Appendix 6

(No. of pages excluding this page = 52)

Air Quality Impact Assessment prepared by Heggies Pty Ltd

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AIR QUALITY IMPACT ASSESSMENT

FOR A

PROPOSED INCREASE IN COAL PRODUCTION

AT

CLARENCE COLLIERY

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EXECUTIVE SUMMARY

Heggies Pty Ltd has been commissioned by R.W Corkery & Co. Pty Ltd on behalf of Centennial Clarence Pty Limited to conduct an air quality impact assessment of proposed increased annual distribution of product coal from Clarence Colliery via road trucks from 200,000 tpa to 500,000 tpa.

The assessment of the proposed transport increase conducted by Heggies has comprised of air dispersion modelling and impact assessment based on air quality pollutant criteria published by the NSW Department of Environment and Climate Change (DECC).

Modelling was conducted in two stages, focusing on particulate matter emissions from Clarence Colliery and automotive fuel combustion emissions from off-site coal distribution by road. Emissions from Clarence Colliery were modelled using Ausplume V 6, while the impact attributable to road haulage was modelled using the USEPA's CAL3QHCR model.

It is noted that the Clarence Colliery emissions modelling was configured to include all surface operation sources, not simply those associated with the proposed increase in coal transportation. Given the relatively low level of operational changes associated with the proposed modification, this methodology is considered appropriate.

Analysis of the modelling results for on-site colliery operations indicated that despite the increase in haul truck loading and movement, the predicted concentrations of particulate matter at the identified surrounding receptor locations would satisfy the relevant DECC assessment criteria. Modelling results for the increased off-site road haulage of coal indicated that predicted concentrations of combustion-related emissions would be unlikely to impact adversely on any receptors in the near-field region adjacent to the haulage route.

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1 INTRODUCTION

Centennial Clarence Pty Ltd (hereafter, "the Proponent") operates Clarence Colliery, comprising an underground coal mine and accompanying surface facilities, including conveyors, wash plant, hardstand stockpiling areas, haul roads, rail loading facility and reject emplacement areas, under Development Consent DA 504-00. Clarence Colliery is located adjacent to the Wollemi National Park, approximately 8km east-northeast of Lithgow on the edge of Blue Mountains region of NSW (see **Figure 1**).

In order to meet the demand of their existing and potential customers, the Proponent is proposing to increase the amount of coal that may be transported by road ("road haulage") to its domestic customers from 200,000 tonnes per annum (tpa) to a maximum of 500,000tpa.

Heggies Pty Ltd (Heggies) has been commissioned by R.W. Corkery & Co. Pty Ltd (RWC) on behalf of the Proponent to conduct an assessment of the air quality impacts in relation to the increased road haulage of coal (hereafter, "the Project").

1.1 Project Description

Current operations at Clarence Colliery involve the extraction of up to 3Mt of coal annually. The coal is brought to the surface where it is processed, washed and stockpiled, prior to distribution. The primary coal product is a low sulphur thermal coal which is exported for use in power generation in Korea, Taiwan and Japan. While a proportion of the ROM coal from the underground requires no further beneficiation, the remaining ROM coal is sent to the coal preparation plant for washing to reduce the ash level of the coal. All thermal coal for export sales is transported from Clarence Colliery by rail.

In addition to the export thermal coal product, the Proponent produces a range of specifically sized coal and coal products for sale to domestic customers predominantly in Sydney, the South Coast and western NSW. These products include the following.

- ROM coal (high ash): is the broken, scalped and crushed coal from the underground which provides an unscreened <50mm product with ash content too high (without washing) for export markets.
- Screened Coal Products: are the variously sized coal products screened following washing to produce:
  - 25mm to 50mm (also referred to as 'Nut Coal'); and
  - <25mm (mid-range diameter coal).
- Coal fines: or tailings which is the <0.5mm fraction which is washed from the coal within the wash plant and discharged into the Clarence Colliery Reject Emplacement Area from where it is excavated.

The sized coal products for domestic customers are transported from Clarence Colliery by road. In order to ensure that the Proponent can meet the existing and forecast future demand for coal products from domestic customers while remaining compliant with all remaining conditions of DA 504-00, an increase in the amount of coal products despatched from the

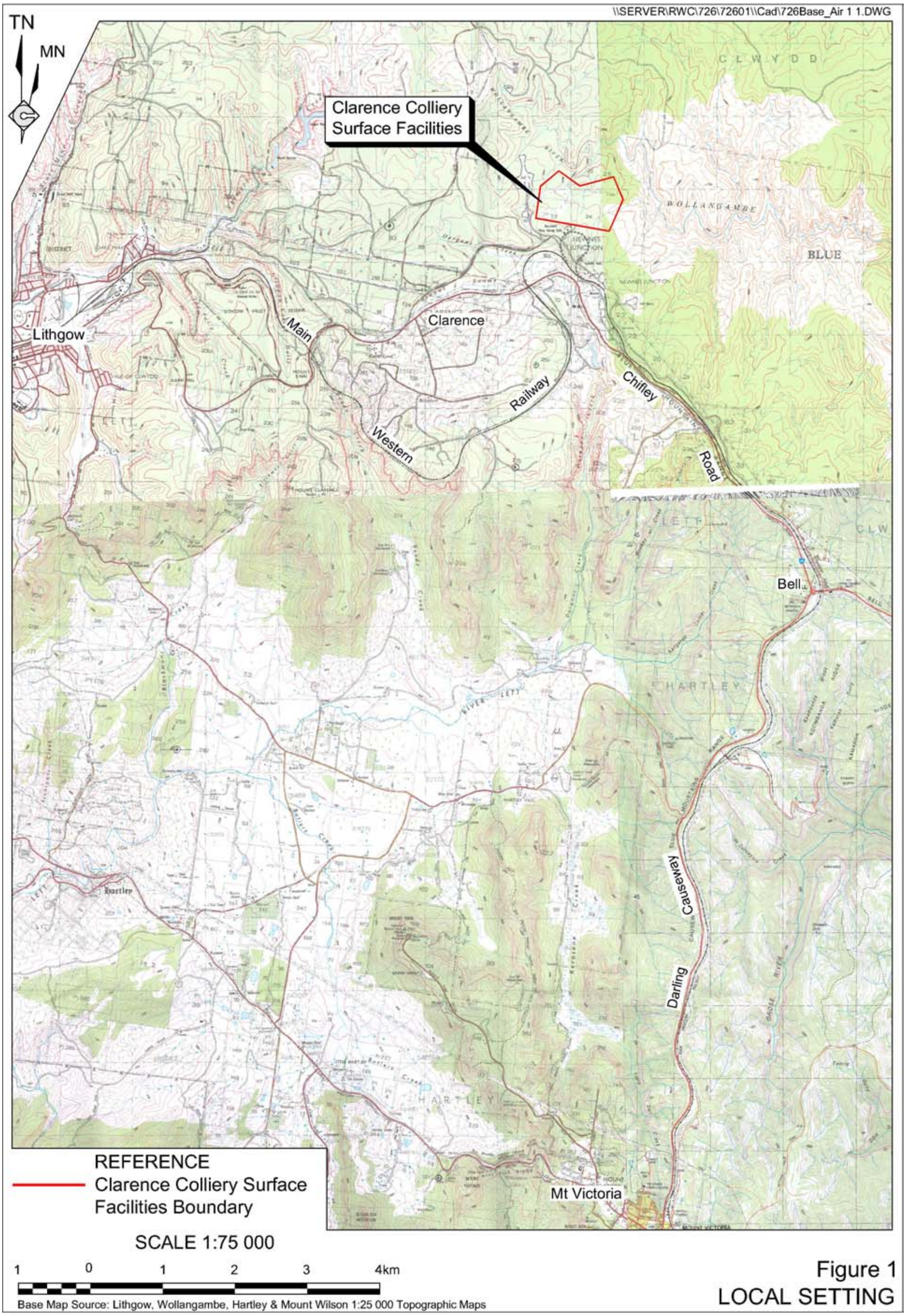


Figure 1
LOCAL SETTING

Note: A colour version of this figure is included on the Project CD

Clarence Colliery by road from 200 000tpa to a maximum of 500 000tpa is proposed. Notably, it is not the intention of the Proponent to necessarily achieve the proposed maximum road haulage (500 000tpa) each year, rather, the proposed modification would enable the Proponent to accommodate for fluctuating domestic demand and local supply issues for the particular sized coal products produced at Clarence Colliery.

Heavy vehicle entry to the Clarence Colliery is via a designated heavy vehicle entry off the Clarence Colliery access road (a private road which intersects with Chifley Road). On entry, the trucks then travel along a sealed road, below the conveyor from the underground mine drift (SC1), and past the colliery weighbridge where the internal haulage network splits depending on the coal product to be loaded. Internal haulage is then via one of three routes presented on **Figure 2**, namely:

(i) the ROM Coal Stockpile Route;

(ii) the Secondary Coal Stockpile Route; or

(iii) the Washed Coal Stockpile Route.

Currently, a single front-end loader moves between loading areas to load the coal to trucks, however, this is a limiting factor on the number of trucks that can be loaded each hour and day and so in order to increase the number of trucks loaded each day, a second front-end loader would be commissioned for sized coal loading. One of the front-end loaders would remain within the Secondary Coal Stockpile Area to load the screened coal products to trucks with the second FEL to traverse between the ROM Coal and Washed Coal Stockpile Areas to load unscreened ROM coal or coal fines as required.

It takes approximately 10 minutes for the front-end loader (FEL) to completely fill the trailer of a standard semi-trailer or truck and dog unit. While theoretically, the introduction of the second FEL would allow for a doubling of the maximum number of trucks loaded each hour, in reality, truck loading would still be limited by the movement of one of the FELs between loading areas and the operation of the single weighbridge. The introduction of a second FEL would, however, allow for the maximum number of trucks to be loaded more consistently across each day. It is proposed that average truck movements would increase to 148 per day (74 loads) with maximum number of truck movements reaching 280 per day (140 loads). The maximum hourly number of truck movements would not exceed 14 during the day (7:00am to 10:00pm) and eight during the night (10:00pm to 7:00am).

All coal carrying trucks turn left (east) from the Clarence Colliery access road onto Chifley Road and continue to Bell where Chifley Road intersects with the Darling Causeway and Bells Line of Road. A small proportion of trucks (12%) would continue along Bells Line of Road, however, the majority would turn right (south) at this intersection and continue along the Darling Causeway towards Mount Victoria. At Mount Victoria, approximately 85% of the coal carrying trucks would turn left at Harley Avenue and then left again at the Great Western Highway for delivery of the coal products to Sydney and the South Coast. The remaining coal carrying trucks continue to the intersection of the Darling Causeway and the Great Western Highway for distribution of coal products to western NSW.

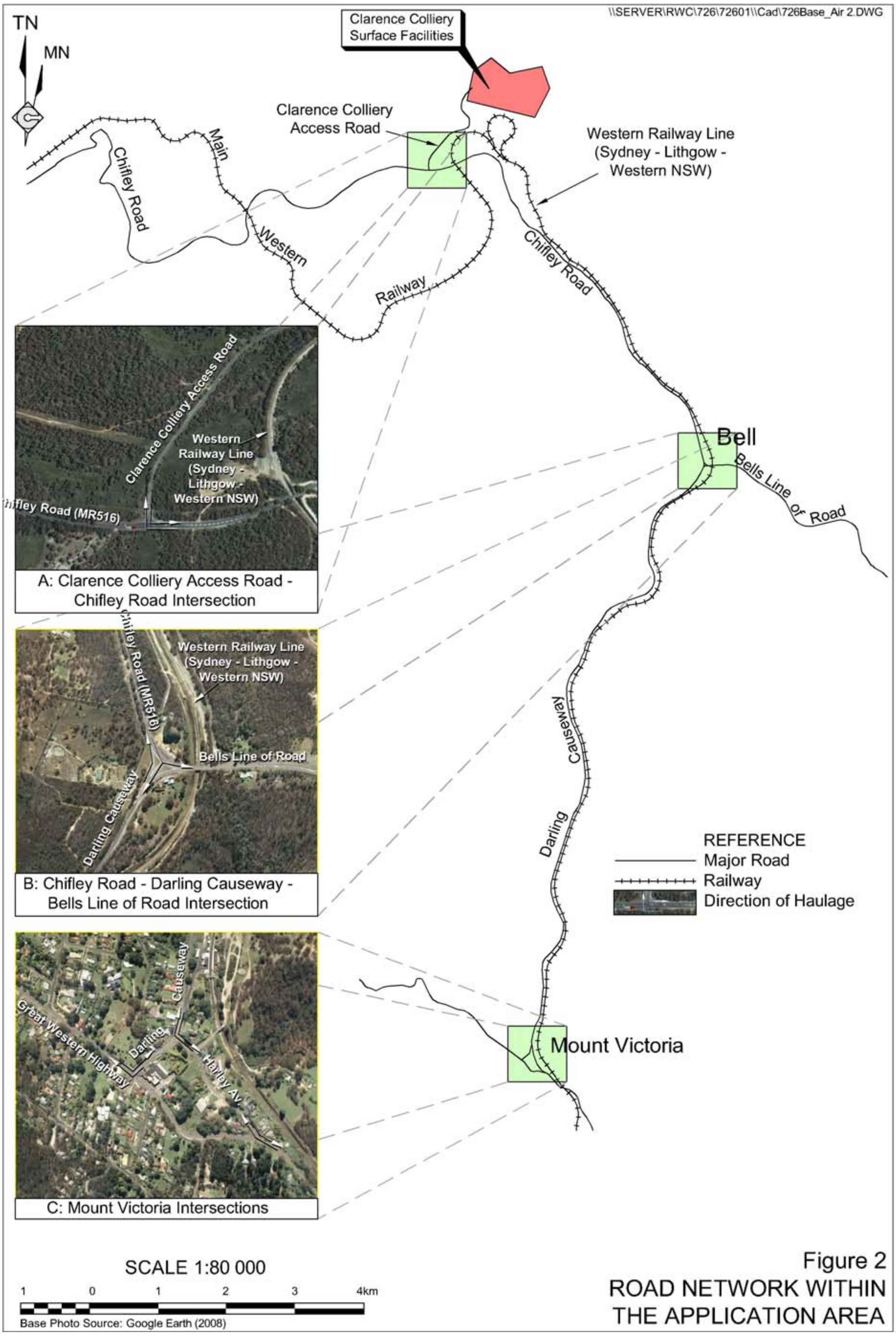


Figure 2
ROAD NETWORK WITHIN THE APPLICATION AREA

Note: A colour version of this figure is included on the Project CD

1.2 Study Objective

The main objective of this report is to identify the level of air quality impact that the Project would have on the surrounding environment, ie. adjacent to Clarence Colliery and adjacent to the haulage route.

