Mt Arthur Coal

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Appendix F – Air Quality and Greenhouse Gas Assessment

AIR QUALITY AND GREENHOUSE GAS ASSESSMENT

FINAL

MT ARTHUR COAL OPEN CUT MODIFICATION

Hunter Valley Energy Coal Pty Ltd

Job No: 2980E

25 January 2013

A PEL Company

PROJECT TITLE:	**MT ARTHUR COAL OPEN CUT MODIFICATION**
JOB NUMBER:	**2980E**
PREPARED FOR:	**HUNTER VALLEY ENERGY COAL PTY LTD**
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ES1 EXECUTIVE SUMMARY

Hunter Valley Energy Coal Pty Ltd (HVEC) seeks to modify the existing Project Approval (PA 09_0062) for the extension of open cut coal mining at Mt Arthur Coal Mine. In 2009, HVEC lodged an Environmental Assessment (EA) under section 75W of Part 3A of the New South Wales (NSW) *Environmental Planning and Assessment Act, 1979* to extend open cut operations and consolidate existing approvals for open cut mining operations and surface infrastructure. This application was subsequently approved by the then NSW Minister for Planning on 24 September 2010 (PA 09_0062). The open cut is approved with a mining rate of up to 32 million tonnes per annum (Mtpa) with an additional 8 Mtpa approved for extraction from underground operations.

HVEC propose to extend open cut mining operations at the Mt Arthur Coal Mine for an additional operational life of approximately four years (the Modification). The Modification will include:

- a four year continuation of the open cut mine life from 2022 to 2026 at the currently approved maximum rate of 32 Mtpa;
- an increase in open cut disturbance areas;
- use of the conveyor corridor for overburden emplacement;
- duplication of the existing rail loop;
- an increase in the maximum number of train movements per day from 24 to 38;
- the relocation of the loading point for the overland conveyor which delivers coal to Macquarie Generation's Bayswater Power Station;
- the relocation and upgrade of the explosives storage facility, magazine and associated facilities; and
- the construction of additional offices, a control room and a small extension to the run-of-mine coal stockpile footprint.

No changes to the mining method or hours of operation are proposed. This report deals with air quality issues that will arise from this Modification and focuses on the following:

- The impacts likely to arise from emissions of dust from the proposed open cut and underground operations and the associated surface activities.
- The cumulative impacts likely to arise from emissions of dust from the Modification considered in combination with emissions from nearby mining.
- An assessment of the greenhouse gas emissions likely to arise from the Modification.

Dust emissions inventories were developed for three stages of operations of the Modification. These stages have been selected to represent the potential worst-case air quality impacts that the Project will have on nearby sensitive receptors and enable a direct comparison with the predictions of the 2009 EA.

The computer dispersion model ISCMOD was used in this assessment in order to allow a comparison with the 2009 EA. In addition, the same meteorological data as the 2009 EA were also used. The emissions inventories developed for each of the stages have been used with local meteorological data to predict the maximum 24-hour average particulate matter less than 10 micrometres in size (PM_{10}), annual average PM_{10}, maximum 24-hour average particulate matter less than 2.5 micrometres in size ($PM_{2.5}$), annual average $PM_{2.5}$, annual average total suspended particulate matter and annual average dust deposition (insoluble solids). The modelling has been undertaken to show both the effects of the Project only and the cumulative effects of the Project with neighbouring mines and other sources of dust.

The assessment generally follows the conventional procedures outlined by the NSW Environment Protection Authority in its document titled *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* and contemporary standards adopted by the NSW Department of Planning and Infrastructure.

The modelling predictions show that annual and maximum 24-hour PM_{10} average concentrations are lower at the majority of the residences compared to the 2009 EA. In particular, eight residences are now below the 24-hour average PM_{10} criterion of 50 micrograms per cubic metre for the modelling predictions for the Modification compared to the 2009 EA. This is partly a result of continual efforts by Mt Arthur Coal Mine to implement controls to reduce dust emissions since 2009.

In summary, there are no private residences outside those in the existing HVEC Zone of Acquisition anticipated to be impacted by dust levels exceeding the annual average PM_{10} criterion.

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1 INTRODUCTION

The Mt Arthur Coal Mine is owned and operated by Hunter Valley Energy Coal Pty Ltd (HVEC), a wholly-owned subsidiary of BHP Billiton. HVEC seeks to modify the existing Project Approval ([PA] 09_0062) for the extension of open cut coal mining at Mt Arthur Coal Mine. In 2009, HVEC lodged an application under section 75W of Part 3A of the New South Wales (NSW) *Environmental Planning and Assessment Act, 1979* to extend open cut operations and consolidate existing approvals for open cut mining operations and surface infrastructure. This application was subsequently approved by the then NSW Minister for Planning on 24 September 2010 (PA 09_0062). The open cut is approved with a mining rate of up to 32 million tonnes per annum (Mtpa).

In addition, underground mining with a rate of up to 8 Mtpa was approved under PA 06_0091 on 2 December 2008. It should be noted that although open cut and underground mining are approved to rates of 32 and 8 Mtpa, respectively, the total site extraction rate is limited to 36 Mtpa by PA 09_0062.

PAEHolmes was commissioned on behalf of HVEC to undertake an air quality assessment for the Mt Arthur Coal Open Cut Modification (the Modification). The Modification will include:

- a four year continuation of the open cut mine life from 2022 to 2026 at the currently approved maximum rate of 32 Mtpa;
- an increase in open cut disturbance areas;
- use of the conveyor corridor for overburden emplacement;
- duplication of the existing rail loop;
- an increase in the daily maximum number of train movements per day from 24 to 38;
- the relocation of the loading point for the overland conveyor which delivers coal to Macquarie Generation's Bayswater Power Station;
- the relocation and upgrade of the explosives storage facility, magazine and associated facilities; and
- the construction of additional offices, a control room and a small extension to the run-of-mine (ROM) coal stockpile footprint.

The purpose of this assessment is to assess the air quality impacts associated with the extension of mine life from 2022 to 2026. The mining years assessed included 2016, 2022 and 2026.

The assessment generally follows the conventional procedures outlined by the NSW Environment Protection Authority (EPA) in its document titled *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (**NSW Department of Environment and Conservation [DEC], 2005**) (referred to hereafter as Approved Methods) and contemporary standards adopted by the NSW Department of Planning and Infrastructure (DP&I) (previously NSW Department of Planning). A computer-based dispersion model was used, with local meteorological data and estimates of dust emissions, to predict the ambient air concentration and deposition levels of particulate matter directly associated with the Modification as well as the cumulative results that include the dust emission contribution of other mines expected to be operating concurrently in the area.

1.1 Scope of Work

The scope of work for this study includes:

- a description of the Modification focusing on aspects relevant to air quality;
- a review of ambient air quality criteria that need to be met to protect the air quality environment;
- a review of meteorological and climatic conditions in the area;
- a review of air quality monitoring data undertaken with a view to describing existing air quality conditions and establishing background air quality;
- an analysis of the Modification and generation of dust emissions inventories for representative stages in the life of the mine;
- a description of the modelling approach used to predict the ambient air concentrations of particulate matter and dust deposition for comparison with ambient air quality assessment criteria;
- predicted dispersion and dust fallout patterns due to emissions from the Modification;
- predicted cumulative effects with other mining operations and existing sources of dust; and
- consideration of dust mitigation and management measures to minimise dust emissions.

In February 2012, HVEC sought Director-General's Requirements (DGRs) from the DP&I for the Modification. **Table 1.1** contains the requirements relating to air quality and greenhouse gas (GHG) assessment, along with a reference to the section of the report which addresses the requirement.

In addition, comments were also received from the EPA in relation to the Modification. These comments are reproduced in **Table 1.2**, along with a reference to the section of the report which addresses the EPA comments.

As part of the Mt Arthur Consolidation Project (Consolidation Project) Environmental Assessment (EA), an air quality and GHG assessment was completed in 2009 by PAEHolmes for a single consolidated approval for open cut operations within the Mt Arthur Coal Mine (**PAEHolmes, 2009**). The results of this assessment will be compared with the results from the 2009 EA to determine the air quality impacts associated with the Modification.

The computer dispersion model ISCMOD was used in this assessment in order to allow a comparison with the 2009 EA. In addition, the same meteorological data as the 2009 EA were also used.

Table 1.1: Director-General's Requirements (DP&I)

Discipline	Requirement	Report Section
Air Quality	*A quantitative assessment of potential:* - *construction and operational impacts, with a particular focus on dust emissions (including $PM_{2.5}$ and PM_{10} emissions, and dust generation from coal transport), as well as diesel and blast fume emissions;* - *reasonable and feasible mitigation measures to minimise dust, diesel, and blast fume emissions, including evidence that there are no such measures available other than those proposed; and* - *monitoring and management measures, in particular real-time air quality monitoring.*	**Sections 5** and **8**
Greenhouse Gases	- *a quantitative assessment of the potential Scope 1, 2 and 3 greenhouse gas emissions;* - *a qualitative assessment of the potential impacts of these emissions on the environment; and* - *an assessment of the reasonable and feasible measures to minimise greenhouse gas emissions and ensure energy efficiency.*	**Section 9**

Table 1.2: EPA Comments

Comment	Report Section
Assess the risk associated with potential discharges of fugitive and point source emissions for all stages of the proposal. Assessment of risk relates to environmental harm, risk to human health and amenity. *Justify the level of assessment undertaken on the basis of risk factors, including but not limited to:* *a. proposal location;* *b. characteristics of the receiving environment: and* *c. type and quantity of pollutants emitted.*	**Entire report**
Describe the receiving environment in detail. The proposal must be contextualised within the receiving environment (local, regional and inter-regional as appropriate). The description must include but need not be limited to: *a. meteorology and climate;* *b. topography;* *c. surrounding land use; receptors; and* *d. ambient air quality.*	**Sections 1.3** and **4**
Include a detailed description of the proposal. All processes that could result in air emissions must be identified and described. Sufficient detail to accurately communicate the characteristics and quantify all emissions must be provided.	**Section 6**
Include a consideration of 'worse case' emission scenarios and impacts at proposed emission limits.	**Sections 5** and **8**
Account for cumulative impacts associated with existing emission sources as well as any currently approved developments linked to the receiving environment. This must include an assessment of cumulative 24-hour PM_{10} impacts.	**Section 8**
Include air dispersion modelling where there is a risk of adverse air quality impacts or where there is sufficient uncertainty to warrant a rigorous numerical impact assessment. Air dispersion modelling must be conducted in accordance with the Approved Methods of the Modelling and Assessment of Air Pollutants in NSW *(2005).* *http://www.environment.nsw.gov.au/resources/air/ammodelling05361.pdf.*	
Demonstrate the proposal's ability to comply with the relevant regulatory framework specifically the Protection of the Environment Operations (POEO) Act (1997) and the POEO (Clean Air) Regulation (2010).	**Section 3**

Comment	Report Section
Provide an assessment of the project in terms of the priorities and targets adopted under the NSW State plan 2010 and its implementation plan 'Action for Air'.	**Section 3**
Provide details of all emission control techniques/practices that will be employed to mitigate air emission impacts from the project.	**Section 7**
The EIS should include a comprehensive assessment of, and report on, the project's predicted greenhouse gas emissions (tCO_2-e). Emissions should be reported broken down by: • *direct emissions (scope 1 as defined by the Greenhouse Gas Protocol),* • *indirect emissions from electricity (scope 2), and* • *upstream and downstream emissions (scope 3)* *both before and after implementation of the project, including annual emissions for each year of the project (construction, operation and decommissioning).*	**Section 9**
The EIS should include an estimate of the greenhouse emissions intensity (per unit of production). Emissions intensity should be compared with best practice if possible.	
The emissions should be estimated using an appropriate methodology, in accordance with NSW, Australian and international guidelines.	
The proponent should also evaluate and report on the feasibility of measures to reduce greenhouse gas emissions associated with the project. This could include a consideration of energy efficiency opportunities or undertaking an energy use audit for the site.	

EIS = Environmental Impact Statement.

tCO_2-e = tonnes of carbon dioxide equivalent.

1.2 Existing Operations

HVEC currently has approval to produce up to 36 Mtpa of ROM coal from the combined open cut and underground operations, of which up to 8 Mtpa is approved for extraction from underground operations. The open cut operations has a maximum approved capacity of up to 32 Mtpa.

Coal production from the Northern Open Cut has been the focus of HVEC's operations since 2002. However, coal production in the southern open cut has been ongoing since 1994. Open cut coal mining is conducted using multi-trench/multi-strip shovel and excavator extraction.

Coal preparation, handling and loading is undertaken at the centralised Mt Arthur Coal Mine Coal Handling and Preparation Plant (CHPP), which is located in a valley to minimise environmental impacts. Export coal is loaded onto trains via the Rail Loading Facility whilst domestic coal is transported via conveyor directly to Macquarie Generation's Bayswater Power Station.

1.3 Local Setting and Topography

Mt Arthur Coal Mine is located southwest of Muswellbrook in the Muswellbrook Shire Council Local Government Area in the Upper Hunter Valley of NSW. The location and mine leases of Mt Arthur Coal Mine and neighbouring mines including Bengalla Local Mine, Mount Pleasant Coal Mine, Mangoola and Drayton Coal Mines are shown in **Figure 1.1**. Also shown are the nearby sensitive receptors and the location of the weather station. Identification labels have been given to each residence and are provided in tabular form with figure reference in **Appendix A**.

The Hunter Valley is characterised by a northwest to southeast oriented ridge which has a strong influence on the dominant east-southeasterly and southeasterly wind directions seen in the area. The terrain within the Hunter Valley is for the most part gently undulating with steeper slopes found along the valley walls. Much of the higher ground and steeper slopes retain moderately dense woodland cover which form part of the national parks and state forests found within the region.

Land ownership at the Mt Arthur Coal Mine is shown on **Figure 1.2** to Figure **1.4**.

The topography in and immediately around the Modification is characterised by a southwest to northeast orientated Hunter River running through the low lying areas to the north of Mt Arthur Coal Mine. **Figure 1.5** shows a pseudo three dimensional (3D) plot of the terrain constructed from data used in the dispersion modelling.

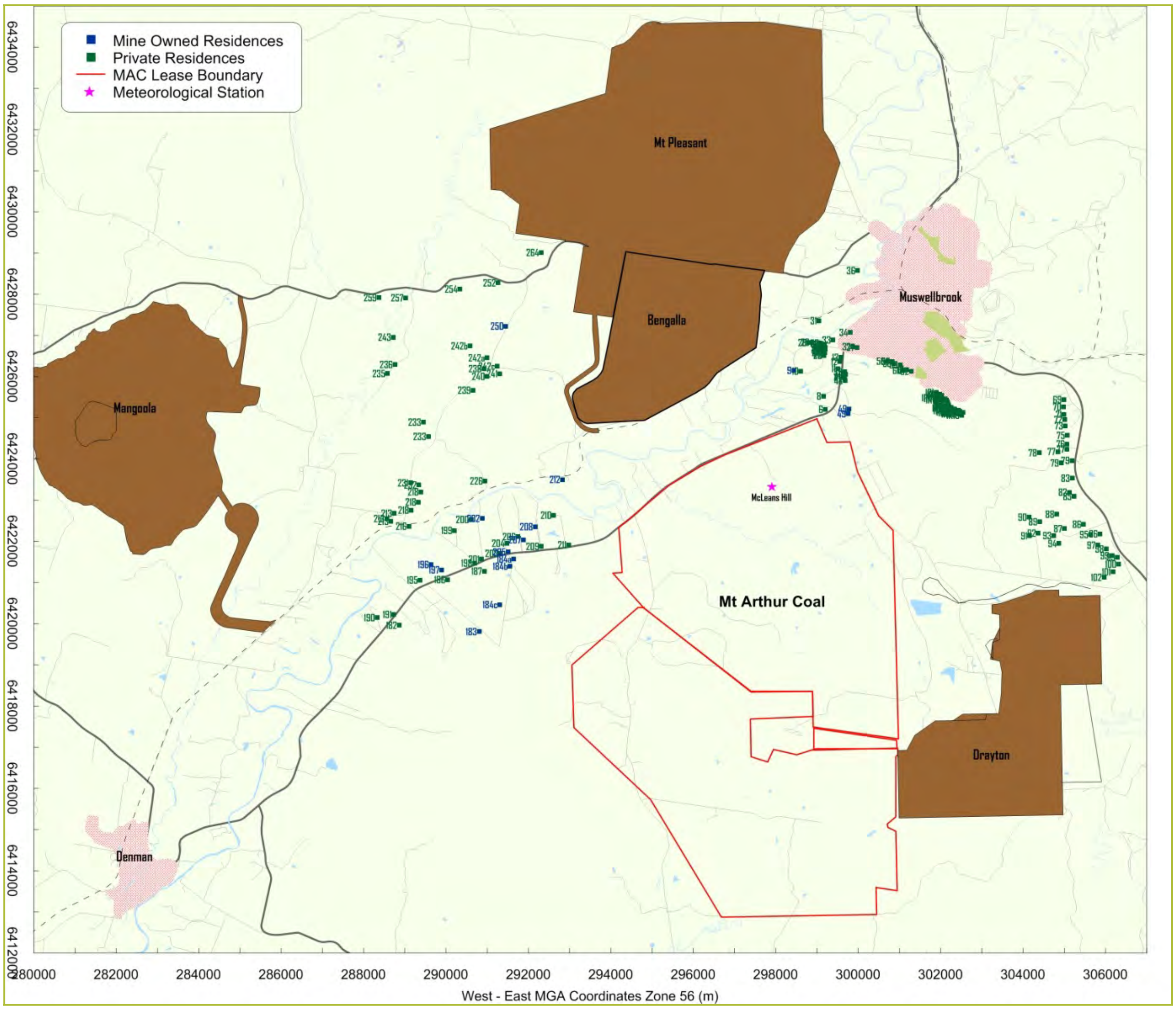
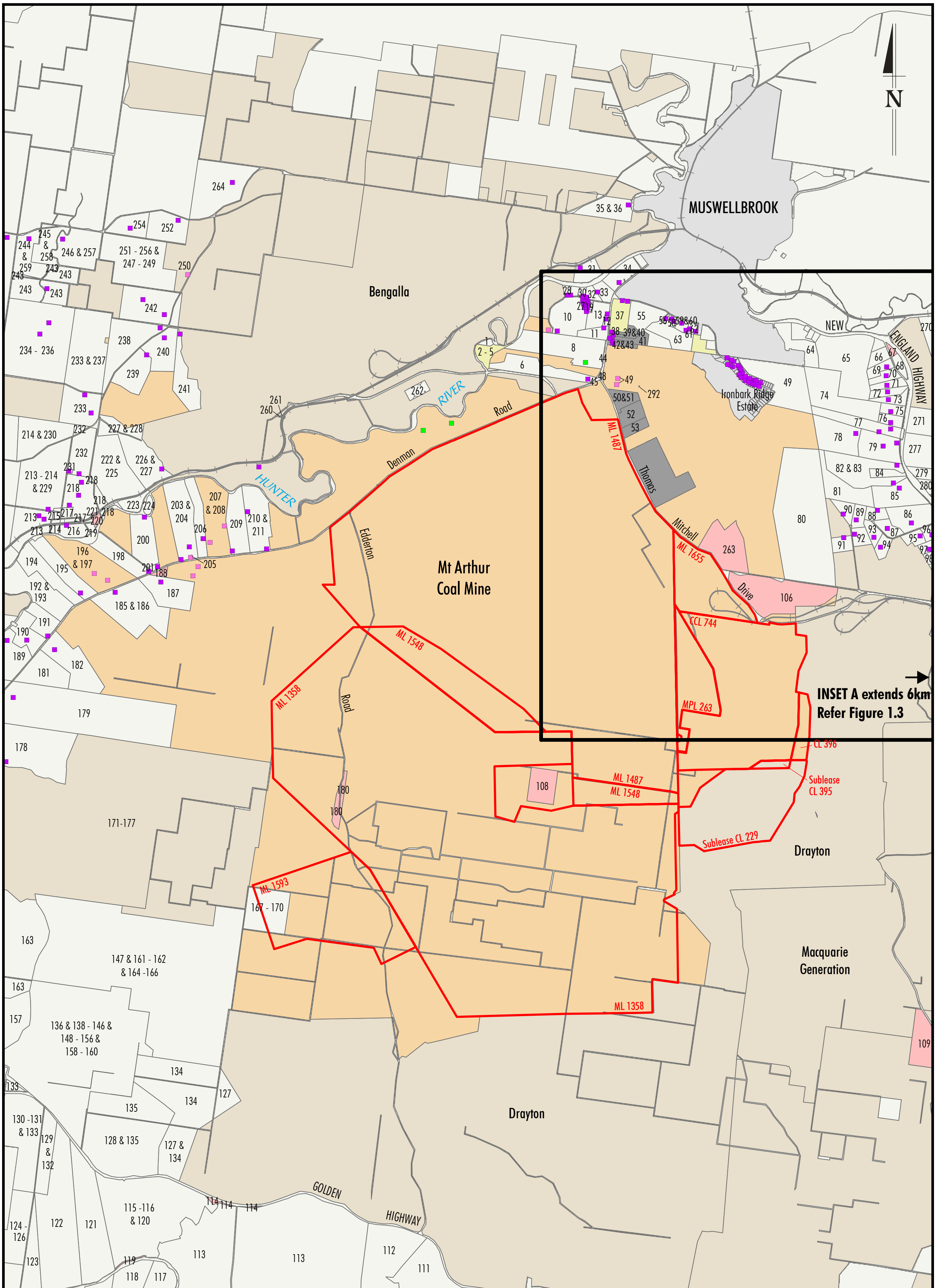


Figure 1.1: Site Location and Sensitive Receptors



LEGEND

- Mt Arthur Coal Mining & Coal Lease Boundary
- HVEC Owned Land
- Mine/Power Generator Owned Land
- Crown Land/ The State of NSW
- Utilities/Government Owned Land
- Industrial Zone
- Private Owned Land
- Dwelling
- Dwelling acquired by Mine Owned Company since 2009 EA
- Heritage Listed Property

0 0.5 1 1.5 2
Kilometres
GRID DATUM MGA 94 ZONE 56

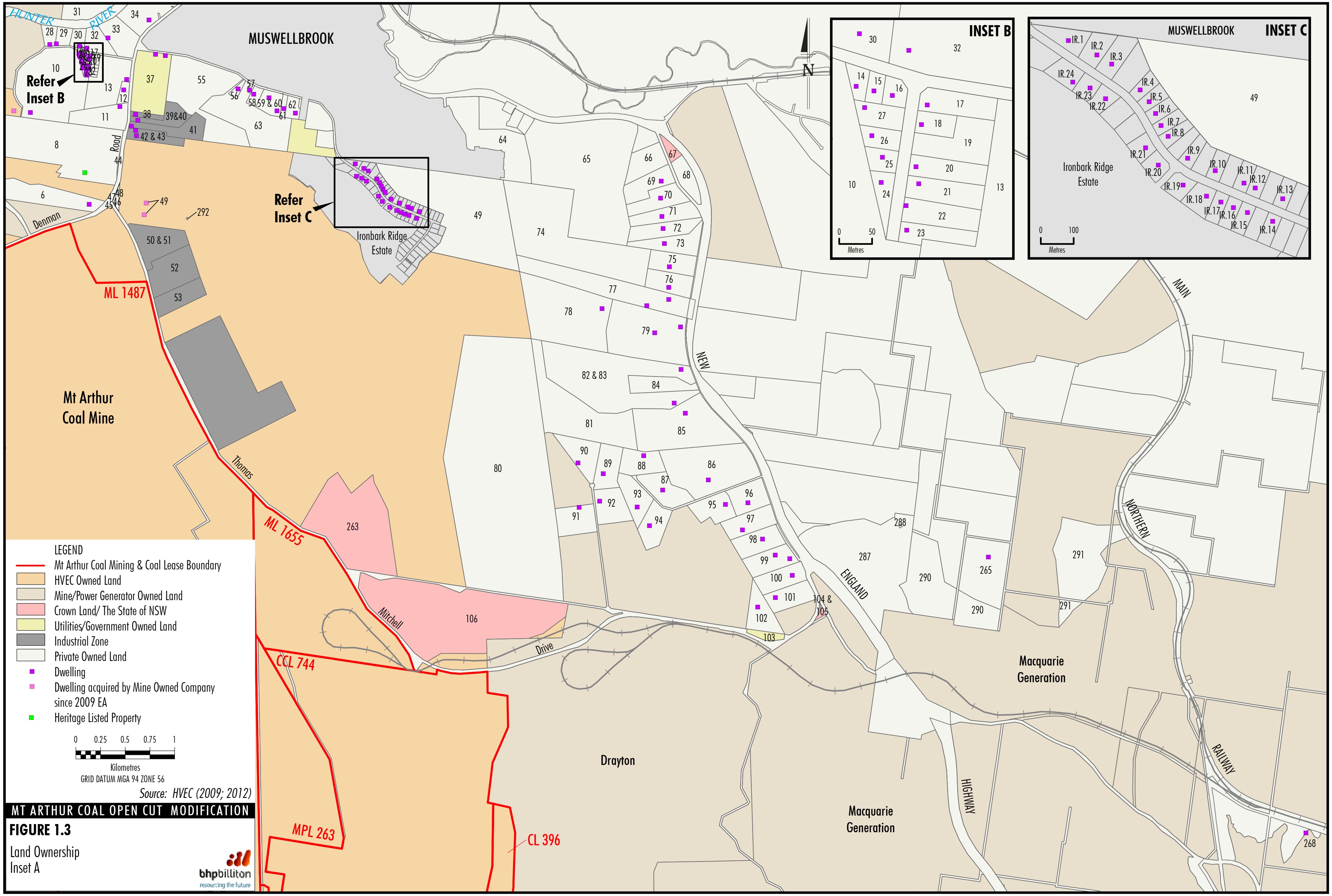
Source: HVEC (2009; 2012)

MT ARTHUR COAL OPEN CUT MODIFICATION

FIGURE 1.2

Land Ownership

HVE-11-01_OCM EA_App AQ_201F



MT ARTHUR COAL OPEN CUT MODIFICATION

FIGURE 1.3

Land Ownership
Inset A

HVE-11-01_OCM EA_App AQ_202E

REF NO	LANDHOLDER
1	MJ Drake
2	The Water Conservation and Irrigation Commission
3	The Water Conservation and Irrigation Commission
4	The Water Conservation and Irrigation Commission
5	The Water Conservation and Irrigation Commission
6	JR Scriven
8	MJ Drake
10	Muswellbrook Race Club Limited
11	JP Drake
12	DR & CJ Tubb
13	Upper Hunter Developers PTY Limited & NR Turner
14	J & DL Robinson
15	MC & LJ Dobie
16	ML & EA Sweeney
17	JR Gleeson & MR Cranfield
18	SM Bredden
19	NJ Rowe
20	AC Good
21	RS & JT Cridland
22	Englebrecht Racing Stables PTY Limited
23	RH Englebrecht
24	RJ & TT Reid
25	GL & IL Andrews
26	RA Byrnes & MA Moller
27	TD Barron
28	MJ McGoldrick
29	KB & JA Bernett
30	DP Englebrecht
31	Jabetin PTY Limited
32	FK & WDG Almond & PW Hume
33	SW & KL Barkley
34	WJ Hardes
35	C Horne
36	C Horne
37	The Council of the Shire of Muswellbrook
38	Monadelphous Properties PTY LTD
39	JR & JA Buckley
40	JR & JA Buckley
41	SRP & RF Ray
42	DJ Hallett & KL & J Campbell
43	DJ Hallett & KL & J Campbell
44	Crail Estates PTY Limited
46	The Council of the Shire of Muswellbrook
47	Webber
48	F & IR Webber
49	F & IR Webber
50	Energy Australia
51	Energy Australia
52	Domaine Property Funds
53	PC & DA & NA Mitchell
55	PM & FP Farrell & HG & MG Cope
56	JT & SE Bancroft
57	GJ Mayer
58	AR & FM Masters
59	RJD & DA Osborn
60	RJD & DA Osborn
61	JFA Burton
62	N Burke & HG Talbot
63	G Gillfeather
64	Eastbrook Estate PTY Limited
65	Eastbrook Pastoral PTY Limited
66	JG Abercrombie
67	Crown
68	BL & JM Bennett
69	BS & MB Wells
70	JA & DR Folpp
71	IE & LF Hunt
72	WR & JM Budden
73	PJ Hogan
74	F Webber
75	D & MJ Harris
76	Merlaust PTY Limited
77	MT Perram
78	Yarramalong Stud PTY LTD
79	SJ & J Jackson
80	EM Casben
81	CS Jacobsen
82	K Newton
83	K Newton
84	J Jacobsen
85	PJ & KJ Collins
86	RE & ID Baxter
87	RB & LJ Halloran
88	WJ Reynolds
89	SR Page
90	BC & SR Page
91	MF & AV Doherty
92	CJ & LE Duck
93	RDJ & DA Osborn
94	RC & LT Skinner
95	GHJ & PH De Boer
96	MJ Bird
97	P & K Clifton
98	BD & B Jones
99	DW & LM Hunter
100	EJ & MC Sharman
102	BJ & NH Robertson
103	The Council of the Shire of Muswellbrook
104	Crown
105	Crown
106	Crown
108	The State of NSW
109	The State of NSW
111	Arrowfield Wines PTY Limited
112	Calogo Bloodstock AG
113	Darley Australia PTY Limited
114	Crown
115	Hynken PTY Limited
116	Hynken PTY Limited
117	Hynken PTY Limited
118	NE Ray
119	Crown
120	Hynken PTY Limited
121	JN & JE Wolfgang
122	WRL Wolfgang
123	TL Wolfgang
124	TL Wolfgang
125	TL Wolfgang
126	TL Wolfgang
127	RL Wolfgang
128	MH Wolfgang
129	SA Wolfgang
130	SA Wolfgang
131	SA Wolfgang
132	SA Wolfgang
133	SA Wolfgang
134	RL Wolfgang
135	MH Wolfgang
136	MH & JN Wolfgang
138	MH & JN Wolfgang
139	MH & JN Wolfgang
140	MH & JN Wolfgang
141	MH & JN Wolfgang
142	MH & JN Wolfgang
143	MH & JN Wolfgang
144	MH & JN Wolfgang
145	MH & JN Wolfgang
146	MH & JN Wolfgang
147	MH & RE Wolfgang
148	MH & JN Wolfgang
149	MH & JN Wolfgang
150	MH & JN Wolfgang
151	MH & JN Wolfgang
152	MH & JN Wolfgang
153	MH & JN Wolfgang
154	MH & JN Wolfgang
155	MH & JN Wolfgang
156	MH & JN Wolfgang
157	G Mediati
158	MH & JN Wolfgang
159	MH & JN Wolfgang
160	MH & JN Wolfgang
161	MH & RE Wolfgang
162	MH & RE Wolfgang
163	PM Wolfgang
164	MH & RE Wolfgang
165	MH & RE Wolfgang
166	MH & RE Wolfgang
167	MH & RE Wolfgang
168	MH & RE Wolfgang
169	MH & RE Wolfgang
170	MH & RE Wolfgang
171	Spur Hill Agricultural
172	Spur Hill Agricultural
173	Spur Hill Agricultural
174	Spur Hill Agricultural
175	Spur Hill Agricultural
176	Spur Hill Agricultural
177	Spur Hill Agricultural
178	Blakefield
179	PR & M Burgmann
180	Crown
181	TR & KM Paulsen
182	TR & KN Paulsen
185	RW Turner
186	RW Turner
187	MJ & MJ Duncan
188	Crown
189	RW Jones
190	DJ Phillips
191	RL Wilks
192	HR & BC Grugeon
193	HR & BC Grugeon
194	Beringer Blass Wine
195	LA & CA MacPherson
198	MJ & MJ Duncan
200	GR & MK Walsh
201	EJ & CA Denton
203	MG & LJ Latham
204	MG & LJ Latham
206	DJ & JM Wild
209	BW & E Rankin
210	BW & E & WJ Rankin
211	BW & E & WJ Rankin
213	SR & JW Lawson
214	SR & JW Lawson
215	Minister for Public Works
216	AA & BT Meyer
217	State Rail Authority of NSW
218	JDM Markham
219	AA & BT Meyer
220	Crown
221	Crown
222	MR & M Peel
223	A Wynne & TW Roots
224	GR & MK Walsh
225	MR & M Peel
226	A Wynne & TW Roots
227	A Wynne & TW Roots
228	A Wynne & TW Roots
229	SR & JW Lawson
230	SR & JW Lawson
231	PJ Brown
232	JI & PJ Brown
233	RM & KF Merrick
234	JM Thompson
235	JM Thompson
236	JM Thompson
237	RM & KF Merrick
238	MR Peel
239	PR Ellis
240	PSJ Murray
241	PG & CM Lane
242	NJ & RY Ellis
243	GT McNeill
244	FN & WL Googe
245	RB & SA Parkinson
246	RB & SA Parkinson
247	RB & SA Parkinson
248	RB & SA Parkinson
249	RB & SA Parkinson
251	RB & SA Parkinson
252	BA & TE Strachan
253	RB & SA Parkinson
254	DR & AK Hughes
255	RB & SA Parkinson
256	RB & SA Parkinson
257	RB & SA Parkinson
258	RB & SA Parkinson
259	FN & WL Googe
260	C & LJ Francis
261	RH Keys & RH Reynolds
262	Aliform PTY Limited
263	Crown
264	J Moore
265	HJG Ray
268	Lake Liddell Recreational Park
287	Wild Group Pty Limited
288	NBN Limited
290	PJ Wild
291	GD Sneddon & JA Passfield
292	CM Bowman
IR.1	JM Standing & CA McLean
IR.2	KJ Nilon
IR.3	BJ Osborn
IR.4	JM Gill & I Hamwi
IR.5	WR Bromfield & KA Bromfield
IR.6	DH Smith & BC Smith
IR.7	SA Fulloon & TD Fulloon
IR.8	NJ Wall & EL Wall
IR.9	TJ Vanderwerf & TL Vanderwerf
IR.10	K Baker & N Baker
IR.11	LG Daniel & JA Daniel
IR.12	RJ Cullen & SM Cullen
IR.13	TP Carr & CA Carr
IR.14	BJ Morgan & LM Morgan
IR.15	MR Hinschen & JM Pawley
IR.16	NT Pollard & SM Pollard
IR.17	DB Bradstreet & AL Bradstreet
IR.18	BC Prosser & TM Prosser
IR.19	JL Adams & TL Adams
IR.20	BS Walsh & RJ Walsh
IR.21	S Strijakov
IR.22	BJ Wilcher & RA Wilcher
IR.23	PJ Langford & CL Landford
IR.24	BD Webber & SP Webber

Source: HVEC (2009; 2012)

MT ARTHUR COAL OPEN CUT MODIFICATION

FIGURE 1.4

Landholder List

(Refer Figure 1.2 and 1.3 for Details)

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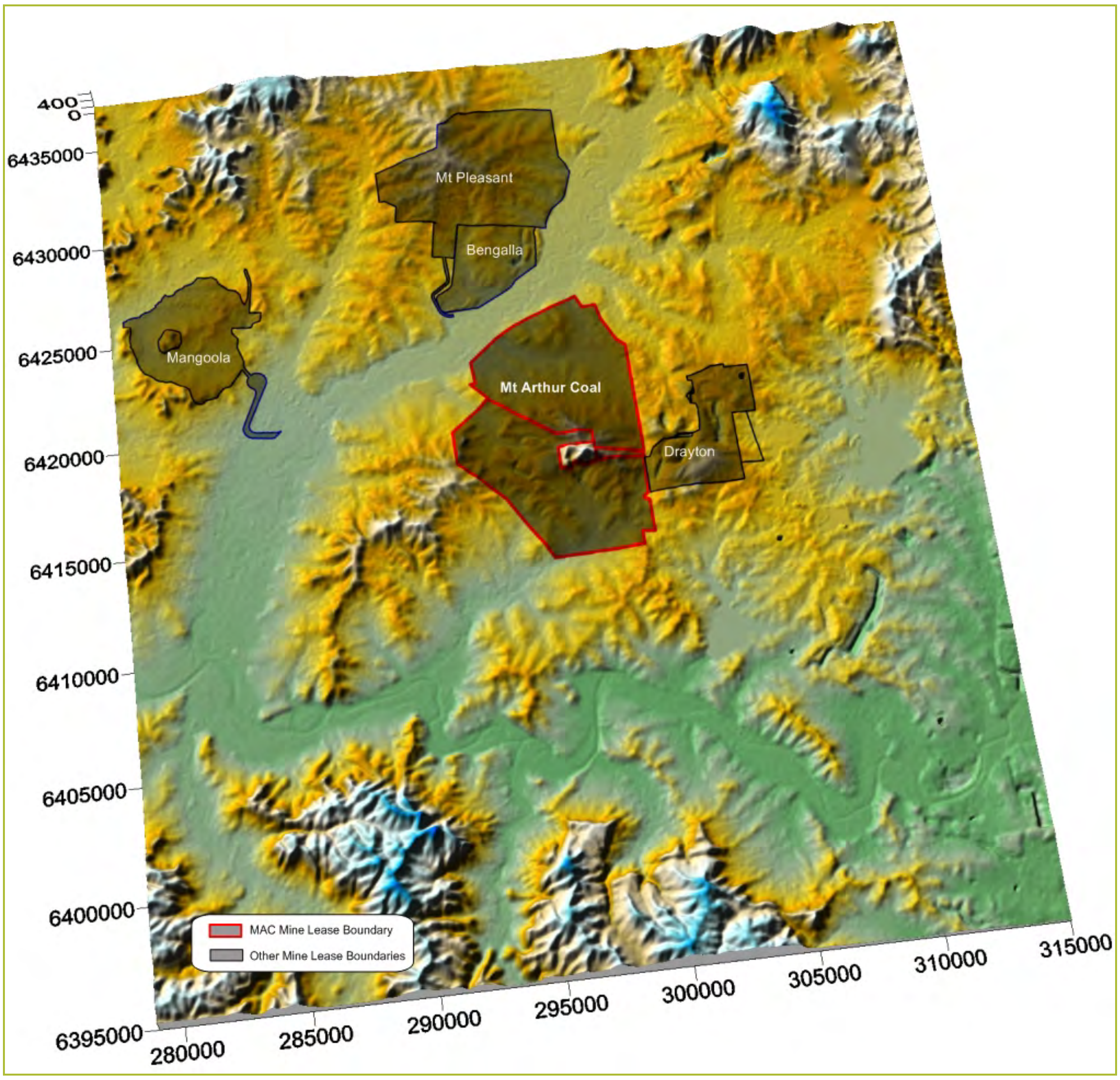


Figure 1.5: Psuedo-3D Terrain Plot of Area

2 MODIFICATION DESCRIPTION

The Modification is a proposed continuation of open cut mining operations at the Mt Arthur Coal Mine for an additional operational life of approximately four years.

Details of each of the main components of the Modification are discussed below.

Mining Operations

Conventional open cut mining methods involving drill and blast, truck and shovel extraction. On-site processing would continue to be used for the Modification.

The continuation of mining for an additional four years would include an extension to the west and southwest of some 400 metres (m).

Additional ROM coal as a result of the Modification would total approximately 128 million tonnes (Mt).

Overburden Management

The existing mine landforms include a conveyor corridor which contains the existing overland conveyor from the Mt Arthur Coal Mine ROM pad to Macquarie Generation's Bayswater Power Station.

As part of the Modification, the existing conveyor load point would be relocated to the south and the portion of the existing conveyor within the conveyor corridor would be decommissioned and removed, allowing overburden material to be placed in this corridor.

Overburden material associated with the Modification would also continue to be backfilled within the open cut. Additional disturbance areas associated with overburden emplacement would total approximately 50 hectares [ha]. Other overburden emplacement areas approved in accordance with PA 09-0062 would remain unchanged for the Modification.

Tailings Management

Additional tailings associated with the Modification would continue to be deposited in the existing tailings storage facility. The expansion of the existing tailing facility is already approved in accordance with PA 09_0062 and works commenced in mid-2012.

Rail Movements

The existing maximum total product coal transportation rate of 27 Mtpa would remain unchanged for the Modification.

As part of the Modification, the daily maximum number of trains would increase from 12 to 19 trains per day (i.e. an increase from 24 to 38 train movements per day).

Rail Loading and Unloading

The requirement for an increase in maximum rail movements at the Mt Arthur Coal Mine means that the existing rail loading infrastructure requires augmentation in order to receive and dispatch the required trains.

This would be achieved by a duplication of the existing rail loop.

Life of Mine

The mining life would be extended to allow for an additional four years of mining (to 2026).

Other Infrastructure

The existing explosives facility and magazine would be relocated to the west of the open cut as part of the Modification.

The location for the facility has been chosen following a review of all environmental aspects, including consideration of potential off-site hazard implications. The benefits of the new location include closer proximity to drill and blast operating areas which would result in a reduction in explosives transport distances on-site.

The Modification would also include minor infrastructure upgrades including an administration building, CHPP, control room and office facilities and a small extension to ROM coal stockpile footprint.

3 AIR QUALITY ASSESSMENT CRITERIA

3.1 Introduction

Extraction of coal requires the clearing of land and excavation of overburden material to recover the coal using heavy earth moving equipment. These activities generate fugitive dust emissions in the form of particulate matter described as total suspended particulate matter (TSP)[a], particulate matter with equivalent aerodynamic diameters of 10 µm or less (PM_{10})[b] and particles with equivalent aerodynamic diameters of 2.5 µm and less ($PM_{2.5}$).

In practice, emissions of carbon monoxide (CO), sulphur dioxide (SO_2) and nitrogen dioxide (NO_2) will occur from diesel-powered equipment and vehicle exhausts. Diesel combustion also results in the emission of particulate matter which is accounted for in the estimates of fugitive emissions of particles, which include diesel particles as well as particles derived from the materials being handled.

The low sulphur content of Australian diesel, in combination with the fact that mining equipment (including generators) is widely dispersed over mine sites, is such that the ambient air quality goals for SO_2 would not be exceeded, even in mining operations that use large quantities of diesel. For this reason, no detailed study is required to demonstrate that emissions of SO_2 from the Modification would not significantly affect ambient SO_2 concentrations. Similarly, NO_2 and CO emissions from the mining activities are limited and too widely dispersed to require a detailed modelling assessment. For this reason these emissions are not considered further in this report.

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

3.2 Assessment Criteria - Suspended Particulate Matter

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.

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 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 criteria make reference to measures of the total mass of all particles suspended in the air, 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 ($PM_{2.5}$ particles are a sub-component of PM_{10} and therefore also a sub-component of TSP).

[a] TSP refers to all particles suspended in air. In practice, the upper size range is typically 30 micrometres (µm).

[b] PM_{10} refers to all particles with equivalent aerodynamic diameters of less than 10µm, that is, all particles that behave aerodynamically in the same way as spherical particles with a unit density.

Mining emissions generate particles in all the above size categories, namely $PM_{2.5}$, PM_{10} and TSP. However, the great majority of the particles from mining operations are due to the abrasion or crushing of rock and coal and general disturbance of dusty material. As such most of the emissions will be larger than 2.5 µm. This is in contrast to particles found in bushfire smoke, or in the atmosphere in urban areas, where many of the particles are the result of combustion processes. A study of the distribution of particle sizes near (within 10 to 200 m) mining dust sources was undertaken on behalf of the NSW State Pollution Control Commission (SPCC) (now EPA) in 1986. The average of approximately 120 samples showed that $PM_{2.5}$ comprised 4.7 per cent (%) of the TSP, and PM_{10} comprised 39.1% of the TSP in the samples (**SPCC, 1986**). Thus, although emissions of $PM_{2.5}$ do occur from mining, the percentages of the emissions in this size range are small, and in practice the concentrations of $PM_{2.5}$ in the vicinity of mining dust sources are likely to be low compared with internationally recognised criteria.

In May 2003, the National Environment Protection Council (NEPC) released a variation to the National Environment Protection Measure (NEPM) (**National Environmental Protection Council, 2003**) to include advisory reporting standards (ARSs) for $PM_{2.5}$. The ARSs for $PM_{2.5}$ are a maximum 24-hour average of 25 micrograms per cubic metre (µg/m^3) and an annual average of 8 µg/m^3. However, there is no timeframe for compliance. The aim 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 $PM_{2.5}$. It is noted that the Ambient Air-NEPM $PM_{2.5}$ ARSs are not impact assessment criteria.

Notwithstanding the above, in the absence of any other relevant criteria, the ARSs have been used in this report for comparison against dispersion modelling results (**Section 8**).

The health-based assessment criteria used by EPA 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[c] origin, the particulate matter would be composed of smaller particles and would generally contain acidic and carcinogenic substances that are associated with combustion.

Table 3.1 includes the air quality criteria for suspended particulate matter from the Approved Methods that are relevant to this study.

Table 3.1: Air Quality Criteria/ Standards for Particulate Matter Concentrations

Pollutant	Criterion/Standard (µg/m^3)	Averaging Period	Source
TSP	90	Annual mean	National Health and Medical Research Council
PM_{10}	50	24-hour average	**DEC** (**2005**) (impact assessment criteria) NEPM (ambient air quality standard, allows five exceedances per year, e.g. for bushfires and dust storms)[1]
	30	Annual mean	**DEC** (**2005**) (impact assessment criteria)
$PM_{2.5}$	8	Annual mean	NEPM (ARS)
	25	24-hour average	

[1] The 50 µg/m^3 24-hour maximum PM_{10} criteria are cumulative (i.e. include background concentrations but exclude extraordinary events such as bushfires) in the existing Mt Arthur Open Cut PA 09_0062, however the 50 µg/m^3 property acquisition criteria applies specifically Project-only. A 150 µg/m^3 cumulative acquisition criterion applies cumulatively in Mt Arthur Open Cut PA 09_0062.

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

3.3 Assessment Criteria - Dust Deposition

In addition to health impacts, airborne dust also has the potential to cause nuisance effects by depositing on surfaces. **Table 3.2** 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 (**DEC, 2005**).

Table 3.2: EPA 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

g/m^2/month = grams per square metre per month.

3.4 Recent Project Approval Conditions

The DP&I project approval conditions contained in PA 09_0062 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. Project Approval conditions include the criteria summarised in **Table 3.3** and **Table 3.4**.

Table 3.3: Air Quality Impact 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 3.4: 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 total impact criteria in recent DP&I 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 a project considered in isolation.

3.5 Legislative Considerations

3.5.1 Action for Air

The NSW State Plan identifies cleaner air and progress on GHG reductions as priorities. In 1998, the NSW Government implemented a 25 year air quality management plan, Action for Air, for Sydney, the Illawarra and the Lower Hunter (**NSW Department of Environment, Climate Change and Water [DECCW], 2009**). Action for Air is a key strategy for implementing the State Plan for cleaner air goals.

Action for Air seeks to provide long-term ongoing emission reductions. It does not target acute and extreme exceedances from events such as bushfires. The aim of Action for Air includes:

- meeting the national air quality standards for six pollutants as identified in the Ambient Air-NEPM; and
- reducing the population's exposure to air pollution, and the associated health costs.

The six pollutants in the Ambient Air-NEPM include CO, NO_2, SO_2, lead, ozone and PM_{10}. The main pollutant from the Project that is relevant to the Action for Air is PM_{10}. Action for Air aims to reduce air emissions to enable compliance with the Ambient Air-NEPM targets to achieve the aims described above, with a focus on motor vehicle emissions.

Whilst Mt Arthur Coal Mine is not located within the areas relevant to the Action for Air plan (i.e. Sydney, the Illawarra and the Lower Hunter), the Project generally addresses the aims of the Action for Air Plan in the following ways:

- HVEC and PAEHolmes have reviewed potential mitigation measures, and a range of measures have been adopted for the Project (**Section 7**).
- Air quality emissions potentially associated with the Modification have been quantified (**Section 5**).
- Dispersion modelling has been completed by PAEHolmes to predict the impact of these emissions on nearby receivers, and assessment made on the effect of the emissions on ambient air concentrations which can then be compared with the Ambient Air-NEPM criteria (**Section 8**).

3.5.2 Protection of the Environment Operations Act, 1997

HVEC currently holds Environment Protection Licence (EPL) No. 11457 issued by the EPA under the NSW *Protection of the Environment Operations Act, 1997.* Relevant to air quality, the EPL includes a requirement to minimise dust emissions and specifies dust deposition and PM_{10} sampling requirements. The EPL also contain a Pollution Reduction Program (PRP) in relation to air quality (**Section 7.2**).

In addition, the *POEO (Clean Air) Regulation, 2010* prescribes requirements for domestic solid fuel heaters, control of burning, motor vehicle emissions and industrial emissions (such as Volatile Organic Carbons). Motor vehicle emissions would be addressed by regular maintenance of all vehicles associated with the Project.

4 EXISTING ENVIRONMENT

This section describes the dispersion meteorology, local climate conditions and existing dust levels in the area surrounding the Mt Arthur Coal Mine.

4.1 Dispersion Meteorology

Wind speed, wind direction, the standard deviation of wind direction (sigma-theta) and temperature are required as inputs to the dispersion modelling. Data was collected at 10-minute intervals from the former Macleans Hill meteorological station[d] in 2007 and 2008 (**Figure 1.1**). As discussed in **Section 1.1**, the same meteorological data used in the 2009 EA were used in this assessment to provide a direct comparison. For the period April 2007 to March 2008 there are a total of 8,688 hours of data available. This corresponds to 98.9% of the data potentially available in a year.

Hourly average data collected over the period April 2007 to March 2008 were used to create annual and seasonal wind roses which are presented in **Figure 4.1**. The wind roses show that in summer, the wind is predominantly from the east-southeast, while in winter, the wind is predominantly from the west-northwest. Autumn and spring months experience a combination of these wind conditions.

Table 4.1 shows the frequency of occurrence of the different stability[e] categories expected in the area. Mixing height[f] was determined using a scheme defined by **Powell (1976)** for day time conditions and an approach described by **Venkatram (1980)** for night time conditions.

Table 4.1: Frequency of Occurrence of Stability Classes in the Study Area

Stability Class	Percentage Frequency
A	7.6
B	4.1
C	9.6
D	55.3
E	17.0
F	6.4
Total	100

[d] Monitoring station removed due to mining encroachment.

[e] In dispersion modelling stability class is used to categorise the rate at which a plume will disperse. In the Pasquill-Gifford stability class assignment scheme, as used in this study, there are six stability classes (A through to F). Class A relates to unstable conditions such as might be found on a sunny day with light winds. In such conditions plumes will spread rapidly. Class F relates to stable conditions, such as those which occur at night-time when the sky is clear, the winds are light and an inversion is present. Plume spreading is slow in these circumstances. The intermediate classes B, C, D and E relate to intermediate dispersion conditions.

[f] The term mixing height refers to the height of the turbulent layer of air near the earth's surface into which ground-level emissions will be rapidly mixed. A plume emitted above the mixed-layer will remain isolated from the ground until such time as the mixed-layer reaches the height of the plume. The height of the mixed-layer is controlled mainly by convection (resulting from solar heating of the ground) and by mechanically generated turbulence as the wind blows over the rough ground.

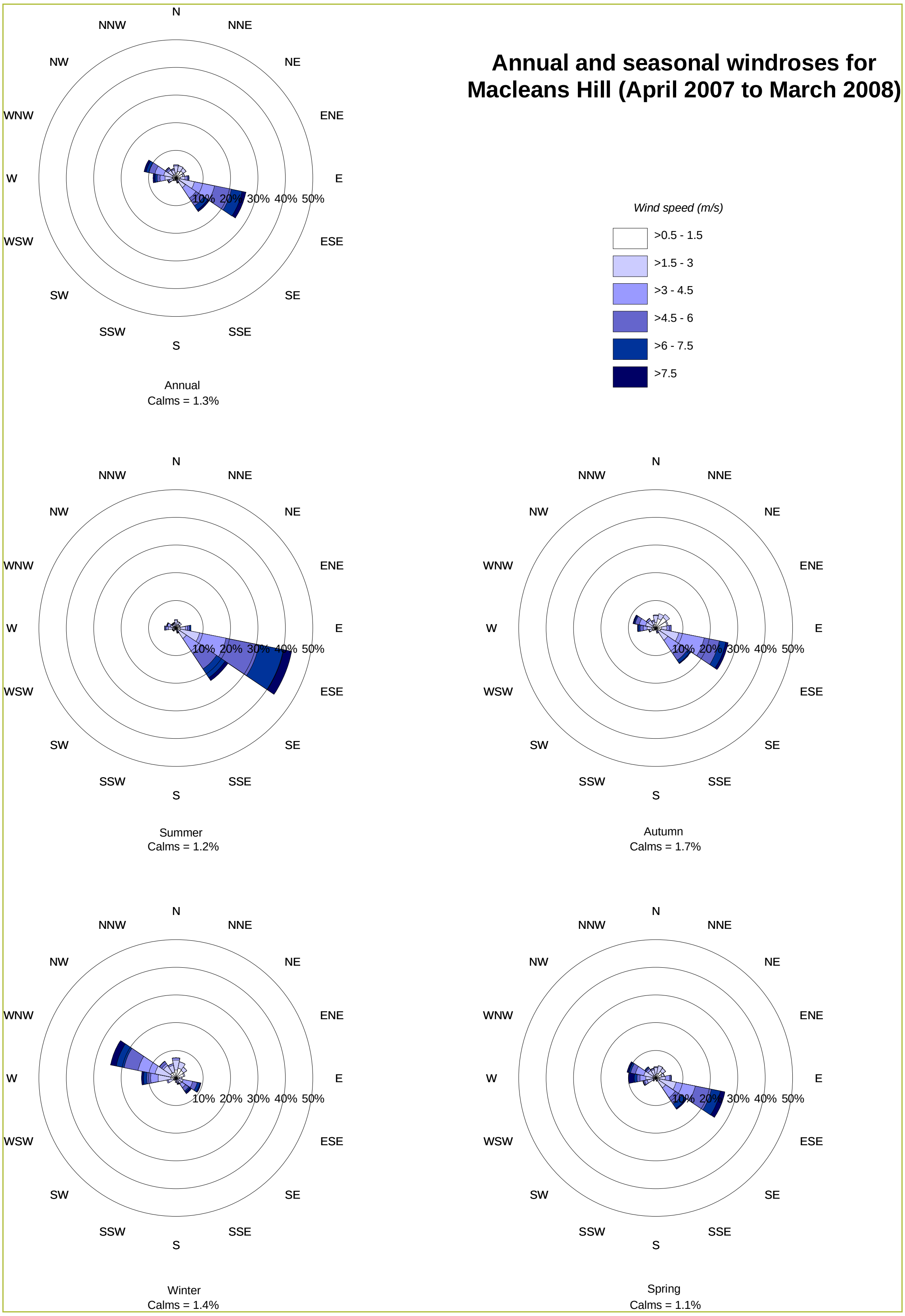


Figure 4.1: Annual and Seasonal Windroses for Macleans Hill (April 2007 to March 2008)

4.2 Climate Data

There are two Bureau of Meteorology (BoM) monitoring stations located near Mt Arthur Coal Mine, Scone Airport (Station number 061363) and Scone Soil Conservation Service (SCS) (Station Number 061089). The Scone Airport and Scone SCS monitoring stations are located approximately 30 kilometres (km) and 28 km from Mt Arthur Coal Mine, respectively. These sites provide information on the long-term average values of climatic elements such as temperature, humidity, rainfall and the number of raindays per year. The station at Scone Airport has been in operation since 1988 whilst the station at Scone SCS has been in operation since 1950.

Table 4.2 and **Table 4.3** present temperature, humidity and rainfall data collected at Scone Airport and Scone SCS, respectively (**BoM, 2012a**). Temperature and humidity data consist of monthly means of 9am and 3pm readings. Also presented are monthly averages of maximum and minimum temperatures. Rainfall data consist of mean and median monthly rainfall and the average number of raindays per month.

The annual mean maximum and minimum temperatures experienced at Scone Airport are 24.1 degrees Celsius (°C) and 10.0°C respectively. On average January is the hottest month with an average maximum temperature of 31.2°C. July is the coldest month, with average minimum temperature of 3.4°C.

At Scone SCS, the annual mean maximum and minimum temperatures experienced are 24.1°C and 11.0°C respectively. On average January is the hottest month with an average maximum temperature of 31.1°C. July is the coldest month, with average minimum temperature of 4.7°C.

The annual mean relative humidity reading collected at 9am at Scone Airport is 74%, and at 3pm the annual mean is 47%. The month with the highest humidity on average is June with a 9am average of 86%, and the lowest is January with a 3pm average of 41%.

At Scone SCS, the annual average relative humidity reading collected at 9am is 69%, and at 3pm the annual average is 47%. The month with the highest humidity on average is June with a 9am average of 78%, and the lowest is December with a 3pm average of 39%.

Rainfall data collected at Scone Airport shows that December is the wettest month, with a mean rainfall of 81.2 millimetres (mm) over 9.5 days. The mean annual rainfall is 609.9 mm with a mean of 107.1 raindays.

At Scone SCS, the rainfall data shows that January is the wettest month, with a mean rainfall of 81.3 mm over 8.2 days. The mean annual rainfall is 646.4 mm with a mean of 94.9 raindays.

Table 4.2: Temperature, Humidity and Rainfall Data for Scone Airport

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
9am Mean Dry-bulb and Wet-bulb Temperatures (ºC) and Relative Humidity (%)													
Dry-bulb	22.3	21.3	19	17	13	10	9.4	11.3	15.3	18.3	19.7	21.6	16.5
Wet-bulb	18.4	18.6	16.7	14.6	11.2	8.9	7.8	9.2	11.9	14.2	16	17.6	13.8
Humidity	70	77	82	77	81	86	83	73	66	62	66	67	74
3pm Mean Dry-bulb and Wet-bulb Temperatures (ºC) and Relative Humidity (%)													
Dry-bulb	29.9	28.9	26.7	23.4	19.4	16.1	15.6	17.7	20.8	23.6	26.0	28.4	23.0
Wet-bulb	20.4	20.5	19.5	16.5	13.9	11.8	10.9	11.7	14.1	15.9	17.7	19.1	16.0
Humidity	41	47	47	49	51	58	55	47	44	42	43	42	47
Daily Maximum Temperature (ºC)													
Mean	31.2	30.4	27.8	24.4	20.2	16.9	16.4	18.6	21.8	24.6	27.5	29.5	24.1
Daily Minimum Temperature (°C)													
Mean	16.7	16.6	14	9.9	6.7	4.6	3.4	3.6	6.8	9.5	13.1	15.2	10.0
Rainfall (mm)													
Mean	58.8	58.5	47.6	35.5	38.8	47.3	39.1	37.6	36.8	53.6	73.8	81.2	609.9
Raindays (Number)													
Mean	8.1	8.1	8.5	6.8	9.5	11.4	10.6	7.9	7.8	8.6	10.3	9.5	107.1

Station number 061363; Commenced: 1988, Latest record: 2012; Latitude (deg S): -32.03; Longitude (deg E): 150.83. *Source:* ***BoM (2012a)***

Table 4.3: Temperature, Humidity and Rainfall Data for Scone SCS

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
9am Mean Dry-bulb and Wet-bulb Temperatures (ºC) and Relative Humidity (%)													
Dry-bulb	22.9	21.9	20.2	17.6	13.3	10.4	9.5	11.5	15.2	18.7	20.3	22.5	17
Wet-bulb	18.8	18.6	17	14.4	11.1	8.7	7.5	8.6	11.4	14.1	15.6	17.6	13.6
Humidity	67	73	73	71	76	78	75	67	62	59	62	61	69
3pm Mean Dry-bulb and Wet-bulb Temperatures (ºC) and Relative Humidity (%)													
Dry-bulb	29.3	28.5	26.4	23	19	15.6	14.9	17.1	20.1	23.3	25.8	28.5	22.6
Wet-bulb	20.2	20.2	18.7	16	14	11.4	10.4	11.2	13.2	15.5	17	18.8	15.6
Humidity	43	47	47	47	56	58	54	46	43	42	41	39	47
Daily Maximum Temperature (ºC)													
Mean	31.1	29.9	27.9	24.5	20.1	16.9	16.3	18.3	21.4	24.9	27.6	30.2	24.1
Daily Minimum Temperature (°C)													
Mean	16.9	16.9	14.6	11.4	8.1	6	4.7	5.6	7.9	10.9	13.3	15.7	11.0
Rainfall (mm)													
Mean	81.3	77	51.3	39.8	47.4	45.2	36.1	39.2	39.2	59.4	61.7	68.4	646.4
Raindays (Number)													
Mean	8.2	7.7	7	6.7	7.5	9.1	7.9	7.8	7.1	8.8	8.5	8.6	94.9

Station number 061089; Commenced: 1950, Latest record: 2012; Latitude (deg S): -32.06; Longitude (deg E): 150.93. *Source:* ***BoM (2012a)***

4.3 Existing Air Quality

4.3.1 Introduction

Air quality standards and criteria refer to pollutant levels that include the contribution from specific projects and existing sources. To fully assess the potential impacts of the Modification against all relevant air quality standards and criteria (**Section 3**), it is necessary to characterise the existing or background conditions.

