APPENDIX B

AIR QUALITY IMPACT
RESPONSE TO PAC REVIEW REPORT

Consulting • Technologies • Monitoring • Toxicology

6 March 2013

Hansen Bailey
Environmental Consultants
Dianne Munro
6/127-129 John Street
Singleton NSW 2330

COALPAC CONSOLIDATION PROJECT

1 INTRODUCTION

We have been asked to provide a report on the air quality effects of the Coalpac Consolidation Project (the Project) following the review of the Project by the Planning Assessment Commission (PAC), at the request of the Minister for Planning. The PAC provided its review report (the PAC Report) for the Project dated 14 December 2012 which included recommendations to the Minister for variations to the Project as it was described in the Environmental Assessment (EA) dated March 2012. The adoption by Coalpac of these variations for the amelioration of the environmental effects of the Project will, we conclude, reduce the air quality effects of the Project.

We have reviewed Sections 5.1 and Section 8.7 of the PAC Report which specifically address the air quality and greenhouse gas assessment for the Project as reviewed by the PAC and in which the PAC makes a number of comments as to air quality assessment methodology and acceptability as applied by past practice and existing Government policy, guidelines, standards and practices (Assessment Issues).

As requested, we comment on the assessment issues raised by the PAC as well as specific recommendations in **Section 7** of this Report.

We have also considered the variations to the Project as proposed by Coalpac (Contracted Project) to ameliorate the air quality impacts of the Project as described and assessed in the EA.

As requested, we report on the predicted concentrations due to the Contracted Project as now proposed, noting the extent of the reduction of off-site predicted ground level concentrations as compared to the Project as proposed and assessed in the EA.

This report responds to the air quality assessment and acceptability observations of the PAC and reports on the changes to predicted ground level concentrations due to the Project.

Pacific Environment Limited
Suite 1, Level 1, 146 Arthur Street, North Sydney, NSW 2060
(ASX: PEH) ABN: 43 692 285 758
www.pacific-environment.com
Ph: +61 2 9870 0900

2 QUALIFICATIONS AND EXPERIENCE

This report has been prepared by Jane Barnett, Principal Consultant at Pacific Environment (formerly PAEHolmes), with over 15 years' experience in air quality impact assessment. A Curriculum Vitae for Jane Barnett is attached as **Appendix A**. I have read the Uniform Civil Procedure Rules 2005 Schedule 7 Expert Witness Code of Conduct and agree to be bound by these terms.

PAEHolmes was formed from the merger of two leading environmental firms, Pacific Air & Environment (est. 1995) and Holmes Air Sciences (est. 1988). In 2012, PAEHolmes became part of the larger organisation, Pacific Environment Limited (PEL), which includes monitoring, toxicology and technologies divisions as well as air quality and acoustics consulting.

With staff in Sydney, Brisbane, Perth, Adelaide and Melbourne, including pioneers in the air quality field in Australia, Pacific Environment is Australia's most experienced air quality management group, specialising in applied meteorology, emissions estimation, emissions inventory development, atmospheric modelling, environmental data management and impact assessment.

Our project experience extends across a wide range of industries including open cut and underground mining, power generation, transport, energy, metals processing, agriculture, refining and steel manufacturing. Many of these projects have been of national and international significance. In addition to projects in Australia, we have also completed assignments in New Zealand, South East Asia, USA and Europe.

Pacific Environment's experience in Air Quality Assessment for the coal industry is second to none. The company has been involved in the majority of coal mine approvals in the Hunter Valley of NSW for the last 15 – 20 years. The firm has worked on over 100 Environmental Assessments for the mining industry within Australia and overseas which have assessed all aspects of coal operations both underground and open cut, including coal handling and loading, transportation and processing.

Some relevant assessments completed by Pacific Environment include (but are not limited to):

- Air Quality Assessment for the Shenhua Watermark Open Cut
- Air quality assessment for constraints assessment for proposed Dartbrook Project
- Air quality impact assessment for the Coalpac Consolidation Project which will consolidate the mining operations of Cullen Valley Mine and Invincible Mine, including the development of a three-dimensional wind field model for the area
- Air Quality Impact Assessment for the Maules Creek Project and the Boggabri Continuation Project
- Development of a blastmod tool for ACARP which enables forecast modelling of atmospheric conditions for blast scheduling in the Hunter Valley
- Air quality assessment for Mt Thorley Warkworth
- Air quality assessment Cannington mine
- Air quality assessment for proposed modifications to Bengalla Mine
- Review of long-term air quality trends for Bulga Operations and review of AEMR
- Air quality assessment for Beltana Underground Mine Power Generation Project
- Air quality assessment for Stratford Coal Modification
- Air quality assessment for Ravensworth Continued Operations
- Air quality assessment for Narama Stage 2 Coal Mine
- Air quality assessment for Ravensworth Underground

- Air quality assessment for Mt Arthur Coal
- Air quality assessment for Ulan Continued Operations
- Air quality assessment for Wilpinjong Coal Mine
- Air quality assessment for Ginkgo and Snapper Mines
- Air quality assessment for Ashton Coal operations
- Air quality assessment for Moolarben Stage 2
- Air quality assessment for Cannington mine
- Air quality assessment for Boggabri mine
- Air quality assessment for Mandalong mine
- Air quality assessment for Integra mine
- Air quality assessment for Newstan mine
- Air quality assessment for Mt Arthur Underground Project
- Air quality assessment for MAN South Pit Extension Project
- Air quality assessment for Glendell mine plan modifications
- Air quality assessment and gap analysis for Mt Pleasant mine
- Air quality assessment for Drayton mine Extension Project
- Air quality assessment for proposed Anvil Hill coal mine
- Air quality assessment for proposed modifications to Bengalla Mine
- Air quality assessment for proposed Wilpinjong Coal Mine
- Air quality assessment for Mt Owen Mine expansion
- Tasman Coal Project – Post Commissioning Verification of Vent Shaft Emissions
- Air Quality Assessment for the Abel Underground Coal Mine
- Air Quality Assessment for Tasman Underground Coal Project

Pacific Environment has also been heavily involved in assisting the NSW coal mining industry with their Dust Stop Pollution Reduction Programs (PRPs) since 2011, completing these studies for more than 30% of NSW operations. We understand the issues facing the industry and are extremely well placed to provide leading edge advice in terms of dust emission calculation and reduction in addition to air quality impact assessment.

3 AIR QUALITY ASSESSMENT

Pacific Environment (then PAEHolmes) carried out the air quality impact and greenhouse gas assessment for the Project and submitted that report in March 2011. This report was reviewed for adequacy in 2011 and comments made by the relevant government departments, in particular the NSW Environment Protection Authority (EPA). Those comments were addressed and a subsequent report provided on 14 December 2011 and included as Appendix G in the EA document submitted for public exhibition. Submissions from the general public, non-government organisations and government departments were made after the exhibition period. Pacific Environment then provided responses which addressed those submissions on 31 July 2012.

The air quality assessment report is used in and supports the project's EA. It provides information suitable for the consideration by the consent authority for determination under the *Environmental Planning and Assessment Act 1979* (NSW EP&A Act).

I am aware that the air quality assessment report assists in the environmental planning assessment and determination of the application for planning approval under the NSW EP&A Act one of the 'objects' (in Section 5 (a)) of which is

"*…to encourage:*

> *(i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment,*
>
> *(ii) the promotion and co-ordination of the orderly and economic use and development of land,…"*

The air quality assessment was completed in accordance with the environmental assessment requirements of the NSW Director General of Planning (DGRs). The Project DGRs require that the key issue of air quality include a *"quantitative assessment of potential:*

- *construction, operation and blasting impacts;*
- *reasonable and feasible mitigation measures, including costing of the proposed measures;*
- *monitoring and management measures, in particular real-time and attended air quality monitoring (including predictive meteorological modelling) to facilitate reactive management of activities to ensure impacts are within the relevant criteria and goals throughout the life of the project."*

The DGRs further required that "*The environmental assessment of the key issues*" which included "*Air Quality" "must take into account relevant guidelines, policies and plans. While not exhaustive, the following attachment contains a list of some guidelines, policies and plans that may be relevant to the environmental assessment of this project.*"

The attachment to the Supplementary DGRs identified the:

- *"Protection of the Environment Operations (Clean Air) Regulation 2002"*
- *"Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (DEC)"*
- *"Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (DEC)"*

The EA assessment followed the procedures outlined by the NSW Environment Protection Authority (EPA) in their document titled *"Approved Methods for the Modelling and Assessment of Air Pollutants in NSW"* (**NSW DEC, 2005**) (Approved Methods). The Approved Methods specify how assessments based on the use of air dispersion models should be undertaken. They include guidelines for the preparation of meteorological data, emissions data and relevant air quality criteria.

Given the complex terrain in the Cullen Bullen region, the atmospheric dispersion model CALPUFF was chosen (as accepted in the Approved Methods – Section 6.3). This system substantially overcomes the basic limitations of the steady-state Gaussian plume models such as AUSPLUME and ISC. Section 5 of the air quality assessment details the modelling approach used, including relevant inputs and methodologies. This is standard and accepted practice in NSW (NSW EPA Approved Methods).

The relevant air quality criteria, against which predictions from major projects such as this have been assessed, are listed below. **Table 1** lists the criteria used to assess impact, while **Table 2** is used to determine acquisition. Assessment criteria provide benchmarks, which are intended to protect the community against the adverse effects of particulates. These criteria reflect current Australian standards for the protection of health and protection against nuisance effects.

Table 1: Air quality assessment criteria

Pollutant	Criterion	Averaging Period	Application	Source
TSP	90 µg/m³	Annual	Cumulative	NHMRC (1996)
PM_{10}	50 µg/m³	24-hour	Cumulative	NEPC (1998)
	30 µg/m³	Annual	Cumulative	NSW EPA (1998)
Deposited Dust	2 g/m²/month	Annual	Incremental	NERDDC (1988)
	4 g/m²/month	Annual	Cumulative	NERDDC (1988)

Table 2: Air quality acquisition criteria

Pollutant	Criterion	Averaging Period	Application
TSP	90 µg/m³	Annual	Cumulative
PM_{10}	150 µg/m³	24-hour	Cumulative
	50 µg/m³	24-hour	Incremental
	30 µg/m³	Annual	Cumulative
Deposited Dust	2 g/m²/month	Annual	Incremental
	4 g/m²/month	Annual	Cumulative

In line with NSW EPA requirements, as is standard practice in NSW, these particulate matter criteria were used to assess the potential impacts on air quality due to the Project.

This is the appropriate and accepted method for assessment of coal mining in NSW.

