High Volume Air Samplers (HVAS) measuring either TSP or PM₁₀, and 11 dust deposition gauges. It is noted that some monitoring locations have changed over the life of the WCM to reflect operational and land ownership changes (e.g. moving monitors closer to the nearest private receivers).

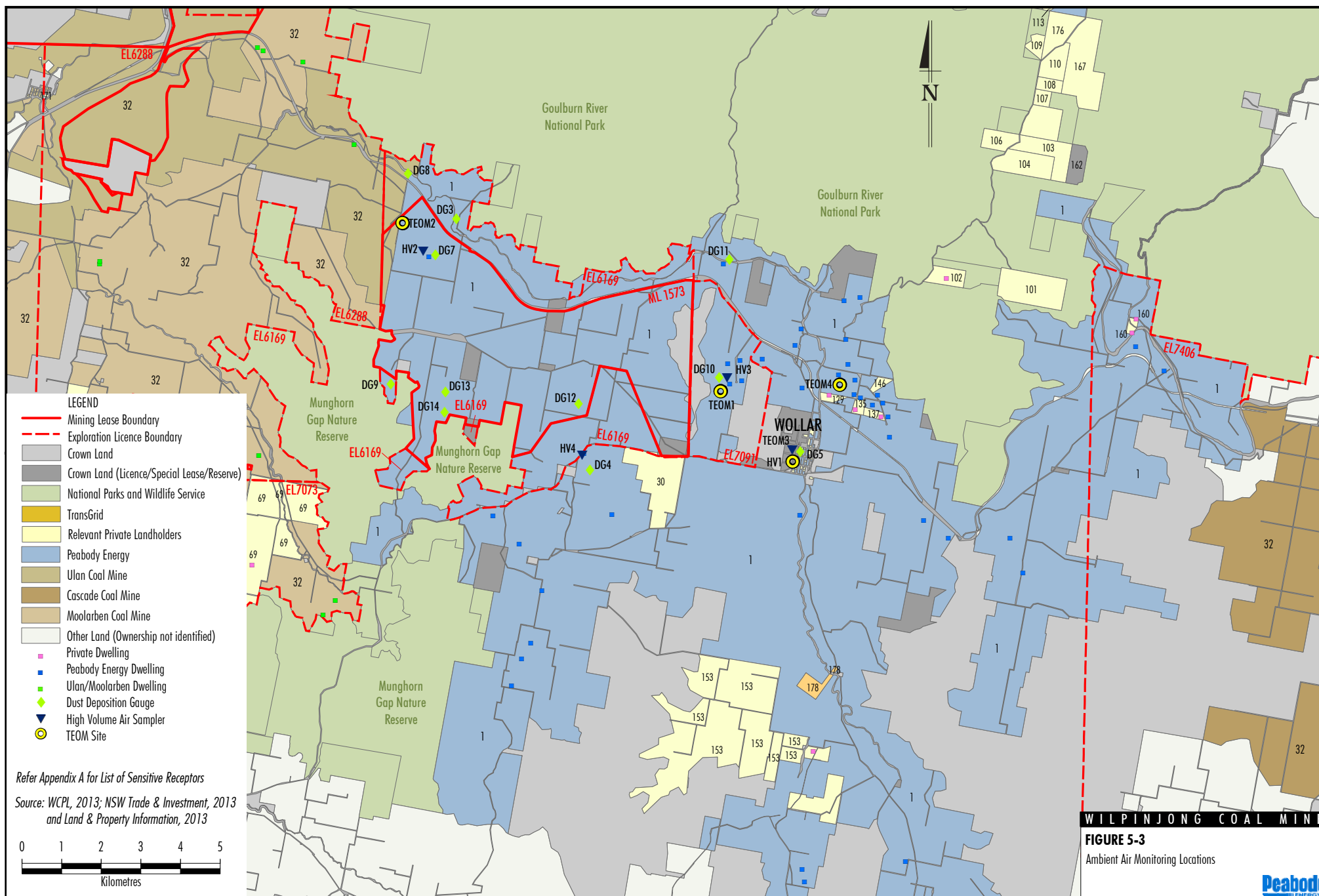
Table 5-2 lists the monitoring stations reviewed in this section and **Figure 5-3** shows the approximate location of each of the monitoring stations. **Appendix B** provides a summary of all monitoring data reviewed in this assessment.

Table 5-2: Summary of ambient monitoring stations

Monitoring site ID	Type	Monitoring data analysed
TEOM 1 (Slate Gully)	TEOM - PM ₁₀	June 2009 - December 2012
TEOM 2 (Mittaville)	TEOM - PM ₁₀	October 2010 - December 2012
HV1 (Wollar)	HVAS - PM ₁₀	March 2006 - December 2012
HV2 (Reids)	HVAS - PM ₁₀	September 2006 - December 2012
HV3 (Mahers)	HVAS - TSP	October 2006 - December 2012
HV4 (Robinsons)	HVAS - PM ₁₀	September 2006 - December 2012
DG3	Dust gauge	2007 - 2010
DG4	Dust gauge	2006 - 2012
DG5	Dust gauge	2006 - 2012
DG7 ⁽¹⁾	Dust gauge	2006
DG8	Dust gauge	2007 - 2012
DG9	Dust gauge	2006 - 2010
DG10	Dust gauge	2006 - 2012
DG11	Dust gauge	2006 - 2012
DG12	Dust gauge	2006 - 2012
DG13	Dust gauge	2006 - 2012
DG14	Dust gauge	2006 - 2012

⁽¹⁾ DG7 was previously referred to as DG2





5.3.2 PM₁₀ monitoring

Ambient PM₁₀ monitoring using TEOM's is conducted for the WCM at two locations (see **Figure 5-3**). A summary of the data from both monitoring stations collected between 2009 and 2012 is presented in **Table 5-3** and **Figure 5-4**.

A review of **Table 5-3** indicates that the annual average PM₁₀ concentrations for each monitoring station were below the criteria of 30µg/m³ for all relevant years. **Figure 5-4** indicates that there were six occasions during 2009 when the maximum 24-hour average PM₁₀ concentration recorded was above the 50µg/m³ criterion at the TEOM 1 station. The cause of these exceedance events is likely to be the widespread regional dust storms that occurred during this period.

On 25th October 2012, TEOM 1 and TEOM 2 recorded a maximum 24-hour average PM₁₀ concentration above the 50µg/m³ criterion. The recorded exceedance on this day was investigated and actions were undertaken to reduce dust emissions from the WCM (e.g. apart from one dozer and the water carts, all equipment was shut down). However, as the cessation of mining activities did not significantly affect monitored dust levels, it is considered that the elevated dust concentrations were caused by a regional dust event. It is noted that the majority of dust monitors in the Hunter Valley also recorded similarly elevated levels on this day, indicating the possibility of a wide spread dust event.

Annual average dust levels are generally less than half of the applicable criteria, indicating that overall, air quality in the area is good in relation to PM₁₀ dust levels. This can also be seen clearly in **Figure 5-4**, which, apart from the dust storms in 2009, shows consistently low levels of dust in the area.

Table 5-3: PM₁₀ levels from TEOM monitoring (µg/m³)

Year	Annual average		Criteria	Maximum 24-hour average		Criteria
	TEOM 1	TEOM 2		TEOM 1	TEOM 2	
2009	15.6 ⁽¹⁾	-	30	191.4 ⁽¹⁾	-	50
2010	11.3	9.6 ⁽¹⁾	30	42.4	36.7 ⁽¹⁾	50
2011	11.7	10.6	30	32.6	49.7	50
2012	13.3	11.5	30	60.3	50.8	50

⁽¹⁾Data available from June 2009

⁽²⁾Data available from October 2010



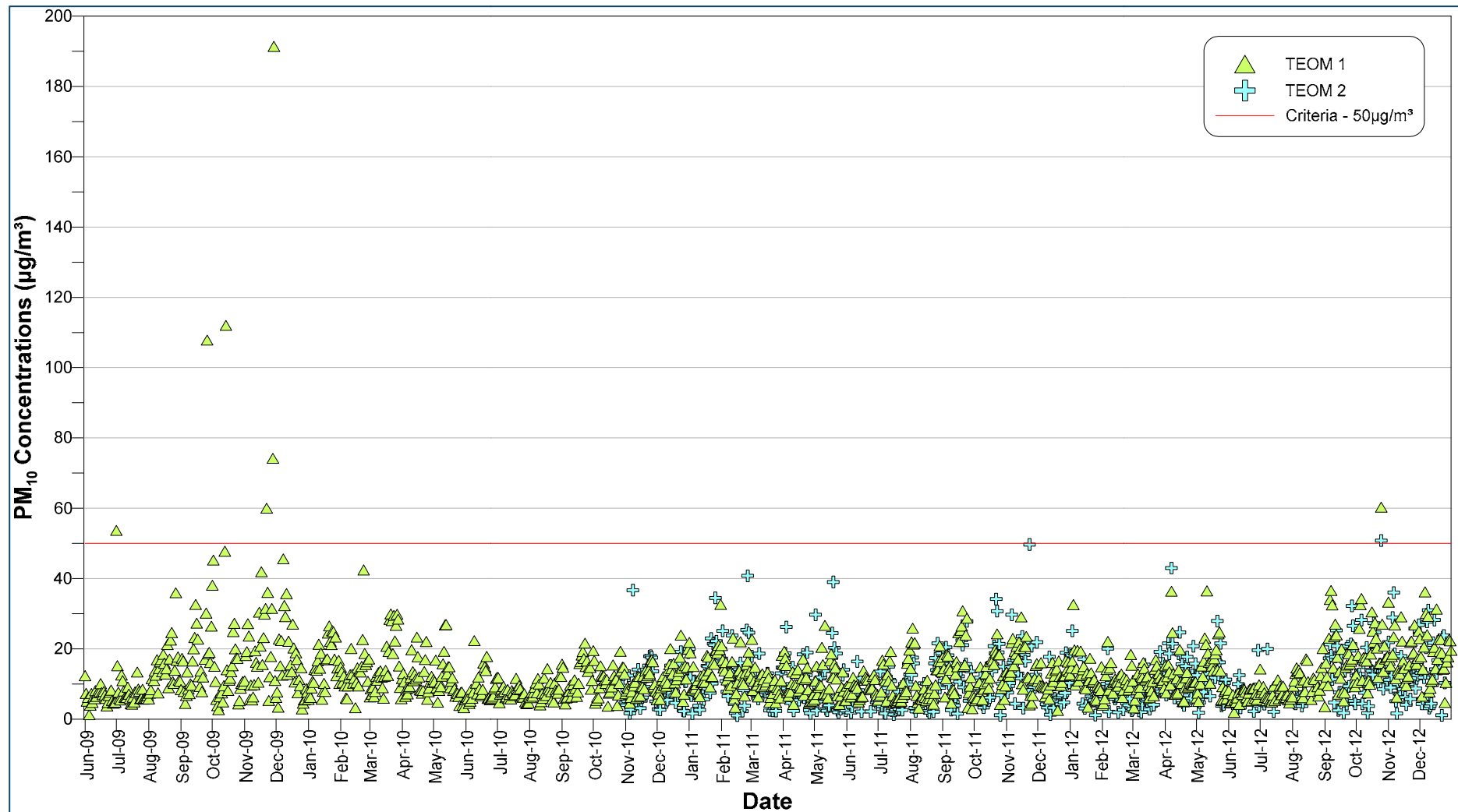


Figure 5-4: TEOM 24-hour average PM₁₀ concentrations



A summary of the results from the three HVAS monitoring stations available during 2006 to 2012 is presented in **Table 5-4** and **Figure 5-5**. The monitoring results in **Table 5-4** indicate that annual average PM₁₀ levels at these monitors are below the criteria of 30µg/m³ and are comparable to the annual average TEOM monitoring results for the same periods.

Figure 5-5 indicates that there were only three periods when the recorded levels were above the 24-hour average PM₁₀ criterion level of 50µg/m³. These occurred in 2006 at the HV 2 station, in November 2009 at the HV 2 station, and in December 2009 at all monitors. The exceedance events in late 2009 occur during the same period as the recorded exceedance at the TEOM stations and would be due to the regional dust storms in 2009.

The monitoring shows a similar pattern to the TEOM data, with recorded levels well below the criteria at most times. Generally, average PM₁₀ levels are below half of the criteria.

Table 5-4: PM₁₀ levels from HVAS monitoring (µg/m³)

Year	Annual average			Criteria	Maximum 24-hour average			Criteria
	HV 1	HV 2	HV 4		HV 1	HV 2	HV 4	
2006	15.5 ⁽¹⁾	21.9 ⁽²⁾	18.5 ⁽²⁾	30	34.5 ⁽¹⁾	59.2 ⁽²⁾	33.3 ⁽²⁾	50
2007	14.1	15.9	12.7	30	35.1	45.1	36.5	50
2008	12.0	12.0	10.7	30	38.4	39.5	36.5	50
2009	14.3	16.3	12.9	30	59.9	61.6	52.5	50
2010	9.1	10.3	9.0	30	29.6	33.7	36.6	50
2011	10.0	13.6	10.7	30	21.9	33.7	25.2	50
2012	9.0	13.6	9.6	30	21.7	47.6	21.8	50

⁽¹⁾Data available from March 2006

⁽²⁾Data available from September 2006

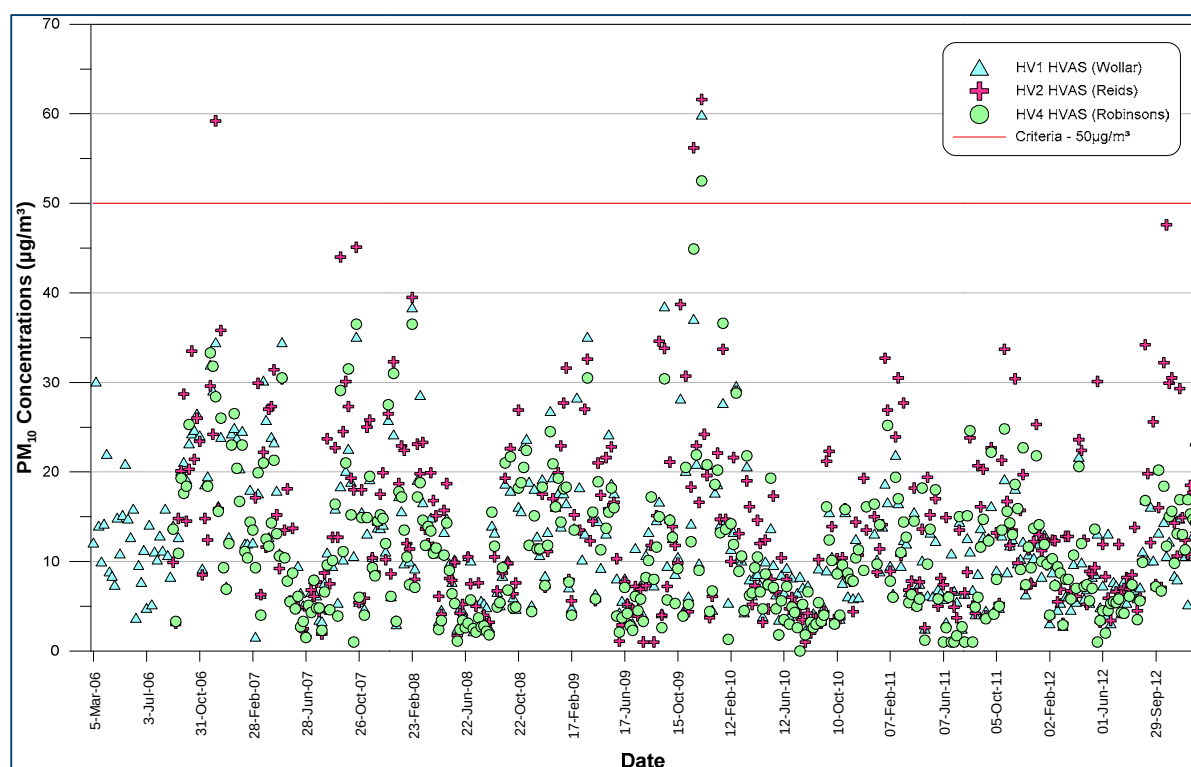


Figure 5-5: HVAS 24-hour average PM₁₀ concentrations



5.3.3 TSP monitoring

TSP monitoring data are collected by WCM using one HVAS monitor, the available monitoring data collected between 2006 and 2012 are summarised in **Table 5-5** and **Figure 5-6**.

The monitoring data summarised in **Table 5-5** indicate that the annual average TSP concentrations for the HV 3 monitoring station were well below the criterion of $90\mu\text{g}/\text{m}^3$. **Figure 5-6** shows that the concentrations are nominally highest in spring and summer with the warmer weather raising the potential for pollen, bushfires and drier ground, which results in higher levels of windblown dust.

TSP levels are low and are typically less than one quarter of the criteria.

Table 5-5: TSP levels from HVAS monitoring ($\mu\text{g}/\text{m}^3$)

Year	Annual average	Criteria
	HV 3	
2006 ⁽¹⁾	16.8	90
2007	19.4	90
2008	19.6	90
2009	24.2	90
2010	16.6	90
2011	19.4	90
2012	18.9	90

⁽¹⁾Data available from October 2006

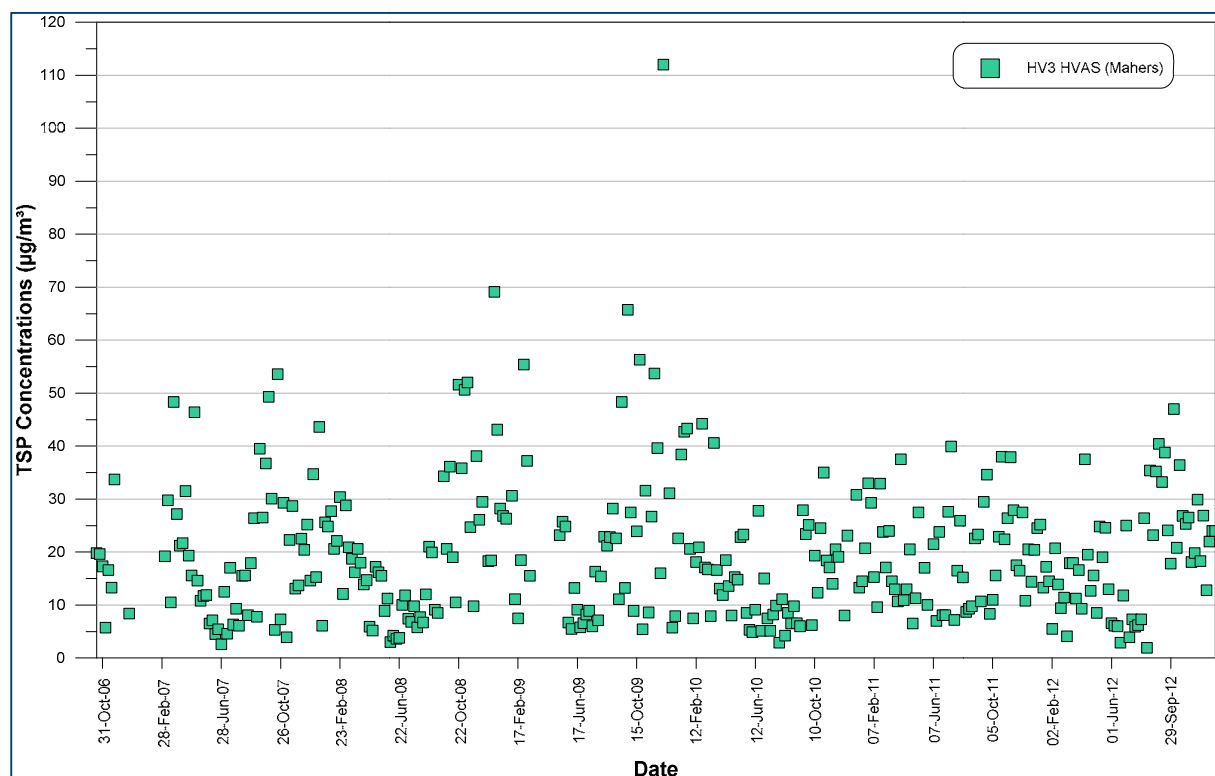


Figure 5-6: HVAS 24-hour average TSP concentrations



5.3.4 Dust deposition monitoring

Figure 5-3 shows the location of the dust deposition gauge monitoring network. It is observed that many of the gauges are located in generally close proximity to the mine or receptor locations. These locations are likely to show the highest levels of deposited dust in the area due to the close proximity of dust sources such as mining activity and traffic on unsealed roads and driveways.

Table 5-6 shows the annual average dust deposition levels at each gauge between 2006 and 2012. The majority of dust gauges recorded annual average insoluble deposition levels below the criterion of 4g/m²/month, during 2006, 2007 and 2011 all gauges recorded deposition levels below the criterion of 4g/m²/month.

Table 5-6: Annual average dust deposition (g/m²/month)

Year	DG3	DG4	DG5	DG7 ⁽¹⁾	DG8	DG9	DG10	DG11	DG12	DG13	DG14	Criteria
2006	-	1.2	1.8	1.0	-	2.1	1.4	1.2	1.6	0.9	1.0	4
2007	1.7	1.2	1.4	1.1	1.1	3.3	1.5	1.6	1.0	1.6	1.0	4
2008	1.2	2.8	1.3	2.03	1.3	2.7	3.6	9.2	2.2	1.2	0.9	4
2009	5.2	2.3	2.8	1.9	2.2	4.5	2.9	2.3	4.0	4.7	3.1	4
2010	2.2	1.3	2.7	1.5	1.7	4.3	8.0	3.2	9.9	2.9	4.5	4
2011	-	0.9	1.4	1.2	0.9	-	3.0	1.3	3.7	2.0	1.9	4
2012	-	1.1	0.7	1.5	1.0	-	1.2	1.4	6.5	2.4	2.2	4

⁽¹⁾ DG7 was previously referred to as DG2

In 2008, DG11 recorded an annual average dust deposition level of 9.2g/m²/month. An investigation into this measurement found that the likely cause was due to unusually high vehicle movements along an unsealed section of road as a result of construction activities not related to or controlled by the WCM.

During 2009, dust gauges DG3, DG9 and DG13 recorded elevated annual average dust deposition levels. Investigations into these measurements indicate that the DG3 gauge recorded spurious levels in March which affected the annual result (**Peabody Energy, 2010**). Replacing this spurious value with the average monthly values from the other nearby gauges results in an annual average dust deposition level of 2.9g/m²/month. The DG9 dust gauge was found to be affected by cattle grazing nearby, also DG13 was possibly affected by regional dust events.

During 2010, dust gauges DG9, DG10, DG12 and DG14 recorded elevated annual average dust deposition levels. An investigation into these elevated levels determined that DG9 and DG14 were affected by spurious monthly results not supported by levels recorded by surrounding gauges; replacing these values would have resulted in annual average levels below criterion (**Peabody Energy, 2011**). DG10 was found to have been influenced by cattle grazing. The DG12 dust gauge was found to be influenced by mining moving closer to the gauge, the annual average result during 2011 for this gauge indicates levels below the criterion.

During 2012, DG12 recorded elevated annual dust deposition levels and is most likely to have been influenced by mining activities occurring near the gauge.

DG5 is the dust gauge located in closest proximity to receivers in Wollar (and is located between the mine and Wollar). This gauge shows generally low levels of deposited dust below criteria in all years.



5.4 Air quality management measures

Condition 20(c) of Schedule 3 of the Project Approval states that WCPL shall:

"ensure real-time air quality monitoring for 24-hour average PM₁₀ and the meteorological monitoring data are assessed regularly, and that mining operations are relocated, modified and/or stopped as required to ensure compliance with the relevant criteria in this approval, to the satisfaction of the Director-General".

The WCM currently uses a number of management measures to maintain air quality in the vicinity of the mine within acceptable levels, as detailed in the WCM Air Quality and Greenhouse Gas Management Plan (AQGGMP) (WCPL, 2011).

Best practice dust mitigation measures (e.g. haul road watering) are currently proactively implemented at the WCM as part of general operational activities of the mine. Further detail regarding these mitigation measures is provided in **Section 6.3.4**.

WCPL has developed internal performance indicators that are compared with ambient monitoring data collected at various locations around the WCM, to assess the performance of the WCM per the statutory air quality criteria. **Table 5-7** outlines the internal performance indicators and monitoring points used by WCPL.

Table 5-7: Internal Performance Indicators

Pollutant	Monitoring Point	Averaging Period	Performance Indicator
PM ₁₀	HV1, HV2, HV4	24-hour	37.5µg/m ³
		Annual	25µg/m ³
	TEOM 1, TEOM 2	5 minute instantaneous reading	150µg/m ³
		Rolling 24-hour average	37.5µg/m ³
Deposited Dust	Dust deposition gauges excluding DG12, DG13 and DG14	Annual	3g/m ² /month

Source: WCPL, 2011

WCPL has also implemented a real-time air quality management system to assist in the implementation of pre-emptive management actions and to avoid potential non-compliances.

The WCM TEOMs record five minute instantaneous (i.e. real-time) PM₁₀ concentrations and rolling 24-hour average PM₁₀ concentrations. The TEOMs send out an alert SMS message and/or email if the real-time PM₁₀ concentrations reach the relevant performance indicators described in **Table 5-7**. If an alert is received from a TEOM, the Standard Protocol described below is implemented to determine the source of the dust and implement management measures to ensure compliance with the relevant impact assessment criteria.

The WCM Standard Protocol involves the following steps:

1. Source identification - identification of the mining activities with most potential for excessive dust generation.
2. Management strategy - determination of dust control and management measures that will be utilised to minimise air quality emissions. This may include modifying operations or shutting down equipment or increased dust suppression activities by water carts.



3. Implementation - implement the chosen dust control and management measures, generally effective immediately once the strategy is determined.
4. Review - compare the results of the air quality monitoring program with the relevant criteria.

The implementation of the real-time air quality management system, internal performance indicators and WCM Standard Protocol has meant that WCM operations have been modified as necessary to limit dust levels or achieve compliance. Examples of operational modifications performed include the cessation or modification of certain operations, the increased frequency of water cart operation and the temporary shutdown of all operations.

Figure 5-7 graphically presents the number of lost excavator hours that occurred as a direct result of the implementation of the WCM Standard Protocol during 2012 (i.e. in response to the exceedance of performance indicators in order to ensure effective mine dust management).

The monitoring data recorded during this period (see **Figure 5-4**) indicates that dust concentrations have generally been low (i.e. below relevant criteria), and therefore, it would appear that the current strategies employed at WCM appear to be effective and to be working as intended.

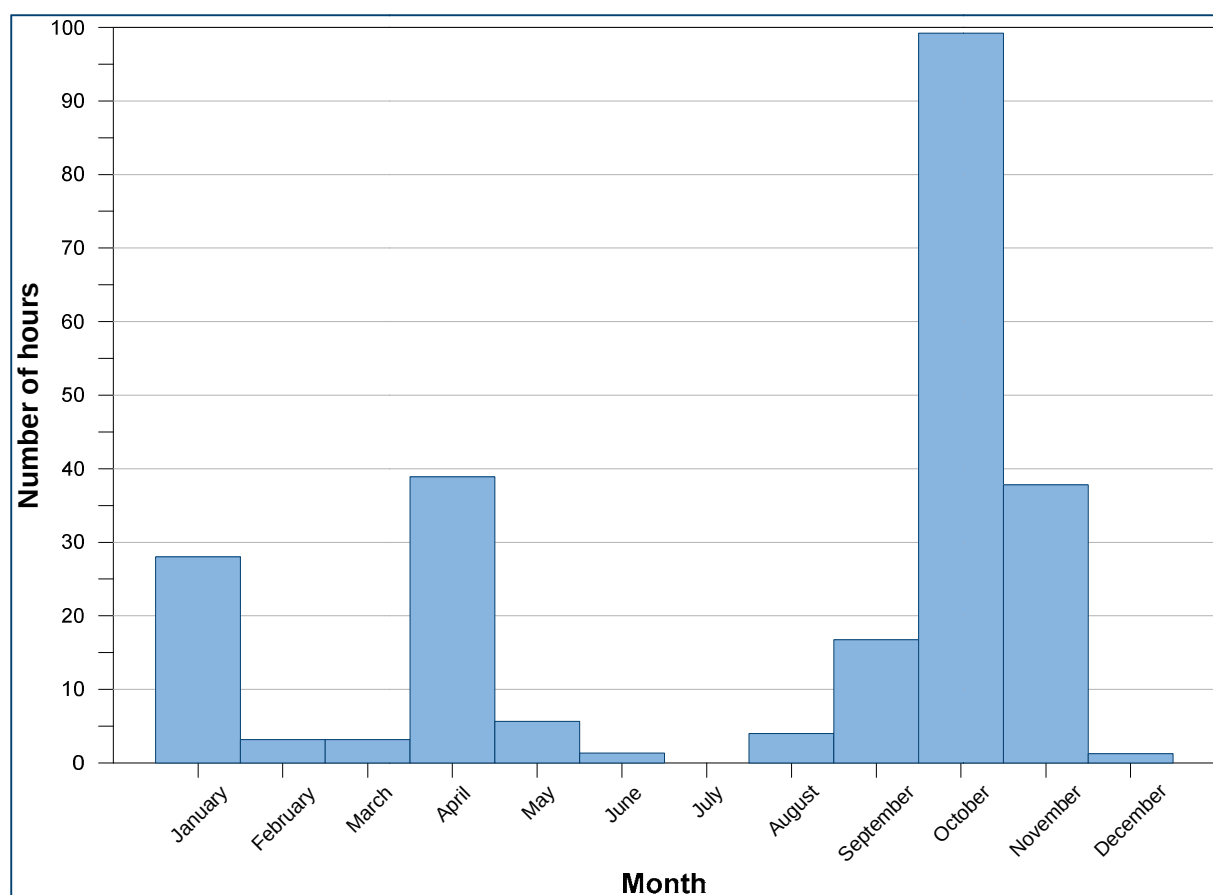


Figure 5-7: Summary of lost excavator hours due to response protocols during 2012

5.5 Odour

The spontaneous combustion of carbonaceous material has the potential to cause off-site odour impacts.

The WCM has recently experienced spontaneous combustion incidents in a ROM coal stockpile (Stockpile 11) and out-of-pit emplacement areas (i.e. waste dumps).

The spontaneous combustion incident at ROM coal Stockpile 11 was caused by downstream supply issues reducing the amount of coal that could be transported from the site, which meant that there was an increase in temporary stockpiling requirements on-site.

The ROM coal in question (Stockpile 11) has since been washed through the CHPP, and therefore, this material does not represent an ongoing spontaneous combustion risk, or require further management. Current coal stockpiles are being actively managed through a risk identification system, whereby stockpiles that have a higher propensity to spontaneously combust are monitored and prioritised for washing in the CHPP prior to these stockpiles reaching a designated storage time on-site. To ensure flexibility in managing coal stockpiles, the Modification is seeking to remove the approved throughput limit of the CHPP of 8.5Mtpa.

The out-of-pit waste dumps (i.e. Keelah, noise bund and Duffy's) were constructed at the commencement of mining and included carbonaceous waste material (e.g. E and G partings have since been identified as having elevated self heating potential) with limited inert capping material. At the commencement of mining, the propensity for spontaneous combustion of carbonaceous material, such as the E and G partings, was not well understood.

To address the ongoing spontaneous combustion propensity of these stockpiles, WCM will progressively rehandle the waste rock material in the Keelah and noise bund emplacements and place the material at the bottom of available mine voids, and then cover it with inert material to prevent ongoing spontaneous combustion. The rehandling of the dump material will result in some episodic spontaneous combustion events until all the material has been disposed of. It is expected that the management of these existing high risk spontaneous combustion areas will be complete in 2015 due to mine void space limitations.

During the rehandling of the Keelah and noise bund emplacements, occurrence of spontaneous combustion will be managed in accordance with the protocols of the Spontaneous Combustion Management Plan.

The other remaining waste stockpile that is prone to spontaneous combustion is Duffy's dump which is being retained for final landform material balance purposes. To manage the occurrence of spontaneous combustion from this waste dump, the western face will be capped with inert waste material.

The characteristics of waste material will continue to be refined through ongoing test-work during mining. The Spontaneous Combustion Management Plan will be periodically updated to address any refinement of waste management practices.

Excavated carbonaceous waste material (e.g. E and G partings) is emplaced on the floor of mining voids, and covered with inert material as a component of general ROM operations. These management measures (e.g. the covering of carbonaceous waste material with inert material, and the application of the Spontaneous Combustion Management Plan) would continue for the Modification to prevent potential spontaneous combustion incidents.

5.6 History of complaints

The WCM has been operating since 2006 and has maintained a complaints register as part of Project Approval requirements. **Figure 5-8** presents a summary of the number of air quality related complaints between 2006 and 2012.

During 2006 the majority of complaints were about traffic on unsealed sections of Ulan-Wollar road. The road has since been upgraded and the number of complaints in this regard has reduced. The number of complaints received between 2007 and 2009 were relatively low in comparison and tended to be non-specific to any particular source but general regarding mining activities.

During 2010 to 2012 the number of complaints received for odour has increased significantly, from two complaints in 2008 and 2009 to 17 in 2010, 10 in 2011 and 21 in 2012. These complaints relate to a burning sulphur based odour, likely arising from spontaneous combustion of coal/carbonaceous material. These complaints tend to occur in the early morning period when dispersion is generally poor.

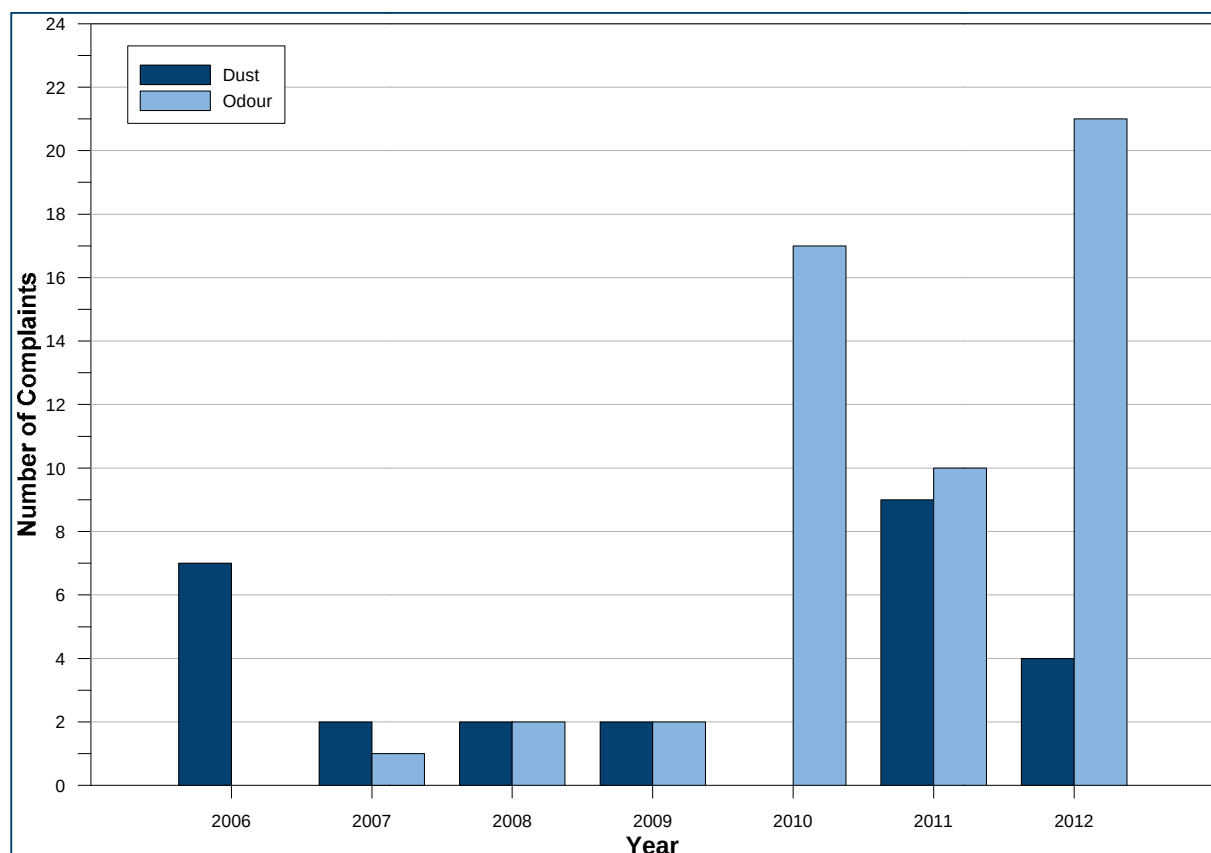


Figure 5-8: Summary of air quality related complaints



No dust complaints were received in 2010. During 2011 and 2012, dust complaints ranged from dust depositing on properties to visible dust from the mine site and equipment. However, during this period odour has caused the greatest number of air quality related complaints that are likely to be due to a number of spontaneous combustion incidents at the WCM. As described, WCPL is currently implementing measures to manage and mitigate potential odour impacts related to spontaneous combustion.

All complaints received at WCM are managed in accordance with the Complaints Response Procedure outlined in the Environmental Management Strategy.