This report comprises of:

- an overview of the regulatory framework as it pertains to air quality;
- characterisation of the existing air quality environment of the area surrounding the Clarence Colliery and haulage route(s);
- identification of sensitive receptors which could potentially be impacted by the Project;
- dispersion modelling of proposed amended operations on the site of the Clarence Colliery, ie. truck loading and movement, to determine the level of impact on the surrounding area;
- dispersion modelling of proposed increased road haulage; and
- conclusions based on the results of this modelling.

2 PROJECT SETTING

The primary road haulage route(s) run along the top of the Blue Mountains Escarpment before merging with the primary distribution routes into and out of Sydney of Bells Line of Road (at Bell) and the Great Western Highway (at Mount Victoria). **Figure 3** presents the road network of the primary road haulage routes.

The assessment of impact related to coal haulage has been restricted to the roads and surrounding environment of restricted to Chifley Road, the Darling Causeway, Harley Avenue and the relevant intersections between Clarence Colliery access road and the primary distribution routes to Sydney, the South Coast and western NSW.

2.1 Surrounding Sensitive Receptors

A number of residential dwellings are situated in the area surrounding the Clarence Colliery. The nearest dwellings were identified as sensitive receptor locations to be taken into account during the assessment of potential air quality impacts due to the expanded on-site operations, ie. increased truck loading and movement.

A list of existing sensitive receptor points (R1 to R6) identified in the immediate vicinity of the Clarence Colliery, and respective distances of such receptor points to the ROM Stockpile Area are listed in **Table 1**.

Figure 4 illustrates the location of the surrounding receptors in relation to Clarence Colliery.

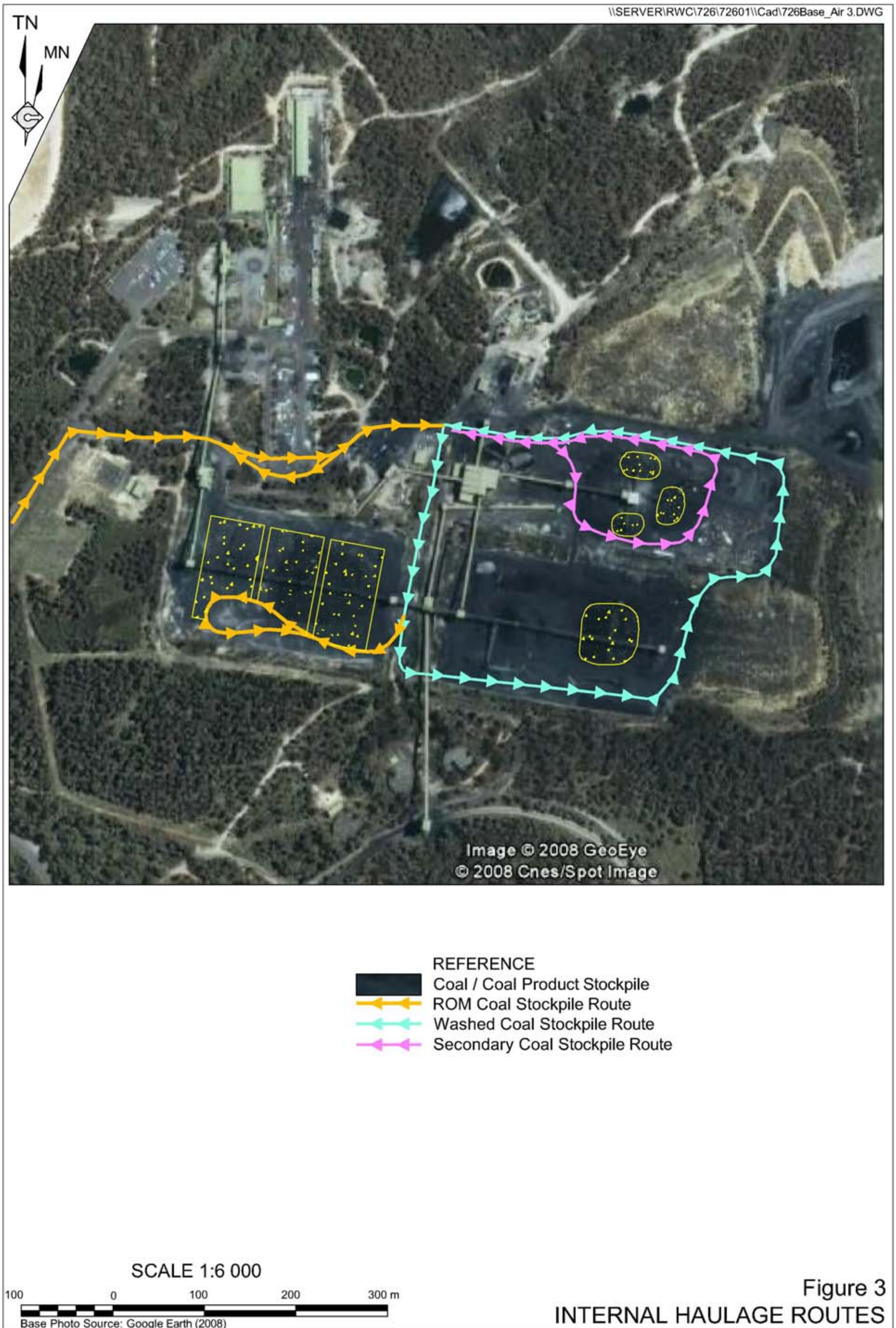
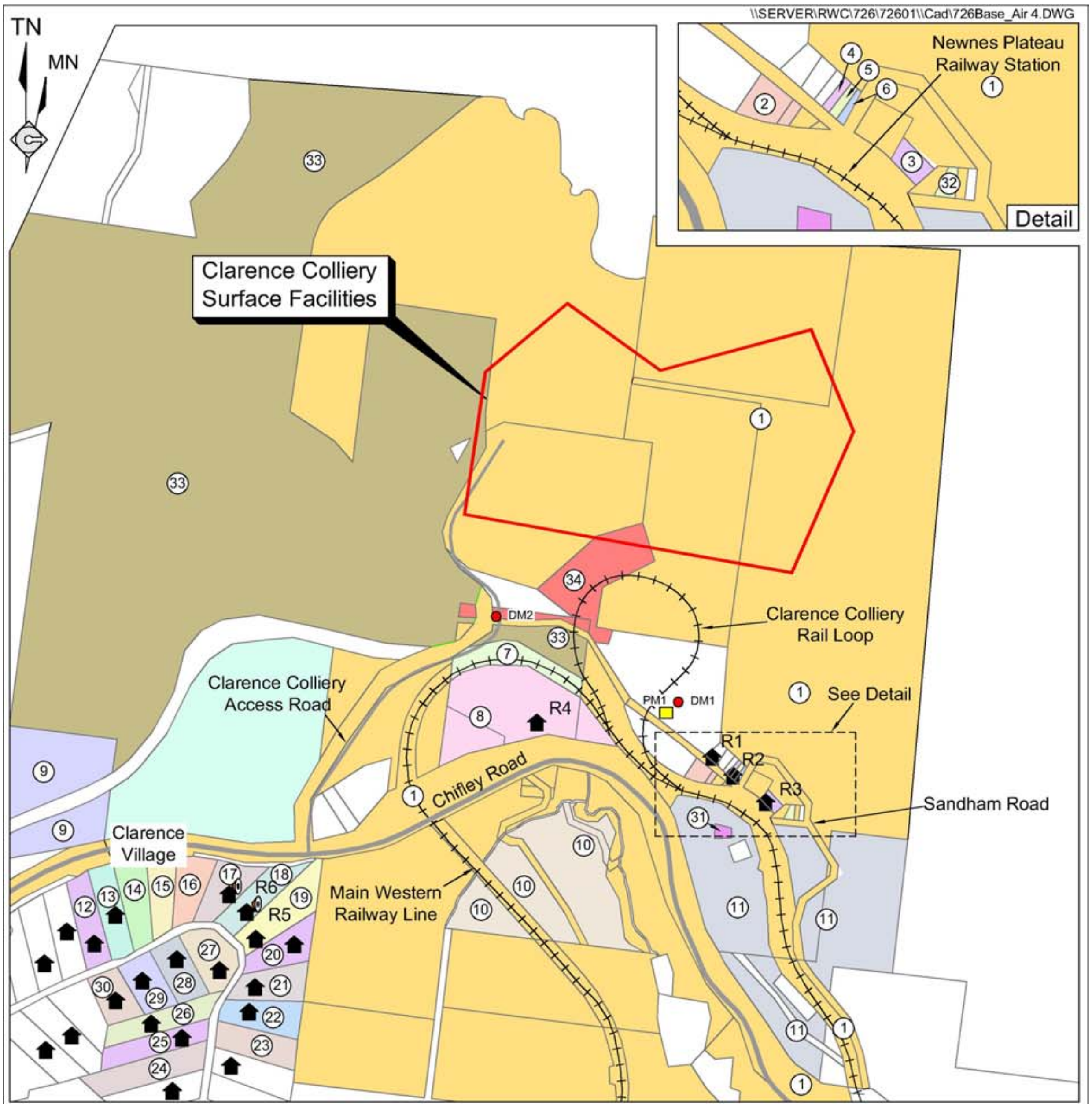


Figure 3
INTERNAL HAULAGE ROUTES

Note: A colour version of this figure is included on the Project CD



Reference	Land Owner	Reference	Land Owner
1	Crown Land	18	B. McPhillamy
2	D. & F. McConnell	19	R. Luczak
3	A. & S. Marjane	20	I. & C. Fitzgerald
4	S. Butler	21	G. Trapp
5	A. Wilson	22	L. & D. Love
6	L. Thompson	23	E. Balcar
7	Rail Corporation of NSW	24	C. McNamara
8	B. Tomlin & F. Pace	25	J. & M. Kable
9	Lithgow City Council	26	R. & G. Pike
10	J. Giokaris	27	P. & S. Sammut
11	Maxmin Pty Limited	28	L. Locke
12	I. & A. Tolhurst	29	S. Flynn & R. Moon
13	E. Oloman	30	H. Churchill
14	B. Bazaad	31	K. Porter
15	P. Singh	32	Newnes - Kaolin Pty Limited
16	S. Chowdhry	33	Zig Zag Railway Co-op Limited
17	P. Honeysett & C. Kerr	34	Coalex Pty Ltd

REFERENCE
Clarence Colliery Surface Facilities Boundary
Cadastral Boundary
R5 Residence
Railway
Road
Crown Land
Land Ownership Reference
DM1 Dust Monitoring Location
PM1 PM_{10} Monitoring Location

SCALE 1:20 000
200 0 200 400 600 800 1000 m

Figure 4
SENSITIVE RECEPTOR LOCATIONS

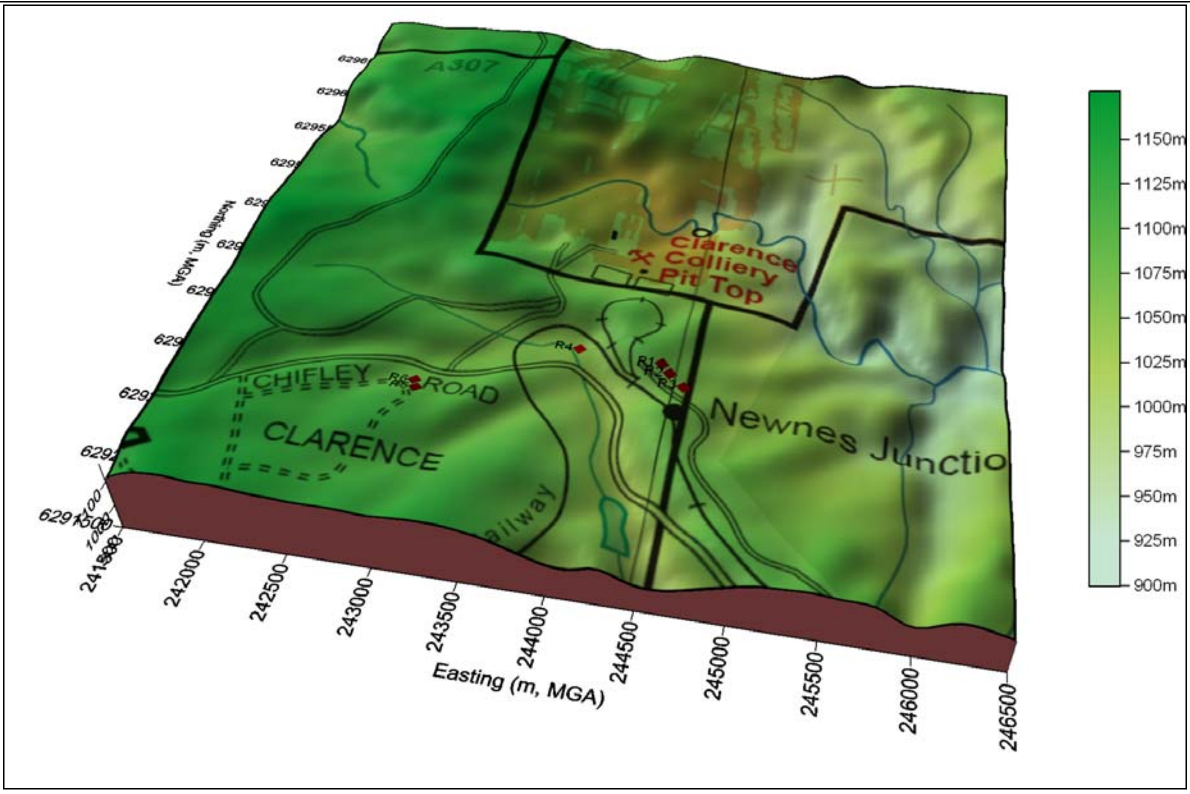
Note: A colour version of this figure is included on the Project CD

Table 1
Surrounding Sensitive Receptor Locations

Receptor ID	Location		Distance (kilometres) (Direction from Coal Loading Areas)
	Easting	Northing	
R1	244383	6293041	0.9 / SSE
R2	244438	6292984	1.0 / SSE
R3	244538	6292902	1.1 / SSE
R4	243838	6293147	0.7 / SSW
R5	242966	6292544	1.6 / SW
R6	242934	6292617	1.6 / SW

2.2 Clarence Colliery Topography

Clarence Colliery is situated amongst undulating topography, with the elevation of the Pit Top Area ranging between approximately 1 020m AHD (northeastern area) and 1 080m AHD (southwestern area). The elevation of the local area increases from east to west. **Figure 5** represents a 3-dimensional view of Clarence Colliery and surrounding topography.