Dust deposition and dust concentration (PM_{10}) is monitored in the vicinity of Mt Arthur Coal Mine. The locations of the monitoring sites are shown in **Figure 4.2**. There are eight high volume air samplers (HVAS) measuring 24-hour average concentrations of PM_{10} every sixth day, and 21 dust deposition gauges (DDG) measuring the monthly average of deposited dust.

There are also six Tapered Element Oscillating Microbalances (TEOMs) which have been continuously monitoring PM_{10} concentrations since 2008. The EPA has also operated a TEOM monitoring PM_{10} and a Beta Attenuation Mass (BAM) monitoring $PM_{2.5}$ in Muswellbrook approximately 5 km northeast of Mt Arthur Coal Mine since December 2010.

The following sections discuss the dust deposition, PM_{10} TEOM and PM_{10} HVAS monitoring results for the period 2002 to 2011.

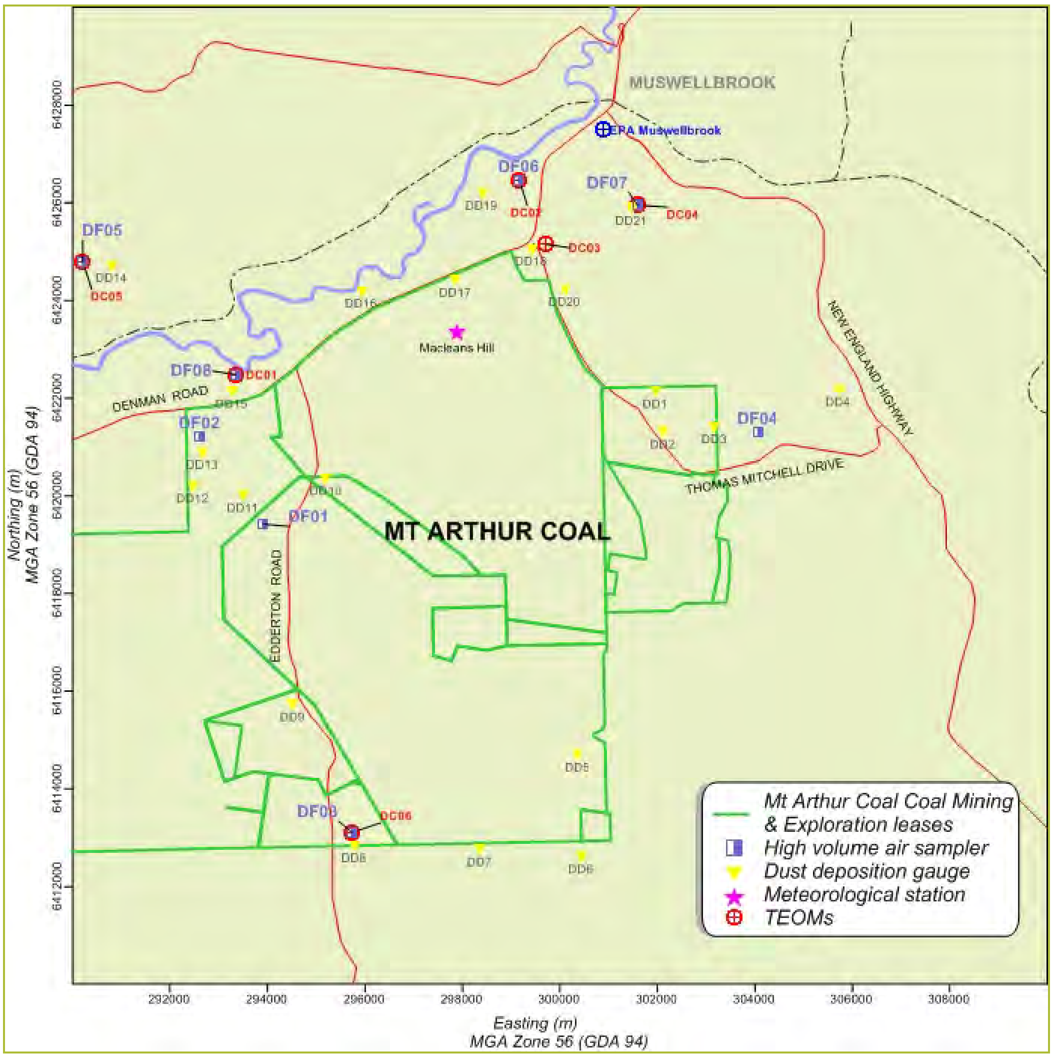


Figure 4.2: Locations of Ambient Monitoring Sites

4.3.2 PM_{10} Concentrations - High Volume Air Samplers

Figure 4.2 shows the locations of the HVAS's used to monitor PM_{10} concentrations. A complete set of HVAS monitoring results are presented in **Appendix B**. From the time series data shown in **Figure 4.3** it can be seen that, generally, the PM_{10} concentrations in the area are lowest in the cooler, winter months when the prevailing winds are from the northwest, and highest in the warmer, summer months when the prevailing winds are most likely to be from the east-southeast.

The time series data also show that all sites have on occasion exceeded the EPA's current 24-hour average PM_{10} ambient air quality criteria of 50 µg/m^3 at all sites. However, a number of these exceedances are caused by widespread dust events. For example, there were several state wide dust storms reported which coincided with high PM_{10} measurements in 2009. It can be seen that PM_{10} measurements were generally higher in 2009 compared to other years.

There are other occasions where the measured PM_{10} levels exceed 50 µg/m^3 at a number of different sites at the same time. This would seem to indicate a widespread wind or bushfire event rather than a more localised source.

A summary of annual average PM_{10} data collected are presented in **Table 4.4** for the period 2002 to 2011. The results in **Table 4.4** show that all sites complied with the EPA's annual average PM_{10} criterion of 30 µg/m^3 from 2002 to 2011. Concentrations were highest at the Sheppard Avenue and South Muswellbrook sites, but still remain below the criterion. It is noted that both HVAS are located away from the predominant wind direction from Mt Arthur Coal Mine (i.e. east-southeasterlies) and therefore the contribution from Mt Arthur Coal Mine to these HVAS are expected to be small.

Table 4.4: Annual average PM_{10} concentration at each monitoring site (µg/m^3)

Station ID	Monitoring location	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Average
		Criterion										
		30	30	30	30	30	30	30	30	30	30	
DF01	Roxburgh South	9.2	16.8	17.3	15.8	16.9	17.7	18.4	23.9	15.8	20.6	17.2
DF02	Windmill	20.2	19	18.7	16.5	15.8	16	13.5	20.2	14.8	15.4	17.0
DF03	Edderton	19.8	17.1	14.6	13.5	16.9	16.7	14.5	17.7	14.1	13.9	15.9
DF04	Wire Lane	24.9	23.7	23.1	19.7	18.2	22	20.3	27.4	19.3	20.6	21.9
DF05	Constable	23.6	21.3	19	16.6	17.5	17.4	16.3	22.8	16.3	16.6	18.7
DF06	Sheppard Ave	ND	*	27.6	21.8	27.3	27.4	21.4	29.8	21.3	21.1	24.7
DF07	South Muswellbrook	*	25.3	28.4	22.4	22.3	23.2	21	28.3	19.9	21.1	23.5
DF08	Denman Rd West	20.9	19.4	18	19.2	18.3	19.7	20.5	26.4	19.2	21.4	20.3

ND – no data.
* - less than six months data available.

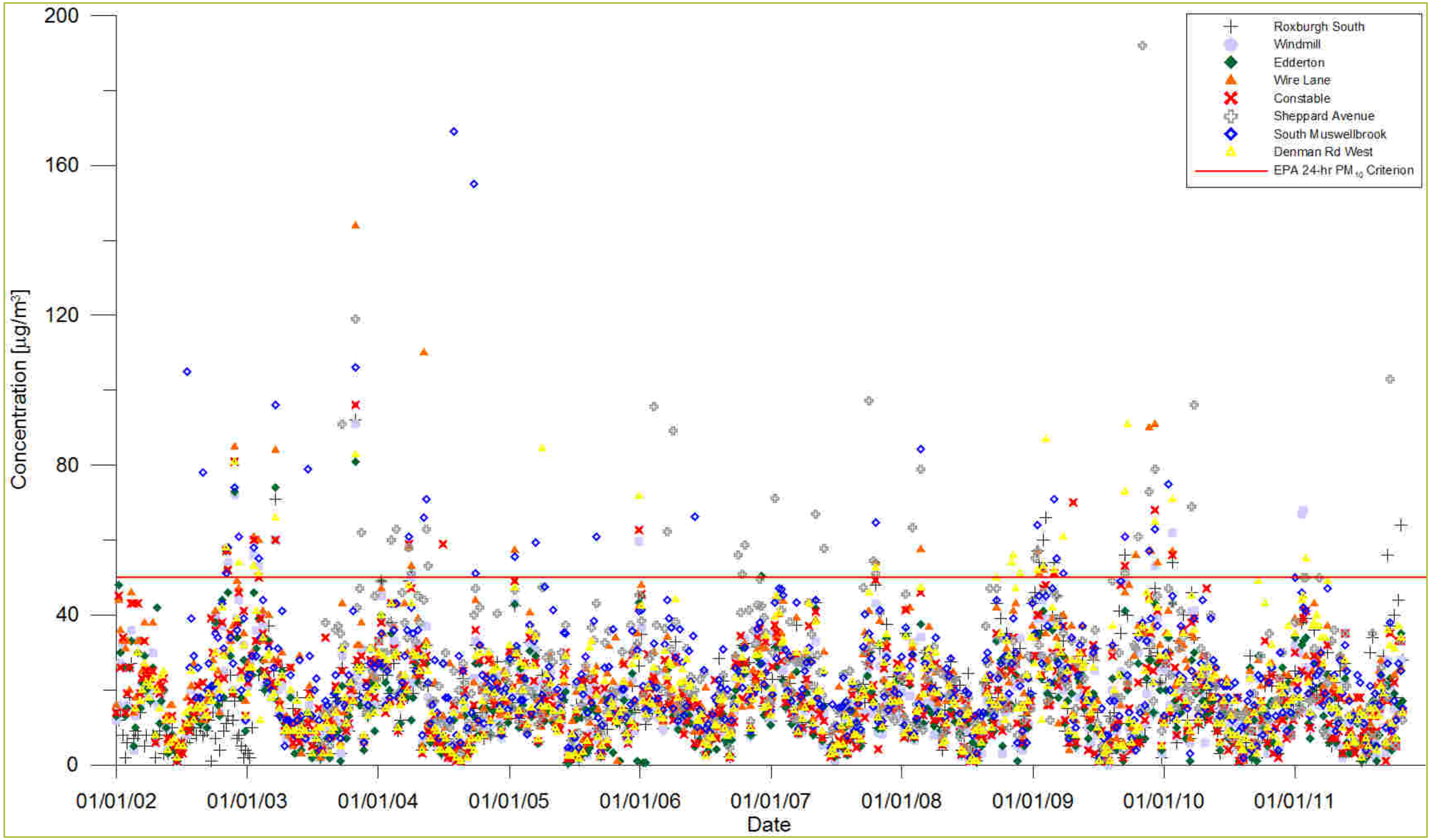


Figure 4.3: HVAS 24-hour PM_{10} Concentrations

4.3.3 PM_{10} Concentrations - Tapered Element Oscillating Microbalances

Real-time PM_{10} monitoring using TEOMs is also completed as part of the internal monitoring scheme for Mt Arthur Coal Mine. Six TEOM monitoring stations have been set up around the general vicinity of Mt Arthur Coal Mine and enable the mine to monitor PM_{10} levels in real time compared with HVAS that only sample every six days (**Figure 4.2**).

A new TEOM was installed in 2011 at Constable (DC05) and less than 12 months of data were available for review at the time of this report. The average PM_{10} concentration collected from March 2011 to November 2011 was 3.6 µg/m^3 which appears very low compared to the other TEOMs and HVAS DF05. This is due to $PM_{2.5}$ concentrations being recorded as PM_{10} concentrations at DC05 between May 2011 and November 2011.

Table 4.5 and **Figure 4.4** show the PM_{10} concentrations measured at the TEOM monitoring sites on an annual average and 24-hour average basis respectively. Monitoring data was available from October 2008 to November 2011 for DC01 to DC04. DC06 was installed in October 2010, therefore monitoring data were available from installation to November 2011. The average values presented in **Table 4.5** exclude elevated monitoring values due to non-mining events (e.g. dust storms).

Figure 4.4 shows some elevated 24-hour PM_{10} concentrations in 2009 of the monitoring data set. On several occasions the monitors recorded 24-hour PM_{10} concentrations greater than 300 µg/m^3 due to dust storm events, these data have been removed from the figure to provide a clearer representation of the data.

A summary of the number of exceedances of EPA's 24-hour PM_{10} criterion from 2008 to 2011 is provided in **Table 4.6** with a description of the possible cause of the exceedance. Regional dust events have been reported by BoM (**BoM, 2012b**) and cross referenced with monitored exceedances. No exceedances were recorded at DC06 between October 2010 and November 2011.

2009 was a very dry year with extreme weather conditions and a record number of dust events occurred in that year. This is reflected in the monitoring where there were a number of exceedances recorded, the majority of which occurred in October and November.

Comments on the other exceedances include localised events and wind directions not originating from Mt Arthur Coal Mine, indicating the possible cause of the event cannot be directly related to activities occurring at Mt Arthur Coal Mine.

Table 4.5: TEOM Annual Average PM_{10} (µg/m^3)

TEOM	Monitoring Location	2008[1]	2009	2010	2011	Criterion
DC01	Denman Road West	19	27	13	14	30
DC02	Racecourse Rd/Sheppard Avenue	29	**32**	4	4	30
DC03	Yammaine	20	**34**	15	16	30
DC04	South Muswellbrook	21	**32**	13	14	30
DC06[2]	Edderton	-	-	13	15	30
	Average	22	**31**	12	13	30
				Average over all sites and years	19	30

[1] Data available from October 2008.
[2] Data available from 23 October 2010.
Note: Exceedances are shown in bold.

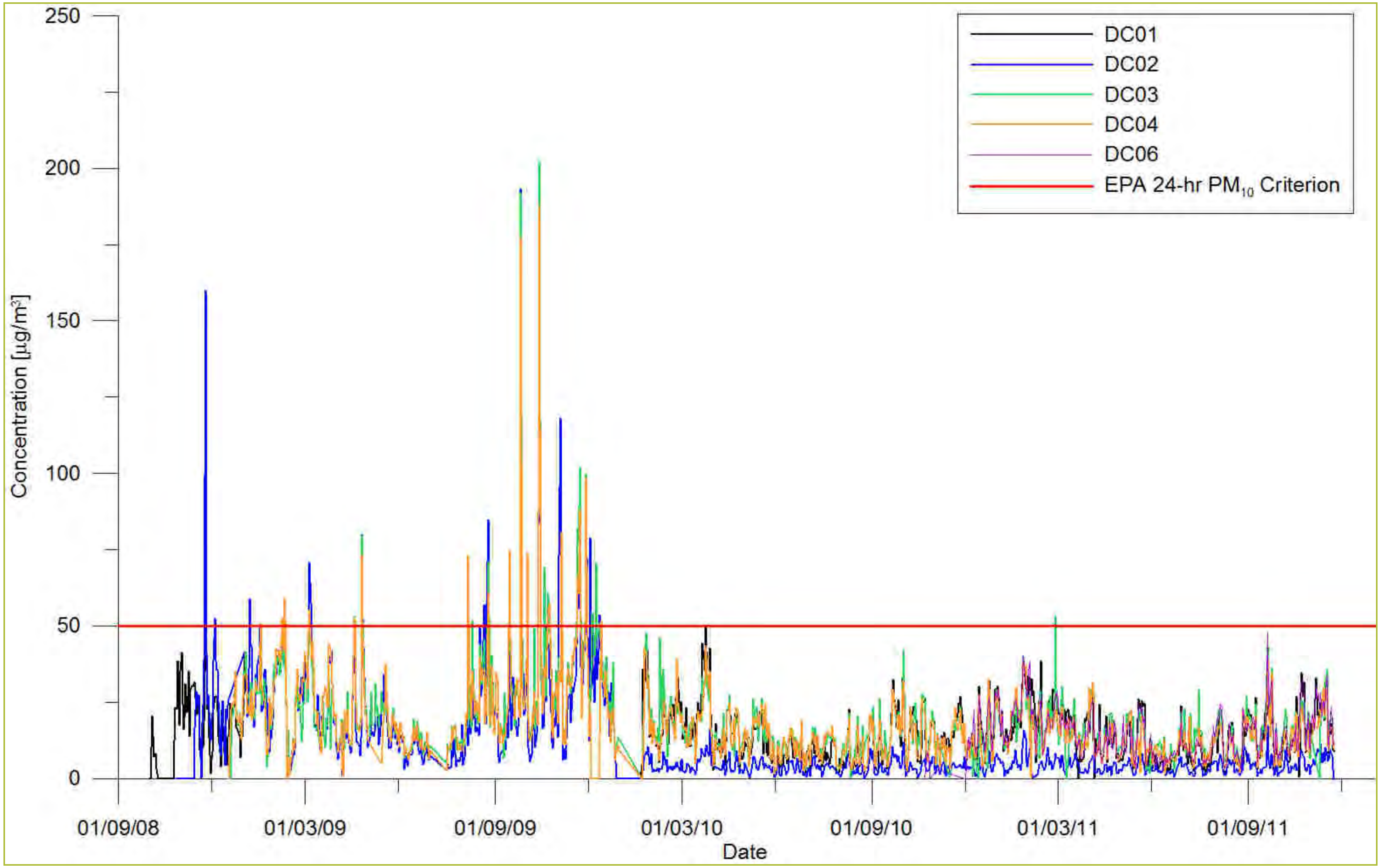


Figure 4.4: TEOM 24-hour PM_{10} Concentrations

Table 4.6: Number of Exceedance events (24-hour criterion) for TEOM Monitors

Date	DC01	DC02	DC03	DC04	Comment
2008	1	2	-	-	Regional strong winds*
2009	12	24	30	24	Regional dust storms*
2010	-	-	-	-	-
2011	-	-	1	-	Wind direction not from Mt Arthur Coal Mine**

* **BoM** (**2012b**).
** **BoM** (**2012a**).

4.3.4 EPA Monitors

The EPA operates a TEOM monitoring PM_{10} and a BAM monitoring $PM_{2.5}$ in Muswellbrook, the monitors are located in Bowman Park in a residential area of Muswellbrook (**Figure 4.2**). The monitors were installed in December 2010. The annual average values are presented in **Table 4.7**. The annual average $PM_{2.5}$ concentration of 9 µg/m^3 exceeded the ARS of 8 µg/m^3 in 2011.

The different monitoring methods used for the two size fractions results in a number of $PM_{2.5}$:PM_{10} ratios greater than 1, which is not realistic given that $PM_{2.5}$ is a subset of PM_{10}. The higher ratios tend to occur during winter months. A possible explanation for $PM_{2.5}$:PM_{10} ratios that are greater than 1 is that a greater proportion of the particulate matter comes from wood burning in domestic fires. These particles are known to be associated with volatile components which are not measured accurately by certain TEOM models.

Figure 4.5 shows no exceedances of the PM_{10} 24-hour criterion at the Muswellbrook monitor. There were four days in 2011 where there were exceedances of the 24-hour average $PM_{2.5}$ ARS of 25 µg/m^3. These four days occur in the winter months where there is an increase in burning from domestic wood fires. The trend for $PM_{2.5}$ also reflects this where lower $PM_{2.5}$ concentrations are recorded during the summer months. The BAM is located in a residential area and therefore local influence (e.g. domestic activities) on the monitor are expected.

Table 4.7: Summary of Annual Average PM_{10} and $PM_{2.5}$ (µg/m^3) Monitoring at Muswellbrook

Particulate	2011	2012[1]	Criterion
PM_{10}	19	20	30
$PM_{2.5}$	**9**	8	8

[1] Data available until May 2012.
Note: Exceedances are shown in bold.

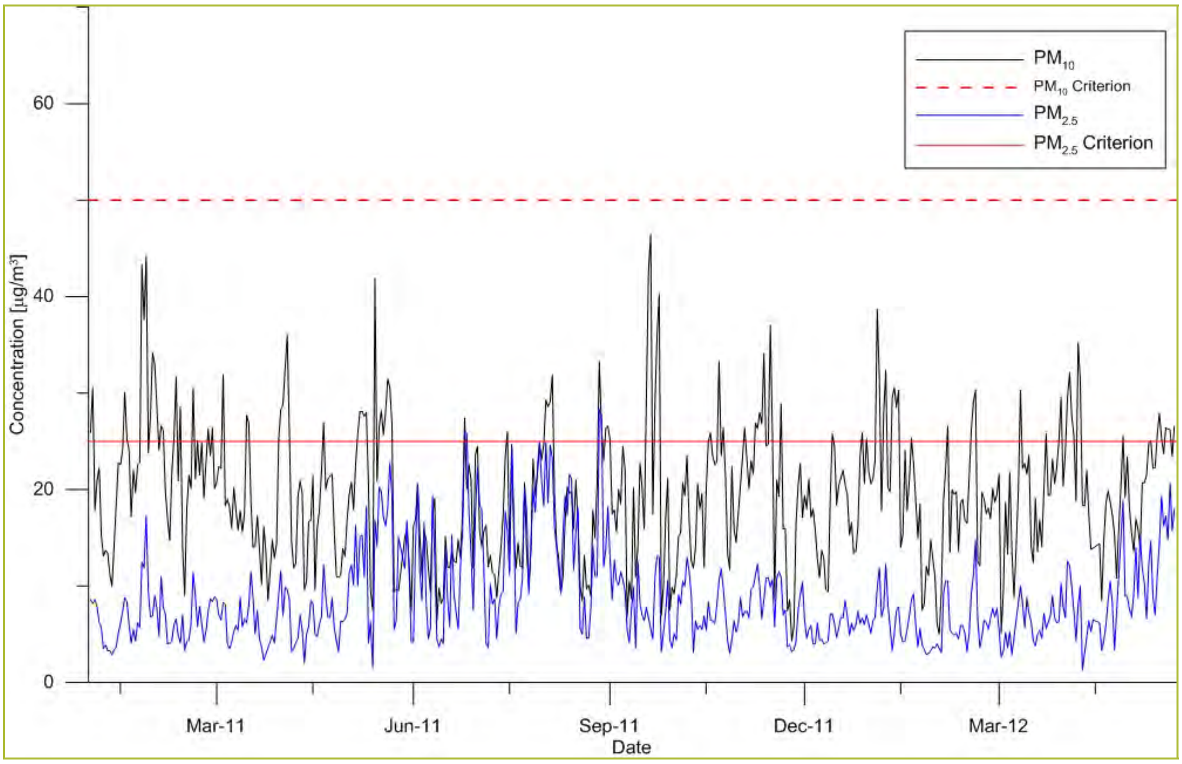


Figure 4.5: TEOM 24-hour PM_{10} and $PM_{2.5}$ Concentrations at Muswellbrook

4.3.5 Dust Deposition

Figure 4.2 shows the locations of the 21 DDGs analysed in this assessment. The monthly data are presented in **Appendix B**, with the annual averages summarised in **Table 4.8**.

Table 4.8: Annual Average Dust Deposition Data (Insoluble Solids) – 2003 to 2011 (g/m^2/month)

Gauge	2003	2004	2005	2006	2007	2008	2009	2010	2011	Average
	Criterion = 4 g/m^2/month									
DD1	3.4	2.2	2.2	2.8	2.0	2.1	2.8	3.4	3.4	2.7
DD2	**4.3**	3.7	2.8	**4.3**	3.4	*	**4.3**	**5.8**	3.5	4.0
DD3	3.7	2.6	3.2	3.6	4.0	3.0	**4.1**	**5.9**	3.4	3.7
DD4	1.8	1.7	1.7	1.9	1.8	1.8	2.8	2.3	1.9	2.0
DD5	2.7	3.1	3.0	2.2	2.6	2.2	3.3	2.8	3.1	2.8
DD6	2.1	1.2	1.8	1.6	1.9	1.9	*	1.9	*	1.8
DD7	3.1	*	1.8	2.2	1.2	1.3	1.5	1.3	1.1	1.7
DD8	1.0	1.2	1.3	1.2	1.1	1.8	1.4	1.0	1.0	1.2
DD9	1.6	1.3	1.1	1.0	1.1	1.1	1.3	1.1	1.2	1.2
DD10	1.8	1.9	1.9	2.1	2.0	1.9	2.5	1.9	2.3	2.0
DD11	3.1	*	3.0	3.5	2.4	2.2	2.5	2.9	2.7	2.8
DD12	2.8	1.9	2.1	2.7	1.7	1.9	1.8	1.9	2.2	2.1
DD13	1.7	1.8	1.4	1.6	1.3	1.4	2.6	*	2.8	1.8
DD14	1.4	1.2	1.0	1.1	0.8	1.1	1.3	2.3	1.1	1.2
DD15	1.9	1.9	2.4	2.4	2.5	1.8	2.1	1.9	1.8	2.1
DD16	**4.2**	3.7	3.3	**4.3**	3.1	3.3	**5.0**	3.7	**4.7**	3.9
DD17	3.5	**4.1**	2.3	2.3	2.2	2.1	3.4	2.6	2.3	2.8
DD18	2.7	2.6	2.1	3.0	2.5	2.0	3.6	2.6	2.4	2.6
DD19	2.7	2.4	2.3	2.7	2.4	2.2	3.4	3.0	2.5	2.6
DD20	2.9	2.3	3.4	3.6	2.9	3.0	**4.6**	3.0	2.9	3.2
DD21	2.1	2.2	2.1	2.8	1.8	1.9	2.6	1.9	1.6	2.1
									Average across all sites	**2.4**

** Less than six months of valid data available.*
Value in bold indicate concentrations above criteria.

In **Table 4.8**, the EPA criterion of 4 g/m^2/month (annual average) has been exceeded 12 times.

2009 and 2010 were particularly dry years where wide spread dust storms were experienced around the state. This is reflected in the dust deposition monitoring where there are the highest number of exceedances recorded at the DDGs. DD3 and DD20 only recorded exceedances during these two years and are below the criterion for all other years.

Site DD16 lies immediately to the northwest of the Mt Arthur Coal Mine operation, across Denman Road on land owned by HVEC, and could potentially be affected by winds from the southeast blowing across the exposed mining areas. This is supported by elevated levels in the summer months when these winds predominate. Measurement of elevated levels during winter months indicates the site is receiving dust from sources in addition to Mt Arthur Coal Mine.

DD17 recorded one result marginally above the criterion in 2004. Since that time, recorded dust deposition levels have remained below the criterion.

Measurements at deposition gauges are heavily influenced by local dust producing activities, and this can be seen in the large variation in levels over small distances. For example, DD1 has reported levels below 4 g/m^2/month for the entire monitoring period while DD2, which is approximately 800 m south of DD1, exceeds this level in four years. It should be noted that DD2 is often contaminated with organic matter and sand. If the Mt Arthur Coal Mine mining activities were the dominant source of dust for both these gauges they should display similar results. It is therefore likely that there are local sources of contamination contributing to the observed levels. This is also the case for DD10 and DD11 which lie close to each other and in the same direction from the mine, but which show different levels of deposition.

The gauges which consistently show the lowest deposition levels are those well away from the mining area to the south, DD6, DD7, DD8 and DD9. An exception to this rule however is DD10 which lies very close to the Mt Arthur Coal Mine activities but has shown levels of less than 2.5 g/m^2/month since 2003. It should be noted, that winds from the northeast which would bring material from Mt Arthur Coal Mine, do not occur very often at this location.

4.3.6 Air Quality Management

Air Quality Management at the Mt Arthur Coal Mine is undertaken in accordance with the Air Quality and Greenhouse Gas Management Plan (**HVEC, 2012a**).

Air quality management was reviewed by **Applied Environmental Management Consultants** (**AEMC**) (**2012**) as part of the Independent Environmental Audit. The review indicated that HVEC generally complies with relevant air quality Project Approval conditions (**AEMC, 2012**).

Dust management measures undertaken at Mt Arthur Coal Mine include:

- minimisation of disturbed areas;
- use of water carts/trucks to control emissions from haul roads;
- use of dust suppressant where necessary;
- progressive rehabilitation;
- delay of blasts if unfavourable weather prevails;
- use of water sprays or curtains for drilling operations;
- shielding of conveyors at rail loading facility and water sprays at transfer points;
- water sprays and/or wind shields at ROM hopper bins and coal stockpiles;
- delay of topsoil stripping until damp or favourable weather conditions; and
- cover cropping of long term topsoil stockpiles not used for over six months.

Additionally, Mt Arthur Coal Mine has a proactive dust management system. An outline of the proactive dust management system (using real-time dust monitoring) is provided in the Air Quality Monitoring Program (**HVEC, 2012b**).

Six TEOMs are installed to monitor PM_{10} concentrations continuously, at locations around Mt Arthur Coal Mine; representative of receivers who may experience short-term elevated dust concentrations (**Figure 4.2**).

In summary, the TEOMs are linked to the site via a telemetry system that relays data to a central server and a short message service alarm function has been implemented and is designed to alert the Environmental Coordinator and Open Cut Examiners of a potential exceedance of the 24-hour average PM_{10} impact assessment criteria. Alarms are based on 15 minute PM_{10} concentration and the rolling 24-hour average concentration.

The alarm allows early warning to implement corrective measures to prevent exceedances from occurring.

5 ESTIMATED DUST EMISSIONS

Dust emissions arise from various sources within open cut coal mines. Total dust emissions were estimated by analysing the types of dust generating activities taking place at the Mt Arthur Coal Mine for three mine stage years.

For predictive modelling, emissions from dust generating sources associated with a proposed development are estimated and are referred to as emission factors. These emission factors allow for the various sources of a proposed development to be simulated in the modelling.

Emission factors developed both locally and by the United States (US) EPA were used to estimate the amount of dust produced by each activity. The emission factors applied are considered to be the most applicable and representative for determining dust generation rates for the proposed activities. The fraction of fine, coarse and residual particles for each activity were taken into account in the dispersion modelling.

The Modification would facilitate continuation of mining from the currently approved 2022 to 2026. Therefore, the primary focus of this assessment is to identify any potential impacts associated with mining in this period. However, because of other changes proposed as part of the Modification (e.g. placement of overburden in the conveyor corridor), assessment years included in the Consolidation Project EA 2016 and 2022 were re-evaluated for this report.

The three selected years (2016, 2022 and 2026) cover impacts arising from a range of production activities (including overburden production). The information used for developing the inventories has been based on operational descriptions and mine plan drawings and was used to determine haul road distances and routes, stockpile and pit areas, activity operating hours, truck sizes and other details that are necessary to estimate dust emissions. All significant dust generating activities from the Modification have been identified and dust emission estimates for each of the three mine plan years are presented below in **Table 5.1**.

Further details of the methods used in calculating the dust emissions are presented in **Appendix C**. Detailed emission inventories for all modelled years are presented in **Appendix D.** The estimated emissions take account of existing air pollution controls including watering of haul roads and water sprays during drilling (refer to **Section 7**).

The pit area labels at Mt Arthur Coal Mine are as follows:

- Macleans Hill (MC);
- Windmill (WM);
- Huon (HU);
- Calool (CA);
- Roxburgh (RX);
- Ayredale (AY); and
- Saddlers (S).

Table 5.1: Estimated TSP Emissions (kg/year)

Activity	2016	2022	2026
OB - Stripping topsoil - MC	1,858	-	-
OB - Stripping topsoil - WM	1,706	1,853	2,106
OB - Stripping topsoil - HU	2,601	1,165	1,178
OB - Stripping topsoil - CA	-	2,184	2,508
OB - Stripping topsoil - RX	1,168	3,753	2,814
OB - Stripping topsoil - AY	298	-	-
OB - Drilling - MC	2,671	-	-
OB - Drilling - WM	6,405	8,478	5,807
OB - Drilling - HU	6,619	4,298	6,723
OB - Drilling - CA	5,064	6,906	10,506
OB - Drilling - RX	8,083	9,506	14,067
OB - Drilling - AY	600	179	179
OB - Drilling - S	1,013	1,569	448
OB - Blasting - MC	31,663	-	-
OB - Blasting - WM	75,922	100,486	68,826
OB - Blasting - HU	78,460	50,945	79,688
OB - Blasting - CA	60,026	81,861	124,528
OB - Blasting - RX	95,810	112,671	166,745
OB - Blasting - AY	7,106	2,123	2,123
OB - Blasting - S	12,013	18,602	5,307
OB - Sh/Ex/FELs loading - MC	63,618	-	-
OB - Sh/Ex/FELs loading - WM	152,542	201,897	138,285
OB - Sh/Ex/FELs loading - HU	157,642	102,359	160,108
OB - Sh/Ex/FELs loading - CA	120,605	164,475	250,201
OB - Sh/Ex/FELs loading - RX	192,501	226,378	335,024
OB - Sh/Ex/FELs loading - AY	14,278	4,265	4,265
OB - Sh/Ex/FELs loading - S	24,137	37,376	10,664
OB - Hauling to emplacement - MC	467,346	-	-
OB - Hauling to emplacement - WM	1,158,426	1,771,141	877,223
OB - Hauling to emplacement - HU	1,085,886	924,166	1,186,082
OB - Hauling to emplacement - CA	816,713	1,243,005	1,829,032
OB - Hauling to emplacement - RX	1,489,888	1,783,646	1,997,928
OB - Hauling to emplacement - AY	91,676	24,437	26,187
OB - Hauling to emplacement - S	60,880	94,274	42,953
OB - Emplacing at dumps - MC	63,618	-	-
OB - Emplacing at dumps - WM	152,542	201,897	138,285
OB - Emplacing at dumps - HU	157,642	102,359	160,108
OB - Emplacing at dumps - CA	120,605	164,475	250,201
OB - Emplacing at dumps - RX	192,501	226,378	335,024
OB - Emplacing at dumps - AY	14,278	4,265	4,265
OB - Emplacing at dumps - S	24,137	37,376	10,664
OB - Dozers on O/B - MC	81,567	-	-
OB - Dozers on O/B - WM	195,580	254,845	153,394
OB - Dozers on O/B - HU	202,119	129,203	177,601
OB - Dozers on O/B - CA	154,632	207,608	277,537
OB - Dozers on O/B - RX	246,812	285,746	371,628
OB - Dozers on O/B - AY	18,306	5,383	4,731
OB - Dozers on O/B - S	30,947	47,178	11,829
OB - Dozers on Rehabilitation - total	445,916	445,916	457,722
CL - Dozers ripping - MC	8,634	-	-
CL - Dozers ripping - WM	23,100	28,966	17,530
CL - Dozers ripping - HU	25,072	9,366	16,142
CL - Dozers ripping - CA	18,253	24,269	27,872
CL - Dozers ripping - RX	26,235	29,871	37,477
CL - Dozers ripping - AY	879	9,571	6,370
CL - Dozers ripping - S	3,094	3,224	1,389
CL - Loading ROM to trucks - MC	125,276	-	-
CL - Loading ROM to trucks - WM	335,182	421,182	254,593
CL - Loading ROM to trucks - HU	363,800	136,187	229,594
CL - Loading ROM to trucks - CA	264,846	352,880	400,004
CL - Loading ROM to trucks - RX	380,667	434,333	539,514
CL - Loading ROM to trucks - AY	12,752	139,171	87,732
CL - Loading ROM to trucks - S	44,898	46,876	19,133
CL - Hauling ROM coal to dump hopper - MC	163,989	-	-
CL - Hauling ROM coal to dump hopper - WM	424,800	618,688	382,377
CL - Hauling ROM coal to dump hopper - HU	348,130	165,998	288,768
CL - Hauling ROM coal to dump hopper - CA	208,911	370,753	442,887
CL - Hauling ROM coal to dump hopper - RX	327,103	476,283	606,375
CL - Hauling ROM coal to dump hopper - AY	13,751	157,066	102,068
CL - Hauling ROM coal to dump hopper - S	63,829	66,640	28,696
CL - Unloading ROM coal at stockpile/hopper - MC	37,583	-	-

Activity	2016	2022	2026
CL - Unloading ROM coal at stockpile/hopper - WM	100,555	126,355	76,378
CL - Unloading ROM coal at stockpile/hopper - HU	109,140	40,856	68,878
CL - Unloading ROM coal at stockpile/hopper - CA	79,454	105,864	120,001
CL - Unloading ROM coal at stockpile/hopper - RX	114,200	130,300	161,854
CL - Unloading ROM coal at stockpile/hopper - AY	3,826	41,751	26,320
CL - Unloading ROM coal at stockpile/hopper - S	13,469	14,063	5,740
CL - Rehandle ROM coal at stockpile/hopper	168,016	168,369	168,363
CL - Handling coal at CHPP	9,587	9,607	9,607
CL - Dozers at CHPP	156,725	156,725	156,725
CL - Transporting rejects	57,660	128,307	167,874
CL - Loading product coal stockpile	6,173	6,186	6,186
CL - Loading coal to trains	6,173	6,186	6,186
WE - OB spoil area - All pits	4,965,987	8,909,024	5,967,686
WE - Open pit - All pits	4,333,102	4,598,046	4,118,014
WE - Active rehab	517,435	929,872	4,010,168
WE - ROM stockpiles	36,149	36,149	36,149
WE - Product stockpiles	11,086	11,086	11,086
Grading roads	73,856	73,856	73,856
Underground_ROM/crushing stockpile area	360,000	360,000	360,000
Underground_CHPP area	360,000	360,000	360,000
TOTAL TSP (kg) (Open Cut)	**22,379,803**	**28,080,554**	**28,384,088**
ROM coal production (tonne) (Open Cut)	**31,932,942**	**32,000,000**	**32,000,000**
TSP/ROM Ratio (kg/tonne) (Open Cut)	**0.70**	**0.88**	**0.89**

(OB – overburden, CL – coal, WE – Wind erosion, Sh – shovel, Ex – Excavator, FELs – Frontend loader, kg - kilograms)

5.1 Estimated Emissions from Neighbouring Mines

The EPA requires an assessment of cumulative emissions in the context of all existing and approved projects (**Table 1.2**). The estimated emissions for the neighbouring mines have been taken from the EIS's for following mines:

- Bengalla (included in 2016) (**PAEHolmes, 2010**).
- Drayton (included in 2016) (**Holmes Air Sciences, 2007**).
- Mangoola (formerly Anvil Hill) (included in 2016, 2022 and 2026) (**Holmes Air Sciences, 2006**).
- Mount Pleasant (included in 2016, 2022 and 2026) (**Zib & Associates Pty Ltd, 1997**).

The approvals for Bengalla and Drayton local mines are scheduled to expire prior to 2022, and therefore have not been included in the assessment for 2022 and 2026. The approval for nearby Muswellbrook Coal Company expires by 2015 and was not included in this assessment. Proposed modification projects are discussed in **Section 5.1.2**.

Where data were not available for the precise years of the Modification, data from the closest available year was used. **Table 5.2** presents a summary of the estimated emissions. The Mount Pleasant Mine EIS (**Zib & Associates Pty Ltd, 1997**) was undertaken 15 years ago and was based on emission factors which have since been superseded. For this assessment, the Mount Pleasant Mine inventory was updated by PAEHolmes with the latest emission factors.

Table 5.2: Summary of Estimated TSP Dust Emissions from Other Mines (kg/year)

Mine	2016	2022	2026
Mount Pleasant	3,159,375	5,479,615	6,010,455
Mangoola	3,677,713	3,770,360	3,013,405
Drayton	3,225,173	-	-
Bengalla	8,535,843	-	-
Total	**18,598,104**	**9,249,975**	**9,023,860**

Mangoola Coal Mine submitted an Air Quality Impact Assessment as part of the EIS for a modification (Mangoola Modification) in December 2010 (**Sinclair Knight Merz, 2010**). The Mangoola Modification includes redesign of the mine plans and mine staging with no change to the approved maximum production rate of 10.5 Mtpa of ROM coal. The results of the modelling for the Mangoola Modification indicates the predicted impacts are similar to the 2006 assessment and the extent of impacts will be within what is currently approved for the site.

A summary of the estimated emissions for Mangoola Coal Mine from the 2006 EIS compared to the 2010 EIS is provided in **Table 5.3**. The estimated TSP emissions between the two assessments are very similar with a difference of approximately 6% in 2016 and 3% in 2022. The Mangoola Modification proposed to ramp down production by 2026 and there is a 78% decrease in estimated dust emissions compared to the 2006 EIS.

The Mangoola Modification was approved on 22 June 2012 approximately six months after the modelling for this Modification was completed. Re-modelling of the Mangoola Coal Mine was not considered to be required based on the similarity in predicted impacts between the 2010 and 2006 EIS. In particular, the modelling completed for Mangoola Coal Mine in this assessment is considered to be very conservative for 2026 as it is based on the higher production rates from the 2006 EIS.

Table 5.3: Mangoola Coal Mine Air Quality Assessments (kg/year)

Assessment	2016	2022	2026
2006 EIS	3,677,713	3,770,360	3,013,405
2010 EIS	3,927,993	3,649,760	674,428

NOTE: 2016 corresponds with Year 5, 2022 corresponds with Year 10 and 2026 corresponds with Year 15 of the Mangoola Modification.

Whilst the preferred approach to the cumulative impact assessment would be to sum the predicted concentrations to the measured concentrations, this is not a practical approach for two main reasons:

- The monitoring data are only applicable to the current activities in the area and do not take account of changes in activities in the future.
- The monitoring data are only applicable to the location where the samples are taken from.

In the cumulative modelling work, each neighbouring mine has been treated as a number of volume sources. These have been located at the apparent points of major emission as estimated from the known locations of the pits and/or major dust sources on the mine or facility.

Sources have been considered in three classes covering all dust emission sources for which there are emission factor equations for open cut mines.

1. Wind erosion sources where emissions vary with the hourly average wind speed raised to the power of three.
2. Loading and dumping operations where emissions vary with wind speed raised to the power of 1.3.
3. All other sources where emissions are assumed to be independent of wind speed.

For neighbouring mines, the proportion of emissions in each of these categories has been assumed to be:

- 0.732 for emissions independent of wind speed;
- 0.135 for emissions that depend on wind speed (such as loading and dumping); and
- 0.133 for wind erosion sources.

These factors are based on a detailed analysis of mine dust inventories undertaken as part of the Mt Arthur North Coal Project EIS (**URS Australia, 2000**), and have subsequently been accepted as appropriate and routinely applied to subsequent air quality impact assessments for mining operations.

5.1.1 Drayton South Coal Project

Drayton South Coal Project is a proposed new coal mine approximately 5 km south of Mt Arthur Coal Mine (**Figure 5.1**). Coal resources at the existing Drayton Coal Mine are expected to be exhausted by 2015 and the Drayton South Coal Project will utilise the existing Drayton Coal Mine facility for the processing of coal. The existing Drayton Coal Mine has a capacity of 8 Mtpa and the Drayton South Coal Mine would have a maximum capacity of 7 Mtpa.

The highest impact at receptors from the Modification is unlikely to correspond with the highest impact from the proposed Drayton South Coal Mine due to the predominant wind direction of the area and the location of the mines and the residences.

The existing Drayton Coal Mine is approved for 8 Mtpa and the Drayton South Coal Mine will have a capacity of 7 Mtpa. Therefore, the processing of coal from the Drayton South Coal Mine at the Drayton processing facilities is expected to have less dust emissions compared to the existing coal processing of the Drayton Coal Mine.

A review of the air quality assessment for the Drayton South Coal Mine indicates that the maximum 24-hour average PM_{10} concentration from Drayton South Coal Mine at the receptors to the west of Mt Arthur Coal Mine is approximately 10 $\mu g/m^3$. The worst case impacts on receptors to the west from the Modification when there are easterlies. Conversely, the worst case impacts from the Drayton South Coal Mine at the same residences are expected when the wind direction is south-easterlies. Based on the location of the two coal mines, the potential impacts from the Drayton South Coal Mine on days when the Modification has the highest impacts should be minimal.

Further discussion on the cumulative impacts of the Drayton South Coal Mine and the Modification is provided in **Section 8.6.5**.

5.1.2 Proposed Modifications to Neighbouring Mines

There are also three proposed modifications or projects related to neighbouring mines in the vicinity of Mt Arthur Coal Mine including:

- Bengalla Continuation Project; and
- Drayton Modification.

Bengalla Coal Mine submitted a Preliminary EA on February 2012 to DP&I for the continuation of its operation for another 24 years mainly within the current mining lease at a capacity of up to 15 Mtpa. Mining is proposed to be undertaken to the west of its current operations the proposed project western boundary will be at Roxburgh Road. The proposed Bengalla Continuation Project is at its preliminary stages and no detailed information is available for review to allow dispersion modelling.

The Drayton Modification consists of an additional 36.5 ha disturbance to that previously approved. An air quality assessment was undertaken by PAEHolmes (**PAEHolmes, 2012**) and the results indicate that there would be no predicted exceedances of the NSW Office of Environment and Heritage's assessment criteria at the nearby privately owned residences as a result of the Drayton Modification. The Drayton Modification EA was exhibited in May/June 2012.

Potential impacts from these proposed mines have been considered qualitatively in this report (**Section 8.6.5**).

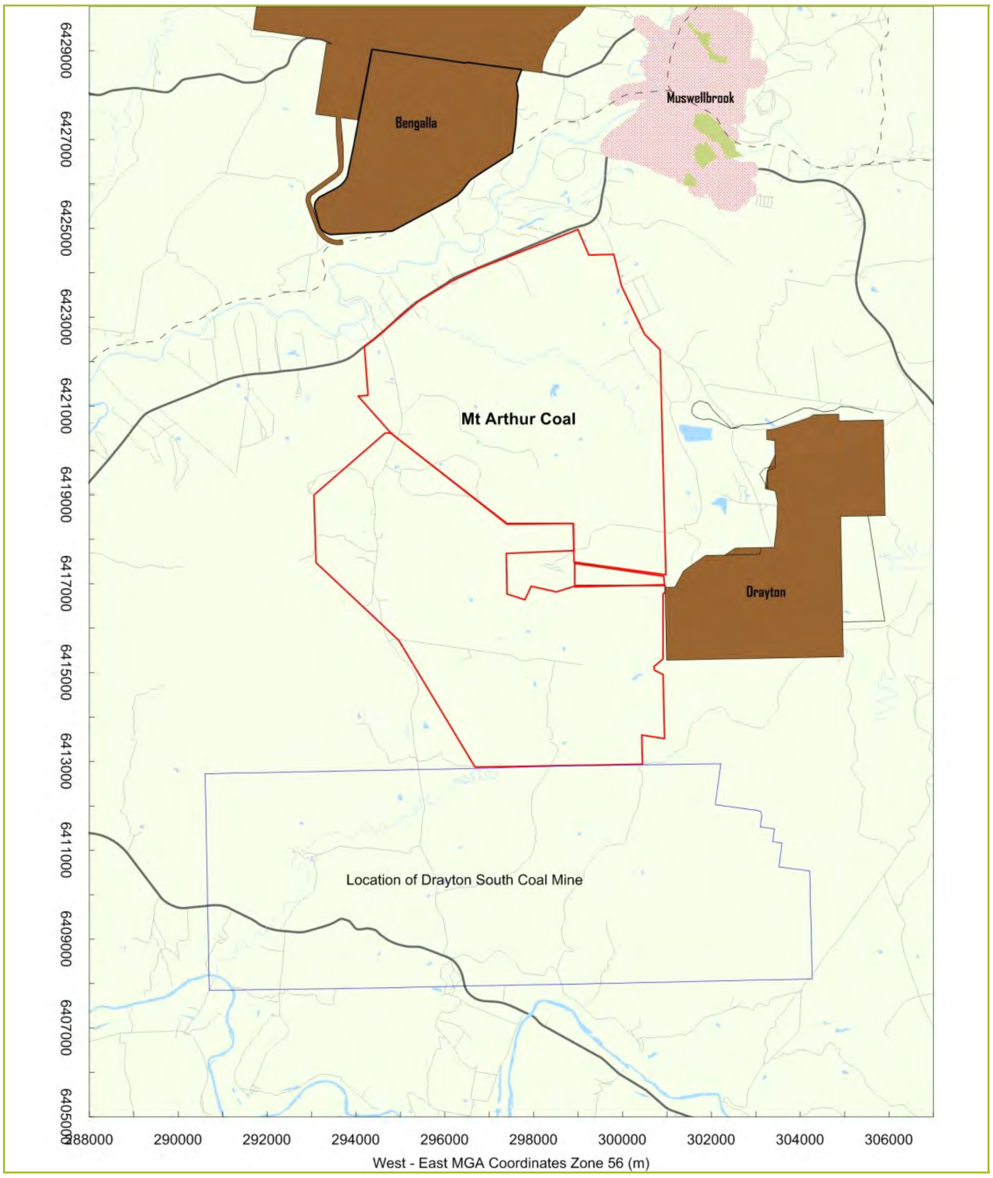


Figure 5.1: Neighbouring Mines

5.2 Estimated Emissions from Distant Mines and Other Sources

In addition to the mines identified in **Section 5.1**, distant mines and other sources will contribute to $PM_{2.5}$, PM_{10}, TSP concentrations and to dust deposition in the area. Estimating the background allowance for distant mines and non-mining sources is difficult and depends on local land use and the associated emission sources, as well as other factors, such as climate and soil type.

Spatially varying grids for annual average predictions for PM_{10} and TSP were developed in the 2009 EA (**PAEHolmes, 2009**). This was done to take into account the spatial variation in the contribution that distant mines and other sources make to the ambient concentrations of annual average PM_{10} and TSP where open cut mining and other emission sources (e.g. residential roads, power stations) are located compared with areas where open-cut mining is not active.

The spatially varying grids for TSP and PM_{10} from the 2009 EA were also used in this assessment. The annual average quantity of deposited dust contributed by these other sources has been set at 1 g/m^2/month which is consistent with the 2009 EA.

Limited $PM_{2.5}$ concentration data are available in the vicinity of the Modification. Co-located monitors for PM_{10} and $PM_{2.5}$ have been operated by the EPA at a number of locations in the Hunter Valley since end of 2010. The meteorological data used in this assessment were from the period of April 2007 to March 2008 and therefore using the spatially varying grid method is not feasible for $PM_{2.5}$ concentrations.

The average ratio of $PM_{2.5}/PM_{10}$ across all EPA monitoring sites is 0.40. As discussed in **Section 4.3.4**, EPA monitors use different monitoring methods for measuring PM_{10} and $PM_{2.5}$ which results in ratios of $PM_{2.5}/PM_{10}$ greater than 1 (particularly during the winter months). Excluding winter months and instances where $PM_{2.5}/PM_{10}$ ratios are greater than 1, the average ratio of $PM_{2.5}/PM_{10}$ at the Muswellbrook EPA monitor is 0.38. In order to correspond with the BAM $PM_{2.5}$ monitoring period, the average PM_{10} concentration measured across the Mt Arthur Coal TEOMs in 2011 is 13 µg/m^3 (**Table 4.5**).

Using this ratio and applying it to the annual average PM_{10} concentration of 13 µg/m^3, the annual average $PM_{2.5}$ background concentration would be approximately 5 µg/m^3. This accounts for >60% of the annual $PM_{2.5}$ ARS of 8 µg/m^3.

In summary, the following has been assumed for background dust concentrations and levels:

- Annual Average PM_{10} – varies spatially.
- 24-hour PM_{10} – varies daily.
- Annual Average TSP – varies spatially.
- Annual Average $PM_{2.5}$ - 5 µg/m^3.
- Dust deposition - 1 g/m^2/month.

6 ASSESSMENT APPROACH

The assessment generally follows the Approved Methods which specify how assessments based on air dispersion models should be undertaken. The Approved Methods include guidelines for the preparation of meteorological data to be used in dispersion models and relevant air quality impact criteria (see **Section 3**).

This assessment generally follows the guidelines in the Approved Methods, but deviates in relation to the use of the ISCMOD model to provide a direct comparison with the 2009 EA instead of the AUSPLUME, CALPUFF and TAPM models which are named in the Approved Methods. The ISCMOD model has been specially developed from the US EPA's ISCST3 model which provides for greater accuracy with the prediction of short-term PM_{10} concentrations compared to the models referenced in the Approved Methods. The use of ISCMOD has been accepted for use in NSW by the EPA for a number of years for mining and quarry assessments, including mining projects in the Hunter Valley.

ISCMOD was derived from the ISCST3 model by applying changes to the horizontal and vertical dispersion curves following recommendations made by the American Meteorological Society Expert Panel on Dispersion Curves (**Hanna et al., 1977**). The ISCST3 model is fully described in the user manual and the accompanying technical description (**US EPA, 1985**). The modelling used three particle-size categories (0 to 2.5 µm - referred to as fine particle [FP], 2.5 to 10 µm - referred to as coarse matter [CM] and 10 to 30 µm - referred to as the Rest). Emission rates of TSP were calculated using emission factors derived from **US EPA (1985)** and **SPCC (1983)** (**Appendix C**).

The distribution of particles has been derived from measurements in the **SPCC (1986)** study. The distribution of particles in each particle size range is as follows:

- $PM_{2.5}$ (FP) is 4.68% of TSP;
- $PM_{2.5-10}$ (CM) is 34.4% of TSP; and
- PM_{10-30} (Rest) is 60.92% of TSP.

Each particle size range was assumed to emit at the full TSP emission rate and to deposit from the plume in accordance with the deposition levels appropriate for particles with an aerodynamic diameter equal to the geometric mean of the limits of the particle size range, except for $PM_{2.5}$, which was assumed to have a particle size of 1 µm. The predicted concentration in the three plot output files for each particle size range were then combined according to the weightings in the bullet points above to determine the concentration of PM_{10} and TSP.

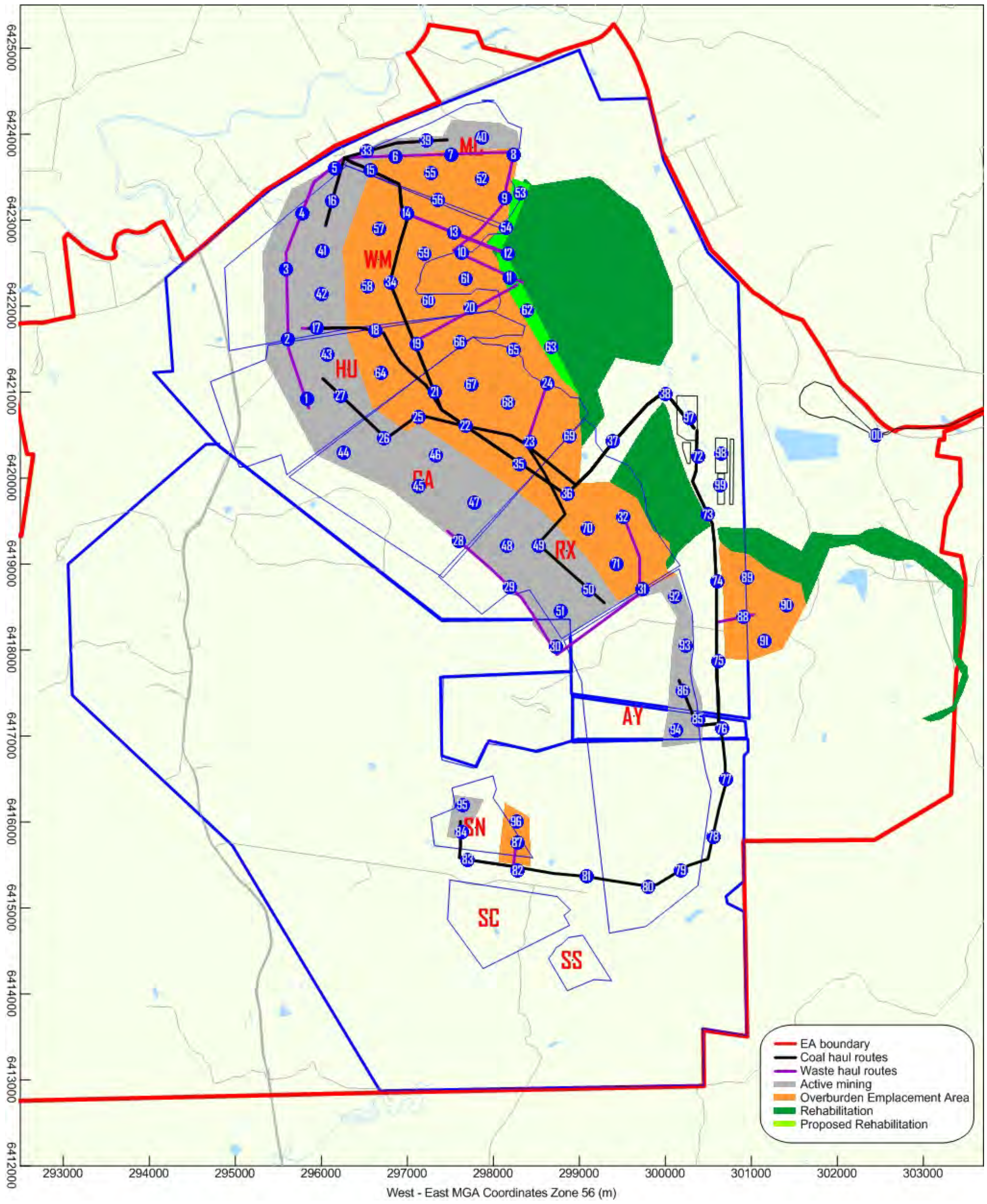
The ISCST3 model also has the capacity to take into account dust emissions that vary in time, or with meteorological conditions. This has proved particularly useful for simulating emissions on mining or quarry operations where wind speed is an important factor in determining the rate at which dust is generated.

For the current study, the operations were represented by a series of volume sources located according to the location of activities for the modelled scenarios (**Figure 6.1** to **Figure 6.3**). Estimates of emissions for each source were developed on an hourly time step taking into account the activities that would take place at that location. Thus, for each source, for each hour, an emission rate was determined which depended upon the level of activity and the wind speed. It is important to do this to ensure that long-term average emission rates are not combined with worst-case dispersion conditions, which are associated with light winds. Light winds at a mine site would correspond with periods of low dust generation (because wind erosion and other wind-dependent emissions rates would be low), and also correspond with periods of poor dispersion. If these measures are not taken then the model has the potential to significantly overstate impacts.

For cumulative modelling, each neighbouring mine was treated as a number of volume sources. These were located at the apparent points of major emissions as estimated from the publicly available information of the pits and/or major dust sources on the mine or facility. Modelled sources from these mines were considered in three classes as follows; wind erosion sources (e.g. exposed pit areas), wind sensitive sources (e.g. loading of materials) and wind insensitive sources (e.g. dozers).

