Werris Creek Coal Pty Limited
ABN:69 107 169 103

Proposed Modification to the Werris Creek Coal Mine

Air Quality Assessment

Prepared by

Heggies Pty Ltd

March, 2009

Specialist Consultant Studies Compendium: Part 3

Air Quality Assessment

of the

Proposed Modification to the Werris Creek Coal Mine

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EXECUTIVE SUMMARY

Heggies Pty Ltd has been commissioned by R.W. Corkery and Co. Pty. Limited on behalf of Werris Creek Coal Pty Limited to conduct an air quality impact assessment of proposed modification to operations at the Werris Creek Coal Mine.

Atmospheric dispersion modelling predictions of fugitive emissions from the mine site were undertaken using the CALPUFF dispersion model in screening mode.

Local meteorological conditions obtained from a weather station operated at the mine site since 2005, and air quality monitoring data from local and regional sources were integrated into the dispersion model.

The selected modelling scenario comprised of a worst-case coal extraction location, in relation to surrounding non-project related receptors, and maximum annual overburden removal from the proposed three-year schedule of modified operations. As these two variables would not coincide in the actual modified operations, this modelling scenario is considered highly conservative.

The results of the dispersion modelling conducted for the modified operations of the Werris Creek Coal Mine, indicate the potential for exceedance of the incremental dust deposition and DECC 24-hour PM_{10} assessment criteria at the nearest non-project related receptor to the north of the site.

However, the modelled scenario presents a conservative prediction of emissions likely to be generated by the proposed modification. The predicted emissions are therefore likely to be higher than those that would actually occur. Also notable is that the land acquisition criteria (listed in **Table 4** of the main report) is not triggered for any receptor.

Continuation of air quality monitoring at the surrounding PM_{10} and dust deposition monitoring network for the life of the modified operations would validate this conclusion.

Greenhouse gas emissions for the proposed modification to the Werris Creek Coal Mine were also calculated. Full fuel cycle (Scope 1 to Scope 3) emissions were calculated to total approximately 400kt CO_2 equivalents (CO_2-e) annually. This represents an increase of less than 0.1% on Australia's national net 2006 emissions.

Furthermore, when compared with the greenhouse gas emissions calculated for the existing operations at the mine site, the proposed expansion to operations will result in an increase in annual Scope 1 emissions of approximately 30%. This equates to an additional increase of less than 0.0001% on Australia's national net 2006 emissions annually.

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1 INTRODUCTION

Werris Creek Coal Pty Limited (the Proponent) is proposing to modify the existing operations at the Werris Creek Coal Mine (the mine site). Operations at the mine site, located approximately 4 km south of the township of Werris Creek in New South Wales, commenced in 2005. The proposed modification to the existing operations includes the following.

- Widening the advancing northern highwall of the open cut area to an alignment corresponding with the eastern extent of the sub-cropping G Seam. The modified open cut area would involve open cut mining through sections of the underground workings of the former Werris Creek Colliery, which are currently saturated with water.
- Dewatering the underground workings, with the extracted groundwater to be stored in four dams to the southwest of the open cut area.
- Extending the out-of-pit overburden emplacement which is located along the eastern perimeter of the approved open cut area to the north (adjoining the northerly extension of the open cut area created to accommodate the widening of the advancing northerly mining face).
- Constructing an additional train loading bin and conveyor at the rail load-out facility to facilitate the separation of product coal for specific markets and therefore increase the efficiency of train loading.

Heggies Pty Ltd (Heggies) has been commissioned by R.W. Corkery & Co. Pty. Limited (RWC) to conduct an air quality impact assessment to identify potential impacts of the proposed modification to operations at the mine site and to recommend any additional mitigation measures.

Reliance has been placed upon the 2004 air quality assessment compiled by Richard Heggie Associates Pty Ltd (Heggies, 2004) for the existing mining operation. In order to maintain some consistency with the 2004 assessment, operational parameters and emission factors have been maintained where relevant. However, due to improvements in dispersion modelling techniques and emissions estimation, the methodology adopted in this assessment has been revised accordingly.

This assessment has been completed to support a Statement of Environmental Effects being prepared by RWC to accompany the application for the proposed modification, sought under Section 96(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

2 PROJECT SETTING

As previously stated, the mine site is situated approximately 4 km south of the township of Werris Creek, 11 km north northwest of Quirindi and 40 km southwest of Tamworth in the North West Slopes and Plains district of New South Wales.

Figure 1 illustrates the local setting of the mine site.

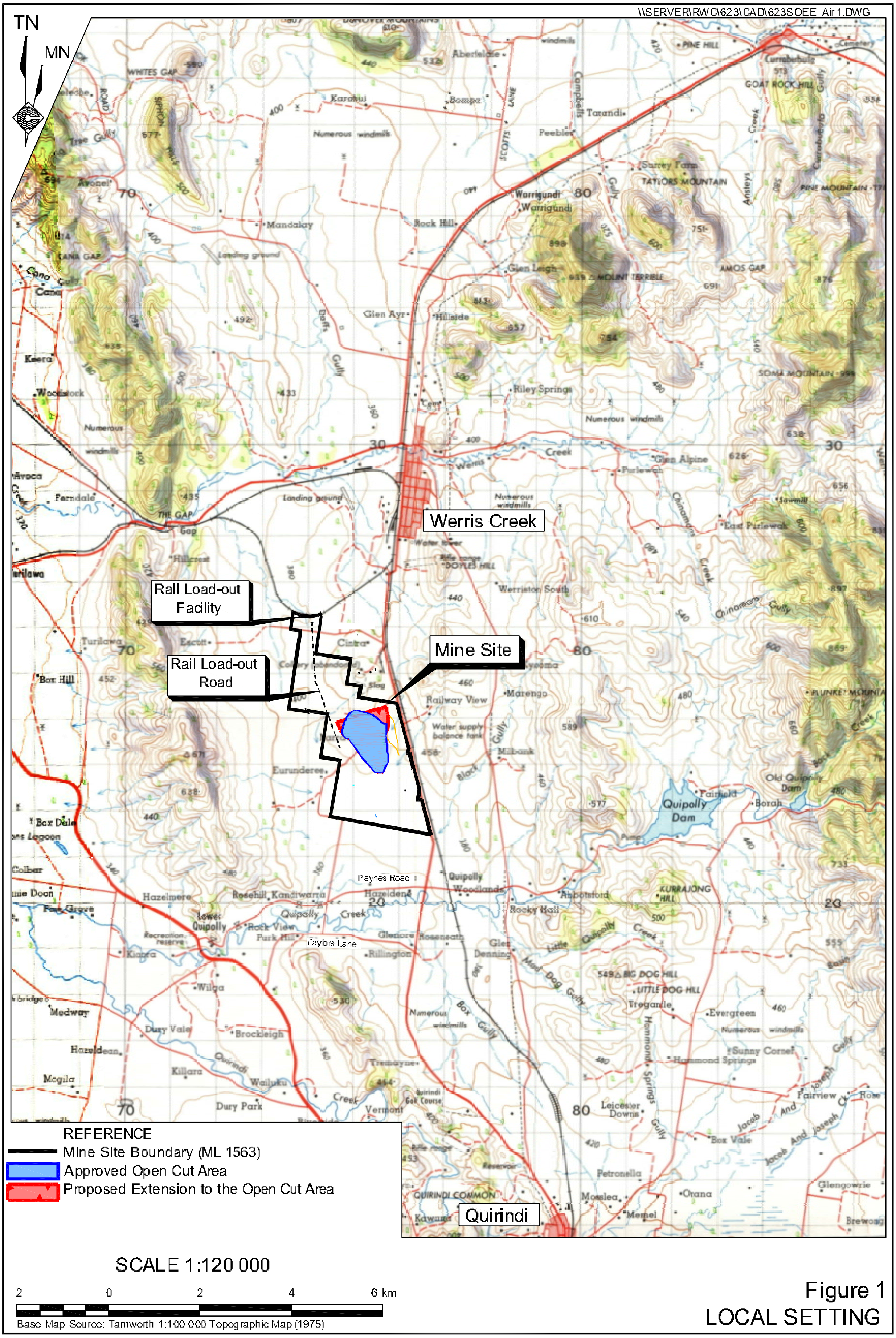


Figure 1
LOCAL SETTING

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

2.1 Sensitive Receptors

A number of project and non-project related residential dwellings are situated in the area surrounding the mine site. 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 operations.

A list of existing sensitive receptor points (R1 to R11) identified in the immediate vicinity of the mine site, and respective distances of such receptor points to the site boundary are listed in.

Figure 2 illustrates the location of the surrounding receptors in relation to the mine site.

2.2 Local Topography

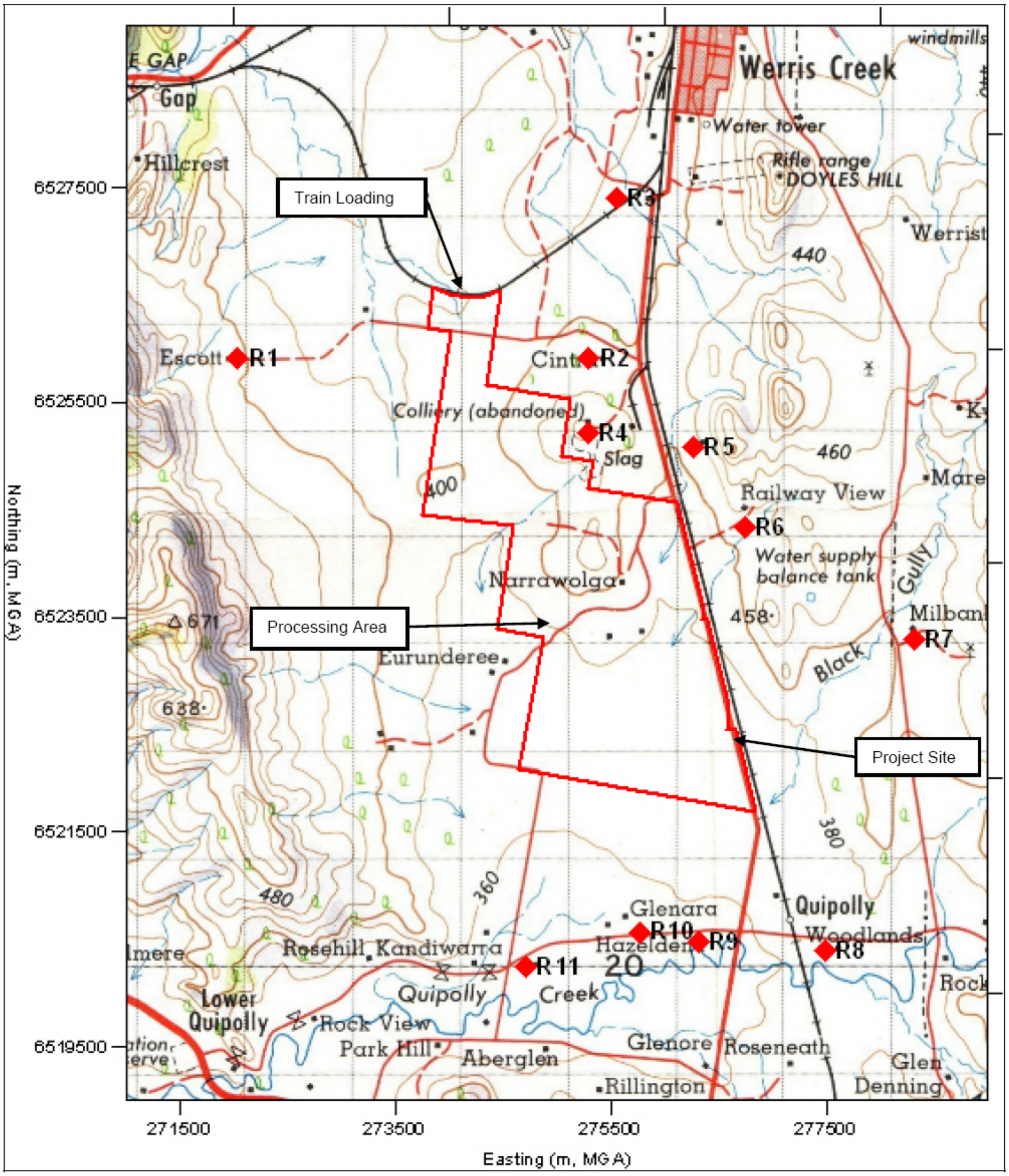
Locally, the mine site and surrounding residences are located in undulating terrain, situated at the centre of valley flanked to the east and west by elevated terrain. A three dimensional representation of the topographical features described above is presented in **Figure 3**.

The mine site is located at an approximate elevation of between approximately 360 m and 440 m AHD, on land that rises from the southern and northern boundaries to the centre of the site (as shown in **Figure 3**). The majority of sensitive receptor locations (see **Table 1**), with the exception of R11, are located at an elevation at or below that of the mine site.

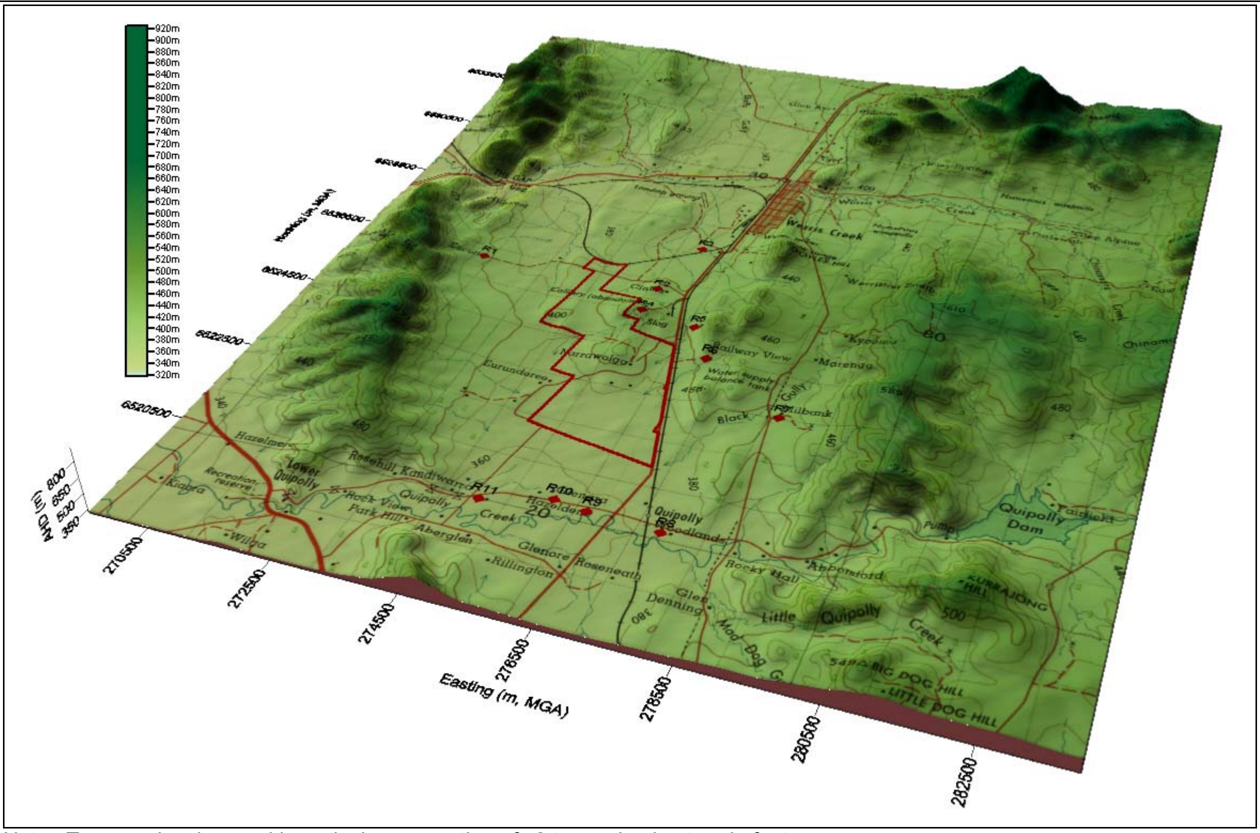
Table 1
Surrounding Sensitive Receptor Locations

Receptor ID Property Name	Location (m, MGA)		Receptor Status	Distance (km) / Direction From		Elevation (m, AHD)
	Easting	Northing		Processing Area	Train Loading	
R1 – “Escott”	272036	6525903	Project	3.7 / NW	2.3 / WSW	410
R2 – “Cintra”	275294	6525914	Non-Project	2.3 / NNE	1.2 / ESE	420
R3 – “Tonsley Park”	275557	6527402	Non-Project	3.9 / NNE	1.6 / NE	385
R4 – “Old Colliery”	275283	6525207	Project	1.7 / NNE	1.6 / SE	445
R5 – “Hillview”	276270	6525077	Project	2.0 / NE	2.5 / SE	415
R6 – “Railway View”	276743	6524341	Project	2.0 / ENE	3.3 / SE	415
R7 – “Milban”	278310	6523292	Non-Project	3.4 / E	5.1 / SE	410
R8 – “Woodlands”	277489	6520401	Non-Project	4.1 / SE	6.9 / SSE	370
R9 – “Hazeldene”	276314	6520473	Non-Project	3.5 / SSE	6.3 / SSE	360
R10 – “Glenara”	275762	6520568	Non-Project	3.1 / SSE	6.1 / SSE	360
R11 – Mountain View”	274714	6520244	Non-Project	3.3 / S	6.2 / S	355

Figure 2
Sensitive Receptor Locations



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



Note: Topography shown with vertical exaggeration of x2 to emphasise terrain features

Figure 3
3-Dimensional Topography Surrounding the Mine Site

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 0.1 μm in size. Particles less than 10 μm are referred to in this report as PM_{10}.