4 AIR QUALITY ASSESSMENT OF THE PROJECT

Pacific Environment provided the air quality impact assessment (AQIA) for the Project which was included in the EA as Appendix G. The assessment was completed in accordance with the best accepted practices and standards current at the time and as required by the relevant Government and EPA policies, guidelines and standards and as required by the DGRs.

Ground level concentrations were predicted across a large modelling domain (20 km x 20 km) as well as at 171 discrete receptors representing the nearest residential receivers. The size of the modelling domain was determined by the extent of the various operations included in the Project, as well as the relative complexity of terrain in the area. Both 24-hour and annual average predictions were made for PM_{10} and $PM_{2.5}$. Annual average predictions were also made for total suspended particulates (TSP) and dust deposition levels. Four mining areas formed part of the Project, namely Hillcroft, Cullen Valley, East Tyldesley and Invincible. Each mining area was modelled separately and the results combined to form part of the cumulative assessment. This was completed for operational Years 2, 8, 14 and 21, modelled as worst-case for the EA.

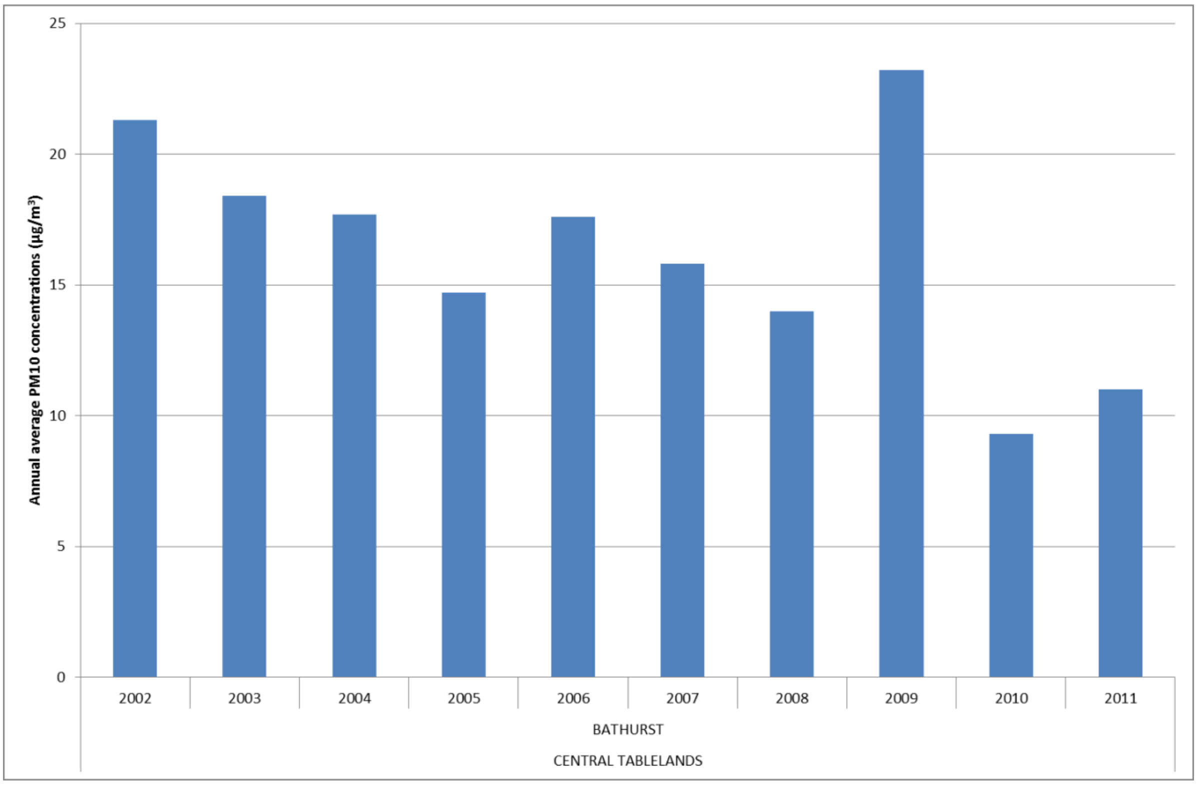
In terms of cumulative impacts, the EA AQIA identified a number of other operations in the area. The PAC accepts on page 37 of their report that;

> *"… there was insufficient information available to the Proponent to model accurately the potential cumulative impacts of two additional proposed open-cut mines in the vicinity of the Coalpac proposal (Pine Dale Stage 2 Extension and Neubeck)."*

In order to account for existing background PM_{10} concentrations we analysed the available PM_{10} monitoring data from January 2008 from two PM_{10} monitoring units located near Cullen Bullen. It was determined from this data that an appropriate annual average background PM_{10} concentration for Cullen Bullen would be approximately 12.8 µg/m³. This will include contributions from existing mining and other operations in the area, so adding it as a background value is conservative.

The nearest NSW EPA monitoring station is at Bathurst and measures continuous PM_{10} using a Tapered Element Oscillating Microbalance (TEOM) instrument. This station is over 40km from Cullen Bullen, and will not be as representative of the area as the monitoring units located near Cullen Bullen. It should be noted, however, the TEOM located at Bathurst does show concentrations of a similar magnitude to those units located near Cullen Bullen. **Figure 1** shows the measured annual average PM_{10} concentrations at the Bathurst site. Bathurst is a relatively urban centre, compared to Cullen Bullen, and it would therefore not be unusual for those measurements to be slightly higher than for Cullen Bullen, due to increased vehicle emissions and other anthropogenic sources.

Even though the monitoring data at Cullen Bullen are limited, it is my opinion that they are generally representative of the area and suitable for the purposes of annual cumulative assessment in the absence of any specific mine plan and emissions data from the Pine Dale Stage 2 Extension and Neubeck Coal Project.



On site meteorological data from both the Cullen Valley Mine and Invincible Colliery meteorological stations were used as input to the CALMET meteorological model which, when combined with prognostic upper air, landuse and terrain data, calculated three dimensional meteorological input for the CALPUFF dispersion model.

It is my opinion that this is the most appropriate way to model a development of this nature, given the complex terrain and large area over which the activities are located. I also note that the NSW EPA provided no comment as to any deficiencies in this methodology in either their adequacy review of the EA or submissions after public exhibition of the EA.

The predicted ground level concentration at each of the residential receivers in the modelling domain, due to emissions from Year 2 as presented in the EA, are shown in **Table B1** in **Appendix B**.

5 RESPONSES TO EPA SUBMISSIONS

In their submission after public exhibition to the PAC, the NSW EPA noted three points for clarification in the emissions inventory presented in the air quality assessment for the EA, being:

1. *No site specific parameterisation was provided to qualify emission variables*
2. *Wind blown dust emission estimation techniques used are not the most up to date methods*
3. *Issues with the emission control efficiencies used in the assessment*

These three points were reiterated by the PAC in Section 5.1.3 of the PAC report and are discussed sequentially in the following sections.

5.1 Site Specific Parameterisation

Site specific parameterisation refers to taking samples of on-site material and analysing them to determine parameters such as silt and moisture content. These results are then used to inform emissions estimate equations to calculate emission factors for individual mining activities.

This issue was addressed in the Response to Submissions document. Much of the current discussion around the requirement for site specific dust emission factor data has arisen since the implementation of the NSW EPA's Dust Stop Pollution Reduction Program (PRP) process in 2011/2012. The purpose of the PRP process was to quantify and rank particle emission sources and identify existing and possible future measures to minimise these emissions.

The EA modelling was conducted well in advance of this process. A high level of conservatism was applied to the EA modelling, which I believed to be sufficient to make unnecessary any requirement to carry out such analysis in order to appropriately assess impacts. Measurements made on 31 January 2013 confirmed this to be the case.

Only since the implementation of the Dust Stop PRP program in 2011/2012 has the use of site specific parameters become current practice for emission estimation in impact assessments. This was not industry practice prior to early 2012.

By way of illustration, the NSW EPA made no mention of any perceived short-coming in the Project's emission inventory during the adequacy phase of the Project (September/October 2011) when it could have been addressed much earlier in this process. It has now been addressed using site specific data and the results included in the emissions inventories for the Contracted Project.

These measurements were undertaken at the current mining operations at both Cullen Valley Mine and Invincible Colliery. As expected, and as noted in our Response to Submissions, the values used in the EA modelling were conservative. Using the site specific data has led to considerable reductions in emission estimates for the Contracted Project.

Table 4 summarises the values used in both the Project and the Contracted Project. With the exception of product coal[1], it can be seen that all EA assumptions were conservative (higher moisture content and lower silt content than assumed in the EA), and therefore our original premise was correct, that the resulting predicted ground level concentrations were also conservative.

[1] It should be noted that emissions from product coal do not form a significant percentage of the total emissions from the site (approximately 0.04%), and the difference between assumption and measurement is also small (1.7%).

It is highlighted that it is standard practice in air quality assessment that when site-specific data is not used, a level of conservatism is adopted. This is to ensure that any potential for air quality impact is over-stated, rather than under-stated.

Table 4: Assumed and measured silt and moisture contents

Area	As adopted in the EA	As adopted in the Contracted Project	As adopted in the EA	As adopted in the Contracted Project
	Moisture content (%)		Silt content (%)	
Haul roads	N/A	N/A	5	3.4 - 3.9
ROM coal	7	7 - 8	10	3
Product coal	7	5.3	N/A	N/A
Overburden	2	4 - 5	10	4 - 5
Topsoil	2	6 - 7	8	5 - 6
Rehab	2	5 - 6	10	5 - 6

Note: A range of values occur as measurements were taken at both Cullen Valley Mine and Invincible Colliery. Values adopted for East Tyldesley Mine were the average of the two.

As expected, these site-specific measurements resulted in significantly lower calculated total dust emissions for the Contracted Project. **Table 5** shows a comparison between the annual total suspended particulate (TSP) calculated for both the EA and the Contracted Project in Year 2.

Table 5: Comparison of calculated TSP emissions for Year 2 – with and without EPA Recommendation for Site Specific Inputs

Estimated TSP in kg/year for Year 2	EA (Conservative Assumptions Made)	Contracted Project (Site Specific Inputs Adopted)	Percentage change
Cullen Valley Mine	371,719	430,587	+ 16%
Hillcroft Mine	966,310	-	- 100%
East Tyldesley Mine	757,984	487,977	- 36%
Invincible Colliery	771,266	523,430	- 32%
TOTAL	**2,867,279**	**1,441,993**	**- 50%**

Note: Cullen Valley Mine extracted sand only in the Exhibited EA modelling and extracts coal in the Varied Project.