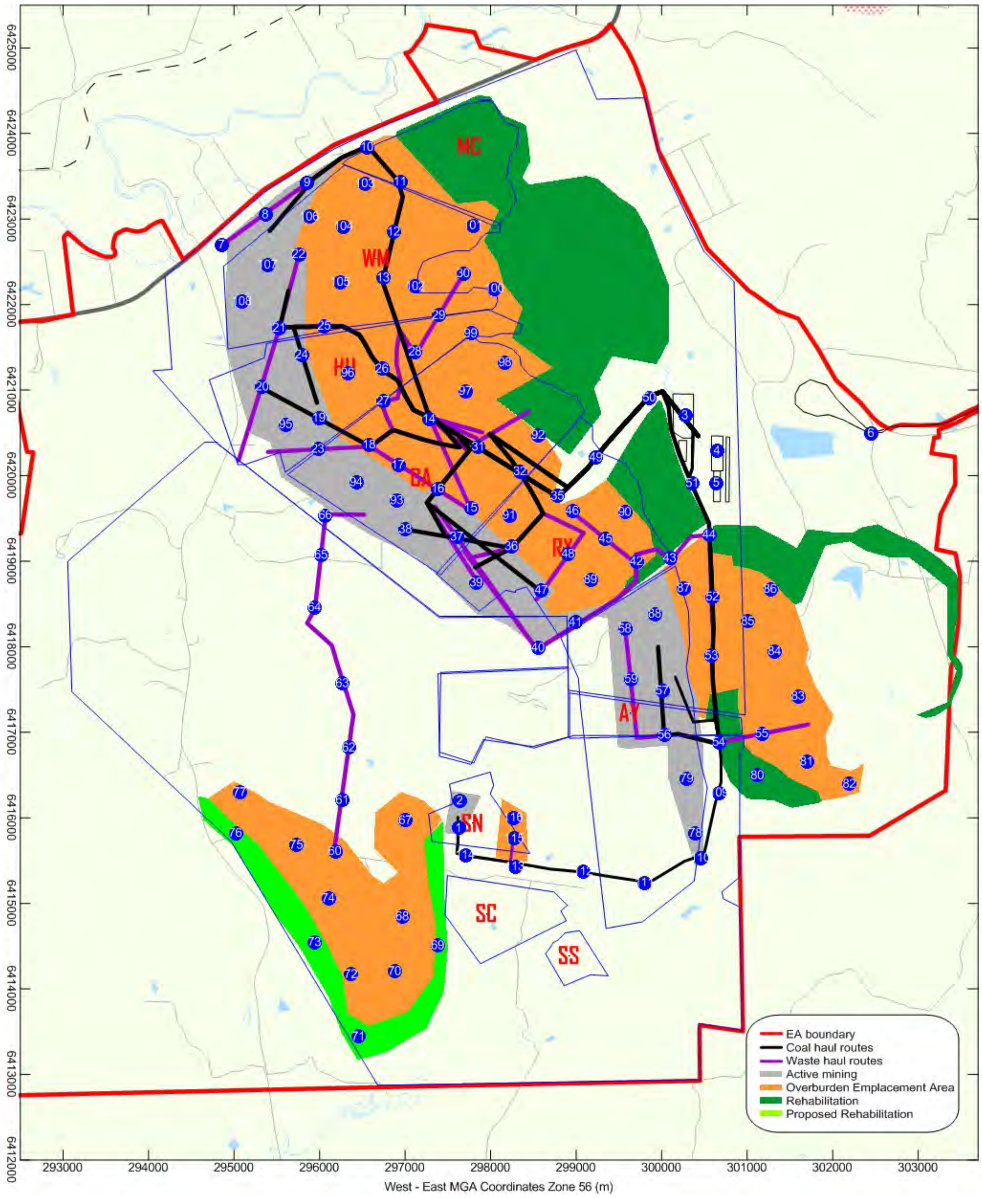
Dust concentrations and deposition levels were predicted over the modelling domain shown in **Figure 1.1** with the mine site located approximately in the centre. Modelling used the meteorological data discussed in **Section 4.1** and the dust emission estimates from **Section** 5 operating 24 hours per day. Dust emission inventories are provided in **Appendix D**.

To assess cumulative impacts, modelling results are presented which consider the contribution of surrounding mines in the area as well as other local sources of dust. The Modification's model results were added to predicted levels of annual average TSP, PM_{10} and dust deposition due to emissions from other mines. In addition, the contribution of other non-modelled mines and dust sources in the area was included through the use of a spatially varying background grid for annual average TSP and PM_{10} and a constant background level for annual dust deposition and $PM_{2.5}$.



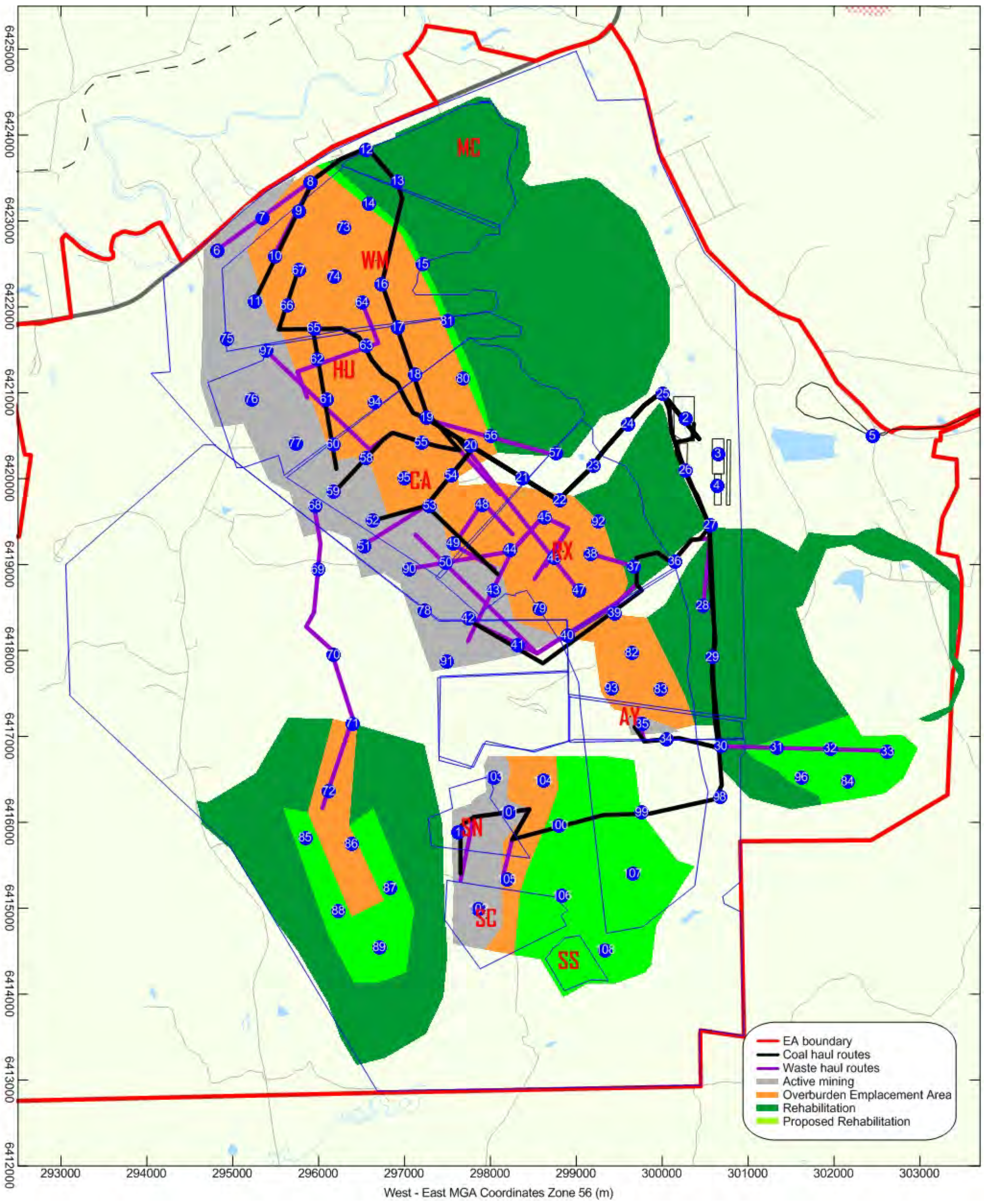
Species:	Location:	Scenario:	Modelling Year:	Plot:
Dust Sources	Mt Arthur Coal Mine	2016	2016	R Kan

Figure 6.1: Location of Modelled Dust Sources – 2016



Species:	**Location:**	**Scenario:**	**Modelling Year:**	**Plot:**
Dust Sources	Mt Arthur Coal Mine	2022	2022	R Kan

Figure 6.2: Location of Modelled Dust Sources – 2022



Species:	**Location:**	**Scenario:**	**Modelling Year:**	**Plot:**
Dust Sources	Mt Arthur Coal Mine	2026	2026	R Kan

Figure 6.3: Location of Modelled Dust Sources – 2026

7 OVERVIEW OF BEST PRACTICE DUST CONTROL

This section describes the best practice air quality mitigation measures to be implemented for the Modification with reference to the recommendations of the *NSW Coal Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining* (**Katestone Environmental Pty Ltd, 2010**), a study that was commissioned by the NSW Office of Environment and Heritage.

Following the Benchmarking study, EPA developed a PRP that requires each mining company to prepare a report on the practicability of implementing best practice measures to reduce particle emissions. The PRP requirements were included in the Mt Arthur Coal Mine EPL (EPL 11457) in August 2011.

7.1 Existing Dust Management and Control Procedures

In April 2011, a detailed review of dust control strategies in place at Mt Arthur Coal Mine compared to the NSW benchmarking study was completed by PAEHolmes and Glade Consulting (**PAEHolmes, 2011**). Subsequent to this, HVEC prepared a formal response to the PRP requirements (the PRP Report) (**BHP Billiton, 2012**). The PRP Report contains a complete list of dust control measures currently applied at Mt Arthur Coal Mine (**BHP Billiton, 2012**).

HVEC has since implemented several of the dust control strategies identified in the 2011 study. **Table 7.1** summarises the control measures applied to this assessment. It should be noted that not all controls in place have a specific control efficiency associated with the calculation of emissions, even though the control measure will reduce the total emissions of the activity (e.g. no blasting in adverse weather).

Table 7.1: Best Practice Control Procedures for Wind Blown Dust

Source	Control Procedures	Percentage control
Haul Road Watering	Mining operational areas watered. HVEC has a program that requires all operators to actively monitor road conditions and to call for water carts when required (above wheel height).	85%
Chemical dust suppressant on unsealed roads	RT9 (a non–hazardous liquid polymer) used on red rock gravel roads (water only on mudstone based roads). Red Rock gravel used on all longer-term roads in the mine.	
Drilling	Water sprays during drilling.	70% (identified in April 2011 review)
ROM stockpiles	Water cart on ROM coal stockpiles to reduce wind erosion emissions.	50% (identified in April 2011 review)
ROM hopper	Enclosed to minimise dust emissions.	70%
Reclaiming product coal (unloading product coal stockpiles)	Underground therefore no emissions.	100%

7.2 Pollution Reduction Program

HVEC submitted the PRP Report in February 2012 (**BHP Billiton, 2012**). In accordance with the PRP requirements, the report included:

- Identification, quantification and justification of existing measures that are being used to minimise particle emissions.
- Identification, quantification and justification of additional measures that could be used to minimise particle emissions.
- Evaluation of the practicality of implementation of additional best practice measures.
- Proposal of a timeframe for implementing all practicable best practice measures.

As discussed in **Section 7.1**, the detailed dust review in April 2011 identified that a significant number of dust controls are already implemented at Mt Arthur Coal Mine. The additional best practice measures proposed for detailed evaluation (**BHP Billiton, 2012**) are presented in **Table 7.2**.

HVEC has committed to developing site specific emission factors for Mt Arthur Coal Mine. A program to develop site specific emissions factors will be implemented by 1 March 2013.

Table 7.2: Best Practice Measures and Timeframes

Mining Activity	Best Practice Measure	Completion Date for Detailed Evaluation
Hauling on unpaved roads	Use of larger OB trucks	1 March 2013
Wind erosion of stockpiles	Chemical wetting agents	31 December 2013
	Surface crusting agent	31 December 2013
	Vegetative windbreaks	30 June 2013
	Wind screens/fences	30 June 2013
Wind erosion of OB	Chemical suppressants	31 December 2013
	Vegetative ground cover	30 June 2013

8 ASSESSMENT OF POTENTIAL IMPACTS

8.1 Introduction

The EPA impact assessment criteria used for identifying which properties are likely to experience air quality impacts are discussed in **Section 3**. These have been applied in the assessment process following the practices used in contemporary approvals for mining projects in NSW.

8.2 Model Predictions

Ambient air dust concentrations and dust deposition levels for the selected years of assessment are presented as isopleth diagrams (**Appendix E**) showing the following:

- predicted maximum 24-hour average PM_{10} concentration;
- predicted maximum annual average PM_{10} concentration;
- predicted maximum annual average TSP concentration;
- predicted maximum annual average dust deposition;
- predicted maximum 24-hour average $PM_{2.5}$ concentrations; and
- predicted maximum annual average $PM_{2.5}$ concentrations.

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 each of the sensitive receptors are presented in tabular form.

Locations which are predicted to experience either concentration or deposition levels above the EPA's assessment criteria are shown in red.

The following sections examine predicted 24-hour PM_{10}, 24-hour $PM_{2.5}$, annual average PM_{10}, $PM_{2.5}$, TSP and dust deposition impacts on a Modification alone basis. Annual average PM_{10}, $PM_{2.5}$, TSP and dust deposition impacts are also assessed on a cumulative basis. A separate cumulative assessment of 24-hour average PM_{10} is provided in **Section 8.6**.

For information purposes, a comparison of the modelling results from this assessment with the 2009 EA is provided in **Section 8.7**.

8.3 2016 Model Predictions

Tabulated model results for 2016 are presented in **Table 8.1** and **Table 8.2**. Contour plots (e.g. **Figure E.1**) are presented in **Appendix E**. Receiver locations are shown on **Figure 1.2** and **Figure 1.3**.

8.3.1 Private Residences

8.3.1.1 Predicted maximum 24-hour average PM_{10} concentrations

Figure E.1 and **Table 8.1** show the predicted maximum 24-hour average PM_{10} concentrations for 2016 due to emissions from the Modification alone. The relevant DP&I acquisition criterion for maximum 24-hour average PM_{10} concentrations is 50 µg/m^3 from the Modification alone.

The private residences predicted to experience maximum 24-hour average PM_{10} concentrations above the DP&I acquisition criterion in 2016 include Residence 209, 210 and 211. It is noted that these residences are within the existing HVEC Zone of Acquisition under the Consolidation Project Approval.

8.3.1.2 Predicted annual average PM_{10} concentrations

Figure E.2 and **Table 8.1** show the predicted annual average PM_{10} concentrations for 2016 due to emissions from the Modification alone. The figure is provided for information only as the DP&I acquisition criterion of 30 µg/m^3 applies to total ambient levels.

Table 8.2 shows the predicted cumulative annual average PM_{10} concentrations for 2016 due to emissions from the Modification and other sources. A contour plot is presented in **Figure E.3**. Residences 241, 252 and 264 are predicted to exceed the cumulative annual average PM_{10} criterion of 30 µg/m^3.

Residences 241, and 264 are currently within the HVEC Zone of Acquisition and Residence 264 is also within the Mount Pleasant Mine's Zone of Acquisition. Residence 252 is within Mount Pleasant Mine's Zone of Acquisition.

8.3.1.3 Predicted annual average TSP concentrations

Figure E.4 and **Table 8.1** show the predicted annual average TSP concentrations due to emissions from the Modification alone in 2016. The figure is provided for information only as the DP&I acquisition criterion of 90 µg/m^3 applies to total ambient levels.

Table 8.2 shows the predicted cumulative annual average TSP concentration for 2016 due to emissions from the Modification and other sources. No private residences are predicted to experience cumulative annual average TSP concentrations above 90 µg/m^3 in 2016. A contour plot is presented in **Figure E.5**.

8.3.1.4 Predicted annual average dust deposition (insoluble solids)

Figure E.6 and **Table 8.1** show the predicted annual average dust deposition levels for 2016 due to emissions from the Modification alone. The assessment criterion is 2 g/m^2/month (annual average).

No private residences are predicted to experience annual average dust deposition levels as a consequence of the Modification above 2 g/m^2/month in 2016.

Table 8.2 shows the predicted cumulative annual average dust deposition levels for 2016 due to emissions from the Modification and other sources. A contour plot is presented in **Figure E.7**. The assessment criterion is 4 g/m^2/month (annual average).

The only residence predicted to experience cumulative annual average dust deposition levels above 4 g/m^2/month in 2016 is Residence 264. It is noted that Residence 264 is located south of the Mt Pleasant lease boundary and falls within Mt Pleasant and HVEC's existing Zones of Acquisition.

8.3.1.5 Predicted 24-hour $PM_{2.5}$ concentrations

Figure E.22 and **Table 8.1** show the predicted maximum 24-hour average $PM_{2.5}$ concentrations for 2016 due to emissions from the Modification alone. The ARS for maximum 24-hour average $PM_{2.5}$ concentrations is 25 µg/m^3.

No private residences are predicted to experience 24-hour average $PM_{2.5}$ levels above 25 µg/m^3 in 2016 as a consequence of the Modification.

8.3.1.6 Predicted Annual $PM_{2.5}$ concentrations

Figure E.23 and **Table 8.1** show the predicted annual average $PM_{2.5}$ concentrations for 2016 due to emissions from the Modification alone.

Table 8.2 shows the predicted cumulative annual average $PM_{2.5}$ concentrations for 2016 due to emissions from the Modification and other sources. Residences 210 and 211 are predicted to exceed the cumulative annual $PM_{2.5}$ ARS of 8 µg/m^3. These residences are currently within the HVEC Zone of Acquisition.

8.3.2 Mine-Owned Residences

8.3.2.1 Predicted maximum 24-hour average PM_{10} concentrations

The mine-owned residences predicted to exceed the 24-hour PM_{10} criterion of 50 µg/m^3 in 2016 include Residences 207, 208 and 212. It is noted that Residence 212 is owned by Coal & Allied.

8.3.2.2 Predicted annual average PM_{10} concentrations

Residence 212 (owned by Bengalla) and residence 250 (owned by HVEC) are predicted to exceed the cumulative annual average PM_{10} criterion of 30 µg/m^3.

No HVEC-owned residences are predicted to exceed the incremental or cumulative annual average PM_{10} criteria in 2016.

8.3.2.3 Predicted annual average TSP concentrations

No mine-owned residences are predicted to experience cumulative annual average TSP concentrations above 90 µg/m^3 in 2016.

8.3.2.4 Predicted annual average dust deposition (insoluble solids)

No mine-owned residences are predicted to experience annual average dust deposition criterion as a consequence of the Modification above 2 g/m^2/month in 2016. There are also no exceedances of the cumulative annual average dust deposition criterion of 4 g/m^2/month for mine-owned residences.

8.3.2.5 Predicted maximum 24-hour average $PM_{2.5}$ concentrations

There are no mine-owned residences predicted to experience maximum 24-hour average $PM_{2.5}$ concentrations above the ARS in 2016.

8.3.2.6 *Predicted annual average $PM_{2.5}$ concentrations*

Residence 212 (owned by Bengalla) is predicted to exceed the cumulative annual average $PM_{2.5}$ ARS of 8 µg/m^3.

No HVEC-owned residences are predicted to exceed the incremental or cumulative annual average PM2.5 ARS in 2016.

Table 8.1: Modelling Predictions 2016 – Modification Alone

ID	2016 – Modification Alone					
	Maximum 24-hour PM_{10} (µg/m^3)	Maximum 24-hour $PM_{2.5}$ (µg/m^3)	Annual Average PM_{10} (µg/m^3)	Annual Average $PM_{2.5}$ (µg/m^3)	Annual Average TSP (µg/m^3)	Annual Average Dust Deposition (g/m^2/month)
	Assessment Criteria					
	50[1]	25	*30*[1]	*8*[1]	*90*[1]	*2*
Private Receptors						
10	24	4	2	0	2	0
11	22	3	2	0	2	0
12	20	3	2	0	2	0
13	20	3	1	0	2	0
14	20	3	1	0	1	0
15	20	3	1	0	1	0
16	19	3	1	0	1	0
17	19	3	1	0	1	0
18	19	3	1	0	1	0
20	19	3	1	0	1	0
21	19	3	1	0	1	0
22	19	3	1	0	1	0
23	19	3	1	0	2	0
24	19	3	1	0	1	0
25	20	3	1	0	1	0
26	20	3	1	0	1	0
27	20	3	1	0	1	0
30	20	3	1	0	1	0
31	19	3	1	0	1	0
32	19	3	1	0	1	0
33	18	3	1	0	1	0
34	17	3	1	0	1	0
36	15	3	1	0	1	0
37a	20	3	1	0	1	0
37b	19	3	1	0	1	0
39	22	3	2	0	2	0
40	23	3	2	0	2	0
41	23	3	2	0	2	0
42	24	3	2	0	2	0
43	24	3	2	0	2	0
56	24	4	2	0	2	0
57	24	4	2	0	2	0
58	25	4	2	0	2	0
59	26	4	2	0	2	0
60	27	4	2	0	2	0
61	27	4	2	0	2	0
62	28	4	2	0	2	0
69	21	4	2	0	2	0
70	23	4	2	0	2	0
71	24	5	2	0	3	0.1
72	25	5	3	0	3	0.1
73	27	5	3	0	3	0.1
75	29	5	3	1	3	0.1
76	30	5	3	1	3	0.1
77a	32	5	3	1	3	0.1
77b	31	5	3	1	3	0.1
78	33	6	3	1	4	0.1
79a	32	5	3	1	3	0.1
79b	34	6	3	1	4	0.1
82	35	7	4	1	4	0.1
83	34	6	4	1	4	0.1
85	35	7	4	1	4	0.1
86	36	7	4	1	5	0.1
87	38	7	5	1	5	0.2
88	37	7	5	1	5	0.2

ID	2016 – Modification Alone					
	Maximum 24-hour PM_{10} (µg/m³)	Maximum 24-hour $PM_{2.5}$ (µg/m³)	Annual Average PM_{10} (µg/m³)	Annual Average $PM_{2.5}$ (µg/m³)	Annual Average TSP (µg/m³)	Annual Average Dust Deposition (g/m²/month)
	Assessment Criteria					
	50[1]	25	30[1]	8[1]	90[1]	2
89	41	8	5	1	5	0.2
90	42	8	5	1	5	0.2
91	44	8	6	1	6	0.2
92	43	8	5	1	6	0.2
93	41	8	5	1	6	0.2
94	42	8	5	1	6	0.2
95	37	7	5	1	5	0.2
96	36	7	4	1	5	0.1
97	37	7	5	1	5	0.2
98	35	7	5	1	5	0.2
99a	35	7	4	1	5	0.2
99b	35	7	5	1	5	0.2
100	35	7	5	1	5	0.2
182	27	4	4	1	4	0.1
186	30	5	6	1	6	0.2
187	37	6	7	2	8	0.3
190	25	4	4	1	4	0.1
191	26	4	4	1	4	0.1
195	27	4	5	1	5	0.2
198	36	6	7	2	7	0.3
200	41	8	8	2	9	0.4
201	38	6	7	2	8	0.3
213a	31	5	5	1	6	0.2
213b	32	6	6	1	6	0.2
213c	31	5	5	1	6	0.2
216	32	5	6	1	6	0.2
218a	35	7	7	2	7	0.3
218b	35	7	7	2	7	0.3
218c	34	6	6	2	7	0.3
231	34	7	7	2	7	0.3
232	35	8	7	2	7	0.3
233a	39	9	8	2	8	0.4
233b	39	9	8	2	8	0.4
235	32	8	6	2	7	0.3
236	31	8	6	2	7	0.3
238	34	10	8	3	8	0.5
239	39	10	8	3	9	0.6
240	38	10	8	3	9	0.6
242a	36	9	7	2	8	0.5
242b	33	9	7	2	7	0.4
243	28	7	6	2	6	0.3
252[2]	23	7	4	1	5	0.3
254	24	7	5	2	5	0.3
257	26	7	5	2	5	0.3
259	25	6	5	2	5	0.3
IR1	30	4	2	0	3	0.0
IR2	29	4	2	0	3	0.1
IR3	29	4	3	0	3	0.1
IR4	29	4	3	0	3	0.1
IR5	29	4	3	0	3	0.1
IR6	29	4	3	0	3	0.1
IR7	30	4	3	0	3	0.1
IR8	30	5	3	0	3	0.1
IR9	31	5	3	0	3	0.1
IR10	31	5	3	0	3	0.1
IR11	30	5	3	0	3	0.1
IR12	29	4	3	0	3	0.1
IR13	30	4	3	0	3	0.1
IR14	30	5	3	0	3	0.1
IR15	31	5	3	0	3	0.1
IR16	32	5	3	0	3	0.1
IR17	32	5	3	0	3	0.1
IR18	32	5	3	0	3	0.1
IR19	32	5	3	0	3	0.1
IR20	32	5	3	0	3	0.1
IR21	32	5	3	0	3	0.1
IR22	32	5	3	0	3	0.1

ID	2016 – Modification Alone					
	Maximum 24-hour PM_{10} (µg/m³)	Maximum 24-hour $PM_{2.5}$ (µg/m³)	Annual Average PM_{10} (µg/m³)	Annual Average $PM_{2.5}$ (µg/m³)	Annual Average TSP (µg/m³)	Annual Average Dust Deposition (g/m²/month)
	Assessment Criteria					
	50[1]	25	30[1]	8[1]	90[1]	2
IR23	32	5	3	0	3	0.1
IR24	31	5	3	0	3	0.1
Private Receptors - Within Existing HVEC Zone of Acquisition						
6	31	5	3	0	3	0.1
8	27	4	2	0	3	0.1
28	21	3	1	0	1	0
29	21	3	1	0	1	0
101	37	7	5	1	5	0.2
102	38	7	5	1	5	0.2
203	42	7	8	2	9	0.4
204	46	8	9	2	10	0.5
206	50	9	10	2	11	0.6
209	55	10	12	3	13	0.7
210	62	13	14	4	16	1.1
211	64	12	15	4	17	1
226	43	11	10	3	11	0.6
241	39	10	8	3	9	0.6
264[3]	29	7	3	1	3	0.1
Mine-Owned Receptors						
9	25	4	2	0	2	0.1
49a	30	4	3	0	3	0.1
49b	31	4	3	1	3	0.1
183	39	6	7	1	7	0.1
184a	45	7	9	2	10	0.4
184b	43	7	9	2	9	0.4
184c	43	6	8	2	8	0.2
196	30	5	5	1	6	0.2
197	30	5	6	1	6	0.2
199	38	7	7	2	7	0.3
202	43	8	9	2	9	0.5
205	44	7	9	2	10	0.4
207	51	9	10	3	11	0.6
208	55	11	12	3	13	0.8
212[4]	69	15	15	4	17	1.4
250[4]	30	8	6	2	6	0.4

NOTE: Bolded – owned by HVEC.
Red – exceedance of the criteria.
[1] Criterion is for cumulative impacts.
[2] Within Mount Pleasant Mine's Zone of Acquisition.
[3] Within HVEC and Mount Pleasant Mine's Zone of Acquisition. Two receivers located at property.
[4] Owned by Coal & Allied.

Table 8.2: Modelling Predictions 2016 – Modification and Other Sources

ID	2016 – Modification and Other Sources			
	Annual Average PM_{10} (µg/m^3)	Annual Average $PM_{2.5}$ (µg/m^3)	Annual Average TSP (µg/m^3)	Annual Average Dust Deposition (g/m^2/month)
	Assessment Criteria			
	30	*8*	*90*	*4*
Private Receptors				
10	27	5	67	2.2
11	26	5	65	1.9
12	26	5	65	1.9
13	26	5	65	1.9
14	27	5	66	2.1
15	27	5	66	2.1
16	27	5	66	2.0
17	27	5	66	2.0
18	27	5	66	2.0
20	27	5	66	2.0
21	27	5	66	2.0
22	27	5	66	2.0
23	27	5	66	2.0
24	27	5	66	2.0
25	27	5	66	2.0
26	27	5	66	2.1
27	27	5	66	2.1
30	27	5	66	2.1
31	27	5	65	2.1
32	27	5	66	2.0
33	26	5	65	1.9
34	25	5	62	1.7
36	24	5	58	1.6
37a	26	5	63	1.7
37b	26	5	63	1.8
39	25	5	64	1.8
40	25	5	64	1.8
41	25	5	64	1.8
42	25	5	64	1.8
43	25	5	63	1.8
56	25	5	60	1.6
57	25	5	60	1.6
58	25	5	60	1.6
59	25	5	59	1.5
60	25	5	59	1.5
61	24	5	59	1.5
62	24	5	58	1.5
69	20	5	50	1.2
70	20	5	50	1.2
71	20	5	50	1.2
72	20	5	50	1.2
73	20	5	50	1.2
75	20	6	50	1.2
76	20	6	50	1.2
77a	20	6	50	1.2
77b	20	6	50	1.2
78	20	6	51	1.3
79a	20	6	50	1.2
79b	20	6	50	1.2
82	20	6	50	1.3
83	20	6	50	1.2
85	20	6	50	1.2
86	20	6	49	1.3
87	20	6	50	1.3
88	20	6	50	1.3
89	20	6	51	1.3
90	20	6	51	1.3
91	21	6	52	1.4
92	20	6	51	1.4
93	20	6	51	1.3
94	20	6	51	1.4
95	20	6	49	1.3
96	20	6	49	1.2
97	20	6	49	1.3
98	20	6	49	1.3

ID	2016 – Modification and Other Sources			
	Annual Average PM_{10} (µg/m³)	Annual Average $PM_{2.5}$ (µg/m³)	Annual Average TSP (µg/m³)	Annual Average Dust Deposition (g/m²/month)
	Assessment Criteria			
	30	*8*	*90*	*4*
99a	20	6	49	1.3
99b	20	6	49	1.3
100	21	6	49	1.3
182	17	6	39	1.2
186	18	6	41	1.3
187	20	7	43	1.4
190	17	6	39	1.2
191	17	6	39	1.2
195	17	6	40	1.3
198	19	7	43	1.4
200	21	7	46	1.6
201	20	7	43	1.5
213a	19	6	43	1.4
213b	20	6	43	1.4
213c	19	6	43	1.4
216	19	6	43	1.4
218a	21	7	45	1.5
218b	21	7	46	1.5
218c	20	7	44	1.5
231	21	7	46	1.5
232	22	7	46	1.5
233a	23	7	49	1.6
233b	23	7	49	1.6
235	22	7	47	1.6
236	23	7	47	1.6
238	29	8	56	2.0
239	27	8	54	1.8
240	29	8	56	2.0
242a	30	7	57	2.2
242b	28	7	54	2.0
243	23	7	48	1.6
252[1]	32	6	59	2.6
254	27	7	54	2.1
257	24	7	49	1.7
259	23	7	48	1.6
IR1	24	5	57	1.4
IR2	23	5	56	1.4
IR3	23	5	56	1.4
IR4	23	5	56	1.4
IR5	23	5	56	1.4
IR6	23	5	56	1.4
IR7	23	5	56	1.4
IR8	23	5	56	1.4
IR9	23	5	55	1.4
IR10	23	5	56	1.4
IR11	23	5	56	1.4
IR12	23	5	56	1.4
IR13	23	5	56	1.4
IR14	23	5	56	1.4
IR15	23	5	55	1.4
IR16	23	5	55	1.4
IR17	22	5	55	1.4
IR18	22	5	55	1.4
IR19	22	5	55	1.4
IR20	22	5	55	1.4
IR21	23	5	55	1.4
IR22	23	5	55	1.4
IR23	23	5	55	1.4
IR24	23	5	55	1.4
Private Receptors - Within Existing HVEC Zone of Acquisition				
6	25	5	62	1.7
8	26	5	64	1.8
28	28	5	67	2.2
29	27	5	67	2.2
101	21	6	50	1.4
102	22	6	52	1.7

ID	2016 – Modification and Other Sources			
	Annual Average PM_{10} (µg/m³)	Annual Average $PM_{2.5}$ (µg/m³)	Annual Average TSP (µg/m³)	Annual Average Dust Deposition (g/m²/month)
	Assessment Criteria			
	30	8	90	4
203	21	7	45	1.6
204	22	7	46	1.7
206	23	7	48	1.8
209	24	8	49	1.9
210	28	9	56	2.3
211	27	9	54	2.2
226	25	8	51	1.8
241	31	8	59	2.3
264[2]	40	6	72	4.2
	Mine-Owned Receptors			
9	28	5	68	2.4
49a	25	5	62	1.7
49b	25	6	62	1.6
183	18	6	41	1.3
184a	21	7	45	1.6
184b	21	7	45	1.5
184c	19	7	42	1.4
196	18	6	41	1.4
197	18	6	41	1.4
199	20	7	44	1.5
202	22	7	47	1.7
205	21	7	45	1.6
207	23	8	48	1.8
208	25	8	51	2.0
212[3]	34	9	64	2.7
250[3]	33	7	61	2.7

NOTE: Bolded – owned by HVEC.
Red – exceedance of the criteria.
[1] Within Mount Pleasant Mine's Zone of Acquisition.
[2] Within HVEC and Mount Pleasant Mine's Zone of Acquisition. Two receivers located at property.
[3] Owned by Coal & Allied.

8.4 2022 Model Predictions

Tabulated model results for 2022 are presented in **Table 8.3** and **Table 8.4**. Contour plots are presented in **Appendix E** (e.g. **Figure E.8**)

8.4.1 Private Residences

8.4.1.1 Predicted maximum 24-hour average PM_{10} concentrations

Figure E.8 and **Table 8.3** show the predicted maximum 24-hour average PM_{10} concentrations for 2022 due to emissions from the Modification alone. The relevant DP&I acquisition criterion for maximum 24-hour average PM_{10} concentrations is 50 µg/m³ from the Modification alone.

The residences predicted to experience maximum 24-hour average PM_{10} concentrations above the DP&I acquisition criterion include Residence 203, 204, 206, 209, 210 and 211. These residences are all within the existing HVEC Zone of Acquisition.

8.4.1.2 Predicted annual average PM_{10} concentrations

Figure E.9 and **Table 8.3** show the predicted annual average PM_{10} concentrations for 2022 due to emissions from the Modification alone. The figure is provided for information only as the criterion of 30 µg/m³ applies to total ambient levels.

Table 8.4 shows the predicted cumulative annual PM_{10} concentrations for 2022 due to emissions from the Modification and other sources. Contour plot is presented in **Figure E.10**. There are no residences predicted to experience cumulative annual average PM_{10} concentrations above 30 µg/m³ in 2022.

8.4.1.3 Predicted annual average TSP concentrations

Figure E.11 and **Table 8.3** show the predicted annual average TSP concentrations in 2022 due to emissions from the Modification alone. The figure is provided for information only as the criterion of 90 µg/m^3 applies to total ambient levels.

Table 8.4 shows the predicted cumulative annual average TSP concentration for the Modification and other sources and a contour plot are shown in **Figure E.12**. No residences are predicted to experience cumulative annual average TSP concentrations above 90 µg/m^3 in 2022.

8.4.1.4 Predicted annual average dust deposition (insoluble solids)

Figure E.13 and **Table 8.3** show the predicted annual average dust deposition levels for 2022 due to emissions from the Modification alone. The assessment criterion is 2 g/m^2/month (annual average).

No residences are predicted to experience annual average dust deposition levels as a consequence of the Modification above 2 g/m^2/month in 2022.

Table 8.4 shows the predicted cumulative annual average dust deposition levels for 2022 due to emissions from the Modification considered with other sources. A contour plot is presented in **Figure E.14**. The assessment criterion is 4 g/m^2/month (annual average).

There are no residences predicted to experience cumulative annual average dust deposition levels above 4 g/m^2/month in 2022.

8.4.1.5 Predicted 24-hour $PM_{2.5}$ concentrations

Figure E.24 and **Table 8.3** show the predicted maximum 24-hour average $PM_{2.5}$ concentrations for 2022 due to emissions from the Modification alone. The ARS for maximum 24-hour average $PM_{2.5}$ concentrations is 25 µg/m^3.

No private residences are predicted to experience 24-hour average $PM_{2.5}$ levels above 25 µg/m^3 in 2022 as a consequence of the Modification.

8.4.1.6 Predicted Annual $PM_{2.5}$ concentrations

Figure E.25 and **Table 8.3** show the predicted annual average $PM_{2.5}$ concentrations for 2022 due to emissions from the Modification alone.

Table 8.4 shows the predicted cumulative annual $PM_{2.5}$ concentrations for 2022 due to emissions from the Modification and other sources. Residences 209, 210 and 211 are predicted to exceed the cumulative annual $PM_{2.5}$ ARS of 8 µg/m^3. These residences are currently within the HVEC Zone of Acquisition.

8.4.2 Mine-Owned Residences

8.4.2.1 Predicted maximum 24-hour average PM_{10} concentrations

The mine-owned residences predicted to exceed the 24-hour PM_{10} criterion of 50 µg/m^3 in 2022 include Residences 184a, 184b, 205, 207, 208 (owned by HVEC) and 212 (owned by Bengalla).

8.4.2.2 Predicted annual average PM_{10} concentrations

There are no mine-owned residences predicted to experience cumulative annual average PM_{10} concentrations above 30 µg/m^3 in 2022.

8.4.2.3 Predicted annual average TSP concentrations

No mine-owned residences are predicted to experience cumulative annual average TSP concentrations above 90 µg/m³ in 2022.

8.4.2.4 Predicted annual average dust deposition (insoluble solids)

No mine-owned residences are predicted to experience annual average dust deposition criterion as a consequence of the Modification above 2 g/m²/month in 2022. There are also no exceedances of the cumulative annual average dust deposition criterion of 4 g/m²/month.

8.4.2.5 Predicted maximum 24-hour average $PM_{2.5}$ concentrations

There are no mine-owned residences predicted to experience maximum 24-hour average $PM_{2.5}$ concentrations above the ARS in 2022.

8.4.2.6 Predicted annual average $PM_{2.5}$ concentrations

Residences 208 (owned by HVEC) and 212 (owned by Bengalla) are predicted to exceed the cumulative annual $PM_{2.5}$ ARS of 8 µg/m³.

Table 8.3: Modelling Predictions 2022 – Modification Alone

ID	2022 – Modification Alone					
	Maximum 24-hour PM_{10} (µg/m³)	Maximum 24-hour $PM_{2.5}$ (µg/m³)	Annual Average PM_{10} (µg/m³)	Annual Average $PM_{2.5}$ (µg/m³)	Annual Average TSP (µg/m³)	Annual Average Dust Deposition (g/m²/month)
	Assessment Criteria					
	50[1]	25	30[1]	8[1]	90[1]	2
Private Receptors						
10	20	3	2	0	2	0
11	22	3	2	0	2	0
12	20	3	2	0	2	0
13	19	3	2	0	2	0
14	17	3	1	0	1	0
15	17	3	1	0	1	0
16	17	3	1	0	1	0
17	17	3	1	0	1	0
18	17	3	1	0	1	0
20	18	3	1	0	2	0
21	18	3	1	0	2	0
22	18	3	1	0	2	0
23	18	3	1	0	2	0
24	18	3	1	0	2	0
25	17	3	1	0	2	0
26	17	3	1	0	1	0
27	17	3	1	0	1	0
30	17	3	1	0	1	0
31	15	3	1	0	1	0
32	17	3	1	0	1	0
33	16	2	1	0	1	0
34	16	2	1	0	1	0
36	12	2	1	0	1	0
37a	19	3	1	0	2	0
37b	18	3	1	0	2	0
39	24	3	2	0	2	0
40	24	4	2	0	2	0
41	25	4	2	0	2	0
42	25	4	2	0	2	0
43	26	4	2	0	2	0
56	26	4	2	0	2	0
57	26	4	2	0	2	0
58	26	4	2	0	2	0
59	26	4	2	0	2	0
60	27	4	2	0	2	0
61	27	4	2	0	2	0
62	27	4	2	0	2	0
69	21	4	2	0	2	0
70	22	4	2	0	2	0
71	24	4	2	0	2	0

ID	2022 – Modification Alone					
	Maximum 24-hour PM_{10} (µg/m³)	Maximum 24-hour $PM_{2.5}$ (µg/m³)	Annual Average PM_{10} (µg/m³)	Annual Average $PM_{2.5}$ (µg/m³)	Annual Average TSP (µg/m³)	Annual Average Dust Deposition (g/m²/month)
	Assessment Criteria					
	50[1]	25	30[1]	8[1]	90[1]	2
72	26	4	2	0	3	0
73	28	5	3	0	3	0
75	30	5	3	0	3	0.1
76	32	6	3	1	3	0.1
77a	34	6	3	1	3	0.1
77b	33	6	3	1	3	0.1
78	34	6	3	1	3	0.1
79a	34	6	3	1	3	0.1
79b	36	7	3	1	3	0.1
82	35	7	4	1	4	0.1
83	34	6	3	1	4	0.1
85	35	7	4	1	4	0.1
86	35	7	4	1	4	0.1
87	37	7	5	1	5	0.1
88	37	7	4	1	5	0.1
89	40	8	5	1	5	0.2
90	41	8	5	1	5	0.2
91	45	8	6	1	6	0.2
92	42	8	5	1	6	0.2
93	41	8	5	1	5	0.2
94	42	8	5	1	5	0.2
95	37	7	4	1	5	0.1
96	36	7	4	1	4	0.1
97	38	7	4	1	5	0.1
98	37	7	4	1	5	0.1
99a	36	7	4	1	5	0.1
99b	36	7	4	1	5	0.1
100	35	7	5	1	5	0.1
182	30	5	6	1	6	0.2
186	36	6	8	2	8	0.3
187	44	8	10	2	10	0.5
190	28	5	5	1	6	0.2
191	28	5	6	1	6	0.2
195	31	5	7	2	7	0.3
198	43	8	9	2	10	0.5
200	47	11	10	3	11	0.6
201	45	9	10	2	10	0.5
213a	35	7	7	2	7	0.3
213b	36	8	7	2	7	0.3
213c	34	7	7	2	7	0.3
216	36	8	7	2	8	0.4
218a	40	9	8	2	9	0.4
218b	41	10	9	3	9	0.5
218c	39	9	8	2	8	0.4
231	40	10	8	2	9	0.4
232	41	10	9	3	9	0.5
233a	43	12	9	3	9	0.5
233b	45	12	9	3	10	0.6
235	34	9	7	2	7	0.4
236	33	9	7	2	7	0.4
238	35	11	8	3	9	0.6
239	42	12	9	3	10	0.7
240	41	12	9	3	9	0.6
242a	37	10	8	2	8	0.5
242b	34	10	7	2	7	0.5
243	31	9	6	2	6	0.4
252[2]	25	9	4	1	4	0.2
254	27	8	5	2	5	0.3
257	26	8	5	2	5	0.3
259	27	8	5	2	5	0.3
IR1	25	4	2	0	2	0.0
IR2	26	4	2	0	2	0.0
IR3	26	4	2	0	2	0.0
IR4	27	4	2	0	3	0.0
IR5	27	4	2	0	3	0.0
IR6	27	4	2	0	3	0.0
IR7	28	4	2	0	3	0.0

ID	2022 – Modification Alone					
	Maximum 24-hour PM_{10} (µg/m³)	Maximum 24-hour $PM_{2.5}$ (µg/m³)	Annual Average PM_{10} (µg/m³)	Annual Average $PM_{2.5}$ (µg/m³)	Annual Average TSP (µg/m³)	Annual Average Dust Deposition (g/m²/month)
	Assessment Criteria					
	50[1]	25	30[1]	8[1]	90[1]	2
IR8	28	4	2	0	3	0.0
IR9	29	5	3	0	3	0.0
IR10	28	5	3	0	3	0.1
IR11	28	4	3	0	3	0.0
IR12	26	4	2	0	3	0.0
IR13	26	4	2	0	3	0.0
IR14	26	4	2	0	3	0.0
IR15	29	5	3	0	3	0.1
IR16	29	5	3	0	3	0.1
IR17	29	5	3	0	3	0.1
IR18	30	5	3	0	3	0.1
IR19	30	5	3	0	3	0.1
IR20	30	5	3	0	3	0.1
IR21	30	5	3	0	3	0.1
IR22	30	5	3	0	3	0.1
IR23	29	5	3	0	3	0.1
IR24	29	5	3	0	3	0.1
Private Receptors - Within Existing HVEC Zone of Acquisition						
6	30	5	3	0	3	0.1
8	29	4	2	0	3	0.1
28	17	3	1	0	1	0
29	17	3	1	0	1	0
101	36	7	5	1	5	0.2
102	38	7	5	1	5	0.2
203	51	10	11	3	12	0.6
204	52	11	12	3	13	0.7
206	56	13	13	3	14	0.8
209	66	14	15	4	17	1
210	75	18	17	5	19	1.5
211	74	18	20	5	22	1.5
226	49	14	12	3	13	0.8
241	41	12	9	3	9	0.6
264[3]	32	8	3	1	3	0.1
Mine-Owned Receptors						
9	20	3	2	0	2	0
49a	29	4	3	0	3	0.1
49b	30	5	3	0	3	0.1
183	44	7	9	2	10	0.3
184a	54	11	12	3	13	0.7
184b	55	10	12	3	13	0.6
184c	48	7	11	2	11	0.4
196	33	6	7	2	8	0.3
197	35	6	8	2	8	0.3
199	42	9	9	2	9	0.5
202	49	12	11	3	11	0.7
205	53	11	12	3	13	0.7
207	58	13	13	3	14	0.9
208	66	16	15	4	16	1.1
212[4]	82	19	19	5	21	2.0
250[4]	33	10	6	2	6	0.4

NOTE: Bolded – owned by HVEC.
Red – exceedance of the criteria.
[1] Criterion is for cumulative impacts.
[2] Within Mount Pleasant Mine's Zone of Acquisition.
[3] Within HVEC and Mount Pleasant Mine's Zone of Acquisition. Two receivers located at property.
[4] Owned by Coal & Allied.

Table 8.4: Modelling Predictions 2022 – Modification and Other Sources

ID	2022 – Modification and Other Sources			
	Annual Average PM_{10} (µg/m³)	Annual Average $PM_{2.5}$ (µg/m³)	Annual Average TSP (µg/m³)	Annual Average Dust Deposition (g/m²/month)
	Assessment Criteria			
	30	*8*	*90*	*4*
Private Receptors				
10	18	5	55	1.1
11	18	5	56	1.1
12	19	5	56	1.1
13	19	5	55	1.1
14	18	5	56	1.1
15	18	5	56	1.1
16	18	5	56	1.1
17	19	5	56	1.1
18	19	5	56	1.1
20	18	5	56	1.1
21	18	5	56	1.1
22	18	5	56	1.1
23	18	5	56	1.1
24	18	5	56	1.1
25	18	5	56	1.1
26	18	5	56	1.1
27	18	5	56	1.1
30	18	5	55	1.1
31	19	5	53	1.1
32	19	5	55	1.1
33	19	5	54	1.1
34	19	5	53	1.1
36	20	5	50	1.2
37a	19	5	54	1.1
37b	19	5	54	1.1
39	19	5	56	1.1
40	19	5	55	1.1
41	18	5	55	1.1
42	18	5	55	1.1
43	18	5	55	1.1
56	19	5	53	1.1
57	19	5	53	1.1
58	19	5	53	1.1
59	19	5	53	1.1
60	19	5	53	1.1
61	19	5	53	1.1
62	19	5	53	1.1
69	18	5	46	1.1
70	18	5	46	1.1
71	18	5	46	1.1
72	18	5	46	1.1
73	18	5	46	1.1
75	18	5	46	1.1
76	18	6	46	1.1
77a	18	6	47	1.1
77b	18	6	46	1.1
78	18	6	47	1.1
79a	18	6	46	1.1
79b	18	6	47	1.1
82	17	6	47	1.1
83	17	6	46	1.1
85	17	6	46	1.1
86	17	6	46	1.1
87	17	6	47	1.2
88	17	6	47	1.1
89	18	6	48	1.2
90	18	6	48	1.2
91	18	6	49	1.2
92	18	6	48	1.2
93	18	6	48	1.2
94	18	6	47	1.2
95	17	6	46	1.2
96	17	6	46	1.1
97	18	6	46	1.2
98	18	6	46	1.2

ID	2022 – Modification and Other Sources			
	Annual Average PM_{10} (µg/m³)	Annual Average $PM_{2.5}$ (µg/m³)	Annual Average TSP (µg/m³)	Annual Average Dust Deposition (g/m²/month)
	Assessment Criteria			
	30	*8*	*90*	*4*
99a	18	6	45	1.2
99b	18	6	46	1.2
100	18	6	46	1.2
182	15	6	40	1.3
186	15	7	40	1.4
187	17	7	41	1.5
190	15	6	40	1.3
191	15	6	40	1.3
195	15	7	40	1.4
198	16	7	41	1.5
200	17	8	42	1.7
201	17	7	41	1.6
213a	17	7	42	1.5
213b	17	7	42	1.5
213c	17	7	42	1.5
216	16	7	41	1.5
218a	18	7	43	1.6
218b	18	8	43	1.6
218c	17	7	42	1.5
231	18	7	43	1.6
232	18	8	44	1.6
233a	19	8	45	1.7
233b	19	8	45	1.7
235	19	7	44	1.5
236	19	7	44	1.5
238	20	8	46	1.7
239	20	8	46	1.7
240	20	8	46	1.7
242a	19	7	45	1.6
242b	19	7	45	1.5
243	19	7	43	1.4
252[1]	19	6	44	1.3
254	18	7	43	1.3
257	18	7	43	1.3
259	18	7	43	1.3
IR1	19	5	52	1.1
IR2	19	5	52	1.1
IR3	19	5	51	1.1
IR4	19	5	51	1.1
IR5	19	5	51	1.1
IR6	19	5	51	1.1
IR7	19	5	51	1.1
IR8	19	5	51	1.1
IR9	19	5	51	1.1
IR10	19	5	51	1.1
IR11	19	5	51	1.1
IR12	19	5	51	1.1
IR13	19	5	52	1.1
IR14	19	5	52	1.1
IR15	19	5	51	1.1
IR16	19	5	51	1.1
IR17	19	5	51	1.1
IR18	19	5	50	1.1
IR19	19	5	50	1.1
IR20	19	5	51	1.1
IR21	19	5	51	1.1
IR22	19	5	51	1.1
IR23	19	5	51	1.1
IR24	19	5	51	1.1
	Private Receptors - Within Existing HVEC Zone of Acquisition			
6	18	5	53	1.1
8	18	5	54	1.1
28	18	5	55	1.1
29	18	5	55	1.1
101	18	6	46	1.2

ID	2022 – Modification and Other Sources			
	Annual Average PM_{10} (µg/m³)	Annual Average $PM_{2.5}$ (µg/m³)	Annual Average TSP (µg/m³)	Annual Average Dust Deposition (g/m²/month)
	Assessment Criteria			
	30	*8*	*90*	*4*
102	18	6	46	1.2
203	17	8	42	1.7
204	18	8	43	1.8
206	19	8	44	1.9
209	20	9	46	2.1
210	22	10	51	2.6
211	25	10	52	2.6
226	20	8	45	1.9
241	20	8	46	1.7
264[2]	20	6	45	1.4
	Mine-Owned Receptors			
9	17	5	54	1.1
49a	18	5	53	1.1
49b	18	5	53	1.1
183	16	7	42	1.4
184a	18	8	43	1.7
184b	18	8	43	1.7
184c	17	7	42	1.5
196	15	7	40	1.4
197	15	7	40	1.4
199	17	7	42	1.6
202	18	8	43	1.8
205	18	8	43	1.8
207	19	8	44	2
208	20	9	46	2.2
212[3]	25	10	55	3
250[3]	19	7	45	1.5

NOTE: Bolded – owned by HVEC.
Red – exceedance of the criteria.
[1] Within Mount Pleasant Mine's Zone of Acquisition.
[2] Within HVEC and Mount Pleasant Mine's Zone of Acquisition. Two receivers located at property.
[3] Owned by Coal & Allied.

8.5 2026 Model Predictions

Tabulated model results for 2026 are presented in **Table 8.5** and **Table 8.6**. Contour plots are presented in **Appendix E** (e.g. **Figure E.15**).

8.5.1 Private Residences

8.5.1.1 Predicted maximum 24-hour average PM_{10} concentrations

Figure E.15 and **Table 8.5** show the predicted maximum 24-hour average PM_{10} concentrations due to emissions from the 2026 due to emissions from the Modification alone. The relevant DP&I acquisition criterion for maximum 24-hour average PM_{10} concentrations is 50 µg/m³ from the Modification alone.

Residences 203, 204, 206, 209, 210, 211 and 226 are predicted to exceed the DP&I acquisition criterion. These residences are within the existing HVEC Zone of Acquisition.

8.5.1.2 Predicted annual average PM_{10} concentrations

Figure E.16 and **Table 8.5** show the predicted annual average PM_{10} concentrations for 2026 due to emissions from the Modification alone. The figure is provided for information only as the criterion of 30 µg/m^3 applies to total ambient levels.

Table 8.6 shows the predicted cumulative annual PM_{10} concentrations from the Modification and other sources and the contour plot is shown in **Figure E.17**. No residences are predicted to experience cumulative annual average PM_{10} concentrations above 30 µg/m^3 in 2026.

8.5.1.3 Predicted annual average TSP concentrations

Figure E.18 and **Table 8.5** show the predicted annual average TSP concentrations due to emissions from the Modification alone in 2026. The figure is provided for information only as the criterion of 90 µg/m^3 applies to total ambient levels.

Table 8.6 shows the predicted cumulative annual average TSP concentration for the Modification and other sources. A contour plot is presented in **Figure E.19**. No residences are predicted to experience cumulative annual average TSP concentrations above 90 µg/m^3 in 2026.

8.5.1.4 Predicted annual average dust deposition (insoluble solids)

Figure E.20 and **Table 8.5** show the predicted annual average dust deposition levels for 2026 for the Modification alone. The assessment criterion is 2 g/m^2/month (annual average).

No private residences are predicted to experience annual average dust deposition levels as a consequence of the Modification above 2 g/m^2/month in 2026.

Table 8.6 shows the predicted cumulative annual average dust deposition levels for 2026 for the Modification considered with other sources and the contour plot is shown in **Figure E.21**. The assessment criterion is 4 g/m^2/month (annual average).

There are no residences predicted to experience cumulative annual average dust deposition levels above 4 g/m^2/month in 2026.

8.5.1.5 Predicted 24-hour $PM_{2.5}$ concentrations

Figure E.26 and **Table 8.5** show the predicted maximum 24-hour average $PM_{2.5}$ concentrations for 2026 due to emissions from the Modification alone. The ARS for maximum 24-hour average $PM_{2.5}$ concentrations is 25 µg/m^3.

No residences are predicted to experience 24-hour average $PM_{2.5}$ levels above 25 µg/m^3 in 2026 as a consequence of the Modification.

8.5.1.6 Predicted Annual $PM_{2.5}$ concentrations

Figure E.27 and **Table 8.5** show the predicted annual average $PM_{2.5}$ concentrations for 2026 due to emissions from Mt Arthur Coal Mine alone.

Table 8.6 shows the predicted cumulative annual $PM_{2.5}$ concentrations from the Modification and other sources. Residences 204, 206, 209, 210, 211 and 226 are predicted to exceed the cumulative annual $PM_{2.5}$ ARS of 8 µg/m^3 in 2026. These residences are currently within the Mt Arthur Coal Mine Zone of Acquisition.

Table 8.5: Modelling Predictions 2026 – Modification Alone

ID	2026 – Modification Alone					
	Maximum 24-hour PM_{10} ($\mu g/m^3$)	Maximum 24-hour $PM_{2.5}$ ($\mu g/m^3$)	Annual Average PM_{10} ($\mu g/m^3$)	Annual Average $PM_{2.5}$ ($\mu g/m^3$)	Annual Average TSP ($\mu g/m^3$)	Annual Average Dust Deposition ($g/m^2/month$)
	Assessment Criteria					
	50[1]	25	30[1]	8[1]	90[1]	2
Private Receptors						
10	18	3	2	0	2	0.0
11	20	3	2	0	2	0.0
12	19	3	1	0	2	0.0
13	18	3	1	0	1	0.0
14	16	3	1	0	1	0.0
15	16	3	1	0	1	0.0
16	16	3	1	0	1	0.0
17	16	3	1	0	1	0.0
18	16	3	1	0	1	0.0
20	17	3	1	0	1	0.0
21	17	3	1	0	1	0.0
22	17	3	1	0	1	0.0
23	17	3	1	0	1	0.0
24	17	3	1	0	1	0.0
25	16	3	1	0	1	0.0
26	16	3	1	0	1	0.0
27	16	3	1	0	1	0.0
30	16	3	1	0	1	0.0
31	15	3	1	0	1	0.0
32	16	3	1	0	1	0.0
33	15	3	1	0	1	0.0
34	15	3	1	0	1	0.0
36	13	2	1	0	1	0.0
37a	18	3	1	0	1	0.0
37b	17	3	1	0	1	0.0
39	21	3	2	0	2	0.0
40	22	3	2	0	2	0.0
41	22	3	2	0	2	0.0
42	22	3	2	0	2	0.0
43	22	3	2	0	2	0.0
56	21	3	2	0	2	0.0
57	21	3	2	0	2	0.0
58	21	3	2	0	2	0.0
59	20	3	2	0	2	0.0
60	21	3	2	0	2	0.0
61	21	3	2	0	2	0.0
62	21	3	2	0	2	0.0
69	23	4	2	0	2	0.0
70	24	4	2	0	2	0.0
71	25	4	2	0	2	0.0
72	25	5	2	0	2	0.0
73	27	5	2	0	3	0.0
75	30	6	3	0	3	0.0
76	32	6	3	0	3	0.1
77a	34	6	3	1	3	0.1
77b	33	6	3	1	3	0.1
78	33	6	3	1	3	0.1
79a	33	6	3	1	3	0.1
79b	36	7	3	1	3	0.1
82	35	7	4	1	4	0.1
83	34	6	3	1	3	0.1
85	34	7	4	1	4	0.1
86	35	7	4	1	4	0.1
87	38	7	4	1	5	0.1
88	37	7	4	1	4	0.1
89	40	8	5	1	5	0.1
90	42	8	5	1	5	0.1
91	43	8	5	1	6	0.2
92	42	8	5	1	5	0.2
93	41	8	5	1	5	0.1
94	42	8	5	1	5	0.2
95	37	7	4	1	4	0.1
96	36	7	4	1	4	0.1
97	38	7	4	1	5	0.1

ID	2026 – Modification Alone					
	Maximum 24-hour PM_{10} (µg/m³)	Maximum 24-hour $PM_{2.5}$ (µg/m³)	Annual Average PM_{10} (µg/m³)	Annual Average $PM_{2.5}$ (µg/m³)	Annual Average TSP (µg/m³)	Annual Average Dust Deposition (g/m²/month)
	Assessment Criteria					
	50[1]	25	30[1]	8[1]	90[1]	2
98	37	7	4	1	4	0.1
99a	35	7	4	1	4	0.1
99b	36	7	4	1	5	0.1
100	35	7	4	1	5	0.1
182	31	5	6	1	6	0.2
186	41	8	9	2	9	0.4
187	50	10	11	3	12	0.6
190	29	5	6	1	6	0.2
191	30	5	6	1	6	0.2
195	36	7	7	2	8	0.3
198	49	10	10	3	11	0.6
200	47	12	11	3	12	0.7
201	48	10	11	3	12	0.6
213a	37	8	8	2	8	0.4
213b	38	9	8	2	8	0.4
213c	37	8	7	2	8	0.4
216	39	9	8	2	9	0.4
218a	42	10	9	3	10	0.5
218b	44	11	9	3	10	0.5
218c	41	10	9	2	9	0.5
231	44	11	9	3	10	0.5
232	45	11	9	3	10	0.5
233a	43	11	9	3	10	0.6
233b	46	12	9	3	10	0.6
235	34	9	7	2	7	0.4
236	34	9	7	2	7	0.4
238	34	11	8	3	8	0.6
239	42	12	9	3	10	0.6
240	39	11	8	3	9	0.6
242a	36	11	7	2	7	0.5
242b	33	10	6	2	7	0.4
243	31	9	6	2	6	0.4
252[2]	26	9	4	1	4	0.2
254	27	8	4	1	4	0.3
257	26	8	5	2	5	0.3
259	26	7	5	2	5	0.3
IR1	25	4	2	0	2	0.0
IR2	25	4	2	0	2	0.0
IR3	26	4	2	0	2	0.0
IR4	26	4	2	0	2	0.0
IR5	27	4	2	0	2	0.0
IR6	27	4	2	0	2	0.0
IR7	27	4	2	0	2	0.0
IR8	28	4	2	0	2	0.0
IR9	28	4	2	0	2	0.0
IR10	28	4	2	0	2	0.0
IR11	28	4	2	0	2	0.0
IR12	26	4	2	0	2	0.0
IR13	26	4	2	0	2	0.0
IR14	25	4	2	0	2	0.0
IR15	28	4	2	0	2	0.0
IR16	29	4	2	0	2	0.0
IR17	29	4	2	0	2	0.0
IR18	29	4	2	0	2	0.0
IR19	29	5	2	0	2	0.0
IR20	29	5	2	0	2	0.0
IR21	29	5	2	0	2	0.0
IR22	29	4	2	0	2	0.0
IR23	29	4	2	0	2	0.0
IR24	29	4	2	0	2	0.0
Private Receptors - Within Existing HVEC Zone of Acquisition						
6	25	4	2	0	3	0.1
8	24	4	2	0	2	0.1
28	16	3	1	0	1	0.0
29	16	3	1	0	1	0.0
101	35	7	5	1	5	0.1
102	37	7	5	1	5	0.2

ID	2026 – Modification Alone					
	Maximum 24-hour PM_{10} (µg/m³)	Maximum 24-hour $PM_{2.5}$ (µg/m³)	Annual Average PM_{10} (µg/m³)	Annual Average $PM_{2.5}$ (µg/m³)	Annual Average TSP (µg/m³)	Annual Average Dust Deposition (g/m²/month)
	Assessment Criteria					
	50[1]	25	*30[1]*	*8[1]*	*90[1]*	2
203	56	12	13	3	14	0.8
204	59	13	13	4	15	0.9
206	65	14	15	4	16	1.0
209	73	16	17	4	19	1.3
210	80	18	19	5	21	1.7
211	83	19	22	6	25	1.8
226	53	14	13	4	14	0.9
241	40	11	8	3	8	0.6
264[3]	32	8	2	1	2	0.1
Mine-Owned Receptors						
9	18	3	2	0	2	0.0
49	25	4	2	0	2	0.1
49	25	4	2	0	3	0.1
183	47	7	10	2	10	0.4
184a	58	12	14	4	15	0.9
184b	62	12	13	3	15	0.8
184c	53	8	12	3	13	0.6
196	39	8	8	2	9	0.4
197	40	8	8	2	9	0.4
199	47	11	10	3	11	0.6
202	55	13	12	3	13	0.8
205	58	13	13	3	15	0.9
207	66	15	15	4	17	1.1
208	72	16	17	5	18	1.3
212[4]	81	19	19	5	22	2.1
250[4]	35	10	5	2	5	0.3

NOTE: Bolded – owned by HVEC.
Red – exceedance of the criteria.
[1] Criterion is for cumulative impacts.
[2] Within Mount Pleasant Mine's Zone of Acquisition.
[3] Within HVEC and Mount Pleasant Mine's Zone of Acquisition. Two receivers located at property.
[4] Owned by Coal & Allied.

