Centennial Coal



Awaba Colliery

Site Specific Particulate Matter Control Best Practice Assessment

Date September 2012

Awaba Colliery

Site Specific Particulate Matter Control

Best Practice Assessment

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Awaba Colliery

Site Specific Particulate Matter Control

Best Practice Assessment

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EXECUTIVE SUMMARY

SLR Consulting Australia Pty Ltd (SLR Consulting) was commissioned by Centennial Newstan Pty Ltd (a subsidiary of Centennial Coal) to perform this assessment, which has included a site inspection, emissions estimation and the identification, quantification and justification of existing and proposed control measures for the site. 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) Environmental Protection Authority (EPA) in November 2011.

Pollution Reduction Program

In 2011, the NSW Environmental Protection Authority (EPA) required, through a Pollution Reduction Program, that Centennial Newstan provide a report which examines in detail the potential measures which could be employed to further reduce particulate emissions from the Awaba Colliery. 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 (EPA) approved emission factors without controls applied. Emission controls currently in place at the Awaba Colliery were to be identified, and the control efficiency afforded by each applied measure, obtained through a literature review and site specific data were to then be applied to these emissions.

Particulate emission sources were then required to be ranked according to the scale of emissions over a one year period with sources contributing to 95% of total site TSP emissions to be identified and taken forward for further assessment. This assessment required that additional controls be 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.

Findings

The Awaba Colliery ceased underground mining activities in early 2012 and no longer is required to handle, process or transport coal from its surface site. In addition, Centennial Newstan is currently seeking approval for the Newstan Colliery Extension of Mining Project, and if this project is granted approval, it will result in a number of modifications to the operations at Awaba Colliery.

In order to address these proposed changes within the PRP assessment framework, baseline (uncontrolled and including existing/proposed control measures) have been estimated for the current operation (based on 2011 activity levels) as well as for the proposed future operations after implementation of the Newstan Colliery Extension of Mining Project. The review of potential additional control options however, was only performed for the proposed future operations (i.e. assuming full implementation of the Newstan Colliery Extension of Mining Project).

Through this process it has been estimated that after implementation of Newstan Colliery Extension of Mining Project emissions of particulate from the site will reduce when compared to 2011 operational scenarios, as follows:

- TSP will reduce from 63,023 kg/annum to 620 kg/annum (a 99% reduction)
- PM_{10} will reduce from 23,424 kg/annum to 125 kg/annum (a 99.5% reduction)

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

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- $PM_{2.5}$ will reduce from 2,343 kg/annum to 96 kg/annum (a 96% reduction)

Only four sources were identified for the proposed future activities at Awaba Colliery, hence ranking of emissions sources to identify the top contributors was not required. All sources were reviewed to assess whether additional controls could be implemented to further reduce emissions from the upgraded site. Specifically, these are:

- Wind erosion from bulk storage areas; and
- Emissions from the ventilation shaft.

Additional control options for the proposed operations at Awaba Colliery have 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 screening process no additional control measures were identified that could be implemented at Awaba Colliery to reduce dust emissions which are not already proposed to be employed at the site or are practical for implementation.

Ongoing Actions and Implementation Timeframe

As no additional particulate control measures have been identified for the proposed future activities at the site, the widespread implementation of any measure has not been committed to at this time.

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1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR Consulting) was commissioned by Centennial Coal Newstan Pty Ltd (a subsidiary of Centennial Coal) to perform this assessment, which has included a site inspection, emissions estimation and the identification, quantification and justification of particulate control measures for the site. The study was performed in accordance with the *Coal Mine Particulate Matter Control – Best Practice: Site Specific Determination Guideline*[2] issued by Office of Environment and Heritage (OEH) in November 2011.

The findings of this assessment are presented in the following report for submission to OEH.

1.1 Background

In 2010, the NSW OEH commissioned a detailed review of particulate matter (PM) emissions from coal mining activities in the Greater Metropolitan Region (GMR) of NSW. This review was completed in 2011 and one of the key recommendations of the study was that each mine should carry out a site-specific determination of best management practice. This recommendation has been adopted by the OEH through the implementation of the "*Dust Stop*" program.

The Dust Stop program aims to ensure that the most reasonable and practical particulate control options are implemented by each coal mine. Under this program, all coal mines in NSW are required to prepare a report that compares their current operation with international best practice. Mines are also required to report on the practicability of implementing each best practice measure and for any measures found to be practicable are required to provide a timetable for implementation. Once complete, copies of each report will be available on the mine's website.

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 for the Awaba 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**.

Briefly, the process that is required is indicated below. 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**

Further to this provided guidance, OEH held a workshop for coal mining companies and their consultants on 8 May 2012. The outcome of this workshop was further clarified guidance relating to the requirements of OEH. These clarifications are summarised as follows:

- The use of air quality monitoring data to identify that sites are complying with OEH ambient air quality criteria and therefore justify the need not to apply further controls is not acceptable. The aim of the PRP process is to reduce particulate emissions as a whole and is not primarily concerned with ambient concentrations.

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

- More site specific data is required. For example, material (silt/moisture), meteorology, vehicles (weights, speeds) and activity data. Where such data is not available, the justification of what *is* used is required, with potentially a recommendation and commitment by the site to collect this data in the future.
- Reports are required to be transparent and consistent with the mine AEMR.
- Reports need to include further detail on the control effectiveness of measures applied to each source. Although the guideline document identifies that the Katestone document should be referred to, blindly following the Katestone report is not acceptable practice.
- When control measures are recommended for implementation, some form of confirmation that controls are effective is required, or at least some indication of how the success of each measures implementation will be measured. This might include KPI's, methods of monitoring, the location, frequency and duration of monitoring, and procedures for management.
- Economic review of each identified measure needs to consider depreciation (ATO rule TR2011/2012 for Coal Mining (Code 06000 and 10900). For off-highway trucks (including articulated, rigid dump, service, fuel and water trucks), the life of assets is classed as 10 years by the ATO.
- The salvage value of, for example trucks also needs to be considered (end of mine life and replacements).
- Implementation commitments will be written into Environmental Protection Licences in some form, but will be flexible if measures are not deemed to be viable at a later date.
- Although the guidance document identifies that the top four emission sources should be assessed, some professional judgement is required. The top four should not be blindly assessed. For example, if the top four only contribute 50% to total site emissions then more sources should be included. The top four sources should cover about 95% of total site emissions.

1.3 Description of Current Activities

Environment Protection Licence (EPL) 443 held by Centennial Newstan covers operations at the Awaba Colliery, which is located approximately one kilometre (km) south of the Awaba village and approximately 5.5 km south-west of Toronto on the western side of Lake Macquarie, near Newcastle New South Wales. The site is situated on crown land under lease to Centennial for the purpose of mining under Consolidated Coal Lease CCL746, and is adjacent to the Newstan-Eraring haul road owned by Eraring Energy.

Awaba Colliery is a small underground mine which has been producing coal by bord and pillar method since 1947 up until early 2012. A form of pillar extraction of narrow panels is used to recover coal in pillars developed previously by bord and pillar methods.   This mining method utilised continuous miners.

The Awaba Colliery consists of a Coal Handling Plant (CHP) and mine support infrastructure which includes decline tunnels, coal stockpiles, conveyors, mine fan, and workshop buildings. The current Project Approval (10-0038) covers an extension to underground continuous mining operations and the ongoing use of associated surface operations, with the site approved to process up to a maximum of 880,000 tonnes per annum (tpa) of Run of Mine (ROM) coal. Coal is transported along dedicated haul roads either directly to the Eraring Power Station or to Newstan Colliery's coal preparation and rail loading facilities for export.

Current approved operational activities at the Awaba Colliery include:

- *Coal Receipt* – raw coal is brought to the surface to a ROM bin with a capacity of approximately 800 tonnes.

- *Coal Handling and Storage* – coal is transferred via conveyor from the ROM bin to the CHP for screening and crushing to less than 100 mm. This material is then delivered to the Final Product Bin by conveyor.
- *Transport of Final Product* – Coal from the Final Product Bin can be loaded into trucks for transport to the Newstan Colliery ROM stockpile or Eraring Power station via paved private haul roads. Alternatively it may be stockpiled in an area adjacent to the Final Product Bin, with the site having the capacity to stockpile up to 30,000 tonnes of coal.

Figure 1 presents graphically the coal extraction, transport, processing and storage procedures performed at Awaba Colliery. A Plan of the Pit Top area at Awaba Colliery is presented in **Figure 2**.

