Air Quality

10

10 Air Quality

The air quality assessment for the Caval Ridge Project has considered the potential release of dust from the site due to earth moving and mining activities associated with the construction and operation of the project. This assessment evaluates the emission sources together with the proposed mitigation measures, to determine the potential impacts at local residential communities.

The air quality assessment comprises an evaluation of the local climate as well as the existing environment in relation to particulate matter. Meteorology plays an important role in the transport and dispersion of dust away from the mine site and an understanding of the local meteorological environment is crucial when assessing the impact on emissions from the mine on nearby sensitive receptors.

Dispersion modelling has been performed using the DERM approved Calmet/Calpuff modelling package. A detailed emissions inventory has been established using expected activity data, in conjunction with emission factors from both the Australian National Pollutant Inventory (NPI) emission estimation manual and USEPA AP-42 emission estimation manual, which are used in the absence of site-specific data.

The predicted impacts from the proposed mine operation on local air quality incorporating BMA's proposed air quality control methods, are presented in this assessment.

Mining activities for the project have been evaluated for three scenarios:

- **Year 1**, representing construction of the initial box cut in the Horse Pit, and mining operations in the Heyford Pit (for which the box cut has already been completed)
- **Year 2**, representing the first year of mining operations, in both pits, on the western side of the project site
- **Year 20**, representing mining towards the eastern side of the project site and reflecting the increasing proportion of overburden removed as the mining depth increases. Mining activities to the north of Horse Pit in Year 20 are close to off-site receptors that are downwind of the mine under prevailing wind conditions and will impact air quality at these locations.

The dust emissions from these activities have been assessed and used in dispersion modelling to predict impacts at nearby residential locations. For each of the years noted above, three scenarios have been modelled:

- Typical operations
- Worst-case emissions
- Upset emissions.

10.1 Description of Environmental Values

Environmental values in the form of the existing air quality in the vicinity of the project and legislation applicable to the ambient air quality in Queensland were considered in the air quality assessment.

Air emissions from the project are comprised primarily of particulate matter which is also referred to as dust. Particulate matter for this project is described in three size categories: particulate matter less than 10 µm (PM_{10}), particulate matter less than 2.5 µm ($PM_{2.5}$), and total suspended particulates (TSP).

The climate at the project site has been documented in Section 4.1 of the EIS. The data for wind speed, wind direction, temperature, temperature inversion, stability class and mixing height are derived from meteorological modelling that has been conducted for the project.

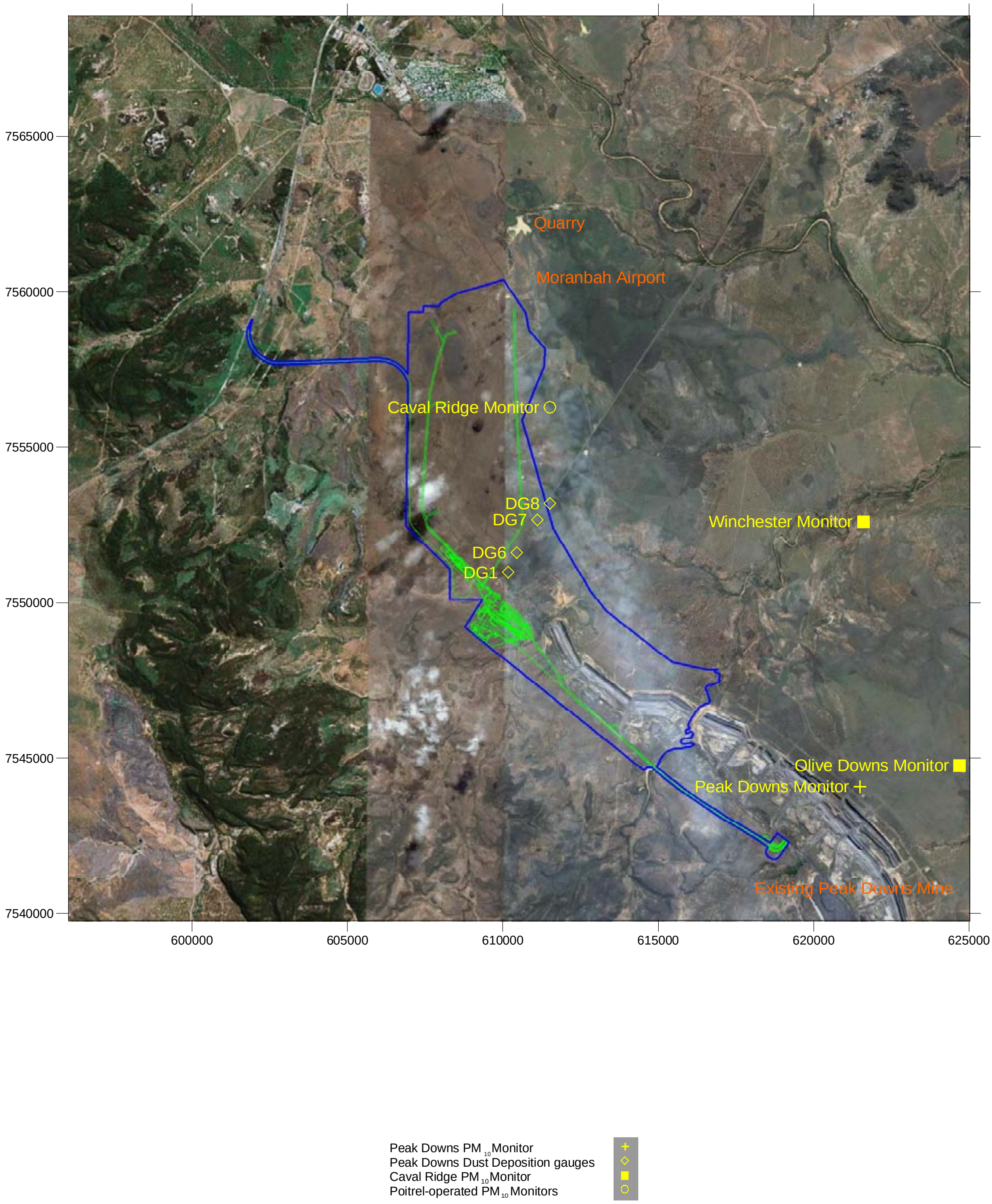
10.1.1 Existing Air Quality

The area surrounding the project site has several operating coal mines, coal seam gas projects and a quarry in addition to agricultural activities such as cropping and grazing which may all be sources of dust.

There are no DERM monitoring stations in the vicinity of the project site; however BMA has provided ambient dust measurements from its nearby mining operations (Peak Downs and two locations near Poitrel). In addition, a site-specific monitoring station was installed in December 2007 to provide data on the existing levels of PM_{10} at the project site. These monitoring locations and the project site are shown on Figure 10.1.

Dust deposition measurements made for the Peak Downs Mine are located on the project site, and are influenced to a small extent by operations from the mine but are sufficiently remote from active mining operations that they are considered appropriate to represent ambient air quality at residential locations.

Based on data collected in the vicinity of coal mines and presented in The Australian Coal Review (Richardson 2000), an average of 40% of TSP was found to consist of particles in the size range of PM_{10}. Particles in the size range of $PM_{2.5}$ were found to comprise only 4% of TSP or equivalently 10% of PM_{10}.



Source: Google Image, 2009

Datum: AGD84, AMG Zone 55

Client: BMA BHP Billiton Mitsubishi Alliance / URS	Project: CAVAL RIDGE PROJECT ENVIRONMENTAL IMPACT STATEMENT	Title: **DUST MONITORING LOCATIONS AND INDUSTRIAL SOURCES IN THE VICINITY OF CAVAL RIDGE MINE**
Drawn: AB	Approved: RS	Date: 15-05-2009
Job No: **4262 6158** /6161	File: 42626158-g-615.srf	Figure: **10.1** Rev:A A4

Monitoring data for PM_{10} and dust deposition at the project site have been used to estimate background levels of dust within the project region as follows:

- 24-hour average ground-level concentration of PM_{10} – 18.8 µg/m³
- 24-hour average ground-level concentration of $PM_{2.5}$ – 2.9 µg/m³
- Annual average ground-level concentration of $PM_{2.5}$ – 1.6 µg/m³
- Annual average ground-level concentration of TSP – 26.2 µg/m³
- Monthly dust deposition – 1.5 g/m²/month

10.1.2 Legislative Framework

The legislative frameworks for Queensland and Australia are detailed in Appendix L. A summary of the relevant guidelines from the Environmental Protection (Air) Policy 2008 (EPP (Air)) for particulate matter is presented in Table 10.1. The dust deposition guideline has been adopted by the DERM for protection from nuisance levels of dust deposition.