Emissions of PM_{10} are considered important pollutants in terms of impact due to their ability to penetrate into the respiratory system. Potential adverse health impacts associated with exposure to PM_{10} include increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, and reduced lung capacity in asthmatic children.

The NSW Department of Environment and Climate Change (DECC) detail PM_{10} impact assessment criteria within the 2005 document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* ("the Approved Methods"), which are presented in **Table 2**.

Table 2
DECC Goals for PM_{10} – 24-hour and Annual

Averaging Period	Maximum Concentration
24-hour	50 µg/m^3
Annual	30 µg/m^3

Source: Approved Methods, DECC 2005

The 24-hour PM_{10} reporting standard of 50 µg/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.

3.2 Criterion Applicable to Total Suspended Particulates (TSP)

The annual goal for Total Suspended Particulates (or TSP) is given as 90µg/m^3 within the Approved Methods.

It is noted that the PM_{10} sub-set is typically approximately 50% of TSP in the ambient air in regions where road traffic is not the dominant particulate source, such as rural areas (USEPA, 2001). Consequently, the annual average TSP criterion of 90 µg/m^3 is consistent with an annual average PM_{10} criterion of approximately 45µg/m^3.

A review of the PM_{10} and TSP data collected from five monitoring locations around the mine site supports this conclusion, with the average (across four monitoring locations) PM_{10} of 13.4μg/m^3 approximately 54% of the average TSP (24.9μg/m^3) (see **Table 7**). **Section 4** considers the air quality monitoring results for the mine site in greater detail as part of a discussion on the existing air quality of the local area. Based on monitoring results available for the mine site, and the experience of Heggies from conducting similar assessments, it is concluded that the annual TSP goal would be achieved if the DECC annual PM_{10} criterion of 30 μg/m^3 is satisfied. TSP has therefore not been considered further in this report.

3.3 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 4 g/m^2/month.

Table 3 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 3
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.

3.4 Werris Creek Coal Mine Specific Assessment Criteria

Development Consent (DA) DA-172-7-2004 prescribes a number of project specific air quality assessment goals that the operation must satisfy as conditions of consent. These goals, listed in Schedule 4 of DA-172-7-2004, relate to both impact assessment (Condition 4(1)) and land acquisition (Condition 4(2)) for TSP, PM_{10} and dust deposition. DA-172-7-2004 identifies that the emissions generated by the Project should not be exceed this criteria "*at any residence on, or on more than 25 percent of, any privately owned land*".

Table 4 details the Project specific air quality criteria prescribed within DA-172-7-2004.

Table 4
Project Specific Air Quality Criteria - DA-172-7-2004

Impact Assessment Criteria		
Pollutant	**Averaging Time**	**Goal**
TSP	Annual	90 µg/m^3
PM_{10}	24 hour	50 µg/m^3
	Annual	30 µg/m^3
Dust Deposition	Annual	2 g/m^2/month (maximum increase)
		3.6 g/m^2/month (maximum level)
Land Acquisition Criteria		
TSP	Annual	90 µg/m^3
PM_{10}	24 hour	150 µg/m^3 (Background + Increment; 99th percentile)
		50 µg/m^3 (Increment Only; 98.6th percentile)
	Annual	30 µg/m^3
Dust Deposition	Annual	2 g/m^2/month (maximum increase)
		3.6 g/m^2/month (maximum level)

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 criteria, are summarised in **Table 5**.

Table 5
Project Air Quality Goals

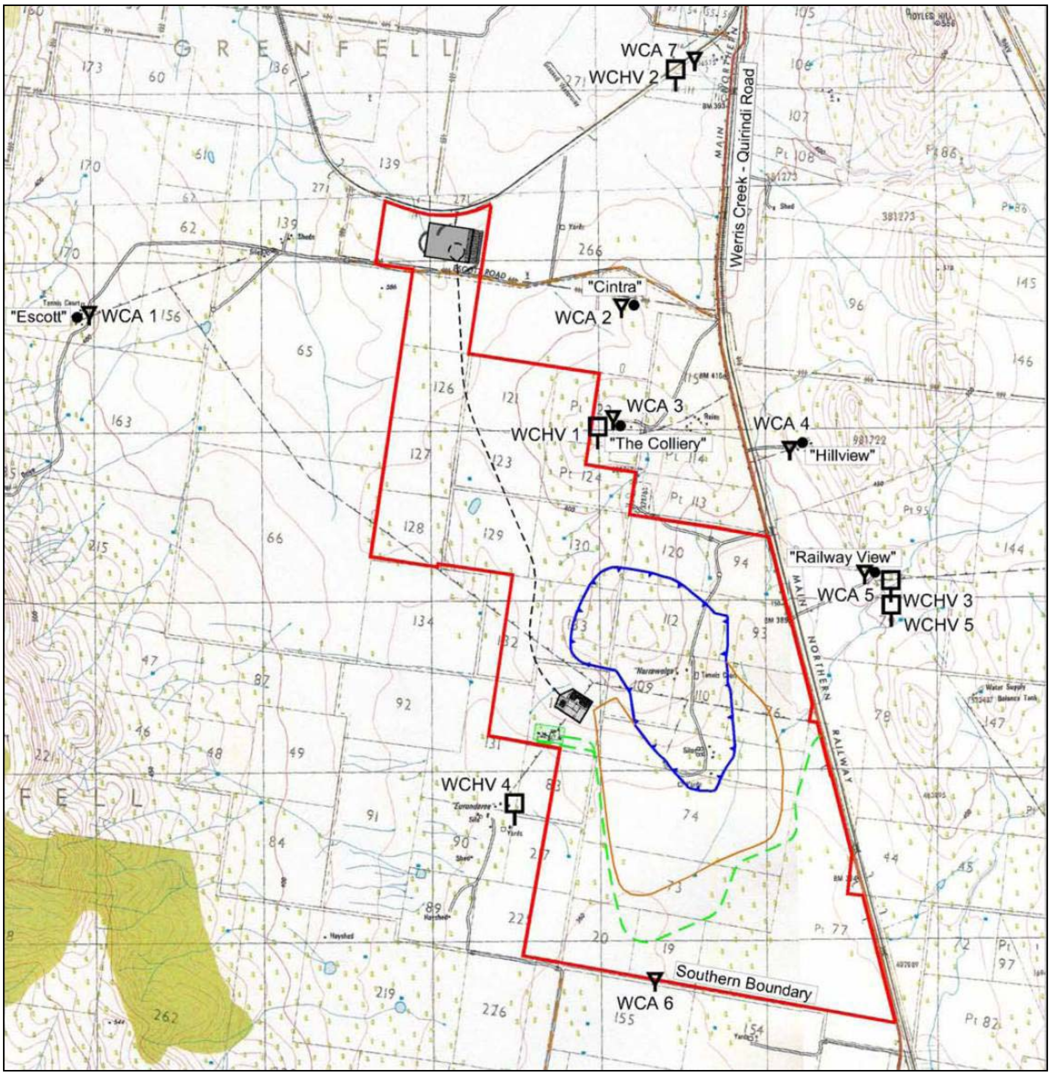
Pollutant	**Averaging Time**	**Goal**
PM_{10}	24 hours Annual	50 µg/m^3 30 µg/m^3
Dust Deposition	Annual	Maximum Increase of 2 g/m^2/month Maximum Total of 3.6 g/m^2/month

4 EXISTING AIR QUALITY ENVIRONMENT

4.1 Air Quality Monitoring at the Mine Site

An air quality monitoring network of high volume air samplers (HVAS), for TSP and PM_{10} monitoring, and dust deposition gauges (DDG) have been established about the mine site. PM_{10}, TSP and dust deposition data has been provided by the Proponent for use in this assessment to provide an indication of the existing air quality environment. The Proponent-owned monitoring locations are presented in **Figure 4**.

Figure 4
Air Quality Monitoring Locations – Werris Creek Coal Mine



NOTE: WCHV – HVAS location; WCA – DDG location. Image source RWC 2009.
Note: A colour version of this figure is included on the Project CD

The monitoring data obtained from the mine site is analysed in the following sections. Of particular focus will be the period selected for the dispersion modelling - September 2007 to August 2008. The reasons for this selection will be discussed further in **Section 5**.

4.2 Background Dust Deposition Environment

Dust deposition monitoring has been conducted at seven locations in the area surrounding the mine site. Monthly dust deposition data for the period between September 2004 and December 2008 is presented in **Table 6**. The location of the seven dust deposition gauges surrounding the mine site, identified as WCA1 to WCA7, are illustrated in **Figure 4**.

Table 6
Ambient Dust Deposition Monitoring Data – September 2004 and December 2008

DDG ID	Number of Samples	Total Average (g/m^2/month)	Maximum 12 month Average (g/m^2/month)	Modelling Period (Sept 07-Aug 08) Average (g/m^2/month)
WCA1	52	0.6	0.8	0.6
WCA2	52	1.2	1.6	1.3
WCA3	52	2.5	4.0	3.4
WCA4	51	0.8	1.1	0.7
WCA5	52	1.1	2.1	0.6
WCA6	52	7.2	10.7	4.6
WCA7	46	1.9	3.9	1.2

Given the distance of WCA1 from the mine site, it may be considered that of the seven dust deposition locations, the results obtained at WCA1 may be viewed as the best representation of dust deposition levels excluding mine site operations. The average dust deposition level at WCA1 over the total monitoring period is 0.6 g/m^2/month.

As stated in **Section 3** , the maximum total dust deposition level (background plus increment) assessment criterion for the Werris Creek Coal Mine is 3.6 g/m^2/month. Based on a maximum allowable incremental increase of 2 g/m^2/month from mine site operations, this would imply that the existing background dust deposition levels of the surrounding environment are 1.6 g/m^2/month. As per the 2004 air quality assessment conducted for the mine site (Heggies, 2004), the background dust deposition levels for assessment purposes will be assumed to be 1.6 g/m^2/month. When compared with the discussed average monthly dust deposition levels recorded at WCA1, this assumed background is considered highly conservative.

4.3 Ambient Particulate Matter Environment

PM_{10} monitoring has been conducted at four locations in the vicinity of the mine site, the locations of which are indicated on **Figure 4** by WCHV-1 to WCHV-4. In addition, TSP monitoring was conducted at WCHV-5. Each monitoring location comprised of a HVAS unit, with 24-hour sampling conducted on a one-in-six day sampling routine. The results of 24-hour PM_{10} monitoring at the mine site, conducted between April 2006 and December 2008, are presented in **Table 7**.

Table 7
24-hour Average PM_{10} and TSP Concentrations – April 2006 and December 2008

HVAS ID	Number of Samples	Total Average ($\mu g/m^3$)	Modelling Period (Sept 07-Aug 08) Average ($\mu g/m^3$)	Modelling Period (Sept 07-Aug 08) Maximum 24 hour ($\mu g/m^3$)
WCHV-1	165	14.2	14.4	52
WCHV-2	167	11.6	11.5	41
WCHV-3	167	11.6	12.5	38
WCHV-4	167	16.0	17.9	47
WCHV-5#	164	24.9	25.0	78

NOTE: # - TSP Monitoring results

Table 7 indicates that the HVAS locations WCHV-1 and WCHV-4 are subject to a greater level of impact from emissions of PM_{10} generated at the mine site than WCHV-2 and WCHV-3. WCHV-2 may be viewed as a reasonable reflection of ambient concentrations of PM_{10} in the local air shed, excluding emissions from the mine site, given the distance of the HVAS location from operations.

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. The dispersion modelling to be conducted in this assessment will run between September 2007 and August 2008, due to available meteorological data (refer **Section 5**).

Data is available from the DECC's Tamworth air quality monitoring station. This air quality monitoring site is located in Hyman Park, off Robert Street and Hillvue Road, Tamworth, approximately 42 km northeast of the mine site.

The 24-hour average PM_{10} concentrations recorded at the Tamworth monitoring station for the period 1 September 2007 to 31 August 2008 are presented in **Figure 5**. This dataset is concurrent with the meteorological data set used in the atmospheric dispersion modelling conducted for this assessment.

The results indicate that the highest 24-hour average PM_{10} concentration recorded at the DECC's Tamworth monitoring site was 58.2 $\mu g/m^3$ recorded on 3 April 2008. It is likely that this recorded exceedance was attributable to an anomalous regional natural event, such as a bushfire or dust storm. In accordance with the Approved Methods, it is appropriate to demonstrate that no additional exceedances of the impact assessment criteria will occur as a result of the proposed activity. Therefore, while this recorded concentration is above the DECC goal of 50 $\mu g/m^3$, it has not been discounted from the assessment.

The second highest PM_{10} concentration at Tamworth was 48.8 $\mu g/m^3$, recorded on 3 October 2007. It is noted that this concentration is also likely attributable to an anomalous natural event and may be considered as elevated for the region. The annual average PM_{10} concentration for the Tamworth dataset was 15.1 $\mu g/m^3$. It is noted that for periods of missing data, the annual average PM_{10} concentration was inserted.

To provide a comparison between the two datasets, concurrent concentrations recorded at the DECC Tamworth monitoring station and the one-in-six day concentrations recorded about the mine site during the modelling period are presented in **Figure 6**.

Figure 5
NSW DECC PM_{10} (24-Hour Average) Monitoring Results for Tamworth, September 2007 to August 2008

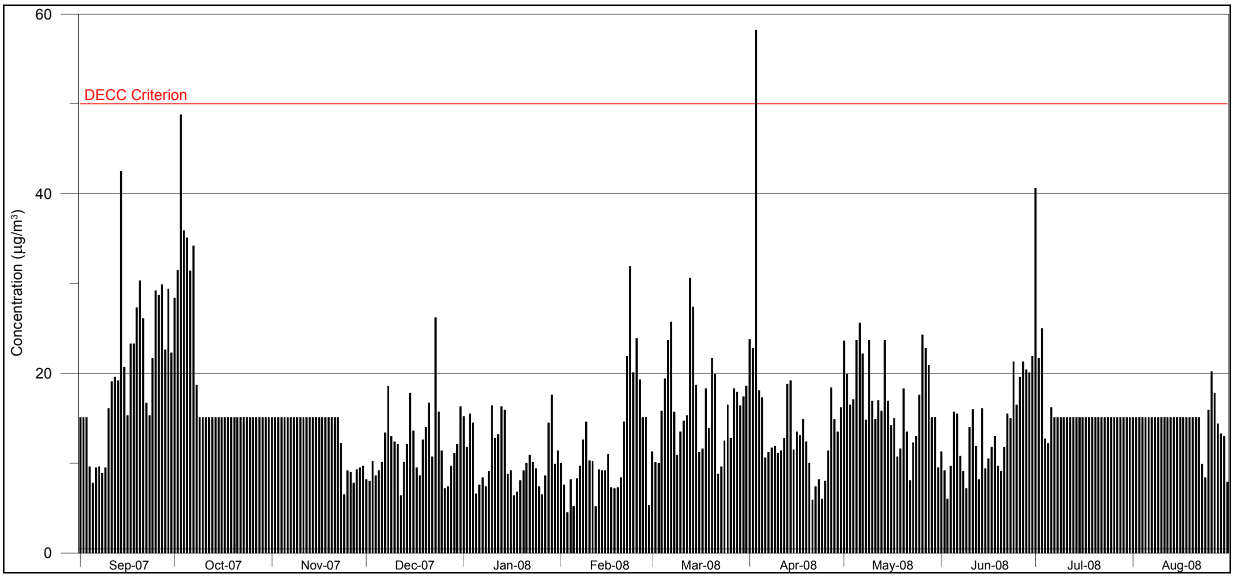
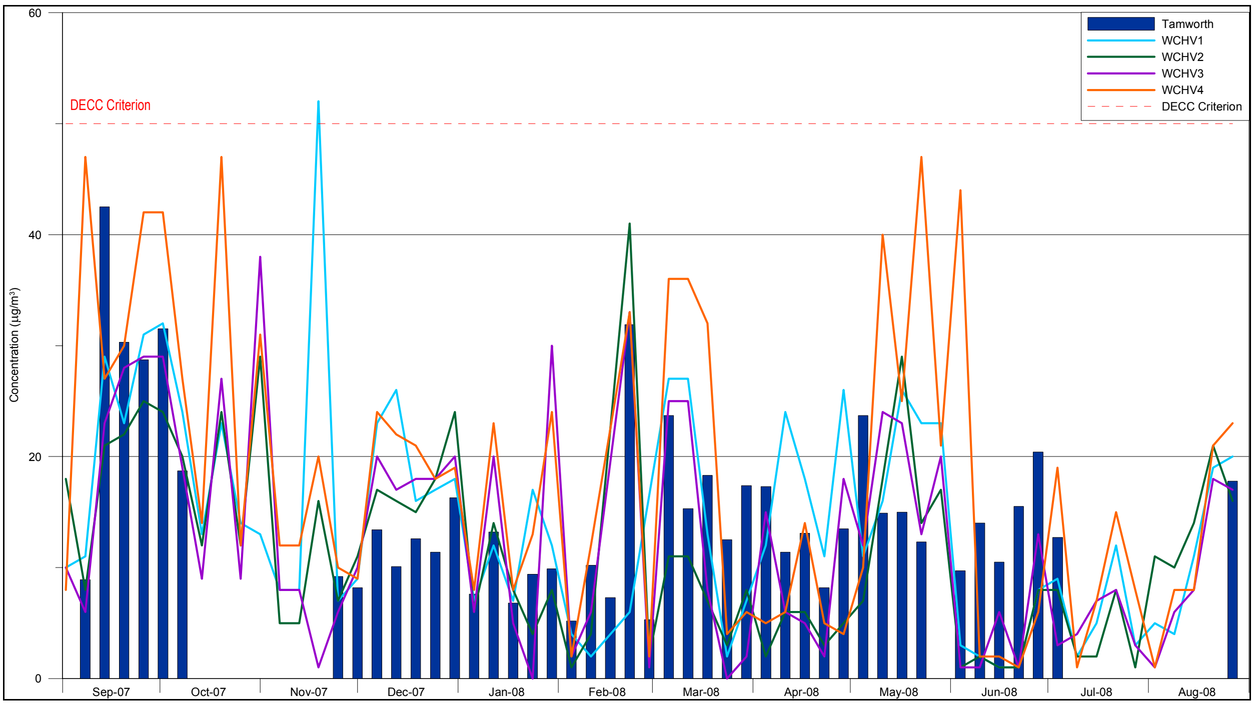