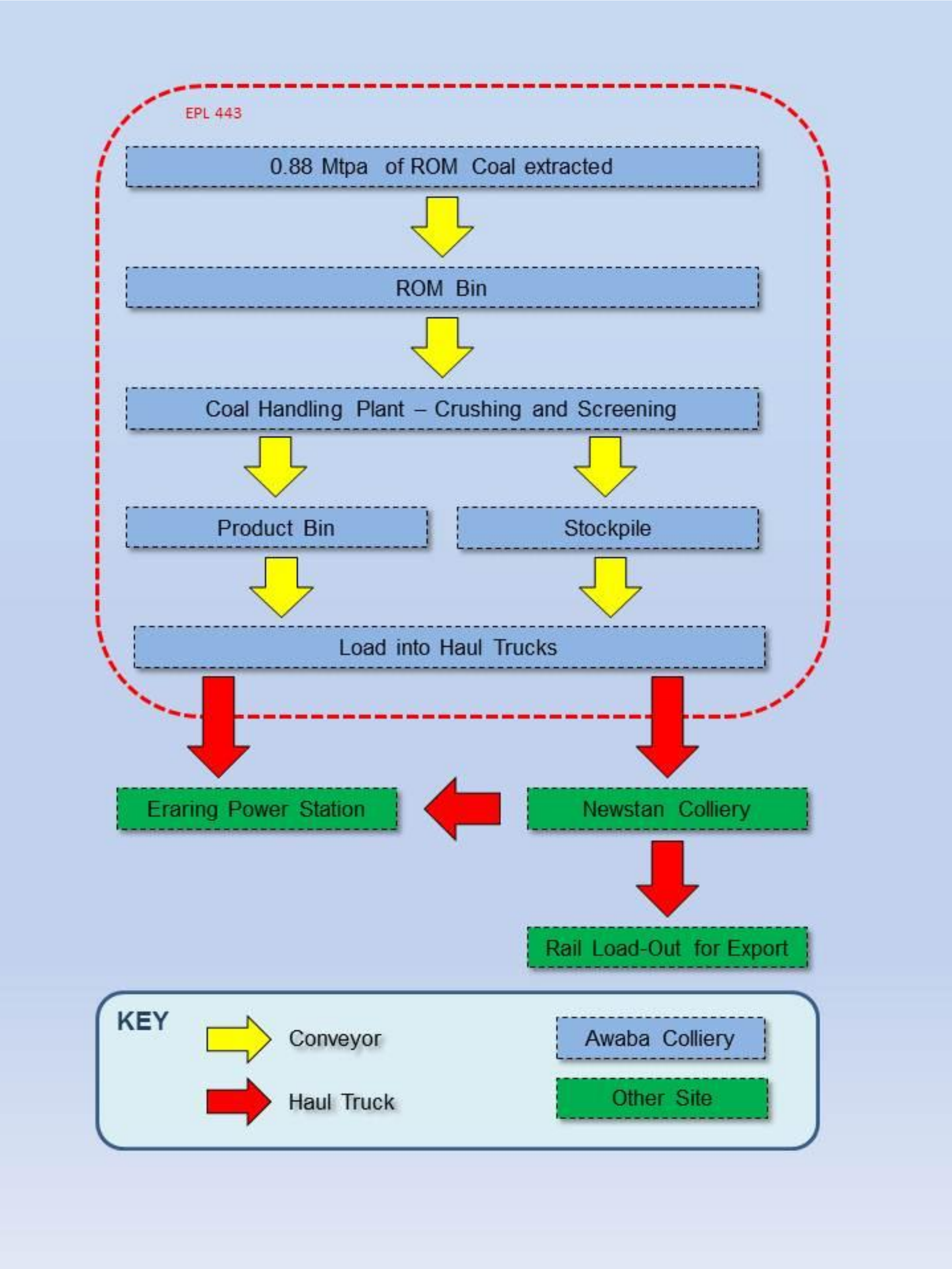
During the most recent Annual Environmental Management Report (AEMR) period of 2011 (1 January 2011 to 31 December 2011), the quantities of coal production and waste generation were reported as presented in **Table 1** (taken from Table 6, AEMR, 2011 p15).

Table 1 Production and Waste Summary, Awaba 2011

Parameter	Reporting Period (1 January 2011 to 31 December 2011)
Topsoil stripped	Nil
Topsoil Used/Spread	Nil
Overburden Moved	Nil
Processing Waste	Nil
ROM Coal Mined	643,814 t
Product	643,814 t

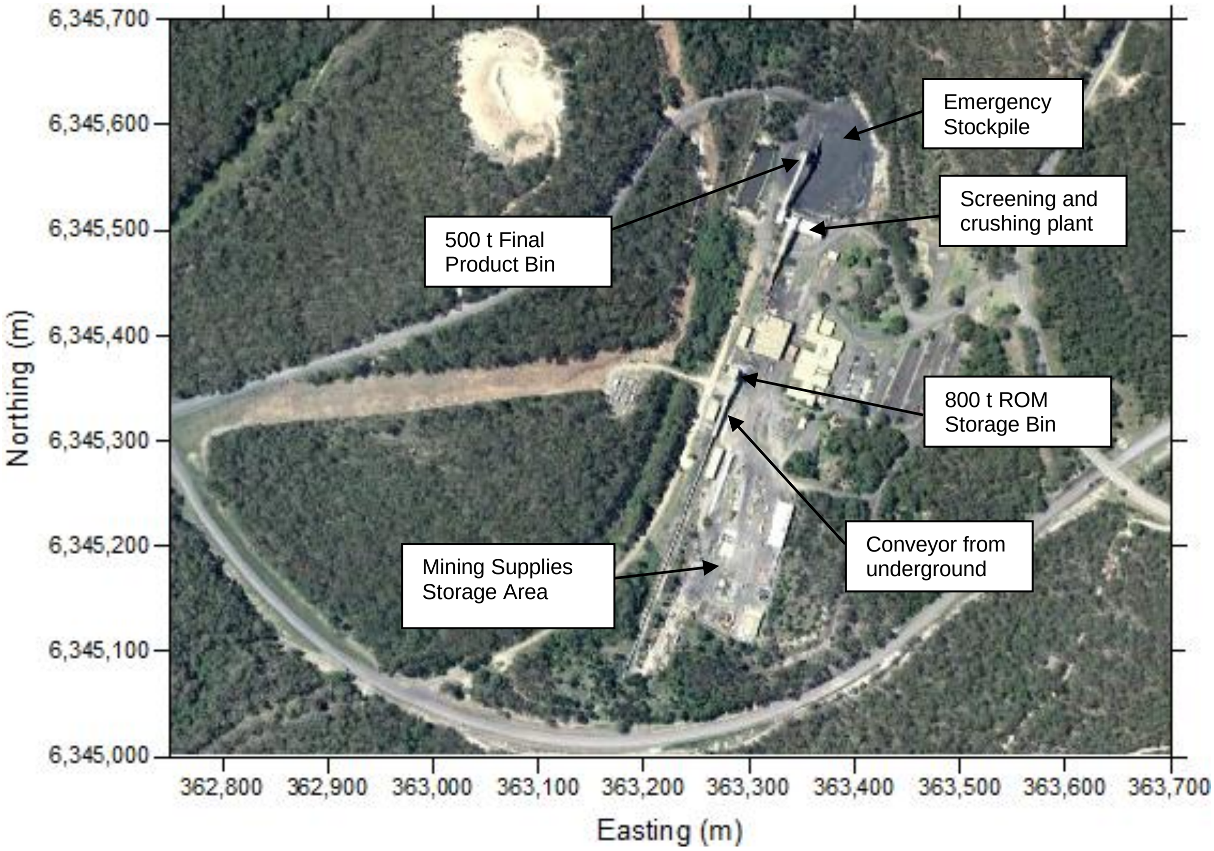
Taken from Table 6, Awaba AEMR 2011 p15

Figure 1 Current Approved Coal Processing, Storage and Transport Activities – Awaba Colliery



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

Figure 2 Awaba Colliery – Pit Top Site Layout



1.4 Proposed Site Activities

The Awaba Colliery ceased underground mining production in early 2012 and is no longer required to handle, process or transport coal for its surface site. Removal of all associated coal handling infrastructure at the Awaba Colliery Surfaces Site has commenced.

Centennial Newstan is currently seeking approval for the Newstan Colliery Extension of Mining Project under Part 4 Division 4.1 of the EP&A Act. If this project is granted approval, it will result in the following possible modifications to Awaba Colliery:

- Construction of a new men and materials drift at the Awaba Colliery Surface Site for access to the Newstan Colliery underground workings;
- Upgrades to the existing Awaba Colliery buildings, including administration buildings, bathhouse facilities and workshop to support the increased workforce of up to 450 employees, which will be relocated from the Newstan Colliery Surface Site to the Awaba Surface Site.
- Construction and operation of an upcast shaft and surface fans
- Installation and operation of other additional surface infrastructure for gas drainage, greenhouse gas capture and abatement, electrical reticulation, water reticulation, water management, communications and other services.

