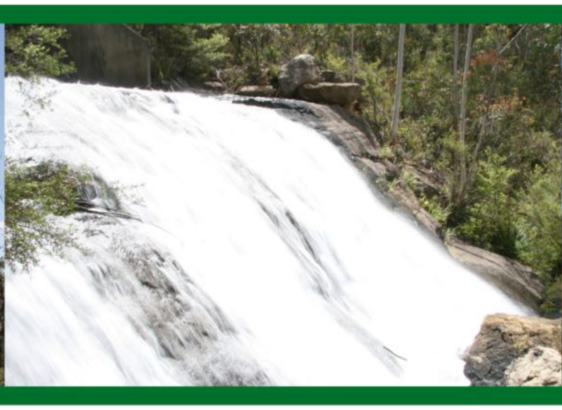
Centennial Coal


Springvale Colliery

Site Specific Particulate Matter Control Best Practice Assessment

Date September 2012

SLR

global environmental solutions

Centennial Coal

Springvale Colliery

Site Specific Particulate Matter Control

Best Practice Assessment

Report Number 630.10284.01400-R1

27 September 2012

Springvale Coal Pty Ltd
Castlereagh Highway,
Lidsdale NSW 2790

Version: Revision 1

Springvale Colliery

Site Specific Particulate Matter Control

Best Practice Assessment

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EXECUTIVE SUMMARY

Background

Springvale Colliery is an underground coal mine operated by Centennial Springvale. The Springvale Colliery consists of a Coal Handling Plant (CHP) and mine support infrastructure which includes decline tunnels, coal stockpiles, conveyors, mine ventilation fan, and workshop buildings.

There is no recent history of fugitive dust complaints from adjoining residents nor has there been any regulatory notices issued requiring surface dust suppression. The Springvale Environmental Management System provides a platform for the maintenance and operation of dust control measures. Compliance monitoring is undertaken for due diligence and compliance purposes using independent contractors.

The Springvale Colliery pit top is situated against the Newnes State Forest and therefore is largely enclosed by native forest. Coal delivered to the ROM stockpile is wet with moisture levels ranging from 10-12% which acts to reduce particulate emissions. Other measures which are routinely employed at the Springvale Colliery to reduce emissions of particulate matter are the implementation of speed limits on internal roads, the enclosure of coal crushing and screening processes and material transfer by conveyor, the application of water sprays on the ROM stockpile and on open areas at the site. In addition, paved and bitumen covered pit top areas are swept with a street sweeper twice per week to minimise dust loading.

Pollution Reduction Program

In 2011, the NSW Environmental Protection Authority (EPA) required, through a Pollution Reduction Program, that Springvale Colliery provide a report which examines in detail the potential measures which could be employed to further reduce particulate emissions from the mine. This is part of a larger program which aims to reduce particulate emissions from the coal mining industry as a whole in NSW.

Emissions were required to be quantified using United States Environmental Protection Agency approved emission factors without controls applied. Emission controls currently in place at Springvale Colliery were identified, and the control efficiency afforded by each applied measure, obtained through a literature review and site specific data were applied to these emissions.

Particulate emission sources were ranked according to the scale of emissions over a one year period with sources contributing to 97% of total site TSP emissions identified and taken forward for further assessment. The assessment required that additional controls (over and above those currently implemented at the site) were investigated, and the feasibility of implementing each control option was assessed with consideration to implementation costs, regulatory requirements, environmental impacts, safety implications and compatibility with current processes and any proposed future developments.

Following this feasibility assessment, a timeframe for implementation of particulate management measures was required to be provided if appropriate.

It is noted that the EPA requirement was for generic emission factors to be applied to all emissions sources in the calculation of particulate emissions. Certain emission factors (for example for wind erosion of coal stockpiles) do not take into account the moisture content of the coal at Springvale Colliery. It may therefore be considered that particulate emissions reported within this study tend to represent an overestimation of the actual emissions from the site.

EXECUTIVE SUMMARY

Findings

After the range of implementation costs, regulatory requirements, environmental impacts, safety implications and compatibility with current processes and any proposed future developments were considered, only one control measure was identified as being potentially feasible for implementation at the Springvale Colliery. The shaping and orientation of the ROM stockpile was identified as potentially resulting in reductions in PM_{10} emissions over 10 years of 450 tonnes.

Although other emissions sources were identified as potentially resulting in a large proportion of the total site particulate emissions, many of the currently implemented control measures were identified as representing best practice.

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1 INTRODUCTION

The study was performed in accordance with the *Coal Mine Particulate Matter Control – Best Practice: Site Specific Determination Guideline*[1] issued by the New South Wales (NSW) Office of Environment and Heritage (OEH) in November 2011.

This submission has been prepared into this format to comply with the OEH specifications as stipulated in the Licence Variation Condition U1.

1.1 Background

The Dust Stop program is being implemented through pollution-reduction programs (PRPs) as operating conditions under the Environmental Protection Licence (EPL). A PRP was issued to Springvale Colliery in December 2011 requiring that a Site Specific Particulate Matter Control Best Practice Assessment be prepared for the site.

1.2 Guidance

OEH has provided guidance on the general structure and methodology of the assessment report. For clarification, the guidance provided has been reproduced in **Appendix A**.

For each required step in the procedure, reference has been provided to the relevant sections in this assessment report:

1. Identify, quantify and justify existing measures that are being used to minimise particle emissions **Section 2**
2. Identify, quantify and justify best practice measures that could be used to minimise particle emissions **Section 3**
3. Evaluate the practicability of implementing these best practice measures **Section 4**
4. Propose a timeframe for implementing all practicable best practice measures **Section 5**

1.3 Description of Activities

EPL 3607 held by Springvale Coal Pty Ltd covers operations at the Springvale Colliery and Springvale Coal Services Wash Plant at Western Main. The Springvale Colliery is an underground mine which utilises the longwall method of mining to extract coal. There are no significant emissions to air of particulate matter from the extraction of coal from this underground operation, hence it is not considered further in this assessment.

EPL 3607 covers activities occurring at both the Springvale Colliery and Western Main Washery, a division of licence boundaries is to be sought to enable the Coal Services site to be included on a separate EPL. This PRP assessment covers activities occurring under EPL 3607 for the Springvale Colliery site only as a separate PRP report will be provided for the Coal Services sites.

The Springvale Colliery consists of a Coal Handling Plant (CHP) and mine support infrastructure which includes decline tunnels, coal stockpiles, conveyors, mine ventilation fan, and workshop buildings. Current activities at the colliery include:

- Coal Receipt – raw coal is brought to the surface to a stackout/reclaim stockpile, which is equipped with underground feeders, enabling coal to be loaded onto the reclaim conveyor. The maximum capacity of the stockpile is 85,000 tonnes, but generally operates at 40,000 tonnes;

[1] http://www.environment.nsw.gov.au/resources/air/20110813coalmineparticulate.pdf

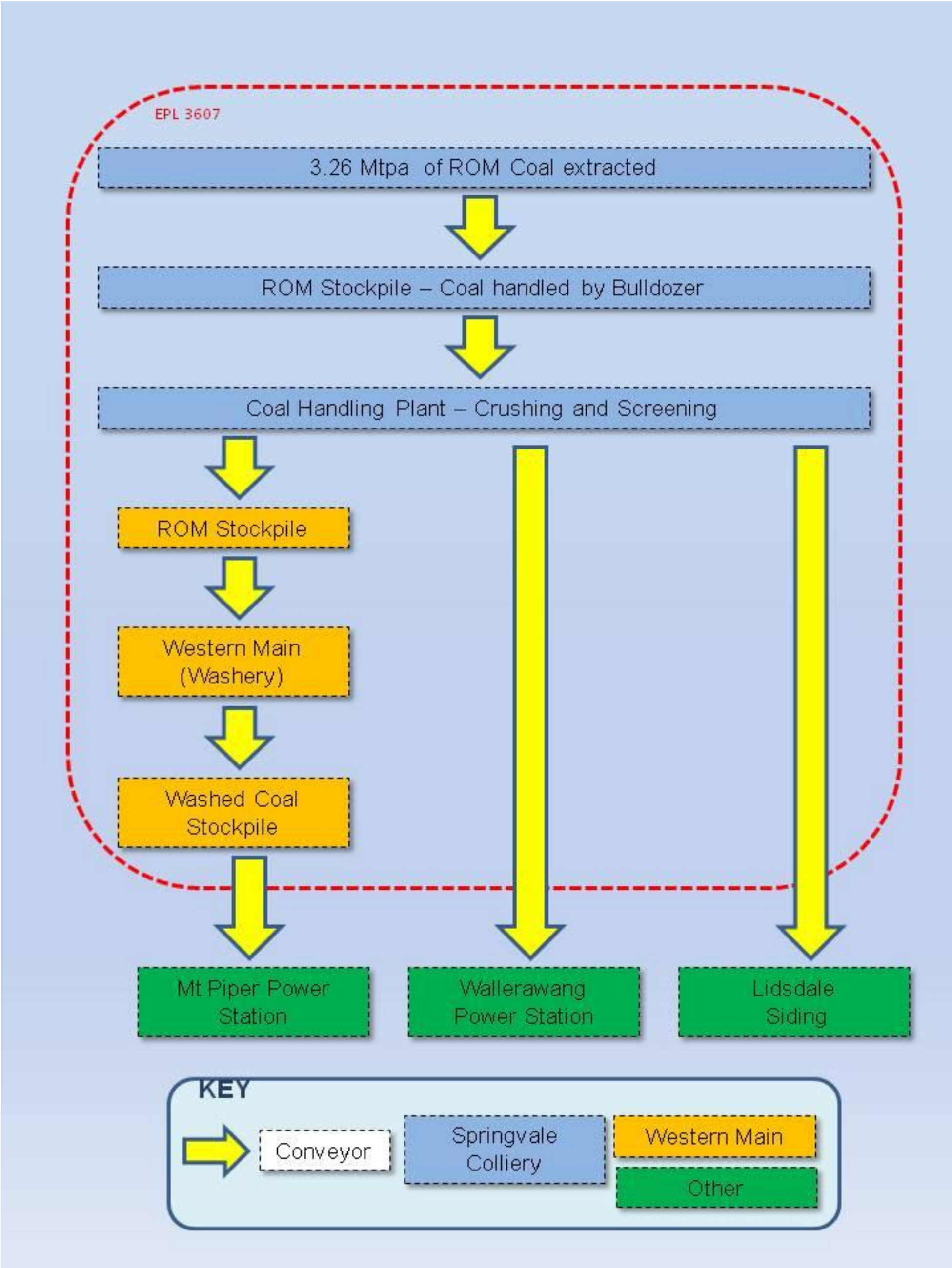
- Coal Handling and Storage – coal is handled on site using bulldozers on the main stockpile before it is transferred to the CHP and onto the conveyor;
- Coal is conveyed to the CHP for screening and crushing;
    - Coal Screening – screening of the raw coal is conducted in the screen and rotary breaker;
    - Coal Crushing – crushing of the coal occurs within the crushing plant;
- Transport of final product – the processed coal from the Project Site is transferred to Western Main (Washery), Lidsdale Siding or Mt Piper or Wallerawang Power stations via conveyor.