Note: Topography has Vertical Exaggeration of 2

Figure 5
3-Dimensional Representation of Local Topography

3 AIR QUALITY CRITERIA

3.1 Criteria Applicable to Particulate Matter

The term *"particulate matter"* refers to a category of airborne particles typically less than 50 microns (µm) in diameter and ranging down to 0.1µm in size. Particles less than 10 µm and 2.5µm are referred to in this report as PM_{10} and $PM_{2.5}$ respectively.

Emissions of PM_{10} and $PM_{2.5}$ are considered important pollutants in terms of impact due to their ability to penetrate into the respiratory system. In the case of the $PM_{2.5}$ category, recent health research has shown that this penetration can occur deep into the lungs. Potential adverse health impacts associated with exposure to PM_{10} and $PM_{2.5}$ include increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, and reduced lung capacity in asthmatic children.

One of the difficulties in dealing with air quality goals governing fine particles such as PM_{10} is that the medical community has not been able to establish a threshold value below which there are no adverse health impacts.

The NSW Department of Environment and Climate Change (hereafter, "DECC") PM_{10} impact assessment goals, as expressed in the 2005 document *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (hereafter, "the Approved Methods"), are:

- a 24-hour maximum of 50µg/m^3; and
- an annual average of 30µg/m^3.

The 24-hour PM_{10} reporting standard of 50µg/m^3 is numerically identical to the equivalent National Environment Protection Measure (NEPM) reporting standard except that the NEPM reporting standard allows for five exceedances per year. These NEPM goals were developed by the National Environmental Protection Council (NEPC) in 1998 to be achieved within 10 years of commencement.

In December 2000, the NEPC initiated a review to determine whether a new ambient air quality goal for particulates of 2.5 microns or less in aerodynamic diameter ($PM_{2.5}$) was needed in Australia, and the feasibility of developing such a goal. The review found that:

- there are health effects associated with fine particles;
- the health effects observed overseas are supported by Australian studies; and
- fine particle standards have been set in Canada and the USA, and an interim goal proposed for New Zealand.

The review concluded that there is sufficient community concern regarding $PM_{2.5}$ to consider it an entity separate from PM_{10}.

As such, in July 2003 a variation to the Ambient Air Quality NEPM was made to extend its coverage to $PM_{2.5.}$ This document references the following goals for $PM_{2.5}$.

- A 24-hour maximum of 25µg/m^3.
- An annual average of 8µg/m^3.

Within this assessment, $PM_{2.5}$ has only been addressed within the assessment of vehicle exhaust emissions from the road distribution of coal.

3.2 Nuisance Impacts of Fugitive Emissions

The preceding sections are concerned in large part with the health impacts of particulate matter. Nuisance impacts need also to be considered, mainly in relation to dust. In NSW, accepted practice regarding the nuisance impact of dust is that dust-related nuisance can be expected to impact on residential areas when annual average dust deposition levels exceed 4g/m^2/month.

Table 2 presents the DECC impact assessment goals for dust fallout, showing the allowable increase in dust deposition level over the ambient (background) level which would be acceptable so that dust nuisance could be avoided.

Table 2
DEC Goals for Allowable Dust Deposition

Averaging Period	Maximum Increase in Deposited Dust Level	Maximum Total Deposited Dust Level
Annual	2g/m^2/month	4g/m^2/month

Source: Approved Methods, DECC 2005.

3.3 Goals Applicable to Nitrogen Dioxide and Carbon Monoxide

The goals specified within the Approved Methods for nitrogen dioxide (NO2) and carbon monoxide (CO) are outlined in **Table 3**.

Table 3
NSW DECC Air Quality Goals - NO_2 and CO

Pollutant	Averaging Time	Maximum Concentration
Nitrogen dioxide (NO_2)	1 hour Annual	246 µg/m^3 62 µg/m^3
Carbon Monoxide (CO)	8-hour	10 mg/m^3

Source: Approved Methods, DECC 2005.

3.4 Goals Applicable to Volatile Organic Compounds

Emissions of volatile organic compounds (VOCs) are associated with the combustion of automotive fuel (diesel, petrol, etc). Benzene, a known carcinogen and a key VOC linked with the combustion of automotive fuel, will be used as an indicator in this assessment for emissions of total VOCs. The goal specified within the Approved Methods for benzene is outlined in **Table 4**.

Table 4
NSW DECC Air Quality Goals - Benzene

Pollutant	Averaging Time	Maximum Concentration
Benzene	1 hour	0.029 mg/m^3

Source: Approved Methods, DECC 2005.

3.5 Project Air Quality Goals

In view of the foregoing, the air quality goals adopted for this assessment, which conform to current DECC air quality goals and other relevant air quality criteria, are summarised in **Table 5**.

Table 5
Project Air Quality Goals

Pollutant	Averaging Time	Maximum Concentration
PM_{10}	24 hours Annual	50 $\mu g/m^3$ 30 $\mu g/m^3$
PM_{10}	24 hours Annual	25 $\mu g/m^3$ 8 $\mu g/m^3$
Dust Deposition	Annual	Incremental increase of 2 g/m^2/month
NO2	1 hour Annual	246 $\mu g/m^3$ 62 $\mu g/m^3$
CO	8-hour	10.4 mg/m^3
VOCs (as Benzene)	1-hour	0.029 mg/m^3

4 EXISTING AIR QUALITY ENVIRONMENT

4.1 Background Dust Deposition Environment

Deposited dust monitoring has been conducted at three locations in the area surrounding Clarence Colliery. Monthly dust deposition data for the period between December 2006 and December 2007 are presented in **Table 6**. The location of the dust deposition gauges, marked DM1 to DM3, are illustrated in **Figure 4**.

Based on the data presented in **Table 6**, a conservatively high estimation of the ambient dust deposition rate at Clarence Colliery for assessment purposes may be assumed to be of the order of 1.6g/m^2/month expressed as an annual average. This value corresponds to the maximum of all the annual average deposition rates from the three monitoring locations.

Table 6
Ambient Dust Deposition Monitoring Data – Clarence Colliery, December 2006 to December 2007

Month	**Insoluble Solids (g/m^2/month)**		
	DM1	**DM2**	**DM3**
December 2006	0.2	1.0	0.8
January 2007	0.3	2.7	1.0
February 2007	0.8	0.8	1.9
March 2007	0.7	1.0	2.6
April 2007	0.7	0.3	2.1
May 2007	0.6	0.5	1.9
June 2007	0.4	0.4	NS
July 2007	0.9	0.8	1.5
August 2007	0.3	1.2	1.4
September 2007	1.0	1.1	0.6
October 2007	0.7	0.3	0.5
November 2007	1.0	ND	3.9
December 2007	0.2	ND	1.2
Average	**0.6**	**1.0**	**1.6**

NS – No Sample Taken
ND – Not Detectable

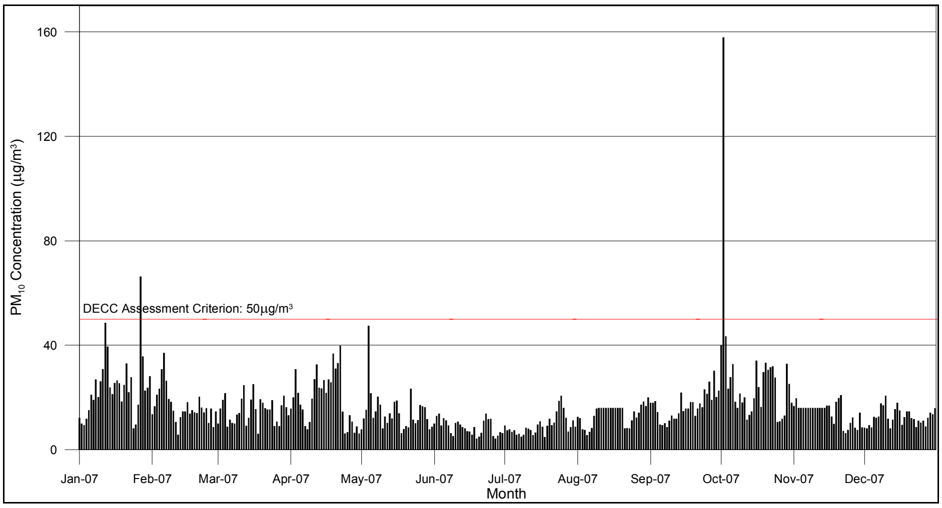
4.2 Ambient Particulate Matter Environment

No PM_{10} monitoring data from Clarence Colliery was available for the 2007 calendar year for use in this assessment. However, Section 5.1.1 of the Approved Methods states that for air quality assessments of this nature, ambient monitoring data for at least one year of continuous measurements should be used in dispersion modelling.

Data is available from the DECC's Central West monitoring station, located at Bathurst. This air quality monitoring site is located at the Sewage Treatment Plant, off Morrisset Street, Bathurst, located approximately 62km west-northwest of Clarence Colliery. It is noted that while Bathurst is the closest DECC monitoring site to Clarence Colliery, it is considerably more built up than the area surrounding Clarence Colliery. However, it is considered that the Bathurst monitoring data will provide a conservatively high estimate of background PM_{10} concentrations in the vicinity of Clarence Colliery.

The 24-hour average PM_{10} concentrations for the period 1 January 2007 to 31 December 2007 are presented in **Figure 6**. This dataset is concurrent with the meteorological data set used in the atmospheric dispersion modelling conducted for this assessment.

Figure 6
NSW DEC PM_{10} (24-Hour Average) Monitoring Results for Bathurst, 2007



The results indicate that the highest 24-hour average PM_{10} concentration recorded at the DECC's Bathurst monitoring site was 157.8µg/m^3, recorded on 2 October 2007. This is above the DECC goal of 50µg/m^3. In addition to this exceedance, there was one further exceedance during this period, 66.3µg/m^3 on 27 January 2007.

It is likely that these exceedances were as a result of an anomalous local event such as a dust storm or bushfire. However, in accordance with the Approved Methods, these values have been included in the assessment as it is appropriate to demonstrate that no additional exceedances of the impact assessment criteria will occur as a result of the Project activities.

The highest PM_{10} concentration not in exceedance of the 24-hour criterion at Bathurst was 44.5µg/m^3, recorded on 12 January 2008. The annual average PM_{10} concentration for 2007, recorded at the DECC's Bathurst monitoring site was 15.9µg/m^3.

No corresponding monitoring data is available for ambient concentrations of $PM_{2.5}$. From analysis of the relationship between concurrent $PM_{2.5}$ and PM_{10} datasets from similar semi-rural locations as Bathurst within Australia, Heggies have noted that ambient concentrations of $PM_{2.5}$ are approximately 40% of corresponding PM_{10} concentrations. In the absence of $PM_{2.5}$ monitoring data from Bathurst and for the purpose of deriving a background ambient concentration, this scaling factor has been applied to the measured PM_{10} concentrations.

4.3 Combustion Pollutants

The combustion associated with on-site mobile equipment and despatch of the additional coal through road haulage has the potential to increase emissions of NO_2, CO and VOCs. No monitoring for any of these pollutants has been conducted in the vicinity of Clarence Colliery. However, due to the non-urban nature of Clarence Colliery, it is deemed acceptable to assume negligible existing background concentrations of NO_2, CO and VOCs in the vicinity of both the Clarence Colliery and associated transportation routes for the purpose of this assessment.

4.4 Ambient Air Quality Environment for Assessment Purposes

For the purposes of assessing the potential air quality impacts from the Project, an estimation of ambient air quality levels is required. The site-specific ambient air quality levels adopted for this assessment are summarised in **Table 7**.

Table 7
Ambient Air Quality Environment for Assessment Purposes

Air Quality Parameter	Averaging Period	Assumed Background Ambient Level
PM_{10}	24-Hour	Daily Varying
	Annual	15.9 µg/m^3
$PM_{2.5}$	24-Hour	Daily Varying
	Annual	6.4 µg/m^3
Dust Deposition	Annual	1.6 g/m^2/month
NO_2	1-hour and Annual	Negligible
CO	8-hour	Negligible
VOCs	1-hour	Negligible

5 CLIMATE AND DISPERSION METEROLOGY

5.1 Introduction

To adequately characterise the dispersion meteorology of the study site information is needed on the prevailing wind regime, ambient temperature, rainfall, relative humidity, mixing depth and atmospheric stability. The climate and meteorology of the local area surrounding Clarence Colliery was characterised based on:

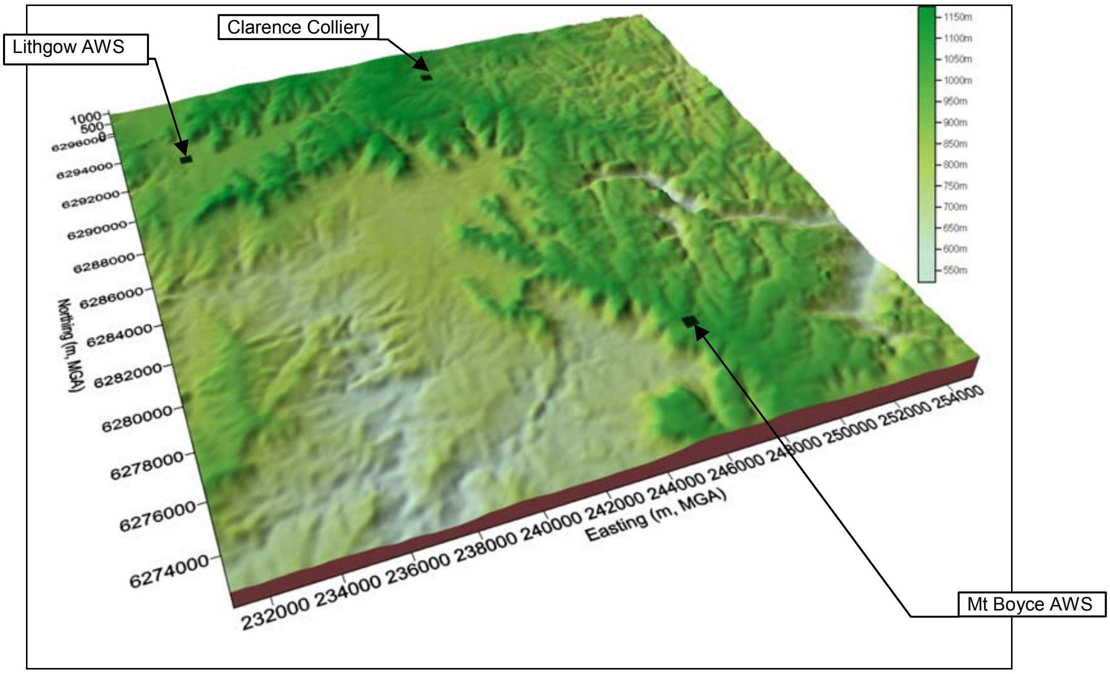
- Climate statistics obtained from the nearest Bureau of Meteorology (BoM) Automatic Weather Station (AWS) at Lithgow (Birdwood St) (Station Number 063224);
- Hourly meteorological data from the BoM weather stations at Lithgow (Cooerwull) (Station Number 063226) (which replaced Station Number 063224 when it closed in 2006) and Mount Boyce (Station Number 063292); and
- Site specific dataset generated through Heggies-conducted meteorological modelling.