- Continued ability to transport of up to 880,000 tpa coal along the Awaba Haul Road to Newstan.

1.5 Current Project Approval Conditions

Project Approval Conditions for the Awaba Colliery under Section 75J of the *Environmental and Planning Assessment Act 1979*, include air quality criteria to ensure that the dust emissions generated by the Colliery do not cause additional exceedances of air quality criteria. These criteria are outlined in **Table 2** and are not to be exceeded at any residence on privately owned land, or on more than 25% of any privately owned land.

Table 2 Impact Assessment Criteria for Particulate Matter and Dust Deposition

Pollutant	Averaging Period	Criterion	
Total suspended particulate matter (TSP)	Annual	90 µg/m^3	
Particulate matter <10 µm (PM_{10})	Annual	30 µg/m^3	
	24 hour	50 µg/m^3	
		Maximum increase in deposited dust level	**Maximum total deposited dust level**
Deposited dust	Annual	2 g/m^2/month	4 g/m^2/month

1.6 Environmental Licence Conditions

The OEH regulates the operations conducted at Awaba Colliery through an Environmental Protection Licence issued under the Protection of the Environment Operations Act 1997 (POEO Act). Environmental Protection Licence number 433 (Centennial Coal Newstan Pty Limited) contains the following conditions in relation to dust (with the exception of the requirements in Condition U2, 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 Activities occurring in or on the premises must be carried out in a manner that will minimise the generation, or emission from the premises, of wind-blown or traffic generated dust.

O3.3 All trafficable areas, coal storage areas and vehicle manoeuvring areas in or on the premises must be maintained, at all times, in a condition that will minimise the generation, or emission from the premises, of wind-blown or traffic generated dust.

O3.4 Trucks transporting coal from the premises must be covered immediately after loading to prevent wind blown emissions and spillage. The covering must be maintained until immediately before unloading the trucks.

O3.5 The tailgates of all haulage trucks leaving the premises must be securely fixed prior to loading or immediately after unloading to prevent loss of material.

O3.6 Coal stockpiles must be maintained in a condition that will minimise the generation and emission of dust on the premises.

Awaba Colliery operates a complaints recording and management system as part of their over-arching management system and in accordance with Conditions M5 and M6 of the EPL. In the last four years, Awaba Colliery has had no complaints relating to dust nuisance, and as such it is considered reasonable that current dust emission controls and management measures employed at the site are sufficient to manage the potentially dust-emitting sources to not create any dust nuisance issues.

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

1.7 Environmental Performance

Considering the requirements of both the Project approval, EPL and due diligence purposes, Awaba Colliery operates an air quality monitoring program for dust deposition. Dust deposition monitoring has been undertaken on a monthly basis since 2003 using a network of four (4) dust gauges positioned around the site boundary at locations to the north, east, south and west. The locations of dust deposition monitoring are identified in **Figure 3**.

Monitoring results for dust deposition are presented in **Figure 4** for the years 2003 to 2009. All dust deposition results met the assessment criterion of 4 g/m^2/month.

Centennial Coal propose to expand the montioring program at Awaba Colliery to include montioring of suspended particulate (TSP and PM_{10}) using high volume samplers on a one-day-in-six cycle. The samplers are proposed to be located adjacent to the Council owned tennis courts, on Olney Street, Awaba. Discussions are still ongoing with Lake Macquarie City Council in regarding to installation of these air quality monitors.

Figure 3 Awaba Colliery (EPL 433) Dust Deposition Monitoring Locations

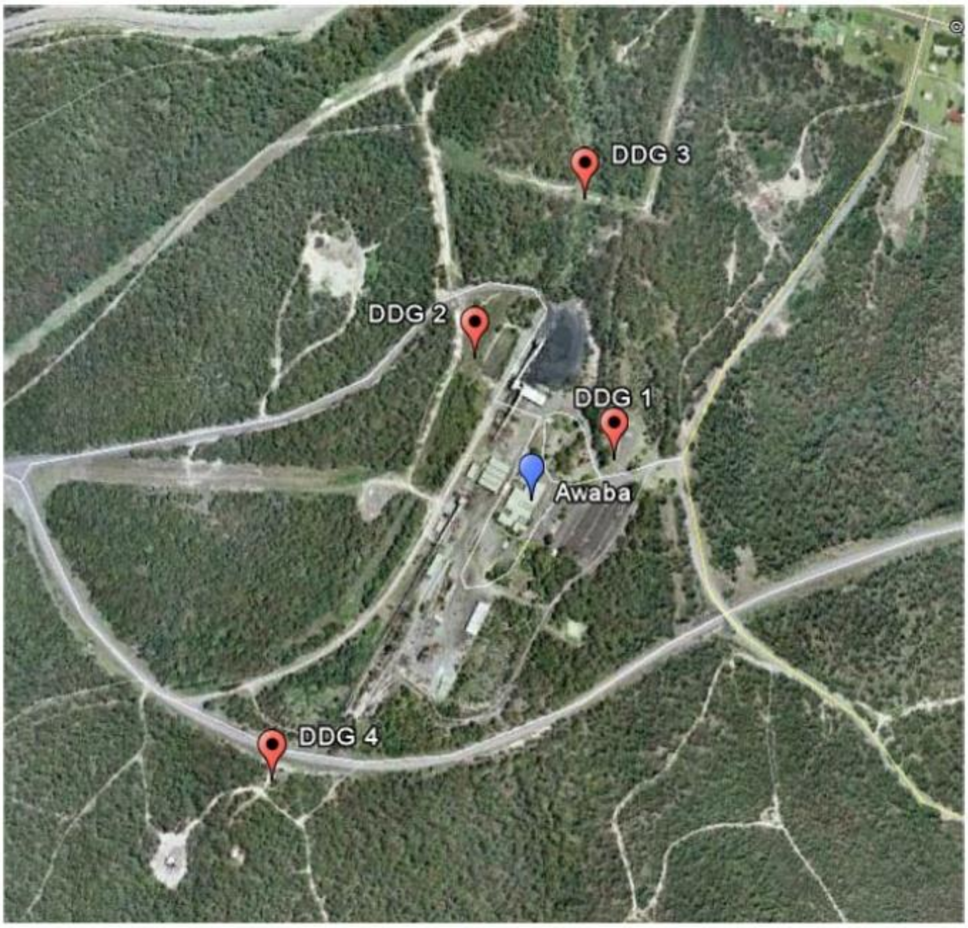
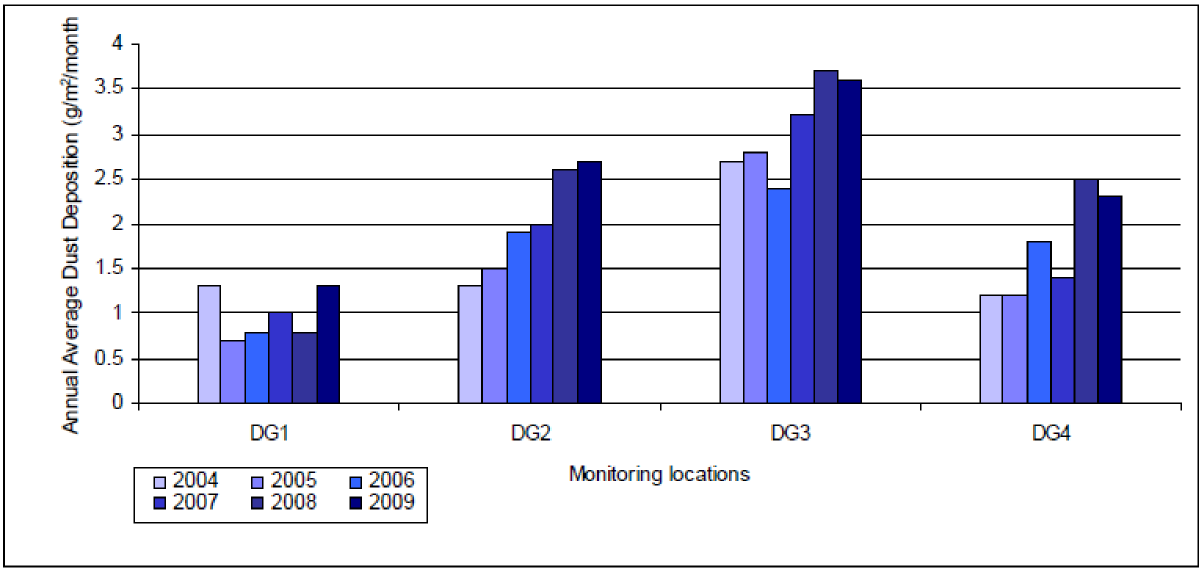


Figure 4 Monitoring Results for Dust Deposition – Awaba Colliery



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 $PM_{2.5}$.