Springvale Colliery extracted 3.26 million tonnes (Mt) of coal during the 2011 reporting period, with 1,445,008 tonnes being washed at the Springvale Coal Services Site (AEMR, 2011). The Springvale Colliery and Coal Services operates 24 hours per day, 7 days a week.

These operational activities are discussed in more detail below. **Figure 1** presents graphically the coal extraction, transport, processing and storage procedures performed at Springvale Colliery. A Plan of the Pit Top area at Springvale Colliery is presented in **Figure 2**.

1.3.1 Springvale Colliery

Figure 1 Coal Processing, Storage and Transport – Springvale Colliery



Note: Only processes occurring at Springvale Colliery (blue boxes) are assessed within this PRP report.

Figure 2 Springvale Colliery – Pit Top Plan

Source: Centennial Coal

1.4 Project Approval Conditions

Project Approval Conditions under 101 of the *Environmental and Planning Assessment Act 1979*, require the monitoring of air quality including dust concentrations surrounding the operation.

1.5 Environmental Licence Conditions

The OEH regulates the operations conducted at Springvale Colliery through an EPL issued under the Protection of the Environment Operations Act 1997 (POEO Act). EPL 3607 (Springvale Coal Pty Limited) contains the following conditions in relation to dust (with the exception of the requirements in condition U1, which are considered within this report):

O3.1 The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.

O3.2 Trucks entering and leaving the premises that are carrying loads must be covered at all times, except during loading and unloading

Springvale Colliery operates a complaints recording and management system as part of their over-arching management system and in accordance with Condition M5 of the EPL. In the last four years, Springvale Colliery has had no complaints relating to dust nuisance. Therefore it is considered reasonable that current dust emission controls and management measures employed at the site are sufficient to manage any dust nuisance issues.

The Springvale pit top is situated against the Newnes State Forest and therefore is largely enclosed by native forest. Coal mined underground and conveyed to the ROM stockpile is wet with moisture levels ranging from 10-12%. The comparatively high moisture content of the coal does reduce the potential for fugitive dust emissions.

OEH do not have any current Notices issued to Springvale Colliery relating to air quality.

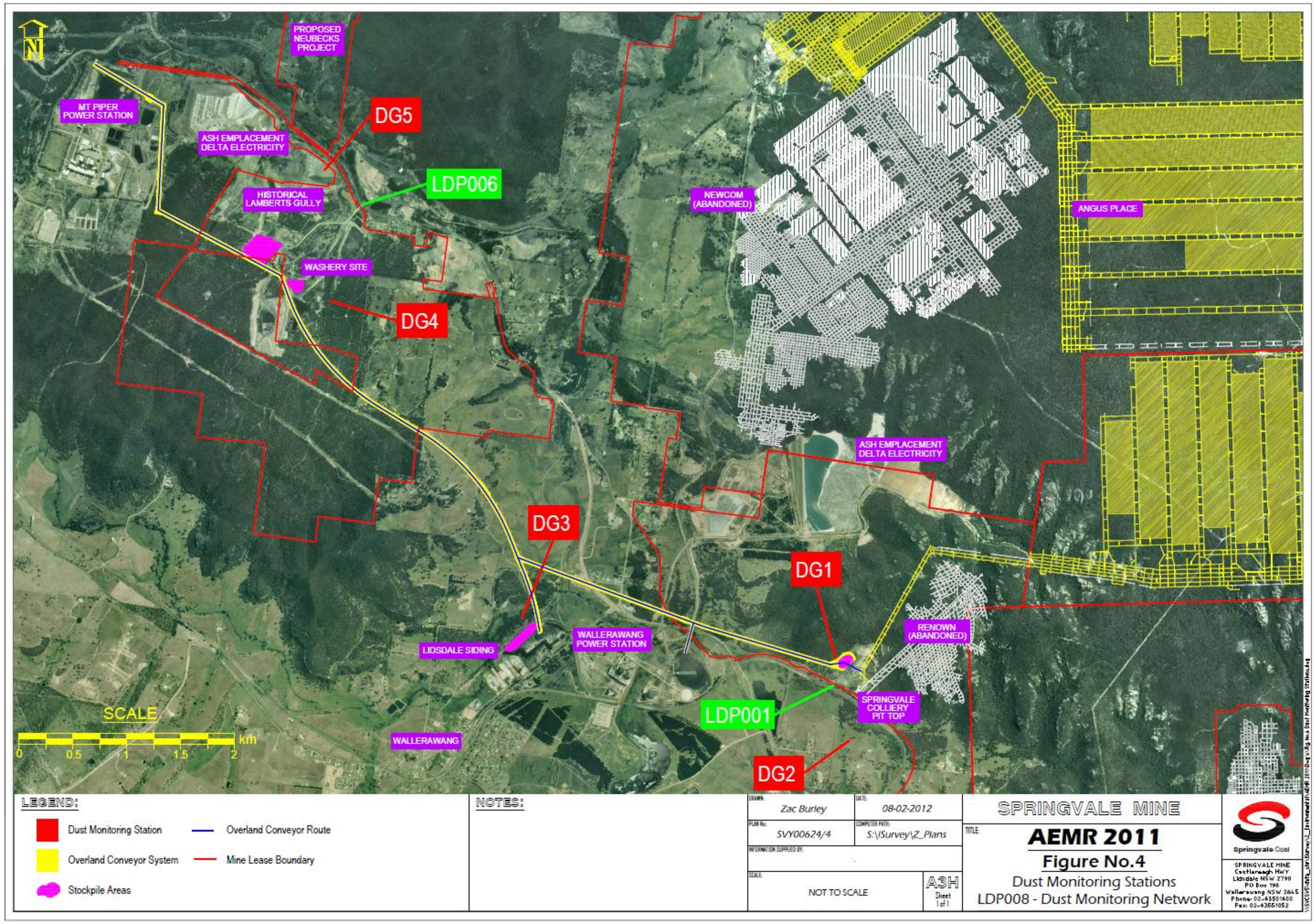
1.6 Environmental Performance

Springvale has an environmental management system and compliance database to manage the consequences of the underground mining operation. Considering the requirements of the EPL and due diligence purposes, Springvale Colliery operates an air quality monitoring program for TSP, PM_{10} and dust deposition.

Monitoring of total suspended particulate (TSP) and particulate matter with a mean aerodynamic diameter less than 10 microns (µm) (PM_{10}) using a high volume air sampler (HVAS) commenced in December 2010 at a location on Springvale Lane, adjacent to Springvale Colliery.

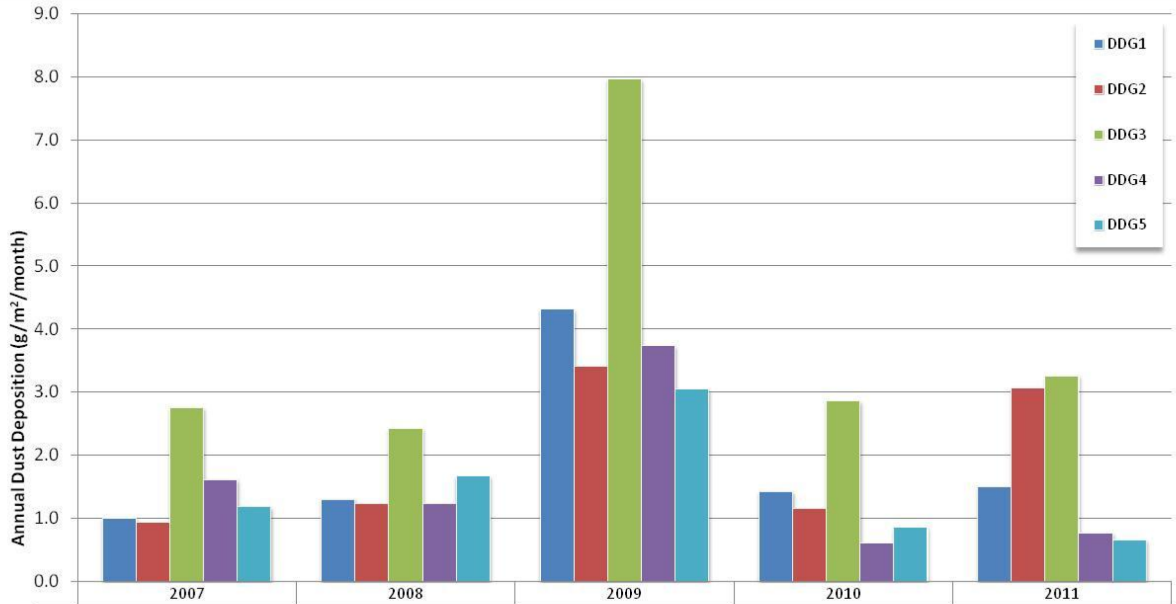
Dust deposition monitoring using dust deposition gauges (DDG) has been performed since 2007. Sampling at five locations surrounding the Colliery, Lidsdale Siding and Coal Services sites is undertaken on a monthly basis. The locations of dust deposition monitoring are identified in **Figure 3**.

Figure 3 Springvale Colliery (EPL 3607) Dust Deposition Monitoring Locations



Monitoring results for dust deposition are presented in **Figure 4** for the years 2007 to 2011. All dust deposition results met the assessment criterion of 4 g/m^2/month with the exception of 2009. Monthly dust deposition results were shown to be elevated in September 2009 (between 10 g/m^2/month and 28 g/m^2/month) and October 2009 (between 7 g/m^2/month and 10 g/m^2/month) due to a severe dust storm experienced at the end of September 2009.

Figure 4 Monitoring Results for Dust Deposition – Springvale Colliery



	2007	2008	2009	2010	2011
DDG1	1.0	1.3	4.3	1.4	1.5
DDG2	0.9	1.2	3.4	1.2	3.1
DDG3	2.8	2.4	8.0	2.9	3.3
DDG4	1.6	1.2	3.7	0.6	0.8
DDG5	1.2	1.7	3.1	0.9	0.7

YEAR

Monitoring results for PM_{10} and TSP are presented in **Table 1** for the period 19 December 2009 to 31 December 2011 and demonstrate that for both PM_{10} and TSP, compliance with contemporary standards is being achieved at the monitoring site.

Table 1 Monitoring Results for Particulate Matter – Springvale Colliery

Pollutant	Averaging Period	Monitoring Results	Criterion	Compliance with Contemporary Standard
Total suspended particulate matter (TSP)	Annual	**18.0 µg/m³** (2010)* **18.4 µg/m³** (2011)	90 µg/m³	✓
Particulate matter <10 µm (PM_{10})	Maximum 24 hour	**14.0 µg/m³** (2010)* **31.0 µg/m³** (2011)	50 µg/m³	✓
	Annual	**7.7 µg/m³** (2010)* **8.2 µg/m³** (2011)	30 µg/m³	✓

*: based on one month of data

2 IDENTIFICATION OF EXISTING CONTROL MEASURES & EMISSION ESTIMATION

1. *Identify, quantify and justify existing measures that are being used to minimise particle emissions*

1.1 Estimate baseline emissions of TSP, PM_{10} and $PM_{2.5}$ (tonne per year) from each mining activity. This estimate must:

- *Utilise USEPA AP-42 emission estimation techniques (or other method as approved in writing by the EPA),*
- *Calculate uncontrolled emissions (with no particulate matter controls in place), and*
- *Calculate controlled emissions (with current particulate matter controls in place).*

Notes: These particulate matter controls must be clearly identified, quantified and justified with supporting information. This means adding supporting information and evidence, including monitoring data, record keeping, management plans and/or operator training.