The locations of the monitoring stations situated in relatively close proximity to Clarence Colliery for which data were obtained for analysis are summarised in **Table 8**. The data from these monitoring stations were used to characterise the local meteorology and provide the input datasets for the meteorological modelling undertaken. The proximity of these two weather stations to Clarence Colliery and the topographical features between is presented in **Figure 7**.

Table 8
Meteorological Monitoring Station Details

Station Name	Location (m, MGA)		Distance (km) / Direction From Clarence Colliery	Elevation (m, AHD)
	Easting	Northing		
Lithgow (Cooerwull)	233340	6292035	10.7 km / W	895 m
Mt Boyce	247106	6276807	17.6 km / SSE	1040 m

Figure 7
Regional Topography and Meteorological Stations Surrounding Clarence Colliery



Note: Topography shown with vertical exaggeration of 1

5.2 Meteorological Modelling

The Air Pollution Model (TAPM) meteorological model (Version 3) was used to compile the meteorological dataset for Clarence Colliery. TAPM, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) is a prognostic model which may be used to predict three-dimensional meteorological data and air pollution concentrations, with no local data inputs required.

TAPM model predicts wind speed and direction, temperature, pressure, water vapour, cloud, rain water and turbulence. The program allows the user to generate synthetic observations by referencing databases (covering terrain, vegetation and soil type, sea surface temperature and synoptic scale meteorological analyses) which are subsequently used in the model input to generate site-specific hourly meteorological observations.

Additionally, the TAPM model may assimilate actual local wind observations so that they can optionally be included in a model solution. The wind speed and direction observations are used to realign the predicted solution towards the observation values. This function of accounting for actual meteorological observations within the region of interest is referred to as “data assimilation”.

Thus, direct measurements for 2007 of hourly average wind speed and wind direction at the BoM's Lithgow (Cooerwull) and Mount Boyce AWS locations were input into the TAPM simulations to provide realignment to local and regional conditions. Annual wind roses of recorded data at each station between 2003 and 2007 are presented **Annexure A**. It can be seen that, based on comparison with the four preceding years, with regards to wind speed and direction, data recorded during 2007 at Lithgow and Mount Boyce is representative of each location.

It is noted that the 2003 to 2007 comparison wind roses for Lithgow (**Annexure A**) are a combined data set between Lithgow (Birdwood St) which closed in 2006 and Lithgow (Cooerwull), which was the Birdwood St replacement station. Both stations record only 9am and 3pm observations.

Table 9 details the parameters used in the meteorological modelling for this assessment.

Table 9
Meteorological parameters used for this study

TAPM (v 3.0)	
Number of grids (spacing)	5 (30 km, 10 km, 3 km, 1 km, 300 m)
Number of grid points	25 x 25 x 30
Year of analysis	2007
Centre of analysis	33°32' S, 150°15' E
Data assimilation	Meteorological data assimilation using wind data from Lithgow (Cooerwull) and Mt Boyce AWS

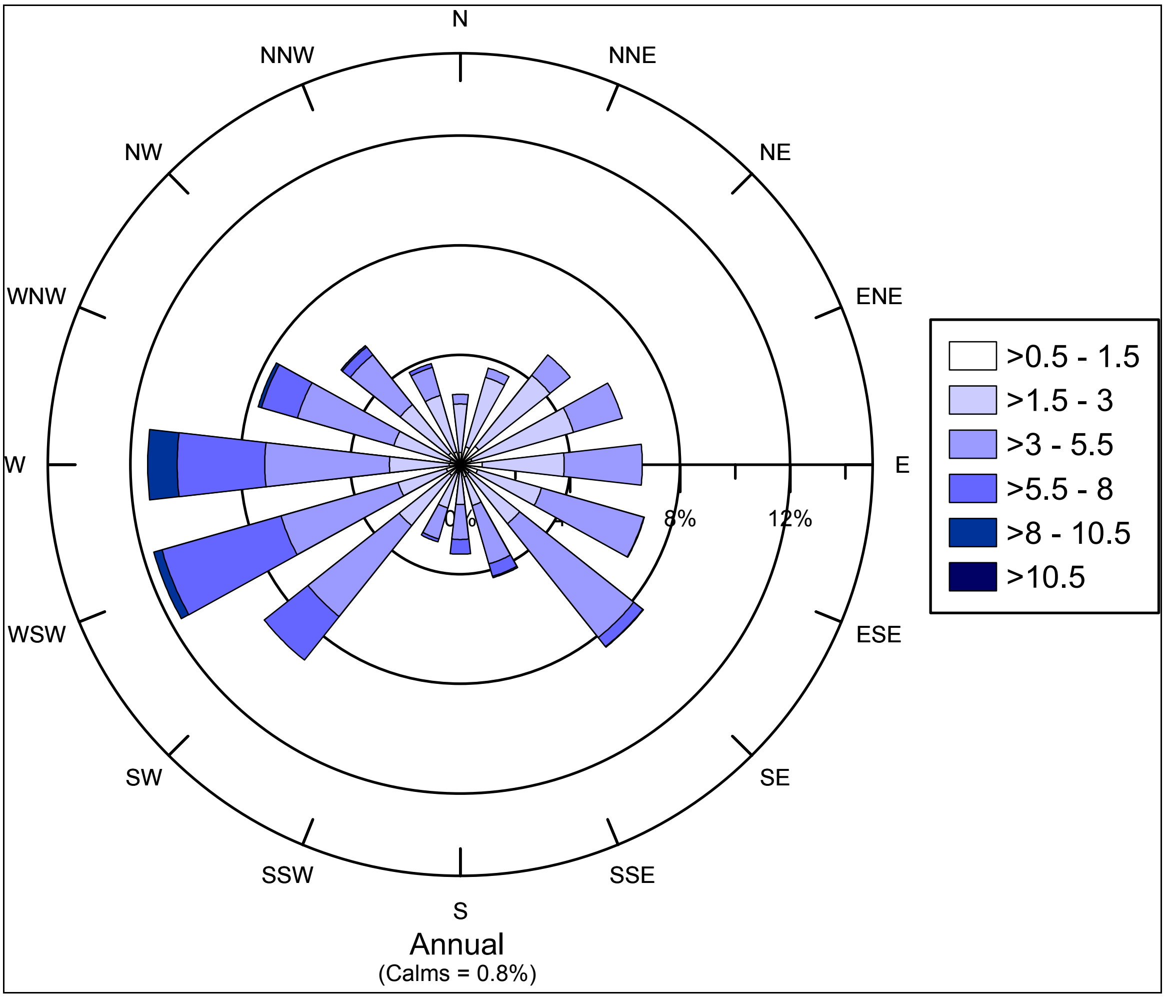
5.3 Meteorological Conditions

5.3.1 Wind Regime

A summary of the 2007 annual wind behaviour predicted for Clarence Colliery by TAPM is presented as a wind rose in **Figure 8.** This wind rose displays occurrences of winds from all quadrants.

Figure 7 indicates that winds experienced at Clarence Colliery are predominantly light to fresh (between 1.5m/s and 10.5m/s) from the western quadrant (approximately 31% combined). Calm wind conditions (wind speed less than 0.5 m/s) were predicted to occur approximately 0.8% of the time throughout 2007.

Figure 8
Annual TAPM-Predicted Wind Rose for Clarence Colliery - 2007



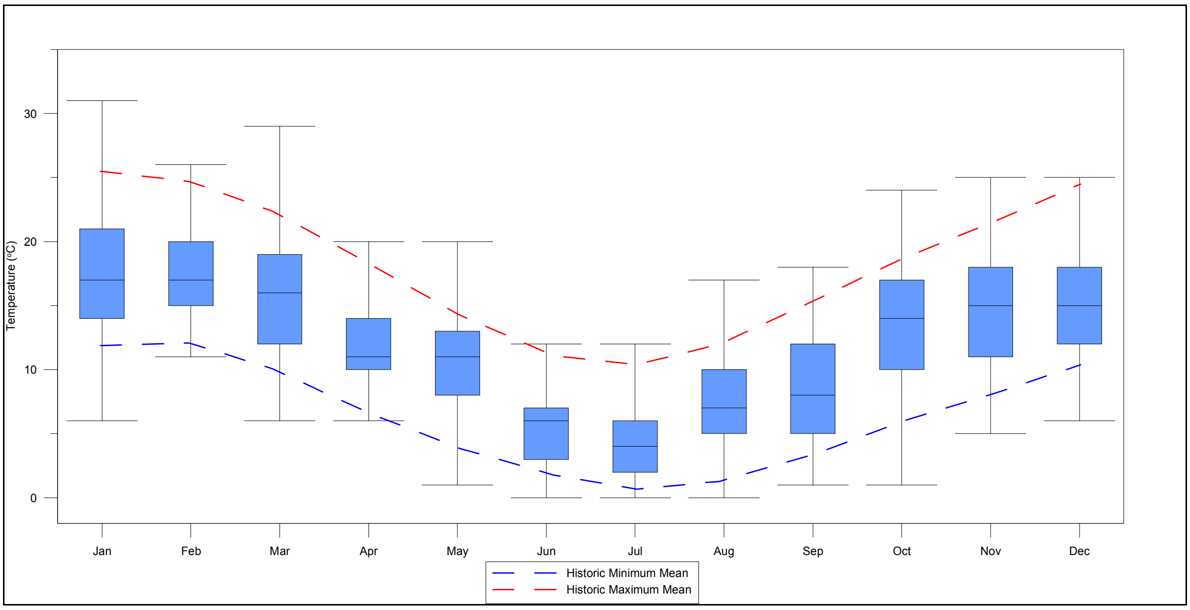
The seasonal variation in predicted wind behaviour at Clarence Colliery is presented in **Annexure B**. The seasonal wind roses indicate that:

- In spring, light to fresh winds are experienced predominantly from the west-northwest to southwest (approximately 40% combined).
- In summer, light winds (between 1.5 m/s and 5.5 m/s) are experienced predominantly from the east to northeast (approximately 36% combined).
- In autumn, light to fresh winds are experienced predominantly from the west-northwest to west-southwest (approximately 34% combined) and light to moderate winds from the southeast.
- In winter, light to fresh winds are experienced from predominantly from the west to west-southwest (approximately 52% combined).

5.3.2 Temperature

Predicted temperature variance by month at Clarence Colliery for 2007 is presented in **Figure 9**. Additionally overlayed in **Figure 9** are the historic maximum/minimum and mean maximum/minimum temperatures recorded at the Lithgow (Birdwood St) station between 1965 and 2006.

Figure 9
Monthly Temperature Variance – Clarence Colliery – 2007 and Regional Historic data for Lithgow



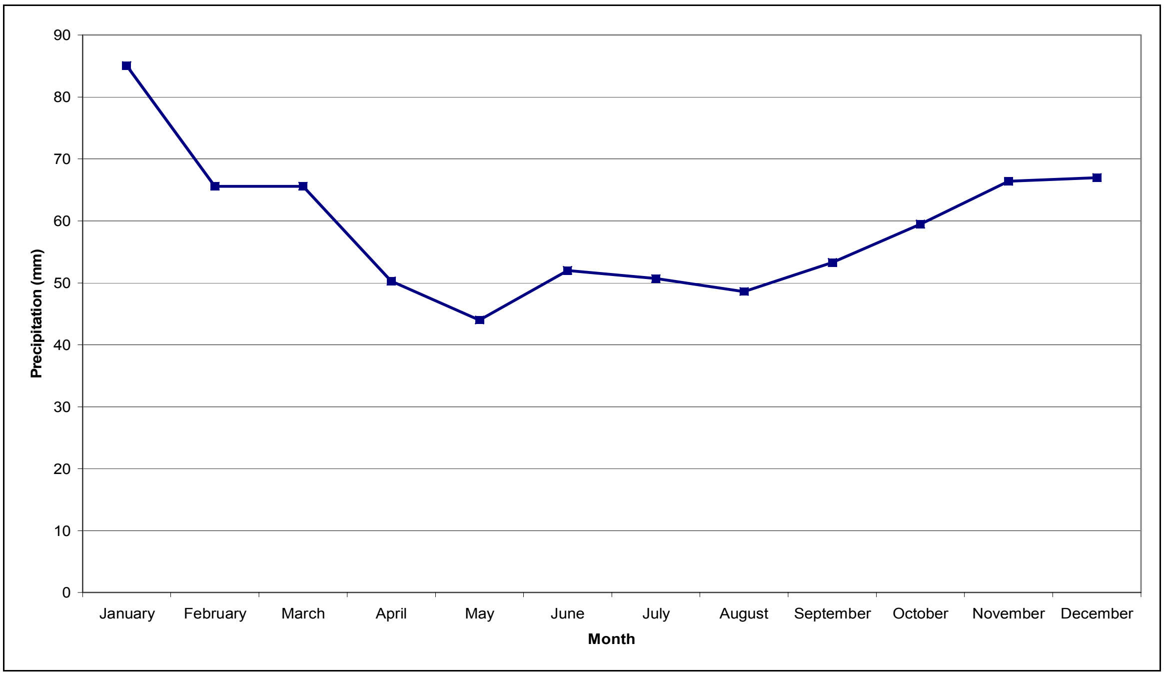
It can be seen in **Figure 9** that the predicted temperature for Clarence Colliery during 2007 matches well with the historical measurements at Lithgow. It can therefore be considered that the 2007 dataset is representative of the temperature likely to be experienced within the region of Clarence Colliery.