As discussed in **Section 1.3** and **Section 1.4**, the Awaba Colliery ceased underground mining activities in early 2012, and no longer is required to handle, process or transport coal from its surface site. In addition, Centennial Newstan is currently seeking approval for the Newstan Colliery Extension of Mining Project and if this project is granted approval, it will result in a number of modifications to the operations at Awaba Colliery. In order to address these proposed changes within the PRP assessment framework, baseline (uncontrolled and including approved/proposed control measures) have been estimated for the current approved operation (based on 2011 activity levels) as well as for the proposed future operations after implementation of the Newstan Colliery Extension of Mining Project. The review of additional control options, however, has only been performed for the proposed future operations (i.e. assuming full implementation of the Newstan Colliery Extension of Mining Project).

2.1 Estimation of Baseline Particulate Emissions

The estimation of baseline emissions of particulate matter for the existing site operations has been performed using the United States Environmental Protection Agency (USEPA) AP-42, *Compilation of Air Pollutant Emission Factors* estimation techniques, 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 Awaba Colliery. **Table 3** presents a summary of the AP-42 reference sections for the various emission factors used in this assessment report. A discussion of the annual activity related to each action 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. Further details of the emission factors used for each activity currently occurring at Awaba Colliery are provided in **Appendix B**.

It is noted that for the purposes of estimating uncontrolled emissions, dust emissions from the haulage of coal have been calculated based on the roads being unpaved.

Table 3 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)	
Wind erosion of disturbed areas	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)	

2.1.1 Activity Data

Annual activity data for the activities presented in **Table 3** are provided in **Table 4** (material handling), **Table 5** (paved and unpaved roads) and **Table 6** (wind erosion sources).**Table 15**

Table 4 Annual Activity Data for Material Handling Operations: Current Approved Activities at Awaba

Operation/Activity	Number	Activity Rate (Annual)	Units	Notes
Front End Loader on Coal	1	24,762	tonnes	Assume 2 weeks production is temporarily stored at the stockpile
Loading Stockpiles	-	643,814	tonnes	2011 AEMR production rate
Conveyor Transfer Points	3	643,814	tonnes	Enclosed
Primary Crushing	-	643,814	tonnes	Enclosed
Screening	-	643,814	tonnes	Enclosed
Truck Loading	-	643,814	tonnes	From CHP Loading Chute

Table 5 Annual Activity Data for Road Haulage: Current Approved Activities at Awaba

Haul Road Name	Paved	Length (km)	Trips/Year (1-way)	VKT per year[1]	Mean Vehicle Weight (tonnes)	Silt Content (%) [2]
Awaba to Newstan	Yes	8.3	4,292	56,999	57	6.4
Awaba to Eraring PS	Yes	3.9	6,438	40,174	57	6.4

Notes: 1 Based on a payload of 60 tonnes and 40% of coal being transported to Newstan and 60% to Eraring Power Station.
2 Assumed silt content for uncontrolled emissions (i.e. based on unpaved haul roads)

Table 6 Annual Activity Data for Wind Erosion Sources: Current Approved Activities at Awaba

Open Area	Total Area (ha)	Active Area (ha)	Emission Factor Applied to Active Area
Product Stockpile	0.8	0.8	Active Storage Pile AP-42 Chapter 11.9
Mining Supplies Storage Area	0.15	0.15	Wind Erosion of Exposed Areas AP-42 Chapter 11.9
Conveyor Exit Area	0.09	0.09	Wind Erosion of Exposed Areas AP-42 Chapter 11.9
Bulk Materials Storage	0.04	0.04	Wind Erosion of Exposed Areas AP-42 Chapter 11.9

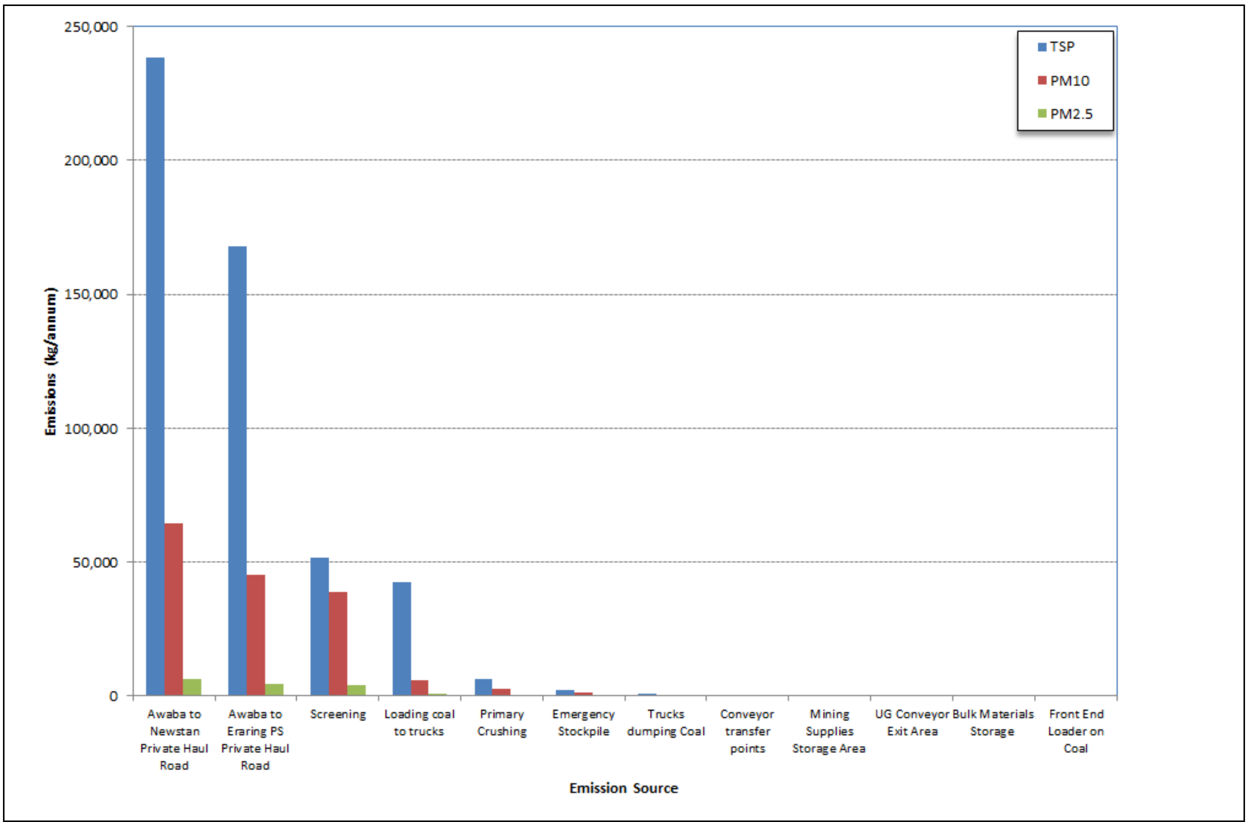
2.1.2 Uncontrolled Particulate Emissions: Current Activities at Awaba

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 currently approved to occur at Awaba Colliery are presented in **Table 7** and graphically in **Figure 5**. As noted above, these calculations assume unpaved haul raods.

Table 7 Uncontrolled Annual Particulate Emissions: Current Activities at Awaba

Emission Source	TSP Emissions (kg/year)	PM_{10} Emissions (kg/year)	$PM_{2.5}$ Emissions (kg/year)
Awaba to Newstan Private Haul Road	238,455	64,373	6,437
Awaba to Eraring PS Private Haul Road	168,068	45,371	4,537
Screening	51,505	38,629	3,863
Loading coal to trucks	42,638	5,653	565
Primary Crushing	6,438	2,575	258
Emergency Stockpile	2,377	1,189	119
Trucks dumping Coal	817	409	41
Conveyor transfer points	453	214	21
Mining Supplies Storage Area	128	64	6
UG Conveyor Exit Area	77	38	4
Bulk Materials Storage	34	17	2
Front End Loader on Coal	17	8	1
TOTAL	**511,007**	**158,540**	**15,854**

Figure 5 Uncontrolled Annual Particulate Emissions: Current Activities at Awaba



2.1.3 Existing Control Measures

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

Table 8 Particulate Emission Controls Currently Applied at Awaba Colliery

Source	Control Measure	Comments
Wheel-generated particulates from haul roads	Private haul roads are paved and cleaned as required	
Coal crushing	Enclosed	CHP is enclosed
Coal Screening	Enclosed	
Material transfer of coal	Conveyors enclosed	Enclosed on three sides
Truck loading		
Wind Erosion – ROM Stockpile	Fixed Water Sprays	
Wind Erosion – Open Areas	Storage areas are covered in gravel to stabilise surface. Plant area paved and swept as required.	