1.2 Using the results of the controlled emission estimates generated from Step 1.1, rank the mining activities according to the mass of TSP, PM_{10} and $PM_{2.5}$ emitted by each mining activity per year from highest to lowest.

1.3 Identify the top four mining activities from step 1.2 that contribute the highest emissions of TSP, PM_{10} and $PM_{2.5}$.

2.1 Estimation of Baseline Particulate Emissions

For the estimation of baseline emissions of particulate matter, United States Environmental Protection Agency (USEPA) AP-42, *Compilation of Air Pollutant Emission Factors* estimation techniques have been utilised, as prescribed in the methodology presented in **Appendix A** (and reproduced above).

AP-42 Chapter 11 (Mineral Products Industry) and AP-42 Chapter 13 (Miscellaneous Sources) have been referenced to estimate emissions from mining activities occurring at the Springvale Colliery. **Table 2** presents a summary of the AP-42 reference sections for the various emission factors used in this assessment report. **Appendix B** outlines the emission factors used for each activity occurring at Springvale Colliery and Coal Services sites.

Table 2 Particulate Emissions Sources and Relevant USEPA AP-42 Emission Factors

Emissions Source	AP-42 Chapter	Notes
Bulldozing coal	Chapter 11.9 Western Surface Coal Mining (1998)	
Miscellaneous Transfer Points (including conveying)	-	NPI Emission Factor in Section 1.1.16 Adopted
Loading coal stockpiles	Chapter 11.9 Western Surface Coal Mining (1998)	
Wind erosion of coal stockpiles	Chapter 11.9 Western Surface Coal Mining (1998)	
Coal crushing	Chapter 11.24 Metallic Minerals Processing (1982)	Adopted in the NPI in absence of coal specific factors
Coal screening	Chapter 11.24 Metallic Minerals Processing (1982)	
Wheel generated particulates on unpaved roads*	Chapter 13.2.2 Unpaved Roads (2006)	

* : Uncontrolled emissions for paved roads calculated using unpaved roads factor, with control factor for paving applied to calculate the emission from the paved road

A discussion of the annual activity related to each activity and the subsequent calculated emission rates of TSP, PM_{10} and $PM_{2.5}$ are provided in **Section 2.1.1**. As required by the OEH, emissions are presented firstly as uncontrolled emissions, and secondly as emissions with controls currently employed in place.

2.1.1 Activity Data

Annual activity data for the activities presented in **Table 2** are provided in **Table 4** (material handling), **Table 4** (unpaved roads), **Table 5** (wind erosion sources), and **Table 6** (ventilation fan).

Table 3 Annual Activity Data for Material Handling Operations (Springvale Colliery)

Operation / Activity	Number	Activity Rate (Annual)	Units	Notes
Bulldozers on Coal	1	2,920	hrs	2,920 hrs on ROM Stockpile (8hrs per day,. 365 days per year)
Conveyor Transfer Points	3	9,780,000	tonnes	All coal from Underground conveyed to ROM stockpile (3,260,000 tonnes) All coal conveyed from ROM Stockpile to CHP (3,260,000 tonnes) All coal conveyed from CHP offsite (3,260,000 tonnes)
Primary Crushing		3,260,000	tonnes	Enclosed
Screening		3,260,000	tonnes	Enclosed

Table 4 Annual Activity Data for Road Operations (Springvale Colliery)

Road Name	Length (m)	Width (m)	VKT per year[1]	Mean Vehicle Weight (tonnes)	Silt Content (%)
Internal Unpaved Road	450	5	15,768	50	3

Note 1: Assumed 2 trucks per hour, 24 hours per day, 365 days per year

Table 5 Annual Activity Data for Wind Erosion Sources (Springvale Colliery)

Open Area	Total Area (ha)	Active Area (ha)	Emission Factor Applied to Active Area	Notes
ROM Stockpile	1.1	1.1	Active Storage Pile AP-42 Chapter 11.9	Coal stockpile
Support Storage Area	0.4	0.4	Wind Erosion of Exposed Areas AP-42 Chapter 11.9	-
Conveyor Storage Area	0.4	0.4	Wind Erosion of Exposed Areas AP-42 Chapter 11.9	-
Mining Supplies Storage Area	0.4	0.4	Wind Erosion of Exposed Areas AP-42 Chapter 11.9	-

Note: Pit top area not included as paved, swept twice weekly and not considered to be a source of emissions.

Table 6 Annual Activity Data for Ventilation Emission Sources (Springvale Colliery)

Source	Volumetric Flow Rate (m^3/s)	TSP Concentration (mg/m^3)[1]	Emission Factor Applied to Ventilation Source	Notes
Ventilation Fan	130	1	No data in AP-42. In-shaft TSP monitoring data provided by Centennial	-

Note 1: PM_{10} concentration assumed to be 50% of TSP concentration. $PM_{2.5}$ concentration assumed to be the same as PM_{10} concentration

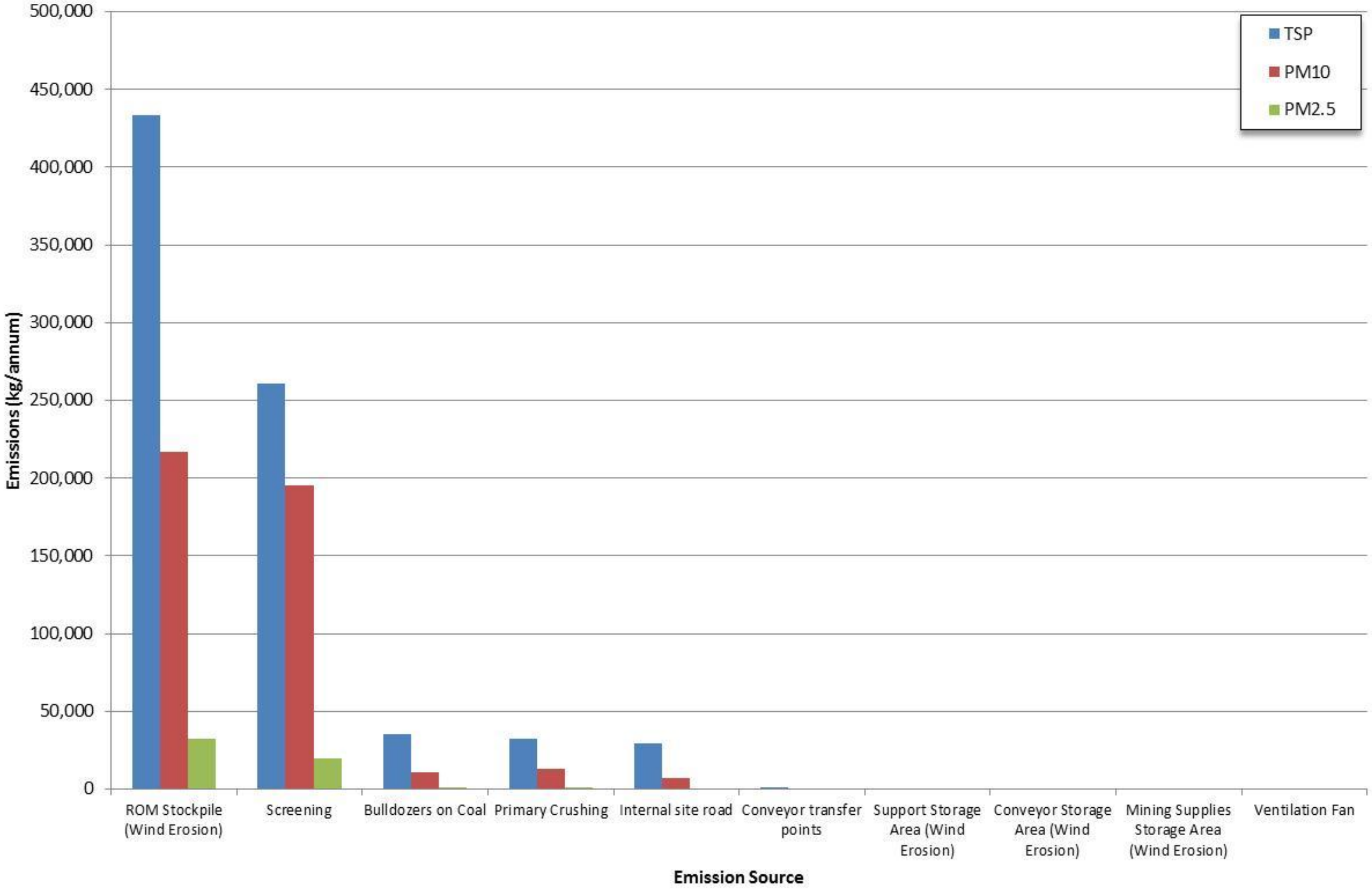
2.1.2 Uncontrolled Particulate Emissions

Using the emission factors calculated in **Appendix B** and the annual activity data presented in **Section 2.1.1**, the annual (uncontrolled) particulate emissions from activities occurring at Springvale Colliery are presented in **Table 7** and graphically in **Figure 5**.

Table 7 Uncontrolled Annual Particulate Emissions – Springvale Colliery

Emission Source	TSP Emissions (kg/year)	PM_{10} Emissions (kg/year)	$PM_{2.5}$ Emissions (kg/year)	Cumulative % Contribution to Total TSP Emissions
ROM Stockpile (Wind Erosion)	433,620	216,810	32,522	55
Screening	260,800	195,600	19,560	87
Bulldozers on Coal	35,532	10,815	1,081	92
Primary Crushing	32,600	13,040	1,304	96
Internal site road	29,272	6,791	679	100
Conveyor transfer points	1,436	679	68	100
Support Storage Area (Wind Erosion)	340	170	26	100
Conveyor Storage Area (Wind Erosion)	340	170	26	100
Mining Supplies Storage Area (Wind Erosion)	340	170	26	100
Ventilation Fan	4	2	2	100
TOTAL	**794,284**	**444,247**	**55,293**	

Figure 5 Uncontrolled Annual Particulate Emissions – Springvale Colliery



2.2 Existing Control Measures

A site audit was conducted in March 2012 to identify and verify the current dust control measures being implemented at Springvale Colliery. A summary of the existing control measures identified as currently being implemented at the Springvale Colliery is provided below. Additional details are provided in the following sections. The emission controls applied currently at Springvale Colliery and observed during the audit are presented in **Table 8**.

Emission control factors can be highly variable, and are generally based on site and material specific field trials. Where a considerable level of uncertainty exists or where the emission source has the potential to contribute a significant percentage to the site dust balance, further work is proposed.