6 DISPERSION MODELLING APPROACH

6.1 Introduction

The following sections are included to provide the reader with an understanding of the model and modelling approach combined with the dust emission estimates for each of the assessed scenarios.

Those familiar with the approach used in historical assessments for Hunter Valley coal mines in NSW will notice that a similar approach has been followed in this assessment however the CALPUFF modelling suite is applied to dispersion modelling rather than ISCMOD. The CALPUFF model is a more advanced "puff" model that can deal with the effects of complex local terrain on the dispersion meteorology over the entire modelling domain in a 3D, hourly varying time step. CALPUFF is an air dispersion model approved by NSW EPA for use in air quality impact assessments.

6.2 Modelling methodology

Modelling was undertaken using a combination of TAPM and the CALPUFF Modelling System. 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 standard, routinely available meteorological and geophysical datasets.

CALMET is a meteorological model that uses the geophysical information and observed/simulated surface and upper air data as inputs and develops wind and temperature fields on a 3D gridded modelling domain.

CALPUFF is a transport and dispersion model that advects "puffs" of material emitted from modelled sources, simulating dispersion processes along the way. It typically uses the 3D meteorological field generated by CALMET.

CALPOST is a post processor used to process the output of the CALPUFF model and produce tabulations that summarise the results of the simulation.

TAPM is a prognostic air model used to simulate the upper air data for CALMET input. The meteorological component of TAPM is an incompressible, non-hydrostatic, primitive equation model with a terrain-following vertical coordinate for 3D simulations. The model predicts the flows important to local scale air pollution, such as sea breezes and terrain induced flows, against a background of larger scale meteorology provided by synoptic analysis.

6.2.1 Meteorological modelling

The TAPM model was applied to the available data to generate a 3D upper air data file for use in CALMET. The centre of analysis for the TAPM modelling used is 32deg16.5min south and 149deg49min east (765000mE, 6425000mN). The simulation involved four nesting grids of 30km, 10km, 3km and 1km with 35 vertical grid levels.



CALMET modelling used a nested approach where the 3D wind field from the coarser grid outer domain is used as the initial guess (or starting) field for the finer grid inner domain. This approach has several advantages over modelling a single domain. Observed surface wind field data from the near field as well as from far field monitoring sites can be included in the model to generate a more representative 3D wind field for the modelled area. Off domain terrain features for the finer grid domain can be allowed to take effect within the finer domain, as would occur in reality, also the coarse scale wind flow fields give a better set of starting conditions with which to operate the finer grid run.

The coarser grid domain was run on a 100 x 100km area with a 2km grid resolution. The available meteorological data for September 2011 to August 2012 from five surrounding meteorological monitoring sites were included in this run.

Table 6-1 outlines the parameters used from each station. 3D upper air data were sourced from TAPM output. The finer grid domain was run on a 30 x 30km grid with 0.3km grid resolution for each modelled year. Local land use and detailed topographical information was included to produce realistic fine scale flow fields (such as terrain forced flows) in surrounding areas, as shown in **Figure 6-1**. Further detail regarding the CALMET input variables are presented in **Appendix C**.

Table 6-1: Surface observation stations

Station ID	Parameters
WCM Weather Station	Wind speed, Wind direction, Temperature, Humidity
Merriwa (Roscommon) Automatic Weather Station (BoM) (Station No. 061287)	Wind speed, Wind direction, Cloud height, Cloud Amount, Temperature, Humidity, Sea level pressure
Scone Airport Automatic Weather Station (BoM) (Station No. 061363)	Wind speed, Wind direction, Temperature, Humidity, Sea level pressure
Mudgee Airport Automatic Weather Station (BoM) (Station No. 062101)	Wind speed, Wind direction, Temperature, Humidity, Sea level pressure
Nullo Mountain Automatic Weather Station (BoM) (Station No. 062100)	Wind speed, Wind direction, Temperature, Humidity



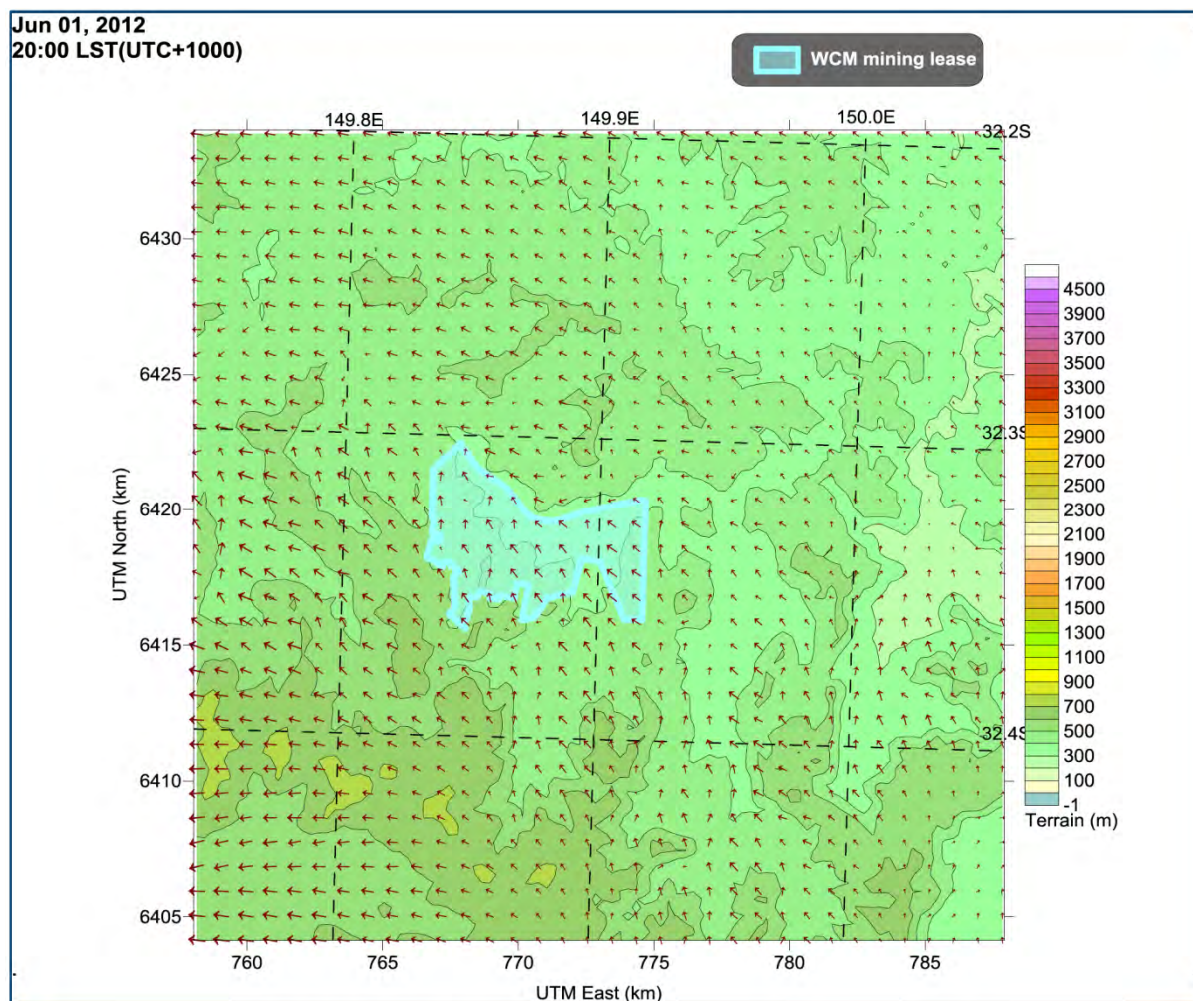


Figure 6-1: Representative snapshot of wind field for WCM

CALMET generated meteorological data were extracted from a point within the CALMET domain and are graphically represented in **Figure 6-2** and **Figure 6-3**.

Figure 6-2 presents the annual and seasonal windroses from the CALMET data. On an annual basis, winds from the east-southeast are most frequent followed by winds from the west-northwest and east. During summer, winds from the east-southeast dominate with a lesser portion of wind from the east. The seasons of autumn and spring have a fairly similar wind distribution and compare well with the annual distribution, winds predominately align in an east-southeast and west-northwest axis. In winter, west-northwest winds dominate the wind distribution with a lesser portion of winds from the west- southwest sector.

Figure 6-3 includes graphs of the temperature, wind speed, mixing height and stability classification over the modelling period and show.



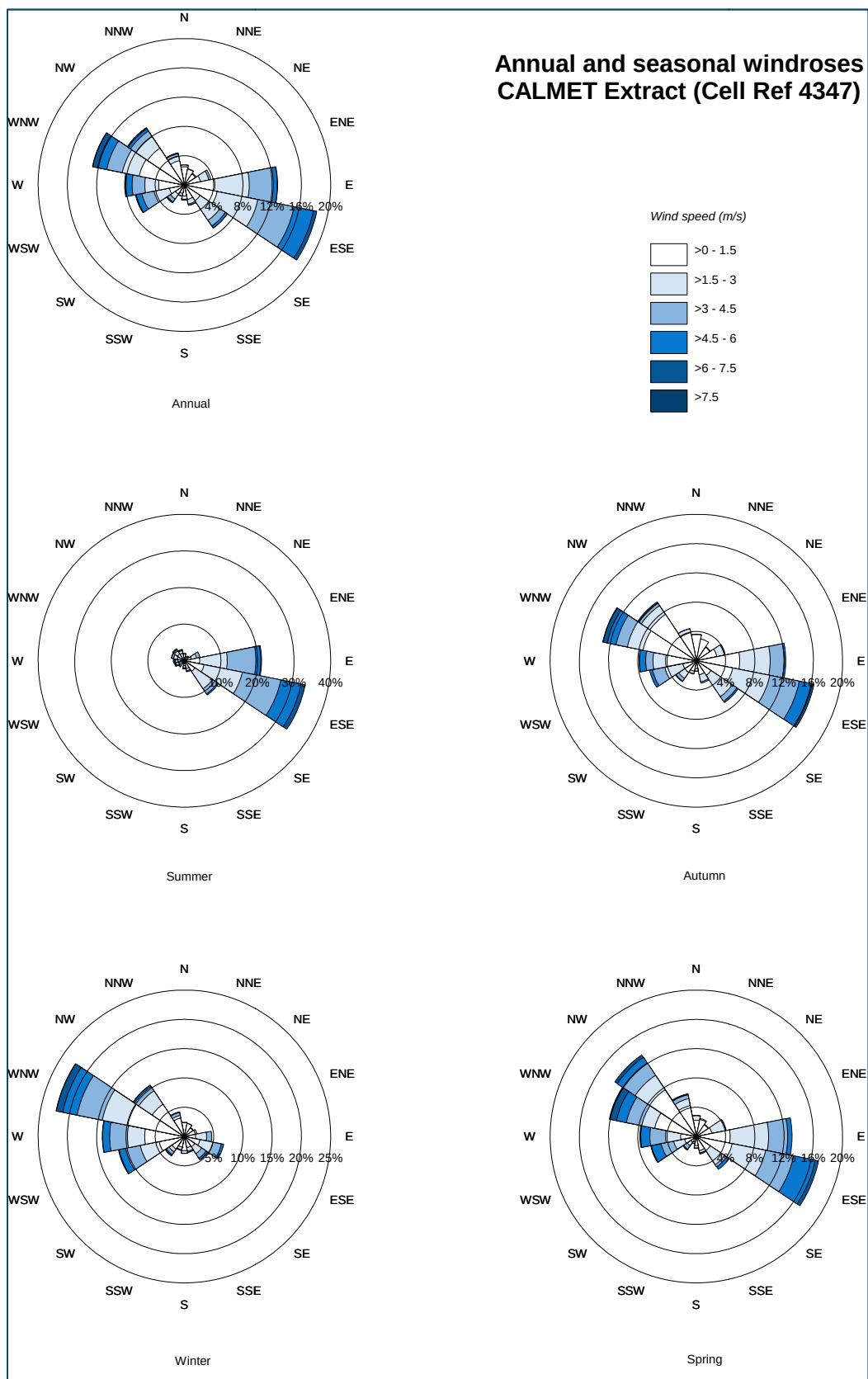


Figure 6-2: Windroses from CALMET extract (Cell Ref 4347)



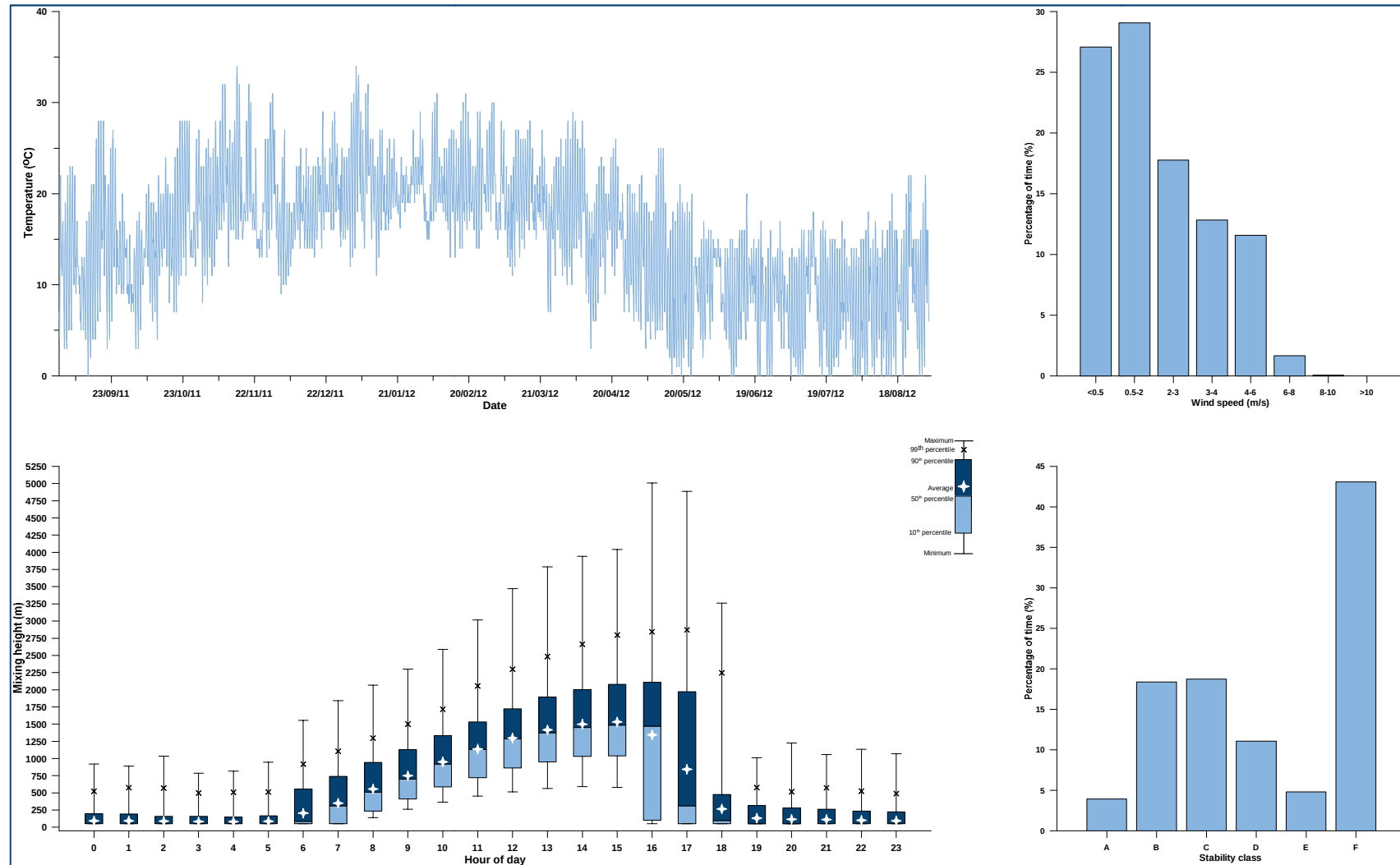


Figure 6-3: Meteorological analyses of CALMET extract (Cell Ref 4347)



6.2.2 Dispersion modelling

CALPUFF modelling is based on the application of three particle size categories Fine Particulates (FP), Coarse Matter (CM) and Rest (RE). The estimated emissions are presented in **Section 6.3.2**. The distribution of particles for each particle size category was derived from measurements in the **SPCC (1986)** study and is presented in **Table 6-2**.

Table 6-2: Distribution of particles

Particle category	Size range	Distribution
Fine particulates (FP)	0 to 2.5µm	4.68% of TSP
Coarse matter (CM)	2.5 to 10µm	34.4% of TSP
Rest (RE)	10 to 30µm	60.92% of TSP

Emissions from each activity occurring at the WCM (incorporating the Modification) were represented by a series of volume sources and were included in the CALPUFF model via an hourly varying emission file. Meteorological conditions associated with dust generation (such as wind speed) and levels of dust generating activity were considered in calculating the hourly varying emission rate for each source. It should be noted that as a conservative measure, the effect of the precipitation rate (rainfall) in reducing dust emissions has not been considered in this assessment. Further detail regarding the CALPUFF input variables are presented in **Appendix C**.

Each particle-size category is modelled separately and later combined to predict short-term and long-term average concentrations for PM_{2.5}, PM₁₀, and TSP. Dust deposition was predicted using the proven dry deposition algorithm within the CALPUFF model. Particle deposition is expressed in terms of atmospheric resistance through the surface layer, deposition layer resistance and gravitational settling (**Slinn and Slinn, 1980** and **Pleim *et al.*, 1984**). Gravitational settling is a function of the particle size and density, simulated for spheres by the Stokes equation (**Gregory, 1973**).

CALPUFF is capable of tracking the mass balance of particles emitted into the modelling domain. For each hour CALPUFF tracks the mass emitted, the amount deposited, the amounts remaining in the surface mixed layer or the air above the mixed layer and the amount advected out of the modelling domain. The versatility to address both dispersion and deposition algorithms in CALPUFF, combined with the 3D meteorological and land use field generally result in a more accurate model prediction compared to other Gaussian plume models (**Pfender *et al.*, 2006**).

6.3 Modelling Scenarios

This assessment has considered two mine plan years to represent the WCM incorporating the Modification. The scenarios modelled were chosen to represent potential worst-case impacts in regards to the potential to generate dust through the (maximum) amount of material handled (Year 13 [2018]) and a concentration of the mining activities in close proximity relative to sensitive receptors to the east and north-east of the WCM (Year 16 [2021]).



The modelled Year 13 (2018) represents a maximum amount of material handled case. During this period, waste rock material handled peaks at 33.3Mbcm and ROM coal extracted reaches 14.7Mt. Active mining occurs in Pits 1, 3, 5 and 6 (see **Figure 6-4**) and includes activities in the south of Pit 3 that are in close proximity to receptors to the east, including Wollar.

Year 16 (2021) has been selected as active mining occurs in areas closest to some nearby sensitive receptors (see **Figure 6-4**), in particular those located to the east and north-east, including Wollar. The Year 16 (2021) scenario represents the highest concentration of mining activity likely to occur in the eastern section of the WCM. However, it should be noted that annual waste rock and ROM coal handling rates in Year 16 (2021) would be well within the currently approved rate.

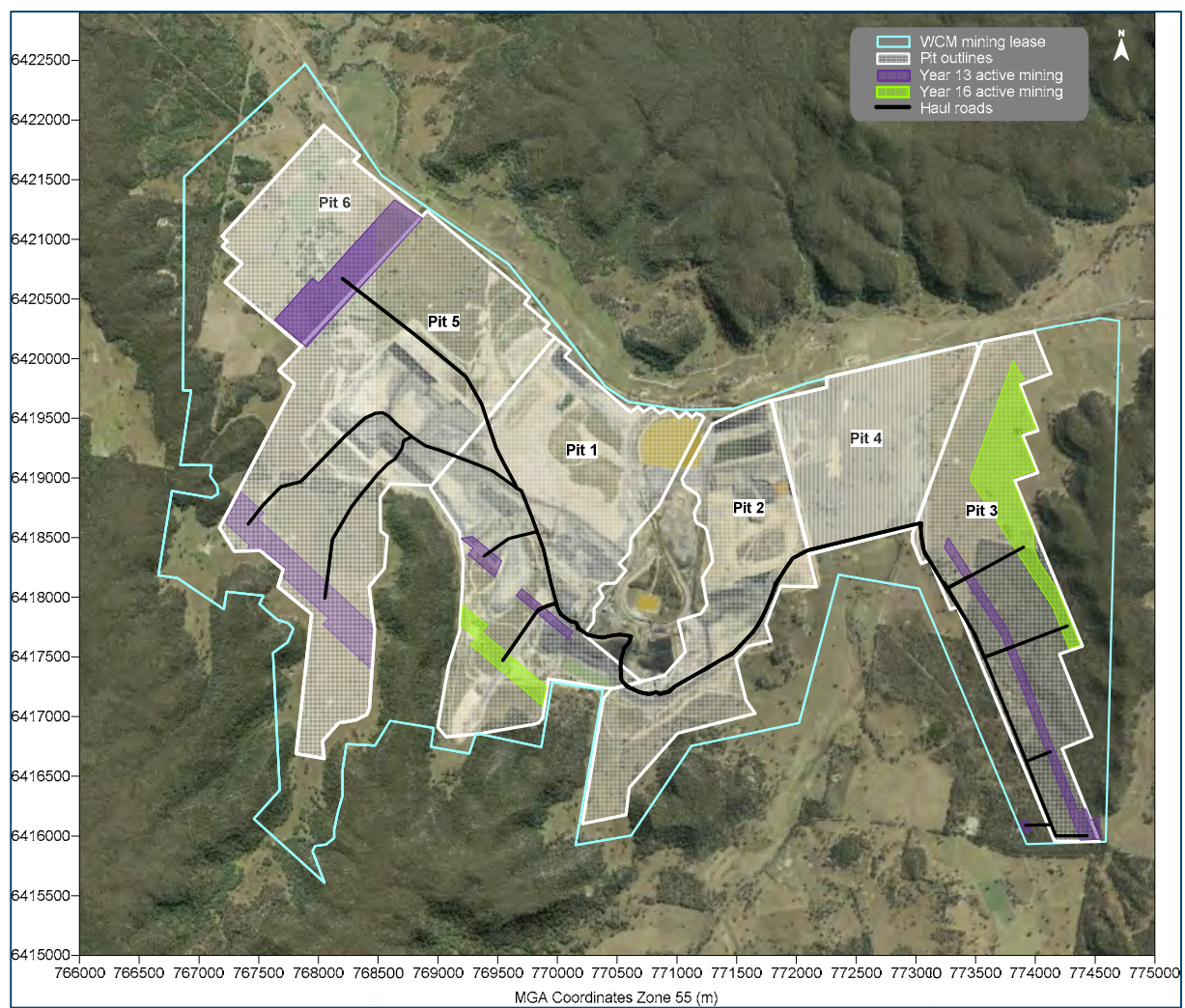


Figure 6-4: Mine plan for the Modification

6.3.1 Comparison to noise modelling scenarios

It is noted that, in addition to Year 13 (2018) and Year 16 (2021), the Noise and Blasting Impact Assessment prepared for the Modification (**SLR Consulting, 2013**) also assessed potential noise impacts associated with the development of an elevated in-pit waste emplacement in Pit 2 that would be constructed over two short campaigns in Year 9 (2014), and proposed operations in Year 10 (2015).

The potential for noise impacts is generally related to the number of noise generating plant items on-site and their proximity to receptors, whereas, the potential for air quality impacts is generally related to the intensity of mining operations (i.e. annual quantities of waste rock and ROM coal excavated and handled) and the proximity of these mining operations to receptors.

It is not considered that the potential for air quality impacts arising from the development of the elevated in-pit waste emplacement in Pit 2 in Year 9 (2014) would be greater than those predicted for the Year 13 (2018) and Year 16 (2021) scenarios (refer to **Section 7**).

This would be the case as dust propagation from sources over long distances is not greatly affected by a (relatively) small change in the source height, especially in this case where there is no increase in the intensity of mining operations in comparison to those assessed for Year 13 (2018) and as the elevated dump would be further away from the closest sensitive receptors in Wollar (i.e. it would be located in Pit 2) in comparison to the mining operations in Year 13 (2018) and Year 16 (2021) (refer to **Figure 6-4**).

In addition it is not considered that the Year 10 (2015) scenario has the potential for air quality impacts greater than those predicted for the Year 13 (2018) or Year 16 (2021) scenarios (refer to **Section 7**) and therefore it was not assessed further in regard to air quality.

The reasons for this are as follows:

- ✦ The Year 10 (2015) scenario has a lower intensity of mining (i.e. with respect to total waste rock material handled and ROM coal excavated) than the Year 13 (2018) scenario, which also involves mining in the south of Pit 3.
- ✦ Mining in the east of the WCM (i.e. in close proximity to Wollar) would occur during Year 10 (2015), however in comparison, mining operations in Year 16 (2021) would be concentrated in the north-eastern section of the WCM for the entire year. This means that potential sources of dust emissions would be located in close proximity to sensitive receptors, operate at a higher intensity, and for a longer period of time in Year 16 (2021) in comparison to Year 10 (2015).

6.3.2 Emission estimation

For each of the chosen modelling scenarios, dust emission estimates have been calculated by analysing the various types of dust generating activities taking place and utilising suitable emission factors.



The emission factors applied are considered the most applicable and representative for determining dust generation rates for the proposed activities. The emission factors were sourced from both locally developed and United States Environmental Protection Agency (US EPA) developed documentation. Total dust emissions from all significant dust generating activities for the WCM incorporating the Modification are presented in **Table 6-3**. Detailed emission inventories and emission estimation calculations are presented in **Appendix D**.

Notwithstanding, after the completion of air quality modelling for this assessment, additional site-specific analysis for haul roads became available which indicated that the hauling emissions in **Table 6-3** are conservative. Further detail is provided in **Section 7.6**.

The dust emissions presented in **Table 6-3** are commensurate with a best practice mining operation utilising reasonable and feasible best practice dust mitigation applied where applicable. Further details on the dust control measures applied for the Modification are outlined in **Section 6.3.4**.

A comparison of the total calculated TSP emissions in **Table 6-3** for each of the mine years with the nearest corresponding mine years modelled in the previous WCM modification (**PAEHolmes, 2010a**), indicates that emissions calculated to arise from the WCM incorporating the Modification would be greater (e.g. in years where there is an increase in annual waste rock movement) or similar to the currently approved operations, depending on the stage of the mine life. These differences arise mainly due to the changes in the amount of material moved during each year.

Table 6-3: Estimated emissions for the WCM incorporating the Modification (kg of TSP)

Activity	Year 13	Year 16
OB - Stripping Topsoil (Pit 1) - Scraper removing topsoil	587	935
OB - Stripping Topsoil (Pit 3) - Scraper removing topsoil	1,535	3,742
OB - Stripping Topsoil (Pit 5) - Scraper removing topsoil	2,825	-
OB - Stripping Topsoil (Pit 6) - Scraper removing topsoil	2,871	-
OB - Loading topsoil to haul truck (Pit 1)	5	8
OB - Loading topsoil to haul truck (Pit 3)	13	33
OB - Loading topsoil to haul truck (Pit 5)	25	-
OB - Loading topsoil to haul truck (Pit 6)	25	-
OB - Hauling to emplacement from Pit 1	447	711
OB - Hauling to emplacement from Pit 3	1,168	2,847
OB - Hauling to emplacement from Pit 5	2,150	-
OB - Hauling to emplacement from Pit 6	2,184	-
OB - Emplacing topsoil at dump (Pit 1)	5	8
OB - Emplacing topsoil at dump (Pit 3)	13	33
OB - Emplacing topsoil at dump (Pit 5)	25	-
OB - Emplacing topsoil at dump (Pit 6)	25	-
OB - Drilling (Pit 1)	733	1,557
OB - Drilling (Pit 3)	1,247	14,550
OB - Drilling (Pit 5)	3,918	-
OB - Drilling (Pit 6)	10,208	-
OB - Blasting (Pit 1)	20,869	44,289
OB - Blasting (Pit 3)	35,493	413,998
OB - Blasting (Pit 5)	111,478	-
OB - Blasting (Pit 6)	290,447	-
OB - Excavator loading OB to haul truck (Pit 1)	2,380	3,597



Activity	Year 13	Year 16
OB - Excavator loading OB to haul truck (Pit 3)	4,048	33,622
OB - Excavator loading OB to haul truck (Pit 5)	12,715	-
OB - Excavator loading OB to haul truck (Pit 6)	33,128	-
OB - Hauling to dump from Pit 1	27,510	41,570
OB - Hauling to dump from Pit 3	46,789	388,588
OB - Hauling to dump from Pit 5	146,955	-
OB - Hauling to dump from Pit 6	382,881	-
OB - Emplacing at dump (Pit 1)	2,380	3,597
OB - Emplacing at dump (Pit 3)	4,048	33,622
OB - Emplacing at dump (Pit 5)	12,715	-
OB - Emplacing at dump (Pit 6)	33,128	-
OB - Dozers on OB in pit (Pit 1)	32,044	54,403
OB - Dozers on OB in pit (Pit 3)	54,499	508,547
OB - Dozers on OB in pit (Pit 5)	171,171	-
OB - Dozers on OB in pit (Pit 6)	445,974	-
CL - Dozers ripping/pushing/clean-up (Pit 1)	10,276	14,836
CL - Dozers ripping/pushing/clean-up (Pit 3)	20,834	82,268
CL - Dozers ripping/pushing/clean-up (Pit 5)	31,391	-
CL - Dozers ripping/pushing/clean-up (Pit 6)	58,878	-
CL - Loading ROM coal to haul truck (Pit 1)	85,874	80,121
CL - Loading ROM coal to haul truck (Pit 3)	174,099	444,277
CL - Loading ROM coal to haul truck (Pit 5)	262,315	-
CL - Loading ROM coal to haul truck (Pit 6)	492,008	-
CL - Hauling ROM to hopper from Pit 1	22,186	31,049
CL - Hauling ROM to hopper from Pit 3	247,381	516,504
CL - Hauling ROM to hopper from Pit 5	304,961	-
CL - Hauling ROM to hopper from Pit 6	699,105	-
CHPP - Unloading ROM to hopper (all pits)	760,722	393,298
CHPP - Rehandle ROM at hopper	507,148	262,199
CHPP – Screening	16,170	8,360
CHPP – Crushing	8,820	4,560
CHPP - Sized Coal Unloading to Existing Product/Raw Stockpiles	1,104	571
CHPP - Loading from RAW to CHPP	1,246	646
CHPP - Loading from RAW to trains (BYPASS)	961	496
CHPP - Unloading from CHPP to Product Stockpile	818	418
CHPP - Loading from Product Stockpile to trains	1,636	836
CHPP - Dozer on ROM Stockpiles	18,253	18,253
CHPP - Dozer on Product/Raw Stockpiles	48,851	48,851
CHPP - Loading coarse rejects	389	194
CHPP - Loading fine rejects from belt filter press	16	10
CHPP - Hauling coarse and fine rejects (Pit 1)	70,756	36,749
CHPP - Unloading coarse rejects	389	194
CHPP - Unloading fine rejects	16	10
WE - Overburden emplacement areas (Pit 1)	14,016	45,552
WE - Overburden emplacement areas (Pit 2)	108,624	-
WE - Overburden emplacement areas (Pit 3)	63,072	294,336
WE - Overburden emplacement areas (Pit 4)	238,272	-
WE - Overburden emplacement areas (Pit 5)	140,160	-
WE - Overburden emplacement areas (Pit 6)	73,584	-
WE - Open pit (Pit 1)	14,016	24,528
WE - Open pit (Pit 3)	38,544	94,608



Activity	Year 13	Year 16
WE - Open pit (Pit 5)	70,080	-
WE - Open pit (Pit 6)	73,584	-
WE - ROM stockpiles	56,064	56,064
WE - Product stockpiles	17,520	17,520
Grading roads	19,409	19,409
Total TSP emissions (kg/yr)	6,674,213	4,046,972

OB - overburden, CL - coal, WE - wind erosion

Note: Totals may vary slightly due to rounding.

6.3.3 Emissions from other mines

In addition to the estimated dust emissions from the WCM incorporating the Modification, all nearby approved or proposed mining operations were included in the modelling to assess potential cumulative dust effects. The operations include:

- ✦ Ulan Coal Continued Operations Project; and
- ✦ Moolarben Coal Mine (as amended – i.e. Stage 2).

Emissions estimates from these sources were derived from information provided in air quality assessments available in the public domain at the time of modelling. These estimates are likely to be conservative as in many cases mines do not operate at the maximum extraction rates assessed in their respective assessments. **Table 6-4** summarises the emissions adopted in this assessment for each of the nearby mining operations.

Table 6-4: Estimated emissions for nearby mining operations (kg of TSP)

Mining operation	Year 13	Year 16
Moolarben Coal Mines ⁽¹⁾	9,193,657	9,313,092
Ulan Coal Mines ⁽²⁾	2,842,032	1,283,404

(1) **PAEHolmes (2011)** for Moolarben Stage 2. Note that emissions in PAEHolmes (2011) also include approved Moolarben Stage 1 operations.

(2) **PAEHolmes (2009)**

It is noted that the Moolarben Coal Project - Stage 1 Optimisation Modification 9 Environmental Assessment was placed on public exhibition in June 2013. Predicted emissions presented in the Moolarben Coal Project - Stage 1 Optimisation Modification 9 Environmental Assessment (which also includes emissions from the proposed Moolarben Stage 2 operations) are lower than those shown in **Table 6-4** for the Moolarben Coal Mines, and on this basis, the emissions used for this assessment are considered to be conservative.

Emissions from nearby mining operations would contribute to the background level of dust in the area surrounding the WCM, and these emissions are explicitly included in the modelling. Additionally, there would be numerous smaller or very distant sources that contribute to the total background dust level. Modelling these sources explicitly is impractical, however the residual level of dust due to all other such non-modelled sources (as estimated in **Section 6.4**) has been included in the cumulative results, as discussed in **Section 7**.

The Mount Penny Coal Project, proposed to be located approximately 20km to the east of the WCM, has received Director-General's Requirements. The Preliminary Environmental Assessment for the Mount Penny Coal Project (**Wells Environmental Services, 2011**), indicates the mine would produce



up to 5Mtpa of ROM coal and would be separated from the WCM by multiple ridges and valleys that intersect the area between the two operations.

Due to the large separation distance, significant intervening terrain, and the significantly smaller scale, the Mount Penny Coal Project would have a limited capacity to influence dust levels at Wollar. Hence no further consideration is made of the Mount Penny Project in this assessment.

6.3.4 Best practice operational dust mitigation measures

WCPL has carefully considered the possible range of air quality mitigation measures that are feasible and can be applied to achieve a standard of mine operation consistent with current best practice for the control of dust emissions from coal mines in NSW, as outlined in the recent NSW EPA document, *"NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining"*, prepared by Katestone Environmental (Katestone Environmental, 2010).

The NSW EPA has also implemented a Pollution Reduction Program (PRP) at the WCM which requires identification and assessment of the practicability of implementing further best practice measures. The identified best practice controls based on PRP have been reviewed and were considered in this assessment.

A summary of the key current dust controls, which would continue to be applied for the Modification, is shown in **Table 6-5**. Where applicable these controls have been applied in the dust emission estimates shown in **Table 6-3**. Further detail on the level of control applied is set out in **Appendix D**.

Table 6-5: Best practice dust mitigation measures

Activity	Dust Control
Scrapers on topsoil and Bulldozers on, overburden and rehabilitation	★ Manage according to dust alarms
Hauling on unsealed roads	★ Watering haul roads ★ Use the largest practical truck size ★ Road edges to be clearly defined with marker post or equivalent to control locations ★ Obsolete roads will be ripped and re-vegetated as soon as practical
Drilling (overburden and coal)	★ Water curtains
Blasting (overburden and coal)	★ Meteorological conditions assessed prior to blasting ★ Adequate stemming
Bulldozers on coal	★ Manage according to dust alarms
Loading/unloading coal	★ Water sprays on ROM bin



Activity	Dust Control
Conveyor transfers (CHPP)	✦ Water sprays ✦ Belt cleaning and spillage minimisation ✦ Enclosures
Road grading	✦ Watering grader routes

6.4 Accounting for background dust levels

All significant dust generating operations in the vicinity of the WCM (i.e. estimated emissions from the Ulan and Moolarben coal mines) were included in the dispersion model to assess the total potential dust impact.

Other, non-mining sources of particulate matter in the wider area would also contribute to existing ambient dust levels. These sources have not been included in the dispersion modelling as it is impractical to do so; however an allowance for their contribution to total dust levels is required to fully assess the total potential impact.

The monitoring data as presented in **Section 5.3** have been used to estimate conservative background levels for use in assessing total potential air quality impacts. These estimates are derived from the annual average HVAS monitoring data collected from 2007 to 2012, TEOM monitoring data collected from 2011 to 2012 and dust deposition data (excluding spurious data) collected from 2011 to 2012.