From analysis of the recorded historic data, the temperature of the Lithgow area may be described as cold to warm overall. Average air temperatures during the day tend to vary between 10.4°C and 12.1°C in winter and 24.5°C and 25.5ºC in summer. Average air temperatures during the night tend to be cold to cool, varying between 0.7ºC and 1.8ºC in winter and between 10.4ºC and 12.0ºC in summer.

5.3.3 Rainfall

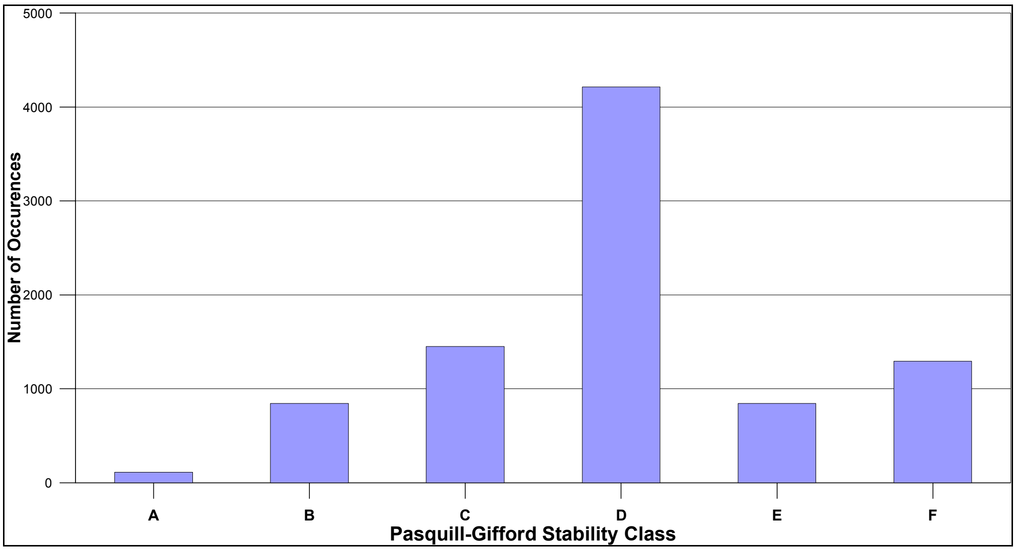
Precipitation is important to air pollution studies since it reduces the potential for fugitive dust emissions and represents an effective removal mechanism of atmospheric pollutants. A graph displaying the median (5th decile) monthly rainfall at Lithgow is shown in **Figure 10**.

Figure 10
Median (5th decile) Monthly Rainfall Measurements, Lithgow



The frequency of each stability class at Clarence Colliery, as predicted by TAPM, is presented in **Figure 11**. The seasonal stability class distributions for each station are included in **Annexure C**.

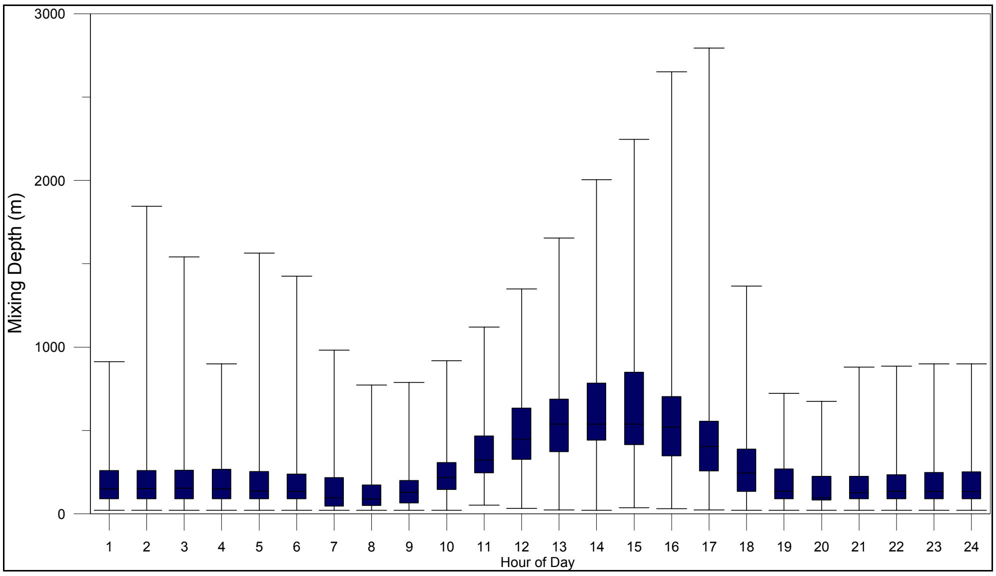
Figure 11
TAPM-Predicted Annual Stability Class Distributions for Clarence Colliery, 2007



The results indicate a high frequency of conditions typical to Stability Class "D". Stability Class "D" is indicative of neutral conditions, conducive to a moderate level of pollutant dispersion due to mechanical mixing.

Diurnal variations in maximum and average mixing depths predicted by TAPM at Clarence Colliery during 2007 are illustrated in **Figure 12**. It can be seen that an increase in the mixing depth during the morning, arising due to the onset of vertical mixing following sunrise, is apparent with maximum mixing heights occurring in the mid to late afternoon, due to the dissipation of ground-based temperature inversions and the growth of convective mixing layer.

Figure 12
TAPM-Predicted Diurnal Variation in Mixing Depth for Clarence Colliery, 2007



6 ATMOSPHERIC DISPERSION MODELLING

6.1 Model Selection and Configuration

6.1.1 Clarence Colliery Site Emissions

The atmospheric dispersion modelling carried out in the present assessment for emissions from Clarence Colliery utilises the Ausplume Gaussian Plume Dispersion Model software (Version 6.0) developed by the EPA Victoria.

Ausplume is the approved dispersion model for use in the majority of applications in NSW. Default options specified in the Technical Users Manual (EPA Victoria, 2000) have been used, as per the Approved Methods.

For this assessment, Ausplume will be configured over a 5km x 5km modelling domain, centred on Clarence Colliery. The gridded receptor spacing will be defined at 55 m, providing adequately fine computational resolution to calculate near field impacts.

In order to account for the potential influence on pollution dispersion and varying receptor elevations across the modelling domain, a terrain file incorporating the local topographical features has been included in the modelling process.

6.1.2 Road Emissions

In order to determine the potential impact along the haulage routes from Clarence Colliery, the transportation dispersion model CAL3QHCR, developed by the United States Environmental Protection Agency (USEPA), was implemented.

CAL3QHCR is based on the dispersion algorithms contained within CALINE-3 and is able to predict the ambient concentrations of inert pollutants along roads and highways while considering hourly-varying meteorological conditions.

A simple "footprint" model has been configured to estimate the extent of impact associated with the increased road haulage operations from Clarence Colliery and existing traffic numbers for the area. Traffic data for the Chifley Road, a primary road link in the distribution of coal from Clarence Colliery, has been adopted from the Traffic Assessment conducted for this Project by Barnson Pty Ltd, dated 16 August 2007. The data contained within *Annexure 3* of the FGF Group Traffic report (2009) has been extracted and presented in **Table 10**.

Table 10
Projected Traffic Data for Bells Line of Road for Proposed Operations

	Projected Traffic Data
Heavy Vehicles per day	251
Light Vehicles per day	3099
Total Vehicles per day	3350

Source: Annexure 3, FGF Group (2009)

6.2 Modelling Scenarios

6.2.1 Clarence Colliery Site Emissions

One scenario has been modelled to reflect the proposed increased road haulage from Clarence Colliery. The modelling scenario takes into consideration the movement of mobile plant and equipment across the different coal loading areas and aims to be representative of worst case conditions present throughout an operational year.

It is noted that the modelling scenario for emissions from the Clarence Colliery has been configured to include all surface operation sources, not simply those associated with the proposed increase in coal transportation. Typically, in assessing the modification of a previously approved operation, comparison between monitoring data obtained during existing data and predicted ambient concentrations associated with new components may be sufficient in assessing the likely additional impact and compliance with assessment criteria. However, due to a lack of quality PM_{10} monitoring data from the vicinity of the Clarence Colliery (as per **Section 4.2**), this approach was not readily applicable. Given the relatively low level of operational changes associated with this proposal, the methodology to assess total operations is considered appropriate.

The modelling scenario incorporates the following operations:

- Conveying of coal from underground operations to processing plant and stockpiles;

- Processing plant operations;
- Stockpiling of ROM and processed materials
- Stockpile management, including the loading of haul trucks;
- Movement of haul trucks about Clarence Colliery; and
- Loading of train wagons.

6.2.2 Off-site Road Haulage Emissions

A general footprint modelling scenario within CAL3QHCR was configured to estimate potential impacts associated with increased road haulage from Clarence Colliery. The modelling domain was chosen in consideration of the USEPA's definition (USEPA, 1995) of the mixing zone; specifically 3m either side of the road corridor. Typical width of Chifley Road in the vicinity of Clarence Colliery was 6m. Consequently the width of the mixing zone was taken to be 12m. For the purpose of deriving a footprint area, a generic length of road of 100m was taken for the domain. **Figure 13** illustrates this described CAL3QHCR modelling domain.

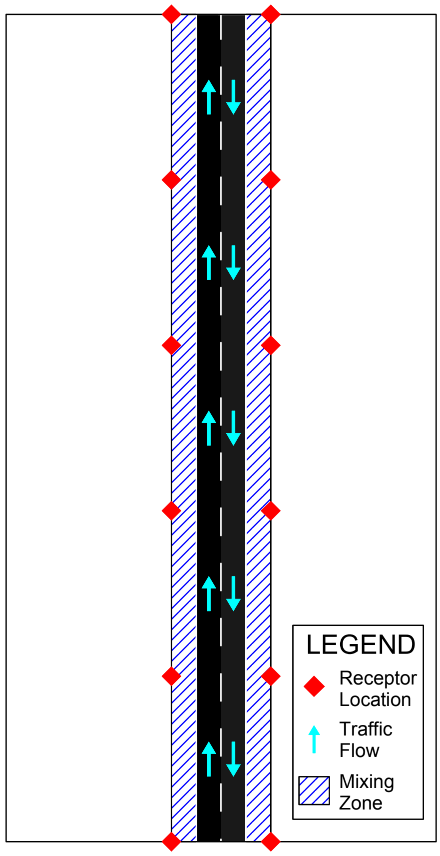


Figure 13
CAL3QHCR Modelling Domain

Following standard convention of the USEPA (1995), receptor locations were selected along the boundary of the mixing zone of this domain at 20m. Receptor heights were fixed at the recommended breathing height of 1.8m.

Traffic was modelled in this domain through two continuous "links", as marked in **Figure 13**. The traffic flow data presented **Table 10** was applied into these two traffic links and used to develop emission rates for the modelling process.

6.3 Emission Factors

6.3.1 Clarence Colliery Site Emissions

Table 11 presents the emission factors for particulate matter from Clarence Colliery used in the dispersion modelling for this assessment. These relate to emissions expected under normal operating conditions. The ratio of the PM_{10} fraction of the total particulate emission (used to predict dust deposition) ranges from 50% (eg wind erosion) down to 25% (eg wheel-generated dust). The proportion of the PM_{10} fraction for each activity was derived primarily from the National Pollutant Inventory document, *Emission Estimation Technique Manual for Mining, Version 2.3*, (hereafter, "EETMM") (Environment Australia, 2001).

Table 11
Particulate Emission Factors for Air Quality Dispersion Modelling

Activity	**Total Particulate Emission Factor**	**PM_{10} Emission Factor**	**Emission Factor Units**
Front-end Loader on Coal	0.00139	0.00066	kg/t
Erosion from Exposed Areas	0.4	0.2	kg/ha/hr
Active Stockpile Wind Erosion	0.3223	0.16115	kg/ha/hr
Haul Truck generated dust	2.50721	0.76751	kg/VKT[1]
Loading Stockpiles	0.00139	0.00066	kg/t
Loading Trains	0.0004	0.00017	kg/t

Note 1: VKT – Vehicle Kilometres Travelled

In general, default emission factors have been used as contained in Table 1 of the EETMM. In some instances, the moisture content of materials at Clarence Colliery is not adequately reflected within the default emission factors contained in the EETMM, and the equations given in either Table 1 of the EETMM document or USEPA AP-42 documentation were therefore used to derive representative emission factors. The following emission factors were derived using this method.

- Haul truck wheel dust (USEPA AP-42).
- Loading Stockpiles (by Conveyer).
- Loading Trucks (by FEL).
- Stockpile wind erosion.

6.3.2 Road Haulage Emissions

Table 12 presents the emission factors calculated for road traffic on the haulage routes from Clarence Colliery for the key atmospheric pollutants associated with the combustion of automotive fuels. Emission factors were derived from the National Pollutant Inventory document, *Emission Estimation Technique Manual for Combustion Engines, Version 3.0*, (hereafter, “EETMCE”) (Environment Australia, 2008).

These emission factors were entered into CAL3QHCR, along with the traffic flow data presented in **Table 10**. It is assumed that a diesel consumption rate of 0.58l/km, used in the calculation of the above emission factors and based on previous Heggies studies, was applicable to the coal distribution fleet.

It is noted that all emissions of NO_X are assumed to be instantly converted to NO_2. Additionally, it is assumed that emissions of Total VOCs are 100% Benzene. Both assumptions are considered highly conservative.

Table 12
Combustion Emissions for Road Sources

Pollutant	**Diesel Combustion – g/VMT[1] (Coal Distribution Trucks)**	**Petrol Combustion – g/VMT (General Road Traffic)**
PM_{10}	1.67	0.013
$PM_{2.5}$	1.58	0.012
CO	6.32	7.08
NO_X	21.39	1.29
Total VOCs	1.67	0.47

Note 1: VMT – Vehicle Mile Travelled, as required by CAL3QHCR

6.4 Modelling Assumptions for the Clarence Colliery Site

Annexure 6 provides details of the emission inventory associated with the modelled scenario for Clarence Colliery using the emission factors given in **Table 11**.