Control factors for each relevant activity has been sourced from the following references :

- Katestone Environmental 2010, "*NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining"*, December 2010

- Australian Government Department of Sustainability, Environment, Water, Population and Communities 2012, "*National Pollutant Inventory Emission Estimation Technique for Mining", Version 3.1*, January 2012

- Countess Environmental 2006, *"WRAP Fugitive Dust Handbook"*, September, 2006

- US Department of Health and Human Services 2012, *"Dust Control Handbook for Industrial Minerals Mining and Processing"*, January 2012

Table 8 Particulate Emission Controls Currently Applied at Springvale Colliery

Source	Control Measure	Comments	Supporting Material / Comments
Wheel generated particulates	Speed limits on internal roads	A 20 km per hour speed limit is enforced on all internal roads	
Coal crushing	Enclosed	CHP is enclosed	Refer **Figure C1** in **Appendix C**
Coal Screening	Enclosed		
Material transfer of coal	Conveyors enclosed	Enclosed on three sides	
Wind Erosion – ROM Stockpile	Water Sprays surrounding ROM stockpile, water cannon on rill tower Natural vegetative screens exist around ROM Stockpile	Also applicable to operation of dozers on stockpile	Refer **Figure C2** in **Appendix C**
Wind Erosion – Open Areas	Water Spray on Mining Supplies Area Water Cart used when required		Refer **Figure C3** in **Appendix C**

Note: Pit top area not included as paved, swept twice weekly and not considered to be a source of emissions.

The applicable control efficiencies of each of the controls identified in **Table 8** are presented in **Table 9**.

Table 9 Control Factors Assumed for Existing Control Measures

Emission Source	Control Measure	Control Factor (%)	Source
Roads	Use of well-defined routes	-	-
Coal Crushing	Enclosed	70	NPI (2011)
Coal Screening	Enclosed	70	NPI (2011)
Material Transfer of Coal	Wind shielding – roof or side wall	40	Katestone (2010)
Stockpiles / Open Areas	Water Sprays Natural Vegetative Screens around Stockpile	50 30	Katestone (2010) Katestone (2010)
Bulldozers operating on Coal	Keep Travel Routes Moist	50	Katestone (2010)

Presented in **Table 10** are the calculated particulate emissions from Springvale Colliery with current emission controls applied. These are also presented graphically in **Figure 6**. A comparison of the total emissions by source (controlled and uncontrolled) are presented in **Figure 7**.

Table 10 Controlled Annual Particulate Emissions – Springvale Colliery

Emission Source	TSP Emissions (kg/year)	PM_{10} Emissions (kg/year)	$PM_{2.5}$ Emissions (kg/year)	Cumulative % Contribution to Total TSP Emissions
ROM Stockpile (Wind Erosion)	151,767	75,884	11,383	57
Screening	78,240	58,680	5,868	86
Bulldozers on Coal	17,766	5,407	541	93
Primary Crushing	9,780	3,912	391	97
Internal site road	7,318	1,698	170	100
Conveyor transfer points	862	408	41	100
Support Storage Area (Wind Erosion)	170	85	13	100
Conveyor Storage Area (Wind Erosion)	170	85	13	100
Mining Supplies Storage Area (Wind Erosion)	170	85	13	100
Ventilation Fan	4	2	2	100
TOTAL	**266,247**	**146,245**	**18,433**	**-**

Figure 6 Controlled Annual Particulate Emissions – Springvale Colliery

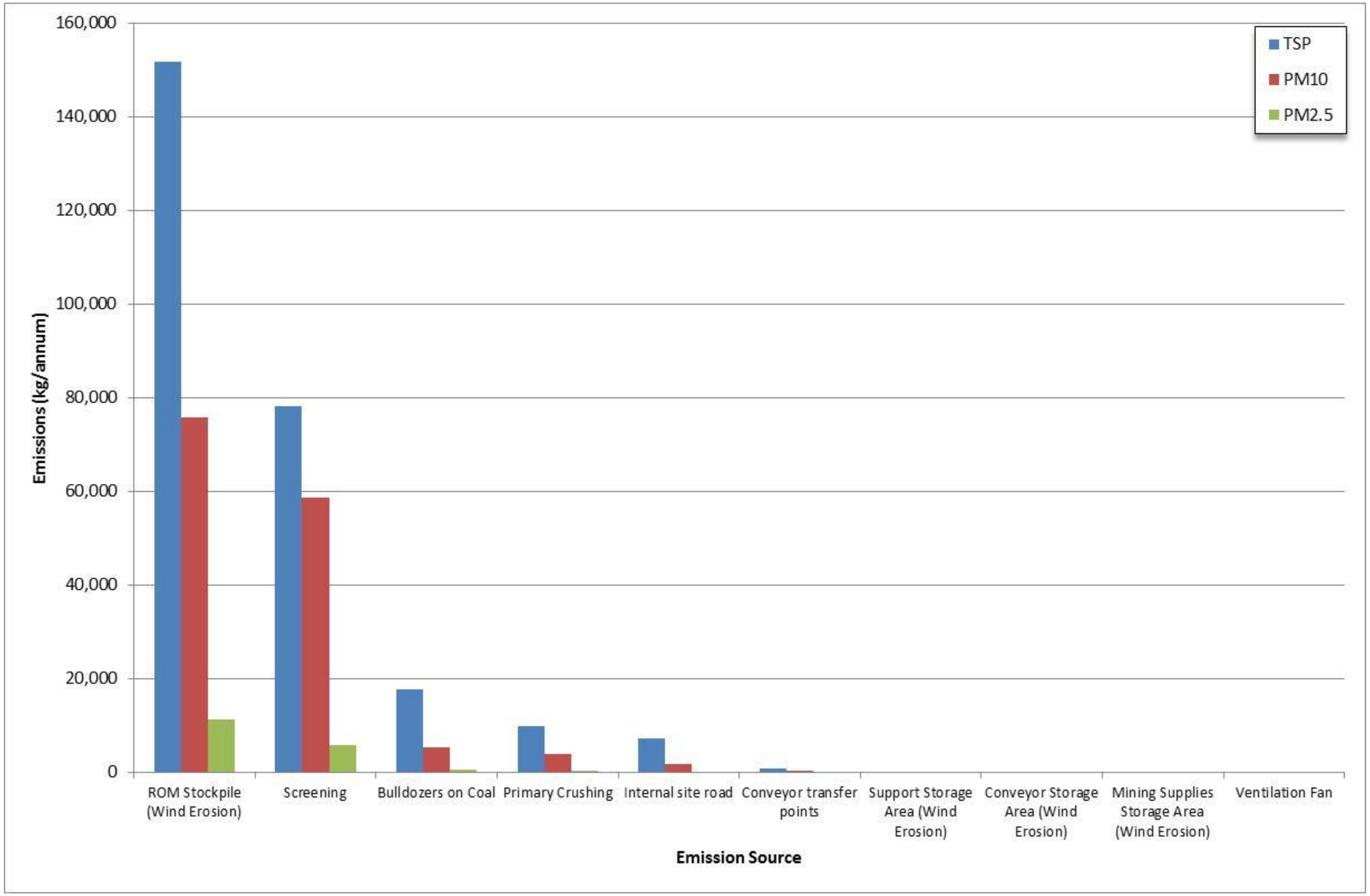
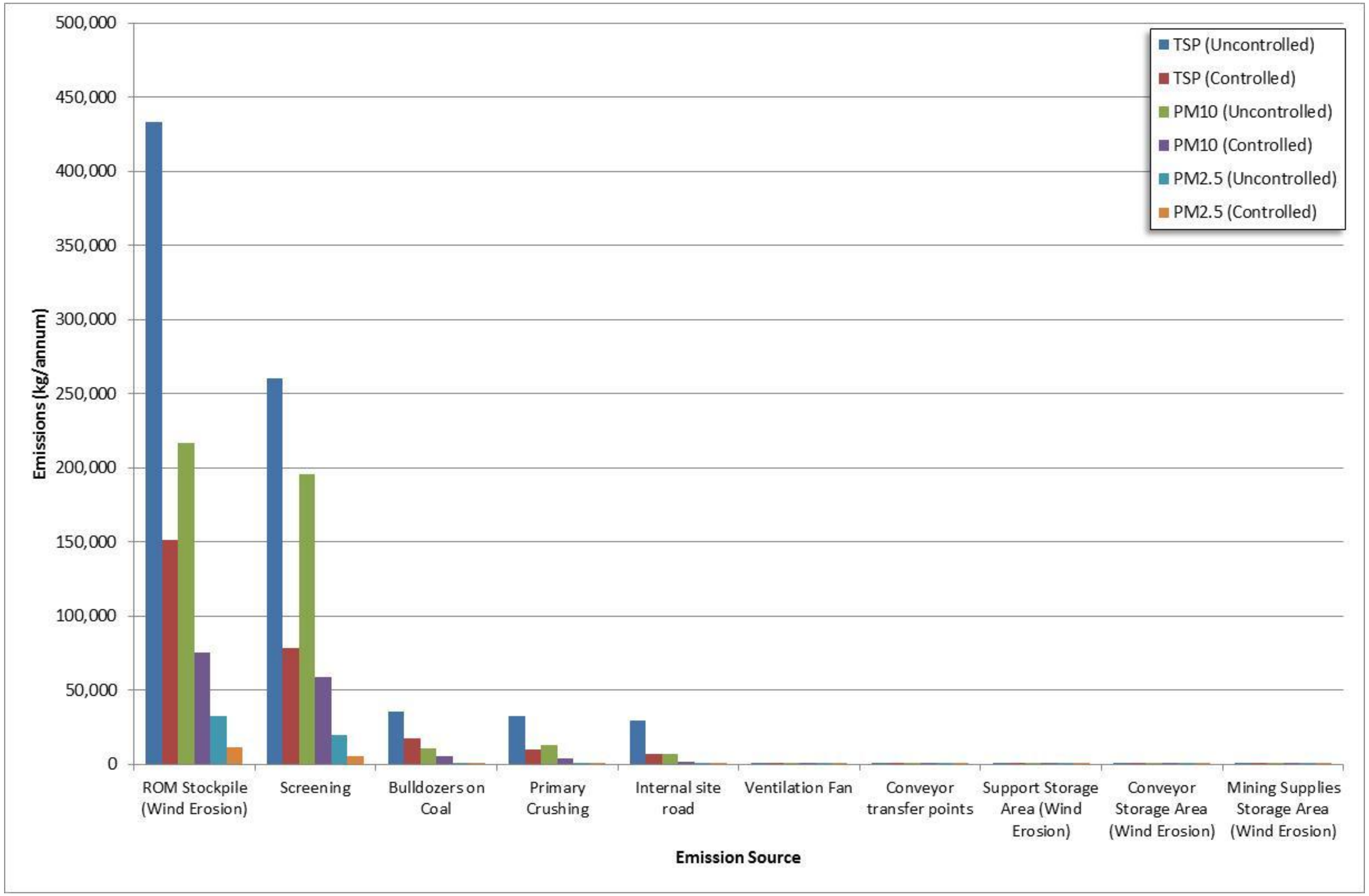


Figure 7 Comparison of Uncontrolled vs Controlled Particulate Emissions

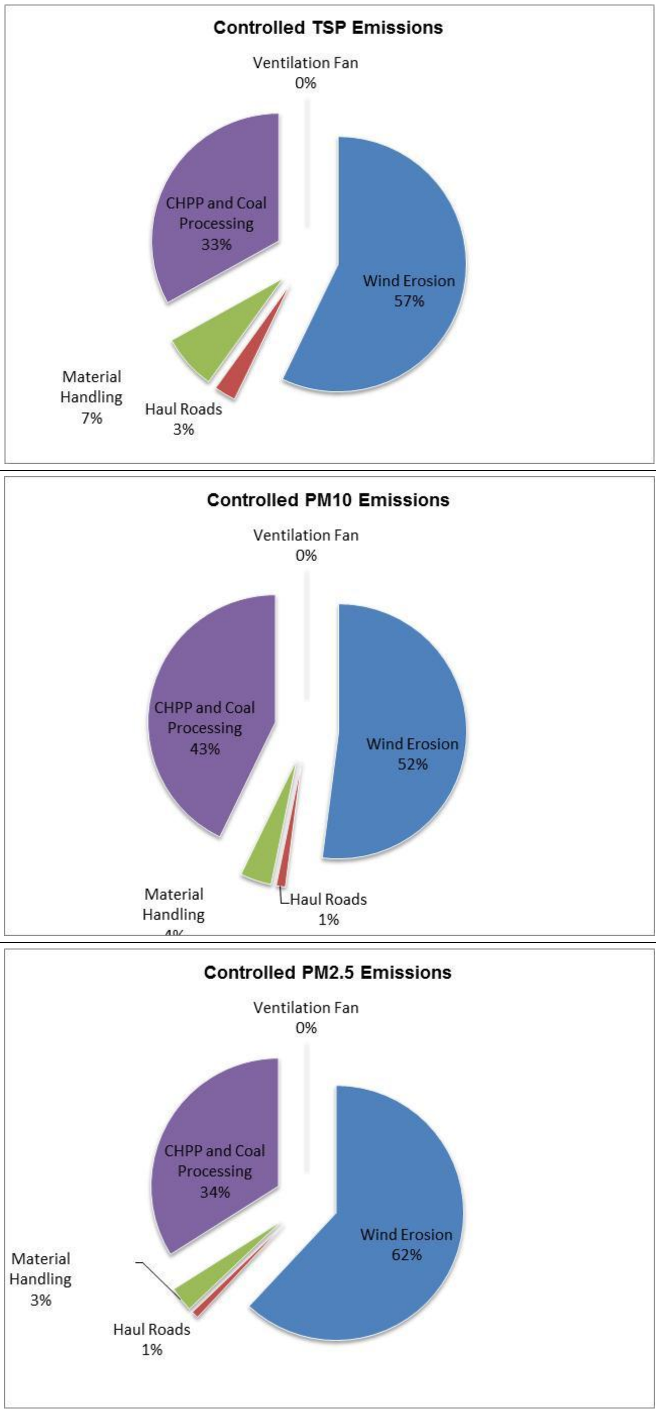


Particulate emissions are presented by source group (wind erosion, roads, material handling, CHPP and coal processing operations and ventilation fan) in **Table 11** and graphically in **Figure 8**.

Table 11 Comparison of Uncontrolled and Controlled Particulate Emissions

Emission Source Group	Uncontrolled Emissions (kg/annum)			Controlled Emissions (kg/annum)		
	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
Wind Erosion	434,640	217,320	32,598	152,277	76,139	11,421
Roads	29,272	6,791	679	7,318	1,698	170
Material Handling	36,968	11,494	1,149	18,628	5,815	581
CHPP and Coal Processing	293,400	208,640	20,864	88,020	62,592	6,259
Ventilation Fan	4	2	2	4	2	2
TOTAL	**794,284**	**444,247**	**55,293**	**266,247**	**146,245**	**18,433**

Figure 8 Representation of Major Controlled Particulate Emission Sources – Springvale



2.3 Ranking of Mining Activities and Identification of Top Four PM Sources

NSW EPA requirements for the assessment of particulate control measures are provided in **Appendix A**. This advice requires the top four controlled particulate emissions sources are assessed for the feasibility of further control measures being applied.

However, further advice from the EPA has indicated that these top four sources should represent a significant proportion of mine emissions. Within this report, the assessment of further control measures has been applied to all sources which cumulatively represent 97% of total site emissions (of TSP). These sources and emission totals are presented in **Table 12**. Potential control measures to be applied to these sources are discussed in detail in **Section 4**

Table 12 Controlled PM Emission Sources Representing 97% of Springvale TSP Emissions

Activity	Rank of Particulate Emissions			
	TSP (kg/annum)	PM_{10} (kg/annum)	$PM_{2.5}$ (kg/annum)	Cumulative % Contribution to Total TSP Emissions
ROM Stockpile (Wind Erosion)	151,767	75,884	11,383	57
Screening	78,240	58,680	5,868	86
Bulldozers on Coal	17,766	5,407	541	93
Primary Crushing	9,780	3,912	391	97

3 POTENTIAL CONTROL MEASURES

> ***2. Identify, quantify and justify best practice measures that could be used to minimise particle emissions***
>
> *2.1 For each of the top four activities identified in step 1.3, identify the measures that could be implemented to reduce emissions, taking into consideration:*
>
> - *The findings of Katestone (June 2011) "NSW coal mining benchmarking study – international best practice measures to prevent and/or minimise emissions of particulate matter from coal mining",*
> - *Any other relevant published information, and*
> - *Any relevant industry experience from either Australia or overseas.*
>
> *2.2 For each of the top four activities identified in step 1.3, estimate the emissions of TSP, PM_{10} and $PM_{2.5}$ from each mining activity after applying the measures identified in step 2.1.*
>
> *Current particulate matter controls being used at the mine must be clearly identified, quantified and justified. This means adding supporting information and evidence, including monitoring data, record keeping, management plans and/or operator training.*

3.1 Wind Erosion

3.1.1 ROM Coal Stockpile

Stockpiles of coal provide a surface for the generation of wind-eroded material and the subsequent propagation of particulate matter emissions. In addition to stockpile dimensions, emissions generated by wind erosion from stockpiles are also dependent on the frequency of disturbance of the exposed surface. Over time the surface of an undisturbed stockpile will become depleted of erodible material and emissions of particulate matter will reduce. However, the nature of ROM and product coal stockpiles is that they are frequently disturbed, causing fresh surface material to be exposed restoring the erosion potential (Katestone, 2011). The moisture content of coal being stored in stockpiles is also a major factor in the resulting emissions from wind erosion. Moisture content of coal at Springvale is generally 10% but can exceed 12% on occasions. This will act to reduce the wind erosion potential of the coal stockpile. However, as identified previously, emission factors for coal stockpiles do not take into account the moisture content of coal, and thus result in conservative estimations of emissions from this source.

For existing stockpiles, the control measures identified in the literature to minimise particulate emissions include:

- Bypassing stockpiles to load directly into ROM bin
- Fencing, bunding or shelterbelts to reduce ambient wind speeds
- Watering to minimise lift-off with automatic control through continuous cycling and increased application based on meteorological conditions
- Chemical suppressants to bind loose fine surface material in response to adverse weather conditions
- Minimising residence time of coal in stockpiles
- Spillage clean-up
- Surface covering

Structures can be used to reduce emissions of particulate matter, such as earth walls (berms) or fences. Berms can act as a windbreak by preventing the erosive and drying effects of the wind. Berms can also reduce the amount of water and use of suppressants making it a cost-effective option in many cases. A study was conducted of the effectiveness of wind screens and determined that the most effective screens for reducing the wind speed had the following dimensions relative to the height of the stockpile (Katestone, 2011):

- Height: 1.25 times the height of the stockpile
- Width: 1.5 times the height of the stockpile
- Distance upwind: 2.0 times the height of the stockpile

Chemical binders and suppressants may be applied to the surface of stockpiles to enhance the cohesion of particles and reduce the potential for wind erosion. These binding agents are usually applied in solution and are sprayed onto the surface. Water sprays by themselves have been shown to offer in the region of 50% to 80% control efficiency. However, the effectiveness of spray additives is reduced by mechanical disturbance as it breaks the surface 'crust', which may be caused by stockpile working (i.e. the addition or removal of material), vehicle disturbance or the action of wild animals.

Wind breaks and screens offer an alternative to reduce wind erosion from stockpiled materials or areas with no vegetative cover. Recent studies have demonstrated a wide range of control efficiencies for screens and windbreaks (summarised in Katestone 2011). Vegetative wind breaks are reported with a control efficiency of 30% and wind screens and fences up to 80%. Natural vegetative wind breaks surround the ROM Stockpile at Springvale with appropriate reduction factors applied to emissions from this source within this study. Studies regarding windbreak design and size have been shown to influence its effectiveness, particularly its relative height to the height of the stockpile, its distance downwind and its structural porosity (Katestone, 2011). Reducing the height of the stockpile may also offer a significant reduction in the wind erosion potential by reducing the wind speed over the stockpile surface.

The use of multiple controls, such as the use of chemical stabilisers and binders with wind breaks may offer enhanced dust control. Studies have reported a reduction in windblown dust emissions of up to 85% for up to 10 days of moderate to high wind speeds through the use of stabilisers and wind breaks (Katestone, 2011).

Similarly, stockpile size and orientation has been shown to affect the efficacy of wind breaks, with "smooth whaleback" profiles being more effective at reducing wind erosion than pointed stockpiles and orientation with the smallest face towards the prevailing wind offering increased protection from wind erosion. Studies suggest a control efficiency of 60% may be attributed to stockpile size, design and orientation.

A summary of the potential control measures for minimising particulate emissions from wind erosion from coal stockpiles, and their effectiveness, is provided in **Table 13** (Katestone, 2011).

Table 13 Best Practice Control Measures – Wind Erosion of Coal Stockpiles

Control Type	Control Measure	Effectiveness
Avoidance	Bypassing stockpiles	100% reduction in wind erosion for coal bypassing stockpiles
Surface stabilisation	Water spray	50%
	Chemical wetting agents	80-99% 85% 90%
	Surface crusting agent	95%
Enclosure	Silo with bag house	100% 95-99% 99%
	Cover storage pile with a tarp during high winds	99%
Wind speed reduction	Vegetative wind breaks	30%
	Reduced pile height	30%
	wind screens/wind fences	>80% 75-80%
	Pile shaping/orientation	<60%
	Erect 3-sided enclosure around storage piles	75%

SOURCE: Katestone (2011), Table 72

3.2 Coal Crushing and Screening

Katestone (2011) does not provide emission reduction factors for coal processing operations. The reduction factor of 70% applied to the uncontrolled emission rate for coal screening and coal crushing (**Section 2.2**) has been adopted from NPI (2011) and it is considered that enclosure of such operations is best practice.

Further control options for the screening and crushing of coal have not been considered further within this report, given that enclosure, as currently implemented, is considered to represent best practice control.

3.3 Bulldozers on Coal

Katestone (2011) presents a comprehensive summary of an options appraisal conducted by Connell Hatch for the control of particulate emissions from bulldozers at the RG Tanna Coal Terminal. Options considered in the study included:

- Minimising travel speed and travel distance.
- Stabilising bulldozer travel routes and use of water or suppressants on travel routes.
- Manage coal moisture to ensure coal is sufficiently moist when working.
- Modify design of the bulldozer to minimise emissions.

Based upon the data available, the emission of particulate from bulldozer operation can only be quantified by hours of operation, and not the speed of the vehicles.

A summary of the potential control measures for minimising particulate emissions from bulldozers, and their effectiveness, is provided in **Table 14** (Katestone, 2011).

Table 14 Best Practice Control Measures – Bulldozers

Control Measure		Effectiveness
Bulldozer	Minimise travel speed and distance	Not quantified
	Keep travel routes and materials moist	50%

SOURCE: Katestone (2011), Table 76

Given that travel routes are currently kept moist through the application of water from water cannons, and that coal moisture content is generally around 10%, it is considered that best practice measures are already employed at the Springvale Colliery for emissions from bulldozers operating on the ROM coal stockpile. No assessment of further options is considered within this report.

3.4 Quantification of Potential Particulate Management Measures

Table 15 presents the emission control factors assumed in this assessment for the potential particulate management measures identified and **Table 16** presents the PM emission loads for each source if each potential control measure was applied.

Table 15 Control Factors Assumed for Potential Control Measures

Emission Source	Control Type	Control Measure	Effectiveness
Wind Erosion – Coal Stockpiles	Avoidance	Bypassing stockpiles	100% reduction in wind erosion for coal bypassing stockpiles
	Surface stabilisation	Water spray (already present)	50%
		Chemical wetting agents	80-99% 85% 90%
		Surface crusting agent	95%
	Enclosure	Silo with bag house	100% 95-99% 99%
		Cover storage pile with a tarp during high winds	99%
	Wind speed reduction	Vegetative wind breaks (already present)	30%
		Reduced pile height	30%
		Wind screens/Wind fences	>80% 75-80%
		Pile shaping/orientation	<60%
		Erect 3-sided enclosure around storage piles	75%

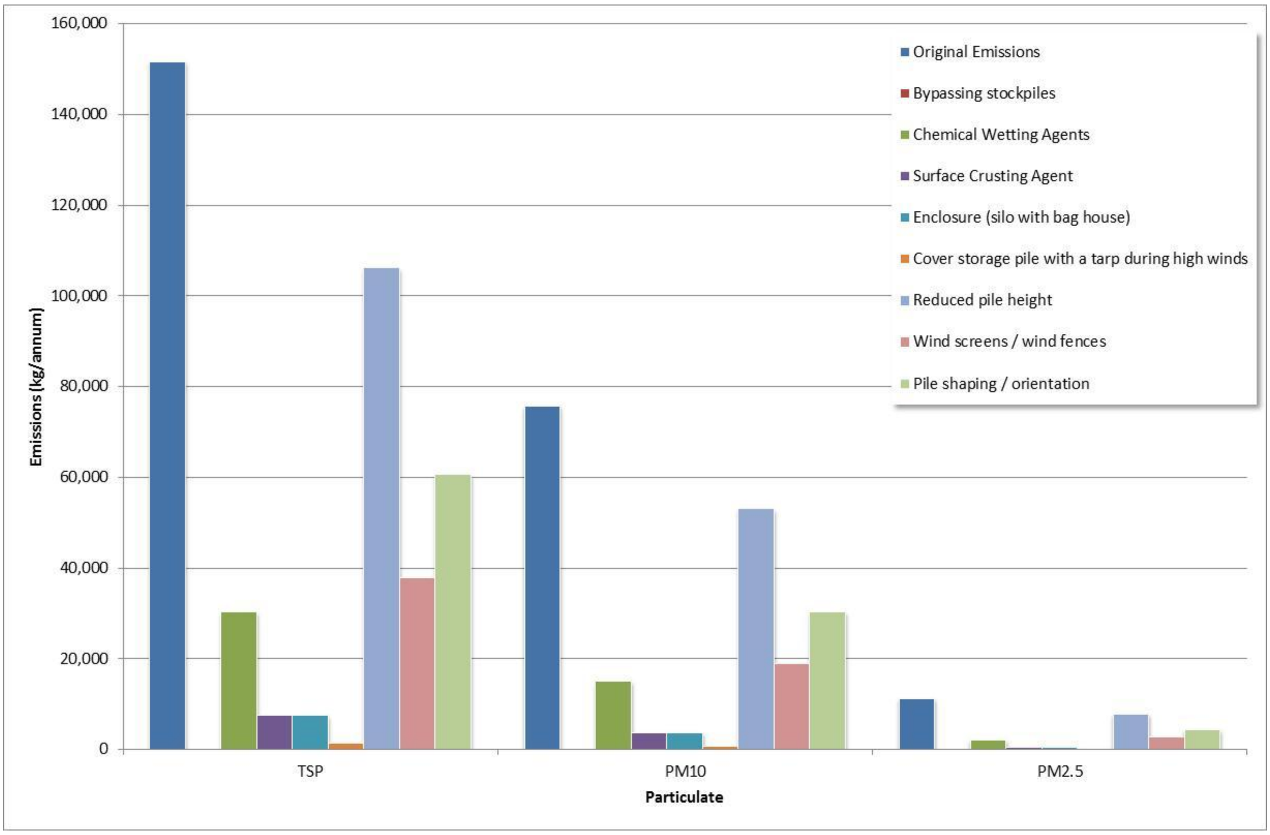
Table 16 Estimated Emissions – Potential Controls

Emission Source	Control Option	TSP (kg/year)	PM_{10} (kg/year)	$PM_{2.5}$ (kg/year)
Wind Erosion of Coal Stockpiles	Bypassing stockpiles	0	0	0
	Chemical Wetting Agents	30,353	15,177	2,277
	Surface Crusting Agent	7,588	3,794	569
	Enclosure (silo with bag house)	7,588	3,794	569
	Cover storage pile with a tarp during high winds	1,518	759	114
	Reduced pile height	106,237	53,118	7,968
	Wind screens / wind fences	37,942	18,971	2,846
	Pile shaping / orientation	60,707	30,353	4,553
	Erect 3-sided enclosure around storage piles	37,942	18,971	2,846

Note: Water Sprays and Vegetative Wind Breaks around ROM Stockpile already implemented

A comparison of each control application against the original (with existing controls) emissions of particulate are presented in **Figure 9** (wind erosion of coal stockpiles).

Figure 9 Potential Reductions in PM Emissions - Wind Erosion of Coal Stockpiles



4 EVALUATION OF ADDITIONAL CONTROL MEASURES

3. Evaluate the practicability of implementing these best practice measures

3.1 For each of the best practice measures identified in step 2.1, assess how practicable each one is to implement by taking into consideration:

- *implementation costs;*
- *regulatory requirements;*
- *environmental impacts;*
- *safety implications; and,*
- *compatibility with current processes and proposed future developments.*

3.2 Identify those best practice measures that will be implemented at the premises to reduce particle emissions.

As required by OEH, the practicability of implementing each of the particulate control options identified in **Section 3** is to be assessed with due consideration given to:

- implementation costs;
- regulatory requirements;
- environmental impacts;
- safety implications; and,
- compatibility with current processes and proposed future developments.

In summary, the control measures identified in **Section 3** for further evaluation are presented in **Table 17**.

Table 17 Summary of Potential Particulate Control Measures

Emission Source	Control Option
Wind Erosion of Coal Stockpiles	Bypassing stockpiles
	Chemical Wetting Agents
	Surface Crusting Agent
	Enclosure (silo with bag house)
	Cover storage pile with a tarp during high winds
	Reduced pile height
	Wind screens / wind fences
	Pile shaping / orientation
	Erect 3-sided enclosure around storage piles

Note: Water Sprays and Vegetative Wind Breaks around ROM Stockpile already implemented

The following sections examine the measures that may constrain the implementation of the particulate control measures outlined in **Table 17,** namely the regulatory requirements, environmental impacts, safety implications and compatibility with current processes and future development.

Each measure is provided a risk rating (**low**, **medium** or **high**) which identifies the constraints which may result in the implementation of the measure not being practical at the Springvale Colliery. Where any of the four measures of practicability are rated as high, these measures are not taken forward for an assessment of cost implication and feasibility.

Section 4.1 examines the potential control measures identified for wind erosion of the ROM stockpile.

4.1 Evaluation Findings – Wind Erosion of ROM Coal Stockpile

4.1.1 Practicality of Implementation

Table 18 provides a discussion of the feasibility of control measures for wind erosion of the ROM coal stockpile.

Table 18 Practicability of Implementing Control Measures on ROM Coal Stockpile

Control Measure – Wind Erodible Areas	Regulatory Requirements RISK	Environmental Impacts RISK	Safety Implications RISK	Compatibility with Current Processes and Future Developments RISK	Conclusion of Evaluation
Bypassing stockpiles	RISK = LOW None	RISK = LOW Improvements in dust emissions would be realised	RISK = LOW None	RISK = HIGH Not compatible. Storage area is required for periods when coal cannot be accepted at the CHP.	✘ Not considered further in this assessment
Chemical wetting agents	RISK = LOW Ensure all chemicals are registered on-site with relevant MSDS at Stores	RISK = MEDIUM Ensure that application rate is appropriate to avoid run off into watercourses. Ensure application is performed during appropriate meteorological conditions to avoid wash/blow off onto other areas Based on the MSDS, a spill management program should be formulated.	RISK = MEDIUM Appropriate PPE required for water truck operative, and personnel involved in the mixing of suppressants with water (if required). If onsite storage required, appropriate signage required and emergency management plan required in event of spill/leakage	RISK = HIGH Not compatible for regularly disturbed areas. Application of wetting agents would need to be performed constantly	✘ Not considered further in this assessment
Surface crusting agents	RISK = LOW Ensure all chemicals are registered on-site with relevant MSDS at Stores	RISK = MEDIUM Ensure that application rate is appropriate to avoid run off into watercourses. Ensure application is performed during appropriate meteorological conditions to avoid wash/blow off onto other areas Based on the MSDS, a spill management program should be formulated.	RISK = MEDIUM Appropriate PPE required for water truck operative, and personnel involved in the mixing of suppressants with water (if required). If onsite storage required, appropriate signage required and emergency management plan required in event of spill/leakage	RISK = HIGH Not compatible for regularly disturbed areas. Application of crusting agents would need to be performed constantly	✘ Not considered further in this assessment

Control Measure – Wind Erodible Areas	Regulatory Requirements RISK	Environmental Impacts RISK	Safety Implications RISK	Compatibility with Current Processes and Future Developments RISK	Conclusion of Evaluation
Enclosure (silo with bag house)	RISK = LOW None	RISK = LOW None	RISK = LOW None	RISK = HIGH Quantity of coal on ROM pad would make the installation of enclosure impractical	✘ Not considered further in this assessment
Cover storage pile with tarp during high winds	RISK = LOW None	RISK = LOW None	RISK = LOW None	RISK = HIGH Constant loading of ROM pad (24/7) would make the use of a tarp impractical	✘ Not considered further in this assessment
Reduced pile height	RISK = LOW None	RISK = LOW None	RISK = LOW None	RISK = HIGH Pile height is dictated by the quantity of coal mined and the speed at which it can be transported offsite. Reduction in pile height may require the more frequent use of the Kerosene Vale stockpile, moving the wind erosion issue elsewhere is not considered appropriate management	✘ Not considered further in this assessment
Wind screens / fences	RISK = LOW None	RISK = LOW None	RISK = LOW None	RISK = HIGH Not compatible – the space required for the required fence height (1.25 times the height of the stockpile), width (1.5 times the width of the stockpile) and distance downwind (2 times the height of the stockpile) is not available at the site.	✘ Not considered further in this assessment
Erect 3-sided enclosure around storage piles	RISK = LOW None	RISK = LOW None	RISK = LOW None	RISK = HIGH Area of stockpiles too large to erect 3-sided enclosures. In addition, access to stockpile to be retained from all sides	✘ Not considered further in this assessment
Pile shaping / orientation	RISK = LOW None	RISK = LOW None	RISK = LOW None	RISK = LOW Compatible	✓ Adopted potential measure **WEC1**

NB * Measures combined with identical control factors, activity rates and risks

4.1.2 Implementation Costs

As required by OEH, the cost implication of each potential particulate control measure has been assessed, taking into account (where applicable):

- Estimated capital expenditure;
- Labour costs;
- Material costs; and,
- Potential cost savings.

It is considered that the shaping and orientation of the ROM coal stockpile could be carried out by existing bulldozers operating on the ROM stockpile and therefore no additional costs would be incurred.

4.2 Summary of Evaluation Findings

A summary of the evaluation process for each control measure identified in **Section 3** is presented in **Table 19**. Any control options rated as high risk for any of the feasibility considerations (regulatory considerations, environmental impacts, safety implications or site compatibility) have not been evaluated for their implementation costs, and are not presented in this summary table.

Table 19 Summary of Control Options Evaluation

Emission Source	Control Measure	Cost/Benefit $/tonne PM_{10}	Regulatory Considerat'ns	Environmental Impacts	Safety Implications	Site Compatibility
Wind erosion of ROM Coal Stockpile	WEC1: Pile Shaping / Orientation	$0	Low	Low	Low	Low

4.3 Identification of Dust Control Measures for Springvale Colliery

The methodology followed above is consistent with the broad outline methodology proposed by NSW OEH, which is reproduced in **Appendix A**.

Through the adoption of this procedure, Springvale Colliery's emissions of particulate matter have been quantified with and without the range of existing control measures implemented on-site, and the top 97% of TSP emitting sources identified.

The particulate control measures that are already implemented at Springvale Colliery are summarised in **Table 8**. It is noted that through the implementation of these controls, the monitoring undertaken around the Colliery demonstrates that the air quality criteria are not exceeded. In this regard, it may be determined that the current controls implemented at the Colliery are adequate in controlling the impact of the mining operations and demonstrates compliance with the Project Approval and EPL conditions concerning the control of particulate emissions.

The range of additional control options for the processes operated at Springvale Colliery has been investigated. All identified control options have been assessed to account for the risk associated with compliance with regulatory requirements, the potential environmental impacts, safety implications and their compatibility with current processes and future developments approved or anticipated at the Colliery. Through this initial screening, any options that were considered to be high risk for the above measures were discounted, resulting in one measure for which the implementation costs were estimated.

This analysis has identified the following control options as providing a significant potential to reduce the total emission of particulates from all sources at site at no cost:

- Consideration of the orientation and shaping of the coal stockpile.

Through the use of the above control options, it is estimated that approximately 450 tonnes of PM_{10} could be abated over the implementation period.

It is noted that although the internal road was not ranked within the top 97% of particulate emission sources on site, Centennial Coal are planning on paving key sections of the road to minimise dust propagation which is estimated to mitigate approximately 15 tonnes of PM_{10} over a 10 year period.

5 IMPLEMENTATION TIMEFRAME

4.	***Propose a timeframe for implementing all practicable best practice measures***
4.1	*For each of the best practice measures identified as being practicable in Step 3.2, provide a timeframe for their implementation.*

After the range of implementation costs, regulatory requirements, environmental impacts, safety implications and compatibility with current processes and any proposed future developments were considered, only one control measure was identified as being potentially feasible for implementation at the Springvale Colliery. The shaping and orientation of the ROM stockpile was identified as potentially resulting in reductions in PM_{10} emissions over 10 years of 450 tonnes.

However, site experience at the Colliery indicates that visible emissions of particulate matter from the ROM Coal Stockpile are rare, given the high moisture content of the coal (10% to 12%) and the application of water sprays on the rill tower and surrounding the stockpile. It is not considered that in reality, the shaping and orientation of the stockpile will result in the quantum of particulate emissions as calculated through the use of generic, non site-specfic emission factors and control efficiencies.

In the interests of determining the propensity for wind erosion from the ROM Coal Stockpile, Springvale Colliery propose to commit to performing a series of tests of coal (e.g. Dust Extinction Moisture [DEM])[2]. This will allow an assessment of the likelihood of wind erosion more accurately than using generic emission factors. Site specific testing will also allow more targeted dust mitigation strategies to be designed (e.g. specific meteorological conditions under which water spraying is initiated) to minimise dust emissions from the site.

Springvale Colliery propose to perform this testing within 6 months of report submission and provide the results to EPA for review. If results do show that the wind erosion potential of the ROM Stockpile is low, no further action will be taken.

[2] DEM tests allow the moisture content at which the coal is deemed to emit no dust to be determined. Combined with wind tunnel dust-lift off tests and a number of moisture contents below the DEM, the wind speed at which erosion is initiated can be calculated and appropriate management measures employed at the mine site in conjunction with site meteorological data.

6 REFERENCES

- Springvale Coal 2011 Annual Environmental Management Report.
- Katestone (2010), NSW Coal Mining Benchmarking Study - International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining.
- USEPA (1995), AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources, Technology Transfer Network - Clearinghouse for Inventories & Emissions Factors, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, USA.
- USEPA (1998), AP 42, Chapter 11.9 Western Surface Coal Mining, Technology Transfer Network - Clearinghouse for Inventories & Emissions Factors, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, USA
- USEPA (1982), AP 42, Chapter 11.24 Metallic Minerals Processing, Technology Transfer Network - Clearinghouse for Inventories & Emissions Factors, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, USA
- USEPA (2006), AP 42, Chapter 13.2.2 Unpaved Roads, Technology Transfer Network - Clearinghouse for Inventories & Emissions Factors, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, USA
- USEPA (2006), AP 42, Chapter 13.2.4 Aggregate Handling and Storage Piles, Technology Transfer Network - Clearinghouse for Inventories & Emissions Factors, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, USA.
- USEPA (2006), AP 42, Chapter 13.2.5 Industrial Wind Erosion, Technology Transfer Network - Clearinghouse for Inventories & Emissions Factors, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, USA.
- DCCEE (2011), National Pollutant Inventory Emission Estimation Technique Manual for Mining , Version 3, Australian Government Department of Sustainability, Environment, Water, Population and Communities.

COAL MINE PARTICULATE MATTER CONTROL BEST PRACTICE – SITE SPECIFIC DETERMINATION GUIDELINE

COAL MINE PARTICULATE MATTER CONTROL BEST PRACTICE – SITE SPECIFIC DETERMINATION GUIDELINE

PURPOSE OF THIS GUIDELINE

The purpose of this guideline is to provide detail of the process to be followed in conducting a site specific determination of best practice measures to reduce emissions of particulate matter from coal mining activities.

This guideline also provides the required content and format of the report required for the Pollution Reduction Program "*Coal Mine Particulate Matter Best Practice - Assessment and Report*".

THE SITE SPECIFIC DETERMINATION PROCESS

In preparing the Report, the following steps must be followed, as a minimum:

1. Identify, quantify and justify existing measures that are being used to minimise particle emissions

1.1. Estimate baseline emissions of TSP, PM_{10} and $PM_{2.5}$ (tonne per year) from each mining activity. This estimate must:

- utilise USEPA AP42 emission estimation techniques;
- calculate uncontrolled emissions (with no particulate matter controls in place); and
- calculate controlled emissions (with current particulate matter controls in place).

(Note: These particulate matter controls must be clearly identified, quantified and justified with supporting information).

1.2. Using the results of the controlled emissions estimates generated from Step 1.1, rank the mining activities according to the mass of TSP, PM_{10} and $PM_{2.5}$ emitted by each mining activity per year from highest to lowest.

1.3. Identify the top four mining activities from Step 1.2 that contribute the highest emissions of TSP, PM_{10} and $PM_{2.5}$.

2. Identify, quantify and justify best practice measures that could be used to minimise particle emissions

2.1. For each of the top four activities identified in Step 1.3, identify the best practice measures that could be implemented to reduce emissions taking into consideration:

- the findings of Katestone (2010), *NSW Coal Mining Benchmarking Study - International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining*, Katestone Environmental Pty Ltd, Terrace 5, 249 Coronation Drive, PO Box 2217, Milton 4064, Queensland, Australia. http://www.environment.nsw.gov.au/resources/air/KE1006953coalminebmpreport.pdf ;
- any other relevant published information; and
- any relevant industry experience from either Australia or overseas.

2.2. For each of the top four activities identified in Step 1.3, estimate emissions of TSP, PM_{10} and $PM_{2.5}$ from each mining activity following the application of the best practice measures identified in Step 2.1.

3. Evaluate the practicability of implementing these best practice measures

3.1. For each of the best practice measures identified in Step 2.1, assess the practicability associated with their implementation, by taking into consideration:
- implementation costs;
- regulatory requirements;
- environmental impacts;
- safety implications; and
- compatibility with current processes and proposed future developments.

3.2. Identify those best practice measures that will be implemented at the premises to reduce particle emissions.

4. Propose a timeframe for implementing all practicable best practice measures

4.1. For each of the best practice measures identified as being practicable in Step 3.2, provide a timeframe for their implementation.

REPORT CONTENT

The report must clearly identify the methodologies utilised and all assumptions made.

The report must contain detailed information justifying and supporting all of the information used in each step of the process. For example, in calculating controlled emissions in Step 1, current particulate matter controls being used at the mine must be clearly identified, quantified and justified with supporting information and evidence including monitoring data, record keeping, management plans and/or operator training etc**.**

In evaluating practicability in Step 3, the licensee must document the following specific information:
- estimated capital, labour, materials and other costs for each best practice measure on an annual basis for a ten year period. This information must be set out in the format provided in Appendix A;
- The details of any restrictions on the implementation of each best practice measure due to an existing approval or licence;
- Quantification of any new or additional environmental impacts that may arise from the application of a particular best practice measure, such as increased noise or fresh water use;
- The details of safety impacts that may result from the application of a particular best practice measure;
- The details of any incompatibility with current operational practices on the premises; and
- The details of any incompatibility with future development proposals on the premises.

REPORT FORMAT

The report must be structured according to the process outlined above and submitted in both electronic format as .PDF format and hard copy format in triplicate. All emission estimates, costs and supporting calculations must be submitted in electronic format as .XLS format.

ABBREVIATIONS AND DEFINITIONS

USEPA AP42 Emission Estimation Techniques – all of the following:
- USEPA (1995), *AP 42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources*, Technology Transfer Network - Clearinghouse for Inventories & Emissions Factors, United States Environmental Protection Agency, Office of Air Quality Planning and

Standards, Research Triangle Park, NC 27711, USA. http://www.epa.gov/ttn/chief/ap42/index.html ;

- USEPA (1998), *AP 42, Chapter 11.9 Western Surface Coal Mining*, Technology Transfer Network - Clearinghouse for Inventories & Emissions Factors, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, USA. http://www.epa.gov/ttn/chief/ap42/ch11/final/c11s09.pdf ;
- USEPA (2006), *AP 42, Chapter 13.2.2 Unpaved Roads*, Technology Transfer Network - Clearinghouse for Inventories & Emissions Factors, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, USA. http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0202.pdf ;
- USEPA (2006), *AP 42, Chapter 13.2.4 Aggregate Handling and Storage Piles*, Technology Transfer Network - Clearinghouse for Inventories & Emissions Factors, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, USA. http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0204.pdf ; and
- USEPA (2006), *AP 42, Chapter 13.2.5 Industrial Wind Erosion*, Technology Transfer Network - Clearinghouse for Inventories & Emissions Factors, United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, USA. http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0205.pdf .

