APPENDIX G

Air Quality Impact Assessment

AIR QUALITY IMPACT ASSESSMENT

COALPAC CONSOLIDATION PROJECT

Coalpac Pty Limited

Job No: 3351C

14 December 2011

A PEL Company

PROJECT TITLE:	**COALPAC CONSOLIDATION PROJECT**
JOB NUMBER:	**3351C**
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1 INTRODUCTION

This report has been prepared by PAEHolmes for Hansen Bailey Environmental Consultants on behalf of Coalpac Pty Limited (Coalpac) and forms an appendix to the Environmental Assessment (EA) to support an application for Project Approval. The report assesses the likely air quality impacts of the proposed Coalpac Consolidation Project (hereafter referred to as the Project) located near Lithgow in NSW New South Wales (NSW).

Coalpac seeks to consolidate the operations and management of the Cullen Valley Mine and Invincible Colliery as well as expanding the existing operations to produce up to a total of 3.5 million tonnes per annum (Mtpa) of product coal. A portion of the coal will be transported locally to the Mount Piper Power Station (MPPS) via conveyor and (emergency supply to) Wallerawang Power Station and minor amounts to other domestic destinations, with up to 1.0 Mtpa transported to export destinations via rail.

The Project also involves the extraction of the Marangaroo Sandstone horizon in the northern coal mining area of the Cullen Valley Mine beneath but with within the coal extraction footprint.

The Project is proposed to access an additional resource of approximately 70 Mt of ROM coal over a period of 21 years and includes processing facilities, rail loading and coal stockpiling areas, waste rock emplacement areas, a conveyor system and associated infrastructure.

The air quality assessment is based on the use of a computer-based dispersion model to predict ground-level dust concentrations and deposition levels in the vicinity of the Project. To assess the effect that the dust emissions would have on existing air quality, the dispersion model predictions have been compared to relevant air quality criteria.

The assessment follows the procedures outlined by the NSW Department of Environment and Climate Change and Water (DECCW) in their document titled "Approved Methods for the Modelling and Assessment of Air Pollutants in NSW" (**NSW DEC, 2005**) (hereafter referred to as the "Approved Methods"). The Approved Methods specify how assessments based on the use of air dispersion models should be undertaken. They include guidelines for the preparation of meteorological data, emissions data and relevant air quality criteria.

In summary, the report provides information on the following:

- The way in which mining is to be undertaken, with a focus on describing those aspects that will affect air quality;
- Air quality criteria that need to be met to protect the air quality environment;
- Meteorological and climatic conditions in the area;
- A discussion as to the likely existing air quality conditions in the area;
- The methods used to estimate dust emissions and the way in which dust emissions from the Project would disperse and fallout;
- The expected dispersion and dust fallout patterns due to emissions from the Project and a comparison between the predicted dust concentration and fallout levels and the relevant air quality criteria;
- Control methods which can be used to reduce dust impacts, spontaneous combustion and odour; and
- The estimated emissions of greenhouse gases from the Project.

2 LOCAL SETTING AND TOPOGRAPHY

The Project is located adjacent to the Castlereagh Highway, approximately 25 kilometres (km) to the northwest of Lithgow and approximately 1 km from the town of Cullen Bullen, NSW.

Figure 2.1 shows the Project location including the Project Boundary, as well as the nearest sensitive receptors. Air quality impacts have been assessed at these locations and will be discussed in subsequent sections. **Appendix A** presents details of land ownership and a map with all sensitive receptors identified.

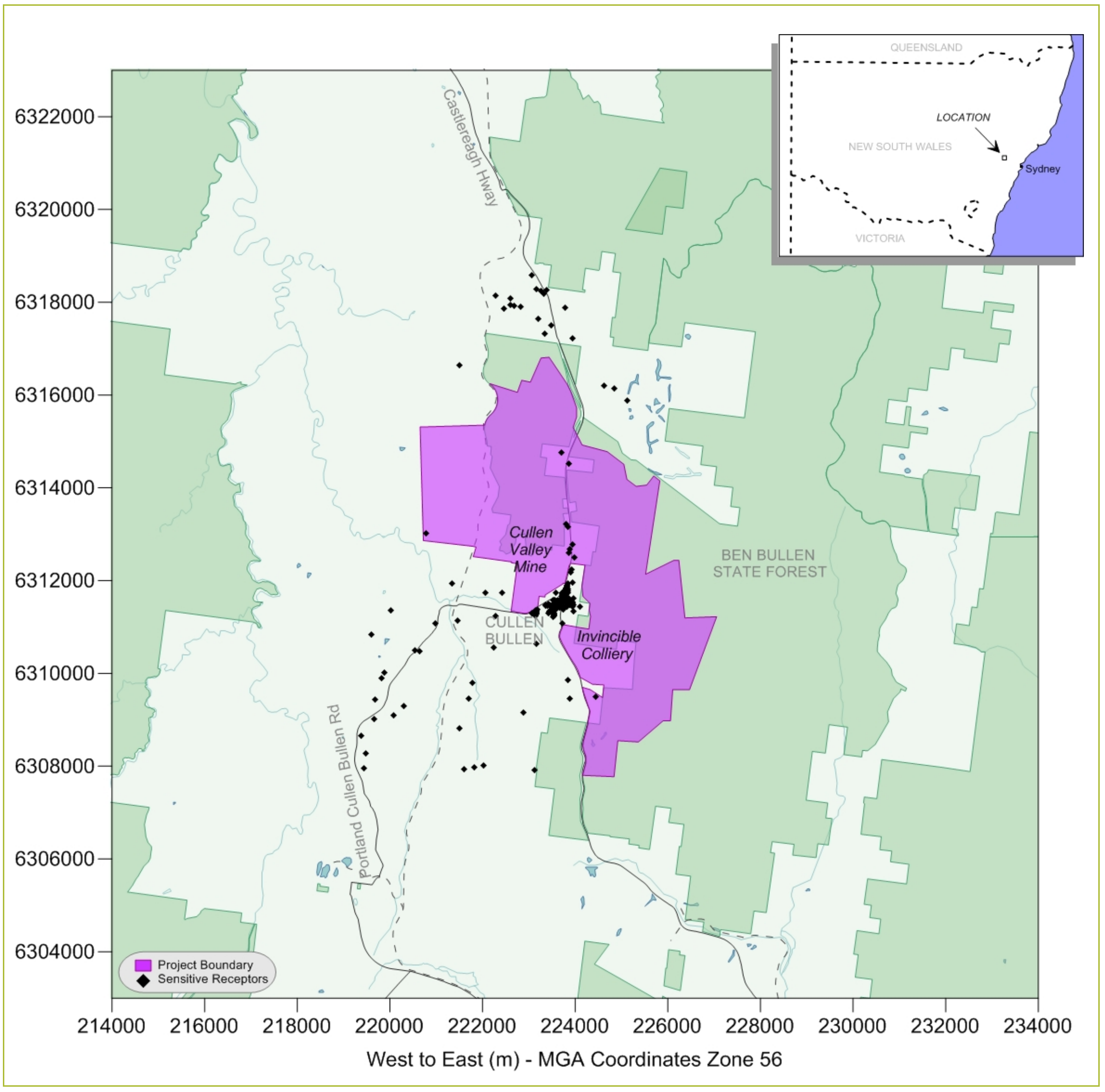

Figure 2.1: Project location

Figure 2.2 shows the topography of the area. The Project is located on the western slopes of the Great Diving Range with several steep sandstone escarpments dividing the site topographically. The topography surrounding the Project typically consists of moderately undulating terrain and includes the Ben Bullen State Forest to the east, Gardens of Stone National Park to the north and the Sunny Corner State Forest and Turon National Park to the west.

Activities within the Project Boundary are predominantly associated with existing mining operations, rural land uses and recreational activities within the Ben Bullen State Forest. Land use in the wider region includes other mining operations (e.g. Baal Bone Colliery, Ivanhoe North Colliery and the Pinedale Colliery) as well as agricultural and forestry activities. The closest residential area to the Project is the township of Cullen Bullen located on the Castlereagh Highway to the southeast of the Cullen Valley Mine and the northwest of the Invincible Colliery.

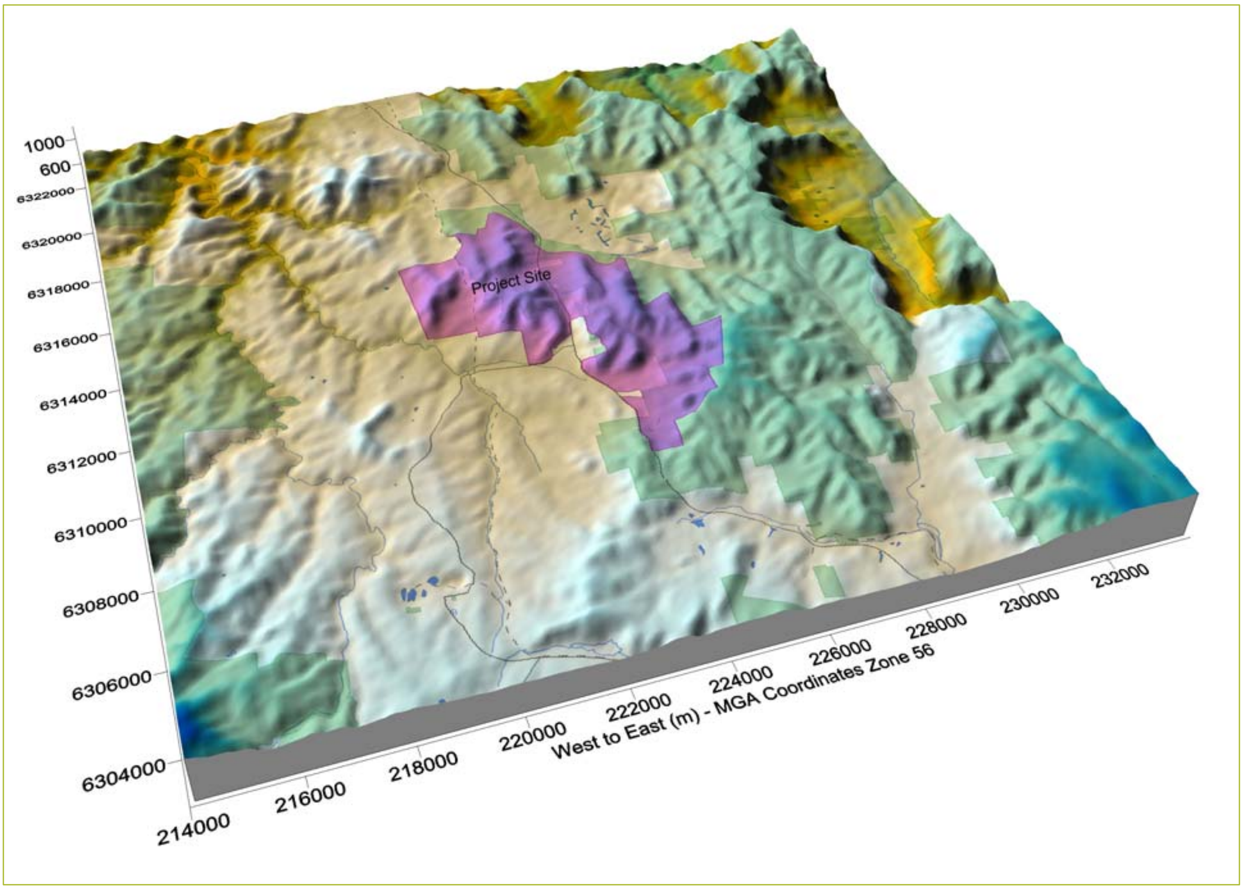

Figure 2.2: **Pseudo 3-Dimensional Topographical Representation of the Study Area**

3 THE PROJECT

Project Approval is sought for the following key elements:

- Consolidation and extension of the existing Cullen Valley Mine and Invincible Colliery operations to produce up to a total of 3.5 Mtpa product coal, including:
  - The continuation of mining operations at Cullen Valley Mine (the area west of the Castlereagh Highway) via both open cut and highwall mining methods to access an additional resource of approximately 25 Mt ROM; and
  - The continuation of mining operations at Invincible Colliery including an extension north into the East Tyldesley area via open cut and highwall mining methods to access an additional resource of approximately 45 Mt ROM;
- Continuation of coal supply to the local Mount Piper Power Station (MPPS) via a dedicated coal conveyor over the Castlereagh Highway (to be constructed), and (emergency supply to) Wallerawang Power Station, with flexibility for supply to additional domestic destinations and Port Kembla for export;
- Upgrades to existing administration, transport and other infrastructure;
- Construction and operation of additional Offices at Cullen Valley Mine;
- Construction and use of the previously approved Coal De-shaling preparation Plant (CDP) at Cullen Valley Mine;
- Construction and use of a bridge over the Castlereagh Highway to link operations east and west of the highway and the development of required access roads to the East Tyldesley area;
- Construction and operation of a bridge and haul road across the Wallerawang - Gwabegar Railway line to permit access to mine the previously approved Hillcroft resource;
- The extraction of the Marangaroo Sandstone horizon from immediately below the Lithgow Coal Seam in the northern coal mining area of Cullen Valley Mine. This material will to be trucked for crushing on site prior to sale into the Sydney (and surrounds) industrial sand market;
- Construction of a rail siding and associated infrastructure to permit transport of product coal and sand products;
- Integration of the water management of both sites into a single system; and
- Integration of the management of mine rehabilitation and conceptual final landform outcomes for Cullen Valley Mine and Invincible Colliery.

4 AIR QUALITY CRITERIA

The Project will result in emissions of dust and particulate matter from the surface mining activities and associated coal handing and processing.

Emissions of carbon monoxide (CO), nitrogen dioxide (NO_2), and sulphur dioxide (SO_2) will occur from diesel-powered equipment used on-site; however these emissions are typically minor and too widely dispersed to give rise to significant off-site concentrations.

4.1 Assessment criteria - Particulate matter

Emissions of particulate matter are considered in three separate size fractions. These are described as total suspended particulate matter (TSP), particulate matter with an equivalent aerodynamic diameter of 10 μm or less (PM_{10}) and particles with an equivalent aerodynamic diameter of 2.5 μm and less ($PM_{2.5}$).

Particulate matter has the capacity to affect health and to cause nuisance effects. The extent to which health or nuisance effects occur relates to the size and/or chemical composition of the particulate matter.

This section provides information on the air quality criteria used to assess the impact of emissions. The assessment criteria provide benchmarks, which if met, are intended to protect the community against the adverse effects of air pollutants. These criteria are generally considered to reflect current Australian community standards for the protection of health and protection against nuisance effects. To assist in interpreting the significance of predicted concentration and deposition levels some background discussion on the potential harmful effects is provided below.

The human respiratory system has in-built defensive systems that prevent particles larger than approximately 10 μm from reaching the more sensitive parts of the respiratory system. Particles with aerodynamic diameters less than 10 μm are referred to as PM_{10}. Particles larger than 10 μm, while not able to affect health, can be deposited on materials and generally degrade aesthetic elements of the environment. For this reason, air quality goals make reference to measures of the total mass of all particles suspended in the air. This is referred to as TSP. In practice, particles larger than 30 to 50 μm settle out of the atmosphere too quickly to be regarded as air pollutants. The upper size range for TSP is usually taken to be 30 μm and includes PM_{10} as a subset.

The health-based assessment criteria used by DECCW have, to a large extent, been developed by reference to epidemiological studies undertaken in urban areas with large populations where the primary pollutants are the products of combustion. This means that, in contrast to dust of crustal[1] origin, the particulate matter would be composed of smaller particles and would generally contain acidic and carcinogenic substances that are associated with combustion.

The Director-General's Requirements (DGR's) for the Project require an assessment of the potential impacts of the project, taking into consideration any relevant guidelines. The DGR's list the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, **NSW DEC (2005)** as applicable guidelines. **Table 4.1** and **Table 4.2** include the air quality criteria from the DECCW guideline that are relevant to this study.

[1] The term crustal dust is used to refer to dust generated from materials that constitute the earth's crust.

Table 4.1: Air quality criteria/ standards for particulate matter concentrations

Pollutant	Criterion/Standard	Averaging Period	Source
TSP	90 µg/m^3	Annual mean	NHMRC
PM_{10}	50 µg/m^3	24-hour average	NSW DEC (**2005**) (impact assessment criteria) NEPM (ambient air quality standard, allows five exceedances per year, e.g. for bushfires and dust storms)
	30 µg/m^3	Annual mean	NSW DEC (**2005**) (impact assessment criteria)

4.2 Assessment criteria - Dust deposition

In addition to health impacts, airborne dust also has the potential to cause nuisance effects by depositing on surfaces. **Table 4.2** shows the maximum acceptable increase in dust deposition over the existing dust levels from an amenity perspective. These criteria for dust fallout levels are set to protect against nuisance impacts (**NSW DEC, 2005**).

Table 4.2: DECCW criteria for dust (insoluble solids) fallout

Pollutant	Averaging period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited dust	Annual	2 g/m^2/month*	4 g/m^2/month

* grams per square metre per month

4.3 Recent Project Approval conditions

Recent Department of Planning (DoP) Project Approval Conditions are relevant to managing an operating project, and it is appropriate to consider these in the overall assessment of mitigation and management options for a proposed project. Recent conditions include the criteria summarised in **Table 4.3** and **Table 4.4**.

Table 4.3: Air quality assessment criteria

Pollutant	Criterion	Averaging Period	Application
TSP	90 µg/m^3	Annual mean	Total impact
PM_{10}	50 µg/m^3	24-hour average	Total impact
	30 µg/m^3	Annual mean	Total impact
Deposited dust	2 g/m^2/month	Annual mean	Incremental impact
	4 g/m^2/month	Annual mean	Total impact

Table 4.4: Air quality acquisition criteria

Pollutant	Criterion	Averaging Period	Application
TSP	90 µg/m^3	Annual mean	Total impact
PM_{10}	150 µg/m^3	24-hour average	Total impact
	50 µg/m^3	24-hour average	Incremental impact
	30 µg/m^3	Annual mean	Total impact
Deposited dust	2 g/m^2/month	Annual mean	Incremental impact
	4 g/m^2/month	Annual mean	Total impact

The criteria for TSP and PM_{10} in recent DoP Project Approval Conditions exclude all extraordinary events such as bushfires and dust storms. Total impact includes the impact of a project and all other sources, whilst incremental impact refers to the impact of the project considered in isolation.

4.3.1 Further Comments

In May 2003, NEPC released a variation to the NEPM (**NEPC, 2003**) to include advisory reporting standards for $PM_{2.5}$. The advisory reporting standards for $PM_{2.5}$ are a maximum 24-hour average of 25 µg/m^3 and an annual average of 8 µg/m^3. However, there is no time line for compliance. The goal was to gather sufficient data nationally to facilitate the review of the Air Quality NEPM which is currently underway. The variation includes a protocol setting out monitoring and reporting requirements for particles as $PM_{2.5}$.

At this stage, the advisory reporting $PM_{2.5}$ standards are not part of the NSW DECCW assessment criteria and while predictions have been made as to the likely contribution that emissions from the Project would make to ambient $PM_{2.5}$ concentrations, these predictions have not been used to assess impacts against the proposed advisory standard.

5 APPROACH TO ASSESSMENT

The air dispersion modelling conducted for this assessment is based on an advanced modelling system using the models TAPM and CALMET/CALPUFF (see **Figure 5.1**). This system substantially overcomes the basic limitations of the steady-state Gaussian plume models such as AUSPLUME and ISCMod.

The modelling system works as follows:

- TAPM is a prognostic meteorological model that generates gridded three-dimensional meteorological data for each hour of the model run period.
- CALMET, the meteorological pre-processor for the dispersion model CALPUFF, calculates fine resolution three-dimensional meteorological data based upon observed ground and upper level meteorological data, as well as observed or modelled upper air data generated for example by TAPM.
- CALPUFF then calculates the dispersion of plumes within this three-dimensional meteorological field.

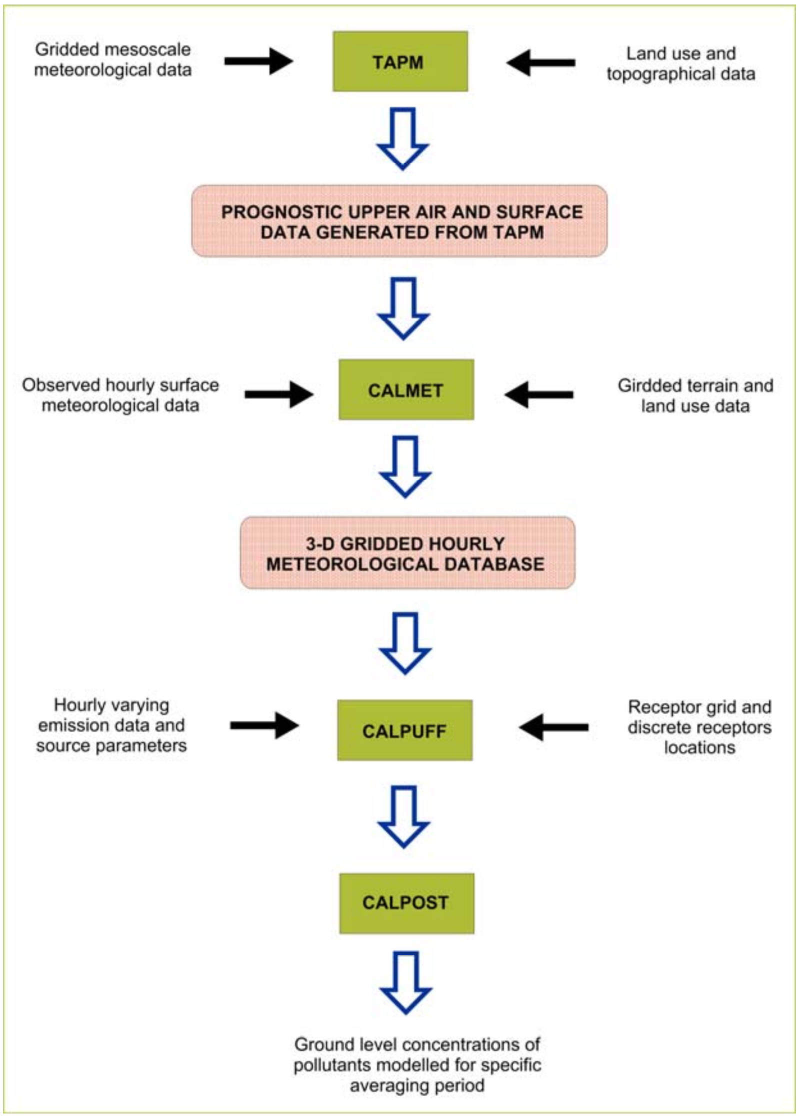

Figure 5.1: Modelling methodology used in this study

5.1 TAPM

The Air Pollution Model, or TAPM, is a three dimensional meteorological and air pollution model developed by the CSIRO Division of Atmospheric Research. Detailed description of the TAPM model and its performance is provided elsewhere. The Technical Paper by **Hurley (2005)** describes technical details of the model equations, parameterisations, and numerical methods. A summary of some verification studies using TAPM is also given in **Hurley *et al*. (2005)**.

TAPM solves the fundamental fluid dynamics and scalar transport equations to predict meteorology and (potentially) pollutant concentrations. It consists of coupled prognostic meteorological and air pollution concentration components. The model predicts airflow important to local scale air pollution, such as sea breezes and terrain induced flows, against a background of larger scale meteorology provided by synoptic analyses.

Upper air data were generated over the Project area using TAPM. The TAPM-generated data and observed surface meteorological data were then entered into the CALMET diagnostic meteorological model, which is discussed below.

5.2 CALMET

CALMET is a meteorological pre-processor that includes a wind field generator containing objective analysis and parameterised treatments of slope flows, terrain effects and terrain blocking effects. The pre-processor produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables to produce the three-dimensional meteorological fields that are used in the CALPUFF dispersion model.

The hourly TAPM-generated data and observed data for the period of analysis were used as input to the CALMET pre-processor to create a fine resolution, three-dimensional meteorological field for input into the dispersion model. CALMET uses the meteorological inputs in combination with land use and geophysical information for the modelling domain to predict girded meteorological fields for the region.

Terrain data has been sourced from the Shuttle Terrain Mission dataset. The spatial resolution of these data is 100 m.

Hourly surface meteorological data from the following surface meteorological stations were input into CALMET for 2009 and are as follows:

- The Cullen Valley Mine meteorological station (part of the Coalpac monitoring network);
- The Invincible Colliery meteorological station (part of the Coalpac monitoring network);
- MPPS meteorological station (approximately 5 km south of the Project);
- Bureau of Meteorology (BoM) Bathurst Airport meteorological station (approximately 38 km southwest of the Project); and
- BoM Mount Boyce meteorological station (approximately 44 km southeast of the Project).

The BoM surface stations (required for cloud cover) are up to 45 km from the site. To use these observed data for the generation of meteorological data files a large computational grid domain is required. However, due to computational limitations, a coarse resolution would then be needed which may result in neglecting local terrain effects.

To overcome this problem, CALMET was run in two stages. The first stage was to run the model over a large domain (75 km by 67.5 km) with a coarse resolution (1.5 km) using the observations from the five surface meteorological stations listed above with any gaps in the data (relative humidity and pressure) supplied by TAPM. The second stage involved using the output from stage one as input for CALMET over a much smaller domain (20 km by 20 km) and finer resolution (100 m) with the Project at the centre. This finer resolution domain allowed any effects due to local terrain to be captured.

The finer resolution CALMET domain was then run for each mine location in each year in order to capture the specific terrain effects (e.g. pit terrain) in each proposed operational year.

Table 5.1 summarises the inputs used for both the TAPM and CALMET models.

Table 5.1: Meteorological Parameters used for TAPM and CALMET

TAPM (v 4.0.4)	
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Number of grid points	25 x 25 x 25
Year of analysis	2009
Centre of analysis	Coalpac Project (33°16' S, 150°2' E)
CALMET (v. 6.327)	
Meteorological grid domain	20 km x 20 km (fine resolution)
Meteorological grid resolution	0.1 km (fine resolution)
Surface meteorological stations	Cullen Valley Meteorological Station - Wind speed - Wind direction - Temperature - Relative humidity Invincible Meteorological Station - Wind speed - Wind direction - Temperature - Relative humidity Mount Piper Meteorological Station - Wind speed - Wind direction - Temperature - Relative humidity Bathurst Airport AWS (Bureau of Meteorology, Station No. 063291) - Wind speed - Wind direction - Temperature - Relative humidity - Cloud Amount - Cloud Height Mount Boyce AWS (Bureau of Meteorology, Station No. 063292) - Wind speed - Wind direction - Temperature - Relative humidity - Cloud Amount - Cloud Height TAPM - Wind speed - Wind direction - Temperature - Relative humidity - Cloud Amount - Cloud Height - Sea Level Pressure
Upper air	Data extracted from TAPM

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5.3 CALPUFF

CALPUFF (**Scire *et al.,* 2000a**) is a multi-layer, multi-species, non-steady state puff dispersion model that can simulate the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal. The model contains algorithms for near-source effects such as building downwash, partial plume penetration, sub-grid scale interactions as well as longer-range effects such as pollutant removal, chemical transformation, vertical wind shear and coastal interaction effects. The model employs dispersion equations based on a Gaussian distribution of pollutants across the puff and takes into account the complex arrangement of emissions from point, area, volume, and line sources.

As with any air dispersion model, CALPUFF requires inputs in three major areas:

- Meteorology;
- Emission rates and source details; and
- Terrain and geophysical data (terrain, land use), as well as specification of specific receptor locations.

CALPUFF is endorsed by the US EPA, and has been used in many studies in New South Wales, Queensland and other parts of Australia. CALPUFF is approved by the NSW DECCW where non-steady conditions can be expected (e.g. where complex terrain exists).

6 EXISTING ENVIRONMENT

This section outlines the meteorological conditions measured at two weather station locations in the Project area, and the more detailed CALMET meteorological modelling conducted to account for the variability anticipated due to the complex local terrain features in the area. A comparison of the measured and CALMET (modelled) data is also provided.

6.1 Dispersion Meteorology

6.1.1 Measured weather conditions

Figure 6.1 presents annual and seasonal windroses for the meteorological stations at Cullen Valley Mine and Invincible Colliery. The locations of these sites are shown on **Figure 6.2**.

Wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points – north, north-northeast, northeast, etc. The bar at the top of each wind rose diagram represents winds blowing from the north (i.e. northerly winds), and so on. The length of the bar represents the frequency of occurrence of winds from that direction, and the widths of the bar sections correspond to wind speed categories, the narrowest representing the lightest winds.

On an annual basis, **Figure 6.1** shows a prominent westerly and easterly pattern of winds at the Cullen Valley site. Winds from the eastern quadrant are more prominent in summer and autumn and winds from the north are also more prominent in summer and spring. Winds from the western quadrant are predominant in winter and spring. On an annual basis, the percentage of calms is 41.2%. This is an unusually high level of calms especially when compared to the annual level of calms (14.3%) at the Invincible Colliery meteorological station (also shown **Figure 6.1**). An explanation for this could be the location of the Cullen Valley meteorological station in the proximity of elevated terrain to the east potentially causing winds from the east to slow down around the terrain before reaching the meteorological station.

On an annual basis **Figure 6.1** shows prominent winds from the southwest and northeast directions at the Invincible Colliery site. The summer and autumn windroses show a higher percentage of winds from the northwest sector whereas the winter windrose shows a higher percentage of winds from the southwest sector. The spring windrose shows a very similar pattern to the annual windrose. On an annual basis, the percentage of calms is 12.9%. This meteorological station is located at the southern end of a valley and is in the proximity of elevated terrain to the west. This may explain the relatively high percentage of calms on an annual basis.

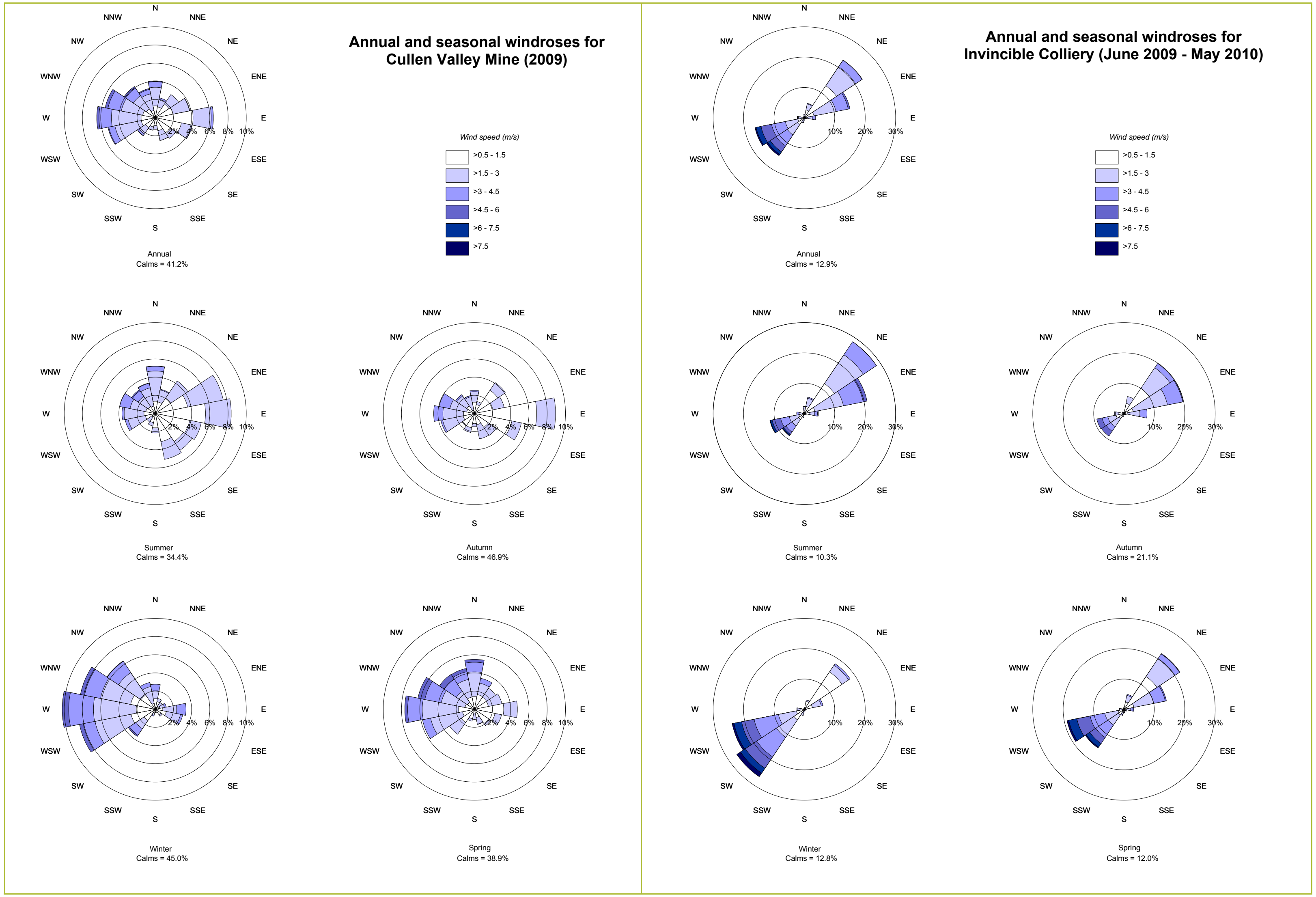


Figure 6.1: Annual and seasonal windroses for the Cullen Valley Mine and Invincible Colliery meteorological stations

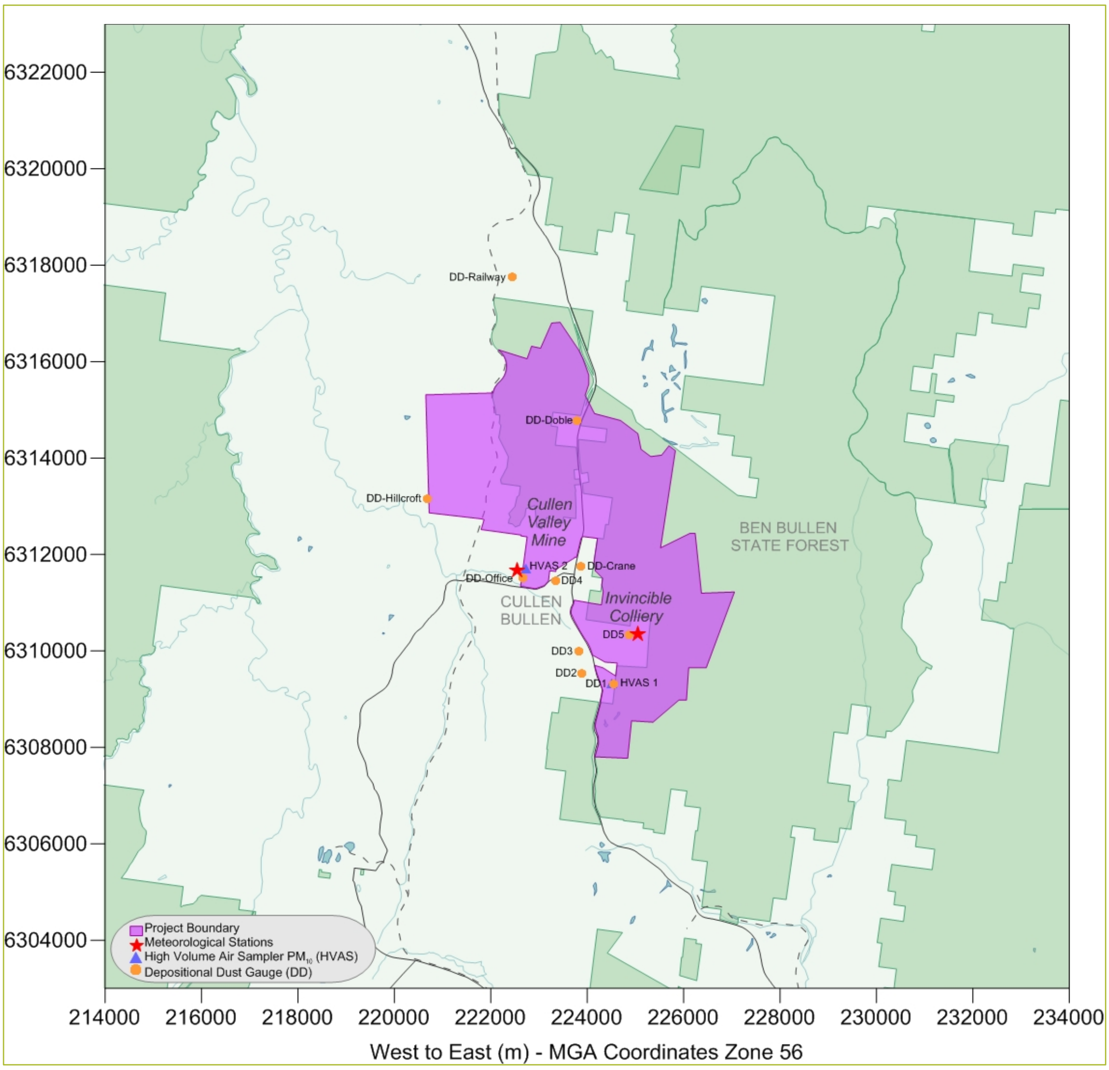


Figure 6.2: Location of Cullen Valley Mine and Invincible Colliery meteorological station together with the Coalpac monitoring network

6.2 CALMET modelled weather conditions

Figure 6.4 presents the annual and seasonal windroses made from CALMET indicative of each mining location.

CALMET was run for each mining area for the Project (i.e. Invincible Colliery, East Tyldesley, Cullen Valley and Hillcroft) and for each modelled scenario in order to account for the different terrain (due to mining) in each assessed year. Points at each mine site have been extracted for one operational scenario in order to provide an indication of wind patterns at that site and therefore, the CALMET windroses are provided for illustrative purposes (e.g. to show effects of local terrain at each point) and are not directly comparable with the meteorological data collected at the Cullen Valley and Invincible Colliery sites as shown in **Figure 6.1**.

Figure 6.3 shows the location of the mine areas extracted for CALMET (presented as windroses in **Figure 6.4**), the location of the on-site meteorological stations as well as the terrain around the site.

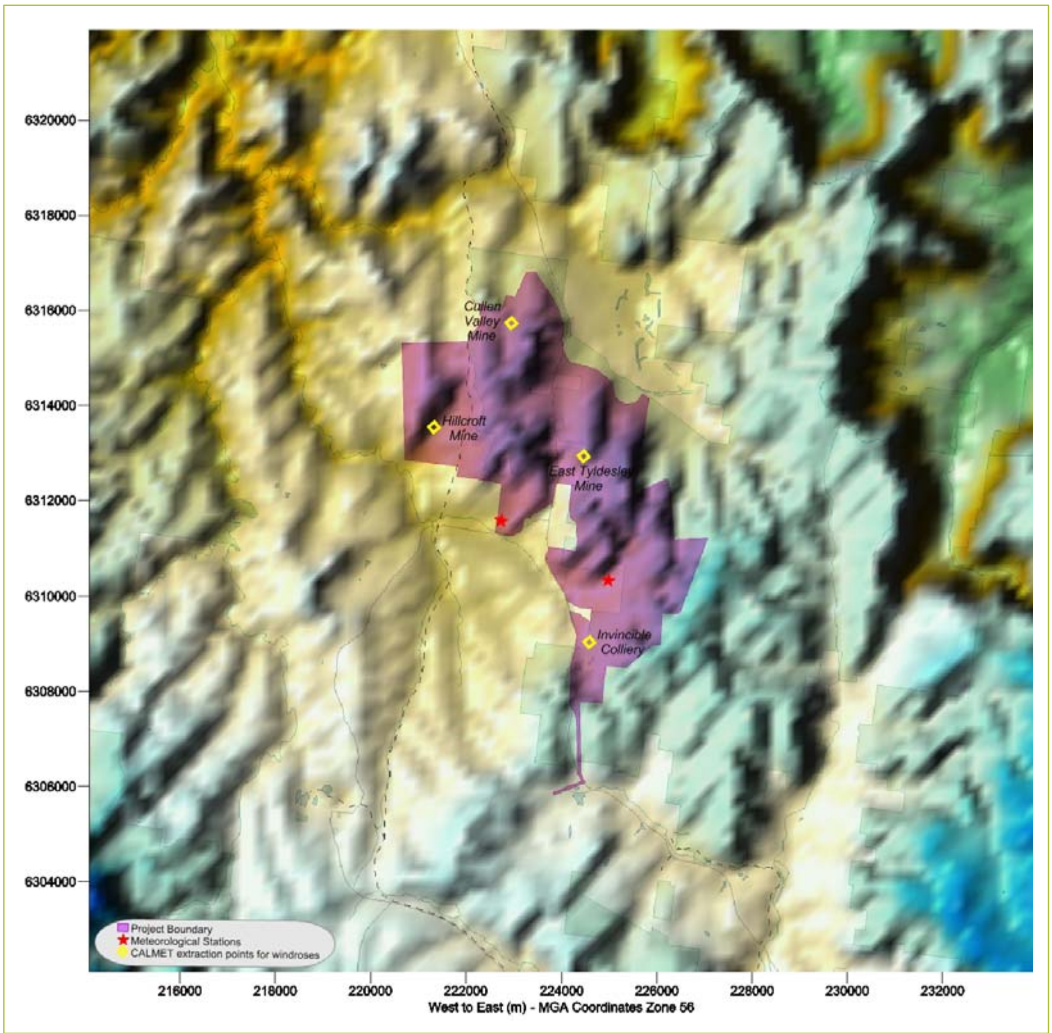


Figure 6.3: Location of CALMET extraction points, meteorological stations and terrain

Figure 6.4 shows a similar pattern of winds between the four modelled mining areas, with prominent winds from the western and eastern quadrants. Windroses for the Hillcroft, Cullen Valley and East Tyldesley mining areas are more similar to each other than the Invincible windrose in that they show a higher prominence of winds from the east in summer and autumn and a higher percentage of winds from the west in winter. For all three sites, the spring windrose is most similar to the annual windrose. The percentages of annual calms for the three sites are also similar and are 3.7% and 4%.

The CALMET windrose made for the Invincible mining area is less similar to that of the other three mine sites. On an annual basis, the prominent winds from the west and east still exist however; there are fewer winds from the north western and northern sectors. Winds from the east are still shown to be prominent in summer and autumn and winds from the west are prominent in winter. As with the other mining areas, the spring windrose is most similar to the annual windrose. The annual percentage of calms is 2.8% which is slightly less than that of the other sites.

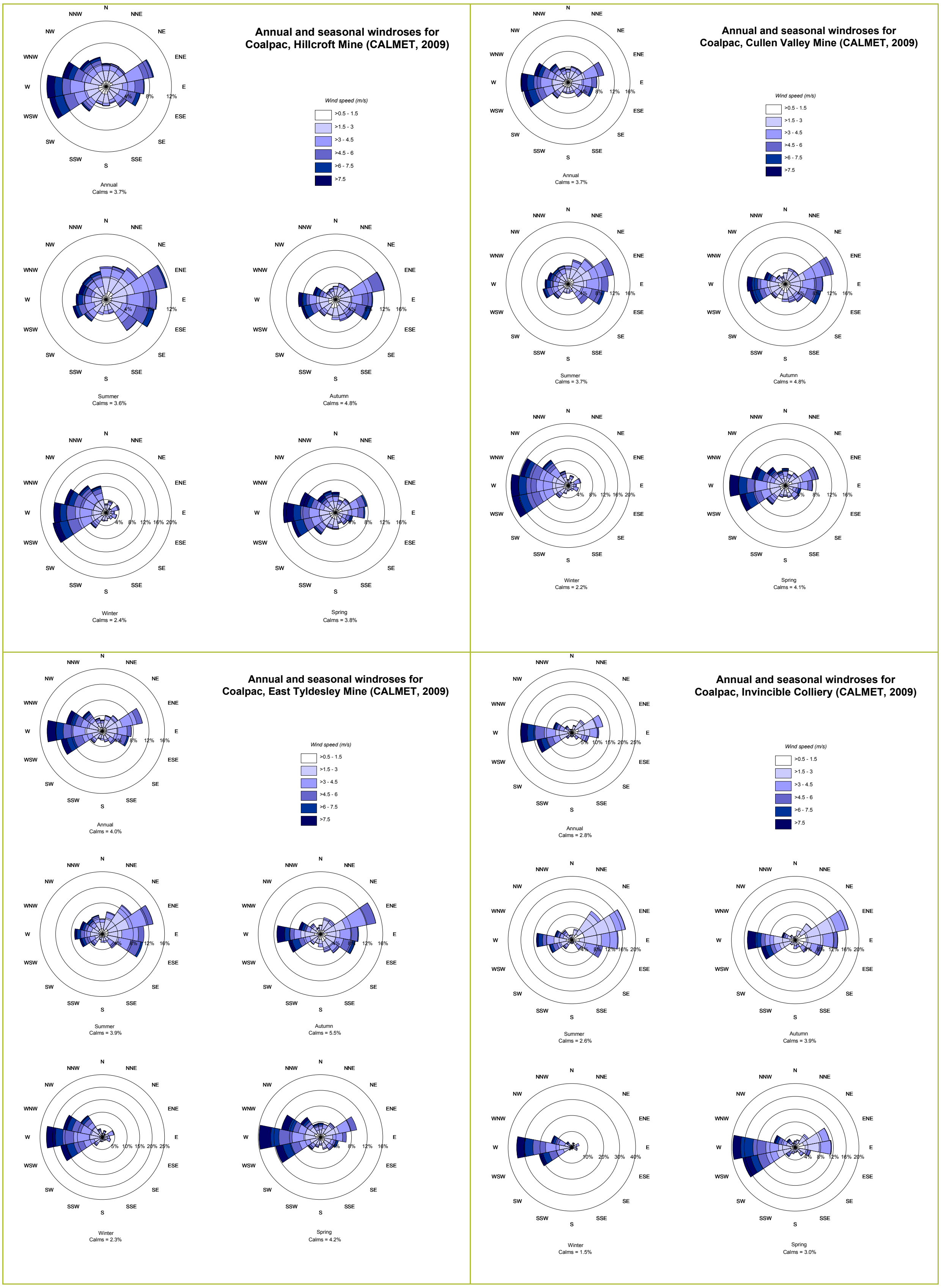


Figure 6.4: Annual and seasonal windroses for (indicative) Hillcroft, Cullen Valley, East Tyldesley and Invincible Mine locations (2009) Stability

6.3 Comparison of the measured meteorological and CALMET data

Figure 6.1 shows that the Cullen Valley site windroses from measured meteorological data is a very similar annual pattern to the Cullen Valley CALMET windrose shown in **Figure 6.4** with prominent winds from the western and easterly quadrants. **Figure 6.4** however, shows a higher percentage of winds from the north on an annual basis. Winds from the west are also most prominent in the CALMET data. On an annual basis, the percentage of calms in the CALMET data is 3.7% compared with 41.2% in the Cullen Valley meteorological station data. A potential reason for this would be the location of the metrological station in proximity to complex terrain to the east.

The Invincible site windroses shown in **Figure 6.1** have been compiled from data collected between June 2009 and May 2010 as data for all of 2009 was not available. Therefore, this windrose is presented to show the general pattern in the area only. The Invincible meteorological station windroses are less similar to the CALMET data than at the Cullen Valley location. It is clear that the Invincible meteorological station data shows more prominent winds from the west south-west and north east sectors. However, while this may be true, as these winds are still evident in the CALMET dataset, more prominent winds are seen from the west. The reason for this difference is most likely that the Invincible station is located at the southern end of a valley surrounded by elevated terrain causing higher wind flow patterns from the north east and west south-west. The CALMET windrose shown in **Figure 6.4** is representative of the mine location and therefore modelled differing terrain. The general overall pattern for this mine location is similar with prominent winds from the north eastern sector in summer and autumn and prominent winds from the south western sector in winter. On an annual basis, the percentage of calms in the CALMET data is 2.8% compared with 12.9% in the Invincible Colliery meteorological station data. A potential reason for this would be the location of the meteorological station in proximity to complex terrain to the west.

6.4 Analysis of meteorological conditions for the CALMET data

6.4.1 Wind Speed

The frequency distribution of hourly averaged wind speed values at each of the four Project mining areas is shown as a graph in **Figure 6.5**. For the purposes of this wind speed analysis, the Cullen Valley mining area was modelled as two separate locations, including the Hillcroft area to the west of the Wallerawang – Gwabegar railway line and the Cullen Valley area further north to the east of the railway line.

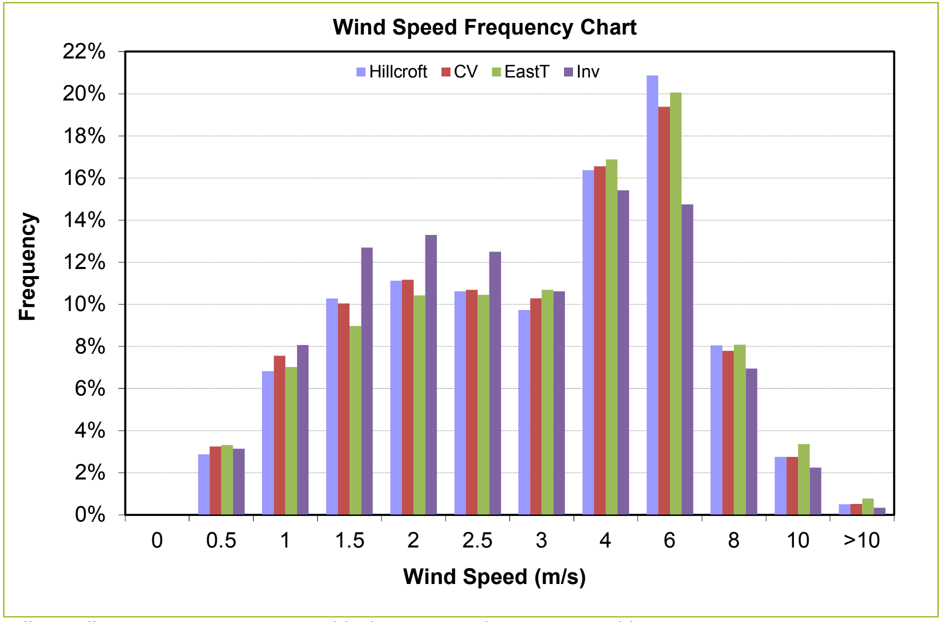
Figure 6.5 illustrates a typical analysis of the wind speed distributions for the four mining locations at one time. Although it is used for illustrative purposes, **Figure 6.5**, provides an indication of the relative wind speed distribution at each Project mining area. The figure indicates a similar distribution of wind speeds at each of the modelled locations, with the Invincible site showing somewhat greater occurrence of low winds between 1.5 and 2.5 m/s and somewhat lower occurrence of wind speeds around 6 m/s.

Light wind speeds (≤ 2 m/s) at the Hillcroft location occur approximately 31% of the time. At the Cullen Valley location light wind speeds occur approximately 32% of the time and at the East Tyldesley and Invincible locations light wind speeds occur approximately 30 and 37% of the time, respectively.

Stronger winds (≥ 6 m/s) at the Hillcroft and Cullen Valley locations occur approximately 11% of the time. At the East Tyldesley location strong winds occur approximately 12% of the time and at the Invincible location they occur approximately 10% of the time.

The annual average wind speed for the Hillcroft and Cullen Valley locations is estimated to be approximately 3.3 m/s. At the East Tyldesley location the annual average wind speed is approximately 3.4 m/s and at the Invincible location the annual average wind speed is approximately 3 m/s.

On an annual basis, calm wind speeds (<0.5 m/s) occur 3.7% of the time at the Hillcroft and Cullen Valley locations. At the East Tyldesley location, calms occur 4% of the time and at the Invincible location calms occur 2.8% of the time.



N.B: CV = Cullen Valley Mine, EastT = East Tyldesley Mine and Inv = Invincible Mine

Figure 6.5: Wind speed distribution for each indicative mine location (2009)

6.4.2 Stability Class

Atmospheric turbulence is an important factor in plume dispersion. Turbulence acts to increase the cross-sectional area of the plume due to random motions, thus diluting or diffusing a plume. As turbulence increases, the rate of plume dilution or diffusion increases. Weak turbulence limits plume diffusion and is a critical factor in causing high plume concentrations downwind of a source, particularly when combined with very low wind speeds.

Turbulence is related to the vertical temperature gradient, which determines what is known as stability, or thermal stability. For traditional dispersion modelling using Gaussian plume models, categories of atmospheric stability are used in conjunction with other meteorological data to describe atmospheric conditions and thus dispersion. The most well-known stability classification is the Pasquill-Gifford scheme, which denotes stability classes from A to F.

Class A is described as highly unstable and occurs in association with strong surface heating and light winds, leading to intense convective turbulence and much enhanced plume dilution. At the other extreme, class F denotes very stable conditions associated with strong temperature inversions and light winds, which commonly occur under clear skies at night and in the early morning. Under these conditions plumes can remain relatively undiluted for considerable distances downwind and therefore concentrations at receptors can be high.

Intermediate stability classes grade from moderately unstable (B), through neutral (D) to slightly stable (E). Whilst classes A and F are strongly associated with clear skies, class D is associated with windy and/or cloudy weather.

As a general rule, unstable (or convective) conditions dominate during the daytime and stable flows are dominant at night. This diurnal pattern is most pronounced when there is relatively little cloud cover and light to moderate winds.

The frequency distribution of estimated stability classes in the meteorological files for the four indicative mining areas is presented in **Table 6.1**.

The most common stability class in the area was determined to be stable F class stability which occurs between 30% and 33.9% of the time. This represents poor dispersion for a significant proportion of the time. D class stability also occurs between 22.5% and 25.9% which would suggest that dispersion conditions would be such that dust emissions would disperse rapidly also for a significant proportion of the time.

Table 6.1: Estimated stability class distribution

Stability Class	% Frequency of Occurrence			
	Hillcroft	Cullen Valley	East Tyldesley	Invincible
A	2.9%	3.4%	3.3%	4.1%
B	14.3%	14.4%	14.1%	15.2%
C	15.0%	14.9%	14.9%	15.0%
D	25.0%	24.6%	25.9%	22.5%
E	11.6%	11.2%	11.7%	9.3%
F	31.1%	31.4%	30.0%	33.9%

6.4.3 Mixing Height

Mixing height is the height to which the air is mixed by turbulence and is variable in space and time. It typically increases during fair-weather daytime over land from tens to hundreds of metres around sunrise up to one to four kilometres in the mid-afternoon, depending on the location, season and day-to-day weather conditions.

The frequency of mixing heights in the meteorological datasets developed for this study is shown in **Figure 6.6**.

Average mixing heights during the night and early morning hours are generally lower than 300 m, increasing after sunrise to an average maximum of just over 3,000 m by mid-afternoon in response to convective mixing from solar heating of the earth’s surface. The relatively rapid decrease in mixing height around the time of sunset can be clearly seen.

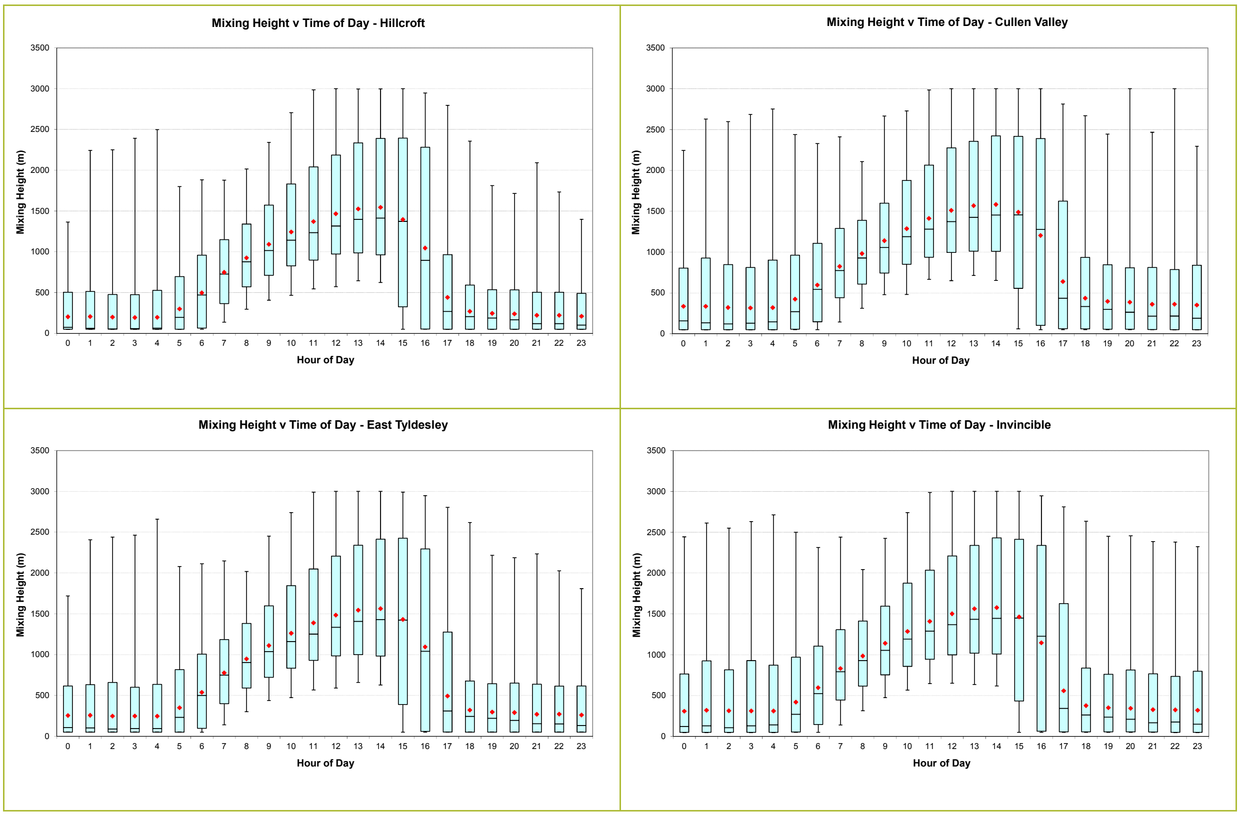


Figure 6.6: Hourly mixing height statistics

6.5 Local Climatic Conditions

The BoM collects climatic information in the vicinity of the study area. A range of climatic information collected from Lithgow (Birdwood St) (located approximately 27 km from the Project) are presented in **Table 6.2** (**BoM, 2010**). Temperature and humidity data consist of monthly averages of 9 am and 3 pm readings. Also presented are monthly averages of maximum and minimum temperatures. Rainfall data consist of mean monthly rainfall and the average number of rain days per month.

The annual average maximum and minimum temperatures experienced at Lithgow are 18.2°C and 6.4°C respectively. On average January is the hottest month, with an average maximum temperature of 25.5°C. July is the coldest month, with average minimum temperature of 0.7°C.

The annual average relative humidity reading collected at 9 am from the Lithgow site is 70% and at 3 pm the annual average is 58%. The month with the highest relative humidity on average is June with a 9 am average of 82%. The month with the lowest relative humidity is December with a 3 pm average of 50%.

Rainfall data collected at Lithgow shows that January is the wettest month, with an average rainfall of 94.3 mm over 8.3 rain days. The average annual rainfall is 858.5 mm with an average of 95.8 rain days.

Table 6.2: Climate Information for Lithgow (Braidwood St)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
9 am Mean Dry-bulb and Wet-bulb Temperatures (°C)[1] and Relative Humidity (%)													
Dry-bulb	18.7	17.8	15.8	12.4	8.5	5.6	4.7	6.4	10.0	13.5	15.7	18.1	12.3
Humidity	64	70	73	76	81	82	79	73	64	60	60	61	70
3 pm Mean Dry-bulb and Wet-bulb Temperatures (°C)[1] and Relative Humidity (%)													
Dry-bulb	23.9	22.9	20.8	17.4	13.3	10.0	9.3	10.8	13.7	17.0	19.7	22.7	16.8
Humidity	54	58	60	59	66	67	66	56	54	51	53	50	58
Mean Maximum Temperature (°C)[1]													
Mean	25.5	24.7	22.4	18.4	14.3	11.1	10.4	12.0	15.4	18.7	21.5	24.5	18.2
Mean Minimum Temperature (°C)[1]													
Mean	11.9	12.1	10.1	6.7	3.9	1.8	0.7	1.3	3.4	6.0	8.1	10.4	6.4
Rainfall (mm)[2]													
Mean	94.3	83.8	83.9	62.7	63.0	67.6	67.6	63.4	58.9	67.7	70.0	76.1	858.5
Raindays (Number)													
Mean	8.3	7.6	8.4	7.0	7.6	8.8	8.4	8.3	7.9	8.2	7.7	7.6	95.8

Source: ***BOM (2010)***
[1] °C = degrees Celsius
[2] mm = millimetres
Climate averages for Station: 063224; Commenced: 1889, Last record: 2006; Latitude: 33.49 °S; Longitude: 150.15 °E.