Figure 6
24-hour Average PM_{10} Comparison – Tamworth and Mine Site HVAS Data – September 2007 to August 2008



Review of **Figure 6** illustrates a number of key points. Firstly, that the Tamworth dataset correlates reasonably well with the PM_{10} concentrations measured around the mine site, the daily variation pattern mirrored across the comparison period. This would suggest that both datasets are detecting regionally generated concentrations of PM_{10} in addition that those from local sources.

Secondly, the 24-hour average PM_{10} concentrations recorded at the two closest HVAS locations to the mine site, WCHV-1 and WCHV-4, are typically greater than concentrations recorded at the Tamworth station throughout the comparison period. The concentrations within the DECC Tamworth PM_{10} dataset are predominantly greater than the corresponding concentrations recorded at WCHV-2 and WCHV-3.

If the data recorded at WCHV-2 is considered the best reflection of existing ambient concentrations of PM_{10} excluding emissions from the mine site, it can therefore be concluded that the Tamworth DECC PM_{10} dataset provides a conservative daily-varying representation of existing concentrations of PM_{10} in the vicinity of the mine site. The use of the Tamworth dataset is therefore considered appropriate in accounting for existing PM_{10} concentrations without double counting emissions from existing operations.

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 8**.

Table 8
Ambient Air Quality Environment for Assessment Purposes

Air Quality Parameter	Averaging Period	Assumed Background Ambient Level	Data Source
PM_{10}	24-Hour	Daily Varying	DECC
	Annual	15.1 µg/m^3	
Dust Deposition	Annual	1.6 g/m^2/month	The Proponent

5 DISPERSION METEOROLOGY

To adequately characterise the dispersion meteorology of the mine site, monitoring data from the on-site meteorological station was sourced. The data from this monitoring station was used to characterise the local meteorology and provide the input datasets for the meteorological modelling undertaken. The following parameters were available from this station.

- Wind Speed.
- Wind Direction.
- Temperature.
- Relative Humidity.
- Dew Point Temperature.

- Precipitation.
- Atmospheric Pressure.
- Solar Radiation.

Data recorded between April 2005 and November 2008 was provided by the Proponent. The most complete period of hourly meteorological data occurred between September 2007 and August 2008, with a total percentage complete data of 94.5%. Consequently, air quality monitoring data corresponding to this meteorological dataset was sourced, as previously discussed.

5.1 Meteorological Modelling

Data obtained by the on-site meteorological monitoring station was used as input to the atmospheric dispersion modelling. For indirect parameters not recorded on-site, as well as missing hourly data points, The Air Pollution Model (TAPM) meteorological model (Version 3) was used supplement the meteorological dataset for the mine site.

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 hourly average wind speed and wind direction at the Proponent’s on-site meteorological station were input into the TAPM simulations to provide realignment to local and regional conditions.

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	September 2007 – August 2008
Centre of analysis	31°24’ S, 150°38’ E
Data assimilation	Meteorological data assimilation using wind data from on-site station.

5.2 Meteorological Conditions

5.2.1 Wind Regime

A summary of the September 2007 to August 2008 annual wind behaviour recorded at the mine site is presented as a wind rose in **Figure 7.** This wind rose displays occurrences of winds from all quadrants.

Figure 7 indicates that winds experienced at the mine site are predominately light to moderate (between 1.5 m/s and 8 m/s) from the southeast to south-southeast (approximately 25% combined) and from the west-northwest to north-northwest (approximately 33% combined). Calm wind conditions (wind speed less than 0.5 m/s) were recorded approximately 8.6% of the time throughout the dataset.

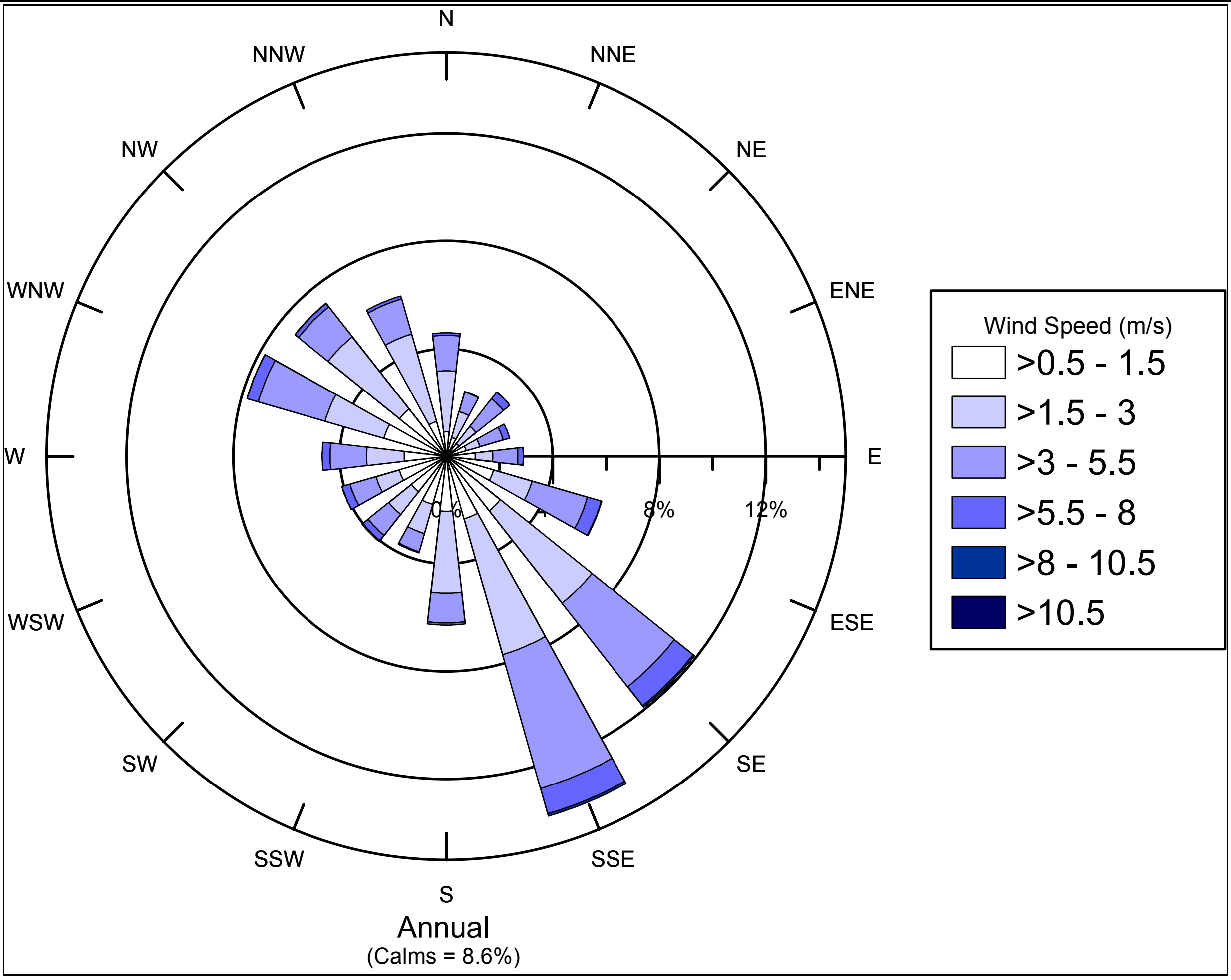


Figure 7
Annual Wind Rose for Mine Site - September 2007 to August 2008

The seasonal variation in predicted wind behaviour at the mine site is presented in **Appendix 1**. The seasonal wind roses indicate that:

- in spring, light to moderate winds are experienced predominantly from the southeast to south-southeast (approximately 22% combined) and west to northwest (approximately 27% combined);
- in summer, light to moderate winds are experienced predominantly from the east-southeast to south-southeast (approximately 44% combined);
- in autumn, light to moderate winds are experienced predominantly from the east-southeast to south (approximately 41% combined); and
- in winter, light to moderate winds are experienced from the west to north (approximately 47% combined) and from the southeast to south (approximately 23% combined).

5.3 Atmospheric Stability and Mixing Depth

Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion. The Pasquill-Turner assignment scheme identifies six Stability Classes, “A” to “F”, to categorise the degree of atmospheric stability. These classes indicate the characteristics of the prevailing meteorological conditions and are used as input into various air dispersion models (**Table 10**).

Table 10
Description of atmospheric stability classes

Atmospheric Stability Class	Category	Description
A	Very unstable	Low wind, clear skies, hot daytime conditions
B	Unstable	Clear skies, daytime conditions
C	Moderately unstable	Moderate wind, slightly overcast daytime conditions
D	Neutral	High winds or cloudy days and nights
E	Stable	Moderate wind, slightly overcast night-time conditions
F	Very stable	Low winds, clear skies, cold night-time conditions

The US EPA solar radiation/delta-T method (USEPA, 2000) was used to calculate hourly varying atmospheric stability. This approach uses the recorded 10 m wind speed in combination with measured solar radiation during daylight hours, and the measured vertical temperature difference between 2 m and 10 m during the night hours to derive atmospheric stability. The calculated frequency of each stability class at the mine site is presented in **Figure 8**. The seasonal stability class distributions for each station are included in **Appendix 2**.

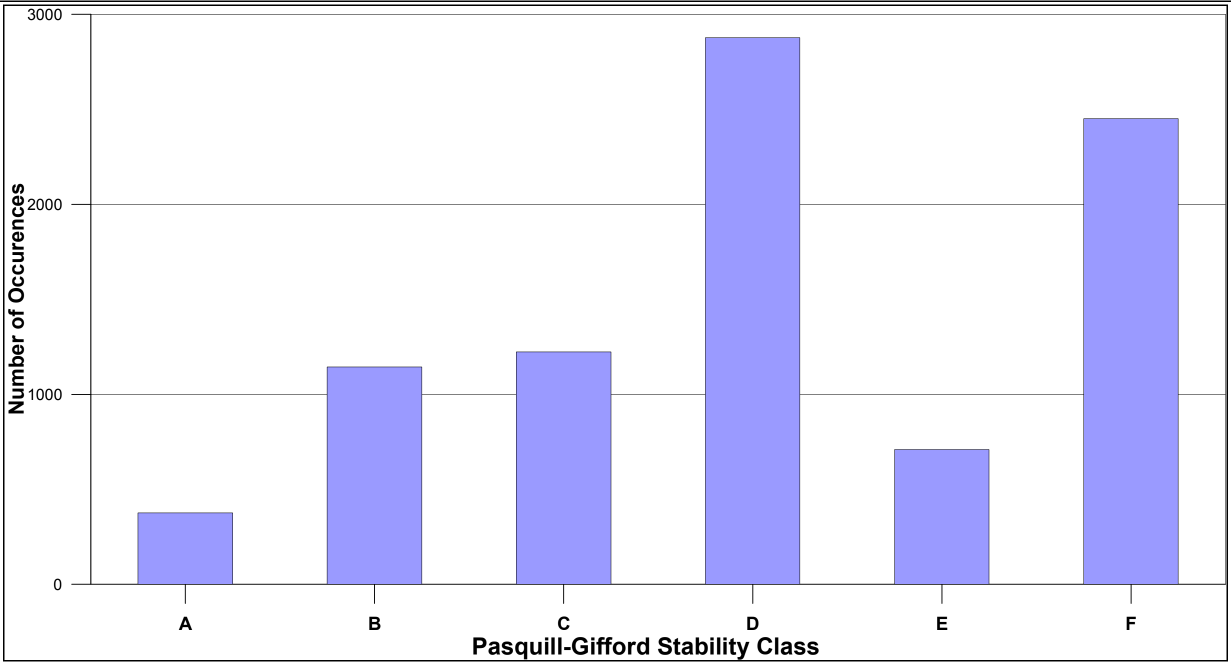


Figure 8
Annual Stability Class Distributions for the Mine Site, September 2007 to August 2008

The results indicate a high frequency of conditions typical to Stability Class "D" and "F". Stability Class "D" is indicative of neutral conditions, conducive to a moderate level of pollutant dispersion due to mechanical mixing. Stability Class "F" is indicative of highly stable conditions, representing a low potential for pollutant dispersion.

Diurnal variations in maximum and average mixing depths predicted by TAPM at the mine site during the dataset are illustrated in **Figure 9**. 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.

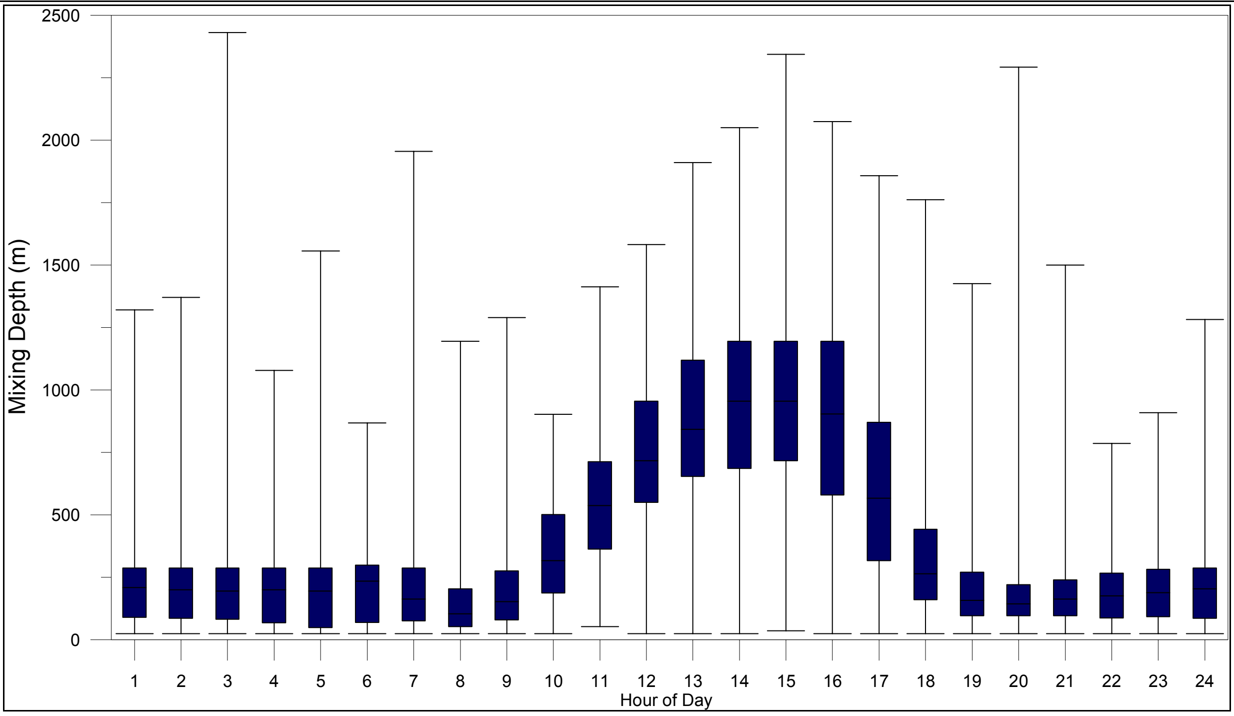


Figure 9
TAPM-Predicted Diurnal Variation in Mixing Depth for the Mine Site - September 2007 to August 2008

6 ATMOSPHERIC DISPERSION MODELLING

6.1 Model Selection and Configuration

CALPUFF, a puff dispersion model suitable for use in complex atmospheric dispersion situations, can be configured in screening mode, using a single meteorological input file such as an Ausplume meteorological input file. Using CALPUFF in screening mode assumes steady state conditions with a single one dimensional wind field applied across the entire modelling domain.