It should be noted that these background levels would include the contribution from operations occurring at the WCM and the surrounding mining operations. Hence the resulting estimate is considered to be significantly conservative for the purposes of this assessment. (i.e. there is double counting of the contribution to total dust levels from the existing Wilpinjong, Moolarben and Ulan mines).

The estimated annual average background levels that have been used for assessment purposes are presented in **Table 6-6**.

Table 6-6: Estimated background levels

Pollutant	Averaging period	Unit	Estimated background level
TSP	Annual	µg/m ³	19.7
PM ₁₀	Annual	µg/m ³	11.9
Dust deposition	Annual	µg/m ³	1.9



To account for background levels when assessing total (cumulative) 24-hour average PM_{10} concentration impacts, the contributions due to the WCM incorporating the Modification were added to the measured daily ambient dust levels (which already include the existing contribution of the currently operating WCM). The cumulative 24-hour average PM_{10} assessment therefore includes double counting of the existing WCM's contribution to dust levels. The assessment was generally conducted per the NSW EPA assessment guidance at Section 11.2 of the Approved Methods (DEC, 2005). Further details regarding the total cumulative 24-hour PM_{10} impacts are provided in **Section 7.3**.



7 DISPERSION MODELLING RESULTS

The dispersion model predictions for each of the assessed years are presented in this section. The results show the estimated maximum 24-hour average PM_{2.5} concentrations, annual average PM_{2.5} concentrations, maximum 24-hour average PM₁₀ concentrations, annual average PM₁₀ concentrations, annual average TSP concentrations and annual average dust (insoluble solids) deposition (DD) rates for the WCM (incorporating the Modification) operating in isolation, as well for the WCM (incorporating the Modification) operating with other sources (cumulative impact).

It is important to note that when assessing impacts per maximum 24-hour average PM₁₀ criteria the predictions show the highest predicted 24-hour average concentrations that were modelled at each point within the modelling domain for the worst day (a 24-hour period) in the one year long modelling period. When assessing the total (cumulative) 24-hour average impacts based on model predictions, challenges arise with identification and quantification of emissions from non-modelled sources over the 24-hour period. Due to these factors, the 24-hour average impacts need to be calculated differently to annual averages and as such, the predicted total (cumulative) impacts for maximum 24-hour average PM₁₀ concentrations have been addressed specifically in **Section 7.3**.

Each of the sensitive receptors shown in **Figure 2-1** and detailed in **Appendix A** were assessed individually as discrete receptors with the predicted results presented in tabular form for each of the assessed years.

Associated isopleth diagrams of the dispersion modelling results are presented in **Appendix E**.

For sources not explicitly included in the model, and to fully account for all cumulative dust levels, the unaccounted fractions of background dust levels (which arise from the other non-modelled sources), were added to the model predictions as described in **Section 6.4** with the results presented in the following sections for each of the assessed years.

7.1 Year 13 (2018)

Table 7-1 presents the model predictions at each of the privately-owned receptors, the values presented in **bold** indicate predicted values above the relevant criteria. **Table 7-2** presents the model predictions at each of the mine-owned receptors.

Figure E-1 to **Figure E-9** in **Appendix E** present isopleth diagrams of the predicted modelling results for each of the assessed pollutants in Year 13 (2018).



Table 7-1: Modelling predictions for Year 13 (2018) of the Modification (privately-owned receptors)

Receptor ID	PM _{2.5} (µg/m³)		PM ₁₀ (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM ₁₀ (µg/m³)	TSP (µg/m³)	DD (g/m²/month)	
	WCM incorporating the Modification impact						Cumulative impact			
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average	
	Advisory*		Air quality impact criteria							
	25	8	50	-	-	2	30	90	4	
69	0.7	0.1	5.0	0.5	0.6	0.0	13.0	21.2	1.9	
102	1.2	0.2	9.4	1.4	2.0	0.1	14.1	23.0	2.0	
129	2.4	0.3	18.3	2.4	3.7	0.1	14.8	24.1	2.0	
135	2.4	0.3	17.5	2.1	3.2	0.1	14.5	23.6	2.0	
137	2.3	0.2	16.9	1.7	2.6	0.1	14.1	23.0	2.0	
150A	2.0	0.2	15.6	1.8	2.7	0.1	14.1	23.0	2.0	
153	0.9	0.1	5.5	0.4	0.6	0.0	12.6	20.7	1.9	
157	0.3	0.0	1.7	0.1	0.2	0.0	12.2	20.0	1.9	
160A	0.8	0.1	6.3	0.7	1.0	0.0	13.0	21.3	1.9	
160B	1.0	0.1	7.2	0.7	1.0	0.0	13.0	21.4	1.9	
900	2.3	0.3	18.3	2.1	3.2	0.1	14.5	23.6	2.0	
901	2.8	0.3	22.1	2.2	3.3	0.1	14.5	23.7	2.0	
903	2.2	0.3	17.1	2.1	3.2	0.1	14.4	23.5	2.0	
908	2.2	0.3	17.5	2.0	3.0	0.1	14.3	23.4	2.0	
914	2.2	0.3	17.3	1.9	2.9	0.1	14.3	23.3	2.0	
921	2.3	0.3	18.3	2.0	3.0	0.1	14.3	23.4	2.0	
933	2.4	0.3	18.8	2.0	3.0	0.1	14.3	23.4	2.0	
935	2.4	0.3	19.5	2.0	3.0	0.1	14.3	23.4	2.0	
942	2.6	0.3	20.5	2.0	3.1	0.1	14.4	23.5	2.0	
944	2.7	0.3	21.7	2.2	3.3	0.1	14.5	23.7	2.0	
947	2.7	0.3	22.0	2.1	3.3	0.1	14.5	23.6	2.0	
952	2.9	0.3	23.0	2.2	3.4	0.1	14.6	23.8	2.0	
953	2.9	0.3	23.0	2.2	3.4	0.1	14.6	23.8	2.0	

*Advisory reporting standard for PM_{2.5} concentrations (refer to Section 4.3).

DD = dust deposition.

Table 7-2: Modelling predictions for Year 13 (2018) of the Modification (mine-owned receptors)

Receptor ID	PM _{2.5} (µg/m³)		PM ₁₀ (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM ₁₀ (µg/m³)	TSP (µg/m³)	DD (g/m²/month)	
	WCM incorporating the Modification impact						Cumulative impact			
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average	
	Advisory*		Air quality impact criteria							
	25	8	50	-	-	2	30	90	4	
1_18	2.1	0.3	15.3	2.2	3.2	0.1	15.0	24.3	2.0	
1_19	2.3	0.3	17.2	2.4	3.6	0.1	15.2	24.6	2.0	
1_25	3.1	0.4	22.7	3.1	4.7	0.1	15.7	25.4	2.1	
1_26	3.4	0.4	24.9	3.1	4.6	0.1	15.8	25.5	2.0	
1_28C	2.6	0.4	20.4	3.0	4.5	0.1	15.5	25.1	2.1	
1_30	2.1	0.3	16.3	2.3	3.5	0.1	14.8	24.1	2.0	
1_31	3.1	0.6	23.1	4.3	6.4	0.2	17.0	27.1	2.1	
32_12	3.0	0.3	22.5	1.8	2.5	0.0	97.9	157.5	3.8	
32_13	3.0	0.3	22.5	1.9	2.6	0.0	124.0	200.5	4.2	



Receptor ID	PM _{2.5} (µg/m³)		PM ₁₀ (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM ₁₀ (µg/m³)	TSP (µg/m³)	DD (g/m²/month)	
	WCM incorporating the Modification impact						Cumulative impact			
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average	
	Advisory*		Air quality impact criteria							
	25	8	50	-	-	2	30	90	4	
32_14	3.3	0.3	23.7	2.1	2.9	0.0	83.4	138.3	3.6	
32_29A	1.3	0.2	9.1	1.2	1.7	0.1	14.2	23.1	2.0	
32_29B	1.0	0.1	7.5	0.9	1.3	0.0	13.7	22.4	2.0	
32_48A	0.7	0.1	5.3	0.4	0.5	0.0	12.9	21.2	1.9	
32_48B	0.8	0.1	6.0	0.5	0.6	0.0	13.0	21.3	1.9	
32_32C	6.9	1.1	53.3	7.8	11.4	0.1	47.4	77.8	2.9	
32_33A	1.7	0.4	13.4	2.9	4.4	0.2	17.8	28.7	2.2	
32_33B_5	1.7	0.4	13.3	2.9	4.4	0.2	18.0	29.0	2.2	
1_45	3.2	0.7	24.6	5.0	7.5	0.1	18.3	29.2	2.1	
1_49	3.5	0.5	24.6	3.2	4.2	0.1	15.8	24.8	2.0	
1_52A	3.4	0.8	26.8	5.7	8.3	0.2	18.2	29.0	2.1	
1_53	3.3	0.8	24.6	5.5	7.9	0.2	18.1	28.7	2.1	
1_55	3.5	0.8	24.3	6.0	8.8	0.2	18.7	29.6	2.2	
1_58	3.6	0.9	28.7	6.2	9.1	0.3	18.8	29.8	2.2	
1_83	2.2	0.3	16.2	2.2	3.3	0.1	14.7	23.9	2.0	
1_100B	0.9	0.1	7.0	0.6	0.9	0.0	12.8	21.0	1.9	
1_127	2.7	0.3	20.2	2.3	3.5	0.1	14.9	24.2	2.0	
1_131	2.1	0.3	16.5	2.2	3.3	0.1	14.6	23.8	2.0	
1_133	2.3	0.3	17.4	2.2	3.3	0.1	14.6	23.7	2.0	
1_136	2.2	0.3	15.8	1.8	2.8	0.1	14.2	23.2	2.0	
1_140	2.3	0.2	17.2	1.5	2.3	0.1	13.8	22.6	2.0	
1_142	2.3	0.2	16.7	1.7	2.5	0.1	14.0	22.9	2.0	
1_143	2.2	0.3	16.9	2.1	3.1	0.1	14.5	23.6	2.0	
1_145	2.1	0.3	15.9	1.8	2.8	0.1	14.2	23.2	2.0	
1_151	1.6	0.1	11.2	0.5	0.6	0.0	12.9	21.1	1.9	
1_152	2.1	0.2	15.4	1.8	2.7	0.1	14.1	23.1	2.0	
1_154	0.6	0.0	3.7	0.3	0.3	0.0	12.4	20.4	1.9	
1_155	0.6	0.0	3.6	0.2	0.3	0.0	12.4	20.3	1.9	
1_156	0.6	0.0	3.8	0.3	0.4	0.0	12.4	20.3	1.9	
1_158	1.0	0.1	7.7	0.5	0.7	0.0	12.7	20.8	1.9	
1_159	0.7	0.1	4.9	0.4	0.6	0.0	12.5	20.6	1.9	
1_162	1.0	0.1	7.8	0.7	1.0	0.0	13.0	21.4	1.9	
1_163	1.0	0.1	7.0	0.6	0.9	0.0	12.9	21.1	1.9	
1_164	9.8	1.7	67.5	12.2	16.0	0.2	24.9	36.8	2.2	
1_905	2.2	0.3	17.1	2.0	3.1	0.1	14.4	23.4	2.0	
1_907	2.2	0.3	17.1	2.0	3.0	0.1	14.3	23.4	2.0	
1_910	2.1	0.3	16.4	1.9	2.9	0.1	14.3	23.2	2.0	
1_912	2.1	0.3	16.6	1.9	2.9	0.1	14.2	23.2	2.0	
1_913	2.1	0.3	16.3	1.9	2.9	0.1	14.2	23.2	2.0	
1_915	2.2	0.3	18.0	2.0	3.1	0.1	14.4	23.4	2.0	
1_916	2.2	0.3	17.8	2.0	3.0	0.1	14.3	23.3	2.0	
1_917	2.2	0.3	17.7	1.9	2.9	0.1	14.3	23.3	2.0	
1_920	2.2	0.3	17.9	1.9	2.9	0.1	14.3	23.3	2.0	
1_923	2.3	0.3	18.7	2.0	3.1	0.1	14.4	23.4	2.0	
1_926	2.3	0.3	18.6	2.0	3.0	0.1	14.3	23.3	2.0	



Receptor ID	PM _{2.5} (µg/m³)		PM ₁₀ (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM ₁₀ (µg/m³)	TSP (µg/m³)	DD (g/m²/month)	
	WCM incorporating the Modification impact						Cumulative impact			
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average	
	Advisory*		Air quality impact criteria							
	25	8	50	-	-	2	30	90	4	
1_927	2.3	0.3	18.5	1.9	2.9	0.1	14.3	23.3	2.0	
1_929	2.4	0.3	19.1	2.0	3.1	0.1	14.4	23.5	2.0	
1_931	2.4	0.3	19.3	2.1	3.2	0.1	14.5	23.6	2.0	
1_934	2.5	0.3	19.8	2.1	3.2	0.1	14.4	23.5	2.0	
1_937	2.5	0.3	20.1	2.1	3.2	0.1	14.4	23.5	2.0	
1_938	2.6	0.3	20.5	2.1	3.3	0.1	14.5	23.6	2.0	
1_939	2.6	0.3	20.8	2.2	3.3	0.1	14.5	23.7	2.0	
1_941	2.6	0.3	20.9	2.1	3.2	0.1	14.5	23.6	2.0	
1_946	2.7	0.3	21.3	2.0	3.1	0.1	14.4	23.5	2.0	
1_950	2.8	0.3	22.2	2.1	3.2	0.1	14.5	23.6	2.0	
1_956	2.9	0.3	22.9	2.3	3.5	0.1	14.7	23.9	2.0	
1_957	2.8	0.3	22.5	2.2	3.5	0.1	14.6	23.9	2.0	
1_W88A	1.7	0.1	12.3	0.6	0.8	0.0	13.1	21.3	1.9	
1_W88B	1.7	0.1	12.4	0.7	0.9	0.0	13.1	21.4	1.9	
1_WA	118.9	28.9	918.8	226.0	409.6	6.8	241.5	434.8	8.9	
1_WF	3.4	0.4	24.9	2.7	3.5	0.1	15.4	24.4	2.0	
1_WJ	2.7	0.3	18.9	1.9	2.5	0.0	14.5	23.2	2.0	
1_WK	2.0	0.2	13.9	1.1	1.5	0.0	13.6	22.1	1.9	
1_WR	1.9	0.2	12.0	1.3	1.9	0.1	13.6	22.2	2.0	
1_WT	1.1	0.1	9.2	0.7	1.1	0.0	13.0	21.2	1.9	

*Advisory reporting standard for PM_{2.5} concentrations (refer to **Section 4.3**).

7.1.1 Predicted maximum 24-hour and annual average PM_{2.5} concentrations

Figure E-1 and **Figure E-2** show the predicted maximum 24-hour average and annual average PM_{2.5} concentrations for Year 13 (2018) due to emissions from the WCM incorporating the Modification.

The results in **Table 7-1** indicate that all privately-owned receptors are predicted to experience maximum 24-hour average and annual average PM_{2.5} concentrations below the advisory reporting standards of 25µg/m³ and 8µg/m³, respectively in Year 13 (2018).

The results in **Table 7-2** indicate that one mine-owned receptor, Receptor 1_WA, is predicted to experience levels above the maximum 24-hour average and annual average PM_{2.5} advisory standard in Year 13 (2018). This receptor is located in close proximity to significant mining activity.

7.1.2 Predicted maximum 24-hour average PM₁₀ concentrations

Figure E-3 shows the predicted maximum 24-hour average PM₁₀ concentrations for Year 13 (2018) due to emissions from the WCM incorporating the Modification.



The results in **Table 7-1** indicate that all privately-owned receptors are predicted to experience maximum 24-hour average PM₁₀ concentrations below the NSW EPA impact assessment criteria of 50µg/m³ in Year 13 (2018).

The results in **Table 7-2** indicate that three mine-owned receptors, Receptor 32_32C, 1_164 and 1_WA, are predicted to experience maximum 24-hour average PM₁₀ concentrations above the NSW EPA impact assessment criteria of 50µg/m³ in Year 13 (2018).

7.1.3 Predicted annual average PM₁₀ concentrations

Figure E-4 shows the predicted annual average PM₁₀ concentrations for Year 13 (2018) due to emissions from the WCM incorporating the Modification. **Figure E-5** shows the predicted cumulative impact from the WCM incorporating the Modification and other sources.

The results in **Table 7-1** indicate that all privately-owned receptors are predicted to experience annual average PM₁₀ concentrations below the NSW EPA impact assessment criteria of 30µg/m³ in Year 13 (2018), inclusive of the contribution from estimated background levels.

The results in **Table 7-2** indicate that five mine-owned receptors, Receptor 32_12, 32_13, 32_14, 32_32C and 1_WA, are predicted to experience annual average PM₁₀ concentrations above the NSW EPA impact assessment criteria of 30µg/m³ in Year 13 (2018), inclusive of the contribution from estimated background levels.

7.1.4 Predicted annual average TSP concentrations

Figure E-6 shows the predicted annual average TSP concentrations for Year 13 (2018) due to emissions from the WCM incorporating the Modification. **Figure E-7** shows the predicted cumulative impact from the WCM incorporating the Modification and other sources.

The results in **Table 7-1** indicate that all privately-owned receptors are predicted to experience annual average TSP concentrations below the NSW EPA impact assessment criteria of 90µg/m³ in Year 13 (2018), inclusive of the contribution from estimated background levels.

The results in **Table 7-2** indicate that four mine-owned receptors, Receptor 32_12, 32_13, 32_14 and 1_WA, are predicted to experience annual average TSP concentrations above 90µg/m³ in Year 13 (2018).

7.1.5 Predicted annual average dust deposition (insoluble solids)

Figure E-8 shows the predicted annual average dust deposition levels for Year 13 (2018) due to emissions from the WCM incorporating the Modification. **Figure E-9** shows the predicted cumulative impact from the WCM incorporating the Modification and other sources.

The results in **Table 7-1** indicate that all privately-owned receptors are predicted to experience an annual average dust deposition level below the NSW EPA impact assessment criteria of 2g/m²/month in Year 13 (2018) due to the WCM incorporating the Modification. All privately owned receptors are also predicted to experience a cumulative annual average dust deposition level below 4g/m²/month in Year 13 (2018), inclusive of the contribution from estimated background levels.



The results in **Table 7-2** indicate that one mine-owned receptor, Receptor 1_WA, is predicted to experience an annual average dust deposition level above the NSW EPA impact assessment criteria of 2g/m²/month in Year 13 (2018) due to the WCM incorporating the Modification. Two mine-owned receptors, Receptors 32_13 and 1_WA, are predicted to experience cumulative annual average dust deposition levels above the NSW EPA impact assessment criteria of 4g/m²/month in Year 13 (2018).

7.2 Year 16 (2021)

Table 7-3 presents the model predictions at each of the privately-owned receptors, the values presented in **bold** indicate predicted values above the relevant criteria. **Table 7-4** presents the model predictions at each of the mine-owned receptors.

Figure E-10 to **Figure E-18** in **Appendix E** present isopleth diagrams of the predicted modelling results for each of the assessed pollutants in Year 16 (2021).

Table 7-3: Modelling predictions for Year 16 (2021) of the Modification (privately-owned receptors)

Receptor ID	PM _{2.5} (µg/m³)		PM ₁₀ (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM ₁₀ (µg/m³)	TSP (µg/m³)	DD (g/m²/month)	
	WCM incorporating the Modification impact						Cumulative impact			
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average	
	Advisory*		Air quality impact criteria							
	25	8	50	-	-	2	30	90	4	
69	0.4	0.0	3.3	0.3	0.4	0.0	12.7	20.9	1.9	
102	1.5	0.2	11.5	1.4	2.1	0.1	14.2	23.1	2.0	
129	2.6	0.3	20.5	2.5	3.9	0.1	14.9	24.4	2.1	
135	2.6	0.3	19.7	2.0	3.2	0.1	14.4	23.6	2.0	
137	2.4	0.2	17.9	1.6	2.6	0.1	14.0	22.9	2.0	
150A	1.9	0.2	13.3	1.4	2.1	0.1	13.7	22.4	2.0	
153	0.6	0.0	3.6	0.3	0.4	0.0	12.4	20.4	1.9	
157	0.2	0.0	1.2	0.1	0.1	0.0	12.1	20.0	1.9	
160A	0.7	0.1	5.7	0.6	0.9	0.0	13.0	21.2	1.9	
160B	0.8	0.1	6.0	0.6	0.9	0.0	13.0	21.3	1.9	
900	2.0	0.2	15.4	1.7	2.6	0.1	14.0	23.0	2.0	
901	2.6	0.3	20.8	1.9	3.0	0.1	14.3	23.4	2.0	
903	2.1	0.2	15.4	1.6	2.5	0.1	14.0	22.8	2.0	
908	2.0	0.2	14.7	1.6	2.4	0.1	13.9	22.8	2.0	
914	1.9	0.2	14.2	1.5	2.4	0.1	13.9	22.7	2.0	
921	1.9	0.2	14.7	1.6	2.5	0.1	14.0	22.8	2.0	
933	1.9	0.2	15.1	1.6	2.5	0.1	14.0	22.9	2.0	
935	2.0	0.2	16.3	1.7	2.6	0.1	14.0	22.9	2.0	
942	2.3	0.2	18.3	1.7	2.7	0.1	14.1	23.0	2.0	
944	2.5	0.3	20.1	1.9	2.9	0.1	14.2	23.3	2.0	
947	2.6	0.3	20.9	1.9	2.9	0.1	14.2	23.3	2.0	
952	2.8	0.3	22.5	2.0	3.2	0.1	14.4	23.6	2.0	
953	2.8	0.3	22.6	2.1	3.3	0.1	14.4	23.6	2.0	

*Advisory reporting standard for PM_{2.5} concentrations (refer to **Section 4.3**).



Table 7-4: Modelling predictions for Year 16 (2021) of the Modification (mine-owned receptors)

Receptor ID	PM _{2.5} (µg/m³)		PM ₁₀ (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM ₁₀ (µg/m³)	TSP (µg/m³)	DD (g/m²/month)	
	WCM incorporating the Modification impact						Cumulative impact			
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average	
	Advisory*		Air quality impact criteria							
	25	8	50	-	-	2	30	90	4	
1_18	2.1	0.4	15.4	2.7	4.1	0.1	15.5	25.1	2.0	
1_19	2.3	0.4	17.0	3.0	4.6	0.1	15.9	25.7	2.0	
1_25	2.6	0.5	18.8	3.9	6.1	0.2	16.5	26.8	2.1	
1_26	2.7	0.5	19.1	3.9	6.0	0.2	16.6	26.9	2.1	
1_28C	3.0	0.4	24.0	3.2	5.1	0.2	15.7	25.7	2.1	
1_30	2.2	0.3	17.2	2.4	3.8	0.1	14.9	24.4	2.0	
1_31	3.3	0.8	24.9	5.7	8.9	0.3	18.3	29.7	2.2	
32_12	1.2	0.1	9.1	0.6	0.8	0.0	95.5	153.7	3.7	
32_13	1.2	0.1	9.2	0.6	0.8	0.0	122.2	197.6	4.1	
32_14	1.4	0.1	10.3	0.6	0.9	0.0	82.0	135.8	3.5	
32_29A	0.8	0.1	5.4	0.7	1.0	0.0	13.6	22.3	2.0	
32_29B	0.6	0.1	4.4	0.6	0.8	0.0	13.3	21.7	1.9	
32_48A	0.4	0.0	2.7	0.2	0.3	0.0	12.7	20.8	1.9	
32_48B	0.4	0.0	3.0	0.3	0.4	0.0	12.8	21.0	1.9	
32_32C	1.7	0.2	13.1	1.4	2.0	0.0	68.2	118.1	3.5	
32_33A	0.9	0.2	6.9	1.4	2.2	0.1	16.0	26.0	2.1	
32_33B_5	0.9	0.2	6.9	1.4	2.2	0.1	16.1	26.2	2.1	
1_45	7.3	1.8	58.2	13.5	21.2	0.3	26.8	43.0	2.3	
1_49	2.0	0.3	12.9	1.9	2.4	0.0	14.4	23.0	2.0	
1_52A	5.0	1.0	36.9	7.7	12.3	0.4	20.3	33.0	2.3	
1_53	4.5	1.1	33.1	8.0	12.6	0.4	20.6	33.4	2.3	
1_55	4.7	1.2	34.7	9.3	15.0	0.5	22.0	35.7	2.5	
1_58	5.7	1.2	42.6	9.0	14.6	0.5	21.6	35.3	2.5	
1_83	2.0	0.3	15.0	2.4	3.7	0.1	14.9	24.3	2.0	
1_100B	0.8	0.1	5.5	0.5	0.7	0.0	12.7	20.8	1.9	
1_127	2.2	0.4	16.4	2.7	4.1	0.1	15.3	24.9	2.0	
1_131	2.2	0.3	17.6	2.2	3.5	0.1	14.7	24.0	2.0	
1_133	2.4	0.3	19.1	2.2	3.4	0.1	14.6	23.8	2.0	
1_136	2.3	0.2	17.2	1.8	2.8	0.1	14.2	23.2	2.0	
1_140	1.9	0.2	15.5	1.4	2.1	0.1	13.7	22.4	2.0	
1_142	2.3	0.2	17.6	1.6	2.5	0.1	13.9	22.8	2.0	
1_143	2.3	0.3	18.3	2.0	3.2	0.1	14.4	23.6	2.0	
1_145	2.2	0.3	16.9	1.8	2.8	0.1	14.2	23.3	2.0	
1_151	0.6	0.0	4.3	0.3	0.3	0.0	12.7	20.8	1.9	
1_152	2.2	0.2	16.2	1.7	2.7	0.1	14.1	23.1	2.0	
1_154	0.5	0.0	2.8	0.2	0.2	0.0	12.3	20.2	1.9	
1_155	0.5	0.0	2.7	0.1	0.2	0.0	12.3	20.2	1.9	
1_156	0.4	0.0	2.0	0.2	0.2	0.0	12.3	20.2	1.9	
1_158	0.7	0.1	5.1	0.4	0.6	0.0	12.5	20.6	1.9	
1_159	0.5	0.0	4.0	0.3	0.5	0.0	12.4	20.5	1.9	
1_162	0.8	0.1	6.4	0.6	0.9	0.0	12.9	21.2	1.9	
1_163	0.8	0.1	6.3	0.5	0.8	0.0	12.8	21.0	1.9	
1_164	5.6	1.0	38.9	6.7	8.6	0.1	19.4	29.5	2.0	
1_905	2.0	0.2	15.2	1.6	2.5	0.1	13.9	22.8	2.0	



Receptor ID	PM _{2.5} (µg/m³)		PM ₁₀ (µg/m³)		TSP (µg/m³)	DD (g/m²/month)	PM ₁₀ (µg/m³)	TSP (µg/m³)	DD (g/m²/month)	
	WCM incorporating the Modification impact						Cumulative impact			
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average	Annual average	Annual average	Annual average	
	Advisory*		Air quality impact criteria							
	25	8	50	-	-	2	30	90	4	
1_907	2.0	0.2	14.9	1.6	2.4	0.1	13.9	22.8	2.0	
1_910	1.9	0.2	14.4	1.5	2.3	0.1	13.8	22.6	2.0	
1_912	1.9	0.2	14.2	1.5	2.3	0.1	13.8	22.6	2.0	
1_913	1.9	0.2	14.1	1.5	2.3	0.1	13.8	22.6	2.0	
1_915	2.0	0.2	14.9	1.6	2.5	0.1	14.0	22.9	2.0	
1_916	1.9	0.2	14.3	1.6	2.4	0.1	13.9	22.8	2.0	
1_917	1.9	0.2	14.2	1.6	2.4	0.1	13.9	22.7	2.0	
1_920	1.9	0.2	14.4	1.6	2.4	0.1	13.9	22.7	2.0	
1_923	1.9	0.2	15.0	1.7	2.6	0.1	14.0	22.9	2.0	
1_926	1.9	0.2	14.8	1.6	2.5	0.1	13.9	22.8	2.0	
1_927	1.9	0.2	14.7	1.6	2.5	0.1	13.9	22.8	2.0	
1_929	2.0	0.2	15.3	1.7	2.6	0.1	14.0	23.0	2.0	
1_931	2.0	0.2	15.5	1.7	2.7	0.1	14.1	23.0	2.0	
1_934	2.1	0.2	16.5	1.7	2.7	0.1	14.1	23.0	2.0	
1_937	2.1	0.2	17.1	1.7	2.7	0.1	14.1	23.1	2.0	
1_938	2.2	0.2	17.5	1.8	2.8	0.1	14.2	23.2	2.0	
1_939	2.3	0.3	18.1	1.8	2.9	0.1	14.2	23.2	2.0	
1_941	2.3	0.2	18.5	1.8	2.8	0.1	14.2	23.2	2.0	
1_946	2.5	0.2	19.9	1.8	2.8	0.1	14.1	23.1	2.0	
1_950	2.7	0.3	21.3	1.9	3.0	0.1	14.2	23.3	2.0	
1_956	2.8	0.3	22.3	2.2	3.5	0.1	14.6	23.9	2.0	
1_957	2.7	0.3	21.8	2.1	3.4	0.1	14.5	23.8	2.0	
1_W88A	0.7	0.0	4.8	0.3	0.4	0.0	12.7	20.9	1.9	
1_W88B	0.8	0.1	5.3	0.4	0.5	0.0	12.8	21.0	1.9	
1_WA	4.7	1.0	35.4	7.0	10.9	0.2	23.0	36.8	2.2	
1_WF	1.4	0.2	9.3	1.3	1.6	0.0	14.0	22.6	2.0	
1_WJ	1.3	0.1	8.1	0.9	1.2	0.0	13.6	22.0	1.9	
1_WK	1.1	0.1	6.9	0.6	0.8	0.0	13.1	21.3	1.9	
1_WR	1.7	0.2	10.9	1.1	1.6	0.0	13.4	21.8	2.0	
1_WT	0.9	0.1	6.5	0.6	0.9	0.0	12.8	21.0	1.9	

*Advisory reporting standard for PM_{2.5} concentrations (refer to **Section 4.3**).

7.2.1 Predicted maximum 24-hour and annual average PM_{2.5} concentrations

Figure E-10 and **Figure E-11** show the predicted maximum 24-hour average and annual average PM_{2.5} concentrations for Year 16 (2021) due to emissions from the WCM incorporating the Modification.

The results in **Table 7-3** indicate that all privately-owned receptors are predicted to experience maximum 24-hour average and annual average PM_{2.5} concentrations below the advisory reporting standards of 25µg/m³ and 8µg/m³, respectively in Year 16 (2021).

The results in **Table 7-4** indicate that all mine-owned receptors are also predicted to experience levels below the maximum 24-hour average and annual average PM_{2.5} advisory standards in Year 16 (2021).



7.2.2 Predicted maximum 24-hour average PM₁₀ concentrations

Figure E-12 shows the predicted maximum 24-hour average PM₁₀ concentrations for Year 13 (2018) due to emissions from the WCM incorporating the Modification.

The results in **Table 7-3** indicate that all privately-owned receptors are predicted to experience maximum 24-hour average PM₁₀ concentrations below the NSW EPA impact assessment criteria of 50µg/m³ in Year 16 (2021).

The results in **Table 7-4** indicate that one mine-owned receptor, Receptor 1_45, is predicted to experience maximum 24-hour average PM₁₀ concentrations above the NSW EPA impact assessment criteria of 50µg/m³ in Year 16 (2021).

7.2.3 Predicted annual average PM₁₀ concentrations

Figure E-13 shows the predicted annual average PM₁₀ concentrations for Year 16 (2021) due to emissions from the WCM incorporating the Modification. **Figure E-14** shows the predicted cumulative impact from the WCM incorporating the Modification and other sources.

The results in **Table 7-3** indicate that all privately-owned receptors are predicted to experience annual average PM₁₀ concentrations below the NSW EPA impact assessment criteria of 30µg/m³ in Year 16 (2021), inclusive of the contribution from estimated background levels.

The results in **Table 7-4** indicate that four mine-owned receptors, Receptor 32_12, 32_13, 32_14 and 32_32C, are predicted to experience annual average PM₁₀ concentrations above the NSW EPA impact assessment criteria of 30µg/m³ in Year 16 (2021).

7.2.4 Predicted annual average TSP concentrations

Figure E-15 shows the predicted annual average TSP concentrations for Year 16 (2021) due to emissions from the WCM incorporating the Modification. **Figure E-16** shows the predicted cumulative impact from the WCM incorporating the Modification and other sources.

The results in **Table 7-3** indicate that all privately-owned receptors are predicted to experience annual average TSP concentrations below the NSW EPA impact assessment criteria of 90µg/m³ in Year 16 (2021), inclusive of the contribution from estimated background levels.

The results in **Table 7-4** indicate that four mine-owned receptors, Receptor 32_12, 32_13, 32_14 and 32_32C, are predicted to experience annual average TSP concentrations above the NSW EPA impact assessment criteria of 90µg/m³ in Year 16 (2021).

7.2.5 Predicted annual average dust deposition (insoluble solids)

Figure E-17 shows the predicted annual average dust deposition levels for Year 16 due to emissions from the WCM incorporating the Modification. **Figure E-18** shows the predicted cumulative impact from the WCM incorporating the Modification and other sources.



The results in **Table 7-3** indicate that all privately-owned receptors are predicted to experience an annual average dust deposition level below the NSW EPA impact assessment criteria of $2\text{g/m}^2/\text{month}$ in Year 16 (2021) due to the WCM incorporating the Modification. All privately owned receptors are also predicted to experience a cumulative annual average dust deposition level below the NSW EPA impact assessment criteria of $4\text{g/m}^2/\text{month}$ in Year 16 (2021), inclusive of the contribution from estimated background levels.

The results in **Table 7-4** indicate that all mine-owned receptors are predicted to experience annual average dust deposition levels below $2\text{g/m}^2/\text{month}$ in Year 16 (2021) due to the WCM incorporating the Modification. One mine-owned receptor, Receptor 32_13 is predicted to experience cumulative annual average dust deposition levels above the NSW EPA impact assessment criteria of $4\text{g/m}^2/\text{month}$ in Year 16 (2021).

7.3 Assessment of cumulative 24-hour average PM_{10} concentrations

The NSW EPA contemporaneous assessment method was applied to examine the potential maximum (cumulative) 24-hour average PM_{10} impacts arising from the WCM incorporating the Modification. This analysis has focused on the privately-owned sensitive receptor locations in Wollar that would be the most likely locations to experience maximum cumulative impacts due to the WCM incorporating the Modification.

An assessment of cumulative 24-hour average PM_{10} impacts was undertaken in accordance with methods outlined in Section 11.2 of the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (NSW DEC, 2005)*. The "Level 1 assessment - Maximum impact" approach was applied to assess potential impacts at private receptors in Wollar.

This approach is highly conservative as it adds the maximum measured level of PM_{10} on any day with the maximum predicted levels due to the WCM incorporating the Modification. The conservative overestimation arises in this case for two reasons. Firstly as it is unlikely that the day on which the maximum ambient level of dust was measured will in fact coincide with the day on which the maximum level due to the WCM incorporating the Modification is predicted to occur. Secondly, in this case the measured data already includes the contributed dust from the existing WCM, thus the emissions from the current mine are double counted.

The nearest PM_{10} ambient air quality monitor to these receptors is HV1 located in Wollar (see **Figure 5-3**). The levels measured at this monitor are considered to be the most representative of the actual dust levels at the receptors. The maximum 24-hour average PM_{10} concentration measured at this monitor in the same year as the weather data applied in the modelling (i.e. September 2011 to August 2012) was $21.7\mu\text{g/m}^3$.

Table 7-5 presents the results of the Level 1 assessment conducted for a sample of privately-owned residences.



Table 7-5: NSW EPA Level 1 assessment - Maximum impact

Receptor	Predicted concentrations ($\mu\text{g}/\text{m}^3$)		Impact assessment criteria ($\mu\text{g}/\text{m}^3$)
	Year 13 cumulative level (WCM incorporating the Modification level)	Year 16 cumulative level (WCM incorporating the Modification level)	
900	40.0 (18.3)	37.1 (15.4)	50
903	38.8 (17.1)	37.1 (15.4)	50
944	43.4 (21.7)	41.8 (20.1)	50
952	44.7 (23.0)	44.2 (22.5)	50
953	44.7 (23.0)	44.3 (22.6)	50

The results in **Table 7-5** indicate that, in accordance with the Level 1 assessment, the most potentially impacted privately-owned receptors are predicted to experience cumulative impacts below the 24-hour average impact assessment criteria $50\mu\text{g}/\text{m}^3$.

The HV1 monitor in Wollar records data every 6th day, hence there is the potential for higher concentrations on the in-between monitoring days, which may affect the results above. To investigate this, a comparison was made between data recorded by HV1 located at Wollar, and data recorded at TEOM 1 (which records data continuously) located between Wollar and the WCM.

For the same period as the weather data applied in the modelling (i.e. September 2011 to August 2012) the comparison shows 24-hour PM_{10} concentrations recorded by TEOM 1 are on average 37% higher than the concentrations recorded by HV1 at Wollar on the same day (which is expected as it is closer to the mine, dirt roads and farming activity).