6.6 Dust

6.6.1 Introduction

Air quality standards and criteria refer to pollutant levels that include the contribution from specific projects and existing sources of dust. To assess impacts against all the relevant air quality standards and criteria (see **Section 4**) it is necessary to have information or estimates on existing dust concentration and deposition levels in the area in which the Project is likely to contribute to these levels. It is important to note that the existing air quality conditions (that is, background conditions) will be influenced by the existing mining operations in the area.

An air quality monitoring program was established in 2004 to monitor dust deposition and dust concentration (as PM_{10}) in the vicinity of the Project. The locations of the current monitoring sites in place for existing Coalpac operations are shown on **Figure 6.2** and include:

- Two High Volume Air Samplers (HVAS) monitoring PM_{10} (one at Cullen Valley Mine and one at Invincible Colliery); and
- 11 dust deposition gauges (five for Cullen Valley Mine and six for Invincible Colliery).

The following sections provide an analysis and summary of the dust monitoring data. The complete data set is also shown in **Appendix B**.

6.6.2 PM_{10} Concentrations

Figure 6.2 shows the location of the Cullen Valley HVAS and Invincible HVAS used to monitor PM_{10} concentrations in the area. Both monitors are located within the existing mining lease boundaries held by Coalpac and within close proximity to sensitive receptors. The Project Boundary is predominantly grassland, with surrounding escarpments within the Ben Bullen State Forest densely vegetated.

It is important to note that the HVAS monitor measures particulate matter from the approved mines in addition to non-mining sources. Non-mining sources of particulate matter in the area would include traffic on unsealed roads, local activities, animal grazing associated with farming activities and to a lesser extent traffic from the other local roads and other sources such as bushfires.

PM_{10} concentration measurements from the Cullen Valley and Invincible HVASs have been made available from February 2008 to July 2010. The 24-hour average PM_{10} concentration measurements and the rolling annual average PM_{10} concentration are shown in **Figure 6.7**.

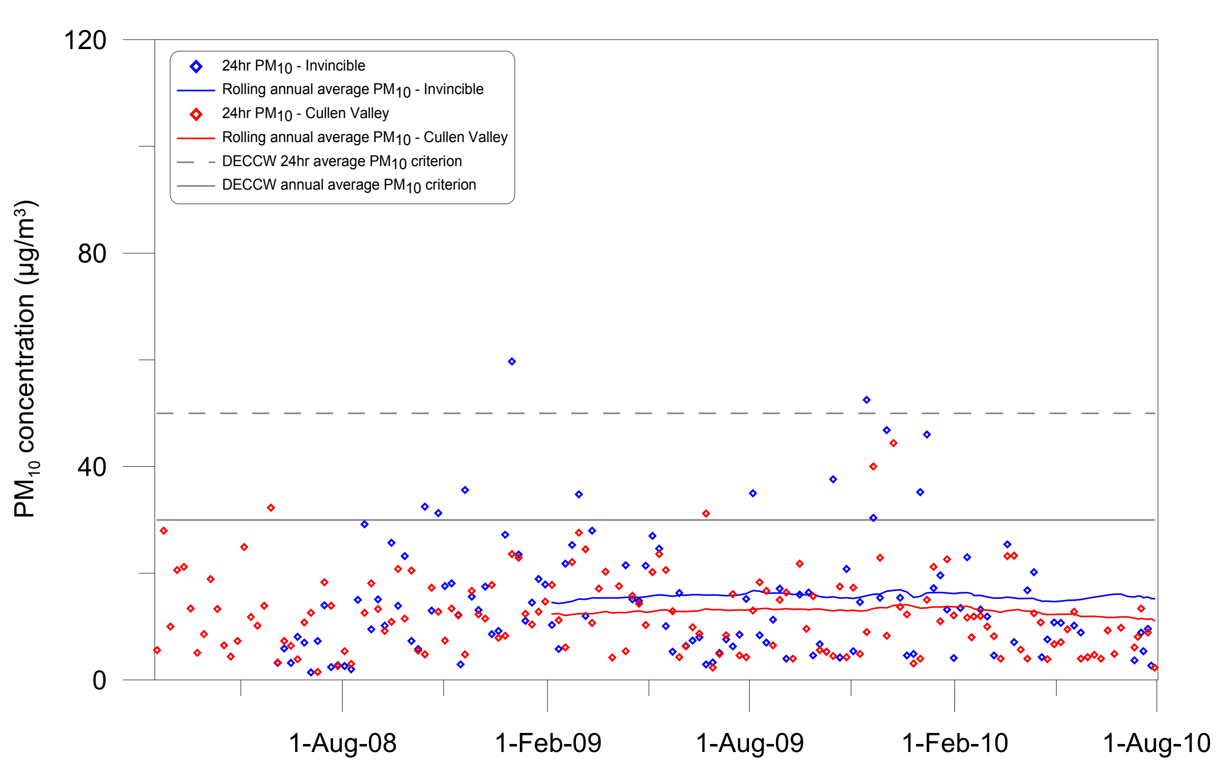


Figure 6.7: HVAS PM_{10} Concentrations

It can be seen from **Figure 6.7** that there are two occasions where the 24-hour average PM_{10} concentration has recorded a level above the DECCW criterion of 50 µg/m^3. Both of these elevated concentrations were measured at the Invincible Mine HVAS.

It should be noted that during this monitoring period, a number of anomalous events such as severe dust storms and also bushfires occurred. These events have been removed from the dataset as per the information on the BoM website. The two values above the 50 µg/m^3 as in **Figure 6.7** are not known to results from a regional event reported by BoM but may be caused by a local dust generating event. For reference, these anomalous days are included in the full dataset provided in **Appendix B**.

Table 6.3 provides a summary of the PM_{10} concentration data presented in **Figure 6.7**.

Table 6.3: Annual average PM_{10} concentration at each HVAS monitoring site (µg/m^3)

HVAS (PM_{10}) Site	2008	2009	2010	Average
HVAS1 (Inv)	13.0	15.2	13.3	13.8
HVAS2 (CV)	12.0	13.3	9.8	11.7
Average of all data				**12.8**

Both **Figure 6.7** and **Table 6.3** show that the annual average PM_{10} concentrations at both sites are well below the DECCW criterion of 30 µg/m^3.

6.6.3 TSP Concentrations

No TSP concentration data are available in the vicinity of the Project. However, annual average total suspended particulate (TSP) concentrations can be estimated from the PM_{10} measurements by assuming that 40% of the TSP is PM_{10}. This relationship was obtained from data collected by co-located TSP and PM_{10} monitors operated for long periods of time in the Hunter Valley (**NSW Minerals Council, 2000**).

Use of this relationship indicates that the annual average TSP concentration is approximately 32 µg/m^3 which is well below the DECCW assessment criterion of 90 µg/m^3.

6.6.4 Dust Deposition

Figure 6.2 shows the locations of the 11 dust deposition gauges that are a part of the Project's air quality monitoring network. A number of these gauges are located within the Project Boundary, or on adjoining Coalpac owned land.

Data have been made available from June 2008 to August 2010. The monthly data are presented in **Appendix B**, and the annual averages for each dust gauge summarised in **Table 6.4**.

Table 6.4: Dust deposition data (insoluble solids) – 2008 to 2010 (g/m^2/month)

Dust Deposition Gauge	2008	2009	2010	Average
DM1 (Inv)	1.2	1.5	1.4	1.4
DM2 (Inv)	0.6	1.1	0.9	0.9
DM3 (Inv)	0.7	1.4	0.9	1.0
DM4 (Inv)	0.7	1.2	0.6	0.8
DM5 (Inv)	0.8	1.5	1.2	1.2
DM6 (Inv)	0.7	1.2	-	1.0
DM Doble (CV)	1.1	1.1	0.5	0.9
DM Crane (CV)	0.7	1.2	0.5	0.8
DM Office (CV)	0.8	1.3	0.7	0.9
DM Hillcroft (CV)	0.7	1.2	0.5	0.8
DM Railway (CV)	1.0	1.4	0.7	1.1
Average of all data				**1.0**

These results show that, at all dust gauge monitoring locations the annual average dust deposition levels are well below the DECCW criterion of 4 g/m^2/month.

It is interesting to note that all gauges recorded the highest annual average dust deposition level in 2009. As discussed previously, there were a number of anomalous weather events including a series of dust storms during the spring of 2009 that would have been captured by the dust deposition measurements. For example, all dust deposition gauges on the 2nd of October 2009 recorded levels between 8.6 g/m^2/month and 26.9 g/m^2/month which on investigation, were likely due to dust storms and bushfires in the area at this time.

7 ESTIMATES OF EMISSIONS OF PARTICULATE MATTER

7.1 Introduction

This section discusses the calculation of the particulate emissions applied in the assessment. Emissions have been calculated for the open-cut operations from the Project.

7.1.1 Emissions from open cut mining operations for the Project

The operation of the Project has been analysed and estimates of dust emissions for the key dust generating activities have been made. Emission factors developed both locally and by the US EPA, have been applied to estimate the amount of dust produced by each activity. The emission factors applied are considered to be the most reliable or up-to-date methods for determining dust generation rates.

The mining plans for the Project have been analysed and detailed emissions inventories have been prepared for four key operating scenarios, being Project Years 2 (nominally 2013), 8, 14 and 20. These modelled scenarios are considered to be representative of worst-case operations; for example where coal and waste material amounts are highest, where extraction or wind erosion areas are largest or where operations are close to sensitive receptors.

Detailed calculations are provided in **Appendix C** which provides information on the equations used, the basic assumptions about material properties (e.g. moisture content, silt content etc.), information on the way in which equipment would be used to undertake different mining operations and the quantities of materials that would be handled in each operation.

Figure 7.1 to **Figure 7.4** show the Project operations represented by a series of volume sources situated according to the location of activities for the modelled scenarios.

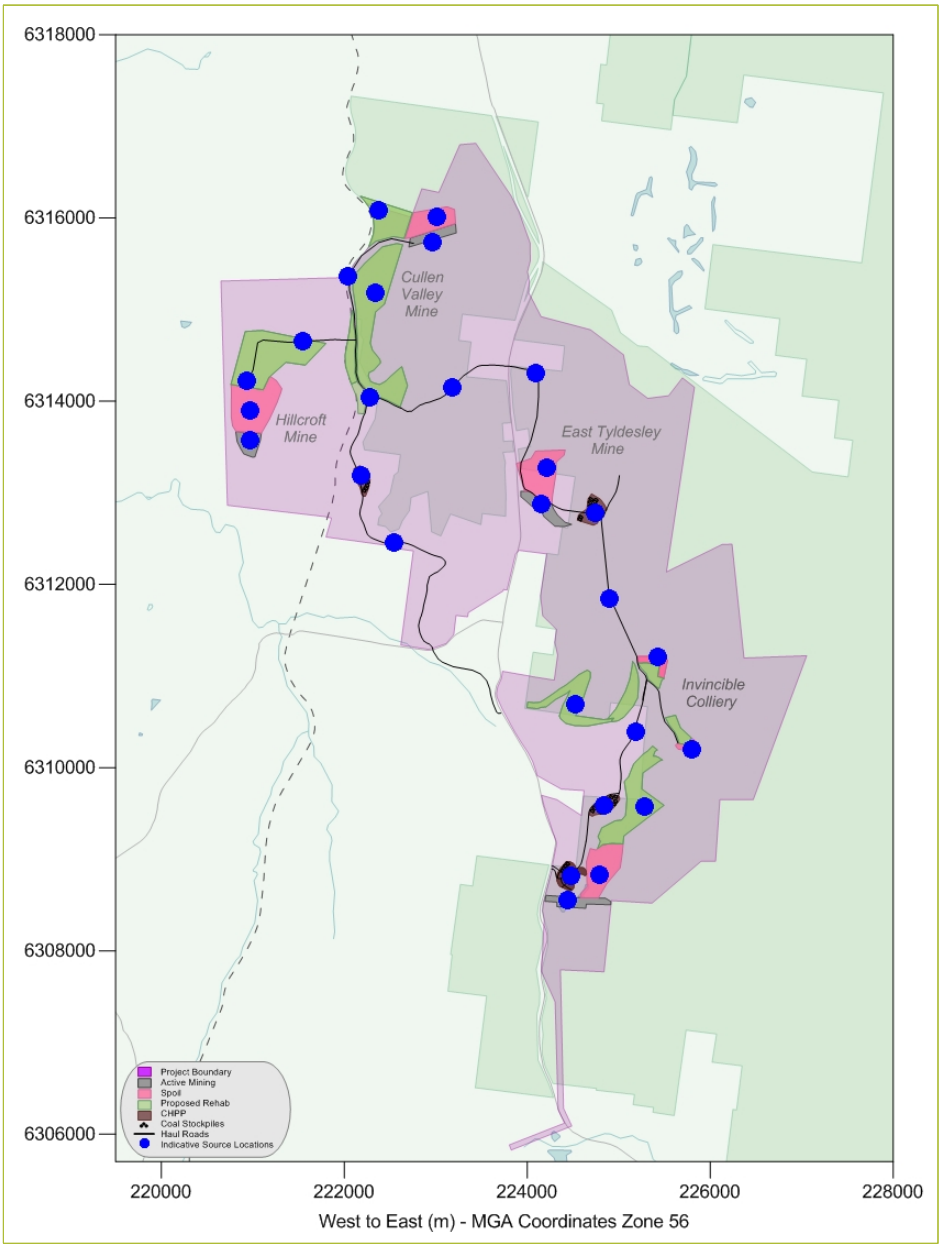


Figure 7.1: Indicative modelling source locations – Year 2

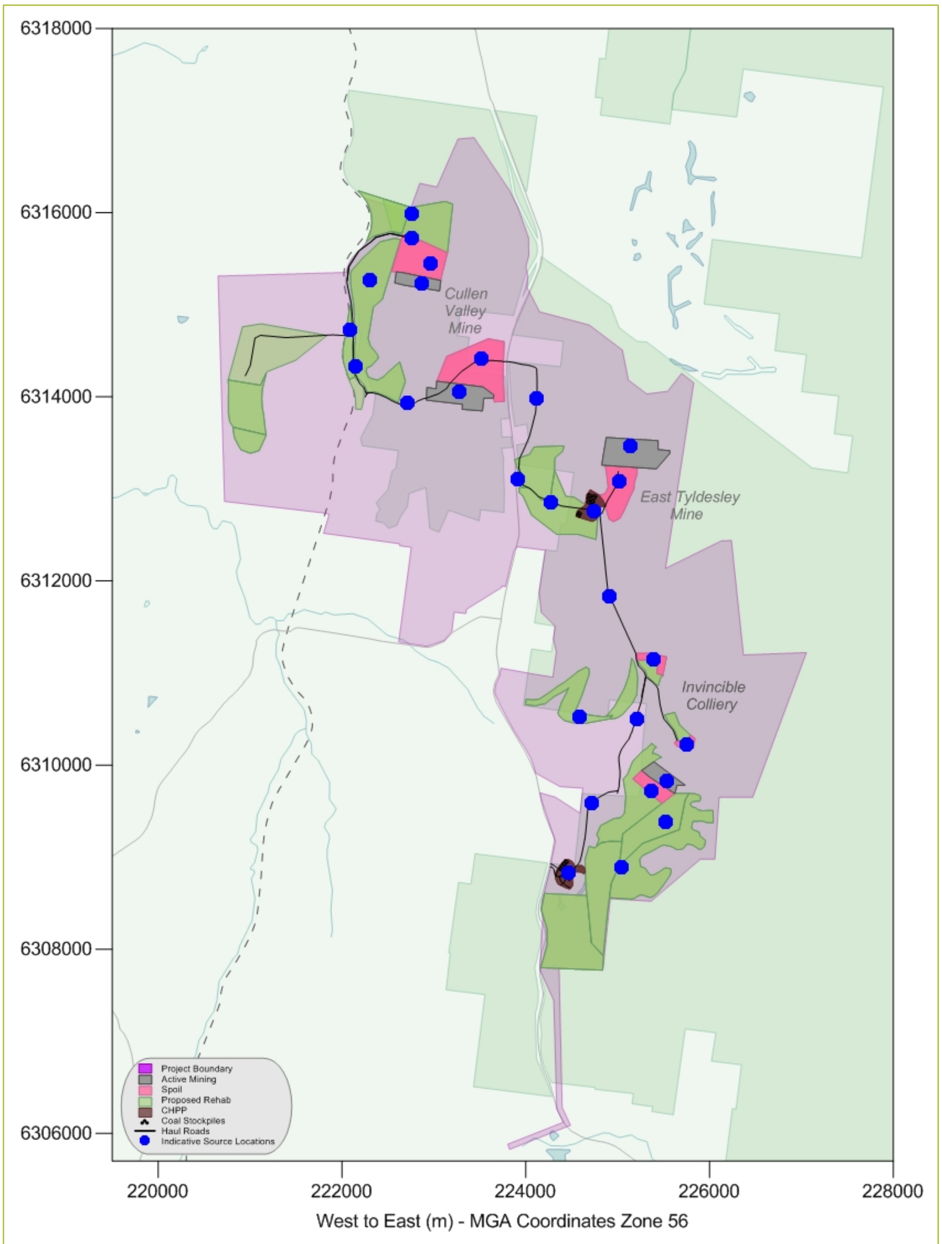


Figure 7.2: Indicative modelling source locations – Year 8

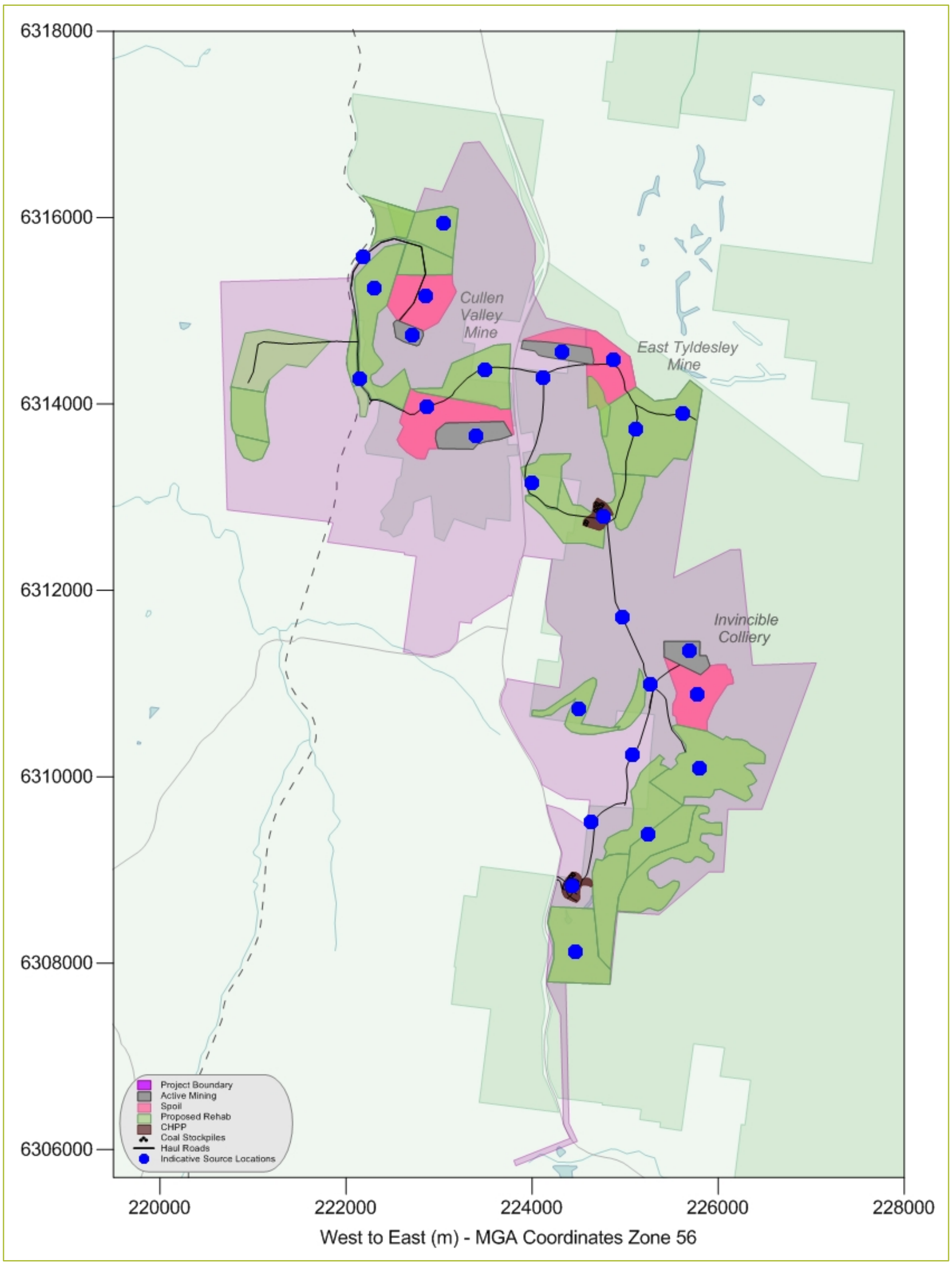


Figure 7.3: Indicative modelling source locations – Year 14

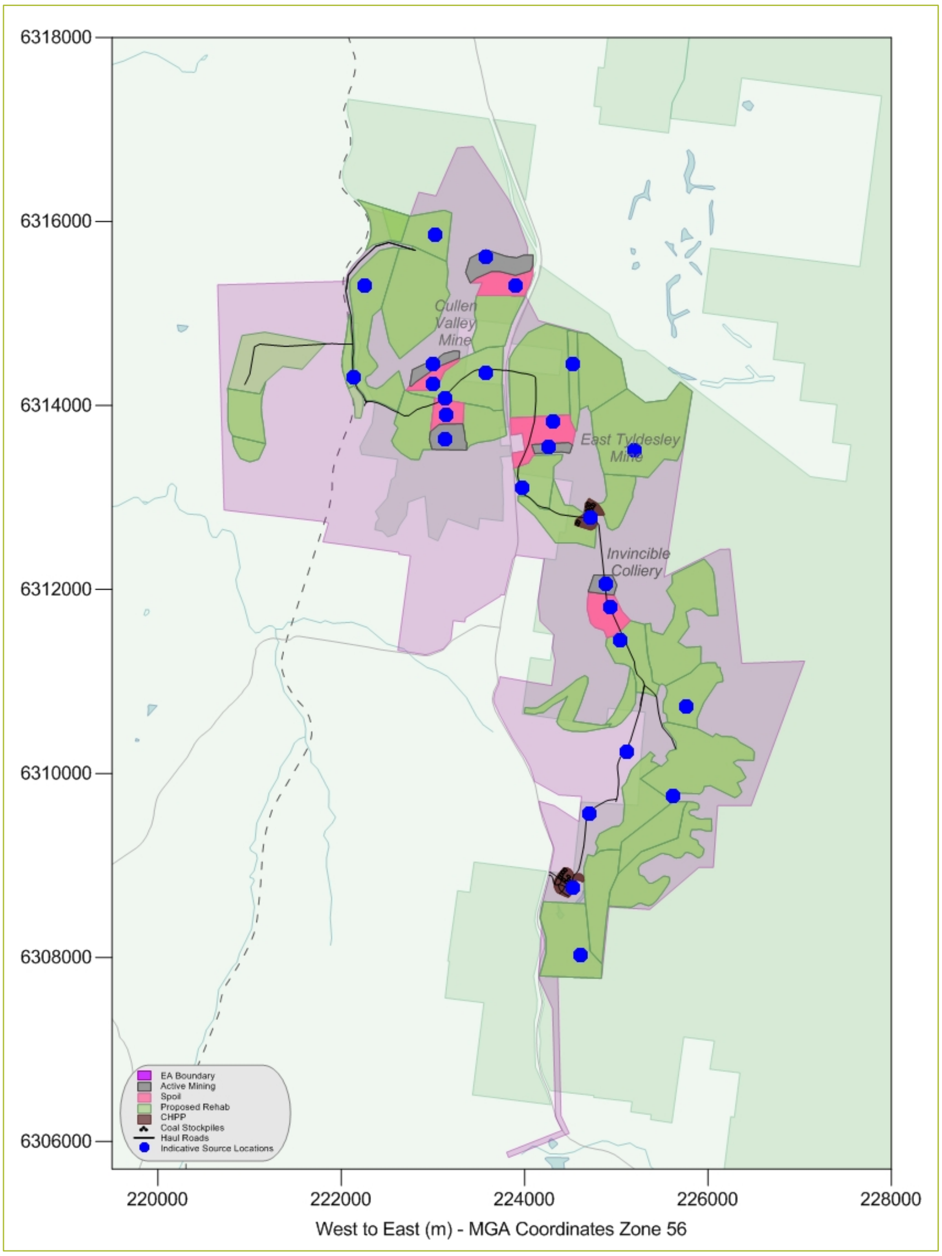


Figure 7.4: Indicative modelling source locations – Year 20

Table 7.1 presents the emission estimates for each year modelled.

It should be noted that the conveyor located to the south of the Invincible Colliery transporting coal to the MPPS was not included as a dust source in the dispersion modelling as the conveyor will be fully enclosed and will include water sprays at the loading point therefore causing negligible dust impacts.

Table 7.1: Estimated emissions of TSP/y for the Project

ACTIVITY	Year 2	Year 8	Year 14	Year 20
HILLCROFT/CULLEN VALLEY MINE (coal) OPERATIONS				
CV: Topsoil Removal - Dozers/Excavators stripping topsoil	333	333	333	333
CV: OB - Drilling Overburden	3,012	4,360	5,056	5,151
CV: OB - Blasting Overburden	3,349	4,847	5,622	5,727
CV: OB - Loading Overburden	18,665	27,015	31,332	31,917
CV: CL - Hauling to dump	88,101	156,945	238,903	231,779
CV: OB - Unloading Overburden to dump	18,665	27,015	31,332	31,917
CV: OB - Dozers on o/b	31,329	31,329	31,329	31,329
CV: CL - Dozers on coal	34,641	34,641	34,641	34,641
CV: CL - Loading coal into trucks	72,722	74,945	74,945	74,945
CV: CL - Hauling coal to ROM coal stockpiles at ET CHPP	185,083	91,341	102,087	99,400
CV: CL - Unloading coal to ROM coal stockpiles	12,953	13,349	13,349	13,349
CV: CL - Rehandle coal to hopper	488	503	801	801
CV: CL - Crushing	777	801	801	801
CV: CL - Screening	1,425	1,468	1,468	1,468
CV: CL - Loading coal to product stockpiles	64,802	64,841	64,841	64,841
CV: CL - Loading coal to trucks	482	483	483	483
CV: CL - Hauling product coal from ET CHPP to MPPS conveyor	72,689	72,751	72,751	72,751
CV: CL - Unloading product coal from trucks to MPPS conveyor	8,208	8,216	8,216	8,216
CV: CL - Hauling product coal from ET CHPP to rail load out	35,220	35,220	35,220	35,220
CV: CL - Unloading product coal from trucks to stockpile	3,333	3,333	3,333	3,333
CV: CL - FEL loading product coal to trains	139	139	139	139
CV: CL - Hauling rejects to dump	43,735	5,554	24,300	25,688
CV: REHAB - Dozers on rehab	200,117	200,117	200,117	200,117
CV: WE - Active Mining Area	9,636	25,229	31,886	54,137
CV: WE - Dumps area	41,347	53,611	75,336	63,422
CV: WE - Main ROM and Product stockpiles	1,233	925	925	925
CV: Grading roads	13,826	13,826	13,826	13,826
CULLEN VALLEY MINE OPERATIONS (Sand quarry operations)				
MS: SAND - Dozer ripping/pushing sand	31,329	31,329	31,329	No longer in operation
MS: SAND - Excavation of sand by shovel/excavator/FEL	1,743	1,743	842	
MS: SAND - Rehandle sandstone to hopper	1,743	481	232	
MS: SAND - Crushing	481	481	232	
MS: SAND - Loading sand to product stockpiles	35,978	35,978	17,382	
MS: SAND - Hauling sand to raw stockpiles at the CHPP	33,128	61,026	31,801	
MS: SAND - Dumping sand to raw stockpile from haul truck	1,395	1,395	674	
MS: SAND - Loading sand to trucks	1,395	1,395	674	
MS: SAND - Hauling product to MPPS conveyor	13,949	39,231	18,954	
MS: SAND - Unloading product from trucks to MPPS conveyor	6,408	6,408	3,096	
MS: REHAB - Dozers on rehab	200,117	200,117	200,117	
MS: WE - Active Mining Area	8,585	10,582	19,272	
MS: WE - Dumps area	20,411	33,989	116,683	
MS: WE - Main ROM and Product stockpiles	1,233	925	925	
MS: Grading roads	13,826	13,826	13,826	
EAST TYLDESLEY OPERATIONS				
ET: Topsoil Removal - Dozers/Excavators stripping topsoil	333	333	333	333
ET: OB - Drilling Overburden	3,012	4,360	5,056	5,151
ET: OB - Blasting Overburden	3,349	4,847	5,622	5,727
ET: OB - Loading Overburden	18,665	27,015	31,332	31,917
ET: OB - Hauling to ET dump	88,101	156,945	136,516	150,656
ET: OB - Unloading Overburden to dump	18,665	27,015	31,332	31,917
ET: OB - Dozers on o/b	31,329	31,329	31,329	31,329
ET: CL - Dozers on coal	34,641	34,641	34,641	34,641
ET: CL - Loading coal into trucks	72,722	74,945	74,945	74,945
ET: CL - Hauling coal to ROM coal stockpiles at ET CHPP	20,854	29,551	77,908	47,014
ET: CL - Unloading coal to ROM coal stockpiles	12,953	13,349	13,349	13,349
ET: CL - Rehandle coal to hopper	488	503	503	503
ET: CL - Crushing	777	801	801	801
ET: CL - Screening	1,425	1,468	1,468	1,468
ET: CL - Loading coal to product stockpiles	64,802	64,841	64,841	64,841
ET: CL - Loading coal to trucks	482	483	483	483

ACTIVITY	Year 2	Year 8	Year 14	Year 20
ET: CL - Hauling product coal from ET CHPP to MPPS conveyor	72,689	72,751	72,751	72,751
ET: CL - Unloading product coal from trucks to MPPS conveyor	8,208	8,216	8,216	8,216
ET: CL - Hauling product coal from ET CHPP to rail load out	35,220	35,220	35,220	35,220
ET: CL - Unloading product coal from trucks to stockpile	3,333	3,333	3,333	3,333
ET: CL - FEL loading product coal to trains	139	139	139	139
ET: CL - Hauling rejects to dump	4,928	1,433	67,405	40,675
ET - REHAB - Dozers on rehab	200,117	200,117	200,117	200,117
ET: WE - Active Mining Area	11,213	33,814	37,843	14,366
ET: WE - Dumps area	32,938	32,062	111,778	78,840
ET: WE - Main ROM and Product stockpiles	2,775	925	925	925
ET: Grading roads	13,826	13,826	13,826	13,826
INVINCIBLE COLLIERY OPERATIONS				
IC: Topsoil Removal - Dozers/Excavators stripping topsoil	333	333	333	333
IC: OB - Drilling Overburden	3,012	4,360	5,056	5,151
IC: OB - Blasting Overburden	3,349	4,847	5,622	5,727
IC: OB - Loading Overburden	18,665	27,015	31,332	31,917
IC: OB - Hauling from pit to IC dump	101,655	58,854	204,774	127,478
IC: OB - Unloading Overburden to dump	18,665	27,015	31,332	31,917
IC: OB - Dozers on o/b	31,329	31,329	31,329	31,329
IC: CL - Dozers on coal	34,641	34,641	34,641	34,641
IC: CL - Loading coal into trucks	72,722	74,945	74,945	74,945
IC: CL - Hauling coal to ROM coal stockpiles at IC CHPP	36,495	55,073	87,311	98,057
IC: CL - Unloading coal to ROM coal stockpiles	12,953	13,349	13,349	13,349
IC: CL - Rehandle coal to hopper	488	503	503	503
IC: CL - Crushing	777	801	801	801
IC: CL - Screening	1,425	1,468	1,468	1,468
IC: CL - Loading coal to product stockpiles	64,802	64,841	64,841	64,841
IC: CL - Loading coal to trucks	482	483	483	483
IC: CL - Hauling product coal from IC CHPP to MPPS conveyor	14,042	-	-	-
IC: CL - Unloading product coal from trucks to MPPS conveyor	8,208	8,216	8,216	8,216
IC: CL - Hauling product coal from IC CHPP to rail load out	65,744	65,744	65,744	65,744
IC: CL - Unloading product coal from trucks to stockpile	3,333	3,333	3,333	3,333
IC: CL - FEL loading product coal to trains	139	139	139	139
IC: CL - Hauling rejects to dump	8,624	2,083	22,564	25,341
IC - REHAB - Dozers on rehab	200,117	200,117	200,117	200,117
IC: WE - Active Mining Area	10,862	10,687	40,296	18,221
IC: WE - Dumps area	38,719	19,447	77,438	52,560
IC: WE - Main ROM and Product stockpiles	5,859	2,467	2,467	2,467
IC: Grading roads	13,826	13,826	13,826	13,826
Total	**2,867,280**	**2,992,218**	**3,643,683**	**2,983,044**

CV = Cullen Valley, MS = Marangaroo Sandstone, ET = East Tyldesley, IC = Invincible Colliery

7.2 Estimated Emissions from Neighbouring Mines

Other sources in addition to the Project will contribute to dust in the area. Estimating the background dust contribution for distant mines and the dust from other closer non-mining sources can be a complicated as dust levels will vary depending on local land use and the associated emission sources, as well as climate, soil type, farming practices, and so on. However where existing total measured dust levels are low these can be conservatively adopted as a background dust level, as done in this case.

The following mines have been identified in the vicinity of the Project:

- Ivanhoe North Mine;
- Pine Dale Coal Mine – Yarraboldy Extension; and
- Baal Bone Colliery.

7.2.1 Ivanhoe North Mine

The Ivanhoe North Mine was granted approval in 2007 with coal mining operations not to exceed three years. Therefore, this mine would not be in operation during any of the modelled Project years and is not included in the cumulative assessment.

7.2.2 Pine Dale Coal Mine – Yarraboldy Extension

The Pine Dale Coal Mine (Yarraboldy Extension) is an extension of open cut mining to the north of the existing Pine Dale coal mine facilities. This extension would include the extraction of approximately 350,000 tonnes of ROM coal per year for three years, including six months at the end of coal extraction to finalise rehabilitation on-site. As per the Department of Planning (DoP) website (**DoP, 2010**), this extension is predicted to be completed by 2012. However, at the time of writing of this report, the Yarraboldy Extension remains under review and is not formally approved. If approved, it is therefore unlikely that this Project will be completed by 2012. The first modelled year for this Project is Year 2 (nominally 2013).

Whilst it is recognised that the two projects may operate simultaneously prior to this time, it is unlikely that the Yarraboldy Extension could materially contribute to cumulative impacts when considered together with the Coalpac's operations. The reasons for this are as follows:

- The windroses presented in the Yarraboldy Extension air quality assessment show prominent winds from the west and east and with few winds from the southeast (in the direction of Coalpac's operations and nearest sensitive receptors) (**Heggies, 2010**);
- The Yarraboldy Extension is located at least six kilometres from the Coalpac Project Boundary. The worst-case contour results for 24-hour cumulative PM_{10} show the criterion of 50 $\mu g/m^3$ approximately two kilometres away from the closest sensitive receptors located to the south west of Coalpac's current operations; and
- The Yarraboldy Extension is proposed to operate over three years (including a final six months of rehabilitation) at a mining rate of 350,000t of ROM coal per year. This would mean that operations at this site are only likely to be simultaneous with Coalpac's operations in the first two years; should this project be approved. Furthermore, these two years do not represent periods of high production for Coalpac operations.

7.2.3 Baal Bone Colliery

The Baal Bone Colliery was granted approval on the 14th of January 2011 for continued underground mining operations with a maximum of 2.8 Mtpa of ROM coal extraction until December 2014. Baal Bone Colliery would therefore be in operation during Year 2 of the Project.

As this is an underground operation including coal processing and rehabilitation (e.g. washing) it is anticipated that dust emissions from this site would be low in comparison to the estimated annual dust emissions from the Coalpac Project in Year 2. Therefore, this mine has not been included in the cumulative assessment for Year 2.

7.3 Estimated Emissions from other Sources

For annual average TSP, PM_{10} and dust deposition the following constant values have been used in the annual average modelling predictions:

- 31.9 $\mu g/m^3$ for annual average TSP;
- 12.8 $\mu g/m^3$ for annual average PM_{10}; and
- 0.9 g/m^2/month for annual average dust deposition.

The above background values were derived from HVAS PM_{10} measurements and dust deposition monitoring conducted by Coalpac between 2008 and 2009 (see **Section 6.6**). Due to the HVAS monitors proximity to the town of Cullen Bullen, an average of data from these two sites over all years was taken as the background. This is considered conservative as any dust from mining operations from the existing Coalpac operations would be included in these data.

There are 11 Coalpac depositional dust gauges located in and around the Project site (see **Figure 6.2**). As a number of these gauges are located very close to the approved mining operations at Cullen Valley Mine and Invincible Colliery, the two gauges located furthest away from the Project were selected as being most representative of ambient background levels. Dust deposition measurements from gauges Hillcroft and Railway (see **Figure 6.2**) were averaged over all years to produce the background level of 0.9 g/m^2/month as above.

No monitored TSP concentration data are available in the vicinity of the Project. However, annual average total suspended particulate (TSP) concentrations can be estimated from the PM_{10} measurements by assuming that 40% of the TSP concentration is PM_{10}. This relationship was obtained from data collected by co-located TSP and PM_{10} monitors operated for reasonably long periods of time in the Hunter Valley (**NSW Minerals Council, 2000**).

8 ASSESSMENT OF IMPACTS

8.1 Assessment Criteria

The air quality criteria used for identifying which properties are likely to experience air quality impacts are those specified in the Approved Methods. These have been applied in the assessment process following the practices used in contemporary approvals for mining projects in NSW.

The criteria are:

- 50 $\mu g/m^3$ for 24-hour average PM_{10} for the Project and other sources (excluding natural events);
- 30 $\mu g/m^3$ for annual average PM_{10} due to the Project and other sources;
- 90 $\mu g/m^3$ for annual average TSP concentrations due to the Project alone and other sources;
- 2 g/m^2/month for annual average dust deposition (insoluble solids) due to the Project considered alone; and
- 4 g/m^2/month for annual average predicted cumulative deposition (insoluble solids) due to the Project and other sources.

Predictions for 24-hour and annual average $PM_{2.5}$ concentrations for the Project are provided in **Appendix D**.

The following sections provide a summary of the affected sensitive receptors and at what stage the effects are predicted to occur during the life of the Project.

8.2 Assessment Approach

Dust concentrations due to mining operations have been presented as isopleth diagrams showing the following:

1. Predicted maximum 24-hour average PM_{10} concentration;
2. Predicted annual average PM_{10} concentration;
3. Predicted annual average TSP concentration; and
4. Predicted annual average dust deposition.

It is important to note that the isopleth figures are presented to provide a visual representation of the predicted impacts. To produce the isopleths it is necessary to make interpolations, and as a result the isopleths will not always match exactly with predicted impacts at any specific location. The actual predicted impacts at the sensitive receptors are presented in tabular form (see **Section 8**).

The following sections examine predicted 24-hour PM_{10}, Annual average PM_{10}, TSP and dust deposition impacts. A separate cumulative assessment of 24-hour average PM_{10} is provided in **Section 8.3**.

8.2.1 Year 2

Modelling results for Year 2 show results above the annual assessment criteria at sensitive receptors. **Table 8.1** provides a summary of properties predicted to exceed the relevant criteria in Year 2.

Table 8.2 presents a summary of the predicted concentrations at each of the nearby sensitive receptors during Year 2, due to the operations of the Project alone and the Project and all other sources. Predicted exceedances of the criteria at sensitive receptors locations are shown in red text.

Figure 8.1 to **Figure 8.7** show the predicted 24-hour average, annual average PM_{10}, TSP concentrations and dust deposition levels in Year 2 due to the operations of the Project alone and the Project and other sources.

Table 8.1: Summary of receptors predicted to exceed the criteria in Year 2

Receptor ID	Ownership Details	24-hour PM_{10} Mine Alone ($\mu g/m^3$)	Annual PM_{10} Mine & Other Sources ($\mu g/m^3$)	Annual TSP Mine & Other Sources ($\mu g/m^3$)	Annual Dust Deposition Mine Alone (g/m^2/month)	Annual Dust Deposition Mine & Other Sources (g/m^2/month)
169[a]	Portland Road Pastoral Co Pty Ltd	62	-	-	-	-
171[a]	Portland Road Pastoral Co Pty Ltd	64	-	-	-	-
195[b]	KJ Blackley	191	49	125	3.0	-
196[b]	Crown-owned	173	45	115	2.7	-
197[b]	BE & CE Leisemann & IL & KID Follington	402	90	231	7.8	8.7
198[b]	DA Tilley	199	49	125	3.2	4.1
199[b]	DA Tilley	136	40	102	2.1	-
217b	Crown-owned	52	-	-	-	-
327	RG Wright & KL Norris	54	-	-	-	-
394	Coalpac	79	-	-	-	-
396	Coalpac	90	-	-	-	-
426	JWJ & SM Taylor	62	-	-	-	-

[a] Coalpac-owned
[b] Located within Project Boundary

Table 8.2: Year 2 – predicted dust concentration and dust deposition levels due to the Project alone and the Project and other sources

ID	Year 2 – Project alone				Year 2 - Project and other sources		
	24-hour PM_{10} (µg/m^3)	Annual PM_{10} (µg/m^3)	Annual TSP (µg/m^3)	Annual Dust deposition (g/m^2/month)	Annual PM_{10} (µg/m^3)	Annual TSP (µg/m^3)	Annual Dust deposition (g/m^2/month)
	Assessment criteria						
ID	*50[1]*	*N/A*	*N/A*	*2*	*30*	*90*	*4*
Sensitive receptors							
81	9	1	3	0.0	13	34	0.9
86[a]	11	2	4	0.1	14	35	1.0
87	9	1	3	0.0	13	34	0.9
103	16	2	6	0.1	14	37	1.0
104	21	3	7	0.1	15	38	1.0
106	23	3	9	0.1	15	40	1.0
107	23	3	8	0.1	15	39	1.0
108	24	3	8	0.1	15	39	1.0
109	21	3	8	0.1	15	39	1.0
111A	9	1	3	0.0	13	34	0.9
111B	9	1	3	0.0	13	34	0.9
112	12	2	5	0.1	14	36	1.0
113	16	3	7	0.1	15	38	1.0
114	17	3	7	0.1	15	38	1.0
119	12	2	4	0.1	14	35	1.0
123	18	3	8	0.2	15	39	1.1
139	19	3	9	0.2	15	40	1.1
142	18	4	11	0.3	16	42	1.2
143	15	4	10	0.3	16	41	1.2
144	14	4	9	0.3	16	40	1.2
169[b]	**62**	15	39	1.2	27	70	2.1
171[b]	**64**	15	39	1.4	27	70	2.3
179[c]	23	4	11	0.5	16	42	1.4
195[c]	**191**	37	94	**3.0**	**49**	**125**	3.9
196[ac]	**173**	33	84	**2.7**	**45**	**115**	3.6
197[c]	**402**	78	200	**7.8**	**90**	**231**	**8.7**
198[c]	**199**	37	94	**3.2**	**49**	**125**	**4.1**
199[c]	**136**	28	71	**2.1**	**40**	**102**	3.0
205	11	3	9	0.3	16	40	1.2
209	13	3	7	0.2	15	38	1.1
210	13	3	8	0.2	15	39	1.1
211	14	3	9	0.3	15	40	1.2
216	42	10	26	0.8	23	58	1.7
217a[a]	46	9	24	0.7	21	55	1.6
217b[a]	**52**	9	22	0.5	21	53	1.4
220	21	5	14	0.3	17	45	1.2
223	23	5	13	0.3	17	44	1.2
225	23	5	13	0.3	17	44	1.2
227	23	5	13	0.3	17	44	1.2
228	23	5	13	0.3	17	44	1.2
229	23	5	14	0.3	17	45	1.2
230	23	5	14	0.3	17	45	1.2
231	24	5	14	0.3	17	45	1.2
232	24	6	14	0.4	18	45	1.3
235	28	6	15	0.4	18	46	1.3
235	30	6	16	0.4	18	47	1.3
236	33	6	16	0.4	18	47	1.3
237	28	6	16	0.4	18	47	1.3
238	29	6	16	0.4	18	47	1.3
238	32	6	16	0.4	18	47	1.3
239	29	6	16	0.4	18	47	1.3
240	31	6	16	0.4	18	47	1.3
242	31	7	17	0.4	19	48	1.3
243	31	7	17	0.4	19	48	1.3
245	34	7	18	0.4	19	49	1.3
247	26	6	14	0.3	18	45	1.2
248	27	6	14	0.3	18	45	1.2
250	28	6	15	0.4	18	46	1.3

[1] 50 µg/m^3 refers to the cumulative criterion and should not be applied to Project alone results. This is shown here for reference only.

	Year 2 – Project alone				Year 2 - Project and other sources		
	24-hour PM_{10} (µg/m³)	Annual PM_{10} (µg/m³)	Annual TSP (µg/m³)	Annual Dust deposition (g/m²/month)	Annual PM_{10} (µg/m³)	Annual TSP (µg/m³)	Annual Dust deposition (g/m²/month)
	Assessment criteria						
ID	*50[1]*	*N/A*	*N/A*	*2*	*30*	*90*	*4*
251	26	6	14	0.3	18	45	1.2
253	26	6	14	0.4	18	45	1.3
254	27	6	15	0.4	18	46	1.3
254	29	6	15	0.4	18	46	1.3
255	29	6	15	0.4	18	46	1.3
256	32	6	16	0.4	18	47	1.3
257	34	6	16	0.4	18	47	1.3
258	49	8	20	0.5	20	51	1.4
262[a]	18	5	12	0.3	17	43	1.2
263	19	5	12	0.3	17	43	1.2
264	19	5	12	0.3	17	43	1.2
267	20	5	12	0.3	17	43	1.2
268	21	5	13	0.3	17	44	1.2
270	19	5	12	0.3	17	43	1.2
270	19	5	12	0.3	17	43	1.2
271	21	5	12	0.3	17	43	1.2
272[a]	23	5	13	0.3	17	44	1.2
272[a]	24	5	13	0.3	17	44	1.2
272[a]	24	5	13	0.3	17	44	1.2
272[a]	24	5	13	0.3	17	44	1.2
273	15	4	10	0.2	16	41	1.1
273	15	4	10	0.2	16	41	1.1
275	15	4	10	0.2	16	41	1.1
276	16	4	11	0.3	16	42	1.2
276	16	4	10	0.3	16	41	1.2
277	16	4	10	0.3	16	41	1.2
278	16	4	11	0.3	16	42	1.2
279	17	4	11	0.3	16	42	1.2
280	17	4	11	0.3	16	42	1.2
281	17	4	11	0.3	16	42	1.2
283	19	5	12	0.3	17	43	1.2
284	20	5	12	0.3	17	43	1.2
285	21	5	12	0.3	17	43	1.2
288	22	5	13	0.3	17	44	1.2
289	23	5	13	0.3	17	44	1.2
291	27	6	14	0.3	18	45	1.2
296	30	6	15	0.3	18	46	1.2
297	30	6	15	0.3	18	46	1.2
298	30	6	15	0.4	18	46	1.3
301	33	6	16	0.4	18	47	1.3
302	33	6	16	0.4	18	47	1.3
304	33	6	16	0.4	18	47	1.3
305	34	6	16	0.4	18	47	1.3
306	36	6	16	0.4	18	47	1.3
308	36	7	17	0.4	19	48	1.3
309	36	7	17	0.4	19	48	1.3
311	42	7	18	0.4	19	49	1.3
312	42	7	18	0.4	19	49	1.3
313	41	7	18	0.4	19	49	1.3
314	43	7	19	0.4	19	50	1.3
315	28	6	14	0.3	18	45	1.2
315	30	6	15	0.3	18	46	1.2
316	27	5	14	0.3	17	45	1.2
317	26	5	14	0.3	17	45	1.2
318	27	5	14	0.3	17	45	1.2
321	33	6	16	0.3	18	47	1.2
325	44	7	19	0.4	19	50	1.3
326	49	8	20	0.4	20	51	1.3
327	**54**	9	22	0.5	21	53	1.4
328	14	4	9	0.2	16	40	1.1
329	14	4	9	0.2	16	40	1.1
330	13	3	9	0.2	15	40	1.1
331	12	3	8	0.2	15	39	1.1
332	12	3	8	0.2	15	39	1.1
333	12	3	8	0.2	15	39	1.1
335	12	3	8	0.2	15	39	1.1
342	12	3	8	0.2	15	39	1.1

ID	Year 2 – Project alone: 24-hour PM_{10} ($\mu g/m^3$)	Year 2 – Project alone: Annual PM_{10} ($\mu g/m^3$)	Year 2 – Project alone: Annual TSP ($\mu g/m^3$)	Year 2 – Project alone: Annual Dust deposition ($g/m^2/month$)	Year 2 - Project and other sources: Annual PM_{10} ($\mu g/m^3$)	Year 2 - Project and other sources: Annual TSP ($\mu g/m^3$)	Year 2 - Project and other sources: Annual Dust deposition ($g/m^2/month$)
Assessment criteria	50[1]	N/A	N/A	2	30	90	4
343	12	3	8	0.2	15	39	1.1
344	12	3	8	0.2	15	39	1.1
345	13	3	8	0.2	15	39	1.1
347	13	3	9	0.2	15	40	1.1
349	19	4	10	0.2	16	41	1.1
350	14	4	9	0.2	16	40	1.1
350	15	4	10	0.2	16	41	1.1
350	15	4	10	0.2	16	41	1.1
350	16	4	10	0.2	16	41	1.1
350	16	4	10	0.2	16	41	1.1
352	17	4	11	0.3	16	42	1.2
352	19	4	11	0.3	16	42	1.2
353	17	4	10	0.2	16	41	1.1
354	17	4	10	0.2	16	41	1.1
355	17	4	10	0.2	16	41	1.1
356	17	4	10	0.2	16	41	1.1
357	16	4	10	0.2	16	41	1.1
358	16	4	10	0.2	16	41	1.1
360[a]	28	5	14	0.3	17	45	1.2
364	21	5	13	0.3	18	45	1.2
367	17	3	9	0.2	16	41	1.1
368	28	5	13	0.2	18	45	1.1
372	14	3	8	0.2	16	40	1.1
373	17	3	9	0.2	15	40	1.1
383	24	4	11	0.2	17	43	1.1
384	22	4	11	0.2	17	43	1.1
385	22	4	11	0.2	17	43	1.1
386	26	4	11	0.2	17	43	1.1
388	14	3	8	0.1	15	39	1.0
391	15	3	8	0.2	16	40	1.1
392	22	6	14	0.3	18	45	1.2
393[b]	35	7	19	0.4	19	50	1.3
394[b]	**79**	13	34	0.6	25	65	1.5
396[b]	**90**	18	47	1.6	30	78	2.5
401	22	4	11	0.2	17	43	1.1
403	21	4	10	0.2	17	42	1.1
404	20	4	9	0.1	16	41	1.0
405	20	4	10	0.1	17	42	1.0
406	15	3	8	0.1	16	40	1.0
407	16	3	8	0.1	16	40	1.0
408	15	3	8	0.1	16	40	1.0
410	20	4	10	0.1	17	42	1.1
419	24	4	10	0.1	17	42	1.0
419	23	4	10	0.1	17	42	1.0
421	24	4	11	0.2	17	43	1.1
426	**62**	8	19	0.3	20	50	1.2

[a] Crown-owned
[b] Coalpac-owned
[c] Located within Project Boundary

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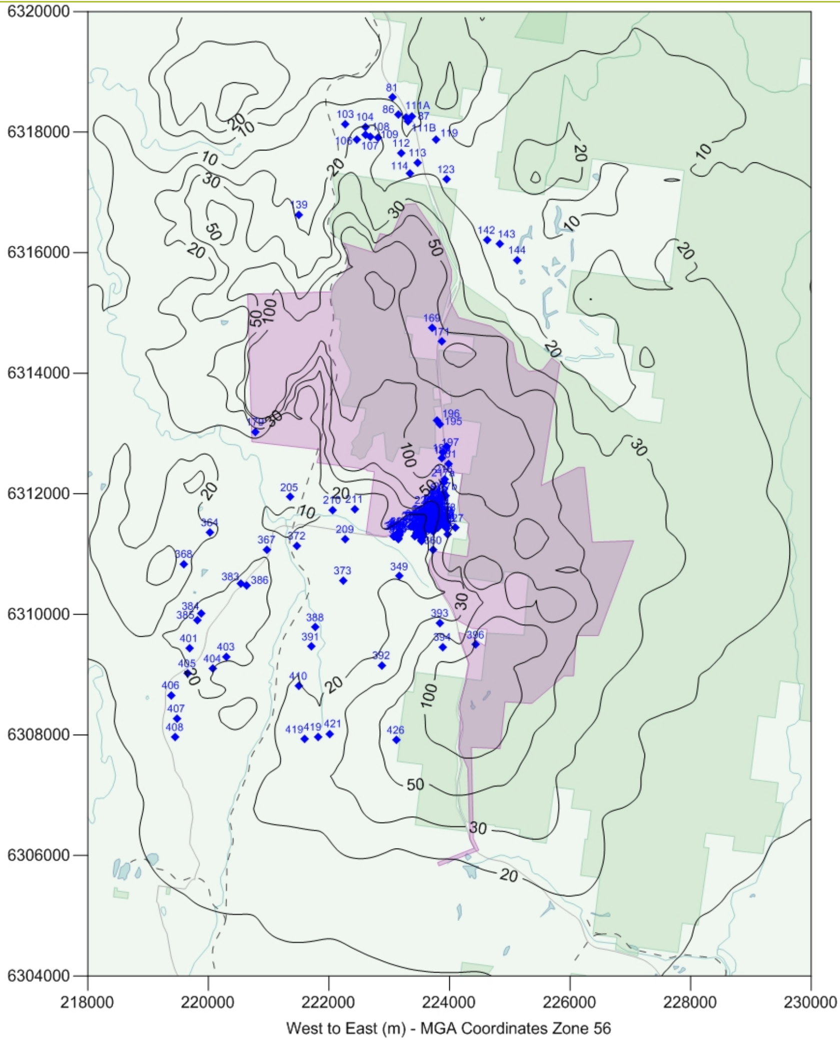
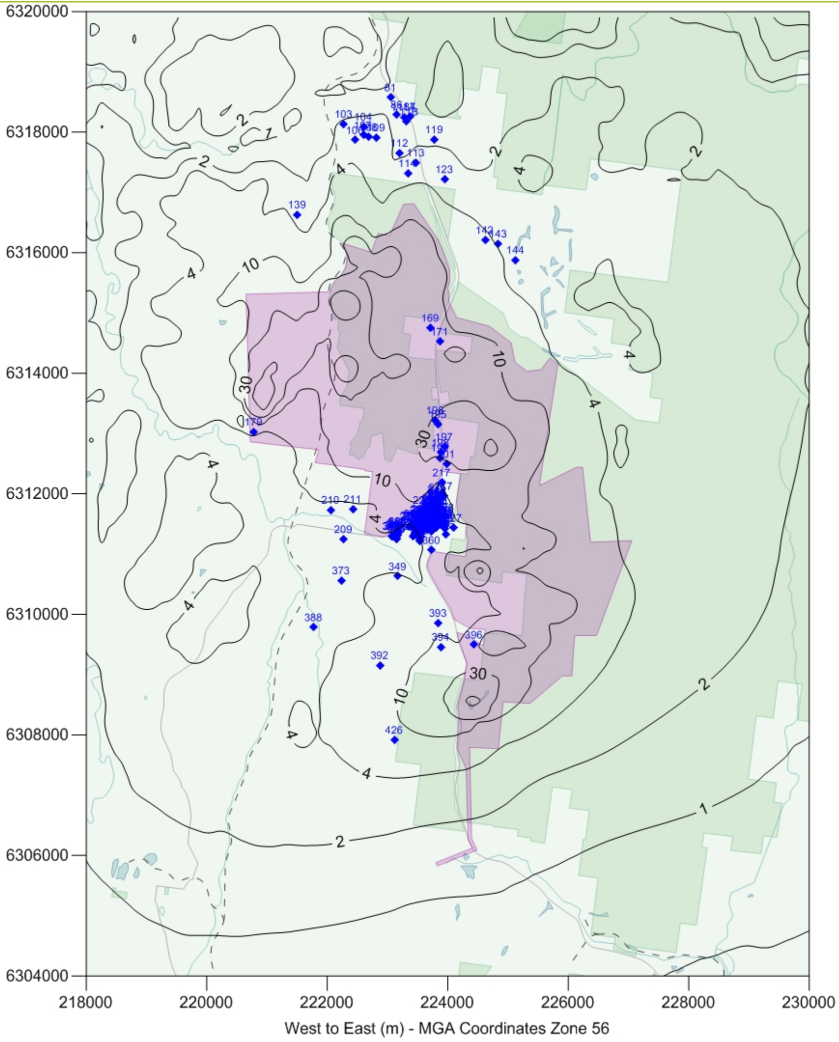


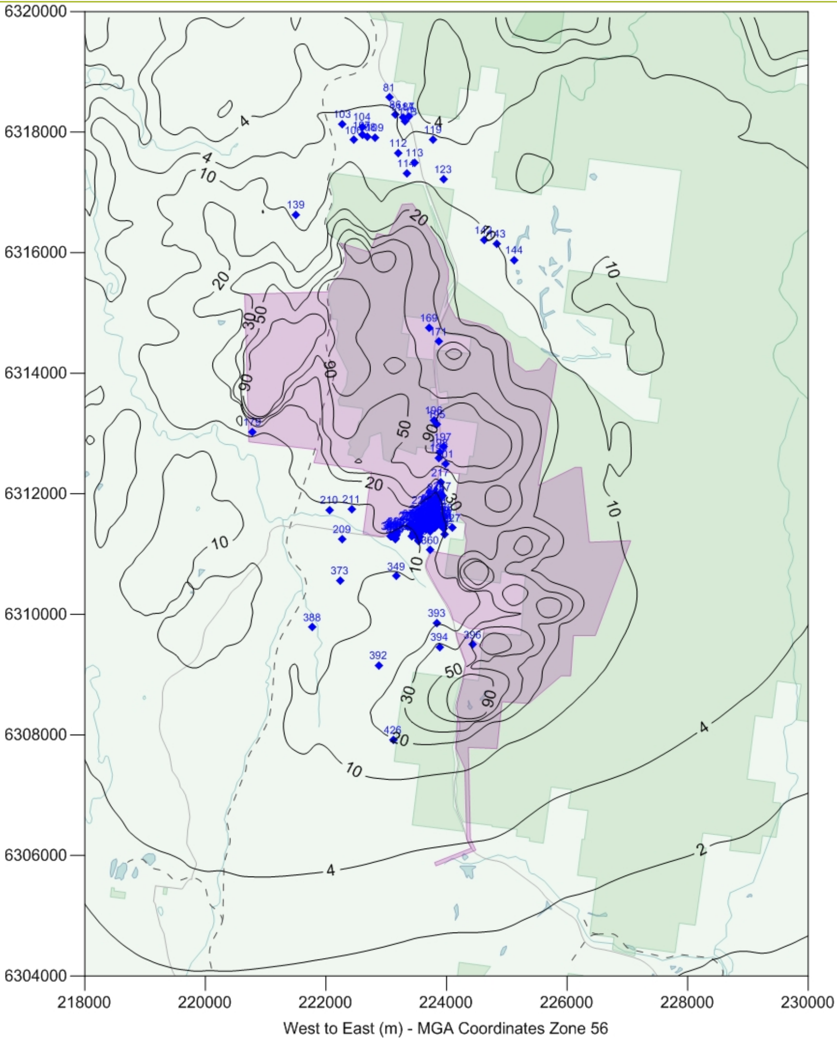
Species: PM10	**Averaging Time:** 24-hour	**Percentile:** Maximum	**Scenario:** Year 2 Project alone	**Location:** Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** $\mu g/m^3$	**Assessment criteria:** N/A	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.1: Predicted 24-hour average PM_{10} concentrations due to emissions from the Project alone in Year 2