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
Haul Roads	Paving	90	Katestone (2010)
Coal Crushing	Enclosure	70	NPI (2011)
Coal Screening	Enclosure	70	NPI (2011)
Material Transfer of Coal	Enclosure	70	NPI (2011) and Katestone (2010)
Emergency Stockpile	Water Sprays	50	NPI (2011) and Katestone (2010)
Storage Areas	Gravelling surface	84	Katestone (2010)
Processing area	Paving and cleaning	95	Katestone (2010)

2.1.4 Controlled Particulate Emissions: Current Approved Activities at Awaba

Using the control factors listed in **Table 9**, the annual (controlled) particulate emissions from activities currently occurring at Awaba Colliery are presented in **Table 10** and graphically in **Figure 6**.

A comparison of the total emissions by source are presented in **Figure 7**. Particulate emissions are presented by source group (wind erosion, haul roads, material handling, and the CHP) in **Table 11**.

Table 10 Controlled Annual Particulate Emissions: Current Approved Activities at Awaba

Emission Source	TSP Emissions (kg/year)	PM_{10} Emissions (kg/year)	$PM_{2.5}$ Emissions (kg/year)
Awaba to Newstan Private Haul Road	23,846	6,437	644
Awaba to Eraring PS Private Haul Road	16,807	4,537	454
Screening	15,452	11,589	1,159
Loading coal to trucks	12,791	1,696	170
Primary Crushing	1,931	773	77
Emergency Stockpile	1,189	594	59
Trucks dumping Coal	817	409	41
Conveyor transfer points	136	64	6
Mining Supplies Storage Area	20	10	1.0
Front End Loader on Coal	17	8	1.2
Bulk Materials Storage	5	3	0.3
UG Conveyor Exit Area	4	2	0.2
TOTAL	**73,015**	**26,122**	**2,613**

Figure 6 Controlled Annual Particulate Emissions: Current Approved Activities at Awaba

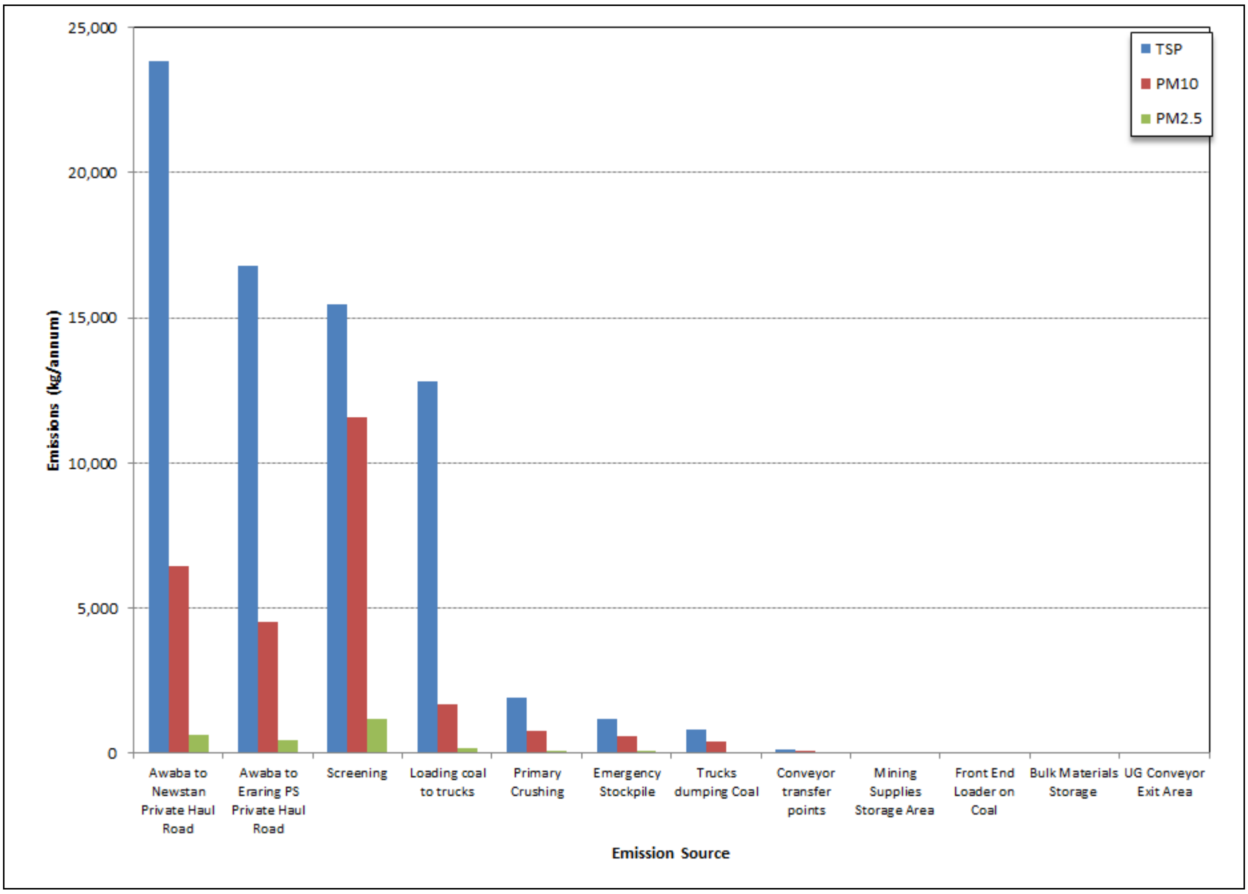


Figure 7 Comparison of Uncontrolled versus Controlled Particulate Emissions: Current Approved Activities at Awaba

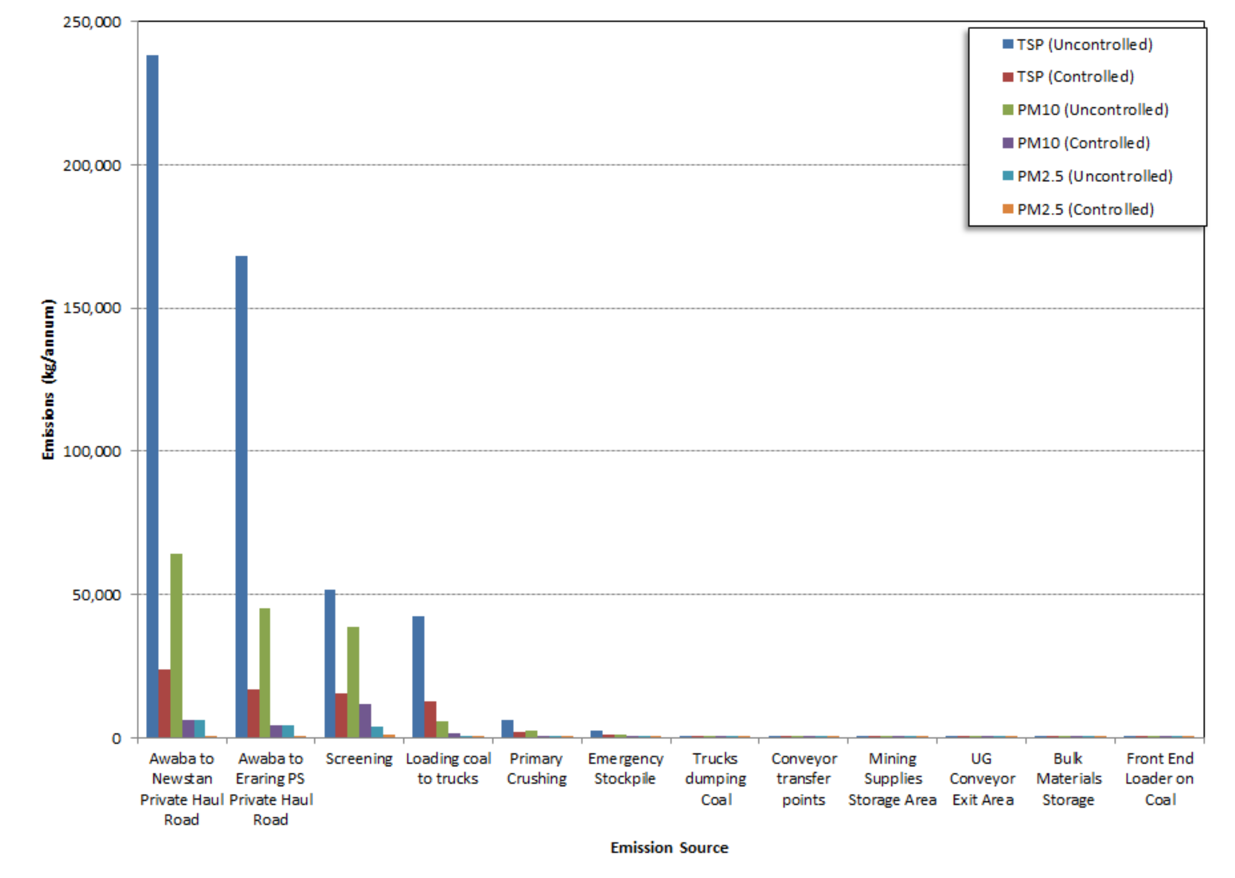


Table 11 Comparison of Uncontrolled and Controlled Particulate Emissions: Current Approved Activities at Awaba