The maximum recorded 24-hour PM_{10} concentration recorded by TEOM1 between September 2011 to August 2012 was $36.4\mu\text{g}/\text{m}^3$, which when scaled by 37% to represent the maximum potential level at Wollar equates to $26.6\mu\text{g}/\text{m}^3$.

When the maximum potential level at Wollar of $26.6\mu\text{g}/\text{m}^3$ is added to the maximum predicted incremental level due to the WCM incorporating the Modification (and double counting the existing mine contribution) (i.e. in accordance with the "Level 1 assessment - Maximum impact" approach described above), the cumulative 24-hour average levels would still remain below the criteria for receptors in Wollar.

Notwithstanding the above, it is noted that there is the potential for elevated background dust levels in the WCM region to occur, as evidenced by the monitoring data for 2006 to 2012 presented in **Section 5.3**.

During periods of elevated background dust levels (i.e. exceeding investigation trigger levels), the real-time air quality management response protocols described in **Section 5 4** would be implemented to target compliance with 24-hour average air quality criteria at privately-owned receptors, as per existing operations at the WCM. This may include, as required, the shutdown of equipment causing dust emissions.



7.4 Comparison with previous assessment

A comparison of the total calculated TSP emissions for each of the mine years with the nearest corresponding mine years modelled in the previous WCM modification (**PAEHolmes, 2010a**), indicates that emissions calculated to arise from the WCM incorporating the Modification would be greater (e.g. in years where there is an increase in annual waste rock movement) or similar to the currently approved operations, depending on the stage of the mine life.

The previous assessment used a simple Gaussian air dispersion model, whereas this assessment uses a more advanced model that considers the effects of terrain on wind flows, and also low speed or stalled wind conditions. Differences arise therefore as this assessment considers the increased reach of dust that can occur along a valley, especially during poor dispersion, low wind speed conditions, but also the reduced reach of mine dust caused by terrain that deflects some winds.

Overall, there are differences between this assessment and the previous, which are expected due to the proposed changes to the mine and also due to the ability of the adopted modelling approach for this assessment to more reliably consider the actual situation.

For Modification 3, no exceedances of the applicable annual dust deposition or suspended particulate matter (i.e. dust) air quality assessment criteria were predicted at the nearest private receivers (**PAEHolmes, 2010a**). Three private receivers were predicted to experience potential exceedances of the 24-hour average PM₁₀ criteria (**PAEHolmes, 2010a**). These three dwellings have since been acquired by WCPL and are no longer privately owned.

As described in **Sections 7.1 to 7.3**, no exceedances of the EPA criteria at privately-owned receptors are predicted due to dust emissions from the WCM incorporating the Modification.

7.5 In-pit waste emplacement

As described in **Section 6.3**, it is not considered that the development of the elevated in-pit waste emplacement in Pit 2 has the potential for air quality impacts greater than those predicted for the Year 13 (2018) and Year 16 (2021) scenarios (refer to **Sections 7.1 and 7.2**), as its development:

- ✦ would not increase the intensity of mining operations in comparison to those assessed for Year 13 (2018); and
- ✦ would be located further away from the closest sensitive receptors in Wollar (i.e. it would be located in Pit 2) in comparison to the mining operations in Year 16 (2021).

7.6 Additional site specific test work and pollution reduction program

Site specific test work was conducted at the WCM to determine haul roads silt levels as part of the requirement to meet PRP U1 (*Particulate Matter Control Best Practice Implementation - Wheel Generated Dust*) listed in EPL No. 12425.



The data became available after completion of the air quality modelling conducted for this assessment. The test work results showed that the silt content of the existing haul roads at the WCM is lower than was used in the emissions inventory calculations prepared for this assessment (**Section 6.3.2** and **Appendix D**).

This means that the potential impacts presented in **Sections 7.1** to **7.3** are likely to be conservative (i.e. if the lower silt content data from the further site specific testing had been used in the emissions calculations, the resulting dust emissions would have been lower than those used in this assessment.)

In addition, PRP U1 in EPL No. 12425 required WCPL to demonstrate that a haul road emission control efficiency of 80% is to be achieved and maintained on all existing haul roads. This assessment assumed a haul road control efficiency of 75%.

As described in **Sections 7.1** to **7.3**, no exceedances of EPA criteria at privately-owned receptors are predicted. Given this, and given that incorporating 80% control (as opposed to 75%) and the lower haul road silt contents recorded by the site specific testing would lower potential dust emissions in comparison to what has been assessed, their incorporation into the emissions inventories would not change the conclusions of this assessment (and would potentially result in slightly lower predicted dust impacts at receptor locations).



8 DUST MITIGATION AND MANAGEMENT

The existing operations at WCM implement dust mitigation measures, including real-time controls, in accordance with the existing AQGGMP (see **Section 5.4**).

In addition to the AQGGMP, a recent PRP implemented at the WCM identified best practice dust mitigation measures for the WCM. These best practice dust mitigation measures were incorporated in the emission estimates for this assessment, where relevant. This assessment has applied conservative assumptions in the estimation of dust levels (**Section 6.4**).

The monitoring data presented in **Section 5.3** indicates that WCM has been generally in compliance with EPA air quality criteria. Where exceedances have occurred, these have typically been associated with regional dust events and not WCM activities.

Relative to the existing operations, the proposed modifications to the mining activities at the WCM are unlikely to lead to any significant change in dust levels at receptors.

This is supported by the air quality assessment for the Modification which predicts that there would be no exceedances of EPA air quality criteria at any privately-owned receptor due to the WCM incorporating the Modification and background sources (including other mining operations).

Given this, and given the demonstrated performance of existing operations, it is considered that the continued implementation of the AQGGMP management measures, including real-time controls with implementation of the best practice mitigation measures identified in the PRP, would be suitable to manage potential air quality impacts from the WCM incorporating the Modification.



9 GREENHOUSE GAS ASSESSMENT

This assessment aims to estimate the predicted emissions of GHGs emitted to the atmosphere due to the WCM incorporating the Modification.

9.1 Greenhouse Gas Inventories

The National Greenhouse Accounts (NGA) Factors document published by the Department of Climate Change and Energy Efficiency (DCCEE) defines three scopes (Scope 1, 2 and 3) for different emission categories based on whether the emissions generated are from "direct" or "indirect" sources.

Scope 1 emissions encompass the direct sources from the WCM incorporating the Modification defined as:

...from sources within the boundary of an organisation and as a result of that organisation's activities (DCCEE, 2012a).

Scope 2 and 3 emissions occur due to the indirect sources from the WCM incorporating the Modification as:

...emissions 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 (DCCEE, 2012a).

Scope 3 emissions can often result in a significant component of the total emissions inventory. As defined above, these emissions are not directly controlled by WCPL and as such are difficult to accurately quantify which can result in an overestimation of these emissions.

9.1.1 Emission Sources

Scope 1 and 2 emission sources identified from the operation of the WCM incorporating the Modification are the on-site combustion of liquid fuels, the use of petroleum based greases and oils, the release of methane from the coal seams as fugitive emissions and the on-site consumption of electricity. Scope 3 emissions have been identified as resulting from the purchase of fuels and electricity for use on-site, the emissions generated during the transport of the product to its final destination and the final use of the product (i.e. coal combustion).

Estimated quantities of materials that have the potential to emit GHG emissions associated with Scope 1 and 2 emissions for the WCM incorporating the Modification have been summarised in **Table 9-1**. These estimates are based on information provided by WCPL and provide a reasonable approximation for the purpose of this assessment.

Scope 3 emissions generated from the transport and final use of the coal may have the potential to vary in the future depending on the market situation at the time. To provide a reasonable estimate of the emissions generated, assumptions have been made that include the transport mode of rail and ship and emissions from the final use of the coal have also been estimated based on the energy content factor of the various types of coal.



Table 9-1: Summary of quantities of materials used for the Modification

Year	ROM Coal (tonnes)	Diesel (kL)	Electricity (MWh)	Explosives (tonnes)	Petroleum based grease/oil (kL)
9	14,900,000	40,927	24,439	10,620	2,565
10	15,000,000	38,740	24,600	9,754	2,582
11	15,000,000	37,604	24,600	9,322	2,582
12	15,000,000	36,72	24,600	8,989	2,582
13	14,700,000	41,976	24,118	11,086	2,531
14	7,800,000	22,912	13,022	6,126	1,343
15	7,300,000	21,600	12,218	5,793	1,257
16	7,600,000	22,912	12,700	6,192	1,308
17	8,000,000	25,361	13,343	6,991	1,377
18	7,200,000	24,399	12,057	6,891	1,240
19	7,100,000	23,874	11,896	6,725	1,222
20	4,700,000	12,943	8,037	3,362	809
21	3,200,000	6,909	5,624	1,565	551

kL = kilolitre

MWh = megawatt hours

9.1.2 Emission Factors

To quantify the amount of carbon dioxide equivalent (CO₂-e) material generated from the WCM incorporating the Modification, emission factors obtained from the NGA Factors (**DCCEE, 2012a**) are required and are summarised in **Table 9-2**.

Table 9-2: Summary of emission factors

Type	Energy content factor	Emission factor			Units	Scope	Source
		CO ₂	CH ₄	N ₂ O			
Diesel	38.6	69.1	0.2	0.5	kg CO ₂ -e/GJ	1	Table 4 (DCCEE, 2012a)
		5.3				3	Table 39 (DCCEE, 2012a)
Petrol	34.2	66.7	0.6	2.3	kg CO ₂ -e/GJ	1	Table 4 (DCCEE, 2012a)
		5.3				3	Table 39 (DCCEE, 2012a)
Grease/oil	38.8	27.9			kg CO ₂ -e/GJ	1	Table 3 (DCCEE, 2012a)
		5.3				3	Table 39 (DCCEE, 2012a)
Electricity		0.88			kg CO ₂ -e/kWh	2	Table 5 (DCCEE, 2012a)
Explosives*		0.17			t CO ₂ -e/GJ	1	Table 4 (DCC, 2008)
Fugitive emissions		1.2			kg CO ₂ -e/t ROM	1	PAEHolmes, 2010a
Rail		0.014			kg CO ₂ -e/t-km	3	QR Network Access, 2002
Ship		3.657			t CO ₂ -e/Mt-km	3	PAEHolmes, 2010b
Thermal coal	29	88.2	0.03	0.2	kg CO ₂ -e/GJ	3	Table 1 (DCCEE, 2012a)

*The emission factor for explosives has been taken from the NGA factors published in February 2008 (**DCC, 2008**) as the current NGA factors document does not include a factor for explosives. Explosives in this assessment are assumed as ammonium nitrate fuel oil.

CO₂ = Carbon Dioxide, CH₄ = Methane, N₂O = Nitrous Oxide, t = tonne, GJ = Gigajoule, M = million



The emission factor based on the release of methane from the coal seams at the WCM is taken to be 1.2 kg of CO₂-e per tonne of ROM. This emission factor has been calculated based on actual testing of methane gas from coal seams at the WCM (**PAEHolmes, 2010a**). This emission factor is lower than the default factor provided in the NGA Factors document and compares with other mining operations in the area.

Emissions associated with the transport of coal to customers will occur via rail and shipping. The emission factor associated with the rail transport activity is taken to be 0.014 kg CO₂-e/tonne-km (**QR Network Access, 2002**). Product coal is transported to the Port of Newcastle by rail and then transferred before being shipped to its final destination. The approximate rail distance is taken to be 500km (return distance) to the Port of Newcastle. The emission factor associated with the shipping transport activity is taken to be 3.657 tonnes of CO₂-e/Mt-km (**PAEHolmes, 2010b**) and assumes an approximate return distance of 16,000km based predominately on destinations in the Asian market.

The emissions generated from the end use of coal produced by the WCM incorporating the Modification have assumed that all product coal is consumed as thermal coal in power stations. As it is difficult to estimate emissions from power stations in other countries, this assessment has assumed the emissions generated would be equivalent to those generated from a power station in NSW. The emission factor provided in the NGA Factors document used is 88.43kg CO₂-e/GJ and energy content factor 29GJ/tonne assuming the type of coal is anthracite (**DCCEE, 2012a**).

9.2 Summary of Emissions

Table 9-3 summarises the estimated annual CO₂-e emissions generated from the WCM incorporating the Modification.



Table 9-3: Summary of CO₂-e emissions for the Modification (t CO₂-e)

Year	Fugitive emissions	Diesel		Grease/oil		Electricity		Explosives	Transport via rail	Transport via ship	Final use of product
	Scope 1	Scope 1	Scope 3	Scope 1	Scope 3	Scope 2	Scope 3	Scope 1	Scope 3	Scope 3	Scope 3
9	17,880	110,426	373	2,777	527	21,507	4,399	1,805	78225	653,872	26,681,542
10	18,000	104,527	7,926	2,795	531	21,648	4,428	1,658	78750	658,260	26,860,613
11	18,000	101,460	7,693	2,795	531	21,648	4,428	1,585	78750	658,260	26,860,613
12	18,000	99,100	7,514	2,795	531	21,648	4,428	1,528	78750	658,260	26,860,613
13	17,640	113,257	8,587	2,740	520	21,224	4,341	1,885	77175	645,095	26,323,400
14	9,360	61,820	4,687	1,454	276	11,459	2,344	1,041	40950	342,295	13,967,519
15	8,760	58,280	4,419	1,360	258	10,752	2,199	985	38325	320,353	13,072,165
16	9,120	61,820	4,687	1,416	269	11,176	2,286	1,053	39900	333,518	13,609,377
17	9,600	68,426	5,188	1,491	283	11,742	2,402	1,189	42000	351,072	14,325,660
18	8,640	65,831	4,991	1,342	255	10,610	2,170	1,172	37800	315,965	12,893,094
19	8,520	64,415	4,884	1,323	251	10,469	2,141	1,143	37275	311,576	12,714,023
20	5,640	34,921	2,648	876	166	7,072	1,447	572	24675	206,255	8,416,325
21	3,840	18,640	1,413	596	113	4,949	1,012	266	16800	140,429	5,730,264
Total	153,000	962,922	65,010	23,761	4,514	185,904	38,026	15,881	669,375	5,595,210	228,315,206

Note: Totals may vary slightly due to rounding.



9.3 Contribution of greenhouse gas emissions

Table 9-4 summarises the emissions associated with the WCM incorporating the Modification based on Scopes 1, 2 and 3.

Table 9-4: Summary of CO₂-e emissions per scope (t CO₂-e)

Year	Scope 1	Scope 2	Scope 3
9	132,888	21,507	27,426,938
10	126,980	21,648	27,610,507
11	123,840	21,648	27,610,274
12	121,423	21,648	27,610,096
13	135,522	21,224	27,059,119
14	73,675	11,459	14,358,071
15	69,385	10,752	13,437,720
16	73,409	11,176	13,990,038
17	80,706	11,742	14,726,605
18	76,985	10,610	13,254,275
19	75,401	10,469	13,070,151
20	42,009	7,072	8,651,516
21	23,342	4,949	5,890,032
Total	1,155,565	185,904	234,695,342

Note: Totals may vary slightly due to rounding.

The estimated annual greenhouse emissions for Australia for the period October 2011 to September 2012 were 546.1 Mt CO₂-e (**DCCEE, 2012b**). In comparison, the estimated annual average greenhouse emissions for the life of the WCM incorporating the Modification is 0.09 Mt CO₂-e (Scope 1). Therefore, the annual contribution of greenhouse emissions from the WCM incorporating the Modification in comparison to the Australian greenhouse emissions for the period October 2011 to September 2012 is estimated to be approximately 0.02%.

The estimated GHG emissions generated in all three scopes defined are based on approximated qualities of materials and where applicable generic emission factors and hence can be considered conservative.

9.4 Comparison with Previous Assessment

Annual average Scope 1 emissions for the WCM incorporating the Modification are estimated to be approximately 88,890 t CO₂-e. By comparison, annual average Scope 1 emissions estimated by **PAEHolmes (2010a)** for Modification 3 (for Years 9 to 21) were approximately 69,848 t CO₂-e.

The comparative increase in annual average Scope 1 emissions estimated for this Modification is attributable to the increase in waste rock handling associated with the Modification, as well as improved material (e.g. diesel) usage data for the WCM.



10 SUMMARY AND CONCLUSIONS

This study has examined potential air quality (i.e. dust) impacts that may arise from the proposed Modification. The Modification seeks to extend the existing approved open cut pits in several small areas in order to access additional coal reserves. This would mean that some additional quantity of material would be handled in some years, and in some cases mining activity would be slightly closer to receptors.

Whilst the changes proposed are relatively small, there is nevertheless scope for some small increase in impact to arise. Hence it was considered appropriate to conduct air dispersion modelling to assess potential impacts using contemporary methods and to assess whether compliance with EPA criteria would be achieved if the Modification proceeds.

The assessment applies advanced air dispersion modelling that is able to account for the varying meteorological conditions that arise due to the interaction of the prevailing winds with the terrain in the area.

The assessment of dust impacts incorporates the predicted effects of the dust emissions from the WCM incorporating the Modification, and finds that all privately-owned receptors would not be subjected to adverse impacts above any EPA criteria.

The existing air quality management measures and monitoring network at WCM are considered appropriate for the Modification and would continue to be implemented for the proposed Modification.

The contribution of the Scope 1 GHG emissions from the WCM incorporating the Modification to Australia's GHG emissions inventory would be negligible.



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Appendix A

Sensitive Receptors



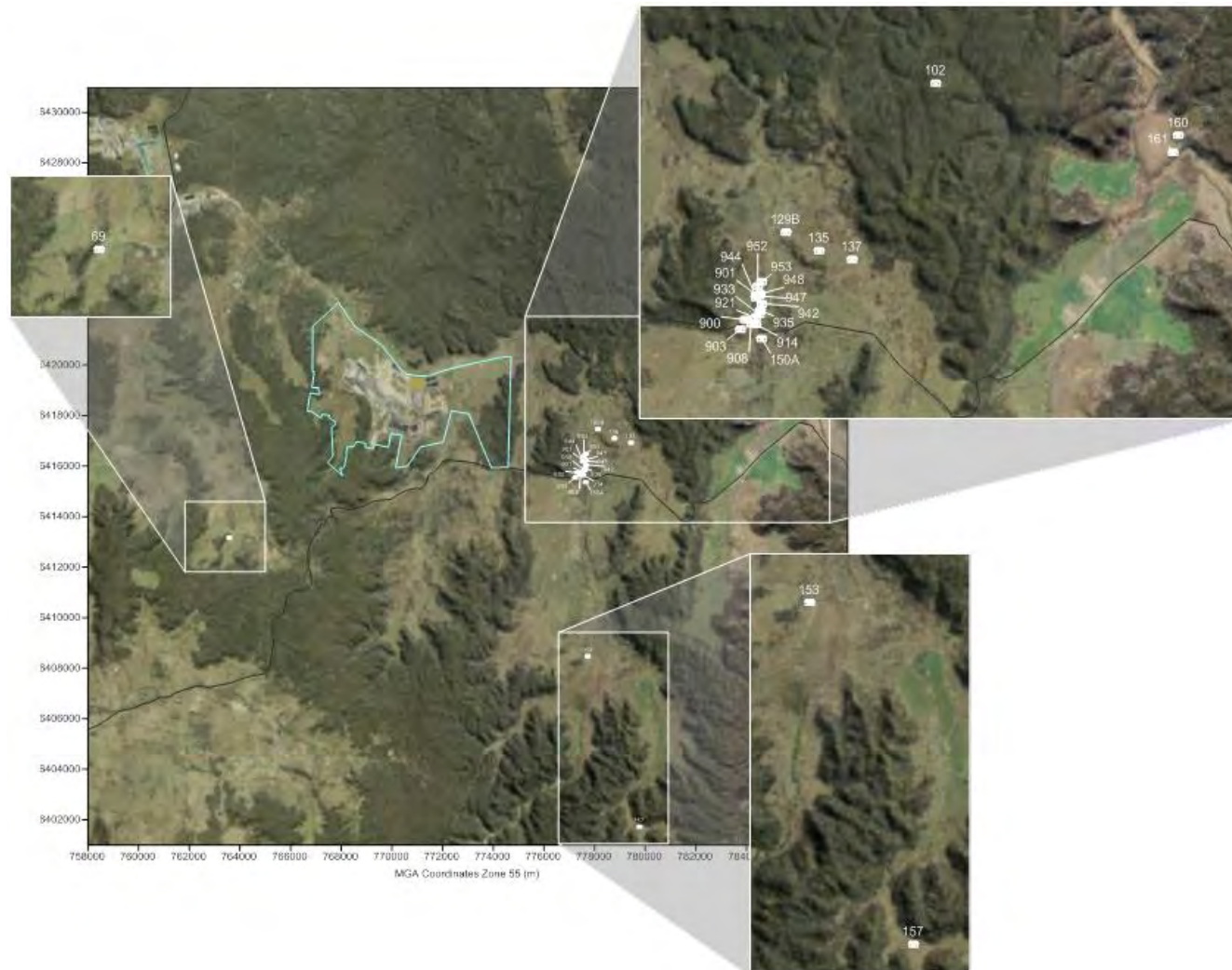


Figure A-1: Privately owned receptors





Table A-1: List of sensitive receptors assessed in the study

ID	Easting (m)	Northing (m)	Ownership	ID	Easting (m)	Northing (m)	Ownership
900	777326.4	6415738.375	Private	1_907	777358.7	6415587	Peabody Energy
150A	777653.5	6415364.8	Private	908	777444.2	6415660	Private
1_917	777583.56	6415700.4	Peabody Energy	1_910	777418.2	6415491	Peabody Energy
935	777632.5167	6415922.014	Community	1_912	777486	6415527	Peabody Energy
1_25	777277.1523	6418726.408	Peabody Energy	1_913	777483.4	6415485	Peabody Energy
1_45	775463.17	6420779.87	Peabody Energy	914	777544.2	6415640	Private
1_49	772652.4	6414452.4	Peabody Energy	1_915	777410.3	6415720	Peabody Energy
1_53	775883.3886	6418355.982	Peabody Energy	1_916	777533.1	6415707	Peabody Energy
1_55	775575.9843	6418269.318	Peabody Energy	1_920	777608.2	6415735	Peabody Energy
1_58	775623.7182	6417748.295	Peabody Energy	921	777533.5	6415777	Private
69	763578.5	6413175.31	Private	1_923	777488.7	6415820	Peabody Energy
1_83	778607.57	6418242.596	Peabody Energy	1_926	777626.2	6415817	Peabody Energy
102	781086.9881	6420412.054	Private	1_927	777674.5	6415806	Peabody Energy
1_18	778908.105	6419925.622	Peabody Energy	1_929	777489.6	6415863	Peabody Energy
1_19	778508.5863	6419847.675	Peabody Energy	1_931	777422.5	6415880	Peabody Energy
1_26	777427.336	6419148.205	Peabody Energy	933	777610.9	6415840	Private
1_30	778368.858	6417985.526	Peabody Energy	1_934	777508.7	6415939	Peabody Energy
1_131	778785.918	6417847.321	Peabody Energy	1_937	777510.2	6415979	Peabody Energy
1_133	778761.112	6417492.39	Peabody Energy	1_938	777439.2	6416006	Peabody Energy
135	778787.2254	6417101.773	Private	1_939	777434.5	6416041	Peabody Energy
137	779441.087	6416928.983	Private	1_941	777517.2	6416064	Peabody Energy
1_142	779616.175	6416920.596	Peabody Energy	942	777658.2	6416052	Private
1_143	778923.522	6417411.939	Peabody Energy	1_946	777749.8	6416175	Peabody Energy
129	778134.088	6417466.32	Private	947	777627.9	6416245	Private
1_145	779348.181	6417463.526	Peabody Energy	952	777578.1	6416399	Private
1_136	779221.513	6417218.86	Peabody Energy	953	777659.8	6416492	Private
1_28C	777446.82	6417650.4	Peabody Energy	1_956	777684.2	6416665	Peabody Energy
1_31	776447.8	6418380	Peabody Energy	1_957	777758.8	6416664	Peabody Energy
32_12	763718.6	6426238.7	Moolarben	32_33A	759734.3	6420774	Moolarben
32_13	763859.18	6426157.7	Moolarben	1_151	770123.8	6410133	Peabody Energy
32_14	764861.2	6425875.65	Moolarben	1_152	779483.7	6417262	Peabody Energy
32_32C	766153.5834	6423779.226	Moolarben	1_154	777451.2	6405506	Peabody Energy
32_33B_5	759739.6	6420835.09	Moolarben	1_155	777506.8	6405187	Peabody Energy
1_52A	775932.23	6417837.7	Peabody Energy	1_156	780057.1	6405697	Peabody Energy
32_29B	762840.6	6415592.28	Moolarben	1_158	782692.6	6413867	Peabody Energy
32_29A	763745.75	6415947.25	Moolarben	1_159	783017.2	6412974	Peabody Energy
32_48A	765370.2	6411929.3	Moolarben	1_162	785864.5	6418687	Peabody Energy
32_48B	765679.75	6412291.9	Moolarben	1_163	786574.4	6418088	Peabody Energy
1_W88A	770375.6	6410813.8	Peabody Energy	153	777729.1	6408478	Private
1_W88B	770610.6	6411217.42	Peabody Energy	157	779778.3	6401722	Private
1_WA	768038.45	6420963.69	Peabody Energy	160A	785872	6419380	Private
1_WF	769652.0072	6414414.137	Peabody Energy	160B	785767.7	6419042	Private
1_WJ	770311.98	6413713.59	Peabody Energy	1_127	778549.3	6418884	Peabody Energy
1_WK	770889.96	6412538.44	Peabody Energy	1_140	779655.6	6416414	Peabody Energy
1_WR	777394.78	6414443.9	Peabody Energy	1_950	777695.7	6416304	Peabody Energy
1_WT	780517.2194	6414296.609	Peabody Energy	901	777546.9	6416227	Private
1_100B	781138.6	6413853.3	Peabody Energy	944	777543.5	6416175	Private
903	777235.1	6415546.6	Private	1_164	771950	6415993	Peabody Energy
1_905	777297.2209	6415568.87	Peabody Energy				



Appendix B

Monitoring data



Table B-1: TEOM monitoring data

Date	TEOM 1	TEOM 2	Date	TEOM 1	TEOM 2	Date	TEOM 1	TEOM 2
1/06/2009	12.4	ND	12/08/2010	4.9	ND	23/10/2011	24.3	30.7
2/06/2009	7.3	ND	13/08/2010	7.3	ND	24/10/2011	18.3	19.0
3/06/2009	5.1	ND	14/08/2010	6.0	ND	25/10/2011	18.3	21.4
4/06/2009	6.1	ND	15/08/2010	11.7	ND	26/10/2011	4.2	1.1
5/06/2009	1.2	ND	16/08/2010	7.3	ND	27/10/2011	8.7	6.8
6/06/2009	3.9	ND	17/08/2010	6.7	ND	28/10/2011	9.9	10.1
7/06/2009	7.3	ND	18/08/2010	14.3	ND	29/10/2011	12.4	14.9
8/06/2009	4.7	ND	19/08/2010	8.8	ND	30/10/2011	5.6	ND
9/06/2009	6.3	ND	20/08/2010	8.3	ND	31/10/2011	9.4	7.7
10/06/2009	5.8	ND	21/08/2010	10.4	ND	1/11/2011	13.4	8.6
11/06/2009	8.1	ND	22/08/2010	7.8	ND	2/11/2011	12.4	7.6
12/06/2009	6.5	ND	23/08/2010	5.7	ND	3/11/2011	12.6	9.4
13/06/2009	7.5	ND	24/08/2010	4.9	ND	4/11/2011	12.2	10.3
14/06/2009	8.1	ND	25/08/2010	10.2	ND	5/11/2011	13.3	14.8
15/06/2009	7.8	ND	26/08/2010	8.3	ND	6/11/2011	21.8	29.7
16/06/2009	10.1	ND	27/08/2010	8.0	ND	7/11/2011	22.9	16.1
17/06/2009	7.5	ND	28/08/2010	7.3	ND	8/11/2011	15.2	16.9
18/06/2009	6.9	ND	29/08/2010	8.5	ND	9/11/2011	19.3	4.4
19/06/2009	7.9	ND	30/08/2010	12.5	ND	10/11/2011	18.4	ND
20/06/2009	6.9	ND	31/08/2010	12.1	ND	11/11/2011	20.8	16.7
21/06/2009	5.9	ND	1/09/2010	15.6	ND	12/11/2011	17.1	13.0
22/06/2009	3.7	ND	2/09/2010	14.7	ND	13/11/2011	21.9	ND
23/06/2009	4.8	ND	3/09/2010	5.8	ND	14/11/2011	20.1	ND
24/06/2009	6.7	ND	4/09/2010	4.3	ND	15/11/2011	29.1	11.6
25/06/2009	7.7	ND	5/09/2010	6.0	ND	16/11/2011	10.1	23.5
26/06/2009	8.2	ND	6/09/2010	6.3	ND	17/11/2011	8.5	3.1
27/06/2009	5.3	ND	7/09/2010	7.9	ND	18/11/2011	20.8	18.3
28/06/2009	4.5	ND	8/09/2010	8.0	ND	19/11/2011	20.6	16.5
29/06/2009	4.6	ND	9/09/2010	9.7	ND	20/11/2011	23.5	22.0
30/06/2009	4.8	ND	10/09/2010	6.2	ND	21/11/2011	11.9	7.8
1/07/2009	53.7	ND	11/09/2010	8.0	ND	22/11/2011	11.8	8.2
2/07/2009	15.2	ND	12/09/2010	9.9	ND	23/11/2011	4.0	49.7
3/07/2009	7.6	ND	13/09/2010	11.1	ND	24/11/2011	6.8	ND
4/07/2009	5.9	ND	14/09/2010	8.7	ND	25/11/2011	4.5	20.7
5/07/2009	5.5	ND	15/09/2010	6.5	ND	26/11/2011	6.7	ND
6/07/2009	12.6	ND	16/09/2010	7.7	ND	27/11/2011	11.1	ND
7/07/2009	10.9	ND	17/09/2010	10.2	ND	28/11/2011	11.6	9.1
8/07/2009	8.0	ND	18/09/2010	15.8	ND	29/11/2011	15.3	12.6
9/07/2009	6.1	ND	19/09/2010	16.4	ND	30/11/2011	15.8	21.9
10/07/2009	6.1	ND	20/09/2010	18.2	ND	1/12/2011	10.7	ND
11/07/2009	6.1	ND	21/09/2010	19.2	ND	2/12/2011	11.5	ND
12/07/2009	9.1	ND	22/09/2010	17.2	ND	3/12/2011	9.5	ND
13/07/2009	7.1	ND	23/09/2010	21.6	ND	4/12/2011	16.1	ND
14/07/2009	5.9	ND	24/09/2010	15.0	ND	5/12/2011	9.6	ND
15/07/2009	4.4	ND	25/09/2010	16.5	ND	6/12/2011	9.2	ND
16/07/2009	4.2	ND	26/09/2010	13.5	ND	7/12/2011	8.9	ND
17/07/2009	6.2	ND	27/09/2010	14.8	ND	8/12/2011	6.4	ND
18/07/2009	4.9	ND	28/09/2010	14.6	ND	9/12/2011	9.2	4.2
19/07/2009	7.8	ND	29/09/2010	8.5	ND	10/12/2011	7.3	3.3
20/07/2009	7.6	ND	30/09/2010	11.0	ND	11/12/2011	8.5	8.4



Date	TEOM 1	TEOM 2	Date	TEOM 1	TEOM 2	Date	TEOM 1	TEOM 2
21/07/2009	13.4	ND	1/10/2010	19.5	ND	12/12/2011	5.7	17.7
22/07/2009	8.6	ND	2/10/2010	16.7	ND	13/12/2011	9.7	1.3
23/07/2009	7.9	ND	3/10/2010	4.6	ND	14/12/2011	13.1	ND
24/07/2009	5.8	ND	4/10/2010	5.3	ND	15/12/2011	16.1	5.4
25/07/2009	5.9	ND	5/10/2010	6.3	ND	16/12/2011	10.7	3.2
26/07/2009	8.5	ND	6/10/2010	6.0	ND	17/12/2011	12.2	5.9
27/07/2009	5.7	ND	7/10/2010	8.9	ND	18/12/2011	13.8	9.7
28/07/2009	5.9	ND	8/10/2010	15.2	ND	19/12/2011	14.3	12.5
29/07/2009	5.9	ND	9/10/2010	12.5	ND	20/12/2011	2.5	4.8
30/07/2009	5.9	ND	10/10/2010	12.1	ND	21/12/2011	16.5	11.2
31/07/2009	6.7	ND	11/10/2010	12.2	ND	22/12/2011	12.1	6.1
1/08/2009	5.7	ND	12/10/2010	11.0	ND	23/12/2011	9.6	4.2
2/08/2009	7.3	ND	13/10/2010	10.1	ND	24/12/2011	10.4	6.2
3/08/2009	8.3	ND	14/10/2010	11.2	ND	25/12/2011	12.1	6.8
4/08/2009	11.5	ND	15/10/2010	3.7	ND	26/12/2011	12.3	4.8
5/08/2009	ND	ND	16/10/2010	7.3	ND	27/12/2011	12.4	7.4
6/08/2009	11.0	ND	17/10/2010	7.7	ND	28/12/2011	16.7	18.9
7/08/2009	13.7	ND	18/10/2010	9.7	ND	29/12/2011	14.1	10.0
8/08/2009	12.4	ND	19/10/2010	9.1	ND	30/12/2011	16.3	11.2
9/08/2009	16.9	ND	20/10/2010	15.4	ND	31/12/2011	13.5	10.3
10/08/2009	7.5	ND	21/10/2010	12.4	ND	1/01/2012	12.6	18.5
11/08/2009	14.4	ND	22/10/2010	11.1	ND	2/01/2012	14.5	18.1
12/08/2009	16.3	ND	23/10/2010	11.3	ND	3/01/2012	16.5	25.1
13/08/2009	17.0	ND	24/10/2010	3.9	ND	4/01/2012	32.6	ND
14/08/2009	13.4	ND	25/10/2010	6.9	ND	5/01/2012	19.7	ND
15/08/2009	18.4	ND	26/10/2010	10.1	ND	6/01/2012	9.7	ND
16/08/2009	15.9	ND	27/10/2010	19.3	ND	7/01/2012	14.3	ND
17/08/2009	12.8	ND	28/10/2010	13.8	ND	8/01/2012	19.5	ND
18/08/2009	14.3	ND	29/10/2010	14.8	9.5	9/01/2012	10.8	ND
19/08/2009	21.2	ND	30/10/2010	14.7	12.6	10/01/2012	12.4	ND
20/08/2009	8.9	ND	31/10/2010	12.8	13.5	11/01/2012	19.4	ND
21/08/2009	17.1	ND	1/11/2010	7.2	4.7	12/01/2012	12.5	ND
22/08/2009	22.5	ND	2/11/2010	8.0	4.0	13/01/2012	14.0	4.4
23/08/2009	24.6	ND	3/11/2010	9.1	5.0	14/01/2012	15.0	17.0
24/08/2009	10.7	ND	4/11/2010	8.6	12.4	15/01/2012	8.9	3.0
25/08/2009	10.1	ND	5/11/2010	4.5	1.7	16/01/2012	8.6	3.8
26/08/2009	13.9	ND	6/11/2010	6.2	2.7	17/01/2012	12.9	9.8
27/08/2009	35.9	ND	7/11/2010	7.8	4.9	18/01/2012	3.4	ND
28/08/2009	16.8	ND	8/11/2010	9.9	36.7	19/01/2012	11.0	10.1
29/08/2009	17.7	ND	9/11/2010	9.4	5.3	20/01/2012	17.3	10.9
30/08/2009	11.0	ND	10/11/2010	10.4	9.0	21/01/2012	13.2	6.5
31/08/2009	10.8	ND	11/11/2010	5.9	4.8	22/01/2012	10.4	5.8
1/09/2009	8.4	ND	12/11/2010	6.3	7.0	23/01/2012	10.6	5.1
2/09/2009	17.3	ND	13/11/2010	12.2	14.1	24/01/2012	11.2	5.3
3/09/2009	16.5	ND	14/11/2010	12.1	12.6	25/01/2012	5.8	1.1
4/09/2009	7.9	ND	15/11/2010	6.6	3.1	26/01/2012	5.4	ND
5/09/2009	4.5	ND	16/11/2010	9.3	5.2	27/01/2012	9.5	4.8
6/09/2009	6.7	ND	17/11/2010	9.2	6.1	28/01/2012	9.1	4.5
7/09/2009	13.4	ND	18/11/2010	12.2	10.8	29/01/2012	9.1	4.5
8/09/2009	8.6	ND	19/11/2010	8.6	9.2	30/01/2012	8.1	ND
9/09/2009	7.2	ND	20/11/2010	13.7	12.0	31/01/2012	14.9	ND