The emission inventory has been derived to reflect the worst-case scenario for airborne emissions over a 24 hour period, and mean average operational conditions for annual assessments. All likely surface operations at the Clarence Colliery, whether associated with the proposed increased coal transportation or not, have been included within this modelling assessment.

The following assumptions were made in creating the emissions inventory for the Project.

- All sources are assumed to operate 24 hours a day.
- The total annual mining rate of coal at Clarence Colliery is assumed to be 3 Mt and this amount has been applied to stockpile loading. From this amount, 500 000tpa is loaded to trucks for road haulage from Clarence Colliery, while the remaining 2.5 Mtpa is assumed to be distributed by rail.
- All mining components have been assumed to have a working schedule of 7 days a week for the entire year.
- The following moisture content (mc) and silt content (sc) were assumed for the modelling.
  - Coal: mc – 2.8%, sc – 6.2% (based on previous Heggies studies).
  - Unsealed Haul Routes: mc – 1.1%, sc – 6.4% (USEPA, 1998).
- The emission factors for the loading of coal to trucks, wind erosion from stockpiles and loading to stockpiles from conveyors were derived from *Table 1* of the EETMM. The equations corresponding to excavators/ front-end loaders (on coal), wind erosion from active coal stockpiles and miscellaneous transfer and conveying were used.
- Due to the enclosed and wet process associated with the wash plant, it is assumed that minimal emissions are associated with this component of Clarence Colliery. Consequently, this source has not been included in the modelling process.

- The default emission factors for the loading of trains and wind erosion from exposed areas were adopted from *Table 1* of the EETMM.
- Due to the installation of a water spraying system at the perimeter of stockpiling area, an emission control reduction of 50% for spraying has been applied to all stockpiles and stockpile loading, consistent with emission reductions quoted in *Table 3* of the EETMM.
- The unsealed haul truck routes about the coal stockpile and loading areas are assumed to be 1.7km, 2.1km and 1.6km for the ROM, Washed and Secondary Coal loading areas respectively.
- Wheel generated dust from the movement of trucks (haul and product) has been represented as a simulated line source using the "volume source" Ausplume input. Each volume source is located along the centreline of the real line source with separations less than one quarter of the distance to the nearest residential receptor. The emission factor for haul trucks was derived using the USEPA method (USEPA, 2006)
- It has been assumed that Level 2 watering (>2 Litres/m^2/hour) will be applied to all unsealed internal routes when required. As such, a reduction factor of 75% has been applied to relevant haul truck movements. This reduction factor consistent with emission reductions quoted in *Table 3* of the EETMM.

7 MODELLING RESULTS

7.1 Dust Deposition

Table 13 shows the results of the Ausplume predictions for dust deposition from Clarence Colliery, using the emission rates calculated in **Annexure D**, at each of the identified receptors.

Table 13
Background and Incremental Dust Deposition at Nearest Residences

Residence	Dust - Annual Average (g/m^2/month)			
	Background	Increment	Background + Increment	Assessment Criterion
R1	1.6	0.1	1.7	4
R2	1.6	0.1	1.7	4
R3	1.6	0.1	1.7	4
R4	1.6	0.1	1.7	4
R5	1.6	0.0	1.6	4
R6	1.6	0.0	1.6	4

The results show the mean average monthly dust deposition predicted at the nearest residences surrounding Clarence Colliery over a one-year time frame. As detailed in **Section 4.1** the background level of dust deposition for the area surrounding Clarence Colliery is taken as 1.6g/m^2/month. The results presented in **Table 13** indicate that the total mean monthly dust deposition (background plus increment) associated with the Project are predicted to be less than 1.7g/m^2/month, at all the nearest residences.

A contour plot of the incremental increase in dust deposition is presented in **Figure 14**. The contour plot is indicative of the levels of dust deposition that can be potentially reached under the conditions modelled.

7.2 PM10 (24-Hour Average)

Table 14 shows the results of the Ausplume predictions for 24-hour average PM_{10} concentrations from Clarence Colliery, using the emission rates calculated in **Annexure D**, at each of the identified receptors

As detailed in **Section 4.2**, it has been assumed that background levels of PM_{10} vary on a daily basis. These background levels have been incorporated into the model. However as noted previously, elevated PM_{10} concentrations within the background file already exceed the impact assessment criteria on two separate occasions.

In accordance with *Section 5* of the Approved Methods, the purpose of this assessment is to demonstrate that no additional exceedances of the impact assessment criterion would occur as a result of the Project. Accordingly, the results in **Table 14** present the maximum (background plus increment) 24-hour average concentration of PM_{10} predicted at the residences surrounding the site, excluding the two days when the background already exceeds the DECC impact assessment criterion.

Table 14
Background and Incremental 24-hour Average PM_{10} Concentrations at Nearest Residences

Residence	PM_{10} – 24-hour Average (µg/m^3)			
	Background	Increment	Background + Increment	Assessment Criterion
R1	48.5	1	49.5	50
R2	48.5	0.9	49.4	50
R3	48.5	1	49.5	50
R4	48.5	0	48.5	50
R5	48.5	0	48.5	50
R6	48.5	0	48.5	50

The results presented in **Table 14** show that the maximum 24-hour average concentration of PM_{10} (background plus increment) (excluding days on which the background PM_{10} concentration is already greater than 50 µg/m^3) are predicted to be below 49.5 µg/m^3 at all residences. As discussed in **Section 4.2**, the use of a daily-varying PM_{10} dataset recorded at Bathurst for the background concentrations at Clarence Colliery is a conservative approach, thus the maximum predicted ground-level concentrations detailed in **Table 14** could be considered conservatively high.

Similarly, a contour plot of the 3rd highest 24-hour PM_{10} concentration (background plus increment) attributable to operations at Clarence Colliery are presented in **Figure 15**.

7.3 PM10 (Annual Average)

Table 15 shows the results of the Ausplume predictions for annual average PM_{10} concentrations from Clarence Colliery, using the emission rates calculated in **Annexure D**, at each of the identified receptors.

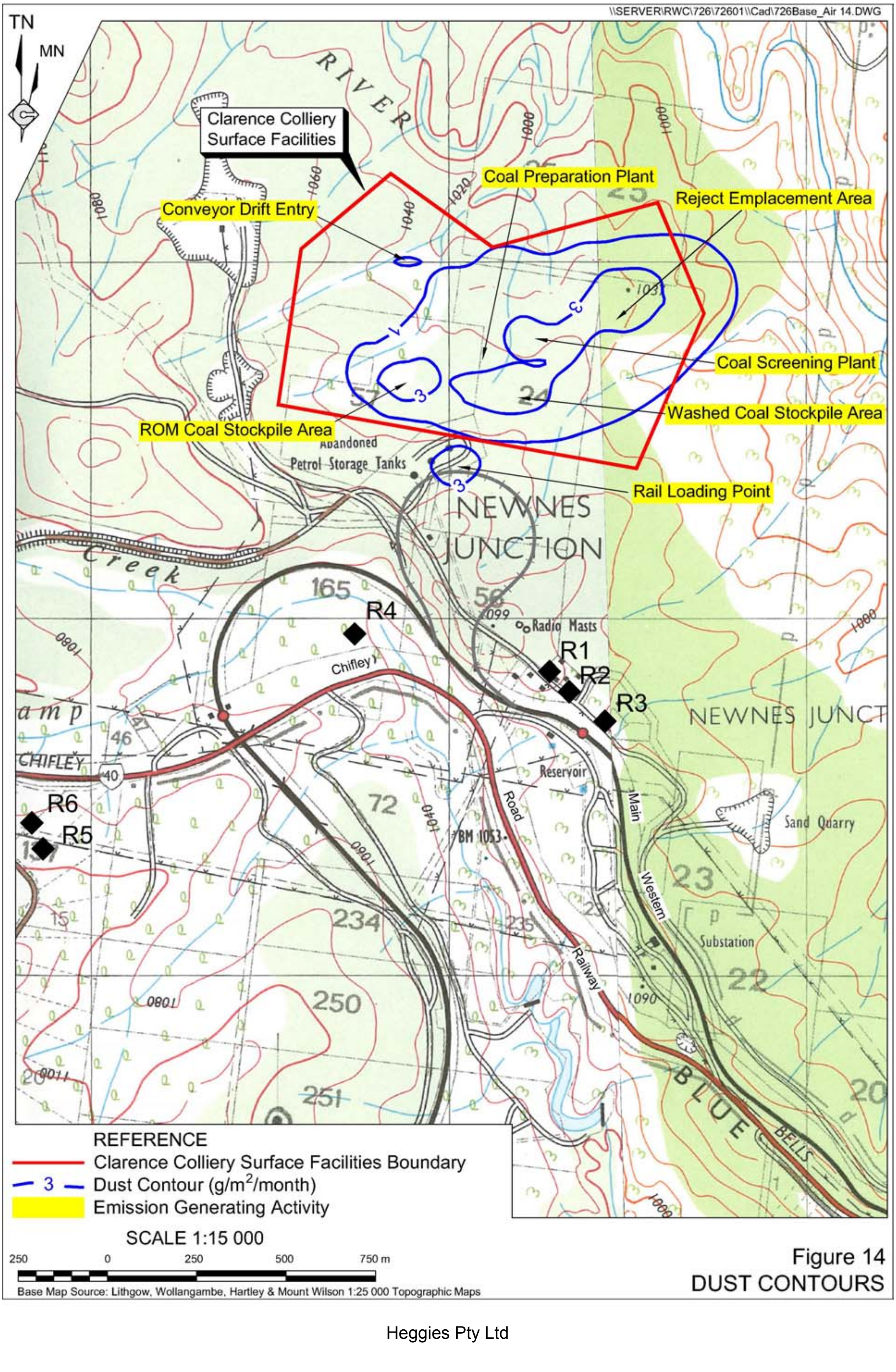


Figure 14
DUST CONTOURS

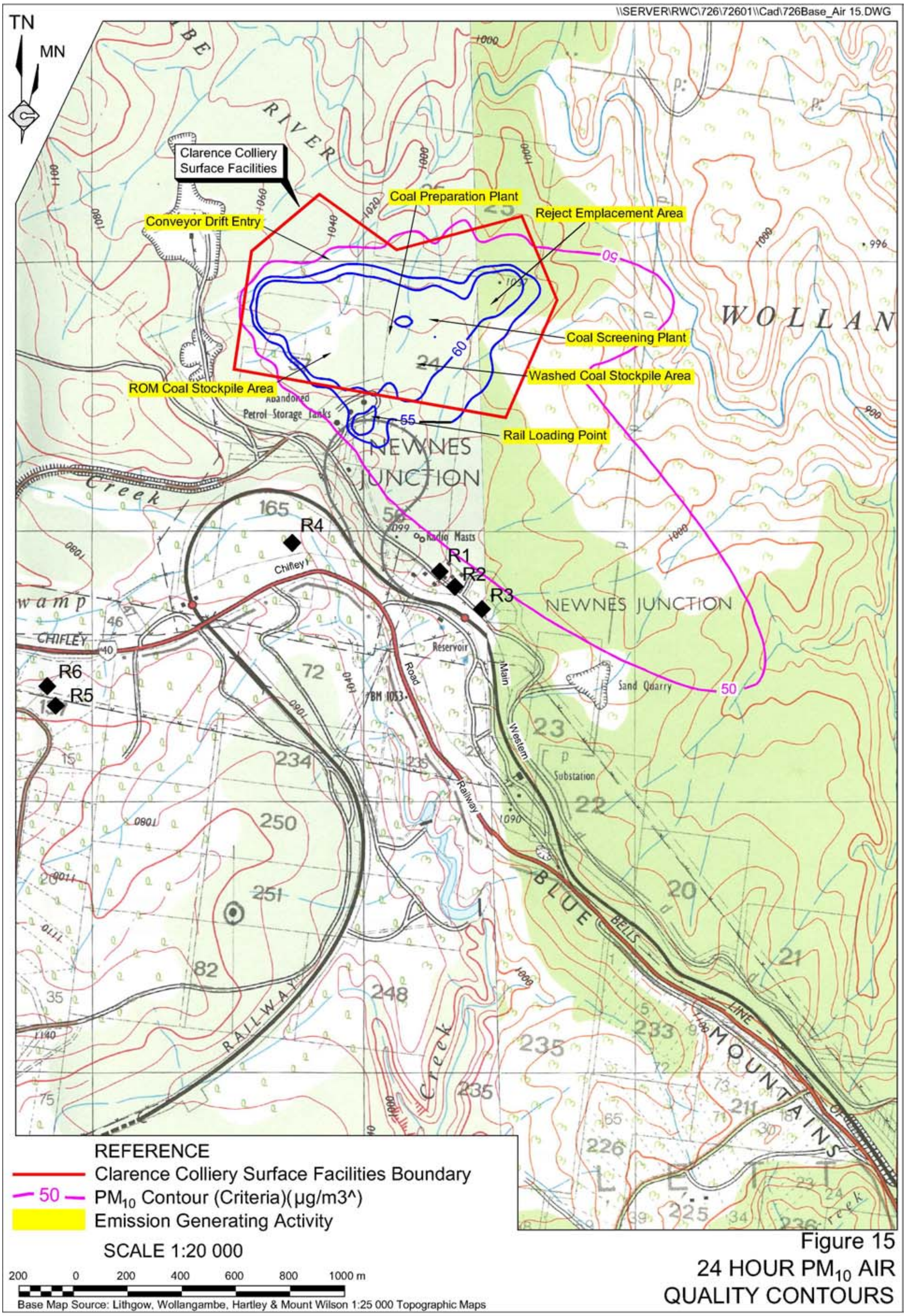


Figure 15
24 HOUR PM_{10} AIR QUALITY CONTOURS

Table 15
Annual Average PM_{10} Concentrations at Nearest Residences

Residence	PM_{10} – Annual Average (µg/m^3)			
	Background	Increment	Background + Increment	Assessment Criterion
R1	15.9	0.4	16.3	30
R2	15.9	0.4	16.3	30
R3	15.9	0.4	16.3	30
R4	15.9	0.5	16.4	30
R5	15.9	0.2	16.1	30
R6	15.9	0.2	16.1	30

As detailed in **Section 4.2** the annual average background concentration of PM_{10} assumed for Clarence Colliery is 15.9µg/m^3. This background level has been incorporated into the model through the hourly varying background file.