The current assessment utilises the CALPUFF (Version 6.2) modelling system run in screening mode using the single point meteorological input file, comprising of the data presented and discussed in **Section 5.** The advantages of using CALPUFF in screening mode (rather than using a steady state Gaussian dispersion model such as Ausplume) is its ability to handle calm (wind speeds less than 0.5 m/s) wind conditions. Ausplume cannot handle calm conditions because of the inverse wind speed dependence within the Gaussian plume equation. Under calm conditions, Ausplume will assume a minimum wind speed which shoots the plume to the edge of the modelling grid, even though the plume may not have moved at all under actual dispersion conditions (DECC 2005).

CALPUFF can handle these low wind speed conditions and will grow a plume by diffusion alone under zero wind speed conditions. Given the relatively high percentage of calm conditions within the input meteorological dataset (approximately 8.6%), the use of CALPUFF in screening mode in place of Ausplume is considered appropriate in this assessment.

The potential influence of local topography, including natural and project related (i.e. open cut pit, earth bunds etc) land forms, on the dispersion of pollutants has not been incorporated into the dispersion modelling process, other than through the application of published emission reduction factors. Consequently, the results obtained from dispersion modelling process should be viewed as conservative in this regard.

6.2 Modelling Scenario

One operational scenario has been modelled to reflect proposed modified operations at the mine site. The modelling scenario combines the worst case location of coal extraction location (Year 3 – northern-most point of open cut development) with the maximum annual overburden removal amounts (Year 1 – 10,042,000 bcm/year) to create a highly conservative representation of actual modified operations. The selection of coal extraction location is situated in the closest proximity to the non-project related receptors to the north of the mine site.

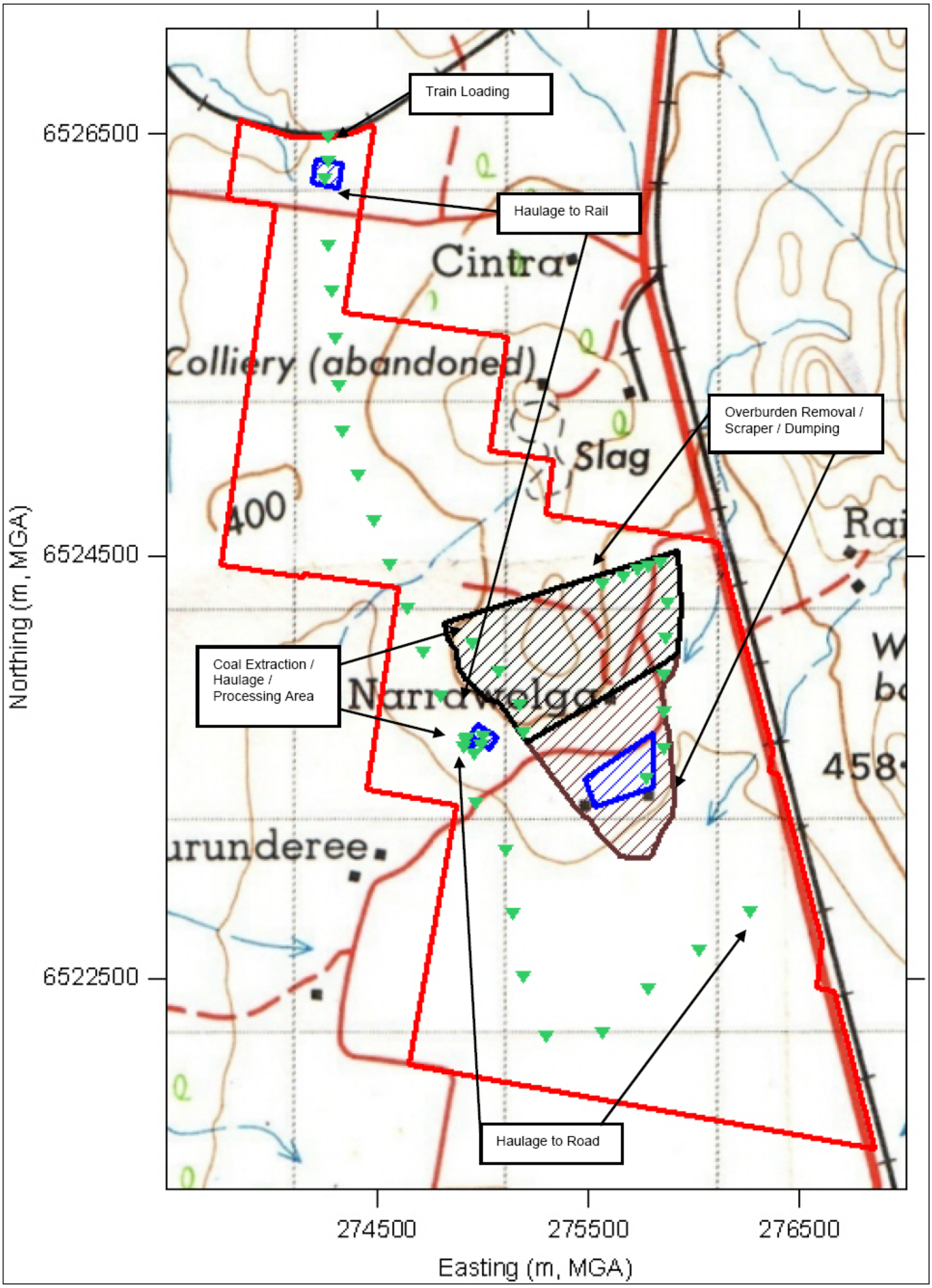
The modelling scenario incorporates the following operations.

- Coal extraction operations, including drilling and blasting, bulldozer and excavator.
- Overburden removal, including use of scraper on topsoil and excavator.
- Construction and maintenance of the overburden dump, including wind-generated erosion.
- Processing Area operations.
- Movement of haul trucks about the mine site.
- Operation of the Rail Load-out Facility in the north of the mine site.

Figure 10 illustrates the location of the sources simulated in the dispersion modelling. The selected source locations are deemed appropriate to represent maximum potential impacts at the closest surrounding receptors.

It is noted that operations are likely to be conducted in more than one location across the mine site, for example coal extraction by excavator. The adopted modelling scenario assumes all emissions for each component occur continuously at a single worst case location (in terms of potential impact on surrounding receptors). This approach is considered worse case in representing potential impacts from typical operations.

Figure 10
Dispersion Modelling Source Locations



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

Emission Factors

Table 11 presents the emission factors for particulate matter from the mine site used in the dispersion modelling for this assessment.

Table 11
Particulate Emission Factors for Air Quality Dispersion Modelling

Activity	Total Particulate Emission Factor	PM_{10} Emission Factor	Emission Factor Units
Bulldozer on coal	28.93	9.54	kg/hr
Bulldozer on overburden	4.49	0.99	kg/hr
Excavator/FEL on coal	0.0185	0.0089	kg/t
Excavator/FEL on overburden	0.0006	0.0002	kg/t
Drilling	0.59	0.31	kg/hole
Blasting	43.26	22.50	kg/blast
Scraper	3.4	0.9	kg/VKT
Trucks Dumping Coal	0.01	0.0042	kg/t
Trucks Dumping OB	0.0006	0.0002	kg/t
Train Loading	0.0004	0.0002	kg/t
Wheel Dust – Paved	0.71	0.14	kg/VKT
Wheel Dust – Unpaved	4.18	1.11	kg/VKT
Primary Crushing	0.010	0.004	kg/t
Secondary Crushing	0.03	0.01	kg/t
Coal Stockpile Loading	0.0040	0.0017	kg/t
Wind Erosion	3,418	1,709	$kg/m^2/yr$

In general, default emission factors have been used as contained in Table 1 of the *Emission Estimation Technique Manual for Mining, Version 2.3*, (hereafter, "EETMM") (Environment Australia, 2001). In some instances, the moisture content of materials at the mine site 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.

6.3.1 Bulldozer on Coal

$$EF = k \times \frac{s^a}{M^b} \text{ kg/h}$$

where k=35.6 for TSP and 6.33 for PM_{10}, a = 1.2 for TSP and 1.5 for PM_{10}, b = 1.4, s = silt content and M = moisture content.

6.3.2 Bulldozer on Overburden

$$EF = k \times \frac{s^{1.2}}{M^{1.3}} \text{ kg/h}$$

where k=2.6 for TSP and 0.34 for PM_{10}, a = 1.2 for TSP and 1.5 for PM_{10}, b = 1.3 for TSP and 1.4 for PM_{10}, s = silt content and M = moisture content.

6.3.3 Miscellaneous Handling of Coal (Excavator, FEL, loading/unloading of material)

$$EF = k \times 0.0596 \times (M)^{-0.9} \text{ kg/t}$$

where k=1.56 for TSP and 0.75 for PM_{10} and M = moisture content.

6.3.4 Miscellaneous Handling of Overburden (Excavator, FEL, loading/unloading of material)

$$EF = k \times 0.0016 \times \left(\frac{U}{2.2}\right)^{1.3} \left(\frac{M}{2}\right)^{-1.4} \text{ kg/t}$$

where k=0.74 for TSP and 0.35 for PM_{10}, U = mean wind speed and M = moisture content.

6.3.5 Scraper Operation

$$EF = 0.0000076 \times s^{1.3} W^{2.4} \text{ kg/VKT}$$

where s= silt content, W = vehicle gross mass.

6.3.6 Blasting

$$EF = 344 \times \frac{A^{0.8}}{M^{1.9} \times D^{1.8}} \text{ kg/blast}$$

where A = Blast area, M = moisture content and D = depth of blast holes. PM_{10} is 52% of TSP.

6.3.7 Haul truck wheel dust – Unpaved Roads (USEPA AP-42)

The emission factor for wheel generated dust from unpaved roads is estimated from the USEPA emission equation for Wheel Generated Dust from Unpaved Roads (2003).

$$EF = \left(k \times \left(\frac{s}{12}\right)^{0.7} \times \left(\frac{W}{3}\right)^{0.45} \times \left(\frac{281.9}{1000}\right)\right) \times \left(\frac{(365 - N)}{365}\right) \text{ kg/VKT}$$

where k=4.9 for TSP and 1.5 for PM_{10}, s = silt content, W = vehicle gross mass and N = number of days with more than 0.254mm of rainfall.

6.3.8 Haul truck wheel dust – Paved Roads (USEPA AP-42)

The emission factor for wheel generated dust from paved roads is estimated from the USEPA emission equation for Wheel Generated Dust from Paved Roads (2006).

$$EF = \left(k \times \left(\frac{sL}{2} \right)^{0.65} \times \left(\frac{W}{3} \right)^{1.5} - 0.1317 \right) \times \left(1 - \frac{P}{(1460)} \right) \text{ kg/VKT}$$

where k= 24 for TSP and 4.6 for PM_{10}, sL = road silt loading (assumed to be $3g/m^2$), W = vehicle gross mass and P = number of days with more than 0.254mm of rainfall.

6.3.9 Stockpile Wind Erosion

Hourly-varying wind erosion from exposed surfaces was estimated using the USEPA AP-42 approach for determining wind erosion (Chapter 13, Section 13.2.5 Industrial Wind Erosion). The total wind erosion potential for the modelling period is presented in **Table 11**.

6.4 Model Assumptions

The following sections detail the assumptions made in creating the emissions inventory for the operational scenario. The majority of details are presented in **Appendix 3**.

- All operations, excluding train loading, external road distribution and the processing area, are assumed to operate for 22 hours a day, 305 days a year (Monday-Saturday, excluding holidays). Rail loading operations are assumed to occur for four hours, road transportation 12 hours and processing 10 hours.
- Annual coal production is 1.5Mt. Based on an assumed density of $1.2t/m^3$, annual overburden removal has been calculated at 12.1Mt.
- It is assumed that one dozer is in operation at each of the coal extraction, overburden dump and rail loading areas.
- Capacity for on-site haul trucks (OB and ROM coal) is assumed to be 150t. Capacity for transportation trucks is assumed to be 30t.
- The following moisture content (mc) and silt content (sc) will be assumed for the modelling.
  - Overburden: mc – 5.5%, sc – 10%.
  - Coal: mc – 6%, sc – 7%.
  - Unsealed Gravel Haul Routes: mc – 1.1%, sc – 6.4% (USEPA, 1998).
- Flocchini (1994) identified that the application of water to an unsealed road would reduce dust generation by 87% +/- 6%. Subsequently, an emissions reduction factor of 87% has been applied to unsealed haul routes.
- Due to watering of sealed haul routes at the mine site, an emission reduction factor of 75% will be applied, as per the EETMM.
- The wind erosion emission factor listed above relates to the hourly disturbance of a stockpile or similar emissions source. Consequently, it is assumed that 10% of each identified wind erosion source is active each hour for wind erosion generation.

- Emission reduction factors corresponding to current emissions control technology implemented at the mine site have been incorporated into the emissions inventory. Furth detail is provided in **Appendix 3**.

7 MODELLING RESULTS

7.1 Dust Deposition

Table 12 shows the results of the dispersion modelling for dust deposition from the mine site, using the emission rates calculated in **Appendix 3**, at each of the identified receptors.

Table 12
Background and Incremental Dust Deposition at Nearest Receptors

Receptor ID Property Name	**Dust - Annual Average (g/m^2/month)**			
	Background	**Increment**	**Background + Increment**	**Assessment Criterion**
R1 – "Escott"	1.6	0.4	2.0	2 - maximum increase 3.6 – total
R2 – "Cintra"		3.3	4.9	
R3 – "Tonsley Park"		0.4	2.0	
R4# - "Old Colliery"		7.7	9.3	
R5# - "Hillview"		3.6	5.2	
R6# - "Railway View"		3.6	5.2	
R7 – "Milban"		0.3	1.9	
R8 – "Voodlands"		0.1	1.7	
R9 – "Hazeldene"		0.2	1.8	
R10 – "Glenara"		0.2	1.8	
R11 – "Mountain View"		0.1	1.7	

Note: # Project Related Receptor

The results show the mean average monthly dust deposition predicted at the nearest receptors surrounding the mine site over a one-year time frame. As detailed in **Section 4.2** the background level of dust deposition for the area surrounding the mine site is taken as 1.6 g/m^2/month.

The results presented in **Table 12** indicate that the total mean monthly dust deposition (background plus increment) associated with the Project are predicted to be less than 3.9 g/m^2/month, at all the nearest non-project related receptors. The assessment criterion, both for incremental increase (2g/m^2/month) and total dust deposition (3.6g/m^2/month), is exceeded at receptor R2.

A contour plot of the incremental increase in dust deposition is presented in **Appendix 4**. The contour plot is indicative of the levels of dust deposition that could potentially be reached under the conditions modelled.

7.2 PM_{10} (24-Hour Average)

Table 13 shows the results of the dispersion modelling for 24-hour average PM_{10} concentrations from the mine site, using the emission rates calculated in **Appendix 3**, at each of the identified receptors.

Table 13
Maximum (Background and Incremental) 24-hour Average PM_{10} Concentrations at Nearest Receptors

Receptor ID Property Name	PM_{10} – 24-hour Average (µg/m^3)			
	Background (Date)	**Increment**	**Background + Increment**	**Assessment Criterion**
R1 – "Escott"	48.8 (03/10/2007)	<0.1	48.8	50
R2 – "Cintra"	17.0 (12/05/2008)	41.8	58.8	
R3 – "Tonsley Park"	48.8 (03/10/2007)	0.1	48.9	
R4# - "Old Colliers"	11.3 (01/06/2008)	86.8	98.1	
R5# - "Hillview"	23.8 (01/04/2008)	41.3	65.1	
R6# - "Railway View"	48.8 (03/10/2007)	15.5	64.3	
R7 – "Milban"	48.8 (03/10/2007)	4.7	53.5	
R8 – "Voodlands"	48.8 (03/10/2007)	0.1	48.9	
R9 – "Hazeldene"	48.8 (03/10/2007)	0.8	49.6	
R10 – "Glenara"	48.8 (03/10/2007)	1.0	49.8	
R11 – "Mountain View"	48.8 (03/10/2007)	0.8	49.6	

As detailed in **Section 4.3**, 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 13** present the maximum (background plus increment) 24-hour average concentration of PM_{10} predicted at the receptors surrounding the site, excluding the day when the background already exceeds the DECC impact assessment criterion.