By way of conclusion, the modelling completed for the EA was significantly more conservative than that completed for the Contracted Project using the NSW EPA's suggested approach, and resulted in a reduction in TSP emissions modelled for Year 2 of 50%.

5.2 Wind blown dust emissions

Wind blown dust emissions refer to those particulate emissions arising from erosion of exposed areas such as the pit or active dumping or rehabilitation areas. The amount of particulate lift-off is dependent on a number of factors which include the threshold friction velocity (the wind velocity necessary to initiate soil erosion).

In their submission after public exhibition, the NSW EPA mention the use of the US EPA AP-42 factor (Chapter 13.2.5) which takes into account site specific wind data and erodible material properties in order to calculate wind blown dust emissions. They state that,

> *"To estimate emissions on a shorter time scale (e.g., worst-case day), the correct procedure is presented in US EPA (2006), AP 42, Chapter 13.2.5, Industrial wind erosion."*

Experience has shown that this method can result in very low emission estimates for wind erosion, which are not realistic. In my opinion it was therefore more conservative to use the older (1986) State Pollution Control Commission (SPCC) factor of 0.4 kg/ha/hr to represent emissions from wind blown dust, as was done in the EA modelling.

To confirm this, a site specific measurement for threshold friction velocity (TFV) was made at the Invincible Colliery on 31 January 2013, to determine the wind blown dust from exposed areas. **Table 6** below presents the measured data relevant to the equation.

Table 6: Measurements of threshold friction velocity from Coalpac

Cullen Valley Mine	
Area measured	**Threshold friction velocity (cm/s)**
Overburden Dump Pit 105	100
Overburden Dump Pit 106	100
Invincible Colliery	
ROM Coal Inpit A	100
ROM Coal Inpit B	76
Overburden Current Dump (average)	72

Not all exposed areas will be active constantly, meaning that dust will only be generated if the wind velocity is sufficient to lift dust from the surface. This occurs when the surface wind velocity is greater than the TFV of the material. Surfaces with a low TFV have greater propensity for fine particles to be lifted at relatively low wind speeds. Since larger material and other non-erodible elements (e.g. crusting of stockpiles) add protection against wind erosion, they act to raise the TFV if they are present on disturbed given surface.

The US EPA AP-42 emission factor (Chapter 13.2.5) takes into account site specific wind data, erodible material properties (TFV, particulate size distribution of the material eroded) and the frequency of material disturbance.

Using the site-specific measurements (**Table 6**) and adopting this approach would result in essentially no wind initiated dust lift-off emissions from exposed areas. This has also been the case for other sites where this approach has been taken and is unrealistic in my opinion. For this reason, I have not used this result, but have adopted the 0.1 kg/ha/hr factor (exposed areas) and [1.8 x wind speed] kg/ha/hr (active stockpiles) for modelling the Contracted Project.

By way of conclusion, the EA modelling was significantly more conservative than that completed using the method recommended by the NSW EPA in their submission to the PAC. By conservatively predicting higher potential for air quality impacts, the EA modelling methodology therefore offers a higher level of protection and safety to receivers in health and nuisance impacts.

5.3 Emission Control Efficiencies

The PAC notes that,

> *"the EPA notes the EA assumption of 75 per cent control of dust on haul roads using 'level 2 watering' and suggests the assessment may underestimate the actual emissions in practice."*

The PAC also notes that,

> *"... the EPA now accepts the Proponent's response to the modelling and predictions for the purposes of assessment of the project. The Commission accepts this with the proviso that the emission estimate predictions should be updated and reconfirmed using the most relevant emission variables prior to any final determination of the project."*

The emission estimates have been updated with on-site measurements of input parameters, as discussed in **Section 5.1**.

It is my opinion that a control efficiency of 75% is reasonable and achievable.

It has been standard practice to use this control efficiency on sites that can demonstrate Level 2 watering (greater than 2 L/m^2/hr). In the PRP for Invincible Colliery (**PAEHolmes, 2012**), it was demonstrated that 2 L/m^2/hr is currently being applied and that this will be increased for the Contracted Project.

Many open-cut mines in NSW have recently been issued with draft PRPs in their Environment Protection Licences (EPLs) to undertake monitoring programs to demonstrate this level of control (in fact slightly higher at 80%) on unsealed haul roads. If the Project is approved, Coalpac will almost certainly be issued with the same PRP.

Regardless of whether this PRP is issued, Coalpac commits to the demonstration of this level of control efficiency to the satisfaction of the NSW EPA. A robust methodology for demonstrating this is well developed.

By way of conclusion, the level of control efficiency used in predictive modelling has been demonstrated as achievable (using mobile monitoring techniques) at several coal mines in NSW. Coalpac commits to demonstrating this to the satisfaction of the NSW EPA following granting of project approval.

6 AIR QUALITY ASSESSMENT OF THE CONTRACTED PROJECT

Coalpac has adopted a number of the recommendations made by the PAC for the amelioration of the environmental impacts of the Project by changing the Project in a number of respects. Those relevant to air quality include;

1. Removal of the Hillcroft mining area,
2. Removal of the sand quarry at the Cullen Valley Mine,
3. Reducing the disturbance footprint of the Cullen Valley Mine and Invincible Colliery to avoid sensitive environmental landscapes, and
4. Mining of coal at the Cullen Valley mining area instead of sand in Year 2.

Using the site specific measurements and updated wind erosion equations, discussed in **Section 5**, to compile new emissions inventories in combination with the other changes to the exhibited EA Project, further dispersion modelling was carried out for Year 2 (considered to be the worst case scenario for Cullen Bullen).

Table 7, 8 and **9** provide a comparison of the predicted ground level concentrations for the Project and the Contracted Project, for those residences where exceedances of the air quality criteria are predicted. As shown, there are significant reductions predicted at all locations where exceedances of the air quality criteria were predicted in the EA for both PM_{10} and TSP. Privately owned properties are in bold text.

Table 7: Comparison of modelling results – 24-hour average PM_{10}

ID	Ownership Details	EA Project		Contracted Project	
		Max 24-hour Average PM_{10} Mine Alone (µg/m³)	Number of days over 50 µg/m³	Max 24-hour Average PM_{10} Mine Alone (µg/m³)	Number of days over 50 µg/m³
		Assessment criteria			
		50	*N/A*	*50*	*N/A*
169[b]	Portland Road Pastoral Co Pty Ltd	62	7	26	0
171[b]	Portland Road Pastoral Co Pty Ltd	64	4	25	0
195[cd]	KJ Blackley	191	105	114	28
196[ac]	Crown-owned	173	81	101	18
197[bc]	BE & CE Leisemann & IL & KID Follington	402	189	255	153
198[cd]	DA Tilley	199	115	126	50
199[cd]	DA Tilley	136	71	84	17
217b[a]	Crown-owned	52	1	28	0
327	**RG Wright & KL Norris**	**54**	**1**	**28**	**0**
394[b]	Coalpac	79	12	55	1
396[b]	Coalpac	90	24	69	4
426	**JWJ & SM Taylor**	**62**	**3**	**40**	**0**

[a] Crown-owned, [b] Coalpac-owned, [c] Located within Project boundary, [d] Under agreement

Table 8: Comparison of modelling results – annual average PM_{10}

ID	Ownership Details	Annual Average PM_{10} Mine & Other Sources (µg/m³) EA	Annual Average PM_{10} Mine & Other Sources (µg/m³) Contracted Project
		Assessment criteria	
		30	
195[cd]	KJ Blackley	49	33
196[ac]	Crown-owned	45	30
197[c]	BE & CE Leisemann & IL & KID Follington	90	62
198[cd]	DA Tilley	49	65
199[cd]	DA Tilley	40	29

[a] Crown-owned, [b] Coalpac-owned, [c] Located within Project boundary, [d] Under agreement

Table 9: Comparison of modelling results – annual average TSP

ID	Ownership Details	Annual Average TSP Mine & Other Sources (µg/m³) EA	Annual Average TSP Mine & Other Sources (µg/m³) Contracted Project
		Assessment criteria	
		90	
195[cd]	KJ Blackley	125	70
196[ac]	Crown-owned	115	65
197[c]	BE & CE Leisemann & IL & KID Follington	231	140
198[cd]	DA Tilley	125	78
199[cd]	DA Tilley	102	65

[a] Crown-owned, [b] Coalpac-owned, [c] Located within Project boundary, [d] Under agreement

Tables 10 provides the same results for residences within the township of Cullen Bullen specifically. These results show predicted reductions at every residence in Year 2, with all annual average PM_{10} predictions reducing from that predicted in the EA and remaining below 20 µg/m³.

Table 10: Predicted Ground Level Concentrations at Cullen Bullen from the EA Project compared to the Contracted Project (Year 2)

ID	Ownership Details	Max 24-hour Average PM_{10} Mine & Other Sources (µg/m³)		Annual Average PM_{10} Mine & Other Sources (µg/m³)	
		EA	Contracted Project	EA	Contracted Project
		Assessment criteria			
		50		*30*	
216	BM Emmott	42	29	23	19
217a	Crown	46	25	21	18
217b	Crown	**52**	28	21	17
220	KL Bunyon	21	10	17	15
223	RJ Whittaker & SR Burrows	23	11	17	15
225	JR Tilley	23	11	17	15
227	RG Wright & KL Norris	23	11	17	15
228	AA Woods , EJ Nicholls & LH Field	23	11	17	15
229	AA Woods , EJ Nicholls & LH Field	23	11	17	15
230	CM & BA Gilbert	23	12	17	15
231	J Fuller	24	12	17	16
232	RM Pyne	24	12	18	16
235	RK & SM Lane	28	14	18	16
235	RK & SM Lane	30	15	18	16
236	TJ & KO Tilley	33	17	18	16
237	MC Crane	28	14	18	16
238	DP Rochester	29	15	18	16
238	DP Rochester	32	16	18	16
239	SG Tweedie	29	15	18	16
240	DW & GJ Mccann	31	16	18	16
242	WF Fitzgerald	31	16	19	16
243	Unknown	31	16	19	16
245	M Botfield	34	17	19	16