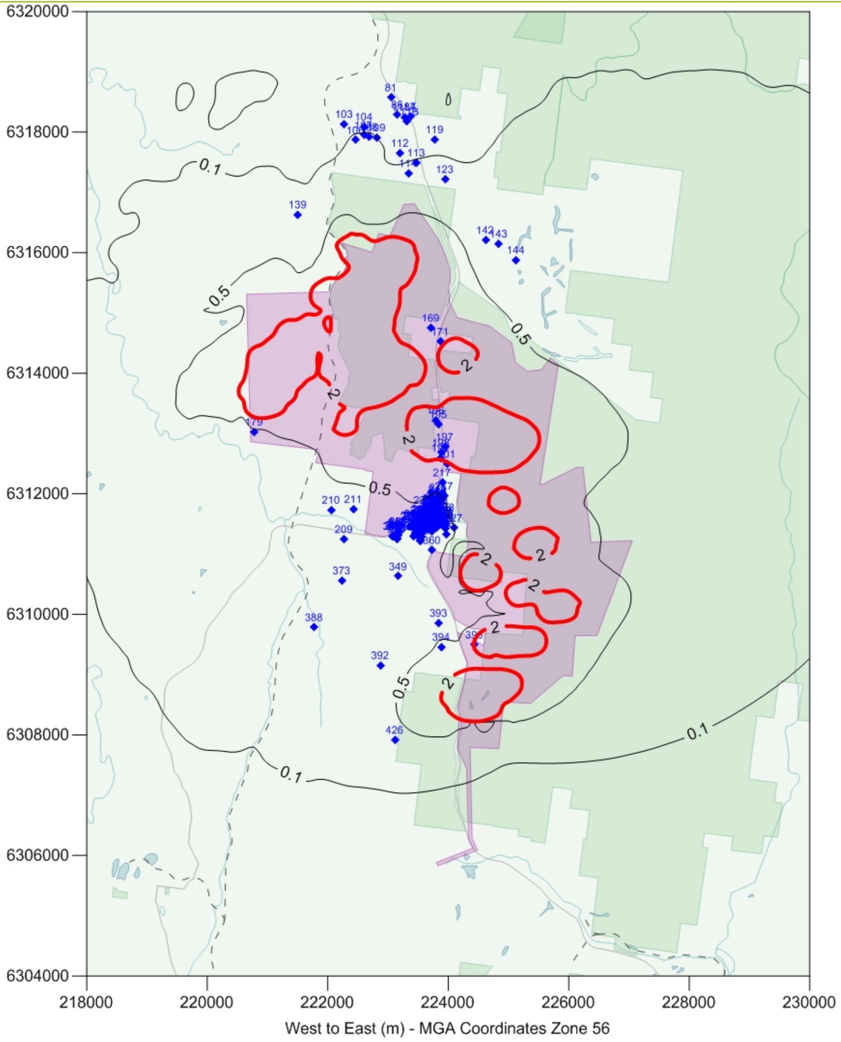
Species: PM10	Averaging Time: Annual	Percentile:	Scenario: Year 2 Project alone	Location: Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** µg/m³	**Assessment criteria:** N/A	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.2: Predicted annual average PM_{10} concentrations due to emissions from the Project alone in Year 2



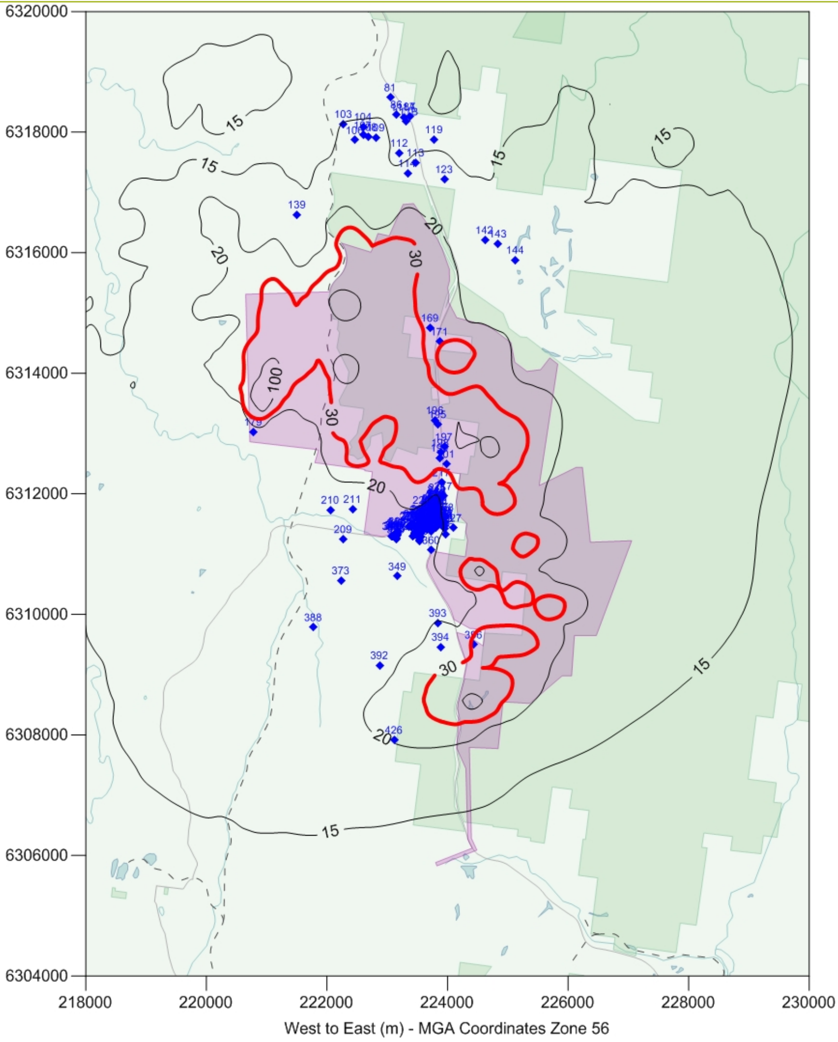
Species: TSP	Averaging Time: Annual	Percentile:	Scenario: Year 2 Project alone	Location: Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** µg/m^3	**Assessment criteria:** N/A	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.3: Predicted annual average TSP concentrations due to emissions from the Project alone in Year 2



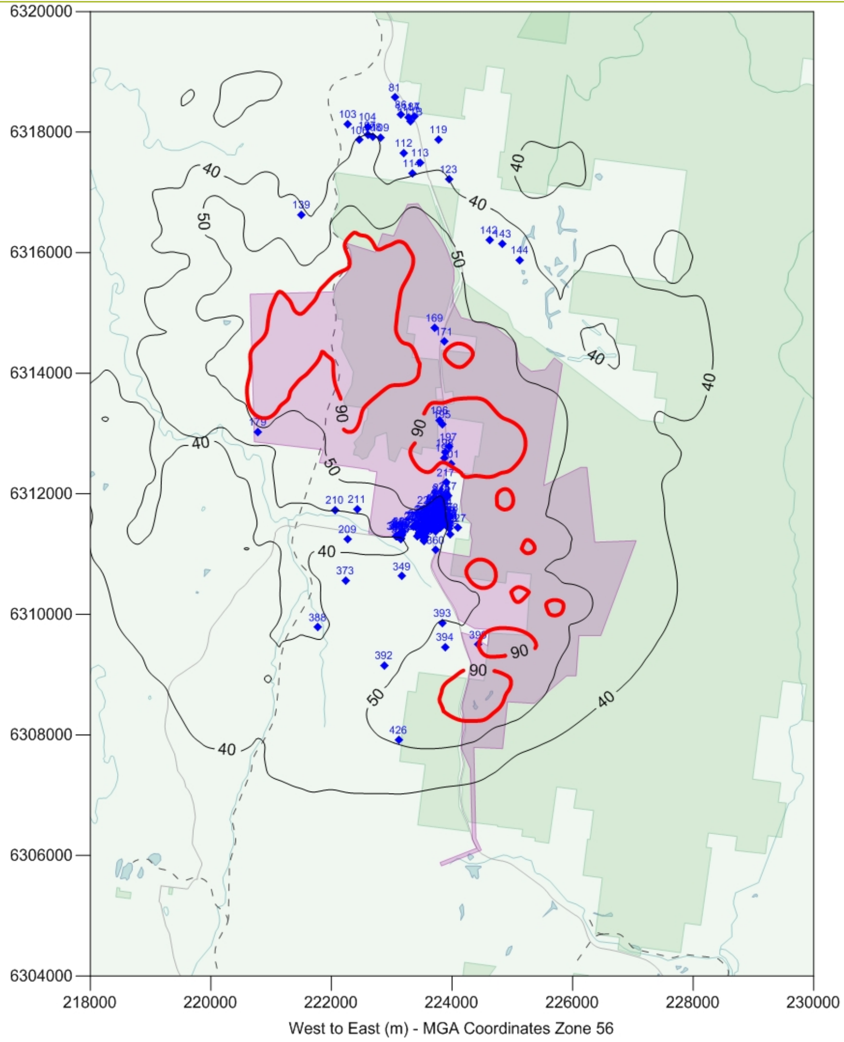
Species: Dust Deposition	Averaging Time: Annual	Percentile:	Scenario: Year 2 Project alone	Location: Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** g/m^2/month	**Assessment criteria:** DECCW = 2 g/m^2/month (shown as a bold red line)	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.4: Predicted annual average dust deposition levels due to emissions from the Project alone in Year 2



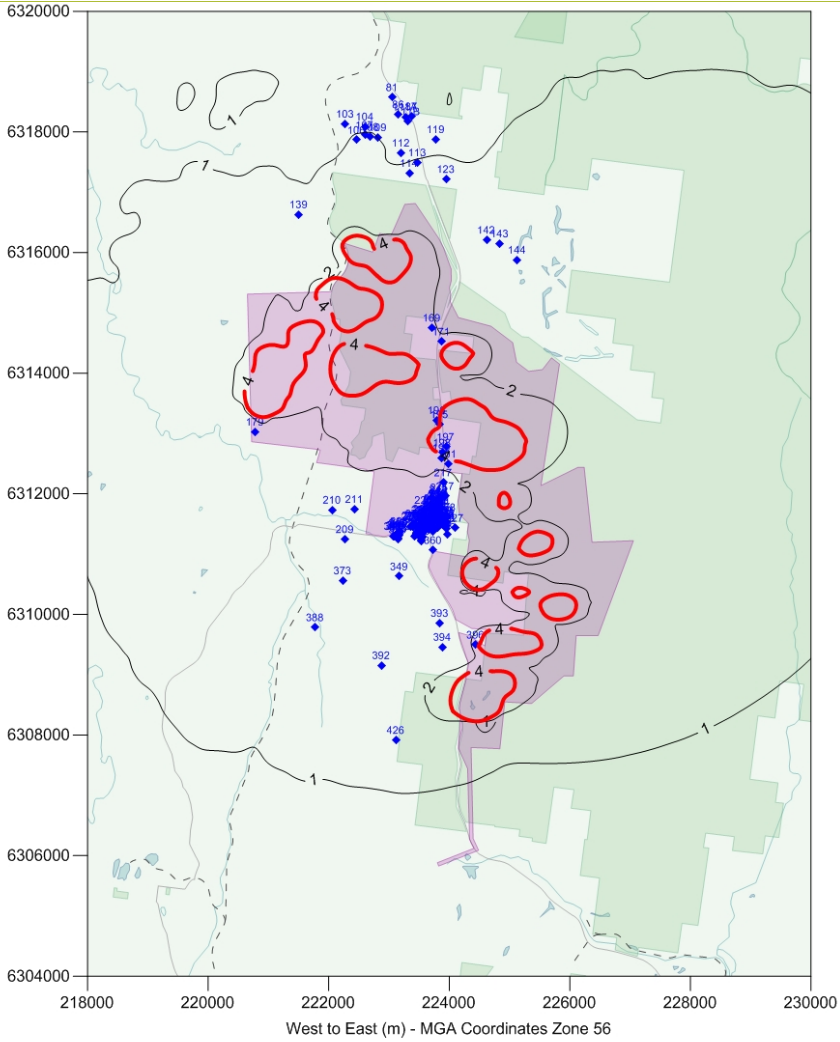
Species: PM$_{10}$	**Averaging Time:** Annual	**Percentile:**	**Scenario:** Year 2 Project and other sources	**Location:** Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** µg/m^3	**Assessment criteria:** DECCW = 30 µg/m^3 (shown as a bold red line)	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.5: Predicted annual average PM$_{10}$ concentrations due to emissions from the Project and other sources in Year 2



Species: TSP	Averaging Time: Annual	Percentile:	Scenario: Year 2 Project and other sources	Location: Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** µg/m^3	**Assessment criteria:** DECCW = 90 µg/m^3 (shown as a bold red line)	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.6: Predicted annual average TSP concentrations due to emissions from the Project and other sources in Year 2



Species: Dust Deposition	**Averaging Time:** Annual	**Percentile:**	**Scenario:** Year 2 Project and other sources	**Location:** Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** g/m^2/month	**Assessment criteria:** DECCW = 4 g/m^2/month (shown as a bold red line)	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.7: Predicted annual average dust deposition levels due to emissions from the Project and other sources in Year 2

8.2.2 Year 8

Modelling results for Year 8 show exceedances of the 24-hour PM_{10} and annual criteria at some sensitive receptors. **Table 8.3** provides a summary of the properties predicted to exceed the relevant criteria in Year 8.

Table 8.4 presents a summary of the Year 8 predicted concentrations at each of the nearby sensitive receptors, due to the operations of the Project alone and the Project and other sources. Predicted exceedances of the criteria at sensitive receptor locations are shown in red text.

Figure 8.8 to **Figure 8.14** show the predicted 24-hour average, annual average PM_{10}, TSP concentrations and dust deposition levels in Year 8 due to the operations of the Project alone and the Project and other sources.

Table 8.3: Summary of receptors predicted to exceed the criteria in Year 8

Receptor ID	Ownership Details	24-hour PM_{10} Mine Alone ($\mu g/m^3$)	Annual PM_{10} Mine & Other Sources ($\mu g/m^3$)	Annual TSP Mine & Other Sources ($\mu g/m^3$)	Annual Dust Deposition Mine Alone ($g/m^2/month$)	Annual Dust Deposition Mine & Other Sources ($g/m^2/month$)
169[a]	Portland Road Pastoral Co Pty Ltd	88	33	-	-	-
171[a]	Portland Road Pastoral Co Pty Ltd	65	33	-	3.5	4.4
195[b]	KJ Blackley	141	48	123	3	-
196[b]	Crown-owned	160	49	126	3	-
197[b]	BE & CE Leisemann & IL & Kid Follington	64	31	-	-	-
198[b]	DA Tilley	56	-	-	-	-
199[b]	DA Tilley	53	-	-	-	-
394[a]	Coalpac	64	-	-	-	-
396[a]	Coalpac	74	-	-	-	-
426	JWJ & SM Taylor	53	-	-	-	-

[a] Coalpac-owned
[b] Located within Project Boundary

Table 8.4: Year 8 – predicted PM_{10} and TSP concentrations and dust deposition levels due to the Project alone and the Project and other sources

ID	Year 8 – Project alone				Year 8 - Project and other sources		
	24-hour PM_{10} ($\mu g/m^3$)	Annual PM_{10} ($\mu g/m^3$)	Annual TSP ($\mu g/m^3$)	Annual Dust deposition ($g/m^2/month$)	Annual PM_{10} ($\mu g/m^3$)	Annual TSP ($\mu g/m^3$)	Annual Dust deposition ($g/m^2/month$)
	Assessment criteria						
	50[1]	*N/A*	*N/A*	*2*	*30*	*90*	*4*
Sensitive receptors							
81	10	1	3	0.0	13	34	0.9
86[a]	11	1	4	0.1	13	35	1.0
87	9	1	3	0.0	13	34	0.9
103	17	2	5	0.1	14	36	1.0
104	18	2	6	0.1	14	37	1.0
106	20	3	7	0.1	15	38	1.0
107	19	3	7	0.1	15	38	1.0
108	19	3	7	0.1	15	38	1.0
109	18	3	6	0.1	15	37	1.0
111A	10	1	3	0.0	13	34	0.9
111B	10	1	3	0.0	13	34	0.9
112	13	2	5	0.1	14	36	1.0
113	14	2	6	0.1	14	37	1.0
114	15	3	6	0.1	15	37	1.0
119	11	2	4	0.1	14	35	1.0
123	18	3	7	0.1	15	38	1.0
139	19	3	8	0.2	15	39	1.1
142	19	4	11	0.3	16	42	1.2
143	18	4	10	0.2	16	41	1.1
144	19	4	10	0.3	16	41	1.2
169[b]	**88**	21	55	1.5	**33**	86	2.4
171[b]	**65**	21	54	**3.5**	**33**	85	**4.4**
179[c]	12	3	8	0.2	15	39	1.1
195[c]	**141**	36	92	**3.0**	**48**	**123**	3.9
196[ac]	**160**	37	95	**3.0**	**49**	**126**	3.9
197[c]	**64**	19	48	1.8	**31**	79	2.7
198[c]	**56**	15	38	1.3	27	69	2.2
199[c]	**53**	14	35	1.1	26	66	2.0
205	12	3	9	0.2	16	41	1.1
209	14	3	7	0.2	15	38	1.1
210	13	3	8	0.2	15	39	1.1
211	16	3	9	0.2	15	40	1.1
216	38	8	21	0.6	21	53	1.5
217a[a]	37	8	20	0.5	20	51	1.4
217b[a]	35	7	17	0.4	19	48	1.3
220	27	5	13	0.3	17	44	1.2
223	25	5	12	0.3	17	43	1.2
225	25	5	12	0.3	17	43	1.2
227	25	5	12	0.3	17	43	1.2
228	25	5	12	0.3	17	43	1.2
229	26	5	13	0.3	17	44	1.2
230	26	5	13	0.3	17	44	1.2
231	26	5	13	0.3	17	44	1.2
232	26	5	13	0.3	17	44	1.2
235	28	5	14	0.3	17	45	1.2
235	28	5	14	0.3	17	45	1.2
236	29	6	14	0.3	18	45	1.2
237	28	5	14	0.3	17	45	1.2
238	28	5	14	0.3	17	45	1.2
238	29	6	14	0.3	18	45	1.2
239	29	6	14	0.3	18	45	1.2
240	29	6	14	0.3	18	45	1.2
242	29	6	15	0.3	18	46	1.2
243	30	6	15	0.3	18	46	1.2
245	31	6	15	0.4	18	46	1.3
247	26	5	13	0.3	17	44	1.2
248	26	5	13	0.3	17	44	1.2
250	27	5	13	0.3	17	44	1.2

[1] 50 $\mu g/m^3$ refers to the cumulative criterion and should not be applied to Project alone results. This is shown here for reference only.

ID	Year 8 – Project alone				Year 8 - Project and other sources		
	24-hour PM_{10} ($\mu g/m^3$)	Annual PM_{10} ($\mu g/m^3$)	Annual TSP ($\mu g/m^3$)	Annual Dust deposition ($g/m^2/month$)	Annual PM_{10} ($\mu g/m^3$)	Annual TSP ($\mu g/m^3$)	Annual Dust deposition ($g/m^2/month$)
	Assessment criteria						
	50[1]	*N/A*	*N/A*	*2*	*30*	*90*	*4*
251	26	5	13	0.3	17	44	1.2
253	27	5	13	0.3	17	44	1.2
254	27	5	13	0.3	17	44	1.2
254	27	5	13	0.3	17	44	1.2
255	27	5	13	0.3	17	44	1.2
256	29	5	14	0.3	17	45	1.2
257	29	5	14	0.3	17	45	1.2
258	36	6	16	0.4	18	47	1.3
262[a]	23	4	11	0.2	16	42	1.1
263	23	4	11	0.2	16	42	1.1
264	23	4	11	0.2	16	42	1.1
267	24	5	12	0.2	17	43	1.1
268	24	5	12	0.2	17	43	1.1
270	23	4	11	0.2	16	42	1.1
270	23	4	11	0.2	16	42	1.1
271	24	4	11	0.2	16	42	1.1
272[a]	25	5	12	0.3	17	43	1.2
272[a]	25	5	12	0.3	17	43	1.2
272[a]	25	5	12	0.3	17	43	1.2
272[a]	25	5	12	0.3	17	43	1.2
273	20	4	10	0.2	16	41	1.1
273	20	4	10	0.2	16	41	1.1
275	20	4	10	0.2	16	41	1.1
276	21	4	10	0.2	16	41	1.1
276	21	4	10	0.2	16	41	1.1
277	21	4	10	0.2	16	41	1.1
278	21	4	10	0.2	16	41	1.1
279	21	4	10	0.2	16	41	1.1
280	21	4	10	0.2	16	41	1.1
281	21	4	10	0.2	16	41	1.1
283	22	4	11	0.2	16	42	1.1
284	23	4	11	0.2	16	42	1.1
285	23	4	11	0.2	16	42	1.1
288	24	4	11	0.2	16	42	1.1
289	25	5	12	0.2	17	43	1.1
291	26	5	13	0.3	17	44	1.2
296	28	5	13	0.3	17	44	1.2
297	28	5	13	0.3	17	44	1.2
298	28	5	13	0.3	17	44	1.2
301	28	5	13	0.3	17	44	1.2
302	29	5	13	0.3	17	44	1.2
304	29	5	13	0.3	17	44	1.2
305	29	5	13	0.3	17	44	1.2
306	30	5	14	0.3	17	45	1.2
308	30	5	14	0.3	17	45	1.2
309	30	5	14	0.3	17	45	1.2
311	33	6	15	0.3	18	46	1.2
312	33	6	15	0.3	18	46	1.2
313	33	6	15	0.3	18	46	1.2
314	34	6	15	0.3	18	46	1.2
315	27	5	12	0.3	17	43	1.2
315	28	5	13	0.3	17	44	1.2
316	26	5	12	0.3	17	43	1.2
317	26	5	12	0.3	17	43	1.2
318	26	5	12	0.3	17	43	1.2
321	29	5	13	0.3	17	44	1.2
325	35	6	15	0.3	18	46	1.2
326	40	6	16	0.4	18	47	1.3
327	45	7	18	0.4	19	49	1.3
328	20	4	9	0.2	16	40	1.1
329	19	4	9	0.2	16	40	1.1
330	18	3	9	0.2	15	40	1.1
331	17	3	8	0.2	15	39	1.1
332	17	3	8	0.2	15	39	1.1
333	17	3	8	0.2	15	39	1.1
335	16	3	8	0.2	15	39	1.1
342	17	3	8	0.2	15	39	1.1

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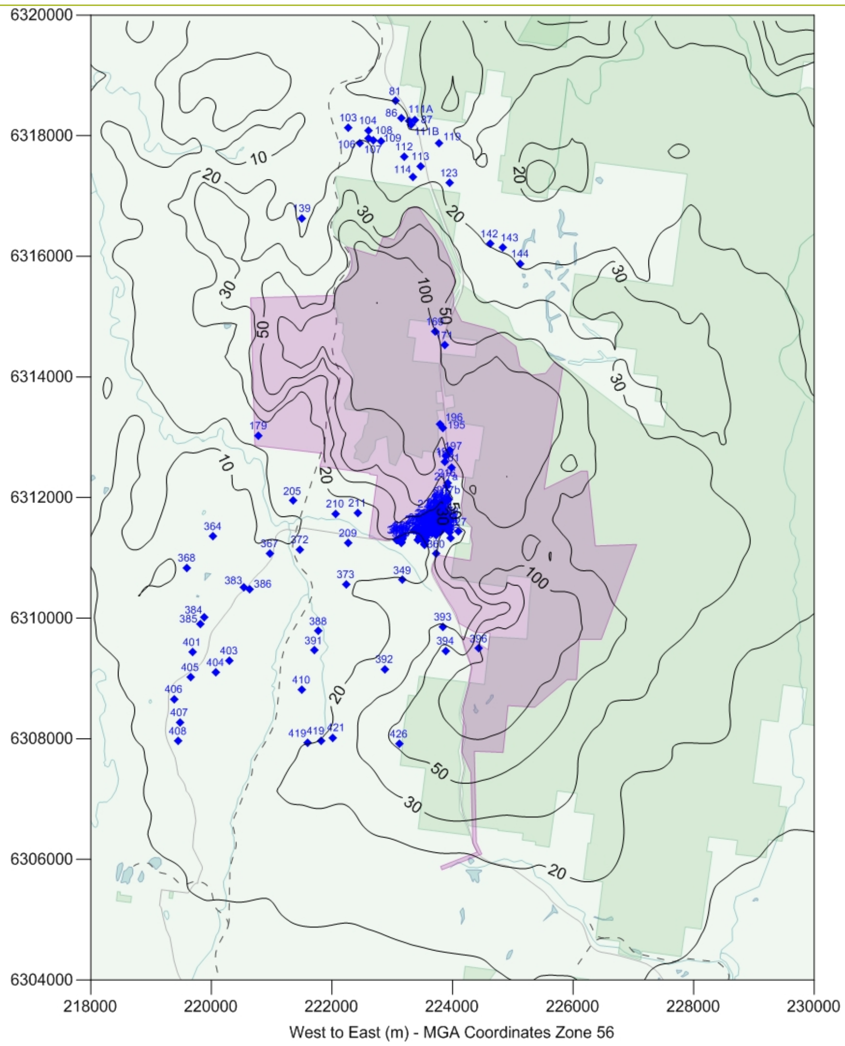
ID	Year 8 – Project alone				Year 8 - Project and other sources		
	24-hour PM_{10} (µg/m^3)	Annual PM_{10} (µg/m^3)	Annual TSP (µg/m^3)	Annual Dust deposition (g/m^2/month)	Annual PM_{10} (µg/m^3)	Annual TSP (µg/m^3)	Annual Dust deposition (g/m^2/month)
	Assessment criteria						
ID	*50[1]*	*N/A*	*N/A*	*2*	*30*	*90*	*4*
343	17	3	8	0.2	15	39	1.1
344	17	3	8	0.2	15	39	1.1
345	18	3	8	0.2	15	39	1.1
347	19	3	9	0.2	15	40	1.1
349	20	4	10	0.2	16	41	1.1
350	19	4	9	0.2	16	40	1.1
350	19	4	9	0.2	16	40	1.1
350	19	4	9	0.2	16	40	1.1
350	20	4	10	0.2	16	41	1.1
350	20	4	10	0.2	16	41	1.1
352	21	4	10	0.2	16	41	1.1
352	22	4	11	0.2	16	42	1.1
353	20	4	10	0.2	16	41	1.1
354	20	4	10	0.2	16	41	1.1
355	20	4	10	0.2	16	41	1.1
356	20	4	10	0.2	16	41	1.1
357	19	4	9	0.2	16	40	1.1
358	13	4	9	0.2	16	41	1.1
360[a]	12	3	8	0.2	16	40	1.1
364	16	4	10	0.2	17	42	1.1
367	13	3	7	0.2	16	39	1.1
368	14	3	9	0.2	16	41	1.1
372	15	3	8	0.1	16	40	1.0
373	15	3	9	0.1	16	41	1.0
383	15	3	9	0.2	16	41	1.1
384	19	4	9	0.2	16	40	1.1
385	26	5	12	0.3	17	43	1.2
386	17	3	8	0.2	15	39	1.1
388	12	3	7	0.1	15	38	1.0
391	14	3	8	0.2	16	40	1.1
392	21	5	12	0.3	17	43	1.2
393[b]	31	7	18	0.4	19	49	1.3
394[b]	**64**	13	34	0.7	25	65	1.6
396[b]	**74**	18	47	1.5	30	78	2.4
401	17	4	9	0.1	17	41	1.0
403	14	3	8	0.1	16	40	1.0
404	14	3	8	0.1	16	40	1.0
405	15	3	8	0.1	16	40	1.0
406	13	3	7	0.2	16	39	1.1
407	13	3	7	0.1	16	39	1.0
408	12	3	7	0.1	16	39	1.0
410	18	4	9	0.2	17	41	1.1
419	20	3	9	0.1	16	41	1.0
419	21	3	8	0.1	16	40	1.0
421	22	4	9	0.1	17	41	1.0
426	**53**	5	14	0.2	17	45	1.1

[a] Crown-owned
[b] Coalpac-owned
[c] Located within Project Boundary



Species: PM10	**Averaging Time:** 24-hour	**Percentile:** Maximum	**Scenario:** Year 8 Project alone	**Location:** Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** $\mu g/m^3$	**Assessment criteria:** N/A	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.8: Predicted 24-hour average PM_{10} concentrations due to emissions from the Project alone in Year 8

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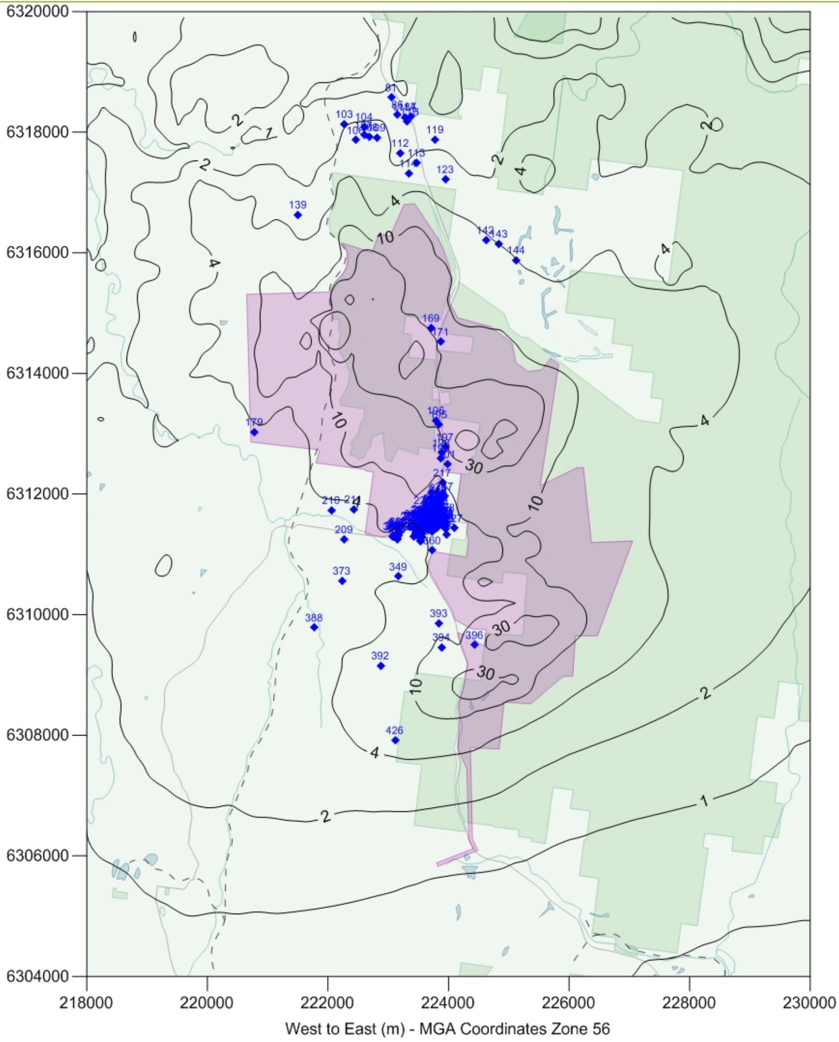
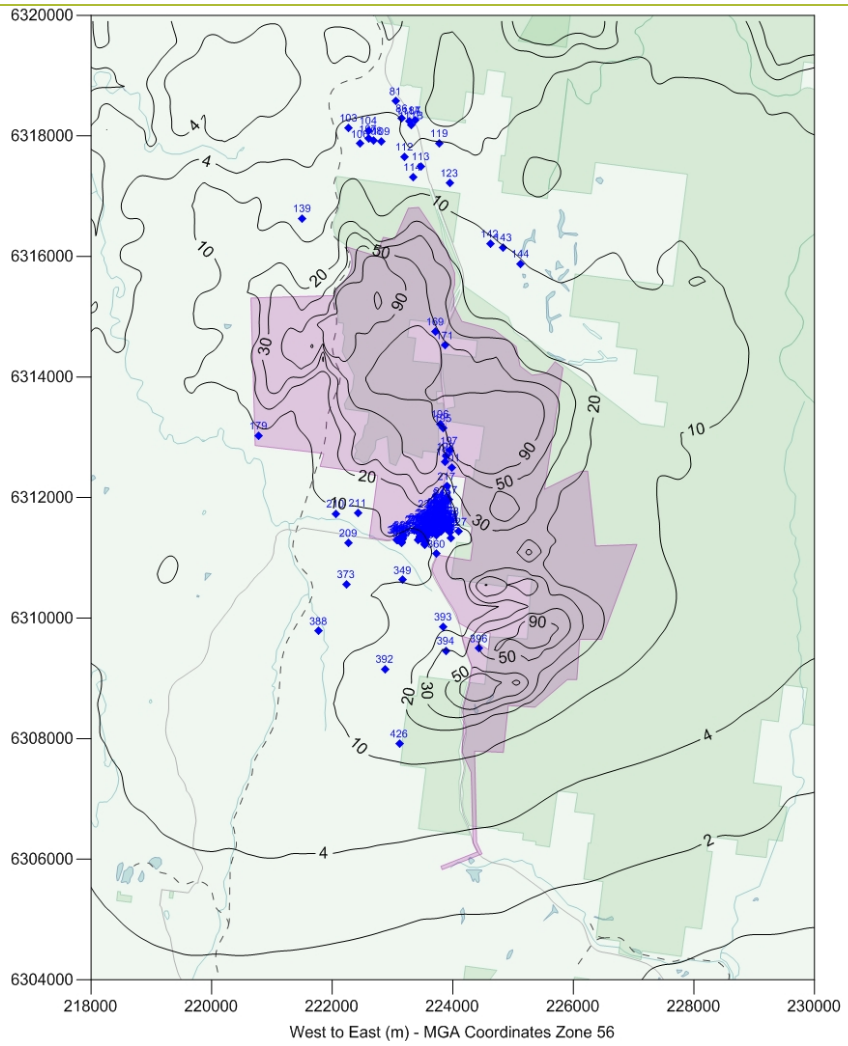


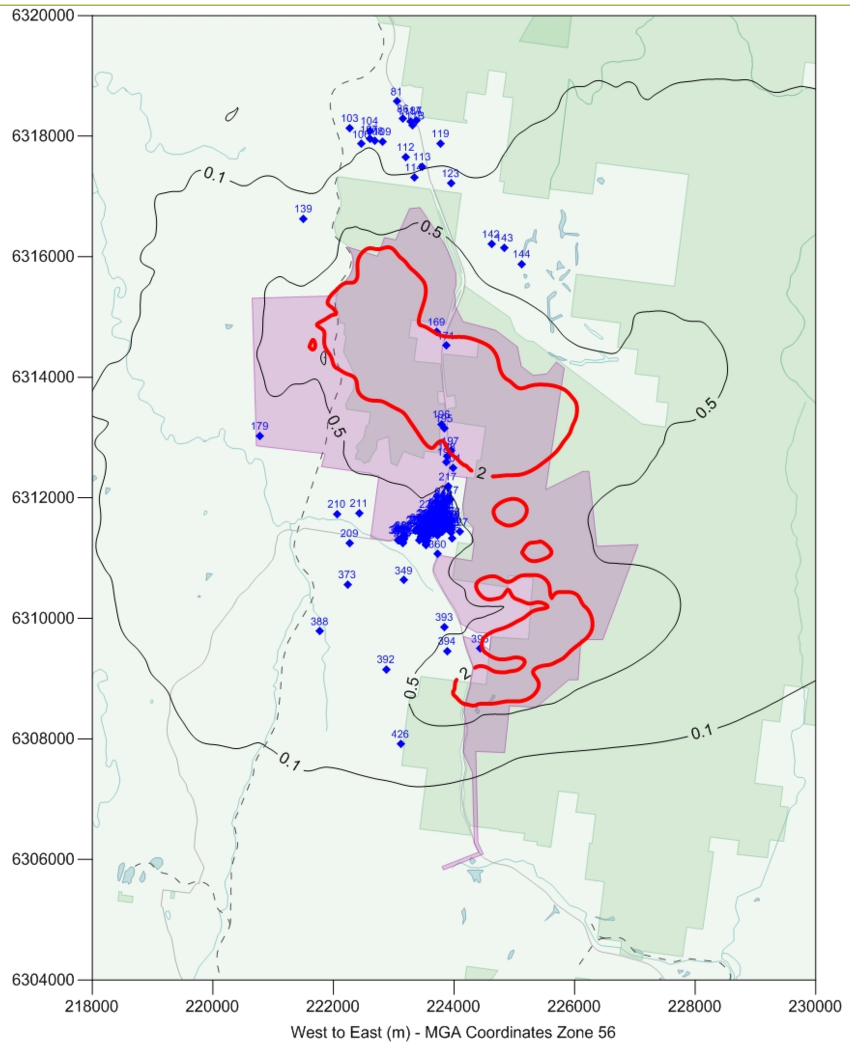
Species: PM$_{10}$	**Averaging Time:** Annual	**Percentile:**	**Scenario:** Year 8 Project alone	**Location:** Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** µg/m^3	**Assessment criteria:** N/A	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.9: Predicted annual average PM$_{10}$ concentrations due to emissions from the Project alone in Year 8



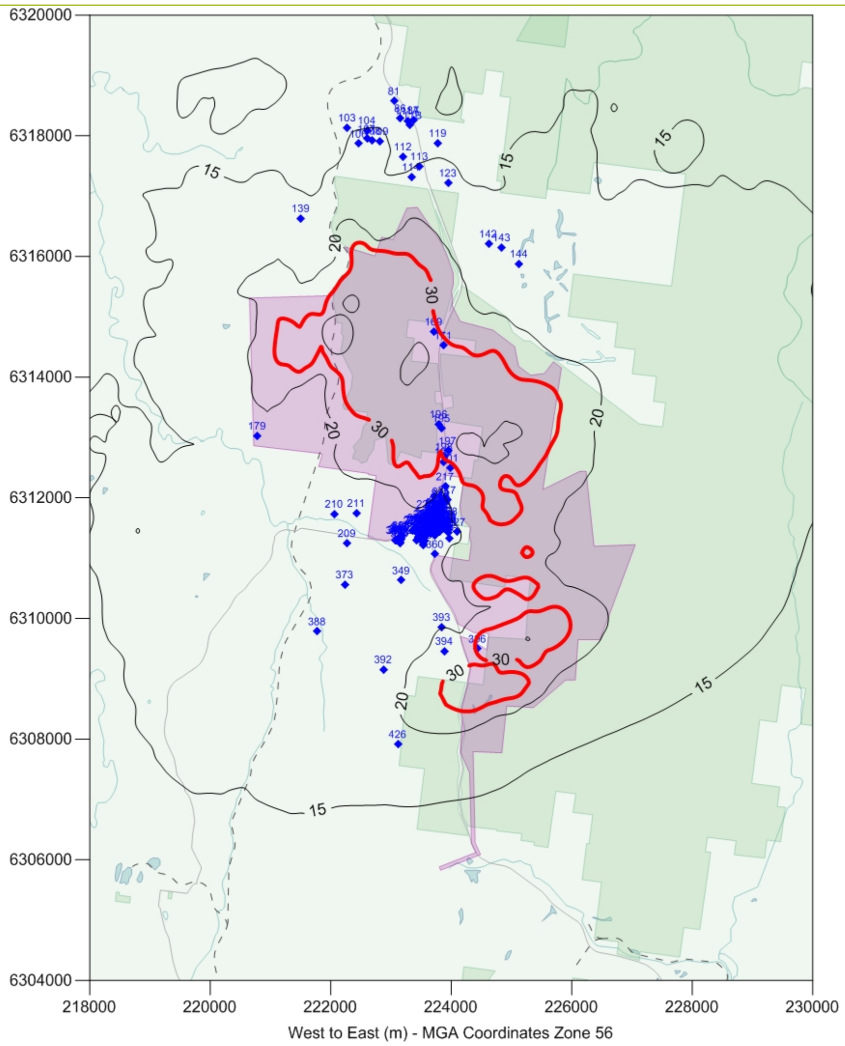
Species: TSP	Averaging Time: Annual	Percentile:	Scenario: Year 8 Project alone	Location: Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** µg/m^3	**Assessment criteria:** N/A	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.10: Predicted annual average TSP concentrations due to emissions from the Project alone in Year 8



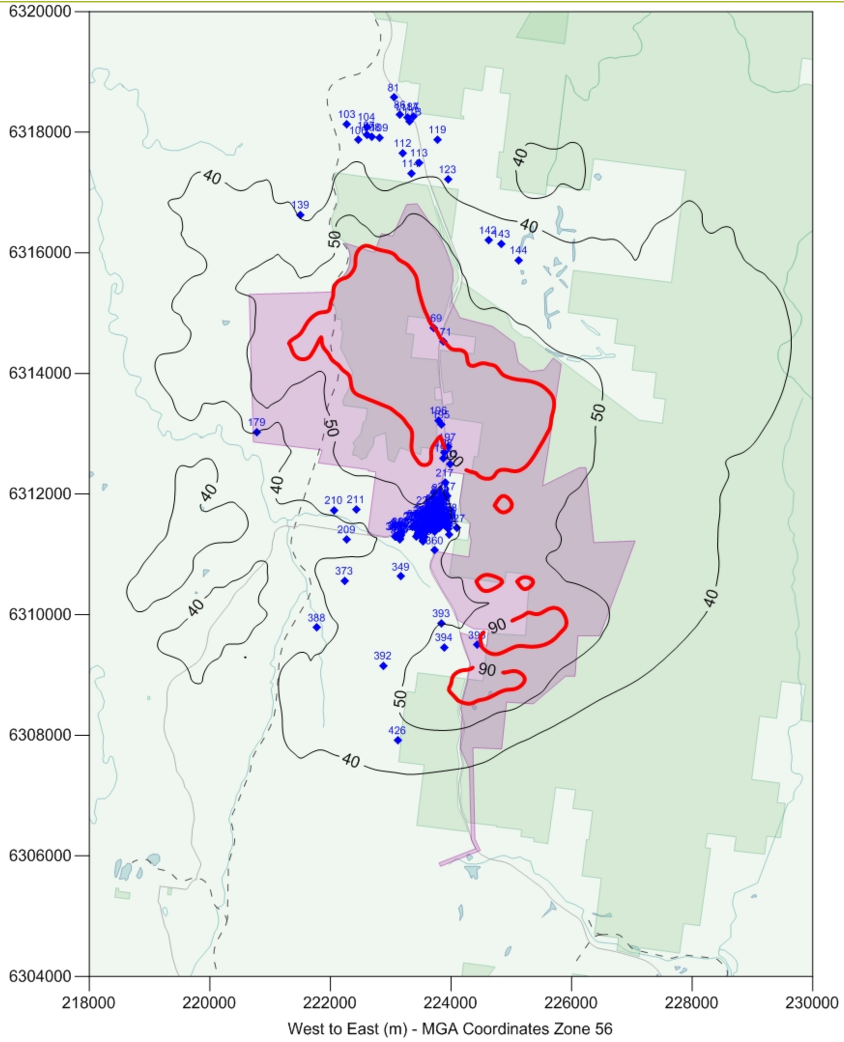
Species: Dust Deposition	**Averaging Time:** Annual	**Percentile:**	**Scenario:** Year 8 Project only	**Location:** Coalpac Mine Project
Model Used: CALPUFF v6.263	**Units:** g/m^2/month	**Assessment criteria:** DECCW= 2 g/m^2/month (shown as a bold red line)	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.11: Predicted annual average dust deposition levels due to emissions from the Project alone in Year 8



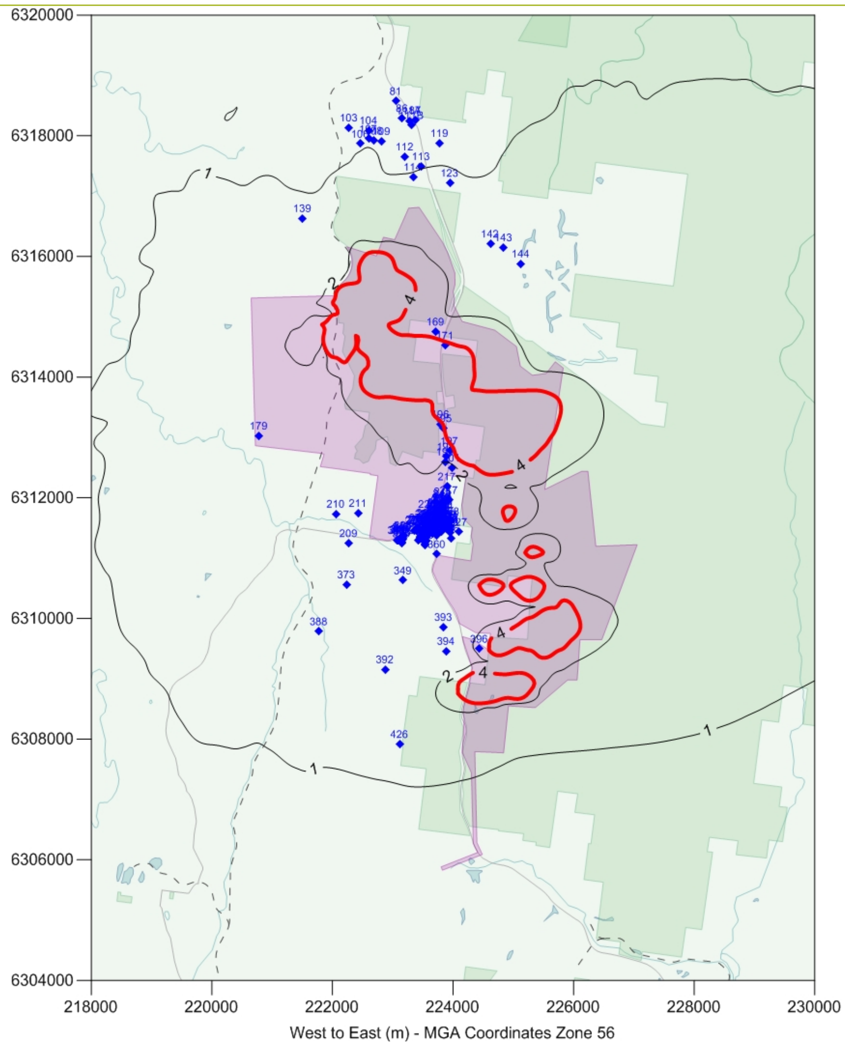
Species: PM10	**Averaging Time:** Annual	**Percentile:**	**Scenario:** Year 8 Project and other sources	**Location:** Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** µg/m³	**Assessment criteria:** DECCW = 30 µg/m³ (shown as a bold red line)	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.12: Predicted annual average PM_{10} concentrations due to emissions from the Project and other sources in Year 8



Species: TSP	Averaging Time: Annual	Percentile:	Scenario: Year 8 Project and other sources	Location: Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** µg/m^3	**Assessment criteria:** DECCW = 90 µg/m^3 (shown as a bold red line)	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.13: Predicted annual average TSP concentrations due to emissions from the Project and other sources in Year 8



Species: Dust Deposition	Averaging Time: Annual	Percentile:	Scenario: Year 8 Project and other sources	Location: Coalpac Consolidation Project
Model Used: CALPUFF v6.263	Units: g/m^2/month	Assessment criteria: DECCW = 4 g/m^2/month (shown as a bold red line)	Met Data: Coalpac, 2009 (CALMET)	Plot: F Triffett

Figure 8.14: Predicted annual average dust deposition levels due to emissions from the Project and other sources in Year 8

8.2.3 Year 14

Modelling results for Year 14 show exceedances of the 24-hour PM_{10} and annual criteria at some sensitive receptors. **Table 8.5** provides a summary of properties predicted to exceed the relevant criteria in Year 14.

Table 8.6 presents a summary of the Year 14 predicted concentrations at each of the nearby sensitive receptors, due to the operations of the Project alone and the Project and other sources.

Figure 8.15 to **Figure 8.21** show the predicted 24-hour average, annual average PM_{10}, TSP concentrations and dust deposition levels in Year 14 due to the operations of the Project alone and the Project and other sources.

Table 8.5: Summary of receptors predicted to exceed the criteria in Year 14

Receptor ID	Ownership Details	24-hour PM_{10} Mine Alone (µg/m³)	Annual PM_{10} Mine & Other Sources (µg/m³)	Annual TSP Mine & Other Sources (µg/m³)	Annual Dust Deposition Mine Alone (g/m²/month)	Annual Dust Deposition Mine & Other Sources (g/m²/month)
169[a]	Portland Road Pastoral Co Pty Ltd	119	42	109	2.3	
171[a]	Portland Road Pastoral Co Pty Ltd	120	45	114	3.6	4.5
195[b]	KJ Blackley	160	56	145	4.3	5.2
196[b]	Crown-owned	150	52	133	3.6	4.5
197[b]	BE & CE Leisemann & IL & Kid Follington	65	-	-	-	-
198[b]	DA Tilley	59	-	-	-	-
199[b]	DA Tilley	60	-	-	-	-
394[a]	Coalpac	63	-	-	-	-
396[a]	Coalpac	58	-	-	-	-

[a] Coalpac-owned
[b] Located within Project Boundary

Table 8.6: Year 14 – predicted PM_{10} and TSP concentrations and dust deposition levels due to the Project alone and the Project and other sources

ID	Year 14 – Project alone				Year 14 - Project and other sources		
	24-hour PM_{10} ($\mu g/m^3$)	Annual PM_{10} ($\mu g/m^3$)	Annual TSP ($\mu g/m^3$)	Annual Dust deposition ($g/m^2/month$)	Annual PM_{10} ($\mu g/m^3$)	Annual TSP ($\mu g/m^3$)	Dust deposition ($g/m^2/month$)
	Assessment criteria						
	50[1]	*N/A*	*N/A*	*2*	*30*	*90*	*4*
Sensitive receptors							
81	12	1	4	0.0	13	35	0.9
86[a]	15	2	5	0.1	14	36	1.0
87	12	2	4	0.1	14	35	1.0
103	21	2	6	0.1	14	37	1.0
104	23	3	7	0.1	15	38	1.0
106	26	3	8	0.1	15	39	1.0
107	25	3	8	0.1	15	39	1.0
108	25	3	8	0.1	15	39	1.0
109	23	3	8	0.1	15	39	1.0
111A	16	2	6	0.1	14	37	1.0
111B	18	3	7	0.1	15	38	1.0
112	12	2	4	0.1	14	35	1.0
113	12	1	4	0.1	13	35	1.0
114	19	3	8	0.1	15	39	1.0
119	15	2	5	0.1	14	36	1.0
123	21	3	9	0.2	15	40	1.1
139	21	4	9	0.2	16	40	1.1
142	24	5	13	0.3	17	44	1.2
143	22	5	12	0.3	17	43	1.2
144	21	5	12	0.3	17	43	1.2
169[b]	**119**	30	78	**2.3**	**42**	**109**	3.2
171[b]	**120**	33	83	**3.6**	**45**	**114**	**4.5**
179[c]	16	4	11	0.2	16	42	1.1
195[c]	**160**	44	114	**4.3**	**56**	**145**	**5.2**
196[ac]	**150**	40	102	**3.6**	**52**	**133**	**4.5**
197[c]	**65**	15	39	1.1	27	70	2.0
198[c]	**59**	13	34	0.9	25	65	1.8
199[c]	**60**	13	33	0.8	25	64	1.7
205	16	4	9	0.2	16	41	1.1
209	14	3	8	0.2	15	39	1.1
210	14	3	8	0.2	15	39	1.1
211	17	4	9	0.2	16	40	1.1
216	46	8	26	0.5	21	53	1.4
217a[a]	46	8	20	0.5	20	51	1.4
217b[a]	46	8	20	0.5	20	51	1.4
220	33	6	14	0.3	18	45	1.2
223	32	5	14	0.3	17	45	1.2
225	32	5	14	0.3	17	45	1.2
227	32	5	14	0.3	17	45	1.2
228	32	6	14	0.3	18	45	1.2
229	32	6	14	0.3	18	45	1.2
230	33	6	14	0.3	18	45	1.2
231	33	6	14	0.3	18	45	1.2
232	33	6	15	0.3	18	46	1.2
235	36	6	16	0.4	18	47	1.3
235	36	6	16	0.4	18	47	1.3
236	37	6	16	0.4	18	47	1.3
237	36	6	16	0.4	18	47	1.3
238	36	6	16	0.4	18	47	1.3
238	37	6	16	0.4	18	47	1.3
239	36	6	16	0.4	18	47	1.3
240	37	6	16	0.4	18	47	1.3
242	37	6	16	0.4	18	47	1.3
243	38	6	17	0.4	18	48	1.3
245	39	7	17	0.4	19	48	1.3
247	34	6	15	0.3	18	46	1.2
248	34	6	15	0.3	18	46	1.2
250	35	6	15	0.4	18	46	1.3

[1] 50 $\mu g/m^3$ refers to the cumulative criterion and should not be applied to Project alone results. This is shown here for reference only.