The results presented in **Table 13** show the maximum 24-hour average concentration of PM_{10} (background plus increment excluding the day on which the background PM_{10} concentration is already greater than 50 µg/m^3) associated with the Project. It can be seen that, with the exception of R2, the maximum predicted concentrations at all non-Project receptors are below the assessment criterion.

It can be seen that background concentrations listed in **Table 13** vary for each receptor. This is attributable to the time-varying meteorological and Tamworth PM_{10} input datasets used in the dispersion modelling process.

As the DECC criterion is predicted to be exceeded at receptor R2, further analysis of the modelling results is required, in accordance with the Approved Methods.

In addition to establishing the maximum (background plus increment) value, it is instructive to evaluate the maximum predicted incremental increase in 24-hour average PM_{10} concentrations at the most effected non-project related receptor, ie. R2. **Table 14** presents the both the incidences of highest background (and their corresponding predicted increment), and the highest predicted incremental increases (and their corresponding background) at these receptor locations. Background PM_{10} concentrations are from the corresponding Tamworth DECC PM_{10} dataset.

Table 14
Predicted Background and Incremental 24-Hour PM_{10} Maxima at Receptor R2

Date	PM_{10} - 24-Hour Average (µg/m^3)			Date	PM_{10} - 24-Hour Average (µg/m^3)		
	Background	Predicted increment	Highest Predicted Total		Background	Highest Predicted Increment	Total
12/05/2008	17.0	41.8	58.8	12/05/2008	17.0	41.8	58.8
28/06/2008	20.4	32.5	52.9	28/06/2008	20.4	32.5	52.9
03/10/2007	48.8	2.7	51.5	04/07/2008	12.7	29.1	41.8
22/02/2008	21.9	28.8	50.7	22/02/2008	21.9	28.8	50.7
14/09/2007	42.5	4.5	47.0	13/05/2008	15.8	27.0	42.8
23/12/2007	26.2	18.7	44.9	03/03/2008	10.0	25.3	35.3
04/10/2007	35.9	6.9	42.8	11/07/2008	15.1	25.0	40.1
13/05/2008	15.8	27.0	42.8	02/06/2008	9.2	20.9	30.1

The left side of **Table 14** shows the total predicted concentration on days with the highest background concentration, while the right side of the table shows the total predicted concentration on days with the highest predicted incremental concentration.

From this additional analysis, it can be seen the maximum (increment plus background) PM_{10} is predicted to exceed the 24-hour PM_{10} assessment criterion an additional three times. Maximum incremental increase at R2 is predicted to be 41.8 µg/m^3.

It is noted that this analysis shows that the land acquisition criteria listed in **Table 4** is not triggered for this receptor. The highest predicted total is less than 150 µg/m^3 and the highest predicted increments comply with increment only goal of 50 µg/m^3 expressed as a 98.6th percentile.

In addition to the data presented above, the maximum predicted incremental increase at each receptor attributable to the Project, the corresponding background concentration within the Tamworth dataset and the combined predicted concentration is presented in **Table 15**.

Table 15
Maximum Predicted Incremental Increase and Corresponding Background

Receptor	PM_{10} – 24-hour Average (µg/m^3)			
	Maximum Predicted Increment	**Background (Date)**	**Background + Increment**	**Assessment Criterion**
R1	12.8	14.9 (18/04/2008)	27.7	50
R2	41.8	17.0 (12/05/2008)	58.8	
R3	12.8	20.4 (28/06/2008)	33.2	
R4#	86.8	11.3 (01/06/2008)	98.1	
R5#	41.3	23.8 (01/04/2008)	65.1	
R6#	38.6	13.0 (18/06/2008)	51.6	
R7	9.3	15.1 (08/08/2008)	24.4	
R8	5.2	19.6 (26/06/2008)	24.8	
R9	8.0	19.6 (26/06/2008)	27.6	
R10	8.6	9.6 (25/03/2008)	18.2	
R11	5.8	15.1 (19/07/2008)	20.9	

A contour plot of the maximum incremental 24-hour PM_{10} concentrations attributable to operations at the mine site is presented in **Appendix 5**.

7.3 PM_{10} (Annual Average)

Table 16 shows the results of the dispersion modelling for annual average PM_{10} concentrations from the mine site, using the emission rates calculated in **Appendix 3**, at each of the identified receptors

As detailed in **Section 4.3** the annual average background concentration of PM_{10} assumed for the mine site is 15.1 µg/m^3. This background level has been incorporated into the model through the hourly varying background file.

The results presented in **Table 16** 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 receptor.

A contour plot of the annual average PM_{10} concentrations (background plus increment) attributable to the mine site is presented in **Appendix 6.**

Table 16
Annual Average PM_{10} Concentrations at Nearest Receptors

Receptor	PM_{10} – Annual Average (µg/m^3)			
	Background	**Increment**	**Background + Increment**	**Assessment Criterion**
R1	15.1	1.3	16.4	30
R2		6.0	21.1	
R3		1.2	16.3	
R4#		14.5	29.6	
R5#		7.2	22.3	
R6#		7.1	22.2	
R7		1.1	16.2	
R8		0.7	15.8	
R9		0.9	16.0	
R10		1.0	16.1	
R11		0.5	15.6	

7.4 Results Discussion

The results of the dispersion modelling conducted for the modified operations at the mine site presented in the preceding sections, indicate the potential for exceedance of the incremental dust deposition and DECC 24-hour PM_{10} assessment criteria at receptor R2.

The dispersion modelling results should be viewed as highly conservative predictions of the likely emissions to be generated by the modified operations at the mine site, particularly for the following reasons.

- A highly conservative modelling scenario, combining maximum annual overburden extraction amount (Year 1) and northern-most coal extraction point (Year 3) from the proposed three year schedule for modified operations, was used to predict incremental dust and particulate matter concentration.
- The worst case operational locations, with regard to nearest receptors, were assumed to be constant throughout the dispersion modelling period.
- With the exception of the application of generic emission reduction factors, due to the limitations of the dispersion model the model did not account for topographic features, eg. small hill to the immediate north of the modified open cut area (see **Figure 3**), that may influence dust and particulate dispersion.

With regard to the final point above, the primary sources of emissions at the mine site within the dispersion modelling are estimated to be the dozer on coal operations, and the haulage of extracted overburden and coal, both from within the open cut. As only generic control factors were applied to these operations, it is likely that the likely pit retention of associated emissions has not been accurately represented within the modelling process, emphasising the conservative nature of predicted concentrations.

It is worth noting that during the modelling period, September 2007 to August 2008, the Proponent has identified that actual operations at the mine site were operating at a rate approximately 35% less than the modified operations modelled within this assessment, with respect to the mining of coal and overburden. Furthermore, mining operations occurred further to the south than the proposed northern extension of the open cut area that was modelled. It could be expected that the monitoring results obtained during the modelling period around the mine site would reflect this difference in actual to modelled operations. Comparison between the closest PM_{10} monitoring location, WCHV-1, and the corresponding receptor predictions for R4 is considered to provide the best reflection of difference.

The one-in-six day monitoring results obtained at WCHV-1 during the modelling period have been ranked in descending order and compared with the predicted concentrations at receptor R4. The comparison of the top 20 values is presented in **Figure 11**. It is noted that these values are not paired in time.

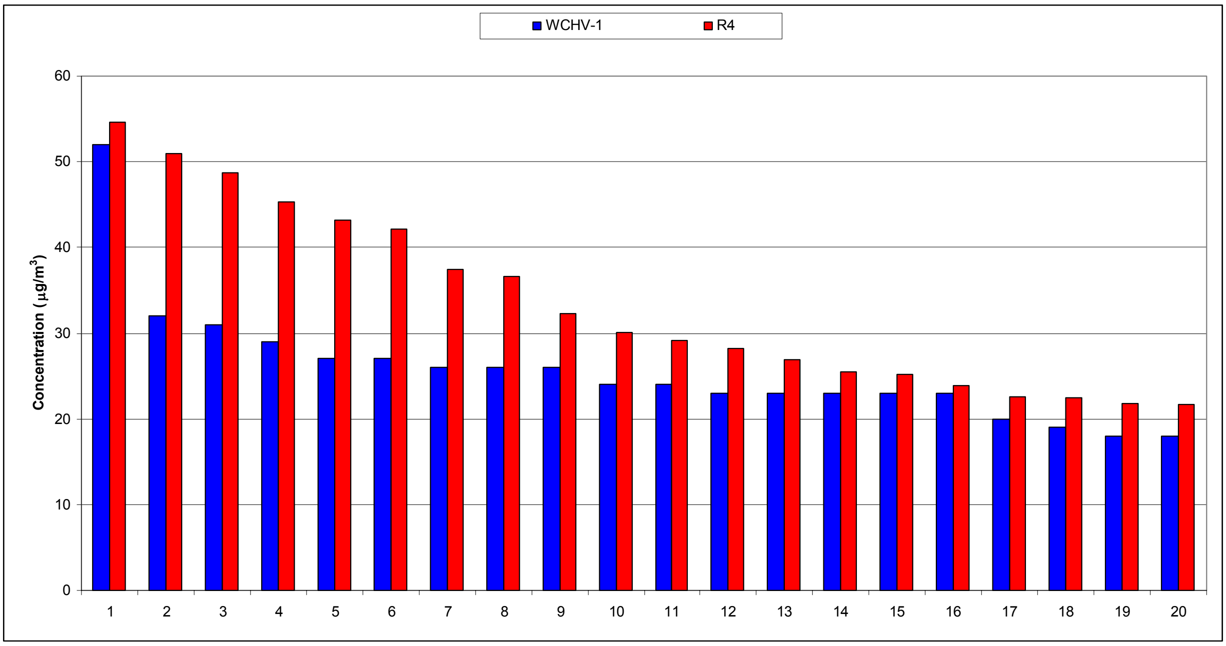


Figure 11
Comparison of Maximum Recorded and Predicted 24-hour PM_{10} Concentrations – WCHV-1/R4

Figure 11 illustrates that while the highest recorded 24-hour PM_{10} is comparable with the highest predicted incremental increase, there is a much higher frequency of elevated incremental PM_{10} concentrations obtained through the dispersion modelling. Indeed, excluding the first value, the top 10 predicted incremental concentrations are between 20% and 45% greater than the top 10 recorded concentrations.

It is stressed that the predicted concentrations are generated by the modelled operations, containing no reflection of background ambient PM_{10} concentrations, unlike the monitoring results obtained at WCHV-1. Taking this fact into consideration, the stated difference between the highest modelled and recorded PM_{10} concentrations strongly indicates that the modelled scenario presents a conservative reflection of emissions likely to be generated by the modification of operations at the mine site.

Consequently it is considered that while the predictions for 24-hour PM_{10} and incremental dust deposition indicate that exceedance of applicable criteria under the proposed modified operations at the mine site, the predictions will be higher than those likely to occur, as a product of the level of conservatism in the dispersion modelling process.

The above notwithstanding, it is reiterated that the land acquisition criteria listed in **Table 4** is not triggered for any receptor.

8 GREENHOUSE GAS ASSESSMENT

The modified operations at the mine site would continue to generate greenhouse gas emissions. This assessment of greenhouse gas emissions from the proposed modification has been conducted in accordance with the methodologies established in a number of policies and guidelines (see **Appendix 7**).

It should be noted that there are three greenhouse gas emission scopes, which are defined as follows.

- Scope 1 emissions are those which result from activities under a company's control or from sources which they own. (e.g. on-site generation of electricity, emissions associated with waste water treatment by the company).
- Scope 2 emissions are those which relate to the generation of purchased electricity consumed in its owned or controlled equipment or operations.
- Scope 3 emissions are defined as those which do not result from the activities of a company although arise from sources not owned or controlled by the company. (eg off-site transportation of purchased fuels, the use of sold products and services, the use of purchased fuels).

The Draft NSW EIA Guidelines were prepared in August 2002 by the NSW Sustainable Energy Development Authority (SEDA) and Planning NSW (now the Department of Planning (DOP)). The guidelines state that they are an advisory document and should principally be applied to projects which require an EIS under Part 4 and Part 5 of the Environmental Planning and Assessment Act 1979 (NSW) but can also be used for the assessment of other projects.

The Draft NSW EIA Guidelines define four scopes of emissions, the first three being adopted along the lines of the greenhouse gas Protocol with the fourth relating to emission abatement. Scope 4 reporting under the Draft NSW EIA Guidelines allows the reporting of any carbon offsets which have occurred as a direct result of the Project. Proponents may report the following if applicable.

- Carbon sequestration performed by the proponents.
- Community based energy use or emissions reduction initiatives.
- The use of government endorsed Kyoto Protocol flexibility mechanisms such as Clean Development Mechanism (CDM) and Joint Implementation (JI).

8.1 Project Related Greenhouse Gas Emissions

The project-related greenhouse gas sources include the following.

- Emissions associated with the purchase of electricity (Scope 2 and Scope 3).
- Diesel consumed during the operation of the Project (Scope 1 and Scope 3).
- Emissions associated with explosive use (Scope 1 and Scope 3).
- Emissions of Methane associated with coal extraction (Scope 1).
- Fuel consumed in employees' vehicles whilst travelling to work (Scope 3).
- Coal combustion post-sale (Scope 3).

Carbon dioxide (CO_2) is produced during fuel combustion as a result of the oxidation of the fuel carbon content. CO_2 is likely to make the largest contribution to greenhouse gas emissions from fuel combustion as approximately 99% of diesel fuel is oxidised during the combustion process (AGO, 2005).

Other greenhouse gases emitted as a result of operations at the mine site may include carbon monoxide (CO), methane (CH_4), oxides of nitrogen (NO_X) and non-methane volatile organic compounds (NMVOCs). These are produced by incomplete fuel combustion, reactions between air and fuel constituents during fuel combustion, and post-combustion reactions. Fugitive emissions of NMVOCs may also be expected due to fuel evaporation.

In accordance with the Department of Climate Change document, *National Greenhouse Accounts (NGA) Factors* (2008) (hereafter, "NGA Workbook"), the greenhouse gas emissions that are required for measurement from the Project are:

- Direct (Scope 1) emissions relating to on-site fuel combustion and waste treatment / disposal as well as release of methane from the exposed coal seams.
- Indirect (Scope 2) emissions resulting from emissions associated with the purchase of electricity.
- Indirect (Scope 3) emissions associated with manufacture and production of purchased materials and end use of coal, employee travel, transport and distribution losses from electricity networks.

For comparative purposes, non-CO_2 greenhouse gases are awarded a "CO_2-equivalence" based on their contribution to the enhancement of the greenhouse effect. The CO_2-equivalence of a gas (CO_2-e) is calculated using an index called the Global Warming Potential (GWP). The GWPs for a variety of non-CO_2 greenhouse gases are contained within Table 24 of the NGA Workbook. The GWPs of relevance to this assessment are:

- **Methane (CH_4)**: GWP of 21 (21 times more effective as a greenhouse gas than CO_2); and
- **Nitrous Oxide (N_2O)**: GWP of 310 (310 times more effective as a greenhouse gas than CO_2).

The short-lived gases such as CO, NO_2, and NMVOCs vary spatially and it is consequently difficult to quantify their global radiative forcing impacts. For this reason, GWP values are generally not attributed to these gases nor have they been considered further as part of this assessment.

An assessment of the predicted greenhouse gas emissions from the operation of the mine site has been undertaken for each of the aforementioned sources and is outlined below.

8.2 Consumption Data and Emissions Calculations

8.2.1 Usage Data

Data on coal production, diesel and electricity consumption and explosive use has been sourced from the Werris Creek Coal Pty Ltd Annual Environmental Management Report (AEMR) 2007/2008. These data cover the period 1 April 2007 to 31 March 2008 and reflect a coal production rate of 1.03 Mtpa (7.82 Mtpa Overburden; 8.85 Mtpa Total).

The proposed modification would result in a coal production rate to 1.5 Mtpa (12.05 Mtpa Overburden; 13.55 Mtpa Total). To determine diesel and electricity consumption, release of coal bed methane and explosive use associated with the proposed modification, a scaling factor of 1.53 has been calculated based on total material extraction (13.55 Mtpa/8.85 Mtpa). This scaling factor has been applied to the 2007/2008 data as shown in **Table 17**. Section 8.3 provides a summary of how each of the usage figures presented in **Table 17** were calculated.

Table 17
Greenhouse Gas Emissions Sources associated with the Werris Creek Coal Mine Expansion

ROM Production (tonnes)	Saleable Coal (tonnes)[1]	Emission Source	Usage			Total Use	Units
			Scope 1	Scope 2	Scope 3		
1,500,000	1,500,000	Methane	3,250			3,250	tonnes
		Diesel	11,581		60 / 4,275 / 83	15,856	kL
		Explosives	6,799			6,799	tonnes
		Electricity		1,452	1,452	1,452	MWh
		Coal			1,500,000	1,500,000	tonnes

Note 1: Based on 100% Saleable Coal

8.2.2 Scope 1: Direct Emissions

8.2.2.1 Fugitive Emissions – Coal Bed Methane

The process of coal formation creates significant amounts of methane (CH_4). This CH_4 remains trapped in the coal until the pressure on the coal is reduced, which occurs during the coal mining process. The stored CH_4 is then released to the atmosphere.