Table 8.6: Modelling Predictions 2026 – Modification and Other Sources

ID	2026 – Modification and Other Sources			
	Annual Average PM_{10} (µg/m³)	Annual Average $PM_{2.5}$ (µg/m³)	Annual Average TSP (µg/m³)	Annual Average Dust Deposition (g/m²/month)
	Assessment Criteria			
	30	*8*	*90*	*4*
Private Receptors				
10	18	5	55	1.1
11	19	5	56	1.1
12	19	5	56	1.1
13	19	5	56	1.1
14	19	5	57	1.1
15	19	5	57	1.1
16	19	5	57	1.1
17	19	5	57	1.1
18	19	5	57	1.1
20	19	5	57	1.1
21	19	5	57	1.1
22	19	5	57	1.1
23	19	5	57	1.1
24	19	5	57	1.1
25	19	5	57	1.1
26	19	5	57	1.1
27	19	5	57	1.1
30	19	5	56	1.1
31	20	5	55	1.1
32	19	5	56	1.1
33	20	5	55	1.1
34	20	5	54	1.1
36	23	5	54	1.5
37a	19	5	54	1.1
37b	19	5	55	1.1
39	19	5	56	1.1
40	19	5	56	1.1
41	19	5	55	1.1
42	19	5	55	1.1
43	19	5	55	1.1
56	19	5	53	1.1
57	19	5	53	1.1
58	19	5	53	1.1
59	19	5	53	1.1
60	19	5	53	1.1
61	19	5	53	1.1
62	19	5	53	1.1
69	18	5	46	1.1
70	18	5	46	1.1
71	18	5	46	1.1
72	18	5	46	1.1
73	18	5	46	1.1
75	18	5	46	1.1
76	18	5	46	1.1
77a	18	6	47	1.1
77b	18	6	46	1.1
78	18	6	47	1.1
79a	18	6	46	1.1
79b	18	6	47	1.1
82	17	6	47	1.1
83	17	6	46	1.1
85	17	6	46	1.1
86	17	6	46	1.1
87	17	6	47	1.1
88	17	6	47	1.1
89	17	6	48	1.2
90	18	6	48	1.2
91	18	6	48	1.2
92	18	6	48	1.2
93	17	6	47	1.2
94	17	6	47	1.2
95	17	6	46	1.1
96	17	6	46	1.1
97	18	6	46	1.1

ID	2026 – Modification and Other Sources			
	Annual Average PM_{10} (µg/m³)	Annual Average $PM_{2.5}$ (µg/m³)	Annual Average TSP (µg/m³)	Annual Average Dust Deposition (g/m²/month)
	Assessment Criteria			
	30	*8*	*90*	*4*
98	18	6	46	1.1
99a	18	6	45	1.1
99b	18	6	46	1.1
100	18	6	46	1.2
182	15	6	40	1.3
186	16	7	41	1.5
187	18	8	43	1.7
190	15	6	40	1.3
191	15	6	40	1.3
195	16	7	41	1.5
198	18	8	43	1.7
200	19	8	44	1.8
201	18	8	43	1.7
213a	17	7	42	1.5
213b	17	7	43	1.5
213c	17	7	42	1.5
216	17	7	42	1.6
218a	18	8	43	1.6
218b	18	8	44	1.6
218c	18	7	43	1.6
231	18	8	44	1.6
232	19	8	44	1.6
233a	19	8	44	1.6
233b	19	8	45	1.7
235	18	7	43	1.5
236	18	7	43	1.5
238	18	8	44	1.6
239	19	8	45	1.7
240	19	8	45	1.6
242a	18	7	44	1.5
242b	18	7	43	1.5
243	18	7	42	1.4
252[1]	17	6	42	1.3
254	17	6	42	1.3
257	17	7	42	1.3
259	18	7	42	1.3
IR1	19	5	51	1.1
IR2	19	5	51	1.1
IR3	19	5	51	1.1
IR4	19	5	51	1.1
IR5	19	5	51	1.1
IR6	19	5	51	1.1
IR7	19	5	51	1.1
IR8	19	5	51	1.1
IR9	18	5	51	1.1
IR10	19	5	51	1.1
IR11	19	5	51	1.1
IR12	19	5	51	1.1
IR13	19	5	51	1.1
IR14	19	5	51	1.1
IR15	18	5	50	1.1
IR16	18	5	50	1.1
IR17	18	5	50	1.1
IR18	18	5	50	1.1
IR19	18	5	50	1.1
IR20	18	5	50	1.1
IR21	18	5	50	1.1
IR22	18	5	50	1.1
IR23	18	5	51	1.1
IR24	18	5	51	1.1
	Private Receptors – Within Existing HVEC Zone of Acquisition			
6	18	5	53	1.1
8	18	5	54	1.1
28	19	5	56	1.1
29	19	5	56	1.1

ID	2026 – Modification and Other Sources			
	Annual Average PM_{10} ($\mu g/m^3$)	Annual Average $PM_{2.5}$ ($\mu g/m^3$)	Annual Average TSP ($\mu g/m^3$)	Annual Average Dust Deposition (g/m^2/month)
	Assessment Criteria			
	30	*8*	*90*	*4*
101	18	6	46	1.2
102	18	6	46	1.2
203	19	8	44	1.9
204	20	9	45	2
206	20	9	46	2.1
210	22	9	48	2.2
211	24	10	52	2.7
226	20	9	46	2
241	19	8	45	1.6
264[2]	17	6	43	1.2
	Mine-Owned Receptors			
9	18	5	55	1.1
49	18	5	53	1.1
49	18	5	53	1.1
183	17	7	42	1.5
184a	20	9	45	1.9
184b	20	8	45	1.9
184c	18	8	43	1.6
196	16	7	41	1.5
197	16	7	41	1.5
199	18	8	43	1.7
202	19	8	44	1.9
205	20	8	44	1.9
207	21	9	46	2.2
208	22	10	48	2.4
212[3]	25	10	55	3
250[3]	18	7	43	1.4

NOTE: Bolded – owned by HVEC.
Red – exceedance of the criteria.
[1] Within Mount Pleasant Mine's Zone of Acquisition.
[2] Within HVEC and Mount Pleasant Mine's Zone of Acquisition. Two receivers located at property.
[3] Owned by Coal & Allied.

8.5.2 Mine-Owned Residences

8.5.2.1 Predicted maximum 24-hour average PM_{10} concentrations

The mine owned residences expected to exceed the 24-hour PM_{10} criterion of 50 $\mu g/m^3$ in 2026 include 184a, 184b, 184c, 202, 205, 207, 208 (owned by HVEC) and 212 (owned by Bengalla).

8.5.2.2 Predicted annual average PM_{10} concentrations

No residences are predicted to experience cumulative annual average PM_{10} concentrations above 30 $\mu g/m^3$ in 2026.

8.5.2.3 Predicted annual average TSP concentrations

No residences are predicted to experience cumulative annual average TSP concentrations above 90 $\mu g/m^3$ in 2026.

8.5.2.4 Predicted annual average dust deposition (insoluble solids)

The only mine-owned residence predicted to experience annual average dust deposition levels as a consequence of the Modification above 2 g/m^2/month in 2026 is Residence 212 (owned by Bengalla).

There are no residences predicted to experience cumulative annual average PM_{10} concentrations above 4 g/m^2/month in 2026.

8.5.2.5 Predicted maximum 24-hour average $PM_{2.5}$ concentrations

There are no mine-owned residences predicted to experience maximum 24-hour average PM_{10} concentrations above the ARS in 2026.

8.5.2.6 Predicted annual average $PM_{2.5}$ concentrations

Residences 184a, 207, 208 and 212 (owned by Bengalla) are predicted to exceed the cumulative annual $PM_{2.5}$ ARS of 8 µg/m^3.

8.6 Cumulative 24-hour Average PM_{10} Concentrations

8.6.1 Introduction

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.

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 e.g. agricultural activity and bushfires, 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 HVAS monitors and TEOM monitors surrounding the mine (**Figure 4.2**).

Cumulative 24-hour PM_{10} impacts are expected to be most significant from the concurrent operations of the Modification and surrounding coal mines, particularly for those residences to the west and northwest where impacts from Mt Arthur Coal Mine are predicted to be the greatest. This is most obviously due to the locations of the mines, but also due to the prevailing winds under which impacts would be the most pronounced.

The wind conditions under which impacts from the Modification would be highest (e.g. east to southeasterly flows creating highest concentrations at residences to the west and northwest), would not correspond to days when highest impacts also occur from Mount Pleasant Mine and Mangoola Coal Mine at these same residences. There may be some contribution to the residences in the west and northwest from Bengalla Coal Mine and Drayton Coal Mine during wind directions from the east to southeast. Due to the distance between Drayton Coal Mine and these residences, contribution from Drayton Coal Mine to these residences is expected to be minimal.

A time series analysis was undertaken to determine the cumulative 24-hour PM_{10} concentration at 11 residences (23, 43, 62, 78, 91, 184a, 187, 211, 226, 238 and 252). These 11 residences were selected based on predominant wind directions experienced around the mine as well as near the Muswellbrook township. The top 10 maximum predicted 24-hour PM_{10} concentration from the Modification at the 11 residences were summed with the predicted impacts from other mines on the corresponding days to determine the worst case cumulative 24-hour PM_{10} concentration from the Modification. The results of the time series analysis for 2016, 2022 and 2026 are provided in **Table 8.7**, **Table 8.8** and **Table 8.9**.

Table 8.7: Cumulative 24-hour PM_{10} Concentrations - 2016

Residence ID													
R23							R184a						
Date	Mt Arthur (µg/m³)	Bengalla (µg/m³)	Drayton (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)	Date	Mt Arthur (µg/m³)	Bengalla (µg/m³)	Drayton (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)
25/05/2007	19	14	0	1	4	39	25/08/2007	45	11	4	0	1	**61**
10/06/2007	18	19	0	1	4	43	14/06/2007	43	27	3	0	3	**76**
6/01/2008	17	1	2	0	3	24	2/04/2007	37	6	2	0	1	47
27/03/2008	14	6	1	1	0	22	13/12/2007	37	0	4	0	0	41
17/06/2007	14	0	3	0	0	17	18/08/2007	36	1	3	4	0	44
6/02/2008	14	31	0	2	2	48	29/12/2007	35	5	5	0	1	45
19/08/2007	13	14	3	1	0	31	7/05/2007	35	2	2	0	0	39
26/05/2007	13	12	0	1	2	29	19/04/2007	35	19	1	0	2	**57**
19/01/2008	12	0	1	0	0	14	23/10/2007	33	1	3	0	1	38
9/12/2007	12	11	0	1	1	24	16/08/2007	32	18	2	1	2	**56**
R43							R187						
Date	Mt Arthur (µg/m³)	Bengalla (µg/m³)	Drayton (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)	Date	Mt Arthur (µg/m³)	Bengalla (µg/m³)	Drayton (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)
10/06/2007	24	13	0	1	4	42	14/06/2007	37	30	2	0	3	**72**
27/03/2008	24	2	1	1	0	27	25/08/2007	36	9	4	0	1	50
19/01/2008	19	0	2	0	0	21	2/04/2007	33	6	2	0	1	42
19/08/2007	18	10	3	1	0	32	13/12/2007	31	0	3	0	0	35
16/08/2007	18	7	0	0	0	25	19/04/2007	31	17	1	0	2	**52**
28/05/2007	17	23	1	2	0	44	7/05/2007	31	3	2	0	0	36
6/01/2008	17	1	2	0	2	22	18/08/2007	30	1	3	5	0	38
9/12/2007	17	9	0	1	0	27	23/10/2007	27	1	3	0	0	32
25/05/2007	15	9	1	1	3	29	29/12/2007	27	3	4	0	1	35
8/10/2007	15	0	2	0	1	18	5/06/2007	26	4	0	0	0	32
R62							R211						
Date	Mt Arthur (µg/m³)	Bengalla (µg/m³)	Drayton (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)	Date	Mt Arthur (µg/m³)	Bengalla (µg/m³)	Drayton (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)
27/03/2008	28	2	0	0	0	31	25/08/2007	64	6	4	0	1	**75**
10/06/2007	22	8	0	1	2	34	14/06/2007	62	8	4	0	2	**75**
16/08/2007	20	6	0	0	1	26	29/12/2007	53	5	5	0	1	**64**
9/12/2007	18	6	0	1	1	26	27/04/2007	52	0	4	0	0	**56**
28/05/2007	18	21	1	2	0	42	13/12/2007	52	0	4	0	0	**56**
19/08/2007	17	9	2	1	0	30	2/04/2007	51	5	3	0	1	**59**
25/05/2007	16	6	1	1	2	26	12/05/2007	51	2	3	0	0	**56**
22/06/2007	15	14	0	2	1	31	10/03/2008	50	8	4	0	1	**63**
27/05/2007	14	19	0	1	1	35	7/05/2007	50	1	2	0	0	**52**
19/01/2008	14	0	2	0	0	17	19/03/2008	49	2	3	0	0	**55**

Residence ID

R78

Date	Mt Arthur (µg/m³)	Bengalla (µg/m³)	Drayton (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)
22/06/2007	33	5	0	1	1	39
28/05/2007	28	6	0	2	0	37
27/03/2008	26	0	1	0	0	28
10/06/2007	26	2	1	1	1	31
16/08/2007	25	4	0	0	0	29
20/09/2007	23	1	0	0	0	24
27/05/2007	20	10	1	1	0	32
12/07/2007	19	5	0	1	1	27
10/02/2008	19	0	0	0	0	19
26/10/2007	19	5	0	1	0	25

R226

Date	Mt Arthur (µg/m³)	Bengalla (µg/m³)	Drayton (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)
27/04/2007	43	0	4	0	0	47
25/08/2007	39	5	3	0	1	48
29/12/2007	37	6	4	0	1	47
14/06/2007	37	34	3	0	5	**79**
17/03/2008	36	10	3	0	1	50
13/12/2007	35	0	3	0	0	38
12/05/2007	35	23	3	0	1	**62**
10/03/2008	35	3	3	0	1	42
9/02/2008	33	0	3	1	0	37
19/04/2007	33	21	2	0	3	**60**

R91

Date	Mt Arthur (µg/m³)	Bengalla (µg/m³)	Drayton (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)
22/06/2007	44	2	0	1	0	48
12/07/2007	37	3	0	1	2	43
11/06/2007	37	9	0	3	1	49
27/10/2007	34	1	0	1	1	37
14/09/2007	33	1	0	1	0	35
10/02/2008	31	0	0	0	0	31
27/05/2007	31	3	1	1	0	37
20/09/2007	31	0	0	0	0	32
28/05/2007	31	2	0	2	0	35
25/07/2007	29	4	0	1	1	34

R238

Date	Mt Arthur (µg/m³)	Bengalla (µg/m³)	Drayton (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)
14/03/2008	34	7	4	0	0	45
8/09/2007	32	4	3	0	0	39
27/04/2007	30	16	4	0	0	50
7/09/2007	30	8	2	0	0	41
18/03/2008	28	19	2	0	5	**55**
21/07/2007	28	13	2	0	4	48
14/05/2007	27	13	2	0	5	48
7/04/2007	27	2	2	0	0	31
9/02/2008	27	15	3	1	0	47
21/04/2007	26	5	3	0	0	35

R252

Date	Mt Arthur (µg/m³)	Bengalla (µg/m³)	Drayton (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)
9/09/2007	23	27	2	0	0	**52**
28/12/2007	22	27	1	0	0	**51**
10/04/2007	22	25	1	1	6	**56**
8/09/2007	22	31	3	0	0	**55**
31/10/2007	21	26	2	0	0	49
7/04/2007	20	26	2	0	0	48
24/04/2007	20	15	1	0	0	36
19/08/2007	20	13	2	2	2	38
3/03/2008	19	15	1	1	2	38
17/06/2007	18	12	1	0	0	31

Table 8.8: Cumulative 24-hour PM_{10} Concentrations - 2022

Residence ID									
R23					R184a				
Date	Mt Arthur (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)	Date	Mt Arthur (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)
10/06/2007	18	1	6	25	14/06/2007	54	0	2	**57**
6/01/2008	17	0	5	22	2/04/2007	47	0	1	48
27/03/2008	16	1	0	16	19/04/2007	45	0	2	47
19/01/2008	15	0	0	15	25/08/2007	45	0	1	46
8/10/2007	14	0	3	17	7/05/2007	41	0	0	41
9/12/2007	14	1	1	15	12/05/2007	41	0	1	41
6/02/2008	13	2	2	17	13/12/2007	40	0	0	40
25/05/2007	13	1	8	22	27/04/2007	37	0	0	37
19/08/2007	13	1	0	14	29/12/2007	37	0	1	38
8/05/2007	13	2	2	16	19/11/2007	36	0	1	37
R43					R187				
Date	Mt Arthur (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)	Date	Mt Arthur (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)
27/03/2008	26	1	0	26	14/06/2007	44	0	3	47
10/06/2007	22	1	6	29	2/04/2007	39	0	1	40
16/08/2007	21	0	0	22	25/08/2007	38	0	1	39
28/05/2007	20	2	0	22	19/04/2007	35	0	2	38
19/01/2008	19	0	0	19	7/05/2007	35	0	0	35
9/12/2007	18	1	0	19	13/12/2007	34	0	0	34
19/08/2007	17	1	0	18	29/12/2007	32	0	1	33
8/10/2007	16	0	3	18	18/08/2007	31	4	0	36
6/01/2008	15	0	4	19	19/11/2007	31	0	1	32
22/06/2007	14	2	1	18	12/05/2007	31	0	1	31
R62					R211				
Date	Mt Arthur (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)	Date	Mt Arthur (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)
27/03/2008	27	0	0	27	14/06/2007	74	0	2	**75**
10/06/2007	22	1	3	25	2/06/2007	71	0	1	**72**
16/08/2007	20	0	0	21	25/08/2007	68	0	1	**69**
25/05/2007	18	1	2	21	7/05/2007	68	0	0	**68**
19/08/2007	18	1	0	19	19/04/2007	68	0	2	**70**
28/05/2007	16	2	0	18	2/04/2007	65	0	1	**66**
9/12/2007	16	1	0	17	12/05/2007	64	0	0	**64**
22/06/2007	15	2	1	18	17/03/2008	61	0	0	**61**
1/04/2007	14	0	0	14	27/04/2007	61	0	0	**61**
19/01/2008	13	0	0	13	15/05/2007	58	0	1	**59**

Residence ID									
R78					R226				
Date	Mt Arthur (µg/m^{3})	Mangoola (µg/m^{3})	Mount Pleasant (µg/m^{3})	Cumulative (µg/m^{3})	Date	Mt Arthur (µg/m^{3})	Mangoola (µg/m^{3})	Mount Pleasant (µg/m^{3})	Cumulative (µg/m^{3})
22/06/2007	34	1	1	36	27/04/2007	49	0	0	49
28/05/2007	31	2	0	33	25/08/2007	47	0	2	49
27/03/2008	30	0	0	30	10/03/2008	41	0	2	43
10/06/2007	28	1	1	29	9/02/2008	40	1	0	42
16/08/2007	28	0	0	28	29/12/2007	40	0	1	41
20/09/2007	21	0	1	22	13/12/2007	39	0	0	39
26/10/2007	19	1	0	20	17/03/2008	38	0	0	39
9/12/2007	19	0	0	20	12/03/2008	36	0	5	42
19/08/2007	19	1	0	20	29/11/2007	36	1	1	38
1/04/2007	18	0	0	18	14/05/2007	35	0	9	44
R91					R238				
Date	Mt Arthur (µg/m^{3})	Mangoola (µg/m^{3})	Mount Pleasant (µg/m^{3})	Cumulative (µg/m^{3})	Date	Mt Arthur (µg/m^{3})	Mangoola (µg/m^{3})	Mount Pleasant (µg/m^{3})	Cumulative (µg/m^{3})
22/06/2007	43	1	1	45	8/09/2007	35	0	0	35
10/02/2008	38	0	0	38	14/03/2008	34	0	0	35
12/07/2007	37	1	3	40	7/09/2007	32	0	0	32
27/10/2007	36	1	1	38	21/07/2007	32	0	6	38
14/09/2007	33	1	0	34	7/04/2007	31	0	0	31
20/09/2007	33	0	1	33	9/09/2007	30	0	0	30
28/05/2007	32	2	0	34	18/03/2008	30	0	2	32
27/05/2007	31	1	0	33	27/04/2007	29	0	0	29
11/06/2007	30	3	1	34	23/09/2007	28	1	2	32
1/06/2007	27	0	0	27	31/10/2007	27	0	0	27
					R252				
					Date	Mt Arthur (µg/m^{3})	Mangoola (µg/m^{3})	Mount Pleasant (µg/m^{3})	Cumulative (µg/m^{3})
					10/04/2007	25	1	11	37
					20/08/2007	23	0	0	23
					9/09/2007	23	0	0	23
					28/12/2007	22	0	0	22
					1/03/2008	21	1	2	25
					8/09/2007	21	0	0	21
					24/04/2007	21	0	0	21
					31/10/2007	21	0	0	21
					7/04/2007	20	0	0	20
					19/08/2007	20	2	3	25

Table 8.9: Cumulative 24-hour PM_{10} Concentrations - 2026

Residence ID									
R23					R184a				
Date	Mt Arthur (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)	Date	Mt Arthur (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)
10/06/2007	17	1	6	24	14/06/2007	58	0	2	**61**
25/05/2007	16	1	7	24	25/08/2007	53	0	1	**54**
6/01/2008	15	0	5	20	19/04/2007	52	0	2	**55**
27/03/2008	15	1	0	16	27/04/2007	50	0	0	50
19/08/2007	13	0	0	14	2/04/2007	50	0	1	**51**
9/12/2007	13	0	1	14	12/05/2007	48	0	1	49
8/10/2007	12	0	2	14	13/12/2007	47	0	0	47
19/01/2008	12	0	0	12	17/03/2008	47	0	0	47
17/06/2007	11	0	0	11	29/12/2007	44	0	1	45
8/05/2007	11	2	2	14	10/03/2008	44	0	2	46
R43					R187				
Date	Mt Arthur (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)	Date	Mt Arthur (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)
27/03/2008	22	1	0	23	14/06/2007	50	0	3	**53**
10/06/2007	20	1	6	27	25/08/2007	44	0	1	46
25/05/2007	16	1	7	23	2/04/2007	43	0	1	44
16/08/2007	16	0	0	16	13/12/2007	41	0	0	41
19/08/2007	15	1	0	16	19/04/2007	40	0	3	43
9/12/2007	15	0	0	16	29/12/2007	40	0	1	41
6/01/2008	15	0	4	19	12/05/2007	39	0	1	39
19/01/2008	15	0	0	15	27/04/2007	38	0	0	38
28/05/2007	14	1	0	16	19/11/2007	37	0	1	38
8/10/2007	12	0	3	15	18/08/2007	36	2	0	38
R62					R211				
Date	Mt Arthur (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)	Date	Mt Arthur (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)
27/03/2008	21	0	0	22	25/08/2007	83	0	1	**84**
10/06/2007	21	1	3	25	27/04/2007	76	0	0	**76**
25/05/2007	18	1	2	21	7/05/2007	74	0	0	**74**
19/08/2007	16	0	0	17	2/06/2007	73	0	1	**74**
9/12/2007	15	0	1	16	2/04/2007	71	0	1	**72**
16/08/2007	14	0	0	15	14/06/2007	70	0	2	**72**
28/05/2007	12	1	0	14	19/04/2007	68	0	2	**70**
6/01/2008	12	0	3	15	17/03/2008	68	0	0	**68**
27/05/2007	12	1	1	13	10/03/2008	65	0	2	**67**
21/09/2007	11	0	1	12	9/02/2008	64	0	2	**66**

Residence ID									
R78					R226				
Date	Mt Arthur (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)	Date	Mt Arthur (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)
22/06/2007	33	1	1	35	27/04/2007	53	0	0	**53**
16/08/2007	31	0	0	31	25/08/2007	49	0	2	**51**
27/03/2008	31	0	0	31	9/02/2008	45	1	1	46
28/05/2007	30	1	0	32	10/03/2008	42	0	2	44
10/06/2007	29	1	1	30	29/11/2007	40	1	1	43
1/04/2007	20	0	0	20	14/03/2008	40	0	0	40
20/09/2007	20	1	1	21	17/03/2008	40	0	0	41
9/12/2007	20	0	0	20	7/09/2007	40	0	0	40
26/10/2007	20	1	0	21	14/05/2007	40	0	10	50
19/08/2007	19	1	0	20	29/12/2007	38	0	2	40
R91					R238				
Date	Mt Arthur (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)	Date	Mt Arthur (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)
22/06/2007	43	1	1	45	8/09/2007	34	0	0	34
10/02/2008	38	0	0	38	7/04/2007	32	0	0	32
12/07/2007	36	1	3	40	14/03/2008	32	0	0	32
27/10/2007	35	1	1	37	9/09/2007	31	0	0	31
20/09/2007	33	0	1	34	7/09/2007	30	0	0	31
14/09/2007	33	0	0	34	21/07/2007	30	0	7	38
27/05/2007	30	1	0	31	28/12/2007	30	0	0	30
28/05/2007	30	2	0	32	31/10/2007	29	0	0	29
1/06/2007	28	0	0	28	18/03/2008	28	0	2	30
11/06/2007	28	2	2	31	19/08/2007	27	1	1	29
					R252				
					Date	Mt Arthur (µg/m³)	Mangoola (µg/m³)	Mount Pleasant (µg/m³)	Cumulative (µg/m³)
					10/04/2007	26	1	12	39
					20/08/2007	25	0	0	25
					1/03/2008	25	1	2	28
					9/09/2007	22	0	0	22
					10/07/2007	22	2	0	24
					24/04/2007	20	0	0	20
					8/09/2007	20	0	0	20
					31/10/2007	20	0	0	20
					28/12/2007	19	0	0	20
					17/06/2007	19	0	0	19

The cumulative 24-hour average PM_{10} results at the residences are discussed in detail in the following sections. The results demonstrate that there are no exceedances of the DP&I cumulative 24-hour PM_{10} acquisition criterion of 150 µg/m^3 at any of the residences. Assessment against the EPA 24-hour PM_{10} criterion of 50 µg/m^3 is discussed in the following sections.

8.6.2 Receptors to the North and East

The cumulative 24-hour average PM_{10} concentration analysis at the selected residences indicates that residences to the north and east (23, 43, 62, 78 and 91) of the Modification are predicted to comply with the EPA cumulative 24-hour PM_{10} criterion of 50 µg/m^3 in 2016, 2022 and 2026 (**Table 8.7**, **Table 8.8** and **Table 8.9**). The results demonstrate that at times when Mt Arthur Coal Mine is expected to have the most impact on these residences the contribution from neighbouring mines is not significant due to the location of the residence and the other mines and the predominant wind direction at these times.

8.6.3 Receptors to the West

Residence 211 is the closest residence to the west of the Mt Arthur Coal Mine boundary and owned by HVEC. At Residence 211, exceedances of the cumulative 24-hour PM_{10} criterion are predicted in 2016, 2022 and 2026. However, the predicted 24-hour PM_{10} impact disperses quickly and this is demonstrated at the residences further west from Mt Arthur Coal Mine. At Residences 184a and 187, the predicted 24-hour PM_{10} concentration from the Modification alone reduces significantly compared to Residence 211. It should be noted that on days where exceedances are predicted to occur at Residences 184a and 187 in 2016 Bengalla Coal Mine is also predicted to be a major contributor at these residences (**Table 8.7**).

At the mine-owned residence 184a exceedances of the cumulative 24-hour average PM_{10} criterion are also predicted in 2022 and 2026 (**Table 8.8** and **Table 8.9**). In 2022, there are no exceedances of the 24-hour PM_{10} criterion at Residence 187 as it is located further west (>3.3 km away) from Mt Arthur Coal Mine. There is one marginal exceedance of the 24-hour PM_{10} criterion at Residence 187 in 2026.

Exceedances of the cumulative 24-hour average PM_{10} criterion are expected at Residence 226 in 2016 and 2026 (**Table 8.7** and **Table 8.9**). On the days with exceedances in 2016, there is significant contribution from Bengalla Coal Mine as well as Mt Arthur Coal Mine. This is expected as Residence 226 is located to the west of the two mines and during easterly flows there would be contribution from both mines. There are no exceedances of the cumulative 24-hour average PM_{10} criterion at Residence 226 in 2022.

The results of the cumulative 24-hour average PM_{10} analysis demonstrate that the residences to the west of Mt Arthur Coal Mine have potential to be impacted by mining operations under some wind directions. However, the dust disperses quickly and by the time it reaches residences to the further west of the site (approximately >3.5 km from the western boundary) the impacts are expected to be below the 24-hour average PM_{10} criterion. The residences closest to Mt Arthur Coal Mine (e.g. 184a, 211, 210, 209 and 208) are mine owned or within the existing HVEC Zone of Acquisition.

As discussed in **Section 5.1.1**, based on the location of the Drayton South Coal Mine and Mt Arthur Coal Mine, the highest impacts from the Modification are unlikely to coincide with the highest impacts from the Drayton South Coal Mine.

8.6.4 Receptors to the Northwest

Residence 238 is predicted to experience exceedances of the cumulative 24-hour average PM_{10} criterion in 2016 (**Table 8.7**). Similar to Residence 226, due to the location of Residence 238 there would be contribution from both Bengalla Coal Mine and Mt Arthur Coal Mine during unfavourable wind conditions. This is evident in the fact that there are no exceedances of the cumulative 24-hour average PM_{10} criterion in 2022 and 2026 when Bengalla Coal Mine has ceased operation (**Table 8.8** and **Table 8.9**).

The results in 2016 demonstrate that contribution of PM_{10} concentration from the Modification at Residence 252 is less than 25 $\mu g/m^3$ (**Table 8.7**). Residence 252 is located west of Mount Pleasant Mine and Bengalla Coal Mine approximately northwest of Mt Arthur Coal Mine. The majority of the contribution of predicted PM_{10} concentration at Residence 252 is from neighbouring mines. In 2022 and 2026, there are no predicted exceedances of the 24-hour average PM_{10} criterion.

The influence of the neighbouring mines is much more significant to the residences to the northwest, particularly in 2016 where several neighbouring mines are in operation. The 24-hour average PM_{10} concentration from the Modification only is well below the criterion.

8.6.5 Proposed Neighbouring Mines

As discussed in **Section 5.1.2**, there are proposed modifications for the Bengalla and Drayton Coal Mines. The proposals are currently not approved, and in the case of Bengalla Coal Mine, no detailed air quality assessment is available. A qualitative discussion of the likely impacts of these proposals on the cumulative assessment is presented below.

The air quality assessment for the proposed Drayton Modification indicates that the Drayton Modification will have the same impacts as those that have already been approved (**PAEHolmes, 2012**).

Based on the predominant wind direction of the area and the location of Mt Arthur Coal Mine, Mangoola Coal Mine and Drayton Coal Mine, the potential impacts from proposed projects on days when the Modification has the highest impacts should be minimal.

The proposed Bengalla Continuation Project will extend its operation towards the west near Roxburgh Road. This will have an impact on the residences near Roxburgh Road. There is no detailed information publicly available on the proposed Bengalla Continuation Project for inclusion in the modelling for 2022 and 2026. As discussed in **Section 8.6.4**, the impact on residences to the northwest of Mt Arthur Coal Mine is mainly due to influences from neighbouring mines. Therefore, should the Bengalla Continuation Project proceed these residences are likely to be impacted however Mt Arthur Coal Mine is unlikely to be the main contributor.

8.7 Comparison with 2009 Environmental Assessment

A comparison of the annual and maximum 24-hour PM_{10} concentration results for the Modification with the corresponding years in the 2009 EA is shown in **Table 8.10**. The comparison focused on PM_{10} because the majority of the exceedances predicted are of the 24-hour average PM_{10} criterion.

The modelling predictions show that annual and maximum 24-hour PM_{10} average concentrations are lower at the majority of the residences compared to the 2009 EA. In particular, Residences 91, 94, 183, 184c, 187, 200, 201 and 226 are below the 24-hour average PM_{10} criterion of 50 $\mu g/m^3$ for the modelling predictions for the Modification. This is partly a result of continual efforts by Mt Arthur Coal Mine to implement controls to reduce dust emissions since 2009. Specifically these include water application while drilling and application of water to ROM stockpiles. Additionally, the changes to the mine plans compared to the 2009 EA have also helped improve dust impacts at some of the residences.

Table 8.10: Comparison of Modelling Predictions – Modification and 2009 EA

ID	2016		2022		2016		2022	
	Modification	2009 EA	Modification	2009 EA	Modification	2009 EA	Modification	2009 EA
	Maximum 24-hour PM_{10} ($\mu g/m^3$)		Maximum 24-hour PM_{10} ($\mu g/m^3$)		Annual PM_{10} ($\mu g/m^3$)		Annual PM_{10} ($\mu g/m^3$)	
	EPA Criterion = 50 $\mu g/m^3$				EPA Criterion = 30 $\mu g/m^3$			
6	31	36	30	45	3	3	3	3
8	27	30	29	35	2	3	2	3
9	25	27	20	26	2	2	2	2
10	24	27	20	26	2	2	2	2
11	22	22	22	24	2	2	2	2
12	20	21	20	23	2	2	2	2
13	20	21	19	22	1	2	2	2
14	20	20	17	22	1	2	1	2
15	20	20	17	21	1	2	1	2
16	19	20	17	21	1	2	1	2
17	19	20	17	21	1	2	1	2
18	19	20	17	21	1	2	1	2
20	19	20	18	21	1	2	1	2
21	19	20	18	22	1	2	1	2
22	19	21	18	22	1	2	1	2
23	19	21	18	22	1	2	1	2
24	19	21	18	22	1	2	1	2
25	20	21	17	22	1	2	1	2
26	20	21	17	22	1	2	1	2
27	20	20	17	22	1	2	1	2
28	21	22	17	22	1	2	1	2
29	21	21	17	22	1	2	1	2
30	20	20	17	21	1	2	1	2
31	19	19	15	18	1	1	1	1
32	19	19	17	21	1	2	1	2
33	18	18	16	19	1	2	1	2
34	17	18	16	17	1	1	1	1
36	15	14	12	14	1	1	1	1
37	20	20	19	20	1	2	1	2
37	19	21	18	21	1	2	1	2
39	22	24	24	27	2	2	2	2
40	23	25	24	28	2	2	2	2
41	23	25	25	29	2	2	2	2
42	24	26	25	30	2	2	2	2
43	24	27	26	30	2	2	2	2
49a	30	33	29	41	3	3	3	3
49b	31	33	30	41	3	3	3	4
56	24	26	26	28	2	2	2	2
57	24	27	26	29	2	2	2	2
58	25	27	26	29	2	2	2	2
59	26	28	26	29	2	2	2	2
60	27	29	27	30	2	2	2	2

ID	2016		2022		2016		2022	
	Modification	2009 EA	Modification	2009 EA	Modification	2009 EA	Modification	2009 EA
	Maximum 24-hour PM_{10} ($\mu g/m^3$)		Maximum 24-hour PM_{10} ($\mu g/m^3$)		Annual PM_{10} ($\mu g/m^3$)		Annual PM_{10} ($\mu g/m^3$)	
	EPA Criterion = 50 $\mu g/m^3$				EPA Criterion = 30 $\mu g/m^3$			
61	27	30	27	30	2	2	2	2
62	28	31	27	31	2	2	2	2
69	21	24	21	22	2	2	2	2
70	23	25	22	24	2	3	2	3
71	24	26	24	26	2	3	2	3
72	25	28	26	28	3	3	2	3
73	27	30	28	31	3	3	3	3
75	29	33	30	34	3	3	3	3
76	30	36	32	37	3	3	3	3
77	32	39	34	39	3	4	3	3
77	31	38	33	39	3	3	3	3
78	33	37	34	38	3	4	3	4
79	32	43	34	43	3	4	3	4
79	34	41	36	41	3	4	3	4
82	35	41	35	40	4	5	4	4
83	34	41	34	40	4	4	3	4
85	35	39	35	39	4	5	4	4
86	36	38	35	40	4	5	4	5
87	38	42	37	44	5	6	5	6
88	37	42	37	42	5	5	4	5
89	41	46	40	47	5	6	5	6
90	42	49	41	48	5	6	5	6
91	44	51	45	52	6	7	6	7
92	43	48	42	49	5	6	5	6
93	41	45	41	47	5	6	5	6
94	42	47	42	52	5	6	5	6
95	37	41	37	44	5	5	4	5
96	36	40	36	43	4	5	4	5
97	37	45	38	48	5	6	4	5
98	35	46	37	47	5	5	4	5
99	35	47	36	46	4	5	4	5
99	35	47	36	44	5	6	4	5
100	35	47	35	43	5	6	5	5
101	37	47	36	43	5	6	5	6
102	38	47	38	45	5	6	5	6
182	27	35	30	35	4	6	6	6
183	39	49	44	51	7	9	9	10
184a	45	53	54	64	9	12	12	14
184b	43	51	55	63	9	12	12	14
184c	43	53	48	59	8	11	11	12
186	30	37	36	42	6	8	8	9
187	37	45	44	53	7	10	10	11
190	25	32	28	33	4	6	5	6
191	26	33	28	34	4	6	6	6
195	27	32	31	36	5	7	7	7
196	30	35	33	38	5	8	7	8
197	30	35	35	40	6	8	8	8
198	36	42	43	50	7	10	9	11
199	38	-	42	-	7	-	9	-
200	41	49	47	54	8	11	10	12
201	38	44	45	52	7	10	10	11
202	43	-	49	-	9	-	11	-
203	42	49	51	58	8	12	11	13
204	46	53	52	59	9	12	12	14
205	44	51	53	61	9	12	12	14
206	50	57	56	66	10	14	13	16
207	51	57	58	66	10	14	13	17
208	55	64	66	77	12	16	15	19
209	55	65	66	75	12	16	15	19
210	62	75	75	88	14	19	17	23
211	64	81	74	95	15	20	20	25
212[1]	69	86	82	92	15	22	19	24
213	31	37	35	39	5	7	7	8
213	32	37	36	39	6	8	7	8
213	31	38	34	40	5	7	7	8

ID	2016		2022		2016		2022	
	Modification	2009 EA	Modification	2009 EA	Modification	2009 EA	Modification	2009 EA
	Maximum 24-hour PM_{10} ($\mu g/m^3$)		Maximum 24-hour PM_{10} ($\mu g/m^3$)		Annual PM_{10} ($\mu g/m^3$)		Annual PM_{10} ($\mu g/m^3$)	
	EPA Criterion = 50 $\mu g/m^3$				EPA Criterion = 30 $\mu g/m^3$			
216	32	39	36	41	6	8	7	8
218	35	41	40	43	7	9	8	10
218	35	42	41	44	7	9	9	10
218	34	42	39	45	6	8	8	9
226	43	55	49	60	10	14	12	15
231	34	41	40	43	7	9	8	10
232	35	42	41	44	7	9	9	10
233	39	44	43	45	8	10	9	11
233	39	45	45	47	8	11	9	11
235	32	35	34	35	6	8	7	8
236	31	35	33	35	6	8	7	8
238	34	42	35	41	8	10	8	10
239	39	46	42	45	8	11	9	11
240	38	44	41	43	8	10	9	10
241	39	43	41	43	8	10	9	10
242a	36	36	37	35	7	9	8	9
242b	33	39	34	39	7	8	7	8
243	28	33	31	32	6	7	6	7
250[1]	30	34	33	33	6	7	6	7
252[2]	23	30	25	30	4	5	4	5
254	24	27	27	26	5	6	5	5
257	26	28	26	27	5	6	5	6
259	25	28	27	27	5	6	5	6
264[3]	29	-	32	-	3	3	3	3

NOTE: Bolded – owned by HVEC.
Italics – in HVEC Zone of Acquisition from the Consolidation Project Approval.
Red – exceedance of the criteria.
[1] Owned by Coal & Allied.
[2] Within Mount Pleasant Mine's Zone of Acquisition.
[3] Within HVEC and Mount Pleasant Mine's Zone of Acquisition. Two receivers located at property.

8.8 Construction Phase

Construction/development activities which would potentially contribute to dust and particulate matter emissions include:

- relocation of existing explosives facility and magazine;
- minor infrastructure upgrades including an administration building, CHPP offices and control room;
- minor extension to ROM coal stockpile footprint; and
- duplication of the existing rail loop.

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.

Procedures for controlling dust impacts during construction would include, but not necessarily be limited to the following:

Clearing/Excavation

Emissions from vegetation stripping, topsoil clearing and excavation may occur, particularly during dry and windy conditions. Emissions would be effectively controlled by increasing the moisture content of the soil/surface (i.e. through the use of water carts/trucks). Other controls that would be undertaken include:

- modifying 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.

Haulage, Heavy Plant and Equipment

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

- all vehicles on-site would be confined to designated routes with speed limits enforced;
- trips and trip distances would 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, a water cart/truck (for water spraying of travel routes) would be used.

Wind Erosion

Wind erosion from exposed surfaces during construction would be controlled as part of the best practice environmental management of the site. Wind erosion from exposed ground would be limited by avoiding unnecessary vegetation clearing and by progressively rehabilitating exposed areas as quickly as possible (e.g. through the use of a cover crop). Wind erosion from temporary stockpiles would be limited by minimising the number of stockpiles on-site and minimising the number of work faces on stockpiles.

8.9 Blast Fume Emissions

The explosive used in blasting will be primarily ammonium nitrate fuel oil (ANFO), the detonation of which produces gas. The principal gases are nitrogen, water vapour and carbon dioxide (CO_2) together with smaller amounts of CO and oxides of nitrogen (NOx).

Samples of blasting fume taken at the Ravensworth Open Cut Mine in 1992 measured a maximum NO_2 concentration of 3 parts per million (ppm) over an exposure period of six minutes. Scientific literature suggests that no adverse health effects would be expected due to this exposure although a noticeable odour would be present.

Given that the concentration at the nearby residences will be significantly lower than the 3 ppm measured on-site at Ravensworth, it is unlikely that there will be any adverse impacts due to NO_2 emissions from the blasting.

A detailed measurement program of NO_x in blast plumes in the Hunter Valley was made by **Attalla et al.** (**2008**). The study used an extensive methodology to predict NO_2 impacts downwind of blasts at two mines in the Hunter Valley. The results from the study show consistency with the work completed for Ravensworth in 1992.

Blasting activities also have the potential to result in fugitive fume and particulate matter emissions. Particulate matter emissions from blasting are included in dispersion modelling results.

HVEC has developed a Blast Management Plan and Blast Monitoring Program to manage compliance with regulatory requirements and minimise impacts on neighbouring receptors.

Best practice control of blast fume, dust and odour is achieved by the following:

- All blast holes are stemmed to ensure blast efficiency and to reduce overpressure effects.
- Coordination of a blasting schedule with neighbouring mines.
- Minimising the potential for delayed firing of shots which have been loaded into wet holes within the constraints of prevailing weather conditions.
- Conducting a pre-blast EA with consideration given to wind speed, direction and shear and the strength of temperature inversions prior to each blast.
- Blasts will be fired in suitable weather conditions that minimise the potential for blast generated dust and/or blast fume to be blown towards neighbouring residential areas. Blasts are postponed if environmental conditions are unfavourable.
- Should blasts need to be fired in less than ideal weather conditions, HVEC will take additional controls to minimise impacts and such decisions will be elevated up the organisational structure, demonstrating the seriousness of such decisions.

8.10 Proposed Spontaneous Combustion Management and Control Procedures

HVEC will continue to monitor and manage spontaneous combustion throughout the life of the Modification. Preventative measures include:

- Overburden areas:
  - minimisation of unplanned coal losses and volume of carbonaceous material sent to overburden emplacement areas;
  - selective placement of carbonaceous material in active dumps where it can be rapidly buried to reduce its exposure;
  - ensuring carbonaceous material is buried in a short space of time that prevents;
  - heating with a minimum depth of inert cover of 10 m where feasible;
  - ensuring that loose carbonaceous material is not used to form safety windrows or other mound constructions from which heat may be generated; and
  - disposing of coarse reject in active tip faces ensuring it is buried as soon as possible.

- Coal stockpiles:
  - limiting the stockpile height to 25 m or less;
  - limiting the amount of time that coal is to remain on a stockpile to below the 'shelf life' for that coal type; and
  - ensuring access is available to all stockpile areas to enable coal rehandling in the event that excessive heating is measured or spontaneous combustion occurs.

8.10.1 Control Measures

Control measures of spontaneous combustion outbreaks at Mt Arthur Coal Mine include:

- Overburden:
  - For loose heaps of material showing signs of spontaneous combustion:
    - spreading the 'hot' material and compaction with a dozer; and/or
    - sealing the hot area with inert material.
  - For overburden emplacement areas showing signs of spontaneous combustion:
    - battering off the face if possible; and/or
    - covering the active face with inert material and, where possible, compact with a dozer; and/or
    - reviewing the type of overburden and the emplacement technique to identify possible improvements.
  - Monitoring of the effectiveness of control measures completed and reporting of findings to relevant personnel.
- Coal stockpiles:
  - To control self-heating within stockpiles the coal will be turned, spread out or removed before ignition occurs.
  - If ignition does occur, the affected area will be dug out and removed from the body of the stockpile and saturated with water to extinguish the heating.

9 GREENHOUSE GAS ASSESSMENT

The DGR's identified GHG as an issue requiring assessment. The DGRs for GHG assessment require:

- quantitative assessment of the potential scope 1, 2 and 3 GHG emissions of the Modification;
- qualitative assessment of the potential impacts of these emissions on the environment; and
- an assessment of the reasonable and feasible measures that could be implemented on-site to minimise the GHG emissions and ensure energy efficiency of the Modification.

This GHG assessment has been prepared in accordance with these requirements.

9.1 Introduction

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

- The World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) GHG Protocol *The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard* (*Revised Edition*) (**WRI/WBCSD, 2004**);
- *National Greenhouse and Energy Reporting (Measurement) Determination 2008*; and
- The Commonwealth Department of Climate Change and Energy Efficiency (DCCEE) *National Greenhouse Accounts (NGA) Factors 2011* (**DCCEE, 2011**).

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

Three 'scopes' of emissions (scope 1, scope 2 and scope 3) are defined for GHG accounting and reporting purposes, as described below. This terminology has been adopted in Australian GHG 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 GHG emissions are defined as those emissions that occur from sources that are owned or controlled by the reporting entity. Direct GHG 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 GHG emissions associated with the Modification.
- Physical or chemical processing. Most of these emissions result from manufacture or processing of chemicals and materials (e.g. the manufacture of cement and aluminium).

- 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).
- Fugitive emissions. These emissions result from intentional or unintentional releases (e.g. equipment leaks from joints, seals, packing, and gaskets; methane (CH_4) emissions from coal mines and venting); hydroflurocarbon emissions during the use of refrigeration and air conditioning equipment; and CH_4 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 GHG 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 coal mines typically covers purchased electricity, defined as electricity that is purchased or otherwise brought into the organisational boundary of the entity.

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 GHG Protocol are extraction and production of purchased materials, transportation of purchased fuels, and use of sold products and services.

In the case of the Modification, scope 3 emissions will include emissions associated with the extraction, processing and transport of diesel, and the transportation and combustion of product coal. The GHG 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 GHG 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 GHG 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.

9.2 Greenhouse Gas Emission Estimates

Emissions of CO_2 and CH_4 would be the most significant GHGs for the Modification. 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 liberation of CH_4 from coal seams.

Inventories of GHG 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 CO_2 equivalent or CO_2-equivalent (CO_2-e) emissions by applying the relevant global warming potential. The GHG assessment has been conducted using the NGA Factors, published by the **DCCEE (2011)**.

Modification-related GHG 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.
- Emissions associated with use of explosives in blasting – Scope 1.
- Indirect emissions associated with consumption of electricity – Scope 2.
- Indirect emissions associated with the production and transport of fuels – Scope 3.
- Emissions from coal transportation (rail and sea) – Scope 3.
- Emissions from the use of the product coal – Scope 3.

9.2.1 Fuel Consumption

GHG emissions from diesel consumption were estimated using the following equation:

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

where:

E_{CO2-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 = gigajoules.
[2] kg CO_2-e/GJ = kilograms of carbon dioxide equivalents per gigajoule.

The quantity of diesel forecast to be consumed in each mine year, has been provided by Mt Arthur Coal Mine. Approximately 5% of diesel usage on-site has been replaced with biodiesel. The quantity of diesel and biodiesel consumed in GJ (Q) is calculated using an energy content factor of 38.6 gigajoules per kilolitre (GJ/kL) for diesel and 34.6 GJ/kL for biodiesel.

GHG emission factors and energy content for diesel were sourced from the NGA Factors (**DCCEE, 2011**). The estimated annual and Modification total GHG emissions from diesel and biodiesel usage are presented in **Table 9.1** and **Table 9.2**.

It is also noted that diesel would be consumed post-mining during rehabilitation and decommissioning of the Modification. However, HVEC estimates that this would involve less diesel consumption due to reduced quantities of material movements relative to the operational phase. These emissions have therefore not been specifically quantified.

Table 9.1: Estimated CO_2-e (tonnes) for Diesel Consumption

Year	Diesel Consumption (kL/annum)	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	
2022	211,329	69.9	5.3	38.6	570,195	43,234	613,429
2023	215,649	69.9	5.3	38.6	581,851	44,117	625,968
2024	225,853	69.9	5.3	38.6	609,382	46,205	655,587
2025	239,038	69.9	5.3	38.6	644,958	48,902	693,860
2026	253,498	69.9	5.3	38.6	683,972	51,861	735,833
Total	**1,145,366**				**3,090,358**	**234,319**	**3,324,677**

Note: Totals may differ to the sum of the columns due to rounding to significant figures.
KL/annum = Kilolitres per annum.

Table 9.2: Estimated CO_2-e (tonnes) for Biodiesel Consumption

Year	Diesel Consumption (kL/annum)	Emission Factor (kg CO_{2-e}/GJ)	Energy Content (GJ/kL)	Scope 1 Emissions (t CO_{2-e})
2022	11,123	3.4	34.6	1,308
2023	11,350	3.4	34.6	1,335
2024	11,887	3.4	34.6	1,398
2025	12,581	3.4	34.6	1,480
2026	13,342	3.4	34.6	1,570
Total	**60,282**			**7,092**

Note: Totals may differ to the sum of the columns due to rounding to significant figures.

9.2.2 Fugitive Methane

Emissions from fugitive CH_4 were estimated using the following equation:

$$E_{CO_2-e} = Q \times EF$$

where:

E_{CO2-e}	=	Emissions of GHG from fugitive CH_4	(t CO_2-e/annum)[1]
Q	=	ROM coal extracted during the year	(t)
EF	=	Scope 1 emission factor	(t CO_2-e/tonne ROM)

[1] t CO_2-e/annum = tonnes of CO_2 equivalent per annum

The default emission factor for fugitive emissions from open cut mines was sourced from the NGA Factors (**DCCEE, 2011**). The estimated annual and Modification total GHG emissions from fugitive CH_4 are presented in **Table 9.3**. The ROM forecast for each mine year was provided by Mt Arthur Coal Mine.

Table 9.3: Estimated CO_2-e (tonnes) for Fugitive CH_4

Year	ROM (Opencut) (Mtpa)	Emission Factor (t CO_{2-e}/tonne ROM)	Scope 1 Emissions (t CO_{2-e})
2022	32.0	0.045	1,440,000
2023	32.0	0.045	1,440,000
2024	32.0	0.045	1,440,000
2025	32.0	0.045	1,440,000
2026	32.0	0.045	1,440,000
Total			**7,200,000**

9.2.3 Explosives

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

$$E_{CO_2-e} = Q \times EF$$

where:

E_{CO2-e}	=	Emissions of GHG from explosives	(t CO_2-e/annum)
Q	=	Quantity of explosive used (assumed ANFO)	(t)
EF	=	Scope 1 emission factor	(t CO_2-e/tonne explosive)

GHG emission factors were sourced from the Australian Greenhouse Office (AGO) Factors and Methods Workbook – December 2006 (**Department of the Environment and Heritage Australia Greenhouse Office, 2011**). It is noted that the AGO Factors and Methods were replaced by the NGA Factors (**DCCEE, 2011**), however the emission factor for explosives was omitted from the latest version.

The estimated annual and Modification total GHG emissions from explosive usage are presented in **Table 9.4**. Expected explosive usage for each year was provided by Mt Arthur Coal Mine.

Table 9.4: Estimated CO_2-e (tonnes) for Explosive Use

Year	Explosive Usage (t per annum)	Emission Factors ($t\ CO_{2-e}$/t product)	Scope 1 Emissions ($t\ CO_{2-e}$)
		ANFO	
2022	76,657	0.167	12,802
2023	82,648	0.167	13,802
2024	88,905	0.167	14,847
2025	91,924	0.167	15,351
2026	93,824	0.167	15,669
Total	**433,958**		**72,471**

9.2.4 Electricity Consumption

The scope 2 and scope 3 emissions associated with the electricity consumption for the processing of Modification coal were estimated using the following equation:

$$E_{CO_2-e} = Q \times EF$$

Where:

E_{CO2-e}	=	Emissions of GHG from electricity consumption	($t\ CO_2$-e)
Q	=	Quantity of electricity	(MWh)[1]
EF	=	Emission factor for electricity consumption	(kg CO_2-e/kWh)[2]

1 MWh = megawatt hours.

2 kg CO_2-e/kWh = kilograms of carbon dioxide equivalents per kilowatt hour.

The scope 2 and 3 emissions factors for electricity consumption in NSW were sourced from the NGA Factors (**DCCEE, 2011**). It should be noted that while the scope 2 emissions factor has been used, all emissions associated with the processing of ROM coal would be scope 3 emissions for the Modification.

The total estimated GHG emissions from electricity consumption are provided in **Table 9.5**.

Table 9.5: Estimated CO_2-e (tonnes) for Electricity Consumption

Year	Electricity (kWh)	Emission Factor (kg CO_2-e/kWh)		Emissions (t CO_2-e)		Total ($t\ CO_{2-e}$)
		Scope 2	Scope 3	Scope 2	Scope 3	
2022	128,405,549	0.89	0.17	114,281	21,829	136,110
2023	137,832,484	0.89	0.17	122,671	23,432	146,102
2024	135,889,153	0.89	0.17	120,941	23,101	144,043
2025	139,336,170	0.89	0.17	124,009	23,687	147,696
2026	140,372,612	0.89	0.17	124,932	23,863	148,795
Total	**681,835,968**	-	-	**606,834**	**115,912**	**722,746**

9.2.5 ROM Coal and Product Coal Transportation

9.2.5.1 Transportation by Rail

Product coal is either transported via conveyor to Macquarie Generation's Bayswater Power Station or transported via rail to the Port of Newcastle for shipment overseas. The total product coal transferred to the Port of Newcastle will not exceed 27 Mtpa. **Table 9.6** presents a summary of the quantity of product coal assumed for each destination. It has conservatively been assumed that the product coal is 88% of ROM coal. Actual recovery rate is expected to be lower than 88%.

Table 9.6: Summary of Product Coal Destinations

	Total Product coal (Mt)	Product coal to Bayswater (Mt)	Balance to Port of Newcastle (Mt)
2022	28.16	1.16	27.00
2023	28.16	1.16	27.00
2024	28.16	1.16	27.00
2025	28.16	1.16	27.00
2026	28.16	1.16	27.00
TOTAL	**140.8**	**5.8**	**135.0**

Scope 3 emissions associated with the transportation by rail of Modification product coal were estimated using the following equation:

$$E_{CO_2-e} = \frac{Q \times D \times EF}{10^6}$$

Where:

E_{CO2-e}	=	Emissions of GHG from rail transport	(t CO_2-e)
Q	=	Quantity of product coal transported per train	(t)
D	=	Total distance travelled to and from Port of Newcastle	(km)
EF	=	Emission factor for rail transport	(g CO_2-e/net tonne-km)

Note: G CO_2-$e_{/net}$ tonne-km = grams of carbon dioxide equivalents per net tonne per kilometre

The scope 3 emissions associated with product coal transportation have been estimated based on all product coal being transported to Newcastle for export by rail. Emissions associated with product coal transportation have been estimated based on an emission factor for loaded trains of 12.3 grams per net tonne per kilometre (**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 the port of Newcastle is estimated to be 240 km.

The total estimated GHG emissions from rail transport of product coal are provided in **Table 9.7**.

Table 9.7: Estimated CO_2-e (tonnes) for ROM Coal and Product Coal Transportation

Year	Product coal to Port of Newcastle(Mt)	Scope 3 emissions from rail transport (t CO_{2-e})
2022	27.0	79,704
2023	27.0	79,704
2024	27.0	79,704
2025	27.0	79,704
2026	27.0	79,704
Total Modification	**135.0**	**398,520**

Note: Totals may differ to the sum of the columns due to rounding to significant figures.

9.2.5.2 Transportation by Ship

There will also be emissions associated with the shipping of the product overseas. **Table 9.8** presents a summary of coal destination and shipping distances from the Port of Newcastle.

Table 9.8: Port of Newcastle Coal Destinations and Distances

Location	Country	% of coal	Return distance (km)
Osaka	Japan	59	16,130
Kaohsiung	Taiwan	14	15,642
Busan	Korea	11	16,760
Mazatlan	Mexico	7	24,906
Penang	Malaysia	4	16,976
Shanghai	China	3	16,938
Rotterdam	Netherlands	2	43,060

Source: **Umwelt (2008)**

Based on information provided by HVEC, **Table 9.9** presents a summary of the assumptions used to calculate the emissions from transport of the product coal by sea.