The results presented in **Table 15** indicate that annual average PM_{10} concentrations (background plus increment) associated with the Project are predicted to be below the assessment criterion of 30 µg/m^3 (annual average) at each residence.

A contour plot of the annual average PM_{10} concentrations (background plus increment) attributable to Clarence Colliery are presented in **Figure 16**.

7.4 Road Haulage Emissions

The maximum increments, as predicted by CAL3QHCR, associated with off-site road traffic along haulage routes for each of the key pollutants are presented in **Table 16**. Additionally, the applicable maximum background concentrations (as per **Section 4**) have been applied to derive a maximum predicted concentration for each pollutant. It is noted that for 24-hour PM_{10} and $PM_{2.5}$, the highest measured daily concentration within the Bathurst 2007 dataset not in exceedance of the assessment criterion (see **Section 4.2**), has been applied.

It can be seen from **Table 16** that for all key pollutants, the predicted maximum concentrations at locations directly adjacent to the road corridor, and therefore potential worst-case locations, are below the relevant assessment criteria.

Table 16
Maximum Predicted Concentrations – CAL3QHCR Road Modelling

Pollutant (unit)	Averaging Period	Maximum Increment	Background Concentration	Maximum Concentration	Assessment Criterion
PM_{10} (µg/m^3)	24-hour	0.71	48.8	49.5	50
	Annual	0.18	15.9	16.1	30
$PM_{2.5}$ (µg/m^3)	24-hour	0.68	19.5	20.2	25
	Annual	0.17	6.4	6.5	8
CO (mg/m^3)	8-hour	0.061	-	0.061	10
NO_2 - As NO_X (µg/m^3)	1-hour	38.8	-	38.8	246
	Annual	3.66	-	3.66	62
Benzene - As Total VOCs (mg/m^3)	1-hour	0.0071	-	0.0071	0.029

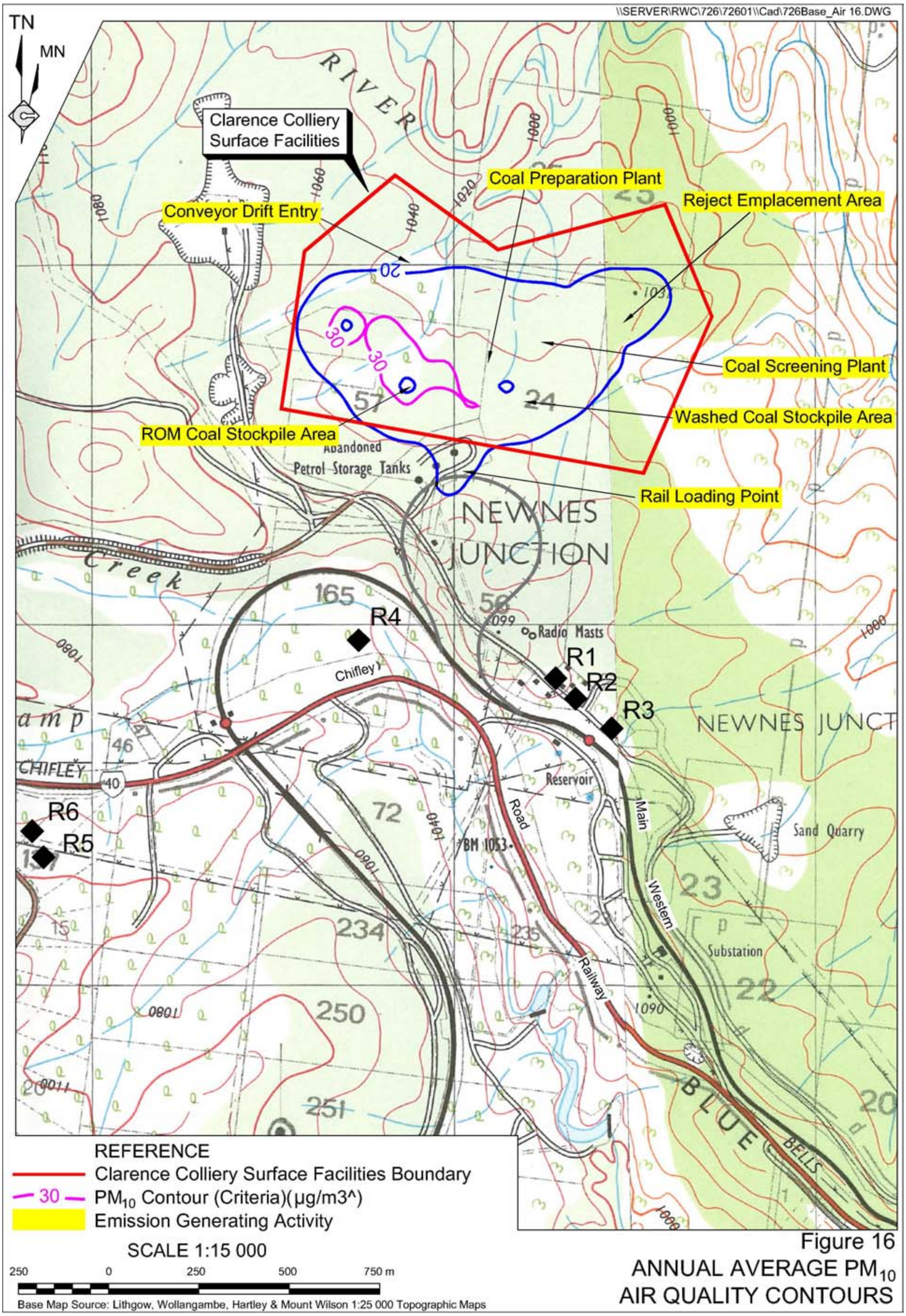


Figure 16
ANNUAL AVERAGE PM_{10}
AIR QUALITY CONTOURS

8 CONCLUSION

Heggies Pty Ltd has been commissioned by R.W Corkery & Co. Pty Ltd on behalf of Centennial Clarence Pty Ltd to conduct an air quality impact assessment of proposed increase in road haulage from the Clarence Colliery, ie. increased annual distribution of product coal via road trucks from 200,000tpa to 500,000tpa.

Modelling was conducted in two stages, focusing on particulate matter emissions from Clarence Colliery and automotive fuel combustion emissions from coal distribution by road. Emissions from Clarence Colliery were modelled using Ausplume V 6, while the impact attributable to off-site road haulage was modelled using the USEPA's CAL3QHCR model.

It is noted that the Clarence Colliery emissions modelling was configured to include all surface operation sources, not simply those associated with the proposed increase in coal transportation.

These predictions indicate that particulate matter and combustion emissions attributable to both the increased on-site operations and increased coal distribution by road trucks would be within the current DECC assessment criteria.

9 REFERENCES

The following documents and resources have been used in the production of this report:

Barnson Pty Ltd (2007), Traffic Impact Assessment conducted for increased operations at Clarence Colliery dated 16 August 2007 – Heading Unknown.

Bureau of Meteorology, Hourly observations for 2003 to 2007 from the Mount Boyce AWS and Lithgow Stations.

Bureau of Meteorology (2008), Historical climate data between 1965 and 2006 at Lithgow Station.

Centennial Coal Company Ltd (2006), Clarence Colliery Annual Environmental Management Report January – December 2005.

Dust Deposition monitoring data conducted at Clarence Colliery, December 2006 to December 2007.

Environment Australia National Pollution Inventory (2001), Emission Estimation Technique Manual for Mining, Version 2.3.

Environment Australia National Pollution Inventory (2008), Emission Estimation Technique Manual for Combustion Engines, Version 3.0.

Heggies generated meteorology file (hourly observations for the year 2007) for Clarence Colliery Site referencing TAPM software outputs.

National Environmental Protection Council (1998) "National Environmental Protection Measure for Ambient Air Quality".

NSW Department of Environment and Climate Change (2005), Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales.

NSW Department of Environment and Conservation (2007), PM_{10} data as measured by TEOM at the DECC's Bathurst monitoring site.

USEPA (1995) User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections.

USEPA (2006) Compilation of Air Pollutant Emission Factors AP-42 - Chapter 13.2.2 Unpaved Roads.

10 GLOSSARY OF TERMS, SYMBOLS AND ACRONYMS

AHD	Australian Height Datum
Approved Methods	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW
AWS	Automatic Weather Station
BoM	Bureau of Meteorology
CO	Carbon Monoxide
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DECC	NSW Department of the Environment and Climate Change
EETMCE	Emission Estimation Technique Manual for Combustion Engines, Version 3.0
EETMM	Emission Estimation Technique Manual for Mining, Version 2.3
FEL	Front-End Loader
Heggies	Heggies Pty Ltd
l/km	litres per kilometre
mg	Milligram (g x 10^{-3})
µg	Microgram (g x 10^{-6})
µm	Micrometre or micron (metre x 10^{-6})
m^3	Cubic meter
MGA	Map Grid of Australia
Mt	Megatonnes
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NO_2	Nitrogen Dioxide
NO_X	Oxides of Nitrogen
PM_{10}	Particulate matter less than 10microns in aerodynamic diameter

$PM_{2.5}$	Particulate matter less than 2.5microns in aerodynamic diameter
Clarence Colliery	Clarence Colliery
The Proponent	Centennial Coal Ltd
tpa	Tonnes per Annum
ROM	Run-of-Mine
RWC	R.W. Corkery & Co. Pty Ltd
TAPM	"The Air Pollution Model"
TEOM	Tapered Element Oscillating Microbalance
TSP	Total Suspended Particulate
USEPA	United States Environmental Protection Agency
VKT	Vehicle Kilometres Travelled
VMT	Vehicle Mile Travelled
VOCs	Volatile Organic Compounds

Annexure A

Annual Wind Roses for Lithgow and Mount Boyce

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Figure A1 Annual Wind Roses for Lithgow – 2003-2007

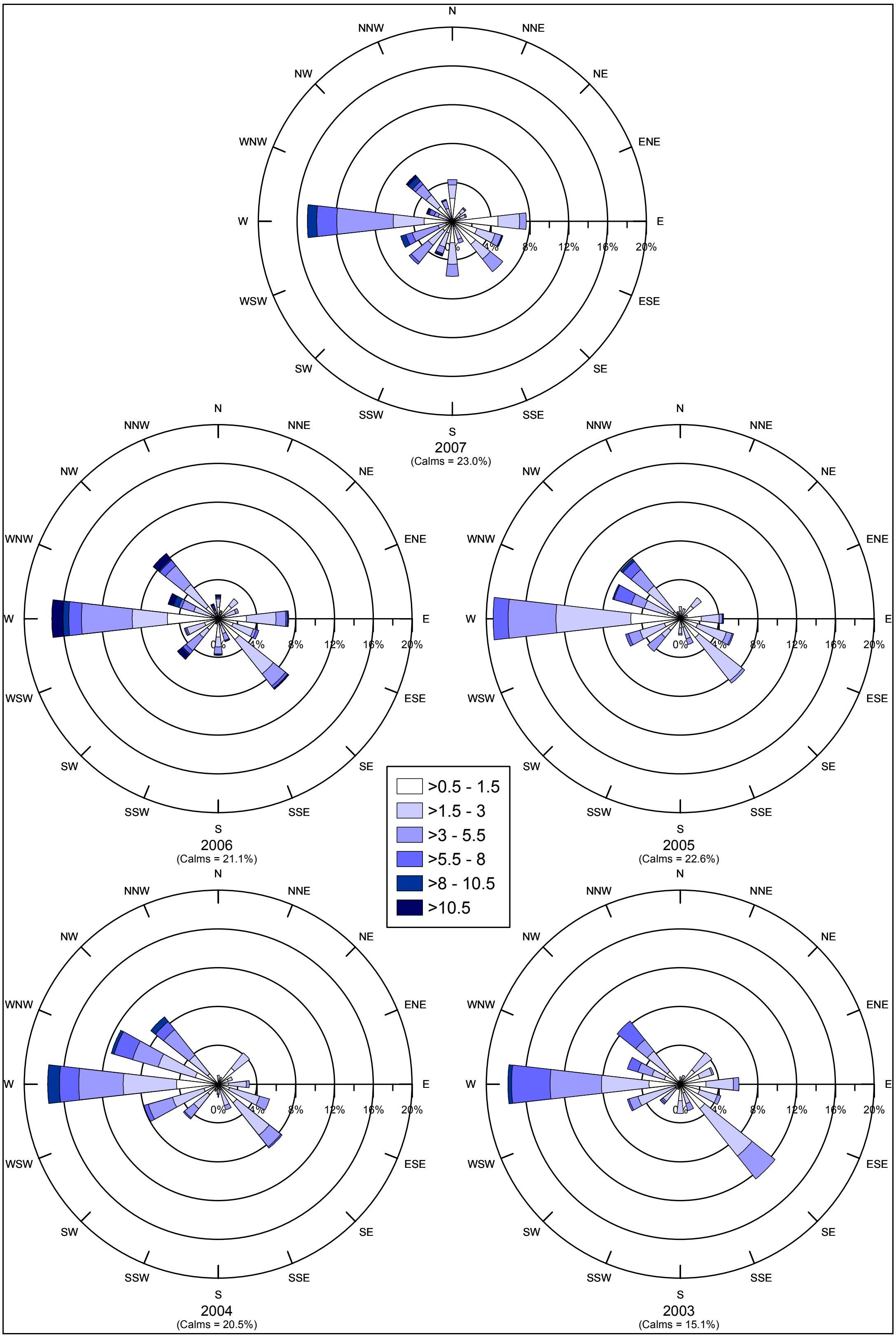
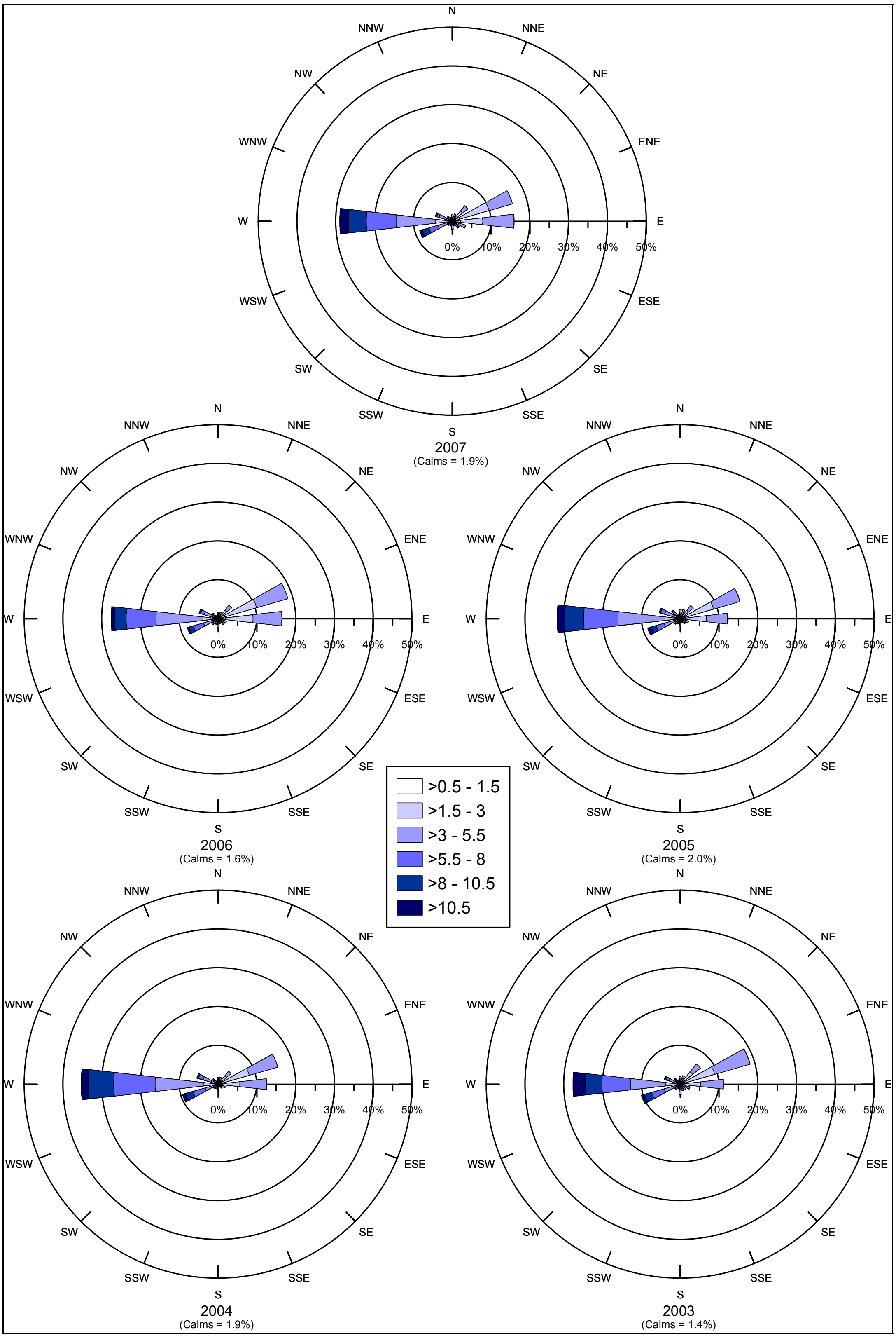