The amount of CH_4 released during coal mining varies considerably as a function of factors such as the coal rank and depth, gas content, excavation methods and moisture levels (IPCC, 1996). As such, there are inherent uncertainties that must be considered when using estimates of CH_4 emission factors for coal excavation.

A proportion of the total CH_4 emitted from coal mining is generated by post-excavation activities such as coal processing and transportation. The processing of coal, including breaking, crushing and thermal drying, increases the surface area of the coal resulting in an increased rate of adsorption. CH_4 is desorbed during the transportation of coal as a result of direct exposure of the coal to air (IPCC, 1996).

The annual emissions of methane from this source have been estimated using *Table 6* of the NGA Workbook. The emission factor for open cut mines in NSW has been used.

8.2.2.2 Diesel Usage

Scope 1 greenhouse gas emissions attributable to diesel relate to the use of on site machinery (including on site transportation of coal product and overburden).

The primary fuel source for the vehicles operating on site is Automotive Diesel Oil (ADO). Data is available on the diesel consumption for all mobile and fixed equipment servicing the site, including on-site electricity generation, and is estimated as 11,580 kL/year.

The annual emissions of CO_2 and other greenhouse gases from this source have been estimated using *Table 3* of the NGA Workbook.

8.2.2.3 Explosives

The use of explosives in mining leads to the release of greenhouse gases. The activity level is the mass of explosive used (in tonnes). Emission factors are available for the three main types of explosives (Ammonium Nitrate with Fuel Oil (ANFO), Heavy ANFO and Emulsion). Based on the 2007/2008 AEMR data, the amount of explosives to be used on site is estimated to be 6,799 t per annum.

An estimate of the CO_2 emissions resulting from blasting activities has been derived using information contained in *Table 4* of the NGA Workbook. The emission factor for ANFO explosives has been used.

8.2.3 Scope 2: Electricity Indirect Emissions

8.2.3.1 Consumption of Purchased Electricity

The use of purchased electricity results in emissions of greenhouse gases from the combustion of fossil fuel in power stations. Based on the 2007/2008 AEMR data, the quantity of electricity predicted to be consumed on site is 1,452 MWh.

Emission factors are provided in *Table 5* of the NGA Workbook for purchased electricity based on the State or Territory in which the electricity is generated. The emission factor for NSW and ACT has been used within this assessment.

8.2.4 Scope 3: Other Indirect Emissions

8.2.4.1 Use of Products Manufactured and Sold

Indirect emissions of greenhouse gases from the combustion of product coal are expected "downstream" due to the extraction activities at the Project. A maximum of 1.5 Mt of coal is expected to be produced annually, with the majority destined for international markets.

The greenhouse gas emissions from combustion of product coal have been based on a coal energy content of 22.5 GJ/t. Standard emission factors for Scope 3 coal combustion (Black coal – NSW and ACT Electricity Generation) have been taken from *Table 1* of the NGA Workbook.

As the product coal is to be sold, the use of a Scope 1 emission factor is not applicable. A Scope 3 emission factor relating to 'use of sold products and services' is applied here.

8.2.4.2 Employees Commuting to and from Work

Fuel usage and consequent greenhouse gas emissions attributable to company employees commuting to and from work can be reported under Scope 3 greenhouse gas emissions.

Employee vehicles are assumed to be passenger cars and use Automotive Diesel Oil (ADO). Distance travelled to and from work per employee is calculated based on the radius of the distance from the mine site to the closest habitation(s) of significance. Information supplied by the Proponent indicates that a maximum of 74 full-time and 10 part-time staff members will be employed at the mine site. The closest habitation of significance to the Project is either Werris Creek to the north or Quirindi to the south of the mine site, approximately 4 km and 11 km by road respectively.

Based on an assumed diesel consumption rate of 0.139 L/km, a worst case annual diesel consumption attributable to employee travel to work is estimated to be 60 kL.

8.2.4.3 Extraction, Production and Transport of Purchased Fuels Consumed

Refer **Section 8.2.2.2**.

8.2.4.4 Extraction, Production and Transport of other Purchased Materials or Goods

Greenhouse gas emissions relating to the extraction, production and transport of other purchased materials or goods such as raw materials in the production of concrete, for example should be reported here. In addition, if any other fuels are consumed on site, such as natural gas, the emissions should be reported both in Scope 1 emissions (direct emissions) and under this heading in Scope 3 relating to the extraction, production and transport of the fuel. In terms of the proposed modification, no significant items relate to this category.

8.2.4.5 Generation of Electricity Consumed in a T & D System

Refer **Section 8.2.3.1**.

8.2.4.6 Transportation of Products, Materials and Waste

Transportation of product coal from the site of mining to the site of combustion will generally involve transport via road, rail and / or boat. Transport of 95% of the product coal from the mine site to its international distribution point at Port Newcastle is expected to occur. 5% of the product coal is despatched by road to local markets and other domestic users.

Transport via Rail

Approximately 10 trains carrying 3,200 tonnes of coal each are despatched from the Werris Creek coal loader per week to Newcastle, approximately 200 km to the southeast. Information provided for a previous Heggies greenhouse gas assessment for the Sunnyside Coal Mine near Gunnedah identified that product trains to Newcastle consumed 0.015 litres of diesel per tonne of coal transported each kilometre. This results in an annual diesel consumption of 4.3 ML.

Transport via Road

Approximately 50,000 tpa of coal is despatched via road to local markets and other domestic users. Up to five truck loads of coal are despatched each day with approximately 30 tonnes of coal per load.

No information on markets for the coal has been provided by the proponent. It has therefore been assumed that each truck travels 100 km to market. Assuming a diesel consumption rate of 0.5 l/km, annual diesel consumption is calculated to be 83 kL.

8.3 Predicted Greenhouse Gas Emissions

Table 18 presents the relevant emissions factor, as sourced from the NGA Workbook for the Scope 1 to 3 emissions sources. **Table 19** then provides the calculated greenhouse gas emissions (as CO_2-e) for the proposed modification.

Table 18
Relevant Greenhouse Gas Emission Factors

Emission Source	Emission Factor			Full Fuel Cycle Emission Factor	Units
	Scope 1	Scope 2	Scope 3		
Methane	45.5			45.5	t CO_2-e / t raw coal
Diesel	2.7		0.2	2.9	t CO_2-e/kL fuel
Explosives	0.17			0.17	t CO_2-e /t explosives
Electricity		0.89	0.17	1.06	kg CO_2-e /kWh
Coal			0.19	0.19	t CO_2-e / t raw coal

Table 19
Predicted Greenhouse Gas Emissions for the Werris Creek Coal Mine Expansion

Emission Source	Emissions (t CO_2-e)[1]			Total (t CO_2-e)
	Scope 1	Scope 2	Scope 3	
Methane	68,250			68,250
Diesel	31,268		3,200	34,468
Explosives	1,156			1,156
Electricity		1,293	247	1,540
Coal			293,625	293,625
TOTAL	**100,674**	**1,293**	**297,043**	**399,039**

Note 1: t CO_2-e – tonnes of CO_2 equivalent.

Australia's national net emissions of greenhouse gas were 576 Mt of CO_2-e in 2006 and 552.6 Mt of CO_2-e in 1990. The proposed expansion represents an increase of less than 0.1% of these 'baseline' emissions.

8.4 Additional Impacts of the Modified Project

As part of the 2004 air quality impact assessment conducted for the Werris Creek Coal Mine (Heggies, 2004), greenhouse gas emissions attributable to the operation of the mine site were calculated. In order to provide an indication of the greenhouse gas related impact of the proposed expansion to the operations at the mine site, the total emissions from the 2004 assessment will be compared with the results presented above.

It is noted that in the course of time since the original assessment, the approach and emission calculation factors have changed fairly significantly. Indeed, the assessment conducted in 2004 was effectively a calculation of Scope 1 emissions. Consequently, to provide a meaningful comparison between the two assessments, the calculated CO_2-e emissions of the 2004 assessment will be compared with the Scope 1 CO_2-e emissions presented in **Table 19**. The results of this comparison are presented in **Table 20**.

Table 20
Comparison of Predicted Greenhouse Gas Emissions – Original and Current Assessments

Emission Source	Emissions (t CO_2-e)[1]		Difference (t CO_2-e)
	2004 Assessment	Scope 1 – Expansion	
Methane	61,908	68,250	6,342
Diesel	14,663	31,268	16,605
Explosives	590	1,156	566
TOTAL	**77,161**	**100,674**	**23,513**

It can be seen from the data listed in **Table 20** that, following a comparison between the calculated greenhouse gas emissions from the 2004 assessment and the Scope 1 emissions from this report, the proposed expansion to the mine site operations will result in an increase of annual greenhouse gas emissions. The comparison presented in **Table 20** indicates that the proposed expanded operations at mine site would result in an increase of approximately 23,500 t CO_2-e, or 30%, on the equivalent emissions calculated in 2004. This equates to an additional increase of less than 0.0001% on Australia's national net 2006 emissions annually.

It is considered that the comparison conducted here is the best possible in light of the changes to greenhouse gas calculation methodology and emission factors since the original assessment was conducted.

9 CONCLUSION

Heggies Pty Ltd has been commissioned by R.W. Corkery and Co. Pty. Limited on behalf of Werris Creek Coal Pty Limited to conduct an air quality impact assessment of proposed modification to operations at the Werris Creek Coal Mine.

Atmospheric dispersion modelling predictions of fugitive emissions from the mine site were undertaken using the CALPUFF dispersion model in screening mode.

The results of the dispersion modelling conducted for the modified operations of the Werris Creek Coal Mine, indicate the potential for exceedance of the incremental dust deposition and DECC 24-hour PM_{10} assessment criteria at the nearest non-project related receptor to the north of the site.

However, the modelled scenario presents a conservative prediction of emissions likely to be generated by the proposed modification. The predicted emissions are therefore likely to be higher than those that would actually occur. Also notable is that the land acquisition criteria (listed in **Table 4**) is not triggered for any receptor.

Continuation of air quality monitoring at the surrounding PM_{10} and dust deposition monitoring network for the life of the modified operations would validate this conclusion.

Greenhouse gas emissions for the proposed modification to the Werris Creek Coal Mine were also calculated. Full fuel cycle (Scope 1 to Scope 3) emissions were calculated to total approximately 400kt CO_2-e annually. This represents an increase of less than 0.1% on Australia's national net 2006 emissions.

Furthermore, when compared with the greenhouse gas emissions calculated for the existing operations at the mine site (Heggies, 2004), the proposed expansion to operations will result in an increase in annual Scope 1 emissions of approximately 30%. This equates to an additional increase of less than 0.0001% on Australia's national net 2006 emissions annually.

10 REFERENCES

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

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

Flocchini, R (1994). *Evaluation of the Emission of PM_{10} Particulates from Unpaved Roads in the San Joaquin Valley*. University of California.

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US EPA (2000), Meteorological Monitoring Guidance for Regulatory Modeling Applications.

US EPA (2003) Compilation of Air Pollutant Emission Factors AP-42 - Chapter 13.2.2 Unpaved Roads.

US EPA (2006) Compilation of Air Pollutant Emission Factors AP-42 - Chapter 13.2.1 Paved Roads.

US EPA (2006) Compilation of Air Pollutant Emission Factors AP-42 (Chapter 13, Section 13.2.5 Industrial Wind Erosion).

Werris Creek Coal Pty Limited (2009), Dust Deposition, PM_{10} and Meteorological Monitoring Data from established monitoring equipment at Project Site.

11 GLOSSARY

ADO	Automotive Diesel Oil
AHD	Australian Height Datum
Approved Methods NSW	Approved Methods for the Modelling and Assessment of Air Pollutants in NSW
BCM	Bank Cubic Meter
CH_4	Methane
CO_2	Carbon Dioxide
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DECC	NSW Department of the Environment and Climate Change
EETMM	Emission Estimation Technique Manual for Mining, Version 2.3
$g/m^2/month$	Grams per square meter per month

ghg	Greenhouse Gas
Heggies	Heggies Pty Ltd
HVAS	High Volume Air Sampler
µg	Microgram (g x 10^{-6})
µm	Micrometre or micron (metre x 10^{-6})
m^3	Cubic meter
MGA	Map Grid of Australia
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
N_20	Nitrous Oxide
NMVOCs	Non-methane volatile organic compounds
PM_{10}	Particulate matter less than 10microns in aerodynamic diameter
The mine site	Werris Creek Coal Mine
The Proponent	Werris Creek Coal Pty Limited
ROM	Run-Of-Mine
RWC	R.W. Corkery and Co Pty Limited
tpa	Tonnes per Annum
TAPM	"The Air Pollution Model"
TSP	Total Suspended Particulate
USEPA	United States Environmental Protection Agency
VKT	Vehicle Kilometres Travelled

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APPENDICES

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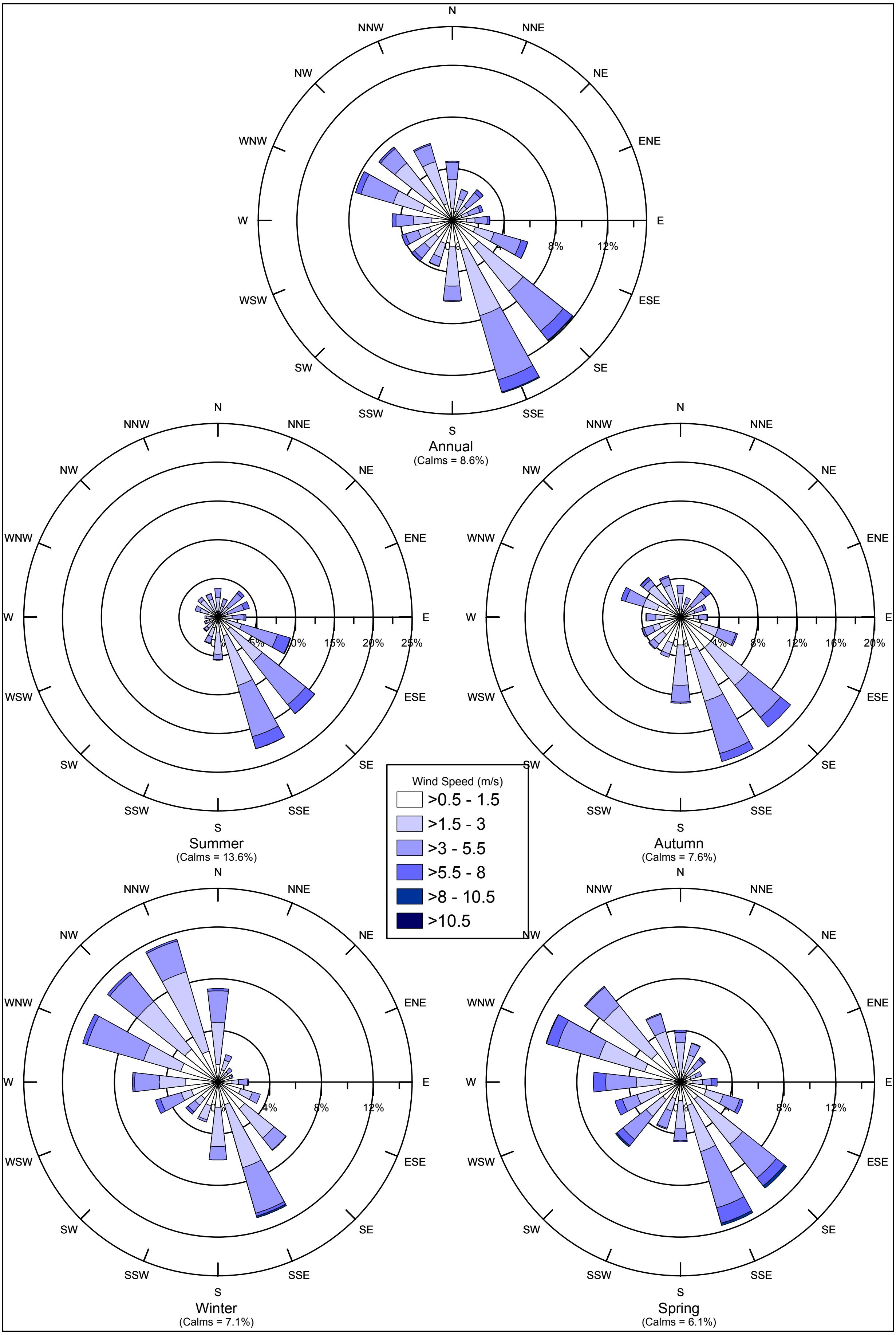
APPENDIX 1