Table 10.1 Project goals for Ambient Air Quality for Particulate Matter

Pollutant	Averaging Period	Objective or Goal	Jurisdiction
Total suspended particulates	Annual	90 µg/m³	EPP(Air)
PM_{10}	24-hour	50 µg/m³	EPP(Air), NEPM (5 exceedences allowed)
$PM_{2.5}$	24-hour	25 µg/m³	EPP(Air), NEPM
	Annual	8 µg/m³	EPP(Air), NEPM
Dust deposition	Monthly	4 g/m²/month	DERM

Emission standards are applicable for releases to air from stack sources, where the quantity of pollutants released to the atmosphere can be measured through source testing. No such sources exist for the project as there are no power generators or stack release points on site. Hence, comparison of site emissions with emissions standards is not applicable for this project.

10.2 Potential Impacts and Mitigation Measures

Air quality impacts from the project have been assessed through the estimation of emissions of dust from project-related activities for typical operating conditions and dispersion modelling in order to estimate the potential impacts on sensitive receptors.

10.2.1 Sensitive Receptors

A review of surrounding land use information, aerial photographs and information provided by BMA has been used to identify nearby sensitive receptor locations. Here sensitive receptor is taken to mean individual residential locations in the vicinity of the project as well as the township of Moranbah. Potential impacts at other sensitive land uses within Moranbah, such as schools, child care centres and health care facilities are addressed through the assessment of receptors at the southern boundary of Moranbah (closest to the proposed development). For ease of analysis and presentation, receivers were combined into groups based on location as indicated in Table 10.2. The locations of these receptors in relation to the project are illustrated in Figure 10.2, with property details indicated where appropriate.

Table 10.2 Sensitive Receptor Locations

Receptor Group	Receptor description	Receptor number for air quality modelling	UTM Easting coordinate (m)	UTM Northing coordinate (m)
Moranbah	Residence in Moranbah town	11	607598	7564396
Moranbah	Residence in Moranbah town	27	610542	7565496
Moranbah	Residence in Moranbah town	28	609454	7565601
Moranbah	Residence in Moranbah town	29	608538	7565916
Moranbah	Residence in Moranbah town	30	606961	7565657
Moranbah	Residence in Moranbah town	31	607430	7567168
Moranbah	Residence in Moranbah town	32	609029	7566790
Southern Moranbah	Residence on Railway Siding Rd	12	605881	7562269
Southern Moranbah	Residence on Railway Siding Rd	13	605314	7562907
Southern Moranbah	Residence on Railway Siding Rd	14	605863	7563024
Southern Moranbah	Residence on Railway Siding Rd	15	604691	7561758
Southern Moranbah	Residence on Railway Siding Rd	17	602915	7560342
Southern Moranbah	Residence on Long Pocket Rd	18	605673	7560755
Southern Moranbah	Residence on Long Pocket Rd	25	605295	7560949
Southern Moranbah	Residence on Long Pocket Rd	26	606308	7561628
Southern Moranbah	Residence on Railway Siding Rd	33	603518	7561264
Homesteads N of site	Homestead on Moranbah Access Rd, Anglo Coal	10	608664	7562107
Homesteads N of site	Homestead	19	611156	7562578
Homesteads N of site	Homestead E of Moranbah	21	613617	7565727

Receptor Group	Receptor description	Receptor number for air quality modelling	UTM Easting coordinate (m)	UTM Northing coordinate (m)
Homesteads E of site	BMA-owned Homestead	1	611967	7557336
Homesteads E of site	BMA-owned Homestead	2	611804	7557308
Homesteads E of site	Homestead	4	613889	7555181
Homesteads E of site	Homestead	5	612115	7554832
Homesteads E of site	Homestead on Moranbah Access Rd, BMA	7	611410	7557801
Homesteads N of site	Homestead on Moranbah Access Rd, Anglo Coal	9	609528	7560998
Homesteads E of site	Homestead	23	624695	7544763
Homesteads E of site	Homestead	24	621596	7552598
Homesteads E of site	Homestead	35	621345	7552469
Homesteads W of site	Homestead	6	606708	7550623
Homesteads W of site	Homestead to W of site	22	597752	7544645
Homesteads W of site	Homestead on Peak Downs Highway	34	606026	7545393
Commercial premises	Shell Roadhouse	3	612880	7555741

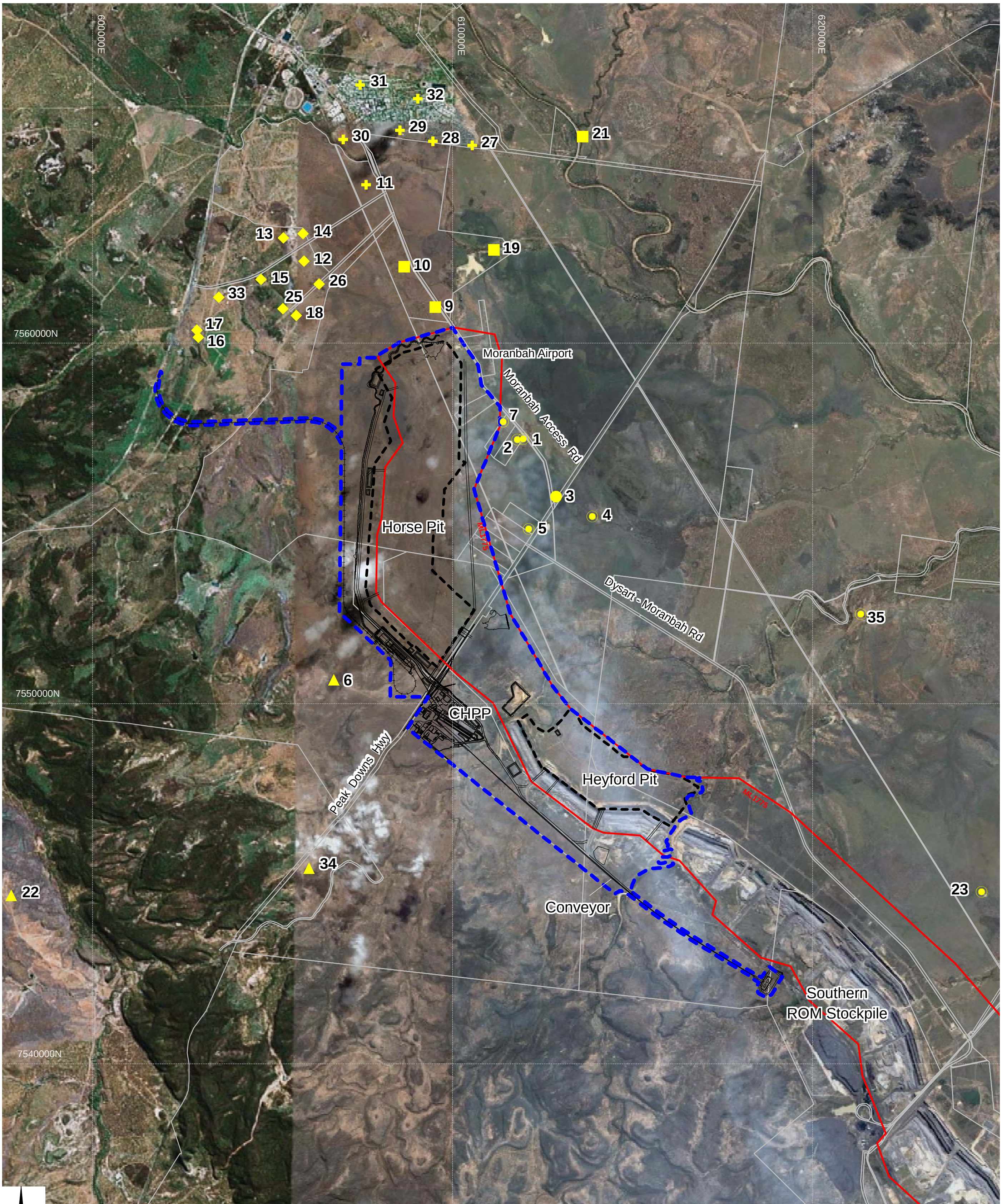
10.2.2 Pollutants Considered in the Assessment

Emissions from the project are generated primarily from activities that move overburden and coal, and to a lesser extent from combustion of diesel fuel in mobile equipment. The emissions and impacts of dust, comprising TSP, PM_{10}, $PM_{2.5}$, and dust deposition have been assessed in detail.

Air pollutants from diesel combustion may release other air pollutants such as sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and trace quantities of volatile organic compounds. These substances are not considered to be emitted in sufficient quantities to affect air quality off-site; therefore these impacts have not been considered in the air quality assessment. The emissions of combustion pollutants (CO_2 and N_2O) that are released during diesel combustion have been addressed in the greenhouse gas assessment in Chapter 11.

10.2.3 Sources of Air Emissions from the Project

Mining activities at the project will take place in the Horse and Heyford Pits, and will produce 5.5 Mtpa of product coal. In addition, 2.5 Mtpa of coal from Peak Downs Mine will be loaded from the Southern ROM and transported by overland conveyor to the project CHPP for washing and export. The additional coal from the Southern ROM has been included in the total CHPP capacity of 8 Mtpa. The location of these activities is shown on Figure 10.2.



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Scale 1:150,000 (A4)

Datum: AGD84, AMG Zone 55

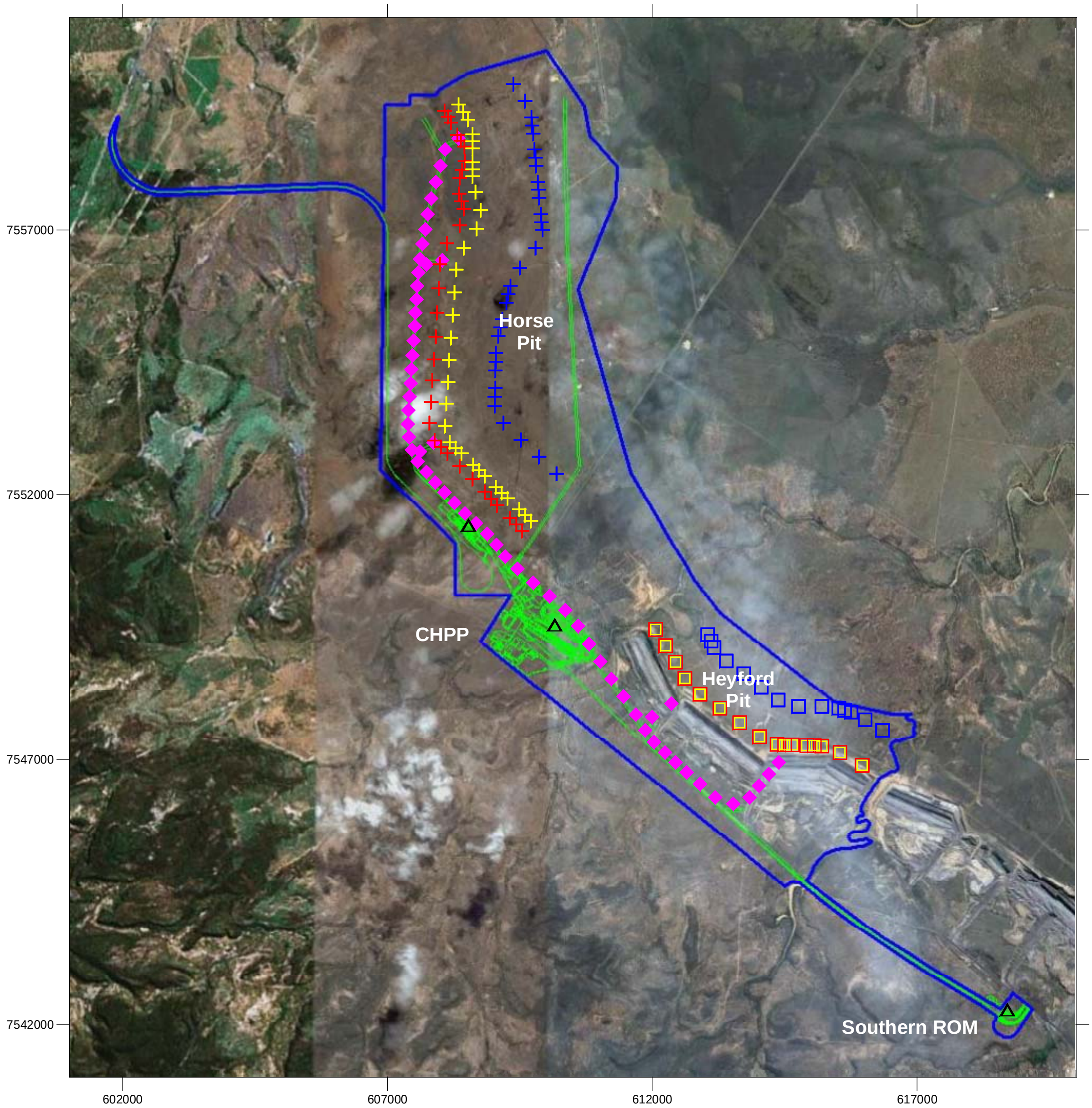
Source: Google, 2008

- Project Site
- Mining Lease
- Proposed Pit Outline
- Project Infrastructure Components

Sensitive Receptors

- Moranbah
- Southern Moranbah
- Homesteads North of Site
- Homestead East of Site
- Homesteads West of Site
- Commercial Premises

Client	Project	Title
BMA BHP Billiton Mitsubishi Alliance	CAVAL RIDGE PROJECT ENVIRONMENTAL IMPACT STATEMENT	LOCATION OF AIR EMISSION SOURCES AND SENSITIVE RECEPTORS
URS	Drawn: VH / Approved: RS / Date: 08-05-2009	Figure: **10.2** / Rev:A
	Job No: **4262 6158** / File No: 42626158-g-508.wor	A4



Year 1 - Horse Pit sources
Year 1 - Heyford Pit sources
Year 2 - Horse Pit sources
Year 2 - Heyford Pit sources
Year 20 - Horse Pit sources
Year 20 - Heyford Pit sources

Project Site
Infrastructure
Haul Road sources - all years of operation
CHPP and Southern ROM sources

Source: Google 2008

Datum: AGD84, AMG Zone 55

Client:	Project:			Title:	
BMA BHP Billiton Mitsubishi Alliance	CAVAL RIDGE PROJECT ENVIRONMENTAL IMPACT STATEMENT			**LOCATION OF DUST SOURCES USED FOR AIR QUALITY MODELLING FOR ALL YEARS**	
URS	Drawn: AB	Approved: RS	Date: 08-05-2009	Figure: **10.3**	Rev:B
	Job No: **4262 6158**	File: 42626158-g-603b.srf			A4

To represent the progressive development of the mine, three years of operation have been modelled:

- **Year 1**, representing construction of the initial box cut in the Horse Pit, and mining operations in the Heyford Pit (for which the box cut has already been completed).
- **Year 2**, representing the first year of mining operations, in both pits, on the western side of the project site.
- **Year 20**, representing mining towards the eastern side of the project site and reflecting the increasing proportion of overburden removed as the mining depth increases. Mining activities to the north of Horse Pit in Year 20 are close to off-site receptors that are downwind of the mine under prevailing wind conditions and will impact air quality at these locations.

The mining processes that will generate dust are as follows:

- Creation of initial box cut during the construction of Horse Pit (Year 1). This does not include construction of other infrastructure such as the CHPP.
- Pre-strip removal of overburden with the truck and shovel fleet and in-pit dumping of overburden.
- Dragline removal of overburden, operating close to the bottom of each pit.
- Excavator removal of coal from the bottom of the pit and transfer to coal trucks.
- Drilling and blasting of overburden and coal seams.
- Dozers, shovels and graders as support to the draglines, truck and shovel fleet, on the overburden dumps and on the coal stockpiles.
- Box cut spoil disposal area and in-pit dumps for dumping of overburden, grading of the surface and wind-generated dust prior to rehabilitation.
- Trucks on haul roads to transport ROM coal to the CHPP for processing, to transport overburden to the dumps and to transport the rejects from the CHPP for disposal in Horse Pit.
- ROM coal handling area, including dumping of coal, dozer operations, stacking and reclaiming ROM coal and coal crushing and sizing.
- ROM coal from the Southern ROM which is crushed at the Southern ROM receival station and transported by overland conveyor to the ROM coal stockpile.
- CHPP **-** all coal is processed wet, therefore is not a source of dust.
- Product coal handling is a source of dust during reclaiming from the product coal stockpiles and due to wind erosion.
- Train loadout entails the dumping of product coal into the rail wagons.

The modelling of typical mining operations has been based on average annual emissions of dust from the site. This represents the spatial extent of dust emissions that may arise from any part of the mine according to the activities at each location. Meteorological data for one year has been used so that a range of meteorological conditions is considered, particularly the distribution of wind direction in the area.

In addition to typical operations that are conducted on site, a worst-case scenario with pit activities occurring to the north or south of each pit has been modelled. An upset condition, based on inadequate dust control from haul roads, has also been modelled. More details on these scenarios are presented below.

10.2.3.1 Emission Factors and Control Measures

Data on the emissions of dust from the project cannot be obtained from direct measurement, as the project is not yet operational. Emission rates were derived from industry-standard emission factors that have been collated by the NPI and the US EPA AP42 emission estimation manuals. These factors are based on measurements of dust emissions from other operational coal mines in Australia and the United States.

Emission factors for TSP and PM_{10} have been combined with the relevant activity data (such as amount of coal or overburden moved per annum) for each specific operation on the site. Site-specific parameters were used to derive emission factors for trucks on unpaved roads, draglines, excavators, shovels, graders, dozers and blasting, as detailed in Appendix L. Default emission factors were used for wind blown dust, dumping of overburden and coal, loading and unloading stockpiles, loading to trains and for transfer points.

Mine equipment scheduling has to be flexible to achieve the required production of coal whilst accommodating equipment breakdowns, thus the equipment used in each pit will change in time and with location. This assessment has assumed representative locations for each of the equipment types on site. For the typical mode of operation for the mining activities, the equipment has been allocated to operation in each pit, haul roads, the CHPP or the Southern ROM loading area.

Studies conducted by the Midwest Research Institute (Cowherd and Ono 2005) into a wide-range of dust generating activities for the purposes of developing emission factors that are utilised by the US EPA, have resulted in proposed $PM_{2.5}$ to PM_{10} ratios as outlined in Table 10.3.

Table 10.3 Midwest Research Institute's proposed $PM_{2.5}$ to PM_{10} ratios

Source Category	$PM_{2.5}/PM_{10}$ Ratio
Paved Roads	0.15
Unpaved Roads	0.1
Construction & Demolition	0.1
Aggregate Handling & Storage Piles	0.1 (traffic), 0.15 (transfer)
Industrial Wind Erosion	0.15
Agricultural Tilling	0.2
Open Area Wind Erosion	0.15

In the absence of additional information, a conservative assumption that 20% of the dust emitted from the project site for all dust sources consists of particles with a diameter less than 2.5 microns, has been applied in this assessment.

10.2.4 Production Data

Proposed production data for project Year 1 to Year 30 includes:

- Tonnes of ROM and product coal moved.
- Volume of overburden removed by dragline, dozer and truck and shovel.
- Area of disturbed land.
- Volume of coal and overburden material blasted.
- Total metres of coal and overburden material drilled.
- Tonnes of reject material from the CHPP.

The tonnes of material moved for each year modelled are presented in the relevant sections.

10.2.5 Comparison to Similar Operations

The use of site-specific emission factors developed for other mine sites can be complicated by a number of factors including:

- The types of equipment used to remove overburden and coal.
- The tonnes of ROM coal and overburden material handled.
- The depth of mining operations for overburden and coal.
- The method of managing overburden stockpiles.
- The inherent moisture of the coal and overburden.
- The configuration of haul roads, dumps and CHPP locations in relation to the pits.

The emissions in this assessment have been based on industry-standard emission estimation methods, with emission factors derived from the NPI and AP-42 emission estimation handbooks. Likewise, industry-standard practices for dust control measures have been incorporated into the project design and air quality assessment.

10.2.6 Dust Reduction Measures

Dust control measures that will be implemented on site will include a mixture of engineering controls (such as enclosure of conveyors) and control measures (such as watering of haul roads and stockpiles). The reduction in dust emissions achieved through the use of these control measures has been included in modelling. The main method of dust control is the use of watering trucks on the haul roads.

Mining activities that take place in an open cut pit do not have the same magnitude of air emissions as the equivalent activity would if conducted at surface level. This is due to the natural retention of dust within the pit, particularly the larger particles which tend to be deposited in the pit close to the dust source due to their larger size and mass. The pit retention factor is used in modelling the dust emissions from mines to represent this natural tendency of larger dust particles to remain within the pit, and thus not become a nuisance to health at residential locations.

The pit retention factor that is recommended for use in the NPI Emission Estimation Technique Manual for Mining is a factor of 50% for TSP and 5% for PM_{10}. This factor is the percentage of particles that are initially emitted by dust-generating activities within the open cut pit but remain in the pit and therefore do not contribute to off-site dust impacts. The pit retention factor has been applied to sources that are at least 50 m below the natural surface level of the pit, such as coal excavation, draglines and dozers in the pit. This has not been included for near-surface sources such as the truck and shovel operations and trucks on haul roads.

10.2.7 Emissions During Construction

The construction of the project for the purposes of air quality modelling encompasses the creation of the initial box cut for Horse Pit, with concurrent mining operations in Heyford Pit. The dust emissions from the box cut operations have been estimated for Year 1 of operation, using the emission factors and estimates of control factors as detailed above. Production data from Horse Pit, Heyford Pit and the ROM coal imported from the Southern ROM to the CHPP during construction activities in Year 1 are presented in Table 10.4. Dragline operations in Year 1 are only conducted at Heyford Pit at a depth well below surface level. This was previously an operating pit so no further excavation of the box cut area is required.

The total distance travelled by coal, reject and overburden haul trucks for this scenario are also presented in the table. The distance in vehicle kilometres travelled (vkt) has been estimated from the number of truck movements required to move the amounts of material listed in the table, as well as the length of haul roads and ramps as estimated from site plans.

Due to the scale of other construction-related activities and their proximity to nearby sensitive receptors, the impact of dust emissions generated resulting from such activities as earthworks during construction of the CHPP, construction of the site buildings and facilities and construction of haul roads, have not been included in the air quality assessment. These activities will be completed prior to commencement of mining. The management of dust impacts from these activities is discussed in the environmental management plan.

Table 10.4 Production data for Year 1 of operations

Project Activity	Horse Pit	Heyford Pit	Southern ROM	Project Total
ROM coal (tonnes)	2,885,924	4,139,164	3,280,411	10,305,500
Product coal (tonnes)	1,800,000	2,200,000	1,767,982	5,767,982
Reject coal (tonnes)	1,429,788	1,747,518	1,512,429	4,689,735
Volume overburden by dragline (bcm)	0	11,383,686	n/a	11,383,686
Volume overburden by truck and shovel (bcm)	35,207,677	16,838,223	n/a	52,045,900
Area disturbed (ha)	140	82	n/a	222
Distance travelled by coal trucks per year (vkt)	217,062	194,999	n/a	412,061
Distance travelled by reject trucks per year (vkt)	391,926	0	n/a	391,926
Distance travelled by overburden trucks per year (vkt)	776,303	290,788	n/a	1,067,091
Area blasted per year (ha)	231	178	n/a	409

The emission rates for construction activities in Year 1 are presented in Table 10.5. The higher dust emissions from Horse Pit reflect the large amount of overburden material moved by truck and shovel operations in Year 1, the conservative assumption that the project coal mining equipment is located mostly in Horse Pit and the larger disturbed area for Horse Pit.

Table 10.5 Emission rates from coal mining sources for Construction in Year 1

Project operation	Emission rates (kg/hr)					
	TSP			PM_{10}		
	Horse Pit	Heyford Pit	Southern ROM	Horse Pit	Heyford Pit	Southern ROM
Pre-strip Truck and Shovel and Reject dumping	228.5	75.3	-	73.8	25.3	-
Dragline	0.0	120.2	-	0.0	32.3	-
Coaling equipment	15.5	10.2	-	9.3	6.9	-
Blasting	139.4	107.2	-	72.5	55.7	-
Coal Hauling	88.2	33.5	-	22.4	8.8	-
Reject Hauling	51.0	-	-	12.5	-	-
Overburden hauling	122.5	46.5	-	30.3	11.6	-
Wind blown dust	56.0	32.8	-	28.0	16.4	-
ROM coal receival at CHPP	30.6		0.1	9.4		0.03
ROM coal sizing and stockpiling	24.4			10.9		
Southern ROM loading and conveying	-	-	32.1	-	-	10.2
Product coal handling and train loadout	21.2			9.8		
Total from each pit	726.3	461.9	46.7	258.4	170.8	16.8

10.2.8 Emissions During Operation

The net emissions from each site operation, with the relevant dust control measures and pit retention factors applied, have been calculated for each scenario.

To represent the changing coal production, location of mining and amount of overburden moved per year, two scenarios have been modelled for operation of the project. Year 2 is the first year of full coal production. Year 20 has been selected as representative of mining operations on the eastern side of the lease, and involving higher amounts of overburden removal due to the deeper coal seam as well as activities that are close to sensitive receptor locations to the north of Horse Pit.

The emission rates that were derived from each operation on the mine site have been grouped according to the type of operation and according to the location of the dust-generating activity. Operations for pre-strip truck and shovel, coal mining equipment and blasting have all been located in the corresponding pit for air quality modelling. Emissions from hauling of coal, rejects and overburden materials were all based on the total distance travelled by the truck fleet, accounting for the locations of the ramps and the tonnes of material moved for each pit. These sources were located along the haul route from each pit to the Northern ROM.

10.2.8.1 Year 2

The dust emissions from Year 2 of operations have been estimated using the emission factors and estimates of control factors as detailed above. Production data from Horse Pit, Heyford Pit and the ROM coal imported from the Southern ROM to the CHPP for Year 2 of operations are presented in Table 10.6. The total distance travelled by coal, rejects and overburden haul trucks for this scenario are also presented in the table. The distance in vehicle kilometres travelled has been estimated from the number of truck movements required to move the amounts of material listed in the table, as well as the length of haul roads and ramps. Dragline operations are scheduled to commence in Horse Pit for Year 2 once the box cut area has been established. The draglines operate in the lower sections of the pit, just above the coal seam.

Table 10.6 Production data for Year 2 of operations

Project Activity	Horse Pit	Heyford Pit	Southern ROM	Project total
ROM coal (tonnes)	4,139,564	5,213,598	5,165,546	14,518,707
Product coal (tonnes)	2,500,000	3,000,000	2,766,699	8,266,699
Reject coal (tonnes)	1,875,906	2,251,087	2,398,847	6,525,840
Volume overburden by dragline (bcm)	20,033,975	12,748,201	n/a	32,782,176
Volume overburden by truck and shovel (bcm)	8,821,356	13,915,838	n/a	22,737,194
Area disturbed (ha)	96	21	n/a	116
Distance travelled by coal trucks per year (vkt)	311,353	245,616	n/a	556,969
Distance travelled by reject trucks per year (vkt)	545,371	0	n/a	545,371
Distance travelled by overburden trucks per year (vkt)	123,245	222,726	n/a	345,971
Area blasted per year (ha)	120	118	n/a	238

The emission rates for Year 2 of operations are presented in Table 10.7. The higher dust emissions from Horse Pit reflect the large amount of overburden material moved by dragline operations in Year 2, the placement of reject material into Horse Pit, the conservative assumption that the project coal mining equipment is located mostly in Horse Pit and the larger disturbed area for Horse Pit.

Table 10.7 Emission rates from coal mining sources for Year 2 of operations

Project operation	Emission rates (kg/hr)					
	TSP			PM_{10}		
	Horse Pit	Heyford Pit	Southern ROM	Horse Pit	Heyford Pit	Southern ROM
Pre-strip Truck and Shovel and Reject dumping	108.3	92.9	-	31.7	28.9	-
Dragline	215.1	132.8	-	58.7	35.2	-
Coaling equipment	16.5	11.1	-	10.2	7.8	-
Blasting	72.3	70.9	-	37.6	36.9	-
Coal Hauling	123.9	41.9	-	31.1	10.9	-
Reject Hauling	71.0	-	-	17.4	-	-
Overburden hauling	20.3	35.8	-	5.2	9.0	-
Wind blown dust	94.4	41.2	-	47.2	20.6	-
ROM coal receival at CHPP	32.0		0.1	10.0		0.1
ROM coal sizing and stockpiling	32.7			14.4		
Southern ROM loading and conveying	-	-	34.3	-	-	11.1
Product coal handling and train loadout	25.9			11.9		
Total from each pit	752.6	465.7	55.3	251.1	164.3	20.5

10.2.8.2 Year 20

The dust emissions from Year 20 of operations have been estimated using the emission factors and control factors as detailed above. Production data from Horse Pit, Heyford Pit and the ROM coal imported from the Southern ROM to the CHPP for Year 20 of operations are presented in Table 10.8. The total distance travelled by coal, reject and overburden haul trucks for this scenario are also presented in the table. The distance in vehicle kilometres travelled have been estimated from the number of truck movements required to move the volume of material listed in the table, combined with the length of the haul roads and ramps.

Table 10.8 Production data for Year 20 of operations

Project Activity	Horse Pit	Heyford Pit	Southern ROM	Project total
ROM coal (tonnes)	4,202,265	5,492,137	6,243,261	15,937,663
Product coal (tonnes)	2,500,000	3,000,000	3,175,767	8,675,767
Reject coal (tonnes)	2,027,148	2,432,578	3,067,494	7,527,219
Volume overburden by dragline (bcm)	26,427,153	11,400,040	n/a	37,827,192
Volume overburden by truck and shovel (bcm)	12,089,456	21,034,310	n/a	33,123,766
Area disturbed (ha)	51	16	n/a	67
Distance travelled by coal trucks per year (vkt)	316,069	258,739	n/a	574,807
Distance travelled by reject trucks per year (vkt)	629,057	0	n/a	629,057
Distance travelled by overburden trucks per year (vkt)	280,755	410,142	n/a	690,898
Area blasted per year (ha)	197	213	n/a	410

The emission rates for Year 20 of operations are presented in Table 10.9. The higher dust emissions from Horse Pit reflect the large amount of overburden material moved by dragline operations in Year 20, the placement of reject material into Horse Pit, the conservative assumption that the project coal mining equipment is located mostly in Horse Pit and the larger disturbed area for Horse Pit.

Table 10.9 Emission rates from coal mining sources for Year 20 of operations

Project operation	Emission rates (kg/hr)					
	TSP			PM_{10}		
	Horse Pit	Heyford Pit	Southern ROM	Horse Pit	Heyford Pit	Southern ROM
Pre-strip Truck and Shovel and Reject dumping	132.9	130.3	-	40.9	43.0	-
Dragline	274.5	120.3	-	72.5	32.3	-
Coaling equipment	16.5	11.4	-	10.3	8.0	-
Blasting	118.8	128.4	-	61.8	66.8	-
Coal Hauling	135.5	44.1	-	34.0	11.4	-
Reject Hauling	81.8	-	-	20.1	-	-
Overburden hauling	44.9	65.2	-	11.2	16.2	-
Wind blown dust	90.4	36.0	-	45.2	18.0	-
ROM coal receival at CHPP	32.2		0.1	10.1		0.06
ROM coal sizing and stockpiling	35.5			15.6		
Southern ROM loading and conveying	-	-	35.6	-	-	11.7
Product coal handling and train loadout	26.7			12.2		
Total from each pit	925.8	575.4	60.1	307.8	211.0	22.7

10.2.9 Worst-Case Emissions

Worst-case emissions from the project have been modelled by accounting for the possible grouping of the in-pit sources located at either the northern or southern end of Horse and Heyford Pits. This grouping of emission sources accounted for the simultaneous operation of the dragline, truck and shovel pre-strip fleet, blasting, coal mining and rejects dumping in close proximity to one another. The production data for each pit was used to derive emission rates for these pit activities, with the exception of the shovel and excavator which were assumed to operate at their peak production capacities (2,600 m^3/hr and 770 m^3/hr respectively). Other equipment that operates on site, such as the coal and overburden hauling and the CHPP, was assumed to operate at normal capacity.

For each of the modelled years (Years 1, 2 and 20), separate model runs were conducted for sources grouped in the north and in the south of the pits. The highest 24 hour average results from the north or south scenario are presented in Appendix L as the worst-case impacts.

10.2.10 Emissions During Upset Conditions

Upset conditions in relation to air quality impacts could arise due to a failure of dust control measures resulting in an increase in the amount of dust released from the site. A likely cause of upset conditions would be inadequate or non-existent dust control on the haul roads, which are a significant source of dust.

The emissions for upset conditions have been estimated by assuming no controls on wheel-generated dust from haul roads. The predicted impacts for the maximum 24-hour average concentration for this upset scenario are presented in the assessment. As this scenario has been assumed to last for only a short time predictions for only the 24-hour averaging period of dust have been reported for the upset scenario.

Emissions for this scenario are presented in Table 10.10 for coal, reject and overburden hauling. These have been combined with emissions estimated for typical operations for all other pit and CHPP activities that remain unchanged for this scenario. The revised total emissions from each pit operation are also presented in the table.

Table 10.10 Emission rates for operation under upset conditions for haul roads

Project operation		Emission rates (kg/hr)			
		TSP		PM_{10}	
		Horse Pit	Heyford Pit	Horse Pit	Heyford Pit
Year 1	Coal Hauling	352.7	134.0	89.4	35.2
	Reject Hauling	204.0	-	50.1	-
	Overburden Hauling	490.1	186.0	121.3	46.5
	Total under upset conditions	1,511.4	701.9	454.1	232.1
Year 2	Coal Hauling	495.5	167.8	124.6	43.5
	Reject Hauling	283.8	-	69.8	-
	Overburden Hauling	81.0	143.3	20.7	36.0
	Total under upset conditions	1,397.8	699.1	412.3	223.9
Year 20	Coal Hauling	542.2	176.5	136.0	45.6
	Reject Hauling	327.4	-	80.5	-
	Overburden Hauling	179.7	260.7	44.9	64.9
	Total under upset conditions	1,712.7	903.4	503.9	293.8

10.2.11 Modelling Methodology

The Calpuff modelling system was used for dispersion modelling of all dust emissions from the project and is approved by the DERM for use in Queensland and is a guideline model in the USA. Calpuff uses three-dimensional wind fields generated by Calmet, which were supplemented with data generated using the CSIRO model TAPM. The Calpuff model is appropriate for use in the assessment of dust impacts from coal mines as it accounts for pollutant recirculation, convective conditions, terrain features and temperature inversions. Due to the inland location of the site, specific treatment of sea breeze conditions was not required.

The Calpuff model was used to predict the ground-level concentrations of TSP and PM_{10}, and the deposition of TSP using appropriate averaging times. Estimated background levels of TSP and PM_{10} concentration and dust deposition, as discussed in Section 10.1.1, have been added to the modelled impacts to determine the cumulative impact from the project with existing land uses in the vicinity.

Local meteorological measurements at the Bureau of Meteorology station located at the Moranbah Water Treatment Plant are insufficient to provide data for detailed dispersion modelling. Hourly records of wind speed and direction, temperature and mixing height were generated for the project site from the three-dimensional prognostic meteorological model TAPM for 2007 and used in Calmet. The Calmet model domain was 30 km by 30 km at a 1 km resolution to capture the project activities as well as the residential areas of Moranbah and individual homesteads that may be affected by the project operations. Calmet calculates parameters such as mixing height and stability class that are used in the model to determine the dispersion conditions for every hour of the year.

The resultant three-dimensional wind fields from Calmet were used as inputs to the dispersion model Calpuff. The winds for the area are characterised by wind speeds of 2 to 5 m/s from the east-south-easterly direction. There is very infrequent occurrence of winds from the west or south at the project site.

The Calpuff model domain was 30 km by 30 km, with the dispersion results calculated at a resolution of 500 m. Impacts at sensitive receptor locations were modelled for for TSP and PM_{10} . These receptors were located at least 650 m from the project boundary and over 1,100 m from project disturbance areas. For ease of analysis and presentation, receptors were combined into groups based on location. The maximum predicted concentration within each receptor group is presented in the assessment.

The pollutants modelled from the operation of the project were TSP and PM_{10}, using the emission rates that were derived for each modelled scenario. All dust emissions from the site were modelled as volume sources, to represent the initial release of a cloud of dust-laden air from the project activities. The locations of each source were derived from the mine plan that was developed for the project. Haul road locations do not change throughout operation of the project, however the progression of the mine pits generally moves eastward.

Haul roads were modelled as volume sources that were spread out along the haul routes at approximately 500 m intervals. Sources that are located in the pit, including draglines, truck and shovel, coal mining equipment and blasting, were modelled as volume sources. For modelling of typical operations and operations during upset conditions from the project, the source locations were spread out along the pit length at 500 m intervals, with emission rates corresponding to the appropriate pit activities. For the worst-case 24 hour scenario, the pit activities were modelled as though they are clustered to either the north or the south of the pit, as detailed above.

Activities at the CHPP, ROM coal dumping and stockpile movements were modelled as volume sources located at the centre of each dust-generating activity. Coal handling activities at the Southern ROM were modelled as a single volume source.

Dust is emitted from an industrial source in a range of sizes that is dependent on the source of the dust. An assumed mean particle diameter of 10 µm and standard deviation of 2 µm was used for TSP, and a mean particle diameter of 5 µm and standard deviation of 1 µm was used for modelling of PM_{10}. Estimates of dust deposition at residential locations were based on the deposition of TSP. Impacts of $PM_{2.5}$ were estimated from results for PM_{10} using a conservative value of 0.2 for the ratio of $PM_{2.5}$ to PM_{10}.

10.2.11.1 Limitations of the Modelling Methodology

The modelling methodology outlined in Section 10.2.11 was developed during mid 2008. At this time, the EPP(Air) Policy 1997 was in effect. There are a number of important differences between the EPP(Air) Policy, 2008 which is currently enacted and the 1997 version of the policy. One of the key differences is the replacement of the 24-hour average PM_{10} criteria of 150 µg/m^3 (EPP(Air) 1997) with a 24-hour average PM_{10} objective of 50 µg/m^3 (EPP(Air) 2008). With background levels of PM_{10} estimated at 20 µg/m^3 the reduction in the criteria has a significant influence on the modelling methodology that is adopted: ie away from one of conservatism towards one of increased accuracy. Outlined in Appendix L are specific areas of modelling methodology refinement that are currently under consideration.

10.2.12 Dispersion Modelling Results

Predicted results from the dispersion modelling have been analysed at discrete receptor locations near the project site. In addition, contour plots showing the predicted impacts across the modelling domain have been presented in Appendix L.

10.2.12.1 Construction Impacts in Year 1

Predicted air quality impacts due to construction of the Horse Pit box cut and operation of mining activities in Heyford Pit for Year 1 are presented in Table 10.11. Predicted exceedences of the relevant project goals are highlighted in bold font.

Results suggest that pollutant levels around the project site will not exceed the EPP (Air) objectives for $PM_{2.5}$ and TSP or the DERM guideline for dust deposition under typical operating conditions.

Results for the 5th highest 24-hour average ground-level concentration of PM_{10} highlights the potential for PM_{10} levels to exceed the EPP (Air) objective of 50 µg/m^3 at some locations within the study region. A detailed investigation into modelled worst-case meteorological conditions (Appendix L) highlighted the strong dependence of the model results on the model default value of the mixing height which plays a key role in the calculation of night time impacts.

The most affected areas are locations in southern Moranbah, homesteads to the west of the project site and residences north of the mine.

Results of the dispersion modelling have been used to aid in the development of a local air quality monitoring program that is outlined in Appendix L. The information obtained from the monitoring program will feed into the operational management of site-based dust emission sources.

Table 10.11 Predicted impacts at residential locations for Year 1 typical operations

Pollutant	TSP		PM_{10}[1]		$PM_{2.5}$[2]		$PM_{2.5}$		Dust Deposition	
Averaging period	Annual		24-hour		24-hour		Annual		Monthly	
Units	µg/m³		µg/m³		µg/m³		µg/m³		g/m²/month	
Sensitive Receptor Group	**Increment**	**Total**	**Increment**	**Total**	**Increment**	**Total**	**Increment**	**Total**	**Increment**	**Total**
Moranbah	3.8	35.2	**52.5**	**71.3**	7.3	10.2	0.5	2.1	0.5	2.0
Southern Moranbah	26.5	57.9	**77.8**	**96.6**	13.7	16.6	2.9	4.5	1.4	2.9
Homesteads N of site	7.2	38.6	**52.9**	**71.7**	11.2	14.1	0.8	2.4	0.8	2.3
Homesteads E of site	7.3	38.7	34.7	**53.5**	4.9	7.8	0.9	2.5	0.7	2.2
Homesteads W of site	50.6	82.0	**78.0**	**96.8**	14.9	17.8	5.3	6.9	2.2	3.7
Commercial premises	5.1	36.5	25.7	44.5	3.4	6.3	0.6	2.2	0.6	2.1
Background	31.4		18.8		2.9		1.6		1.5	
EPP (Air) Objective	90		50		25		8		4	

Note 1 - The fifth highest 24-hour average ground-level concentration is presented.

Note 2 - The maximum 24-hour average ground-level concentration is presented.

10.2.12.2 Operational impacts in Year 2

Predicted air quality impacts due to operation of the project for Year 2 are presented in Table 10.12. Predicted exceedences of the relevant project goals are highlighted in bold font.

Results suggest that pollutant levels around the Caval Ridge mine will not exceed the EPP (Air) objectives for $PM_{2.5}$ and TSP or the DERM guideline for dust deposition under typical operating conditions.

These results again highlight the potential exceedence of the EPP (Air) objective of 50 µg/m³ for the 24-hour average of PM_{10} at some locations under typical operating conditions for Year 2.

The most affected areas are residences in southern Moranbah, homesteads to the west and residential locations to the north of the project.

Table 10.12 Predicted impacts at residential locations for Year 2 for typical operations

Pollutant	TSP		PM_{10}[1]		$PM_{2.5}$[2]		$PM_{2.5}$		Dust Deposition	
Averaging period	**Annual**		**24-hour**		**24-hour**		**Annual**		**Monthly**	
Units	**µg/m³**		**µg/m³**		**µg/m³**		**µg/m³**		**g/m²/month**	
Sensitive Receptor Group	**Increment**	**Total**	**Increment**	**Total**	**Increment**	**Total**	**Increment**	**Total**	**Increment**	**Total**
Moranbah	4.4	35.8	35.6	**54.4**	8.9	11.8	0.6	2.2	0.5	2.0
Southern Moranbah	28.8	60.2	**83.7**	**102.5**	14.7	17.6	3.1	4.7	1.5	3.0
Homesteads N of site	8.3	39.7	46.3	**65.1**	11.2	14.1	0.9	2.5	0.9	2.4
Homesteads E of site	8.6	40.0	38.4	**57.2**	6.0	8.9	1.0	2.6	0.8	2.3
Homesteads W of site	56.4	87.8	**89.5**	**108.3**	16.1	19.0	5.8	7.4	2.4	3.9
Commercial premises	6.0	37.4	28.2	47.0	4.5	7.4	0.7	2.3	0.6	2.1
Background	31.4		18.8		2.9		1.6		1.5	
EPP(Air) Objective	90		50		25		8		4	

Note 1 - The fifth highest 24-hour average ground-level concentration is presented.

Note 2 - The maximum 24-hour average ground-level concentration is presented.

10.2.12.3 Operational Impacts in Year 20

Predicted air quality impacts due to operation of the project for Year 20 are presented in Table 10.13. Predicted exceedences of the relevant project goals are highlighted in bold font.

Results suggest that pollutant levels around the project will not exceed the EPP (Air) objectives for $PM_{2.5}$ and TSP or the DERM guideline for dust deposition under typical operating conditions.

As was the case for Year 1 and Year 2 operations, these results again highlight the potential exceedence of the EPP (Air) objective of 50 µg/m³ for the 24-hour average of PM_{10} at some locations under typical operating conditions.

The most affected areas are residences north of the project, locations in southern Moranbah, homesteads to the east and west of the site.

Table 10.13 Predicted impacts at residential locations for Year 20 for typical operations

Pollutant	TSP		PM_{10}[1]		$PM_{2.5}$[2]		$PM_{2.5}$		Dust Deposition	
Averaging period	**Annual**		**24-hour**		**24-hour**		**Annual**		**Monthly**	
Units	**µg/m^3**		**µg/m^3**		**µg/m^3**		**µg/m^3**		**g/m^2/month**	
Sensitive Receptor Group	**Increment**	**Total**	**Increment**	**Total**	**Increment**	**Total**	**Increment**	**Total**	**Increment**	**Total**
Moranbah	7.9	39.3	**53.9**	**72.7**	13.4	16.3	1.0	2.6	0.7	2.2
Southern Moranbah	35.4	66.8	**87.2**	**106.0**	16.0	18.9	3.9	5.5	1.7	3.2
Homesteads N of site	17.4	48.8	**73.5**	**92.3**	18.3	21.2	1.6	3.2	1.9	3.4
Homesteads E of site	18.0	49.4	**62.4**	**81.2**	15.4	18.3	1.8	3.4	1.4	2.9
Homesteads W of site	53.0	84.4	**90.2**	**109.0**	17.1	20.0	5.6	7.2	2.4	3.9
Commercial premises	10.7	42.1	36.8	**55.6**	6.4	9.3	1.2	2.8	0.9	2.4
Background	31.4		18.8		2.9		1.6		1.5	
EPP(Air) Objective	90		50		25		8		4	

Note 1 - The fifth highest 24-hour average ground-level concentration is presented.

Note 2 - The maximum 24-hour average ground-level concentration is presented.

10.2.12.4 Impacts for Worst-Case Operations

The predicted fifth highest 24-hour average PM_{10} impact and the maximum 24-hour average $PM_{2.5}$ impact for project operation under worst-case conditions are presented in Table 10.14 and Table 10.15 respectively. Predicted exceedences of the relevant project goals are highlighted in bold font.

Results suggest that under worst-case operations, ground-level concentrations of dust may exceed the relevant short term EPP (Air) objectives for both PM_{10} and $PM_{2.5}$, with adverse impacts in general predicted to increase from Year 1 and Year 2 through Year 20.

As noted in Section 10.2.11.1, results of the dispersion modelling have been used to aid in the development of a local air quality monitoring program that is outlined in Appendix L. The information obtained from the monitoring program will feed into the operational management of site-based dust emission sources to ensure that impacts from the construction and operation of the mine are minimised at all times.

Operational procedures that prevent these worst-case conditions from occurring may be implementable. Due to the varying depths of pit activities, particular consideration needs to be paid to operations that are close to the natural surface level, such as truck and shovel operations and overburden dumping. To prevent worst-case conditions from occurring, consideration will be given to:

- Scheduling pit activities, particularly for activities to the north of Horse Pit, to stagger the operation of equipment.
- Maintaining adequate separation of pre-strip truck and shovel, coal mining fleet and dragline operation, particularly for activities to the north of Horse Pit.
- Implementing additional dust control measures for operations that are close to the natural surface level. These could include watering of truck and shovel operations that are close to the northern end of Horse Pit.
- Implementation of dust monitoring to gauge the level of off-site impacts to the north of the project.
- Implementation of management strategies that restrict operations in the north of Horse Pit for adverse meteorological conditions.

Table 10.14 Predicted short-term impacts at residential locations for Year 1, Year 2 and Year 20 for worst-case operations

Sensitive receptor group	Fifth highest 24-hour average of PM_{10} (µg/m³)					
	Year 1		Year 2		Year 20	
	Incremental	Total	Incremental	Total	Incremental	Total
Moranbah	**52.5**	**71.3**	**72.7**	**91.5**	**93.3**	**112.1**
Southern Moranbah	**134.5**	**153.3**	**148.4**	**167.2**	**113.1**	**131.9**
Homesteads N of site	**101.4**	**120.2**	**97.5**	**116.3**	**194.3**	**213.1**
Homesteads E of site	48.9	**67.7**	**58.6**	**77.4**	**120.1**	**138.9**
Homesteads W of site	**100.2**	**119.0**	**110.7**	**129.5**	**107.2**	**126.0**
Commercial premises	35.3	**54.1**	45.1	**63.9**	**61.5**	**80.3**
Background	18.8					
EPP(Air) Objective	50					

Table 10.15 Predicted short-term impacts of $PM_{2.5}$ at residential locations for Year 1, Year 2 and Year 20 for worst-case operations

Sensitive receptor group	Maximum 24-hour average of $PM_{2.5}$ (µg/m³)					
	Year 1		Year 2		Year 20	
	Incremental	Total	Incremental	Total	Incremental	Total
Moranbah	20.1	23.0	**27.0**	**29.9**	**31.6**	**34.5**
Southern Moranbah	**33.1**	**36.0**	**37.4**	**40.3**	**31.2**	**34.1**
Homesteads N of site	**27.6**	**30.5**	**32.7**	**35.6**	**50.9**	**53.8**
Homesteads E of site	14.5	17.4	15.5	18.4	**27.9**	**30.8**
Homesteads W of site	21.9	24.8	**25.6**	**28.5**	24.9	**27.8**
Commercial premises	12.5	15.4	15.1	18.0	16.6	19.5
Background	2.9					
EPP(Air) Objective	25					

10.2.12.5 Impacts for Upset Conditions

Impacts under the potential upset condition where dust control measures on the haul roads are inadequate or absent have also been modelled. Results are presented for the 24-hour averaging periods for PM_{10} and $PM_{2.5,}$ in Appendix L. These results are presented for the short term averaging periods only as any failure of controls would be quickly rectified as part of the mine's operations.

10.2.13 Mitigation Measures

Dust mitigation for the operation of the project involves several elements to ensure adequate management of air quality in the vicinity of the mine, namely:

- Engineering control measures
- Dust suppression measures
- Rehabilitation of exposed surfaces
- Operational procedures
- Measurement of ambient air quality.

10.2.13.1 Engineering Control Measures

BMA has designed engineering control measures into the project where appropriate and technically possible. In particular, these control measures have been applied at the CHPP and include the following:

- Enclosure of transfer points and sizing stations
- Roof on overland conveyors
- Belt washing and belt scrapers to minimise dust from the return conveyors
- Reduced drop height from stackers to stockpiles
- Enclosure of raw coal surge bins.

The dust mitigation associated with these engineering controls has been incorporated into the impact assessment for the project.

10.2.13.2 Dust Suppression Measures

Dust suppression measures primarily include the application of water to control dust emissions. The following measures will be implemented:

- Watering of haul roads to best-practice level of more than 2 litres/m²/hour of water applied.
- Watering of ROM stockpiles using water sprays and water cannons that are operated on timers. The use of timers avoids the potential for missing a scheduled watering operation. The timers can also be operated manually in particularly hot or windy conditions.
- Fogging system on outlets from transfer points and sizing stations.
- Water sprays on stacker/reclaimer units.
- High moisture content of product coal and reject material as they leave the CHPP which avoids the need for supplementary watering. Immediately after the coal is dewatered in the CHPP, the coal will be above the dust extinction moisture limit (the lower limit at which dust-prone materials will no longer create dust) and so will not be a source of dust.
- Train loadout to incorporate chemical reagent to be sprayed onto the surface of each loaded wagon. This will form a barrier that binds small dust particles together and prevents dust generation from the coal trains as they are transported from the project to the port.

In the event that adverse conditions are encountered during operation of the project, additional dust suppression measures will have to be implemented. The circumstances where this might be required include pre-strip and overburden dumping operations in the north of Horse Pit and during construction of the CHPP and associated infrastructure. These measures are discussed in the Section 3.3 of the Environmental Management Plan, Appendix Q.

10.2.13.3 Rehabilitation of Exposed Surfaces

Rehabilitation of exposed surfaces will be undertaken progressively as mining and stockpiling activities are completed. The effective time from first mining activities on each area of land, until that area is rehabilitated and hence has effective dust control from vegetation, has been estimated to be five years. A detailed rehabilitation plan will be developed for the project, which will include the use of fast-growing temporary cover material to accelerate the effectiveness of dust controls. Improving the effectiveness and time for rehabilitation measures will result in reduced dust emissions from exposed areas, however these benefits cannot be incorporated into modelling until the rehabilitation strategy has been formulated.

10.2.13.4 Operational Procedures

Operational procedures set out how the project is to be operated in order to meet targets for air quality performance. In relation to air quality, the following procedures will be incorporated into the site operational procedures:

- Use of water trucks to achieve sufficient watering of haul roads and other high-risk areas. The schedule for truck use will be developed for the project and will incorporate consideration of recent rainfall and weather conditions.
- Use of water sprays and foggers as directed, with additional use as determined by ambient conditions.
- Maintenance of water spray equipment and engineering controls to minimise dust emissions.
- Maintenance of all fuel-burning equipment to reduce air pollutant emissions and maximise fuel efficiency.
- Sufficient number of watering trucks to allow for continuation of dust suppression when one or more trucks are out of service.
- Reduction or cessation of haul truck movements in the event of failure of dust control measures. This strategy must be undertaken in conjunction with data on ambient impacts and weather conditions.
- Monitoring of ambient air quality in the vicinity of the mine.
- Restrictions on pre-strip and overburden dumping in the north of Horse Pit for adverse weather conditions as assessed by visual inspection combined with on-site meteorological monitoring data.
- Restrictions on the co-location of pre-strip, overburden dumping, coal excavation and draglines in the north of Horse Pit for adverse weather conditions as assessed by visual inspection combined with on-site meteorological monitoring data.

These procedures will be incorporated into the site Environmental Management Plan (EM Plan). The EM Plan will be regularly audited to ensure that these key elements for air quality management are satisfied.

10.2.13.5 Measurement of Ambient Air Quality

It is widely recognised that although elevated levels of TSP may lead to dust nuisance, it is elevated levels of PM_{10} that is associated with an increased risk of adverse impacts on human health. More recent studies suggest that particulate matter in the range associated with $PM_{2.5}$ may pose an even greater risk to human health as the smaller sized particles have an increased potential to penetrate deep into the lungs.

The results of the dispersion modelling have highlighted the potential for adverse air quality impacts at nearby receptor locations. However, the confirmation of (both adverse and absence of) air quality impacts predicted by the model can only be validated by observational data.

In general, the mechanical generation of dust (as opposed to particulate matter associated with combustion processes) is associated with only a small fraction (i.e. 10% - 20%) of particulate matter in the range of $PM_{2.5}$. Thus the proposed site-based ambient air quality monitoring program focuses on dust deposition and PM_{10}.

A three-staged monitoring program is proposed for the monitoring air quality within the region predicted to be directly impacted upon by dust generating activities at the proposed Caval Ridge Mine site. This monitoring program is detailed in Appendix L and will allow BMA to monitor local air quality on a monthly basis. The level of monitoring undertaken will be dependent on the impacts that are demonstrated at receptor locations.

The outcomes of the ambient monitoring program outlined in Appendix L will be used by BMA to determine whether the mine's operations are contributing to excessive dust levels at nearby residential locations. BMA will take action to avoid adverse impacts on air quality at nearby receptor locations.

10.3 Conclusion

The air quality assessment of the project has evaluated the existing climate and air quality in the region, estimated the emissions of dust from the project and predicted the air quality impacts.

Ambient air monitoring data from the project and Peak Downs Mine monitoring sites has been used to estimate the background air quality within the study region. This data suggests that the existing air quality at this location is good, with no exceedences of the EPP (Air) objectives for dust recorded at the project site during 2008.

Mining activities for the project have been evaluated for three scenarios:

- **Year 1**, representing construction of the initial box cut in the Horse Pit, and mining operations in the Heyford Pit (for which the box cut has already been completed)
- **Year 2**, representing the first year of mining operations, in both pits, on the western side of the project site
- **Year 20**, representing mining towards the eastern side of the project site and reflecting the increasing proportion of overburden removed as the mining depth increases. Mining activities to the north of Horse Pit in Year 20 are close to off-site receptors that are downwind of the mine under prevailing wind conditions and will impact air quality at these locations.

The dust emissions from these activities have been assessed and used in dispersion modelling to predict impacts at nearby residential locations. For each of the years noted above, three scenarios have been modelled:

- Typical operations
- Worst-case emissions
- Upset emissions.

Results of the dispersion modelling suggest that air quality impacts due to construction activities in Year 1 are below the EPP (Air) objectives for TSP, $PM_{2.5}$ and dust deposition at residential locations. Operational impacts in Year 2 and Year 20 also satisfy the EPP (Air) objectives for TSP, $PM_{2.5}$ and dust deposition for typical operating conditions.

The dispersion modelling highlights the potential for PM_{10} levels to exceed the EPP (Air) objective of 50 µg/m^3 for the 24-hour average concentration, at some sensitive receptor locations, for each of the three year scenarios. A detailed investigation into modelled worst-case meteorological conditions highlights the strong dependence of the model results on the model default value of the mixing height which plays a key role in the calculation of night time impacts. This insight into the model behaviour has lead to a more detailed study of model inputs which is currently underway.

Impacts under worst-case short-term operating conditions, accounting for the possible proximity of key dust-generating equipment to either the north or south of each pit, show that high dust levels are possible to the north of the project under adverse meteorological conditions. An ambient air monitoring program has been developed that will monitor the impact of dust-generating emission sources at sensitive receptor locations. The information obtained from the monitoring program will feed into the operational management of site-based dust emission sources.

Estimated impacts for upset conditions, namely the failure of dust suppression measures on the haul roads, shows that high dust levels are predicted for locations to the north and west of the project. The occurrence of these upset conditions can be managed by BMA by ensuring that adequate dust suppression measures are maintained at all times.

Mitigation measures have been proposed for the project. These comprise a combination of the following:

- Engineering controls
- Dust suppression measures
- Rehabilitation of exposed surfaces
- Operational procedures
- Measurement of ambient air quality.

The implementation of these procedures is expected to result in adequate management of dust emissions from the project. The mitigation measures and procedures to minimise dust release from the site have been incorporated into the Environmental Management Plan for the project.

Due to the implications of the differences in the EPP(Air) Policy 2008 which came into affect on January 1, 2009, and the EPP(Air) Policy 1997 which was in affect in mid 2008 at the time this assessment methodology was developed, further refinement of the applied methodology will be carried out.