Figure A2 Annual Wind Roses for Mount Boyce AWS – 2003-2007

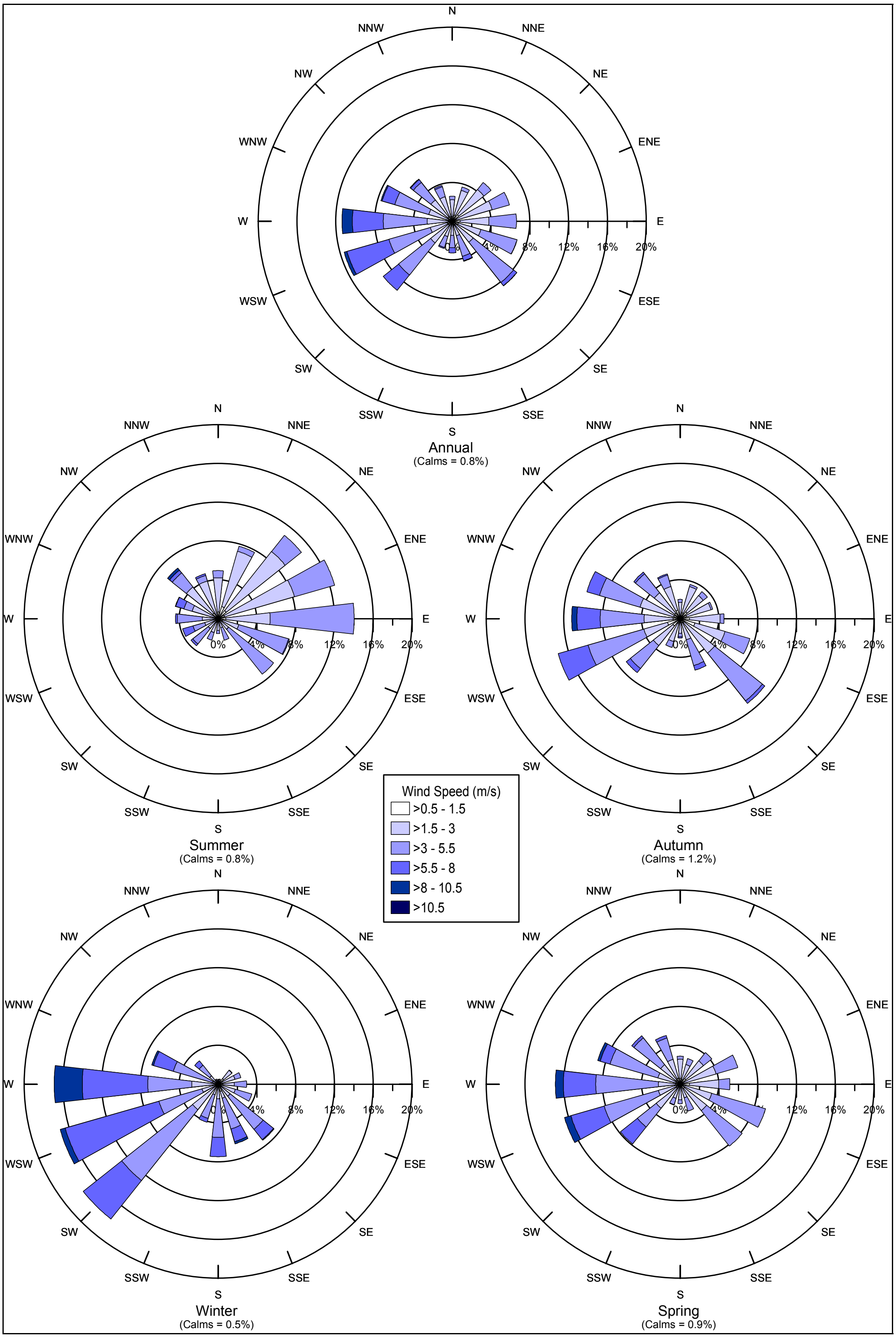


Annexure B

TAPM Predicted Seasonal Wind Roses for the Clarence Colliery

(No. of pages excluding this page = 1)

Figure B1 Seasonal Wind Roses for Clarence Colliery (TAPM) –2007



Annexure C

TAPM Predicted Seasonal Stability Class for the Clarence Colliery

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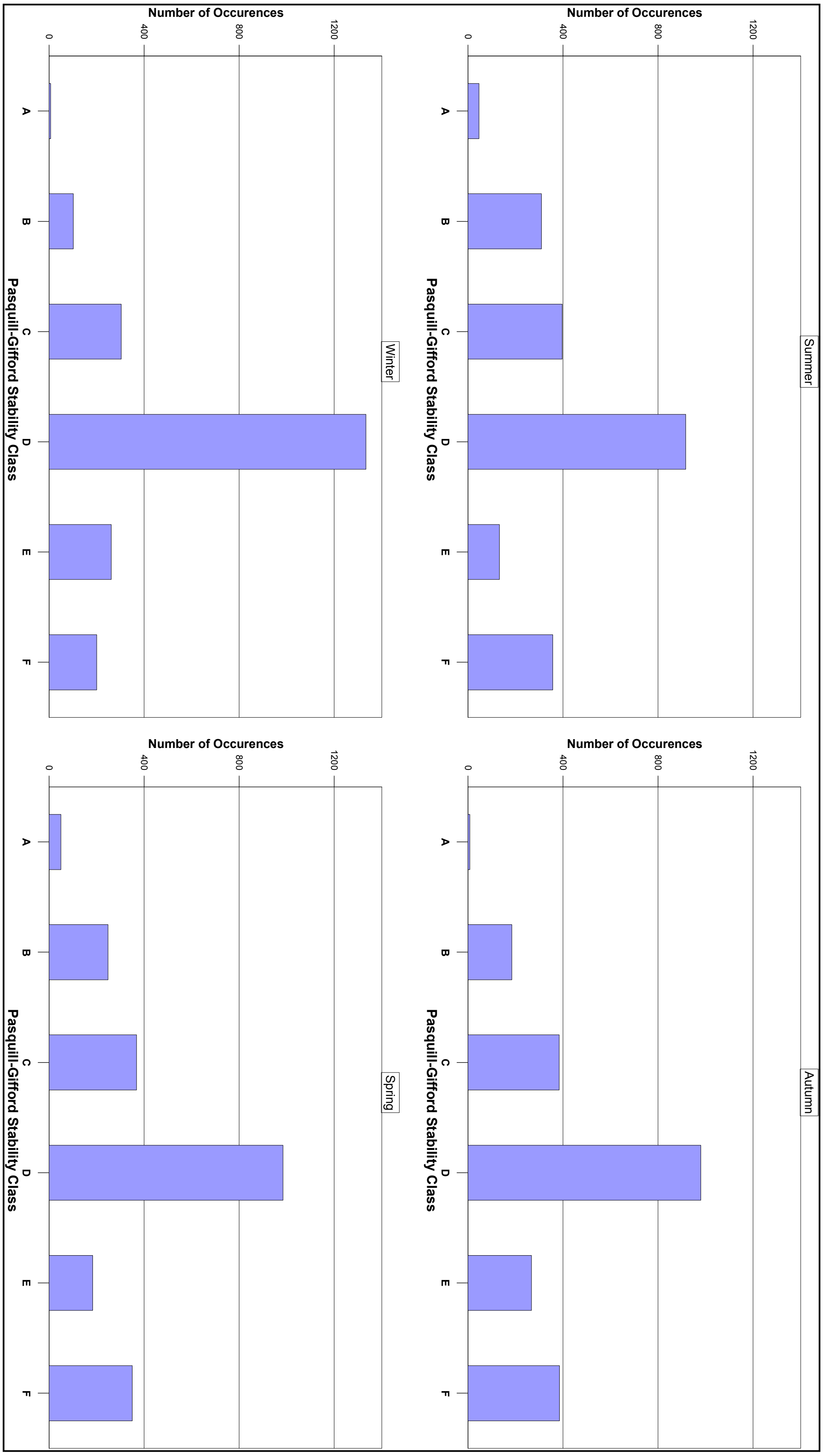
Figure C1 Seasonal Variation in Stability Class for Clarence Colliery (TAPM) –2007



Annexure D

Clarence Colliery Emissions Inventory

(No. of pages excluding this page = 1)

	TSP Emission Factor	PM10 Emission Factor	Emission Factor Units	Throughput (tonnes per hour)	Average number of kilometres per hour	Working days available	Working hours per day	Dust Deposition Emission Rate (mg/s)	PM10 Emission Rate (mg/s)	TSP Emission Flux (mg/s/m2)	PM10 Emission Flux (mg/s/m2)
Stockpile Area 1											
Front End Loader	0.00139	0.00066	kg/t	13.70	N/A	365	15	5.297	2.505	N/A	N/A
(Active Coal) Stockpile Wind Erosion	0.32230	0.16115	kg/ha/hr	N/A	N/A	365	24	N/A	N/A	0.00448	0.00224
Stockpile loading	0.00139	0.00066	kg/t	342.47	N/A	365	24	66.21487	31.31785	N/A	N/A
Wind Erosion from Exposed areas	0.40000	0.20000	kg/ha/hr	N/A	N/A	365	24	N/A	N/A	0.00556	0.00278
Stockpile Area 2											
FEL	0.00139	0.00066	kg/t	32.88	N/A	365	15	12.713	6.013	N/A	N/A
Stockpile Wind Erosion	0.32230	0.16115	kg/ha/hr	N/A	N/A	365	24	N/A	N/A	0.00448	0.00224
Stockpile Loading	0.00139	0.00066	kg/t	342.47	N/A	365	24	66.21487	31.3178	N/A	N/A
Wind Erosion from Exposed areas	0.40000	0.20000	kg/ha/hr	N/A	N/A	365	24	N/A	N/A	0.00556	0.00278
Stockpile Area 3											
FEL	0.00139	0.00066	kg/t	31.05	N/A	365	15	12.007	5.679	N/A	N/A
Stockpile Wind Erosion	0.32230	0.16115	kg/ha/hr	N/A	N/A	365	24	N/A	N/A	0.00448	0.00224
Stockpile Loading	0.00139	0.00066	kg/t	342.47	N/A	365	24	66.215	31.318	N/A	N/A
Wind Erosion from Exposed areas	0.40000	0.20000	kg/ha/hr	N/A	N/A	365	24	N/A	N/A	0.00556	0.00278
Stockpile Area 4											
Wind Erosion from Exposed areas	0.40000	0.20000	kg/ha/hr	N/A	N/A	365	15	N/A	N/A	0.01111	0.00556
FEL	0.00139	0.00066	kg/t	12.79	N/A	365	24	4.944	2.338	N/A	N/A
Haulage											
ROM	2.50721	0.76751	kg/VKT	N/A	1.20	365	15	18.918	5.79126	N/A	N/A
Secondary Dump	2.50721	0.76751	kg/VKT	N/A	3.35	365	15	48.656	14.89465	N/A	N/A
Wash Dump	2.50721	0.76751	kg/VKT	N/A	2.46	365	15	53.454	16.36343	N/A	N/A
Train Loading											
Train Loading	0.00040	0.00017	kg/t	285.39	N/A	365	24	31.70979	13.47666	N/A	N/A