Date	TEOM 1	TEOM 2	Date	TEOM 1	TEOM 2	Date	TEOM 1	TEOM 2
10/09/2009	10.0	ND	21/11/2010	11.9	12.2	1/02/2012	4.0	ND
11/09/2009	9.7	ND	22/11/2010	12.3	ND	2/02/2012	4.4	5.6
12/09/2009	16.5	ND	23/11/2010	14.0	15.3	3/02/2012	5.8	ND
13/09/2009	20.0	ND	24/11/2010	12.9	17.9	4/02/2012	12.4	7.9
14/09/2009	23.2	ND	25/11/2010	16.8	18.0	5/02/2012	14.1	10.0
15/09/2009	32.6	ND	26/11/2010	17.0	17.5	6/02/2012	22.1	20.0
16/09/2009	27.3	ND	27/11/2010	16.3	13.6	7/02/2012	8.2	2.1
17/09/2009	22.8	ND	28/11/2010	9.1	8.5	8/02/2012	14.5	8.0
18/09/2009	12.0	ND	29/11/2010	9.9	7.0	9/02/2012	16.1	10.3
19/09/2009	9.2	ND	30/11/2010	8.0	5.1	10/02/2012	10.0	ND
20/09/2009	13.7	ND	1/12/2010	5.5	ND	11/02/2012	7.4	ND
21/09/2009	7.8	ND	2/12/2010	7.6	2.8	12/02/2012	10.4	6.3
22/09/2009	11.9	ND	3/12/2010	7.2	4.9	13/02/2012	11.4	5.7
23/09/2009	ND	ND	4/12/2010	5.6	2.6	14/02/2012	10.6	6.3
24/09/2009	17.0	ND	5/12/2010	8.9	9.6	15/02/2012	10.4	6.5
25/09/2009	30.2	ND	6/12/2010	11.2	9.8	16/02/2012	9.3	1.9
26/09/2009	107.8	ND	7/12/2010	12.1	8.8	17/02/2012	12.2	7.7
27/09/2009	18.6	ND	8/12/2010	9.5	5.9	18/02/2012	10.6	9.5
28/09/2009	19.0	ND	9/12/2010	10.9	7.4	19/02/2012	12.8	7.7
29/09/2009	16.1	ND	10/12/2010	9.3	4.8	20/02/2012	6.2	ND
30/09/2009	26.4	ND	11/12/2010	10.2	5.4	21/02/2012	8.2	2.6
1/10/2009	38.1	ND	12/12/2010	13.9	7.6	22/02/2012	11.8	9.9
2/10/2009	45.3	ND	13/12/2010	15.5	11.5	23/02/2012	10.4	ND
3/10/2009	15.0	ND	14/12/2010	20.1	15.3	24/02/2012	11.2	4.5
4/10/2009	10.7	ND	15/12/2010	14.4	9.9	25/02/2012	9.8	7.4
5/10/2009	5.6	ND	16/12/2010	12.9	8.2	26/02/2012	8.3	3.9
6/10/2009	3.8	ND	17/12/2010	15.9	11.4	27/02/2012	9.0	5.8
7/10/2009	2.7	ND	18/12/2010	10.2	6.7	28/02/2012	18.4	ND
8/10/2009	6.3	ND	19/12/2010	7.7	4.6	29/02/2012	15.3	2.4
9/10/2009	7.6	ND	20/12/2010	11.2	ND	1/03/2012	10.8	2.9
10/10/2009	7.5	ND	21/12/2010	12.3	6.7	2/03/2012	3.2	10.7
11/10/2009	4.9	ND	22/12/2010	13.5	12.8	3/03/2012	5.3	ND
12/10/2009	9.5	ND	23/12/2010	17.6	15.8	4/03/2012	ND	ND
13/10/2009	47.8	ND	24/12/2010	23.9	19.1	5/03/2012	8.4	ND
14/10/2009	112.0	ND	25/12/2010	14.4	12.7	6/03/2012	12.9	4.8
15/10/2009	14.0	ND	26/12/2010	5.0	2.4	7/03/2012	7.4	2.3
16/10/2009	8.1	ND	27/12/2010	7.1	2.2	8/03/2012	9.0	ND
17/10/2009	11.1	ND	28/12/2010	15.1	10.6	9/03/2012	12.2	2.0
18/10/2009	11.6	ND	29/12/2010	11.4	10.7	10/03/2012	11.8	4.1
19/10/2009	13.5	ND	30/12/2010	14.7	14.3	11/03/2012	16.1	8.1
20/10/2009	15.2	ND	31/12/2010	19.9	18.9	12/03/2012	14.4	15.5
21/10/2009	24.9	ND	1/01/2011	21.8	20.0	13/03/2012	11.1	5.6
22/10/2009	27.3	ND	2/01/2011	18.9	12.1	14/03/2012	11.8	5.3
23/10/2009	20.0	ND	3/01/2011	8.3	6.7	15/03/2012	12.1	5.8
24/10/2009	17.4	ND	4/01/2011	8.3	1.6	16/03/2012	9.7	11.1
25/10/2009	17.2	ND	5/01/2011	14.9	10.6	17/03/2012	6.1	2.8
26/10/2009	4.3	ND	6/01/2011	8.9	7.3	18/03/2012	9.0	5.8
27/10/2009	5.3	ND	7/01/2011	8.8	7.5	19/03/2012	8.0	3.8
28/10/2009	8.8	ND	8/01/2011	9.9	6.9	20/03/2012	10.7	6.3
29/10/2009	10.2	ND	9/01/2011	11.0	8.9	21/03/2012	6.6	4.1
30/10/2009	10.6	ND	10/01/2011	7.4	3.8	22/03/2012	14.2	ND



Date	TEOM 1	TEOM 2	Date	TEOM 1	TEOM 2	Date	TEOM 1	TEOM 2
31/10/2009	9.9	ND	11/01/2011	6.3	2.6	23/03/2012	16.9	11.4
1/11/2009	10.9	ND	12/01/2011	12.3	9.3	24/03/2012	15.1	7.3
2/11/2009	18.1	ND	13/01/2011	10.3	8.1	25/03/2012	11.5	10.6
3/11/2009	19.2	ND	14/01/2011	10.6	8.6	26/03/2012	12.9	12.1
4/11/2009	27.1	ND	15/01/2011	12.8	5.6	27/03/2012	11.8	19.1
5/11/2009	23.6	ND	16/01/2011	10.5	ND	28/03/2012	10.4	7.8
6/11/2009	5.7	ND	17/01/2011	12.5	8.7	29/03/2012	10.3	11.4
7/11/2009	9.6	ND	18/01/2011	18.1	15.2	30/03/2012	11.0	15.8
8/11/2009	5.4	ND	19/01/2011	17.7	15.0	31/03/2012	8.8	14.1
9/11/2009	6.3	ND	20/01/2011	13.7	11.0	1/04/2012	15.2	15.1
10/11/2009	9.8	ND	21/01/2011	9.1	7.5	2/04/2012	7.5	6.9
11/11/2009	19.4	ND	22/01/2011	12.0	23.0	3/04/2012	12.0	11.7
12/11/2009	16.1	ND	23/01/2011	12.1	10.1	4/04/2012	15.5	21.6
13/11/2009	15.0	ND	24/01/2011	16.2	21.4	5/04/2012	13.4	18.6
14/11/2009	10.5	ND	25/01/2011	15.6	21.1	6/04/2012	9.7	11.3
15/11/2009	30.4	ND	26/01/2011	19.5	34.5	7/04/2012	36.4	43.0
16/11/2009	20.7	ND	27/01/2011	19.7	22.2	8/04/2012	24.6	21.4
17/11/2009	41.9	ND	28/01/2011	18.8	16.7	9/04/2012	12.9	8.6
18/11/2009	15.5	ND	29/01/2011	21.0	18.8	10/04/2012	7.1	6.1
19/11/2009	23.2	ND	30/01/2011	19.8	17.9	11/04/2012	7.1	10.9
20/11/2009	29.9	ND	31/01/2011	32.6	20.1	12/04/2012	11.5	11.9
21/11/2009	31.5	ND	1/02/2011	20.9	17.2	13/04/2012	7.4	12.5
22/11/2009	60.0	ND	2/02/2011	16.8	25.1	14/04/2012	14.0	18.6
23/11/2009	36.0	ND	3/02/2011	14.5	ND	15/04/2012	19.8	24.7
24/11/2009	5.3	ND	4/02/2011	13.6	14.0	16/04/2012	10.7	18.3
25/11/2009	12.1	ND	5/02/2011	16.1	10.8	17/04/2012	10.1	15.6
26/11/2009	17.8	ND	6/02/2011	11.2	7.8	18/04/2012	4.9	4.6
27/11/2009	31.5	ND	7/02/2011	8.7	6.5	19/04/2012	5.1	3.9
28/11/2009	74.2	ND	8/02/2011	12.4	11.0	20/04/2012	8.9	11.3
29/11/2009	191.4	ND	9/02/2011	13.2	11.3	21/04/2012	11.7	15.1
30/11/2009	11.0	ND	10/02/2011	9.5	12.9	22/04/2012	13.3	17.7
1/12/2009	6.2	ND	11/02/2011	16.3	23.8	23/04/2012	9.2	13.0
2/12/2009	7.7	ND	12/02/2011	23.1	12.4	24/04/2012	9.6	6.8
3/12/2009	3.4	ND	13/02/2011	5.7	4.3	25/04/2012	10.6	5.3
4/12/2009	22.8	ND	14/02/2011	3.3	1.7	26/04/2012	10.0	5.9
5/12/2009	15.2	ND	15/02/2011	7.2	ND	27/04/2012	9.8	12.5
6/12/2009	22.3	ND	16/02/2011	10.2	1.0	28/04/2012	9.6	20.7
7/12/2009	12.5	ND	17/02/2011	13.6	ND	29/04/2012	10.4	8.0
8/12/2009	45.6	ND	18/02/2011	13.8	14.2	30/04/2012	10.6	15.8
9/12/2009	32.3	ND	19/02/2011	22.0	16.0	1/05/2012	6.0	12.4
10/12/2009	29.2	ND	20/02/2011	12.6	ND	2/05/2012	7.4	12.5
11/12/2009	35.7	ND	21/02/2011	10.6	2.3	3/05/2012	5.0	1.8
12/12/2009	12.7	ND	22/02/2011	9.9	8.3	4/05/2012	10.5	4.7
13/12/2009	22.1	ND	23/02/2011	6.6	3.8	5/05/2012	10.0	6.6
14/12/2009	ND	ND	24/02/2011	13.1	ND	6/05/2012	15.1	6.2
15/12/2009	15.4	ND	25/02/2011	15.5	25.4	7/05/2012	12.1	6.9
16/12/2009	13.5	ND	26/02/2011	16.5	40.8	8/05/2012	16.5	7.7
17/12/2009	27.0	ND	27/02/2011	19.0	24.6	9/05/2012	23.1	14.2
18/12/2009	20.2	ND	28/02/2011	13.5	12.3	10/05/2012	21.2	11.2
19/12/2009	10.6	ND	1/03/2011	11.7	11.2	11/05/2012	36.5	14.1
20/12/2009	18.8	ND	2/03/2011	22.7	17.9	12/05/2012	18.8	12.8



Date	TEOM 1	TEOM 2	Date	TEOM 1	TEOM 2	Date	TEOM 1	TEOM 2
21/12/2009	16.9	ND	3/03/2011	8.1	7.3	13/05/2012	16.2	9.2
22/12/2009	7.5	ND	4/03/2011	10.7	10.7	14/05/2012	10.2	6.5
23/12/2009	11.3	ND	5/03/2011	14.8	11.9	15/05/2012	16.6	14.1
24/12/2009	9.5	ND	6/03/2011	9.7	7.0	16/05/2012	15.1	14.7
25/12/2009	14.6	ND	7/03/2011	9.6	6.8	17/05/2012	13.7	16.3
26/12/2009	2.9	ND	8/03/2011	6.3	5.7	18/05/2012	17.2	15.4
27/12/2009	4.5	ND	9/03/2011	10.9	18.6	19/05/2012	18.6	11.8
28/12/2009	5.5	ND	10/03/2011	12.3	10.6	20/05/2012	19.7	16.5
29/12/2009	5.6	ND	11/03/2011	9.2	8.1	21/05/2012	14.0	27.9
30/12/2009	8.7	ND	12/03/2011	12.8	11.0	22/05/2012	24.2	12.6
31/12/2009	7.7	ND	13/03/2011	11.2	10.3	23/05/2012	24.8	16.2
1/01/2010	5.6	ND	14/03/2011	9.2	8.1	24/05/2012	13.7	21.6
2/01/2010	6.6	ND	15/03/2011	9.7	7.7	25/05/2012	5.5	3.8
3/01/2010	6.1	ND	16/03/2011	10.6	8.8	26/05/2012	9.2	4.2
4/01/2010	8.8	ND	17/03/2011	13.3	13.1	27/05/2012	5.5	4.2
5/01/2010	10.8	ND	18/03/2011	11.7	11.2	28/05/2012	7.9	10.2
6/01/2010	10.4	ND	19/03/2011	4.8	2.5	29/05/2012	8.3	11.2
7/01/2010	14.1	ND	20/03/2011	6.1	ND	30/05/2012	5.8	7.7
8/01/2010	14.6	ND	21/03/2011	9.2	6.5	31/05/2012	7.2	ND
9/01/2010	13.9	ND	22/03/2011	7.3	2.4	1/06/2012	8.2	ND
10/01/2010	16.6	ND	23/03/2011	9.5	4.8	2/06/2012	4.6	ND
11/01/2010	21.3	ND	24/03/2011	11.1	7.8	3/06/2012	4.9	ND
12/01/2010	14.5	ND	25/03/2011	4.6	2.3	4/06/2012	5.2	ND
13/01/2010	18.7	ND	26/03/2011	9.0	6.4	5/06/2012	7.0	ND
14/01/2010	5.6	ND	27/03/2011	8.4	7.6	6/06/2012	1.9	ND
15/01/2010	7.9	ND	28/03/2011	7.0	6.1	7/06/2012	5.5	ND
16/01/2010	10.1	ND	29/03/2011	6.0	8.8	8/06/2012	4.8	ND
17/01/2010	7.8	ND	30/03/2011	10.9	13.0	9/06/2012	6.0	3.1
18/01/2010	16.9	ND	31/03/2011	18.1	14.7	10/06/2012	7.4	10.0
19/01/2010	17.1	ND	1/04/2011	15.5	14.7	11/06/2012	4.2	12.5
20/01/2010	24.5	ND	2/04/2011	19.3	17.2	12/06/2012	ND	3.2
21/01/2010	26.5	ND	3/04/2011	17.2	18.7	13/06/2012	7.6	7.9
22/01/2010	22.1	ND	4/04/2011	15.2	26.2	14/06/2012	7.0	7.6
23/01/2010	21.2	ND	5/04/2011	7.6	8.7	15/06/2012	8.5	8.3
24/01/2010	25.1	ND	6/04/2011	6.5	6.8	16/06/2012	8.4	5.6
25/01/2010	24.9	ND	7/04/2011	8.1	6.0	17/06/2012	7.7	ND
26/01/2010	17.0	ND	8/04/2011	7.6	4.6	18/06/2012	6.1	ND
27/01/2010	23.4	ND	9/04/2011	10.1	6.7	19/06/2012	5.1	ND
28/01/2010	12.3	ND	10/04/2011	13.4	14.8	20/06/2012	7.4	ND
29/01/2010	14.5	ND	11/04/2011	4.2	2.3	21/06/2012	8.5	7.8
30/01/2010	16.7	ND	12/04/2011	9.9	5.3	22/06/2012	8.6	ND
31/01/2010	10.2	ND	13/04/2011	13.0	ND	23/06/2012	5.3	ND
1/02/2010	14.8	ND	14/04/2011	9.8	5.1	24/06/2012	8.7	ND
2/02/2010	13.5	ND	15/04/2011	14.1	8.0	25/06/2012	8.8	2.2
3/02/2010	10.4	ND	16/04/2011	8.0	5.4	26/06/2012	5.9	8.6
4/02/2010	12.3	ND	17/04/2011	9.4	7.0	27/06/2012	7.4	ND
5/02/2010	9.4	ND	18/04/2011	8.9	12.0	28/06/2012	5.6	ND
6/02/2010	6.0	ND	19/04/2011	11.6	10.3	29/06/2012	7.1	19.6
7/02/2010	5.8	ND	20/04/2011	17.1	18.4	30/06/2012	9.8	3.8
8/02/2010	9.4	ND	21/04/2011	6.8	6.1	1/07/2012	14.2	5.3
9/02/2010	11.8	ND	22/04/2011	11.2	ND	2/07/2012	7.5	ND



Date	TEOM 1	TEOM 2	Date	TEOM 1	TEOM 2	Date	TEOM 1	TEOM 2
10/02/2010	12.6	ND	23/04/2011	11.8	12.5	3/07/2012	8.5	ND
11/02/2010	20.1	ND	24/04/2011	14.6	19.0	4/07/2012	9.2	7.9
12/02/2010	12.7	ND	25/04/2011	8.4	10.8	5/07/2012	7.5	4.2
13/02/2010	10.2	ND	26/04/2011	4.7	2.5	6/07/2012	6.1	7.4
14/02/2010	11.6	ND	27/04/2011	5.0	1.7	7/07/2012	5.3	ND
15/02/2010	3.2	ND	28/04/2011	6.3	4.4	8/07/2012	6.1	20.0
16/02/2010	10.4	ND	29/04/2011	5.1	ND	9/07/2012	5.9	ND
17/02/2010	14.6	ND	30/04/2011	6.9	ND	10/07/2012	5.1	ND
18/02/2010	9.4	ND	1/05/2011	5.7	7.9	11/07/2012	4.8	ND
19/02/2010	13.6	ND	2/05/2011	10.8	29.7	12/07/2012	4.9	7.9
20/02/2010	13.4	ND	3/05/2011	15.1	2.4	13/07/2012	6.9	5.0
21/02/2010	15.0	ND	4/05/2011	7.0	5.0	14/07/2012	9.3	2.1
22/02/2010	22.6	ND	5/05/2011	9.0	9.0	15/07/2012	5.3	ND
23/02/2010	42.4	ND	6/05/2011	9.7	11.5	16/07/2012	ND	ND
24/02/2010	18.7	ND	7/05/2011	9.6	11.9	17/07/2012	ND	ND
25/02/2010	15.6	ND	8/05/2011	20.4	14.2	18/07/2012	11.2	ND
26/02/2010	16.3	ND	9/05/2011	15.5	13.7	19/07/2012	5.8	ND
27/02/2010	10.7	ND	10/05/2011	7.2	6.9	20/07/2012	9.4	ND
28/02/2010	17.1	ND	11/05/2011	26.6	13.8	21/07/2012	8.7	ND
1/03/2010	6.3	ND	12/05/2011	6.8	2.8	22/07/2012	6.9	ND
2/03/2010	8.6	ND	13/05/2011	7.1	2.4	23/07/2012	9.4	ND
3/03/2010	7.1	ND	14/05/2011	6.0	3.6	24/07/2012	6.0	ND
4/03/2010	9.1	ND	15/05/2011	8.6	3.9	25/07/2012	6.5	ND
5/03/2010	6.4	ND	16/05/2011	16.6	6.4	26/07/2012	6.1	ND
6/03/2010	7.8	ND	17/05/2011	18.5	15.7	27/07/2012	6.8	ND
7/03/2010	12.1	ND	18/05/2011	12.1	24.5	28/07/2012	5.4	ND
8/03/2010	11.0	ND	19/05/2011	11.9	39.0	29/07/2012	4.6	ND
9/03/2010	13.2	ND	20/05/2011	15.6	20.3	30/07/2012	5.7	ND
10/03/2010	12.2	ND	21/05/2011	14.5	14.0	31/07/2012	6.6	ND
11/03/2010	13.8	ND	22/05/2011	11.4	18.7	1/08/2012	6.3	ND
12/03/2010	11.9	ND	23/05/2011	6.8	2.5	2/08/2012	9.3	ND
13/03/2010	9.0	ND	24/05/2011	4.3	1.9	3/08/2012	10.9	4.6
14/03/2010	6.0	ND	25/05/2011	4.2	3.1	4/08/2012	13.0	4.3
15/03/2010	12.1	ND	26/05/2011	6.6	2.9	5/08/2012	14.6	6.6
16/03/2010	13.8	ND	27/05/2011	9.0	ND	6/08/2012	13.6	5.8
17/03/2010	20.7	ND	28/05/2011	13.4	12.5	7/08/2012	13.9	5.0
18/03/2010	12.4	ND	29/05/2011	8.0	14.1	8/08/2012	13.2	6.4
19/03/2010	19.2	ND	30/05/2011	5.3	8.3	9/08/2012	10.4	5.2
20/03/2010	28.4	ND	31/05/2011	5.3	2.4	10/08/2012	6.8	3.7
21/03/2010	29.9	ND	1/06/2011	9.4	7.1	11/08/2012	6.1	4.7
22/03/2010	28.0	ND	2/06/2011	7.7	6.3	12/08/2012	11.1	9.9
23/03/2010	18.6	ND	3/06/2011	7.0	6.1	13/08/2012	7.9	ND
24/03/2010	29.5	ND	4/06/2011	10.1	8.9	14/08/2012	17.2	ND
25/03/2010	22.2	ND	5/06/2011	6.3	1.9	15/08/2012	16.7	ND
26/03/2010	26.7	ND	6/06/2011	7.1	3.5	16/08/2012	10.7	ND
27/03/2010	29.9	ND	7/06/2011	11.9	5.3	17/08/2012	ND	ND
28/03/2010	28.4	ND	8/06/2011	9.7	ND	18/08/2012	ND	ND
29/03/2010	15.1	ND	9/06/2011	9.3	5.3	19/08/2012	5.6	ND
30/03/2010	9.0	ND	10/06/2011	9.5	6.0	20/08/2012	7.9	ND
31/03/2010	5.8	ND	11/06/2011	8.8	16.4	21/08/2012	11.6	ND
1/04/2010	11.5	ND	12/06/2011	4.9	8.2	22/08/2012	11.2	ND



Date	TEOM 1	TEOM 2	Date	TEOM 1	TEOM 2	Date	TEOM 1	TEOM 2
2/04/2010	13.0	ND	13/06/2011	5.6	ND	23/08/2012	ND	ND
3/04/2010	10.6	ND	14/06/2011	6.3	11.6	24/08/2012	ND	ND
4/04/2010	6.4	ND	15/06/2011	6.4	2.1	25/08/2012	9.2	ND
5/04/2010	8.7	ND	16/06/2011	6.5	ND	26/08/2012	6.6	ND
6/04/2010	7.1	ND	17/06/2011	13.7	ND	27/08/2012	8.2	ND
7/04/2010	8.9	ND	18/06/2011	11.1	ND	28/08/2012	12.3	ND
8/04/2010	9.3	ND	19/06/2011	11.9	ND	29/08/2012	14.7	ND
9/04/2010	11.8	ND	20/06/2011	11.5	ND	30/08/2012	20.1	ND
10/04/2010	19.7	ND	21/06/2011	11.1	ND	31/08/2012	10.0	ND
11/04/2010	13.5	ND	22/06/2011	8.9	ND	1/09/2012	3.6	ND
12/04/2010	10.9	ND	23/06/2011	8.4	ND	2/09/2012	16.0	ND
13/04/2010	12.7	ND	24/06/2011	8.4	2.2	3/09/2012	12.0	ND
14/04/2010	11.4	ND	25/06/2011	8.8	8.1	4/09/2012	9.5	ND
15/04/2010	23.3	ND	26/06/2011	12.1	10.3	5/09/2012	23.0	17.3
16/04/2010	17.7	ND	27/06/2011	12.6	7.4	6/09/2012	34.0	21.2
17/04/2010	12.0	ND	28/06/2011	11.3	ND	7/09/2012	36.6	ND
18/04/2010	8.3	ND	29/06/2011	7.4	4.8	8/09/2012	ND	ND
19/04/2010	8.2	ND	30/06/2011	6.8	5.3	9/09/2012	ND	ND
20/04/2010	7.4	ND	1/07/2011	5.3	4.1	10/09/2012	23.5	ND
21/04/2010	8.1	ND	2/07/2011	6.3	6.1	11/09/2012	27.0	17.7
22/04/2010	13.5	ND	3/07/2011	6.8	13.5	12/09/2012	24.0	25.2
23/04/2010	16.9	ND	4/07/2011	7.7	ND	13/09/2012	17.6	20.8
24/04/2010	22.1	ND	5/07/2011	16.7	3.7	14/09/2012	7.1	2.5
25/04/2010	5.7	ND	6/07/2011	15.6	ND	15/09/2012	13.5	7.6
26/04/2010	7.8	ND	7/07/2011	11.5	1.7	16/09/2012	11.6	18.6
27/04/2010	8.9	ND	8/07/2011	10.9	1.6	17/09/2012	19.9	17.6
28/04/2010	10.6	ND	9/07/2011	5.1	6.0	18/09/2012	7.7	14.0
29/04/2010	12.1	ND	10/07/2011	12.6	8.8	19/09/2012	5.1	1.8
30/04/2010	10.4	ND	11/07/2011	10.8	14.9	20/09/2012	7.4	13.5
1/05/2010	11.3	ND	12/07/2011	16.5	11.2	21/09/2012	14.8	8.8
2/05/2010	10.6	ND	13/07/2011	19.2	10.8	22/09/2012	15.4	4.3
3/05/2010	16.8	ND	14/07/2011	9.7	2.4	23/09/2012	18.9	20.8
4/05/2010	8.9	ND	15/07/2011	6.7	4.1	24/09/2012	18.6	9.3
5/05/2010	4.8	ND	16/07/2011	4.7	1.3	25/09/2012	15.6	19.5
6/05/2010	8.1	ND	17/07/2011	5.3	2.3	26/09/2012	16.4	21.4
7/05/2010	10.2	ND	18/07/2011	5.0	2.8	27/09/2012	17.1	32.2
8/05/2010	9.2	ND	19/07/2011	4.8	3.3	28/09/2012	21.2	26.5
9/05/2010	12.2	ND	20/07/2011	5.3	7.8	29/09/2012	10.2	5.2
10/05/2010	15.7	ND	21/07/2011	6.1	2.9	30/09/2012	9.2	4.3
11/05/2010	19.3	ND	22/07/2011	4.8	4.5	1/10/2012	12.5	12.4
12/05/2010	26.8	ND	23/07/2011	5.1	6.1	2/10/2012	10.4	10.2
13/05/2010	26.9	ND	24/07/2011	6.2	2.6	3/10/2012	18.1	12.7
14/05/2010	12.9	ND	25/07/2011	10.2	5.9	4/10/2012	25.8	12.8
15/05/2010	14.9	ND	26/07/2011	7.1	10.0	5/10/2012	32.5	11.7
16/05/2010	14.9	ND	27/07/2011	8.0	7.8	6/10/2012	34.3	28.2
17/05/2010	8.9	ND	28/07/2011	7.9	10.5	7/10/2012	11.1	4.4
18/05/2010	10.8	ND	29/07/2011	15.9	9.8	8/10/2012	17.5	16.0
19/05/2010	11.8	ND	30/07/2011	17.2	15.7	9/10/2012	16.5	7.5
20/05/2010	8.1	ND	31/07/2011	19.7	12.7	10/10/2012	17.5	10.0
21/05/2010	8.6	ND	1/08/2011	14.4	15.8	11/10/2012	16.5	20.4
22/05/2010	6.5	ND	2/08/2011	21.9	12.5	12/10/2012	7.4	1.7



Date	TEOM 1	TEOM 2	Date	TEOM 1	TEOM 2	Date	TEOM 1	TEOM 2
23/05/2010	7.5	ND	3/08/2011	25.9	17.5	13/10/2012	11	3.7
24/05/2010	7.3	ND	4/08/2011	21.3	15.8	14/10/2012	9.9	10.1
25/05/2010	6.5	ND	5/08/2011	21.7	3.2	15/10/2012	18.5	14
26/05/2010	3.9	ND	6/08/2011	9.5	2.2	16/10/2012	30.5	13.7
27/05/2010	7.5	ND	7/08/2011	6.7	ND	17/10/2012	25	12.6
28/05/2010	7.7	ND	8/08/2011	4.7	ND	18/10/2012	21.9	27.3
29/05/2010	3.9	ND	9/08/2011	3.1	ND	19/10/2012	27.4	24.7
30/05/2010	3.3	ND	10/08/2011	5.6	ND	20/10/2012	23	20.6
31/05/2010	5.5	ND	11/08/2011	5.9	ND	21/10/2012	20.2	14.6
1/06/2010	5.5	ND	12/08/2011	5.7	4.6	22/10/2012	11.9	10.4
2/06/2010	6.2	ND	13/08/2011	6.6	4.0	23/10/2012	15.9	13.5
3/06/2010	5.8	ND	14/08/2011	8.6	10.2	24/10/2012	15.9	13.8
4/06/2010	4.5	ND	15/08/2011	6.2	6.6	25/10/2012	60.3	50.8
5/06/2010	5.1	ND	16/08/2011	5.3	10.0	26/10/2012	27	13.6
6/06/2010	8.5	ND	17/08/2011	11.0	ND	27/10/2012	13.5	8.5
7/06/2010	5.9	ND	18/08/2011	7.8	2.3	28/10/2012	20.8	13.6
8/06/2010	7.7	ND	19/08/2011	5.9	1.8	29/10/2012	17.1	16.8
9/06/2010	22.3	ND	20/08/2011	7.3	6.3	30/10/2012	17.5	14
10/06/2010	ND	ND	21/08/2011	8.8	7.1	31/10/2012	17.8	10.6
11/06/2010	10.2	ND	22/08/2011	5.8	5.1	1/11/2012	33.3	21.9
12/06/2010	7.2	ND	23/08/2011	4.3	2.1	2/11/2012	16.7	11.2
13/06/2010	12.0	ND	24/08/2011	7.3	15.9	3/11/2012	15.1	9
14/06/2010	8.7	ND	25/08/2011	9.7	17.4	4/11/2012	17.8	12.4
15/06/2010	6.7	ND	26/08/2011	14.0	14.0	5/11/2012	18.4	28.9
16/06/2010	7.1	ND	27/08/2011	14.0	21.6	6/11/2012	23.4	36
17/06/2010	8.5	ND	28/08/2011	16.5	13.5	7/11/2012	26.8	18.5
18/06/2010	15.9	ND	29/08/2011	20.9	8.9	8/11/2012	11.5	5.1
19/06/2010	14.8	ND	30/08/2011	16.4	13.9	9/11/2012	6.2	1.6
20/06/2010	13.8	ND	31/08/2011	13.4	18.7	10/11/2012	13.8	10
21/06/2010	17.8	ND	1/09/2011	17.6	19.7	11/11/2012	13.2	7.3
22/06/2010	5.9	ND	2/09/2011	14.3	10.9	12/11/2012	12.8	7.1
23/06/2010	6.0	ND	3/09/2011	6.3	14.1	13/11/2012	29.1	17.9
24/06/2010	5.5	ND	4/09/2011	11.5	20.4	14/11/2012	22.2	13.1
25/06/2010	5.8	ND	5/09/2011	18.3	16.7	15/11/2012	16.5	8.5
26/06/2010	6.0	ND	6/09/2011	18.0	18.2	16/11/2012	14.4	9.9
27/06/2010	6.5	ND	7/09/2011	14.8	10.0	17/11/2012	10.4	6.2
28/06/2010	8.6	ND	8/09/2011	13.9	15.7	18/11/2012	9.5	4.1
29/06/2010	9.2	ND	9/09/2011	4.5	2.5	19/11/2012	11.7	12.7
30/06/2010	11.6	ND	10/09/2011	8.4	5.6	20/11/2012	12.2	10
1/07/2010	11.9	ND	11/09/2011	8.3	4.8	21/11/2012	15.4	11.7
2/07/2010	11.8	ND	12/09/2011	7.2	3.9	22/11/2012	21.9	5.7
3/07/2010	4.7	ND	13/09/2011	12.8	6.3	23/11/2012	22.2	13.1
4/07/2010	7.1	ND	14/09/2011	16.3	ND	24/11/2012	18.4	12.3
5/07/2010	8.5	ND	15/09/2011	14.9	1.5	25/11/2012	18.8	14.9
6/07/2010	7.5	ND	16/09/2011	24.6	12.2	26/11/2012	26.8	25.8
7/07/2010	9.3	ND	17/09/2011	22.1	10.6	27/11/2012	16.2	8.7
8/07/2010	7.9	ND	18/09/2011	25.2	13.9	28/11/2012	15.6	11.6
9/07/2010	6.1	ND	19/09/2011	26.5	22.4	29/11/2012	17.2	12.5
10/07/2010	6.4	ND	20/09/2011	30.8	21.1	30/11/2012	25	26.8
11/07/2010	8.4	ND	21/09/2011	15.0	9.1	1/12/2012	22.9	24.3
12/07/2010	5.8	ND	22/09/2011	15.5	15.1	2/12/2012	17.7	13.1



Date	TEOM 1	TEOM 2	Date	TEOM 1	TEOM 2	Date	TEOM 1	TEOM 2
13/07/2010	7.0	ND	23/09/2011	23.9	15.7	3/12/2012	6.5	4.3
14/07/2010	5.7	ND	24/09/2011	28.7	27.8	4/12/2012	14.2	5.8
15/07/2010	8.1	ND	25/09/2011	3.3	ND	5/12/2012	20.5	11.8
16/07/2010	7.6	ND	26/09/2011	7.5	5.2	6/12/2012	36.2	13
17/07/2010	6.7	ND	27/09/2011	9.4	8.9	7/12/2012	30.1	20.3
18/07/2010	6.9	ND	28/09/2011	11.9	13.6	8/12/2012	24	27.7
19/07/2010	11.6	ND	29/09/2011	3.0	ND	9/12/2012	29.2	31
20/07/2010	8.8	ND	30/09/2011	6.7	ND	10/12/2012	7.7	3.1
21/07/2010	8.4	ND	1/10/2011	6.2	ND	11/12/2012	8.8	3.7
22/07/2010	9.5	ND	2/10/2011	5.2	ND	12/12/2012	10.8	4.4
23/07/2010	8.5	ND	3/10/2011	5.9	ND	13/12/2012	11.3	9.7
24/07/2010	6.2	ND	4/10/2011	5.8	ND	14/12/2012	19.2	21.7
25/07/2010	6.6	ND	5/10/2011	9.9	8.9	15/12/2012	20.4	28.2
26/07/2010	6.2	ND	6/10/2011	10.4	6.2	16/12/2012	14.3	14.2
27/07/2010	7.2	ND	7/10/2011	14.8	11.8	17/12/2012	31.3	13
28/07/2010	4.8	ND	8/10/2011	7.9	4.6	18/12/2012	17	16.7
29/07/2010	4.4	ND	9/10/2011	5.5	4.2	19/12/2012	22.6	18.2
30/07/2010	4.6	ND	10/10/2011	8.5	3.3	20/12/2012	19.2	14.5
31/07/2010	4.6	ND	11/10/2011	10.1	4.5	21/12/2012	22.6	14.7
1/08/2010	6.4	ND	12/10/2011	12.9	7.4	22/12/2012	18.8	1.1
2/08/2010	6.1	ND	13/10/2011	15.1	10.8	23/12/2012	14.2	23.3
3/08/2010	7.6	ND	14/10/2011	10.6	7.0	24/12/2012	14.4	23.8
4/08/2010	6.5	ND	15/10/2011	8.8	5.3	25/12/2012	4.7	10.3
5/08/2010	7.6	ND	16/10/2011	11.6	6.2	26/12/2012	10.4	ND
6/08/2010	9.0	ND	17/10/2011	16.3	15.8	27/12/2012	16.2	ND
7/08/2010	10.3	ND	18/10/2011	17.1	13.6	28/12/2012	17.7	ND
8/08/2010	7.5	ND	19/10/2011	16.8	15.6	29/12/2012	22.7	ND
9/08/2010	11.6	ND	20/10/2011	15.5	20.8	30/12/2012	22.3	ND
10/08/2010	10.0	ND	21/10/2011	19.7	18.8	31/12/2012	19.6	ND
11/08/2010	4.0	ND	22/10/2011	18.8	34.2			