ID	Ownership Details	Max 24-hour Average PM_{10} Mine & Other Sources (µg/m³)		Annual Average PM_{10} Mine & Other Sources (µg/m³)	
		EA	Contracted Project	EA	Contracted Project
		Assessment criteria			
		50		*30*	
247	KO & SL Rochester	26	13	18	16
248	PB Draper	27	13	18	16
250	GER Young	28	14	18	16
251	GER Young	26	13	18	16
253	M Pasztor	26	13	18	16
254	RW Selmes	27	13	18	16
254	RW Selmes	29	15	18	16
255	GE Lane	29	14	18	16
256	GE Lane	32	16	18	16
257	DJ Tilley	34	17	18	16
258	S & H Filla	49	26	20	17
262	Crown	18	9	17	15
263	M Stone	19	10	17	15
264	RD & DJ Blackley	19	10	17	15
267	AW Gleeson & SA Muldoon	20	10	17	15
268	EA & DM Lane	21	10	17	15
270	RD Blackley	19	10	17	15
270	RD Blackley	19	10	17	15
271	CD & JD Mccann	21	11	17	15
272	Crown (School)	23	11	17	15
272	Crown (School)	24	12	17	15
272	Crown (School)	24	12	17	15
272	Crown (School)	24	12	17	15
273	GJ & TA Hutchison	15	8	16	15
273	GJ & TA Hutchison	15	8	16	15
275	JL & MB Howden	15	9	16	15
276	KJ Blackley (Perpetual Lease)	16	9	16	15
276	KJ Blackley (Perpetual Lease)	16	9	16	15
277	RJ Tilley	16	9	16	15
278	FS Gilson	16	9	16	15
279	N & JA Anderson	17	9	16	15
280	SR Williams	17	9	16	15
281	Jj Brooks	17	9	16	15
283	MW Mercer	19	10	17	15
284	VN & E Deveigne	20	10	17	15
285	E Banks	21	11	17	15
288	MB Banks	22	11	17	15
289	NG Harradine	23	11	17	15
291	A & R Inzitari	27	13	18	15
296	PF Kendall	30	15	18	16
297	PF & DM Toner	30	15	18	16
298	BJ Scott	30	15	18	16
301	CM O'Neill	33	17	18	16
302	CJ Conroy	33	17	18	16

ID	Ownership Details	Max 24-hour Average PM_{10} Mine & Other Sources (µg/m³)		Annual Average PM_{10} Mine & Other Sources (µg/m³)	
		EA	Contracted Project	EA	Contracted Project
		Assessment criteria			
		50		*30*	
304	Al Miller & BS Wilson	33	17	18	16
305	Al Miller & BS Wilson	34	17	18	16
306	Al Miller & BS Wilson	36	18	18	16
308	T Bates	36	19	19	16
309	ME Stewart	36	19	19	16
311	WG Brown	42	22	19	16
312	LM Mcdonald	42	22	19	16
313	N Viaphay	41	21	19	16
314	KR Waters	43	23	19	16
315	KL Godden	28	14	18	15
315	KL Godden	30	15	18	16
316	CE & SM Davis	27	13	17	15
317	CE & SM Davis	26	13	17	15
318	AW Hall	27	13	17	15
321	N Thorne	33	16	18	16
325	SP & SA Duggan	44	23	19	16
326	The Minister For Energy & Utilities	49	25	20	16
327	J Playford	**54**	28	21	17
328	RP Harris	14	8	16	15
329	R Bailey	14	8	16	15
330	DJ Annesley	13	8	15	14
331	GJ & VC Walsh	12	7	15	14
332	BN Rochester	12	7	15	14
333	RP Doyle	12	7	15	14
335	P Warner & Ya Harris	12	7	15	14
342	GJ Williams	12	7	15	14
343	AG & RL Williams	12	7	15	14
344	RT & VE Dobson	12	7	15	14
345	DK & K Northey	13	7	15	14
347	DJ Annesley	13	8	15	14
350	Tanwind Pty Ltd	14	8	16	15
350	Tanwind Pty Ltd	15	8	16	15
350	Tanwind Pty Ltd	15	9	16	15
350	Tanwind Pty Ltd	16	9	16	15
350	Tanwind Pty Ltd	16	9	16	15
352	RS Speirs	17	9	16	15
352	RS Speirs	19	10	16	15
353	RJ Duncan	17	9	16	15
354	ST & CP Wilson	17	9	16	15
355	DC & KT Claydon & JD Garrett	17	9	16	15
356	MS Ivey	17	9	16	15
357	E Fabits	16	9	16	15
358	JM Ellis	16	9	16	15
360	Crown	28	14	17	15

Figures 2, **3** and **4** provide isopleths showing the changes in predicted ground level concentrations in Year 2, due to the Contracted Project. The blue contour shows the EA predictions and red contour indicates predicted air quality results from the Contracted Project in Year 2.

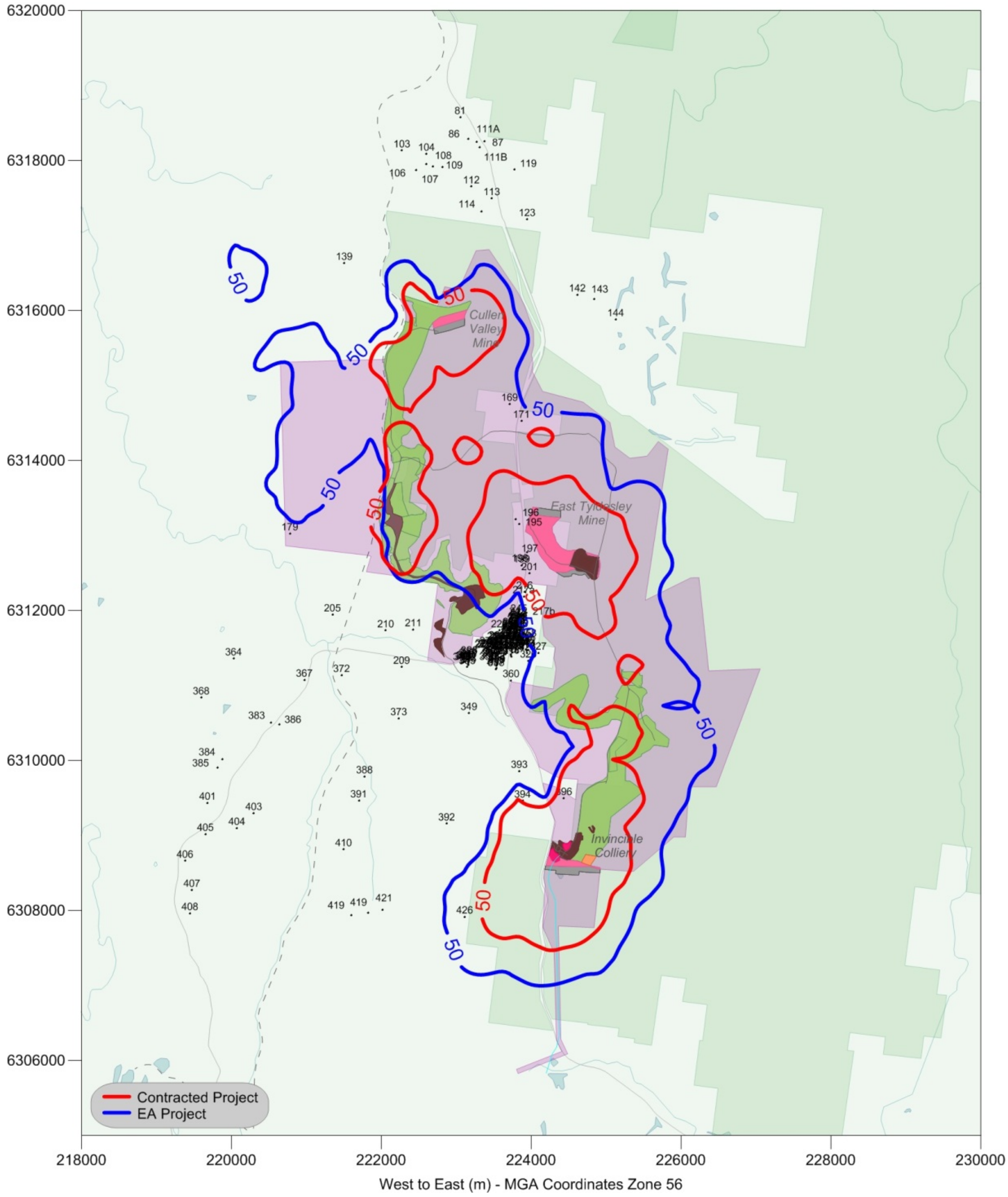


Figure 2: Comparison of Year 2 modelling results – 24-hour average PM_{10} (µg/m³)