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	2,615	1,308	131	1,218	609	61
Haul Roads	406,523	109,744	10,974	40,652	10,974	1,097
Material Handling	43,472	6,070	607	13,626	2,113	212
CHP and Coal Processing	58,396	41,418	4,142	17,519	12,426	1,243
TOTAL	**511,007**	**158,540**	**15,854**	**73,015**	**26,122**	**2,613**

2.2 Estimation of Proposed Future Baseline Particulate Emissions

Table 12 presents a summary of the AP-42 reference sections for the various emission factors used in the assessment of the proposed future activities at Awaba Colliery. A discussion of the annual activity related to each action and the subsequent calculated emission rates of TSP, PM_{10} and $PM_{2.5}$ are provided in **Section 2.2.1**. The emissions are presented firstly as uncontrolled emissions, and secondly as emissions with the proposed controls in place. Further details of the emission factors used for each activity occurring at Awaba Colliery are provided in **Appendix B**.

As for the emission estimates for the current approved activities, for the purposes of estimating uncontrolled emissions, dust emissions from the haulage of coal have been calculated based on the roads being unpaved.

Table 12 Particulate Emissions Sources and Relevant USEPA AP-42 Emission Factors

Emissions Source	AP-42 Chapter	Notes
Wheel generated particulates on unpaved roads	Chapter 13.2.2 Unpaved Roads (2006)	
Wind erosion of disturbed areas	Chapter 11.9 Western Surface Coal Mining (1998)	
Ventilation shaft emissions	-	No factors available

2.2.1 Activity Data

Annual activity data for the activities presented in **Table 12** are provided in **Table 13** (road haulage) **Table 14** (wind erosion sources) and **Table 15** (ventilation shaft emissions).

Table 13 Annual Activity Data for Road Haulage Operations: Proposed Activities at Awaba

Haul Road Name	Paved	Length (km)	Trips/Year (1-way)	VKT per year[1]	Mean Vehicle Weight (tonnes)	Silt Content (%) [2]
Awaba to Newstan	Yes	8.3	14,667	243,467	57	6.4

Notes: 1 Based on a payload of 60 tonnes and 100% of coal being transported to Newstan.
2 Assumed silt content for uncontrolled emissions (i.e. based on unpaved haul roads)

Table 14 Annual Activity Data for Wind Erosion Sources: Proposed Activities at Awaba

Open Area	Total Area (ha)	Active Area (ha)	Emission Factor Applied to Active Area
Mining Supplies Storage Area	0.15	0.15	Wind Erosion of Exposed Areas AP-42 Chapter 11.9
Bulk Materials Storage Area	0.04	0.04	Wind Erosion of Exposed Areas AP-42 Chapter 11.9
New Bulk Materials Storage	0.28	0.28	Wind Erosion of Exposed Areas AP-42 Chapter 11.9

Table 15 Annual Activity Data for Proposed Ventilation Shaft

Source	Gas Flow Rate (m^3/s)	Particulate Concentration (mg/m^3)[1]		Emission Factor Applied to Ventilation Source
		TSP	PM_{10}	
Ventilation Fan	147	7.2	1.2	No data in AP-42. In-shaft TSP and PM_{10} monitoring data performed by SLR Consulting at Mandalong Mine has been used

Note: $PM_{2.5}$ concentration assumed to be the same as PM_{10} concentration

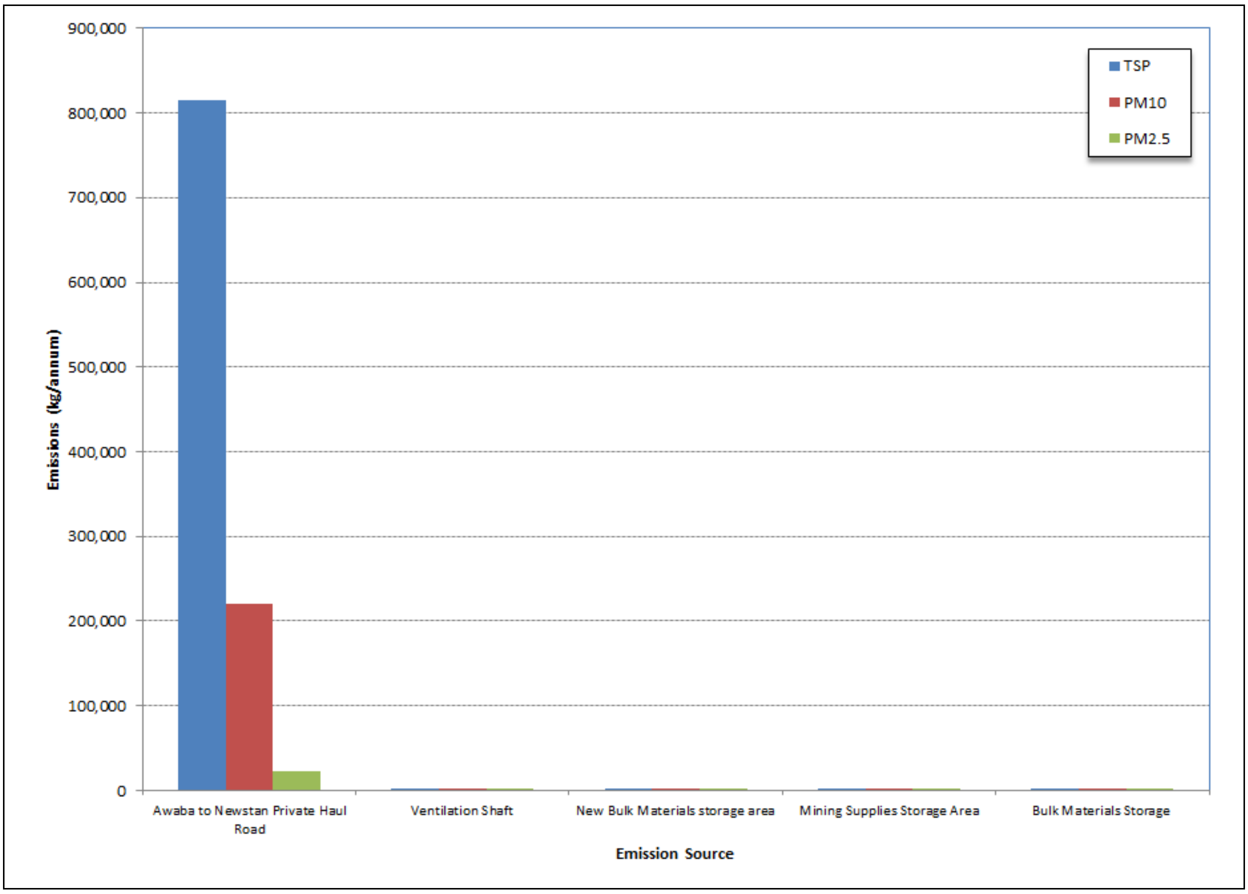
2.2.2 Uncontrolled Particulate Emissions

Using the emission factors calculated in **Appendix B** and the annual activity data presented in **Section 2.2.1**, the annual (uncontrolled) particulate emissions from the proposed future activities at Awaba Colliery are presented in **Table 16** and graphically in **Figure 5**.

Table 16 Uncontrolled Annual Particulate Emissions: Proposed Activities at Awaba

Emission Source	TSP Emissions (kg/year)	PM_{10} Emissions (kg/year)	$PM_{2.5}$ Emissions (kg/year)
Awaba to Newstan Private Haul Road	814,834	219,970	21,997
Ventilation Shaft	556	93	93
New Bulk Materials storage area	238	119	12
Mining Supplies Storage Area	128	64	6
Bulk Materials Storage	34	17	2
TOTAL	**815,789**	**220,263**	**22,110**

Figure 8 Uncontrolled Annual Particulate Emissions: Proposed Activities at Awaba



2.2.3 Proposed Control Measures

A summary of the control measures that are proposed to be included in the site upgrade at the Awaba Colliery, and the applicable control efficiencies of each of the controls, is presented in **Table 17**.

Table 17 Particulate Emission Controls Proposed as Part of Upgrades at Awaba Colliery

Emission Source	Control Measure	Control Factor (%)	Source
Haul Roads	Paving	90	Katestone (2010)
Storage Areas	Gravelling surface	84	Katestone (2010)

2.2.4 Controlled Particulate Emissions: Proposed Activities at Awaba

Using the control factors listed in **Table 17**, the annual (controlled) particulate emissions from activities proposed as part of future operations at Awaba Colliery are presented in **Table 18** and graphically in **Figure 9**.

Table 18 Controlled Annual Particulate Emissions – Proposed Activities at Awaba

Emission Source	TSP Emissions (kg/year)	PM_{10} Emissions (kg/year)	$PM_{2.5}$ Emissions (kg/year)
Awaba to Newstan Private Haul Road	81,483	21,997	2,200
Ventilation Shaft	556	93	93
New Bulk Materials storage area	38	19	1.9
Mining Supplies Storage Area	20	10	1.0
Bulk Materials Storage	5	3	0.3
TOTAL	**82,104**	**22,122**	**2,296**

Figure 9 Controlled Annual Particulate Emissions: Proposed Activities at Awaba

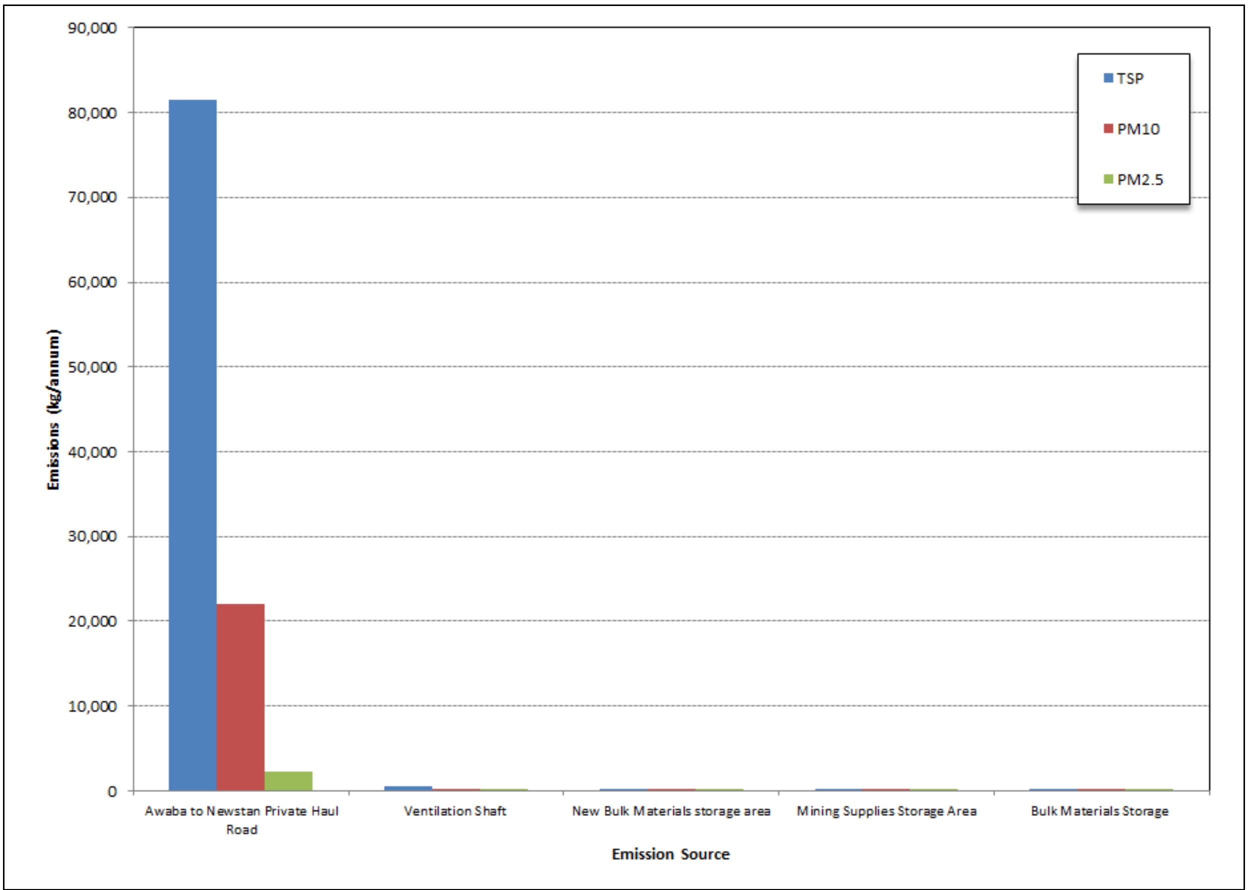
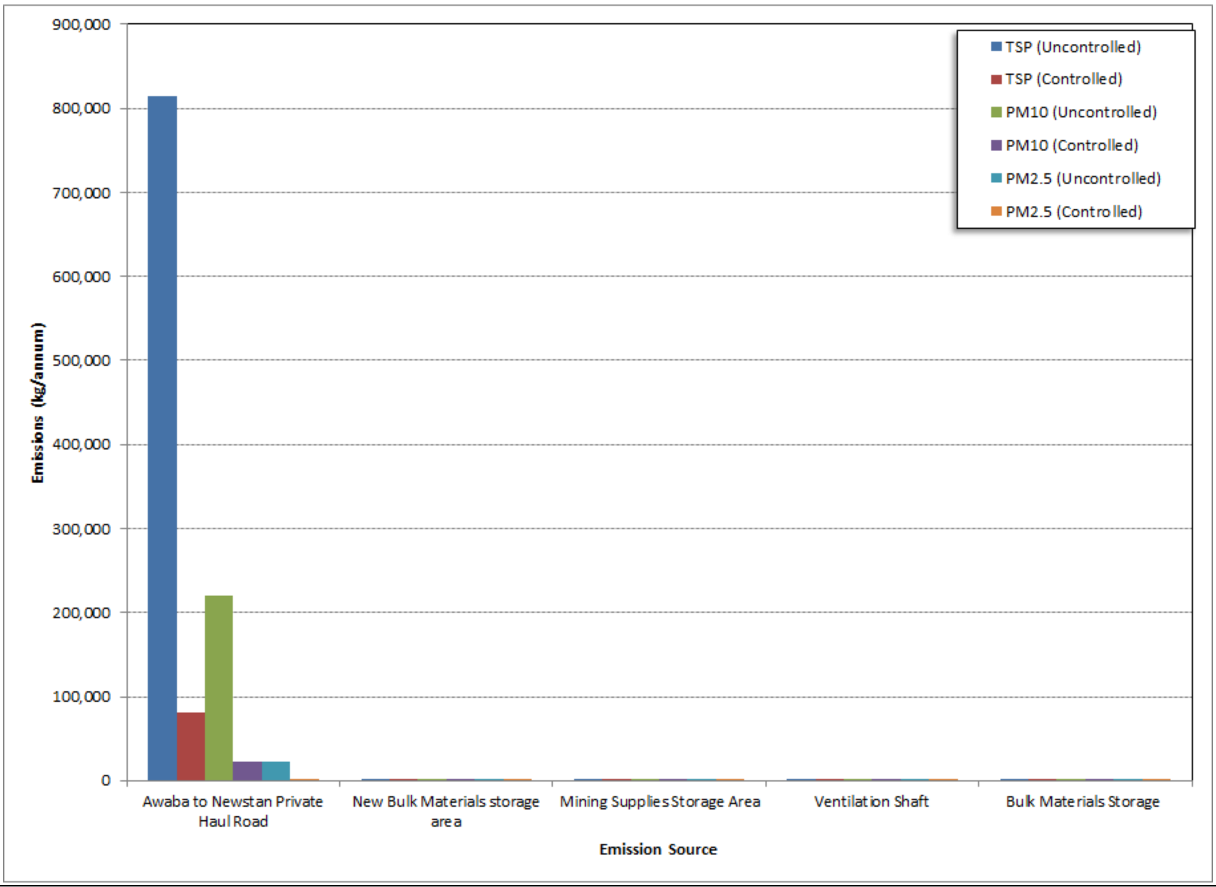


Figure 10 Comparison of Uncontrolled versus Controlled Particulate Emissions: Proposed Activities at Awaba



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

As only five sources have been identified for the proposed future activities at Awaba Colliery, ranking of emissions sources to identify the top contributors is not required. All sources have been reviewed to assess whether additional controls could be implemented to further reduce emissions from the upgraded site. Specifically, these are:

- Emisisons from haulage of coal along the Awaba to Newstan Private Haul Road
- Wind erosion from bulk storage areas; and
- Emissions from the ventilation shaft.

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 Vehicle Movements on Haul Roads

Options for the control of dust emissions from haul roads fall into the following three categories:

- Vehicle restrictions that limit the speed, weight or number of vehicles on the road.
- Surface improvement by measures such as (a) paving or (b) adding gravel or slag to a dirt road.
- Surface treatment such as watering or treatment with chemical dust suppressants.

A summary of the potential control measures for minimising particulate emissions from haul roads, and their effectiveness, is provided in **Table 19** (Katestone, 2010). As shown by the table, paving of the road surface offers the greatest reduction in dust emisisons at greater than 90%. As the Awaba to Newstan Private haul Road is paved, and this represents best practice for dust control, no potential additional control measures have been identified for further analysis.

Table 19 Best Practice Control Measures - Unpaved Roads

Control Type	Control Measure	Effectiveness
Vehicle Restrictions	Reduction from 75 km/hr to 50 km/hr	40-75
	Reduction from 65 km/hr to 30 km/hr	50-85
Surface Improvements	Pave the surface (currently implemented)	>90%
	Low silt aggregate	30%
	Oil and double chip surface	80%
Surface Treatments	Watering (standard procedure)	10-74%
	Watering Level 2 (>2 l/m²/hr)	75%
	Watering twice a day for industrial unpaved road	55%
	Hygroscopic salts[a]	Av. 45% over 14 days
		82% within 2 weeks
	Polymer and Tar/Bitumen emulsions	70% over 58 days

Notes: [a] Use of hygroscopic salts can also act to extend the required time between watering by 33% to 50% (USDHHS, 2012)
[b] Reductions achieved by the use of larger vehicles, conveyors and lower grader speeds have been calculated from the emission factors for these activities

SOURCE: Katestone (2010), Table 66

3.2 Wind Erosion of Exposed Areas

To control the generation and/or propagation of particulate emissions due to wind erosion, the following techniques are recommended, including those identified in Katestone, 2011:

- Paving – usually feasible for small areas in and around workshops
- Fencing, bunding or shelterbelts to reduce ambient wind speeds
- Adding gravel to the surface to reduce surface fines content and to reduce the surface wind speed
- Spillage clean up
- Watering
- Chemical suppressants
- Revegetation – use of vegetation as an interim measure to minimise emissions of particulate matter from areas that may be exposed for an extended period of time
- Rehabilitation – use of vegetation and land contouring to produce the final post-mining land form

A summary of the potential control measures for minimising particulate emissions from wind erosion in exposed areas, and their effectiveness, is provided in **Table 20**, reproduced from Katestone (2011).

It is already propsed to stabilise the surface of the storage areas by applying gravel, which is reported to control emissions by 84%. The only alternative option listed in in **Table 20** that would provide a greater control of emissions would be paving and cleaning at >95%.

Table 20 Best Practice Control Measures – Wind Erosion of Exposed Areas

Control Type	Control Measure	Effectiveness
Surface stabilisation	Watering	50%
	Chemical suppressants	70% 84%
	Paving and cleaning	>95%
	Apply gravel to stabilise disturbed open areas	84%
	Rehabilitation. EMP should specify a rehabilitation goal and report annually against progress to meeting goal.	99%
Wind speed reduction	Fencing, bunding, shelterbelts or in-pit dump. Height should be greater than the height of the erodible surface	30% 70-80%
	Vegetative ground cover	70%

SOURCE: Katestone (2011), Table 71

3.3 Ventilation Shaft Emissions

Katestone (2011) does not provide emission reduction factors for ventilation shaft emissions.

As the emisisons are emitted from a point source, the use of filters to reduce the concentration of particulate in the gas stream is theoreticaly possible. The uncontrolled particulate emission estimates for this source are based on measurements of ventilation shaft emissions at another mine site, which gave an in-stack PM_{10} concentration of 1.2 mg/m^3. This is very low, and is below the emission specifications typically quoted for baghouse and electrostatic precipitator technology of 5 – 50 mg/m^3. On this basis, no potential additional control measures have been identified for further analysis.

3.4 Quantification of Potential Particulate Management Measures

Table 21 presents the emission control factor assumed in this assessment for the one potential particulate management measure identified for the storage areas and **Table 22** presents the particulate emission loads for this source if the identified potential control measure was applied.

Table 21 Control Factors Assumed for Potential Additional Control Measures

Emission Type	Control Type	Control Measure	Effectiveness
Exposed Areas	Suface stabilisation	Paving and cleaning	95% (instead of 84% for gravelling)

Table 22 Estimated Emissions – Including Potential Additional Controls

Emission Source	Proposed Controls			Control Option	Additional Controls		
	TSP (kg/year)	PM_{10} (kg/year)	$PM_{2.5}$ (kg/year)		TSP (kg/year)	PM_{10} (kg/year)	$PM_{2.5}$ (kg/year)
Wind erosion from storage areas	64	32	3	Paving and cleaning	20	10	1

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.

The following sections examine the issues that may constrain the implementation of the additional particulate control measures outlined in **Table 21**, 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 Awaba 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 storage areas.

4.1 Evaluation Findings – Wind Erosion of Storage Areas

4.1.1 Practicality of Implementation

Table 23 provides a discussion of the feasibility of control measures for wind erosion of storage areas.

Table 23 Practicability of Implementing Control Measures on Wind Eroded Storage Areas

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
Paving and cleaning	RISK = LOW None	RISK = MEDIUM Significant additional runoff is likely following paving which would require additional controls to be implemented within the stormwater and sediment management plans Post-mining C&I waste would be increased.	RISK = LOW Safety would likely be improved following paving as risk of accidents would be reduced. Speed restrictions would need to be closely monitored when vehicles are travelling on paved areas	RISK = HIGH If the site layout is altered there may be additional costs associated with the removal of paved areas. Maintenance requirements of paved surface is likely to be high due to use as storage areas for bulk materials and mining supplies.	✘ Not considered further in this assessment

4.2 Implementation Costs

As no additional control measures have been identified as being practicable for the proposed future activities at Awaba Colliery, the cost implications of potential particulate control measures have not been quantified.

4.3 Identification of Dust Control Measures for Awaba 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, Awaba Colliery's emissions of particulate matter have been quantified for both the current site operations, and for the proposed future operations, with and without the range of existing/proposed control measures implemented on-site. Through this process it has been estimated that after implementation of Newstan Colliery Extension of Mining Project and once coal processing, handling and transport activities cease at the Awaba Colliery, emissions of particulate from the site (i.e. excluding emissions from the transport of coal off-site by haul truck) will reduce as follows:

- TSP will reduce from 32,363 kg/annum to 620 kg/annum (a 98% reduction)
- PM_{10} will reduce from 15,147 kg/annum to 125 kg/annum (a 99% reduction)
- $PM_{2.5}$ will reduce from 1,515 kg/annum to 96 kg/annum (a 94% reduction)

The calculations gave an increase in the estimated particulate emissions from the transport of coal by truck along the paved private haul road (e.g, from 10,974 kg/annum PM_{10} to 21,977 kg/annum), however this is based on the proposed future maximum haulage rate of 880,000 tonnes/annum to Newstan. Actual emissions may be lower and will depend on the quantity of coal transported.

Additional control options for the proposed operations at Awaba Colliery have 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 screening process no additional control measures were identified that could be implemented at Awaba Colliery to reduce dust emissions which are not already proposed to be employed at the site.

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.

As discussed in **Section 4.3**, no additional particulate control measures have been identified for the site. The widespread implementation of any measure has therefore not been committed to at this time.

6 REFERENCES

- 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

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

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.

An average wind speed of 2.4 m/s has been adopted for the Angus Place Colliery, based on onsite meteorological monitoring for calendar year 2008.

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). Hourly wind speed data from the Newstan Colliery for 8,760 hours monitored during 2008 has been adopted.

Based on this data, an emission rate of TSP of 77,263 kg/ha/yr has been applied within this assessment. This equates to an average emission rate of 8.8 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 24**.

Table 24 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 24** have been used within this report to calculate the emissions of $PM_{2.5}$ attributable to the activities occurring at Awaba 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 24**) 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 24**) 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 5**, 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 5**.**

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