Annual and Seasonal Wind Roses – Mine Site

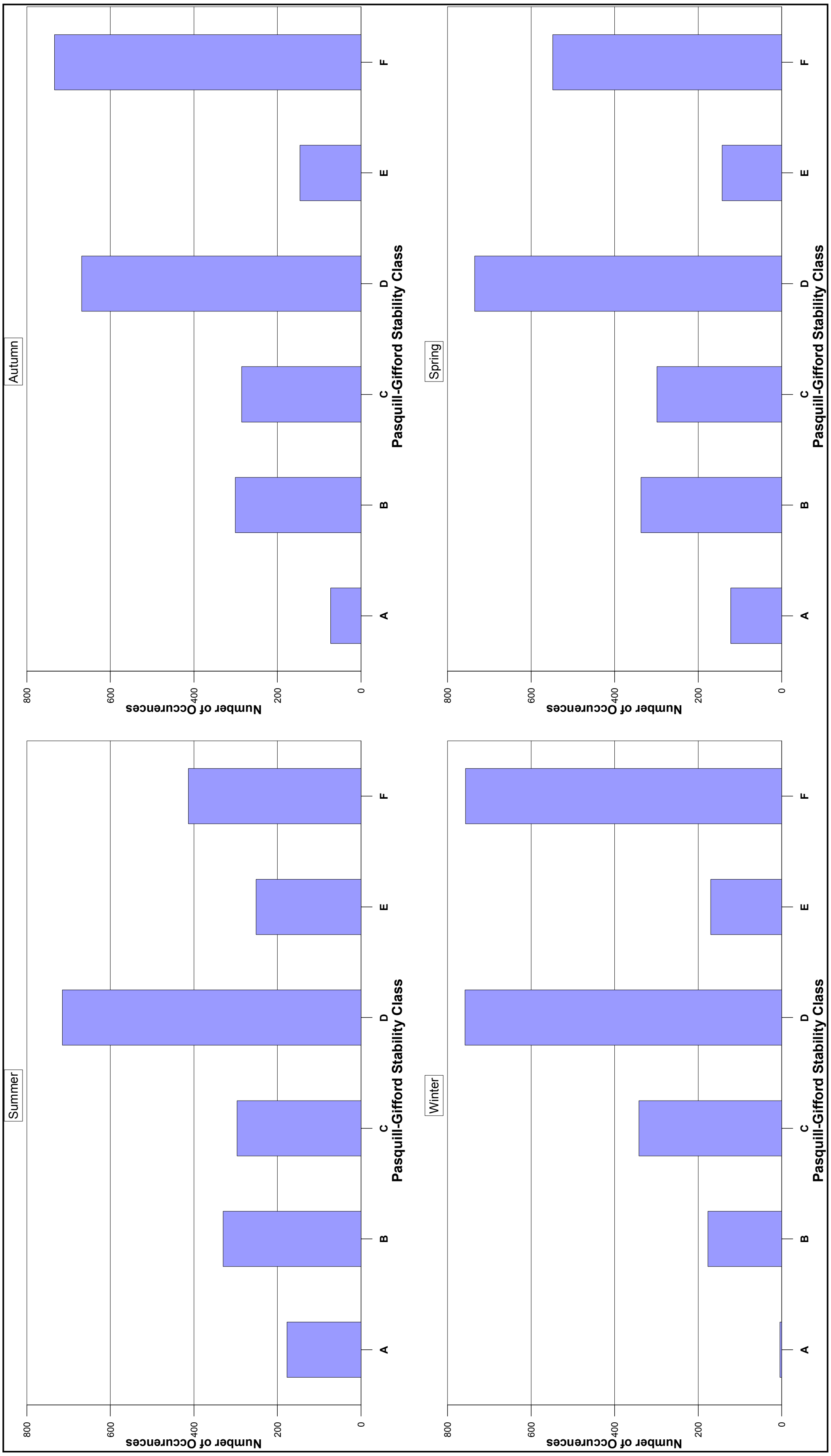
(No. of pages excluding this page = 1)


N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
4%
8%
12%
16%
20%
5%
10%
15%
20%
25%
Annual
(Calms = 8.6%)
Summer
(Calms = 13.6%)
Autumn
(Calms = 7.6%)
Winter
(Calms = 7.1%)
Spring
(Calms = 6.1%)
Wind Speed (m/s)
>0.5 - 1.5
>1.5 - 3
>3 - 5.5
>5.5 - 8
>8 - 10.5
>10.5

APPENDIX 2

Seasonal Stability Class – Mine Site

(No. of pages excluding this page = 1)


Autumn
Summer
Spring
Winter
Pasquill-Gifford Stability Class
Number of Occurrences
A
B
C
D
E
F
0
200
400
600
800

APPENDIX 3

Emissions Inventory

(No. of pages excluding this page = 1)

	Moisture Content (%)	Silt Content (%)	TSP Emission Factor	PM10 Emission Factor	Emission Factor Unit	Notes/Contols	Emissions Reduction From Controls	Variable		Mine Working Days	Modelled Working hours	TSP Emission Rate (mg/s)	PM10 Emission Rate (mg/s)	TSP Emission Flux (mg/s/m^2)	PM_{10} Emission Flux (mg/s/m^2)
Coal Extraction															
Dozer pit	6	7	29.93	9.54	kg/hr	Pit Retention (50% TSP and 5% PM10)	55%/12%	22.0	hours/day	305	22	4157.4	2518.0	N/A	N/A
Excavator (Coal) pit	6	7	0.01854	0.01	kg/t	Pit Retention (55% TSP and 12% PM10)	55%/12%	223.55	t/hr	305	22	575.5	525.7	N/A	N/A
Excavator (OB) pit	5.5	10	0.0006	0.0002	kg/t	Pit Retention (55% TSP and 12% PM10)	55%/12%	1795.9	t/hr	305	22	144.1	73.4	N/A	N/A
Haulage (3 sources) ROM	1.1	6	4.18	1.11	kg/VKT	87% reduction for watering of haul roads (Flocchini, 1994), Pit Retention (50% TSP and 5% PM10)	87%	2.2	VKT/hour	305	22	56.3	28.5	N/A	N/A
Drilling	5.5	10	0.59	0.31	kg/hole	70% reduction for water sprays, Pit Retention (55% TSP and 12% PM10)	70%, 55%/12%	2.7	holes/hour	305	22	67.0	66.9	N/A	N/A
Blasting	5.5	10	43.26	22.50	kg/blast	Pit Retention (55% TSP and 12% PM10)	55%/12%	1.0	blast/day	305	22	6008.5	5936.4	1.001416102	0.989399109
Scraper on Topsoil (3 sources)	4	10	3.40	0.90	kg/VKT	50% reduction for watering during topsoil removal	50%	1.5	VKT/hour	305	22	236.3	62.3	N/A	N/A
Overburden Dump															
Dozer Dump	5.5	10	4.49	0.99	kg/hr			22.0	hours/day	305	22	1248.0	274.6	N/A	N/A
Haulage (5 sources) OB	1.1	6	4.18	1.11	kg/VKT	87% reduction for watering of haul roads (Flocchini, 1994), Pit Retention (50% TSP and 5% PM10)	87%	23.9	VKT/hour	305	22	361.6	183.1	N/A	N/A
Unloading OB	5.5	10	0.0006	0.0002	kg/t			1795.9	t/hr	305	22	288.3	77.3	N/A	N/A
Processing Plant										305					
Paved Haulage (9 sources)	N/A	N/A	0.71	0.14	kg/VKT	75% reduction for sprays	75%	2.7	VKT/hour	305	12	15.0	2.9	N/A	N/A
Hopper Loading	6	7	0.02	0.01	kg/t	50% reduction for water sprays	50%	500.0	t/hr	305	10	1287.3	618.9	N/A	N/A
Primary Crushing	6	7	0.010	0.004	kg/t	50% reduction for water sprays	50%	500.0	t/hr	305	10	694.4	277.8	N/A	N/A
Secondary Crushing	6	7	0.03	0.01	kg/t	50% reduction for water sprays	50%	500.0	t/hr	305	10	2083.3	833.3	N/A	N/A
Coal Bin Transfer	6	7	0.0005	0.0001	kg/t	50% reduction for water sprays	50%	500.0	t/hr	305	10	35.5	9.5	N/A	N/A
Product SP Loading	6	7	0.0040	0.0017	kg/t	50% reduction for water sprays	50%	500.0	t/hr	305	10	277.8	118.1	N/A	N/A
Unloading ROM coal	6	7	0.010	0.004	kg/t			223.5	t/hr	305	22	621.0	260.8	N/A	N/A
Road Truck Loading	6	7	0.02	0.01	kg/t			13.7	t/hr	305	12	70.3	33.8	N/A	N/A
Rail Truck Loading	6	7	0.02	0.01	kg/t			272.7	t/hr	305	22	1404.3	675.1	N/A	N/A
Rail Loadout															
Paved Haulage (11 sources) rail	1.1	6	0.71	0.14	kg/VKT	75% reduction for sprays	75%	49.1	VKT/hour	305	22	220.6	42.3	N/A	N/A
Dozer rail	6	7	29.93	9.54	kg/hr			4.0	hours/day	305	4	8314.8	2650.6	N/A	N/A
Loading Train	6	7	0.0004	0.0002	kg/t	50% reduction for water sprays	50%	1600.0	t/hr	305	4	88.9	37.8	N/A	N/A
Unloading Trucks Rail	6	7	0.0100	0.0042	kg/t			272.7	t/hr	305	22	757.6	318.2	N/A	N/A
Wind Erosion															
Rail Stockpile	6	7	0.39	0.19	kg/ha/hr	Assume 10% of total area is active		1.4	Hectares	366	24	N/A	N/A	Variable by each hour of year	
ROM Stockpile	6	7	0.39	0.19	kg/ha/hr	Assume 10% of total area is active		0.6	Hectares	366	24	N/A	N/A		
Product Stockpile	6	7	0.39	0.19	kg/ha/hr	Assume 10% of total area is active		0.1	Hectares	366	24	N/A	N/A		
OB Dump	5.5	10	0.39	0.19	kg/ha/hr	Assume 10% of total area is active		6.4	Hectares	366	24	N/A	N/A		

APPENDIX 4

Average Incremental Dust Deposition (g/m^2/month)

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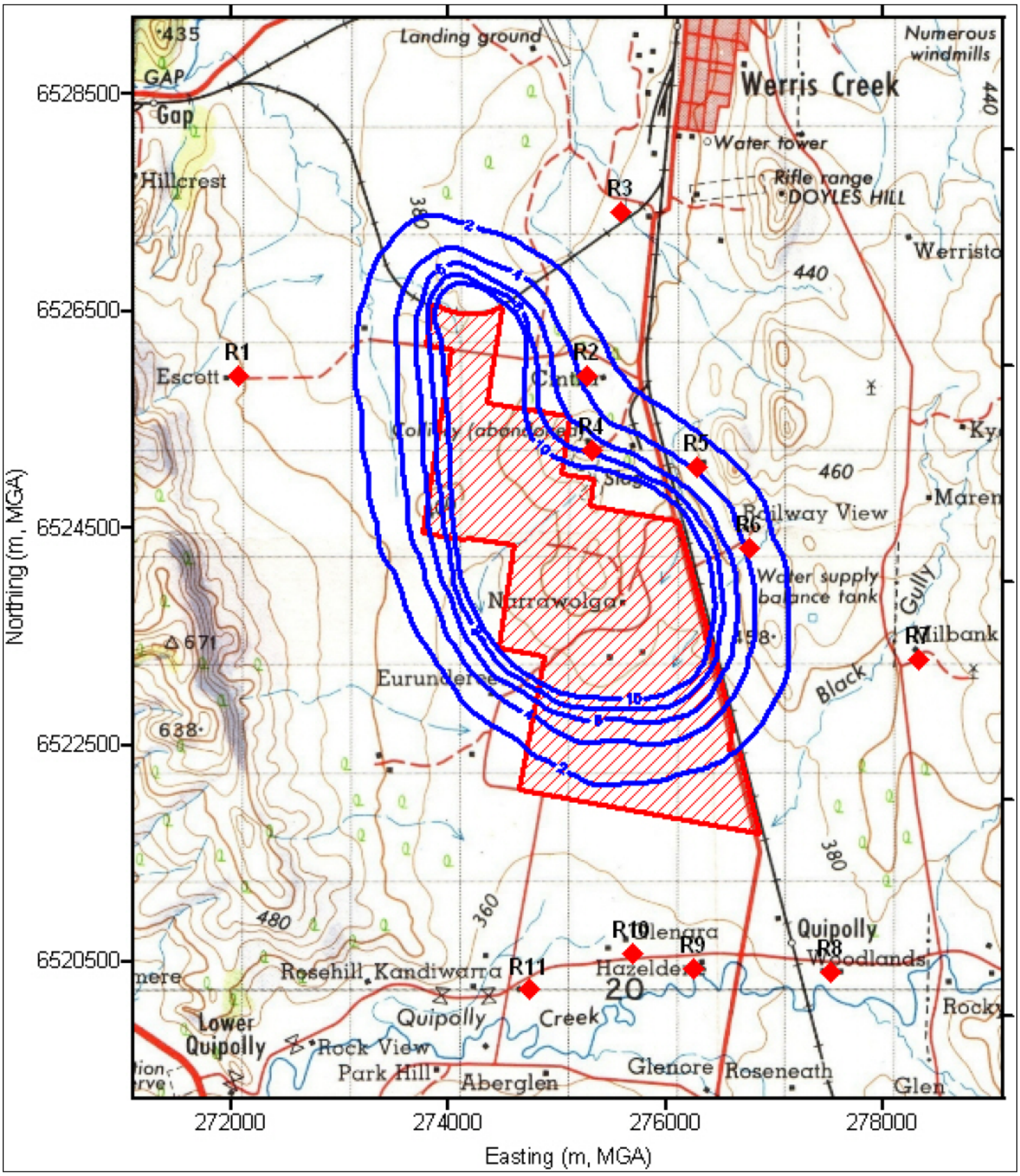
Northing (m, MGA)
Easting (m, MGA)
6528500
6526500
6524500
6522500
6520500
272000
274000
276000
278000
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
Werris Creek
Landing ground
Numerous windmills
Water tower
Rifle range
DOYLES HILL
Hillcrest
Gap
Escott
Railway View
Water supply balance tank
Narrawolga
Eurunderee
Quipolly
Woodlands
Hazeldene
Rosehill
Kandiwarra
Quipolly Creek
Lower Quipolly
Rock View
Park Hill
Aberglen
Glenore
Roseneath
Milbank
Black Gully

APPENDIX 5

Incremental 24-hour Average PM_{10} (µg/m^3)

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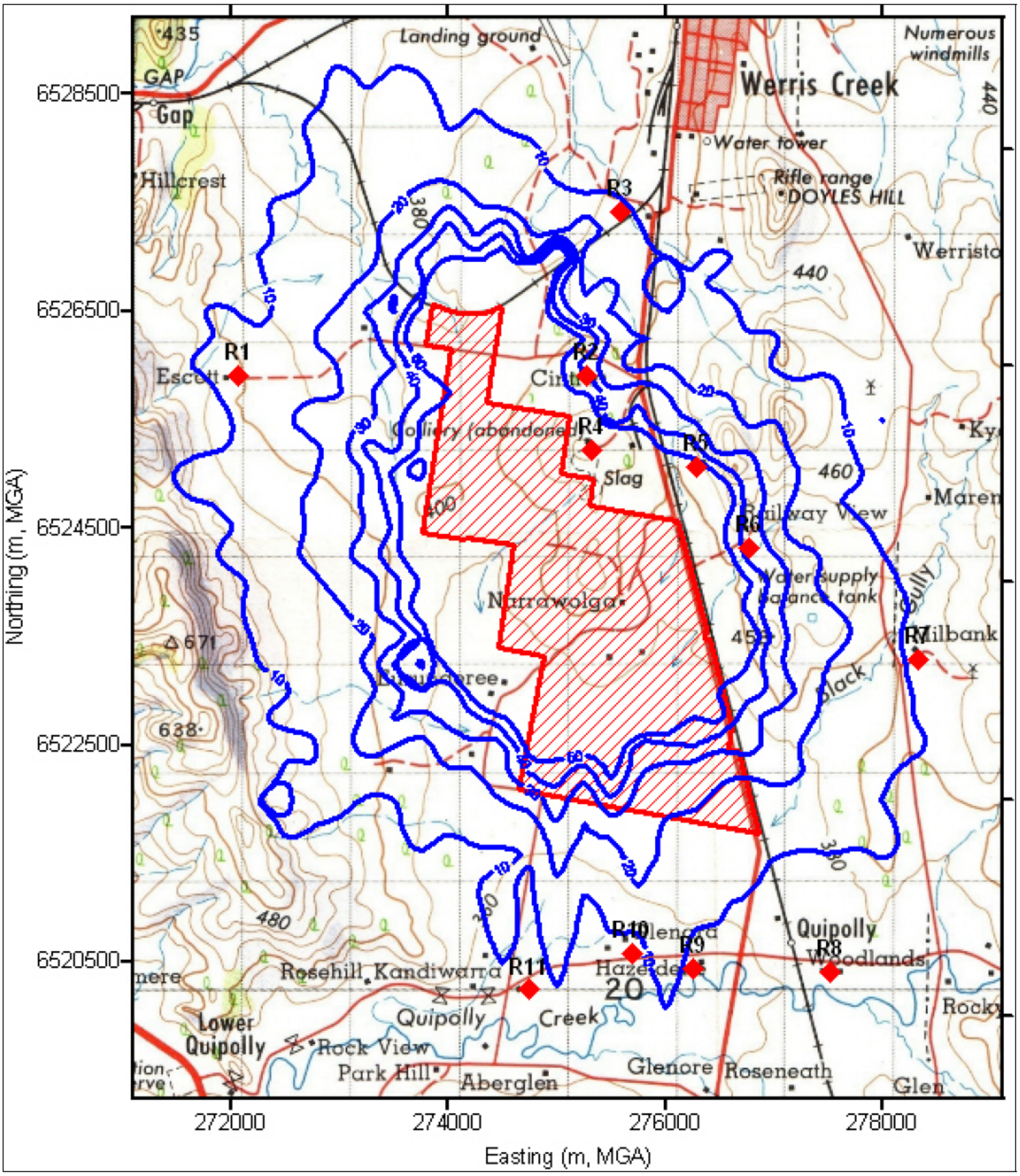