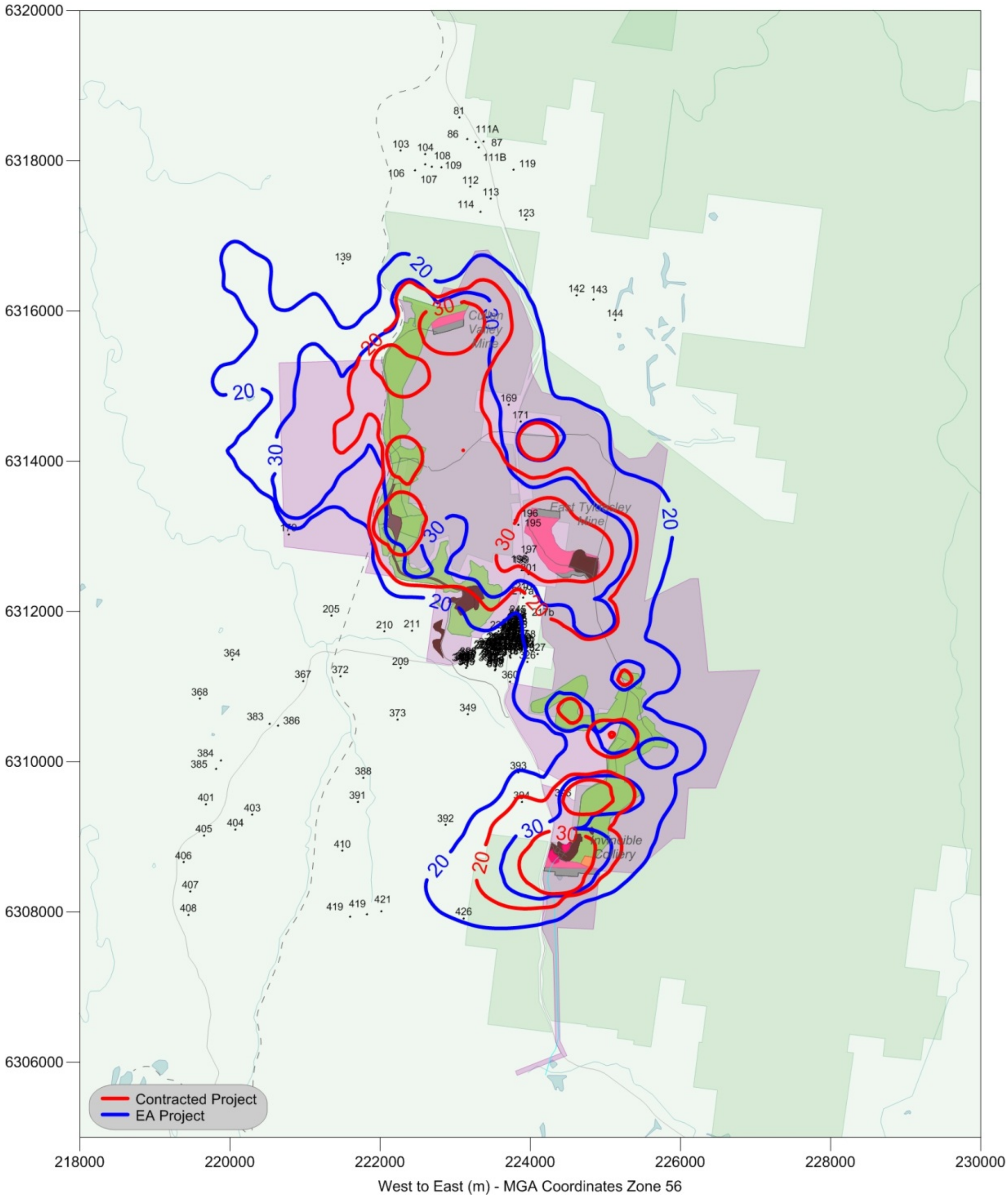


Figure 3: Comparison of Year 2 modelling results – annual average cumulative PM_{10} (µg/m³)

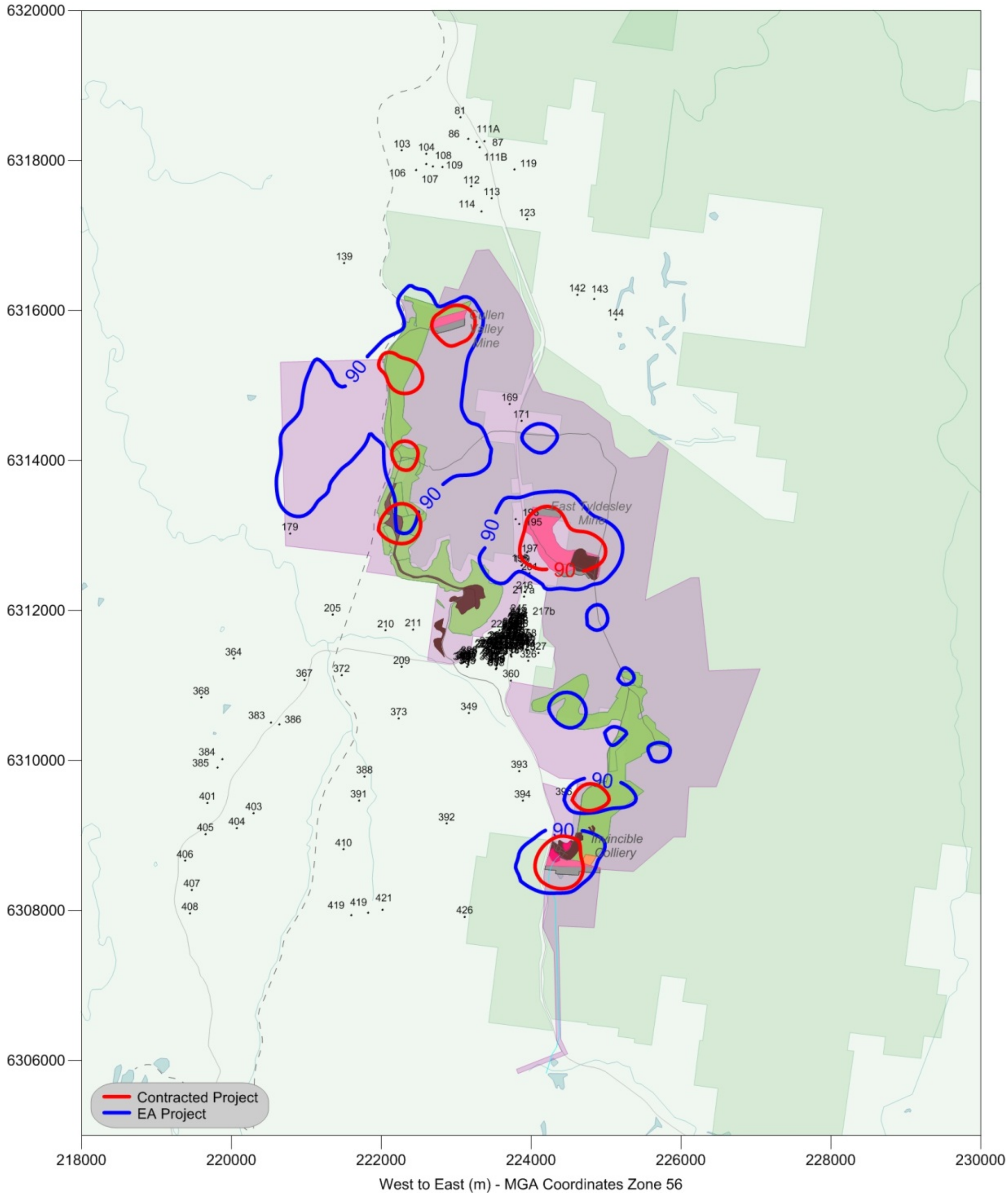


Figure 4: Comparison of Year 2 modelling results – annual average cumulative TSP (µg/m³)

7 PAC POSITION

From the PAC report it would appear that the PAC attributed material evidenced as summarised in Section 5.1.9 of the PAC to:

- *"the strong submissions by NSW Health predicting adverse health impacts on residents; and*
- *whether the proposed measures can reliably meet the air quality goals over the life of the project" [page 41]*

7.1 NSW Health Issues

In relation to the submissions by NSW Health, the PAC notes that:

> *"... the real significance of the issue raised by NSW Health is that this project will cause a large increase in PM10s [sic] above the existing level in Cullen Bullen (even if it complies with the NSW criteria) and this will have a direct impact on the health of the community, a community that is already socially disadvantaged and with poor health statistics compared to the rest of NSW."*

In particular, NSW Health's concerns are based on (as observed by the PAC):

> *"... a predicted incremental annual average PM10 in Cullen Bullen of 30 – 100%. This represents up to a doubling of the exposure to dust particles in the township and its community and thus an increase in the risk of residents experiencing respiratory problems known to be associated with coarse particulate matter exposure such as asthma. The World Health Organization guidelines indicate that an incremental exposure to PM_{10} of this magnitude could be associated with an increase mortality risk of 3%."*

The World Health Organisation (WHO) has set an air quality guideline value for annual average PM_{10} of 20 µg/m^3. This guideline has been developed taking into account the most sensitive groups with the population including those with existing respiratory and cardiovascular disease and low socioeconomic status. NSW Health claims that the residences of Cullen Bullen fall into these sensitive groups, however this has been taken into account by the WHO in establishing its air quality guideline.

The WHO has also set an interim target, based on acceptable health risks, used in developing countries as a way of moving towards the air quality guideline value. These populations have high levels of poor health and low socioeconomic status. The annual average WHO guideline of 20 µg/m^3 has an interim target of 70 µg/m^3. The WHO claims that this difference of 50 µg/m^3 increases the long-term mortality risk by 15%. While not explicitly stated in their submission, it is assumed this is the source of the NSW Health reference to 3% increase in mortality risk for a 10 µg/m^3.

NSW Health recommended that *"measures be taken to minimise the increment in annual average PM_{10} in Cullen Bullen as far as feasible."* This has been done by way of variations in mine plans and more refined representation of on-site emissions, as assessed in **Section 6** (the Contracted Project).

Predictions for the EA modelling were shown to be below the NSW EPA annual average PM_{10} criterion of 30 µg/m^3 in Cullen Bullen. The modelling for the Contracted Project has now shown that predicted ground level concentrations in the town in Year 2, are below the annual average WHO guideline of 20 µg/m^3. It should be noted that the background concentrations used will also be conservative as they will include emissions from existing mining operations as well as from other non-mining sources.

With the removal of the Hillcroft mining area and the update of emissions inventories using site-specific measurements, Coalpac's contributions are predicted to have been reduced by approximately 50%, resulting in levels at the town of approximately 2 – 5 µg/m³.

It is my opinion that the variations made to the Project will significantly reduce both 24-hour and annual average PM_{10} concentrations at the township of Cullen Bullen, particularly at the school. Predictions now show that annual average PM_{10} concentrations in the town are below 20 µg/m³ (the WHO guideline as recommended by NSW Health) and significantly below the NSW EPA annual average PM_{10} criterion of 30 µg/m³.

In its submission to the PAC, NSW Health also stated that:

> *"… the proposed "real-time management system" to reduce peak particulate matter emissions will have no impact on reducing the overall increase in long-term exposure to particulate matter for local residents. We recommend that Coalpac conduct further evaluation into measures to prevent or minimise dust impact. This may involve a change to the staging of the project so that the intensity of particulate matter impacts on the Cullen Bullen residents is reduced."*

Firstly, decreasing 24-hour concentrations will, by definition, decrease the annual concentration and thus reduce the overall increase in long-term exposure to particulate matter. The more often these peaks can be reduced the lower the resulting annual average concentrations.

Secondly, as demonstrated, Coalpac has made changes to mine plan and staging which have resulted in reductions of up to 50% in the predicted annual average PM_{10} ground level concentrations in Cullen Bullen.

7.2 Predictive dust management technology

There are various comments throughout the PAC report raising concerns about the reliance on the predictive dust management system to achieve the predicted ground level concentrations. Concerns are also raised about the on-going reliability of the system itself. Such comments include (but are not limited to):

"… achievement of the predicted air quality levels relies on a large suite of control measures and a real-time management system, and failure of any of these could result in the exceedance of the acceptable air quality criteria in Cullen Bullen." [Section 5.1.3.3, page 30 and Section 5.1.4, page 31]

"… calls into question the reliance on Real Time Air Quality Management Systems as the potential panacea for air quality problems from open-cut coal mines." [Section 5.1.4, page 32]

"… the Proponent's reliance on a large suite of equipment attenuations, day to day operational variations, monitoring, predictive and reactive measures to achieve the predicted levels. … and the potential for human or equipment failure of any of these would increase the risk of increased air emissions." [Section 5.1.4, page 33]

"As this system is essential to achieving the required air quality standards for this project, the risks associated with the exceedance of the standards must be considered high." [Section 5.1.8, page 40]

"… the reliance on a suite of operational management action including the proposed Real Time Air Quality Management System to achieve the air quality criteria …" [Section 5.1.9, page 41]

There appears to be a misunderstanding by both NSW Health and the PAC as to the purpose of and what part the predictive dust management tool has played in the air quality impact assessment for the Project.