Table 9.9: Summary of Assumptions

Parameter	Assumption	
Average size of Cape vessels	120,000	tonnes
Average size of Panamax vessels	80,000	tonnes
Average size of Handy Size vessels	60,000	tonnes
Proportion shipped on Cape vessels	35%	-
Proportion shipped on Panamax vessels	60%	-
Proportion shipped on Handy vessels	5%	-
Average Cape vessel speed	14.5	knots
Average Panamax vessel speed	14.5	knots
Average Handy vessel speed	13.5	knots
Average Cape vessel fuel consumption	57.0	tonnes per day
Average Panamax vessel fuel consumption	36.0	tonnes per day
Average Handy vessel fuel consumption	33.0	tonnes per day
Density of fuel oil	1010.0	kilograms per cubic metre
Energy content fuel oil	39.7	GJ/kL
Total scope 3 emission factor	78.6	kg CO_2-e/GJ

Source: **BHP Billiton (2009)**

Scope 3 emissions associated with the transportation by ship of Modification product coal were estimated using the following equation:

$$E_{CO_2-e} = Q \times EF$$

Where:

E_{CO2-e}	=	Emissions of GHG from sea transport	(t CO_2-e)
Q	=	Quantity of diesel consumed	(GJ)
EF	=	Emission factor for sea transport	(kg CO_2-e/GJ)

Estimated GHG emissions from the sea transportation of the coal are provided in **Table 9.10**.

Table 9.10: Estimated CO_2-e Emissions from Sea Transport of Product Coal (Mt/y)

Year	Product coal to Port of Newcastle (Mt/y)	Scope 3 emissions from sea transport (t CO_{2-e})
2022	27.0	1,032,117
2023	27.0	1,032,117
2024	27.0	1,032,117
2025	27.0	1,032,117
2026	27.0	1,032,117
Total Modification	**135.0**	**5,160,583**

Mt/y = million tonnes per year.

9.2.6 Use of Product Coal

All product coal from Mt Arthur Coal Mine will be sold as thermal coal. The scope 3 emissions associated with the combustion of product coal were estimated using the following equation:

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

Where:

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

[1] GJ/t = gigajoules per tonne

The quantity of thermal coal burnt in Mtpa is converted to GJ using an energy content factor for black coal of 27 GJ/t.

The GHG emission factor and energy content for coal were sourced from the NGA Factors (**DCCEE, 2011**). The emissions associated with the use of the product coal are presented in **Table 9.11**.

Table 9.11: Estimated CO_2-e Emissions from Usage of Product Coal (Mt/y)

Year	Product Coal (Mtpa)	Energy Content (GJ/t)	EF (kg CO_{2-e}/GJ)	Scope 3 Emissions (t CO_{2-e})
2022	28.16	27	88.43	67,235,098
2023	28.16	27	88.43	67,235,098
2024	28.16	27	88.43	67,235,098
2025	28.16	27	88.43	67,235,098
2026	28.16	27	88.43	67,235,098
Total				**336,175,488**

9.3 Summary of Emissions

Average annual scope 1 emissions from the Modification (2 million tonnes of carbon dioxide equivalent [Mt CO_2-e]) would represent 0.3% of Australia's Kyoto commitment (591.5 Mt CO_2-e) and a very small portion of global GHG emissions.

A summary of the annual GHG emissions is provided in **Table 9.12**.

Table 9.12: Summary of Estimated Annual GHG Emissions from Mt Arthur Coal Mine

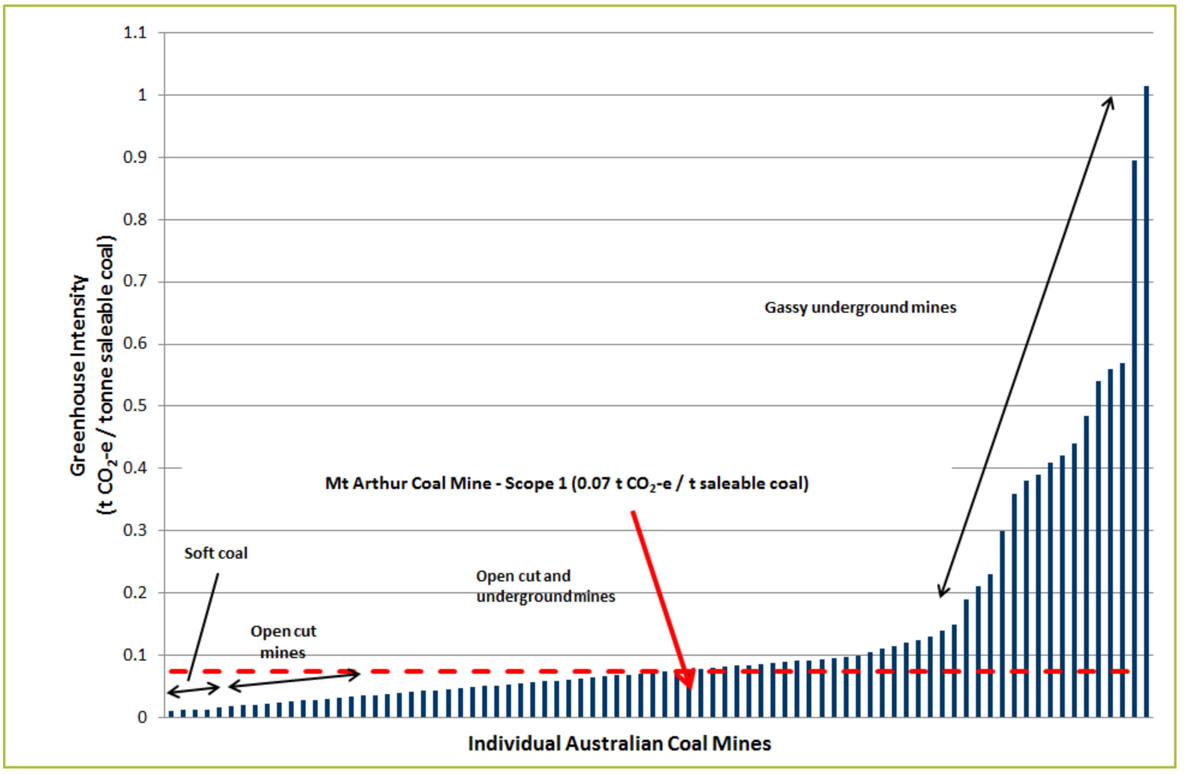
	Scope 1 Emissions (t CO_{2-e})					Scope 2 Emissions (t CO_{2-e})	Scope 3 Emissions (t CO_{2-e})					
Year	**On-site Diesel**	**On-site Biodiesel**	**Coal Seam Methane**	**Blasting**	***Total***	**Electricity**	**On-site Diesel**	**Electricity**	**Coal Burning**	**Rail Transport**	**Sea Transport**	**Total**
2022	570,195	1,308	1,440,000	12,802	2,024,305	114,281	43,234	21,829	67,235,098	79,704	1,032,117	68,411,981
2023	581,851	1,335	1,440,000	13,802	2,036,988	122,671	44,117	23,432	67,235,098	79,704	1,032,117	68,414,467
2024	609,382	1,398	1,440,000	14,847	2,065,628	120,941	46,205	23,101	67,235,098	79,704	1,032,117	68,416,224
2025	644,958	1,480	1,440,000	15,351	2,101,789	124,009	48,902	23,687	67,235,098	79,704	1,032,117	68,419,508
2026	683,972	1,570	1,440,000	15,669	2,141,211	124,932	51,861	23,863	67,235,098	79,704	1,032,117	68,422,642
Total	**3,090,358**	**7,092**	**7,200,000**	**72,471**	**10,369,921**	**606,834**	**234,319**	**115,912**	**336,175,488**	**398,520**	**5,160,583**	**342,084,822**

Note: Totals may differ to the sum of the columns due to rounding and significant figures.

9.4 Greenhouse Gas Emissions Intensity

The estimated GHG emissions intensity of the Modification is approximately 0.07 t CO_2-e/t saleable coal (this includes all scope 1 emissions). The estimated emissions intensity of the Modification is comparable with the average emissions intensity of existing open cut coal mines in Australia (0.05 t CO_2-e/t saleable coal) (**Deslandes, 1999**).

Figure 9.1 shows the GHG intensity of the Modification compared to other Australian coal mines. The emissions intensity is comparable to other open cut coal mines and significantly less than gassy underground mines.



Source: Derived from **Deslandes (1999).**

Figure 9.1: GHG Intensity Comparison

9.5 Qualitative Assessment of Impact

According to the Intergovernmental Panel of Climate Change's (IPCC) Fourth Assessment Report, global surface temperature has increased 0.74 ± 0.18°C during the 100 years ending 2005 (**IPCC, 2007a**). The IPCC has determined most of the observed increase in globally averaged temperatures since the mid-twentieth century is very likely due to the observed increase in anthropogenic GHG concentrations. Very likely is defined by the IPCC as greater than 90% probability of occurrence (**IPCC, 2007b**).

Climate change projections specific to Australia have been determined by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), based on the following global emissions scenarios predicted by the IPCC (**CSIRO, 2007**):

- A1F1 (high emissions scenario) – assumes very rapid economic growth, a global population that peaks in mid-century and technological change that is fossil fuel intensive.

- A1B (mid emissions scenario) – assumes the same economic and population growth as A1F1, with a balance between fossil and non-fossil fuel intensive technological changes.
- B1 (low emissions scenario) – assumes the same economic and population growth as A1F1, with a rapid change towards clean and resource efficient technologies.

For the global emissions scenarios described above, the projected changes in annual temperature relative to 1990 levels for Australian cities for 2030 and 2070 are presented in **Table 9.13**, as determined by the **CSIRO** (**2007**). The towns/cities presented in **Table 9.13** are those closest to Mt Arthur Coal Mine for which results are available.

Table 9.13: Projected Changes in Annual Temperature (relative to 1990)

Location	2030 - A1B (mid-range emissions scenario)	2070 - B1 (low emissions scenario)	2070 - A1F1 (high emissions scenario)
	Temperature (°C)		
Brisbane	0.7 - 1.4	1.1 - 2.3	2.1 - 4.4
Dubbo	0.7 - 1.5	1.2 - 2.5	2.2 - 4.8
St George (Queensland)	0.7 - 1.6	1.2 - 2.7	2.4 - 5.2
Sydney	0.6 - 1.3	1.1 - 2.2	2.1 - 4.3

Notes: Range of values represents the 10th and 90th percentile results.
For 2030, only A1B results are shown as there is little variation in projected results for the global emission scenarios A1B, B1 and A1F1 (**CSIRO, 2007**).
Source: **CSIRO (2007).**

CSIRO also details projected changes to other meteorological parameters (for example rainfall, potential evaporation, wind speed, relative humidity and solar radiation) and the predicted changes to the prevalence of extreme weather events (for example droughts, bush fires and cyclones).

The potential social and economic impacts of climate change to Australia are detailed in The Garnaut Climate Change Review (**Garnaut, 2008**), which draws on IPCC assessment work and the CSIRO climate projections. The Garnaut review details the negative and positive impacts associated with predicted climate change with respect to:

- agricultural productivity;
- water supply infrastructure;
- urban water supplies;
- buildings in coastal settlements;
- temperature related deaths;
- ecosystems and biodiversity; and
- geopolitical stability and the Asia-Pacific region.

The Modification's contribution to projected climate change, and the associated impacts, would be in proportion with its contribution to global GHG emissions. Average annual scope 1 emissions from the Modification (2 Mt CO_2-e) would represent approximately 0.3% of Australia's commitment under the Kyoto Protocol (591.5 Mt CO_2-e) and a very small portion of global GHG emissions, given that Australia contributed approximately 1.5% of global GHG emissions in 2010 **(DCC, 2011)**.

A comparison of predicted annual GHG emissions from the Modification with global, Australian and NSW emissions inventories are presented in **Table 9.14**.

Table 9.14: Comparison of GHG Emissions

Geographic coverage	Source coverage	Timescale	Emission Mt CO_2-e	Reference
Modification	Scope 1 only	Average annual	2	This report.
Global	Consumption of fossil fuels	Total since industrialisation 1750 - 1994	865,000	**IPCC (2007a)** Figure 7.3 converted from Carbon unit basis to CO_2 basis. Error is stated greater than ±20%.
Global	CO_2-e emissions	2010	35,000	Based on Australia representing 1.5% of global emissions (**DCC, 2011**).
Global	CO_2-e emission increase 2004 to 2005	2005	733	**IPCC (2007a)** From tabulated data presented in Table 7.1 on the basis of an additional 733 Mt/a. Data converted from Carbon unit basis to CO_2 basis.
Australia	1990 Base	1990	547.7	**Department of Climate Change Energy Efficiency (2012b)**
Australia	Kyoto target	Average annual 2008 - 2012	591.5	**Department of Climate Change Energy Efficiency (2012b)** Based on 1990 net emissions multiplied by 108% Australia's Kyoto emissions target.
Australia	Total (inclusive of existing Mt Arthur Coal Mine)	2010	580.6	**Department of Climate Change Energy Efficiency (2012b)** Table 2.1 Australia's net greenhouse gas emissions
NSW	Total	2010	157.4	**Department of Climate Change Energy Efficiency (2012c)**

GHG emissions from Australian sources will be collectively managed at a national level, through initiatives implemented by the Australian Government. The Australian Government has committed to reduce GHG emissions by between 5 to 25% below 2000 levels by 2020, with the level of reduction dependent on the extent of reduction actions undertaken internationally (**Commonwealth of Australia, 2011**). Similarly, the Federal Opposition has committed to a 5% reduction below 1990 levels by 2020 in its Direct Action Plan (**Liberal Party of Australia, 2010**).

The commitment from the Australian Government to reduce GHG emissions is proposed to be achieved through the introduction of the Australian Government's proposed carbon pricing mechanisms. From 1 July 2012, this will involve a fixed price on GHG emissions, with no cap on Australia's GHG emissions, or emissions from individual facilities (**Commonwealth of Australia, 2011**).

From 1 July 2015 (i.e. during Modification Year 3) an emissions trading scheme is proposed to be implemented. As such, Australia's GHG emissions, inclusive of emissions associated with the Modification, would be capped at a level specified by the Australian Government. Under the emissions trading scheme, there will specifically be no limit on the level of GHG emissions from individual facilities, with the incentive for facilities to reduce their GHG emissions driven by the carbon pricing mechanism (**Commonwealth of Australia, 2011**).

It is expected that the Modification would exceed the facility threshold of 25,000 t CO_2-e/annum for participation in the carbon pricing mechanisms, and as such scope 1 GHG emissions from the Modification would be subject to the carbon pricing mechanism. As such, HVEC would directly contribute to the revenue generated by the carbon pricing mechanism, which is to be used to fund the following initiatives designed to reduce Australia's GHG emissions (**Commonwealth of Australia, 2011**):

- A $1.2 billion Clean Technology Program to improve energy efficiency in manufacturing industries and support research and development in low-pollution technologies.
- A $10 billion Clean Energy Finance Corporation to invest in renewable energy, low-pollution and energy efficiency technologies.
- A $946 million Biodiversity Fund (over the first six years) to protect biodiverse carbon stores and secure environmental outcomes from carbon farming.

In addition to contributing to these initiatives, Mt Arthur Coal Mine would implement Modification-specific GHG mitigation measures, as described in **Section 9.6**, below.

9.6 Greenhouse Gas Reduction Measures

HVEC is committed to implementing reasonable and feasible GHG mitigation measures. In order to facilitate the control of GHG emissions, HVEC has developed an Energy Excellence Working Group. The working group has held workshops across the site to identify potential energy efficiency opportunities.

Ongoing review will include:

- Reviewing equipment purchases with a view to keeping fuel efficiency levels high.
- Maintaining equipment to ensure that diesel and electrically powered equipment are operated efficiently.
- Reviewing mining practices to minimise double handling of materials and ensuring that coal and overburden haulage is undertaken using the most efficient routes.
- Ensuring that lighting and heating are only used when required.
- Increase use of alternative fuels (e.g. bio-diesel, solar panels and solar hot water systems) where feasible.
- Improving blasting practices to minimise diesel use and emissions.
- Managing spontaneous combustion to minimise emissions of all gases including GHG (see **Section 8.10**).

Key focus areas for GHG management on-site listed in the Mt Arthur Coal Mine Air Quality and Greenhouse Gas Management Plan (**HVEC, 2012a**) include:

- establishing a National Greenhouse and Energy Reporting (NGER) Method 3 assessment of fugitive seam gas emissions;
- improving blasting practices to minimise diesel use and emissions;
- generating and maintaining best practice management for synthetic and refrigeration gases; and
- exploring the increase of the percentage of biodiesel used across site.

Ongoing monitoring and management of GHG emissions and energy consumption at Mt Arthur Coal Mine would be achieved through HVEC's participation in the Commonwealth Government's NGER system. Under NGER requirements, relevant sources of GHG emissions and energy consumption must be measured and reported on an annual basis, allowing major sources and trends in emissions/energy consumption to be identified.

BHP Billiton participates in the Commonwealth Government's Energy Efficiency Opportunities Program. Several Energy Efficiency Opportunities projects have been identified and implemented by BHP Billiton and details are reported in the annual environmental monitoring report.

BHP Billiton is also a participant in the Cooperative Research Centre for GHG Technologies program that actively researches emission reductions from the use of coal. BHP Billiton also contributes to the COAL21 fund which supports the pre-commercial demonstration of low emissions technologies in the power generation sector.

Additionally, a drilling program commenced during 2010 investigating coal seam gas levels to enable better understanding of fugitive emissions at Mt Arthur Coal Mine.

10 CONCLUSIONS

This study assesses the potential impacts on air quality from the Modification. Dispersion modelling was used to predict off-site dust concentrations and dust deposition levels that may arise due to the Modification. The modelling took account of local meteorology and terrain and used dust emission estimates of the proposed activities over three key mining years to predict dust levels at off-site receptor locations.

Predictions of air quality impacts considered the effects of surrounding mines as well as other non-mining and non-modelled sources of dust. Model predictions at privately-owned residential receptors were compared with applicable air quality criteria. Predictions equal to or below the criteria indicate an acceptable air quality impact.

Analysis of the dispersion modelling results indicates that the Modification may exceed EPA impact assessment criteria at residences to the west of Mt Arthur Coal Mine for 24-hour average PM_{10}. The modelling indicates that dust disperses quickly and impacts are significantly lower further to the west.

There is no predicted exceedance of annual average PM_{10}, TSP or dust deposition at any privately owned residences that are not already within an existing Zone of Acquisition.

There are no exceedances of the DP&I total or incremental 24-hour PM_{10} acquisition criterion as a result of the Modification that are not already within an existing Zone of Acquisition.

In comparison to the 2009 EA, the predicted 24-hour average PM_{10} concentrations are generally lower at the residences in 2016 and 2022 for the Modification. This is partly due to additional mitigation employed by HVEC since the 2009 EA.

Generally, the predictions presented in this report incorporate a level of conservatism due to worst case assumptions and the inherent conservative nature of dispersion modelling. As a result, it is expected that actual ground level concentrations would be lower during the normal operation of the Modification. Notwithstanding, it is proposed that the emissions would be managed day-to-day using best practice dust mitigation measures.

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Appendix A: Receptor Details

Table A.1: Residence ownership details

Residence ID	Ownership details	MGA coordinates Zone 56	
		Easting (m)	Northing (m)
Private Receptors			
10	Muswellbrook Race Club Ltd	298607	6426131
11	JP Drake	299512	6426192
12	DR & CJ Tubb	299551	6426363
13	Upper Hunter Developers Pty Ltd & Turner	299580	6426467
14	Robinson	299098	6426730
15	Dobie	299125	6426723
16	Sweeney	299153	6426716
17	Gleeson & Cranfield	299206	6426702
18	SM Bredden	299197	6426672
20	Good	299189	6426608
21	Cridland	299193	6426582
22	Englebrecht Racing Stables Pty Ltd	299174	6426549
23	Englebrecht	299175	6426512
24	RJ & TT Reid	299136	6426584
25	Andrews	299138	6426622
26	Byrnes & Moller	299122	6426655
27	TD Barron	299111	6426698
30	Englebrech	299103	6426810
31	Jabetin PT	299051	6427356
32	Almond & Hume	299178	6426785
33	Barkley	299391	6426889
34	Hardes	299807	6427071
36	Horne	299985	6428573
37a	The Council of the Municipality of Muswellbrook	299972	6426709
37b	The Council of the Municipailty of Muswellbrook	299872	6426725
39	JR & JA Buckley	299669	6426114
40	JR & JA Buckley	299693	6426053
41	Ray	299629	6425993
42	Hallett & Campbell	299671	6425952
43	Hallett & Campbell	299680	6425898
56	Bancroft	300708	6426373
57	Mayer	300823	6426365
58	Masters	300866	6426319
59	Osborn	301020	6426283
60	Osborn	301102	6426149
61	Burton	301171	6426174
62	Burke & Talbot	301288	6426127
69	Wells	304991	6425439
70	Folpp	304984	6425266
71	Hunt	304996	6425080
72	Budden	305009	6424957
73	Hogan	305023	6424805
75	Harris	305073	6424570
76	Merlaust Pty Ltd	305066	6424362
77a	Perram	304844	6424178
77b	Perram	305067	6424239
78	Yarramolong Stud Pty Ltd	304392	6424149
79a	Jackson	305185	6423962
79b	Jackson	304925	6423902
82	Newton	305122	6423190
83	K Newton	305192	6423531
85	Collins	305235	6423088
86	Baxter	305468	6422411
87	Halloran	305005	6422307
88	Reynolds	304813	6422657
89	Page	304403	6422473
90	Page	304148	6422584
91	Doherty	304161	6422132
92	Duck	304367	6422195
93	Osborn	304746	6422136
94	Skinner	304872	6421947

Residence ID	Ownership details	MGA coordinates Zone 56	
		Easting (m)	Northing (m)
95	De Boer	305641	6422163
96	Bird	305867	6422181
97	Clifton	305812	6421905
98	Jones	306016	6421813
99a	Hunter	306291	6421613
99b	Hunter	306144	6421650
100	Sharman	306317	6421445
186	Turner	290039	6421068
187	Duncan	290930	6421274
190	Phillips	288331	6420146
191	Wilks	288736	6420223
195	MacPherson	289371	6421057
198	Duncan	290692	6421470
200	Walsh	290612	6422527
201	Denton	290865	6421565
213a	Lawson	288662	6422483
213b	Lawson	288744	6422679
213c	Lawson	288562	6422551
216	Meyer	289099	6422365
218a	Markham	289332	6422951
218b	Markham	289390	6423199
218c	Markham	289157	6422757
231	Brown	289144	6423418
232	Brown	289343	6423367
233a	Merrick	289450	6424892
233b	Merrick	289573	6424545
235	Thompson	288582	6426073
236	Thompson	288759	6426291
238	M Peel	290918	6426190
239	P Ellis	290654	6425667
240	Murray	290998	6426004
242a	Ellis	290998	6426453
242b	Ellis	290581	6426744
243	McNeill	288720	6426954
252	B & T Strachan	291263	6428276
254	Hughes	290335	6428124
257	Parkinson	289023	6427912
259	Googe	288371	6427916
IR1	Ironbark Ridge	301894	6425612
IR2	Ironbark Ridge	301980	6425569
IR3	Ironbark Ridge	302025	6425541
IR4	Ironbark Ridge	302112	6425463
IR5	Ironbark Ridge	302139	6425427
IR6	Ironbark Ridge	302159	6425390
IR7	Ironbark Ridge	302175	6425354
IR8	Ironbark Ridge	302197	6425321
IR9	Ironbark Ridge	302256	6425255
IR10	Ironbark Ridge	302167	6425234
IR11	Ironbark Ridge	302128	6425287
IR12	Ironbark Ridge	302007	6425436
IR13	Ironbark Ridge	301960	6425468
IR14	Ironbark Ridge	301907	6425486
IR15	Ironbark Ridge	302340	6425216
IR16	Ironbark Ridge	302427	6425179
IR17	Ironbark Ridge	302461	6425164
IR18	Ironbark Ridge	302544	6425132
IR19	Ironbark Ridge	302514	6425062
IR20	Ironbark Ridge	302438	6425089
IR21	Ironbark Ridge	302395	6425105
IR22	Ironbark Ridge	302357	6425122
IR23	Ironbark Ridge	302313	6425140
IR24	Ironbark Ridge	302242	6425172

Residence ID	Ownership details	MGA coordinates Zone 56	
		Easting (m)	Northing (m)
Private Receptors - Within Existing HVEC Zone of Acquisition			
6	Scriven	299201	6425202
8	Drake	299156	6425525
28	McGoldrick	298804	6426824
29	Berrnett	298868	6426831
101	Horder	306182	6421257
102	Robertson	305966	6421123
182	Paulsen	288865	6419960
203	Latham	291319	6421705
204	Latham	291481	6421952
206	Wild	291745	6422110
209	Rankin	292313	6421874
210	Rankin	292613	6422632
211	Rankin	292977	6421911
226	T Roots	290946	6423464
241	P & C Lane	291304	6426070
264	Moore	292314	6429010
Mine-Owned Receptors			
9	'Former' Englebrecht	298437	6426150
49a	'Former' Webber	299780	6425216
49b	'Former' Webber	299759	6425096
183	'Former' Beringer Blass Wine	290804	6419806
184a	'Former' Fosters Wine	291646	6421567
184b	'Former' Fosters Wine	291553	6421392
184c	'Former' Fosters Wine	291305	6420460
196	'Former' Eglington, Fuller & Goodchild	289638	6421433
197	'Former' Eglington, Fuller & Goodchild	289898	6421304
199	Boyle	290205	6422263
202	'Former' Fosters Wine	290876	6422553
205	'Former' Lambkin	291506	6421741
207	'Former' Zahra	291881	6422035
208	'Former' Zahra	292164	6422353
212[1]	'Former' Chudyk	292824	6423499
250[1]	'Former' Hamilton	291451	6427224

Note: Bolded – owned by HVEC
Italics – in HVEC Zone of Acquisition from Consolidation Project Approval
[1] Owned by Coal & Allied
m = metres
MGA = Map Grid of Australia

Appendix B: Dust Deposition and HVAS PM_{10} Monitoring Data

Table B.1: Dust Deposition Monitoring Data (g/m²/month)

	Month	Deposition gauge ID																				
		DD1	DD2	DD3	DD4	DD5	DD6	DD7	DD8	DD9	DD10	DD11	DD12	DD13	DD14	DD15	DD16	DD17	DD18	DD19	DD20	DD21
2003	January	4.1	ND	5.3	2.5	2.9	4.7	2.6	2.4	2.8	2.4	6.2	2.7	2.3	2.7	5.3	5.8	4.1	5.5	3.5	7.6	3.8
	February	4.4	4.8	5.2	2.2	4.2	2.8	3.0	1.8	2.6	1.8	2.5	4.6	1.6	1.8	2.3	3.7	2.6	2.6	2.7	3.3	2.7
	March	5.0	6.0	ND	1.7	3.1	2.6	6.1	1.8	1.9	3.2	2.9	3.8	1.8	2.5	2.8	3.7	4.6	3.1	1.6	3.8	2.9
	April	4.6	3.5	4.5	0.8	1.7	1.0	1.9	0.9	1.4	2.2	1.0	3.3	1.3	1.4	1.4	2.1	2.2	2.2	2.1	2.2	1.4
	May	3.0	8.4	ND	1.6	1.9	1.0	1.2	0.4	0.6	1.3	0.9	0.8	0.7	1.0	1.1	3.4	3.4	2.2	2.9	2.7	1.6
	June	1.5	2.1	ND	0.9	1.6	0.8	2.8	0.5	0.3	1.1	ND	2.4	0.7	0.6	0.8	5.8	2.0	1.9	1.4	1.5	1.5
	July	0.9	1.5	1.0	0.8	1.8	0.8	ND	0.4	4.0	0.8	ND	7.0	0.6	0.5	0.4	1.6	3.4	0.9	4.3	1.1	1.0
	August	3.3	3.4	1.9	0.9	3.0	0.8	6.9	0.6	0.5	1.2	2.6	1.3	0.7	0.8	1.0	3.8	3.8	1.5	2.0	1.4	1.9
	September	ND	2.1	1.9	1.3	2.7	0.7	0.8	0.6	0.6	0.8	1.3	0.8	0.9	0.7	1.1	4.5	2.7	1.7	3.1	1.4	1.8
	October	1.6	3.8	2.5	1.4	1.4	7.3	1.2	0.9	1.5	1.7	7.5	1.9	1.2	1.7	1.8	4.3	5.3	2.8	3.3	2.5	2.3
	November	5.5	4.4	5.4	1.6	4.2	1.3	4.7	1.0	1.1	2.8	ND	1.5	4.1	1.2	1.9	6.5	4.2	3.2	3.2	3.3	1.7
	December	3.2	7.8	5.2	6.2	4.4	1.7	ND	1.1	1.5	2.0	ND	3.6	4.2	1.7	2.4	5.3	4.1	4.3	2.5	3.5	ND
	Average	**3.4**	**4.3**	**3.7**	**1.8**	**2.7**	**2.1**	**3.1**	**1.0**	**1.6**	**1.8**	**3.1**	**2.8**	**1.7**	**1.4**	**1.9**	**4.2**	**3.5**	**2.7**	**2.7**	**2.9**	**2.1**
2004	January	2.4	3.3	4.2	1.8	2.0	1.5	ND	1.2	2.0	2.7	ND	ND	4.1	1.6	C	C	9.3	2.5	C	2.4	ND
	February	2.3	5.1	2.5	1.2	ND	1.6	ND	1.2	1.0	1.9	ND	C	2.4	1.0	1.5	3.9	3.9	2.9	3.0	3.6	2.1
	March	2.0	5.6	2.9	6.3	ND	1.1	ND	1.7	2.8	2.0	ND	1.4	1.5	1.0	1.8	5.0	3.1	2.2	2.1	2.3	ND
	April	2.2	4.0	2.6	1.4	5.3	1.2	8.8	1.3	1.1	3.2	ND	1.3	2.2	1.2	2.0	C	5.2	3.5	2.8	2.1	2.6
	May	1.8	3.5	1.9	1.2	ND	0.9	1.4	0.9	0.9	1.6	2.7	0.9	1.2	0.9	1.6	5.1	5.7	4.2	3.5	2.5	2.5
	June	1.0	1.9	1.4	0.7	5.1	0.5	ND	0.6	0.4	1.5	ND	0.7	0.3	1.9	5.4	5.3	ND	2.1	2.2	1.6	1.4
	July	2.3	3.0	ND	1.4	ND	0.4	6.5	2.7	0.6	1.1	ND	1.1	0.8	0.6	1.1	2.2	3.0	1.9	2.4	1.7	3.6
	August	1.8	3.4	C	1.1	1.5	1.1	C	0.9	1.0	1.6	ND	1.1	1.3	0.9	1.3	3.4	3.0	2.2	2.7	2.5	ND
	September	2.6	2.3	ND	1.4	C	1.6	1.3	0.7	0.9	C	C	5.0	0.9	1.0	C	2.1	2.1	1.9	2.5	2.0	2.3
	October	2.3	6.9	ND	1.9	1.7	1.7	ND	1.1	1.0	ND	ND	2.9	2.4	1.9	1.5	ND	2.6	2.8	2.9	3.0	1.7
	November	4.0	2.3	C	1.1	2.8	1.9	ND	1.1	1.1	1.3	C	3.1	0.9	0.8	1.3	2.5	4.4	3.3	1.4	2.1	1.4
	December	1.6	2.7	C	1.4	C	1.4	1.8	1.5	2.3	1.6	C	1.8	3.3	1.6	1.7	C	3.1	2.0	0.9	2.3	2.5
	Average	**2.2**	**3.7**	**2.6**	**1.7**	**3.1**	**1.2**	**4.0**	**1.2**	**1.3**	**1.9**	**2.7**	**1.9**	**1.8**	**1.2**	**1.9**	**3.7**	**4.1**	**2.6**	**2.4**	**2.3**	**2.2**
2005	January	2.0	2.3	C	1.4	3.3	2.1	1.6	1.1	1.5	ND	C	0.6	1.3	1.0	2.1	C	1.9	1.8	1.7	1.8	1.7
	February	2.7	C	2.7	2.3	1.4	1.9	1.9	2.0	1.9	1.6	C	6.6	2.2	1.9	2.5	C	3.0	3.1	2.9	2.3	2.7
	March	2.7	C	3.7	2.4	2.9	1.9	1.6	1.3	1.0	2.1	C	1.6	1.4	1.1	2.4	3.9	2.7	1.5	1.3	3.4	3.2
	April	3.6	C	C	2.0	7.3	3.8	2.2	1.5	1.3	2.3	3.1	2.1	1.5	1.3	2.2	2.0	2.5	1.8	2.4	5.3	2.4
	May	1.6	2.4	2.1	1.3	2.1	1.3	3.4	1.2	0.5	3.0	3.5	2.2	1.4	0.9	1.8	4.4	2.5	1.8	2.3	3.2	1.7
	June	1.5	C	2.6	1.3	1.7	0.7	1.0	1.3	0.9	2.3	2.5	1.4	1.2	0.8	1.2	3.6	1.2	1.8	1.4	8.5	2.4
	July	1.8	3.8	2.8	1.6	1.5	1.2	1.2	0.7	1.1	2.4	C	1.3	0.8	0.7	C	2.6	2.8	2.4	2.4	2.2	2.4
	August	2.0	2.0	2.7	1.7	3.0	1.6	1.1	1.1	0.8	2.3	C	1.5	1.4	0.5	C	C	2.7	3.0	3.2	ND	2.3
	September	2.0	C	4.1	1.3	2.4	2.3	2.3	2.0	1.0	1.1	C	1.2	1.0	0.6	0.6	2.2	1.7	2.0	2.3	1.8	1.6
	October	1.7	C	2.8	1.1	2.3	1.4	1.8	0.8	0.8	0.6	ND	2.0	0.8	0.8	3.8	2.0	1.8	1.8	2.4	2.3	1.3
	November	ND	C	4.8	1.8	3.6	1.9	ND	1.9	1.1	ND	C	3.0	3.2	1.2	3.2	4.5	2.2	2.8	2.6	3.6	2.1
	December	ND	3.7	3.7	2.2	4.2	1.5	1.5	1.0	1.1	1.3	C	1.6	1.1	0.8	3.9	4.2	2.3	1.9	2.9	2.6	1.7
	Average	**2.2**	**2.8**	**3.2**	**1.7**	**3.0**	**1.8**	**1.8**	**1.3**	**1.1**	**1.9**	**3.0**	**2.1**	**1.4**	**1.0**	**2.4**	**3.3**	**2.3**	**2.1**	**2.3**	**3.4**	**2.1**
2006	January	2.7	7.0	5.5	1.8	2.9	1.8	2.2	1.5	1.5	3.4	8.0	7.0	1.6	1.4	3.4	2.0	1.7	3.5	2.1	3.3	1.8
	February	2.6	4.6	3.2	1.6	2.1	2.9	2.9	1.4	1.3	2.2	3.2	1.5	1.1	0.9	4.5	7.0	3.6	3.0	2.3	3.7	2.3
	March	1.7	5.6	3.1	1.4	1.9	1.6	0.9	2.3	0.8	1.3	ND	4.6	1.0	0.9	2.5	3.7	1.3	1.6	1.6	1.8	1.6

	Month	Deposition gauge ID																				
		DD1	DD2	DD3	DD4	DD5	DD6	DD7	DD8	DD9	DD10	DD11	DD12	DD13	DD14	DD15	DD16	DD17	DD18	DD19	DD20	DD21
	April	2.3	6.0	3.8	2.1	2.0	1.0	1.9	1.2	0.8	1.7	4.6	2.3	1.1	1.1	3.0	3.4	2.4	2.5	3.2	2.9	2.9
	May	2.1	4.6	3.0	1.7	2.4	1.2	3.0	1.3	0.8	1.9	5.1	5.3	2.9	1.4	2.3	5.7	2.6	2.7	4.3	5.3	4.5
	June	2.0	3.7	2.9	2.5	2.8	1.4	6.9	1.0	0.9	2.7	2.6	1.7	1.5	1.2	2.3	5.0	2.4	2.3	2.3	3.2	2.9
	July	6.6	3.0	2.0	1.4	2.0	0.8	0.6	0.6	0.4	1.5	4.7	0.9	0.9	0.7	1.7	2.4	2.8	1.7	1.7	2.5	1.1
	August	2.0	2.9	ND	1.6	2.6	1.3	1.5	1.0	1.0	1.6	2.1	1.5	1.6	0.8	1.9	3.6	2.5	2.8	2.8	2.9	3.0
	September	2.5	2.9	3.2	1.5	1.6	1.0	1.1	0.9	0.9	1.2	2.0	1.6	1.4	0.9	1.6	2.8	2.2	2.0	2.1	3.4	2.2
	October	2.8	2.9	2.3	2.2	1.0	1.6	0.9	1.4	1.7	2.6	2.7	1.9	1.9	1.4	3.2	6.3	2.2	2.9	3.0	4.0	3.9
	November	3.0	4.1	5.2	3.0	3.0	1.9	1.8	0.9	0.7	3.3	1.0	1.4	1.6	1.0	1.3	3.7	2.0	8.8	4.4	ND	4.3
	December	3.3	4.7	4.9	2.4	2.0	2.7	ND	1.1	1.2	1.6	2.7	2.9	2.7	1.3	1.3	5.4	2.1	2.6	2.2	6.1	3.0
	Average	**2.8**	**4.3**	**3.6**	**1.9**	**2.2**	**1.6**	**2.2**	**1.2**	**1.0**	**2.1**	**3.5**	**2.7**	**1.6**	**1.1**	**2.4**	**4.3**	**2.3**	**3.0**	**2.7**	**3.6**	**2.8**
2007	January	1.7	ND	ND	2.4	1.4	1.9	2.1	1.3	0.9	1.7	ND	0.6	1.4	ND	5.3	ND	1.6	1.1	2.2	1.8	1.0
	February	3.2	ND	6.3	1.9	6.1	1.2	ND	0.7	1.1	4.2	3.0	1.9	1.9	1.5	1.8	ND	3.3	3.1	4.3	5.5	2.1
	March	1.6	4.3	3.5	1.7	2.2	1.2	1.1	1.5	1.0	2.4	2.3	1.1	1.8	0.7	2.4	ND	1.9	3.3	ND	3.2	2.5
	April	2.8	ND	ND	1.8	1.5	1.1	0.8	0.7	0.6	1.5	2.9	2.0	1.8	ND	4.4	ND	2.2	2.1	1.9	2.9	1.9
	May	2.1	ND	ND	1.2	3.0	1.3	0.8	1.0	0.7	1.4	ND	1.0	1.0	0.7	1.4	2.6	1.7	2.1	1.8	ND	1.8
	June	ND	ND	2.5	1.1	1.3	ND	1.3	1.4	1.1	2.5	2.3	1.5	0.8	0.6	0.6	2.7	1.3	1.5	1.6	0.8	1.0
	July	1.0	2.0	2.1	1.0	0.9	0.3	0.2	0.6	0.3	0.8	ND	0.9	0.5	0.1	0.6	2.1	2.1	ND	1.4	0.9	1.0
	August	0.9	2.7	2.2	0.9	1.7	1.0	0.6	0.4	0.6	1.2	0.2	4.2	0.4	0.3	0.8	1.8	1.4	1.7	2.8	2.5	2.1
	September	0.8	ND	ND	1.1	1.9	1.3	0.5	1.0	1.7	1.1	ND	1.2	1.2	0.4	1.5	2.4	1.3	2.2	1.4	1.5	2.1
	October	ND	ND	ND	3.4	ND	ND	2.7	1.8	3.0	ND	ND	ND	ND	ND	5.3	ND	4.0	ND	4.2	4.1	3.2
	November	3.0	ND	5.5	2.7	3.1	8.1	2.2	1.8	1.6	3.2	3.9	2.8	2.5	1.5	3.8	4.8	3.4	5.2	2.6	5.2	1.4
	December	2.9	4.7	5.6	1.9	5.5	1.6	0.9	0.8	0.8	1.6	2.1	1.8	1.2	1.2	2.5	5.6	2.1	2.5	2.2	3.2	1.8
	Average	**2.0**	**3.4**	**4.0**	**1.8**	**2.6**	**1.9**	**1.2**	**1.1**	**1.1**	**2.0**	**2.4**	**1.7**	**1.3**	**0.8**	**2.5**	**3.1**	**2.2**	**2.5**	**2.4**	**2.9**	**1.8**
2008	January	2.0	ND	ND	1.9	1.0	2.0	0.8	N	0.5	1.0	2.1	2.6	1.0	0.9	1.5	3.4	1.6	2.0	1.5	2.9	1.9
	February	2.5	ND	3.5	2.2	2.6	3.1	2.2	5.9	1.0	2.1	1.8	2.3	1.5	1.3	2.7	5.8	ND	3.3	2.8	3.9	2.7
	March	3.2	ND	5.4	N	1.9	2.2	0.7	0.6	1.0	2.8	1.2	3.5	1.7	1.4	1.9	5.3	1.8	2.4	2.6	4.0	1.6
	April	ND	ND	ND	1.9	1.5	1.5	1.0	0.8	0.7	1.5	2.1	1.2	1.0	1.0	1.9	4.2	2.7	2.8	3.1	3.9	2.4
	May	ND	ND	ND	N	ND	1.4	0.9	1.3	1.0	2.5	ND	ND	1.6	1.0	1.8	3.6	1.9	2.0	3.0	2.0	2.3
	June	1.4	ND	3.1	1.1	1.2	1.3	0.3	1.7	1.7	0.6	2.3	0.5	0.4	0.5	ND	1.5	1.8	1.3	1.7	2.6	0.9
	July	1.2	2.1	ND	1.6	3.1	1.1	ND	2.1	2.0	2.6	ND	2.4	2.2	1.3	1.7	2.7	1.5	2.0	3.3	2.5	1.5
	August	1.5	ND	1.9	1.1	ND	2.2	2.6	1.5	0.8	1.4	ND	0.8	0.9	0.7	0.7	1.6	1.2	1.3	2.2	1.7	2.4
	September	2.2	3.5	3.0	1.8	3.7	1.8	0.9	0.8	0.9	1.3	1.4	1.2	1.1	0.9	1.3	3.3	1.6	1.2	1.4	2.4	1.0
	October	1.7	3.7	3.2	1.3	2.2	2.7	2.1	1.0	1.3	2.8	ND	2.0	1.4	0.7	1.4	0.5	2.2	1.4	2.3	2.3	0.9
	November	3.2	ND	2.0	1.6	ND	ND	1.3	2.0	1.1	1.8	3.0	2.1	2.7	1.2	3.0	3.9	3.8	2.4	1.5	4.4	3.6
	December	2.2	ND	1.7	3.9	ND	2.1	1.1	N	1.2	2.6	3.3	1.8	ND	1.8	2.2	3.5	3.3	1.6	1.4	3.7	1.2
	Average	**2.1**	**3.1**	**3.0**	**1.8**	**2.2**	**1.9**	**1.3**	**1.8**	**1.1**	**1.9**	**2.2**	**1.9**	**1.4**	**1.1**	**1.8**	**3.3**	**2.1**	**2.0**	**2.2**	**3.0**	**1.9**
2009	January	2.1	2.4	3.7	2.3	ND	1.5	0.2	1.3	0.8	1.5	ND	3.0	1.3	0.6	2.0	3.2	2.3	2.4	2.7	3.9	1.5
	February	2.9	5.6	5.9	2.9	3.1	1.5	1.6	1.4	1.1	0.9	3.3	1.3	3.1	0.4	0.9	4.3	7.4	5.5	4.5	2.4	1.6
	March	3.4	5.3	4.5	3.5	4.2	1.9	3.4	1.5	1.6	1.7	3.3	2.3	2.0	1.8	2.2	4.9	2.8	3.2	3.1	5.6	4.2
	April	ND	ND	2.8	3.0	2.5	1.2	1.3	1.2	1.0	1.5	0.9	1.2	1.8	1.1	1.6	4.8	1.7	2.0	2.1	2.6	1.9
	May	1.7	2.5	3.7	1.8	1.6	1.1	1.1	1.0	0.9	1.5	1.8	1.0	2.4	1.1	1.3	3.3	2.0	2.3	2.1	ND	1.4
	June	1.5	2.1	3.7	1.4	ND	ND	0.6	0.5	0.8	2.0	ND	1.2	ND	0.4	0.8	1.9	1.4	2.7	1.0	1.6	1.5
	July	1.6	1.7	3.4	1.2	2.4	ND	0.7	0.6	0.5	0.7	ND	0.7	0.6	0.5	0.7	2.8	1.5	1.7	1.6	ND	1.0
	August	1.3	2.0	ND	1.7	ND	ND	2.0	0.4	0.7	ND	0.3	0.7	1.0	0.5	0.9	1.8	1.7	2.1	3.1	1.6	2.4

	Month	Deposition gauge ID																				
		DD1	DD2	DD3	DD4	DD5	DD6	DD7	DD8	DD9	DD10	DD11	DD12	DD13	DD14	DD15	DD16	DD17	DD18	DD19	DD20	DD21
	September	4.0	3.9	4.3	3.0	5.3	ND	1.6	3.3	2.3	6.5	3.2	ND	ND	2.4	4.3	7.0	5.7	6.0	4.4	9.7	4.2
	October	4.7	4.1	4.6	3.3	4.1	ND	1.9	2.4	2.1	4.1	ND	2.9	ND	2.0	4.8	6.7	4.5	6.3	5.4	5.7	4.1
	November	4.4	10.3	ND	4.2	3.6	ND	1.8	1.2	1.7	4.5	4.5	3.1	7.6	1.7	2.9	7.6	5.4	ND	5.3	6.8	3.0
	December	ND	7.5	ND	5.2	3.3	ND	1.7	2.4	2.0	ND	3.0	2.6	3.4	2.5	2.7	11.3	4.4	5.0	5.9	6.2	4.0
	Average	**2.8**	**4.3**	**4.1**	**2.8**	**3.3**	**1.4**	**1.5**	**1.4**	**1.3**	**2.5**	**2.5**	**1.8**	**2.6**	**1.3**	**2.1**	**5.0**	**3.4**	**3.6**	**3.4**	**4.6**	**2.6**
	January	ND	12.4	5.2	3.0	2.6	3.5	3.5	1.5	1.5	1.4	ND	ND	ND	0.8	2.6	4.9	1.7	2.7	2.9	4.0	2.6
	February	7.5	ND	14.0	3.9	1.9	3.6	1.8	1.4	1.7	2.9	ND	4.6	ND	13.1	2.2	0.3	3.9	3.5	4.9	4.6	3.2
	March	ND	6.5	9.3	3.2	2.7	3.9	1.6	1.2	1.3	2.4	3.8	4.1	ND	2.8	2.2	6.7	2.8	3.8	3.9	4.5	3.6
	April	3.6	5.1	5.8	1.0	ND	1.1	0.9	1.5	1.3	2.1	2.9	2.2	2.7	1.6	3.0	4.4	2.2	1.2	1.6	1.4	1.8
	May	ND	3.9	3.4	2.9	ND	1.3	1.1	0.7	0.8	1.2	ND	1.7	ND	0.9	1.7	2.6	2.0	2.2	2.6	2.2	2.0
	June	3.3	3.5	2.2	1.1	2.4	0.8	0.4	0.4	0.4	0.8	ND	0.8	ND	0.8	0.7	1.8	1.4	1.5	1.2	2.4	0.8
2010	July	2.5	ND	2.6	1.0	4.6	0.9	1.0	0.4	0.3	1.3	3.7	0.5	ND	1.1	0.9	1.6	ND	1.3	2.2	1.5	1.5
	August	1.9	ND	ND	1.8	1.2	0.8	0.6	0.5	0.3	1.3	0.7	0.9	ND	1.5	1.2	4.7	2.0	2.3	2.5	2.9	1.6
	September	3.2	ND	7.6	2.5	1.8	1.6	1.7	1.2	1.0	1.5	1.6	ND	1.2	1.1	1.4	1.5	2.1	3.5	2.2	4.8	1.9
	October	2.2	4.4	4.8	2.8	3.2	1.7	0.8	0.6	ND	3.2	2.6	1.4	2.7	1.1	2.1	ND	4.9	ND	4.7	2.7	1.4
	November	3.2	4.5	4.2	1.4	3.5	1.3	1.0	0.9	2.8	2.0	ND	1.2	2.0	1.0	2.0	ND	2.7	2.8	3.7	1.6	0.6
	December	3.0	ND	ND	2.6	4.2	2.5	0.6	1.4	ND	2.4	5.3	ND	2.3	2.1	2.2	8.2	2.5	3.4	3.1	ND	2.1
	Average	**3.4**	**5.8**	**5.9**	**2.3**	**2.8**	**1.9**	**1.3**	**1.0**	**1.1**	**1.9**	**2.9**	**1.9**	**2.2**	**2.3**	**1.9**	**3.7**	**2.6**	**2.6**	**3.0**	**3.0**	**1.9**
	January	5.5	6.5	6.4	3.0	2.0	ND	ND	1.5	1.5	2.7	1.8	4.0	1.8	1.6	1.8	4.5	1.6	2.7	2.4	3.6	1.8
	February	5.4	ND	ND	2.7	4.2	ND	1.4	ND	1.9	3.7	2.1	2.3	4.2	1.8	2.4	ND	3.3	4.1	4.4	4.5	2.8
	March	7.2	ND	0.5	3.1	3.7	2.4	0.9	2.7	2.3	3.1	2.7	2.1	5.4	2.2	3.2	ND	3.2	3.2	3.1	4.7	1.6
	April	1.6	1.7	2.9	1.8	ND	2.6	0.7	0.8	0.8	1.6	2.4	1.2	2.9	1.0	1.6	5.5	1.3	2.3	1.1	1.3	0.9
	May	2.2	4.8	3.6	1.6	ND	0.9	0.6	0.5	0.7	3.4	3.7	0.8	1.0	0.6	1.3	3.4	1.5	2.1	1.9	2.9	0.9
	June	2.1	4.2	5.9	1.0	ND	1.6	2.4	0.8	0.9	1.9	2.9	1.7	1.2	0.4	1.1	5.5	3.6	2.4	3.0	2.3	1.9
2011	July	2.0	3.3	3.3	1.0	ND	1.8	0.4	0.2	0.3	1.0	ND	0.6	0.7	0.8	0.7	3.6	1.6	1.8	2.0	2.8	1.6
	August	1.7	2.6	2.3	2.0	ND	1.8	0.9	1.0	0.9	2.2	ND	ND	5.8	1.1	1.5	4.8	ND	2.1	2.9	2.7	1.4
	September	4.7	2.7	2.0	1.1	2.5	1.3	1.3	0.8	1.3	2.6	ND	3.6	ND	0.9	2.0	4.9	2.2	2.0	2.0	2.2	1.5
	October	2.0	2.3	ND	1.5	ND	1.0	1.4	1.0	1.0	1.2	3.1	3.2	2.5	1.0	2.5	5.4	2.0	1.7	2.4	1.7	1.8
	November	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	December	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Average	**3.4**	**3.5**	**3.4**	**1.9**	**3.1**	**1.7**	**1.1**	**1.0**	**1.2**	**2.3**	**2.7**	**2.2**	**2.8**	**1.1**	**1.8**	**4.7**	**2.3**	**2.4**	**2.5**	**2.9**	**1.6**

$g/m^2/month$ = grams per square metre per month

C = sample contaminated

ND = no available data

Table B.2: HVAS 24-hour Average PM_{10} Monitoring Data ($\mu g/m^3$)

Date	Monitoring ID							
	Constable	Denman Rd West	South Muswellbrook	Sheppard Ave	Windmill	Edderton	Roxburgh Sth	Wire Lane
1/01/2002	14	-	-	-	12	13	-	16
7/01/2002	45	-	-	-	16	48	12	44
13/01/2002	26	-	-	-	27	30	13	36
19/01/2002	34	-	-	-	32	26	8	33
25/01/2002	14	-	-	-	15	13	2	31
31/01/2002	19	-	-	-	16	15	6	33
6/02/2002	26	-	-	-	26	26	18	20
12/02/2002	43	-	-	-	36	33	27	46
18/02/2002	43	-	-	-	4	5	7	14
24/02/2002	15	15	-	-	13	10	9	18
2/03/2002	43	30	-	-	33	30	8	33
8/03/2002	19	17	-	-	16	15	14	33
14/03/2002	23	20	-	-	22	22	19	25
20/03/2002	33	27	-	-	26	29	5	38
26/03/2002	25	22	-	-	25	20	8	26
1/04/2002	23	18	-	-	18	21	-	25
7/04/2002	23	21	-	-	20	17	17	23
13/04/2002	25	23	-	-	30	26	8	38
19/04/2002	6	8	-	-	6	8	2	8
25/04/2002	20	20	-	-	16	42	7	21
1/05/2002	19	15	-	-	16	11	9	22
7/05/2002	21	24	-	-	19	17	-	20
13/05/2002	23	25	-	-	20	20	3	-
19/05/2002	12	12	-	-	10	10	8	13
25/05/2002	7	4	-	-	4	3	3	6
31/05/2002	7	6	-	-	5	4	6	16
6/06/2002	13	12	-	-	8	8	10	16
12/06/2002	5	7	-	-	5	4	4	5
18/06/2002	1	2	-	-	1	1	2	5
24/06/2002	3	5	-	-	4	3	4	6
30/06/2002	6	9	-	-	4	5	6	4
6/07/2002	3	5	-	-	5	5	6	6
12/07/2002	11	14	-	-	10	10	9	10
18/07/2002	10	11	105	-	8	9	6	18
24/07/2002	9	15	26	-	11	13	7	11
30/07/2002	17	25	39	-	20	10	13	21
5/08/2002	13	12	29	-	12	13	10	27
11/08/2002	16	15	18	-	15	12	8	14
17/08/2002	21	16	26	-	18	18	14	18
23/08/2002	15	15	18	-	13	11	10	22
29/08/2002	22	16	78	-	15	12	8	12

Date	Monitoring ID							
	Constable	Denman Rd West	South Muswellbrook	Sheppard Ave	Windmill	Edderton	Roxburgh Sth	Wire Lane
4/09/2002	14	13	13	-	13	13	9	12
10/09/2002	13	13	20	-	10	10	9	17
16/09/2002	19	19	27	-	17	17	12	17
22/09/2002	39	17	21	-	19	18	1	19
28/09/2002	30	26	21	-	19	21	14	28
4/10/2002	36	30	35	-	40	38	7	41
10/10/2002	23	22	34	-	20	16	14	25
16/10/2002	-	20	18	-	14	13	4	14
22/10/2002	38	42	43	-	37	44	17	-
28/10/2002	23	29	31	-	25	18	9	30
3/11/2002	57	58	51	-	58	57	11	52
9/11/2002	52	-	58	-	54	46	13	57
15/11/2002	35	31	34	-	33	29	24	33
21/11/2002	19	20	27	-	20	19	12	37
27/11/2002	81	81	74	-	72	73	17	85
3/12/2002	38	39	36	-	39	34	7	49
9/12/2002	46	54	61	-	44	38	8	47
15/12/2002	25	23	20	-	24	18	5	23
21/12/2002	41	32	39	-	32	28	2	35
27/12/2002	13	13	12	-	12	9	4	17
2/01/2003	22	19	23	-	21	24	3	27
8/01/2003	26	26	24	-	28	25	2	24
14/01/2003	29	26	29	-	29	24	10	30
20/01/2003	60	53	58	-	56	46	-	61
26/01/2003	33	41	29	-	36	31	-	33
1/02/2003	50	51	55	-	53	39	24	60
7/02/2003	39	12	34	-	40	25	-	33
13/02/2003	35	34	44	-	37	28	-	41
19/02/2003	25	24	24	-	21	20	20	28
25/02/2003	24	29	22	-	23	21	33	23
3/03/2003	32	30	31	-	33	33	37	40
9/03/2003	22	18	20	-	18	21	20	21
15/03/2003	21	19	26	-	21	21	25	28
21/03/2003	60	66	96	-	60	74	71	84
27/03/2003	27	22	31	-	20	17	20	28
2/04/2003	16	15	13	-	14	13	13	17
8/04/2003	23	24	41	-	21	25	26	30
14/04/2003	9	9	5	-	9	11	12	9
20/04/2003	12	10	12	-	7	11	11	13
26/04/2003	10	9	12	-	9	8	11	8
2/05/2003	26	20	24	-	19	18	-	26
8/05/2003	6	9	11	-	8	9	15	5
14/05/2003	8	9	8	-	7	3	9	11

Date	Monitoring ID							
	Constable	Denman Rd West	South Muswellbrook	Sheppard Ave	Windmill	Edderton	Roxburgh Sth	Wire Lane
20/05/2003	14	17	12	-	12	12	18	12
26/05/2003	6	8	28	-	12	12	8	29
1/06/2003	7	10	13	-	6	4	9	3
7/06/2003	10	9	-	-	-	9	10	9
13/06/2003	9	9	7	-	7	9	9	8
19/06/2003	11	14	79	-	8	14	18	12
25/06/2003	19	18	29	-	16	13	20	21
1/07/2003	5	3	13	-	2	2	3	12
7/07/2003	9	9	20	-	4	3	6	9
13/07/2003	9	7	23	-	4	7	9	10
19/07/2003	15	10	12	-	8	5	9	10
25/07/2003	4	10	4	6	2	2	2	2
31/07/2003	4	3	-	13	3	3	3	5
6/08/2003	34	13	17	38	13	12	14	14
12/08/2003	12	11	16	15	9	7	10	14
18/08/2003	12	3	7	5	2	2	3	7
24/08/2003	8	9	8	14	7	7	8	8
30/08/2003	15	10	19	16	8	8	8	11
5/09/2003	21	14	24	36	12	19	18	20
11/09/2003	-	20	17	37	11	9	17	14
17/09/2003	-	5	7	35	3	1	3	6
23/09/2003	25	31	31	91	29	21	26	43
29/09/2003	11	18	16	32	15	10	14	14
5/10/2003	9	11	15	11	8	7	10	16
11/10/2003	11	15	24	15	10	13	9	17
17/10/2003	20	22	22	22	19	17	18	23
23/10/2003	17	17	41	22	17	17	19	20
29/10/2003	96	83	106	119	91	81	92	144
4/11/2003	28	26	26	42	24	27	27	32
10/11/2003	26	25	25	47	21	16	20	32
16/11/2003	29	26	18	62	31	26	26	38
22/11/2003	7	8	6	7	7	4	7	6
28/11/2003	22	18	21	14	17	-	15	22
4/12/2003	14	13	16	15	13	13	13	19
10/12/2003	28	31	27	31	27	22	27	-
16/12/2003	27	20	20	25	25	15	17	24
22/12/2003	18	14	26	45	16	9	15	31
28/12/2003	27	21	-	23	28	21	17	23
3/01/2004	33	30	27	33	30	28	29	29
9/01/2004	38	40	35	49	45	40	49	47
15/01/2004	28	29	27	30	26	26	24	35
21/01/2004	14	15	16	30	17	22	16	16
27/01/2004	26	28	25	26	26	25	24	26

Date	Monitoring ID							
	Constable	Denman Rd West	South Muswellbrook	Sheppard Ave	Windmill	Edderton	Roxburgh Sth	Wire Lane
2/02/2004	17	16	18	38	17	20	19	17
8/02/2004	43	43	43	60	43	35	38	43
14/02/2004	31	29	36	30	33	-	27	37
20/02/2004	29	30	43	63	32	29	30	43
26/02/2004	9	10	18	19	10	10	9	18
3/03/2004	17	16	19	23	18	11	12	24
9/03/2004	18	18	22	46	20	20	20	23
15/03/2004	21	24	29	38	23	-	21	43
21/03/2004	20	20	36	34	20	18	18	30
27/03/2004	59	48	61	58	58	-	49	58
2/04/2004	47	43	42	51	50	12	50	53
8/04/2004	28	30	35	29	22	18	19	29
14/04/2004	30	29	25	33	32	27	26	24
20/04/2004	31	29	36	45	32	22	25	39
26/04/2004	24	25	29	38	24	24	31	26
2/05/2004	3	4	8	21	6	5	4	5
8/05/2004	27	29	66	44	29	32	28	110
14/05/2004	29	32	71	63	37	27	32	33
20/05/2004	9	25	22	53	18	11	21	11
26/05/2004	7	7	11	16	7	6	7	9
1/06/2004	10	14	16	17	11	11	17	9
7/06/2004	13	10	28	17	9	7	6	22
13/06/2004	6	9	14	12	6	6	7	8
19/06/2004	7	4	7	21	4	6	4	7
25/06/2004	5	4	8	11	3	3	3	5
1/07/2004	59	8	27	27	12	6	12	13
7/07/2004	7	7	18	30	6	4	7	10
13/07/2004	2	4	18	11	2	3	3	4
19/07/2004	3	4	12	10	3	3	3	27
25/07/2004	2	3	5	6	-	4	2	3
31/07/2004	16	14	169	25	14	12	14	16
6/08/2004	1	2	8	17	1	2	2	4
12/08/2004	5	8	29	20	5	5	5	6
18/08/2004	1	1	6	3	2	1	2	13
24/08/2004	25	17	25	27	17	17	23	17
30/08/2004	20	15	18	22	15	13	14	19
5/09/2004	3	2	10	9	2	3	3	6
11/09/2004	4	5	5	11	3	3	4	6
17/09/2004	7	7	14	19	6	5	9	10
23/09/2004	16	4	155	40	23	13	15	22
29/09/2004	36	29	51	47	33	27	32	44
5/10/2004	11	7	12	10	7	8	12	12
11/10/2004	28	30	32	42	32	27	31	32

Date	Monitoring ID							
	Constable	Denman Rd West	South Muswellbrook	Sheppard Ave	Windmill	Edderton	Roxburgh Sth	Wire Lane
17/10/2004	20	17	24	20	21	15	14	20
23/10/2004	8	8	11	13	9	8	7	15
29/10/2004	24	20	23	18	20	15	15	22
4/11/2004	28	30	21.1	20.7	30	20.8	19.7	29.4
10/11/2004	12.4	11.8	11.4	7.9	10.5	8.4	7.9	17.6
16/11/2004	19.6	25.3	23	23.8	18.8	14.4	16.4	27
22/11/2004	15.9	19.3	20	19.3	15.4	14.8	15.5	16.9
28/11/2004	20.9	26	20.3	40.5	23.8	22.1	27.5	21.9
4/12/2004	14.8	14.8	15.7	15.4	11.8	10.7	11.2	13.4
10/12/2004	8.7	9	7.9	10.2	7.3	8.6	7.4	13.3
16/12/2004	16.8	18	19	19.8	16.8	16.8	17.4	25
22/12/2004	23.7	24.3	20.5	24.3	25	22.7	23.7	22.9
28/12/2004	13	13.3	14.9	22	13.5	11.2	12.3	16.9
3/01/2005	30.4	32	28.4	27.3	30.5	27.9	27.7	29.7
9/01/2005	20.6	20.1	18	15.3	19.2	15.4	16.5	21.2
15/01/2005	49.2	47.3	55.6	46.7	43	42.8	42.4	57.3
21/01/2005	29.4	29.7	31.7	30.2	31.1	30.6	29.5	29.7
27/01/2005	13.6	14.4	13.3	11.4	14.7	9.9	12.3	14.5
2/02/2005	23.2	27.2	17.3	19.2	25.6	25.7	24	22.3
8/02/2005	10.9	19.9	17.3	14.3	18.1	16	17.6	13.6
14/02/2005	27.1	26.5	23	20.9	26.5	22.3	27	27.4
20/02/2005	9.7	10.9	8.1	8.8	8.5	8.2	9.3	9
26/02/2005	33.9	35.8	37.4	37.2	32.7	30.4	32.7	40.6
4/03/2005	13.5	15.3	13.8	19.4	14	12.9	14.4	14.4
10/03/2005	22.3	26.4	33.1	18.7	20.4	18.1	18.8	26.7
16/03/2005	27.3	34.2	59.3	34.9	30.7	29	30.6	34.8
22/03/2005	6.3	6.9	15.4	10.8	5.9	5.7	6.1	17.3
28/03/2005	10.8	15.8	16.4	13	13.8	13.9	18.5	10.2
3/04/2005	12.6	84.5	18.6	47.4	21.9	16.6	23.9	14.9
9/04/2005	17.4	15.5	47.6	20.6	15.7	11.6	16.1	13.6
15/04/2005	21.5	24.2	24.2	28.6	21.7	14.2	19.8	17.1
21/04/2005	18.3	15.5	26.1	19.3	14.8	14.3	15.2	22.4
27/04/2005	18.3	21.8	23.1	29.8	24.9	15.2	19.9	28.9
3/05/2005	15.9	14.4	41.2	27.6	19.6	11.3	13.9	12.7
9/05/2005	13.2	9.9	9.5	12.8	11.8	11.2	12.4	11
15/05/2005	10.4	8.9	20.1	12.8	10.4	9.6	11.1	19
21/05/2005	9.5	12	15.3	16.4	10.4	10.4	11.2	10.6
27/05/2005	13.1	14.3	18.1	30	14	12.9	16.7	15.9
2/06/2005	24.1	22.9	35.2	28.5	20.4	17.3	21.6	21.9
8/06/2005	29.9	29.1	35	37.3	27.8	19.5	26.9	26.2
14/06/2005	1.8	2.6	4.5	4.2	2.4	0.4	0.5	1.9
20/06/2005	1.8	2.3	4.2	4.2	2.3	2	3.2	3.3
26/06/2005	8.3	8.2	8.2	6.8	6.4	6.7	6.7	11.8

Date	Monitoring ID							
	Constable	Denman Rd West	South Muswellbrook	Sheppard Ave	Windmill	Edderton	Roxburgh Sth	Wire Lane
2/07/2005	3	3	7.3	4.2	3	3	3	3.5
8/07/2005	13.9	14.5	22.2	21.1	15.1	12.2	16	19.4
14/07/2005	2.3	1.8	4.5	8.6	1.5	1.8	1.2	3.2
20/07/2005	22.4	20.6	24.2	16.2	15.2	12.5	16.2	22.6
26/07/2005	3.9	3.4	18.8	20.2	3.4	3.1	4.5	6.7
1/08/2005	22.9	-	28.9	26.5	18.3	14.9	21.1	25.7
7/08/2005	7.6	6.4	13.9	12.7	2.6	3.3	4.4	5.8
13/08/2005	6.2	31.4	-	23.7	8.4	4.6	12.2	11.2
19/08/2005	17.4	33	16.7	36.6	20.6	14.9	20	16.8
25/08/2005	22.6	25.1	38.4	33.4	18.7	15.5	19.1	24.5
31/08/2005	20	18.5	60.9	43.1	18.7	13.9	19.6	26.1
6/09/2005	9.8	7.5	12.6	9.6	6.9	8	9.7	14.9
12/09/2005	2.3	2.3	3.6	8.7	2.4	2.1	3	5.5
18/09/2005	3.6	5	10.6	11.4	2.6	4.3	5.1	17
24/09/2005	20.5	22.3	25.9	32.6	18.4	17.6	18	-
30/09/2005	5.8	6.7	16.7	14.2	6.9	4.7	9.4	24.5
6/10/2005	12.4	13.6	26.1	35.8	15.3	16.8	15.6	31.7
12/10/2005	17.5	16.8	18.1	19.8	16.4	13.3	14.4	18.6
18/10/2005	18.9	15.4	36.2	17.8	13	3.3	13.3	22.1
24/10/2005	11.6	12.2	14.6	19.3	12.4	12	12	34
30/10/2005	13.9	11.5	12.8	12.6	20.2	11	11.5	1
5/11/2005	13.3	14	13.8	13.1	12.6	1	11.3	12.3
11/11/2005	14.3	15.1	20.1	30.1	13.9	14.4	12.9	27.6
17/11/2005	26.8	22.1	20.2	20.8	18.1	17.3	17.4	22.4
23/11/2005	7.6	8.3	12.5	13.6	9.1	8.6	8.4	13.3
29/11/2005	5.6	6.5	7.1	6.7	7.2	10.8	7.4	8.2
5/12/2005	10.9	11.8	16.2	37.3	12.6	14.1	15	21.5
11/12/2005	29.3	26.8	35.7	29.9	22.7	24.3	21	30.6
17/12/2005	10.1	10.1	17.3	15.3	9	10.7	13.9	16.8
23/12/2005	31.6	28.9	30.6	32.4	30.6	1	30.5	35.1
29/12/2005	62.7	71.7	41.1	45.3	59.6	43.4	26.4	42.3
4/01/2006	45.6	42.5	41.2	38.5	36.7	45.2	34.9	48
10/01/2006	19.9	17	21	18.4	18	0.5	14.6	18.6
16/01/2006	17.6	13.5	14.9	14.6	12.9	0.5	10.8	16.2
22/01/2006	29.6	20.8	14.6	12.6	16.2	-	16.5	15.9
28/01/2006	20.4	16.8	21.4	28.3	15.2	21.5	15.8	18.2
3/02/2006	22.2	16.2	17.1	29.5	15	20.4	13.8	23.3
9/02/2006	23.6	25.9	32.3	95.7	24.5	-	21.2	30.1
15/02/2006	-	-	20.6	37.2	-	-	-	22.4
21/02/2006	17.8	14.4	17.7	25.2	12.4	14.2	-	16.4
27/02/2006	13.8	12.8	13.2	20.5	12.4	-	-	16.1
5/03/2006	12.1	12.3	14.6	12.7	9.5	-	9.7	11.5
11/03/2006	27.9	30.5	32.1	36.5	24.8	-	25.5	25.6

Date	Monitoring ID							
	Constable	Denman Rd West	South Muswellbrook	Sheppard Ave	Windmill	Edderton	Roxburgh Sth	Wire Lane
17/03/2006	22.3	23.6	44	62.3	23	25.3	18.7	34.1
23/03/2006	16.2	27.3	39.1	18.8	20.5	-	16.2	20.8
29/03/2006	18.6	26.6	36.6	30.8	15.9	15.5	16.3	16.8
4/04/2006	11.9	20.2	15.1	89.2	14.9	13.1	18.3	14.7
10/04/2006	28.7	44.3	28.6	38.3	29.3	28.7	32.8	27.1
16/04/2006	-	18	11.6	13.2	9.6	9.5	12.5	15.7
22/04/2006	17.6	22	36.1	16.5	9.8	13.1	15.1	14.6
28/04/2006	19.3	25.5	27.3	15.8	15	15.8	18.3	21.5
4/05/2006	8.1	22.3	13.3	20.6	10.9	14.7	17	9.1
10/05/2006	11.6	28.1	15.7	31.1	11.6	11.1	12.1	15.5
16/05/2006	17	20.9	30.3	19.3	11.9	13.3	13.5	15.3
22/05/2006	15.4	21.8	22.1	23.4	13.3	11.1	15	18.1
28/05/2006	-	-	34.3	18.7	-	-	-	-
3/06/2006	5.6	17.7	66.2	19.9	9.5	4.9	8.7	8.9
9/06/2006	16.2	11.9	10.1	10.8	9.5	9.9	9.6	10.4
15/06/2006	5.8	11.7	14.5	22.9	7	6.8	8.7	9
21/06/2006	11.7	13.6	13.5	14.1	7.7	9.2	8.1	15.6
27/06/2006	9	6	25.2	24.3	6.6	9.1	11.5	9.2
3/07/2006	2.6	2.3	9.8	7.3	2.7	2.7	3.3	20.7
9/07/2006	6.1	5.3	10.9	9.8	9.2	3.6	7.7	7.2
15/07/2006	12.4	7.6	8.9	7	6.5	6.1	6.1	8.8
21/07/2006	13.3	7.2	13.4	11.7	9.3	7.4	9.2	14.2
27/07/2006	22.6	10.5	17.9	10.5	8	7.4	7.8	9.9
2/08/2006	7	10.5	17.1	11.4	8.1	4.1	13.8	7.8
8/08/2006	13.7	17.7	22.6	19	16.5	15.8	28.4	17
14/08/2006	14.5	17.3	20.6	20.1	13.1	12.4	15.9	16.3
20/08/2006	18.6	17.9	30.9	23.9	18.4	13.6	22.3	10.1
26/08/2006	9.7	9.7	12.1	9.9	8.8	6.5	8.7	9.5
1/09/2006	9.8	7.6	20.2	18.7	5.7	5.2	8	11.2
7/09/2006	1.9	2.3	-	4.7	2.2	2.6	2.2	8.6
13/09/2006	9.9	8.3	12	9	7.7	6.7	-	13.6
19/09/2006	11.5	15.1	15.5	16.4	14.2	17.7	-	26.1
25/09/2006	27.4	23.3	25.8	29	23.1	20	20.1	29.3
1/10/2006	27.4	17.3	25.1	56.1	-	24.2	-	21.3
7/10/2006	34.5	22.9	23.7	40.6	24.5	27.4	26.3	23.3
13/10/2006	17.7	28.7	20.6	50.8	25.1	31.4	32	15.6
19/10/2006	27.4	25.2	31.2	58.7	33.8	24.3	26.8	32.4
25/10/2006	-	-	-	-	-	-	32.5	-
31/10/2006	19.8	19.9	17.6	41.2	24.3	16.7	27.4	17.1
6/11/2006	10.6	9.7	9	11.8	7.6	7.9	7.9	15.8
12/11/2006	19.5	17.6	18.9	35.7	20.7	19.1	21.3	25.2
18/11/2006	23.6	29.3	20	32.5	22.7	21.9	22.7	22.1
24/11/2006	33.9	20.6	36.1	42.7	33.4	28.6	31.5	30.9

Date	Monitoring ID							
	Constable	Denman Rd West	South Muswellbrook	Sheppard Ave	Windmill	Edderton	Roxburgh Sth	Wire Lane
30/11/2006	36.4	29.6	38	49.5	34.2	26.8	30.3	-
6/12/2006	24.2	24.2	27.1	42.5	-	50.5	20.9	31.5
12/12/2006	17.3	15.3	21.4	39.2	17.6	13.3	15.8	21.9
18/12/2006	32.8	34.5	24.7	35.3	27.2	21.1	24.6	31
24/12/2006	14.2	15.8	-	17.1	15.2	14.2	14.2	13.7
30/12/2006	16.3	13.3	14.5	16.7	11.5	10.6	11.8	14.3
5/01/2007	26.2	20.4	18.9	30	20.6	18.7	22.9	18.2
11/01/2007	37.3	39.5	43.3	71.1	34.9	31.3	35	36.9
17/01/2007	35.4	45.2	28.5	44.3	32.3	26.1	32.1	34
23/01/2007	32.9	40.6	47.2	45.4	31.5	31.5	30.4	40.2
29/01/2007	27.7	32.6	46.9	41.4	25.2	31.6	22.9	35
4/02/2007	30.5	33.3	45.4	31.4	25.6	22.5	23.5	43.7
10/02/2007	16.7	18.3	30.7	21.3	15.8	15.2	15.6	17.4
16/02/2007	16.9	-	19.7	27.8	19.9	16.2	18.3	21.8
22/02/2007	19.3	-	29	38.3	19.6	17.7	21.7	28.3
28/02/2007	13.8	-	17	19.4	13.4	10.8	11.6	23.7
6/03/2007	12.6	14.6	14.3	12.3	13.1	11.8	15.4	19.2
12/03/2007	29.3	29.9	43.4	27.5	27.2	24.9	37.2	39.4
18/03/2007	8.4	8.8	9.8	12	8.1	8.4	8.6	9.5
24/03/2007	18.3	-	18.1	27.6	15.4	16.2	18.4	15.6
30/03/2007	9.9	12.3	20.2	27.1	9	9.9	11.2	17.7
5/04/2007	15.8	15.3	25.1	29.4	14.3	15.2	18.5	29.5
11/04/2007	22.9	30.4	27.3	26.1	21.3	19.2	22.1	20.8
17/04/2007	37	43	31.4	43.4	30.2	28.1	28.7	-
23/04/2007	15.2	16.9	27.6	34.8	14.9	11.4	14	27.7
29/04/2007	9.2	11.1	10.4	20.9	9.2	8	10.2	12.4
5/05/2007	40.8	38.3	43.9	67	32.8	41.7	43.3	38.6
11/05/2007	18.7	19.5	17.9	29.2	16.9	17.7	20.5	17.9
17/05/2007	13.4	20	16.1	24.6	13	14.1	14.8	14.9
23/05/2007	7.2	9.1	15.6	18.7	5.2	6.4	7.2	7
29/05/2007	11.7	25	24.7	57.7	14	15.8	16.4	30.2
4/06/2007	-	-	-	-	-	-	-	-
10/06/2007	-	-	-	-	-	-	-	-
16/06/2007	2.1	2.9	4.5	8.3	2.7	2.9	2.5	4.9
22/06/2007	8.8	4.6	16.1	9.7	4.2	5.4	5.5	-
28/06/2007	2.8	3.2	3.6	10.6	1.3	2.1	2	3.1
4/07/2007	5.1	5.4	10.4	14.8	3.5	4.8	4.3	9.4
10/07/2007	6.5	5.2	15.3	13.9	5.1	5.3	3.5	20.8
16/07/2007	5.6	10.4	15.5	15.1	9.9	6.1	12.8	9.3
22/07/2007	6.1	5.5	23.3	24.1	4	4.4	4.1	7.4
28/07/2007	16	13.1	16.9	15.9	11.1	10.2	13.3	14.6
3/08/2007	3	3.4	7.7	17	2.7	2.5	3.5	7.8
9/08/2007	6.7	11.2	14.5	25	7.1	6.5	11.1	10.5

Date	Monitoring ID							
	Constable	Denman Rd West	South Muswellbrook	Sheppard Ave	Windmill	Edderton	Roxburgh Sth	Wire Lane
15/08/2007	18.6	22.1	21.4	21.8	15.4	14.3	15.2	20.6
21/08/2007	7.7	8	9	10.3	-	7.9	7.5	9.1
27/08/2007	4.6	7.9	11.2	11.8	16.1	10	10.9	13.4
2/09/2007	17	17.7	16.3	21.5	16.7	20.3	19.5	15.5
8/09/2007	6.9	6.8	9.4	8.6	5.3	5	5.8	9
14/09/2007	18.9	20.1	31.5	47.3	-	20.5	21.4	29.6
20/09/2007	12.5	18.7	40.3	30.5	13.9	18.7	16.5	35.2
26/09/2007	29.9	33.7	34	27	23.8	23.7	27.5	31.3
2/10/2007	26.7	45.9	35.1	97.2	26.2	29.9	30.2	41.1
8/10/2007	17.9	20.8	28.5	31.5	13.7	19.6	18.5	33
14/10/2007	21.2	16.6	15.6	54.5	15.1	17.1	14.2	16.6
20/10/2007	49.3	52.7	64.6	51	43	54	48	54.1
26/10/2007	4.2	12.6	11.5	15.3	8.7	9.8	9.9	13
1/11/2007	-	32.4	41.2	40.6	26.4	32.4	31.1	38.5
7/11/2007	10.9	10.2	11.6	13.4	8.2	9.8	10.4	15.5
13/11/2007	25.7	27.4	18.2	19.2	22.3	22.3	26.8	22.7
19/11/2007	31.2	34.8	28.6	28.7	30	33.7	37.5	32.6
25/11/2007	19.6	21.4	14.6	15.4	16.1	19.2	16.2	15.8
1/12/2007	14.9	16.8	15.9	13	15.5	16.1	14.8	15.3
7/12/2007	19.5	22	21.4	19.2	20.8	21.7	23.6	20.8
13/12/2007	17.6	16.9	19.6	11.6	13	15.5	14.6	18.2
19/12/2007	27.1	25.7	25	24.6	20.3	22.6	19.9	24.5
25/12/2007	15.2	17	18.9	15.6	12.8	15.4	15.2	17.5
31/12/2007	23.5	25.9	28.9	23.1	19.5	22.4	21.2	26.7
6/01/2008	7.3	8.4	10.5	12.9	9.2	10.6	10.7	13.3
12/01/2008	41.4	34.1	36.6	45.5	-	34.4	35	41.5
18/01/2008	8.7	9.6	8.8	11	-	8.7	7.6	9.3
24/01/2008	21.9	23.5	26.4	23.9	18.3	21.2	-	41.9
30/01/2008	28.7	32.3	29.5	63.4	32.6	29.4	-	31.2
5/02/2008	7.4	7.6	8.4	9.4	6.7	7	-	8.1
11/02/2008	13.1	14.1	12.4	16.1	12.2	11.4	-	14.8
17/02/2008	14.2	14.9	16.2	10.1	-	10.7	-	18
23/02/2008	45.9	47.3	84.3	78.9	34.2	37.5	-	57.6
29/02/2008	13.3	18.8	15.1	9.2	10.5	11	11.5	15.2
6/03/2008	20.6	25.7	27.1	30.2	20.4	28.4	29.9	23.4
12/03/2008	25.9	28.9	25.6	23	16.7	15.1	19.9	22.3
18/03/2008	28.9	31.1	31.1	28.3	22.7	22	25.9	36.8
24/03/2008	20.7	26.7	20.5	19.8	15.8	13.7	17	19.1
30/03/2008	11.9	19.6	20.2	31.5	7.9	10.3	13.5	18
5/04/2008	27	29.9	33.9	25.5	16.1	17.4	20.6	24.7
11/04/2008	17.9	19	13.9	14.5	12.3	12.4	13.3	16.4
17/04/2008	12.4	13.6	18.3	24.5	7.8	9.2	10.1	25.4
23/04/2008	5.2	5.7	5.8	7.7	-	-	4	7.2

Date	Monitoring ID							
	Constable	Denman Rd West	South Muswellbrook	Sheppard Ave	Windmill	Edderton	Roxburgh Sth	Wire Lane
29/04/2008	11	6.3	12.8	9.3	5.5	8.5	14.7	-
5/05/2008	9.5	11.1	25.8	23.3	10.2	10.5	23.5	17
11/05/2008	24.2	21.1	23.8	18.3	18.6	17	24.8	21.6
17/05/2008	13.2	-	28.3	19	12.6	14.5	27.6	19.9
23/05/2008	20.1	17	18	23.1	13.9	13.7	22.3	24.8
29/05/2008	16.1	16.2	19.9	22.9	12.5	11.4	23.5	19
4/06/2008	-	-	-	-	-	-	-	-
10/06/2008	10.4	11.4	13.8	7.5	9.2	8.3	21.3	14.1
16/06/2008	2.7	4	11.7	10.1	2.4	2.7	4	17.5
22/06/2008	4.9	3.4	12.7	4.6	2.4	4.7	7.6	10.6
28/06/2008	17.2	13.3	19.8	15.1	9.2	10.8	19	14.5
4/07/2008	12.1	13.9	19	17.9	11.8	11.1	24.4	15.6
10/07/2008	1	1	2	3	1	2	3	3
16/07/2008	1	2	8	4	1	6	5	1
22/07/2008	13	9	13	11	6	5	8	10
28/07/2008	3	1	3	3	2	2	1	2
3/08/2008	8	10	14	12	7	8	10	9
9/08/2008	8	6	13	9	3	5	6	7
15/08/2008	7	9	14	22	7	6	7	11
21/08/2008	22	23	28	37	20	22	22	19
27/08/2008	20	19	30	27	17	14	19	24
2/09/2008	23	17	24	47	14	17	19	28
8/09/2008	8	10	16	15	8	12	17	15
14/09/2008	11	16	13	14	10	9	11	15
20/09/2008	35	50	44	47	33	33	43	42
26/09/2008	20	16	23	24	11	20	18	17
2/10/2008	25	35	27	34	24	28	39	24
8/10/2008	9	18	17	15	3	5	16	10
14/10/2008	16	12	29	17	14	24	27	24
20/10/2008	16	33	34	28	18	29	35	31
26/10/2008	15	29	19	10	15	26	29	22
1/11/2008	25	54	27	15	22	16	22	26
7/11/2008	34	56	39	33	26	28	30	41
13/11/2008	27	47	30	27	21	24	16	43
19/11/2008	11	15	6	8	5	1	5	11
25/11/2008	23	51	21	16	34	11	31	29
1/12/2008	6	16	9	23	4	6	11	8
7/12/2008	6	15	15	12	9	5	13	19
13/12/2008	11	24	6	24	11	10	16	14
19/12/2008	16	17	23	29	11	10	19	23
25/12/2008	17	34	19	15	18	18	19	15
31/12/2008	29	34	43	44	28	28	43	37
6/01/2009	29	27	35	55	34	35	46	34

Date	Monitoring ID							
	Constable	Denman Rd West	South Muswellbrook	Sheppard Ave	Windmill	Edderton	Roxburgh Sth	Wire Lane
12/01/2009	40	52	64	57	39	34	57	57
18/01/2009	40	24	45	32	40	35	54	51
24/01/2009	24	12	27	29	29	23	36	24
30/01/2009	47	53	53	46	44	41	60	52
5/02/2009	48	87	45	26	39	27	66	35
11/02/2009	16	21	37	17	19	19	22	28
17/02/2009	16	26	22	12	16	18	19	17
23/02/2009	30	42	47	29	38	36	40	39
1/03/2009	51	52	71	46	46	22	54	51
7/03/2009	25	37	55	45	30	28	45	34
13/03/2009	21	32	27	39	23	18	26	11
19/03/2009	30	30	37	25	27	24	39	23
25/03/2009	37	61	51	35	20	29	33	40
31/03/2009	12	16	23	22	12	11	9	23
6/04/2009	23	25	26	21	17	17	15	28
12/04/2009	6	9	7	9	7	8	5	4
18/04/2009	26	28	34	33	25	19	26	37
24/04/2009	70	13	12	28	7	7	7	14
30/04/2009	6	8	10	15	5	5	5	12
6/05/2009	25	28	24	27	18	23	24	27
12/05/2009	30	30	32	27	22	22	26	21
18/05/2009	30	26	37	33	26	24	27	37
24/05/2009	16	27	18	23	20	15	15	18
30/05/2009	20	17	17	18	15	17	13	20
5/06/2009	4	19	17	17	10	7	10	13
11/06/2009	12	14	18	17	6	10	12	13
17/06/2009	32	26	30	29	18	19	28	29
23/06/2009	3	16	31	36	25	18	31	15
29/06/2009	10	10	10	11	8	9	14	17
5/07/2009	1	1	2	1	2	1	2	2
11/07/2009	9	8	15	5	3	4	3	9
17/07/2009	2	3	7	2	2	1	2	4
23/07/2009	3	5	8	4	3	2	2	6
29/07/2009	1	4	8	4	0	1	3	2
4/08/2009	5	1	17	12	5	6	13	7
10/08/2009	29	37	32	49	20	23	32	31
16/08/2009	10	20	17	18	18	10	14	11
22/08/2009	11	5	10	18	9	4	7	7
28/08/2009	12	24	13	30	16	11	41	6
3/09/2009	48	5	49	18	25	24	35	16
9/09/2009	2	5	<1	4	<1	1	2	6
15/09/2009	53	73	61	51	49	41	56	46
21/09/2009	21	91	24	22	23	20	40	22

Date	Monitoring ID							
	Constable	Denman Rd West	South Muswellbrook	Sheppard Ave	Windmill	Edderton	Roxburgh Sth	Wire Lane
27/09/2009	15	12	14	27	10	11	11	48
3/10/2009	4	6	7	8	4	6	5	10
9/10/2009	6	11	12	32	5	5	7	29
15/10/2009	6	9	4	31	7	7	7	56
21/10/2009	22	35	34	61	30	27	35	37
27/10/2009	6	10	14	15	8	7	6	10
2/11/2009	37	37	38	192	34	35	38	35
8/11/2009	12	25	16	15	11	7	10	14
14/11/2009	26	46	33	33	19	23	22	35
20/11/2009	45	44	57	73	34	28	31	90
26/11/2009	35	36	39	32	34	28	29	57
2/12/2009	25	22	22	17	14	14	14	37
8/12/2009	68	65	63	79	53	43	47	91
14/12/2009	41	42	37	45	39	27	30	54
20/12/2009	28	29	<1	22	26	20	22	32
26/12/2009	5	5	<1	9	3	4	2	12
1/01/2010	11	11	13	13	11	12	11	13
7/01/2010	27	29	30	27	25	20	24	35
13/01/2010	29	35	75	47	34	34	30	41
19/01/2010	14	15	20	24	16	30	13	30
25/01/2010	56	71	45	43	62	43	54	57
31/01/2010	26	19	12	15	24	17	23	21
6/02/2010	8	12	13	15	8	10	6	22
12/02/2010	18	22	24	31	20	22	33	33
18/02/2010	22	23	37	41	15	14	20	31
24/02/2010	36	35	23	34	36	16	40	32
2/03/2010	16	17	<1	20	18	7	22	28
8/03/2010	9	11	15	21	7	9	12	26
14/03/2010	9	9	3	17	6	1	7	7
20/03/2010	38	45	25	69	41	28	46	35
26/03/2010	39	36	39	96	41	30	34	34
1/04/2010	20	22	23	20	20	19	20	24
7/04/2010	11	12	13	15	11	11	10	14
13/04/2010	21	24	27	31	19	20	20	23
19/04/2010	24	26	44	24	22	17	23	29
25/04/2010	29	16	15	25	6	13	12	15
1/05/2010	47	21	22	29	14	17	18	21
7/05/2010	12	26	21	27	23	14	19	15
13/05/2010	15	23	39	40	15	17	20	18
19/05/2010	18	18	28	21	22	17	15	24
25/05/2010	22	24	26	21	21	21	21	26
31/05/2010	9	11	18	12	10	9	9	11
6/06/2010	6	6	13	12	6	4	3	13

Date	Monitoring ID							
	Constable	Denman Rd West	South Muswellbrook	Sheppard Ave	Windmill	Edderton	Roxburgh Sth	Wire Lane
12/06/2010	18	11	22	16	15	14	14	17
18/06/2010	15	17	21	14	14	13	13	16
24/06/2010	21	22	21	18	15	17	16	23
30/06/2010	4	9	18	8	10	7	7	9
6/07/2010	13	13	21	14	11	9	9	14
12/07/2010	7	8	12	7	5	6	5	8
18/07/2010	6	17	22	8	5	6	5	14
24/07/2010	18	8	18	13	11	14	12	6
30/07/2010	1	6	9	7	4	1	4	5
5/08/2010	3	4	10	13	2	1	2	5
11/08/2010	2	4	2	2	2	2	2	1
17/08/2010	10	7	11	14	4	4	6	15
23/08/2010	12	12	17	12	9	9	10	14
29/08/2010	14	23	19	9	23	26	29	25
4/09/2010	9	5	4	9	2	2	2	4
10/09/2010	6	14	16	19	12	12	15	6
16/09/2010	5	3	5	6	2	1	2	5
22/09/2010	15	49	24	15	23	29	8	28
28/09/2010	17	17	23	29	11	14	14	21
4/10/2010	12	15	8	10	9	10	8	12
10/10/2010	33	43	-	14	14	13	21	23
16/10/2010	6	10	13	12	3	5	6	9
22/10/2010	22	27	22	35	11	16	24	27
28/10/2010	24	32	26	26	11	17	21	27
3/11/2010	3	8	9	16	<1	6	6	8
9/11/2010	10	16	13	17	3	<1	<1	17
15/11/2010	2	6	4	17	<1	3	3	12
21/11/2010	23	21	30	23	5	18	18	20
27/11/2010	12	19	14	30	13	26	21	12
3/12/2010	17	21	19	19	17	16	18	24
9/12/2010	7	16	9	20	10	13	10	8
15/12/2010	17	37	16	14	21	22	23	24
21/12/2010	8	17	14	8	8	10	13	17
27/12/2010	12	18	18	13	14	13	15	22
2/01/2011	30	35	50	38	32	34	25	39
8/01/2011	21	23	20	14	20	14	18	23
14/01/2011	14	18	24	16	30	16	14	38
20/01/2011	25	44	46	15	67	32	38	44
26/01/2011	39	45	42	50	68	33	39	42
1/02/2011	41	55	41	50	26	34	39	29
7/02/2011	24	22	19	18	14	11	17	23
13/02/2011	10	14	13	17	10	7	10	19
19/02/2011	18	37	21	13	17	20	23	25

Date	Monitoring ID							
	Constable	Denman Rd West	South Muswellbrook	Sheppard Ave	Windmill	Edderton	Roxburgh Sth	Wire Lane
25/02/2011	29	38	27	31	27	27	36	43
3/03/2011	18	40	24	18	17	18	20	29
9/03/2011	17	37	25	50	16	17	24	27
15/03/2011	27	34	30	25	24	21	30	30
21/03/2011	19	27	16	9	21	13	25	21
27/03/2011	18	34	19	8	16	10	25	19
2/04/2011	32	49	47	22	23	24	30	37
8/04/2011	11	16	17	18	9	6	10	23
14/04/2011	7	15	14	33	6	7	5	20
20/04/2011	19	23	24	36	14	18	22	21
26/04/2011	7	15	9	15	7	6	11	14
2/05/2011	9	14	11	12	5	15	17	11
8/05/2011	18	20	28	29	11	12	25	29
14/05/2011	3	10	19	27	2	3	4	10
20/05/2011	35	28	32	35	22	23	27	26
26/05/2011	5	5	25	21	5	6	11	17
1/06/2011	9	13	17	13	11	3	11	18
7/06/2011	5	8	12	13	5	5	8	9
13/06/2011	5	6	13	13	5	4	4	14
19/06/2011	3	6	12	6	5	5	5	5
25/06/2011	18	12	24	12	12	11	14	18
1/07/2011	18	14	22	13	7	6	7	15
7/07/2011	7	2	13	11	2	1	1	5
13/07/2011	9	13	11	14	11	8	8	14
19/07/2011	3	7	4	3	2	2	2	4
25/07/2011	6	5	6	8	3	3	4	4
31/07/2011	9	15	21	16	13	9	30	11
6/08/2011	13	13	16	35	5	17	34	8
12/08/2011	13	15	19	17	7	5	15	21
18/08/2011	9	4	5	8	2	1	2	15
24/08/2011	15	13	16	15	14	8	17	25
30/08/2011	22	21	24	26	16	24	19	28
5/09/2011	18	19	19	21	10	22	29	17
11/09/2011	1	6	10	6	3	5	5	5
17/09/2011	17	36	27	18	28	21	56	11
23/09/2011	35	32	38	103	21	23	37	35
29/09/2011	9	11	9	11	5	4	6	7
5/10/2011	22	31	17	10	15	19	40	24
11/10/2011	5	7	12	5	NR	7	18	13
17/10/2011	33	37	27	13	NR	16	44	25
23/10/2011	33	34	25	33	28	35	64	26
29/10/2011	13	14	15	12	15	17	28	15

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

Appendix C: Emission Calculations

Mt Arthur Coal Emissions Inventory

Description of operations

The dust emission inventories have been prepared using the operational description of the proposed mining activities provided by Hunter Valley Energy Coal (HVEC).

Topsoil would be removed using a scraper followed by blasting to fragment the overburden prior to excavation using face shovels, hydraulic excavators and trucks. Following removal of the overburden, the exposed coal would be cleaned using a dozer and/or grader. The coal seam would then be ripped if less than 1 metre thick and loaded into haul trucks using a hydraulic excavator and transported either directly or via a temporary run-of-mine (ROM) coal stockpile to the Coal Handling Preparation Plant (CHPP).

The overburden would be hauled for placement in-pit or out-of-pit, as required.

Emission estimates

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.

Extraction and processing activities are assumed to occur 24 hours a day, 7 days a week. Dust from wind erosion is assumed to occur over 24 hours per day, however, wind erosion is also assumed to be proportional to the third power of wind speed. This will mean that most wind erosion occurs in the day when wind speeds are highest.

Removal of topsoil

The total suspended particulate (TSP) matter emission factor for removal of topsoil is 14 kilograms per hour (kg/hour) (**State Pollution Control Comission, 1983**).

Drilling overburden

The emission factor used for drilling is 0.59 kilogram per hole (**United States Environmental Protection Agency [US EPA], 1985**). 70 percent (%) control was assumed for the use of water sprays during drilling.

The number of holes per year were calculated based on information provided by HVEC.

Blasting overburden

TSP emissions from blasting were estimated using the **US EPA (1985)** emission factor equation given in **Equation 1**.

Equation 1

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

where,

A = area to be blasted in square metres.
Kg/blast = kilogram per blast.

The area to be blasted per blast and number of blasts per year were calculated based on information provided by HVEC.

Loading material / dumping overburden using shovels/excavators/Front end loaders

Each tonne (t) of material loaded will generate a quantity of TSP that will depend on the wind speed and the moisture content. **Equation 2** shows the relationship between these variables.

Equation 2

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

where,

E_{TSP} = *TSP emissions*

$k = 0.74$

U = *wind speed (m/s)*

M = *moisture content (%)*

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

The wind speed value was taken from the Macleans Hill April 2007 to March 2008 meteorological dataset. The moisture content for overburden was assumed to be 2%.

Hauling material/product on unsealed surfaces

After the use of agglomeration agents, the emission factor used for trucks hauling overburden or ROM coal on unsealed surfaces is 0.6 kg per vehicle kilometre travelled (kg/VKT). An assumption of 85% control is inbuilt into this emission factor for the use of watering and dust suppressants on haul roads.

The average return trip for each year was provided by HVEC. It was assumed haul trucks with an average capacity of 298 t was used for the hauling of overburden using a combination of Cat 793 and Liebherr T282 trucks. For ROM coal the average truck capacity was assumed to be 150 t using Cat 789 trucks.

Dozers on overburden

Emissions from dozers on overburden have been calculated using the US EPA emission factor equation (**US EPA, 1985**), given in **Equation 3**.

Equation 3

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

where,

E_{TSP} = *TSP emissions*

s = silt content (%), and

M = moisture (%)

The silt content in the overburden was assumed to be 10%, and the moisture content 2%. This results in a emission factor of 16.7 kg/hour.

Dozers ripping coal and handling ROM coal at CHPP

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

Equation 4

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

Where,

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

The silt content in the coal whilst ripping was assumed to be 5%, and the moisture content 8%, resulting in an emission factor of 20 kg/hour.

For dozers handling coal at the CHPP, the coal was assumed to have a silt content of 4%, and a moisture content of 6%, resulting in an emission factor of 15.3 kg/hour.

Loading/unloading coal

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

Equation 5

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

where,

$E_{TSP} = TSP \ emissions$

M = moisture (%)

The moisture content was assumed to be 8%. 70% control was assumed for unloading coal to ROM hopper as the hoppers are enclosed with rubber.

Reloading coal from stockpiles to trains

Equation 2 was used and the moisture content was assumed to be 10%.

Wind erosion

The emission factor for wind erosion is given in **Equation 6** below.

Equation 6

$$E_{TSP} = 1.9 \times \left(\frac{s}{1.5}\right) \times \left(\frac{365 - p}{235}\right) \times \left(\frac{f}{15}\right) \quad kg/ha/day$$

where,

kg/ha/day = kilograms per hectare per day
s = silt content (%)
p = number of raindays per year, and
f = percentage of the time that wind speed is above 5.4 m/s

It was assumed that silt content is 10%, the number of raindays was taken as 101 days. This is the average of the raindays from the Bureau of Meteorology sites at Scone Airport and Scone Soil Conservation Service. The percentage of winds above 5.4 m/s was calculated to be 17.4%, based on the Macleans Hill April 2007 to March 2008 meteorological dataset.

For ROM stockpiles 50% control was assumed for use of water cart on stockpiles.

Grading roads

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

Equation 7

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

where,

S = speed of the grader in kilometres per hour (taken to be 8 km/hour).

Appendix D: Emission Inventory

Table D.1: 2016 Emissions Inventory

ACTIVITY	TSP emission/year for 2016 in kg	Intensity	units	Emission factor	units	Variable 1	units	Variable 2	units	Variable 3	units	Variable 4	units	Source type
OB - Stripping topsoil - MC	1,858	133	h/y	14.0	kg/h									1
OB - Stripping topsoil - WM	1,706	122	h/y	14.0	kg/h									1
OB - Stripping topsoil - HU	2,601	186	h/y	14.0	kg/h									1
OB - Stripping topsoil - RX	1,168	83	h/y	14.0	kg/h									1
OB - Stripping topsoil - AY	298	21	h/y	14.0	kg/h									1
OB - Drilling - MC	2,671	15,092	holes/y	0.59	kg/hole							70	% control	1
OB - Drilling - WM	6,405	36,187	holes/y	0.59	kg/hole							70	% control	1
OB - Drilling - HU	6,619	37,397	holes/y	0.59	kg/hole							70	% control	1
OB - Drilling - CA	5,064	28,611	holes/y	0.59	kg/hole							70	% control	1
OB - Drilling - RX	8,083	45,667	holes/y	0.59	kg/hole							70	% control	1
OB - Drilling - AY	600	3,387	holes/y	0.59	kg/hole							70	% control	1
OB - Drilling - S	1,013	5,726	holes/y	0.59	kg/hole							70	% control	1
OB - Blasting - MC	31,663	29	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Blasting - WM	75,922	70	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Blasting - HU	78,460	72	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Blasting - CA	60,026	55	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Blasting - RX	95,810	88	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Blasting - AY	7,106	7	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Blasting - S	12,013	11	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Sh/Ex/FELs loading - MC	63,618	30,425,493	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Sh/Ex/FELs loading - WM	152,542	72,953,746	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Sh/Ex/FELs loading - HU	157,642	75,392,815	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Sh/Ex/FELs loading - CA	120,605	57,679,646	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Sh/Ex/FELs loading - RX	192,501	92,064,167	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Sh/Ex/FELs loading - AY	14,278	6,828,282	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Sh/Ex/FELs loading - S	24,137	11,543,460	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Hauling to emplacement - MC	467,346	30,425,493	t/y	0.01536	kg/t	296	t/truck load	7.6	km/return trip	0.6	kg/VKT	85	% control	1
OB - Hauling to emplacement - WM	1,158,426	72,953,746	t/y	0.01588	kg/t	296	t/truck load	7.8	km/return trip	0.6	kg/VKT	85	% control	1
OB - Hauling to emplacement - HU	1,085,886	75,392,815	t/y	0.01440	kg/t	296	t/truck load	7.1	km/return trip	0.6	kg/VKT	85	% control	1
OB - Hauling to emplacement - CA	816,713	57,679,646	t/y	0.01416	kg/t	296	t/truck load	7.0	km/return trip	0.6	kg/VKT	85	% control	1
OB - Hauling to emplacement - RX	1,489,888	92,064,167	t/y	0.01618	kg/t	296	t/truck load	8.0	km/return trip	0.6	kg/VKT	85	% control	1
OB - Hauling to emplacement - AY	91,676	6,828,282	t/y	0.01343	kg/t	296	t/truck load	6.6	km/return trip	0.6	kg/VKT	85	% control	1
OB - Hauling to emplacement - S	60,880	11,543,460	t/y	0.00527	kg/t	296	t/truck load	2.6	km/return trip	0.6	kg/VKT	85	% control	1
OB - Emplacing at dumps - MC	63,618	30,425,493	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Emplacing at dumps - WM	152,542	72,953,746	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Emplacing at dumps - HU	157,642	75,392,815	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Emplacing at dumps - CA	120,605	57,679,646	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Emplacing at dumps - RX	192,501	92,064,167	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Emplacing at dumps - AY	14,278	6,828,282	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Emplacing at dumps - S	24,137	11,543,460	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Dozers on O/B - MC	81,567	4,874	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on O/B - WM	195,580	11,687	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on O/B - HU	202,119	12,077	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on O/B - CA	154,632	9,240	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on O/B - RX	246,812	14,748	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on O/B - AY	18,306	1,094	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on O/B - S	30,947	1,849	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on Rehabilitation - total	445,916	26,645	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
CL - Dozers ripping - MC	8,634	1,846	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Dozers ripping - WM	23,100	4,939	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Dozers ripping - HU	25,072	5,361	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Dozers ripping - CA	18,253	3,903	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Dozers ripping - RX	26,235	5,610	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Dozers ripping - AY	879	188	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Dozers ripping - S	3,094	662	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Loading ROM to trucks - MC	125,276	2,619,080	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Loading ROM to trucks - WM	335,182	7,007,459	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Loading ROM to trucks - HU	363,800	7,605,757	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Loading ROM to trucks - CA	264,846	5,536,989	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Loading ROM to trucks - RX	380,667	7,958,400	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Loading ROM to trucks - AY	12,752	266,596	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Loading ROM to trucks - S	44,898	938,660	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Hauling ROM coal to dump hopper - MC	163,989	2,619,080	t/y	0.06261	kg/t	150	t/load	15.7	km/return trip	0.6	kg/VKT	85	% control	1
CL - Hauling ROM coal to dump hopper - WM	424,800	7,007,459	t/y	0.06062	kg/t	150	t/load	15.2	km/return trip	0.6	kg/VKT	85	% control	1
CL - Hauling ROM coal to dump hopper - HU	348,130	7,605,757	t/y	0.04577	kg/t	150	t/load	11.4	km/return trip	0.6	kg/VKT	85	% control	1
CL - Hauling ROM coal to dump hopper - CA	208,911	5,536,989	t/y	0.03773	kg/t	150	t/load	9.4	km/return trip	0.6	kg/VKT	85	% control	1
CL - Hauling ROM coal to dump hopper - RX	327,103	7,958,400	t/y	0.04110	kg/t	150	t/load	10.3	km/return trip	0.6	kg/VKT	85	% control	1
CL - Hauling ROM coal to dump hopper - AY	13,751	266,596	t/y	0.05158	kg/t	150	t/load	12.9	km/return trip	0.6	kg/VKT	85	% control	1
CL - Hauling ROM coal to dump hopper - S	63,829	938,660	t/y	0.06800	kg/t	150	t/load	17.0	km/return trip	0.6	kg/VKT	85	% control	1
CL - unloading ROM coal at stockpile/hopper - MC	37,583	2,619,080	t/y	0.04783	kg/t							70	% control	1
CL - unloading ROM coal at stockpile/hopper - WM	100,555	7,007,459	t/y	0.04783	kg/t							70	% control	1
CL - unloading ROM coal at stockpile/hopper - HU	109,140	7,605,757	t/y	0.04783	kg/t							70	% control	1
CL - unloading ROM coal at stockpile/hopper - CA	79,454	5,536,989	t/y	0.04783	kg/t							70	% control	1
CL - unloading ROM coal at stockpile/hopper - RX	114,200	7,958,400	t/y	0.04783	kg/t							70	% control	1
CL - unloading ROM coal at stockpile/hopper - AY	3,826	266,596	t/y	0.04783	kg/t							70	% control	1
CL - unloading ROM coal at stockpile/hopper - S	13,469	938,660	t/y	0.04783	kg/t							70	% control	1
CL - Rehandle ROM coal at stockpilepile/hopper	168,016	3,512,624	t/y	0.04783	kg/t									1
CL - Handling coal at CHPP	9,587	31,932,942	t/y	0.00030	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/s	8	moisture content of coal in %					2
CL - Dozers at CHPP	156,725	15,330	h/y	10.2	kg/h	4	silt content in %	8	moisture content in %					1
CL - Transporting rejects	57,660	4,582,634	t/y	0.01258	kg/t	150	t/load	3.1	km/return trip	0.6	kg/VKT	85.0	% control	1
CL - Loading product coal stockpile	6,173	28,100,989	t/y	0.00022	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/s	10	moisture content of coal in %					2
CL - Loading coal to trains	6,173	28,100,989	t/y	0.00022	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/s	10	moisture content of coal in %					2
WE - OB spoil area - All pits	4,965,987	969.7	ha	6024.9	kg/ha/y	101	Average number of raindays	10	silt content in %	17.4	% of winds above 5.4 m/s			3
WE - Open pit - All pits	4,333,102	719.2	ha	6024.9	kg/ha/y	101	Average number of raindays	10	silt content in %	17.4	% of winds above 5.4 m/s			3
WE - Active rehab	517,435	85.9	ha	6024.9	kg/ha/y	101	Average number of raindays	10	silt content in %	17.4	% of winds above 5.4 m/s			3
WE - ROM stockpiles	36,149	12.0	ha	6024.9	kg/ha/y	101	Average number of raindays	10	silt content in %	17.4	% of winds above 5.4 m/s	50	% control	3
WE - Product stockpiles	11,086	4.6	ha	2410.0	kg/ha/y	101	Average number of raindays	4	silt content in %	17.4	% of winds above 5.4 m/s			3
Grading roads	73,856	120,000	km	0.61547	kg/VKT	8	speed of graders in km/h							1
Underground_ROM/crushing stockpile area	360,000	4,000,000	t/y	0.09	kg/t									1
Underground_CHPP area	360,000	4,000,000	t/y	0.09	kg/t									1
TOTAL (O/C)	22,379,803													
ROM coal production (O/C)	31,932,942													
ROM: dust Ratio (O/C)	0.701													

MC= Macleans Hill
WM = Windmill
HU = Huon
AY = Ayredale
S = Saddlers
CA = Calool

OB = overburden
CL = coal
WE = wind erosion
ROM = run-of-mine
CHPP = coal handling and preparation plant
RX - Roxburgh

Table D.2: 2022 Emissions Inventory

ACTIVITY	TSP emission/year for 2022 in kg	Intensity	units	Emission factor	units	Variable 1	units	Variable 2	units	Variable 3	units	Variable 4	units	Source type
OB - Stripping topsoil - MC	-	0	h/y	14.0	kg/h									1
OB - Stripping topsoil - WM	1,853	132	h/y	14.0	kg/h									1
OB - Stripping topsoil - HU	1,165	83	h/y	14.0	kg/h									1
OB - Stripping topsoil - CA	2,184	156	h/y	14.0	kg/h									1
OB - Stripping topsoil - RX	3,753	268	h/y	14.0	kg/h									1
OB - Stripping topsoil - AY	-	0	h/y	14.0	kg/h									1
OB - Drilling - MC	-	0	holes/y	0.59	kg/hole							70	% control	1
OB - Drilling - WM	8,478	47,896	holes/y	0.59	kg/hole							70	% control	1
OB - Drilling - HU	4,298	24,283	holes/y	0.59	kg/hole							70	% control	1
OB - Drilling - CA	6,906	39,018	holes/y	0.59	kg/hole							70	% control	1
OB - Drilling - RX	9,506	53,703	holes/y	0.59	kg/hole							70	% control	1
OB - Drilling - AY	179	1,012	holes/y	0.59	kg/hole							70	% control	1
OB - Drilling - S	1,569	8,867	holes/y	0.59	kg/hole							70	% control	1
OB - Blasting - MC	-	0	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Blasting - WM	100,486	92	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Blasting - HU	50,945	47	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Blasting - CA	81,861	75	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Blasting - RX	112,671	104	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Blasting - AY	2,123	2	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Blasting - S	18,602	17	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Sh/Ex/FELs loading - MC	-	0	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Sh/Ex/FELs loading - WM	201,897	96,557,961	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Sh/Ex/FELs loading - HU	102,359	48,953,543	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Sh/Ex/FELs loading - CA	164,475	78,660,442	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Sh/Ex/FELs loading - RX	226,378	108,266,163	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Sh/Ex/FELs loading - AY	4,265	2,039,722	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Sh/Ex/FELs loading - S	37,376	17,875,200	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Hauling to emplacement - MC	-	0	t/y	0.00000	kg/t	296	t/truck load	0.0	km/return trip	0.6	kg/VKT	85	% control	1
OB - Hauling to emplacement - WM	1,771,141	96,557,961	t/y	0.01834	kg/t	296	t/truck load	9.0	km/return trip	0.6	kg/VKT	85	% control	1
OB - Hauling to emplacement - HU	924,166	48,953,543	t/y	0.01888	kg/t	296	t/truck load	9.3	km/return trip	0.6	kg/VKT	85	% control	1
OB - Hauling to emplacement - CA	1,243,005	78,660,442	t/y	0.01580	kg/t	296	t/truck load	7.8	km/return trip	0.6	kg/VKT	85	% control	1
OB - Hauling to emplacement - RX	1,783,646	108,266,163	t/y	0.01647	kg/t	296	t/truck load	8.1	km/return trip	0.6	kg/VKT	85	% control	1
OB - Hauling to emplacement - AY	24,437	2,039,722	t/y	0.01198	kg/t	296	t/truck load	5.9	km/return trip	0.6	kg/VKT	85	% control	1
OB - Hauling to emplacement - S	94,274	17,875,200	t/y	0.00527	kg/t	296	t/truck load	2.6	km/return trip	0.6	kg/VKT	85	% control	1
OB - Emplacing at dumps - MC	-	0	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Emplacing at dumps - WM	201,897	96,557,961	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Emplacing at dumps - HU	102,359	48,953,543	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Emplacing at dumps - CA	164,475	78,660,442	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Emplacing at dumps - RX	226,378	108,266,163	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Emplacing at dumps - AY	4,265	2,039,722	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Emplacing at dumps - S	37,376	17,875,200	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Dozers on O/B - MC	-	0	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on O/B - WM	254,845	15,228	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on O/B - HU	129,203	7,720	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on O/B - CA	207,608	12,405	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on O/B - RX	285,746	17,074	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on O/B - AY	5,383	322	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on O/B - S	47,178	2,819	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on Rehabilitation - total	445,916	26,645	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
CL - Dozers ripping - MC	-	0	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Dozers ripping - WM	28,966	6,194	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Dozers ripping - HU	9,366	2,003	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Dozers ripping - CA	24,269	5,189	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Dozers ripping - RX	29,871	6,387	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Dozers ripping - AY	9,571	2,047	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Dozers ripping - S	3,224	689	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Loading ROM to trucks - MC	-	0	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Loading ROM to trucks - WM	421,182	8,805,423	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Loading ROM to trucks - HU	136,187	2,847,183	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Loading ROM to trucks - CA	352,880	7,377,473	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Loading ROM to trucks - RX	434,333	9,080,349	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Loading ROM to trucks - AY	139,171	2,909,572	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Loading ROM to trucks - S	46,876	980,000	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Hauling ROM coal to dump hopper - MC	-	0	t/y	0.00000	kg/t	150	t/load	0.0	km/return trip	0.6	kg/VKT	85	% control	1
CL - Hauling ROM coal to dump hopper - WM	618,688	8,805,423	t/y	0.07026	kg/t	150	t/load	17.6	km/return trip	0.6	kg/VKT	85	% control	1
CL - Hauling ROM coal to dump hopper - HU	165,998	2,847,183	t/y	0.05830	kg/t	150	t/load	14.6	km/return trip	0.6	kg/VKT	85	% control	1
CL - Hauling ROM coal to dump hopper - CA	370,753	7,377,473	t/y	0.05025	kg/t	150	t/load	12.6	km/return trip	0.6	kg/VKT	85	% control	1
CL - Hauling ROM coal to dump hopper - RX	476,283	9,080,349	t/y	0.05245	kg/t	150	t/load	13.1	km/return trip	0.6	kg/VKT	85	% control	1
CL - Hauling ROM coal to dump hopper - AY	157,066	2,909,572	t/y	0.05398	kg/t	150	t/load	13.5	km/return trip	0.6	kg/VKT	85	% control	1
CL - Hauling ROM coal to dump hopper - S	66,640	980,000	t/y	0.06800	kg/t	150	t/load	17	km/return trip	0.6	kg/VKT	85	% control	1
CL - unloading ROM coal at stockpile/hopper - MC	-	0	t/y	0.04783	kg/t							70	% control	1
CL - unloading ROM coal at stockpile/hopper - WM	126,355	8,805,423	t/y	0.04783	kg/t							70	% control	1
CL - unloading ROM coal at stockpile/hopper - HU	40,856	2,847,183	t/y	0.04783	kg/t							70	% control	1
CL - unloading ROM coal at stockpile/hopper - CA	105,864	7,377,473	t/y	0.04783	kg/t							70	% control	1
CL - unloading ROM coal at stockpile/hopper - RX	130,300	9,080,349	t/y	0.04783	kg/t							70	% control	1
CL - unloading ROM coal at stockpile/hopper - AY	41,751	2,909,572	t/y	0.04783	kg/t							70	% control	1
CL - unloading ROM coal at stockpile/hopper - S	14,063	980,000	t/y	0.04783	kg/t							70	% control	1
CL - Rehandle ROM coal at stockpilepile/hopper	168,369	3,520,000	t/y	0.04783	kg/t									1
CL - Handling coal at CHPP	9,607	32,000,000	t/y	0.00030	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/s	8	moisture content of coal in %					2
CL - Dozers at CHPP	156,725	15,330	h/y	10.2	kg/h	4	silt content in %	8	moisture content in %					1
CL - Transporting rejects	128,307	4,946,858	t/y	0.02594	kg/t	150	t/load	6.5	km/return trip	0.6	kg/VKT	85.0	% control	1
CL - Loading product coal stockpile	6,186	28,160,000	t/y	0.00022	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/s	10	moisture content of coal in %					2
CL - Loading coal to trains	6,186	28,160,000	t/y	0.00022	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/s	10	moisture content of coal in %					2
WE - OB spoil area - All pits	8,909,024	1740	ha	6024.9	kg/ha/y	101	Average number of raindays	10	silt content in %	17.4	% of winds above 5.4 m/s			3
WE - Open pit - All pits	4,598,046	763	ha	6024.9	kg/ha/y	101	Average number of raindays	10	silt content in %	17.4	% of winds above 5.4 m/s			3
WE - Active rehab	929,872	154.3	ha	6024.9	kg/ha/y	101	Average number of raindays	10	silt content in %	17.4	% of winds above 5.4 m/s			3
WE - ROM stockpiles	36,149	12	ha	6024.9	kg/ha/y	101	Average number of raindays	10	silt content in %	17.4	% of winds above 5.4 m/s	50	% control	3
WE - Product stockpiles	11,086	5	ha	2410.0	kg/ha/y	101	Average number of raindays	4	silt content in %	17.4	% of winds above 5.4 m/s			3
Grading roads	73,856	120,000	km	0.61547	kg/VKT	8	speed of graders in km/h							1
Underground_ROM/crushing stockpile area	360,000	4,000,000	t/y	0.09	kg/t									1
Underground_CHPP area	360,000	4,000,000	t/y	0.09	kg/t									1
TOTAL (O/C)	28,080,554													
ROM coal production (O/C)	32,000,000													
ROM: dust Ratio (O/C)	0.878													

MC= Macleans Hill
WM = Windmill
HU = Huon
AY = Ayredale
S = Saddlers
CA = Calool

OB = overburden
CL = coal
WE = wind erosion
ROM = run-of-mine
CHPP = coal handling and preparation plant
RX - Roxburgh