ND - No data



Table B-2: HVAS monitoring data

Date	HV1	HV2	HV3	HV4	Date	HV1	HV2	HV3	HV4
5/03/2006	12.1	ND	ND	ND	4/08/2009	10.7	7.3	15.4	8.2
11/03/2006	30.1	ND	ND	ND	10/08/2009	13.3	ND	22.9	10.1
17/03/2006	14	ND	ND	ND	16/08/2009	11.8	11.8	21.2	17.2
23/03/2006	10	ND	ND	ND	22/08/2009	7.3	1	22.8	8
29/03/2006	14.2	ND	ND	ND	28/08/2009	14.6	15.1	28.2	11.6
4/04/2006	22	ND	ND	ND	3/09/2009	16.7	34.6	22.6	15
10/04/2006	8.9	ND	ND	ND	9/09/2009	4.2	4	11.1	2.6
16/04/2006	8.4	ND	ND	ND	15/09/2009	38.5	33.8	48.3	30.4
22/04/2006	7.4	ND	ND	ND	21/09/2009	9.5	7.2	13.2	5.7
28/04/2006	14.9	ND	ND	ND	27/09/2009	14.8	21.1	65.7	14.6
4/05/2006	10.9	ND	ND	ND	3/10/2009	12.6	13.9	27.5	12.7
10/05/2006	15.2	ND	ND	ND	9/10/2009	8.6	11.8	8.9	5.3
16/05/2006	20.9	ND	ND	ND	15/10/2009	10.5	9.8	23.9	9.2
22/05/2006	14.8	ND	ND	ND	21/10/2009	28.2	38.7	56.3	ND
28/05/2006	12.7	ND	ND	ND	27/10/2009	4.4	4	5.4	3.9
3/06/2006	15.9	ND	ND	ND	2/11/2009	20.1	30.7	31.6	20.5
9/06/2006	3.7	ND	ND	ND	8/11/2009	6.1	4.4	8.6	5.2
15/06/2006	9.6	ND	ND	ND	14/11/2009	14.2	18.3	26.7	12.2
21/06/2006	7.7	ND	ND	ND	20/11/2009	37.1	56.2	53.7	44.9
27/06/2006	11.3	ND	ND	ND	26/11/2009	20.9	22.9	39.6	21.9
3/07/2006	4.8	ND	ND	ND	2/12/2009	9.8	16.6	16	9
9/07/2006	14.1	ND	ND	ND	8/12/2009	59.9	61.6	112	52.5
15/07/2006	5.2	ND	ND	ND	14/12/2009	ND	24.2	ND	ND
21/07/2006	11.1	ND	ND	ND	20/12/2009	20.8	19.6	31.1	20.8
27/07/2006	10.2	ND	ND	ND	26/12/2009	4.4	3.7	5.7	4.4
2/08/2006	12.9	ND	ND	ND	1/01/2010	4.6	6.1	7.9	6.7
8/08/2006	11.2	ND	ND	ND	7/01/2010	17.7	18.5	22.6	18.6
14/08/2006	15.9	ND	ND	ND	13/01/2010	18.6	22.1	38.4	20.2
20/08/2006	10.7	ND	ND	ND	19/01/2010	14.1	14.7	42.7	13.2
26/08/2006	8.3	ND	ND	ND	25/01/2010	27.7	33.7	43.3	36.6
1/09/2006	14	9.9	ND	13.6	31/01/2010	14.6	14.7	20.6	13.6
7/09/2006	3.3	3.1	ND	3.3	6/02/2010	5.4	ND	7.5	1.3
13/09/2006	12.7	14.8	ND	10.9	12/02/2010	11.4	10	18.1	14.2
19/09/2006	20.1	20.1	ND	19.3	18/02/2010	13.3	21.6	20.9	11.9
25/09/2006	21.1	28.7	ND	17.6	24/02/2010	29.6	29	44.2	28.8
1/10/2006	19.2	14.5	ND	18.4	2/03/2010	10.3	13.1	17.1	8.9
7/10/2006	23.2	20.3	ND	25.3	8/03/2010	10.1	10.4	16.7	10.6
13/10/2006	24.3	33.5	ND	ND	14/03/2010	4.3	4.5	7.9	4.5
19/10/2006	24.7	21.4	19.8	ND	20/03/2010	20.6	19	40.6	21.8
25/10/2006	26.5	26	19.6	ND	26/03/2010	8	16.1	16.6	6.2
31/10/2006	24.1	23.4	17.3	ND	1/04/2010	6.2	5.2	13.1	6.5
6/11/2006	9.2	8.5	5.7	ND	7/04/2010	8.4	7.3	11.9	9.3
12/11/2006	18.6	14.8	16.6	ND	13/04/2010	8.6	14.6	18.5	10.5
18/11/2006	19.5	12.4	13.3	18.4	19/04/2010	7.4	12	13.6	6.6
24/11/2006	32	29.6	33.7	33.3	25/04/2010	3.9	3.2	8	4.7
30/11/2006	29.1	24.2	ND	31.8	1/05/2010	10	12.4	15.3	8.6
6/12/2006	34.5	59.2	ND	28.4	7/05/2010	8.1	4.7	14.8	7.4
12/12/2006	16.2	15.9	ND	15.6	13/05/2010	13.7	8	22.8	19.3
18/12/2006	23.9	35.8	ND	26	19/05/2010	9.6	17.3	23.3	7.1
24/12/2006	ND	ND	8.4	9.3	25/05/2010	6.3	6.6	8.5	4.7



Date	HV1	HV2	HV3	HV4	Date	HV1	HV2	HV3	HV4
30/12/2006	7.2	ND	ND	6.9	31/05/2010	3.5	1.8	5.3	1.8
5/01/2007	12.7	ND	ND	12	6/06/2010	8.5	10.4	4.9	5.6
11/01/2007	24.3	ND	ND	23	12/06/2010	6.5	3.4	9.1	3.5
17/01/2007	24.9	ND	ND	26.5	18/06/2010	9.3	8	27.8	7.2
23/01/2007	23.8	ND	ND	20.4	24/06/2010	3.9	4.7	5.1	3
29/01/2007	20.4	ND	ND	16.7	30/06/2010	8.2	6	15	4.9
4/02/2007	24.6	ND	ND	23	6/07/2010	5.1	5.4	7.5	4.3
10/02/2007	12	ND	ND	11.1	12/07/2010	6.5	4	5.1	2.6
16/02/2007	12	ND	ND	10.4	18/07/2010	8.3	4.8	8.2	0
22/02/2007	18	ND	ND	14.4	24/07/2010	7.1	3.5	9.9	5.2
28/02/2007	12.1	ND	ND	13.5	30/07/2010	2.3	1	2.9	1.8
6/03/2007	1.6	17.1	19.2	9.3	5/08/2010	7.3	4.2	11.1	6.6
12/03/2007	17.6	29.9	29.8	19.9	11/08/2010	2.8	2	4.2	3.2
18/03/2007	6.4	6.3	10.5	4	17/08/2010	4.2	3.5	8.5	2.6
24/03/2007	30.2	22.2	48.3	21	23/08/2010	3.9	3.6	6.5	3
30/03/2007	25.8	11.6	27.2	12.5	29/08/2010	9.2	10.2	9.8	5.4
5/04/2007	12.7	27	21.2	11.7	4/09/2010	3.4	3.1	6.6	3.3
11/04/2007	23.9	27.3	21.7	14.3	10/09/2010	4.9	4.4	6	4
17/04/2007	23.3	31.4	31.5	21.3	16/09/2010	9	21.2	27.9	16.1
23/04/2007	17.9	15.2	19.3	13.1	22/09/2010	15.5	22.3	23.4	12.4
29/04/2007	10.9	9.2	15.6	10.6	28/09/2010	10.5	13.9	25.1	10.1
5/05/2007	34.5	30.4	46.4	30.5	4/10/2010	3.2	3.5	6.2	3
11/05/2007	ND	13.5	14.6	10.4	10/10/2010	8.9	10.3	19.3	8.6
17/05/2007	ND	18.1	10.8	7.8	16/10/2010	3.6	3.6	12.3	4
23/05/2007	ND	5.6	11.7	5.5	22/10/2010	7.6	10.4	24.5	9.6
29/05/2007	ND	13.7	11.9	8.7	28/10/2010	15.5	15.9	35	15.8
4/06/2007	ND	4.9	6.5	4.7	3/11/2010	6.1	8.2	18.4	8.7
10/06/2007	9.5	4.9	7.1	6.1	9/11/2010	8.3	7.8	17.1	8
16/06/2007	6.5	2.6	4.5	2.7	15/11/2010	5.9	4.4	14	7.8
22/06/2007	5.1	2.5	5.4	3.3	21/11/2010	12.5	14.4	20.5	10.4
28/06/2007	2	1.6	2.6	1.5	27/11/2010	6	10.7	19.1	11.3
4/07/2007	5	4.6	12.5	5.1	3/12/2010	ND	ND	ND	ND
10/07/2007	6.6	6.8	4.6	4.3	9/12/2010	ND	19.3	8	9
16/07/2007	8	6.1	17	7.9	15/12/2010	ND	13.5	23.1	16.1
22/07/2007	6.2	7.7	6.3	4.8	21/12/2010	ND	ND	ND	ND
28/07/2007	3.5	4.4	9.3	4.8	27/12/2010	ND	ND	ND	ND
3/08/2007	3.3	1.9	6.1	2.3	2/01/2011	13.1	15	30.8	16.4
9/08/2007	7.6	8.7	15.5	6.6	8/01/2011	10.2	8.8	13.3	9.7
15/08/2007	11	23.7	15.6	9.6	14/01/2011	8.9	11.4	14.5	14.1
21/08/2007	4.6	7.5	8.1	4.6	20/01/2011	13.9	14.1	20.7	ND
27/08/2007	9.5	12.7	17.9	10.1	26/01/2011	18.7	32.7	33	ND
2/09/2007	15.9	22.7	26.4	16.4	1/02/2011	16.6	26.9	29.3	25.2
8/09/2007	5.4	12.7	7.8	3.9	7/02/2011	9.5	8.9	15.3	7.8
14/09/2007	18.4	44	39.5	29.1	13/02/2011	6.4	6	9.6	6
20/09/2007	10.2	24.5	26.5	11.1	19/02/2011	21.9	23.9	32.9	19.4
26/09/2007	20.1	30.1	36.7	21	25/02/2011	16.5	30.5	23.8	17
2/10/2007	22.6	27.3	49.3	31.5	3/03/2011	9.5	10.7	17.1	11
8/10/2007	18.9	19.3	30.1	15.2	9/03/2011	12.4	27.7	24	14.4
14/10/2007	10.6	18	5.3	1	15/03/2011	12	ND	14.5	12.7
20/10/2007	35.1	45.1	53.6	36.5	21/03/2011	6.6	6.8	13	5.4
26/10/2007	5.5	5.4	7.3	6	27/03/2011	6.5	7.8	10.7	6.3



Date	HV1	HV2	HV3	HV4	Date	HV1	HV2	HV3	HV4
1/11/2007	15.5	18	29.3	14.9	2/04/2011	15.5	18.2	37.5	14.5
7/11/2007	4.7	5.9	3.9	4	8/04/2011	5.1	6.4	10.9	5
13/11/2007	13.1	25	22.3	14.9	14/04/2011	7.5	7.7	13	5.8
19/11/2007	19.2	25.8	28.7	19.5	20/04/2011	10.1	13.6	20.5	18.2
25/11/2007	10.5	10.4	13.1	9.3	26/04/2011	2.5	2.6	6.5	1.2
1/12/2007	8.9	8.8	13.7	8.4	2/05/2011	6.2	19.4	11.3	9.7
7/12/2007	13.8	14.2	22.5	14.5	8/05/2011	13.2	15.2	27.5	13.6
13/12/2007	13.7	17.5	20.4	15.2	14/05/2011	6.1	ND	ND	ND
19/12/2007	14.1	19.9	25.2	14.8	20/05/2011	12.3	17	17	18
25/12/2007	11.1	10.2	14.6	12	26/05/2011	6.9	5	10	5.8
31/12/2007	25.8	26.5	34.7	27.5	1/06/2011	6.5	8.1	ND	ND
6/01/2008	6.1	8.6	15.3	6.1	7/06/2011	5.8	7.4	21.5	1
12/01/2008	24.2	32.3	43.6	31	13/06/2011	3.2	14.9	7	2.6
18/01/2008	3	3.3	6.1	3.3	19/06/2011	6.1	ND	23.8	6
24/01/2008	17.3	18.7	25.6	17.8	25/06/2011	10.9	6.5	8.1	1
30/01/2008	15.6	22.9	24.8	17.2	1/07/2011	6.7	4.9	8.1	1
5/02/2008	9.8	22.4	27.7	13.5	7/07/2011	5.5	3.7	27.6	1.7
11/02/2008	10.9	12	20.6	10.5	13/07/2011	14.4	13.5	39.9	15
17/02/2008	10	11.4	22.1	7.4	19/07/2011	2.5	ND	7.2	2.7
23/02/2008	38.4	39.5	30.4	36.5	25/07/2011	6.4	6.5	16.5	1
29/02/2008	9.2	8	12.1	7.1	31/07/2011	12.6	8.8	25.9	15.1
6/03/2008	19.1	23.1	28.8	17.2	6/08/2011	11.1	23.8	15.2	24.6
12/03/2008	28.6	19.8	20.9	18.8	12/08/2011	6.8	5	8.7	1
18/03/2008	16.6	23.3	18.7	14.6	18/08/2011	4.1	4.2	9.3	4.9
24/03/2008	14.3	13.6	16.2	11.8	24/08/2011	8.6	20.7	9.8	6
30/03/2008	11.8	12	20.6	13.9	30/08/2011	13.7	16.1	22.6	11.6
5/04/2008	14.9	19.9	18	13.4	5/09/2011	12.7	20.3	23.3	14.7
11/04/2008	11.7	16.8	13.9	10.9	11/09/2011	4.5	3.9	10.7	3.6
17/04/2008	10.9	15.1	14.7	11.5	17/09/2011	12.6	12.4	29.5	12.3
23/04/2008	3.3	6.1	5.9	2.4	23/09/2011	16.2	22.7	34.6	22.2
29/04/2008	4.6	4.1	5.2	3.4	29/09/2011	4.5	4.2	8.3	4.1
5/05/2008	13.3	15.7	17.2	10.7	5/10/2011	9	13.2	11	8
11/05/2008	14.8	18.7	16.2	14.3	11/10/2011	4.8	5.3	15.6	5
17/05/2008	9.8	8.1	15.5	9	17/10/2011	12.9	21.3	22.9	13.5
23/05/2008	7.7	7.9	8.9	6.4	23/10/2011	19.2	33.7	38	24.8
29/05/2008	10.2	9.9	11.2	5.3	29/10/2011	8.8	16.7	22.4	15.6
4/06/2008	2.5	1.7	3	1.1	4/11/2011	11.8	11.8	26.4	14.3
10/06/2008	4.8	4.2	4.2	2.4	10/11/2011	12.5	13.5	37.9	13
16/06/2008	4.5	5.2	3.6	3.4	16/11/2011	18.1	30.4	27.9	18.6
22/06/2008	3.7	3	3.8	2.6	22/11/2011	9.8	9.8	17.5	15.9
28/06/2008	10.6	10.5	10	3.1	28/11/2011	10.3	15.7	16.5	9.1
4/07/2008	10.1	7.5	11.8	5.7	4/12/2011	12.2	19.7	27.5	22.7
10/07/2008	2.2	2.3	7.4	2.5	10/12/2011	6.3	7	10.8	7.4
16/07/2008	ND	5	6.8	2.1	16/12/2011	10.8	11.3	20.5	11.6
22/07/2008	ND	7.6	9.8	3.7	22/12/2011	7.7	7.5	14.4	9.3
28/07/2008	5.6	2.4	5.8	2.7	28/12/2011	10.4	12.2	20.4	13.7
3/08/2008	5.3	4	7.7	2.8	3/01/2012	13.9	25.3	24.5	21.8
9/08/2008	4.9	3	6.7	2.2	9/01/2012	12	13	25.2	14.1
15/08/2008	2.6	3.2	12	1.8	15/01/2012	8.3	11.2	13.3	10
21/08/2008	14	ND	21	15.5	21/01/2012	13	12.5	17.2	11.9
27/08/2008	13.2	10.5	19.9	11.7	27/01/2012	10.1	9.6	14.5	9.7



Date	HV1	HV2	HV3	HV4	Date	HV1	HV2	HV3	HV4
2/09/2008	6.6	6.7	9.1	4.9	2/02/2012	3.1	3.8	5.5	4
8/09/2008	5.1	5.3	8.5	5.4	8/02/2012	8.8	12.4	20.7	10.3
14/09/2008	8.4	8.7	ND	9.3	14/02/2012	7.5	12.3	13.9	7.3
20/09/2008	18.7	19.3	34.3	21	20/02/2012	4.6	5.5	9.4	9.4
26/09/2008	10.1	9.8	20.6	6.8	26/02/2012	5.4	6.9	11.4	8.7
3/10/2008	17.9	22.6	36.1	21.7	3/03/2012	2.8	3.1	4.1	2.9
9/10/2008	6	6.4	19	4.8	9/03/2012	6.1	12.8	17.9	8
15/10/2008	4.7	7.6	10.5	4.9	15/03/2012	6.1	12.8	17.9	8
22/10/2008	16.1	26.9	51.6	18.2	21/03/2012	4.6	6.7	11.2	5.8
27/10/2008	15.6	ND	35.8	18.8	27/03/2012	9.7	ND	16.6	10.7
5/11/2008	22.9	ND	50.6	20.5	2/04/2012	5.5	6.1	9.3	7
11/11/2008	23.7	ND	52	22.4	8/04/2012	21.7	23.6	37.5	20.6
14/11/2008	18.9	ND	24.7	11.8	14/04/2012	9.9	22.4	19.5	12
21/11/2008	5.1	ND	9.8	4.4	20/04/2012	5.8	12.4	12.7	7.2
27/11/2008	18.1	ND	38.1	15.1	26/04/2012	6.9	5.2	15.6	7.4
1/12/2008	12.8	ND	26.1	11.4	2/05/2012	5.4	8.9	8.5	5.6
7/12/2008	10.7	11.3	29.5	11.4	8/05/2012	8.3	8.6	24.8	7
13/12/2008	19.2	17.5	ND	18.3	14/05/2012	8.6	9.3	19	13.6
19/12/2008	8.4	7.1	18.3	7.3	20/05/2012	13.1	30.1	24.6	1
25/12/2008	13.3	11.1	18.4	11.8	26/05/2012	4.9	3.2	13	3.4
31/12/2008	26.8	ND	69.1	24.5	1/06/2012	7.3	11.9	6.6	4.5
6/01/2009	19.4	17	43.1	20.9	7/06/2012	4	8.3	6.1	2
12/01/2009	16.1	16.2	28.2	16.1	13/06/2012	13.1	5.9	6	4.5
18/01/2009	17.6	19.9	26.8	19.3	19/06/2012	3.1	3.4	2.9	5.3
24/01/2009	13.9	22.9	26.3	14.4	25/06/2012	ND	ND	11.8	ND
30/01/2009	17.6	27.7	ND	18.1	1/07/2012	7.3	6.6	25	5.4
5/02/2009	16.5	31.6	30.6	18.3	7/07/2012	6.2	11.9	3.9	5.8
11/02/2009	7.1	8	11.1	7.7	13/07/2012	4.2	6.4	7.3	4.3
17/02/2009	4.8	5.6	7.5	4	19/07/2012	7.8	7	5.9	4.2
23/02/2009	13.7	15.2	18.5	13.5	25/07/2012	5.4	8.2	6.2	<1
1/03/2009	28.3	ND	55.4	ND	31/07/2012	7.7	6.9	7.3	6.1
7/03/2009	18.3	13.5	37.2	ND	6/08/2012	6.5	8.5	26.4	7.4
13/03/2009	10.2	ND	15.5	ND	12/08/2012	6.8	13.8	1.9	<1
19/03/2009	13.1	27	ND	ND	18/08/2012	5.9	4.5	35.4	3.5
25/03/2009	35.1	32.6	ND	30.5	24/08/2012	7.1	5.9	23.2	5.6
31/03/2009	ND	12.3	ND	ND	30/08/2012	11.1	10.1	35.2	9.9
6/04/2009	15	14.5	ND	15.5	5/09/2012	16.9	34.2	40.4	16.8
12/04/2009	6.4	5.6	ND	5.8	11/09/2012	10.1	19.8	33.2	<1
18/04/2009	14.5	21	ND	18.9	17/09/2012	16.1	12.1	38.8	<1
24/04/2009	9.3	17.4	ND	11.3	23/09/2012	10.1	25.6	24.1	<1
30/04/2009	ND	ND	ND	ND	29/09/2012	7.3	7.4	17.8	7.2
6/05/2009	13.1	21.6	ND	13.7	5/10/2012	13.2	16	47	20.2
12/05/2009	24.2	15.9	23.2	15.5	11/10/2012		7.1	20.8	6.7
18/05/2009	18.7	22.8	25.7	18.2	17/10/2012	14.4	32.2	36.4	18.4
24/05/2009	17.6	16.6	24.8	16	23/10/2012	10.6	47.6	26.8	11.7
30/05/2009	8.1	10.3	6.7	3.9	29/10/2012	12.2	29.9	25.3	15
5/06/2009	4.3	1.1	5.5	2.1	4/11/2012	15.4	30.5	26.5	15.6
11/06/2009	5.6	2.9	13.2	3.7	10/11/2012	8.4	14.3	18.1	9.8
17/06/2009	8.1	7.7	9.1	7.1	16/11/2012	8	10.6	19.8	13.1
23/06/2009	5.4	5.2	5.8	4.2	22/11/2012	14.8	29.3	29.9	16.9
29/06/2009	4.3	2.9	6.6	2.8	28/11/2012	13	14.9	18.3	13



Date	HV1	HV2	HV3	HV4	Date	HV1	HV2	HV3	HV4
5/07/2009	3.1	4.6	8.2	2.3	4/12/2012	10.6	12.4	26.9	11.3
11/07/2009	11.5	7.2	8.9	6.1	10/12/2012	5.2	10.8	12.8	16.9
17/07/2009	4.7	3.9	6	4.5	16/12/2012	10.9	18.5	22	15.3
23/07/2009	7.3	6.9	16.3	5.8	22/12/2012	12.9	17.7	24	14.7
29/07/2009	4	1	7.1	3.3	28/12/2012	13.7	23	24	14.3

ND - No data



Appendix C

CALMET/CALPUFF Input Variables



Table C-1: CALMET input variables

Parameter	Value
Terrain radius of influence (TERRAD)	10km
Vertical extrapolation of surface wind observations (IEXTRP)	-4
Layer dependent weighting factor of surface vs. upper air wind observations (BIAS [NZ])	-1,-0.5,-0.25,0,0,0,0
Weighting parameter for Step 1 wind field vs. Observations	R1 = 0.5km, R2 = 0.5km
Maximum radius of influence for meteorological stations in Layer 1 and layers aloft	RMAX1=1.0km, RMAX2=1.0km

Table C-2: CALPUFF input variables

Parameter	Used option	Value
Aqueous phase transformation modelled?	No	0
Boundary conditions modelled?	No	0
CGRUP (Species groups)	PM _{2.5} , PM ₁₀ and TSP	-
Chemical transformation	Not modelled	0
Dry deposition modelled?	Yes	1
Gravitational settling (plume tilt) modelled?	No	0
Horizontal size of puff (m) beyond which time-dependent dispersion equations (Heffter) are used to determine sigma-y and sigma-z	Default	550
Individual source conditions saved?	No	0
Maximum length of a slug (met. grid units)	Default	1
Maximum mixing height	Default	3000
Maximum number of sampling steps for one puff/slug during one time step	-	60
Maximum number of slugs/puffs release from one source during one time step	-	60
Maximum sigma z allowed to avoid numerical problem in calculating virtual time or distance	Default	5.00E+06
Maximum travel distance of a puff/slug during one sampling step	Default	1
Method used to compute dispersion coefficients?	Internally calculated sigma v, sigma w using micrometeorological variables	2
Method used for lagrangian timescale for Sigma-y	Draxler default 617.284	0
Method used to compute turbulence sigma-v & sigma-w using micrometeorological variables	Standard CALPUFF subroutines	1
Minimum mixing height	Default	50
Minimum sigma y for a new puff/slug	Default	1
Minimum sigma z for a new puff/slug	Default	1
Minimum turbulence velocities sigma-v and sigma-w for each stability class over land and over water	Default	-
Near-field puffs modelled as elongated slugs?	No	0
Plume path coefficients for each stability class	Default	-
Potential temperature gradient for stable classes E, F	Default	-
Puff splitting allowed?	No	0
Range of land use categories for which urban dispersion is assumed	Default	-
Slug - to - puff transition criterion factor	Default	10
Stability class used to determine plume growth rates for puffs above the boundary layer	Default	5
Sub grid-scale complex terrain	Not Modelled	0
Switch for using Heffter equation for sigma-z	Default(Not use Heffter)	0
Terrain adjustment method	Default(Partial plume path adjustment)	3
Vegetation state in unirrigated areas	Default(Active and unstressed)	1
Vertical dispersion constant for stable conditions	Default	0.01
Vertical distribution used in the near field	Default (Gaussian)	1
Wet removal modelled?	No	0
Wind speed classes	Default	-
Wind speed profile power-law exponents for stabilities	Default	-



Appendix D

Emission Inventory



WCM - Emission Calculation

The mining schedule and mine plan designs provided by WCPL have been combined with emissions factor equations that relate to the quantity of dust emitted from particular activities based on intensity, the prevailing meteorological conditions and composition of the material being handled.

Emission factors and associated controls have been sourced from the United States (US EPA) AP42 Emission Factors (**US EPA, 1985 and Updates**), the National Pollutant Inventory (NPI) document "*Emission Estimation Technique Manual for Mining, Version 3.1*" (**NPI, 2012**), the State Pollution Control Commission (SPCC) document "*Air Pollution from Coal Mining and Related Developments*" (**SPCC, 1983**) and the Office of Environment and Heritage document, "*NSW Coal Mining Benchmarking Study: International Best Practise Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining*", prepared by Katestone Environmental (**Katestone Environmental, 2010**).

The emission factor equations used for each dust generating activity are outlined in **Table D-1** below. Detailed emission inventories for each modelled year are presented in **Table D-2** to **Table D-3**.



Table D-1: Emission factor equations

Activity	Emission factor equation	Variables	Control	Source
Drilling (overburden/coal)	$EF = 0.59 \text{ kg/hole}$	-	70% - water sprays	US EPA, 1985 NPI, 2012
Blasting (overburden/coal)	$EF = 0.00022 \times A^{1.5} \text{ kg/blast}$	A = area to be blasted (m ²)	-	US EPA, 1985
Loading / emplacing overburden	$EF = k \times 0.0016 \times \left(\frac{U^{1.3}}{2.2} / \frac{M^{1.4}}{2} \right) \text{ kg/tonne}$	Ktsp = 0.74 U = wind speed (m/s) M = moisture content (%)	-	US EPA, 1985
Hauling on unsealed surfaces	$EF = \left(\frac{0.4536}{1.6093} \right) \times k \times (s/12)^{0.7} \times (1.1023 \times M/3)^{0.45} \text{ kg/VKT}$	S = silt content (%) M = average vehicle gross mass (tonnes)	80% - watering of trafficked areas	US EPA, 1985
Dozers on overburden	$EF = 2.6 \times \frac{s^{1.2}}{M^{1.3}} \text{ kg/hour}$	S = silt content (%) M = moisture content (%)	-	US EPA, 1985
Dozers on coal	$EF = 35.6 \times \frac{s^{1.2}}{M^{1.4}} \text{ kg/hour}$	S = silt content (%) M = moisture content (%)	-	US EPA, 1985
Loading / emplacing coal	$EF = \frac{0.58}{M^{1.2}} \text{ kg/tonne}$	M = moisture content (%)	85% - enclosed dump hopper and water sprays	US EPA, 1985
Loading product coal to stockpile / train	$EF = k \times 0.0016 \times \left(\frac{U^{1.3}}{2.2} / \frac{M^{1.4}}{2} \right) \text{ kg/tonne}$	Ktsp = 0.74 U = wind speed (m/s) M = moisture content (%)	75% - telescopic chute with water sprays	US EPA, 1985
Wind erosion on exposed areas / stockpiles	$EF = 0.4 \text{ kg/ha / hour}$	-	21% - vegetation on 30% of area / 50% - water sprays	SPCC, 1983
Grading roads	$EF = 0.0034 \times s^{2.5} \text{ kg/VKT}$	S = speed of grader (km/hr)	-	US EPA, 1985



Table D-2: Emissions inventory - Year 13

ACTIVITY	TSP emission (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units
OB - Stripping Topsoil (Pi 1) - Scraper removing topsoil	587	20,249	tonnes/year	0.03	kg/t												
OB - Stripping Topsoil (Pi 2) - Scraper removing topsoil	-	-	tonnes/year	0.03	kg/t												
OB - Stripping Topsoil (Pi 3) - Scraper removing topsoil	1,335	52,923	tonnes/year	0.03	kg/t												
OB - Stripping Topsoil (Pi 4) - Scraper removing topsoil	-	-	tonnes/year	0.03	kg/t												
OB - Stripping Topsoil (Pi 5) - Scraper removing topsoil	3,825	97,428	tonnes/year	0.03	kg/t												
OB - Stripping Topsoil (Pi 6) - Scraper removing topsoil	2,874	98,994	tonnes/year	0.03	kg/t												
OB - Loading topsoil to haul truck (Pi 1)	-	5	tonnes/year	0.000	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Loading topsoil to haul truck (Pi 2)	-	-	tonnes/year	0.000	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Loading topsoil to haul truck (Pi 3)	13	52,923	tonnes/year	0.000	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Loading topsoil to haul truck (Pi 4)	-	-	tonnes/year	0.000	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Loading topsoil to haul truck (Pi 5)	25	97,428	tonnes/year	0.000	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Loading topsoil to haul truck (Pi 6)	25	98,994	tonnes/year	0.000	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Hauling to emplacement from Pi 1	1,447	20,249	tonnes/year	0.088	kg/t	40	tonnes/load	1.0	km/return trip	3.5	kg/VKT	7.1	% silt c	50	Ave GMV item	75	Control
OB - Hauling to emplacement from Pi 2	-	-	tonnes/year	0.000	kg/t	40	tonnes/load	1.0	km/return trip	3.5	kg/VKT	7.1	% silt c	50	Ave GMV item	75	Control
OB - Hauling to emplacement from Pi 3	1,168	52,923	tonnes/year	0.088	kg/t	40	tonnes/load	1.0	km/return trip	3.5	kg/VKT	7.1	% silt c	50	Ave GMV item	75	Control
OB - Hauling to emplacement from Pi 4	-	-	tonnes/year	0.000	kg/t	40	tonnes/load	1.0	km/return trip	3.5	kg/VKT	7.1	% silt c	50	Ave GMV item	75	Control
OB - Hauling to emplacement from Pi 5	2,150	97,428	tonnes/year	0.088	kg/t	40	tonnes/load	1.0	km/return trip	3.5	kg/VKT	7.1	% silt c	50	Ave GMV item	75	Control
OB - Hauling to emplacement from Pi 6	2,184	98,994	tonnes/year	0.088	kg/t	40	tonnes/load	1.0	km/return trip	3.5	kg/VKT	7.1	% silt c	50	Ave GMV item	75	Control
OB - Emplacing topsoil at dump (Pi 1)	-	5	tonnes/year	0.000	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Emplacing topsoil at dump (Pi 2)	-	-	tonnes/year	0.000	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Emplacing topsoil at dump (Pi 3)	13	52,923	tonnes/year	0.000	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Emplacing topsoil at dump (Pi 4)	-	-	tonnes/year	0.000	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Emplacing topsoil at dump (Pi 5)	25	97,428	tonnes/year	0.000	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Emplacing topsoil at dump (Pi 6)	25	98,994	tonnes/year	0.000	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Drilling (Pi 1)	733	12,431	holes/year	0.59	kg/ha												90% Control
OB - Drilling (Pi 2)	-	-	holes/year	0.59	kg/ha												90% Control
OB - Drilling (Pi 3)	1,247	21,143	holes/year	0.59	kg/ha												90% Control
OB - Drilling (Pi 4)	-	-	holes/year	0.59	kg/ha												90% Control
OB - Drilling (Pi 5)	3,918	66,407	holes/year	0.59	kg/ha												90% Control
OB - Drilling (Pi 6)	10,208	173,018	holes/year	0.59	kg/ha												90% Control
OB - Blasting (Pi 1)	20,852	32	blasts/year	1743	kg/blast	40,040	Area of blast in square metres										
OB - Blasting (Pi 2)	-	-	blasts/year	1743	kg/blast	40,040	Area of blast in square metres										
OB - Blasting (Pi 3)	35,493	20	blasts/year	1743	kg/blast	40,040	Area of blast in square metres										
OB - Blasting (Pi 4)	-	-	blasts/year	1743	kg/blast	40,040	Area of blast in square metres										
OB - Blasting (Pi 5)	111,478	63	blasts/year	1743	kg/blast	40,040	Area of blast in square metres										
OB - Blasting (Pi 6)	290,447	165	blasts/year	1743	kg/blast	40,040	Area of blast in square metres										
OB - Excavator loading OB to haul truck (Pi 1)	2,880	2,057,681	tonnes/year	0.001	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Excavator loading OB to haul truck (Pi 2)	-	-	tonnes/year	0.001	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Excavator loading OB to haul truck (Pi 3)	4,048	3,499,639	tonnes/year	0.001	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Excavator loading OB to haul truck (Pi 4)	-	-	tonnes/year	0.001	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Excavator loading OB to haul truck (Pi 5)	12,715	10,991,808	tonnes/year	0.001	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Excavator loading OB to haul truck (Pi 6)	33,128	28,638,291	tonnes/year	0.001	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Hauling to dump from Pi 1	27,510	2,057,681	tonnes/year	0.053	kg/t	181	tonnes/load	1.5	km/return trip	6.5	kg/VKT	7.1	% silt c	191	Ave GMV item	75	Control
OB - Hauling to dump from Pi 2	-	-	tonnes/year	0.000	kg/t	181	tonnes/load	1.5	km/return trip	6.5	kg/VKT	7.1	% silt c	191	Ave GMV item	75	Control
OB - Hauling to dump from Pi 3	46,789	3,499,639	tonnes/year	0.053	kg/t	181	tonnes/load	1.5	km/return trip	6.5	kg/VKT	7.1	% silt c	191	Ave GMV item	75	Control
OB - Hauling to dump from Pi 4	-	-	tonnes/year	0.000	kg/t	181	tonnes/load	1.5	km/return trip	6.5	kg/VKT	7.1	% silt c	191	Ave GMV item	75	Control
OB - Hauling to dump from Pi 5	146,955	10,991,808	tonnes/year	0.053	kg/t	181	tonnes/load	1.5	km/return trip	6.5	kg/VKT	7.1	% silt c	191	Ave GMV item	75	Control
OB - Hauling to dump from Pi 6	382,881	28,638,291	tonnes/year	0.053	kg/t	181	tonnes/load	1.5	km/return trip	6.5	kg/VKT	7.1	% silt c	191	Ave GMV item	75	Control
OB - Emplacing at dump (Pi 1)	2,380	2,057,681	tonnes/year	0.001	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Emplacing at dump (Pi 2)	-	-	tonnes/year	0.001	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Emplacing at dump (Pi 3)	4,048	3,499,639	tonnes/year	0.001	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Emplacing at dump (Pi 4)	-	-	tonnes/year	0.001	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Emplacing at dump (Pi 5)	12,715	10,991,808	tonnes/year	0.001	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Emplacing at dump (Pi 6)	33,128	28,638,291	tonnes/year	0.001	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Dozers on OB in pit (Pi 1)	32,044	2,393	hours/year	16.7	kg/h	10	silt content in %										20% Control
OB - Dozers on OB in pit (Pi 2)	-	-	hours/year	16.7	kg/h	10	silt content in %										20% Control
OB - Dozers on OB in pit (Pi 3)	54,499	4,071	hours/year	16.7	kg/h	10	silt content in %										20% Control
OB - Dozers on OB in pit (Pi 4)	-	-	hours/year	16.7	kg/h	10	silt content in %										20% Control
OB - Dozers on OB in pit (Pi 5)	174,771	12,785	hours/year	16.7	kg/h	10	silt content in %										20% Control
OB - Dozers on OB in pit (Pi 6)	445,974	33,311	hours/year	16.7	kg/h	10	silt content in %										20% Control
CL - Dozers ripping/pushing/clean-up (Pi 1)	10,276	2,225	hours/year	5.8	kg/h	1.74	silt content in %										20% Control
CL - Dozers ripping/pushing/clean-up (Pi 2)	-	-	hours/year	5.8	kg/h	1.74	silt content in %										20% Control
CL - Dozers ripping/pushing/clean-up (Pi 3)	20,834	4,511	hours/year	5.8	kg/h	1.74	silt content in %										20% Control
CL - Dozers ripping/pushing/clean-up (Pi 4)	-	-	hours/year	5.8	kg/h	1.74	silt content in %										20% Control
CL - Dozers ripping/pushing/clean-up (Pi 5)	31,393	6,786	hours/year	5.8	kg/h	1.74	silt content in %										20% Control
CL - Dozers ripping/pushing/clean-up (Pi 6)	58,878	12,748	hours/year	5.8	kg/h	1.74	silt content in %										20% Control
CL - Loading ROM coal to haul truck (Pi 1)	95,874	1,244,555	tonnes/year	0.069	kg/t	5.895	moisture content in %										
CL - Loading ROM coal to haul truck (Pi 2)	-	-	tonnes/year	0.069	kg/t	5.895	moisture content in %										
CL - Loading ROM coal to haul truck (Pi 3)	174,099	2,523,184	tonnes/year	0.069	kg/t	5.895	moisture content in %										
CL - Loading ROM coal to haul truck (Pi 4)	-	-	tonnes/year	0.069	kg/t	5.895	moisture content in %										
CL - Loading ROM coal to haul truck (Pi 5)	262,315	3,803,684	tonnes/year	0.069	kg/t	5.895	moisture content in %										
CL - Loading ROM coal to haul truck (Pi 6)	492,008	7,130,577	tonnes/year	0.069	kg/t	5.895	moisture content in %										
CL - Hauling ROM to hopper from Pi 1	24,185	1,244,555	tonnes/year	0.071	kg/t	181	tonnes/load	2.0	km/return trip	6.5	kg/VKT	7.1	% silt c	191	Ave GMV item	75	Control
CL - Hauling ROM to hopper from Pi 2	-	-	tonnes/year	0.000	kg/t	181	tonnes/load	2.0	km/return trip	6.5	kg/VKT	7.1	% silt c	191	Ave GMV item	75	Control
CL - Hauling ROM to hopper from Pi 3	247,381	2,523,184	tonnes/year	0.071	kg/t	181	tonnes/load	2.0	km/return trip	6.5	kg/VKT	7.1	% silt c	191	Ave GMV item	75	Control
CL - Hauling ROM to hopper from Pi 4	-	-	tonnes/year	0.000	kg/t	181	tonnes/load	2.0	km/return trip	6.5	kg/VKT	7.1	% silt c	191	Ave GMV item	75	Control
CL - Hauling ROM to hopper from Pi 5	304,961	3,803,684	tonnes/year	0.071	kg/t	181	tonnes/load	2.0	km/return trip	6.5	kg/VKT	7.1	% silt c	191	Ave GMV item	75	Control
CL - Hauling ROM to hopper from Pi 6	599,105	7,130,577	tonnes/year	0.071	kg/t	181	tonnes/load	2.0	km/return trip	6.5	kg/VKT	7.1	% silt c	191	Ave GMV item	75	Control
CHPP - Unloading ROM to hopper (all pits)	760,722	14,700,000	tonnes/year	0.069	kg/t	5.895	moisture content in %										
CHPP - Rehandle ROM to hopper	907,148	2,500,000	tonnes/year	0.069	kg/t	5.895	moisture content in %										
CHPP - Screening	16,170	14,700,000	tonnes/year	0.0011	kg/t												
CHPP - Crushing	8,820	14,700,000	tonnes/year	0.0006	kg/t												
CHPP - Sized Coal Unloading to Existing Product/Raw Stockpiles	1,104	14,700,000	tonnes/year	0.000	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	5.24	moisture content in %								75% Control
CHPP - Loading from RAW to CHPP	1,248	8,300,000	tonnes/year	0.000	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	5.24	moisture content in %								50% Control
CHPP - Loading from ROM to CHPP (all pits)	961	4,400,000	tonnes/year	0.000	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	5.24	moisture content in %								50% Control
CHPP - Unloading from CHPP to Product Stockpile	818	4,700,000	tonnes/year	0.000	kg/t	0.977	average of (wind speed/2) ² *1.3 in m/s	4.715	moisture content in %								50% Control
CHPP - Loading from Product Stockpile to trains	1,836																