In short, this system plays no part in the air quality assessment. In other words, to say that the Proponent will rely on these predictive and reactive measures to achieve the predicted concentrations (as quoted above) is incorrect and misleading. The emissions inventories calculated and used for the dispersion modelling, for the EA and for the Contracted Project, do not take into account any reliance on a predictive management technology. This tool is to be implemented as part of a management strategy to achieve *further* air quality emission reductions. Such a tool is an additional safeguard that may be applied to operational dust management for the facility, and will act to further augment dust controls and reduce potential off site impacts.

To say that a "*failure of any of these could result in the exceedance of the acceptable air quality criteria in Cullen Bullen"* is also incorrect. In fact, given that these measures are not included in the modelling, their failure would have no impact on the results of the modelling predictions presented in either the EA or this assessment for the Contracted Project.

The only mitigation measures incorporated into the modelling related to emissions from two activities, namely haulage and wind erosion. Regarding the former, we note above that Coalpac has committed to demonstrating the level of assumed control (75%), or more if required by the PRP. Regarding the latter, the above discussions conclude that modelling presented in the EA is conservatively high compared to the recommended approach of NSW EPA.

In other words, the modelling has not taken into consideration any further emission reductions that may be achievable at the source due to good practice operational dust management, such as the use of a predictive dust management system. Such other measures that have not been explicitly modelled, but will be incorporated into an operational Air Quality Management Plan (AQMP) for the Project include (but are not be limited to) watering at truck loading and dumping locations, water injection in drill holes and dust curtains on drill rigs. All of these planned activities will aid to reduce actual particulate emissions below the values assumed in the modelling to date.

The aim of a predictive dust management system is to reduce emissions at their source and in advance of any adverse meteorological conditions, rather than to react to a potential exceedance recorded at a monitor located off site.

The PAC notes that this is new technology, which is true, and the potential benefits to both Coalpac and the local community are clearly evident. Such systems are currently successfully in use at a number of sites in NSW, as well as Queensland and Western Australia.

Such a system does not claim to be the *"panacea for air quality problems from open-cut mines"*, as noted by the PAC report, but rather another (leading practice) tool in the management of air quality, particularly at the source. It enables dust generating activities to be monitored more closely and adjusted in advance, in ways that have not been available before.

When Pacific Environment stated in our response to submissions that *"Coalpac acknowledges that it is paramount that an effective AQMP is developed and implemented for this Project"*, it was not meant that the predictions were reliant on this system, as seems to be the interpretation of the PAC when it states:

"This creates some question over the certainty of the predictions that can be made in the EA and the capacity of the available mitigation strategies to keep the project within the criteria."

The predictions are not reliant on this system. The Contracted Project predictions show that the criteria are met at Cullen Bullen. The predictive management tool would be implemented to achieve further emission reductions and therefore further potential reductions in ground level concentrations beyond those which have been predicted.

8 PAC REVIEW RECOMMENDATIONS

8.1 Recommendation 1

> *"The Commission recommends that the emission estimate predictions should be updated and reconfirmed using the most relevant emission variables as recommended by the EPA prior to any determination of the project."*

This has been done and the results are discussed in **Section 5.1**. The parameters used in the EA modelling were conservative and the emission factors recalculated with site specific measurements for the Contracted Project were significantly lower (see **Section 6**).

The outcome of this work was as we expected, and consistent with our stated position in the EA air quality assessment report and the Response to Submissions report.

The EA modelling was more conservative than that completed for the Contracted Project using site specific variables, in terms of emissions estimation and assumptions regarding emission factor parameters.

8.2 Recommendation 2

> *"The Commission recommends the current acquisition criterion for PM_{10}s [sic], 150 µg/m³ 24-hour average from all sources, should be reviewed from a health perspective given the NEPC criteria of 50 µg/m³ and more recent advice from NSW Health about mortality and morbidity impacts. This should be done in consultation with NSW Health and the EPA prior to any final approval for the Coalpac project."*

It is not within the scope of an air quality impact assessment to comment on the acceptability or otherwise of the relevant air quality assessment criteria (**Section 3**). This is a matter for the relevant government departments such as NSW Health, NSW EPA and the NSW DP&I.

The air quality assessment references current air quality criteria that apply in NSW. It is noted that the air quality criteria adopted within Australia are amongst the most stringent compared to other Organisation for Economic Co-operation and Development (OECD) countries.

8.3 Recommendation 3

> *"The Commission recommends the NSW long-term acquisition criterion for annual average particulate matter less than 10 microns (PM10) of 30 µg/m³ should be reviewed against the WHO goal of 20 µg/m³ for this parameter."*

It is not within the scope of an air quality impact assessment to comment on the acceptability or otherwise of the relevant air quality assessment criteria. This is a matter for the relevant government departments such as NSW Health, NSW EPA and the NSW DP&I.

The air quality assessment references current air quality criteria that apply in NSW. It is noted that the air quality criteria adopted within Australia are amongst the most stringent compared to other OECD countries.

8.4 Recommendation 4

> *"The Commission recommends that any approval for the project should include the relevant condition from the Ashton South East Open Cut Coal Project determination relating to air quality exceedences at mine owned residences. These conditions relate to adequate notification of the tenant, termination of the tenancy without penalty, air mitigation measures and ongoing monitoring information and notification of the owners of the land with an option for acquisition."*

Coalpac have adopted this recommendation and will comply with any final consent conditions from NSW DP&I consistent with the conditions of the Ashton *South East Open Cut Coal Project* (Project Approval 08_0182) regarding the occupancy of mine-owned residences. Coalpac commit to this in their revised Statement of Commitments for the Contracted Project – Reference 98.

8.5 Recommendation 5

> *"The Commission recommends that blasting should only be conducted when the wind will transport fumes away from the Cullen Bullen School, Cullen Bullen village and any residences."*

This is current standard practice at Coalpac's operations. This is a reasonable recommendation that Coalpac will adopt for the Contracted Project. Blasting only under favourable wind conditions was already noted and described in the EA and will form part of the AQMP. Such criteria may be easily integrated within a Real Time Air Quality Management System (RTAQMS). Coalpac commit to this in their revised Statement of Commitments for the Contracted Project – Reference 45.

8.6 Recommendation 6

> *"The Commission recommends the proposed Air Quality Management Plan (AQMP) should include key performance indicators and outcomes across the full range of potential sources of air emissions. The AQMP should be developed in consultation with the EPA and be approved by the Director General of the Department prior to commencement of works associated with the development. Specific attention should be given to the performance outcomes to achieve the air quality criteria."*

Coalpac will revise its Air Quality Management Plan (AQMP) such that it includes key performance indicators (KPI) and outcomes across the full range of potential sources of air emissions. The AQMP will be revised in consultation with the NSW EPA and be approved by the Director General.

Air quality KPIs will be developed to ensure performance outcomes for the Contracted Project are achieved. A number of KPIs have already been identified as part of the Dust Stop PRP studies for Cullen Valley Mine and Invincible Colliery. These include parameters to be measured, frequency of these measurements, goals and timing.

8.7 Recommendation 7

> *"The Commission recommends that the total area of active mining and un-rehabilitated dumps should not exceed 180 hectares at any one time."*

This is reasonable and we recommend that Coalpac accepts this recommendation. Coalpac has confirmed that, consistent with the Statement of Commitments in the EA, the total area of active open cut mining in any given year will be limited to less than 100 ha (Statement of Commitments for the Contracted Project – Reference 5).

8.8 Recommendation 8

"The Commission recommends that operational conditions are sufficiently rigorous to ensure the Real Time Air Quality Management System is used predictively and that failure to do this amounts to non-compliance."

Coalpac will utilise technologies and initiatives for the Contracted Project to achieve the air quality outcomes described in this document, consistent with the EA and Response to Submissions. This includes the installation of an RTAQMS as part of the Air Quality Management Plan as discussed further in **Section 7.2**.

In the absence of any other controls, Coalpac will restrict operating hours or shut down relevant activities to ensure ongoing compliance with the Project Approval air quality goals at private receptors.

8.9 Recommendation 9

"The Commission recommends that auditing requirements are imposed to assess compliance and to assess whether additional management responses are required. It is also necessary to ensure long-term commitment to effective use of the Real Time Air Quality Management System."

Coalpac has committed to the installation of an RTAQMS prior to increasing coal production above currently approved limit of 2.2 Mtpa. The system will be audited as part of the Project Approval compliance auditing process to assess whether additional management responses are required and to confirm that a long term commitment to the effective use of the RTAQMS is in place.

8.10 Recommendation 10

"The Commission recommends that shutting down of operations should be adopted as a management response in this airshed to ensure the air quality criteria are met."

Coalpac will utilise technologies and initiatives predictive dust management system to achieve the air quality outcomes described in this document, consistent with the EA and Response to Submissions. In the absence of any other controls, Coalpac will restrict operating hours or shut down relevant activities to ensure ongoing compliance with the Project Approval air quality goals at private receptors.

The specifics of what constitutes 'unfavourable conditions' are dependent on locations of mining activities and residential receivers, and will be confirmed as part of the development and implementation of the RTAQMS.

8.11 Recommendation 11

"The Commission recommends restriction of hours as well as production limits to be included if the Real Time Air Quality Management System doesn't deliver all required outcomes."

This is reasonable and we recommend that Coalpac accepts this recommendation. Coalpac commit to this in their revised Statement of Commitments for the Contracted Project – Reference 14.

8.12 Recommendation 12

"The Commission recommends that an evaluation should be conducted of Real Time Air Quality Management Systems (RTAQMS) including their effectiveness in controlling emissions from open-cut mines. This should include investigation of the relationship between suppression

of peak emission levels and the effect (if any) on annual average emission levels from open-cut mines in NSW."

This is an action that could be carried out in the future by the regulator and a number of co-operative mine operators, as it will require both monitoring and management data to be collected over a period of time and across a number of operating coal mines before any analysis can be undertaken. It is assumed that such an investigation would be a matter for the relevant government departments such as NSW EPA and NSW DP&I to scope and coordinate.

An initiative such as this is not within the scope of an air quality impact assessment, should not form a condition of Project Approval for the Contracted Project and should not be applied specifically to a single site.