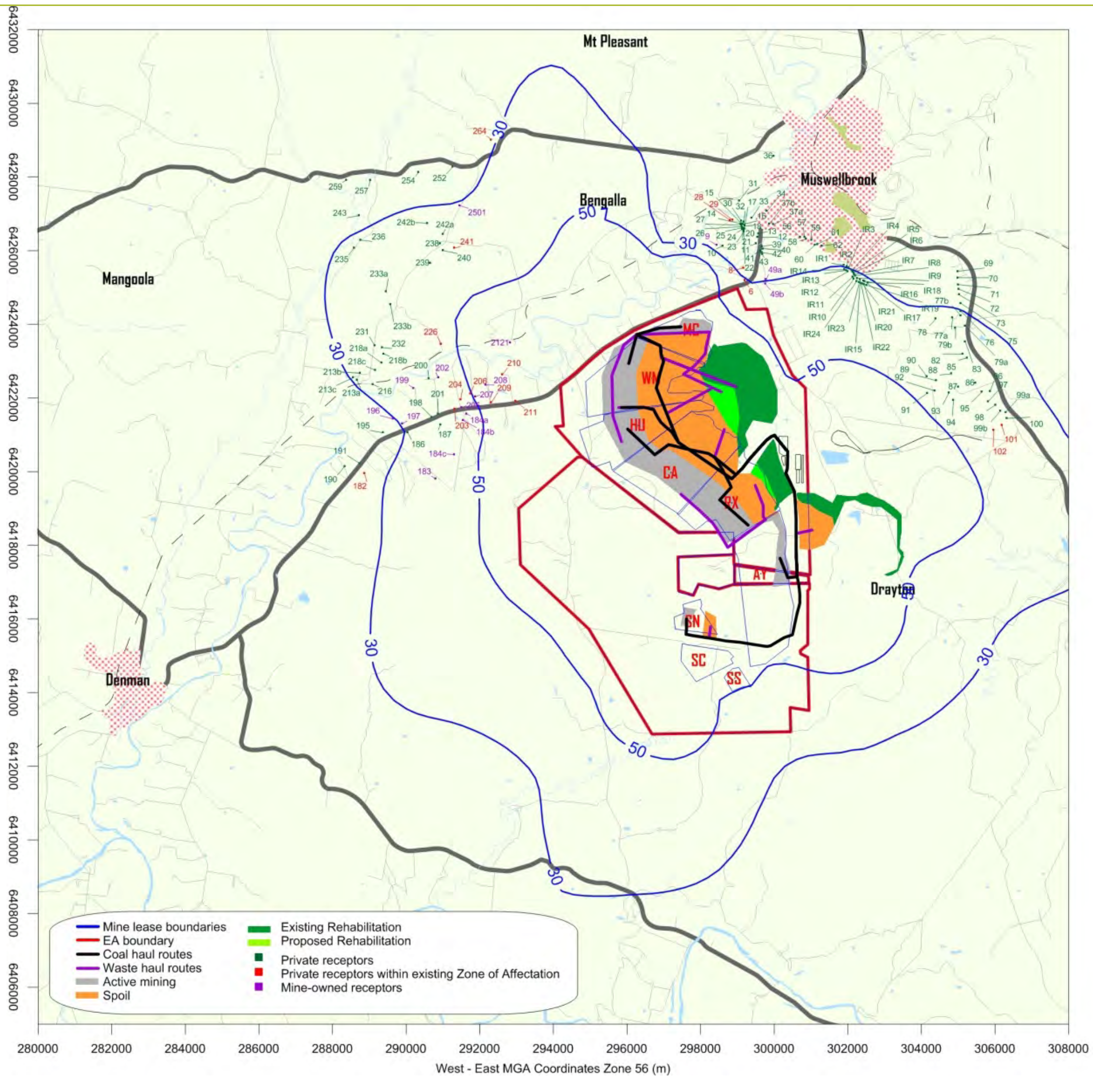
Table D.3: 2026 Emissions Inventory

ACTIVITY	TSP emission/year for 2026 in kg	Intensity	units	Emission factor	units	Variable 1	units	Variable 2	units	Variable 3	units	Variable 4	units	Source type
OB - Stripping topsoil - MC	-	0	h/y	14.0	kg/h									1
OB - Stripping topsoil - WM	2,106	150	h/y	14.0	kg/h									1
OB - Stripping topsoil - HU	1,178	84	h/y	14.0	kg/h									1
OB - Stripping topsoil - CA	2,508	179	h/y	14.0	kg/h									1
OB - Stripping topsoil - RX	2,814	201	h/y	14.0	kg/h									1
OB - Stripping topsoil - AY	-	0	h/y	14.0	kg/h									1
OB - Drilling - MC	-	0	holes/y	0.59	kg/hole							70	% control	1
OB - Drilling - WM	5,807	32,805	holes/y	0.59	kg/hole							70	% control	1
OB - Drilling - HU	6,723	37,982	holes/y	0.59	kg/hole							70	% control	1
OB - Drilling - CA	10,506	59,355	holes/y	0.59	kg/hole							70	% control	1
OB - Drilling - RX	14,067	79,477	holes/y	0.59	kg/hole							70	% control	1
OB - Drilling - AY	179	1,012	holes/y	0.59	kg/hole							70	% control	1
OB - Drilling - S	448	2,530	holes/y	0.59	kg/hole							70	% control	1
OB - Blasting - MC	-	0	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Blasting - WM	68,826	63	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Blasting - HU	79,688	73	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Blasting - CA	124,528	115	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Blasting - RX	166,745	153	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Blasting - AY	2,123	2	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Blasting - S	5,307	5	blasts/y	1086	kg/blast	29000	Area of blast in square metres							1
OB - Sh/Ex/FELs loading - MC	-	0	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Sh/Ex/FELs loading - WM	138,285	66,135,303	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Sh/Ex/FELs loading - HU	160,108	76,572,324	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Sh/Ex/FELs loading - CA	250,201	119,659,408	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Sh/Ex/FELs loading - RX	335,024	160,226,425	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Sh/Ex/FELs loading - AY	4,265	2,039,722	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Sh/Ex/FELs loading - S	10,664	5,100,000	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Hauling to emplacement - MC	-	0	t/y	0.00000	kg/t	296	t/truck load	0.0	km/return trip	0.6	kg/VKT	85	% control	1
OB - Hauling to emplacement - WM	877,223	66,135,303	t/y	0.01326	kg/t	296	t/truck load	6.5	km/return trip	0.6	kg/VKT	85	% control	1
OB - Hauling to emplacement - HU	1,186,082	76,572,324	t/y	0.01549	kg/t	296	t/truck load	7.6	km/return trip	0.6	kg/VKT	85	% control	1
OB - Hauling to emplacement - CA	1,829,032	119,659,408	t/y	0.01529	kg/t	296	t/truck load	7.5	km/return trip	0.6	kg/VKT	85	% control	1
OB - Hauling to emplacement - RX	1,997,928	160,226,425	t/y	0.01247	kg/t	296	t/truck load	6.1	km/return trip	0.6	kg/VKT	85	% control	1
OB - Hauling to emplacement - AY	26,187	2,039,722	t/y	0.01284	kg/t	296	t/truck load	6.3	km/return trip	0.6	kg/VKT	85	% control	1
OB - Hauling to emplacement - S	42,953	5,100,000	t/y	0.00842	kg/t	296	t/truck load	4.2	km/return trip	0.6	kg/VKT	85	% control	1
OB - Emplacing at dumps - MC	-	0	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Emplacing at dumps - WM	138,285	66,135,303	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Emplacing at dumps - HU	160,108	76,572,324	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Emplacing at dumps - CA	250,201	119,659,408	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Emplacing at dumps - RX	335,024	160,226,425	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Emplacing at dumps - AY	4,265	2,039,722	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Emplacing at dumps - S	10,664	5,100,000	t/y	0.00209	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/	2	moisture content in %					2
OB - Dozers on O/B - MC	-	0	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on O/B - WM	153,394	9,166	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on O/B - HU	177,601	10,612	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on O/B - CA	277,537	16,584	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on O/B - RX	371,628	22,206	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on O/B - AY	4,731	283	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on O/B - S	11,829	707	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
OB - Dozers on Rehabilitation - total	457,722	27,351	h/y	16.7	kg/h	10	silt content in %	2	moisture content in %					1
CL - Dozers ripping - MC	-	0	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Dozers ripping - WM	17,530	3,748	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Dozers ripping - HU	16,142	3,451	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Dozers ripping - CA	27,872	5,959	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Dozers ripping - RX	37,477	8,013	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Dozers ripping - AY	6,370	1,362	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Dozers ripping - S	1,389	297	h/y	13.4	kg/h	5	silt content in %	8	moisture content in %					1
CL - Loading ROM to trucks - MC	-	0	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Loading ROM to trucks - WM	254,593	5,322,622	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Loading ROM to trucks - HU	229,594	4,800,000	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Loading ROM to trucks - CA	400,004	8,362,661	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Loading ROM to trucks - RX	539,514	11,279,305	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Loading ROM to trucks - AY	87,732	1,834,173	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Loading ROM to trucks - S	19,133	400,000	t/y	0.04783	kg/t	8	moisture content of coal in %							1
CL - Hauling ROM coal to dump hopper - MC	-	0	t/y	0.00000	kg/t	150	t/load	0.0	km/return trip	0.6	kg/VKT	85	% control	1
CL - Hauling ROM coal to dump hopper - WM	382,377	5,322,622	t/y	0.07184	kg/t	150	t/load	18.0	km/return trip	0.6	kg/VKT	85	% control	1
CL - Hauling ROM coal to dump hopper - HU	288,768	4,800,000	t/y	0.06016	kg/t	150	t/load	15.0	km/return trip	0.6	kg/VKT	85	% control	1
CL - Hauling ROM coal to dump hopper - CA	442,887	8,362,661	t/y	0.05296	kg/t	150	t/load	13.2	km/return trip	0.6	kg/VKT	85	% control	1
CL - Hauling ROM coal to dump hopper - RX	606,375	11,279,305	t/y	0.05376	kg/t	150	t/load	13.4	km/return trip	0.6	kg/VKT	85	% control	1
CL - Hauling ROM coal to dump hopper - AY	102,068	1,834,173	t/y	0.05565	kg/t	150	t/load	13.9	km/return trip	0.6	kg/VKT	85	% control	1
CL - Hauling ROM coal to dump hopper - S	28,696	400,000	t/y	0.07174	kg/t	150	t/load	17.9	km/return trip	0.6	kg/VKT	85	% control	1
CL - unloading ROM coal at stockpile/hopper - MC	-	0	t/y	0.04783	kg/t							70	% control	1
CL - unloading ROM coal at stockpile/hopper - WM	76,378	5,322,622	t/y	0.04783	kg/t							70	% control	1
CL - unloading ROM coal at stockpile/hopper - HU	68,878	4,800,000	t/y	0.04783	kg/t							70	% control	1
CL - unloading ROM coal at stockpile/hopper - CA	120,001	8,362,661	t/y	0.04783	kg/t							70	% control	1
CL - unloading ROM coal at stockpile/hopper - RX	161,854	11,279,305	t/y	0.04783	kg/t							70	% control	1
CL - unloading ROM coal at stockpile/hopper - AY	26,320	1,834,173	t/y	0.04783	kg/t							70	% control	1
CL - unloading ROM coal at stockpile/hopper - S	5,740	400,000	t/y	0.04783	kg/t							70	% control	1
CL - Rehandle ROM coal at stockpilepile/hopper	168,363	3,519,864	t/y	0.04783	kg/t									1
CL - Handling coal at CHPP	9,607	32,000,000	t/y	0.00030	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/s	8	moisture content of coal in %					2
CL - Dozers at CHPP	156,725	15,330	h/y	10.2	kg/h	4	silt content in %	8	moisture content in %					1
CL - Transporting rejects	167,874	5,828,957	t/y	0.02880	kg/t	150	t/load	7.2	km/return trip	0.6	kg/VKT	85.0	% control	1
CL - Loading product coal stockpile	6,186	28,158,911	t/y	0.00022	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/s	10	moisture content of coal in %					2
CL - Loading coal to trains	6,186	28,158,911	t/y	0.00022	kg/t	1.766	average of (wind speed/2.2)^1.3 in m/s	10	moisture content of coal in %					2
WE - OB spoil area - All pits	5,967,686	1165	ha	6024.9	kg/ha/y	101	Average number of raindays	10	silt content in %	17.4	% of winds above 5.4 m/s			3
WE - Open pit - All pits	4,118,014	684	ha	6024.9	kg/ha/y	101	Average number of raindays	10	silt content in %	17.4	% of winds above 5.4 m/s			3
WE - Active rehab	4,010,168	666	ha	6024.9	kg/ha/y	101	Average number of raindays	10	silt content in %	17.4	% of winds above 5.4 m/s			3
WE - ROM stockpiles	36,149	12	ha	6024.9	kg/ha/y	101	Average number of raindays	10	silt content in %	17.4	% of winds above 5.4 m/s	50	% control	3
WE - Product stockpiles	11,086	5	ha	2410.0	kg/ha/y	101	Average number of raindays	4	silt content in %	17.4	% of winds above 5.4 m/s			3
Grading roads	73,856	120,000	km	0.61547	kg/VKT	8	speed of graders in km/h							1
Underground_ROM/crushing stockpile area	360,000	4,000,000	t/y	0.09	kg/t									1
Underground_CHPP area	360,000	4,000,000	t/y	0.09	kg/t									1
TOTAL (O/C)	28,384,088													
ROM coal production (O/C)	32,000,000													
ROM: dust Ratio (O/C)	0.887													

MC= Macleans Hill
WM = Windmill
HU = Huon
AY = Ayredale
S = Saddlers
CA = Calool

OB = overburden
CL = coal
WE = wind erosion
ROM = run-of-mine
CHPP = coal handling and preparation plant
RX - Roxburgh

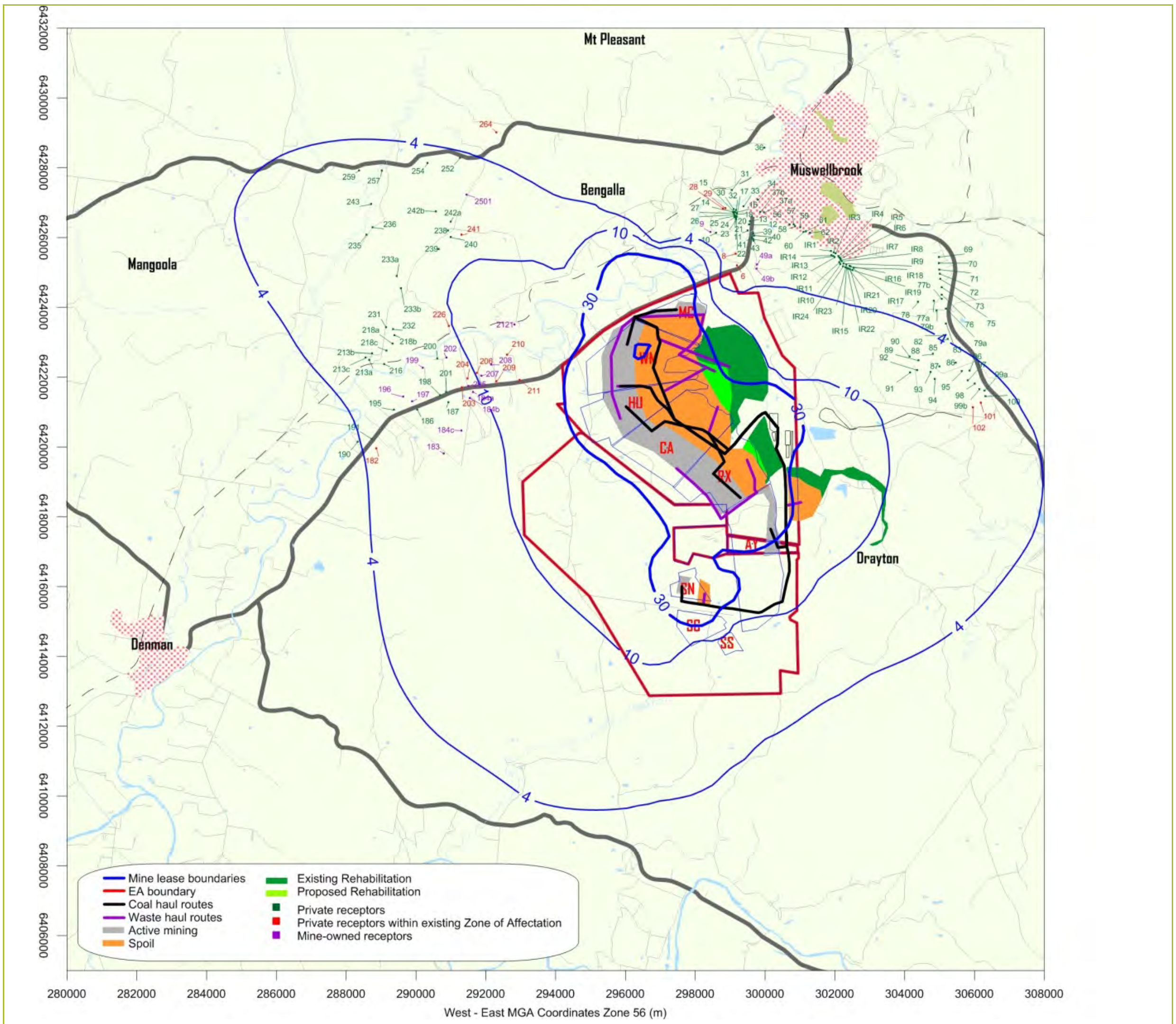
Appendix E: Contour Plots



Species:	Averaging Time:	Percentile:	Scenario:	Location:
PM_{10}	24-hour	Maximum	Mt Arthur Coal Mine 2016 Modification alone	Mt Arthur Coal Mine
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** N/A	**Met Data:** Macleans Hill 2007-2008	**Plot:** R Kan

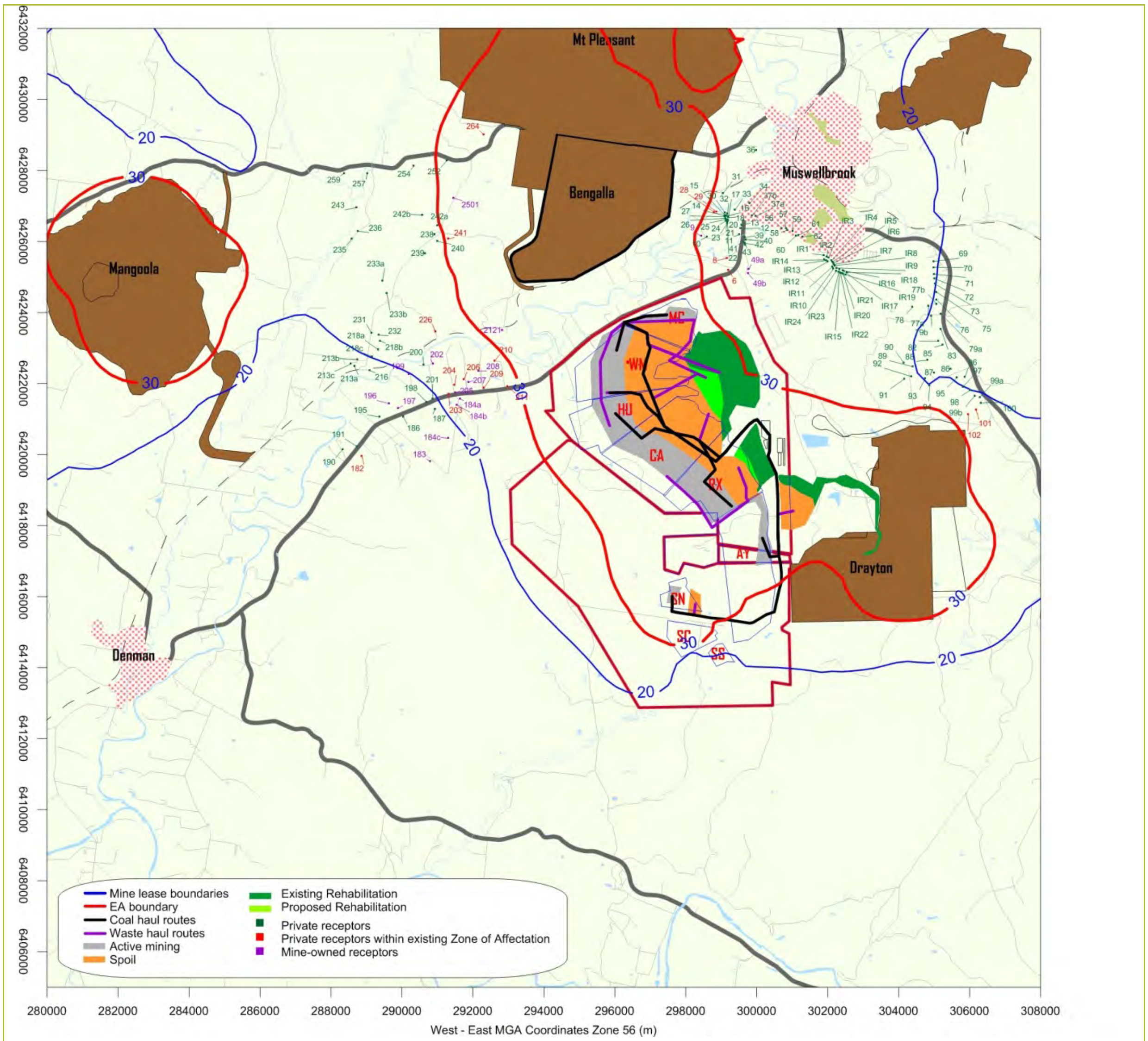
µg/m3 = micrograms per cubic metre

Figure E.1: Predicted 24-hour Average PM_{10} Concentrations due to Emissions from the Modification Alone -2016



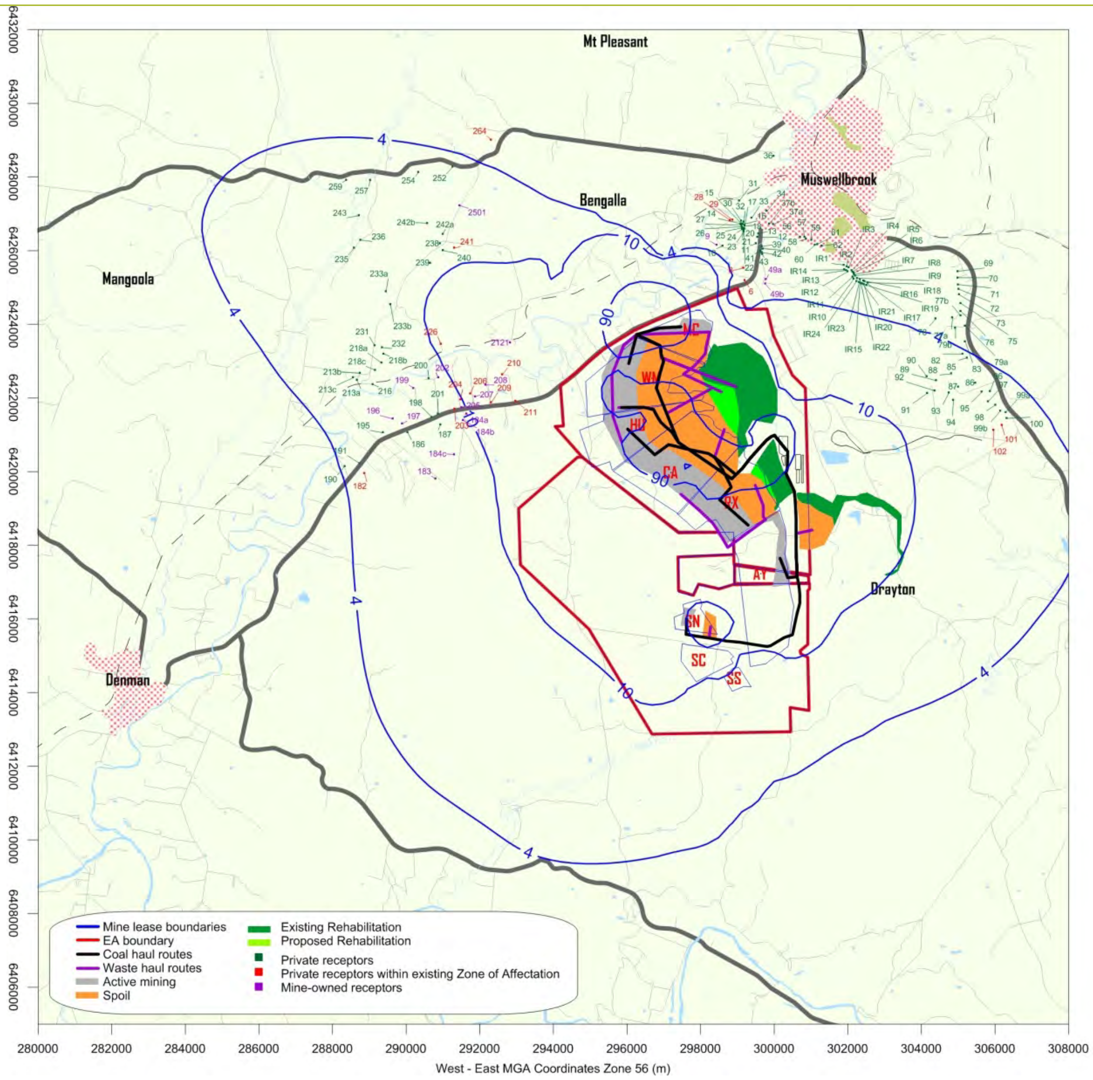
Species:	**Averaging Time:**	**Percentile:**	**Scenario:**	**Location:**
PM_{10}	Annual	Maximum	Mt Arthur Coal Mine 2016 Modification alone	Mt Arthur Coal Mine
Model Used: ISCMOD	**Units:** $\mu g/m^3$	**Assessment criteria:** N/A	**Met Data:** Macleans Hill 2007-2008	**Plot:** R Kan

Figure E.2: Predicted Annual Average PM_{10} Concentrations due to Emissions from the Modification Alone -2016



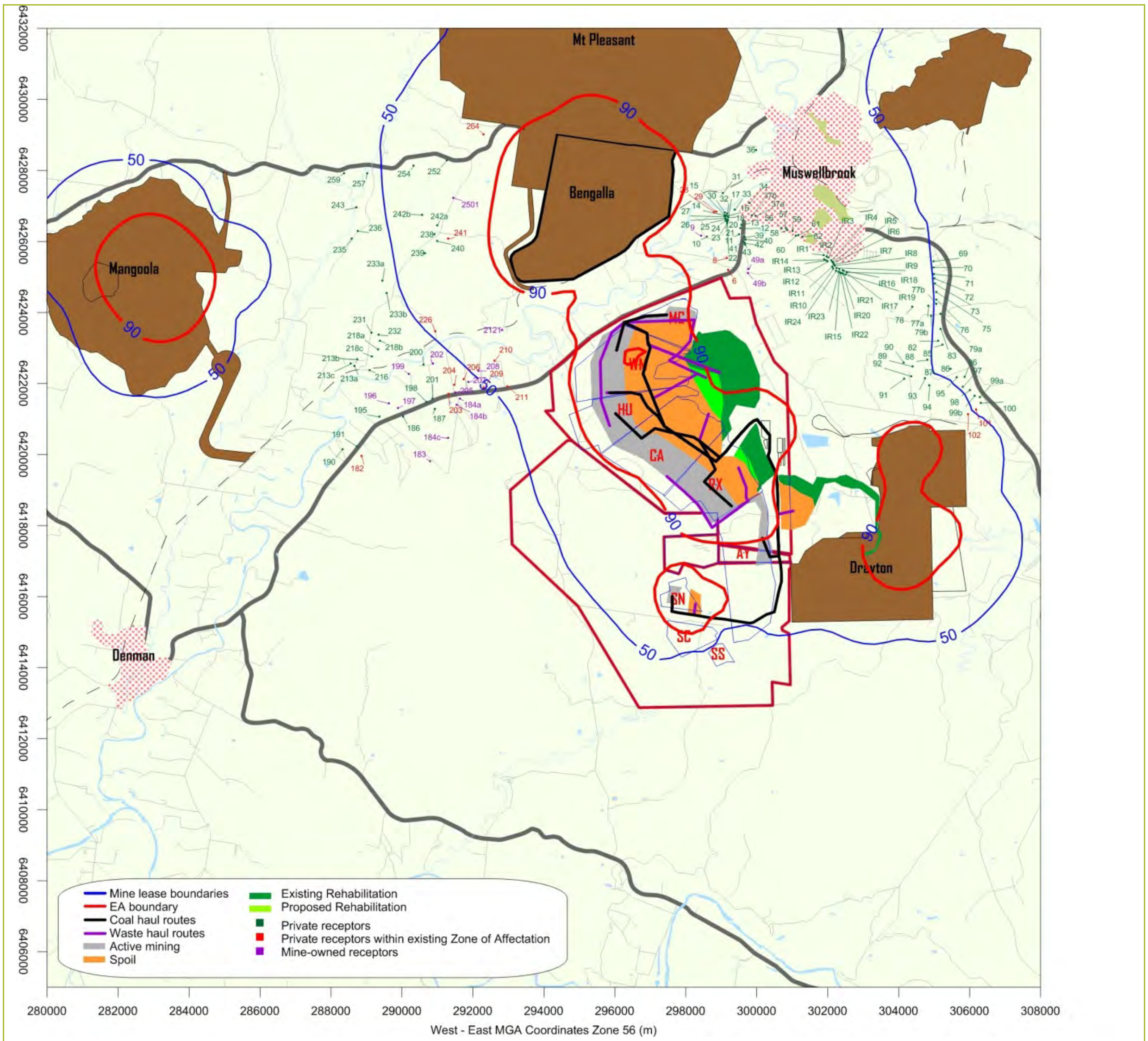
Species: PM$_{10}$	Averaging Time: Annual	Percentile: Maximum	Scenario: Mt Arthur Coal Mine 2016 Modification and other sources	Location: Mt Arthur Coal Mine
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** 30 µg/m^3	**Met Data:** Macleans Hill 2007-2008	**Plot:** R Kan

Figure E.3: Predicted Annual Average PM$_{10}$ Concentrations due to Emissions from the Modification and Other Sources -2016



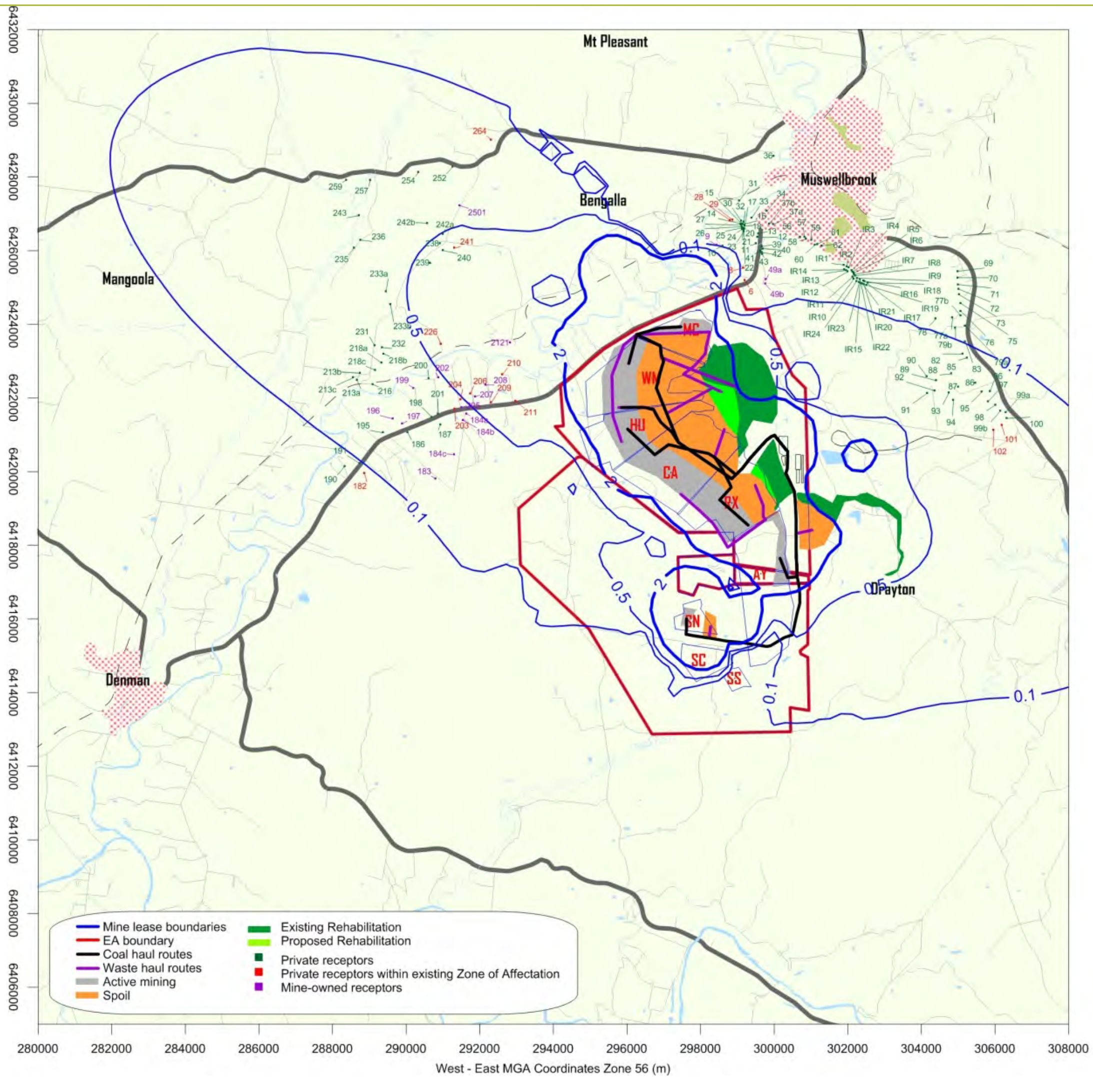
Species:	**Averaging Time:**	**Percentile:**	**Scenario:**	**Location:**
TSP	Annual	Maximum	Mt Arthur Coal Mine 2016 Modification alone	Mt Arthur Coal Mine
Model Used:	**Units:**	**Assessment criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m³	N/A	Macleans Hill 2007-2008	R Kan

Figure E.4: Predicted Annual Average TSP Concentrations due to Emissions from the Modification Alone - 2016



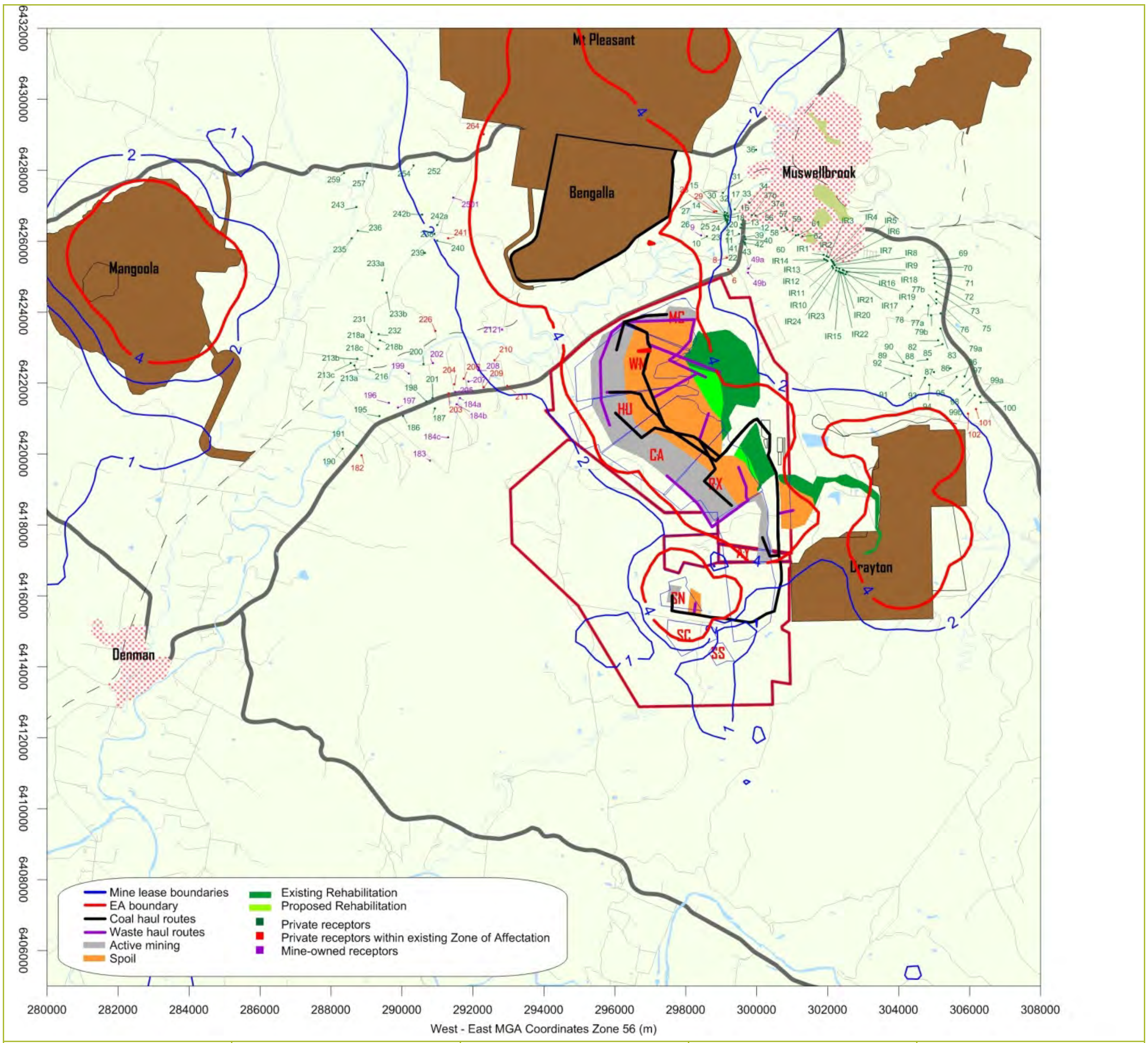
Species: TSP	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Mt Arthur Coal Mine 2016 Modification and other sources	**Location:** Mt Arthur Coal Mine
Model Used: ISCMOD	**Units:** µg/m³	**Assessment criteria:** 90 µg/m³	**Met Data:** Macleans Hill 2007-2008	**Plot:** R Kan

Figure E.5: Predicted Annual Average TSP Concentrations due to Emissions from the Modification and Other Sources - 2016



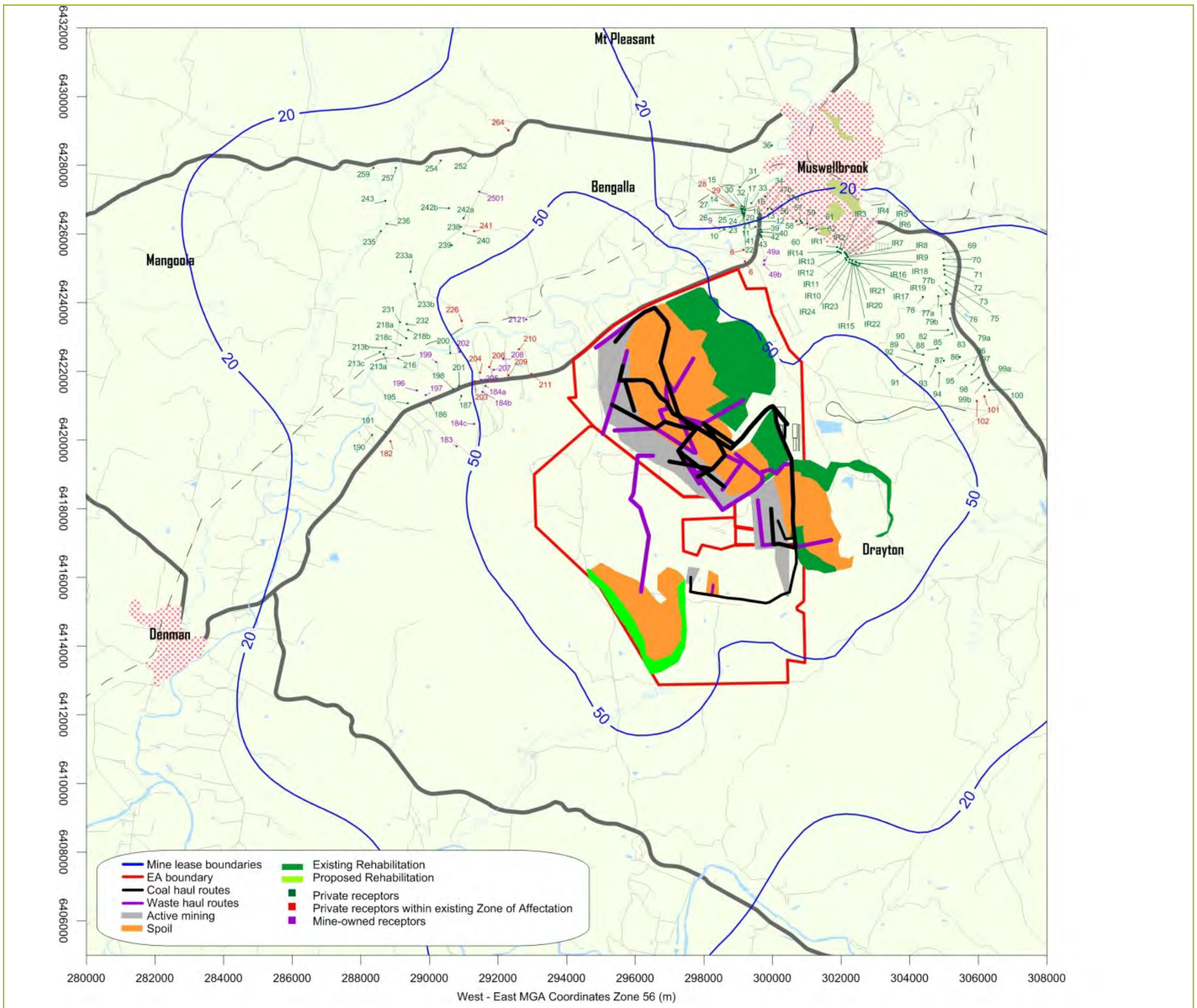
Species:	Averaging Time:	Percentile:	Scenario:	Location:
Dust Deposition	Annual	Maximum	Mt Arthur Coal Mine 2016 Modification alone	Mt Arthur Coal Mine
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** 2 g/m^2/month	**Met Data:** Macleans Hill 2007-2008	**Plot:** R Kan

Figure E.6: Predicted Annual Average Dust Deposition Levels due to Emissions from the Modification Alone -2016



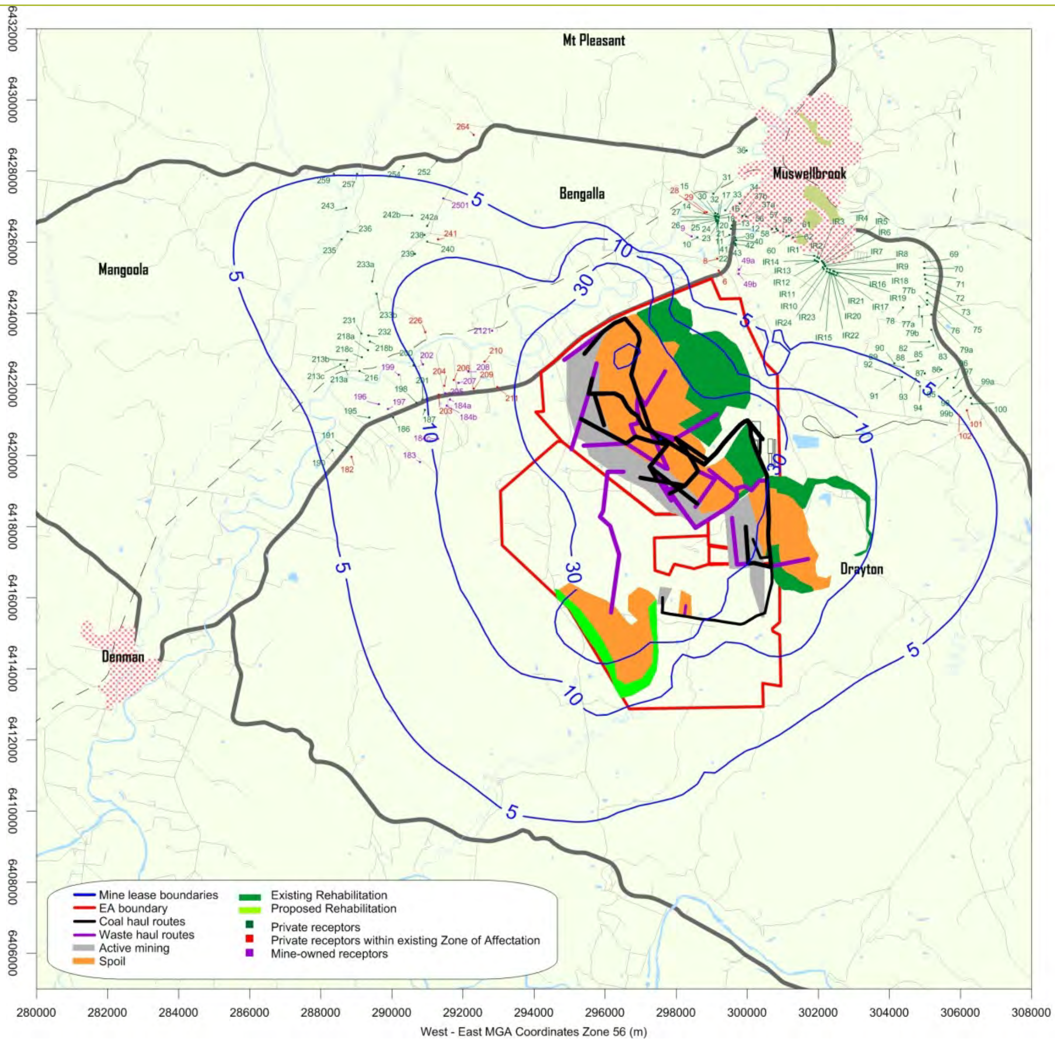
Species: Dust Deposition	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Mt Arthur Coal Mine 2016 Modification and other sources	**Location:** Mt Arthur Coal Mine
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** 4 g/m^2/month	**Met Data:** Macleans Hill 2007-2008	**Plot:** R Kan

Figure E.7: Predicted Annual Average Dust Deposition Levels due to Emissions from the Modification and Other Sources -2016



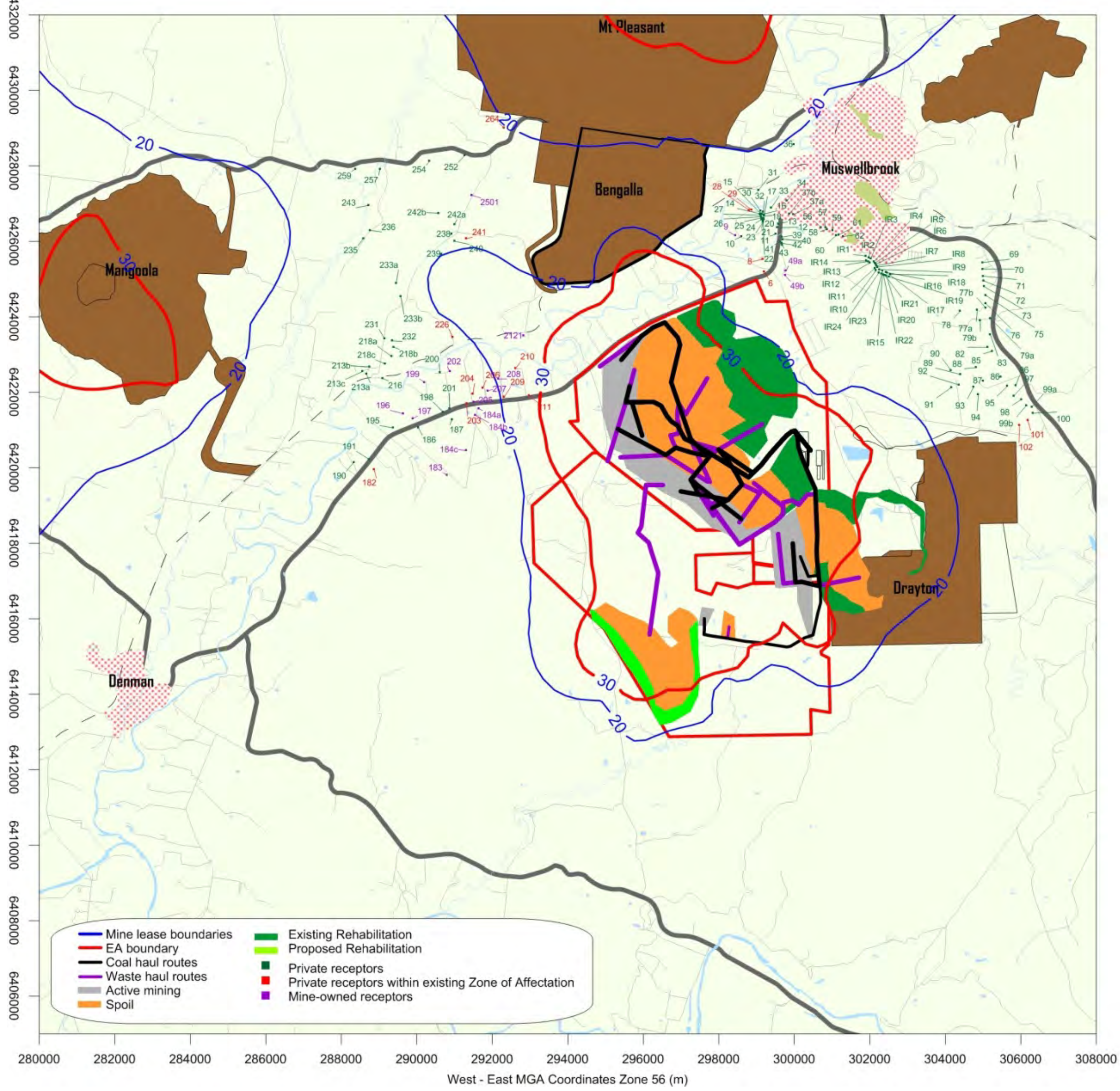
Species: PM_{10}	**Averaging Time:** 24-hour	**Percentile:** Maximum	**Scenario:** Mt Arthur Coal Mine 2022 Modification alone	**Location:** Mt Arthur Coal Mine
Model Used: ISCMOD	**Units:** $\mu g/m^3$	**Assessment criteria:** N/A	**Met Data:** Macleans Hill 2007-2008	**Plot:** K Dissanayake

Figure E.8: Predicted 24-hour Average PM_{10} Concentrations due to Emissions from the Modification Alone -2022



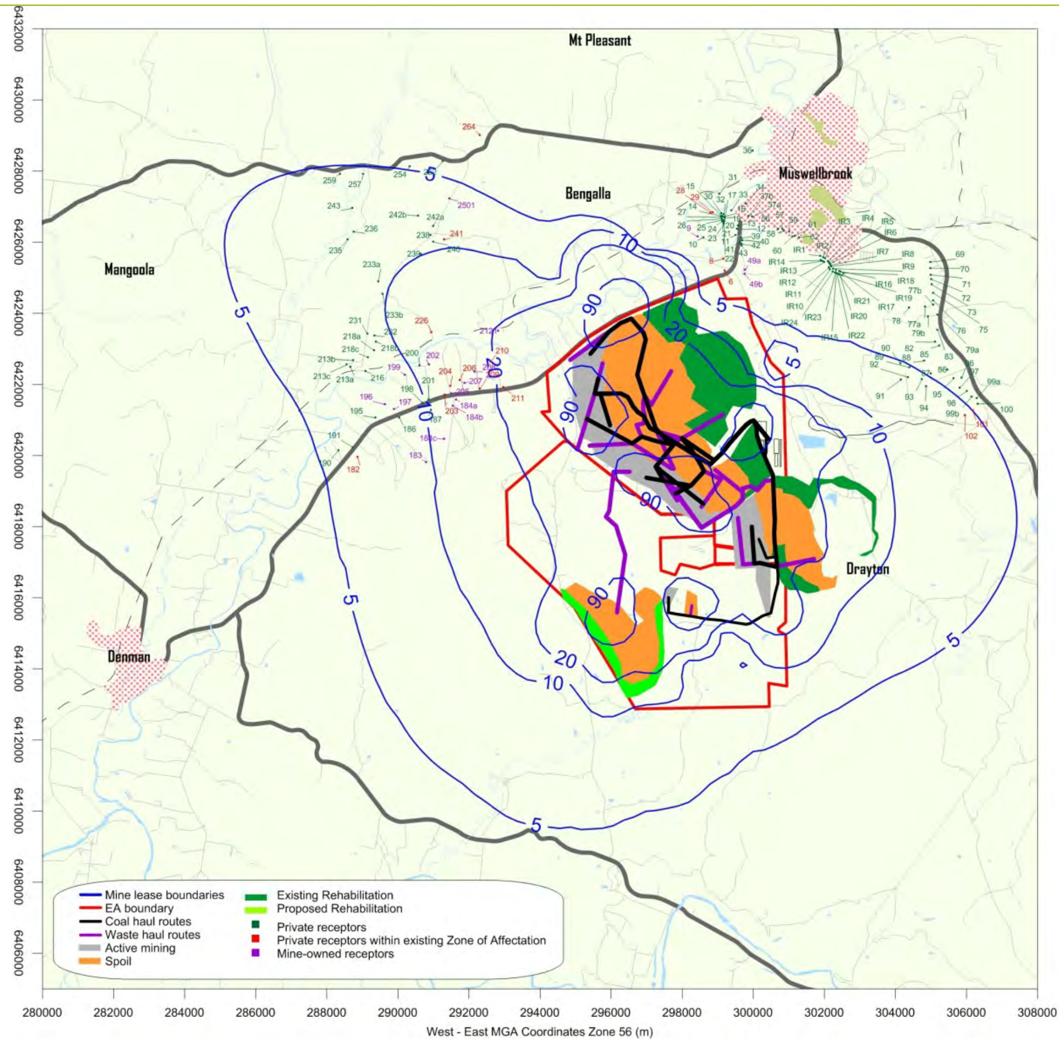
Species: PM_{10}	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Mt Arthur Coal Mine 2022 Modification alone	**Location:** Mt Arthur Coal Mine
Model Used: ISCMOD	**Units:** $\mu g/m^3$	**Assessment criteria:** N/A	**Met Data:** Macleans Hill 2007-2008	**Plot:** K Dissanayake

Figure E.9: Predicted Annual Average PM_{10} Concentrations due to Emissions from the Modification Alone -2022



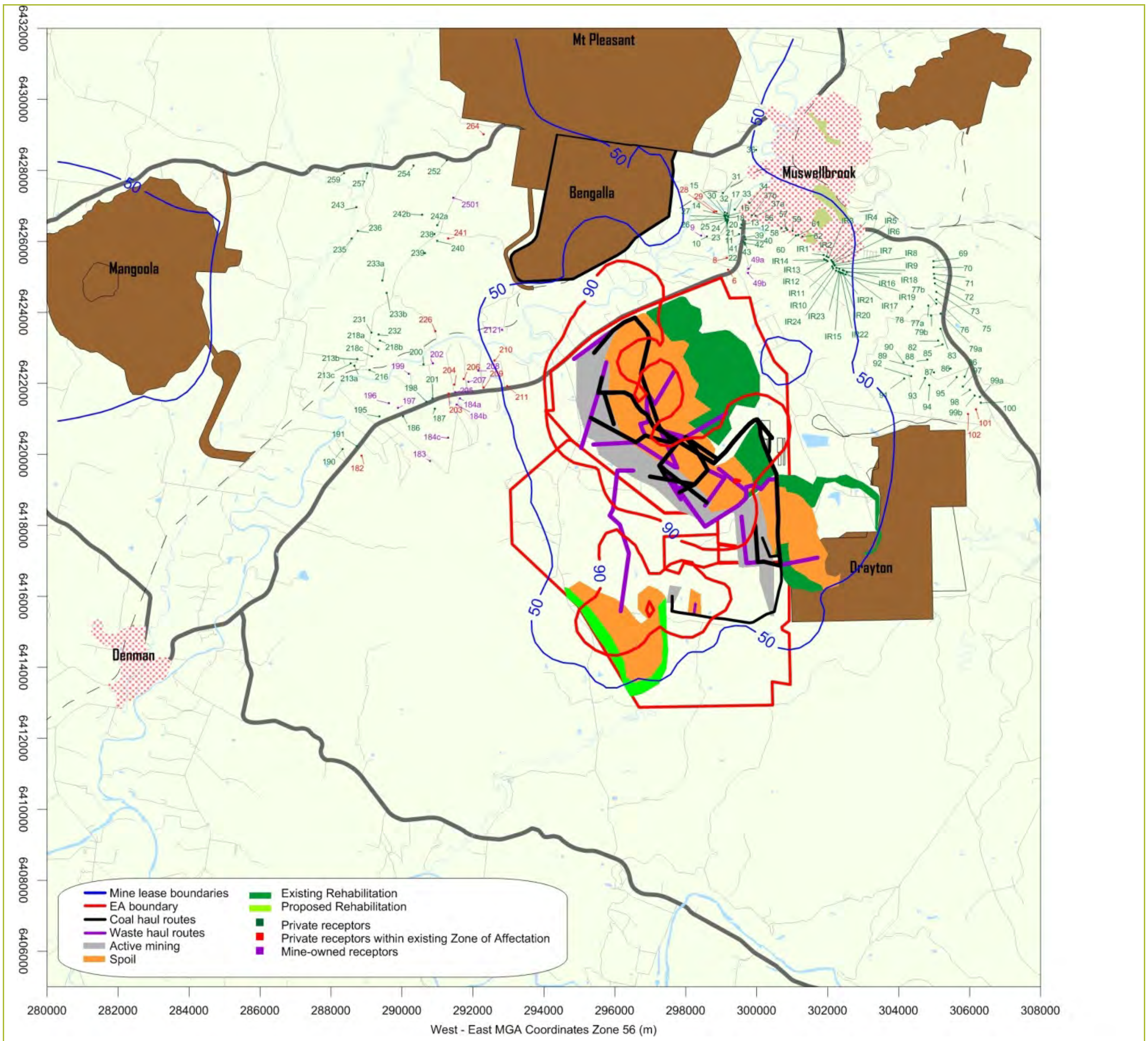
Species:	**Averaging Time:**	**Percentile:**	**Scenario:**	**Location:**
PM_{10}	Annual	Maximum	Mt Arthur Coal Mine 2022 Modification and other sources	Mt Arthur Coal Mine
Model Used:	**Units:**	**Assessment criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	30 µg/m^3	Macleans Hill 2007-2008	R Kan

Figure E.10: Predicted Annual Average PM_{10} Concentrations due to Emissions from the Modification and Other Sources -2022



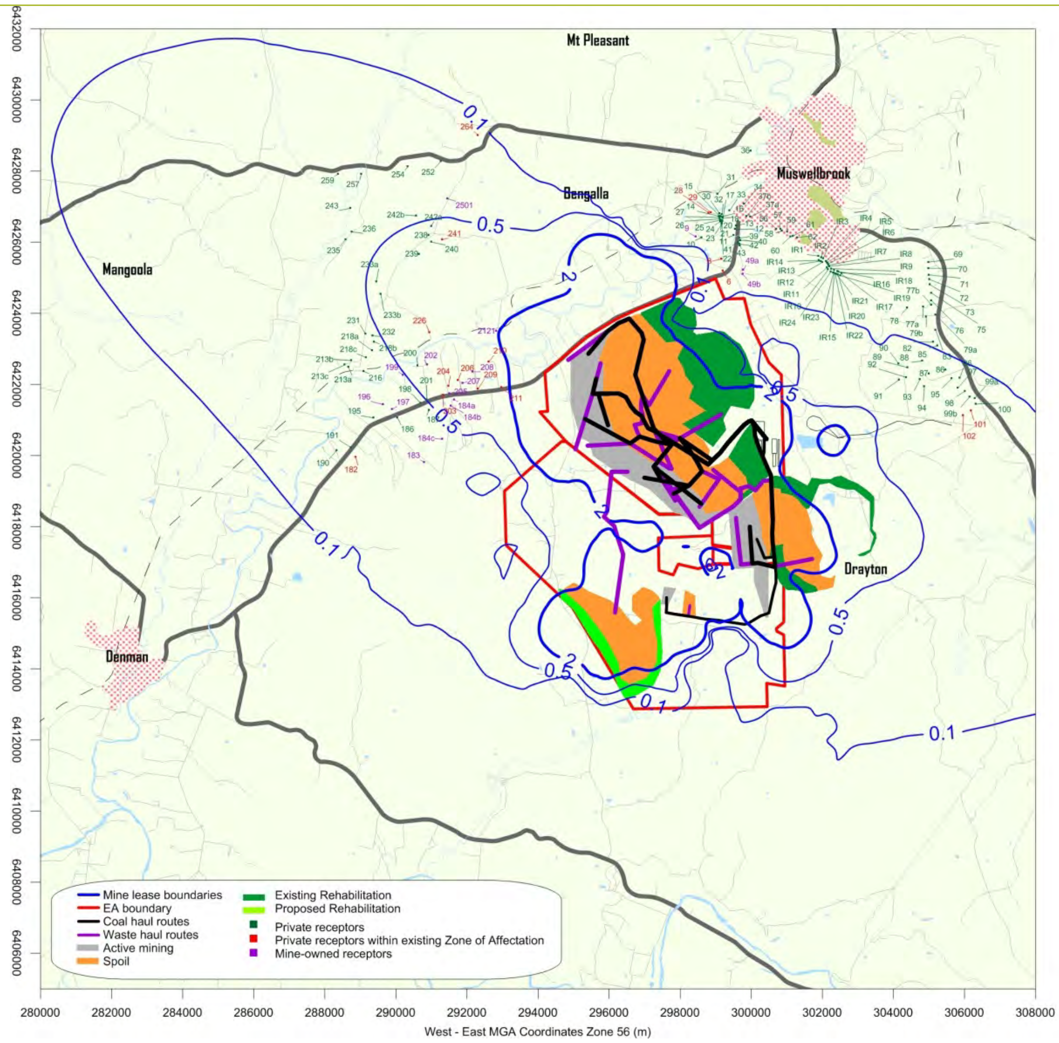
Species:	Averaging Time:	Percentile:	Scenario:	Location:
TSP	Annual	Maximum	Mt Arthur Coal Mine 2022 Modification alone	Mt Arthur Coal Mine
Model Used:	**Units:**	**Assessment criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	N/A	Macleans Hill 2007-2008	R Kan