Table D-3: Emissions inventory - Year 16

ACTIVITY	TSP emission (kg/yr)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units
OB - Stripping Topsoil (Pi 1) - Scraper re-moving topsoil	935	32,239	tonnes/year	0.03 kg/t													
OB - Stripping Topsoil (Pi 2) - Scraper re-moving topsoil	-	-	tonnes/year	0.03 kg/t													
OB - Stripping Topsoil (Pi 3) - Scraper re-moving topsoil	3,742	129,023	tonnes/year	0.03 kg/t													
OB - Stripping Topsoil (Pi 4) - Scraper re-moving topsoil	-	-	tonnes/year	0.03 kg/t													
OB - Stripping Topsoil (Pi 5) - Scraper re-moving topsoil	-	-	tonnes/year	0.03 kg/t													
OB - Stripping Topsoil (Pi 6) - Scraper re-moving topsoil	-	-	tonnes/year	0.03 kg/t													
OB - Loading topsoil to haul truck (Pi 1)	8	32,239	tonnes/year	0.000 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Loading topsoil to haul truck (Pi 2)	-	-	tonnes/year	0.000 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Loading topsoil to haul truck (Pi 3)	33	129,023	tonnes/year	0.000 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Loading topsoil to haul truck (Pi 4)	-	-	tonnes/year	0.000 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Loading topsoil to haul truck (Pi 5)	-	-	tonnes/year	0.000 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Loading topsoil to haul truck (Pi 6)	-	-	tonnes/year	0.000 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Hauling to emplacement from Pi 1	111	32,239	tonnes/year	0.004 kg/t			40 tonnes/load	1.0	km/return trip	3.0 kg/VKT	7.1 % silt c	191	Ave GMV (ton)	75	% Control		
OB - Hauling to emplacement from Pi 2	-	-	tonnes/year	0.000 kg/t			40 tonnes/load	-	km/return trip	3.0 kg/VKT	7.1 % silt c	191	Ave GMV (ton)	75	% Control		
OB - Hauling to emplacement from Pi 3	2,847	129,023	tonnes/year	0.004 kg/t			40 tonnes/load	1.0	km/return trip	3.0 kg/VKT	7.1 % silt c	191	Ave GMV (ton)	75	% Control		
OB - Hauling to emplacement from Pi 4	-	-	tonnes/year	0.000 kg/t			40 tonnes/load	-	km/return trip	3.0 kg/VKT	7.1 % silt c	191	Ave GMV (ton)	75	% Control		
OB - Hauling to emplacement from Pi 5	-	-	tonnes/year	0.000 kg/t			40 tonnes/load	-	km/return trip	3.0 kg/VKT	7.1 % silt c	191	Ave GMV (ton)	75	% Control		
OB - Hauling to emplacement from Pi 6	-	-	tonnes/year	0.000 kg/t			40 tonnes/load	-	km/return trip	3.0 kg/VKT	7.1 % silt c	191	Ave GMV (ton)	75	% Control		
OB - Emplacing topsoil at dump (Pi 1)	8	32,239	tonnes/year	0.000 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Emplacing topsoil at dump (Pi 2)	-	-	tonnes/year	0.000 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Emplacing topsoil at dump (Pi 3)	33	129,023	tonnes/year	0.000 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Emplacing topsoil at dump (Pi 4)	-	-	tonnes/year	0.000 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Emplacing topsoil at dump (Pi 5)	-	-	tonnes/year	0.000 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Emplacing topsoil at dump (Pi 6)	-	-	tonnes/year	0.000 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	5.915	moisture content in %								
OB - Drilling (Pi 1)	1,557	26,383	holes/year	0.59 kg/hole													90 % Control
OB - Drilling (Pi 2)	-	-	holes/year	0.59 kg/hole													90 % Control
OB - Drilling (Pi 3)	14,550	246,617	holes/year	0.59 kg/hole													90 % Control
OB - Drilling (Pi 4)	-	-	holes/year	0.59 kg/hole													90 % Control
OB - Drilling (Pi 5)	-	-	holes/year	0.59 kg/hole													90 % Control
OB - Drilling (Pi 6)	-	-	holes/year	0.59 kg/hole													90 % Control
OB - Blasting (Pi 1)	44,289	29	blasts/year	1793 kg/blast			40,040 Area of blast in square metres										
OB - Blasting (Pi 2)	-	-	blasts/year	1793 kg/blast			40,040 Area of blast in square metres										
OB - Blasting (Pi 3)	413,098	235	blasts/year	1793 kg/blast			40,040 Area of blast in square metres										
OB - Blasting (Pi 4)	-	-	blasts/year	1793 kg/blast			40,040 Area of blast in square metres										
OB - Blasting (Pi 5)	-	-	blasts/year	1793 kg/blast			40,040 Area of blast in square metres										
OB - Blasting (Pi 6)	-	-	blasts/year	1793 kg/blast			40,040 Area of blast in square metres										
OB - Excavator loading OB to haul truck (Pi 1)	3,597	3,109,330	tonnes/year	0.001 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Excavator loading OB to haul truck (Pi 2)	-	-	tonnes/year	0.001 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Excavator loading OB to haul truck (Pi 3)	33,622	29,065,160	tonnes/year	0.001 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Excavator loading OB to haul truck (Pi 4)	-	-	tonnes/year	0.001 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Excavator loading OB to haul truck (Pi 5)	-	-	tonnes/year	0.001 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Excavator loading OB to haul truck (Pi 6)	-	-	tonnes/year	0.001 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Hauling to dump from Pi 1	41,670	3,109,330	tonnes/year	0.003 kg/t			181 tonnes/load	1.5	km/return trip	6.0 kg/VKT	7.1 % silt c	191	Ave GMV (ton)	75	% Control		
OB - Hauling to dump from Pi 2	-	-	tonnes/year	0.000 kg/t			181 tonnes/load	-	km/return trip	6.0 kg/VKT	7.1 % silt c	191	Ave GMV (ton)	75	% Control		
OB - Hauling to dump from Pi 3	388,588	29,065,160	tonnes/year	0.003 kg/t			181 tonnes/load	1.5	km/return trip	6.0 kg/VKT	7.1 % silt c	191	Ave GMV (ton)	75	% Control		
OB - Hauling to dump from Pi 4	-	-	tonnes/year	0.000 kg/t			181 tonnes/load	-	km/return trip	6.0 kg/VKT	7.1 % silt c	191	Ave GMV (ton)	75	% Control		
OB - Hauling to dump from Pi 5	-	-	tonnes/year	0.000 kg/t			181 tonnes/load	-	km/return trip	6.0 kg/VKT	7.1 % silt c	191	Ave GMV (ton)	75	% Control		
OB - Hauling to dump from Pi 6	-	-	tonnes/year	0.000 kg/t			181 tonnes/load	-	km/return trip	6.0 kg/VKT	7.1 % silt c	191	Ave GMV (ton)	75	% Control		
OB - Emplacing at dump (Pi 1)	3,597	3,109,330	tonnes/year	0.001 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Emplacing at dump (Pi 2)	-	-	tonnes/year	0.001 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Emplacing at dump (Pi 3)	33,622	29,065,160	tonnes/year	0.001 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Emplacing at dump (Pi 4)	-	-	tonnes/year	0.001 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Emplacing at dump (Pi 5)	-	-	tonnes/year	0.001 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Emplacing at dump (Pi 6)	-	-	tonnes/year	0.001 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	2	moisture content in %								
OB - Dozers on OB in pit (Pi 1)	54,403	4,064	hours/year	16.7 kg/h			10 silt content in %										20 % Control
OB - Dozers on OB in pit (Pi 2)	-	-	hours/year	16.7 kg/h			10 silt content in %										20 % Control
OB - Dozers on OB in pit (Pi 3)	508,547	37,984	hours/year	16.7 kg/h			10 silt content in %										20 % Control
OB - Dozers on OB in pit (Pi 4)	-	-	hours/year	16.7 kg/h			10 silt content in %										20 % Control
OB - Dozers on OB in pit (Pi 5)	-	-	hours/year	16.7 kg/h			10 silt content in %										20 % Control
OB - Dozers on OB in pit (Pi 6)	-	-	hours/year	16.7 kg/h			10 silt content in %										20 % Control
CL - Dozers ripping/pushing/clean-up (Pi 1)	14,836	9,212	hours/year	5.8 kg/h			1.74 silt content in %										20 % Control
CL - Dozers ripping/pushing/clean-up (Pi 2)	-	-	hours/year	5.8 kg/h			1.74 silt content in %										20 % Control
CL - Dozers ripping/pushing/clean-up (Pi 3)	82,268	17,312	hours/year	5.8 kg/h			1.74 silt content in %										20 % Control
CL - Dozers ripping/pushing/clean-up (Pi 4)	-	-	hours/year	5.8 kg/h			1.74 silt content in %										20 % Control
CL - Dozers ripping/pushing/clean-up (Pi 5)	-	-	hours/year	5.8 kg/h			1.74 silt content in %										20 % Control
CL - Dozers ripping/pushing/clean-up (Pi 6)	-	-	hours/year	5.8 kg/h			1.74 silt content in %										20 % Control
CL - Loading ROM coal to haul truck (Pi 1)	80,121	1,161,182	tonnes/year	0.089 kg/t			5.895 moisture content in %										
CL - Loading ROM coal to haul truck (Pi 2)	-	-	tonnes/year	0.089 kg/t			5.895 moisture content in %										
CL - Loading ROM coal to haul truck (Pi 3)	444,277	6,439,818	tonnes/year	0.089 kg/t			5.895 moisture content in %										
CL - Loading ROM coal to haul truck (Pi 4)	-	-	tonnes/year	0.089 kg/t			5.895 moisture content in %										
CL - Loading ROM coal to haul truck (Pi 5)	-	-	tonnes/year	0.089 kg/t			5.895 moisture content in %										
CL - Loading ROM coal to haul truck (Pi 6)	-	-	tonnes/year	0.089 kg/t			5.895 moisture content in %										
CL - Hauling ROM to hopper from Pi 1	31,649	1,161,182	tonnes/year	0.107 kg/t			181 tonnes/load	3.0	km/return trip	6.0 kg/VKT	7.1 % silt c	191	Ave GMV (ton)	75	% Control		
CL - Hauling ROM to hopper from Pi 2	-	-	tonnes/year	0.000 kg/t			181 tonnes/load	-	km/return trip	6.0 kg/VKT	7.1 % silt c	191	Ave GMV (ton)	75	% Control		
CL - Hauling ROM to hopper from Pi 3	516,604	6,439,818	tonnes/year	0.321 kg/t			181 tonnes/load	9.0	km/return trip	6.0 kg/VKT	7.1 % silt c	191	Ave GMV (ton)	75	% Control		
CL - Hauling ROM to hopper from Pi 4	-	-	tonnes/year	0.000 kg/t			181 tonnes/load	-	km/return trip	6.0 kg/VKT	7.1 % silt c	191	Ave GMV (ton)	75	% Control		
CL - Hauling ROM to hopper from Pi 5	-	-	tonnes/year	0.000 kg/t			181 tonnes/load	-	km/return trip	6.0 kg/VKT	7.1 % silt c	191	Ave GMV (ton)	75	% Control		
CL - Hauling ROM to hopper from Pi 6	-	-	tonnes/year	0.000 kg/t			181 tonnes/load	-	km/return trip	6.0 kg/VKT	7.1 % silt c	191	Ave GMV (ton)	75	% Control		
CHPP - Unloading ROM to hopper (all pits)	393,298	7,600,000	tonnes/year	0.089 kg/t			5.895 moisture content in %										
CHPP - Rehandle ROM at hopper	262,199	3,800,000	tonnes/year	0.089 kg/t			5.895 moisture content in %										
CHPP - Screening	8,360	7,600,000	tonnes/year	0.001 kg/Mg													
CHPP - Crushing	4,560	7,600,000	tonnes/year	0.000 kg/Mg													
CHPP - Sized Coal Unloading to Existing Product/Raw Stockpiles	671	7,600,000	tonnes/year	0.000 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	5.24	moisture content in %								75 % Control
CHPP - Loading from RAW to CHPP	846	4,400,000	tonnes/year	0.000 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	5.24	moisture content in %								50 % Control
CHPP - Loading from RAW to trains (BWPASS)	496	3,400,000	tonnes/year	0.000 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	5.24	moisture content in %								50 % Control
CHPP - Unloading from CHPP to Product Stockpile	418	2,400,000	tonnes/year	0.000 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	4.715	moisture content in %								50 % Control
CHPP - Loading from Product Stockpile to trains	836	2,400,000	tonnes/year	0.000 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	5.55	moisture content in %								50 % Control
CHPP - Dozer on ROM Stockpiles	18,263	6,500	hours/year	5.2 kg/h			1.40 silt content in %										
CHPP - Dozer on Product/Raw Stockpiles	48,851	6,000	hours/year	6.1 kg/h			1.40 silt content in %										
CHPP - Loading coarse rejects	194	1,600,000	tonnes/year	0.000 kg/t			0.977 average of (wind speed/2) ² *1.3 in m/s	10	moisture content in %								
CHPP - Loading fine rejects from belt filter press	10	461,538															

Appendix E

Isoleth Diagrams



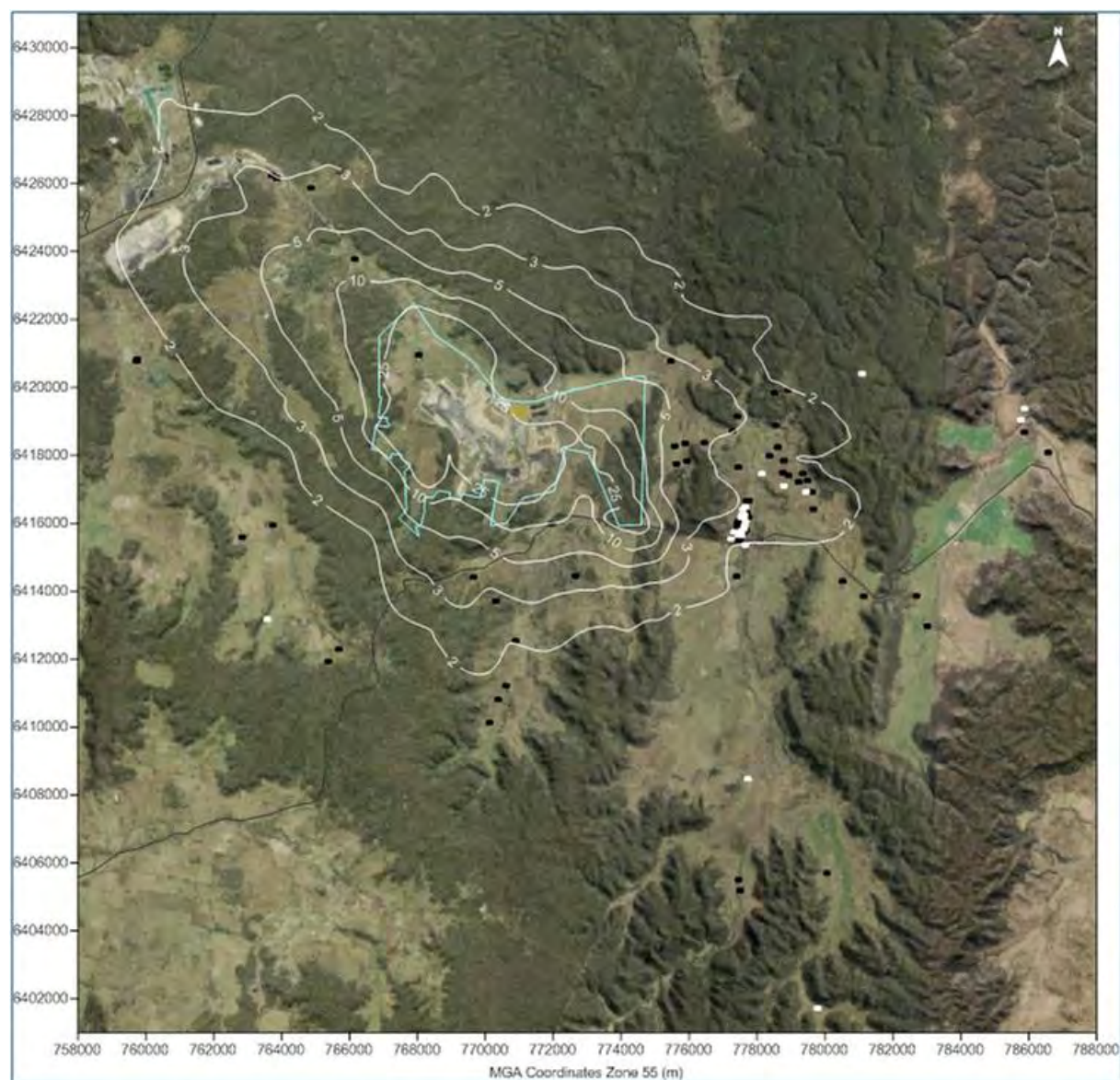


Figure E-1: Predicted maximum 24-hour average PM_{2.5} concentrations due to emissions from the Modification - Year 13 (2018)



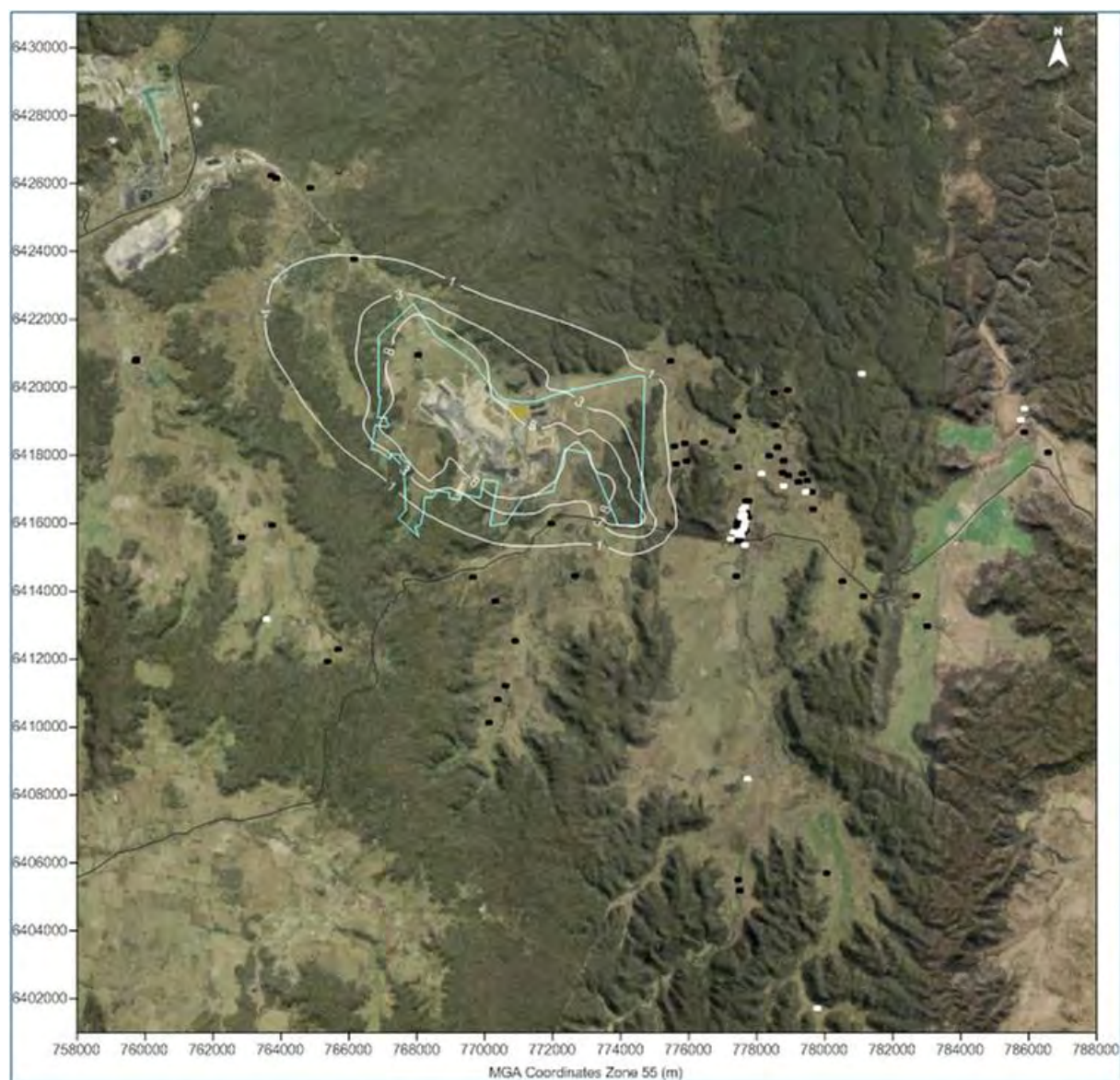


Figure E-2: Predicted annual average PM_{2.5} concentrations due to emissions from the Modification - Year 13 (2018)



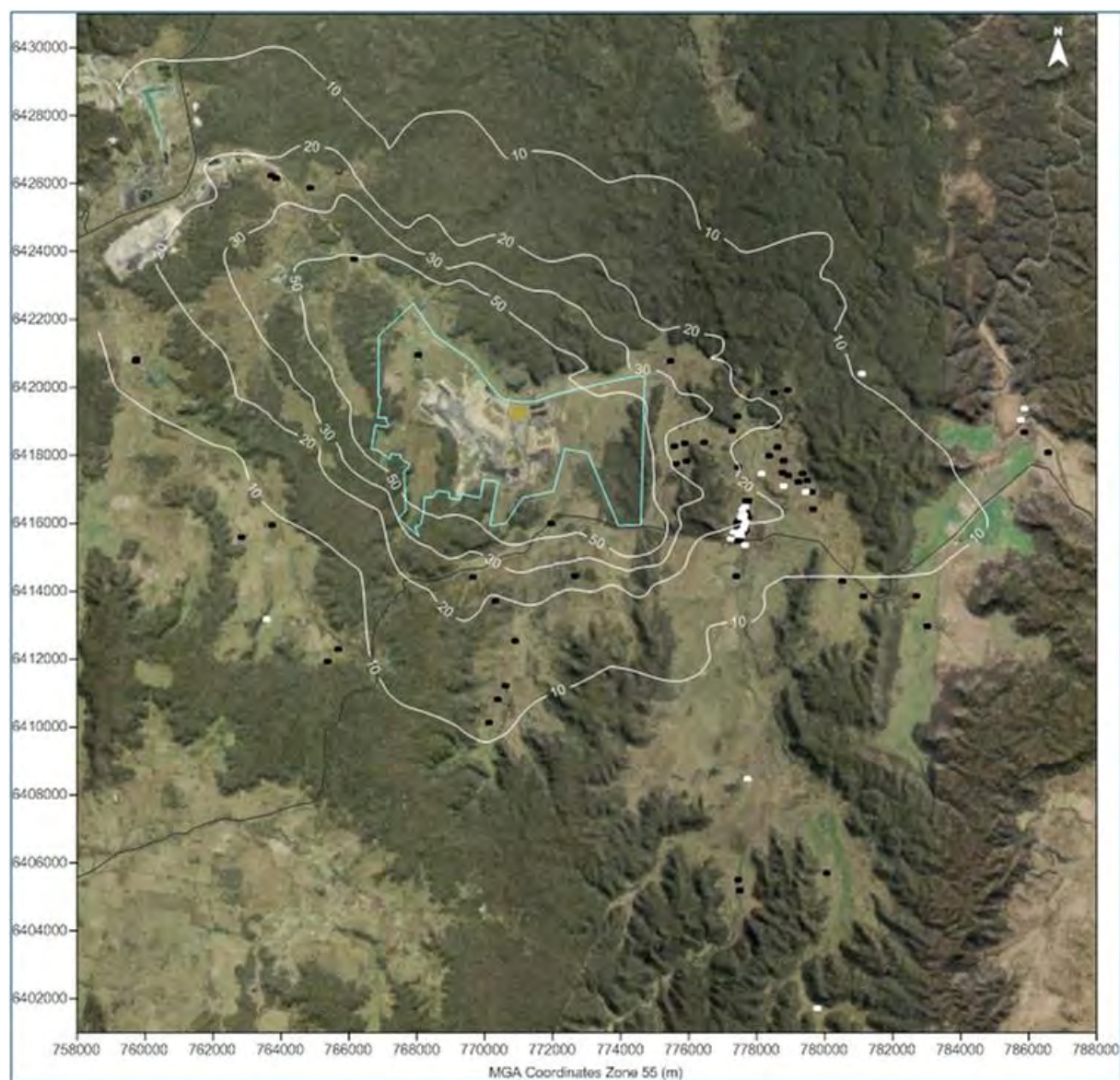


Figure E-3: Predicted maximum 24-hour average PM₁₀ concentrations due to emissions from the Modification - Year 13 (2018)



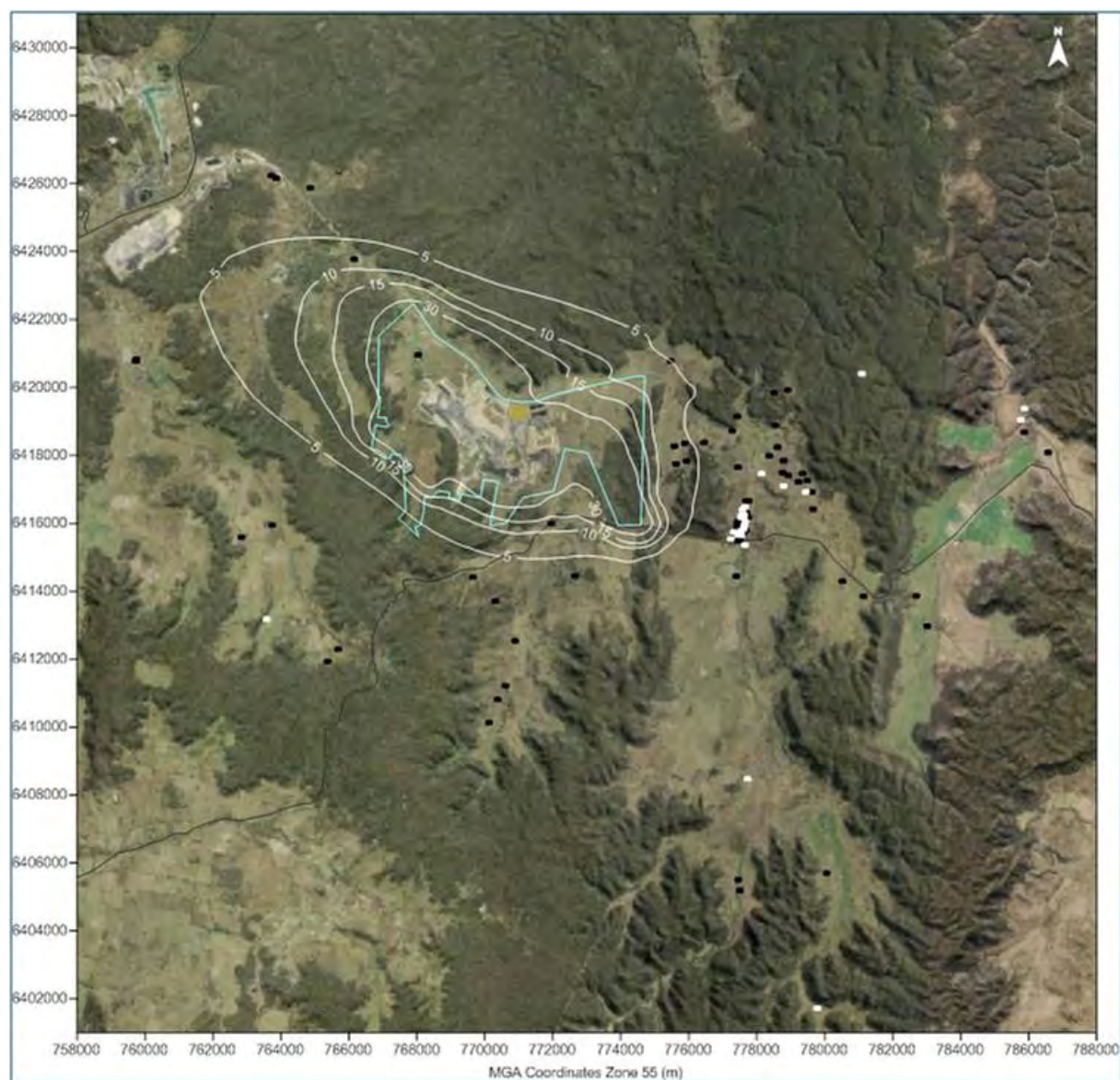


Figure E-4: Predicted annual average PM₁₀ concentrations due to emissions from the Modification - Year 13 (2018)



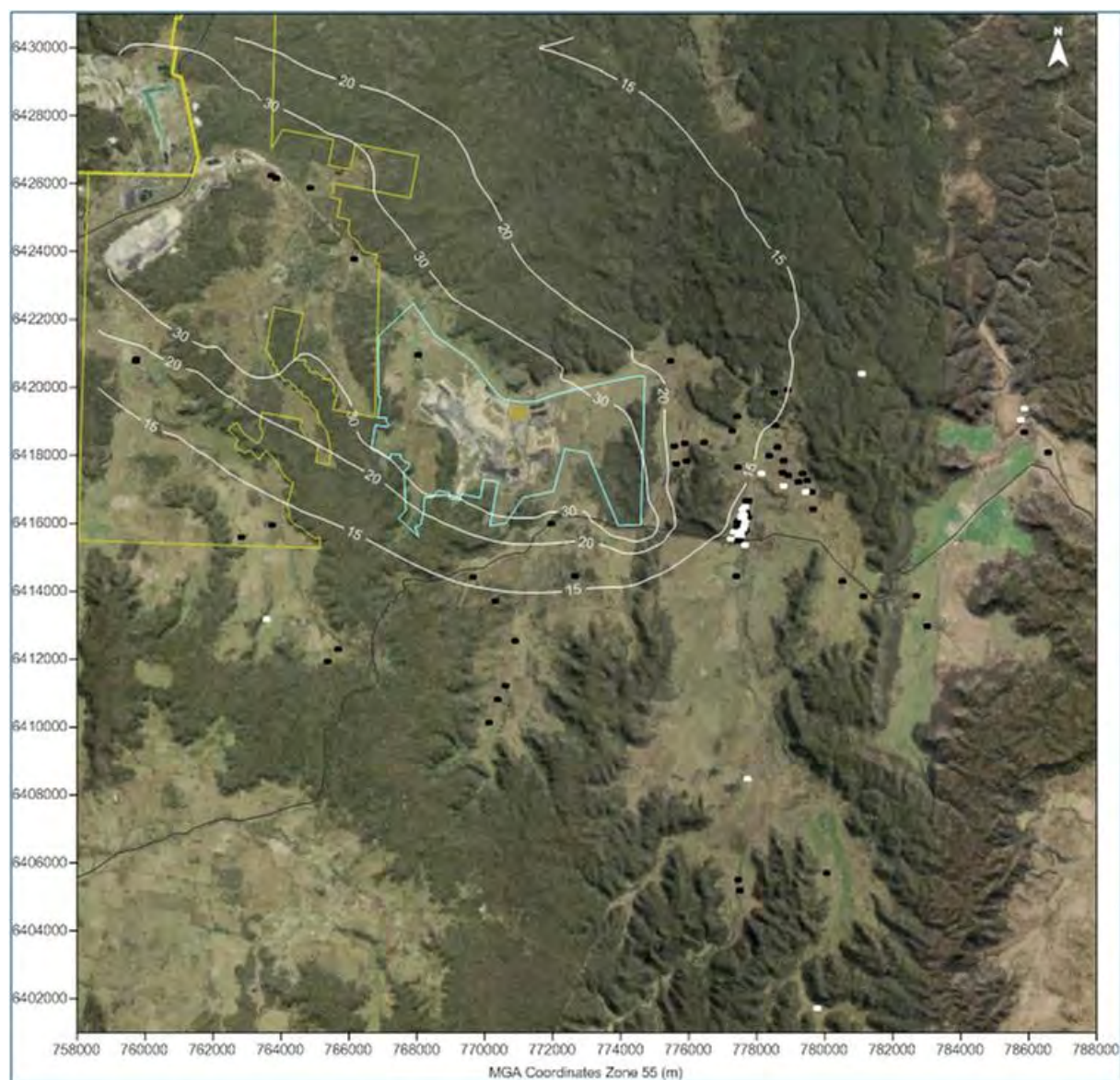


Figure E-5: Predicted annual average PM₁₀ concentrations due to emissions from the Modification and other sources - Year 13 (2018)



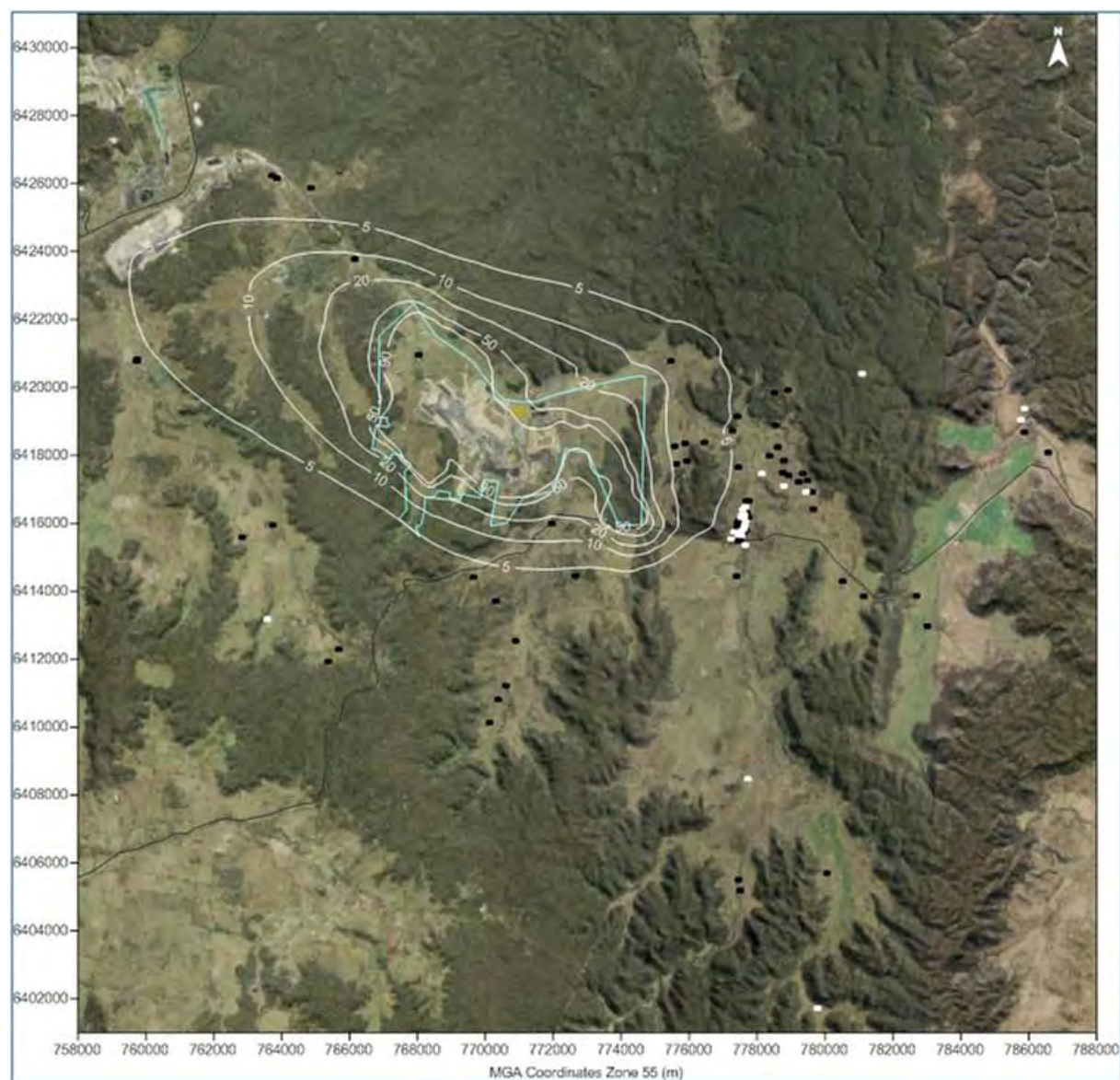


Figure E-6: Predicted annual average TSP concentrations due to emissions from the Modification - Year 13 (2018)