PM_{10} – Particulate matter of 10 micrometres or less in diameter

$PM_{2.5}$ - Particulate matter of 2.5 micrometres or less in diameter

Mining Activities – means:

- Wheel generated particulates on unpaved roads
- Wind erosion of overburden
- Blasting
- Bulldozing Coal
- Trucks unloading overburden
- Bulldozing overburden
- Front-end loaders on overburden
- Wind erosion of exposed areas
- Wind erosion of coal stockpiles
- Unloading from coal stockpiles
- Dragline
- Front-end loaders on overburden
- Trucks unloading coal
- Loading coal stockpiles
- Graders
- Drilling
- Coal crushing
- Material transfer of coal
- Scrapers on overburden
- Train loading
- Screening; or
- Material transfer of overburden

TSP - Total Suspended Particulate Matter

Emission Factors

US Environmental Protection Agency AP-42 Particulate Matter Emission Factors

Bulldozing coal

The emission factors for bulldozing coal are taken from Table 11.9-2 of Chapter 11.9 of AP-42 (USEPA, 1998):

$$TSP\ (kg/hr) = \frac{35.6(s)^{1.2}}{(M)^{1.3}}$$

$$PM_{10}\ (kg/hr) = \left(\frac{8.44(s)^{1.5}}{(M)^{1.4}}\right) \times 0.75$$

$$PM_{2.5}\ (kg/hr) = \left(\frac{35.6(s)^{1.2}}{(M)^{1.3}}\right) \times 0.022$$

Where M is equal to the coal moisture content and s is equal to the coal silt content.

Front end loaders and excavators on coal and overburden

Specific emission factors for the operation of front end loaders and excavators on coal and overburden are not provided within AP-42. However, a default factor for TSP of 0.018 kg/t is provided in Table 11.9-4 of Chapter 11.9 of AP-42 (USEPA, 1998) for the activity of "truck loading by power shovel (batch drop)". The note provided with this figure however, encourages the user to make use of the predictive emission factor equations in Chapter 13 of AP-42 instead.

The quantity of particulate emissions (kg) generated by a batch drop process (per tonne) (e.g. a truck dumping to a storage pile, or loading out from a pile to a truck) may be estimated using the following expression:

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

Where EF is the emission factor for TSP, PM_{10} or $PM_{2.5}$, k is the aerodynamic size multiplier (0.74 for TSP, 0.35 for PM_{10} and 0.053 for $PM_{2.5}$), U is the mean wind speed in m/s and M is the moisture content of coal and overburden.

Material transfer of coal by conveyor

Specific emission factors for the transfer of material by conveyor at transfer points are not provided within AP-42. The Environment Australia Document "*National Pollutant Inventory for Mining (Version 3.0)*" (June, 2011) identifies that emissions of particulates at miscellaneous transfer points (including conveying) are estimated using the same emission factor as outlined in **Front end Loaders and excavators on coal** and this emission factor has been adopted within this report, using specific information for coal.

Loading coal stockpiles

See **Front end Loaders and excavators on coal**.

Wind erosion of coal stockpiles and overburden/disturbed areas

The emission factors for wind erosion of coal stockpiles and overburden are taken from Table 11.9-2 of Chapter 11.9 of AP-42 (USEPA, 1998) as discussed in **Section 2.1.1**.

$$TSP\ (kg/ha/hr) = 1.8u$$

Where u is equal to the wind speed (m/s).

Based on this data, an emission rate of TSP of 37,882 kg/ha/yr has been applied within this assessment. This equates to an average emission rate of 4 kg/ha/hr.

As discussed in Section **2.1**, the application of the AP-42 emission factor equation relating to industrial wind erosion of overburden (Chapter 13.2.5) yielded unrealistic emissions when the threshold friction velocity for overburden (and coal dust) was applied. Therefore the emission factor for coal stockpiles has been applied to all areas subject to wind erosion.

No emission factors for PM_{10} are provided for this emission source within Table 11.9-2 of Chapter 11.9 of AP-42. An assumption that 50% of the TSP is emitted as PM_{10} has been adopted for the purposes of this assessment. This is in line with the PM_{10}/TSP ratio quoted within the "*National Pollutant Inventory for Mining (Version 3.0)*" (June, 2011) for wind erosion sources.

Certain emission factors contained within the US EPA emission factor handbook AP-42 do not contain emission factors for $PM_{2.5}$ as often, little validated research has been undertaken to assess the fraction of PM_{10} which would be emitted as $PM_{2.5}$ from the wide range of sources involved.

Limited research has been conducted by the Midwest Research Institute (MRI) on behalf of the Western Regional Air Partnership (WRAP) with findings published within the document entitled *'Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors'* (MRI, 2006). This document provides seven proposed $PM_{2.5}$/PM_{10} ratios for fugitive dust source categories as presented in **Table 20**.

Table 20 Proposed $PM_{2.5}$ / PM_{10} Particle Size Ratios

Fugitive Dust Source	AP-42 Section	Proposed $PM_{2.5}$ / PM_{10} Ratio
Paved Roads	13.2.1	0.15
Unpaved Roads	13.2.2	0.1
Aggregate Handling and Storage Piles	13.2.4	0.1
Industrial Wind Erosion	13.2.5	0.15
Open Area Wind Erosion	-	0.15

The $PM_{2.5}$ / PM_{10} ratios presented in **Table 20** have been used within this report to calculate the emissions of $PM_{2.5}$ attributable to the activities occurring at Springvale Colliery, where specific $PM_{2.5}$ emission factors or scaling factors are not provided.

Coal crushing and screening

Emission factors for coal crushing are not provided specifically in AP-42 but are taken from AP-42 Chapter 11.24 Metallic Minerals Processing (1982). This approach is also taken within the National Pollutant Inventory for Mining (Version 3.0, June 2011).

Of relevance to this report are emission factors relating to primary coal crushing of high moisture (>4% by weight) coal and coal screening. Default emission factors for TSP and PM_{10} are provided for coal crushing as:

$$TSP\ (kg/t) = 0.01$$

$$PM_{10}\ (kg/t) = 0.004$$

And for screening as:

$$TSP\ (kg/t) = 0.08$$

$$PM_{10}\ (kg/t) = 0.06$$

Loading coal to trains

The emission factors for loading coal to trains are taken from Table 11.9-4 of Chapter 11.9 of AP-42 (USEPA, 1998):

$$TSP\ (kg/t) = 0.014$$

No PM_{10} or $PM_{2.5}$ emission factors are available for this source within AP-42, and as previously discussed, the PM_{10} emission factor is derived by applying a factor of 0.5 to the TSP emission factor whilst the emission factor for $PM_{2.5}$ is derived by applying the appropriate ratio of 0.1 (refer **Table 20**) to the PM_{10} emission factor. Resulting emission factors for PM_{10} and $PM_{2.5}$ are presented below.

$$PM_{10}\ (kg/t) = 0.007$$

$$PM_{2.5}\ (kg/t) = 0.0007$$

Loading coal to trucks

The emission factors for loading coal to trucks are taken from Table 11.9-2 of Chapter 11.9 of AP-42 (USEPA, 1998):

$$TSP\ (kg/t) = \frac{0.58}{(M)^{1.2}}$$

$$PM_{10}\ (kg/t) = \frac{0.0596}{(M)^{0.9}} \times 0.75$$

$$PM_{2.5}(kg/t) = \frac{0.58}{(M)^{1.2}} \times 0.019$$

Where M equals the material moisture content.

Bulldozing overburden

The emission factors for bulldozing overburden are taken from Table 11.9-2 of Chapter 11.9 of AP-42 (USEPA, 1998):

$$TSP\ (kg/hr) = \frac{2.6(s)^{1.2}}{(M)^{1.3}}$$

$$PM_{10}\ (kg/hr) = \left(\frac{0.45(s)^{1.5}}{(M)^{1.4}}\right) \times 0.75$$

$$PM_{2.5}\ (kg/hr) = \left(\frac{2.6(s)^{1.2}}{(M)^{1.3}}\right) \times 0.105$$

Where M is equal to the coal moisture content and s is equal to the coal silt content.

Loading and dumping of overburden

The emission factors for loading and dumping of overburden are taken from Table 11.9-4 of Chapter 11.9 of AP-42 (USEPA, 1998):

$$TSP\ (kg/t) = 0.001$$

No PM_{10} or $PM_{2.5}$ emission factors are available for this source within AP-42, and as previously discussed, the PM_{10} emission factor is derived by applying a factor of 0.5 to the TSP emission factor whilst the emission factor for $PM_{2.5}$ is derived by applying the appropriate ratio of 0.1 (refer **Table 20**) to the PM_{10} emission factor. Resulting emission factors for PM_{10} and $PM_{2.5}$ are presented below.

$$PM_{10}\ (kg/t) = 0.0005$$

$$PM_{2.5}\ (kg/t) = 0.00005$$

Wheel generated particulates on unpaved roads

The emission factors per vehicle kilometre travelled (VKT) for vehicles travelling on unpaved roads are taken from Chapter 13.2.2 of AP-42 (USEPA, 2006).

$$EF\ (kg/VKT) = k \times \left(\frac{s}{12}\right)^{a} \times \left(\frac{W}{3}\right)^{b}$$

Where EF is the emission factor for TSP, PM_{10} or $PM_{2.5}$, k is the aerodynamic size multiplier (4.9 for TSP, 1.5 for PM_{10} and 0.15 for $PM_{2.5}$), s is the silt content of the road (%) as taken from **Table 4**, W is the average weight of vehicles travelling on the road (in tonnes) and a and b are empirical constants (for TSP, a = 0.7 and 0.9 for PM_{10} and $PM_{2.5}$, b = 0.45 for TSP, PM_{10} and $PM_{2.5}$). A conversion from lb/VKT to kg/VKT is also applied where 1 lb = 281.9 g).

Graders operating on unpaved roads

The emission factors for graders is taken from Table 11.9-2 of Chapter 11.9 of AP-42 (USEPA, 1998):

$$TSP\ (kg/VKT) = 0.0034 \times (S)^{2.5}$$

$$PM_{10}\ (kg/VKT) = 0.0056 \times (S)^{2.0} \times 0.6$$

$$PM_{2.5}\ (kg/VKT) = 0.0034 \times (S)^{2.5} \times 0.031$$

Where S is equal to the silt content of roads as provided in **Table 4**.

SUPPORTING PHOTOGRAPHS

Supporting Photographs

Figure C1 Enclosed CHP

Figure C2 Water Spray on ROM Stockpile Load Point

Figure C3 Water Spray on Mining Supplies Storage Area

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