8.13 Recommendation 83

"The Commission recommends that in the event of an approval appropriate conditions are included requiring compliance with the Proponent's Statement of Commitment 13 and for Coalpac to minimise its Scope 1 greenhouse gas emissions."

Consistent with Statement of Commitment 13 presented in the EA, Coalpac will undertake calculations of greenhouse gas emissions and annually review energy efficiency initiatives to ensure that Scope 1 greenhouse gas emissions per tonne of coal are kept to a the minimum practicable level.

Coalpac should comply with any final consent from NSW DP&I regarding the minimisation of greenhouse gas emissions. Coalpac remains committed to implementing a Greenhouse Gas Management Plan (GHGMP) for the Project, should it be approved. It is noted that the current price on carbon provides a real (and significant) incentive for Coalpac to minimise its Scope 1 and Scope 2 GHG emissions.

9 FINAL REMARKS

The Contracted Project results in significant reductions for Year 2 in both 24-hour and annual average predicted ground level PM_{10} concentrations. This reduction in predictions is a result of mine plan changes and the use of site-specific measurements of parameters in the calculation of total emissions from Contracted Project mining activities.

Predicted concentrations of PM_{10} in Cullen Bullen (for the Contracted Project) are below the WHO annual goal of 20 µg/m^3 in Year 2, and well below the NSW EPA criterion of 30 µg/m^3.

The model predictions in this report and the EA do not assume or include any further reductions in emissions which may be achieved either by additional mitigation and controls on emission sources (other than those modelled), or by the implementation of the RTAQMS. Any reductions in emissions from individual sources from such control measures would be expected to further reduce predicted concentrations.

10 REFERENCES

NEPC 1998

Ambient Air – National Environment Protection Measure for Ambient Air Quality, National Environment Protection Council, Canberra.

NERDDC 1988

Air Pollution from Surface Coal Mining: Measurement, Modelling and Community Perception, Project No. 921, National Energy Research Development and Demonstration Council, Canberra.

NHMRC 1996

Ambient Air Quality Goals Recommended by the National Health and Medical Research Council, National Health and Medical Research Council, Canberra.

NSW DEC 2005

"Approved Methods for Modelling and Assessment of Air Pollutants in New South Wales", EPA August 2005

NSW EPA 1998

Action for Air: The NSW Government's 25-Year Air Quality Management Plan, NSW Environment Protection Authority, Sydney

PAEHolmes (2012)

"Coalpac particulate matter control best practice pollution reduction program – Invincible Colliery", prepared by PAEHolmes, February 2012

APPENDIX A CURRICULUM VITAE FOR JANE BARNETT

Curriculum Vitae

Jane Barnett

Principal Consultant – Air Quality

Pacific Environment Consulting

Telephone: 02 9870 0900

Mobile: 0412 558 366

Email: jane.barnett@pacific-environment.com

AREAS OF EXPERTISE

- Air Dispersion Modelling (AUSPLUME, ISCSCT3, CALMET/CALPUFF, TAPM, CALINE, AERMOD)
- Emissions estimation
- Air Quality Impact Assessment
- Odour Assessment
- Meteorology

QUALIFICATIONS & PROFESSIONAL AFFILIATIONS

- Bachelor of Technology in Atmospheric Science (Macquarie University, NSW)
- Bachelor of Science (Hons) (Macquarie University, NSW)
- Clean Air Society of Australia & New Zealand

PROFESSIONAL EXPERIENCE

Jane has nearly 20 years of experience in air quality consulting. She began with Holmes Air Sciences (now Pacific Environment) in 1995 after graduating from Macquarie University with a Bachelor of Technology in Atmospheric Science (BTech)(Hons). Since that time she has worked on a wide variety of projects including opencut and underground mines, landfill sites, sewage treatment plants, quarries, sand mines, roadways, power stations, concrete batching plants, composting operations and recycling facilities among others.

She has experience in dispersion modelling including AUSPLUME, ISC, CALINE, TAPM, AERMOD, CALMET and CALPUFF. She also has experience in noise modelling and meteorological and dust data collection, preparation of emission inventories, as well as processing and analysis of these and other types of data. She has experience across the full range of air quality and noise work, from client contact to final report delivery.

PROJECT EXPERIENCE

Industry / Mining

- Coal mines including (but not limited to):
  - Air quality impact assessment for the Coalpac Consolidation Project which will consolidate the mining operations of Cullen Valley Mine and Invincible Mine, including the development of a three-dimensional wind field model for the area.
  - Air quality assessment for Ravensworth Continued Operations
  - Air quality assessment for Mt Arthur Coal
  - Air quality assessment for Mt Owen Operations

- Air quality assessment for Liddell Colliery
- Air quality assessment for Rocglen Mine
- Air quality assessment for Newstan mine
- Air quality assessment for Centennial Coal Services
- Air quality assessment for Muswellbrook Coal
- Air quality assessment for Rixs Creek
- Air quality assessment for Hunter Valley Operations (Carrington West Wing)
- Air quality assessment for Bengalla
- Particulate matter control best practice pollution reduction program – Cullen Valley Mine
- Particulate matter control best practice pollution reduction program – Invincible Colliery
- Particulate matter control best practice pollution reduction program – Berrima Colliery

- Gold and mineral mines including (but not limited to):
  - Air quality assessment for Cannington
  - Air quality assessment for Cadia Valley Operations
  - Air quality assessment for Cadia East
  - Air quality assessment for Stawell Gold Mine
  - Air quality assessment for Cowal Gold Mine

- Quarries and sand mines including (but not limited to):
  - Air quality assessment for Williamsdale Quarry
  - Air quality assessment for Maroota Quarry
  - Air quality assessment for Wilton Quarry
  - Air quality assessment for Marulan Quarry
  - Air quality assessment for O'Allen Quarry

- HF dispersion study for a proposed Phosphoric acid plant at Sybella Creek and Phosphate Hill, near Mt. Isa, Queensland

- SO_2 dispersion study for proposed Platinum smelter at Hartley, Zimbabwe

<u>Odour impact</u>

- Waste disposal – odour assessments for:
  - Liquid waste plant at Lidcombe (Sydney)
  - Non-putrescible waste disposal areas at Marsden Park (Sydney) and Buttonderry (NSW, Central Coast)
  - Putrescible waste disposal areas at:
    - Alternative Waste Technology facilities at Jacks Gully, Lucas Heights (proposed), Kemps Creek, Terrey Hills, Whites Creek Landfill (Hunter Valley)
    - Eastern Creek Landfill
    - Lucas Heights Landfill
    - Cessnock Landfill expansion
    - Whytes Gully Landfill
    - Mixed waste Newcastle resource recovery centre (proposed)
    - Waste transfer station Wetherill Park (Sydney)

- Sewage Treatment Plants including (but not limited to):
  - Air quality assessment for St Marys STP
  - Air quality assessment for Murwillumbah STP
  - Air quality assessment for Rouse Hill STP

    - Air quality assessment for Port Macquarie STP
    - Air quality assessment for Ulladulla STP
    - Air quality assessment for Forster STP
    - Air quality assessment for Pacific Palms STP
    - Air quality assessment for Moree STP
    - Air quality assessment for Taree STP
    - Air quality assessment for South West Rocks STP
    - Air quality assessment for Quakers Hill STP

- Feedlots including:
    - Air quality assessment for The Mount Feedlot
    - Air quality assessment for Mungeribar Feedlot
    - Air quality assessment for Widgiewa Feedlot
    - Air quality assessment for Gooloogong Feedlot
    - Air quality assessment for Deniliquin Feedlot

- Air quality assessment of odour emissions from plastics factories in Botany and St Peters.

Roads and infrastructure

- RTA NSW – analysis and reporting of extensive air quality monitoring, impact assessments for various roadway projects, including the M2, M4, M5, M5 East, M5 West and M7, Cross-city tunnel, widening of Epping Road, Liverpool to Parramatta Bus Transitway, North Kiama, Charlestown, Alstonville and Coopernook Bypasses
- Ryde City Council – Ryde Landuse and Planning Strategy an Air Quality Overview
- Various projects in the ACT to assess the impacts of proposed increases in local traffic due to new residential developments

Noise impact

- Noise impact assessments for various projects including Kayuga Coal Mine, Cessnock Landfill, Caltex Birkenhead Fuel Terminal Upgrade in Port Adelaide, Intermodal Transfer Facilities and Iluka Mineral Sands Project in Ouyen.

PROFESSIONAL DEVELOPMENT AND TRAINING

- Annual Australasian Climate Forum – Toowoomba, February 1994
- Energy and Air Quality (CASANZ) – Sydney, November 1995
- MODSIM 95 (Modeling and simulation) – Newcastle, November 1995
- Winds of Change, Air Quality and Health – Brisbane, December 1995
- 13th International Clean Air & Environment Conference – Adelaide, September 1996
- 14th International Clean Air & Environment Conference – Melbourne, October 1998
- MODSIG Workshop – Melbourne, October 1998
- Fine Particles Seminar – Leura, December 1998
- 16th International Clean Air & Environment Conference – Auckland, August 2002
- Air Dispersion Modelling, CALPUFF. CASANZ Training Course by Earth Tech Inc. USA – Sydney, November 2008
- 19th International Clean Air & Environment Conference – Perth, September 2009
- 20th International Clean Air & Environment Conference – Auckland, August 2011
- AERMOD View Introductory and Advanced Training Course by Lakes Environmental and CASANZ –

Perth, September 2012

- NSW Minerals Industry 2012 Environment and Community Conference, October 2012

PUBLICATIONS

- Field Evaluation of an Urban Canyon Airflow and Scalar Dispersion Model. Part I - Description of Field Experiments and Airflow Regimes - H Cleugh, J Barnett, D Williams, J Carras, L Hunter and G Johnson, Volume 2: Air Pollution and Climate - Proceedings of MODSIM 95 International Congress on Modelling and Simulation, 1995.
- *Field Evaluation of an Urban Canyon Airflow and Scalar Dispersion Model. Part II - Model Evaluation*, G Johnson, L Hunter, H Cleugh and J Barnett, Volume 2 : Air Pollution and Climate - Proceedings of MODSIM 95 International Congress on Modelling and Simulation, 1995
- *Effect Of Road Tunnel Ventilation Emissions on Ambient Air Quality – M5 East: A Case Study*, Jane R. Barnett, Judith A. Cox, Nigel E. Holmes and Jay Stricker. Presented at the CASANZ Annual Conference, Newcastle, NSW, 2003.

APPENDIX B SUMMARY OF PREDICTED GROUND LEVEL CONCENTRATIONS FROM THE EA MODELLING

Bold red values are those which were predicted to exceed the relevant criteria in the EA modelling.