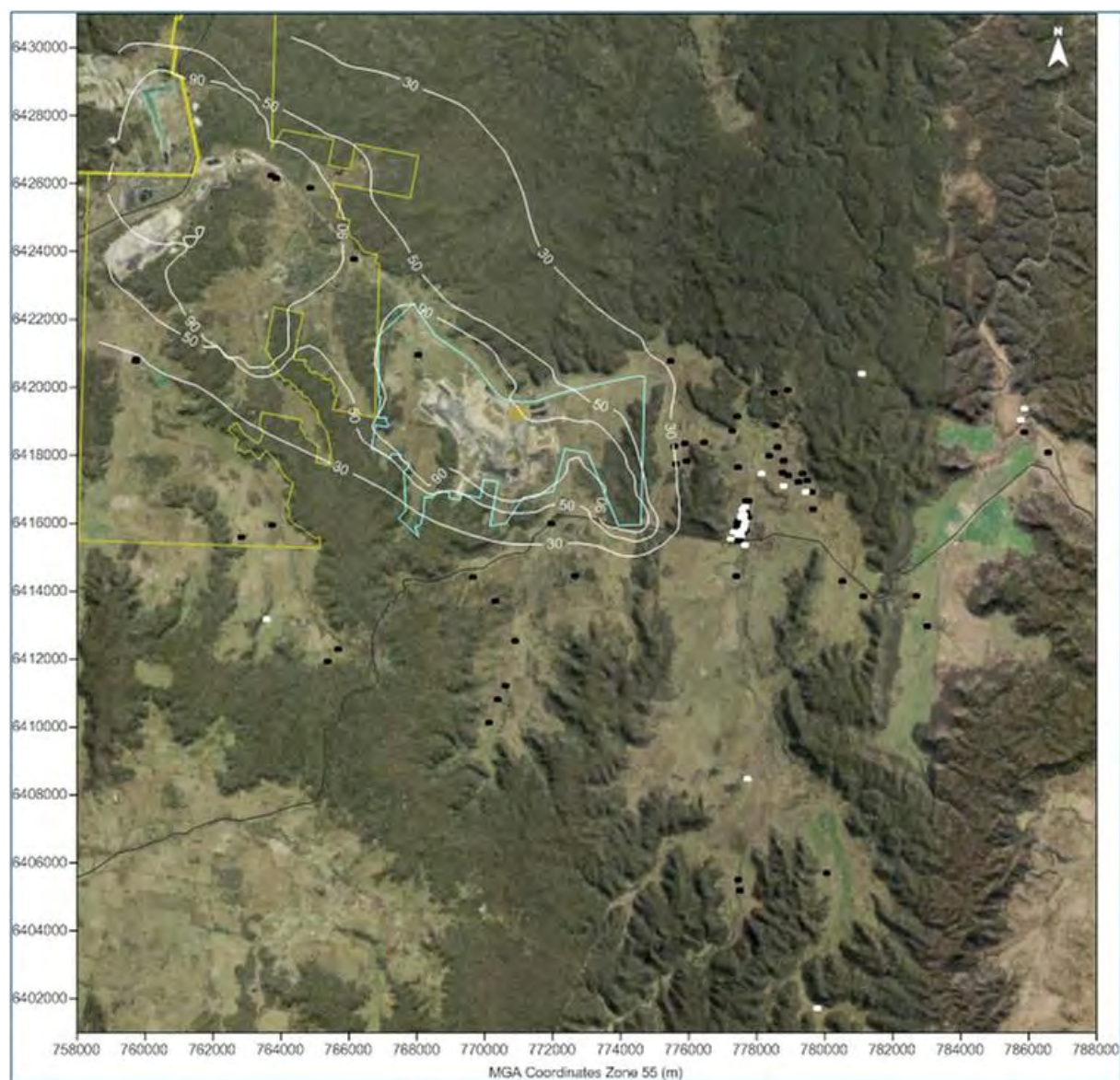


Figure E-7: Predicted annual average TSP concentrations due to emissions from the Modification and other sources - Year 13 (2018)



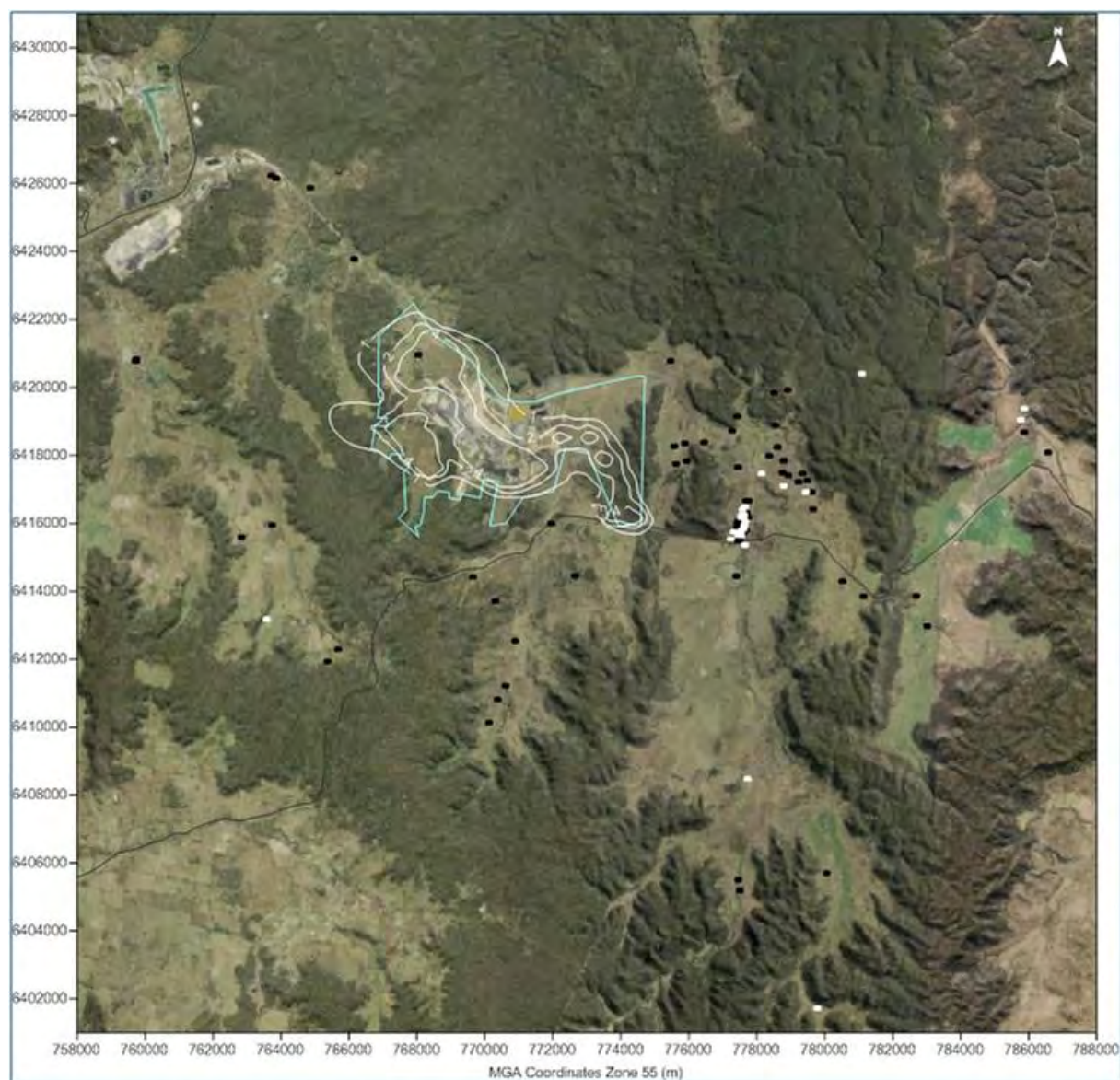


Figure E-8: Predicted annual average dust deposition levels due to emissions from the Modification - Year 13 (2018)



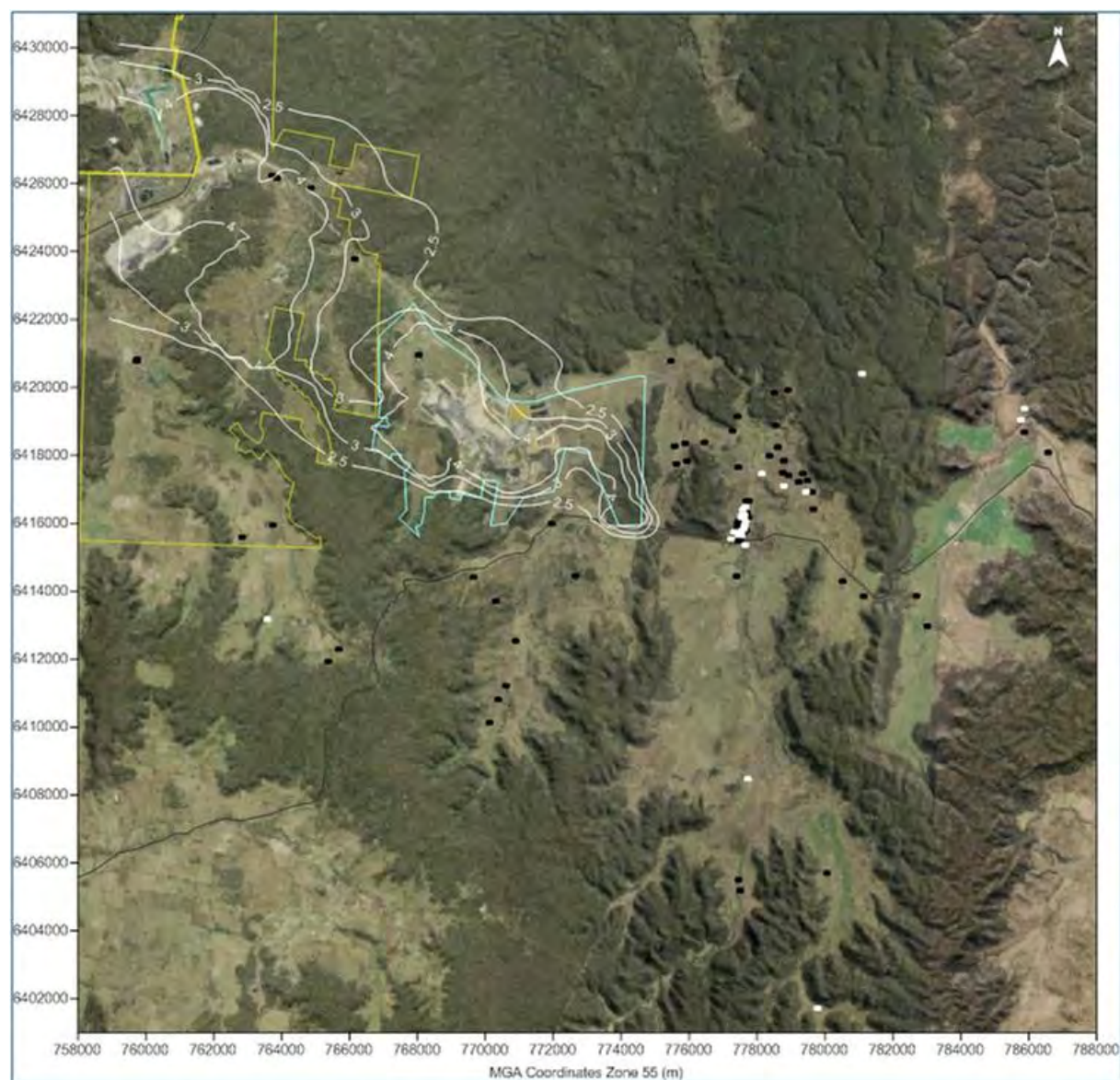


Figure E-9: Predicted annual average dust deposition levels due to emissions from the Modification and other sources - Year 13 (2018)



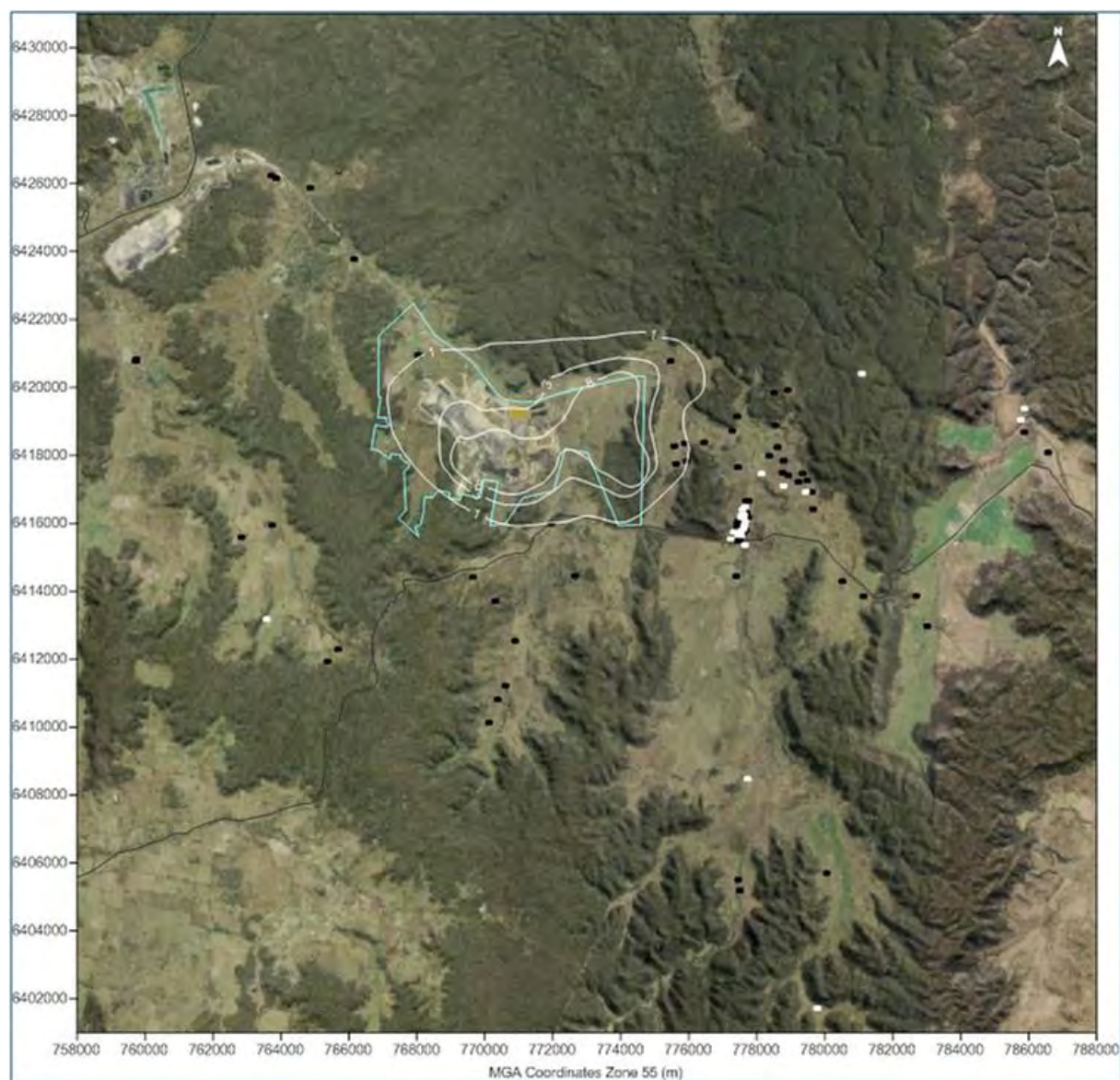


Figure E-11: Predicted annual average PM_{2.5} concentrations due to emissions from the Modification - Year 16 (2021)



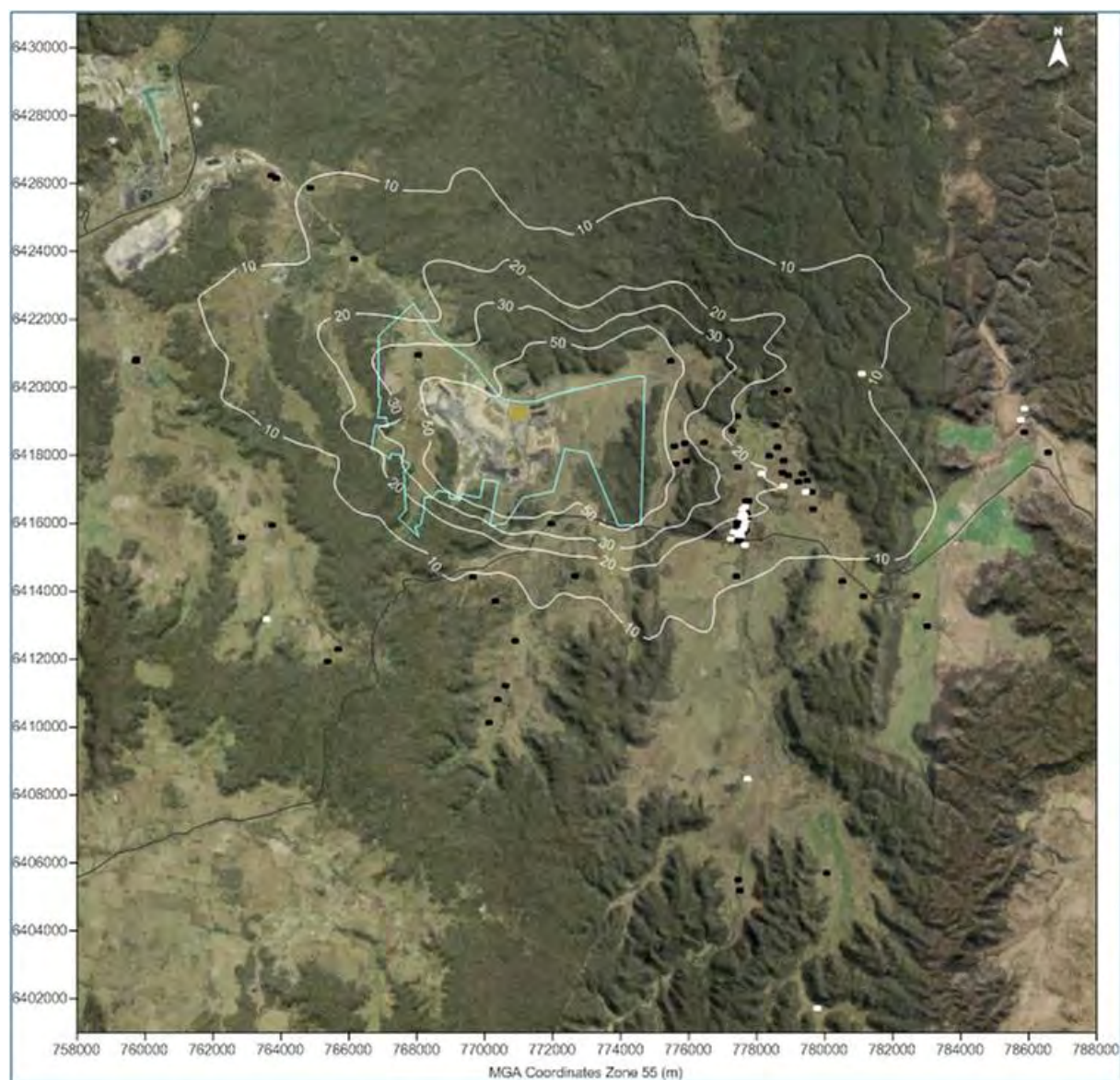


Figure E-12: Predicted maximum 24-hour average PM_{10} concentrations due to emissions from the Modification - Year 16 (2021)





Figure E-13: Predicted annual average PM₁₀ concentrations due to emissions from the Modification - Year 16 (2021)



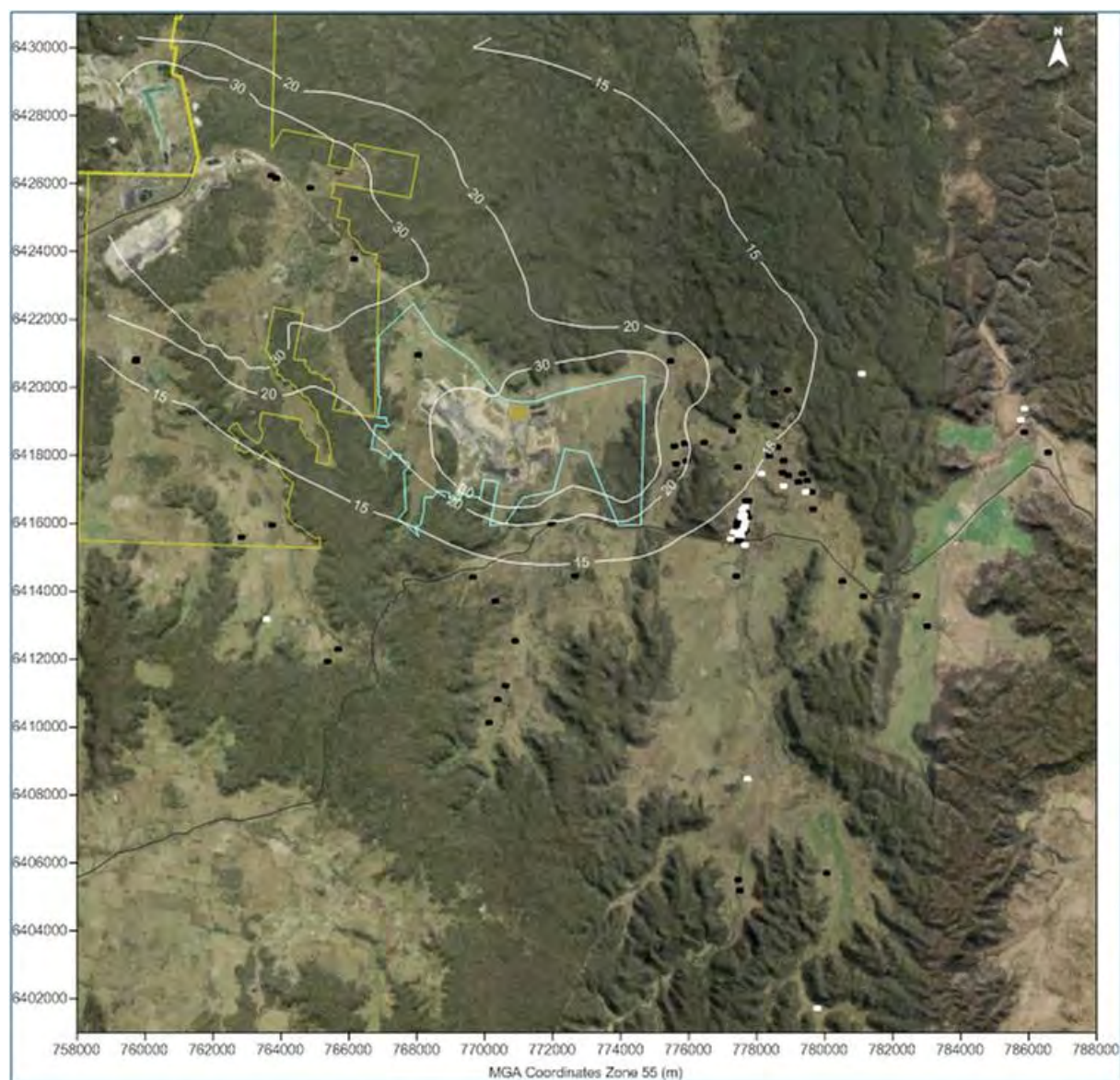


Figure E-14: Predicted annual average PM₁₀ concentrations due to emissions from the Modification and other sources - Year 16 (2021)





Figure E-15: Predicted annual average TSP concentrations due to emissions from the Modification - Year 16 (2021)

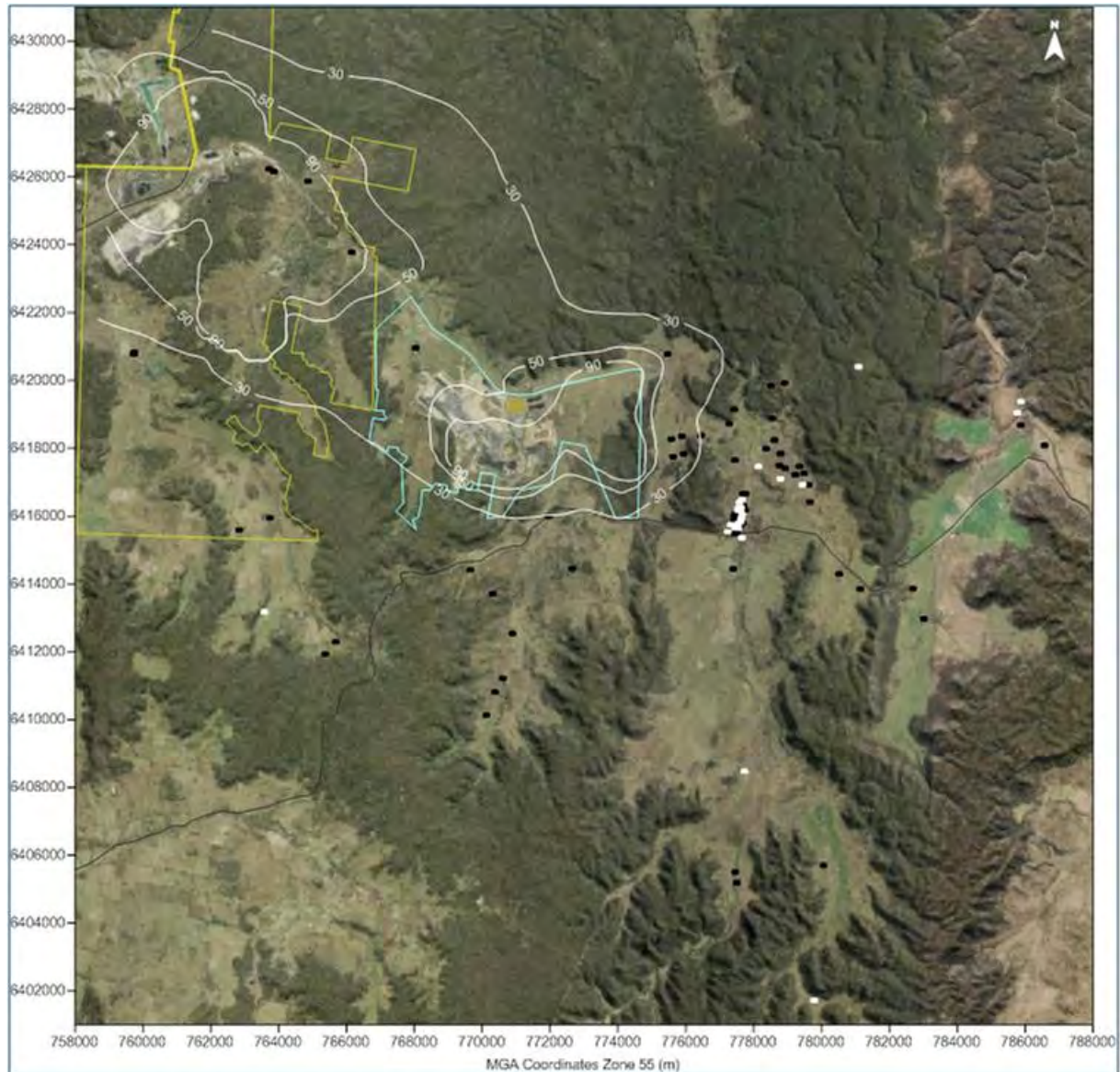


Figure E-16: Predicted annual average TSP concentrations due to emissions from the Modification and other sources - Year 16 (2021)



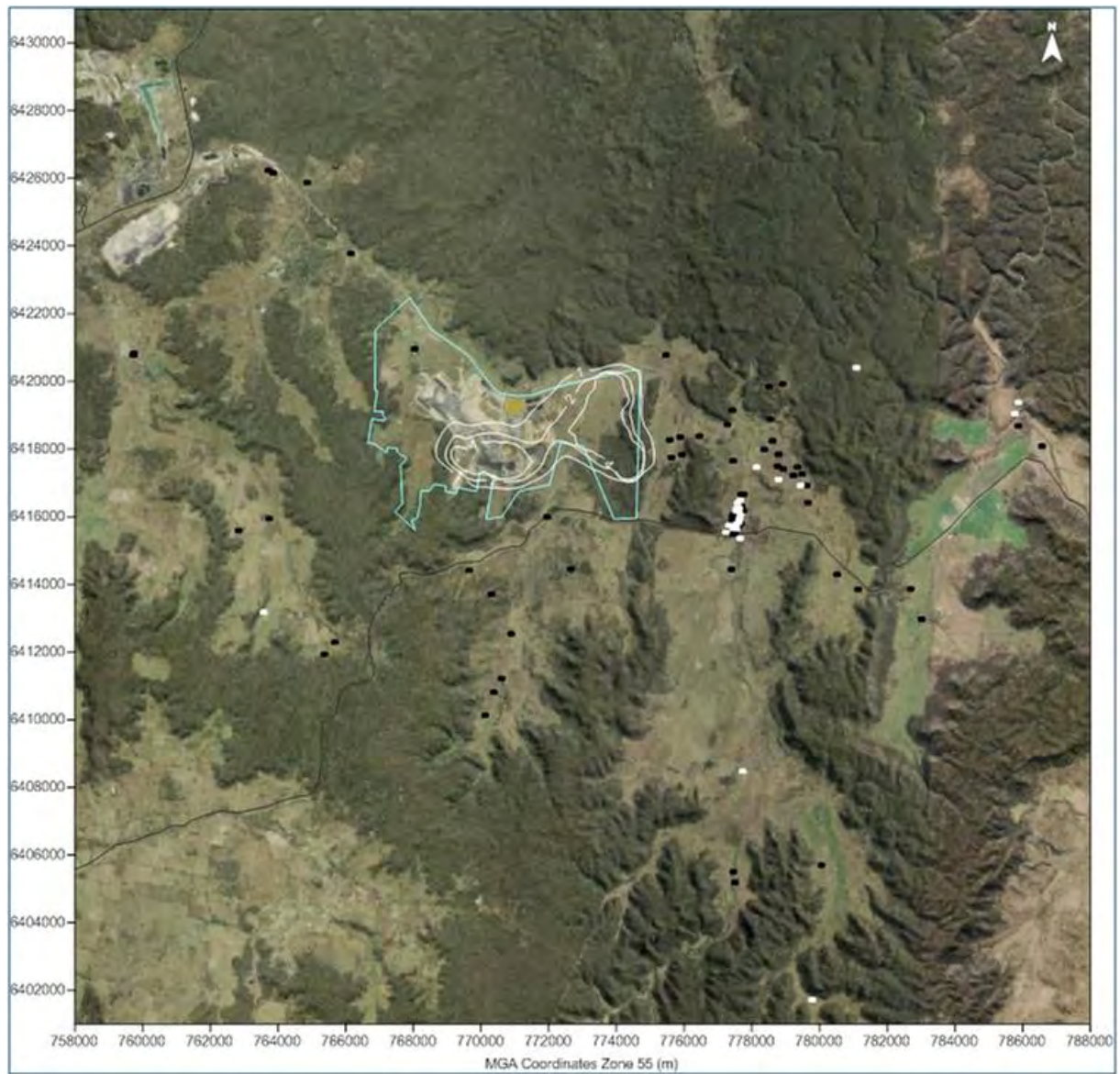


Figure E-17: Predicted annual average dust deposition levels due to emissions from the Modification - Year 16 (2021)



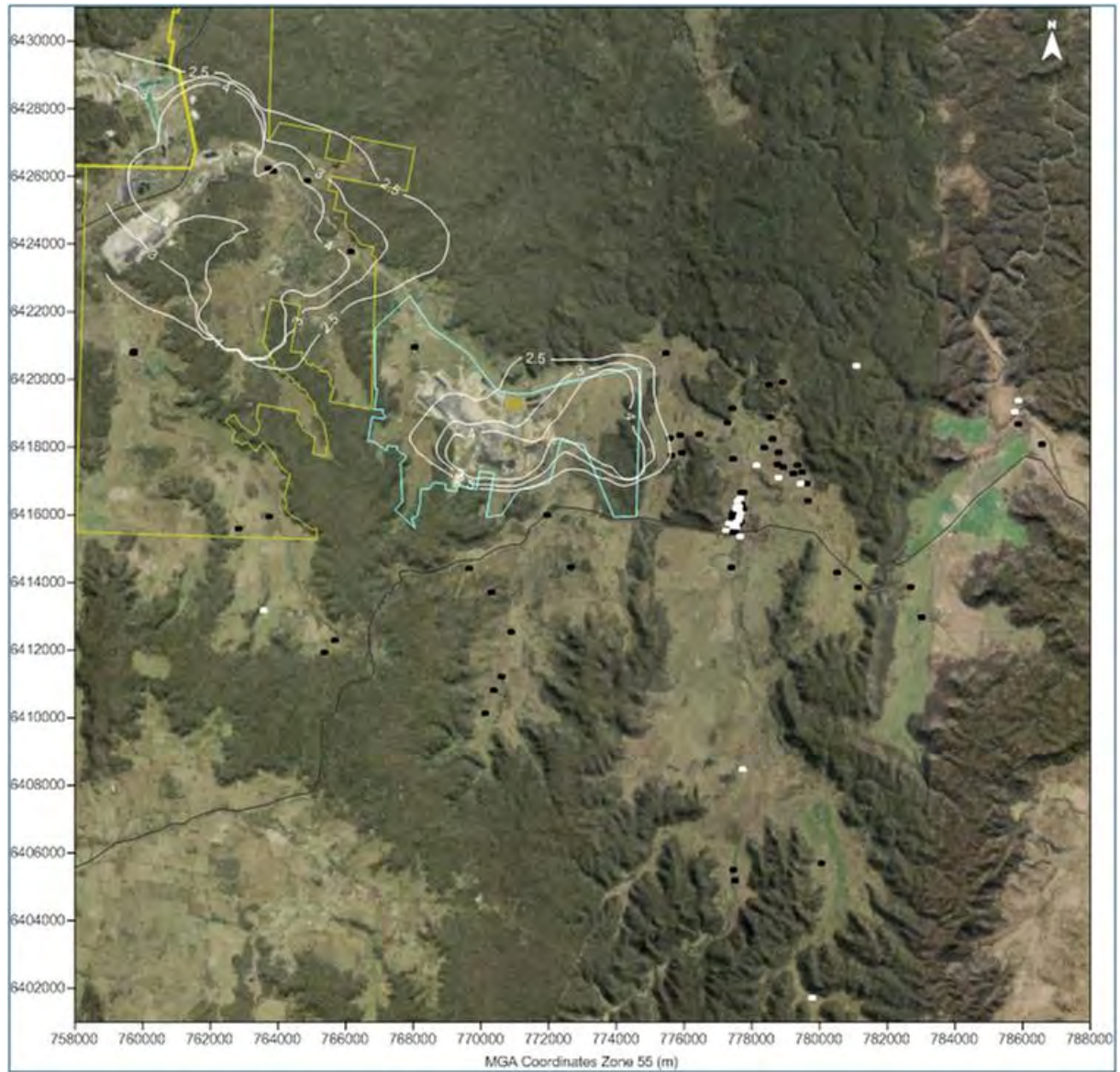


Figure E-18: Predicted annual average dust deposition levels due to emissions from the Modification and other sources - Year 16 (2021)