Figure E.11: Predicted Annual Average TSP Concentrations due to Emissions from the Modification Alone – 2022



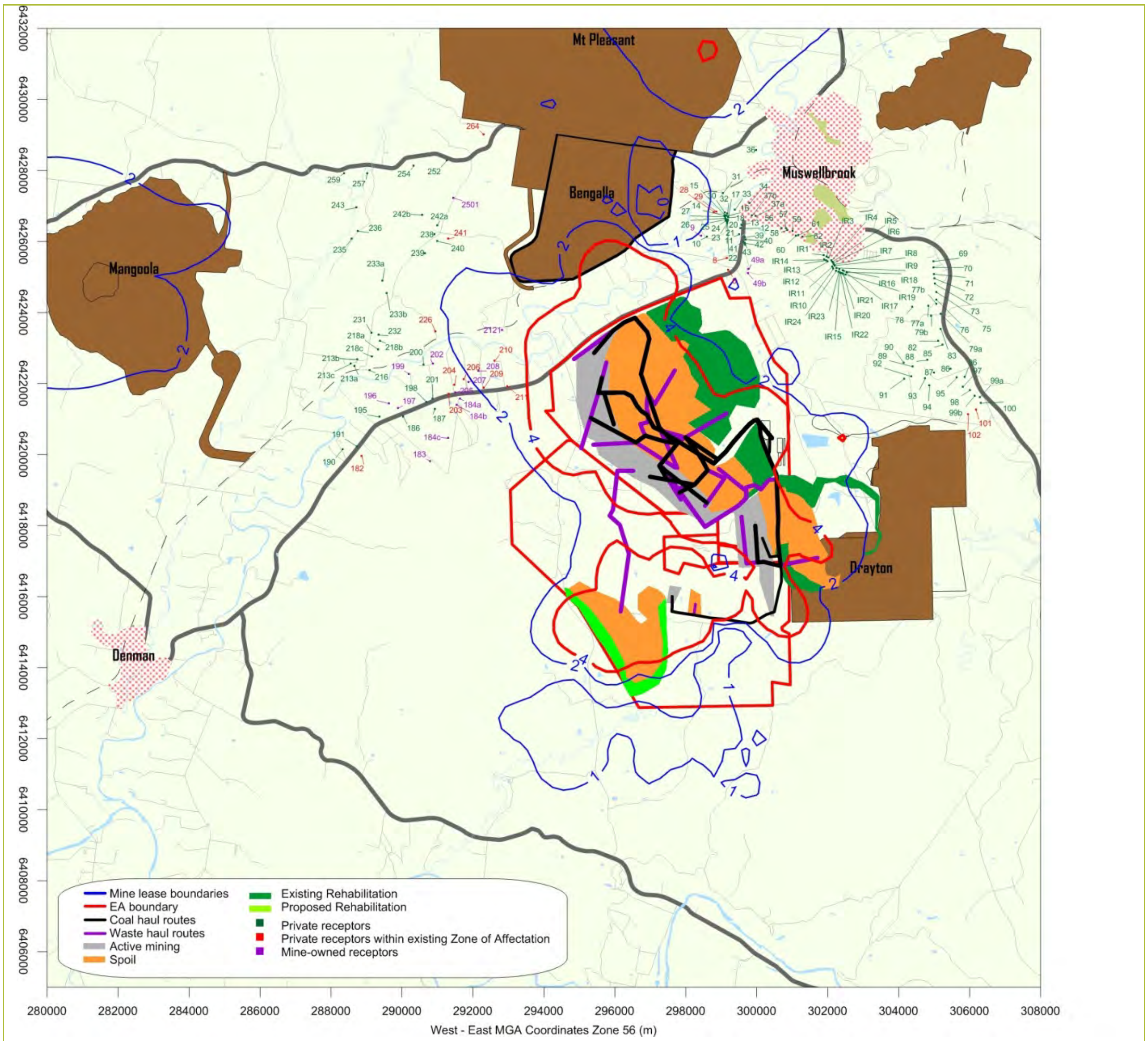
Species: TSP	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Mt Arthur Coal Mine 2022 Modification and other sources	**Location:** Mt Arthur Coal Mine
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** 90 µg/m^3	**Met Data:** Macleans Hill 2007-2008	**Plot:** R Kan

Figure E.12: Predicted Annual Average TSP Concentrations due to Emissions from the Modification and Other Sources - 2022



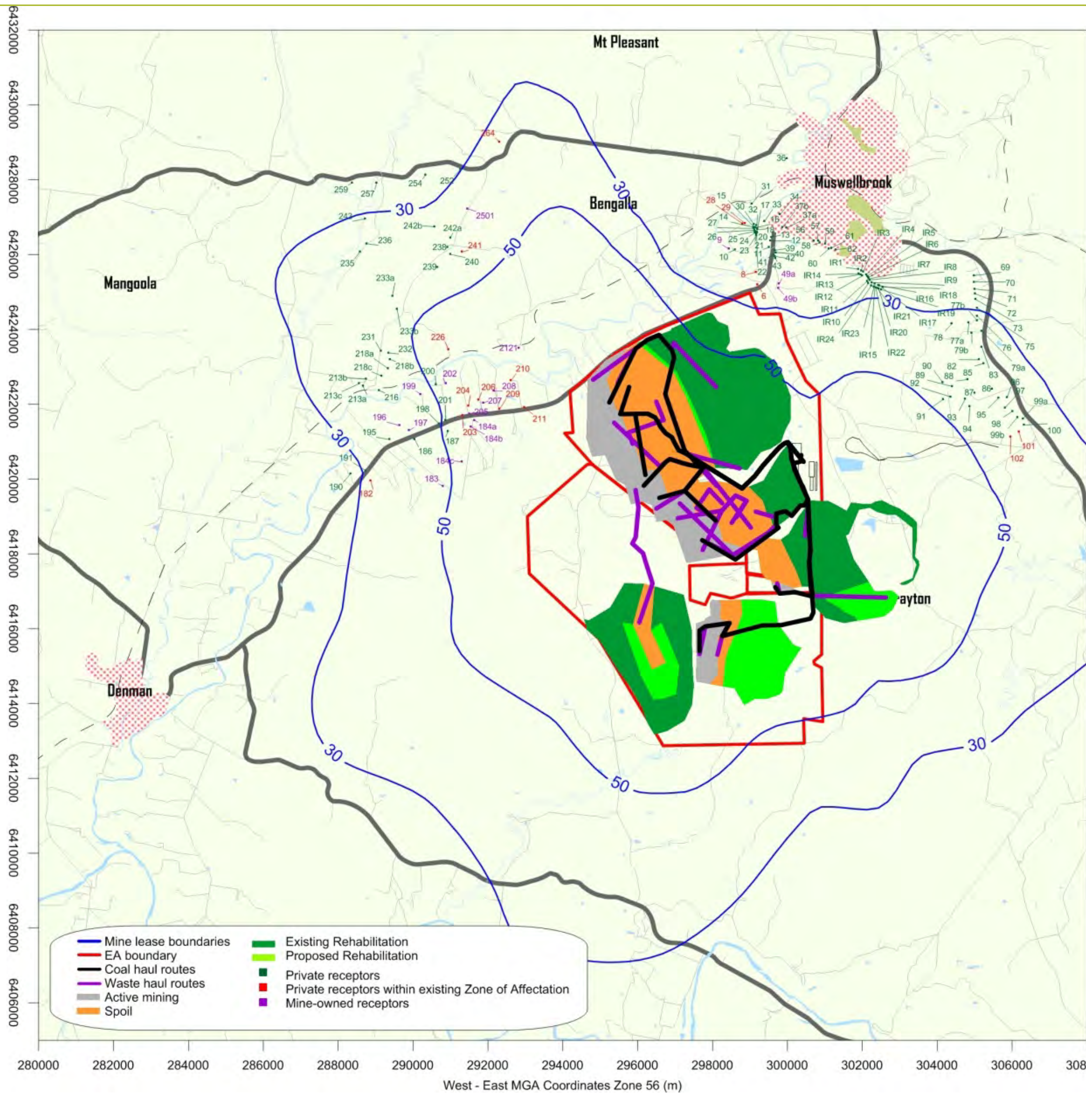
Species:	**Averaging Time:**	**Percentile:**	**Scenario:**	**Location:**
Dust Deposition	Annual	Maximum	Mt Arthur Coal Mine 2022 Modification alone	Mt Arthur Coal Mine
Model Used:	**Units:**	**Assessment criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	2 g/m^2/month	Macleans Hill 2007-2008	R Kan

Figure E.13: Predicted Annual Average Dust Deposition Levels due to Emissions from the Modification Alone -2022



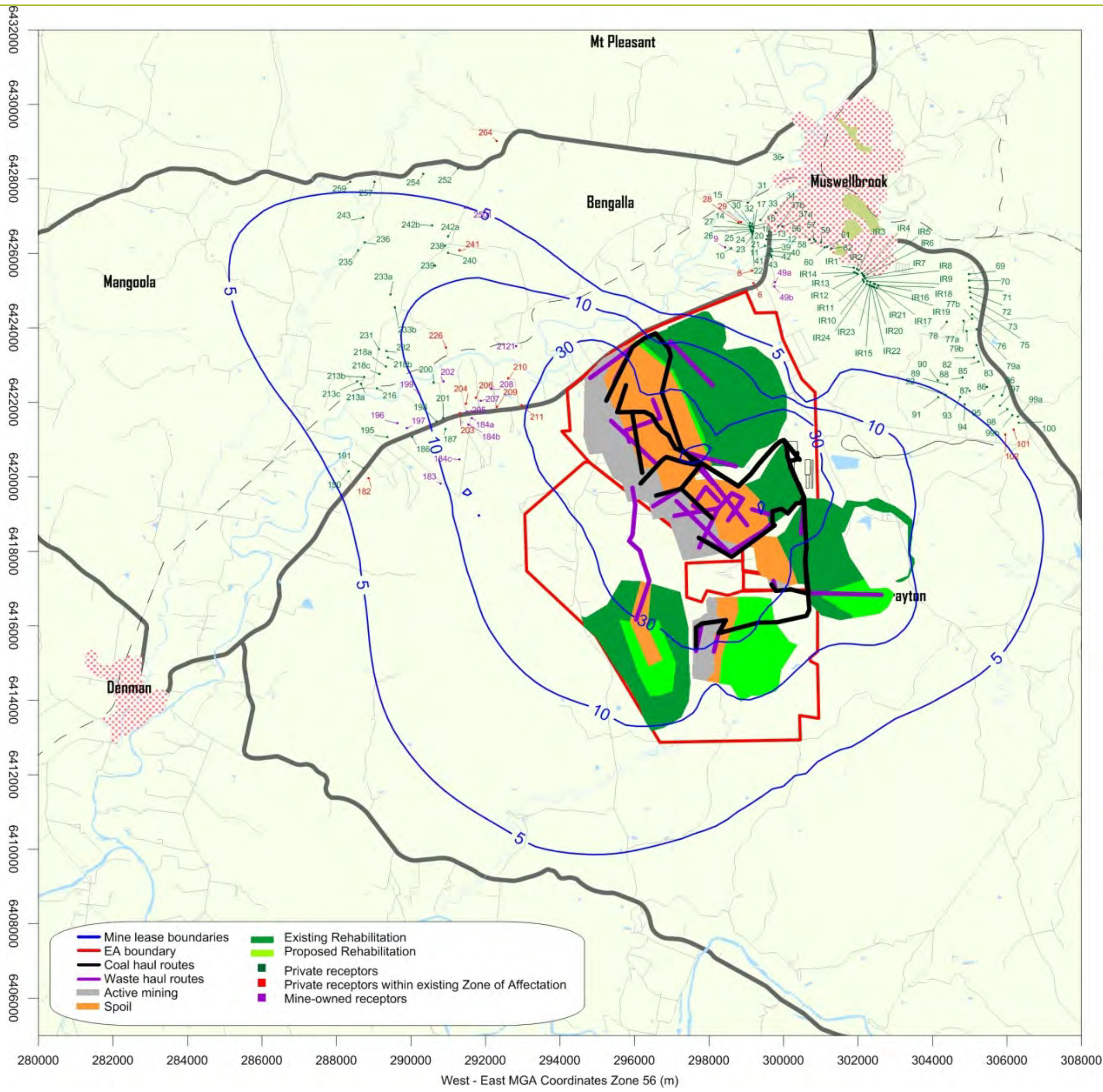
Species: Dust Deposition	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Mt Arthur Coal Mine 2022 Modification and other sources	**Location:** Mt Arthur Coal Mine
Model Used: ISCMOD	**Units:** $\mu g/m^3$	**Assessment criteria:** 4 g/m^2/month	**Met Data:** Macleans Hill 2007-2008	**Plot:** R Kan

Figure E.14: Predicted Annual Average Dust Deposition Levels due to Emissions from the Modification and Other Sources -2022



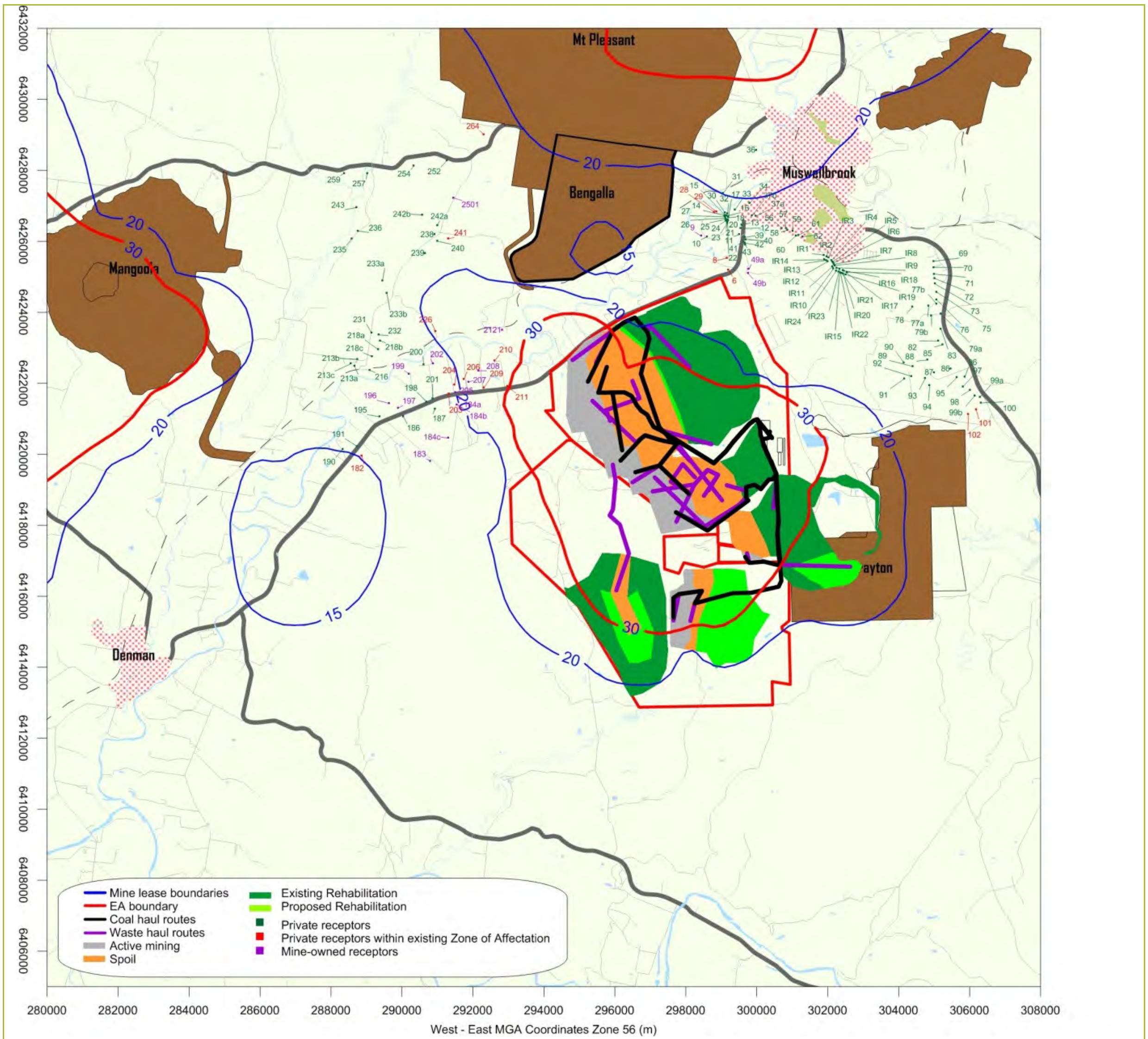
Species:	Averaging Time:	Percentile:	Scenario:	Location:
PM_{10}	24-hour	Maximum	Mt Arthur Coal Mine 2026 Modification alone	Mt Arthur Coal Mine
Model Used: ISCMOD	**Units:** µg/m³	**Assessment criteria:** N/A	**Met Data:** Macleans Hill 2007-2008	**Plot:** R Kan

Figure E.15: Predicted 24-hour Average PM_{10} Concentrations due to Emissions from the Modification Alone -2026



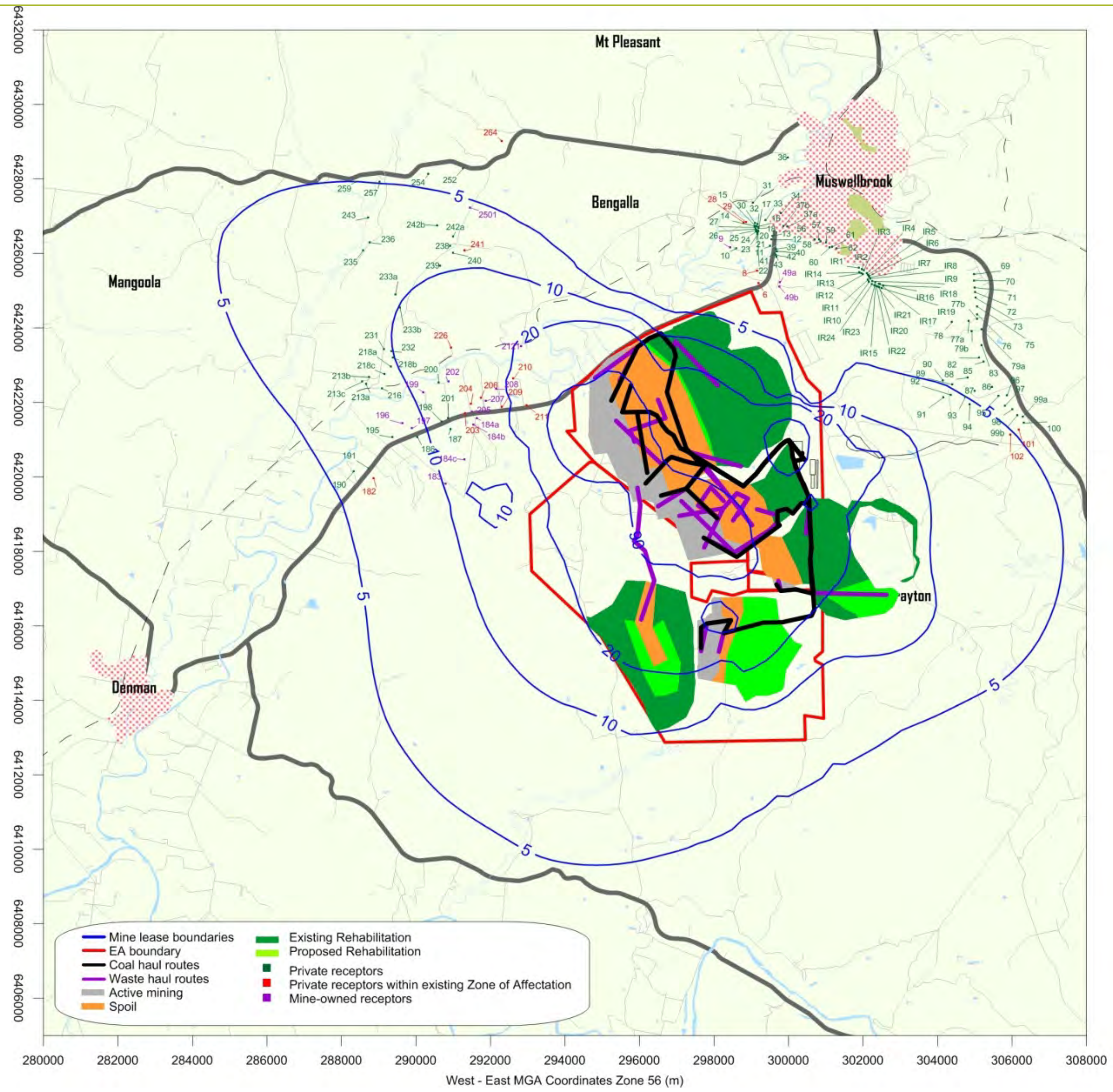
Species: PM_{10}	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Mt Arthur Coal Mine 2026 Modification alone	**Location:** Mt Arthur Coal Mine
Model Used: ISCMOD	**Units:** µg/m³	**Assessment criteria:** N/A	**Met Data:** Macleans Hill 2007-2008	**Plot:** R Kan

Figure E.16: Predicted Annual Average PM_{10} Concentrations due to Emissions from the Modification Alone -2026



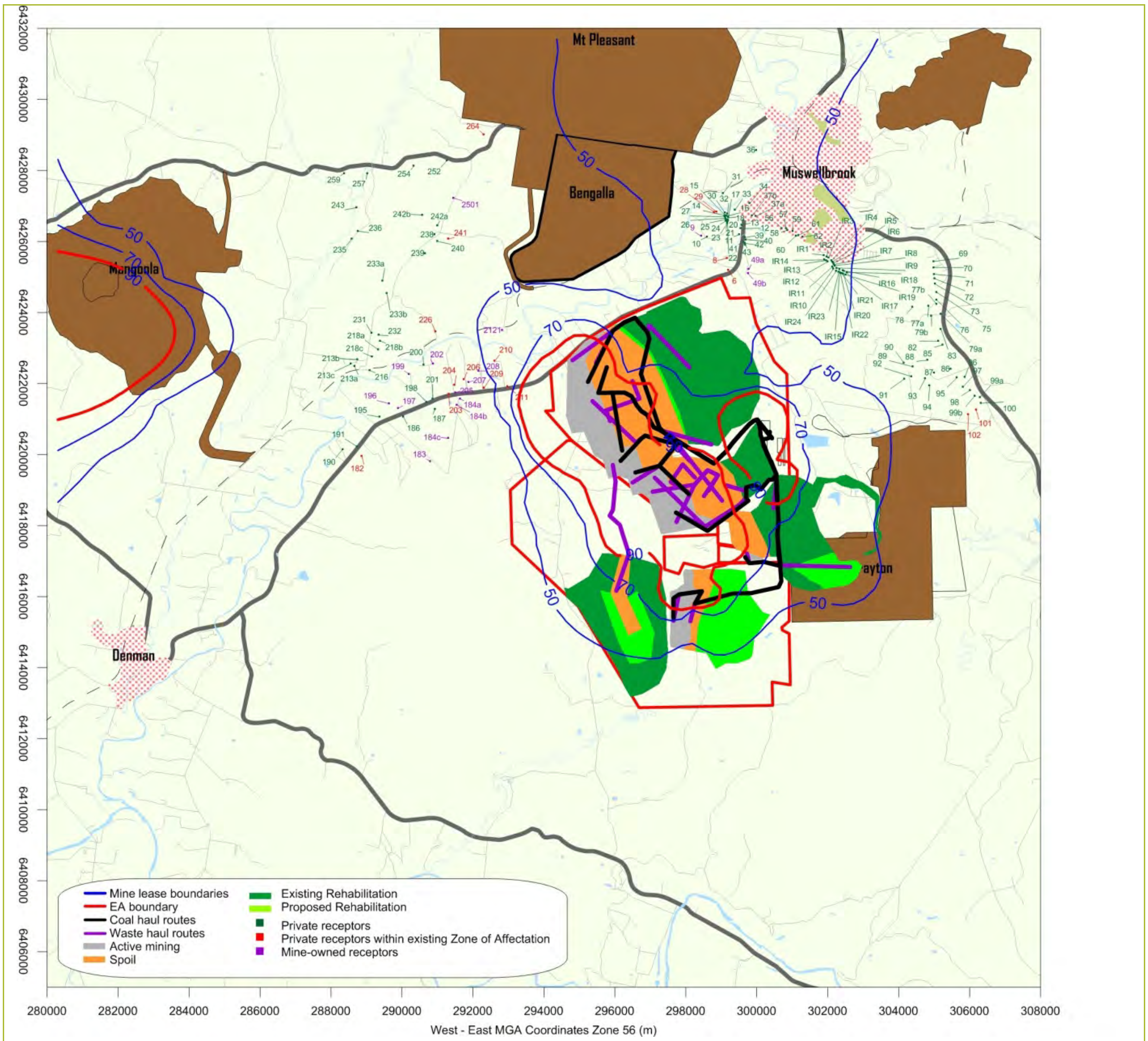
Species:	Averaging Time:	Percentile:	Scenario:	Location:
PM_{10}	Annual	Maximum	Mt Arthur Coal Mine 2026 Modification and other sources	Mt Arthur Coal Mine
Model Used:	**Units:**	**Assessment criteria:**	**Met Data:**	**Plot:**
ISCMOD	$\mu g/m^3$	30 $\mu g/m^3$	Macleans Hill 2007-2008	R Kan

Figure E.17: Predicted Annual Average PM_{10} Concentrations due to Emissions from the Modification and Other Sources -2026



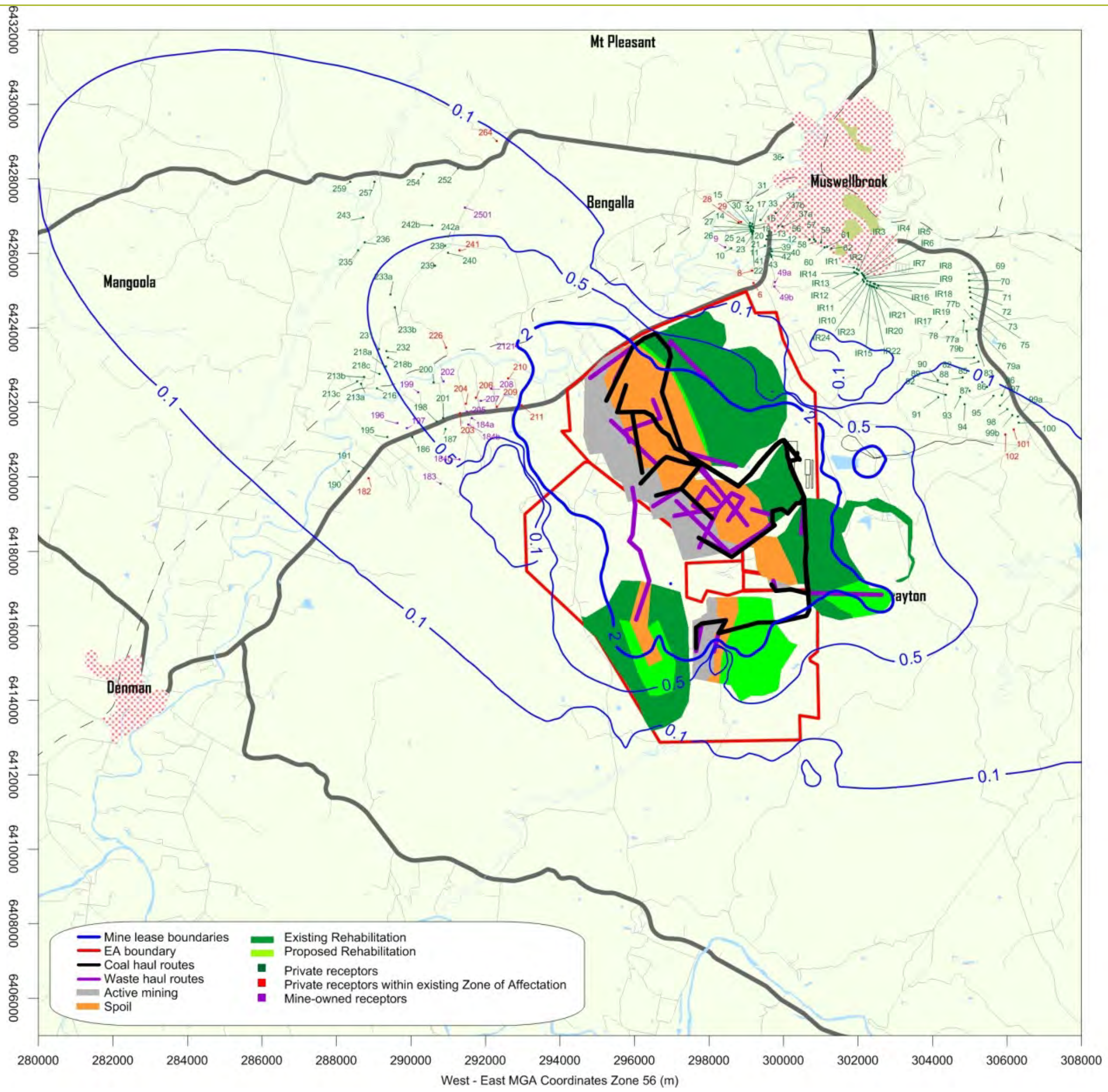
Species: TSP	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Mt Arthur Coal Mine 2026 Modification alone	**Location:** Mt Arthur Coal Mine
Model Used: ISCMOD	**Units:** µg/m³	**Assessment criteria:** N/A	**Met Data:** Macleans Hill 2007-2008	**Plot:** R Kan

Figure E.18: Predicted Annual Average TSP Concentrations due to Emissions from the Modification Alone - 2026



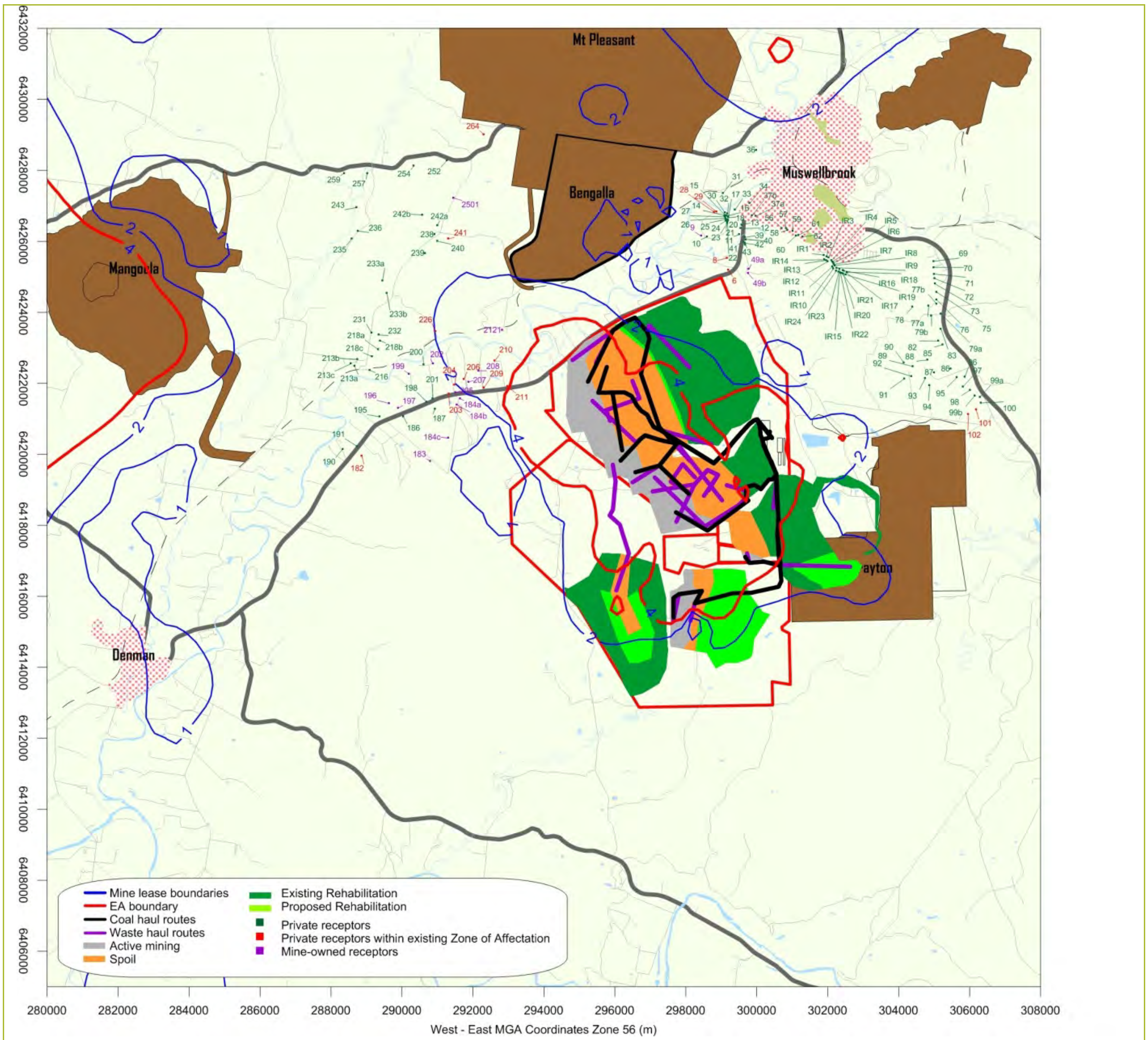
Species:	**Averaging Time:**	**Percentile:**	**Scenario:**	**Location:**
TSP	Annual	Maximum	Mt Arthur Coal Mine 2026 Modification and other sources	Mt Arthur Coal Mine
Model Used:	**Units:**	**Assessment criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	90 µg/m^3	Macleans Hill 2007-2008	R Kan

Figure E.19: Predicted Annual Average TSP Concentrations due to Emissions from the Modification and Other Sources - 2026



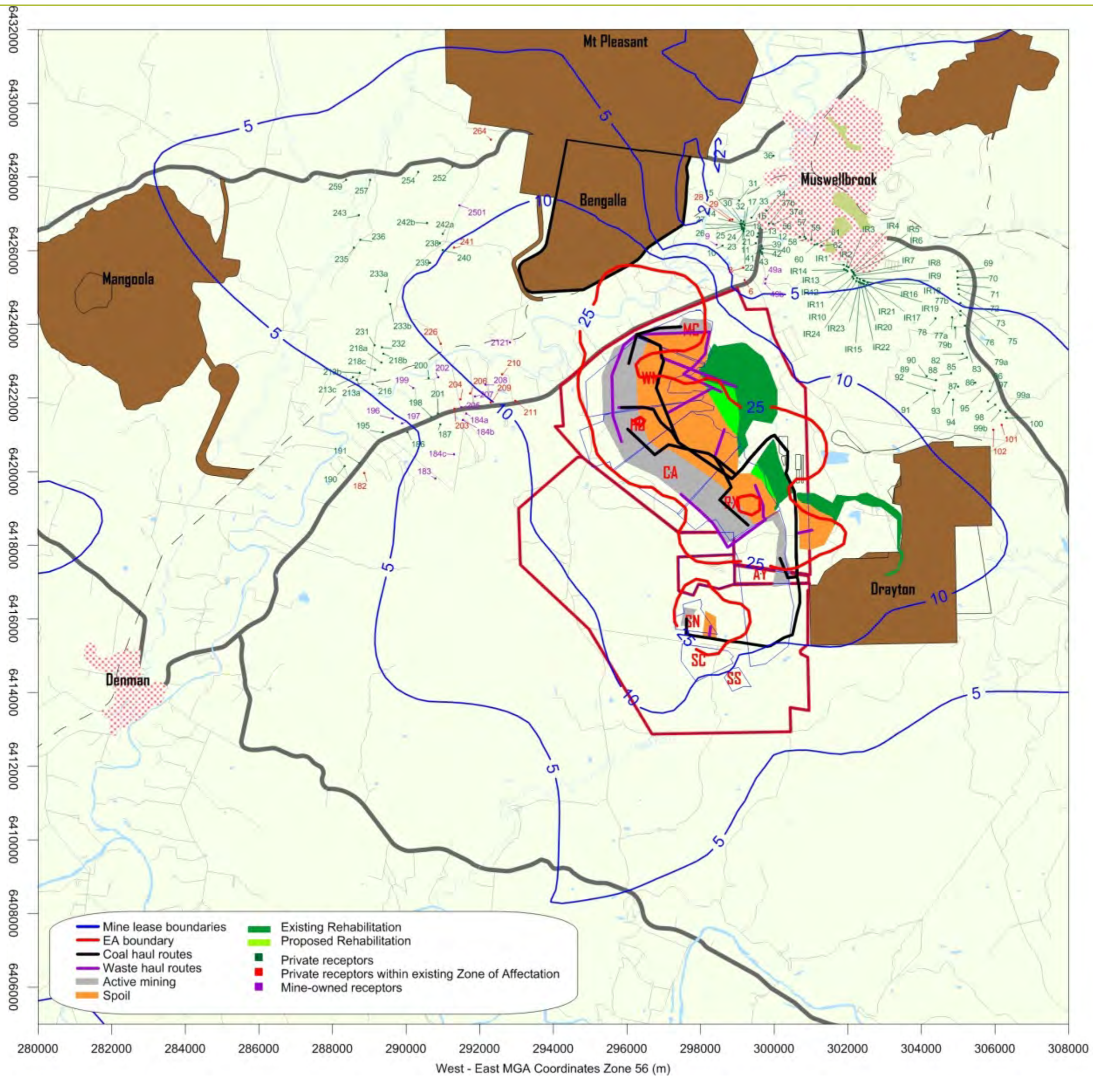
Species: Dust Deposition	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Mt Arthur Coal Mine 2026 Modification alone	**Location:** Mt Arthur Coal Mine
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** 2 g/m^2/month	**Met Data:** Macleans Hill 2007-2008	**Plot:** R Kan

Figure E.20: Predicted Annual Average Dust Deposition Levels due to Emissions from the Modification Alone -2026



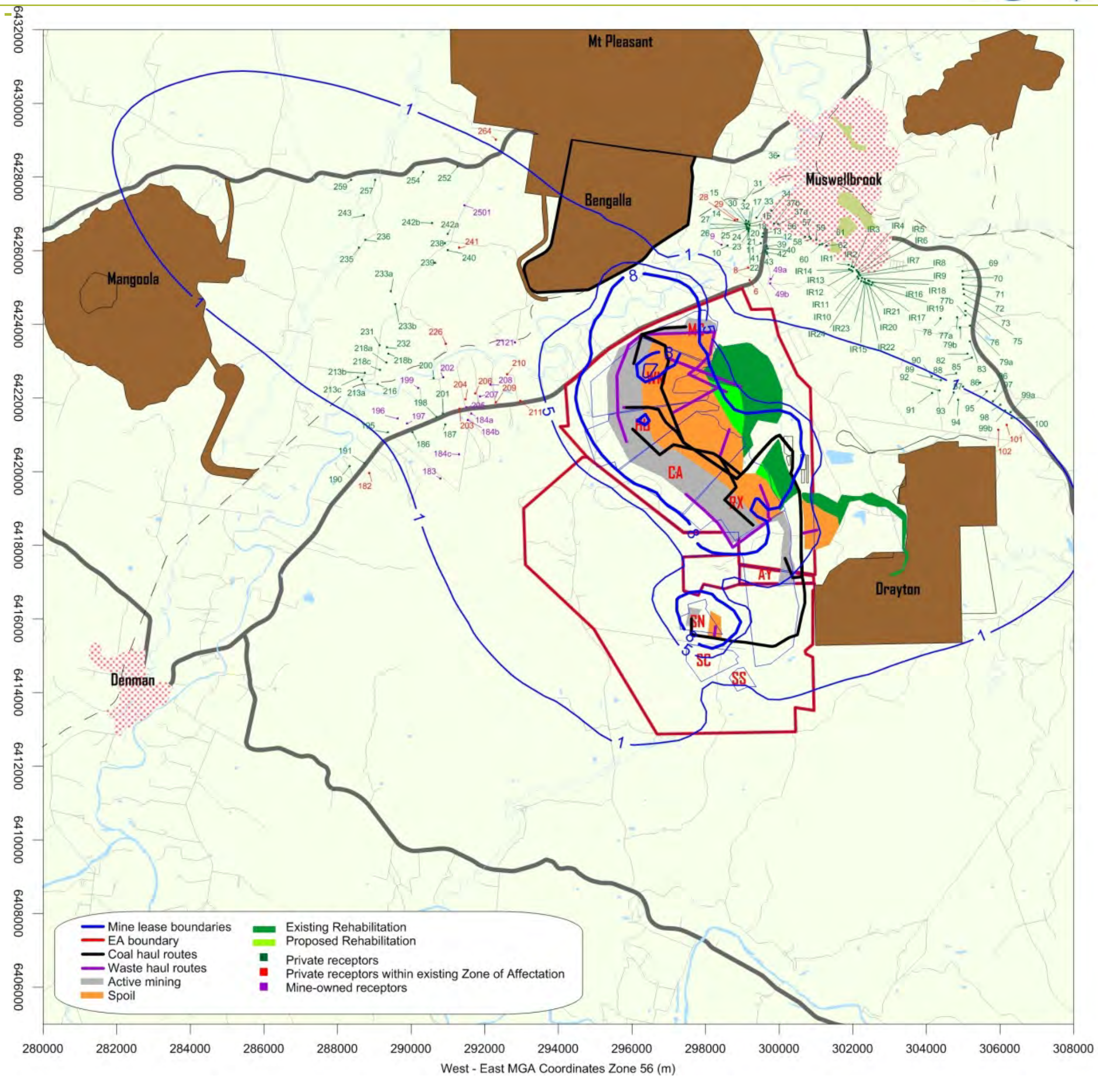
Species: Dust Deposition	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Mt Arthur Coal Mine 2026 Modification and other sources	**Location:** Mt Arthur Coal Mine
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** 4 g/m^2/month	**Met Data:** Macleans Hill 2007-2008	**Plot:** R Kan

Figure E.21: Predicted Annual Average Dust Deposition Levels due to Emissions from the Modification and Other Sources -2026



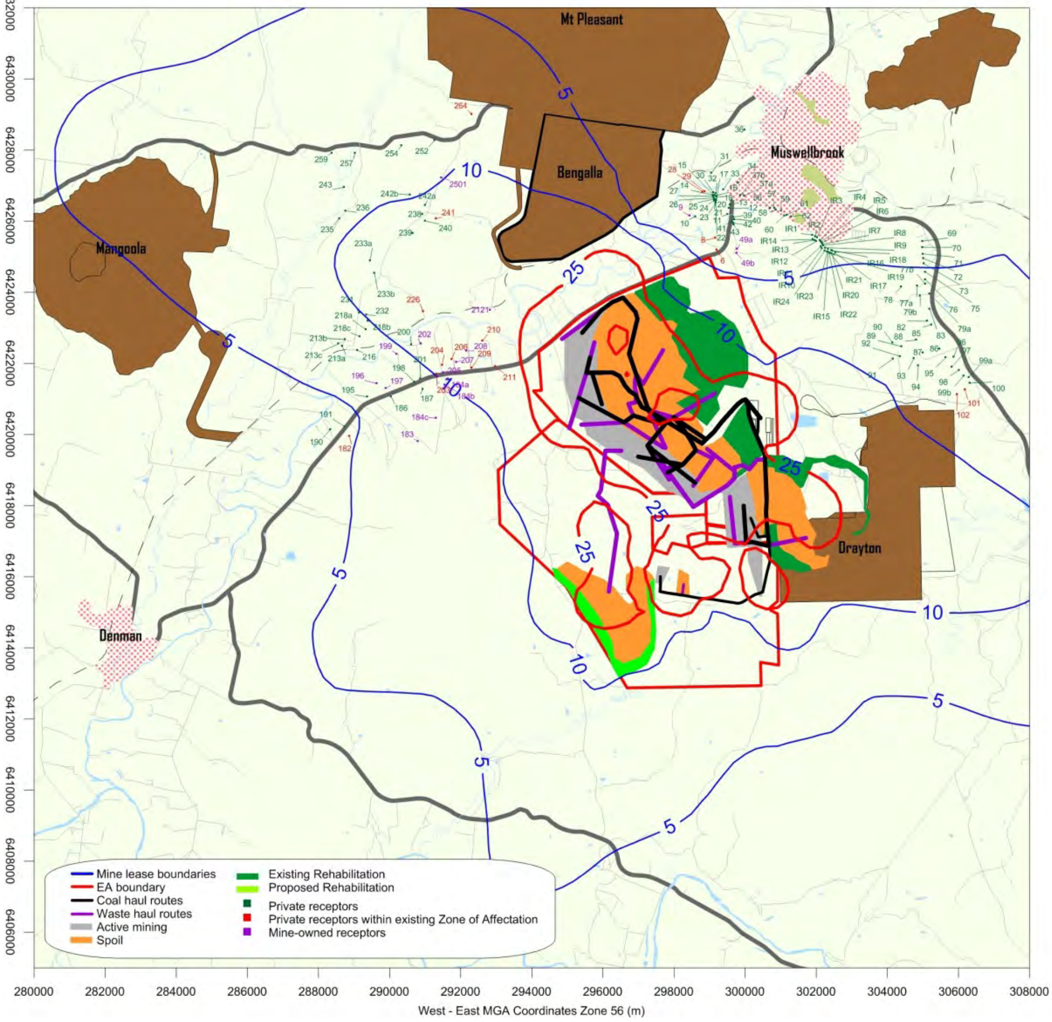
Species: PM$_{2.5}$	**Averaging Time:** 24-hour	**Percentile:** Maximum	**Scenario:** Mt Arthur Coal Mine 2016 Modification alone	**Location:** Mt Arthur Coal Mine
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** 25 µg/m^3	**Met Data:** Macleans Hill 2007-2008	**Plot:** R Kan

Figure E.22: Predicted 24-hour Average PM$_{2.5}$ Concentrations due to Emissions from the Modification Alone -2016



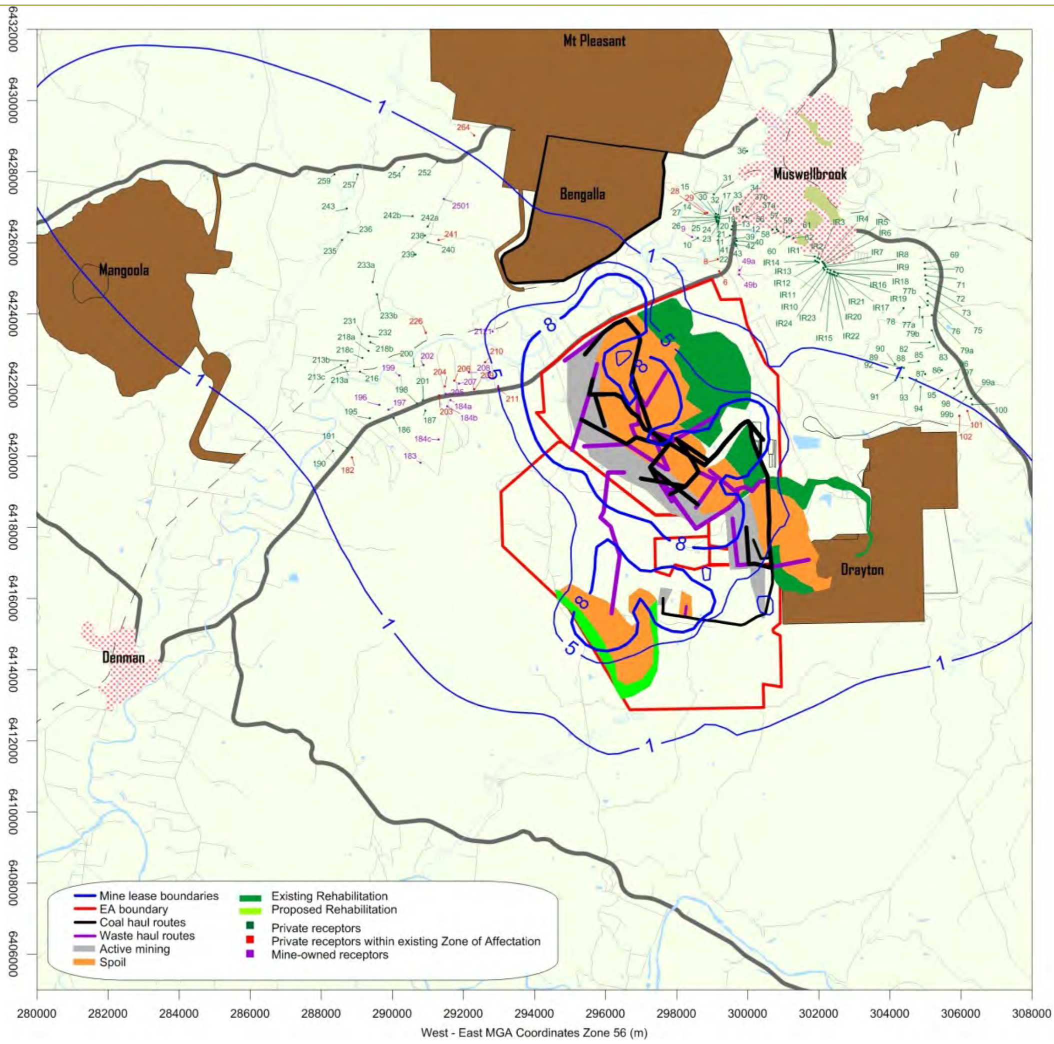
Species:	Averaging Time:	Percentile:	Scenario:	Location:
$PM_{2.5}$	Annual	Maximum	Mt Arthur Coal Mine 2016 Modification alone	Mt Arthur Coal Mine
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** N/A	**Met Data:** Macleans Hill 2007-2008	**Plot:** R Kan

Figure E.23: Predicted Annual Average $PM_{2.5}$ Concentrations due to Emissions from the Modification Alone -2016



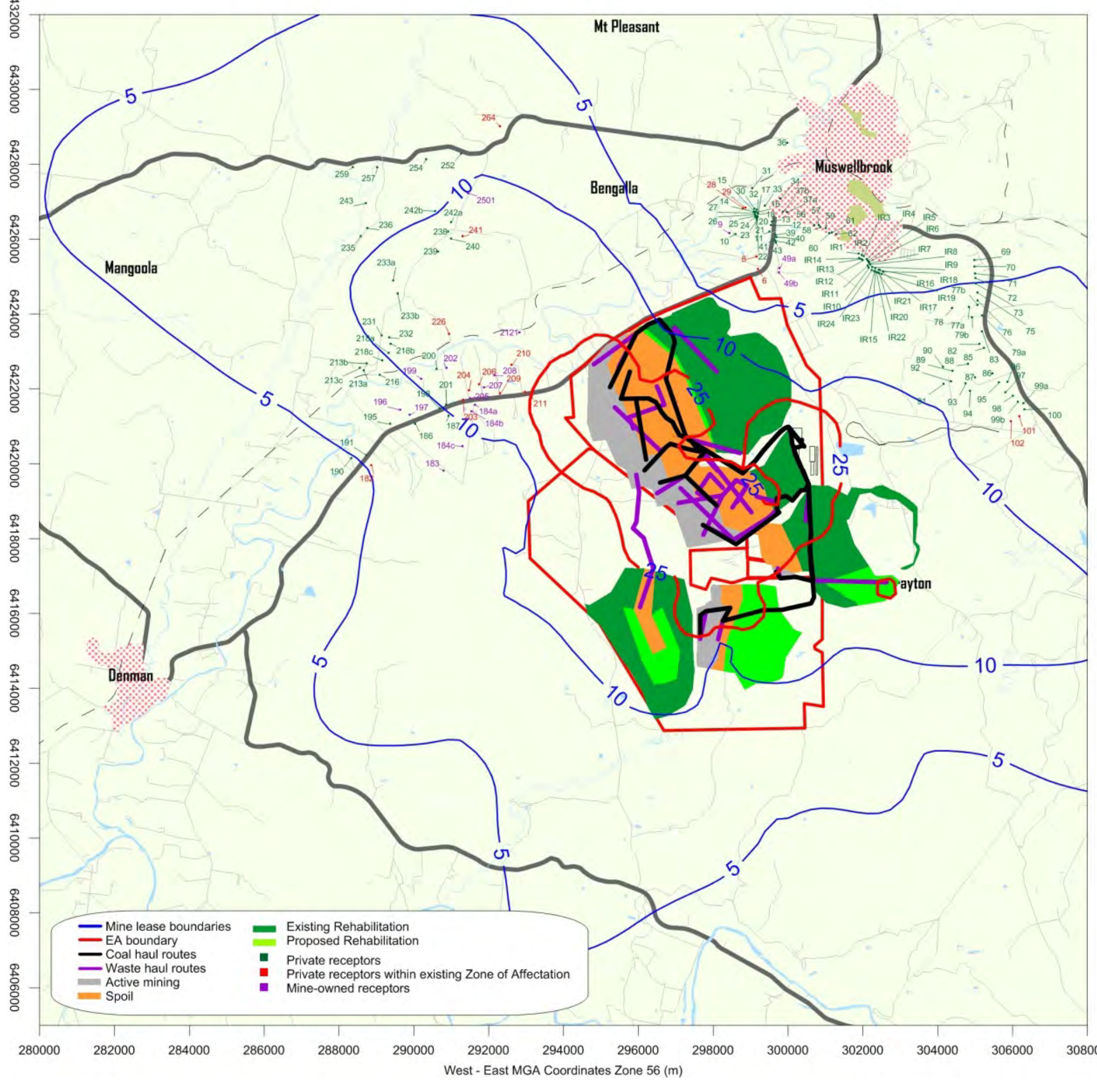
Species:	**Averaging Time:**	**Percentile:**	**Scenario:**	**Location:**
$PM_{2.5}$	24-hour	Maximum	Mt Arthur Coal Mine 2022 Modification alone	Mt Arthur Coal Mine
Model Used:	**Units:**	**Assessment criteria:**	**Met Data:**	**Plot:**
ISCMOD	µg/m^3	N/A	Macleans Hill 2007-2008	R Kan

Figure E.24: Predicted 24-hour Average $PM_{2.5}$ Concentrations due to Emissions from the Modification Alone -2022



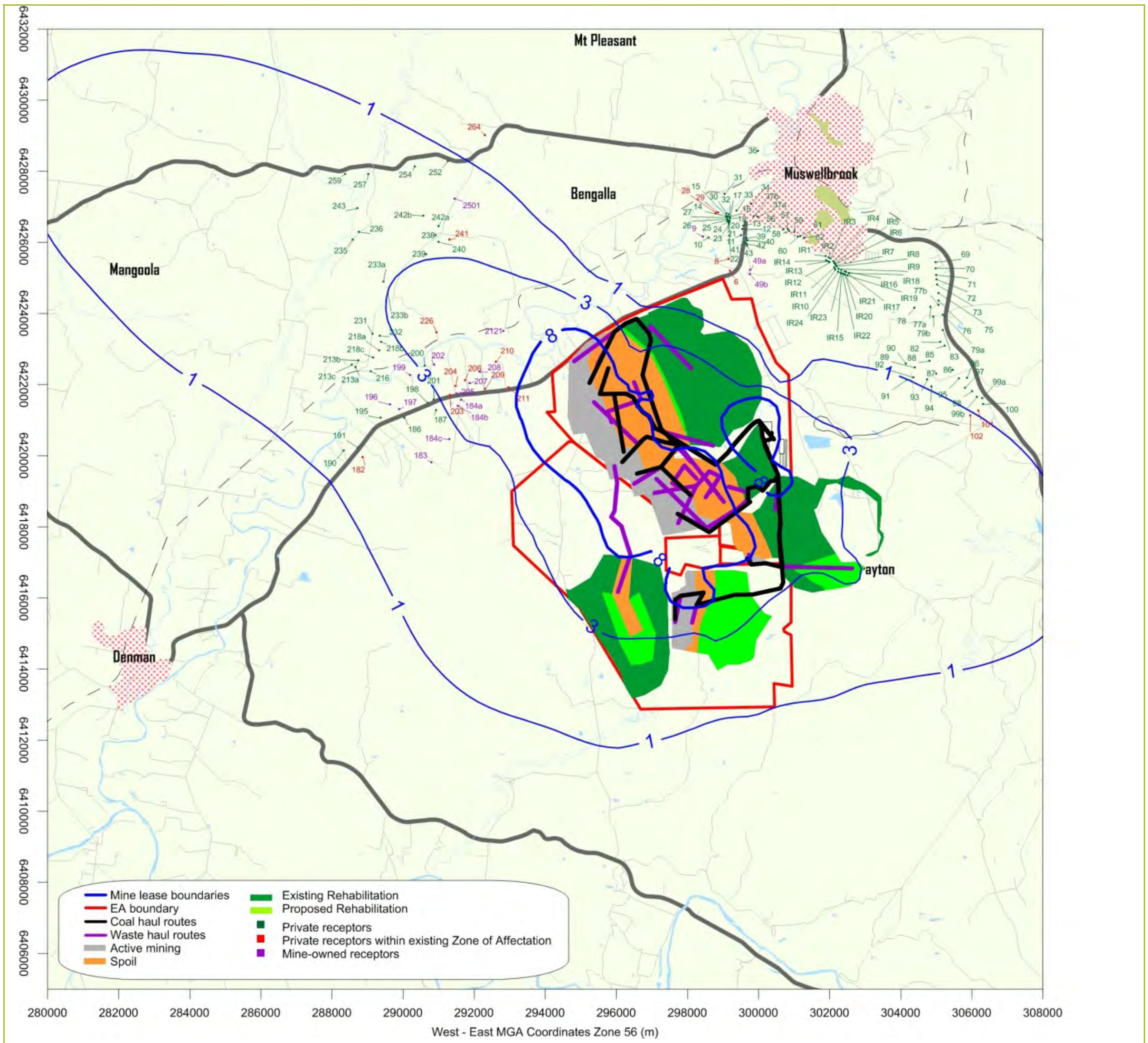
Species: PM$_{2.5}$	Averaging Time: Annual	Percentile: Maximum	Scenario: Mt Arthur Coal Mine 2022 Modification alone	Location: Mt Arthur Coal Mine
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** N/A	**Met Data:** Macleans Hill 2007-2008	**Plot:** R Kan

Figure E.25: Predicted Annual Average PM$_{2.5}$ Concentrations due to Emissions from the Modification Alone -2022



Species:	Averaging Time:	Percentile:	Scenario:	Location:
$PM_{2.5}$	24-hour	Maximum	Mt Arthur Coal Mine 2026 Modification alone	Mt Arthur Coal Mine
Model Used:	**Units:**	**Assessment criteria:**	**Met Data:**	**Plot:**
ISCMOD	$\mu g/m^3$	N/A	Macleans Hill 2007-2008	R Kan

Figure E.26: Predicted 24-hour Average $PM_{2.5}$ Concentrations due to Emissions from the Modification Alone -2026



Species: PM$_{2.5}$	**Averaging Time:** Annual	**Percentile:** Maximum	**Scenario:** Mt Arthur Coal Mine 2026 Modification alone	**Location:** Mt Arthur Coal Mine
Model Used: ISCMOD	**Units:** µg/m^3	**Assessment criteria:** N/A	**Met Data:** Macleans Hill 2007-2008	**Plot:** R Kan

Figure E.27: Predicted Annual Average PM$_{2.5}$ Concentrations due to Emissions from the Modification Alone -2026