	Year 14 – Project alone				Year 14 - Project and other sources		
	24-hour PM_{10} (µg/m³)	Annual PM_{10} (µg/m³)	Annual TSP (µg/m³)	Annual Dust deposition (g/m²/month)	Annual PM_{10} (µg/m³)	Annual TSP (µg/m³)	Dust deposition (g/m²/month)
	Assessment criteria						
ID	*50[1]*	*N/A*	*N/A*	*2*	*30*	*90*	*4*
251	34	6	15	0.3	18	46	1.2
253	34	6	15	0.3	18	46	1.2
254	34	6	15	0.3	18	46	1.2
254	35	6	16	0.4	18	47	1.3
255	35	6	16	0.4	18	47	1.3
256	37	6	16	0.4	18	47	1.3
257	37	6	16	0.4	18	47	1.3
258	45	8	20	0.5	20	51	1.4
262[a]	28	5	12	0.3	17	43	1.2
263	29	5	13	0.3	17	44	1.2
264	29	5	13	0.3	17	44	1.2
267	30	5	13	0.3	17	44	1.2
268	30	5	13	0.3	17	44	1.2
270	29	5	12	0.3	17	43	1.2
270	29	5	13	0.3	17	44	1.2
271	30	5	13	0.3	17	44	1.2
272[a]	32	5	14	0.3	17	45	1.2
272[a]	32	5	14	0.3	17	45	1.2
272[a]	32	5	14	0.3	17	45	1.2
272[a]	32	5	14	0.3	17	45	1.2
273	24	4	11	0.2	16	42	1.1
273	25	4	11	0.2	16	42	1.1
275	25	4	11	0.2	16	42	1.1
276	26	4	11	0.3	16	42	1.2
276	26	4	11	0.3	16	42	1.2
277	26	4	11	0.3	16	42	1.2
278	26	4	11	0.3	16	42	1.2
279	26	4	11	0.3	16	42	1.2
280	26	5	12	0.3	17	43	1.2
281	27	5	12	0.3	17	43	1.2
283	28	5	12	0.3	17	43	1.2
284	29	5	13	0.3	17	44	1.2
285	30	5	13	0.3	17	44	1.2
288	31	5	13	0.3	17	44	1.2
289	32	5	14	0.3	17	45	1.2
291	34	6	15	0.3	18	46	1.2
296	35	6	16	0.4	18	47	1.3
297	36	6	16	0.4	18	47	1.3
298	36	6	16	0.4	18	47	1.3
301	37	6	16	0.4	18	47	1.3
302	37	6	16	0.4	18	47	1.3
304	37	6	16	0.4	18	47	1.3
305	37	6	17	0.4	18	48	1.3
306	38	7	17	0.4	19	48	1.3
308	38	7	17	0.4	19	48	1.3
309	38	7	17	0.4	19	48	1.3
311	42	7	19	0.5	19	50	1.4
312	42	7	19	0.5	19	50	1.4
313	41	7	18	0.5	19	49	1.4
314	42	7	19	0.5	19	50	1.4
315	34	6	15	0.4	18	46	1.3
315	36	6	16	0.4	18	47	1.3
316	34	6	15	0.3	18	46	1.2
317	33	6	14	0.3	18	45	1.2
318	34	6	15	0.3	18	46	1.2
321	37	6	16	0.4	18	47	1.3
325	43	8	19	0.5	20	50	1.4
326	47	8	21	0.5	20	52	1.4
327	50	9	23	0.6	21	54	1.5
328	23	4	10	0.2	16	41	1.1
329	22	4	10	0.2	16	41	1.1
330	21	4	10	0.2	16	41	1.1
331	20	4	9	0.2	16	40	1.1
332	20	4	9	0.2	16	40	1.1
333	20	4	9	0.2	16	40	1.1
335	20	4	9	0.2	16	40	1.1

	Year 14 – Project alone				Year 14 - Project and other sources		
	24-hour PM_{10} (µg/m³)	Annual PM_{10} (µg/m³)	Annual TSP (µg/m³)	Annual Dust deposition (g/m²/month)	Annual PM_{10} (µg/m³)	Annual TSP (µg/m³)	Dust deposition (g/m²/month)
	Assessment criteria						
ID	*50[1]*	*N/A*	*N/A*	*2*	*30*	*90*	*4*
342	19	4	9	0.2	16	40	1.1
343	19	4	9	0.2	16	40	1.1
344	20	4	9	0.2	16	40	1.1
345	21	4	9	0.2	16	40	1.1
347	22	4	10	0.2	16	41	1.1
349	25	4	11	0.2	16	42	1.1
350	23	4	10	0.2	16	41	1.1
350	23	4	11	0.2	16	42	1.1
350	24	4	11	0.3	16	42	1.2
350	24	4	11	0.3	16	42	1.2
350	25	4	11	0.3	16	42	1.2
352	26	5	12	0.3	17	43	1.2
352	28	5	12	0.3	17	43	1.2
353	25	4	11	0.3	16	42	1.2
354	25	4	11	0.3	16	42	1.2
355	25	4	11	0.3	16	42	1.2
356	25	4	11	0.3	16	42	1.2
357	24	4	11	0.3	16	42	1.2
358	24	4	11	0.3	16	42	1.2
360[a]	33	6	15	0.4	18	46	1.3
364	19	4	13	0.2	17	42	1.1
367	15	3	9	0.2	16	40	1.1
368	20	4	13	0.2	17	42	1.1
372	13	3	8	0.2	16	40	1.1
373	19	4	9	0.2	16	40	1.1
383	17	4	11	0.2	17	41	1.1
384	17	4	11	0.1	17	41	1.0
385	18	4	11	0.1	17	41	1.0
386	17	4	11	0.2	17	41	1.1
388	14	3	7	0.1	15	38	1.0
391	16	3	8	0.2	16	40	1.1
392	24	5	12	0.2	17	43	1.1
393[b]	35	7	17	0.4	19	48	1.3
394[b]	**63**	11	28	0.5	23	59	1.4
396[b]	**58**	15	38	1.7	27	69	2.6
401	22	4	11	0.1	17	42	1.0
403	16	3	10	0.1	16	41	1.0
404	15	3	9	0.1	16	40	1.0
405	17	3	10	0.1	16	41	1.0
406	14	3	8	0.1	16	39	1.0
407	14	3	8	0.1	16	39	1.0
408	14	3	8	0.1	16	39	1.0
410	18	4	10	0.1	17	41	1.0
419	19	3	10	0.1	16	41	1.0
419	18	3	10	0.1	16	40	1.0
421	19	3	11	0.1	16	41	1.0
426	45	6	14	0.2	18	45	1.1

[a] Crown-owned
[b] Coalpac-owned
[c] Located within Project Boundary

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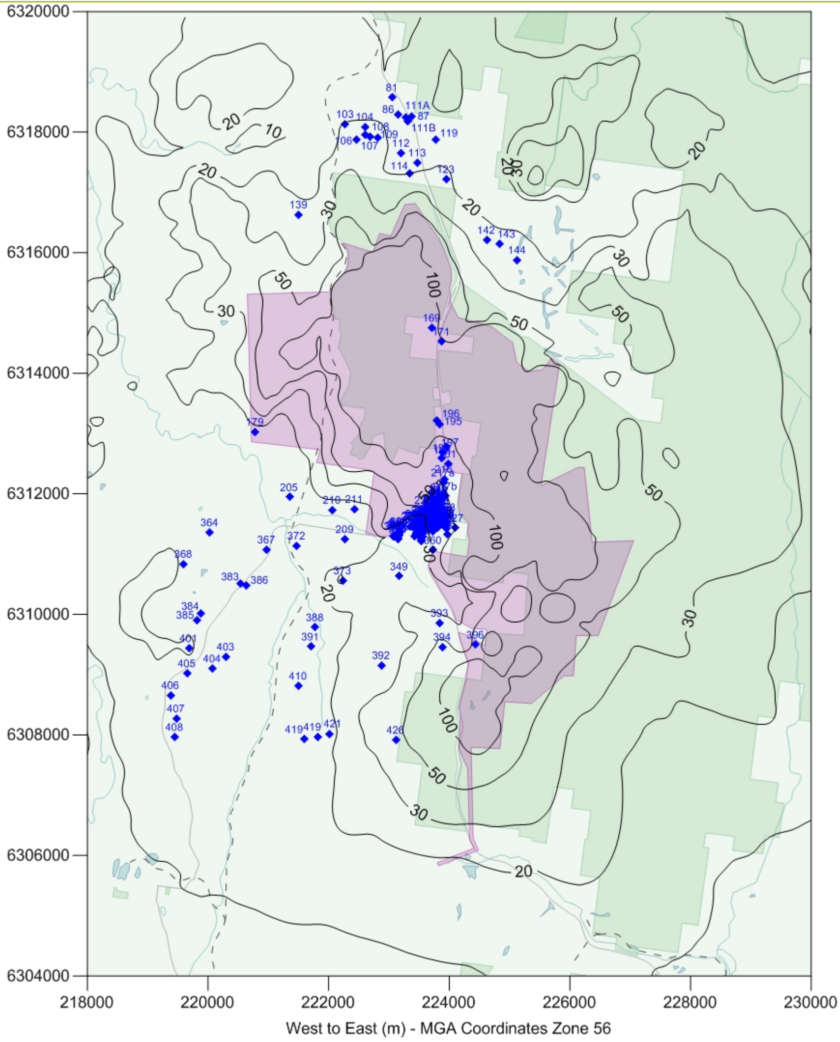
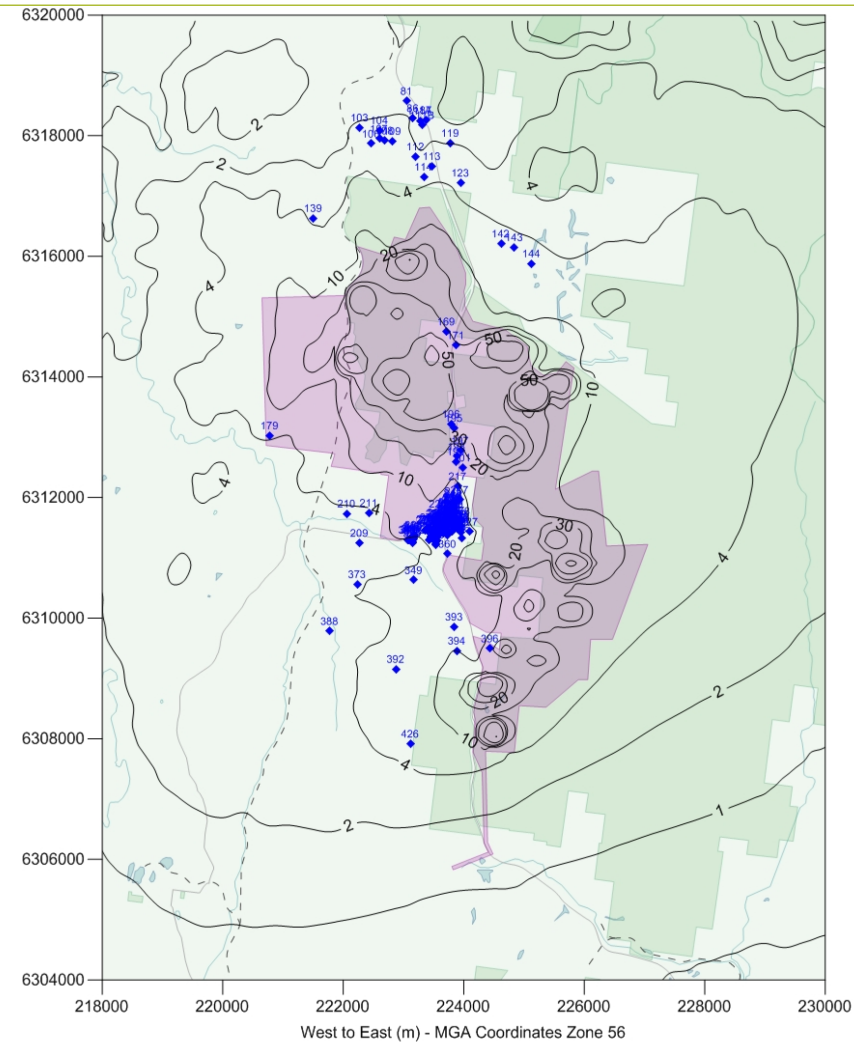


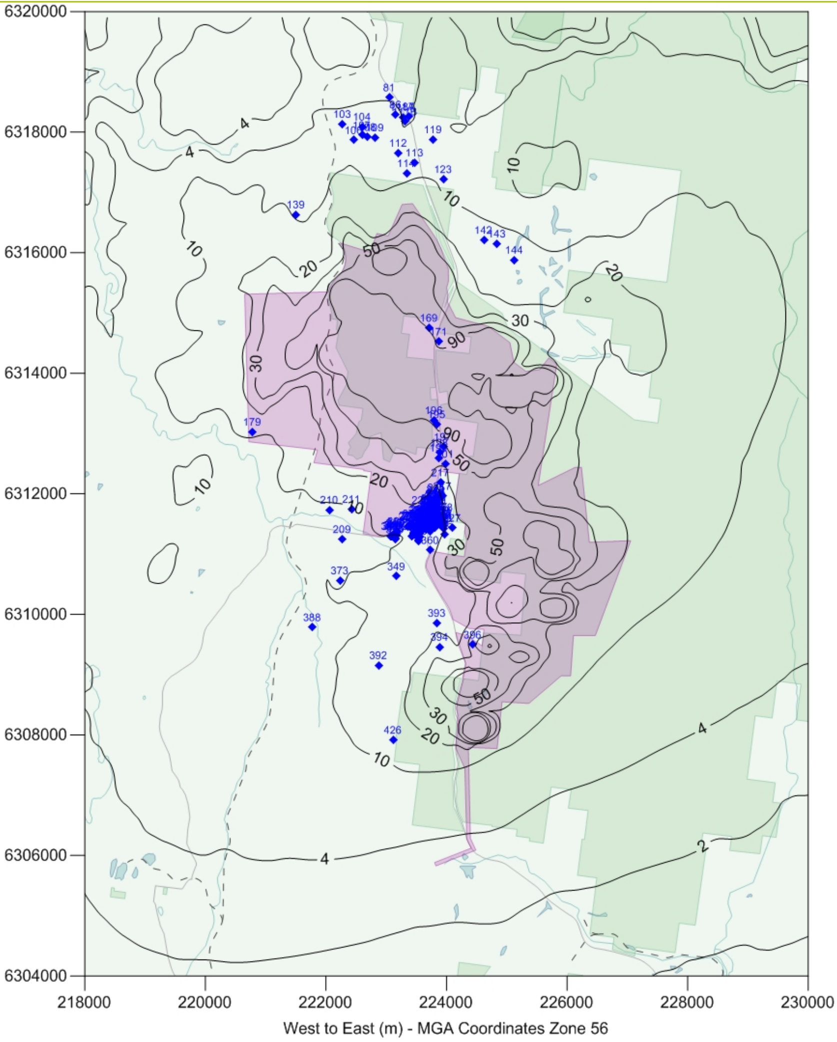
Species: PM_{10}	Averaging Time: 24-hour	Percentile: Maximum	Scenario: Year 14 Project alone	Location: Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** $\mu g/m^3$	**Assessment criteria:** N/A	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.15: Predicted 24-hour average PM_{10} concentrations due to emissions from the Project alone in Year 14



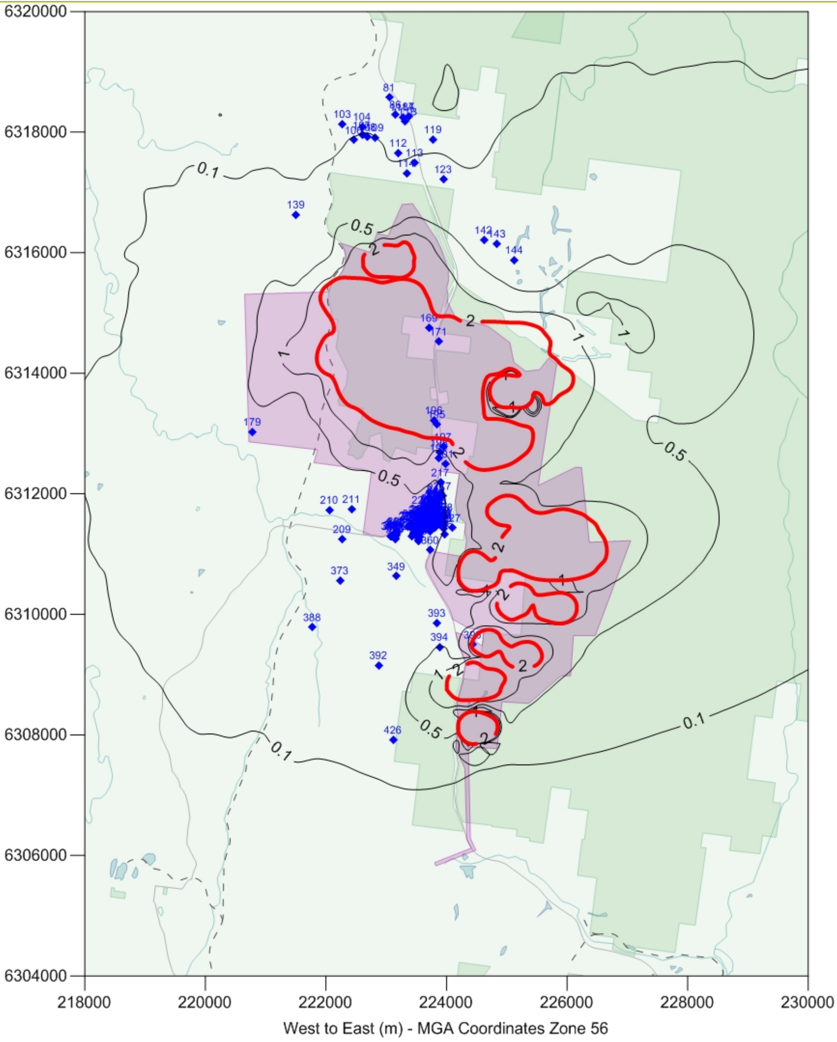
Species: PM10	**Averaging Time:** Annual	**Percentile:**	**Scenario:** Year 14 Project alone	**Location:** Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** µg/m^3	**Assessment criteria:** N/A	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.16: Predicted annual average PM_{10} concentrations due to emissions from the Project alone in Year 14



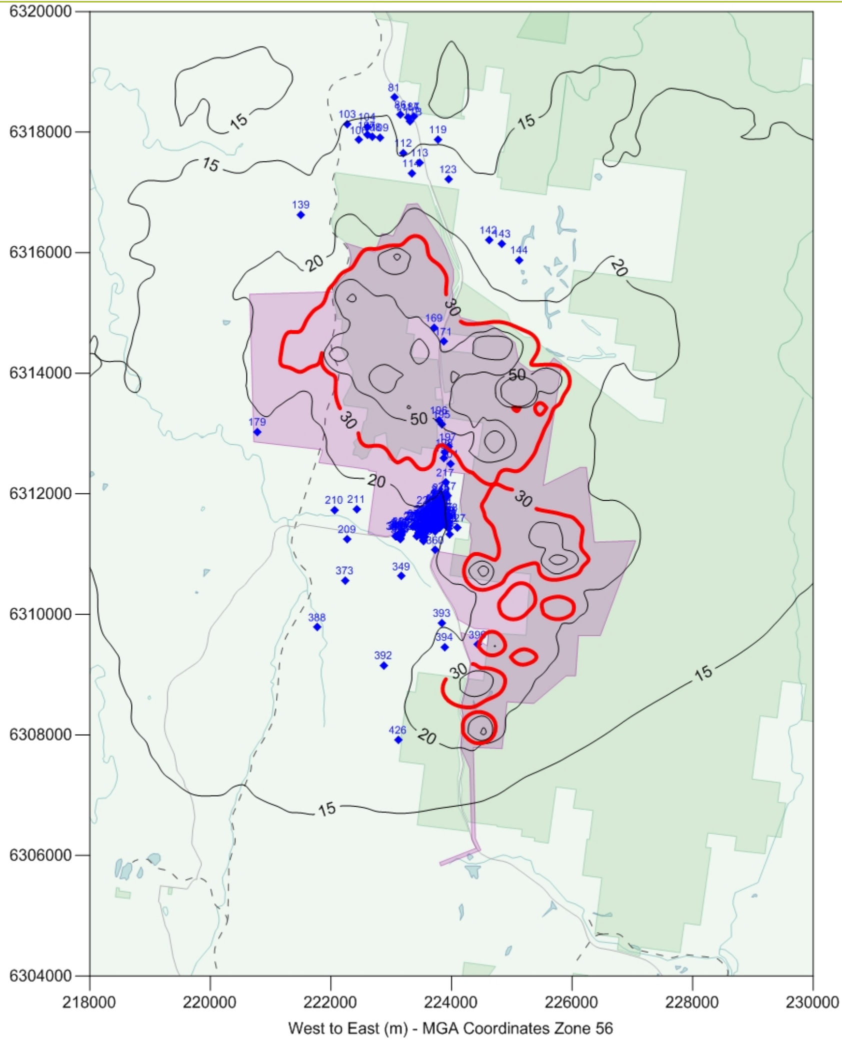
Species: PM$_{10}$	Averaging Time: TSP	Percentile:	Scenario: Year 14 Project alone	Location: Coalpac Consolidation Project
Model Used: CALPUFF v6.263	Units: µg/m^3	Assessment criteria: N/A	Met Data: Coalpac, 2009 (CALMET)	Plot: F Triffett

Figure 8.17: Predicted annual average TSP concentrations due to emissions from the Project alone in Year 14



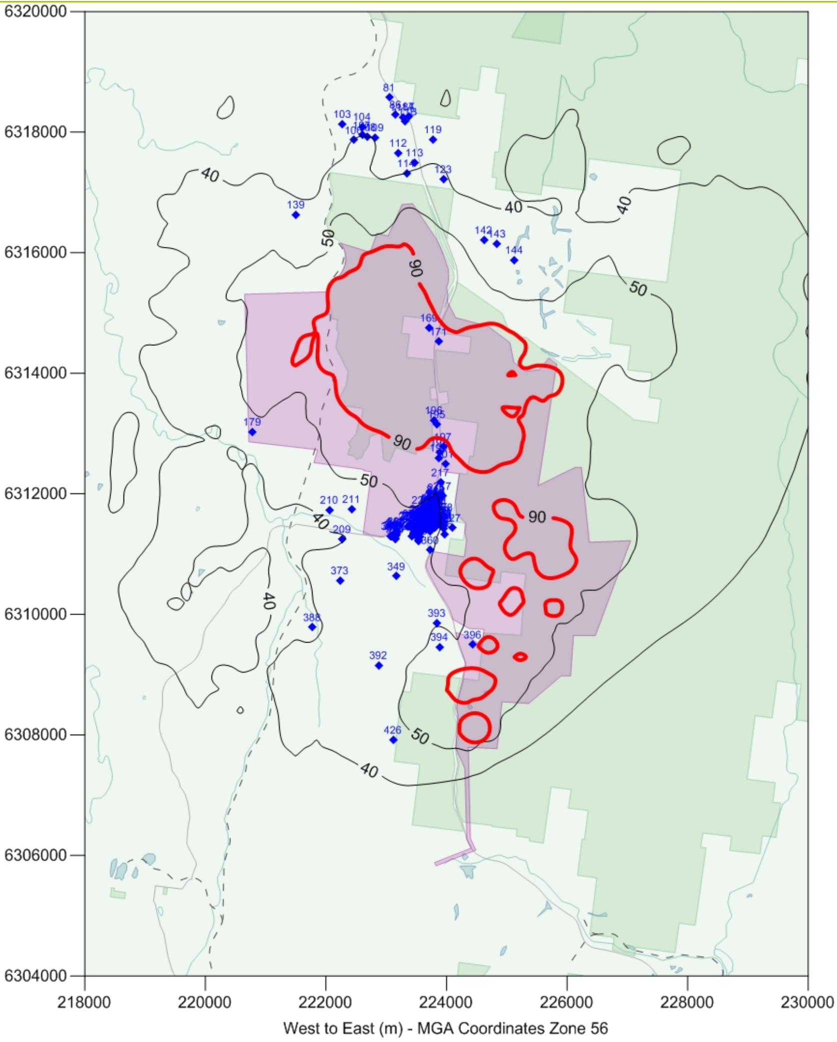
Species: Dust Deposition	**Averaging Time:** Annual	**Percentile:**	**Scenario:** Year 14 Project alone	**Location:** Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** g/m^2/month	**Assessment criteria:** DECCW = 2 g/m^2/month (shown as a bold red line)	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.18: Predicted annual average dust deposition levels due to emissions from the Project alone in Year 14



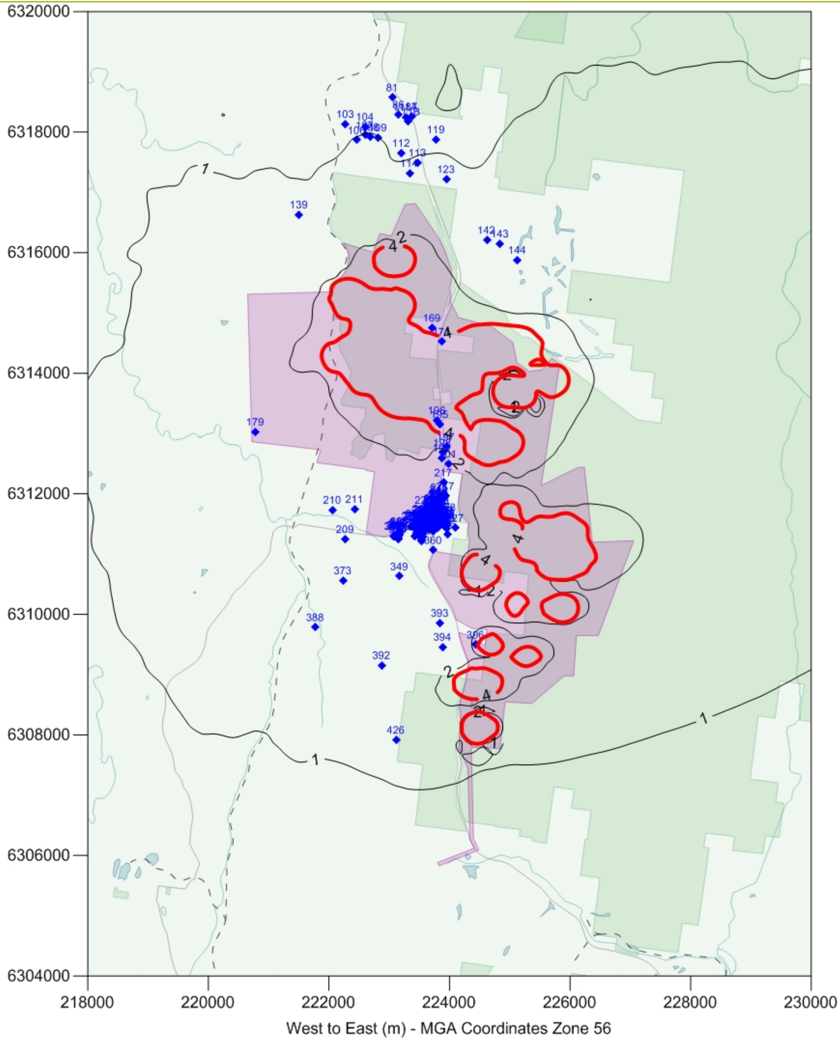
Species:	Averaging Time:	Percentile:	Scenario:	Location:
PM_{10}	Annual		Year 14 Project and other sources	Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** $\mu g/m^3$	**Assessment criteria:** DECCW = 30 $\mu g/m^3$ (shown as a bold red line)	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.19: Predicted annual average PM_{10} concentrations due to emissions from the Project and other sources in Year 14



Species: PM$_{10}$	**Averaging Time:** TSP	**Percentile:**	**Scenario:** Year 14 Project and other sources	**Location:** Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** µg/m^3	**Assessment criteria:** DECCW = 90 µg/m^3 (shown as a bold red line)	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.20: Predicted annual average TSP concentrations due to emissions from the Project and other sources in Year 14



Species:	**Averaging Time:**	**Percentile:**	**Scenario:**	**Location:**
Dust Deposition	Annual		Year 14 Project and other sources	Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** $g/m^2/month$	**Assessment criteria:** DECCW = 4 $g/m^2/month$ (shown as a bold red line)	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.21: Predicted annual average dust deposition levels due to emissions from the Project and other sources in Year 14

8.2.4 Year 20

Modelling results for Year 20 show exceedances of the 24-hour PM_{10} and annual criteria at some sensitive receptors. **Table 8.7** provides a summary of properties predicted to exceed relevant the criteria in Year 20.

Table 8.8 presents a summary of the Year 20 predicted concentrations at each of the nearby sensitive receptors, due to the operations of the Project alone and the Project and other sources.

Figure 8.22 to **Figure 8.28** show the predicted 24-hour average, annual average PM_{10}, TSP concentrations and dust deposition levels in Year 20 due to the operations of the Project alone and the Project and other sources.

Table 8.7: Summary of receptors predicted to exceed the criteria in Year 20

Receptor ID	Ownership Details	24-hour PM_{10} Mine Alone ($\mu g/m^3$)	Annual PM_{10} Mine & Other Sources ($\mu g/m^3$)	Annual TSP Mine & Other Sources ($\mu g/m^3$)	Annual Dust Deposition Mine Alone ($g/m^2/month$)	Annual Dust Deposition Mine & Other Sources ($g/m^2/month$)
169[a]	Portland Road Pastoral Co Pty Ltd	127	39	100	-	-
171[a]	Portland Road Pastoral Co Pty Ltd	90	35	90	-	-
195[b]	KJ Blackley	667	157	400	14.5	15.4
196[b]	Crown-owned	366	99	251	7.5	8.4
197[b]	BE & CE Leisemann & IL & Kid Follington	118	34	-	-	-
198[b]	DA Tilley	90	-	-	-	-
199[b]	DA Tilley	89	-	-	-	-
216	BM Emmott	56	-	-	-	-
217a	Crown-owned	57	-	-	-	-
217b	Crown-owned	58	-	-	-	-
258	S & H Filla	56	-	-	-	-
325	SP & SA Duggan	51	-	-	-	-
326	The Minister for Energy & Utilities	54	-	-	-	-
327	J Playford	58	-	-	-	-
394[a]	Coalpac	53	-	-	-	-

[a] Coalpac-owned
[b] Located within Project Boundary

Table 8.8: Year 20 – predicted PM_{10} and TSP concentrations and dust deposition levels due to the Project alone and the Project and other sources

ID	Year 20 – Project alone				Year 20 - Project and other sources		
	24-hour PM_{10} ($\mu g/m^3$)	Annual PM_{10} ($\mu g/m^3$)	Annual TSP ($\mu g/m^3$)	Annual Dust deposition ($g/m^2/month$)	Annual PM_{10} ($\mu g/m^3$)	Annual TSP ($\mu g/m^3$)	Dust deposition ($g/m^2/month$)
	Assessment criteria						
	50[1]	*N/A*	*N/A*	*2*	*30*	*90*	*4*
Sensitive receptors							
81	10	1	3	0.0	14	35	0.9
86[a]	11	1	3	0.0	14	35	0.9
87	10	1	3	0.0	14	35	0.9
103	17	2	4	0.1	15	36	1.0
104	18	2	5	0.1	15	37	1.0
106	20	2	6	0.1	15	38	1.0
107	19	2	6	0.1	15	38	1.0
108	20	2	6	0.1	15	38	1.0
109	18	2	6	0.1	15	37	1.0
111A	10	1	3	0.0	14	35	0.9
111B	10	1	3	0.0	14	35	0.9
112	13	2	4	0.1	14	36	1.0
113	14	2	5	0.1	15	37	1.0
114	15	2	6	0.1	15	38	1.0
119	11	1	4	0.1	14	36	1.0
123	17	3	6	0.1	15	38	1.0
139	19	3	7	0.1	15	39	1.0
142	22	4	9	0.2	16	41	1.1
143	20	3	8	0.2	16	40	1.1
144	19	3	9	0.2	16	41	1.1
169[b]	**127**	27	68	1.7	**39**	**100**	2.6
171[b]	**90**	23	58	2.3	**35**	**90**	3.2
179[c]	15	4	9	0.2	16	41	1.1
195[c]	**667**	144	368	**14.5**	**157**	**400**	**15.4**
196[ac]	**366**	86	219	**7.5**	**99**	**251**	**8.4**
197[c]	**118**	21	54	1.4	**34**	86	2.3
198[c]	**90**	17	43	1.1	30	75	2.0
199[c]	**89**	16	41	1.0	29	73	1.9
205	12	3	8	0.2	16	40	1.1
209	13	3	7	0.2	16	39	1.1
210	13	3	8	0.2	16	40	1.1
211	15	3	9	0.2	16	41	1.1
216	**56**	10	25	0.7	23	57	1.6
217a[a]	**57**	9	24	0.7	22	56	1.6
217b[a]	**58**	9	23	0.7	22	55	1.6
220	31	6	15	0.4	18	46	1.3
223	33	6	15	0.4	19	47	1.3
225	33	6	15	0.4	19	47	1.3
227	33	6	15	0.4	19	47	1.3
228	33	6	15	0.4	19	47	1.3
229	33	6	15	0.4	19	47	1.3
230	34	6	15	0.4	19	47	1.3
231	34	6	15	0.4	19	47	1.3
232	35	6	16	0.4	19	48	1.3
235	39	7	17	0.5	19	49	1.4
235	41	7	17	0.5	20	49	1.4
236	43	7	18	0.5	20	50	1.4
237	39	7	17	0.5	20	49	1.4
238	40	7	17	0.5	20	49	1.4
238	43	7	18	0.5	20	50	1.4
239	41	7	18	0.5	20	50	1.4
240	42	7	18	0.5	20	50	1.4
242	42	7	18	0.5	20	50	1.4
243	42	7	18	0.5	20	50	1.4
245	45	8	19	0.6	20	51	1.5
247	36	6	15	0.4	19	47	1.3
248	37	6	16	0.4	19	48	1.3
250	38	6	16	0.5	19	48	1.4

[1] 50 $\mu g/m^3$ refers to the cumulative criterion and should not be applied to Project alone results. This is shown here for reference only.

ID	Year 20 – Project alone				Year 20 - Project and other sources		
	24-hour PM_{10} (µg/m³)	Annual PM_{10} (µg/m³)	Annual TSP (µg/m³)	Annual Dust deposition (g/m²/month)	Annual PM_{10} (µg/m³)	Annual TSP (µg/m³)	Dust deposition (g/m²/month)
	Assessment criteria						
ID	*50[1]*	*N/A*	*N/A*	*2*	*30*	*90*	*4*
251	37	6	16	0.4	19	48	1.3
253	37	6	16	0.5	19	48	1.4
254	37	6	16	0.5	19	48	1.4
254	39	7	17	0.5	19	49	1.4
255	39	7	17	0.5	19	49	1.4
256	42	7	18	0.5	20	50	1.4
257	43	7	18	0.5	20	50	1.4
258	**56**	9	22	0.7	21	54	1.6
262[a]	26	5	12	0.3	18	44	1.2
263	27	5	13	0.3	18	45	1.2
264	27	5	13	0.3	18	45	1.2
267	29	5	13	0.4	18	45	1.3
268	30	5	13	0.4	18	45	1.3
270	27	5	12	0.3	18	44	1.2
270	28	5	12	0.3	18	44	1.2
271	30	5	13	0.3	18	45	1.2
272[a]	32	5	14	0.4	18	46	1.3
272[a]	33	5	14	0.4	18	46	1.3
272[a]	33	6	14	0.4	18	46	1.3
272[a]	33	6	14	0.4	18	46	1.3
273	21	4	10	0.3	17	42	1.2
273	21	4	11	0.3	17	42	1.2
275	22	4	11	0.3	17	43	1.2
276	23	4	11	0.3	17	43	1.2
276	23	4	11	0.3	17	43	1.2
277	23	4	11	0.3	17	43	1.2
278	23	4	11	0.3	17	43	1.2
279	24	4	11	0.3	17	43	1.2
280	24	4	11	0.3	17	43	1.2
281	25	4	11	0.3	17	43	1.2
283	27	5	12	0.3	18	44	1.2
284	28	5	13	0.3	18	44	1.2
285	29	5	13	0.3	18	45	1.2
288	31	5	13	0.3	18	45	1.2
289	32	5	14	0.4	18	45	1.3
291	36	6	15	0.4	19	47	1.3
296	39	6	16	0.4	19	48	1.3
297	40	6	16	0.5	19	48	1.4
298	40	6	16	0.5	19	48	1.4
301	42	7	17	0.5	19	49	1.4
302	41	7	17	0.5	19	49	1.4
304	42	7	17	0.5	19	49	1.4
305	42	7	17	0.5	19	49	1.4
306	44	7	17	0.5	20	49	1.4
308	45	7	18	0.5	20	50	1.4
309	45	7	18	0.5	20	50	1.4
311	50	8	20	0.6	20	52	1.5
312	49	8	19	0.6	20	51	1.5
313	48	7	19	0.5	20	51	1.4
314	50	8	19	0.6	20	51	1.5
315	37	6	15	0.4	19	47	1.3
315	39	6	16	0.4	19	48	1.3
316	35	6	14	0.4	18	46	1.3
317	35	6	14	0.4	18	46	1.3
318	35	6	14	0.4	18	46	1.3
321	41	6	16	0.4	19	48	1.3
325	**51**	8	19	0.5	20	51	1.4
326	**54**	8	20	0.5	21	52	1.4
327	**58**	9	23	0.7	22	55	1.6
328	20	4	10	0.2	17	42	1.1
329	19	4	9	0.2	16	41	1.1
330	19	4	9	0.2	16	41	1.1
331	18	3	9	0.2	16	41	1.1
332	17	3	9	0.2	16	41	1.1
333	17	3	9	0.2	16	40	1.1
335	17	3	8	0.2	16	40	1.1

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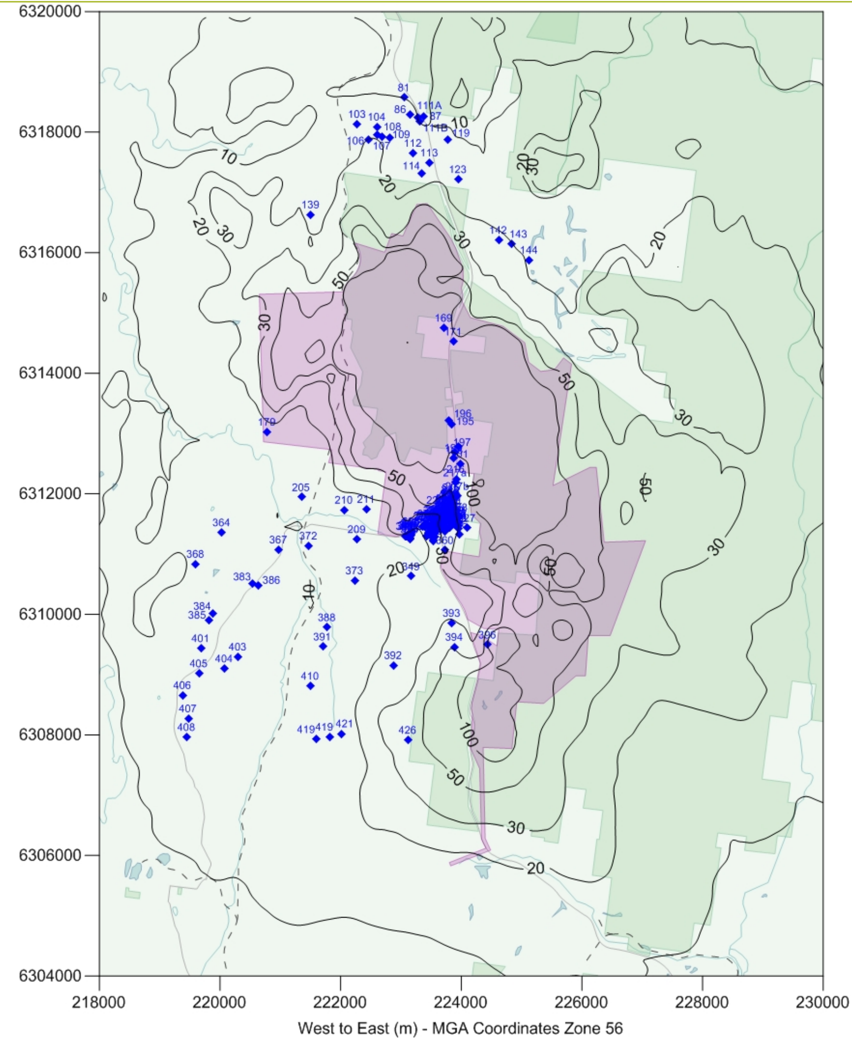
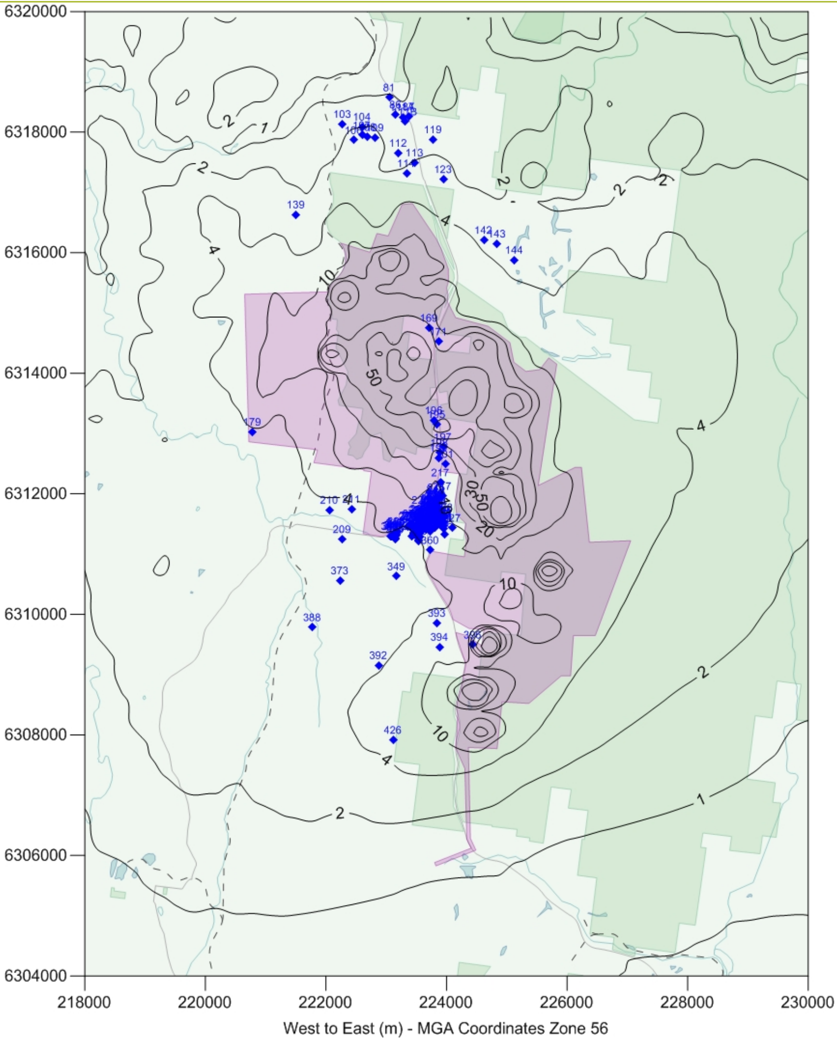
ID	Year 20 – Project alone				Year 20 - Project and other sources		
	24-hour PM_{10} (µg/m³)	Annual PM_{10} (µg/m³)	Annual TSP (µg/m³)	Annual Dust deposition (g/m²/month)	Annual PM_{10} (µg/m³)	Annual TSP (µg/m³)	Dust deposition (g/m²/month)
	Assessment criteria						
	50[1]	*N/A*	*N/A*	*2*	*30*	*90*	*4*
342	17	3	8	0.2	16	40	1.1
343	17	3	8	0.2	16	40	1.1
344	17	3	9	0.2	16	41	1.1
345	18	3	9	0.2	16	41	1.1
347	19	4	9	0.2	16	41	1.1
349	23	3	9	0.2	16	41	1.1
350	21	4	10	0.3	17	42	1.2
350	21	4	10	0.3	17	42	1.2
350	22	4	10	0.3	17	42	1.2
350	22	4	10	0.3	17	42	1.2
350	23	4	11	0.3	17	42	1.2
352	25	4	11	0.3	17	43	1.2
352	27	5	12	0.3	17	44	1.2
353	24	4	11	0.3	17	43	1.2
354	24	4	10	0.3	17	42	1.2
355	23	4	10	0.3	17	42	1.2
356	23	4	10	0.3	17	42	1.2
357	23	4	10	0.3	17	42	1.2
358	23	4	10	0.3	17	42	1.2
360[a]	34	5	13	0.3	18	44	1.2
364	16	4	9	0.2	17	41	1.1
367	14	3	7	0.2	16	39	1.1
368	18	4	9	0.2	17	41	1.1
372	12	3	7	0.2	16	39	1.1
373	16	3	8	0.2	16	40	1.1
383	17	3	9	0.2	16	41	1.1
384	17	3	8	0.1	16	40	1.0
385	17	3	8	0.1	16	40	1.0
386	17	3	9	0.2	16	41	1.1
388	12	2	6	0.1	15	38	1.0
391	13	3	7	0.1	16	39	1.0
392	22	4	10	0.2	17	42	1.1
393[b]	32	5	14	0.3	18	45	1.2
394[b]	**53**	9	24	0.5	22	56	1.4
396[b]	47	13	32	1.4	25	64	2.3
401	20	4	9	0.1	17	41	1.0
403	16	3	7	0.1	16	39	1.0
404	15	3	7	0.1	16	39	1.0
405	17	3	8	0.1	16	40	1.0
406	14	2	6	0.1	15	38	1.0
407	14	2	6	0.1	15	38	1.0
408	14	2	6	0.1	15	38	1.0
410	15	3	7	0.1	16	39	1.0
419	16	3	8	0.1	16	40	1.0
419	16	3	7	0.1	16	39	1.0
421	17	3	8	0.1	16	40	1.0
426	41	6	14	0.3	18	46	1.2

[a] Crown-owned
[b] Coalpac-owned
[c] Located within Project Boundary



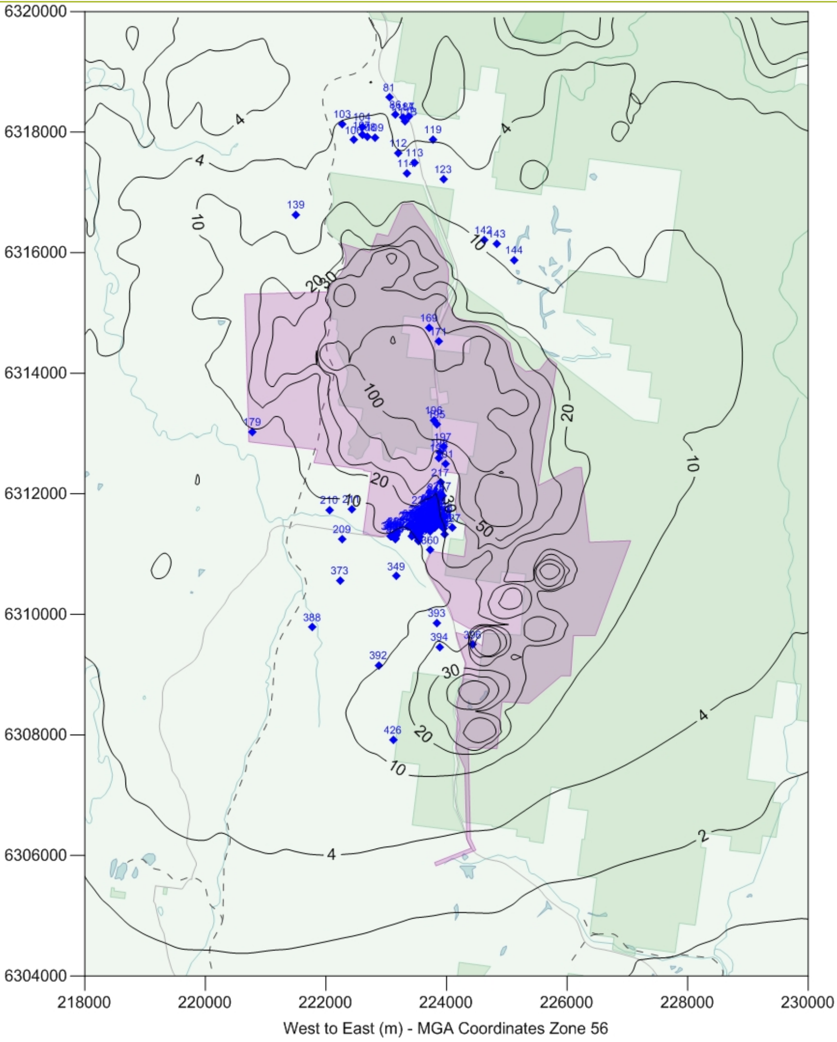
Species: PM$_{10}$	**Averaging Time:** 24-hour	**Percentile:** Maximum	**Scenario:** Year 20 Project only	**Location:** Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** µg/m^3	**Assessment criteria:** N/A	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.22: Predicted 24-hour average PM$_{10}$ concentrations due to emissions from the Project alone in Year 20



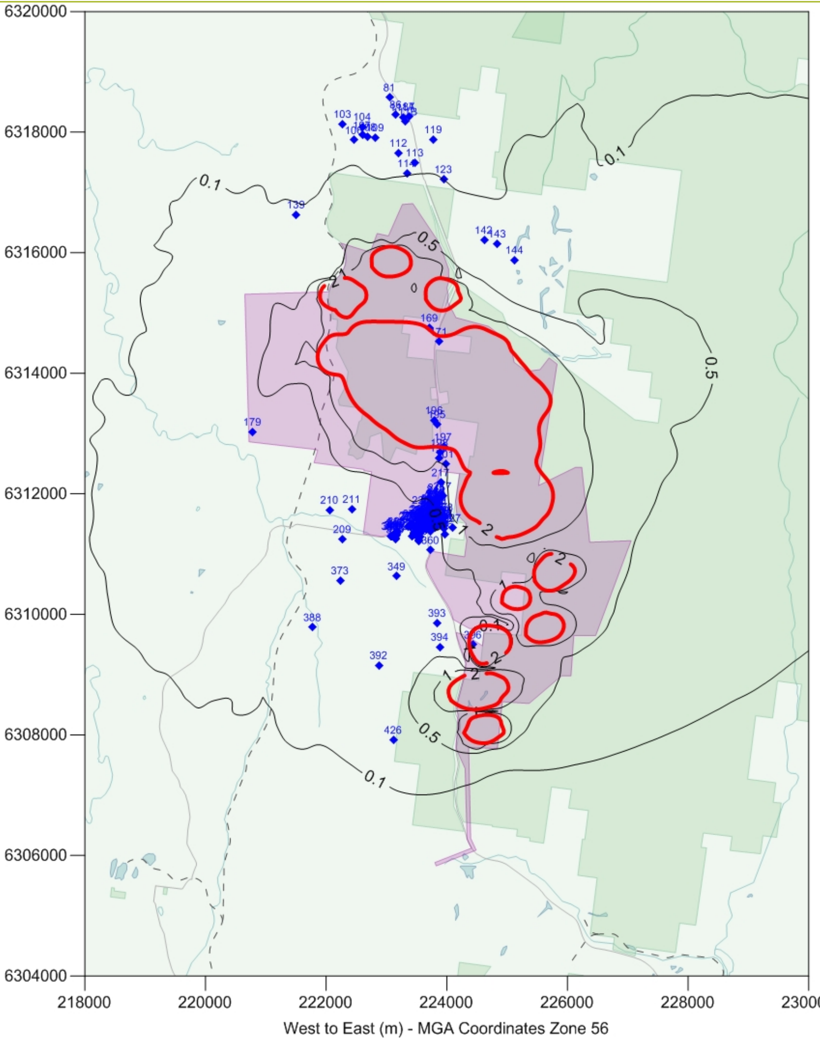
Species: PM10	**Averaging Time:** Annual	**Percentile:**	**Scenario:** Year 20 Project only	**Location:** Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** μg/m^3	**Assessment criteria:** N/A	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.23: Predicted annual average PM_{10} concentrations due to emissions from the Project alone in Year 20



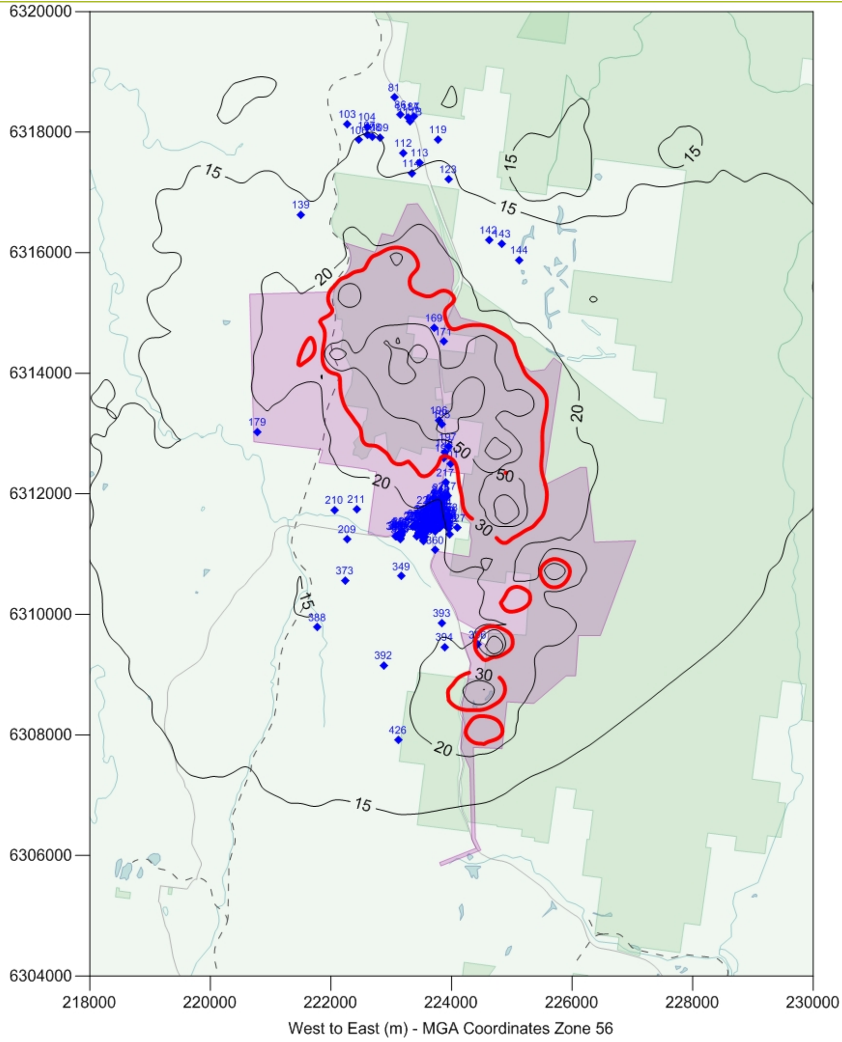
Species: TSP	**Averaging Time:** Annual	**Percentile:**	**Scenario:** Year 20 Project alone	**Location:** Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** µg/m^3	**Assessment criteria:** N/A	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.24: Predicted annual average TSP concentrations due to emissions from the Project alone in Year 20



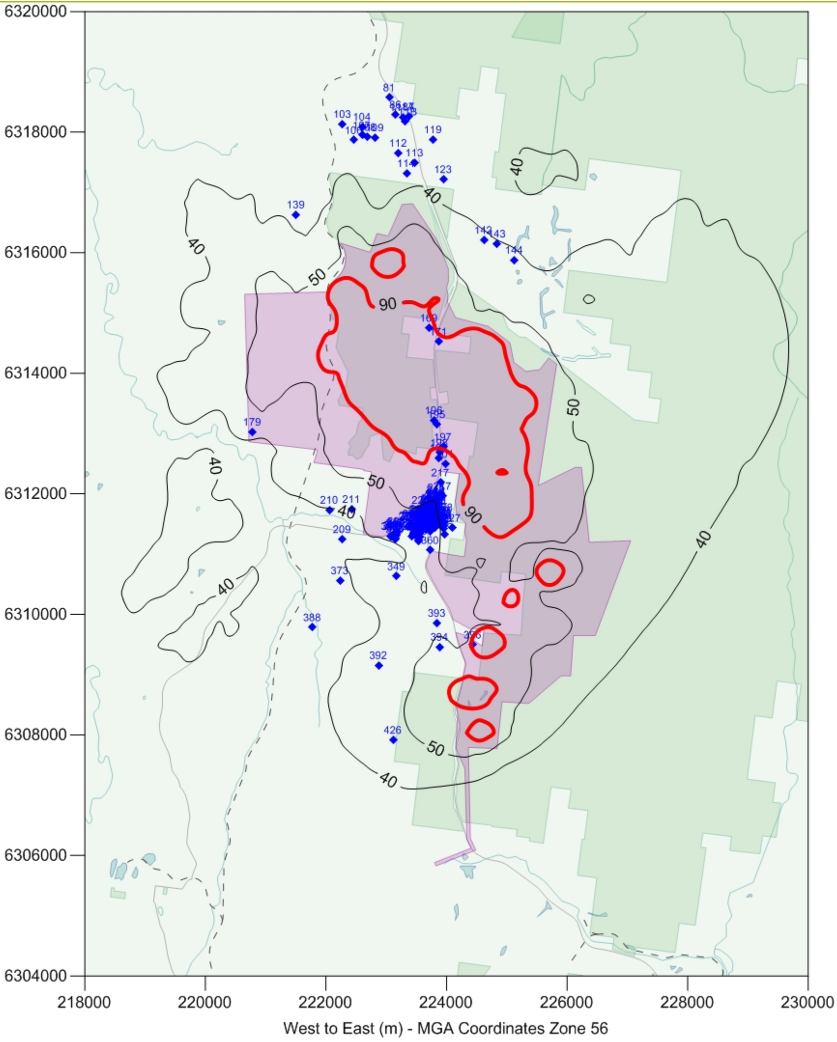
Species: Dust Deposition	**Averaging Time:** Annual	**Percentile:**	**Scenario:** Year 20 Project alone	**Location:** Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** g/m^2/month	**Assessment criteria:** DECCW = 2 g/m^2/month (shown as a bold red line)	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.25: Predicted annual average dust deposition levels due to emissions from the Project alone in Year 20



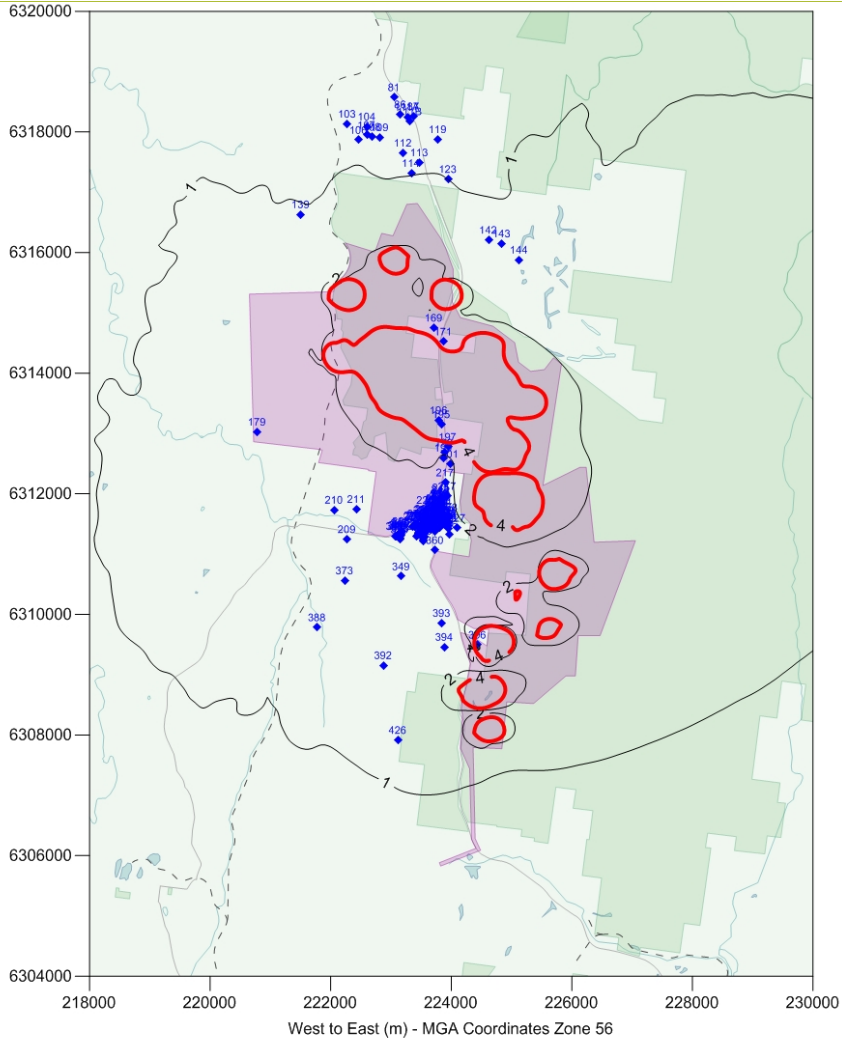
Species: PM$_{10}$	Averaging Time: Annual	Percentile:	Scenario: Year 20 Project and other sources	Location: Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** µg/m^3	**Assessment criteria:** DECCW = 30 µg/m^3 (shown as a bold red line)	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.26: Predicted annual average PM$_{10}$ concentrations due to emissions from the Project and other sources in Year 20



Species: TSP	Averaging Time: Annual	Percentile:	Scenario: Year 20 Project and other sources	Location: Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** µg/m³	**Assessment criteria:** DECCW = 90 µg/m³ (shown as a bold red line)	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.27: Predicted annual average TSP concentrations due to emissions from the Project and other sources in Year 20



Species: Dust Deposition	Averaging Time: Annual	Percentile:	Scenario: Year 20 Project and other sources	Location: Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** g/m^2/month	**Assessment criteria:** DECCW = 4 g/m^2/month (shown as a bold red line)	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure 8.28: Predicted annual average dust deposition due to emissions from the Project and other sources in Year 20

8.3 Cumulative 24-hour Average PM_{10} concentrations

8.3.1 Introduction

Table 8.9 presents a summary of sensitive receptors and their corresponding maximum 24-hour PM_{10} concentrations for each modelled year.

Due to the large number of receptors, a select number of receptors were chosen for this cumulative assessment, representative of key areas in vicinity of the mine. For example, receptors in the town of Cullen Bullen have been selected around the perimeter of the town to represent receptor clusters or impacts at the town. It can be assumed that receptors behind (or further from the Project sources) selected receptors will experience less impacts.

Table 8.9: Maximum 24-hour PM_{10} concentrations for representative receptors (µg/m^3)

Receptor ID	Year 2	Year 8	Year 14	Year 20
81	9	10	12	10
106	23	20	26	20
114	17	15	19	15
123	18	18	21	17
139	19	19	21	19
142	18	19	24	22
143	15	18	22	20
144	14	19	21	19
169[a]	**62**	**88**	**119**	**127**
171[a]	**64**	**65**	**120**	**90**
179[b]	23	12	16	15
195[b]	**191**	**141**	**160**	**667**
196[b]	**173**	**160**	**150**	**366**
197[b]	**402**	**64**	**65**	**118**
198[b]	**199**	**56**	**59**	**90**
199[b]	**136**	**53**	**60**	**89**
205	11	12	16	12
209	13	14	14	13
210	13	13	14	13
211	14	16	17	15
216	42	38	46	**56**
217[c]	46	37	46	**57**
217[c]	**52**	35	46	**58**
220	21	27	33	31
238	29	29	36	40
239	29	29	36	41
254	27	27	34	37
258	49	36	45	**56**
276	16	21	26	23
326	49	40	47	**54**
325	44	35	43	**51**
327	**54**	45	50	**58**
328	14	20	23	20
349	19	20	25	23
350	14	19	23	21
360[c]	28	26	33	34
364	21	13	19	16
367	17	12	15	14
368	28	16	20	18
372	14	13	13	12
373	17	17	19	16
383	24	14	17	17
384	22	15	17	17
385	22	15	18	17
386	26	15	17	17
388	14	12	14	12
391	15	14	16	13
392	22	21	24	22
393[a]	35	31	35	32

Receptor ID	Year 2	Year 8	Year 14	Year 20
394[a]	**79**	**64**	**63**	**53**
396[ab]	**90**	**74**	**58**	47
401	22	17	22	20
403	21	14	16	16
404	20	14	15	15
405	20	15	17	17
406	15	13	14	14
407	16	13	14	14
408	15	12	14	14
410	20	18	18	15
419	24	20	19	16
419	23	21	18	16
421	24	22	19	17
426	**62**	**53**	45	41

[a] Coalpac-owned
[b] Located within Project Boundary
[c] Crown-owned

Further analysis was conducted for each residence that is predicted to experience maximum 24-hour average PM_{10} concentrations above 50 µg/m^3 by identifying the number of days that this is likely to occur.

Table 8.10 summarises the number of days on which the 24-hour average PM_{10} concentration at each receptor is predicted to be above 50 µg/m^3.

Table 8.10: Number of days per year the 24-hour average PM_{10} concentration is predicted to be greater than 50 µg/m^3

Receptor ID	Year 2	Year 8	Year 14	Year 20
169[a]	7	38	71	62
171[a]	4	14	60	23
195[a]	105	102	142	246
196[a]	81	106	124	218
197[a]	189	6	8	35
198[a]	115	3	2	14
199[a]	71	2	2	11
216	-	-	-	2
217a[b]	-	-	-	1
217b[b]	1	-	-	1
258	-	-	-	1
325	-	-	-	1
326	-	-	-	1
327	1	-	-	1
394[c]	12	6	2	1
396[ac]	24	20	3	-
426	3	1	-	-

[a] Located within Project Boundary
[b] Crown-owned
[c] Coalpac-owned

It can be seen from **Table 8.10** that there are nine receptors that are predicted to experience potentially significant impacts, with maximum 24-hour average PM_{10} concentrations above 50 µg/m^3 for more than five days during any of the years modelled for the Project. However, it should be noted that of these nine receptors, seven receptors (Receptors 169 to Receptor 199) are located within the Project Boundary, and receptors 394 and 396 are Coalpac owned.

Therefore, there are no privately owned receptors located outside of the Project Boundary that are predicted to experience significant 24-average PM_{10} impacts above criteria (on more than 5 days annually) from the Project alone.

8.3.1.1 Cumulative 24-hour Average PM10 analysis

It is difficult to accurately predict the cumulative 24-hour PM_{10} concentrations using dispersion modelling due to the difficulties in resolving (on a day to day basis) the varying intensity, duration and precise locations of activities at mine sites, the weather conditions at the time of the activity, or combination of activities. With weather conditions for each hour of a year it is possible to provide more accurate annual average predictions than 24-hour average prediction.

The difficulties in predicting cumulative 24-hour impacts are compounded by the day to day variability in ambient dust levels and the spatial and temporal variation in any other anthropogenic activity, including mining in the future. Experience shows that the worst-case 24-hour PM_{10} concentrations are strongly influenced by other sources in the area, such as bushfires and dust storms, which are essentially unpredictable. The variability in 24-hour average PM_{10} concentrations can be clearly seen in the data collected at the two HVAS monitors located at the Cullen Valley Mine and the Invincible Colliery (see **Figure 6.2**).

The DECCW Approved Methods describe two methods for assessing cumulative air quality impacts (see Section 11.2 of the Approved Methods).

The Level 1 assessment (suitable for a screening assessment) requires that the highest predicted concentration from a proposal is added to the highest observed concentration in a data set which provides measurements of PM_{10} concentrations representative of conditions at the site being assessed.

The second method, a Level 2 assessment, provides a more rigorous approach and requires that the highest observed 24-hour PM_{10} concentrations are added to the predicted concentrations at the same days and also that the highest predicted 24-hour PM_{10} concentrations are added to the observed concentrations for the same days.

Both methods assume that a data set exists that can provide information on 24-hour PM_{10} concentrations representative of the sites being assessed. Some 24-hour PM_{10} monitoring data (collected every sixth day) for the area are available from Coalpac's monitoring program.

There are no continuous measurements of PM_{10} available in the Project area that could be considered "background" (i.e. the ambient concentration due to all other sources). As noted in **Section 6.6.2,** the HVAS monitor located at Cullen Valley Mine (HVAS) is located in closer proximity to the town of Cullen Bullen than the HVAS monitor in place for Invincible Colliery. The Cullen Valley Mine HVAS monitor also recorded a higher percentage of data as compared with HVAS1 located at the Invincible Colliery. Therefore data from the Cullen Valley Mine HVAS have been used in the following 24-hour PM_{10} cumulative assessment.

There are also no monitoring data that would characterise background in the absence of these other mining operations as the data collected at the Coalpac is already influenced by existing mining operations.

However the approach taken for this assessment is to use the monitoring data collected at HVAS1 to characterise background 24-hour PM_{10}, including the contributions of current mining operations at all Coalpac mining operations. These monitoring data would provide a conservatively high indication of background for the receptors most influenced by the Project, given the monitor's proximity to mining operations and the Project Boundary.

The approach for the cumulative 24-hour PM_{10} assessment is to consider the probability that the dust contribution from the Project will occur when background concentrations are sufficiently high to result in cumulative dust concentrations greater than 50 µg/m^3. The analysis was completed for the following scenarios, chosen to reflect 4 different scenarios where increment and background levels combined would result in concentrations greater than 50 µg/m^3:

- Probability that the background is greater than or equal to 40 µg/m^3 AND the predicted impact from modelling is greater than 10 µg/m^3;
- Probability that the background is greater than or equal to 30 µg/m^3 AND the predicted impact from modelling is greater than 20 µg/m^3;
- Probability that the background is greater than or equal to 20 µg/m^3 AND the predicted impact from modelling is greater than 30 µg/m^3; and
- Probability that the background is greater than or equal to 10 µg/m^3 AND the predicted impact from modelling is greater than 40 µg/m^3.

Results are shown for predicted 24-hour PM_{10} concentrations at each residence for only the worst case year of impact, for that receptor.

Table 8.11 presents an estimation of the statistical probability that the cumulative impacts would result in a 24-hour average PM_{10} concentration greater than 50 µg/m^3. The results are presented only where the cumulative probability of the 24-hour concentration exceeding 50 µg/m^3 is 1% or greater. The analysis indicates that the residences most likely to experience cumulative 24-hour PM_{10} impacts are those already predicted to be impacted from the Project alone (see **Table 8.9**).

Table 8.11: Probability of Cumulative 24-hour Impacts

ID	Year	Background probability >40	Increment probability >10	Total Cumulative Probability	Background probability >30	Increment probability >20	Total Cumulative Probability	Background probability >20	Increment probability >30	Total Cumulative Probability	Background probability >10	Increment probability >40	Total Cumulative Probability
169[a]	21	0.7%	68.4%	**0.5%**	2.7%	50.0%	**1.3%**	16.7%	35.2%	**5.9%**	54.7%	26.4%	**14.4%**
171[a]	15	0.7%	89.8%	**0.6%**	2.7%	68.4%	**1.8%**	16.7%	49.7%	**8.3%**	54.7%	31.6%	**17.3%**
195[b]	21	0.7%	82.7%	**0.6%**	2.7%	75.3%	**2.0%**	16.7%	72.0%	**12.0%**	54.7%	69.2%	**37.8%**
196[b]	15	0.7%	82.4%	**0.5%**	2.7%	71.4%	**1.9%**	16.7%	55.8%	**9.3%**	54.7%	44.2%	**24.2%**
197[b]	3	0.7%	69.5%	**0.5%**	2.7%	60.7%	**1.6%**	16.7%	56.6%	**9.4%**	54.7%	55.2%	**30.2%**
198[b]	3	0.7%	63.5%	**0.4%**	2.7%	55.5%	**1.5%**	16.7%	45.9%	**7.6%**	54.7%	38.7%	**21.2%**
199[b]	3	0.7%	62.6%	**0.4%**	2.7%	51.9%	**1.4%**	16.7%	38.2%	**6.4%**	54.7%	29.9%	**16.4%**
394[b]	3	0.7%	47.3%	**0.3%**	2.7%	20.6%	**0.5%**	16.7%	13.7%	**2.3%**	54.7%	6.3%	**3.5%**
396[ab]	3	0.7%	57.4%	**0.4%**	2.7%	39.3%	**1.0%**	16.7%	23.4%	**3.9%**	54.7%	12.1%	**6.6%**
426	3	0.7%	24.5%	**0.2%**	2.7%	11.5%	**0.3%**	16.7%	6.0%	**1.0%**	54.7%	2.5%	**1.4%**

[a] Coalpac-owned
[b] Located within Coalpac Mining Lease

8.4 Summary of Project operational impacts

Table 8.2 below presents a summary of sensitive receptors that may experience an impact in any modelled year of the Project. Results are only shown where an impact may occur.

Table 8.12: Summary of sensitive receptors predicted to experience an impact in any modelled year

Receptor ID	Ownership Details	Max 24-hour PM_{10} Mine Alone (μg/m³)	Number of days over 50 μg/m³	Annual PM_{10} Mine & Other Sources (μg/m³)	Annual TSP Mine & Other Sources (μg/m³)	Annual Dust Deposition Mine Alone (g/m²/month)	Annual Dust Deposition Mine & Other Sources (g/m²/month)
Year 2							
169[a]	Portland Road Pastoral Co Pty Ltd	62	7	-	-	-	-
171[a]	Portland Road Pastoral Co Pty Ltd	64	4	-	-	-	-
195[b]	KJ Blackley	191	105	49	125	3	-
196[b]	Crown-owned	173	81	45	115	2.7	-
197[b]	BE & CE Leisemann & IL & Kid Follington	402	189	90	231	7.8	8.7
198[b]	DA Tilley	199	115	49	125	3.2	4.1
199[b]	DA Tilley	136	71	40	102	2.1	-
217b	Crown-owned	52	1	-	-	-	-
327	RG Wright & KL Norris	54	1	-	-	-	-
394[a]	Coalpac	79	12	-	-	-	-
396[a]	Coalpac	90	24	-	-	-	-
426	JWJ & SM Taylor	62	3	-	-	-	-
Year 8							
169[a]	Portland Road Pastoral Co Pty Ltd	88	38	33	-	-	-
171[a]	Portland Road Pastoral Co Pty Ltd	65	14	33	-	3.5	4.4
195[b]	KJ Blackley	141	102	48	123	3	-
196[b]	Crown-owned	160	106	49	126	3	-
197[b]	BE & CE Leisemann & IL & Kid Follington	64	6	31	-	-	-
198[b]	DA Tilley	56	3	-	-	-	-
199[b]	DA Tilley	53	2	-	-	-	-
394[a]	Coalpac	64	6	-	-	-	-
396[a]	Coalpac	74	20	-	-	-	-
426	JWJ & SM Taylor	53	1	-	-	-	-
Year 14							
169[a]	Portland Road Pastoral Co Pty Ltd	119	71	42	109	2.3	
171[a]	Portland Road Pastoral Co Pty Ltd	120	60	45	114	3.6	4.5
195[b]	KJ Blackley	160	142	56	145	4.3	5.2
196[b]	Crown-owned	150	124	52	133	3.6	4.5
197[b]	BE & CE Leisemann & IL & Kid Follington	65	8	-	-	-	-
198[b]	DA Tilley	59	2	-	-	-	-
199[b]	DA Tilley	60	2	-	-	-	-
394[a]	Coalpac	63	2	-	-	-	-
396[a]	Coalpac	58	3	-	-	-	-
Year 20							
169[a]	Portland Road Pastoral Co Pty Ltd	127	62	39	100	-	-
171[a]	Portland Road Pastoral Co Pty Ltd	90	23	35	90	-	-
195[b]	KJ Blackley	667	246	157	400	14.5	15.4
196[b]	Crown-owned	366	218	99	251	7.5	8.4
197[b]	BE & CE Leisemann & IL & Kid Follington	118	35	34	-	-	-
198[b]	DA Tilley	90	14	-	-	-	-
199[b]	DA Tilley	89	11	-	-	-	-
216	BM Emmott	56	2	-	-	-	-
217a	Crown-owned	57	1	-	-	-	-
217b	Crown-owned	58	1	-	-	-	-
258	S & H Filla	56	1	-	-	-	-
325	SP & SA Duggan	51	1	-	-	-	-

Receptor ID	Ownership Details	Max 24-hour PM_{10} Mine Alone ($\mu g/m^3$)	Number of days over 50 $\mu g/m^3$	Annual PM_{10} Mine & Other Sources ($\mu g/m^3$)	Annual TSP Mine & Other Sources ($\mu g/m^3$)	Annual Dust Deposition Mine Alone ($g/m^2/month$)	Annual Dust Deposition Mine & Other Sources ($g/m^2/month$)
326	The Minister for Energy & Utilities	54	1	-	-	-	-
327	J Playford	58	1	-	-	-	-
394[a]	Coalpac	53	1	-	-	-	-

[a] Coalpac-owned
[b] Located within Coalpac Mining Lease

8.5 Assessment of Impacts on Privately Owned Land

This section provides a summary of sensitive receptors predicted to exceed the assessment criteria on more than 25 percent of privately owned land, including vacant land.

Table 8.12 describes in detail the predicted impacts at individual residences.

An additional assessment has been conducted to identify privately-owned land, including vacant land, where more than 25% of the land is predicted to experience dust levels above the relevant DECCW criteria. Blocks of land that have the same owner and are contiguous have been considered as a single area. For reference, the block numbers associated with each owner are provided in **Appendix A**.

The privately-owned land that is predicted to be impacted by dust levels above the DECCW criteria is presented in **Table 8.13**. A '**Y**' represents land that is predicted to exceed the assessment criteria on more than 25 percent of land.

Table 8.13: Percentage of privately-owned land area predicted to be impacted

Receptor Name	Block ID	Year 2	Year 8	Year 14	Year 20
Cumulative annual average PM_{10} concentration					
B & E Nakhle	170	**Y**	**Y**	**Y**	**Y**
BE & CE Leisemann & IL & Kid Follington*	197	**Y**	**Y**	**Y**	**Y**
DA Tilley	198, 199	**Y**	**Y**	**Y**	**Y**
Hyrock NSW Pty Ltd (Industrial)	395	**Y**	**Y**	N	**Y**
J Knox*	194	**Y**	**Y**	**Y**	**Y**
KD & RL Kellam	201	**Y**	N	N	N
KJ Blackley	195	**Y**	**Y**	**Y**	**Y**
R Tilley*	200	**Y**	**Y**	**Y**	**Y**
State of NSW (Crown)	168, 172, 377	**Y**	**Y**	**Y**	**Y**
Maximum 24-hour average PM_{10} concentration					
B & E Nakhle	170	**Y**	**Y**	**Y**	**Y**
BE & CE Leisemann & IL & Kid Follington*	197	**Y**	**Y**	**Y**	**Y**
BM Emmott	216	**Y**	**Y**	**Y**	**Y**
DA Tilley	198, 199	**Y**	**Y**	**Y**	**Y**
DW & GJ McCann	240, 246	N	N	N	**Y**
G Muenzer*	394	**Y**	**Y**	**Y**	N
Hyrock NSW Pty Ltd (Industrial)	395	**Y**	**Y**	**Y**	**Y**
J Knox*	194	**Y**	**Y**	**Y**	**Y**
J Playford	327	**Y**	**Y**	**Y**	**Y**
JWJ & SM Taylor	426, 439, 440	**Y**	N	N	N
KD & RL Kellam	201	**Y**	**Y**	**Y**	**Y**
KJ Blackley	195	**Y**	**Y**	**Y**	**Y**
KR Waters	314	N	N	N	**Y**
LM McDonald	312	N	N	N	**Y**
M Botfield	245	N	N	N	**Y**
R Tilley*	200	**Y**	**Y**	**Y**	**Y**
S & H Filla	258, 300	**Y**	**Y**	**Y**	**Y**
SJ Bandiera	310	N	N	N	**Y**

Receptor Name	Block ID	Year 2	Year 8	Year 14	Year 20
SP & SA Duggan	325	N	N	N	**Y**
State of NSW (Crown)	168, 172, 377	**Y**	**Y**	**Y**	**Y**
The Minister for Energy & Utilities (Crown)	326	N	N	N	**Y**
WG Brown	311	N	N	N	**Y**

Note: Includes land where sensitive receptors exist and are also assessed in previous sections.
*Agreement in place

It can be seen from **Table 8.13** that there are 22 properties that are predicted to experience dust impacts on more than 25% of their land area for the maximum 24-hour average PM_{10} concentration (project alone) and 9 for the cumulative annual average PM_{10} concentration.

9 CONSTRUCTION PHASE IMPACTS

9.1 Overview

As the Project is an existing operation, limited construction would be required. However, the following major construction activities would be required for the consolidation:

- Construction of the previously approved Coal De-shaling preparation Plant (CDP at the Cullen Valley Mine);
- Construction of a bridge over the Castlereagh Highway to link operations east and west of the highway and the development of required access roads to the East Tyldesley area;
- Construction of a bridge and haul road across Wallerawang – Gwabegar Railway line to permit access to mine the Hillcroft area;
- Construction of the overland conveyor to MPPS;
- Construction of the East Tyldesley Coal Preparation Plant (ETCPP); and
- Construction of a rail siding with associated infrastructure to permit transport of product coal.

From an air quality perspective it is important to consider the potential emissions that would occur during construction. While dust emissions from construction activities can have impacts on local air quality, impacts are typically of a short duration (especially when compared to the life of mining operations) and relatively easy to manage through commonly applied dust control measures. Dust emissions from construction sites vary substantially from day to day, depending on the intensity and location of particular activities and it is very difficult to confidently estimate emissions on a day to day basis.

Emissions of carbon monoxide (CO), nitrogen dioxide (NO_2), and sulphur dioxide (SO_2) will occur from diesel-powered plant and equipment used on-site and vehicle movements to site. However these emissions are typically minor for projects of this scale and too widely dispersed to give rise to significant off-site concentrations.

Procedures for controlling dust impacts during construction will include, but are not necessarily be limited to the activities outlined in the following sections.

9.1.1 Clearing / Excavation

Emissions from vegetation stripping, topsoil clearing and excavation can occur, particularly during dry and windy conditions. Emissions can be effectively controlled by increasing the moisture content of the soil / surface. Other controls that will be undertaken include:

- Modify working practices by limiting excavation during periods of high winds; and
- Limiting the extent of clearing of vegetation and topsoil to the designated footprint required for construction and appropriate staging of any clearing.

9.1.2 Bridge & Conveyor Overpass Construction

The use of earth moving equipment can be a significant source of dust, and emissions should be controlled through the use of water sprays during road construction. Where conditions are excessively dusty and windy, and fugitive dust can be seen leaving the site, work practices can be modified by limiting any scraper / grader activity.

9.1.3 Haulage and Heavy Plant and Equipment

Vehicles travelling over paved or unpaved surfaces tend to produce wheel generated dust. The following measures should be implemented during construction to minimise dust emissions from these activities:

- All vehicles on-site should be confined to designated routes with speed limits enforced;
- Trips and trip distances should be controlled and reduced where possible, for example by coordinating delivery and removal of materials to avoid unnecessary trips; and
- When conditions are excessively dusty and windy, and dust can be seen leaving the works site the use of a water truck (for water spraying of travel routes) should be used.

9.1.4 Wind Erosion

Wind erosion from exposed surfaces during construction should be controlled as part of the best practice environmental management of the site. Wind erosion from exposed ground should be limited by avoiding unnecessary vegetation clearing and ensuring rehabilitation occurs as quickly as possible. Wind erosion from temporary stockpiles can be limited by minimising the number of stockpiles on-site and minimising the number of work faces on stockpiles.

9.1.5 Rail Siding Construction

The following measures should be implemented during the construction of the rail spur and loop:

- Modify working practices by limiting clearing and excavation during periods of high winds;
- Limiting the extent of clearing of vegetation and topsoil to the designated footprint required for the rail corridor; and
- Use of water sprays during rail construction for dusty activities such as ballast dumping and compacting.

10 FUGITIVE DUST EMISSIONS FROM RAIL TRANSPORT

The Project will involve construction and operation of a rail siding and loading area. Dust emissions from train loading have been included as part of the assessment of Project mining operations. Impacts due to fugitive dust emissions from coal wagons during rail transportation are discussed below.

Fugitive dust from coal wagons is an emerging environmental and community issue, in terms of potential impacts on human health and amenity. Queensland Rail (QR) commissioned an environmental evaluation of coal dust emissions from rolling stock in the Central Queensland Coal

Industry (**Connell Hatch, 2008**). The purpose of this study was to determine the extent of the issue and identify, if possible, any potential environmental harm caused by fugitive dust from coal wagons, in the context of nuisance and health impacts and to identify the potential reasonable and feasible measures that could reduce any environmental harm.

In terms of impacts on human health, the QR study concluded that there appears to be minimal risk of adverse impacts due to fugitive coal emissions from trains throughout the network, based on results of monitoring and modelling predictions. In terms of impacts on amenity, the results of monitoring and modelling indicate that nuisance coal dust at the edge of the rail corridor are below levels that are known to cause adverse impacts on amenity.

PAEHolmes has reviewed the QR study to determine if the conclusions presented are applicable to NSW based on, for example, differences in coal volumes, loading practices, train speeds, wagon shapes, coal properties, etc., and it was concluded that many of the observations from the QR study can be applied to the NSW network.

On that basis, the potential for environmental harm caused by the increased coal train movements from the Project is likely to be low, in terms of health and amenity impacts, beyond distances of approximately 15 m from the rail lines. There are no receptors along the proposed rail spur located within 15 m of the rail line.

11 PROPOSED MITIGATION AND DUST MANAGEMENT MEASURES

11.1 Introduction

The Project has the potential to generate dust. It is therefore necessary to take reasonable and practicable measures to prevent or minimise dust impacts at sensitive receptors.

Coalpac is committed to leading practice dust management for the Project through the use of a real-time and proactive dust management system. This would enable Coalpac to pro-actively manage the short-term impacts of the Project and prevent or minimise dust impacts at sensitive receptors to the greatest practical extent. Further detail on how this can be achieved is provided in **Section 11.2**.

Other control measures (minimising disturbance, progressive rehabilitation etc.) which have not necessarily been quantified in the modelling but would be undertaken by Coalpac as part of their ongoing dust management practices are outlined in **Section 11.3**.

Full details of the dust management measures would be outlined in an Air Quality Management Plan and Air Quality Environmental Monitoring Program, which would be consolidated and updated prior to the commencement of Project mining activities.

11.2 Real-Time Proactive Dust Management

Dispersion modelling for the Project indicates that the most significant source of dust emissions, in terms of short term 24-hour impacts, results from the hauling of overburden and ROM coal. The proposed real-time dust management system is therefore discussed in specific relation to this dust source, however it is equally applicable to controlling excessive dust emissions from any Project source.

Coalpac would be able to respond to the potential for excessive dust impacts through the installation at a representative location of a real-time dust monitor to be located within the town of

Cullen Bullen. The real-time monitor would continuously log short-term dust concentrations (15min, 30min and 1-hour averages) and report the data via GPS/GRSM modem to a web based recording system. When certain short-term trigger levels are reached / exceeded, a message is delivered to the appropriate personnel, alerting them to the high dust levels. The on-site weather station could also report wind conditions at the time, allowing appropriate personnel to determine the origin of the elevated dust levels. For example, the annual windroses in **Figure 6.1** show that winds closest to the town as measured at the Cullen Valley meteorological station are predominantly from the east and west. Therefore, a response system could be implemented whereby mining activities in the vicinity of the town may be reduced or stopped in order to minimise dust impacts at Cullen Bullen when dust levels at the town reach a certain value, and dominant winds are shown from the east and/or west.

The short-term trigger levels (say 1-hour average) would be derived based on a statistical analysis of appropriate peak to mean ratios and set at a level where a few consecutive readings at these high levels risks a breach of the 24-hour impact assessment criteria. During the life of the Project, should more suitable technology become available, this system may be modified and enhanced if required.

An additional component of the dust management procedures would be to develop a meteorological and air quality forecasting system to predict, one day in advance, what the meteorological conditions and air quality impact will be. This would allow the appropriate personnel to manage the intensity of activities for that day, increase controls or limit activity to various areas of the Project. The above measures would be incorporated into the Air Quality Management Plan for the Project.

11.2.1 Opportunities for Cooperative Management Measures

The proposed real-time monitoring as discussed in **Section 11.2** as well as the current dust monitoring conducted at the Project site will monitor the cumulative emissions from all sources of dust in the area, not just from Coalpac operations. Therefore dust from all neighbouring operations (see **Section 7.2**) will be monitored at these locations.

As part of their proposed real-time management system, Coalpac will identify when certain trigger levels are breached and then investigate the likely cause of the elevated dust levels. When the investigation determines that Coalpac operations are not causing the elevated dust levels and regional dust levels are not high, Coalpac will inform its neighbouring operations of the investigation and the likely source of elevated dust levels. This will enable neighbouring operations to instigate controls as required. This practice would also be reciprocated. It is proposed that this would happen at the investigation trigger level to allow neighbouring operations to also respond to short-term elevated dust levels. Where Coalpac determine that exceedances of the impact assessment criteria at any one of their monitoring locations have resulted from sources other than their own operations, they will report the results of the compliance assessment to neighbouring operations so that cumulative impacts can be better controlled and managed.

When elevated dust results are identified, Coalpac, as well as the surrounding mines may also discuss ways in which to develop management measures together. For example, when winds are blowing from a certain direction to impacted sensitive receptors, operations at more than one operation may be reduced to limit cumulative dust effects.

11.3 Summary of Dust Management and Control Measures

The term "best practice" is frequently used in pollution control and pollution management. However, what constitutes "best practice" is difficult to define in practical situations. Environment Australia published a series of booklets in the 1990's to assist the mining industry with incorporating best practice environmental management through all phases of mineral production from exploration through construction and eventual closure. In the booklet for Dust Control (**Environment Australia, 1998**) they defined "best practice" as follows:

"Best Practice can be defined as the most practical and effective methodology that is currently in use or otherwise available. Best practice dust management can be achieved by appropriate planning in the case of new or expanding mining operations, and by identifying and controlling dust sources during the active phases of all mining operations."

This document has since been updated by the Department of Energy, Resources and Tourism (DERT) who have published the handbook *Leading Practice Sustainable Development Program for the Mining Industry* (**DERT, 2009**). This new handbook introduces the term "leading practice", in which:

"*...considers the latest and most appropriate technology applied in order to seek better financial, social and environmental outcomes for present stakeholders and future generations.*"

The implementation of a reactive or proactive dust management system, as described above, is considered best and leading practice and would apply leading technology to achieve the best possible outcomes currently available.

Other procedures proposed for the management of dust emissions from the Project have been considered against those determined to be leading practice in the **DERT (2009)** handbook.

Specific measures should be made as to how the proposed mitigation measures align with best practice, as outlined in the NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining, 2010, prepared for DECCW by Katestone Environmental (**Katestone, 2011**). **Table 11.1** provides an overview of the best practice air quality mitigation measures to be implemented for the Project. These are targeted at the main sources of air quality emissions identified in **Katestone (2011)**.

Table 11.1: Overview of Best Practice Emission Reduction Measures Described in Katestone (2011)

Air Quality Emission Source	Emission Reduction Measure	Used for the Project?	Comments	Effectiveness of reduction in Emissions Inventory
Haul Trucks travelling on Unpaved Roads	Use of water carts to control emissions	Yes	Level 2 watering will be applied	75%
	Use of additional water application and/or surfactants	Yes	Additional/extended haul truck shifts to be undertaken. Coalpac would also undertake an education campaign with haul truck drivers to ensure targeted application of additional watering.	N/A
	Use of conveyor for coal transportation instead of unpaved road	Yes	An enclosed conveyor will be used to transport coal from the Invincible Colliery to the MPPS.	The conveyor was not included as a dust source in the emissions inventory as it will be fully enclosed.
	Control of the speed of trucks	Yes	Speed controlled to approximately 40 kilometres per hour (kph).	Emission factor based on amount of material moved, so no reduction to the emissions inventory, however there would be a marginal reduction in practice.
	Largest practical truck size	Yes	Based on the amount of material being moved, Coalpac has assessed and given the largest economic and practical size haul trucks for assessment.	Emission factor partially based on size of truck. A smaller sized truck will give a higher estimate of TSP emissions per year for each hauling activity
Wind Erosion of Overburden	Progressive Rehabilitation	Yes	Minimise overburdens dump area to allow for increased rehabilitation and complete rehabilitation as soon as practical after disturbance.	Overburden areas are included in the emissions inventory in hectares. A larger area would result in higher TSP emissions per year and possibly higher predictions.
Wind Erosion of Exposed Materials and Stockpiles	Use of water carts to control emissions	Yes	Water carts to be used on dumps and pits.	50%
ROM Coal Handling	Water application	No	Not considered to be necessary by Coalpac based on operational experience. Coalpac would review the feasibility over the life of the project.	N/A
	Use of chemical Suppressants	No	Not considered to be necessary by Coalpac based on operational experience. Coalpac would review the feasibility over the life of the project.	N/A
ROM Coal Stockpile (Cont.)	Minimisation of drop heights	Yes	Coalpac would undertake an education campaign with truck drivers to minimise drop heights where possible.	Emission factor does not consider drop height, so no reduction to the emissions

Air Quality Emission Source	Emission Reduction Measure	Used for the Project?	Comments	Effectiveness of reduction in Emissions Inventory
				inventory, however there would be a material reduction in practice.
	Enclosure of ROM coal stockpile	No	This is not considered to be feasible by Coalpac due to the effectiveness of the existing control measures, as evidenced by operational experience and compliance with air quality criteria.	N/A
Bulldozing	Watering of trafficked areas	Yes	Application rates would be as per the unpaved roads.	Emission factor based on hours used, so no reduction to the emissions inventory, however there would be a marginal reduction in practice.
	Minimisation of travel speed and distance travelled.	Yes	Coalpac would undertake an education campaign with dozer drivers to ensure appropriate speeds and routes are used.	
Blasting	Delay of blasts if unfavourable weather prevails	Yes	Coalpac will delay blasting during unfavourable conditions, including strong winds and temperature inversions.	Emission factor does not consider weather conditions, so no reduction to the emissions inventory, however there would be a material reduction in short-term emissions practice.
	Minimisation of blast area	Yes	Appropriate blast design, including minimisation of blasting area is an objective of blasting operations.	Where required in order to reduce impacts, blasting areas will be kept to 5,040 square metres (m^2).
Drilling	Water Sprays or curtains	No	Drilling typically uses water injection.	Emission factor does not consider moisture content, so no reduction to the emissions inventory, however there would be a marginal reduction in practice.
	Air Extraction to a Bag Filter	No	This is not considered to be necessary by Coalpac due to the effectiveness of the existing control measures.	N/A
Loading and dumping of Overburden	Minimisation of drop heights	Yes	Coalpac would undertake an education campaign with truck drivers to minimise drop heights where possible.	Emission factor does not consider drop height, so no reduction to the emissions inventory, however there would be a material reduction in practice.
	Use of water sprays	No	Direct spraying of overburden is not considered to be operationally feasible by Coalpac due to	N/A

Air Quality Emission Source	Emission Reduction Measure	Used for the Project?	Comments	Effectiveness of reduction in Emissions Inventory
			the dispersed nature of potential overburden loading/unloading locations (i.e. multiple loading and unloading locations are typically used). Water carts are used on active haul roads as described above.	
Conveying	All conveyors will have transfer points enclosed. Dust curtains are to be installed at transition points from transfer station.	Yes	This conveyor will transport product coal to the MPPS.	The conveyor was not included in the emissions inventory as it will be fully enclosed and dust impacts would therefore be negligible.

11.4 Blasting

Coalpac currently blasts overburden material and will continue to blast overburden as a part of the proposed Consolidation Project.

It is important to be aware of the potential impacts associated with the gaseous emissions from blasting, often referred to as 'blast fumes'. Pollutants such as CO, SO_2, NO and particularly NO_2 can be released following a blast to varying degrees depending on different conditions including:

- Explosive formulation and quality assurance (e.g. explosive product incorrectly formulated, inadequate mixing of raw materials and explosive precursors not manufactures to specification);
- Geological conditions (e.g. dynamic water in holes/moisture in clay, inadequate confinement in soft ground and chemistry of rock type);
- Blast design (e.g. explosive desensitisation due to the blast hole depth and inappropriate priming and/or placement);
- Explosive product selection (e.g. non water-resistant explosive products loaded into wet or dewatered holes and inappropriate explosive product for application);
- On bench practices (e.g. hole condition incorrectly identified and blast not drilled/loaded as per blast plan); and
- Contamination of explosives in the blast hole (e.g. interaction of explosives product with drilling muds and rainfall on a sleeping shot) (**AEISG, 2011**).

There are potential risks to human health associated with exposure of blast fume. Acute and short term risks may include; coughing, shortness of breath, irritations of the mucous membranes of the eyes, nose and throat and pulmonary oedema. Medium and long term effects may include Reactive Airways Dysfunction Syndrome (RADS), in rare cases bronchiolitis obliterans and chronic respiratory insufficiency (**AEISG, 2011**).

Coalpac currently have blast management plans in place for the Cullen Valley Mine and the Invincible Colliery which include potential blast impacts, blast monitoring, management and specific mitigation measures and reporting and review (see **Coalpac 2009a** and **Coalpac 2009b**).

To limit impacts associated with blast fumes, Coalpac have already considered adopting some of the following mitigation measures:

- Blasts should be fired under favourable wind conditions when wind will transport any fume away from the nearest sensitive receptors. This may also be achieved through a real-time/predictive blast management tool which incorporates on-site meteorological data, receptor location information and potential blast locations in order to predict potential fume impacts;
- Blasts should be delayed where possible during rainfall;
- Blast size and depth to be minimised;
- Bench heights to be reduced where practicable; and
- Bench design to be constructed for effective water run-off.

Should there be concern of blast fume, the following proactive measures may be undertaken by

Coalpac:

- Residences in the potentially affected areas may be told to close windows/doors to minimise risk of inhalation;
- A complaints register will be kept to determine possible impacted areas and causes of complaints; and
- Post-blast gases should be identified and rated by blast site personnel and reported to blast site management to determine any significant events or trends to minimise the potential for ongoing generation of gases.

11.5 Monitoring

The locations of the current monitoring stations are shown on **Figure 6.2** and it is envisaged that the monitoring network would consist of one additional real-time TEOM monitor for the operation of the Project.

A review of the existing air quality monitoring network will be conducted so as to ensure that locations are representative of key locations for monitoring (e.g. near the town of Cullen Bullen). As per **Section 11.1** the findings of this review would be included as a part of an Air Quality Management Plan and Environmental Monitoring Program prior to the commencement of Project mining activities. The monitoring plan would also include the following:

- A review of baseline monitoring data collected for the Project (including both meteorological and particulate monitoring) and comparison with relevant impact assessment criteria;
- A review of the monitoring locations at the time and any recommendations for additional monitors or revised siting;
- Monitoring standards relevant to the Project; and
- Specific condition requirements as specified by the Project's Approval.

11.6 Spontaneous Combustion

Spontaneous combustion occurs when coal and other carbonaceous materials undergo natural oxidation and heat up. Under the right conditions, the heat from the oxidation reaction can build up to a point where the coal will ignite and burn. For self-heating to occur, the composition of the coal must be such that low temperature oxidation can occur. Further, the material must be confined in such a way that heat from the oxidation is trapped, allowing the temperature to build up, but not so confined as to preclude the ingress of oxygen to the combustible material at a rate sufficient to promote the combustion and release of heat energy.

Once the coal reaches a high enough temperature it will liberate smoke, steam and volatile organic compounds (VOCs), some of which are odorous and can be harmful.

11.6.1 Cullen Valley Mine Heating Response Plan

The heating in the abandoned underground workings (old Tyldesley Colliery) at the Cullen Valley Mine has been present since the 1970s. The heating was relatively dormant up until the abandoned underground workings were intersected by the open cut excavation in 2003. In addition to the heating in the old underground workings there also appear to be small pockets of carbonaceous material that are spontaneously combusting at various sites.

A study was completed in August 2010 which defined the extent and condition of the heating at the Cullen Valley Mine. This report also recommended a response plan to address the issues identified. Coalpac Pty Ltd created a Response Plan in November 2010 to provide scope and direction to the proposed mitigation works.

The primary aim of the Response Plan is to contain and to mitigate against the impacts of the heating upon the local community and the environment. The gases and odour produced by the heating have been a source of complaints by immediate neighbours. The heating has also affected the local vegetation with die-back in areas of rehabilitation.

A thermographic survey conducted in mid-2010 revealed the extent and condition of venting around the affected area. A programme of works is proposed to progressively clear the area of dead vegetation and to excavate out the venting and to emplace clay material to cover the vents. The intention is to stabilise the situation and limit the gases and odours that have been the source of complaints.

There are four main phases of activity proposed in the Response Plan which are as follows:

1. Preparation

- Preparing permanent vehicular access to the Restricted Area (area of heating);
- Clearing any vents or heating of dead wood and other materials; and
- Convene a Risk Assessment to evaluate the hazards and controls required in conducting the proposed remediation and monitoring works. The outcome of the Risk Assessment will provide the basis for a Heating Management Plan for Cullen Valley Mine to provide procedures to manage the related health and safety, environmental and statutory compliance issues.

2. Excavation

- Progressively excavate the venting along the interface between the crest of the old open cut highwall and the backfill. The area will then be backfilled and compacted progressively in layers to restrict the ingress of oxygen and water; and
- The profile of the central area will be lifted to limit the water action. The aim is to raise and cover the whole area to provide a long-term stable profile that will incorporate drainage channels.

3. Monitoring

- A monitoring program will be developed to determine the condition of the heating, post mitigation works. This program will comprise the following:
    - Thermographic imagery (ground and aerial) to track the lateral extent of the heating and the location of vents and hotspots;
    - Monitoring of the water level in old workings of Tyldesley Colliery;
    - Regular inspection to detect and remediate any new vents. Detailed records will be kept of the condition of areas over time together with records of the prevailing weather conditions. Any areas found to produce any significant emissions indicating heating or elevated temperatures will be remediated; and

- Installation of thermal probes to monitor temperatures at depth in key locations. Research will be conducted to determine the most appropriate design configurations for the thermal probes in order to maximise operating life and reliability.

4. Rehabilitation

- The affected area will be progressively rehabilitated once it is confirmed that the earthworks have been effective via thermographic imagery; and

- The area will be rehabilitated leaving access for monitoring activities. The performance of the rehabilitation will be surveyed regularly to monitor its performance and rate of re-growth over the area.

12 GREENHOUSE GAS ASSESSMENT

The Director-General's Environmental Assessment Requirements identifies Greenhouse Gases as a key issue for the Project. The DGRs for greenhouse gas assessment require:

- Qualitative assessment of the potential scope 1, 2 and 3 greenhouse gas emissions of the Project;
- A qualitative assessment of the potential impacts of these emissions on the environment; and
- An assessment of all reasonable and feasible measures that could be implemented to minimise greenhouse gas emissions of the Project and ensure energy efficiency.

12.1 Introduction

Greenhouse gas emissions have been estimated based upon the methods outlined in the following documents:

- The World Resources Institute/World Business Council for Sustainable Development Greenhouse Gas Protocol (**WBCSD**/**WRI 2004**);
- National Greenhouse and Energy Reporting (Measurement) Determination 2008; and
- The Australian Government Department of Climate Change and Energy Efficiency (DCCEE) National Greenhouse Accounts Factors 2010.

The Greenhouse Gas Protocol establishes an international standard for accounting and reporting of greenhouse gas emissions. The Greenhouse Gas Protocol has been adopted by the International Standard Organisation, endorsed by greenhouse gas initiatives (such as the Carbon Disclosure Project) and is compatible with existing greenhouse gas trading schemes.

Three 'scopes' of emissions (scope 1, scope 2 and scope 3) are defined for greenhouse gas accounting and reporting purposes. This terminology has been adopted in Australian greenhouse reporting and measurement methods and has been employed in this assessment. The 'scope' of an emission is relative to the reporting entity, indirect scope 2 and scope 3 emissions will be reportable as direct scope 1 emissions from another facility.

1) Scope 1: Direct Greenhouse Gas Emissions

Direct greenhouse gas emissions are defined as those emissions that occur from sources that are owned or controlled by the reporting entity. Direct greenhouse gas emissions are those emissions that are principally the result of the following types of activities undertaken by an entity:

- Generation of electricity, heat or steam. These emissions result from combustion of fuels in stationary sources, the principal source of greenhouse emissions associated with the operation of the Project;
- Physical or chemical processing. Most of these emissions result from manufacture or processing of chemicals and materials, e.g., the manufacture of cement, aluminium, etc;
- Transportation of materials, products, waste and employees. These emissions result from the combustion of fuels in entity owned/controlled mobile combustion sources (e.g. trucks, trains, ships, aeroplanes, buses and cars); and
- 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); HFC emissions during the use of refrigeration and air conditioning equipment; and methane leakages from gas transport.

2) Scope 2: Energy Product Use Indirect Greenhouse Gas Emissions

Scope 2 emissions are a category of indirect emissions that account for greenhouse gas emissions from the generation of purchased energy products (principally, electricity, steam/heat and reduction materials used for smelting) by the entity.

Scope 2 in relation to the Project covers purchased electricity, defined as electricity that is purchased or otherwise brought into the organisational boundary of the entity. Scope 2 emissions physically occur at the facility where electricity is generated. Entities report the emissions from the generation of purchased electricity that is consumed in its owned or controlled equipment or operations as scope 2.

3) Scope 3: Other Indirect Greenhouse Gas Emissions

Scope 3 emissions are defined as those emissions that are a consequence of the activities of an entity, but which arise from sources not owned or controlled by that entity. Some examples of Scope 3 activities provided in the Greenhouse Gas Protocol are extraction and production of purchased materials, transportation of purchased fuels, and use of sold products and services.

The Greenhouse Gas Protocol provides that reporting scope 3 emissions is optional. If an organisation believes that Scope 3 emissions are a significant component of the total emissions inventory, these can be reported along with Scope 1 and Scope 2. However, the Greenhouse Gas Protocol notes that reporting Scope 3 emissions can result in double counting of emissions and can also make comparisons between organisations and/or products difficult because reporting is voluntary.

Double counting needs to be avoided when compiling national (country) inventories under the Kyoto Protocol. The Greenhouse Gas Protocol also recognises that compliance regimes are more likely to focus on the "point of release" of emissions (i.e. direct emissions) and/or indirect emissions from the purchase of electricity.

12.2 Greenhouse Gas Assessment Policy Summary

12.2.1 National Greenhouse and Energy Reporting Act

The *National Greenhouse and Energy Reporting Act 2007 (*NGER Act) was passed in September 2007. The NGER Act establishes a mandatory corporate reporting system for greenhouse gas emissions, energy consumption and production. The NGER scheme consolidates existing greenhouse reporting schemes. The NGER Act is underpinned by a number of legislative instruments that provide greater detail about obligations, which in conjunction with the NGER Act, form the National Greenhouse and Energy Reporting System, as follows:

- The National Greenhouse and Energy Reporting Regulations 2008; and
- The National Greenhouse and Energy Reporting (Measurement) Determination 2008.

NGER is seen as an important first step in the establishment of a domestic emissions trading scheme. Companies must register and report if they emit greenhouse emissions or produce/consume energy at or above the following trigger thresholds:

- If they own facilities that emit greater than 25 kilotonnes (kt) greenhouse emissions (expressed as CO_2-e) or produce consume greater than 100 terajoules (TJ) of energy; and
- If the corporate group emits greater than 125 kt of greenhouse emissions (expressed as CO_2-e) or produce consume greater than 500 TJ of energy.

Scope 1 and Scope 2 greenhouse gas emissions are required to be reported under the NGER Act.

12.2.2 Proposed Legislation – The Carbon Price Mechanism

On 10 July 2011, the Australian Government released its Clean Energy Plan, which incorporates a Carbon Pricing Mechanism. Under this proposed policy, from 1 July 2012, the eligible industries in Australia will be required to pay for every tonne of carbon pollution released to the atmosphere (**Australian Government, 2011**). This mechanism is expected to replace the Carbon Pollution Reduction Scheme (CPRS) put forward by the Australian Government in 2008.

The CPRS was intended to be the principal mechanism used to reduce Australia's greenhouse gas emissions for the Kyoto period, and beyond. The centrepiece of the CPRS was a "cap and trade" emissions trading scheme to constrain greenhouse gas emissions and establish a price for greenhouse gas emissions in Australia. On 27 April 2010 the Australian Government announced the deferral of the CPRS implementation date.

Although the framework of the proposed carbon mechanism resembles that proposed in the Green and White Papers (**DCC, 2008a and DCC, 2008b**) for the CPRS, the carbon price mechanism involves the following distinguishing features:

- For the first three years, a fixed price stage will operate with the price of all carbon permits set by the government;
- Subsequent to this three year period, a flexible cap and trade emissions trading scheme will commence;
- During the fixed price stage, *eligible* Australian carbon credit units (ACCUs) produced from Australian projects under the Carbon Farming Initiative (CFI), will be accepted as currency as an alternative of purchasing Australian Permits.
- The *Clean Energy Plan* is expected to cut pollution by a minimum of 5% below 2000 levels *by 2020 and by 80% below 2000 lev*els *by 2050.*
- Before the flexible price period, the Government will set annual caps on pollution for the first *five years which w*ill be extended each year to assist businesses planning their strategy for compliance.

As proposed in the CPRS, the threshold for facilities will be identical to that employed for NGER reporting (i.e. 25,000 kt CO_2-e/year or more - excluding emissions from transport fuels and some synthetic greenhouse gases) and will be used to identify whether a facility will be covered by the carbon pricing mechanism.

12.2.2.1 Emissions Trading

Subsequent to the fixed price stage, a variable price as part of a "cap and trade" system will be implemented where the carbon price will be set by the market. The number of permits issued by the Government each year will be capped. In cap and trade schemes, an aggregate cap is enforced. Organisations within the cap are able to trade emission permits to meet their permitting liabilities. International carbon markets and land abatement programs will also be available to acquire permits for compliance. During the flexible price period, an unlimited amount of eligible ACCUs can be surrendered for compliance, as opposed to the 5% limit set for the fixed price period.

Carbon permits can enter the market either by auction or by administrative allocation. Companies will have an economic incentive to pay for permits if their internal costs of abatement are higher than the price of permits, and to directly reduce their emissions if their internal costs of abatement are lower than the price of permits. In theory, companies that own permits would be willing to sell them if the revenue received from selling permits exceeds the profits from using them.

These market incentives are designed to encourage the cheapest abatement to occur first.

The carbon price mechanism will cover the same emissions as proposed under the CPRS, with the exception of the definite exclusion of agricultural carbon emissions. Approximately 60 % of Australia's carbon pollution is expected to be covered by the carbon price, which encompasses the following emission sources:

- Stationary energy production (e.g., natural gas, coal, petroleum fuels, electricity);
- Some business transport;
- Industrial processes (e.g., cement or aluminium production);
- Fugitive emissions (other than from decommissioned coal mines); and
- Emissions from non-legacy waste.

The scheme will have broad economic ramifications beyond large emitters with direct obligations. Households are likely to experience increased costs associated with carbon intensive goods and services such as electricity, gas and food. However, a significant portion of the scheme is devoted to measures to ease the transition to carbon-constrained economy and assistance from the Australian Government will be provided to approximately 8 million households.

12.2.2.2 Support Measures

Assistance will be provided through allocation of permits early in each compliance period to new and existing entities undertaking an eligible emissions-intensive trade-exposed (EITE) activity prescribed in regulations. The most emissions-intensive trade-exposed activities will receive assistance to cover 94.5% of industry average carbon costs in the first year of the carbon price. Less emissions-intensive trade-exposed activities will also receive assistance to cover 66% of industry average carbon costs. Assistance will be reduced by 1.3% each year to encourage industry to cut pollution (**Australian Government, 2011**).

12.3 Greenhouse Gas Emission Estimates

Emissions of CO_2 and CH_4 will be the most significant greenhouse gases for the Project. These gases are formed and released during the combustion of fuels used on site and from fugitive emissions occurring during the mining process, due to the fracturing of coal seams.

Inventories of greenhouse gas emissions can be calculated using published emission factors. Different gases have different greenhouse warming effects (referred to as global warming potentials) and emission factors take into account the global warming potentials of the gases created during combustion. The estimated emissions are referred to in terms of carbon dioxide equivalent or CO_2-equivalent (CO_2-e) emissions by applying the relevant global warming potential.

The greenhouse gas assessment has been conducted using the National Greenhouse Accounts (NGA) Factors, published by the Department of Climate Change and Energy Efficiency (**DCCEE, 2010**). Project-related greenhouse gas sources included in the assessment are as follows:

- Fuel consumption (diesel) during mining operations – Scope 1;
- Release of fugitive CH_4 during mining – Scope 1;
- Indirect emissions resulting from the consumption of purchased electricity - Scope 2;
- Indirect emissions associated with the production and transport of fuels – Scope 3;
- Indirect emissions associated with transmission and distribution losses from electricity supply – Scope 3;
- Emissions from coal transportation – Scope 3; and
- Emissions from the burning of the product coal – Scope 3.

Emissions from the shipping of product coal are not included in this assessment due to the difficulties in emission estimates, including uncertainty in export markets and destination of product into the future and limited data on emission factors and / or fuel consumption for ocean going vessels.

12.3.1 On-site Fuel Consumption

Greenhouse gas emissions from diesel consumption were estimated using the following equation:

$$E_{CO_2\text{-}e} = \frac{Q \ x \ EF}{1000}$$

where:

$E_{CO2\text{-}e}$	=	Emissions of GHG from diesel combustion	(t CO_2-e)
Q	=	Estimated combustion of diesel	(GJ)[1]
EF	=	Emission factor (Scope 1 or Scope 3)for diesel combustion	(kg CO_2-e/GJ)[2]

[1] GJ = giga joules

[2] kg CO_2-e/GJ = kilograms of carbon dioxide equivalents per gigajoule

The quantity of diesel consumed (Q) in each year is based on a derived diesel intensity rate (megalitres per million tonnes per annum of run of mine coal [ML/Mtpa ROM]) derived from the 2009 average diesel consumption (7.62 megalitres [ML]) and ROM rate of 1.5 Mtpa. The quantity of diesel consumed in GJ is then calculated using an energy content factor for diesel of 38.6 gigajoules per kilolitre (GJ/kL). Greenhouse gas emission factors and energy content for diesel were sourced from the NGA Factors (**DCCCEE, 2010**). The estimated annual and project total GHG emissions from diesel usage are presented in **Table 12.1**.

Table 12.1: Estimated CO_2-e (tonnes) for On-site Diesel Consumption

Year	ROM (Mtpa)	Emission Factor (kg CO_2-e/GJ		Energy Content (GJ/kL)	Emissions (t CO_2-e)		Total
		Scope 1	Scope 3		Scope 1	Scope 3	
Year 1	2.400	69.9	5.3	38.6	32,735	2,482	35,217
Year 2	3.300	69.9	5.3	38.6	45,010	3,413	48,423
Year 3	4.425	69.9	5.3	38.6	60,355	4,576	64,931
Year 4	4.545	69.9	5.3	38.6	61,992	4,700	66,692
Year 5	4.545	69.9	5.3	38.6	61,992	4,700	66,692
Year 6	4.545	69.9	5.3	38.6	61,992	4,700	66,692
Year 7	4.545	69.9	5.3	38.6	61,992	4,700	66,692
Year 8	4.545	69.9	5.3	38.6	61,992	4,700	66,692
Year 9	4.545	69.9	5.3	38.6	61,992	4,700	66,692
Year 10	4.545	69.9	5.3	38.6	61,992	4,700	66,692
Year 11	4.545	69.9	5.3	38.6	61,992	4,700	66,692
Year 12	4.545	69.9	5.3	38.6	61,992	4,700	66,692
Year 13	4.545	69.9	5.3	38.6	61,992	4,700	66,692
Year 14	4.545	69.9	5.3	38.6	61,992	4,700	66,692
Year 15	4.545	69.9	5.3	38.6	61,992	4,700	66,692
Year 16	4.545	69.9	5.3	38.6	61,992	4,700	66,692
Year 17	4.545	69.9	5.3	38.6	61,992	4,700	66,692
Year 18	4.545	69.9	5.3	38.6	61,992	4,700	66,692
Year 19	4.545	69.9	5.3	38.6	61,992	4,700	66,692
Year 20	4.545	69.9	5.3	38.6	61,992	4,700	66,692
Year 21	4.545	69.9	5.3	38.6	61,992	4,700	66,692
Total	**91.9**				**1,253,949**	**95,078**	**1,349,026**

12.3.2 Electricity

Greenhouse gas emissions from electricity usage were estimated using the following equation:

$$E_{CO_2\text{-}e} = \frac{Q \; x \; EF}{1000}$$

where:

$E_{CO2\text{-}e}$	=	Emissions of greenhouse gases from electricity usage	(tCO_2-e/annum)
Q	=	Estimated electricity usage	(kWh/annum)[1]
EF	=	Emission factor (Scope 2 or Scope 3) for electricity usage	($kgCO_2$-e/kWh)[2]

[1] kWh/annum = kilowatt hours per annum

[2] $kgCO_2$-e/kWh = kilograms of carbon dioxide equivalents per kilowatt hour

The quantity of electricity used each year is based on a derived intensity rate (kWh/Mtpa ROM) derived from the 2009 annual electricity consumption (1,483,306 kilowatt hours [kWh]) and ROM rate of 1.5 Mtpa for 2009). Greenhouse gas emission factors were sourced from the NGA Factors (**DCCEE, 2010**). The estimated annual and project total GHG emissions from electricity usage are presented in **Table 12.2**.

Table 12.2: Estimated CO_2-e (tonnes) for On-site Electricity Use

Year	ROM (Mtpa)	Emission Factor (kg CO_2-e/kWh)		Emissions (t CO_2-e)		Total
		Scope 2	Scope 3	Scope 2	Scope 3	
Year 1	2.4	0.89	0.18	3,168	641	3,809
Year 2	3.3	0.89	0.18	4,356	881	5,238
Year 3	4.425	0.89	0.18	5,842	1,181	7,023
Year 4	4.545	0.89	0.18	6,000	1,213	7,214
Year 5	4.545	0.89	0.18	6,000	1,213	7,214
Year 6	4.545	0.89	0.18	6,000	1,213	7,214
Year 7	4.545	0.89	0.18	6,000	1,213	7,214
Year 8	4.545	0.89	0.18	6,000	1,213	7,214
Year 9	4.545	0.89	0.18	6,000	1,213	7,214
Year 10	4.545	0.89	0.18	6,000	1,213	7,214
Year 11	4.545	0.89	0.18	6,000	1,213	7,214
Year 12	4.545	0.89	0.18	6,000	1,213	7,214
Year 13	4.545	0.89	0.18	6,000	1,213	7,214
Year 14	4.545	0.89	0.18	6,000	1,213	7,214
Year 15	4.545	0.89	0.18	6,000	1,213	7,214
Year 16	4.545	0.89	0.18	6,000	1,213	7,214
Year 17	4.545	0.89	0.18	6,000	1,213	7,214
Year 18	4.545	0.89	0.18	6,000	1,213	7,214
Year 19	4.545	0.89	0.18	6,000	1,213	7,214
Year 20	4.545	0.89	0.18	6,000	1,213	7,214
Year 21	4.545	0.89	0.18	6,000	1,213	7,214
Total	**91.9**			**121,367**	**24,546**	**145,913**

12.3.3 Fugitive Emissions

Fugitive emissions were estimated based on the using the following equation:

$$E_{CO_2\text{-}e} = Q \ x \ EF$$

where:

$E_{CO2\text{-}e}$	=	Emissions of greenhouse gases from fugitive emissions	(t CO_2-e/annum)
Q	=	ROM coal extracted during the year	(t)
EF	=	Site Specific Emission Factor	(t CO_2-e/tonne)

A site specific emission factor for fugitive methane has been derived based on measurements of gas content for boreholes samples taken for each coal seam by GeoGAS and CSG Partners. These data are shown in their raw format in **Appendix E**. Measurements of less than 0.3 m^3/t were below the adopted Limit of Detection (see **Geos Mining Memorandum, 2011**) and were therefore treated as 0 m^3/t.

The measured gas content in m^3/t was converted to t CO_2-e / t using the measured % gas composition (reported for CH_4 and CO_2) and using the conversion factors reported in the NGERs Technical Guidelines (**DCC, 2009**) to convert from m^3 to CO_2-e tonnes, as follows:

- For methane – $6.784 \times 10^{-4} \times 21$
- For CO_2 – 1.861×10^{-3}

The derived site specific emission factor and estimated annual and project total GHG emissions from fugitive emissions are presented in **Table 12.3**.

Table 12.3: Estimated CO_2-e (tonnes) for Fugitive Emissions

Year	ROM (Mtpa)	Site Specific EF (t CO_2-e/t)	Total Emission (t CO_2-e)
Year 1	2.400	0.001	1,624
Year 2	3.300	0.001	2,233
Year 3	4.425	0.001	2,994
Year 4	4.545	0.001	3,076
Year 5	4.545	0.001	3,076
Year 6	4.545	0.001	3,076
Year 7	4.545	0.001	3,076
Year 8	4.545	0.001	3,076
Year 9	4.545	0.001	3,076
Year 10	4.545	0.001	3,076
Year 11	4.545	0.001	3,076
Year 12	4.545	0.001	3,076
Year 13	4.545	0.001	3,076
Year 14	4.545	0.001	3,076
Year 15	4.545	0.001	3,076
Year 16	4.545	0.001	3,076
Year 17	4.545	0.001	3,076
Year 18	4.545	0.001	3,076
Year 19	4.545	0.001	3,076
Year 20	4.545	0.001	3,076
Year 21	4.545	0.001	3,076
Total	**91.9**		**62,212**

12.3.4 Explosives

Emissions from explosive usage were estimated based on the using the following equation:

$$E_{CO_2\text{-}e} = Q \ x \ EF$$

where:

$E_{CO2\text{-}e}$	=	Emissions of greenhouse gases from explosives	(tCO_2-e/annum)
Q	=	Quantity of explosive used (assumed ANFO)	(t)
EF	=	Scope 1 emission factor	(tCO_2-e/tonne explosive)

Greenhouse gas emission factors were sourced from the Australian Greenhouse Office (AGO) Factors and Methods Workbook – December 2006. It is noted that the AGO Factors and Methods were replaced by the NGA Factors (**DCCEE, 2010**), however the emission factor for explosives was dropped from the latest version. Emissions from explosives do not have to be reported under NGERS.

The estimated annual and project total GHG emissions from explosive usage are presented in **Table 12.4**.

Table 12.4: Estimated CO_2-e (tonnes) for Explosive Use

Year	ROM (Mtpa)	Emission Factors (t CO_2 / tonne product) ANFO	Scope 1 Emissions (t CO_2-e)
Year 1	2.400	0.167	329
Year 2	3.300	0.167	452
Year 3	4.425	0.167	606
Year 4	4.545	0.167	622
Year 5	4.545	0.167	622
Year 6	4.545	0.167	622
Year 7	4.545	0.167	622
Year 8	4.545	0.167	622
Year 9	4.545	0.167	622
Year 10	4.545	0.167	622
Year 11	4.545	0.167	622
Year 12	4.545	0.167	622
Year 13	4.545	0.167	622
Year 14	4.545	0.167	622
Year 15	4.545	0.167	622
Year 16	4.545	0.167	622
Year 17	4.545	0.167	622
Year 18	4.545	0.167	622
Year 19	4.545	0.167	622
Year 20	4.545	0.167	622
Year 21	4.545	0.167	622
Total	**91.9**		**12,588**

12.3.5 Other Scope 3 Emissions

12.3.5.1 Transportation

Emissions from coal transportation have been estimated based on 1 Mt product coal being transported via rail to Port Kembla for export. It has been conservatively assumed that up to 1 Mtpa coal in all Project years will be transported to that destination. Emissions associated with product coal transportation have been estimated based on an emission factor for loaded trains of 12.3 g/net tonne-km (**QR Network Access, 2002**). Emission factors were not available for unloaded trains so the factor for loaded trains is conservatively applied for the return trip. The return rail trip to Port Kembla is estimated to be 190.88 km.

The total estimated GHG emissions from rail transport are provided in **Table 12.5**.

It is important to note that Coalpac is seeking approval for 1Mt of product coal to be transported by rail to Port Kembla and is not seeking to increase this amount at any time in the Project's life. The AQIA assumes that much of the remaining volume of product coal will be transported via conveyor to the MPPS for each year of the Project's operation. It is recognised that although unlikely, there may be some potential for the MPPS to be unable to receive the remaining product coal from the Project at a stage in the Project's life. Should this scenario occur, the Project would need a modification to Project Approval and be re-assessed at said time.

Coalpac will also continue to transport product sand by truck off-site to the end of Year 14 of the Project. These scope 3 emissions have been estimated using the same method described in **Section 12.3.1**. The total estimated GHG emissions from off-site transport of sand are provided in **Table 12.7**.

Emissions from transporting coal by truck off-site are not included in this GHG assessment due to the minor amount of coal to be transported by truck per year. Further, the amount trucked per year will be transported to end users (e.g. power stations or other domestic suppliers) on a needs basis and therefore the amount will be variable per year. The GHG emissions from this activity are scope 3 emissions and are likely to be minor and will not have a significant effect on the total overall GHG emissions from the Project.

Table 12.5: Estimated CO_2-e (tonnes) for coal transportation by rail

Year	Total Product coal (t)	Total Emissions (t CO_2-e)
Year 1	1,000,000	2,348
Year 2	1,000,000	2,348
Year 3	1,000,000	2,348
Year 4	1,000,000	2,348
Year 5	1,000,000	2,348
Year 6	1,000,000	2,348
Year 7	1,000,000	2,348
Year 8	1,000,000	2,348
Year 9	1,000,000	2,348
Year 10	1,000,000	2,348
Year 11	1,000,000	2,348
Year 12	1,000,000	2,348
Year 13	1,000,000	2,348
Year 14	1,000,000	2,348
Year 15	1,000,000	2,348
Year 16	1,000,000	2,348
Year 17	1,000,000	2,348
Year 18	1,000,000	2,348
Year 19	1,000,000	2,348
Year 20	1,000,000	2,348
Year 21	1,000,000	2,348
TOTAL	**21,000,000**	**49,304**

Table 12.6: Estimated CO_2-e (tonnes) for sand transportation off-site by truck

Year	Total Product Sand (Mtpa)	Total Emissions (t CO_2-e)
Year 1	0.64	9,391
Year 2	0.64	9,391
Year 3	0.64	9,391
Year 4	0.64	9,391
Year 5	0.64	9,391
Year 6	0.64	9,391
Year 7	0.64	9,391
Year 8	0.64	9,391
Year 9	0.64	9,391
Year 10	0.64	9,391
Year 11	0.64	9,391
Year 12	0.64	9,391
Year 13	0.64	9,391
Year 14	0.64	9,391
Total	**9.0**	**131,476**

12.3.5.2 Burning Product Coal

Greenhouse gas emissions from the burning of product coal were estimated using the following equation:

$$E_{CO_2\text{-}e} = \frac{Q \ x \ EC \ x \ EF}{1000}$$

Where:

$E_{CO2\text{-}e}$	=	Emissions of GHG from coal combustion	(t CO_2-e)
Q	=	Quantity of product coal burnt	(GJ)
EC	=	Energy Content Factor for black coal	(GJ/t)[1]
EF	=	Emission factor for coal combustion	(kg CO_2-e/GJ)

[1] GJ/t = gigajoules per tonne

The quantity of coal burnt in Mtpa is converted to GJ using an energy content factor for coal of 23 GJ/t. The greenhouse gas emission factor was sourced from the NGA Factors (**DCCEE, 2010**). The energy content factor was calculated and provided by Coalpac as site-specific data (**Communication with Hansen Bailey, 2011**).

The emissions associated with burning of the product coal are presented in **Table 12.7.**

Table 12.7: Scope 3 Emissions for Product Coal

Year	Product Coal Mtpa	Energy Content GJ/t	EF kg CO2 e/GJ	Scope 3 Emissions (t CO2-e)
Year 1	2.069	23	88	4,207,712
Year 2	2.714	23	88	5,518,961
Year 3	3.498	23	88	7,113,581
Year 4	3.500	23	88	7,117,903
Year 5	3.500	23	88	7,117,903
Year 6	3.500	23	88	7,117,903
Year 7	3.500	23	88	7,117,903
Year 8	3.500	23	88	7,117,903
Year 9	3.500	23	88	7,117,903
Year 10	3.500	23	88	7,117,903
Year 11	3.500	23	88	7,117,903
Year 12	3.500	23	88	7,117,903
Year 13	3.500	23	88	7,117,903
Year 14	3.500	23	88	7,117,903
Year 15	3.500	23	88	7,117,903
Year 16	3.500	23	88	7,117,903
Year 17	3.500	23	88	7,117,903
Year 18	3.500	23	88	7,117,903
Year 19	3.500	23	88	7,117,903
Year 20	3.500	23	88	7,117,903
Year 21	3.500	23	88	7,117,903
Total	**71.274**			**144,962,510**

12.4 Summary of GHG Emissions

A summary of the total GHG emissions associated with the Project are presented in **Table 12.8**. The emissions from the burning of product coal will be much larger than those associated with the extraction and processing of the coal. These are indirect emissions (Scope 3) from sources not owned or controlled by Coalpac, and therefore measures to minimise or reduce these emissions cannot be made by Coalpac.

Table 12.8: Summary of GHG Emissions (t CO_2-e)

Emission Source	Scope 1	Scope 2	Scope 3	Total
	Average t CO_2-e/annum			
Diesel	59,712	-	4,528	64,239
Electricity	-	5,779	1,169	6,948
Explosives	599	-	-	599
Fugitive Emissions	2,962	-	-	2,962
Coal Transportation	-	-	2,348	2,348
Off-site Sand Transportation	-	-	9,391	9,391
Coal Burning	-	-	6,902,977	6,902,977
Total: Annual	**63,274**	**5,779**	**6,920,412**	**6,989,465**
Total: Year 1 - 21	**1,328,748**	**121,367**	**145,262,914**	**146,713,030**

12.5 Assessment of Potential Impact on Environment

Australia ratified the Kyoto Protocol in December 2007, an international agreement under the United Nations Framework on Climate Change (UNFCC) that was agreed in 1997. The aim of the Protocol is to reduce global greenhouse gas emissions by requiring developed countries to meet national targets for greenhouse gas emissions over the five year period from 2008 to 2012.

A comparison is therefore made with the baseline 1990 Australian emissions, which are reported under the Kyoto Protocol as 547.7 Mt CO_2-e (**DCC, 2009a**). The baseline is used to assign Australian target under the Kyoto Protocol, which is 108% of the 1990 level. Comparing the average annual Scope 1 emissions from the Project against the 1990 baseline indicates that the Project emissions are 0.01% of the 1990 levels.

The relationship between GHG emissions and global warming is not linear and there is no accepted method to determine the contribution that a given emission of GHGs might make to global warming.

The estimated quantity of carbon dioxide stored in the atmosphere now is approximately 3,000 Gigatonnes (Gt). The International Energy Agency estimates that in 2007, global emissions of CO_2 from burning fossil fuels were 28,962 Mt, of which Australia's emissions of CO_2 from burning fossil fuels were 396.3 Mt CO_2 (i.e. approximately 1.4% of the global anthropogenic, or human-related, total) (**IEA, 2009**).

At any point in time, it would be reasonably simple to compare the estimated emission of CO_2-e from the various activities with the 3,000 Gt of CO_2-e currently estimated to be stored in the atmosphere. On this basis, average annual emissions over the lifetime of the proposal from the mining and burning of coal (including mining, transporting the coal to the Port Kembla and usage of the coal) are estimated to be 0.0003% of the current global CO_2–e atmospheric load. Thus, the Project could be considered to contribute 0.0003% to the increase in global temperatures caused by the increase in GHG emissions as they are currently. This invites the question as to what temperature rise might be attributed to the GHG emissions from the proposal.

Based on the IPPC estimate that a doubling of the CO_2-e concentration in the atmosphere would lead to a 2.5°C increase in global average temperature and that the current global CO_2–e load is approximately 3,000 Gt, it can be estimated that the annual average emissions (Scope 1, 2 and 3) during the life of proposal (including mining, transporting the coal to Port Kembla and usage of the coal) could lead to an annual increase in global temperature of 0.00001 C (0.0009% of 2.5°C). Based on the above, there is not likely to be any measurable environmental effect due to the emissions of GHGs from the proposal, i.e. the contribution of the project to GHG emissions will be negligible. In practice, of course, the effects of global warming and associated climate change are the cumulative effect of many thousands of such sources.

12.6 GHG Emission Reduction Measures

Coalpac has plans and standards to minimize energy usage and GHG emissions from its operations, including the Coalpac Consolidation Project. Reasonable and feasible measures will be implemented on-site to minimise greenhouse gas emissions of the Project and ensure it is energy efficient. These measures include objectives, commitments, procedures and responsibilities for:

- Researching and promoting low emission coal technologies;
- Monitoring and improving energy use and efficiency and reducing GHG emissions from the mining, processing and use of coal;
- Consideration of the use of alternative fuels where economically and practically feasible;
- Review of mining practices to minimise double handling of materials and ensuring that coal and overburden haulage is undertaken using the most efficient routes;
- Ongoing scheduled and preventative maintenance to ensure that diesel and electrically powered plant operate efficiently; and
- Develop targets for greenhouse gas emissions and energy use onsite and monitor and report against these.

Coalpac has already committed to ensuring that certain GHG measures are implemented on-site. These site specific measures are listed in **Table 12.9** and will continue to be implemented during the life of the Project, along with consideration of the reasonable and feasible measures listed above.

Table 12.9: Greenhouse Gas Management Measures

Management Measure	Implementation Date
Ensuring that there is a dedicated number of trucks for each digging unit (i.e. front-end-loader and excavator) to minimise truck wait time.	On-going
Ensuring that dump trucks are fully loaded for each load prior to hauling to maximise productivity and efficiency with regard to the amount of fuel used per unit of material moved. This is measured by the number of buckets loaded into each truck.	On-going
Review haul road maintenance and materials used in main haul roads to reduce rolling resistance and decrease fuel consumption.	On-going

13 CONCLUSIONS

This assessment has investigated the potential air quality impacts of the Coalpac Consolidation Project with respect to air quality and greenhouse gas emissions.

Dispersion modelling has been used to predict off-site dust concentration and dust deposition levels due to the dust generating activities that would occur as a result the Project. Emissions inventories were developed for Year 2, Year 8, Year 14 and Year 20 of the Project. The dispersion conditions for the area were characterised based on regional and local meteorological data, generated using a diagnostic meteorological modelling system known as CALMET. The dispersion model CALPUFF was used to predict the maximum 24-hour PM_{10}, annual average PM_{10}, annual average TSP and annual average dust deposition. CALPUFF is endorsed by the US EPA, and has been used in many studies in New South Wales, Queensland and other parts of Australia. CALPUFF is approved by the NSW DECCW where non-steady conditions can be expected (e.g. where complex terrain exists).

Detailed modelling was conducted to assess whether the proposed mining operations of the Project would adversely impact any privately owned or mine-owned residences located within the vicinity of the Project. The assessment included predictions of air quality impacts from the Project in isolation as well as the potential cumulative impacts of other sources. The modelling indicates that over the proposed 21-year period of the Project there will be some sensitive receptors that have the potential to experience dust concentrations above the DECCW's air quality assessment criteria. These residences are summarised in **Table 13.1**.

Generally, the predictions presented in this report incorporate a level of conservatism due to worst case assumptions and the nature of dispersion modelling. As a result, it is expected that actual ground level concentrations would be lower than those predicted in the model during normal operation of the Project.

Notwithstanding this, it is proposed that the worst case impacts would be managed on a day to day basis with the implementation of a real-time air quality monitoring station, which will enable mine personnel to respond to high dust levels prior to their reaching critical levels and modify activities or increase controls as required.

The potential greenhouse gas emissions that are likely to occur as a result of the operation of the Project have been estimated based on an inventory for each year of the Project's life. On average, Scope 1 emissions from the Project would increase emissions by 0.01% of the 1990 baseline Australian levels.

Table 13.1: Summary of receptors that have the potential to experience dust impact

Residence ID	Potential Impact
169[a]	24-hour PM_{10} impacts above 50 µg/m^3 occur on more than 5 days per year from mine alone.
171[a]	24-hour PM_{10} impacts above 50 µg/m^3 occur on more than 5 days per year from mine alone.
195[b]	24-hour PM_{10} impacts above 50 µg/m^3 occur on more than 5 days per year from mine alone. Cumulative annual average PM_{10} concentrations above 30 µg/m^3 based on conservative worst case assessment.
196[b]	24-hour PM_{10} impacts above 50 µg/m^3 occur on more than 5 days per year from mine alone. Cumulative annual average PM_{10} concentrations above 30 µg/m^3 based on conservative worst case assessment.
197[b]	24-hour PM_{10} impacts above 50 µg/m^3 occur on more than 5 days per year from mine alone. Cumulative annual average PM_{10} concentrations above 30 µg/m^3 based on conservative worst case assessment.
198[b]	24-hour PM_{10} impacts above 50 µg/m^3 occur on more than 5 days per year from mine alone. Cumulative annual average PM_{10} concentrations above 30 µg/m^3 based on conservative worst case assessment.
199[b]	24-hour PM_{10} impacts above 50 µg/m^3 occur on more than 5 days per year from mine alone. Cumulative annual average PM_{10} concentrations above 30 µg/m^3 based on conservative worst case assessment.
216	24-hour PM_{10} impacts above 50 µg/m^3 occur but for less than 5 days per year from mine alone.
217a[c] and 217b[bc]	24-hour PM_{10} impacts above 50 µg/m^3 occur but for less than 5 days per year from mine alone.
258	24-hour PM_{10} impacts above 50 µg/m^3 occur but for less than 5 days per year from mine alone.
325	24-hour PM_{10} impacts above 50 µg/m^3 occur but for less than 5 days per year from mine alone.
326	24-hour PM_{10} impacts above 50 µg/m^3 occur but for less than 5 days per year from mine alone.
327	24-hour PM_{10} impacts above 50 µg/m^3 occur but for less than 5 days per year from mine alone.
394[a]	24-hour PM_{10} impacts above 50 µg/m^3 occur on more than 5 days per year from mine alone.
396[a]	24-hour PM_{10} impacts above 50 µg/m^3 occur on more than 5 days per year from mine alone.
426	24-hour PM_{10} impacts above 50 µg/m^3 occur but for less than 5 days per year from mine alone.

[a] Coalpac-owned
[b] Located within Coalpac Mining Lease
[c] Crown-owned

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Appendix A: Land Ownership Details

Table A.1: Land ownership details

BLOCK ID	LOT	DP	OWNER ID	OWNER
1	120	704711	179	JR TILLEY & DG McGRATH
2	122	704711	2	CROWN
3	82	621620	180	DESTANAG PTY LTD
4	2	748283	181	WDD & AM CLARK
5	84	755759	182	RJ ALLEN
6	2	1083114	182	RJ ALLEN
7	20	755759	183	BJ & LL SKEEN
8	77	755759	184	B & F KUHNER
9	26	755759	185	JK HUTCHISON
10	73	755759	185	JK HUTCHISON
11	13	755766	186	RS HUTCHISON
12	76	755795		NATIONAL PARKS & WILDLIFE SERVICE
13	107	755767		NATIONAL PARKS & WILDLIFE SERVICE
14	7301	1131637	2	CROWN
15	7302	1137845	2	CROWN
16	38	755759	179	JR TILLEY & DG McGRATH
17	64	661880	180	DESTANAG PTY LTD
18	7300	1131637	2	CROWN
19	11	755759	180	DESTANAG PTY LTD
20	12	755759	180	DESTANAG PTY LTD
21	59	755759	180	DESTANAG PTY LTD
22	13	755759	180	DESTANAG PTY LTD
23	56	755759	180	DESTANAG PTY LTD
24	14	755759	180	DESTANAG PTY LTD
25	7	1035759	187	O'FARRELL PASTORAL COMPANY PTY LTD
26	68	755759	188	GJ & TJ MORRIS
27	4	1035759	187	O'FARRELL PASTORAL COMPANY PTY LTD
28	5	1035759	189	PJ PERROTT
29	97	755759	190	RL KELLAM
30	98	755759	2	CROWN
31	7001	1026563	2	CROWN
32	6	1035759	187	O'FARRELL PASTORAL COMPANY PTY LTD
33	8	1035759	187	O'FARRELL PASTORAL COMPANY PTY LTD
34	100	1028251	191	RF & RA CARTER
35	18	7881	191	RF & RA CARTER
36	1	385225	5	RI & GM LARKIN
37	26	7881	5	RI & GM LARKIN
38	27	7881	192	PMG & CE PARR
39	72	755759	2	CROWN
40	54	755767	193	VA , CA , SL & JA HANTOS
41	76	755759	3	PR & KA HALL
42	A	391695	4	LARKIN PASTORAL CO PTY LTD
43	58	755759	180	DESTANAG PTY LTD
44	55	755759	180	DESTANAG PTY LTD
45	57	755759	180	DESTANAG PTY LTD
46	47	755759	2	CROWN
47	46	755759	2	CROWN
48	45	755759	2	CROWN
49	54	755759	4	LARKIN PASTORAL CO PTY LTD
50	1	951805	4	LARKIN PASTORAL CO PTY LTD
51	48	755759	2	CROWN
52	49	1094781	4	LARKIN PASTORAL CO PTY LTD
53	7	1035759	187	O'FARRELL PASTORAL COMPANY PTY LTD
54	8	1035759	187	O'FARRELL PASTORAL COMPANY PTY LTD
55	1	834137	194	CJ & MH O'FARRELL PTY LTD
56	101	1028251	195	AP & MA CONSTANTINIDES & DR GAZZARD
57	1	382576	2	CROWN (THE COUNCIL OF THE SHIRE OF BLAXLAND)
58	A	380377	196	KA & MJ KIRK
59	B	380377	196	KA & MJ KIRK
60	1	204931	197	TJ & BN GILSHENAN
61	2	204931	198	KM PRICE
62	1	735808	2	CROWN (RTA)
63	1	633720	200	RN HARRIS
64	7	755759	3	PR & KA HALL
65	10	755759	3	PR & KA HALL
66	8	755759	3	PR & KA HALL
67	9	755759	3	PR & KA HALL

BLOCK ID	LOT	DP	OWNER ID	OWNER
68	53	755759	4	LARKIN PASTORAL CO PTY LTD
69	74	755759	4	LARKIN PASTORAL CO PTY LTD
70	11	1125934	4	LARKIN PASTORAL CO PTY LTD
71	12	1125934	4	LARKIN PASTORAL CO PTY LTD
72	1	770408	195	AP & MA CONSTANTINIDES & DR GAZZARD
73	3	755759	187	O'FARRELL PASTORAL COMPANY PTY LTD
74	94	755759	43	JC MURRAY & KL MCFARLANE
75	37	755759	43	JC MURRAY & KL MCFARLANE
76	40	755759	43	JC MURRAY & KL MCFARLANE
77	41	755759	43	JC MURRAY & KL MCFARLANE
78	112	751640		NATIONAL PARKS & WILDLIFE SERVICE
79	33	1125887	46	RI , AM & GM LARKIN
80	31	572044	44	AG DICKSON
81	32	1125887	45	THE MINISTER FOR EDUCATION & TRAINING
82	66	755759	2	CROWN
83	62	755759	2	CROWN
84	61	755759	2	CROWN
85	1	744575	48	A & L TETTE
86	60	755759	2	CROWN
87	3	737188	49	BK ABRAHAMS
88	15	755767	3	PR & KA HALL
89	100	755769	3	PR & KA HALL
90	7302	1131637	2	CROWN
91	99	755769	3	PR & KA HALL
92	77	755769	3	PR & KA HALL
93	25	755769	3	PR & KA HALL
94	24	755769	3	PR & KA HALL
95	36	755759	4	LARKIN PASTORAL CO PTY LTD
96	26	755769	4	LARKIN PASTORAL CO PTY LTD
97	1	1148995	5	RI & GM LARKIN
98	87	755759	5	RI & GM LARKIN
99	88	755759	5	RI & GM LARKIN
100	99	755759	5	RI & GM LARKIN
101	4	114337	5	RI & GM LARKIN
102	5	114337	5	RI & GM LARKIN
103	10	245921	57	JR & DM CRAM
104	11	245921	47	KA THOMAS
105	9	245921	56	A & M ABOU-TOUMA
106	8	245921	56	A & M ABOU-TOUMA
107	7	245921	55	G & M GEBRAEL
108	6	245921	54	PJ & CI DI MAURO
109	5	245921	53	J , P , GG & CG PICCIONE
110	4	245921	52	J HANNOUCHE
111	23	1065421	58	A & R SALMAN
112	3	245921	52	J HANNOUCHE
113	2	245921	51	MB & AM RINGIN
114	1	245921	50	PJ & EJ ISAACSON
115	24	755759	59	GA & BS JESSEP
116	44	755759	59	GA & BS JESSEP
117	34	755759	60	P & WE TILLEY
118	1	114337	59	GA & BS JESSEP
119	10	812300	61	LN GOLDSPINK
120	11	812300	59	GA & BS JESSEP
121	86	755759	59	GA & BS JESSEP
122	1	734531	62	JL MACPHEE
123	22	1103948	64	TW & JA NOLAN
124	21	1103948	63	DW MACPHEE
125	93	755759		NATIONAL PARKS & WILDLIFE SERVICE
126	39	755759		STATE FORESTS OF NSW
127	53	755767	3	PR & KA HALL
128	1	130047	3	PR & KA HALL
129	2	130047	3	PR & KA HALL
130	77	755767	199	D BARBER
131	76	755767	199	D BARBER
132	43	755767	199	D BARBER
133	119	755769	3	PR & KA HALL
134	2	502588	3	PR & KA HALL
135	119	755769	3	PR & KA HALL
136	2	502588	3	PR & KA HALL
137	105	755769	4	LARKIN PASTORAL CO PTY LTD

BLOCK ID	LOT	DP	OWNER ID	OWNER
138	85	755769	5	RI &GM LARKIN
139	27	755769	5	RI & GM LARKIN
140	81	755769	5	RI & GM LARKIN
141	41	755769	5	RI &GM LARKIN
142	3	734531	65	PG DESCH & KC FARRUGIA
143	4	734531	66	DB SPEIRS
144	95	755759	67	DA & DM MULDOON
145	29	755759	42	WALLERWANG COLLIERIES
146	33	664527	42	WALLERWANG COLLIERIES
147	1	796723	42	WALLERWANG COLLIERIES
148	78	755759	42	WALLERWANG COLLIERIES
149	A	421385	42	WALLERWANG COLLIERIES
150	2	235194	42	WALLERWANG COLLIERIES
151	30	755759	42	WALLERWANG COLLIERIES
152	43	755759	42	WALLERWANG COLLIERIES
153	28	755759	42	WALLERWANG COLLIERIES
154	B	421385	42	WALLERWANG COLLIERIES
155	31	755759	42	WALLERWANG COLLIERIES
156	89	755759	42	WALLERWANG COLLIERIES
157	101	723771	42	WALLERWANG COLLIERIES
158	C	421385	42	WALLERWANG COLLIERIES
159	3	235194	42	WALLERWANG COLLIERIES
160	102	723771	42	WALLERWANG COLLIERIES
161	83	755759	42	WALLERWANG COLLIERIES
162	50	755759	42	WALLERWANG COLLIERIES
163	51	755759	42	WALLERWANG COLLIERIES
164	1	620791	42	WALLERWANG COLLIERIES
165	91	755759	42	WALLERWANG COLLIERIES
166	2	620791	42	WALLERWANG COLLIERIES
167	35	755759	42	WALLERWANG COLLIERIES
168	92	755759		STATE FORESTS OF NSW
169	17	755769	27	PORTLAND ROAD PASTORAL CO PTY LTD
170	59	755769	29	BE NAKHLE
171	164	755759	27	PORTLAND ROAD PASTORAL CO PTY LTD
172	96	755759		STATE FORESTS OF NSW
173	35	755769	6	RK DICKENS (PERPETUAL LEASE)
174	1	502588	6	RK DICKENS
175	126	755769	6	RK DICKENS
176	261	755769	7	GE ORELLANA
177	7301	1131640	2	CROWN
178	330	755769	6	RK DICKENS
179	1	220269	6	RK DICKENS
180	20	870537	6	RK DICKENS
181	125	755769	6	RK DICKENS
182	62	755769	6	RK DICKENS
183	49	755769	6	RK DICKENS
184	3	220269	6	RK DICKENS
185	42	755769	6	RK DICKENS
186	1	870538	6	RK DICKENS
187	7316	1142025	2	CROWN (THE STATE OF NSW)
188	36	755769	27	PORTLAND ROAD PASTORAL CO PTY LTD
189	331	46518	27	PORTLAND ROAD PASTORAL CO PTY LTD
190	332	46518	27	PORTLAND ROAD PASTORAL CO PTY LTD
191	1	1025909	27	PORTLAND ROAD PASTORAL CO PTY LTD
192	63	755769	2	CROWN (THE STATE OF NSW)
193	7005	1026565	2	CROWN (THE STATE OF NSW)
194	333	41170	34	J KNOX
195	345	720602	33	KJ BLACKLEY
196	7315	1142024	2	CROWN (THE STATE OF NSW)
197	74	755769	31	BE & CE LEISEMANN & IL &KID FOLLINGTON
198	57	744769	30	DA TILLEY
199	1	376417	30	DA TILLEY
200	3	1148418	35	R TILLEY
201	1	160808	32	KD & RL KELLAM
202	11	1093481	36	GJ KEIGHTLEY
203	2	857736	8	JR GRACEY
204	12	1093481	8	JR GRACEY
205	2	870538	9	D DINO & J SERAGLIO
206	2	870538	9	D DINO & J SERAGLIO
207	7344	1154791	2	CROWN

BLOCK ID	LOT	DP	OWNER ID	OWNER
208	326	755769	2	CROWN
209	1	249955	68	DJ RYAN
210	2	249955	69	FC & K TILLEY
211	3	249955	70	BJ & JM FITZGERALD
212	4	249955	27	PORTLAND ROAD PASTORAL CO PTY LTD
213	5	249955	28	LITHGOW COAL CO PTY LTD
214	1	48808	28	LITHGOW COAL CO PTY LTD
215	1	528538	27	PORTLAND ROAD PASTORAL CO PTY LTD
216	348	722331	137	BM EMMOTT
217	7312	1142022	2	CROWN
218	101	1106315	98	G & BA TILLEY
219	102	1106315	99	JR TILLEY
220	3	528538	97	KL BUNYON
221	1	218896	45	THE MINISTER FOR EDUCATION & TRAINING
222	1	973647	108	CP BAINY
223	1	315600	107	RJ WHITTAKER & SR BURROWS
224	2	315600	99	JR TILLEY
225	4	980222	99	JR TILLEY
226	1	944003	99	JR TILLEY
227	1	305258	106	RG WRIGHT & KL NORRIS
228	1	944657	105	AA WOODS , EJ NICHOLLS & LH FIELD
229	1	302241	105	AA WOODS , EJ NICHOLLS & LH FIELD
230	1	302242	104	CM & BA GILBERT
231	2	302240	103	J FULLER
232	1	302239	102	RM PYNE
233	1	958777	101	TE CADDIS & RM PYNE
234	1	1094180	100	S NAPOLI
235	1	626789	143	RK & SM LANE
236	2	626789	144	TJ & KO TILLEY
237	8	2284	142	MC CRANE
238	7	2284	141	DP ROCHESTER
239	6	2284	140	SG TWEEDIE
240	5	2284	139	DW & GJ McCANN
241	4	2284	77	WF FITZGERALD
242	3	2284	77	WF FITZGERALD
243	2	2284		UNREF
244	1	2284		UNREF
245	328	755769	138	M BOTFIELD
246	25	2284	139	DW & GJ McCANN
247	20	2284	157	KO & SL ROCHESTER
248	19	2284	156	PB DRAPER
249	18	2284	155	GER YOUNG
250	17	2284	155	GER YOUNG
251	16	2284	155	GER YOUNG
252	15	2284	155	GER YOUNG
253	14	2284	154	M PASZTOR
254	13	2284	153	RW SELMES
255	12	2284	152	GE LANE
256	11	2284	152	GE LANE
257	21	2284	145	DJ TILLEY
258	21	249955	146	S & H FILLA
259	20	755769	2	CROWN
260	7014	1067906	2	CROWN
261	323	755769	2	CROWN
262	142	755769	2	CROWN (THE COUNCIL OF THE CITY OF GREATER LITHGOW)
263	A	382206	109	M STONE
264	B	382206	110	RD & DJ BLACKLEY
265	144	755769	2	CROWN (THE COUNCIL OF THE SHIRE OF BLAXLAND)
266	145	755769	2	CROWN (THE COUNCIL OF THE SHIRE OF BLAXLAND)
267	150	755769	114	AW GLEESON & SA MULDOON
268	148	755769	112	EA & DM LANE
269	146	755769	111	RD BLACKLEY
270	147	755769	111	RD BLACKLEY
271	149	755769	113	CD & JD McCANN
272	82	755769	2	CROWN
273	84	755769	115	GJ & TA HUTCHISON
274	307	755769	116	JL & MB HOWDEN
275	308	755769	116	JL & MB HOWDEN
276	309	755769	33	KJ BLACKLEY (PERPETUAL LEASE)
277	310	755769	117	RJ TILLEY

BLOCK ID	LOT	DP	OWNER ID	OWNER
278	311	755769	118	FS GILSON
279	312	755769	119	N & JA ANDERSON
280	313	755769	120	SR WILLIAMS
281	314	755769	121	SJ BROOKS
282	343	42953	122	MW MERCER
283	317	755769	122	MW MERCER
284	318	755769	123	VN & E DEVEIGNE
285	319	755769	124	E BANKS
286	320	755769	125	MB BANKS
287	321	755769	126	KD FRIPP
288	322	755769	125	MB BANKS
289	118	755769	127	NG HARRADINE
290	1	934774	177	SW HOBBY
291	1	925015	158	A & R INZITARI
292	3	925015	159	SP MAYBURY
293	1/A	13644	159	SP MAYBURY
294	2/A	13644	158	A & R INZITARI
295	3/A	13644	160	DR & JA BATTERSBY
296	4/A	13644	161	PF KENDALL
297	7	13644	162	BJ SCOTT
298	6	13644	163	PF & DM TONER
299	5/A	13644	161	PF KENDALL
300	8/A	13644	146	S & H FILLA
301	9/A	13644	164	CM O'NEILL
302	10/A	13644	165	CJ CONROY
303	11/A	13644	166	AI MILLER & BS WILSON
304	12/A	13644	166	AI MILLER & BS WILSON
305	13/A	13644	166	AI MILLER & BS WILSON
306	14/A	13644	166	AI MILLER & BS WILSON
307	15/A	13644	166	AI MILLER & BS WILSON
308	16/A	13644	167	T BATES
309	17	13644	178	ME STEWART
310	18/A	13644	147	SJ BANDIERA
311	19/A	13644	148	WG BROWN
312	20/A	13644	149	LM McDONALD
313	21/A	13644	150	N VIAPHAY
314	22/A	13644	151	KR WATERS
315	1	1004175	168	KL GODDEN
316	1/B	13644	169	CE & SM DAVIS
317	2/B	13644	169	CE & SM DAVIS
318	100	1050450	170	AW HALL
319	5/B	13644	170	AW HALL
320	6/B	13644	170	AW HALL
321	20	1013496	171	N THORNE
322	21	1013496	172	J & DLA MARKOWSKI
323	22	1013496	172	J & DLA MARKOWSKI
324	23	1013496	173	P REDDAN
325	24	1013496	174	SP & SA DUGGAN
326	1	1047161	175	THE MINISTER FOR ENERGY & UTILITIES
327	2	1047161	176	J PLAYFORD
328	1	10141	86	RP HARRIS
329	2	10141	87	R BAILEY
330	3	10141	88	DJ ANNESLEY
331	4	10141	89	GJ & VC WALSH
332	5	10141	90	BN ROCHESTER
333	6	10141	91	RP DOYLE
334	7	10141	92	P WARNER & YA HARRIS
335	8	10141	92	P WARNER & YA HARRIS
336	9	10141	92	P WARNER & YA HARRIS
337	10	10141	92	P WARNER & YA HARRIS
338	11	10141	93	GJ WILLIAMS
339	12	10141	93	GJ WILLIAMS
340	13	10141	93	GJ WILLIAMS
341	14	10141	93	GJ WILLIAMS
342	15	10141	93	GJ WILLIAMS
343	16	10141	94	AG & RL WILLIAMS
344	17	10141	95	RT & VE DOBSON
345	18	10141	96	DK & K NORTHEY
346	19	10141	89	GJ & VC WALSH
347	20	10141	88	DJ ANNESLEY

BLOCK ID	LOT	DP	OWNER ID	OWNER
348	1	1008594	71	RE GILMORE & MG & PJ BULKELEY
349	2	1008594	72	RM CRANE
350	7	1017620	128	TANWIND PTY LTD
351	1	171665	2	CROWN
352	8	1017620	129	RS SPEIRS
353	1	24575	130	JM ELLIS
354	2	24575	131	E FABITS
355	3	24575	132	MS IVEY
356	4	24575	133	DC & KT CLAYDON & JD GARRETT
357	5	24575	134	ST & CP WILSON
358	6	24575	135	RJ DUNCAN
359	112	755769	2	CROWN
360	7314	1142023	2	CROWN
361	344	46506	136	RR COLE
362	3	1008594	71	RE GILMORE & MG & PJ BULKELEY
363	112	877190	1	COALPAC PTY LTD
364	1	556504	8	JR GRACEY
365	2	556504	8	JR GRACEY
366	65	755769	2	CROWN
367	1	872187	8	JR GRACEY
368	2	827480	10	RA FULLER
369	2	872187	10	RA FULLER
370	1	1038480	16	JA , SE BYROM & DC HUTTON
371	18	249955	15	MA & JL TAYLOR
372	15	249955	76	RE GILMORE
373	16	249955	77	WF FITZGERALD
374	14	249955	73	MG BULKELEY
375	13	249955	73	MG BULKELEY
376	4	1008594	73	MG BULKELEY
377	16	755769		STATE FORESTS OF NSW
378	113	877190	1	COALPAC PTY LTD
379	104	755767	39	VL CHADWICK
380	5	816995	37	LJ WALLWORK
381	4	816995	38	SG & DR BOLZAN
382	6	816995	12	DA & KL MITCHELL
383	1	620560	11	BS BRETHERTON & B CHANDWICK
384	21	633083	13	A TABONE
385	22	633083	14	CEEDIVE PTY LTD
386	3	727017	17	TJ GRIFFITHS
387	19	249955	18	JR EMBLETON KJ KELLY
388	17	249955	78	VA McFADDEN
389	7302	1142032	2	CROWN
390	12	249955	73	MG BULKELEY
391	11	249955	73	MG BULKELEY
392	10	249955	75	IG PALMER
393	8	249955	74	B & G MUENZER
394	1	860892	84	G MUENZER
395	11	614429	83	HYROCK NSW PTY LTD
396	1	180294	1	COALPAC PTY LTD
397	11	755767	40	J MENCHIN
398	50	755767	40	J MENCHIN
399	3	816995	19	PJ & TM McFADDEN
400	2	816995	20	D HART
401	1	816995	21	KG & DA NEAVES
402	7	816995	22	KJ & DK SHAW
403	1	717021	23	BR & E BROWN
404	2	717021	23	BR & E BROWN
405	3	717021	23	BR & E BROWN
406	4	717021	24	PW GRIFFITHS
407	5	717021	25	TJ & SM GRIFFITHS
408	6	717021	26	RH GRIFFITHS
409	1	728859	78	VA McFADDEN
410	7	717021	79	PJ & SL McFADDEN
411	179	755769	82	SJ & DS TAYLOR
412	177	755769	80	V & F FAVA , C ROSITANO , F TEDESCO & E TODORELLO
413	13	755769	80	V & F FAVA , C ROSITANO , F TEDESCO & E TODORELLO
414	71	755769	80	V & F FAVA , C ROSITANO , F TEDESCO & E TODORELLO
415	72	755769	82	SJ & DS TAYLOR
416	68	755769	82	SJ & DS TAYLOR
417	178	755769	81	AP & KA BROWN

BLOCK ID	LOT	DP	OWNER ID	OWNER
418	14	755769	81	AP & KA BROWN
419	15	755769	81	AP & KA BROWN
420	281	755769	82	SJ & DS TAYLOR
421	280	755769	82	SJ & DS TAYLOR
422	38	755769	82	SJ & DS TAYLOR
423	76	755769	82	SJ & DS TAYLOR
424	73	755769	82	SJ & DS TAYLOR
425	69	755769	82	SJ & DS TAYLOR
426	186	755769	85	JWJ & SM TAYLOR
427	121	41586	40	J MENCHIN
428	100	755767	41	KJ TAYLOR
429	6	1127747	201	DELTA ELECTRICITY
430	18	751636	201	DELTA ELECTRICITY
431	52	827626	201	DELTA ELECTRICITY
432	51	827626	201	DELTA ELECTRICITY
433	50	827626	201	DELTA ELECTRICITY
434	49	827626	201	DELTA ELECTRICITY
435	18	755769	202	GW & JL & TJ & JA CLARK
435	1	248472		STATE FORESTS OF NSW
436	22	755769	202	GW & JL & TJ & JA CLARK
437	185	755769	202	GW & JL & TJ & JA CLARK
438	64	755769	202	GW & JL & TJ & JA CLARK
439	264	755769	85	JWJ & SM TAYLOR
440	263	755769	85	JWJ & SM TAYLOR
441	1	1016508	203	GW & JL CLARK
442	1	813288	201	DELTA ELECTRICITY
443	5	1127747	204	LITHGOW DISTRICT CAR CLUB INC.
444	366	740604	201	DELTA ELECTRICITY
445	362	740604	201	DELTA ELECTRICITY
446	59	751636	201	DELTA ELECTRICITY
447	5	1092737	201	DELTA ELECTRICITY
448	191	629212	201	DELTA ELECTRICITY
449	1	803655	201	DELTA ELECTRICITY
450	1	702619	201	DELTA ELECTRICITY
451	5	804929	201	DELTA ELECTRICITY
452	7	804292	201	DELTA ELECTRICITY
453	48	827626	201	DELTA ELECTRICITY
454	1	999329	201	DELTA ELECTRICITY
455	2	999329	201	DELTA ELECTRICITY
456	5	999329	201	DELTA ELECTRICITY
457	4	999329	201	DELTA ELECTRICITY
458	3	999329	201	DELTA ELECTRICITY
459	46	827626	201	DELTA ELECTRICITY
460	47	827626	201	DELTA ELECTRICITY
461	45	827626	205	CENTENNIAL FASSIFERN PTY LIMITED
462	44	827626	205	CENTENNIAL FASSIFERN PTY LIMITED
463	16	751636	205	CENTENNIAL FASSIFERN PTY LIMITED
464	343	751636	205	CENTENNIAL FASSIFERN PTY LIMITED
465	12	751636	205	CENTENNIAL FASSIFERN PTY LIMITED
466	342	751636	205	CENTENNIAL FASSIFERN PTY LIMITED
467	43	827626	205	CENTENNIAL FASSIFERN PTY LIMITED
468	20	877752	205	CENTENNIAL FASSIFERN PTY LIMITED
469	1	325532	201	DELTA ELECTRICITY
470	9	804929	206	CENTENNIAL SPRINGVALE PTY LIMITED & SPRINGVALE SK KORES PTY LIMITED
471	8	804929	201	DELTA ELECTRICITY
472	42	827626	201	DELTA ELECTRICITY
473	41	827626	201	DELTA ELECTRICITY
474	1	400022	201	DELTA ELECTRICITY
475	40	827626	201	DELTA ELECTRICITY
476	38	827626	207	EHANCE PLACE PTY LIMITED
477	363	740604	2	CROWN (THE COUNCIL OF THE CITY OF GREATER LITHGOW)
478	364	740604	2	CROWN
479	22	832446	208	TRANSGRID

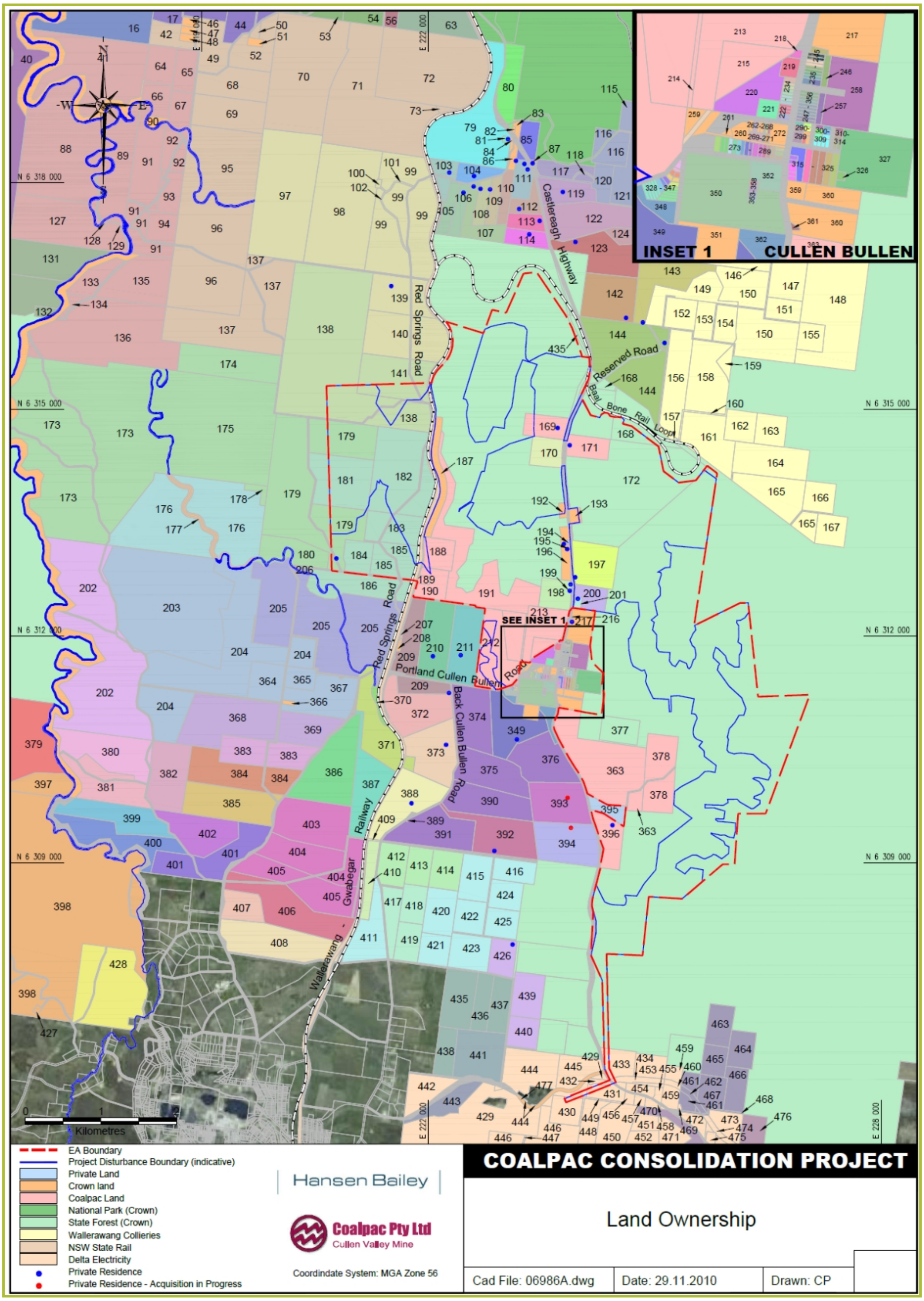


Figure A.1: Receptor location map

Appendix B: PM_{10} and dust deposition monitoring data

Table B.1: Cullen Valley HVAS PM_{10} data

Sample No.	Sample Location	Sample Date	Sampler	Particulate Matter 10 ug/m³	Run Time (00:00 hrs)
29423.01	Cullen Valley	17-Feb-08	C Sheehan EEL	5.6	24:00
29496.01	Cullen Valley	23-Feb-08	C Sheehan EEL	28	24:00
29545.01	Cullen Valley	29-Feb-08	C Sheehan EEL	10	24:00
29590.01	Cullen Valley	06-Mar-08	C Sheehan EEL	20.6	24:00
29684.01	Cullen Valley	12-Mar-08	C Sheehan EEL	21.2	24:00
29704.01	Cullen Valley	18-Mar-08	C Sheehan EEL	13.4	24:00
29801.01	Cullen Valley	24-Mar-08	C Sheehan EEL	5.1	24:00
29872.01	Cullen Valley	30-Mar-08	C Sheehan EEL	8.6	24:00
29876.01	Cullen Valley	05-Apr-08	C Sheehan EEL	18.9	24:00
29975.01	Cullen Valley	11-Apr-08	J Maloney EEL	13.3	24:00
30003.01	Cullen Valley	17-Apr-08	J Maloney EEL	6.5	24:00
30059.01	Cullen Valley	23-Apr-08	C Sheehan EEL	4.4	24:00
30150.01	Cullen Valley	29-Apr-08	C Sheehan EEL	7.3	24:00
30175.01	Cullen Valley	05-May-08	C Sheehan EEL	24.9	24:00
30263.01	Cullen Valley	11-May-08	C Sheehan EEL	11.8	24:00
30273.01	Cullen Valley	17-May-08	J Maloney EEL	10.2	24:00
30353.01	Cullen Valley	23-May-08	C Sheehan EEL	13.9	24:00
30420.01	Cullen Valley	29-May-08	C Sheehan EEL	32.3	24:00
30474.01	Cullen Valley	04-Jun-08	C Sheehan EEL	3.3	24:00
30504.01	Cullen Valley	10-Jun-08	C Sheehan EEL	7.3	24:00
30564.01	Cullen Valley	16-Jun-08	C Sheehan EEL	6.4	24:00
30642.01	Cullen Valley	22-Jun-08	C Sheehan EEL	3.9	24:00
30707.01	Cullen Valley	28-Jun-08	J Maloney EEL	10.8	24:00
30759.01	Cullen Valley	04-Jul-08	C Sheehan EEL	12.6	23:59
30834.01	Cullen Valley	10-Jul-08	C Sheehan EEL	1.5	24:00
30867.01	Cullen Valley	16-Jul-08	C Sheehan EEL	18.3	24:00
30942.01	Cullen Valley	22-Jul-08	C Sheehan EEL	13.9	24:00
30990.01	Cullen Valley	28-Jul-08	C Sheehan EEL	2.6	24:00
31000.01	Cullen Valley	03-Aug-08	C Sheehan EEL	5.4	24:00
31052.01	Cullen Valley	09-Aug-08	C Sheehan EEL	3	24:00
31128.01	Cullen Valley	15-Aug-08	C Sheehan EEL	<1.0	24:00
31183.01	Cullen Valley	21-Aug-08	C Sheehan EEL	12.6	24:00
31254.01	Cullen Valley	27-Aug-08	C Sheehan EEL	18.1	24:00
31309.01	Cullen Valley	02-Sep-08	C Sheehan EEL	13.3	24:00
31377.01	Cullen Valley	08-Sep-08	C Sheehan EEL	9.2	24:00
31383.01	Cullen Valley	14-Sep-08	C Sheehan EEL	10.9	24:00
31445.01	Cullen Valley	20-Sep-08	C Sheehan EEL	20.8	24:00
31511.01	Cullen Valley	26-Sep-08	C Sheehan EEL	11.5	24:00
31565.01	Cullen Valley	02-Oct-08	C Sheehan EEL	20.5	24:00
31616.01	Cullen Valley	08-Oct-08	C Sheehan EEL	5.5	24:00
31684.01	Cullen Valley	14-Oct-08	C Sheehan EEL	4.8	24:00
31739.01	Cullen Valley	20-Oct-08	C Sheehan EEL	17.3	24:00
31798.01	Cullen Valley	26-Oct-08	J Maloney EEL	12.8	24:00
31831.01	Cullen Valley	03-Nov-08	C Sheehan EEL	7.4	24:00
31909.01	Cullen Valley	07-Nov-08	C Sheehan EEL	13.4	24:00
31955.01	Cullen Valley	13-Nov-08	J Maloney EEL	12.1	24:00
31982.01	Cullen Valley	19-Nov-08	C Sheehan EEL	4.8	24:00
32038.01	Cullen Valley	25-Nov-08	J Maloney EEL	16.7	24:00
32071.01	Cullen Valley	01-Dec-08	C Sheehan EEL	12.3	24:00
32119.01	Cullen Valley	07-Dec-08	C Sheehan EEL	11.5	24:00
32230.01	Cullen Valley	13-Dec-08	J Maloney EEL	17.8	24:00
32327.01	Cullen Valley	19-Dec-08	C Sheehan EEL	7.9	24:00
32339.01	Cullen Valley	25-Dec-08	C Sheehan EEL	8.3	24:00
32369.01	Cullen Valley	31-Dec-08	C Sheehan EEL	23.6	24:00
32434.01	Cullen Valley	06-Jan-09	J Maloney EEL	22.9	24:00
32499.01	Cullen Valley	12-Jan-09	C Sheehan EEL	12.4	24:00
32503.01	Cullen Valley	18-Jan-09	C Sheehan EEL	10.4	24:00
32592.01	Cullen Valley	24-Jan-09	C Sheehan EEL	12.8	24:00
32626.01	Cullen Valley	30-Jan-09	C Sheehan EEL	14.7	24:00
32725.01	Cullen Valley	05-Feb-09	C Sheehan EEL	17.8	24:00
32799.01	Cullen Valley	11-Feb-09	C Sheehan EEL	11.2	24:00
32865.01	Cullen Valley	17-Feb-09	C Sheehan EEL	6.1	24:00
32900.01	Cullen Valley	23-Feb-09	C Sheehan EEL	22.1	24:00
33014.01	Cullen Valley	01-Mar-09	C Sheehan EEL	27.6	24:00
33050.01	Cullen Valley	07-Mar-09	C Sheehan EEL	24.5	24:00
33093.01	Cullen Valley	13-Mar-09	C Sheehan EEL	10.7	24:00
33157.01	Cullen Valley	19-Mar-09	C Sheehan EEL	17.1	24:00
33234.01	Cullen Valley	25-Mar-09	C Sheehan EEL	20.3	24:00
33267.01	Cullen Valley	31-Mar-09	C Sheehan EEL	4.2	24:00
33382.01	Cullen Valley	06-Apr-09	J Maloney EEL	17.6	24:00
33404.01	Cullen Valley	12-Apr-09	C Sheehan EEL	5.4	24:00

Sample No.	Sample Location	Sample Date	Sampler	Particulate Matter 10 ug/m^3	Run Time (00:00 hrs)
33465.01	Cullen Valley	18-Apr-09	C Sheehan EEL	15.8	24:00
33532.01	Cullen Valley	24-Apr-09	J Maloney EEL	14.3	24:01
33564.01	Cullen Valley	30-Apr-09	C Sheehan EEL	10.3	24:00
33633.01	Cullen Valley	06-May-09	J Maloney EEL	20.2	24:00
33695.01	Cullen Valley	12-May-09	C Sheehan EEL	23.6	24:00
33747.01	Cullen Valley	18-May-09	C Sheehan EEL	20.6	24:00
33793.01	Cullen Valley	24-May-09	J Maloney EEL	12.9	24:00
33846.01	Cullen Valley	30-May-09	J Maloney EEL	4.3	24:00
33889.01	Cullen Valley	05-Jun-09	C Sheehan EEL	6.3	24:00
33930.01	Cullen Valley	11-Jun-09	C Sheehan EEL	9.9	23:58
34011.01	Cullen Valley	17-Jun-09	C Sheehan EEL	8.7	24:00
34043.01	Cullen Valley	23-Jun-09	C Sheehan EEL	31.2	24:00
34113.01	Cullen Valley	29-Jun-09	C Sheehan EEL	2.3	24:00
34155.01	Cullen Valley	05-Jul-09	C Sheehan EEL	4.9	24:00
34222.01	Cullen Valley	11-Jul-09	J Maloney EEL	8.4	24:00
34248.01	Cullen Valley	17-Jul-09	C Sheehan EEL	16.1	24:00
34271.01	Cullen Valley	23-Jul-09	C Sheehan EEL	4.6	24:00
34333.01	Cullen Valley	29-Jul-09	C Sheehan EEL	4.3	24:00
34389.01	Cullen Valley	04-Aug-09	J Maloney EEL	13	24:00
34446.01	Cullen Valley	10-Aug-09	J Maloney EEL	18.3	24:00
34489.01	Cullen Valley	16-Aug-09	J Maloney EEL	16.7	24:00
34508.01	Cullen Valley	22-Aug-09	C Sheehan EEL	6.5	24:00
34583.01	Cullen Valley	28-Aug-09	J Maloney EEL	15	24:00
34610.01	Cullen Valley	03-Sep-09	J Maloney EEL	16.4	24:00
34657.01	Cullen Valley	09-Sep-09	C Sheehan EEL	4	24:00
34707.01	Cullen Valley	15-Sep-09	C Sheehan EEL	21.8	24:00
34759.01	Cullen Valley	21-Sep-09	C Sheehan EEL	9.6	24:00
34795.01	Cullen Valley	27-Sep-09	C Sheehan EEL	15.7	24:00
34862.01	Cullen Valley	03-Oct-09	C Sheehan EEL	5.6	24:00
34881.01	Cullen Valley	09-Oct-09	C Sheehan EEL	5.3	24:00
34954.01	Cullen Valley	15-Oct-09	C Sheehan EEL	4.5	24:00
34994.01	Cullen Valley	21-Oct-09	C Sheehan EEL	17.5	24:00
35036.01	Cullen Valley	27-Oct-09	C Sheehan EEL	4.3	24:00
35097.01	Cullen Valley	02-Nov-09	J Maloney EEL	17.3	24:00
35115.01	Cullen Valley	08-Nov-09	C Sheehan EEL	4.9	24:00
35211.01	Cullen Valley	14-Nov-09	J Maloney EEL	9	24:00
35249.01	Cullen Valley	20-Nov-09	J Maloney EEL	40	24:00
35326.01	Cullen Valley	26-Nov-09	J Maloney EEL	22.9	24:00
35348.01	Cullen Valley	02-Dec-09	J Maloney EEL	8.3	24:00
35401.01	Cullen Valley	08-Dec-09	C Sheehan EEL	44.4	24:00
35427.01	Cullen Valley	14-Dec-09	C Sheehan EEL	13.7	24:00
35498.01	Cullen Valley	20-Dec-09	J Maloney EEL	12.3	24:00
35560.01	Cullen Valley	26-Dec-09	J Maloney EEL	3.1	24:00
35582.01	Cullen Valley	01-Jan-10	C Sheehan EEL	4	24:00
35638.01	Cullen Valley	07-Jan-10	C Sheehan EEL	15	24:00
35672.01	Cullen Valley	13-Jan-10	J Maloney EEL	21.2	24:00
35736.01	Cullen Valley	19-Jan-10	J Maloney EEL	11	24:00
35783.01	Cullen Valley	25-Jan-10	C Sheehan EEL	22.6	24:00
35824.01	Cullen Valley	31-Jan-10	C Sheehan EEL	12.1	24:00
35878.01	Cullen Valley	06-Feb-10	C Sheehan EEL	Runtime outside specified limits of 24 hours ± 1 hour	20:13
35922.01	Cullen Valley	12-Feb-10	C Sheehan EEL	11.7	24:00
35956.01	Cullen Valley	16-Feb-10	C Sheehan EEL	8	24:00
35968.01	Cullen Valley	18-Feb-10	C Sheehan EEL	11.9	24:00
36022.01	Cullen Valley	24-Feb-10	C Sheehan EEL	12	24:00
36074.01	Cullen Valley	02-Mar-10	C Sheehan EEL	10	24:00
36158.01	Cullen Valley	08-Mar-10	C Sheehan EEL	8.2	24:00
36160.01	Cullen Valley	14-Mar-10	C Sheehan EEL	4	24:00
36280.01	Cullen Valley	20-Mar-10	C Sheehan EEL	23.2	24:00
36294.01	Cullen Valley	26-Mar-10	C Sheehan EEL	23.3	24:00
36353.01	Cullen Valley	01-Apr-10	C Sheehan EEL	5.7	24:00
36386.01	Cullen Valley	07-Apr-10	C Sheehan EEL	4	24:00
36418.01	Cullen Valley	13-Apr-10	C Sheehan EEL	12.5	24:00
36496.01	Cullen Valley	19-Apr-10	C Sheehan EEL	10.8	24:00
36531.01	Cullen Valley	25-Apr-10	C Sheehan EEL	3.9	24:00
36573.01	Cullen Valley	01-May-10	A Knapik EEL	6.7	24:00
36580.01	Cullen Valley	07-May-10	T Hamilton ALS	7.1	24:00
36619.01	Cullen Valley	13-May-10	T Hamilton ALS	9.5	24:00
36656.01	Cullen Valley	19-May-10	T Hamilton ALS	12.8	24:00
36708.01	Cullen Valley	25-May-10	T Hamilton ALS	4	24:00
36730.01	Cullen Valley	31-May-10	T Hamilton ALS	4.3	24:00
36746.01	Cullen Valley	06-Jun-10	T Hamilton ALS	4.7	24:00
36803.01	Cullen Valley	12-Jun-10	C Sheehan EEL	4	24:00
36852.01	Cullen Valley	18-Jun-10	C Sheehan EEL	9.3	24:00

Sample No.	Sample Location	Sample Date	Sampler	Particulate Matter 10 ug/m^3	Run Time (00:00 hrs)
36889.01	Cullen Valley	24-Jun-10	T Hamilton ALS	4.9	24:00
36924.01	Cullen Valley	30-Jun-10	T Hamilton ALS	9.8	24:00
36944.01	Cullen Valley	06-Jul-10	T Hamilton ALS	Runtime outside specified limits of 24 hours ± 1 hour	13:19
36999.01	Cullen Valley	12-Jul-10	C Sheehan EEL	6.1	24:00
37025.01	Cullen Valley	15-Jul-10	C Sheehan EEL	8.1	24:00
37034.01	Cullen Valley	18-Jul-10	T Hamilton ALS	13.4	24:00
37112.01	Cullen Valley	24-Jul-10	T Hamilton ALS	8.9	24:00
37161.01	Cullen Valley	30-Jul-10	T Hamilton ALS	2.3	24:00

Source: Coalpac Pty Ltd

Table B.2: Cullen Valley HVAS dust deposition data

Sample Num	Sample Location	Sample Date	Sampler	Ash g/m^2/mth	NO SAMPLE : (d)	Time: (d)	Total Insoluble Matter g/m^2/mth	Volume Collected mL
29547.01	DM Doble	04-Mar-08	C Sheehan EEL		Site not installed			
29547.02	DM Cranes	04-Mar-08	C Sheehan EEL	0.3		1352	0.5	635
29547.03	DM Office	04-Mar-08	C Sheehan EEL	0.5		1306	1	1380
29547.04	DM Hillcroft	04-Mar-08	C Sheehan EEL	0.4		1252	0.6	760
29547.05	DM Railway	04-Mar-08	C Sheehan EEL	0.5		1234	0.7	740
29832.01	DM Doble	02-Apr-08	C Sheehan EEL		Site not yet installed			
29832.02	DM Cranes	02-Apr-08	C Sheehan EEL	0.4		1242	0.5	820
29832.03	DM Office	02-Apr-08	C Sheehan EEL	0.4		1235	0.5	1100
29832.04	DM Hillcroft	02-Apr-08	C Sheehan EEL	0.5		1126	1.2	940
29832.05	DM Railway	02-Apr-08	C Sheehan EEL	0.3		1111	0.5	650
30151.01	DM Doble	02-May-08	C Sheehan EEL		Site not installed			
30151.02	DM Cranes	02-May-08	C Sheehan EEL	0.7		1321	0.9	350
30151.03	DM Office	02-May-08	C Sheehan EEL	1.8		1150	2.2	440
30151.04	DM Hillcroft	02-May-08	C Sheehan EEL	1		1137	1.3	415
30151.05	DM Railway	02-May-08	C Sheehan EEL	0.7		1124	1	540
30422.01	DM Doble	03-Jun-08	C Sheehan EEL		Site not installed			
30422.02	DM Cranes	03-Jun-08	C Sheehan EEL	0.2		1312	0.3	550
30422.03	DM Office	03-Jun-08	C Sheehan EEL	0.3		1217	0.4	565
30422.04	DM Hillcroft	03-Jun-08	C Sheehan EEL	0.3		1204	0.5	155
30422.05	DM Railway	03-Jun-08	C Sheehan EEL	0.3		1139	0.7	580
30718.01	DM Railway	02-Jul-08	J Maloney EEL	0.4		1221	1.1	865
30718.02	DM Hillcroft	02-Jul-08	J Maloney EEL	0.4		1237	0.6	675
30718.03	DM Office	02-Jul-08	J Maloney EEL	0.2		1300	0.4	925
30718.04	DM Cranes	02-Jul-08	J Maloney EEL	0.2		1428	0.4	820
30718.05	DM Doble	02-Jul-08	J Maloney EEL		Recommissioned 02/07/08	1436		
30995.01	DM Railway	01-Aug-08	C Sheehan EEL	0.6		1012	0.9	600
30995.02	DM Hillcroft	01-Aug-08	C Sheehan EEL	<0.1		1024	0.2	555
30995.03	DM Office	01-Aug-08	C Sheehan EEL	0.4		1037	0.4	615
30995.04	DM Cranes	01-Aug-08	C Sheehan EEL	0.3		1120	0.4	590
30995.05	DM Doble	01-Aug-08	C Sheehan EEL	0.6		957	0.7	495
31259.01	DM Railway	02-Sep-08	C Sheehan EEL	2		1254	2.9	1040
31259.02	DM Hillcroft	02-Sep-08	C Sheehan EEL	0.5		1317	0.7	950
31259.03	DM Office	02-Sep-08	C Sheehan EEL	0.6		1327	0.9	1040
31259.04	DM Cranes	02-Sep-08	C Sheehan EEL	0.5		1400	0.7	890
31259.05	DM Doble	02-Sep-08	C Sheehan EEL	1.5		1409	2.1	975
31544.01	DM Railway	02-Oct-08	C Sheehan EEL	0.5		1112	0.6	570
31544.02	DM Hillcroft	02-Oct-08	C Sheehan EEL	0.5		1128	0.6	650
31544.03	DM Office	02-Oct-08	C Sheehan EEL	0.6		1140	0.8	795
31544.04	DM Cranes	02-Oct-08	C Sheehan EEL	0.7		1220	1	690
31544.05	DM Doble	02-Oct-08	C Sheehan EEL	0.7		1231	1	695
31817.01	DM Railway	03-Nov-08	C Sheehan EEL	0.8		1015	0.9	1365
31817.02	DM Hillcroft	03-Nov-08	C Sheehan EEL	0.5		1029	0.5	1410
31817.03	DM Office	03-Nov-08	C Sheehan EEL	0.6		1037	0.7	1560
31817.04	DM Cranes	03-Nov-08	C Sheehan EEL	0.7		1137	0.8	1365
31817.05	DM Doble	03-Nov-08	C Sheehan EEL	0.4		1144	0.6	1295
32074.01	DM Railway	02-Dec-08	C Sheehan EEL	0.8		1056	1	1420
32074.02	DM Hillcroft	02-Dec-08	C Sheehan EEL	0.6		1110	0.8	1330

Sample Num	Sample Location	Sample Date	Sampler	Ash g/m^2 /mth	NO SAMPLE : (d)	Time: (d)	Total Insoluble Matter g/m^2/mth	Volume Collected mL
32074.03	DM Office	02-Dec-08	C Sheehan EEL	0.6		1122	0.9	1705
32074.04	DM Cranes	02-Dec-08	C Sheehan EEL	0.6		1135	1	1530
32074.05	DM Doble	02-Dec-08	C Sheehan EEL	0.6		1143	0.9	1675
32368.01	DM Railway	02-Jan-09	C Sheehan EEL	0.8		1055	1.2	1640
32368.02	DM Hillcroft	02-Jan-09	C Sheehan EEL	0.6		1112	1	1840
32368.03	DM Office	02-Jan-09	C Sheehan EEL	0.7		1122	1.1	1960
32368.04	DM Cranes	02-Jan-09	C Sheehan EEL	0.8		1128	1.4	1810
32368.05	DM Doble	02-Jan-09	C Sheehan EEL	0.7		1137	1.1	1835
32623.01	DM Railway	02-Feb-09	C Sheehan EEL	1.3		1107	1.5	535
32623.02	DM Hillcroft	02-Feb-09	C Sheehan EEL	0.5		1121	0.8	200
32623.03	DM Office	02-Feb-09	C Sheehan EEL	0.6		1133	0.9	385
32623.04	DM Cranes	02-Feb-09	C Sheehan EEL	0.7		1146	1.2	300
32623.05	DM Doble	02-Feb-09	C Sheehan EEL	0.6		1155	0.8	275
32940.01	DM Railway	03-Mar-09	J Maloney EEL	1		1120	1.1	2310
32940.02	DM Hillcroft	03-Mar-09	J Maloney EEL	0.5		1137	0.6	1530
32940.03	DM Office	03-Mar-09	J Maloney EEL	0.9		1149	1.1	1635
32940.04	DM Cranes	03-Mar-09	J Maloney EEL	0.8		1300	1	1605
32940.05	DM Doble	03-Mar-09	J Maloney EEL	0.7		1426	0.7	1525
33265.01	DM Railway	02-Apr-09	C Sheehan EEL	0.5		1044	0.9	545
33265.02	DM Hillcroft	02-Apr-09	C Sheehan EEL			1059		250
33265.03	DM Office	02-Apr-09	C Sheehan EEL	1.1		1114	1.6	780
33265.04	DM Cranes	02-Apr-09	C Sheehan EEL	0.6		1126	0.8	630
33265.05	DM Doble	02-Apr-09	C Sheehan EEL	0.6		1136	0.8	410
33570.01	DM Railway	04-May-09	C Sheehan EEL	0.4		1204	0.5	1045
33570.02	DM Hillcroft	04-May-09	C Sheehan EEL	0.6		1221	0.7	120
33570.03	DM Office	04-May-09	C Sheehan EEL	0.8		1235	1	715
33570.04	DM Cranes	04-May-09	C Sheehan EEL	0.5		1250	0.6	820
33570.05	DM Doble	04-May-09	C Sheehan EEL	0.5		1258	0.7	860
33828.01	DM Railway	02-Jun-09	J Maloney EEL	0.4		1123	0.7	840
33828.02	DM Hillcroft	02-Jun-09	J Maloney EEL		Stand & bottle on ground	1140		
33828.03	DM Office	02-Jun-09	J Maloney EEL	0.3		1205	0.4	630
33828.04	DM Cranes	02-Jun-09	J Maloney EEL	0.3		1217	0.4	740
33828.05	DM Doble	02-Jun-09	J Maloney EEL	0.5		1226	0.6	870
34120.01	DM Railway	02-Jul-09	C Sheehan EEL	0.2		1109	0.4	700
34120.02	DM Hillcroft	02-Jul-09	C Sheehan EEL		Stand & bottle on ground	1127		
34120.03	DM Office	02-Jul-09	C Sheehan EEL	0.3		1146	0.5	645
34120.04	DM Cranes	02-Jul-09	C Sheehan EEL	0.3		1205	0.5	675
34120.05	DM Doble	02-Jul-09	C Sheehan EEL	0.3		1213	0.5	585
34339.01	DM Railway	03-Aug-09	J Maloney EEL	0.2		1124	0.3	780
34339.02	DM Hillcroft	03-Aug-09	J Maloney EEL	0.1		1144	0.2	640
34339.03	DM Office	03-Aug-09	J Maloney EEL	0.2		1157	0.3	740
34339.04	DM Cranes	03-Aug-09	J Maloney EEL	0.3		1211	0.4	710
34339.05	DM Doble	03-Aug-09	J Maloney EEL	0.5		1218	0.7	715
34575.01	DM Railway	02-Sep-09	J Maloney EEL	0.5		1134	0.6	695
34575.02	DM Hillcroft	02-Sep-09	J Maloney EEL	0.4		1114	0.5	590
34575.03	DM Office	02-Sep-09	J Maloney EEL	0.5		1100	0.8	705
34575.04	DM Cranes	02-Sep-09	J Maloney EEL	0.6		1036	0.8	660
34575.05	DM Doble	02-Sep-09	J Maloney EEL	0.7		1311	1	520
34829.01	DM Railway	02-Oct-09	C Sheehan EEL	32		1000	36	510
34829.02	DM Hillcroft	02-Oct-09	C Sheehan EEL	0.8		1016	1	240
34829.03	DM Office	02-Oct-09	C Sheehan EEL	10		1025	12	565
34829.04	DM Cranes	02-Oct-09	C Sheehan EEL	12		1031	13.9	540
34829.05	DM Doble	02-Oct-09	C Sheehan EEL	13		1040	14.8	545
35080.01	DM Railway	03-Nov-09	J Maloney EEL	2.5		1145	2.9	1100
35080.02	DM Hillcroft	03-Nov-09	J Maloney EEL	3		1206	3.6	740
35080.03	DM Office	03-Nov-09	J Maloney EEL	3.7		1231	3.8	815
35080.04	DM Cranes	03-Nov-09	J Maloney EEL	2.9		1243	3.6	740
35080.05	DM Doble	03-Nov-09	J Maloney EEL	2.3		1252	2.8	785
35334.01	DM Railway	02-Dec-09	C Sheehan EEL	2		938	2.5	340
35334.02	DM Hillcroft	02-Dec-09	C Sheehan EEL	1.5		952	1.8	145
35334.03	DM Office	02-Dec-09	C Sheehan EEL	2.3		1001	3.3	310
35334.04	DM Cranes	02-Dec-09	C Sheehan EEL	1.7		1008	2.4	310
35334.05	DM Doble	02-Dec-09	C Sheehan EEL	1.8		1017	2.7	370
35585.01	DM Railway	05-Jan-10	C Sheehan EEL	1		956	1.7	1800
35585.02	DM Hillcroft	05-Jan-10	C Sheehan EEL	0.8		1007	1.2	1310
35585.03	DM Office	05-Jan-10	C Sheehan EEL	0.9		1021	1.3	1450
35585.04	DM Cranes	05-Jan-10	C Sheehan EEL	0.8		1033	1.1	1455

Sample Num	Sample Location	Sample Date	Sampler	Ash g/m^2 /mth	NO SAMPLE : (d)	Time: (d)	Total Insoluble Matter g/m^2/mth	Volume Collected mL
35585.05	DM Doble	05-Jan-10	C Sheehan EEL	1.2		1043	1.6	1555
35827.01	DM Railway	02-Feb-10	C Sheehan EEL	0.8		1015	1.2	1330
35827.02	DM Hillcroft	02-Feb-10	C Sheehan EEL	0.8		1029	1.6	1575
35827.03	DM Office	02-Feb-10	C Sheehan EEL	0.9		1050	1.5	1455
35827.04	DM Cranes	02-Feb-10	C Sheehan EEL	0.9		1056	1.3	1735
35827.05	DM Doble	02-Feb-10	C Sheehan EEL	1		1107	1.4	1515
36066.01	DM Railway	02-Mar-10	C Sheehan EEL	0.4		1100	0.6	2280
36066.02	DM Hillcroft	02-Mar-10	C Sheehan EEL	0.1		1114	0.4	1605
36066.03	DM Office	02-Mar-10	C Sheehan EEL	0.3		1126	0.7	2215
36066.04	DM Cranes	02-Mar-10	C Sheehan EEL	0.2		1133	0.5	2360
36066.05	DM Doble	02-Mar-10	C Sheehan EEL	0.2		1140	0.4	2655
36320.01	DM Railway	31-Mar-10	C Sheehan EEL	0.3		1205	0.3	1180
36320.02	DM Hillcroft	31-Mar-10	C Sheehan EEL	0.2		1221	0.2	830
36320.03	DM Office	31-Mar-10	C Sheehan EEL	0.4		1235	0.4	1005
36320.04	DM Cranes	31-Mar-10	C Sheehan EEL	0.2		1242	0.2	1145
36320.05	DM Doble	31-Mar-10	C Sheehan EEL	0.1		1250	0.1	1095
36544.01	DM Railway	30-Apr-10	C Sheehan EEL	0.2		1016	0.2	1190
36544.02	DM Hillcroft	30-Apr-10	C Sheehan EEL	0.1		1029	0.1	845
36544.03	DM Office	30-Apr-10	C Sheehan EEL	0.2		1038	0.2	895
36544.04	DM Cranes	30-Apr-10	C Sheehan EEL	0.2		1045	0.2	910
36544.05	DM Doble	30-Apr-10	C Sheehan EEL	0.1		1104	0.1	955
36694.01	DM Railway	31-May-10	T Hamilton ALS	0.6		1453	1.6	1610
36694.02	DM Hillcroft	31-May-10	T Hamilton ALS	<0.1		1515	<0.1	1340
36694.03	DM Office	31-May-10	T Hamilton ALS	0.1		1220	0.3	1280
36694.04	DM Cranes	31-May-10	T Hamilton ALS	0.2		1231	0.2	1440
36694.05	DM Doble	31-May-10	T Hamilton ALS	<0.1		1245	0.1	1540
36902.01	DM Railway	01-Jul-10	T Hamilton ALS	0.7		1500	1.3	650
36902.02	DM Hillcroft	01-Jul-10	T Hamilton ALS	0.1		1319	0.2	560
36902.03	DM Office	01-Jul-10	T Hamilton ALS	0.2		1233	0.5	615
36902.04	DM Cranes	01-Jul-10	T Hamilton ALS	0.2		1259	0.5	640
36902.05	DM Doble	01-Jul-10	T Hamilton ALS	0.1		1315	0.4	555
37078.01	DM Railway	02-Aug-10	T Hamilton ALS	0.2		1445	0.3	2065
37078.02	DM Hillcroft	02-Aug-10	T Hamilton ALS	0.1		1242	0.1	1735
37078.03	DM Office	02-Aug-10	T Hamilton ALS	0.2		1215	0.3	1665
37078.04	DM Cranes	02-Aug-10	T Hamilton ALS	0.2		1256	0.3	1775
37078.05	DM Doble	02-Aug-10	T Hamilton ALS	0.1		1310	0.2	1800

Source: Coalpac Pty Ltd

Table B.3: Invincible HVAS PM_{10} data

Sample No.	Sample Location	Sample Date	Sampler	NO SAMPLE: (a)	Particulate Matter 10 ug/m^3	Run Time (00:00 hrs)
30561.01	Invincible	04-Jun-08	C Sheehan EEL	No filter paper in unit		
30562.01	Invincible	10-Jun-08	C Sheehan EEL		3.2	24:00
30563.01	Invincible	16-Jun-08	C Sheehan EEL		5.9	24:00
30643.01	Invincible	22-Jun-08	C Sheehan EEL		3.2	23:59
30708.01	Invincible	28-Jun-08	J Maloney EEL		8.1	23:57
30758.01	Invincible	04-Jul-08	C Sheehan EEL		7	23:59
30833.01	Invincible	10-Jul-08	C Sheehan EEL		1.4	24:00
30868.01	Invincible	16-Jul-08	C Sheehan EEL		7.3	23:59
30943.01	Invincible	22-Jul-08	C Sheehan EEL		14	23:59
30989.01	Invincible	28-Jul-08	C Sheehan EEL		2.4	23:59
30999.01	Invincible	03-Aug-08	C Sheehan EEL		2.8	23:59
31053.01	Invincible	09-Aug-08	C Sheehan EEL		2.6	23:58
31127.01	Invincible	15-Aug-08	C Sheehan EEL		2	23:59
31184.01	Invincible	21-Aug-08	C Sheehan EEL		15	24:00
31253.01	Invincible	27-Aug-08	C Sheehan EEL		29.2	23:59
31310.01	Invincible	02-Sep-08	C Sheehan EEL		9.5	23:58
31378.01	Invincible	08-Sep-08	C Sheehan EEL		15.1	23:58
31382.01	Invincible	14-Sep-08	C Sheehan EEL		10.2	23:58
31444.01	Invincible	20-Sep-08	C Sheehan EEL		25.7	24:00
31512.01	Invincible	26-Sep-08	C Sheehan EEL		13.9	23:59
31566.01	Invincible	02-Oct-08	C Sheehan EEL		23.2	23:58
31617.01	Invincible	08-Oct-08	C Sheehan EEL		7.3	23:59
31685.01	Invincible	14-Oct-08	C Sheehan EEL		5.8	23:59
31738.01	Invincible	20-Oct-08	C Sheehan EEL		32.5	23:58
31797.01	Invincible	26-Oct-08	J Maloney EEL		13	23:59

Sample No.	Sample Location	Sample Date	Sampler	NO SAMPLE: (a)	Particulate Matter 10 ug/m^3	Run Time (00:00 hrs)
31815.01	Invincible	01-Nov-08	C Sheehan EEL		31.3	23:59
31910.01	Invincible	07-Nov-08	C Sheehan EEL		17.6	23:59
31954.01	Invincible	13-Nov-08	J Maloney EEL		18.1	23:59
31957.01	Invincible	15-Nov-08	C Sheehan EEL		12.2	23:59
31983.01	Invincible	19-Nov-08	C Sheehan EEL		2.9	23:59
32037.01	Invincible	25-Nov-08	J Maloney EEL		35.6	23:59
32072.01	Invincible	01-Dec-08	C Sheehan EEL		15.6	23:58
32120.01	Invincible	07-Dec-08	C Sheehan EEL		13.1	23:59
32229.01	Invincible	13-Dec-08	J Maloney EEL		17.5	23:59
32328.01	Invincible	19-Dec-08	C Sheehan EEL		8.6	23:59
32340.01	Invincible	25-Dec-08	C Sheehan EEL		9.2	23:59
32370.01	Invincible	31-Dec-08	C Sheehan EEL		27.2	23:59
32430.01	Invincible	06-Jan-09	J Maloney EEL		59.7	23:59
32500.01	Invincible	12-Jan-09	C Sheehan EEL		23.5	23:59
32502.01	Invincible	18-Jan-09	C Sheehan EEL		11.1	23:59
32591.01	Invincible	24-Jan-09	C Sheehan EEL		14.5	23:59
32627.01	Invincible	30-Jan-09	C Sheehan EEL		18.9	23:59
32724.01	Invincible	05-Feb-09	C Sheehan EEL		17.9	23:59
32798.01	Invincible	11-Feb-09	C Sheehan EEL		10.3	23:59
32866.01	Invincible	17-Feb-09	C Sheehan EEL		5.8	23:59
32899.01	Invincible	23-Feb-09	C Sheehan EEL		21.8	23:56
33015.01	Invincible	01-Mar-09	C Sheehan EEL		25.3	23:59
33049.01	Invincible	07-Mar-09	C Sheehan EEL		34.8	23:59
33092.01	Invincible	13-Mar-09	C Sheehan EEL		12	23:59
33156.01	Invincible	19-Mar-09	C Sheehan EEL		28	23:59
33235.01	Invincible	25-Mar-09	C Sheehan EEL	Unit away for repairs		
33266.01	Invincible	31-Mar-09	C Sheehan EEL	Unit away for repairs		
33426.01	Invincible	06-Apr-09	J Maloney EEL	Unit away for repairs		
33427.01	Invincible	12-Apr-09	J Maloney EEL	Unit away for repairs		
33466.01	Invincible	18-Apr-09	C Sheehan EEL		21.5	24:05
33533.01	Invincible	24-Apr-09	J Maloney EEL		15.1	24:00
33565.01	Invincible	30-Apr-09	C Sheehan EEL		14.8	23:59
33632.01	Invincible	06-May-09	J Maloney EEL		21.4	23:59
33694.01	Invincible	12-May-09	C Sheehan EEL		27	23:59
33752.01	Invincible	18-May-09	J Maloney EEL		24.6	23:59
33792.01	Invincible	24-May-09	J Maloney EEL		10.1	23:59
33845.01	Invincible	30-May-09	J Maloney EEL		5.3	23:59
33890.01	Invincible	05-Jun-09	C Sheehan EEL		16.3	23:59
33931.01	Invincible	11-Jun-09	C Sheehan EEL		6.4	23:59
34012.01	Invincible	17-Jun-09	C Sheehan EEL		7.4	23:59
34044.01	Invincible	23-Jun-09	C Sheehan EEL		8	23:59
34112.01	Invincible	29-Jun-09	C Sheehan EEL		2.9	24:00
34154.01	Invincible	05-Jul-09	C Sheehan EEL		3.3	23:59
34221.01	Invincible	11-Jul-09	J Maloney EEL		5.1	23:59
34249.01	Invincible	17-Jul-09	C Sheehan EEL		7.6	23:59
34270.01	Invincible	23-Jul-09	C Sheehan EEL		6.3	23:59
34332.01	Invincible	29-Jul-09	C Sheehan EEL		8.5	23:59
34388.01	Invincible	04-Aug-09	J Maloney EEL		15.2	23:59
34445.01	Invincible	10-Aug-09	J Maloney EEL		35	23:59
34488.01	Invincible	16-Aug-09	J Maloney EEL		8.4	23:59
34510.01	Invincible	22-Aug-09	C Sheehan EEL		7	23:58
34585.01	Invincible	28-Aug-09	J Maloney EEL		11.3	23:59
34611.01	Invincible	03-Sep-09	J Maloney EEL		17.1	23:59
34658.01	Invincible	09-Sep-09	C Sheehan EEL		4	24:00
34708.01	Invincible	15-Sep-09	C Sheehan EEL		Runtime outside specified limits of 24 hrs ± 1 hr	9:55
34760.01	Invincible	21-Sep-09	C Sheehan EEL		16	23:59
34788.01	Invincible	23-Sep-09	C Sheehan EEL		1330	23:59
34792.01	Invincible	27-Sep-09	C Sheehan EEL		16.4	23:59
34861.01	Invincible	03-Oct-09	C Sheehan EEL		4.6	23:59
34880.01	Invincible	09-Oct-09	C Sheehan EEL		6.7	23:59
34957.01	Invincible	15-Oct-09	C Sheehan EEL		5.3	23:59
34995.01	Invincible	21-Oct-09	C Sheehan EEL		37.6	23:58
35035.01	Invincible	27-Oct-09	C Sheehan EEL		4.2	23:58
35098.01	Invincible	02-Nov-09	J Maloney EEL		20.8	23:59
35116.01	Invincible	08-Nov-09	C Sheehan EEL		5.4	23:59
35212.01	Invincible	14-Nov-09	J Maloney EEL		14.6	23:59
35250.01	Invincible	20-Nov-09	J Maloney EEL		52.5	24:00
35327.01	Invincible	26-Nov-09	J Maloney EEL		30.4	23:59
35349.01	Invincible	02-Dec-09	J Maloney EEL		15.4	23:58
35402.01	Invincible	08-Dec-09	C Sheehan EEL		46.8	23:59

Sample No.	Sample Location	Sample Date	Sampler	NO SAMPLE: (a)	Particulate Matter 10 ug/m^3	Run Time (00:00 hrs)
35426.01	Invincible	14-Dec-09	C Sheehan EEL		74.9	23:59
35497.01	Invincible	20-Dec-09	J Maloney EEL		15.4	23:59
35559.01	Invincible	26-Dec-09	J Maloney EEL		4.6	23:59
35583.01	Invincible	01-Jan-10	C Sheehan EEL		4.9	24:00
35639.01	Invincible	07-Jan-10	C Sheehan EEL		35.2	23:59
35673.01	Invincible	13-Jan-10	J Maloney EEL		46	23:59
35737.01	Invincible	19-Jan-10	J Maloney EEL		17.2	23:58
35782.01	Invincible	25-Jan-10	C Sheehan EEL		19.6	23:59
35823.01	Invincible	31-Jan-10	C Sheehan EEL		13.2	23:59
35893.01	Invincible	06-Feb-10	C Sheehan EEL		4.1	23:59
35941.01	Invincible	12-Feb-10	C Sheehan EEL		13.5	23:59
35969.01	Invincible	18-Feb-10	C Sheehan EEL		23	23:59
36021.01	Invincible	24-Feb-10	C Sheehan EEL		Invalid sample: Beetle on filter paper; holes in filter	23:59
36075.01	Invincible	02-Mar-10	C Sheehan EEL		13.2	23:59
36157.01	Invincible	08-Mar-10	C Sheehan EEL		11.9	23:59
36159.01	Invincible	14-Mar-10	C Sheehan EEL		4.6	23:59
36274.01	Invincible	20-Mar-10	C Sheehan EEL		Runtime outside specified limits of 24 hrs ± 1 hr	12:05
36295.01	Invincible	26-Mar-10	C Sheehan EEL		25.4	23:59
36314.01	Invincible	30-Mar-10	C Sheehan EEL		7.1	23:59
36351.01	Invincible	01-Apr-10	C Sheehan EEL	Runtime outside specified limits of 24 hrs ± 1 hr		
36373.01	Invincible	07-Apr-10	C Sheehan EEL		Runtime outside specified limits of 24 hrs ± 1 hr	12:59
36419.01	Invincible	13-Apr-10	C Sheehan EEL		16.8	23:59
36452.01	Invincible	15-Apr-10	C Sheehan EEL		20.2	23:59
36453.01	Invincible	19-Apr-10	C Sheehan EEL		Runtime outside specified limits of 24 hrs ± 1 hr	13:39
36499.01	Invincible	20-Apr-10	C Sheehan EEL		MUR for 19/04/10.Runtime outside specified limits of 24 hours ± 1 hour	12:14
36532.01	Invincible	25-Apr-10	C Sheehan EEL		4.3	23:59
36572.01	Invincible	01-May-10	T Hamilton ALS		7.6	23:59
36578.01	Invincible	07-May-10	T Hamilton ALS		10.8	23:59
36618.01	Invincible	13-May-10	T Hamilton ALS		10.7	23:59
36655.01	Invincible	19-May-10	T Hamilton ALS	No apparent reason for unit not running programmed 24:00hr period		
36710.01	Invincible	25-May-10	T Hamilton ALS		10.2	23:59
36731.01	Invincible	31-May-10	T Hamilton ALS		8.9	23:59
36824.01	Invincible	06-Jun-10	T Hamilton ALS	Faulty unit, to be repaired		
36825.01	Invincible	12-Jun-10	C Sheehan EEL	Unit away for repair		
36851.01	Invincible	18-Jun-10	C Sheehan EEL		Hire PM10 unit placed at site and calibrated 18/06/10.Runtime outside specified limits of 24 hours ± 1 hour.	26:13
36890.01	Invincible	24-Jun-10	T Hamilton ALS		Runtime outside specified limits of 24 hrs ± 1 hr	26:13
36925.01	Invincible	30-Jun-10	T Hamilton ALS		Runtime outside specified limits of 24 hrs ± 1 hr	26:13
36943.01	Invincible	06-Jul-10	T Hamilton ALS		Runtime outside specified limits of 24 hrs ± 1 hr	26:13
37000.01	Invincible	12-Jul-10	C Sheehan EEL	Unit re-installed 09/07/10. Runtime outside specified limit of 24hr ± 1 hr		
37035.01	Invincible	18-Jul-10	T Hamilton ALS		3.7	23:59
37094.01	Invincible	20-Jul-10	C Sheehan EEL		8.9	23:59
37113.01	Invincible	24-Jul-10	T Hamilton ALS		5.4	23:59
37134.01	Invincible	27-Jul-10	T Hamilton ALS		9.6	23:59

Sample No.	Sample Location	Sample Date	Sampler	NO SAMPLE: (a)	Particulate Matter 10 ug/m^3	Run Time (00:00 hrs)
37162.01	Invincible	30-Jul-10	T Hamilton ALS		2.7	23:10

Source: Coalpac Pty Ltd

Table B.4: Invincible dust deposition data

Sample No.	Sample Location	Sample Date	Sampler	Ash g/m^2/mth	Combustible Matter g/m2/mth	NO SAMPLE: (d)	Time: (d)	Total Insoluble Matter g/m^2/mth	Volume Collected mL
30546.01	DM1	16-Jun-08	C Sheehan EEL	0.4	0.2		1122	0.6	755
30546.02	DM2	16-Jun-08	C Sheehan EEL	0.1	0.1		1329	0.2	800
30546.03	DM3	16-Jun-08	C Sheehan EEL	0.2	0.1		1346	0.3	700
30546.04	DM4	16-Jun-08	C Sheehan EEL	0.2	0.1		1407	0.3	815
30546.05	DM5	16-Jun-08	C Sheehan EEL	0.2	0.1		1200	0.3	855
30546.06	DM6	16-Jun-08	C Sheehan EEL	0.1	0.1		1440	0.2	810
30831.01	DM1	14-Jul-08	C Sheehan EEL	0.3	0.2		1229	0.5	670
30831.02	DM2	14-Jul-08	C Sheehan EEL	0.2	<0.1		1356	0.2	670
30831.03	DM3	14-Jul-08	C Sheehan EEL	0.2	0.1		1404	0.3	680
30831.04	DM4	14-Jul-08	C Sheehan EEL	0.2	0.1		1208	0.3	670
30831.05	DM5	14-Jul-08	C Sheehan EEL	0.3	0.1		1305	0.4	710
30831.06	DM6	14-Jul-08	C Sheehan EEL	0.2	0.2		1425	0.4	700
31049.01	DM1	11-Aug-08	C Sheehan EEL	0.9	0.4		1211	1.3	715
31049.02	DM2	11-Aug-08	C Sheehan EEL	0.5	0.2		1317	0.7	650
31049.03	DM3	11-Aug-08	C Sheehan EEL	0.7	0.3		1323	1	695
31049.04	DM4	11-Aug-08	C Sheehan EEL	0.8	0.2		1113	1	600
31049.05	DM5	11-Aug-08	C Sheehan EEL	0.8	0.6		1218	1.4	665
31049.06	DM6	11-Aug-08	C Sheehan EEL	0.7	0.2		1347	0.9	655
31326.01	DM1	08-Sep-08	C Sheehan EEL	0.5	0.3		1154	0.8	920
31326.02	DM2	08-Sep-08	C Sheehan EEL	0.1	0.2		1334	0.3	820
31326.03	DM3	08-Sep-08	C Sheehan EEL	0.2	0.4		1343	0.6	835
31326.04	DM4	08-Sep-08	C Sheehan EEL	0.2	<0.1		1352	0.2	875
31326.05	DM5	08-Sep-08	C Sheehan EEL	0.2	0.1		1224	0.3	835
31326.06	DM6	08-Sep-08	C Sheehan EEL	0.2	<0.1		1413	0.2	865
31600.01	DM1	08-Oct-08	C Sheehan EEL	1.2	0.7		1125	1.9	1215
31600.02	DM2	08-Oct-08	C Sheehan EEL	0.9	0.5		1311	1.4	1090
31600.03	DM3	08-Oct-08	C Sheehan EEL	0.6	0.3		1321	0.9	1020
31600.04	DM4	08-Oct-08	C Sheehan EEL	1.1	0.4		1330	1.5	860
31600.05	DM5	08-Oct-08	C Sheehan EEL	1	0.4		1152	1.4	1055
31600.06	DM6	08-Oct-08	C Sheehan EEL	0.6	0.4		1348	1	1285
31818.01	DM1	03-Nov-08	C Sheehan	0.3	0.8		1200	1.1	730

Sample No.	Sample Location	Sample Date	Sampler	Ash g/m^2 /mth	Combustible Matter g/m2/mth	NO SAMPLE: (d)	Time: (d)	Total Insoluble Matter g/m^2/mth	Volume Collected mL
			EEL						
31818.02	DM2	03-Nov-08	C Sheehan EEL	0.4	0.3		1235	0.7	620
31818.03	DM3	03-Nov-08	C Sheehan EEL	0.3	0.3		1242	0.6	625
31818.04	DM4	03-Nov-08	C Sheehan EEL	0.5	0.2		1250	0.7	575
31818.05	DM5	03-Nov-08	C Sheehan EEL	0.5	0.3		1225	0.8	670
31818.06	DM6	03-Nov-08	C Sheehan EEL	0.4	0.5		1309	0.9	1005
32075.01	DM1	02-Dec-08	C Sheehan EEL	1.4	1		1258	2.4	1840
32075.02	DM2	02-Dec-08	C Sheehan EEL	0.5	0.4		1332	0.9	1600
32075.03	DM3	02-Dec-08	C Sheehan EEL	0.6	0.4		1340	1	1580
32075.04	DM4	02-Dec-08	C Sheehan EEL	0.5	0.5		1356	1	1385
32075.05	DM5	02-Dec-08	C Sheehan EEL	0.5	0.4		1320	0.9	1645
32075.06	DM6	02-Dec-08	C Sheehan EEL	0.7	0.6		1416	1.3	2050
32366.01	DM1	02-Jan-09	C Sheehan EEL	0.4	0.2		1301	0.6	2135
32366.02	DM2	02-Jan-09	C Sheehan EEL	0.7	0.2		1322	0.9	1940
32366.03	DM3	02-Jan-09	C Sheehan EEL	1	0.9		1333	1.9	1710
32366.04	DM4	02-Jan-09	C Sheehan EEL	1.1	0.6		1343	1.7	1490
32366.05	DM5	02-Jan-09	C Sheehan EEL	0.6	0.3		1309	0.9	1805
32366.06	DM6	02-Jan-09	C Sheehan EEL	0.6	0.4		1410	1	2040
32625.01	DM1	02-Feb-09	C Sheehan EEL	0.6	0.2		1333	0.8	660
32625.02	DM2	02-Feb-09	C Sheehan EEL	0.4	0.1		1359	0.5	395
32625.03	DM3	02-Feb-09	C Sheehan EEL	0.4	0.2		1411	0.6	280
32625.04	DM4	02-Feb-09	C Sheehan EEL	0.7	0.1		1424	0.8	<10
32625.05	DM5	02-Feb-09	C Sheehan EEL	0.6	0.1		1321	0.7	225
32625.06	DM6	02-Feb-09	C Sheehan EEL	0.8	0.9		1444	1.7	450
32939.01	DM1	03-Mar-09	J Maloney EEL	1.1	0.4		1240	1.5	1470
32939.02	DM2	03-Mar-09	J Maloney EEL	0.6	0.3		1220	0.9	1255
32939.03	DM3	03-Mar-09	J Maloney EEL	1.3	1.5		1208	2.8	1210
32939.04	DM4	03-Mar-09	J Maloney EEL	1	0.2		1157	1.2	1195
32939.05	DM5	03-Mar-09	J Maloney EEL	1.2	0.3		1249	1.5	1315
32939.06	DM6	03-Mar-09	J Maloney EEL	1	0.5		1340	1.5	1910
33263.01	DM1	02-Apr-09	C Sheehan EEL	1.3	0.8		1316	2.1	755
33263.02	DM2	02-Apr-09	C Sheehan EEL	0.7	0.2		1325	0.9	630
33263.03	DM3	02-Apr-09	C Sheehan EEL	0.9	0.2		1332	1.1	645
33263.04	DM4	02-Apr-09	C Sheehan EEL	1	0.2		1343	1.2	500
33263.05	DM5	02-Apr-09	C Sheehan EEL	1.3	0.4		1308	1.7	685
33263.06	DM6	02-Apr-09	C Sheehan EEL	0.5	0.3		1401	0.8	1035
33571.01	DM1	04-May-09	C Sheehan EEL	0.7	0.2		1509	0.9	775
33571.02	DM2	04-May-09	C Sheehan	0.4	0.1		1438	0.5	715

Sample No.	Sample Location	Sample Date	Sampler	Ash g/m²/mth	Combustible Matter g/m2/mth	NO SAMPLE: (d)	Time: (d)	Total Insoluble Matter g/m²/mth	Volume Collected mL
			EEL						
33571.03	DM3	04-May-09	C Sheehan EEL	0.4	0.2		1444	0.6	735
33571.04	DM4	04-May-09	C Sheehan EEL	0.5	<0.1		1430	0.5	715
33571.05	DM5	04-May-09	C Sheehan EEL	0.6	0.1		1501	0.7	835
33571.06	DM6	04-May-09	C Sheehan EEL	0.4	0.2		1414	0.6	1100
33822.01	DM1	02-Jun-09	J Maloney EEL	0.8	0.3		1530	1.1	795
33822.02	DM2	02-Jun-09	J Maloney EEL	0.4	<0.1		1450	0.4	605
33822.03	DM3	02-Jun-09	J Maloney EEL	0.5	0.4		1438	0.9	635
33822.04	DM4	02-Jun-09	J Maloney EEL	0.4	0.1		1422	0.5	665
33822.05	DM5	02-Jun-09	J Maloney EEL	0.7	0.1		1519	0.8	765
33822.06	DM6	02-Jun-09	J Maloney EEL	0.3	0.2		1401	0.5	780
34118.01	DM1	02-Jul-09	C Sheehan EEL	0.4	0.1		1353	0.5	730
34118.02	DM2	02-Jul-09	C Sheehan EEL	0.2	0.4		1413	0.6	605
34118.03	DM3	02-Jul-09	C Sheehan EEL	0.3	0.1		1420	0.4	640
34118.04	DM4	02-Jul-09	C Sheehan EEL	0.3	0.2		1428	0.5	555
34118.05	DM5	02-Jul-09	C Sheehan EEL	0.4	0.1		1344	0.5	700
34118.06	DM6	02-Jul-09	C Sheehan EEL	0.2	0.1		1447	0.3	720
34340.01	DM1	03-Aug-09	J Maloney EEL	0.2	0.1		1523	0.3	685
34340.02	DM2	03-Aug-09	J Maloney EEL	0.1	0.2		1457	0.3	630
34340.03	DM3	03-Aug-09	J Maloney EEL	0.2	0.1		1445	0.3	690
34340.04	DM4	03-Aug-09	J Maloney EEL	0.2	0.1		1423	0.3	645
34340.05	DM5	03-Aug-09	J Maloney EEL	0.6	1.6		1515	2.2	630
34340.06	DM6	03-Aug-09	J Maloney EEL	0.3	0.2		1402	0.5	785
34574.01	DM1	02-Sep-09	J Maloney EEL	0.7	0.5		920	1.2	720
34574.02	DM2	02-Sep-09	J Maloney EEL	0.4	0.4		1000	0.8	710
34574.03	DM3	02-Sep-09	J Maloney EEL	0.9	0.4		1015	1.3	640
34574.04	DM4	02-Sep-09	J Maloney EEL	0.6	0.3		1042	0.9	520
34574.05	DM5	02-Sep-09	J Maloney EEL	0.5	0.3		929	0.8	575
34574.06	DM6	02-Sep-09	J Maloney EEL	0.5	0.4		1335	0.9	755
34828.01	DM1	02-Oct-09	C Sheehan EEL	8	1.2		1118	9.2	520
34828.02	DM2	02-Oct-09	C Sheehan EEL	7.3	1.3		1129	8.6	515
34828.03	DM3	02-Oct-09	C Sheehan EEL	9.8	1.5		1136	11.3	385
34828.04	DM4	02-Oct-09	C Sheehan EEL	11	1.7		1142	12.7	330
34828.05	DM5	02-Oct-09	C Sheehan EEL	22	4.6		1110	26.9	475
34828.06	DM6	02-Oct-09	C Sheehan EEL	9.2	1.6		1202	10.8	660
35081.01	DM1	03-Nov-09	J Maloney EEL	3.3	0.9		1541	4.2	830
35081.02	DM2	03-Nov-09	J Maloney EEL	3	0.5		1609	3.5	740
35081.03	DM3	03-Nov-09	J Maloney	3	1.3		1603	4.3	685

Sample No.	Sample Location	Sample Date	Sampler	Ash g/m^2/mth	Combustible Matter g/m2/mth	NO SAMPLE: (d)	Time: (d)	Total Insoluble Matter g/m^2/mth	Volume Collected mL
			EEL						
35081.04	DM4	03-Nov-09	J Maloney EEL	3.1	0.6		1622	3.7	465
35081.05	DM5	03-Nov-09	J Maloney EEL	3.8	0.7		1517	4.5	665
35081.06	DM6	03-Nov-09	J Maloney EEL	3.2	1.1		1445	4.3	755
35335.01	DM1	02-Dec-09	C Sheehan EEL	2.4	1.3		1253	3.7	315
35335.02	DM2	02-Dec-09	C Sheehan EEL	1.8	0.8		1215	2.6	250
35335.03	DM3	02-Dec-09	C Sheehan EEL	1.1	0.6		1232	1.7	235
35335.04	DM4	02-Dec-09	C Sheehan EEL	1.6	0.6		1207	2.2	185
35335.05	DM5	02-Dec-09	C Sheehan EEL	1.8	0.7		1247	2.5	265
35335.06	DM6	02-Dec-09	C Sheehan EEL			No access, fallen tree	1145		
35584.01	DM1	05-Jan-10	C Sheehan EEL	1.1	0.9		1245	2	1440
35584.02	DM2	05-Jan-10	C Sheehan EEL	0.6	0.4		1309	1	1405
35584.03	DM3	05-Jan-10	C Sheehan EEL	1	0.7		1322	1.7	1390
35584.04	DM4	05-Jan-10	C Sheehan EEL	0.8	0.4		1332	1.2	1265
35584.05	DM5	05-Jan-10	C Sheehan EEL	1.1	0.4		1235	1.5	1405
35584.06	DM6	05-Jan-10	C Sheehan EEL			No access, fallen tree	1345		
35825.01	DM1	02-Feb-10	C Sheehan EEL	1.2	0.8		1308	2	2405
35825.02	DM2	02-Feb-10	C Sheehan EEL	0.9	0.6		1330	1.5	1870
35825.03	DM3	02-Feb-10	C Sheehan EEL	1.1	0.9		1342	2	1715
35825.04	DM4	02-Feb-10	C Sheehan EEL	0.8	0.3		1353	1.1	1245
35825.05	DM5	02-Feb-10	C Sheehan EEL	1.5	0.6		1255	2.1	1580
36064.01	DM1	02-Mar-10	C Sheehan EEL	0.7	2.8		1327	3.5	2140
36064.02	DM2	02-Mar-10	C Sheehan EEL	0.3	0.5		1340	0.8	2145
36064.03	DM3	02-Mar-10	C Sheehan EEL			No access	1355		
36064.04	DM4	02-Mar-10	C Sheehan EEL	0.2	0.6		1348	0.8	2260
36064.05	DM5	02-Mar-10	C Sheehan EEL	0.8	0.7		1320	1.5	2355
36319.01	DM1	31-Mar-10	C Sheehan EEL	0.7	0.4		1438	1.1	1050
36319.02	DM2	31-Mar-10	C Sheehan EEL	0.3	0.1		1510	0.4	945
36319.03	DM3	31-Mar-10	C Sheehan EEL	0.2	0.1		1527	0.3	2745
36319.04	DM4	31-Mar-10	C Sheehan EEL	0.3	0.1		1541	0.4	905
36319.05	DM5	31-Mar-10	C Sheehan EEL	1.2	0.3		1428	1.5	1080
36542.01	DM1	30-Apr-10	C Sheehan EEL	0.3	0.3		1302	0.6	895
36542.02	DM2	30-Apr-10	C Sheehan EEL	0.2	0.2		1240	0.4	815
36542.03	DM3	30-Apr-10	C Sheehan EEL	0.4	0.9		1232	1.3	900
36542.04	DM4	30-Apr-10	C Sheehan EEL	0.2	<0.1		1225	0.2	785
36542.05	DM5	30-Apr-10	C Sheehan	0.4	0.2		1253	0.6	915

PAEHolmes Job 3351C

Sample No.	Sample Location	Sample Date	Sampler	Ash g/m^2 /mth	Combustible Matter g/m2/mth	NO SAMPLE: (d)	Time: (d)	Total Insoluble Matter g/m^2/mth	Volume Collected mL
			EEL						
36693.01	DM1	31-May-10	T Hamilton ALS	0.3	0.3		1100	0.6	1260
36693.02	DM2	31-May-10	T Hamilton ALS	0.3	0.7		1137	1	1140
36693.03	DM3	31-May-10	T Hamilton ALS	0.2	0.1		1154	0.3	1180
36693.04	DM4	31-May-10	T Hamilton ALS	0.2	<0.1		1212	0.2	1320
36693.05	DM5	31-May-10	T Hamilton ALS	0.7	0.2		1114	0.9	1480
36903.01	DM1	01-Jul-10	T Hamilton ALS	0.2	0.3		1056	0.5	700
36903.02	DM2	01-Jul-10	T Hamilton ALS	0.4	0.9		1202	1.3	615
36903.03	DM3	01-Jul-10	T Hamilton ALS	0.1	0.2		1215	0.3	680
36903.04	DM4	01-Jul-10	T Hamilton ALS	0.2	0.1		1223	0.3	595
36903.05	DM5	01-Jul-10	T Hamilton ALS	0.4	0.3		1118	0.7	655
37089.01	DM1	02-Aug-10	T Hamilton ALS	0.3	0.4		1055	0.7	1665
37089.02	DM2	02-Aug-10	T Hamilton ALS	0.2	0.3		1143	0.5	1605
37089.03	DM3	02-Aug-10	T Hamilton ALS	0.1	0.1		1156	0.2	1675
37089.04	DM4	02-Aug-10	T Hamilton ALS	0.2	<0.1		1205	0.2	1725
37089.05	DM5	02-Aug-10	T Hamilton ALS	0.6	0.1		1127	0.7	1740

Source: Coalpac Pty Ltd

Appendix C: Emission Calculations

Coalpac Consolidation Project

The dust emission inventories have been prepared using the operational description of the proposed mining activities provided by Hansen Bailey on behalf of the Proponent. Estimated emissions are presented for all significant dust generating activities associated with the operations.

The relevant emission factors used for the study are described below.

Stripping topsoil

Emissions from dozers on overburden have been calculated using the US EPA emission factor equation (**US EPA, 1985 and updates**), per **Equation 1**.

Equation 1

$$E_{TSP} = 2.6 \times \frac{s^{1.2}}{M^{1.3}} \qquad \text{kg/hour}$$

where,

$E_{TSP} = TSP\ emissions$

$s = \text{silt content (\%), and}$

$M = \text{moisture (\%)}$

The silt content in the overburden was assumed to be 8%, and the moisture content 2%. This results in a emission factor of 12.8 kg/h.

Drilling overburden and coal

The emission factor used for drilling has been taken to be 0.59 kg/hole (**US EPA, 1985 and updates**).

Blasting overburden and coal

TSP emissions from blasting were estimated using the **US EPA (1985 and updates)** emission factor equation given in **Equation 2**.

Equation 2

$$E_{TSP} = 0.00022 \times A^{1.5} \qquad \text{kg/blast}$$

where,

A = area to be blasted in m^2

Loading material / dumping overburden

Each tonne of material loaded will generate a quantity of TSP that will depend on the wind speed and the moisture content. **Equation 3** shows the relationship between these variables.

Equation 3

$$E_{TSP} = k \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \right) \quad kg/t$$

where,

E_{TSP} = *TSP emissions*

$k = 0.74$

U = *wind speed (m/s)*

M = *moisture content (%)*

[where $0.25 \leq M \leq 4.8$*]*

Hauling material / product on unsealed surfaces

The **US EPA (1985 and updates)** emission factor equation has been used. It is given below in **Equation 4**.

$$E = k\,(s/12)^a (W/3)^b$$

Where,

k = 1.38

s = surface material silt content (%)

a = 0.7

W = mean vehicle weight (tons)

b = 0.45

Dozers working on overburden

Emissions from dozers on overburden have been calculated using the US EPA emission factor **Equation 1** (**US EPA, 1985 and updates**).

Dozers working on coal

The **US EPA (1985 and updates)** emission factor equation has been used. It is given below in **Equation 5**.

Equation 5

$$E_{TSP} = 35.6 \times \frac{s^{1.2}}{m^{1.4}} \quad kg/hour$$

Where,
s = silt content (%), and
M = moisture (%)

Loading/unloading coal

The **US EPA (1985 and updates)** emission factor equation has been used. It is given below in **Equation 6**.

Equation 6

$$E_{TSP} = \frac{0.580}{M^{1.2}} \qquad kg/t$$

where,

$E_{TSP} = TSP\ \ emissions$

M = moisture (%)

Loading / unloading / transfer of coal

A default value of 0.01 kg/t has been used **US EPA (1985 and updates)**.

Wind erosion

The latest wind erosion equation made available from the **US EPA (1985 and updates)** require information on the threshold frictional velocity for the surface of the exposed area.

As this information is not available the default emission factor of 0.4 kg/ha/h **(SPCC, 1983)** has been used to estimate TSP emissions for wind erosion.

It has been assumed that any active mining and dump areas that have not yet been rehabilitated would be reduced by 50% to account for water carts and sprays.

Grading roads

Estimates of TSP emissions from grading roads have been made using the **US EPA (1985 and updates)** emission factor equation (Equation 7).

Equation 7

$$E_{TSP} = 0.0034 \times S^{2.5} \qquad kg/VKT$$

where,

S = speed of the grader in km/h (taken to be 8 km/h)

The following tables present the calculated emissions for Year 5, year 10, Year 15 and Year 21 which correspond to the sources allocations as represented in **Section 7**.

The abbreviations used in the tables are as follows:

- OB - overburden related activities
- CL - coal related activities
- WE - wind erosion emissions
- CV – Cullen Valley
- ET – East Tyldesley
- IC - Invincible

Table C.1: Emissions estimates for Year 2

ACTIVITY	TSP emission/year for Year 2 in(kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Source type
HILLCROFT MINE OPERATIONS																		
CV: Topsoil Removal - Dozers/Excavators stripping topsoil	333	26	h/y	12.8	kg/h	8	silt content in %	2	moisture content in %									1
CV: OB - Drilling Overburden	3,012	5,105	holes/y	0.59	kg/hole													1
CV: OB - Blasting Overburden	3,349	43	blasts/y	78.717	kg/blast	5,040	Area of blast in square metres	120	holes/blast									1
CV: OB - Loading Overburden	18,665	8,576,821	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
CV: CL - Hauling to Hillcroft dump	88,101	8,576,821	t/y	0.0103	kg/t	150	t/load	200	Vehicle gross mass (	1.3	km/return tri	4.74	kg/VKT	5	% silt conte	75	% control	1
CV: OB - Unloading Overburden to dump	18,665	8,576,821	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
CV: OB - Dozers on o/b	31,329	1,872	h/y	16.735	kg/h	10	silt content in %	2	moisture content in %									1
CV: CL - Dozers on coal	34,641	936	h/y	37.0	kg/h	10	silt content in %	7	moisture content in %									1
CV: CL - Loading coal into trucks	72,722	1,295,250	t/y	0.056	kg/t	7	moisture content in %											1
CV: CL - Hauling coal to ROM coal stockpiles at ET CHPP	185,083	1,295,250	t/y	0.14289	kg/t	90	t/load	110	Vehicle gross mass (	14.2	km/return tri	3.62	kg/VKT	5	% silt conte	75	% control	1
CV: CL - Unloading coal to ROM coal stockpiles	12,953	1,295,250	t/y	0.01	kg/t													1
CV: CL - Rehandle coal to hopper	488	1,295,250	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	7	moisture content in %									2
CV: CL - Crushing	777	1,295,250	t/y	0.0006	kg/t													1
CV: CL - Screening	1,425	1,295,250	t/y	0.0011	kg/t													1
CV: CL - Loading coal to product stockpiles	64,802	1,154,183	t/y	0.056	kg/t	7	moisture content in %											1
CV: CL - Loading coal to trucks	482	1,154,183	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
CV: CL - Hauling product coal from ET CHPP to S conveyor	72,689	820,850	t/y	0.08855	kg/t	90	t/load	110	Vehicle gross mass (	8.8	km/return tri	3.62	kg/VKT	5	% silt conte	75	% control	1
CV: CL - Unloading product coal from trucks to conveyor	8,208	820,850	t/y	0.01	kg/t													1
CV: CL - Hauling product coal from ET CHPP to rail load out	35,220	333,333	t/y	0.10566	kg/t	90	t/load	110	Vehicle gross mass (	10.5	km/return tri	3.62	kg/VKT	5	% silt conte	75	% control	1
CV: CL - Unloading product coal from trucks to stockpile	3,333	333,333	t/y	0.01	kg/t													1
CV: CL - FEL loading product coal to trains	139	333,333	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %			2.00						2
CV: CL - Hauling rejects to dump	43,735	306,067	t/y	0.14289	kg/t	90	t/load	110	Vehicle gross mass (	14.2	km/return tri	3.62	kg/VKT	5	% silt conte	75	% control	1
CV - REHAB - Dozers on rehab	200,117	936	h/y	213.8	kg/h	10	silt content in %	2	moisture content in %									1
CV: WE - Active Mining Area	9,636	5.5	ha	0.4	kg/ha/h	8760	h/y	50%	control									3
CV: WE - Dumps area	41,347	23.6	ha	0.4	kg/ha/h	8760	h/y	50%	control									3
CV: WE - Main ROM and Product stockpiles	1,233	0.35	ha	0.4	kg/ha/h	8760	h/y											3
CV: Grading roads	13,826	22,464	km	1	kg/ha/h	8	speed of graders in km/h											1
CULLEN VALLEY MINE OPERATIONS (Sand quarry operations)																		
CV: SAND - Dozer ripping/pushing sand	31,329	1,872	h/y	16.74	kg/h	10	silt content in %	2	moisture content in %									1
CV: SAND - Excavation of sand by shovel/excavator/FEL	1,743	801,000	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content (%)									2
CV: SAND - Rehandle sandstone to hopper	1,743	801,000	t/y	0.0022	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
CV: SAND - Crushing	481	801,000	t/y	0.001	kg/t													1
CV: SAND - Loading sand to product stockpiles	35,978	640,800	t/y	0.056	kg/t	7	moisture content in %											1
CV: SAND - Hauling sand to raw stockpiles at the CV CHPP	33,128	640,800	t/y	0.05170	kg/t	180	t/load	215	Vehicle gross mass (	7.6	km/return tri	5	kg/VK	5	% silt conte	75	% control	1
CV: SAND - Dumping sand to raw stockpile from haul truck	1,395	640,800	t/y	0.0022	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content (%)									2
CV: SAND - Loading sand to trucks	1,395	640,800	t/y	0.0022	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
CV: SAND - Hauling product to S conveyor	13,949	640,800	t/y	0.02177	kg/t	180	t/load	215	Vehicle gross mass (	3.2	km/return tri	5	kg/VK	5	% silt conte	75	% control	1
CV: SANDL - Unloading product from trucks to conveyor	6,408	640,800	t/y	0.01	kg/t													1
CV - REHAB - Dozers on rehab	200,117	936	h/y	213.8	kg/h	10	silt content in %	2	moisture content in %									1
CV: WE - Active Mining Area	8,585	4.9	ha	0.4	kg/ha/h	8760	h/y	50%	control									3
CV: WE - Dumps area	20,411	11.7	ha	0.4	kg/ha/h	8760	h/y	50%	control									3
CV: WE - Main ROM and Product stockpiles	1,233	0.35	ha	0.4	kg/ha/h	8760	h/y											3
CV: Grading roads	13,826	22,464	km	1	kg/ha/h	8	speed of graders in km/h											1
EAST TYLDESLEY OPEN CUT OPERATIONS																		
ET: Topsoil Removal - Dozers/Excavators stripping topsoil	333	26	h/y	12.8	kg/h	8	silt content in %	2	moisture content in %									1
ET: OB - Drilling Overburden	3,012	5,105	holes/y	0.59	kg/hole													1
ET: OB - Blasting Overburden	3,349	43	blasts/y	78.717	kg/blast	5,040	Area of blast in square metres	120	holes/blast									1
ET: OB - Loading Overburden	18,665	8,576,821	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
ET: OB - Hauling to ET dump	88,101	8,576,821	t/y	0.01027	kg/t	150	t/load	200	Vehicle gross mass (	1.3	km/return tri	4.74	kg/VKT	5	% silt conte	75	% control	1
ET: OB - Unloading Overburden to dump	18,665	8,576,821	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
ET: OB - Dozers on o/b	31,329	1,872	h/y	16.735	kg/h	10	silt content in %	2	moisture content in %									1
ET: CL - Dozers on coal	34,641	936	h/y	37.0	kg/h	10	silt content in %	7	moisture content in %									1
ET: CL - Loading coal into trucks	72,722	1,295,250	t/y	0.056	kg/t	7	moisture content in %											1
ET: CL - Hauling coal to ROM coal stockpiles at ET CHPP	20,854	1,295,250	t/y	0.01610	kg/t	90	t/load	110	Vehicle gross mass (	1.6	km/return tri	3.62	kg/VKT	5	% silt conte	75	% control	1
ET: CL - Unloading coal to ROM coal stockpiles	12,953	1,295,250	t/y	0.01	kg/t													1
ET: CL - Rehandle coal to hopper	488	1,295,250	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	7	moisture content in %									2
ET: CL - Crushing	777	1,295,250	t/y	0.0006	kg/t													1
ET: CL - Screening	1,425	1,295,250	t/y	0.0011	kg/t													1
ET: CL - Loading coal to product stockpiles	64,802	1,154,183	t/y	0.056	kg/t	7	moisture content in %											1
ET: CL - Loading coal to trucks	482	1,154,183	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
ET: CL - Hauling product coal from ET CHPP to S conveyor	72,689	820,850	t/y	0.08855	kg/t	90	t/load	110	Vehicle gross mass (	8.8	km/return tri	3.62	kg/VKT	5	% silt conte	75	% control	1
ET: CL - Unloading product coal from trucks to conveyor	8,208	820,850	t/y	0.01	kg/t													1
ET: CL - Hauling product coal from ET CHPP to rail load out	35,220	333,333	t/y	0.10566	kg/t	90	t/load	110	Vehicle gross mass (	10.5	km/return tri	3.62	kg/VKT	5	% silt conte	75	% control	1
ET: CL - Unloading product coal from trucks to stockpile	3,333	333,333	t/y	0.01	kg/t													1
ET: CL - FEL loading product coal to trains	139	333,333	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
ET: CL - Hauling rejects to dump	4,928	306,067	t/y	0.01610	kg/t	90	t/load	110	Vehicle gross mass (	1.6	km/return tri	3.62	kg/VKT	5	% silt conte	75	% control	1
ET - REHAB - Dozers on rehab	200,117	936	h/y	213.8	kg/h	10	silt content in %	2	moisture content in %									1
ET: WE - Active Mining Area	11,213	6.4	ha	0.4	kg/ha/h	8760	h/y	50%	control									3
ET: WE - Dumps area	32,938	18.8	ha	0.4	kg/ha/h	8760	h/y	50%	control									3
ET: WE - Main ROM and Product stockpiles	2,775	0.79	ha	0.4	kg/ha/h	8760	h/y											3
ET: Grading roads	13,826	22,464	km	1	kg/ha/h	8	speed of graders in km/h											1
INVINCIBLE COLLEIRY OPERATIONS																		
IC: Topsoil Removal - Dozers/Excavators stripping topsoil	333	26	h/y	12.8	kg/h	8	silt content in %	2	moisture content in %									1
IC: OB - Drilling Overburden	3,012	5,105	holes/y	0.59	kg/hole													1
IC: OB - Blasting Overburden	3,349	43	blasts/y	78.717	kg/blast	5,040	Area of blast in square metres	120	holes/blast									1
IC: OB - Loading Overburden	18,665	8,576,821	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
IC: OB - Hauling from pit to IC dump	101,655	8,576,821	t/y	0.01185	kg/t	150	t/load	200	Vehicle gross mass (	1.5	km/return tri	4.74	kg/VKT	5	% silt conte	75	% control	1
IC: OB - Unloading Overburden to dump	18,665	8,576,821	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
IC: OB - Dozers on o/b	31,329	1,872	h/y	16.735	kg/h	10	silt content in %	2	moisture content in %									1
IC: CL - Dozers on coal	34,641	936	h/y	37.0	kg/h	10	silt content in %	7	moisture content in %									1
IC: CL - Loading coal into trucks	72,722	1,295,250	t/y	0.056	kg/t	7	moisture content in %											1
IC: CL - Hauling coal to ROM coal stockpiles at CHPP	36,495	1,295,250	t/y	0.02818	kg/t	90	t/load	110	Vehicle gross mass (	2.8	km/return tri	3.62	kg/VKT	5	% silt conte	75	% control	1
IC: CL - Unloading coal to ROM coal stockpiles	12,953	1,295,250	t/y	0.01	kg/t													1
IC: CL - Rehandle coal to hopper	488	1,295,250	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	7	moisture content in %									2
IC: CL - Crushing	777	1,295,250	t/y	0.0006	kg/t													1
IC: CL - Screening	1,425	1,295,250	t/y	0.0011	kg/t													1
IC: CL - Loading coal to product stockpiles	64,802	1,154,183	t/y	0.056	kg/t	7	moisture content in %											1
IC: CL - Loading coal to trucks	482	1,154,183	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
IC: CL - Hauling product coal from IC CHPP to S conveyor	14,042	820,850	t/y	0.01711	kg/t	90	t/load	110	Vehicle gross mass (	1.7	km/return tri	3.62	kg/VKT	5	% silt conte	75	% control	1
IC: CL - Unloading product coal from trucks to conveyor	8,208	820,850	t/y	0.01	kg/t													1
IC: CL - Hauling product coal from IC CHPP to rail load out	65,744	333,333	t/y	0.19723	kg/t	90	t/load	110	Vehicle gross mass (	19.6	km/return tri	3.62	kg/VKT	5	% silt conte	75	% control	1
IC: CL - Unloading product coal from trucks to stockpile	3,333	333,333	t/y	0.01	kg/t													1
IC: CL - FEL loading product coal to trains	139	333,333	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
IC: CL - Hauling rejects to dump	8,624	306,067	t/y	0.02818	kg/t	90	t/load	110	Vehicle gross mass (	2.8	km/return tri	3.62	kg/VKT	5	% silt conte	75	% control	1
IC - REHAB - Dozers on rehab	200,117	936	h/y	213.8	kg/h	10	silt content in %	2	moisture content in %									1
IC: WE - Active Mining Area	10,862	6.2	ha	0.4	kg/ha/h	8760	h/y	50%	control									3
IC: WE - Dumps area	38,719	22.1	ha	0.4	kg/ha/h	8760	h/y	50%	control									3
IC: WE - Main ROM and Product stockpiles	5,859	1.7	ha	0.4	kg/ha/h	8760	h/y											3
IC: Grading roads	13,826	22,464	km	1	kg/ha/h	8	speed of graders in km/h											1

Table C.2: Emissions estimates for Year 8

ACTIVITY	TSP emission/year for Year 8 in(kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Source type
CULLEN VALLEY MINE OPERATIONS																		
CV: Topsoil Removal - Dozers/Excavators stripping topsoil	333	26	h/y	12.8	kg/h	8	silt content in %	2	moisture content in %									1
CV: OB - Drilling Overburden	4,360	7,389	holes/y	0.59	kg/hole													1
CV: OB - Blasting Overburden	4,847	62	blasts/y	78.717	kg/blast	5,040	Area of blast in square metres	120	holes/blast									1
CV: OB - Loading Overburden	27,015	12,414,072	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
CV: CL - Hauling to CV dump	156,945	12,414,072	t/y	0.0126	kg/t	150	t/load	200	Vehicle gross mass (	1.6	km/return trip	4.74	kg/VKT	5	% silt conten	75	% control	1
CV: OB - Unloading Overburden to dump	27,015	12,414,072	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
CV: OB - Dozers on o/b	31,329	1,872	h/y	16.735	kg/h	10	silt content in %	2	moisture content in %									1
CV: CL - Dozers on coal	34,641	936	h/y	37.0	kg/h	10	silt content in %	7	moisture content in %									1
CV: CL - Loading coal into trucks	74,945	1,334,850	t/y	0.056	kg/t	7	moisture content in %											1
CV: CL - Hauling coal to ROM coal stockpiles at ET CHPP	91,341	1,334,850	t/y	0.06843	kg/t	90	t/load	110	Vehicle gross mass (	6.8	km/return trip	3.62	kg/VKT	5	% silt conten	75	% control	1
CV: CL - Unloading coal to ROM coal stockpiles	13,349	1,334,850	t/y	0.01	kg/t													1
CV: CL - Rehandle coal to hopper	503	1,334,850	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	7	moisture content in %									2
CV: CL - Crushing	801	1,334,850	t/y	0.0006	kg/t													1
CV: CL - Screening	1,468	1,334,850	t/y	0.0011	kg/t													1
CV: CL - Loading coal to product stockpiles	64,841	1,154,885	t/y	0.056	kg/t	7	moisture content in %											1
CV: CL - Loading coal to trucks	483	1,154,885	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
CV: CL - Hauling product coal from ET CHPP to S conveyor	72,751	821,551	t/y	0.08855	kg/t	90	t/load	110	Vehicle gross mass (	8.8	km/return trip	3.62	kg/VKT	5	% silt conten	75	% control	1
CV: CL - Unloading product coal from trucks to conveyor	8,216	821,551	t/y	0.01	kg/t													1
CV: CL - Hauling product coal from ET CHPP to rail load out	35,220	333,333	t/y	0.10566	kg/t	90	t/load	110	Vehicle gross mass (	10.5	km/return trip	3.62	kg/VKT	5	% silt conten	75	% control	1
CV: CL - Unloading product coal from trucks to stockpile	3,333	333,333	t/y	0.01	kg/t													1
CV: CL - FEL loading product coal to trains	139	333,333	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
CV: CL - Hauling rejects to dump	5,554	344,966	t/y	0.01610	kg/t	90	t/load	110	Vehicle gross mass (	1.6	km/return trip	3.62	kg/VKT	5	% silt conten	75	% control	1
CV - REHAB - Dozers on rehab	200,117	936	h/y	213.8	kg/h	10	silt content in %	2	moisture content in %									1
CV: WE - Active Mining Area	25,229	14.4	ha	0.4	kg/ha/h	8760	h/y	50%	control									3
CV: WE - Dumps area	53,611	30.6	ha	0.4	kg/ha/h	8760	h/y	50%	control									3
CV: WE - Main ROM and Product stockpiles	925	0.3	ha	0.4	kg/ha/h	8760	h/y											3
CV: Grading roads	13,826	22,464	km	1	kg/ha/h	8	speed of graders in km/h											1
CULLEN VALLEY MINE OPERATIONS (Sand quarry operations)																		
CV: SAND - Dozer ripping/pushing sand	31,329	1,872	h/y	16.74	kg/h	10	silt content in %	2	moisture content in %									1
CV: SAND - Excavation of sand by shovel/excavator/FEL	1,743	801,000	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content (%)									2
CV: SAND - Rehandle sandstone to hopper	481	801,000	t/y	0.0022	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
CV: SAND - Crushing	481	801,000	t/y	0.0006	kg/t													1
CV: SAND - Loading sand to product stockpiles	35,978	640,800	t/y	0.056	kg/t	7	moisture content in %											1
CV: SAND - Hauling sand to raw stockpiles at the ET CHPP	61,026	640,800	t/y	0.09523	kg/t	180	t/load	215	Vehicle gross mass (	14	km/return trip	4.90	kg/VKT	5	% silt conten	75	% control	1
CV: SAND - Dumping sand to raw stockpile from haul truck	1,395	640,800	t/y	0.0022	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content (%)									2
CV: SAND - Loading sand to trucks	1,395	640,800	t/y	0.0022	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
CV: SAND - Hauling product to S conveyor	39,231	640,800	t/y	0.06122	kg/t	180	t/load	215	Vehicle gross mass (	9	km/return trip	4.90	kg/VKT	5	% silt conten	75	% control	1
CV: SAND - Unloading product from trucks to conveyor	6,408	640,800	t/y	0.01	kg/t													1
CV - REHAB - Dozers on rehab	200,117	936	h/y	213.8	kg/h	10	silt content in %	2	moisture content in %									1
CV: WE - Active Mining Area	10,582	6.0	ha	0.4	kg/ha/h	8760	h/y	50%	control									3
CV: WE - Dumps area	33,989	19.4	ha	0.4	kg/ha/h	8760	h/y	50%	control									3
CV: WE - Main ROM and Product stockpiles	925	0.3	ha	0.4	kg/ha/h	8760	h/y											3
CV: Grading roads	13,826	22,464	km	1	kg/ha/h	8	speed of graders in km/h											1
EAST TYLDESLEY OPEN CUT OPERATIONS																		
ET: Topsoil Removal - Dozers/Excavators stripping topsoil	333	26	h/y	12.8	kg/h	8	silt content in %	2	moisture content in %									1
ET: OB - Drilling Overburden	4,360	7,389	holes/y	0.59	kg/hole													1
ET: OB - Blasting Overburden	4,847	62	blasts/y	78.717	kg/blast	5,040	Area of blast in square metres	120	holes/blast									1
ET: OB - Loading Overburden	27,015	12,414,072	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
ET: OB - Hauling to ET dump	156,945	12,414,072	t/y	0.01264	kg/t	150	t/load	200	Vehicle gross mass (	1.6	km/return trip	4.74	kg/VKT	5	% silt conten	75	% control	1
ET: OB - Unloading Overburden to dump	27,015	12,414,072	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
ET: OB - Dozers on o/b	31,329	1,872	h/y	16.735	kg/h	10	silt content in %	2	moisture content in %									1
ET: CL - Dozers on coal	34,641	936	h/y	37.0	kg/h	10	silt content in %	7	moisture content in %									1
ET: CL - Loading coal into trucks	74,945	1,334,850	t/y	0.056	kg/t	7	moisture content in %											1
ET: CL - Hauling coal to ROM coal stockpiles at ET CHPP	29,551	1,334,850	t/y	0.02214	kg/t	90	t/load	110	Vehicle gross mass (	2.2	km/return trip	3.62	kg/VKT	5	% silt conten	75	% control	1
ET: CL - Unloading coal to ROM coal stockpiles	13,349	1,334,850	t/y	0.01	kg/t													1
ET: CL - Rehandle coal to hopper	503	1,334,850	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	7	moisture content in %									2
ET: CL - Crushing	801	1,334,850	t/y	0.0006	kg/t													1
ET: CL - Screening	1,468	1,334,850	t/y	0.0011	kg/t													1
ET: CL - Loading coal to product stockpiles	64,841	1,154,885	t/y	0.056	kg/t	7	moisture content in %											1
ET: CL - Loading coal to trucks	483	1,154,885	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
ET: CL - Hauling product coal from ET CHPP to S conveyor	72,751	821,551	t/y	0.08855	kg/t	90	t/load	110	Vehicle gross mass (	8.8	km/return trip	3.62	kg/VKT	5	% silt conten	75	% control	1
ET: CL - Unloading product coal from trucks to conveyor	8,216	821,551	t/y	0.01	kg/t													1
ET: CL - Hauling product coal from ET CHPP to rail load out	35,220	333,333	t/y	0.10566	kg/t	90	t/load	110	Vehicle gross mass (	10.5	km/return trip	3.62	kg/VKT	5	% silt conten	75	% control	1
ET: CL - Unloading product coal from trucks to stockpile	3,333	333,333	t/y	0.01	kg/t													1
ET: CL - FEL loading product coal to trains	139	333,333	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
ET: CL - Hauling rejects to dump	1,433	89,000	t/y	0.01610	kg/t	90	t/load	110	Vehicle gross mass (	1.6	km/return trip	3.62	kg/VKT	5	% silt conten	75	% control	1
ET - REHAB - Dozers on rehab	200,117	936	h/y	213.8	kg/h	10	silt content in %	2	moisture content in %									1
ET: WE - Active Mining Area	33,814	19.3	ha	0.4	kg/ha/h	8760	h/y	50%	control									3
ET: WE - Dumps area	32,062	18.3	ha	0.4	kg/ha/h	8760	h/y	50%	control									3
ET: WE - Main ROM and Product stockpiles	925	0.3	ha	0.4	kg/ha/h	8760	h/y											3
ET: Grading roads	13,826	22,464	km	1	kg/ha/h	8	speed of graders in km/h											1
INVINCIBLE COLLEIRY OPERATIONS																		
IC: Topsoil Removal - Dozers/Excavators stripping topsoil	333	26	h/y	12.8	kg/h	8	silt content in %	2	moisture content in %									1
IC: OB - Drilling Overburden	4,360	7,389	holes/y	0.59	kg/hole													1
IC: OB - Blasting Overburden	4,847	62	blasts/y	78.717	kg/blast	5,040	Area of blast in square metres	120	holes/blast									1
IC: OB - Loading Overburden	27,015	12,414,072	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
IC: OB - Hauling from pit to IC dump	58,854	12,414,072	t/y	0.00474	kg/t	150	t/load	200	Vehicle gross mass (	0.6	km/return trip	4.74	kg/VKT	5	% silt conten	75	% control	1
IC: OB - Unloading Overburden to dump	27,015	12,414,072	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
IC: OB - Dozers on o/b	31,329	1,872	h/y	16.735	kg/h	10	silt content in %	2	moisture content in %									1
IC: CL - Dozers on coal	34,641	936	h/y	37.0	kg/h	10	silt content in %	7	moisture content in %									1
IC: CL - Loading coal into trucks	74,945	1,334,850	t/y	0.056	kg/t	7	moisture content in %											1
IC: CL - Hauling coal to ROM coal stockpiles at IC CHPP	55,073	1,334,850	t/y	0.04126	kg/t	90	t/load	110	Vehicle gross mass (	4.1	km/return trip	3.62	kg/VKT	5	% silt conten	75	% control	1
IC: CL - Unloading coal to ROM coal stockpiles	13,349	1,334,850	t/y	0.01	kg/t													1
IC: CL - Rehandle coal to hopper	503	1,334,850	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	7	moisture content in %									2
IC: CL - Crushing	801	1,334,850	t/y	0.0006	kg/t													1
IC: CL - Screening	1,468	1,334,850	t/y	0.0011	kg/t													1
IC: CL - Loading coal to product stockpiles	64,841	1,154,885	t/y	0.056	kg/t	7	moisture content in %											1
IC: CL - Loading coal to trucks	483	1,154,885	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
IC: CL - Unloading product coal from trucks to conveyor	8,216	821,551	t/y	0.01	kg/t													1
IC: CL - Hauling product coal from IC CHPP to rail load out	65,744	333,333	t/y	0.19723	kg/t	90	t/load	110	Vehicle gross mass (	19.6	km/return trip	3.62	kg/VKT	5	% silt conten	75	% control	1
IC: CL - Unloading product coal from trucks to stockpile	3,333	333,333	t/y	0.01	kg/t													1
IC: CL - FEL loading product coal to trains	139	333,333	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
IC: CL - Hauling rejects to dump	2,083	344,966	t/y	0.00604	kg/t	90	t/load	110	Vehicle gross mass (	0.6	km/return trip	3.62	kg/VKT	5	% silt conten	75	% control	1
IC - REHAB - Dozers on rehab	200,117	936	h/y	213.8	kg/h	10	silt content in %	2	moisture content in %									1
IC: WE - Active Mining Area	10,687	6.1	ha	0.4	kg/ha/h	8760	h/y	50%	control									3
IC: WE - Dumps area	19,447	11.1	ha	0.4	kg/ha/h	8760	h/y	50%	control									3
IC: WE - Main ROM and Product stockpiles	2,467	0.7	ha	0.4	kg/ha/h	8760	h/y											3
IC: Grading roads	13,826	22,464	km	1	kg/ha/h	8	speed of graders in km/h											1

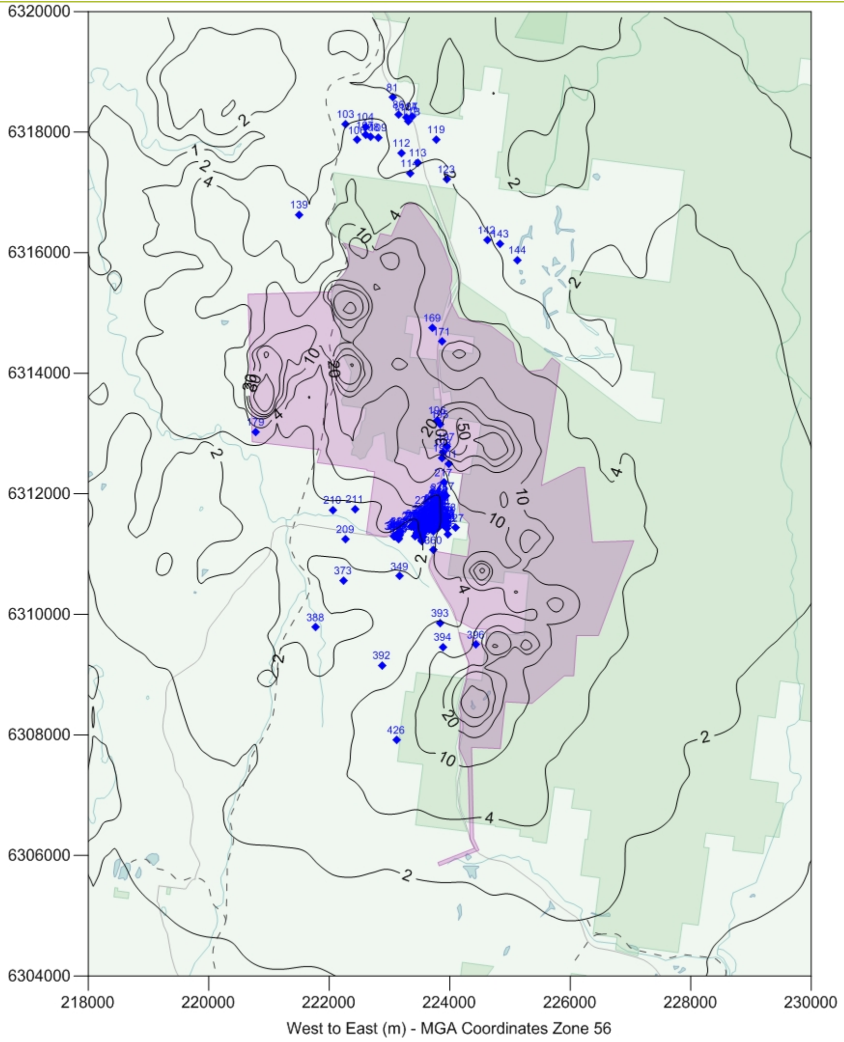
Table C.3: Emissions estimates for Year 14

ACTIVITY	TSP emission/year for Year 14 in(kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Source type
CULLEN VALLEY MINE OPERATIONS																		
CV: Topsoil Removal - Dozers/Excavators stripping topsoil	333	26	h/y	12.8	kg/h	8	silt content in %	2	moisture content in %									1
CV: OB - Drilling Overburden	5,056	8,570	holes/y	0.59	kg/hole													1
CV: OB - Blasting Overburden	5,622	71	blasts/y	78.717	kg/blast	5,040	Area of blast in square metres	120	holes/blast									1
CV: OB - Loading Overburden	31,332	14,397,625	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
CV: CL - Hauling to CV dump	238,903	14,397,625	t/y	0.0166	kg/t	150	t/load	200	Vehicle gross mass (	2.1	km/return trip	4.74	kg/VKT	5	% silt content	75	% control	1
CV: OB - Unloading Overburden to dump	31,332	14,397,625	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
CV: OB - Dozers on o/b	31,329	1,872	h/y	16.735	kg/h	10	silt content in %	2	moisture content in %									1
CV: CL - Dozers on coal	34,641	936	h/y	37.0	kg/h	10	silt content in %	7	moisture content in %									1
CV: CL - Loading coal into trucks	74,945	1,334,850	t/y	0.056	kg/t	7	moisture content in %											1
CV: CL - Hauling coal to ROM coal stockpiles at ET CHPP	102,087	1,334,850	t/y	0.07648	kg/t	90	t/load	110	Vehicle gross mass (	7.6	km/return trip	3.62	kg/VKT	5	% silt content	75	% control	1
CV: CL - Unloading coal to ROM coal stockpiles	13,349	1,334,850	t/y	0.01	kg/t			0.7	% control									1
CV: CL - Rehandle coal to hopper	801	1,334,850	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	7	moisture content in %									2
CV: CL - Crushing	801	1,334,850	t/y	0.0006	kg/t													1
CV: CL - Screening	1,468	1,334,850	t/y	0.0011	kg/t													1
CV: CL - Loading coal to product stockpiles	64,841	1,154,885	t/y	0.056	kg/t	7	moisture content in %	0.5	% control									1
CV: CL - Loading coal to trucks	483	1,154,885	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
CV: CL - Hauling product coal from ET CHPP to S conveyor	72,751	821,551	t/y	0.08855	kg/t	90	t/load	110	Vehicle gross mass (	8.8	km/return trip	3.62	kg/VKT	5	% silt content	75	% control	1
CV: CL - Unloading product coal from trucks to conveyor	8,216	821,551	t/y	0.01	kg/t													1
CV: CL - Hauling product coal from ET CHPP to rail load out	35,220	333,333	t/y	0.10566	kg/t	90	t/load	110	Vehicle gross mass (	10.5	km/return trip	3.62	kg/VKT	5	% silt content	75	% control	1
CV: CL - Unloading product coal from trucks to stockpile	3,333	333,333	t/y	0.01	kg/t													1
CV: CL - FEL loading product coal to trains	139	333,333	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
CV: CL - Hauling rejects to dump	24,300	344,966	t/y	0.07044	kg/t	90	t/load	110	Vehicle gross mass (	7	km/return trip	3.62	kg/VKT	5	% silt content	75	% control	1
CV - REHAB - Dozers on rehab	200,117	936	h/y	213.8	kg/h	10	silt content in %	2	moisture content in %									1
CV: WE - Active Mining Area	31,886	18.2	ha	0.4	kg/ha/h	8760	h/y	50%	control									3
CV: WE - Dumps area	75,336	43.0	ha	0.4	kg/ha/h	8760	h/y	50%	control									3
CV: WE - Main ROM and Product stockpiles	925	0.3	ha	0.4	kg/ha/h	8760	h/y											3
CV: Grading roads	13,826	22,464	km	1	kg/ha/h	8	speed of graders in km/h											1
CULLEN VALLEY MINE OPERATIONS (Sand quarry operations)																		
CV: SAND - Dozer ripping/pushing sand	31,329	1,872	h/y	16.74	kg/h	10	silt content in %	2	moisture content in %									1
CV: SAND - Excavation of sand by shovel/excavator/FEL	842	387,000	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content (%)									2
CV: SAND - Rehandle sandstone to hopper	232	387,000	t/y	0.0022	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
CV: SAND - Crushing	232	387,000	t/y	0.0006	kg/t													1
CV: SAND - Loading sand to product stockpiles	17,382	309,600	t/y	0.056	kg/t	7	moisture content in %											1
CV: SAND - Hauling sand to raw stockpiles to the ET CHPP	31,801	309,600	t/y	0.10272	kg/t	180	t/load	215	Vehicle gross mass (	15.1	km/return trip	4.90	kg/VKT	5	% silt content	75	% control	1
CV: SAND - Dumping sand to raw stockpile/or hopper from haul truck	674	309,600	t/y	0.0022	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content (%)									2
CV: SAND - Loading sand to trucks	674	309,600	t/y	0.0022	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
CV: SAND - Hauling product to S conveyor	18,954	309,600	t/y	0.06122	kg/t	180	t/load	215	Vehicle gross mass (	9	km/return trip	4.90	kg/VKT	5	% silt content	75	% control	1
CV: SAND - Unloading product from trucks to conveyor	3,096	309,600	t/y	0.01	kg/t													1
CV - REHAB - Dozers on rehab	200,117	936	h/y	213.8	kg/h	10	silt content in %	2	moisture content in %									1
CV: WE - Active Mining Area	19,272	5.5	ha	0.4	kg/ha/h	8760	h/y											3
CV: WE - Dumps area	116,683	33.3	ha	0.4	kg/ha/h	8760	h/y											3
CV: WE - Main ROM and Product stockpiles	925	0.3	ha	0.4	kg/ha/h	8760	h/y											3
CV: Grading roads	13,826	22,464	km	1	kg/ha/h	8	speed of graders in km/h											1
EAST TYLDESLEY OPEN CUT OPERATIONS																		
ET: Topsoil Removal - Dozers/Excavators stripping topsoil	333	26	h/y	12.8	kg/h	8	silt content in %	2	moisture content in %									1
ET: OB - Drilling Overburden	5,056	8,570	holes/y	0.59	kg/hole													1
ET: OB - Blasting Overburden	5,622	71	blasts/y	78.717	kg/blast	5,040	Area of blast in square metres	120	holes/blast									1
ET: OB - Loading Overburden	31,332	14,397,625	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
ET: OB - Hauling to ET dump	136,516	14,397,625	t/y	0.00948	kg/t	150	t/load	200	Vehicle gross mass (	1.2	km/return trip	4.74	kg/VKT	5	% silt content	75	% control	1
ET: OB - Unloading Overburden to dump	31,332	14,397,625	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
ET: OB - Dozers on o/b	31,329	1,872	h/y	16.735	kg/h	10	silt content in %	2	moisture content in %									1
ET: CL - Dozers on coal	34,641	936	h/y	37.0	kg/h	10	silt content in %	7	moisture content in %									1
ET: CL - Loading coal into trucks	74,945	1,334,850	t/y	0.056	kg/t	7	moisture content in %											1
ET: CL - Hauling coal to ROM coal stockpiles at ET CHPP	77,908	1,334,850	t/y	0.05836	kg/t	90	t/load	110	Vehicle gross mass (	5.8	km/return trip	3.62	kg/VKT	5	% silt content	75	% control	1
ET: CL - Unloading coal to ROM coal stockpiles	13,349	1,334,850	t/y	0.01	kg/t													1
ET: CL - Rehandle coal to hopper	503	1,334,850	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	7	moisture content in %									2
ET: CL - Crushing	801	1,334,850	t/y	0.0006	kg/t													1
ET: CL - Screening	1,468	1,334,850	t/y	0.0011	kg/t													1
ET: CL - Loading coal to product stockpiles	64,841	1,154,885	t/y	0.056	kg/t	7	moisture content in %											1
ET: CL - Loading coal to trucks	483	1,154,885	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
ET: CL - Hauling product coal from ET CHPP to S conveyor	72,751	821,551	t/y	0.08855	kg/t	90	t/load	110	Vehicle gross mass (	8.8	km/return trip	3.62	kg/VKT	5	% silt content	75	% control	1
ET: CL - Unloading product coal from trucks to conveyor	8,216	821,551	t/y	0.01	kg/t													1
ET: CL - Hauling product coal from ET CHPP to rail load out	35,220	333,333	t/y	0.10566	kg/t	90	t/load	110	Vehicle gross mass (	10.5	km/return trip	3.62	kg/VKT	5	% silt content	75	% control	1
ET: CL - Unloading product coal from trucks to stockpile	3,333	333,333	t/y	0.01	kg/t													1
ET: CL - FEL loading product coal to trains	139	333,333	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
ET: CL - Hauling rejects to dump	67,405	1,154,885	t/y	0.05836	kg/t	90	t/load	110	Vehicle gross mass (	5.8	km/return trip	3.62	kg/VKT	5	% silt content	75	% control	1
ET - REHAB - Dozers on rehab	200,117	936	h/y	213.8	kg/h	10	silt content in %	2	moisture content in %									1
ET: WE - Active Mining Area	37,843	10.8	ha	0.4	kg/ha/h	8760	h/y											3
ET: WE - Dumps area	111,778	31.9	ha	0.4	kg/ha/h	8760	h/y											3
ET: WE - Main ROM and Product stockpiles	925	0.3	ha	0.4	kg/ha/h	8760	h/y											3
ET: Grading roads	13,826	22,464	km	1	kg/ha/h	8	speed of graders in km/h											1
INVINCIBLE COLLEIRY OPERATIONS																		
IC: Topsoil Removal - Dozers/Excavators stripping topsoil	333	26	h/y	12.8	kg/h	8	silt content in %	2	moisture content in %									1
IC: OB - Drilling Overburden	5,056	8,570	holes/y	0.59	kg/hole													1
IC: OB - Blasting Overburden	5,622	71	blasts/y	78.717	kg/blast	5,040	Area of blast in square metres	120	holes/blast									1
IC: OB - Loading Overburden	31,332	14,397,625	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
IC: OB - Hauling from pit to IC dump	204,774	14,397,625	t/y	0.01422	kg/t	150	t/load	200	Vehicle gross mass (	1.8	km/return trip	4.74	kg/VKT	5	% silt content	75	% control	1
IC: OB - Unloading Overburden to dump	31,332	14,397,625	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
IC: OB - Dozers on o/b	31,329	1,872	h/y	16.735	kg/h	10	silt content in %	2	moisture content in %									1
IC: CL - Dozers on coal	34,641	936	h/y	37.0	kg/h	10	silt content in %	7	moisture content in %									1
IC: CL - Loading coal into trucks	74,945	1,334,850	t/y	0.056	kg/t	7	moisture content in %											1
IC: CL - Hauling coal to ROM coal stockpiles at IC CHPP	87,311	1,334,850	t/y	0.06541	kg/t	90	t/load	110	Vehicle gross mass (	6.5	km/return trip	3.62	kg/VKT	5	% silt content	75	% control	1
IC: CL - Unloading coal to ROM coal stockpiles	13,349	1,334,850	t/y	0.01	kg/t			0.7	% control									1
IC: CL - Rehandle coal to hopper	503	1,334,850	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	7	moisture content in %									2
IC: CL - Crushing	801	1,334,850	t/y	0.0006	kg/t													1
IC: CL - Screening	1,468	1,334,850	t/y	0.0011	kg/t													1
IC: CL - Loading coal to product stockpiles	64,841	1,154,885	t/y	0.056	kg/t	7	moisture content in %											1
IC: CL - Loading coal to trucks	483	1,154,885	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
IC: CL - Unloading product coal from trucks to conveyor	8,216	821,551	t/y	0.01	kg/t													1
IC: CL - Hauling product coal from IC CHPP to rail load out	65,744	333,333	t/y	0.19723	kg/t	90	t/load	110	Vehicle gross mass (	19.6	km/return trip	3.62	kg/VKT	5	% silt content	75	% control	1
IC: CL - Unloading product coal from trucks to stockpile	3,333	333,333	t/y	0.01	kg/t													1
IC: CL - FEL loading product coal to trains	139	333,333	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
IC: CL - Hauling rejects to dump	22,564	344,966	t/y	0.06541	kg/t	90	t/load	110	Vehicle gross mass (	6.5	km/return trip	3.62	kg/VKT	5	% silt content	75	% control	1
IC - REHAB - Dozers on rehab	200,117	936	h/y	213.8	kg/h	10	silt content in %	2	moisture content in %									1
IC: WE - Active Mining Area	40,296	11.5	ha	0.4	kg/ha/h	8760	h/y											3
IC: WE - Dumps area	77,438	22.1	ha	0.4	kg/ha/h	8760	h/y											3
IC: WE - Main ROM and Product stockpiles	2,467	0.7	ha	0.4	kg/ha/h	8760	h/y											3
IC: Grading roads	13,826	22,464	km	1	kg/ha/h	8	speed of graders in km/h											1

Table C.4: Emissions estimates for Year 20

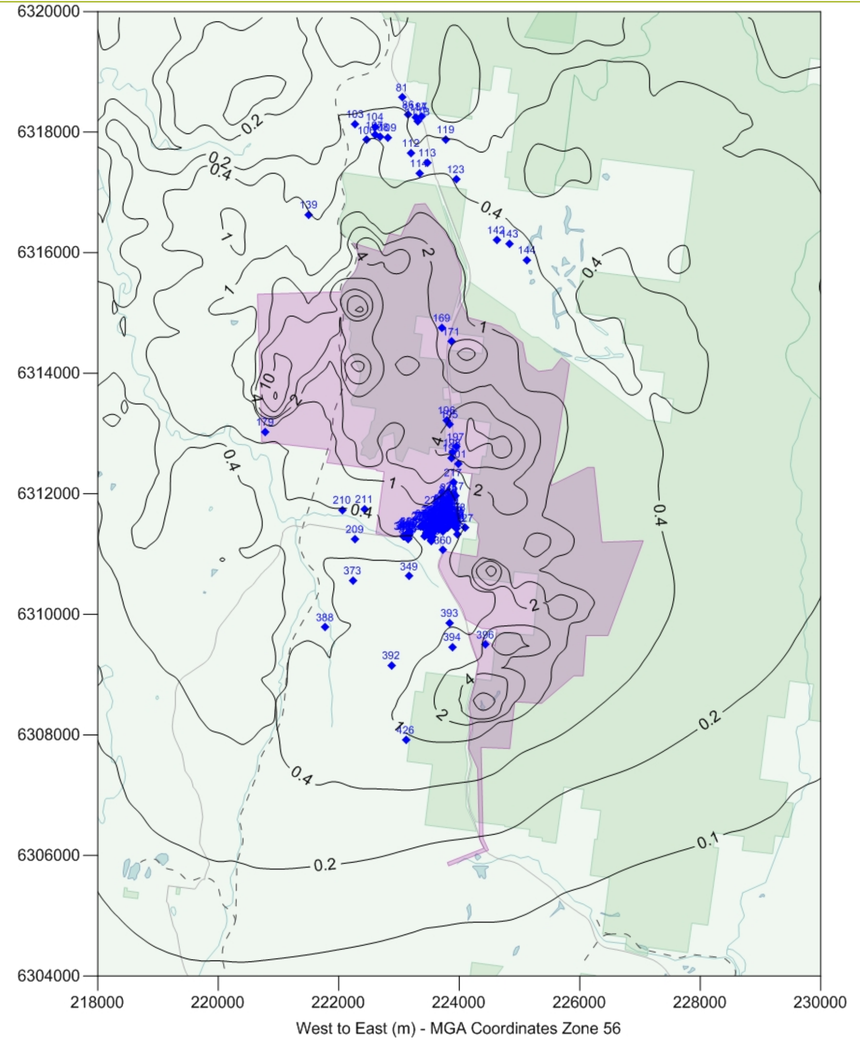
ACTIVITY	TSP emission/year for Year 20 in(kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Source type
CULLEN VALLEY MINE OPERATIONS																		
CV: Topsoil Removal - Dozers/Excavators stripping topsoil	333	26	h/y	12.8	kg/h	8	silt content in %	2	moisture content in %									1
CV: OB - Drilling Overburden	5,151	8,730	holes/y	0.59	kg/hole													1
CV: OB - Blasting Overburden	5,727	73	blasts/y	78.717	kg/blast	5,040	Area of blast in square metres	120	holes/blast									1
CV: OB - Loading Overburden	31,917	14,666,667	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
CV: CL - Hauling to CV dump	231,779	14,666,667	t/y	0.0158	kg/t	150	t/load	200	Vehicle gross mass (	2.0	km/return trip	4.74	kg/VK	5	% silt content	75	% control	1
CV: OB - Unloading Overburden to dump	31,917	14,666,667	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
CV: OB - Dozers on o/b	31,329	1,872	h/y	16.735	kg/h	10	silt content in %	2	moisture content in %									1
CV: CL - Dozers on coal	34,641	936	h/y	37.0	kg/h	10	silt content in %	7	moisture content in %									1
CV: CL - Loading coal into trucks	74,945	1,334,850	t/y	0.056	kg/t	7	moisture content in %											1
CV: CL - Hauling coal to ROM coal stockpiles at ET CHPP	99,400	1,334,850	t/y	0.07447	kg/t	90	t/load	110	Vehicle gross mass (	7.4	km/return trip	3.62	kg/VK	5	% silt content	75	% control	1
CV: CL - Unloading coal to ROM coal stockpiles	13,349	1,334,850	t/y	0.01	kg/t			0.7	% control									1
CV: CL - Rehandle coal to hopper	801	1,334,850	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	7	moisture content in %									2
CV: CL - Crushing	801	1,334,850	t/y	0.0006	kg/t													1
CV: CL - Screening	1,468	1,334,850	t/y	0.0011	kg/t													1
CV: CL - Loading coal to product stockpiles	64,841	1,154,885	t/y	0.056	kg/t	7	moisture content in %	0.5	% control									1
CV: CL - Loading coal to trucks	483	1,154,885	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
CV: CL - Hauling product coal from ET CHPP to S conveyor	72,751	821,551	t/y	0.08855	kg/t	90	t/load	110	Vehicle gross mass (	8.8	km/return trip	3.62	kg/VK	5	% silt content	75	% control	1
CV: CL - Unloading product coal from trucks to conveyor	8,216	821,551	t/y	0.01	kg/t													1
CV: CL - Hauling product coal from ET CHPP to rail load out	35,220	333,333	t/y	0.10566	kg/t	90	t/load	110	Vehicle gross mass (	10.5	km/return trip	3.62	kg/VK	5	% silt content	75	% control	1
CV: CL - Unloading product coal from trucks to stockpile	3,333	333,333	t/y	0.01	kg/t													1
CV: CL - FEL loading product coal to trains	139	333,333	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
CV: CL - Hauling rejects to dump	25,688	344,966	t/y	0.07447	kg/t	90	t/load	110	Vehicle gross mass (	7.4	km/return trip	3.62	kg/VK	5	% silt content	75	% control	1
CV - REHAB - Dozers on rehab	200,117	936	h/y	213.8	kg/h	10	silt content in %	2	moisture content in %									1
CV: WE - Active Mining Area	54,137	30.9	ha	0.4	kg/ha/h	8760	h/y	50%	control									3
CV: WE - Dumps area	63,422	36.2	ha	0.4	kg/ha/h	8760	h/y	50%	control									3
CV: WE - Main ROM and Product stockpiles	925	0.3	ha	0.4	kg/ha/h	8760	h/y											3
CV: Grading roads	13,826	22,464	km	1	kg/ha/h	8	speed of graders in km/h											1
EAST TYLDESLEY OPEN CUT OPERATIONS																		
ET: Topsoil Removal - Dozers/Excavators stripping topsoil	333	26	h/y	12.8	kg/h	8	silt content in %	2	moisture content in %									1
ET: OB - Drilling Overburden	5,151	8,730	holes/y	0.59	kg/hole													1
ET: OB - Blasting Overburden	5,727	73	blasts/y	78.717	kg/blast	5,040	Area of blast in square metres	120	holes/blast									1
ET: OB - Loading Overburden	31,917	14,666,667	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
ET: OB - Hauling to ET dump	150,656	14,666,667	t/y	0.01027	kg/t	150	t/load	200	Vehicle gross mass (	1.3	km/return trip	4.74	kg/VK	5	% silt content	75	% control	1
ET: OB - Unloading Overburden to dump	31,917	14,666,667	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
ET: OB - Dozers on o/b	31,329	1,872	h/y	16.735	kg/h	10	silt content in %	2	moisture content in %									1
ET: CL - Dozers on coal	34,641	936	h/y	37.0	kg/h	10	silt content in %	7	moisture content in %									1
ET: CL - Loading coal into trucks	74,945	1,334,850	t/y	0.056	kg/t	7	moisture content in %											1
ET: CL - Hauling coal to ROM coal stockpiles at ET CHPP	47,014	1,334,850	t/y	0.03522	kg/t	90	t/load	110	Vehicle gross mass (	3.5	km/return trip	3.62	kg/VK	5	% silt content	75	% control	1
ET: CL - Unloading coal to ROM coal stockpiles	13,349	1,334,850	t/y	0.01	kg/t													1
ET: CL - Rehandle coal to hopper	503	1,334,850	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	7	moisture content in %									2
ET: CL - Crushing	801	1,334,850	t/y	0.0006	kg/t													1
ET: CL - Screening	1,468	1,334,850	t/y	0.0011	kg/t													1
ET: CL - Loading coal to product stockpiles	64,841	1,154,885	t/y	0.056	kg/t	7	moisture content in %											1
ET: CL - Loading coal to trucks	483	1,154,885	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
ET: CL - Hauling product coal from ET CHPP to S conveyor	72,751	821,551	t/y	0.08855	kg/t	90	t/load	110	Vehicle gross mass (	8.8	km/return trip	3.62	kg/VK	5	% silt content	75	% control	1
ET: CL - Unloading product coal from trucks to conveyor	8,216	821,551	t/y	0.01	kg/t													1
ET: CL - Hauling product coal from ET CHPP to rail load out	35,220	333,333	t/y	0.10566	kg/t	90	t/load	110	Vehicle gross mass (	10.5	km/return trip	3.62	kg/VK	5	% silt content	75	% control	1
ET: CL - Unloading product coal from trucks to stockpile	3,333	333,333	t/y	0.01	kg/t													1
ET: CL - FEL loading product coal to trains	139	333,333	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
ET: CL - Hauling rejects to dump	40,675	1,154,885	t/y	0.03522	kg/t	90	t/load	110	Vehicle gross mass (	3.5	km/return trip	3.62	kg/VK	5	% silt content	75	% control	1
ET - REHAB - Dozers on rehab	200,117	936	h/y	213.8	kg/h	10	silt content in %	2	moisture content in %									1
ET: WE - Active Mining Area	14,366	4.1	ha	0.4	kg/ha/h	8760	h/y											3
ET: WE - Dumps area	78,840	22.5	ha	0.4	kg/ha/h	8760	h/y											3
ET: WE - Main ROM and Product stockpiles	925	0.3	ha	0.4	kg/ha/h	8760	h/y											3
ET: Grading roads	13,826	22,464	km	1	kg/ha/h	8	speed of graders in km/h											1
INVINCIBLE COLLEIRY OPERATIONS																		
IC: Topsoil Removal - Dozers/Excavators stripping topsoil	333	26	h/y	12.8	kg/h	8	silt content in %	2	moisture content in %									1
IC: OB - Drilling Overburden	5,151	8,730	holes/y	0.59	kg/hole													1
IC: OB - Blasting Overburden	5,727	73	blasts/y	78.717	kg/blast	5,040	Area of blast in square metres	120	holes/blast									1
IC: OB - Loading Overburden	31,917	14,666,667	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
IC: OB - Hauling from pit to IC dump	127,478	14,666,667	t/y	0.00869	kg/t	150	t/load	200	Vehicle gross mass (	1.1	km/return trip	4.74	kg/VK	5	% silt content	75	% control	1
IC: OB - Unloading Overburden to dump	31,917	14,666,667	t/y	0.002	kg/t	1.838	average of (wind speed/2.2)^1.3	2	moisture content in %									2
IC: OB - Dozers on o/b	31,329	1,872	h/y	16.735	kg/h	10	silt content in %	2	moisture content in %									1
IC: CL - Dozers on coal	34,641	936	h/y	37.0	kg/h	10	silt content in %	7	moisture content in %									1
IC: CL - Loading coal into trucks	74,945	1,334,850	t/y	0.056	kg/t	7	moisture content in %											1
IC: CL - Hauling coal to ROM coal stockpiles at IC CHPP	98,057	1,334,850	t/y	0.07346	kg/t	90	t/load	110	Vehicle gross mass (	7.3	km/return trip	3.62	kg/VK	5	% silt content	75	% control	1
IC: CL - Unloading coal to ROM coal stockpiles	13,349	1,334,850	t/y	0.01	kg/t			0.7	% control									1
IC: CL - Rehandle coal to hopper	503	1,334,850	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	7	moisture content in %									2
IC: CL - Crushing	801	1,334,850	t/y	0.0006	kg/t													1
IC: CL - Screening	1,468	1,334,850	t/y	0.0011	kg/t													1
IC: CL - Loading coal to product stockpiles	64,841	1,154,885	t/y	0.056	kg/t	7	moisture content in %											1
IC: CL - Loading coal to trucks	483	1,154,885	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
IC: CL - Unloading product coal from trucks to conveyor	8,216	821,551	t/y	0.01	kg/t													1
IC: CL - Hauling product coal from IC CHPP to rail load out	65,744	333,333	t/y	0.19723	kg/t	90	t/load	110	Vehicle gross mass (	19.6	km/return trip	3.62	kg/VK	5	% silt content	75	% control	1
IC: CL - Unloading product coal from trucks to stockpile	3,333	333,333	t/y	0.01	kg/t													1
IC: CL - FEL loading product coal to trains	139	333,333	t/y	0.0004	kg/t	1.838	average of (wind speed/2.2)^1.3	6.5	moisture content in %									2
IC: CL - Hauling rejects to dump	25,341	344,966	t/y	0.07346	kg/t	90	t/load	110	Vehicle gross mass (	7.3	km/return trip	3.62	kg/VK	5	% silt content	75	% control	1
IC - REHAB - Dozers on rehab	200,117	936	h/y	213.8	kg/h	10	silt content in %	2	moisture content in %									1
IC: WE - Active Mining Area	18,221	5.2	ha	0.4	kg/ha/h	8760	h/y											3
IC: WE - Dumps area	52,560	15.0	ha	0.4	kg/ha/h	8760	h/y											3
IC: WE - Main ROM and Product stockpiles	2,467	0.7	ha	0.4	kg/ha/h	8760	h/y											3
IC: Grading roads	13,826	22,464	km	1	kg/ha/h	8	speed of graders in km/h											1

Appendix D: Predicted $PM_{2.5}$ emissions from mining sources



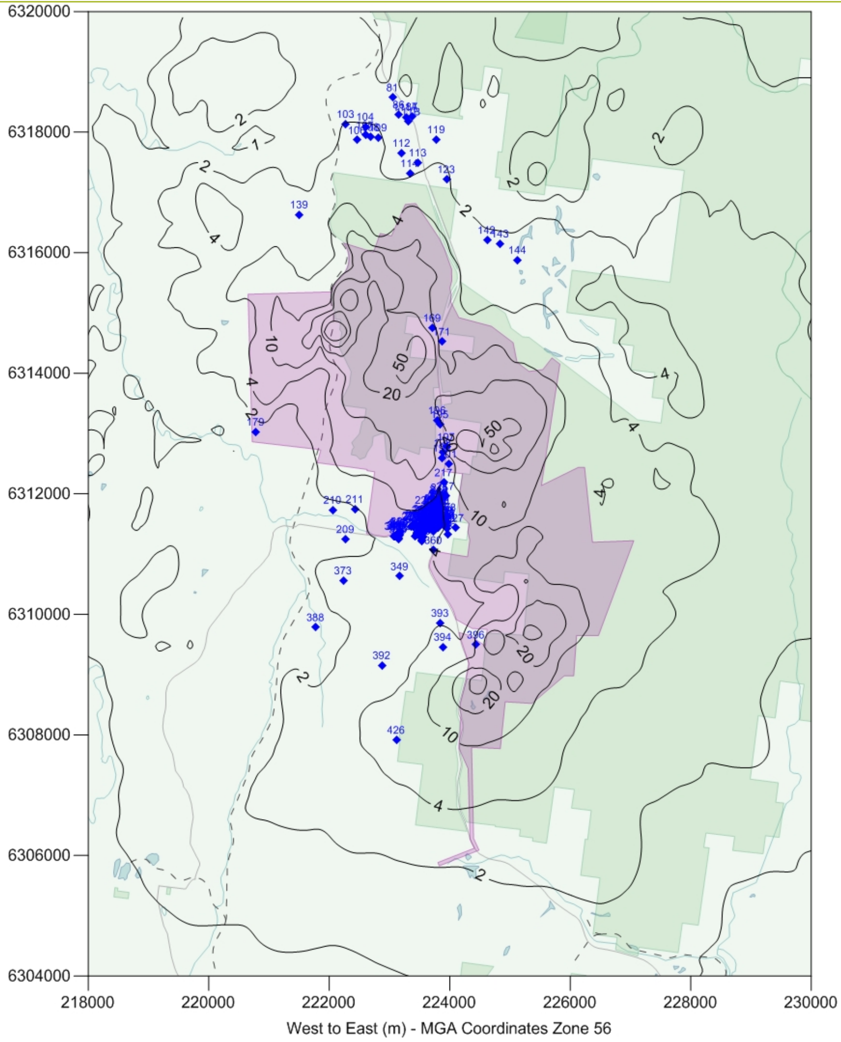
Species: PM2.5	**Averaging Time:** 24-hour	**Percentile:** Maximum	**Scenario:** Year 2 Project alone	**Location:** Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** µg/m^3	**Assessment criteria:** N/A	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure D.1: Predicted 24-hour average $PM_{2.5}$ concentrations due to emissions from the Project and other sources in Year 2



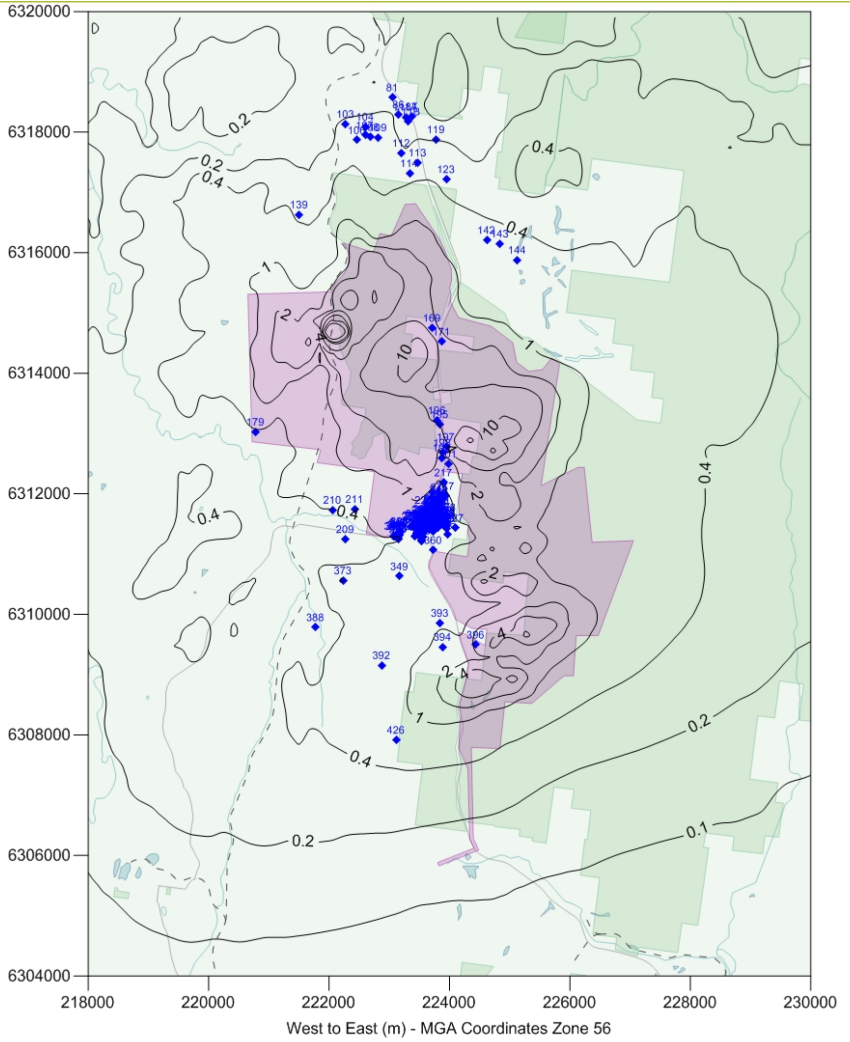
Species: PM2.5	**Averaging Time:** Annual	**Percentile:**	**Scenario:** Year 2 Project alone	**Location:** Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** µg/m³	**Assessment criteria:** N/A	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure D.2: Predicted annual average $PM_{2.5}$ concentrations due to emissions from the Project and other sources in Year 2



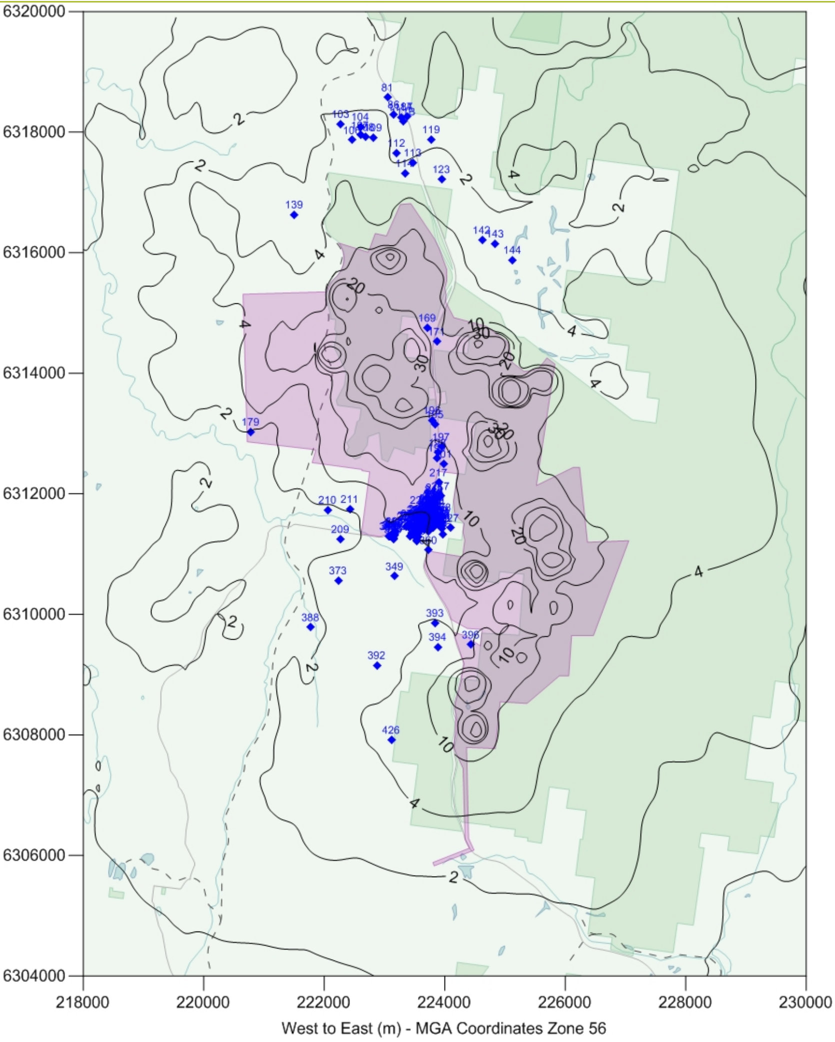
Species: $PM_{2.5}$	Averaging Time: 24-hour	Percentile: Maximum	Scenario: Year 8 Project alone	Location: Coalpac Consolidation Project
Model Used: CALPUFF v6.263	Units: µg/m^3	Assessment criteria: N/A	Met Data: Coalpac, 2009 (CALMET)	Plot: F Triffett

Figure D.3: Predicted 24-hour average $PM_{2.5}$ concentrations due to emissions from the Project and other sources in Year 8



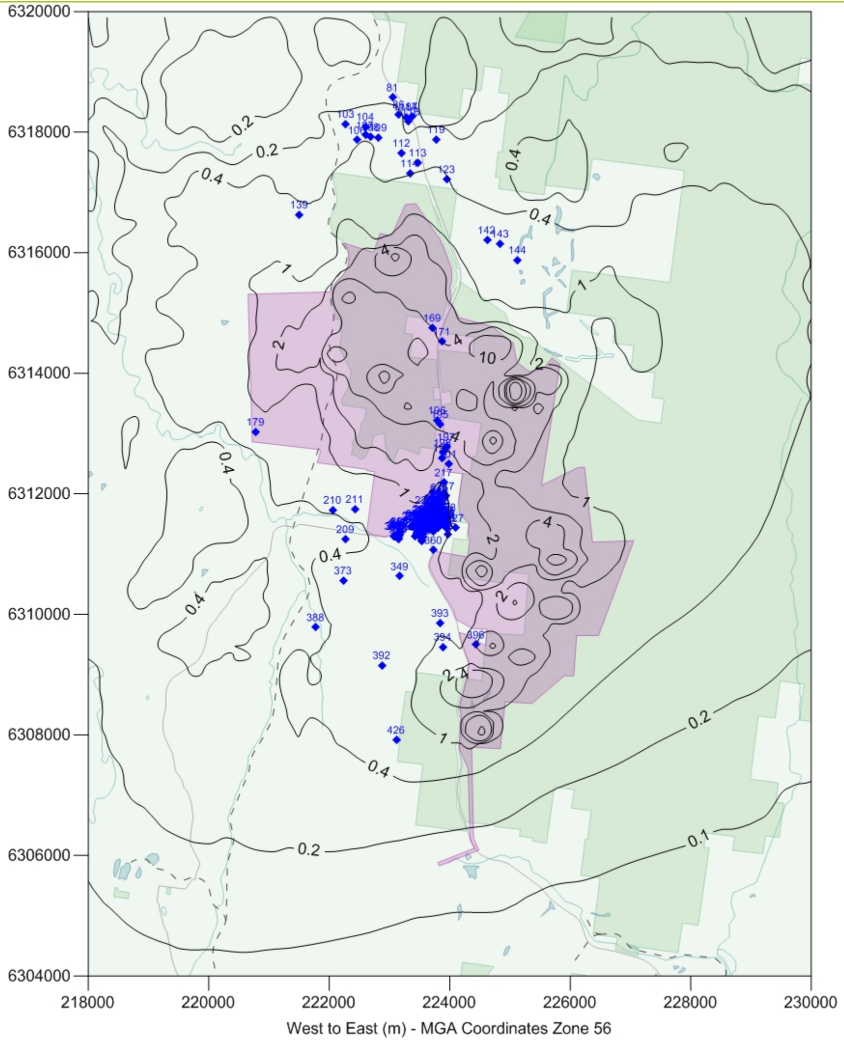
Species: PM2.5	Averaging Time: Annual	Percentile:	Scenario: Year 8 Project alone	Location: Coalpac Consolidation Project
Model Used: CALPUFF v6.263	Units: µg/m^3	Assessment criteria: N/A	Met Data: Coalpac, 2009 (CALMET)	Plot: F Triffett

Figure D.4: Predicted annual average $PM_{2.5}$ concentrations due to emissions from the Project and other sources in Year 8



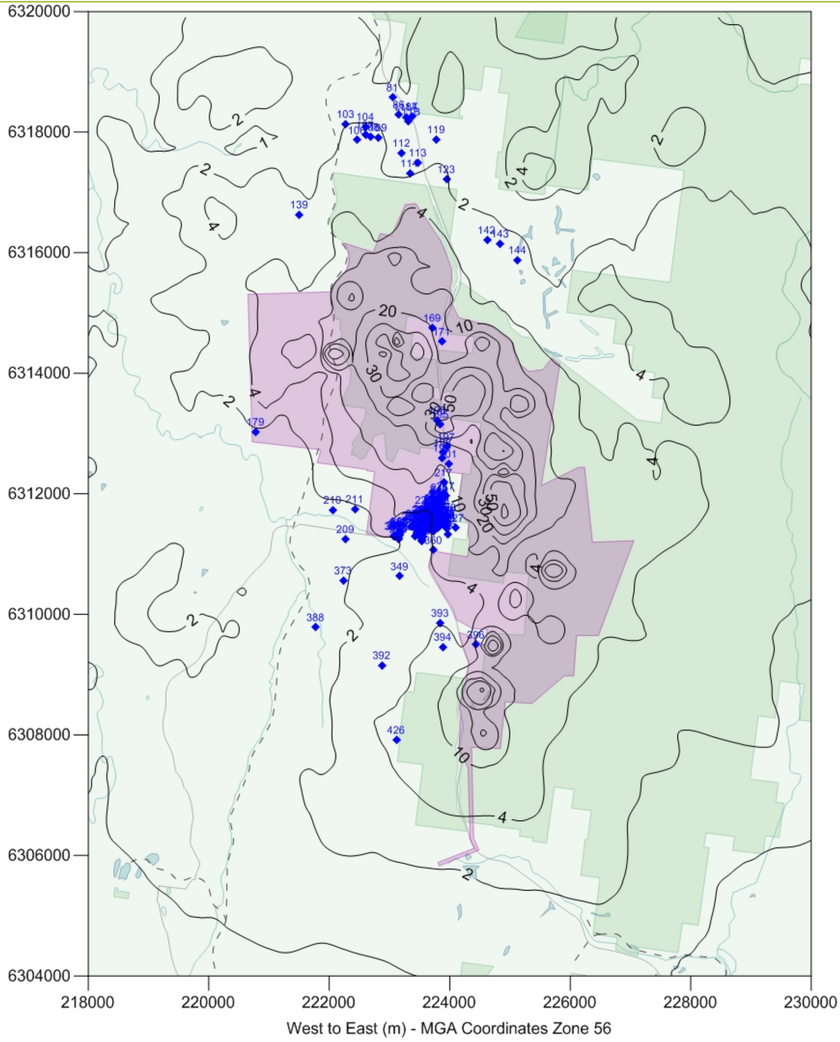
Species: PM2.5	**Averaging Time:** 24-hour	**Percentile:** Maximum	**Scenario:** Year 14 Project alone	**Location:** Coalpac Consolidation Project
Model Used: I CALPUFF v6.263	**Units:** µg/m³	**Assessment criteria:** N/A	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure D.5: Predicted 24-hour average $PM_{2.5}$ concentrations due to emissions from the Project and other sources in Year 14



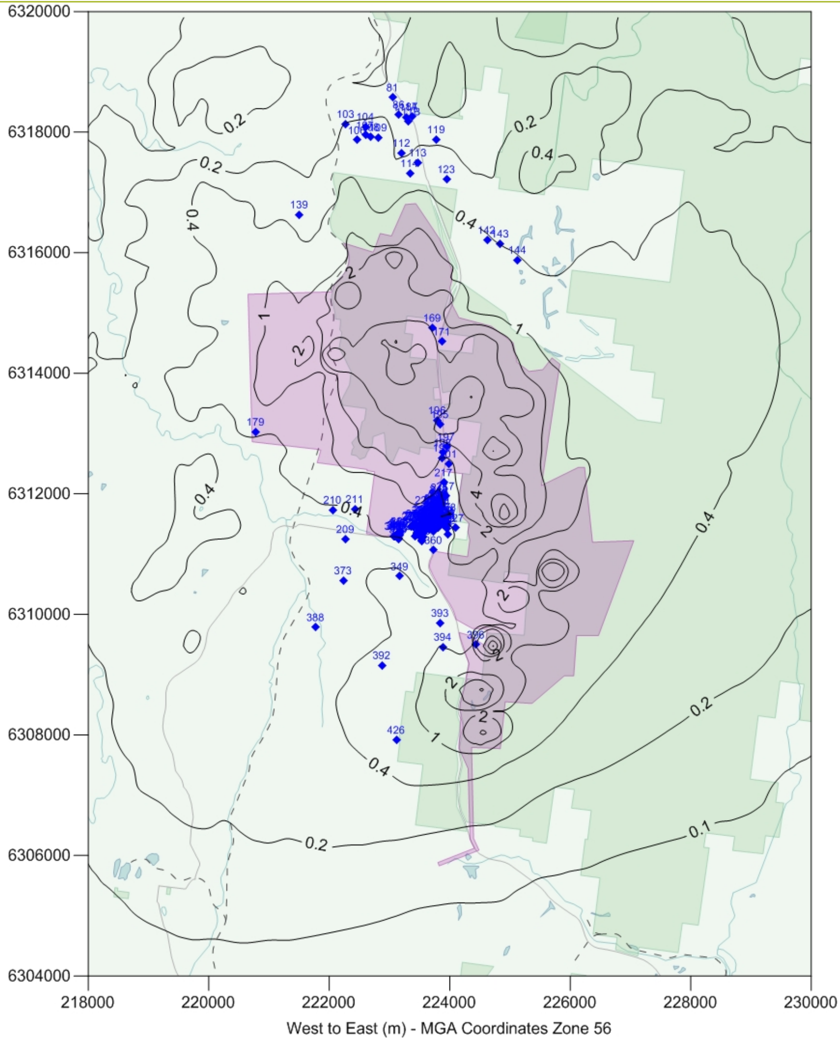
Species: PM2.5	Averaging Time: Annual	Percentile:	Scenario: Year 14 Project alone	Location: Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** µg/m^3	**Assessment criteria:** N/A	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure D.6: Predicted annual average $PM_{2.5}$ concentrations due to emissions from the Project and other sources in Year 14



Species: PM2.5	**Averaging Time:** 24-hour	**Percentile:** Maximum	**Scenario:** Year 20 Project alone	**Location:** Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** µg/m³	**Assessment criteria:** N/A	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure D.7: Predicted 24-hour average $PM_{2.5}$ concentrations due to emissions from the Project and other sources in Year 20



Species: PM2.5	**Averaging Time:** Annual	**Percentile:**	**Scenario:** Year 20 Project alone	**Location:** Coalpac Consolidation Project
Model Used: CALPUFF v6.263	**Units:** µg/m³	**Assessment criteria:** N/A	**Met Data:** Coalpac, 2009 (CALMET)	**Plot:** F Triffett

Figure D.8: Predicted annual average $PM_{2.5}$ concentrations due to emissions from the Project and other sources in Year 20

Appendix E: Borehole Sample Data for Fugitive Emissions GHG calculations

Table E.1: Seam Gas Testing Results

Seam	Sample no.	Depth to Top of Sample (rounded)(m)	Sample thickness (m)	Measured gas content Qm (m3/t) on an as received (raw) basis	Average gas content gas content (m3/t)
Upper Irondale C - E	CP0001 (Geogas)	3	0.43	0.06	
	CP0002 (Geogas)	4	0.83	0.11	0.26
	CP0003 (Geogas)	5	0.79	0.52	
Irondale main	CP0004 (Geogas)	10	1.09	0.59	
	CP0005 (Geogas)	11	0.82	0.50	
	CP0006 (Geogas)	12	0.42	0.70	0.50
	Gas7 (CSGP)	11	0.54	0.3	
	Gas8 (CSGP)	12	0.42	0.34	
	Gas1 (CSGP)	53	0.78	0.14	
	Gas2 (CSGP)	54	0.49	0.21	0.19
	Gas3 (CSGP)	55	0.54	0.25	
Lithgow	CP0007 (Geogas)	27	0.69	0.58	
	CP0008 (Geogas)	28	0.76	0.72	
	CP0009 (Geogas)	29	0.77	0.71	
	CP0010 (Geogas)	29	0.31	0.59	0.52
	Gas9 (CSGP)	28	0.55	0.3	
	Gas10 (CSGP)	29	0.79	0.42	
	Gas11 (CSGP)	30	0.48	0.18	
	Gas4 (CSGP)	76	0.61	0.34	
	Gas5 (CSGP)	77	0.79	0.31	0.33
	Gas6 (CSGP)	78	0.74	0.33	

Source: **GEOS Mining (2011)**