Table B1: Predicted Ground Level Concentrations from the EA

ID	Year 2 – Project alone				Year 2 - Project and other sources		
	24-hour PM_{10} (µg/m³)	Annual PM_{10} (µg/m³)	Annual TSP (µg/m³)	Annual Dust Deposition (g/m²/month)	Annual PM_{10} (µg/m³)	Annual TSP (µg/m³)	Annual Dust Deposition (g/m²/month)
	Assessment criteria						
	50	*N/A*	*N/A*	*2*	*30*	*90*	*4*
Sensitive receptors							
81	9	1	3	0	13	34	0.9
86[a]	11	2	4	0.1	14	35	1
87	9	1	3	0	13	34	0.9
103	16	2	6	0.1	14	37	1
104	21	3	7	0.1	15	38	1
106	23	3	9	0.1	15	40	1
107	23	3	8	0.1	15	39	1
108	24	3	8	0.1	15	39	1
109	21	3	8	0.1	15	39	1
111A	9	1	3	0	13	34	0.9
111B	9	1	3	0	13	34	0.9
112	12	2	5	0.1	14	36	1
113	16	3	7	0.1	15	38	1
114	17	3	7	0.1	15	38	1
119	12	2	4	0.1	14	35	1
123	18	3	8	0.2	15	39	1.1
139	19	3	9	0.2	15	40	1.1
142	18	4	11	0.3	16	42	1.2
143	15	4	10	0.3	16	41	1.2
144	14	4	9	0.3	16	40	1.2
169[b]	**62**	15	39	1.2	27	70	2.1
171[b]	**64**	15	39	1.4	27	70	2.3
179[c]	23	4	11	0.5	16	42	1.4
195[c]	**191**	37	94	**3**	**49**	**125**	3.9
196[ac]	**173**	33	84	**2.7**	**45**	**115**	3.6
197[c]	**402**	78	200	**7.8**	**90**	**231**	**8.7**
198[c]	**199**	37	94	**3.2**	**49**	**125**	**4.1**
199[c]	**136**	28	71	**2.1**	**40**	**102**	3
205	11	3	9	0.3	16	40	1.2
209	13	3	7	0.2	15	38	1.1
210	13	3	8	0.2	15	39	1.1
211	14	3	9	0.3	15	40	1.2
216	42	10	26	0.8	23	58	1.7
217a[a]	46	9	24	0.7	21	55	1.6
217b[a]	**52**	9	22	0.5	21	53	1.4
220	21	5	14	0.3	17	45	1.2
223	23	5	13	0.3	17	44	1.2
225	23	5	13	0.3	17	44	1.2
227	23	5	13	0.3	17	44	1.2
228	23	5	13	0.3	17	44	1.2
229	23	5	14	0.3	17	45	1.2
230	23	5	14	0.3	17	45	1.2
231	24	5	14	0.3	17	45	1.2
232	24	6	14	0.4	18	45	1.3
235	28	6	15	0.4	18	46	1.3
235	30	6	16	0.4	18	47	1.3
236	33	6	16	0.4	18	47	1.3
237	28	6	16	0.4	18	47	1.3
238	29	6	16	0.4	18	47	1.3

ID	Year 2 – Project alone				Year 2 - Project and other sources		
	24-hour PM_{10} (µg/m³)	Annual PM_{10} (µg/m³)	Annual TSP (µg/m³)	Annual Dust Deposition (g/m²/month)	Annual PM_{10} (µg/m³)	Annual TSP (µg/m³)	Annual Dust Deposition (g/m²/month)
	Assessment criteria						
	50	*N/A*	*N/A*	*2*	*30*	*90*	*4*
238	32	6	16	0.4	18	47	1.3
239	29	6	16	0.4	18	47	1.3
240	31	6	16	0.4	18	47	1.3
242	31	7	17	0.4	19	48	1.3
243	31	7	17	0.4	19	48	1.3
245	34	7	18	0.4	19	49	1.3
247	26	6	14	0.3	18	45	1.2
248	27	6	14	0.3	18	45	1.2
250	28	6	15	0.4	18	46	1.3
251	26	6	14	0.3	18	45	1.2
253	26	6	14	0.4	18	45	1.3
254	27	6	15	0.4	18	46	1.3
254	29	6	15	0.4	18	46	1.3
255	29	6	15	0.4	18	46	1.3
256	32	6	16	0.4	18	47	1.3
257	34	6	16	0.4	18	47	1.3
258	49	8	20	0.5	20	51	1.4
262[a]	18	5	12	0.3	17	43	1.2
263	19	5	12	0.3	17	43	1.2
264	19	5	12	0.3	17	43	1.2
267	20	5	12	0.3	17	43	1.2
268	21	5	13	0.3	17	44	1.2
270	19	5	12	0.3	17	43	1.2
270	19	5	12	0.3	17	43	1.2
271	21	5	12	0.3	17	43	1.2
272[a]	23	5	13	0.3	17	44	1.2
272[a]	24	5	13	0.3	17	44	1.2
272[a]	24	5	13	0.3	17	44	1.2
272[a]	24	5	13	0.3	17	44	1.2
273	15	4	10	0.2	16	41	1.1
273	15	4	10	0.2	16	41	1.1
275	15	4	10	0.2	16	41	1.1
276	16	4	11	0.3	16	42	1.2
276	16	4	10	0.3	16	41	1.2
277	16	4	10	0.3	16	41	1.2
278	16	4	11	0.3	16	42	1.2
279	17	4	11	0.3	16	42	1.2
280	17	4	11	0.3	16	42	1.2
281	17	4	11	0.3	16	42	1.2
283	19	5	12	0.3	17	43	1.2
284	20	5	12	0.3	17	43	1.2
285	21	5	12	0.3	17	43	1.2
288	22	5	13	0.3	17	44	1.2
289	23	5	13	0.3	17	44	1.2
291	27	6	14	0.3	18	45	1.2
296	30	6	15	0.3	18	46	1.2
297	30	6	15	0.3	18	46	1.2
298	30	6	15	0.4	18	46	1.3
301	33	6	16	0.4	18	47	1.3
302	33	6	16	0.4	18	47	1.3
304	33	6	16	0.4	18	47	1.3
305	34	6	16	0.4	18	47	1.3
306	36	6	16	0.4	18	47	1.3
308	36	7	17	0.4	19	48	1.3

ID	Year 2 – Project alone				Year 2 - Project and other sources		
	24-hour PM_{10} (µg/m³)	Annual PM_{10} (µg/m³)	Annual TSP (µg/m³)	Annual Dust Deposition (g/m²/month)	Annual PM_{10} (µg/m³)	Annual TSP (µg/m³)	Annual Dust Deposition (g/m²/month)
	Assessment criteria						
	50	***N/A***	***N/A***	***2***	***30***	***90***	***4***
309	36	7	17	0.4	19	48	1.3
311	42	7	18	0.4	19	49	1.3
312	42	7	18	0.4	19	49	1.3
313	41	7	18	0.4	19	49	1.3
314	43	7	19	0.4	19	50	1.3
315	28	6	14	0.3	18	45	1.2
315	30	6	15	0.3	18	46	1.2
316	27	5	14	0.3	17	45	1.2
317	26	5	14	0.3	17	45	1.2
318	27	5	14	0.3	17	45	1.2
321	33	6	16	0.3	18	47	1.2
325	44	7	19	0.4	19	50	1.3
326	49	8	20	0.4	20	51	1.3
327	**54**	9	22	0.5	21	53	1.4
328	14	4	9	0.2	16	40	1.1
329	14	4	9	0.2	16	40	1.1
330	13	3	9	0.2	15	40	1.1
331	12	3	8	0.2	15	39	1.1
332	12	3	8	0.2	15	39	1.1
333	12	3	8	0.2	15	39	1.1
335	12	3	8	0.2	15	39	1.1
342	12	3	8	0.2	15	39	1.1
343	12	3	8	0.2	15	39	1.1
344	12	3	8	0.2	15	39	1.1
345	13	3	8	0.2	15	39	1.1
347	13	3	9	0.2	15	40	1.1
349	19	4	10	0.2	16	41	1.1
350	14	4	9	0.2	16	40	1.1
350	15	4	10	0.2	16	41	1.1
350	15	4	10	0.2	16	41	1.1
350	16	4	10	0.2	16	41	1.1
350	16	4	10	0.2	16	41	1.1
352	17	4	11	0.3	16	42	1.2
352	19	4	11	0.3	16	42	1.2
353	17	4	10	0.2	16	41	1.1
354	17	4	10	0.2	16	41	1.1
355	17	4	10	0.2	16	41	1.1
356	17	4	10	0.2	16	41	1.1
357	16	4	10	0.2	16	41	1.1
358	16	4	10	0.2	16	41	1.1
360[a]	28	5	14	0.3	17	45	1.2
364	21	5	13	0.3	18	45	1.2
367	17	3	9	0.2	16	41	1.1
368	28	5	13	0.2	18	45	1.1
372	14	3	8	0.2	16	40	1.1
373	17	3	9	0.2	15	40	1.1
383	24	4	11	0.2	17	43	1.1
384	22	4	11	0.2	17	43	1.1
385	22	4	11	0.2	17	43	1.1
386	26	4	11	0.2	17	43	1.1
388	14	3	8	0.1	15	39	1
391	15	3	8	0.2	16	40	1.1
392	22	6	14	0.3	18	45	1.2
393[b]	35	7	19	0.4	19	50	1.3

ID	Year 2 – Project alone				Year 2 - Project and other sources		
	24-hour PM_{10} (µg/m³)	Annual PM_{10} (µg/m³)	Annual TSP (µg/m³)	Annual Dust Deposition (g/m²/month)	Annual PM_{10} (µg/m³)	Annual TSP (µg/m³)	Annual Dust Deposition (g/m²/month)
	Assessment criteria						
	50	***N/A***	***N/A***	***2***	***30***	***90***	***4***
394[b]	**79**	13	34	0.6	25	65	1.5
396[b]	**90**	18	47	1.6	30	78	2.5
401	22	4	11	0.2	17	43	1.1
403	21	4	10	0.2	17	42	1.1
404	20	4	9	0.1	16	41	1
405	20	4	10	0.1	17	42	1
406	15	3	8	0.1	16	40	1
407	16	3	8	0.1	16	40	1
408	15	3	8	0.1	16	40	1
410	20	4	10	0.1	17	42	1.1
419	24	4	10	0.1	17	42	1
419	23	4	10	0.1	17	42	1
421	24	4	11	0.2	17	43	1.1
426	**62**	8	19	0.3	20	50	1.2

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