Northing (m, MGA)
Easting (m, MGA)
6528500
6526500
6524500
6522500
6520500
272000
274000
276000
278000
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
Werris Creek
Landing ground
Numerous windmills
Water tower
Rifle range
DOYLES HILL
Hillcrest
Gap
GAP
Escott
Colliery (abandoned)
Slag
Railway View
Water supply balance tank
Narrawolga
Milbank
Quipolly
Woodlands
Rosehill
Kandiwarra
Hazeldene
Lower Quipolly
Rock View
Park Hill
Aberglen
Glenore
Roseneath
Quipolly Creek
Rocky
Glen

APPENDIX 6

Incremental Annual Average PM_{10} ($\mu g/m^3$)

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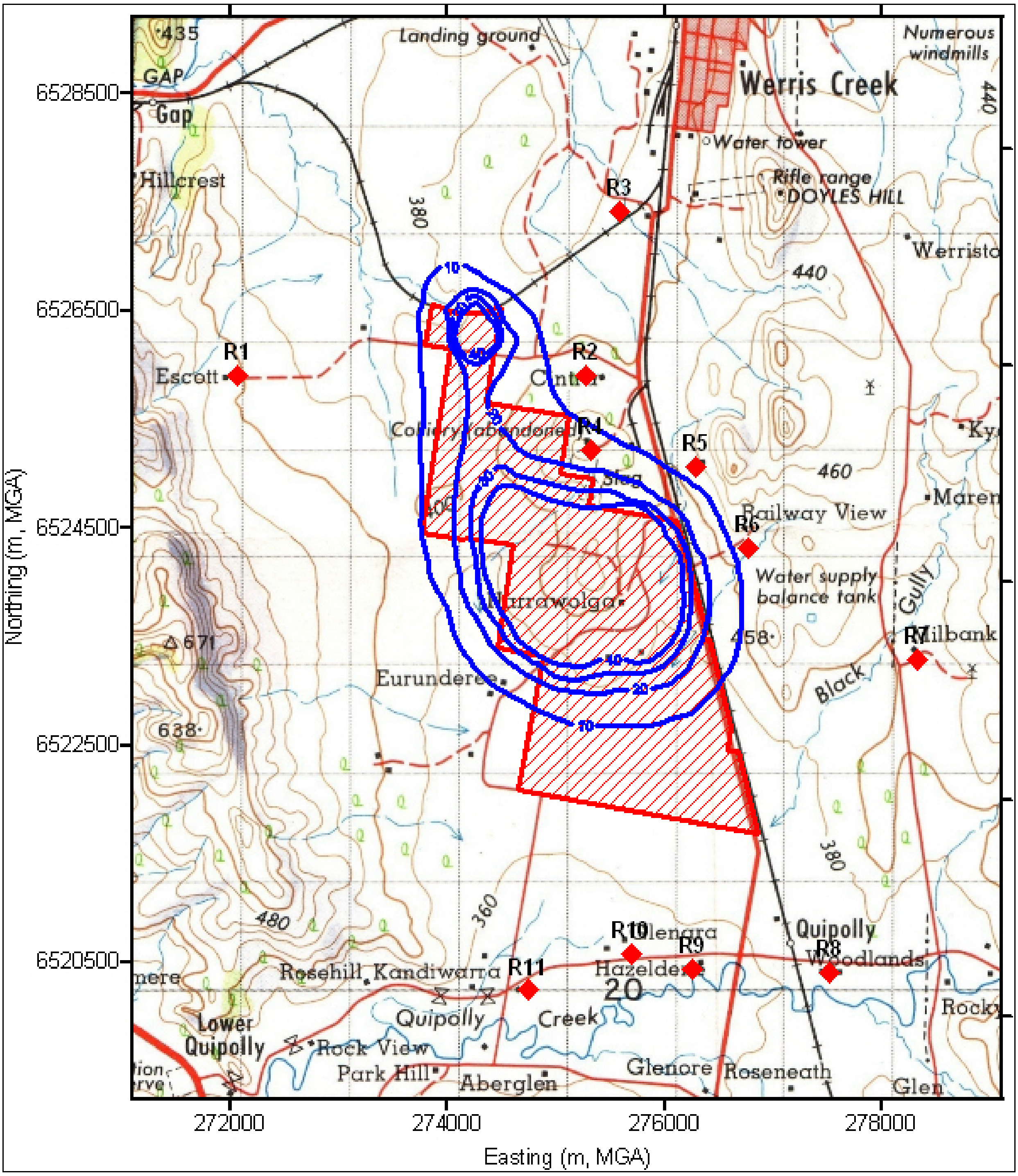
Northing (m, MGA)
Easting (m, MGA)
6528500
6526500
6524500
6522500
6520500
272000
274000
276000
278000
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
Werris Creek
Landing ground
Numerous windmills
Water tower
Rifle range
DOYLES HILL
Hillcrest
Escott
Colliery (abandoned)
Railway View
Water supply balance tank
Eurunderee
Quipolly
Woodlands
Hazeldene
Rosehill
Kandiwarra
Quipolly Creek
Rock View
Park Hill
Aberglen
Glenore
Roseneath
Lower Quipolly
Black Gully
Milbank
Gap
GAP
Slag

APPENDIX 7

Greenhouse Gas Policies and Guidelines

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1. The Greenhouse Gas Protocol Initiative

The Greenhouse Gas Protocol Initiative (hereafter, "the greenhouse gas Protocol") is a multi-stakeholder partnership of businesses, non-governmental organizations (NGOs), governments, and others convened by the World Resources Institute (WRI), a U.S.-based environmental NGO, and the World Business Council for Sustainable Development (WBCSD), a Geneva-based coalition of 170 international companies. Launched in 1998, the Initiative's mission is to develop internationally accepted greenhouse gas (greenhouse gas) accounting and reporting standards for business and to promote their broad adoption. (WBCSD, 2005)

The greenhouse gas Protocol comprises two separate but linked standards:

- *greenhouse gas Protocol Corporate Accounting and Reporting Standard* (this document, which provides a step-by-step guide for companies to use in quantifying and reporting their greenhouse gas emissions).
- *greenhouse gas Protocol Project Quantification Standard* (forthcoming; a guide for quantifying reductions from greenhouse gas mitigation projects).

There are three scopes of emissions that are established for greenhouse gas accounting and reporting purposes, defined as follows.

1.1 Scope 1 Emissions – Direct greenhouse gas Emissions

The greenhouse gas Protocol defines Scope 1 emissions as those which result from activities under the company's control or from sources which they own. They are principally a result of the following activities:

- generation of electricity, heat or steam. These emissions result from the combustion of fuels in stationary sources, e.g. boilers, furnaces or turbines;
- physical or chemical processing. The majority of these emissions result from the manufacture or processing of chemicals and materials e.g. the manufacture of cement, aluminium, adipic acid and ammonia, or waste processing;
- transportation of materials, products, waste, and employees. These emissions result from the combustion of fuels in company owned/controlled mobile combustion sources (e.g., trucks, trains, ships, airplanes, buses, and cars)
- fugitive emissions. These emissions result from intentional or unintentional releases, e.g., equipment leaks from joints, seals, packing, and gaskets; methane emissions from coal mines and venting; hydrofluorocarbon (HFC) emissions during the use of refrigeration and air conditioning equipment; and methane leakages from gas transport.

1.2 Scope 2 Emissions – Electricity indirect greenhouse gas Emissions

Scope 2 emissions are those which relate to the generation of purchased electricity consumed in its owned or controlled equipment or operations. For many companies, purchased electricity represents one of the largest sources of greenhouse gas emissions and the most significant opportunity to reduce these emissions.

1.3 Scope 3 Emissions – Other indirect greenhouse gas Emissions

The greenhouse gas protocol states that Scope 3 reporting is optional and covers all other indirect greenhouse gas emissions. Scope 3 emissions are defined as those which do not result from the activities of a company although arise from sources not owned or controlled by the company. Examples of Scope 3 emissions include the extraction and production of purchased materials, transportation of purchased fuels and the use of sold products and services.

In the case of the coal mining industry, Scope 3 emissions may include the transportation of sold coal and the use of this coal, either at home or overseas.

The greenhouse gas protocol flags the issue that the reporting of Scope 3 emissions may result in the double counting of emissions. A second problem is that as their reporting is optional, comparisons between countries and / or projects may become difficult. The greenhouse gas protocol also states that compliance regimes are more likely to focus on the "point of release" of emissions (direct emissions) and / or indirect emissions from the use of electricity. However, for greenhouse gas risk management and voluntary reporting, double counting is less important.

2. National Greenhouse Accounts (NGA) Factors

The National Greenhouse Accounts (NGA) Factors document, issued by the Department of Climate Change (DCC) in January 2008 and revised in February 2008, updates and replaces the the Australian Greenhouse Office (AGO) Factors and Methods Workbook published in December 2006.

The NGA Factors are generally taken from the *Technical Guidelines for the Estimation of Greenhouse Emissions and Energy at Facility Level*, published by the DCC in December 2007. The NGA Factors have bee designed to support reporting under the *National Greenhouse and Energy Reporting Act 2007*, once the first reporting period under the Act commences on 1 July 2008.

The NGA Factors however have a general application to a broader range of greenhouse emissions inventories, and their use is not intended to be restricted to reporting under the Act. Further information on the emission estimation methods employed in the National Greenhouse Accounts is available in the *Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks* series.

NGA Factors are consistent with international guidelines and are to be subject to international expert review each year.

2.1 Direct Emissions

Direct emissions are defined in the NGA Workbook as those which are produced from sources within the boundary of an organisation and as a direct result of that organisation's activities and arise from the following activities:

- generation of energy, heat steam and electricity, including carbon dioxide (CO_2) and the products of incomplete combustion (methane and nitrous oxide);

- manufacturing processes, which produce emissions (for example, cement, aluminium and ammonia production);
- transportation of materials, products, waste and people; for example, use of vehicles owned and operated by the reporting organisation;
- fugitive emissions – intentional or unintentional greenhouse gas releases (such as methane emissions from coal mines, natural gas leaks from joints and seals); and
- on-site waste management, such as emissions from company owned and operated landfill sites.

The NGA 2008 document gives several examples of direct emissions; a company with a vehicle fleet would report the greenhouse gas emissions from the combustion of petrol or diesel in these vehicles as direct emissions. A mining company would report methane escaping from a coal seam during mining (fugitive emissions) as direct emissions and a cement manufacturer would report carbon dioxide released during cement production as direct emissions.

2.2 Indirect Emissions

Indirect emissions as those which are defined as being 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. The most important category of indirect emissions is from the consumption of electricity. Other examples of indirect emissions from an organisation's activities include upstream emissions generated in the extraction and production of fossil fuels, downstream emissions from transport of an organisation's product to customers, and emissions from contracted / outsourced activities. The appropriate emissions factor for these activities depends on the parts of the upstream production and downstream use considered in calculating emissions associated with the activity.

For purposes of harmonisation, the NGA emission factors for indirect emissions have been subdivided into Scope 2 and Scope 3 emissions (adopted by the greenhouse gas Protocol).

Broadly, the NGA Workbook defines Scope 3 emissions as including:

- disposal of waste generated (e.g. if the waste is transported outside the organisation and disposed of);
- use of products manufactured and sold;
- disposal (end of life) of products sold;
- employee business travel (in vehicles or aircraft not owned or operated by the reporting organisation);
- employees commuting to and from work;
- extraction, production and transport of purchased fuels consumed;

- extraction, production and transport of other purchased good and materials;
- purchase of electricity that is sold to an end user (reported by electricity retailer);
- generation of electricity that is consumed in a transport and distribution system (reported by end user);
- out-sourced activities; and
- transportation of products, materials and waste.

3. Draft Guidelines for Energy and Greenhouse in EIA

The Draft NSW EIA Guidelines were prepared in August 2002 by the NSW Sustainable Energy Development Authority (SEDA) and Planning NSW (now the Department of Planning (DOP)). The guidelines state that they are an advisory document and should principally be applied to projects which require an EIS under Part 4 and Part 5 of the Environmental Planning and Assessment Act 1979 (NSW) but can also be used for the assessment of other projects.

The Draft NSW EIA Guidelines define four scopes of emissions, the first three being adopted along the lines of the greenhouse gas Protocol with the fourth relating to emission abatement.

3.1 Scope 1: Direct Energy Use or greenhouse gas Emissions

Scope 1 considers energy use and greenhouse gas emissions that occur on site or are under a proponent's direct and immediate control. Scope 1 emissions broadly consist of the energy use and greenhouse gas emissions produced by the following activities:

- production of electricity, heat or steam;
- combustion of fossil fuels for any other purpose;
- physical or chemical processing on site;
- transportation of materials, products, waste and employees by proponent controlled vehicles;
- fugitive emissions occurring on site;
- on site landfill wastes or wastewater treatment;
- animal husbandry; and
- on site vegetation or soil disturbance.

3.2 Scope 2: Indirect Energy Use or greenhouse gas Emissions from Imports and Exports of Electricity, Heat or Steam

Scope 2 broadly focuses on the indirect emissions associated with the generation of purchased and imported electricity, heat or steam.

3.3 Scope 3: Other Indirect Energy Use or greenhouse gas Emissions

Scope 3 considers the indirect energy use or greenhouse gas emissions that are a consequence of the Project but do not occur on site or those emissions which are removed from the proponent's direct control. Examples of Scope 3 emissions as described in the Draft NSW EIA Guidelines include the following:

- off site waste management (e.g. land filled waste or waste water treatment);
- transportation of products, materials and waste by vehicles not controlled by the proponent;
- employee related business or commuter travel;
- outsourced activities;
- production of imported materials, plant and equipment; and
- use of products or services produced by the Project (and end of life phases of products).

3.4 Scope 4: greenhouse gas Emission Abatement from Offset Opportunities

Scope 4 reporting under the Draft NSW EIA Guidelines allows the reporting of any carbon offsets which have occurred as a direct result of the Project. Proponents may report the following if applicable:

- carbon sequestration performed by the proponents;
- community based energy use or emissions reduction initiatives;
- the use of government endorsed Kyoto Protocol flexibility mechanisms such as Clean Development Mechanism (CDM) and Joint Implementation (JI) (refer **Section 3.4.1** below).

3.4.1 Kyoto Protocol Flexibility Mechanisms

The greenhouse gas offset mechanisms contained within the Kyoto Protocol (KP) can be used as instruments for carbon reduction and can be reported in Scope 4 of the Draft NSW EIA Guidelines. The following mechanisms are relevant for reporting under Scope 4:

- Clean Development Mechanism (CDM) – Developed countries can invest in greenhouse gas emission reduction projects in developing countries;
- Joint Implementation (JI) – Developed countries can invest in greenhouse gas reduction projects in other developed countries.

4. Policy Instruments

4.1 The NSW Greenhouse Plan

Published in November 2005, the NSW Greenhouse Plan is a strategic document which sets out the NSW Government's aims and initiatives in terms of greenhouse gas emissions abatement over the next 20 to 45 years. The NSW Government state that it would like to meet the following criteria:

- a 60% reduction in greenhouse gas emissions by 2050; and
- cutting greenhouse gas emissions to year 2000 levels by 2025.

The NSW Greenhouse Plan does not set out a methodology for reporting greenhouse gas emissions, rather seeks to:

- increase awareness among those expected to be most affected by the impacts of climate change;
- begin to develop adaptation strategies to those unavoidable climate change impacts; and
- put NSW on track to meeting the targets set out above.

5. References

- Commonwealth of Australia (2006), AGO Factors and Methods Workbook, December 2006.
- Department of Climate Change (2008). National Greenhouse Accounts (NGA) Factors, Updating and Replacing the AGO Factors and Methods Workbook, Commonwealth Government of Australia, February 2008.
- NSW Government (2005), NSW Greenhouse Plan.
- Sustainable Energy Development Authority and Planning NSW (2002), Draft NSW Energy and Greenhouse Guidelines for Environmental Impact Assessment.
- World Business Council for Sustainable Development and World Resources Institute (2005), The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard.