Coal Train Dust Management

Hunter Valley Coal Industry

March 2016

NSW MINERALS COUNCIL

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This document has been prepared by the NSW Minerals Council with the assistance of mine, train, rail and coal export terminal operators in the Hunter Valley coal chain.

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Executive Summary

The Hunter Valley Coal Chain is the world's largest coal export network. Coal is transported by rail from mines in the Gunnedah, Western, Hunter Valley and Newcastle coalfields to the Port of Newcastle, where the trains are unloaded at coal export terminals before being shipped internationally.

The coal mining industry generates significant economic benefits for the Hunter region. Mining companies directly spent $4.8 billion on wages and suppliers in the Hunter region during 2014-15, supporting 3,417 supplier businesses and generating around 23% of gross regional product.

Concerns have been raised by some members of the community regarding the potential impact of coal dust emissions from coal trains operating in the Hunter Valley, with particular concerns about air quality around the rail corridor in the Lower Hunter and Newcastle area. The industry takes these concerns seriously and has been working to understand the effect coal trains have on air quality and the adequacy of management practices that are in place.

Research indicates that coal trains do not have significant impact on air quality around the rail corridor

Multiple pieces of research indicate that air quality around the rail corridor is good and that coal trains do not have a significant impact on air quality. Some facts about air quality include:

- **Air quality meets national air quality standards** – Australia has some of the most stringent air quality standards in the world, and air quality monitoring shows these standards are met the vast majority of the time near the rail corridor and in the Newcastle region more broadly.

- **Evidence indicates coal trains are not significant sources of dust** – Analysis of trackside monitoring data by an independent statistical expert has shown that on average, coal trains and freight trains both generate a similar, minor, temporary increase in dust as trains pass and that the likely cause of the increase is dust being stirred up from within the rail corridor.

- **Air quality has remained stable while coal exports have increased** – While coal exports grew 60% between 2010 and 2014, annual average particulate levels in the Lower Hunter remained stable, indicating no relationship between train movements and air quality trends in the region.

- **Wind tunnel testing of coal samples indicates a low risk of dust emissions from loaded coal wagons** – Wind tunnel research indicates that the moisture content of the NSW coal types tested is likely to minimise the risk of dust emissions from the surface of loaded coal wagons under typical NSW operating conditions

The industry continues to improve management practices across the coal chain to minimise potential coal dust emissions

While the evidence does not suggest coal trains are having a significant impact on air quality, the industry has been working to review existing management practices, identify practical improvements and assess where further work is needed to better understand potential coal dust emissions from coal trains.

There are good management practices already in place and the industry has been working to ensure these practices are applied more consistently. Some of these practices include:

- ‘Profiling’ the surface of loaded coal to achieve an even, consistent shape, which helps to minimise wind erosion
- Minimising the occurrence of overfilling and spillage during train loading
- Monitoring wagon doors to ensure they lock closed after unloading at the coal export terminals, which demonstrates that greater than 99.9% of doors automatically close according to specification
- Regular scheduled maintenance of wagon doors including testing wagon door gaps against design specifications
- Procedures to prevent coal ‘ploughing’ during train unloading at port operations, which would otherwise lead to large amounts of coal being caught on the lower parts of the wagons.

Along with all aspects of the industry’s operations, the industry will continue to look at ways in which it can improve practices:

- The Hunter Valley track manager is investigating coal deposition on departure tracks from the Newcastle coal export terminals and assessing the effectiveness of removing deposited coal with industrial vacuum equipment. These commitments have been presented to and agreed with the EPA which has led to them being formalised in the track manager’s Environment Protection Licence.
- The Newcastle coal export terminals have implemented systems to identify trains arriving at the ports that show signs of loading issues such as overfilling, so that the loading point can be notified and loading issues resolved. These systems have been formalised in the terminals’ Environment Protection Licences.
- Mines have been assessing the potential risk of dust emissions from their coal types, with some mines installing equipment to apply water to the surface of loaded wagons to reduce the risk of dust emissions during transport.
- The Hunter Valley track manager is investigating plans to establish monitoring in the rail network that can measure opacity across the top of coal wagons, which is an indicator of dust emissions from the surface of loaded wagons, to verify that controls to minimise potential emissions are working effectively.

The industry’s actions are summarised in the table below.

Potential coal dust emissions from trains will continue to be a focus of operators throughout the coal chain and the industry will evaluate the outcomes of ongoing studies, including the NSW Chief Scientist and Engineer's review of coal train dust issues, to inform continual improvements.

Summary of industry actions on coal dust management in the rail corridor

Operator	Actions
Coal mine train loading facilities	• Avoiding overfilling of wagons and spillage of coal during train loading • Profiling loaded coal at overhead loading facilities to achieve a consistent shape that reduces potential wind erosion • Investigating options to further improve coal loading at the site using front end loaders • Ensuring wagon doors are securely closed • Installing water sprays at some mines to increase moisture content of the coal surface before transport • Working with track manager to investigate monitoring that could identify any trains that are emitting dust from the surface of loaded wagons
Track manager	• Investigating coal deposition on departure tracks from the Newcastle coal export terminals • Assessing the effectiveness of removing coal deposited on the rail track with industrial vacuum equipment • Working with the coal export terminals and coal train operators to share outcomes of ongoing studies • Investigating monitoring that could identify any trains that are emitting dust from the surface of loaded wagons
Coal train operators	• Roll by visual inspections of all wagon doors after unloading to identify any wagon door issues and intervene where necessary • Regular scheduled wagon maintenance that includes testing wagon door gap tolerances against design specification • Maintenance crews respond to wagon door issues identified in the field • Wagon door performance data collection to identify systemic issues • Continual improvements to new wagon design • Ongoing focus on reducing coal on wagon exterior in conjunction with loading and unloading points
Coal export terminals	• Reporting on loading issues identified on trains arriving at the ports so that the loading point can be notified and loading issues resolved • Procedures to avoid coal ploughing during unloading, to reduce the risk of coal being caught on the underside of wagons that can be released during transport • Water sprays beneath unloading trains to minimise dust generation during unloading • Investigating the potential for residual coal remaining in wagons after unloading to emit dust through the tops of wagons on the return journey • Investigating the relationship between unloading processes and coal deposition on departure tracks from the export terminals

1. The Hunter Valley Coal Chain

1.1 About this document

Some members of the community have expressed concerns about coal dust being emitted from coal trains and the potential impact this has on air quality around the rail corridor, particularly in the Lower Hunter and Newcastle region.

The Hunter Valley coal industry has carefully considered these issues. This document outlines the steps that the coal industry is taking to understand air quality around the rail corridor in the Hunter Valley, the effect coal trains have on air quality and what management practices are appropriate to reduce potential coal dust emissions from coal trains.

The industry has conducted this work in consultation with expert consultants, government regulators such the NSW Environment Protection Authority, and feedback from the community.

1.2 Hunter Valley coal chain capacity and infrastructure

The Hunter Valley Coal Chain is the world's largest coal export supply chain

Rail transport is acknowledged as the most efficient way of moving large quantities of coal from mine to port. The Hunter Valley Coal Chain is the world's largest coal export infrastructure network, with exports totalling 159 million tonnes in 2014[i]. Coal is transported by rail from mines in the Hunter Valley, Gunnedah, Western and Newcastle coalfields to the Port of Newcastle, where Port Waratah Coal Services operates two export terminals at Kooragang Island and Carrington, and Newcastle Coal Infrastructure Group operates a third at Kooragang Island.

There are four main train operators that haul coal in the Hunter Valley Coal Chain: Pacific National, Aurizon, Freightliner Australia and Southern Shorthaul Railroad. Australian Rail Track Corporation manages the track.

There are around 31 facilities that load coal onto trains for transport to Newcastle. Different facilities use different loading techniques. 30 facilities use overhead loading infrastructure, where coal is loaded from an overhead bin into the coal wagon. For some mines this is a fully automated loading process while at other mines it semi-automated or manually controlled.

One mine that transports coal to Newcastle by rail uses front end loaders to load the trains, however a very small proportion of the total coal transported to Newcastle is loaded this way and the travel distance is short.

Table 1: Hunter Valley coal loading facilities

Region	Total loading facilities	Overhead loading facilities	Front end loading facilities	Travel distance to Newcastle ports	Approximate travel time to Newcastle port
Newcastle/ Central Coast	4	3	1	30-70km	1-2 hours
Upper Hunter/ Gloucester	16	16	0	80-150km	2-5 hours
Western Coalfield (Mudgee and Lithgow)	6	6	0	150-280km	5-9 hours
Gunnedah	5	5	0	250-360km	8-13 hours
Total	**31**	**30**	**1**		

198 million tonnes of saleable coal was produced in NSW during 2014. 159 million tonnes was exported through the Port of Newcastle, 13 million tonnes was exported from Port Kembla[ii] (from mines located in the Southern Coalfield and Lithgow regions), while around 23 million tonnes was used in domestic power generation and 3 million tonnes in domestic steel production.

Table 2: 2014 saleable coal production by coalfield[iii]

Coalfield	Saleable coal production (Mt)
Gunnedah	16
Hunter	111
Newcastle	18
Western	40
Southern	13
Total NSW	**198**

The approved and installed capacity of the Newcastle coal export terminals is 211 million tonnes per annum. Current exports (159 Mt in 2014) are below this approved capacity so there is room for exports to grow within existing infrastructure. Port Waratah Coal Services has approval to expand its Kooragang Island operations that if fully implemented could add a further 70 million tonnes of capacity, bringing the total capacity of all Newcastle coal export terminals to 281 million tonnes. However, a decision to proceed with the construction of this project will only be made if demand forecasts indicate it is required.

Table 3: Coal export terminals at the Port of Newcastle

Port	Capacity p.a. (Mt)	2014 exports (Mt)
PWCS – Kooragang Island	120	92
PWCS – Terminal 4*	70	n/a
PWCS - Carrington	25	20
NCIG – Kooragang Island	66	47
Total	**281**	**159**

*PWCS Terminal 4 will only be constructed if demand forecasts indicate additional capacity is required

There are more than 50 coal trains operating in the Hunter Valley Coal Chain. Most trains have between 82 and 96 wagons with a capacity to haul just under 100 tonnes of coal per wagon, with the largest trains carrying around 9,000 tonnes of coal. A small number of trains have fewer wagons and/or smaller wagon capacities. In total, there are more than 4,200 wagons operating in the Hunter Valley coal chain of varying capacities and designs.

Coal train speed limits and average train speeds vary depending on whether the trains are loaded or unloaded. The speed limit for loaded trains between Muswellbrook and Newcastle is 60 kilometres per hour. Speed limits for unloaded trains vary between 80 and 100 kilometres per hour, depending on wagon and locomotive configuration. Average train speeds are significantly less than these posted track speed limits, and trains tend to travel slower in the Newcastle area where the train line is more congested.

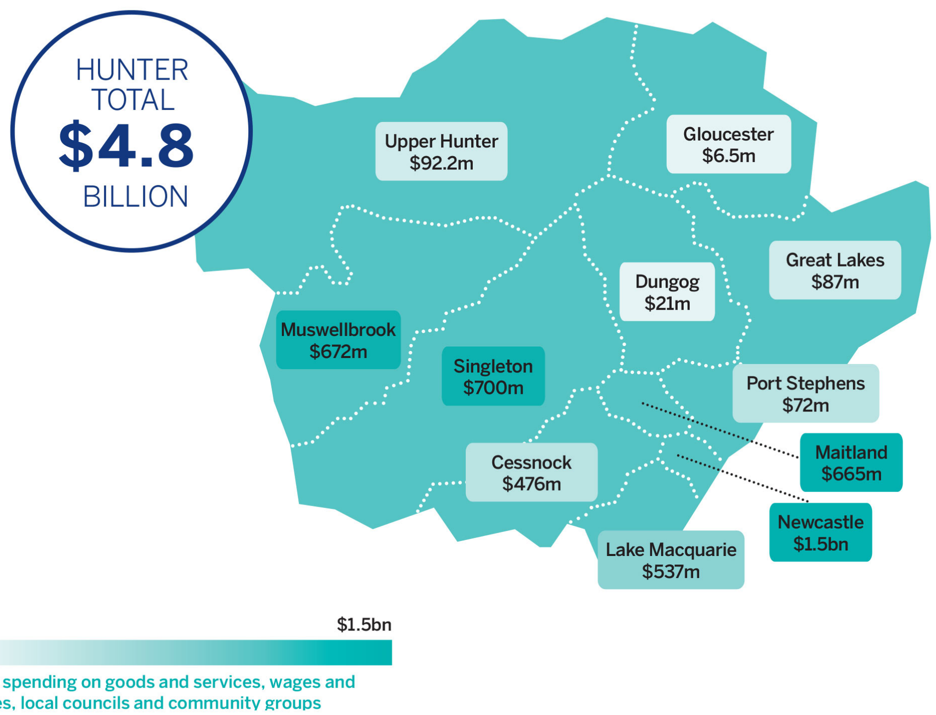
1.3 Economic contribution of the Hunter Valley coal industry

Coal mining companies in the Hunter region spent $4.8 billion on wages and suppliers during 2014-15

The coal mining industry is a fundamental component of the Hunter economy. In 2014-15, mining companies spent $4.8 billion on wages and suppliers in the Hunter region – almost half of the total expenditure by mining companies in NSW. 3,417 supplier businesses in the region benefited from this spending, which generated 23% of the Gross Regional Product.

Coal mining in other regions that export coal through Newcastle also generates significant economic activity in their regions, such as the Western Coalfield near Mudgee and the Gunnedah region.

Figure 1: Direct spending by mining companies in the Hunter region 2014-15



2. Rail corridor air quality

2.1 Coal dust and air quality

Small particles of coal can become airborne and contribute to a form of air pollution known as particulate matter, or PM. Airborne particulate matter includes all types of airborne particles from sources such as vehicle exhausts, bushfires, power stations, domestic wood heaters, mining, agriculture, industrial furnaces, sea spray and windblown dust.

The size of airborne particulate matter is classified as shown in Table 4. Health research indicates that it is the size of particulate matter that is of primary importance from a human health perspective, with the smallest particles – known as $PM_{2.5}$ – having the greatest health impact since they can be inhaled deep into the lungs and absorbed into the bloodstream. **Error! Reference source not found.** demonstrates the relative size of different particles.

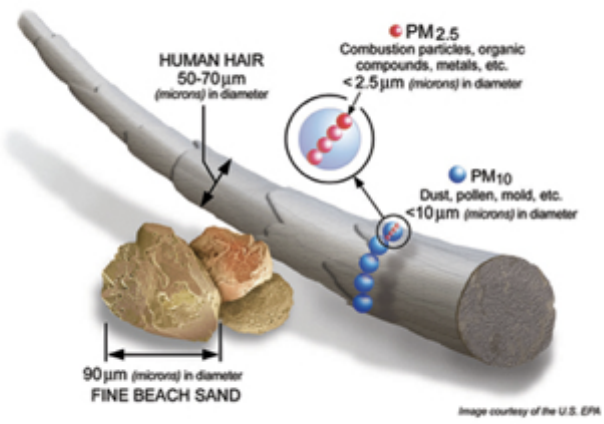
$PM_{2.5}$ particles are mainly produced by combustion processes such as vehicle exhaust, fires and power generation. Because coal is derived from mechanical (i.e. crushing) rather than combustion processes, coal dust is less likely to contribute significantly to $PM_{2.5}$ emissions.

Coal is loaded into trains at a range of moistures (around 7-12 per cent). The majority of the moisture resides in the smaller particles making the coal resistant to dust generation.

Table 4: Particle size classifications and descriptions[iv]

Particle Size	Description
TSP	Total Suspended Particulate Matter (TSP) refers to the total of all particles suspended in the air. Even the largest of these particles is barely half the width of a human hair.
"Larger than"PM_{10}	A subset of TSP, and refers to all particles of size 10 µm in diameter and greater.
PM_{10}	Also a subset of TSP, and includes all particles smaller than 10 µm in diameter (smaller than 1/7th of a hair width). Particles in the size range 2.5 µm to 10 µm in diameter are referred to as coarse particles ($PM_{2.5\text{-}10}$).
$PM_{2.5}$	A subset of both PM_{10} and TSP categories and refers to all particles less than 2.5µm in diameter. $PM_{2.5}$ is referred to as fine particles and is mainly produced from combustion processes such as vehicle exhaust.

Figure 2: Relative size of particulate matter



2.2 Particulate matter air quality standards

Australia has some of the most stringent air quality standards in the world

There is a range of air quality standards that apply in NSW. Standards are designed to protect either population health or to provide acceptable levels of amenity. Different standards apply to different size particles and different averaging periods (i.e. 24 hours, a month or annually). The range of air quality standards for particulate matter that apply in NSW are outlined in **Error! Reference source not found.**.

Table 5: Air quality standards for particulate matter that apply in NSW[v]

Pollutant	Averaging period	Concentration standard	Source of standard
TSP	Annual	90 µg/m3	NSW EPA
PM10	1 day (24h)	50 µg/m3	National standard
	Annual	25 µg/m3	National standard
PM2.5	1 day (24h)	25 µg/m3	National standard
	Annual	8 µg/m3	National standard
Dust deposition	Month (total)	$4g/m^2$	NSW EPA
	Month (increase)	$2g/m^2$	NSW EPA

Australia has some of the most stringent ambient air quality standards in the world. The Australian national standards were reviewed and strengthened in February 2016. For comparison, the most recent revision to ambient air quality standards for particulate matter internationally occurred in the United States. In comparison to the updated US EPA standards:

- Australia's PM_{10} 24 hour health standard is three times as strict (50 $\mu g/m^3$ vs 150 $\mu g/m^3$)
- Australia's $PM_{2.5}$ 24 hour health standard is 40% more strict (25 $\mu g/m^3$ vs 35 $\mu g/m^3$)
- Australia's $PM_{2.5}$ annual average health standard is 50% more strict (8 $\mu g/m^3$ vs 12 $\mu g/m^3$).

2.3 Air quality around the rail corridor

Monitoring data indicates that air quality around the rail corridor is good and that coal trains do not have a significant impact on air quality

The potential for coal dust emissions from trains depends on factors such as the coal characteristics and moisture content, train speeds, temperature, humidity and wind speeds, combined with any operational practices that influence potential emissions. These factors vary between different mines, seasons and regions.

There has been a range of air quality monitoring and other research conducted by government, industry, and independent research bodies that has focused on the Hunter Valley in NSW. The scientific evidence indicates that coal trains do not have a significant impact on ambient air quality and that air quality around the rail corridor and the Lower Hunter more broadly is good. This is a view supported by several agencies including:

- The NSW Planning Assessment Commission – *"There is little or no evidence that uncovered wagons contribute significantly to particulate air quality in the Newcastle area …"*[vi]

- The NSW Office of Environment and Heritage – *"Overall air quality in the Lower Hunter is as good – or better than – air quality in Sydney and the Illawarra."*[vii]

This section outlines some of the main sources of air quality evidence available.

1.1.1. Trackside particulate monitoring

Loaded coal trains, unloaded coal trains and freight trains all generate a small, temporary increase in dust levels as they pass

Trackside particulate monitoring indicates that loaded coal trains, unloaded coal trains and freight trains all generate a small, temporary increase in dust levels as they pass.

Australian Rail Track Corporation

A statistical expert, Professor Louise Ryan from the University of Technology Sydney, analysed 61 days of air quality, weather and train data collected on behalf of the Australian Rail Track Corporation at a trackside monitoring location at Metford in the Newcastle region.[viii]

Professor Ryan's analysis found that loaded coal trains, unloaded coal trains and freight trains all increase particulate matter levels across all sizes by approximately 10% on average.

This is a relatively minor, temporary increase in particulate matter levels within the rail corridor as coal and freight trains pass by, similar to a vehicle travelling on a road and stirring up dust. The monitoring was undertaken within the rail corridor approximately 3 metres from the tracks, and therefore the temporary increase in particulate levels is greater than what would be experienced outside the rail corridor when the dust is more dispersed. It does not indicate that coal trains are having a significant impact on ambient air quality levels around the rail corridor.

Further analysis of the data, including correlation with local rainfall data, found that dust generation by trains was significantly influenced by whether it had rained the previous day. Professor Ryan concluded that the analysis *"suggests that a key mechanism for the increased particulate levels was stirring up by passing trains of dust particles that had settled previously on the tracks."*[ix]

Office of Environment and Heritage Beresfield Monitoring Station

The Office of Environment and Heritage operates an air quality monitoring station at Beresfield in the Lower Hunter, monitoring both PM_{10} and $PM_{2.5}$. The monitor is located less than 400m from the rail line and provides a good indication of long term air quality in the vicinity of the rail corridor including the contribution from trains and other local and regional sources.

The monitoring shows that national air quality standards for PM_{10} were met 9 of the last 10 years (i.e. there have been 5 or less exceedances of the 24 hour criterion in the calendar year).[x] The only year when standards were exceeded was 2009, when significant dust storms affected ambient air quality across the state.

The $PM_{2.5}$ annual average national standard was exceeded at the Beresfield monitor in two of the last 10 years – in 2009 and 2013. Given the relatively larger size of coal dust it is unlikely that coal dust makes a significant contribution to $PM_{2.5}$ at the Beresfield monitor.

Figure 3: Office of Environment and Heritage air quality monitoring station at Beresfield (Source: NSW Minerals Council)

1.1.2. Trackside dust deposition studies

Dust deposition monitoring around the rail corridor shows that dust levels are well within regulatory criteria for amenity

Dust deposition monitoring around the rail corridor shows that dust levels are well within amenity criteria and that coal makes a small contribution to deposited dust.

Deposited dust is made up of larger particles that have a nuisance effect rather than health implications. Coal dust is one of many potential sources of visible dust that can deposit on surfaces such as windowsills and outdoor furniture.

While black dust is often attributed to coal, there are several other sources of black dust and the presence of black dust isn't unique to areas around coal related infrastructure. Other sources of black dust include mould, soot and rubber tyre particles, and some dust derived from soil can appear black in colour.

Nuisance dust is measured using dust deposition monitors, in which dust settles and can then be weighed and compared against amenity criteria. Analysis of the dust may also be conducted to understand potential sources. There have been several trackside dust deposition monitoring programs around rail corridors in NSW and Queensland, all of which show that nuisance dust impact assessment criterion of 4 g/m^2/month is rarely exceeded and is generally well below the criterion.

Bloomfield Collieries dust deposition gauges at Thornton

Bloomfield Collieries has operated two dust deposition gauges at two different locations in Thornton in the lower Hunter Valley since January 1997. One site is within the main Hunter Valley rail corridor and the other site is 1.2 kilometres away next to the New England Highway.

During more than 15 years of monitoring there have only been two months at each monitor that have exceeded the amenity standard of 4g/m^2/month for deposited dust. On average, more dust settles at the monitor next to the highway than at the monitor next to the rail corridor, with 59% of months recording a higher reading at the monitor next to the highway and 32% recording a higher reading next to the rail corridor (9% of months showed equal readings).

These monitoring results show that the deposited dust levels around the New England Highway are greater than they are around the rail corridor, and that average deposited dust levels in the rail corridor are less than half the amenity standard.

Table 6: Summary dust deposition data, Thornton, 1997-2014 (g/m^2/month) [xi]

Gauge ID	D7	D8
Location	New England Hwy, Thornton	Main North Rail Line, Thornton
Min	0.40	0.20
Mean	1.74	1.51
Median	1.60	1.40
99^{th} percentile	3.93	4.08
Maximum	4.9	5.68
Exceedances (by month)	2	2
Total readings	188	185

Figure 4 - Proximity of Thornton dust deposition gauge (on fence to the right) to the Main North Rail Line (Source: Bloomfield Collieries)

Whitehaven Coal

Whitehaven Coal has conducted trackside dust deposition monitoring near Quirindi since 2011. Three dust deposition gauges are positioned on each side of the rail line, at distances of 13m, 20m and 30m from the rail line. The deposited material has been analysed to determine the relative proportions of coal, vegetable/insect matter and dirt that make up each monthly sample.

A summary of 18 months of monitoring data from the Quirindi trackside monitoring program (October 2011 – March 2013) is presented below. The following conclusions can be drawn from the data:

- The rolling annual average at all sites was below the nuisance dust impact assessment criterion of 4 g/m^2/month for the entire period.

- The rolling annual average of the contribution of coal to deposition at all monitors (maximum of 0.33 g/m^2/month) was well below the NSW EPA assessment criteria for incremental increase in dust deposition of 2 g/m^2/month.

- The highest coal contribution recorded at any of the monitors was 1 g/m^2/month, which is half the NSW EPA assessment criteria for incremental increase in dust deposition of 2 g/m^2/month.

Table 7: Dust deposition monitoring at Quirindi October 2011-March 2013 ($g/m^2/month$)

Parameter	West			East		
	30m	**20m**	**13m**	**30m**	**20m**	**13m**
Average deposited material	1.04	0.92	1.08	0.80	1.14	1.36
Maximum deposited material	1.80	1.60	3.40	2.40	3.80	3.60
Average coal contribution	0.23	0.20	0.31	0.18	0.13	0.18
Maximum coal contribution	0.75	0.40	1.02	0.44	0.38	0.41
Maximum – rolling annual average – deposited material	1.11	0.94	1.10	0.91	1.20	1.53
Maximum – rolling annual average – coal	0.28	0.24	0.33	0.21	0.15	0.21

NSW Environment Protection Authority – Lower Hunter Dust Deposition Study

The NSW Environment Protection Authority has commissioned a dust deposition monitoring program focusing on the rail corridor between Hexham and Port Waratah, which will provide further insights into the levels and composition of dust deposited around the rail corridor by measuring the rate of dust deposition and analysing the type of material present in the samples collected.

An interim report was released in July 2015[xii] outlining the results of analysis completed on 29 samples (11 brush samples, 6 dust deposition gauge samples and 12 petri dish samples). Given the results are interim, no conclusions have been drawn from the data.

Coal was detected in measurable amounts in 22 of the 29 samples analysed to date, comprising an average of 6.2% of the samples. The NSW EPA noted in its media release that *"It is also pleasing to see that the overall levels of dust deposited were below guideline levels. The six-month rolling averages for data collected at the 12 monitoring sites were all well below 4 grams per square metre per month, which is the EPA guideline value for the acceptable annual average amount of deposited dust."*[xiii]

1.1.3. Regional particulate monitoring

Air quality in the Lower Hunter and Newcastle area is good and meets national air quality standards

Air quality around coal transport and handling infrastructure, particularly in the Newcastle area, has been the subject of a significant amount of debate. The available data shows that air quality in the region is good.

NSW Office of Environment and Heritage – Lower Hunter and Newcastle Monitoring Stations

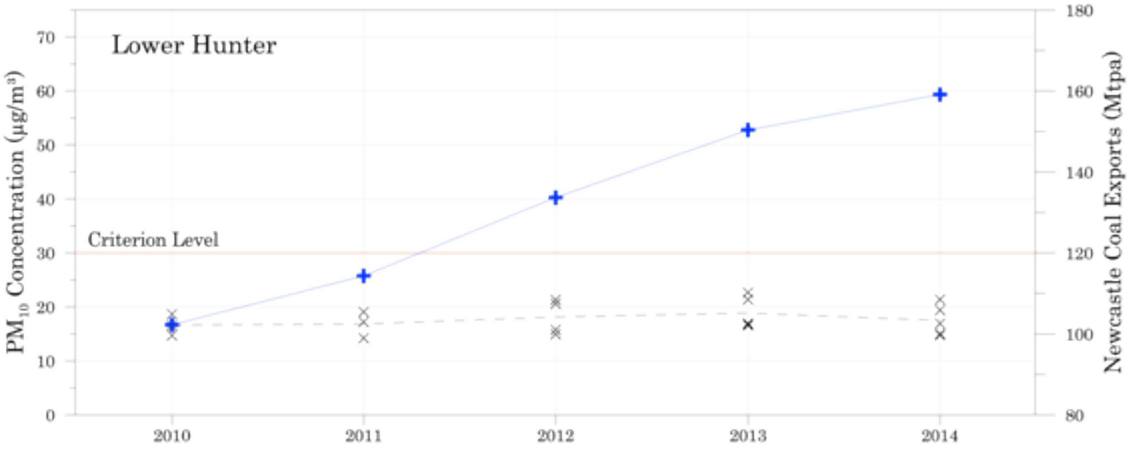
Long term air quality data for the Lower Hunter and Newcastle region is available from three air quality monitors operated by the Office of Environment and Heritage at Beresfield, Wallsend and Newcastle.

National annual air quality standards for PM_{10} have been met at the three NSW Office of Environment and Heritage monitors in the Lower Hunter region for the last 10 years[xiv] (i.e. there have been 5 or less exceedances of the 24 hour criterion in the calendar year), except for 2009 when dust storms affected ambient air quality across NSW.

A report prepared by the Office of Environment and Heritage in 2012 concluded that *"Overall air quality in the Lower Hunter is as good – or better than – air quality in Sydney and the Illawarra."*[xv]

Analysis of trends in annual average particulate levels and coal exports through the Port of Newcastle do not show any relationship between coal production levels and air quality in the region. While there was a 60% increase in coal exports through Newcastle between 2010 and 2014, air quality remained stable.

Figure 5: While coal exports (blue line) grew 60% between 2010 and 2014, Lower Hunter annual average PM_{10} concentrations (black line) remained stable [xvi]



Australian Nuclear Science and Technology Organisation (ANSTO) Particulate characterisation

Independent sampling and analysis at Mayfield of $PM_{2.5}$ - the smallest particles of greatest health concern - by the Australian Nuclear Science and Technology Organisation (ANSTO) between 1998-2009 has shown that automobiles (27%), secondary sources (23%), smoke (20%) and sea salt spray (16%) are the major sources of $PM_{2.5}$. Industry and soil combined make up 14%, of which coal dust is a proportion along with industrial facilities, agriculture and other windblown dust[xvii].

1.1.4. Wind tunnel testing of NSW coal types

Wind tunnel testing indicates a low risk of dust emissions from the surface of loaded wagons

Wind tunnel testing provides an indication of the risk of dust emissions from the surface of loaded coal wagons, which informs whether there are circumstances in which mines may need to investigate additional management controls because of their specific coal properties and travel distance.

The results of two wind tunnel testing programs indicate that for the coal types tested there is a low risk of dust emissions from the surface of loaded wagons during transport from mines to ports.[xviii xix] The testing indicated that mass moisture content of the coal was sufficient to minimise any dust emissions even under high wind speeds that would be rarely experienced in NSW.

3. Industry management of potential coal dust emissions

3.1 Train loading facilities

- ***The independent NSW Planning Assessment Commission has found that "There is little or no evidence that uncovered wagons contribute significantly to particulate air quality in the Newcastle area and there is no justification for recommending that wagons be covered."***
- ***Wind tunnel testing on a range of NSW coal types indicates that the moisture content of the coal types tested is sufficient to minimise potential dust emissions during transport under typical NSW travel conditions.***
- ***Train loading facilities are focusing on avoiding overfilling and spillage of coal during loading; shaping coal loads to reduce potential wind erosion; and investigating potential monitoring in the rail corridor to validate the results of the wind tunnel testing program.***

When coal is loaded onto trains at mining operations there is a range of measures that can be taken to minimise potential coal dust emissions during transport to the coal export terminals.

Different mines use different loading techniques, which require different approaches. All except one site loading coal that is exported through Newcastle use overhead loading infrastructure, where coal is loaded from an overhead chute into the coal wagon. For some mines this is fully automated, others are semi automated while at others it is manually controlled. Overhead loading provides a good degree of management control over the loading process.

One mine that transports coal to Newcastle by rail loads coal wagons using front end loaders. This gives less control over the loading process, making it more difficult to load coal consistently and without spillage, however a very small proportion of the total coal exported through Newcastle is loaded this way.

The steps being taken by loading facilities are outlined below.

1. Avoiding wagon overfilling and coal spillage during train loading

On some occasions, small amounts of coal can spill over the sides and other exterior parts of the wagon during the loading process. Some of this coal can be lost from wagons during transport, potentially contributing to air quality impacts.

Mines have been reviewing their loading practices to reduce the potential for wagon overfilling and spillage. The measures being taken include raising operator awareness, recalibrating loading infrastructure, improving maintenance regimes and updating procedures. These steps will help ensure the load height and alignment are within the track provider's requirements and that coal is contained within the wagon.

Some community members have expressed a view that loading coal above the height of the wagon leads to more dust being generated during transport. The effect of the height of coal loaded above the wagon was modelled during coal train dust studies conducted in Queensland. The modelling indicated that loading coal above the wagon had a negligible impact on the wind speed over the coal surface, and therefore a negligible impact on the risk of dust emissions.[xx] Furthermore, loading below the wagon would reduce the capacity of each train and increase the number of train movements needed to transport the same amount of coal.

Starting on 1 February 2016, the Newcastle coal export terminals have procedures in place to identify any trains arriving at the ports that exhibit potential loading issues such as spillage over the sides of wagons, so that loading facilities can be notified and corrective action taken. This system is formalised through the terminals' Environment Protection Licences.

2. Profiling loaded coal at overhead loading facilities to achieve a consistent shape that reduces potential wind erosion

Computer modelling has shown that shaping the top of loaded coal so that it has an even, consistent profile can help reduce the wind speed over the surface of the coal, as opposed to a load that has several separate mounds in each wagon.

Load profiling equipment is installed at nearly all overhead loading facilities in the Hunter Valley network. In its audits of loading facilities conducted during 2014, the NSW Environment Protection Authority found that all overhead loading facilities that were audited had load profiling equipment in place. However, the audit found that some facilities could improve the consistency and shape of the load profiles and ensure they are centrally aligned in the wagon. The industry is focusing on achieving consistent load profiles to reduce the risk of coal loss.

Figure 6: Coal loads on the Main North Rail Line showing an even, consistent surface profile (Source: NSW Minerals Council)

3. Investigating options to further improve coal loading at front end loading sites

There is only one facility using front end loaders to load coal wagons in the Hunter Valley coal chain, which represents a very small proportion of the total coal transported in the network. This facility has been investigating ways to improve loading practices, including improving operator awareness, using a water cart to clean up coal spillage, improving the coal profile by flattening the load with the front end loader bucket and investigating the viability of new infrastructure to help profile loads.

4. Installing water sprays at some mines to increase moisture content of the coal surface before transport

Wind tunnel testing indicates that there is a low risk of dust emissions from the surface of loaded wagons during transport. The independent NSW Planning Assessment Commission stated *"There is little or no evidence that uncovered wagons contribute significantly to particulate air quality in the Newcastle area and there is no justification for recommending that wagons be covered."*

The NSW Planning Assessment Commission went on to say that *"To the extent to which emissions from loaded wagons are identified as a problem, requirements to profile loads, maintain moisture levels and/or apply veneers to suppress dust appear to represent more viable, cost effective alternative controls [than wagon covers]"*.

While the wind tunnel testing indicates that water or veneers are unlikely to be necessary for the coal types tested, some mines have installed water spray bars at their loading facilities to add additional moisture to the surface of the loaded coal to minimise the risk of the coal surface drying sufficiently to emit dust during transport.

Further monitoring in the rail corridor is being investigated by the track manager, which could identify any train that is emitting visible dust from the top of loaded wagons. The purpose of this monitoring is to validate the results of the wind tunnel testing, determine whether there are loading facilities that require additional dust controls for their coal types, then test the effectiveness of any additional controls.

5. Ensuring wagon doors are securely closed after exiting the loading facility

The primary point at which wagon doors are closed and checked is following unloading at the coal export terminals. Automatic door closing mechanisms at the coal export terminals are extremely effective, with more than 99.9% of doors closing automatically. Visual 'roll by inspections' by train operators are then completed, checking wagon doors are properly closed and taking immediate corrective action if they have not.

Loading facilities have various mechanisms in place such as trip wires, laser detection systems and visual observations to monitor wagons before they re-enter the main rail lines to ensure that wagon doors are safely closed and the coal load is secure.

3.2 Track manager

- ***A review of trackside monitoring data by an expert statistician indicates that a primary mechanism for dust generation is the stirring up of existing dust within the rail corridor as trains pass by.***
- ***The track manager is investigating coal deposition in the rail corridor, particularly in the tracks leading away from coal export terminals where visible coal deposition is apparent.***
- ***The track manager is also investigating the viability of a monitoring system that can identify trains that are emitting dust from the top of loaded wagons, so that the causes can be investigated and addressed.***

As the main rail track manager in the Hunter Valley coal chain, the Australian Rail Track Corporation (ARTC) manages the rail corridor infrastructure and is responsible for track maintenance, track upgrades and network control. While ARTC does not handle any coal directly, it is taking steps to help the industry better understand any dust emissions from coal trains. These steps are outlined below. ARTC is working with the other coal chain operators to share the outcomes of this work.

1. Investigating coal deposition on departure tracks from the Newcastle port terminals

Visible build up of coal has been observed on some localised sections of the departure tracks from the Newcastle coal export terminals, on which unloaded trains travel. These deposits are not apparent on the inbound tracks, indicating that coal is being lost from unloaded trains soon after unloading, particularly in areas where the trains cross tracks and the trains are subject to greater vibration.

It is likely that the build up is caused by very small amounts of coal being lost from a high volume of trains. Much of the coal is too large to generate any dust, but some dust may be emitted or stirred up by other trains using the network along with other dust in the rail corridor.

ARTC is conducting studies to monitor the levels of coal deposition at several locations in the rail corridor. The results will be used to inform what further work might be required. This work, which ARTC initiated, has now been formalised into a licence condition with the Environment Protection Authority, with a report due in March 2016.

2. Assessing the effectiveness of removing deposited coal with vacuum equipment

ARTC has been conducting trials using an industrial vacuum to remove coal from areas of the track where there are visible deposits of coal. The vacuuming trial has also been formalised through the licence condition with the Environment Protection Authority, with a report due in March 2016.

While vacuuming can remove loose material and therefore reduce potential dust generation, the ballast can remain discoloured, which may not address community perceptions about coal deposition on the track.

3. Investigating rail corridor opacity monitoring to identify dust emissions from the surface of loaded wagons

Wind tunnel testing conducted on a range of NSW coal types indicates that for the coal types tested, there is a low risk of dust emissions from the surface of loaded coal wagons under typical NSW operating conditions.

To validate the results of the wind tunnel testing and identify any trains that are emitting higher levels of visible dust from the surface of loaded wagons, ARTC is investigating the viability of establishing a monitor that measures opacity across the top of coal wagons at a point in the rail corridor. Opacity is a measure of how much light travels through the air, with reductions in the amount of light indicating dust emissions.

The concept of opacity monitoring is taken from the Queensland rail networks, where it has proven to be successful in a similar application. Opacity monitoring is not designed to measure air quality, but to indicate dust emissions. It has the benefit of being targeted at a single source (the top of loaded coal wagons) and can continually record data that can be matched with specific trains so that the cause of high readings can be investigated.

3.3 Coal train operators

- ***Industry wagon door performance data shows automatic wagon door closing mechanisms successfully close more than 99.9% of doors after unloading and visual inspections of every door are conducted to identify and rectify issues.***
- ***Modern wagon door design specifications provide for a small gap of around 1mm-3mm in closed wagon doors to allow for manufacturing tolerances, thermal expansion of materials, water drainage from wagons and to ensure doors are not obstructed from closing.***
- ***Scheduled inspection and maintenance occurs for every coal wagon. Periodic workshop maintenance includes testing door tolerances against specification and repairing where necessary. Maintenance crews can respond immediately if significant defects are identified.***
- ***Significant investments are made in continually improving coal wagon design to reduce the potential for coal loss from wagons during transport.***

Wagon design and maintenance can influence the potential for coal dust emissions from trains. For example, the design of the top of the wagon can influence train loading effectiveness, the surface area of coal exposed to wind, and the wind speed across the surface of the loaded coal. The design and maintenance of the wagon doors and equipment under the wagon such as axels and springs can influence the potential for coal to be deposited in the rail corridor.

Coal train operators have a strong focus on wagon design and maintenance programs that include consideration of coal loss along with other factors such as safety, reliability, maintainability, aerodynamics and efficient train loading and unloading. With the typical design life of a coal wagon being around 25 years, there is a range of wagon designs operating in the Hunter Valley coal chain with each new design improving on the last.

Wagon door design specifications require a gap to allow the wagon door to open and close due to the over centre locking mechanism on each wagon; without this gap, it would not be possible to open or close the wagon door. A Queensland study[xxi] found that there appeared to be no correlation between coal lost through doors and the door clearance (i.e. the gap between the door and the wagon). Operationally, it has been determined that if doors are designed without a gap, coal obstructing the doors may cause a door to not close effectively, potentially leading to more serious door failures.

Management processes are established and are monitored to maximise door open and close performance, and to minimise the potential for coal spillage. Analysis of wagon door performance data indicates that greater than 99.9% of doors close successfully and do not require any manual intervention after unloading.

1. Roll by visual inspections of all wagons after unloading to ensure wagon doors close and to identify any critical safety issues

After trains are unloaded, a 'roll-by' visual inspection is conducted by a qualified operator to ensure the automatic door closing mechanisms have securely closed every door. Where a wagon door issue is identified, the train is stopped, isolated and there is a manual intervention to physically close the door on site. Where it is not possible to rectify the issue immediately, a lock is applied to the wagon door and the wagon is removed from service.

2. **Regularly scheduled wagon maintenance including testing door tolerances against design specification**

All train operators complete maintenance on doors as a component of their maintenance program, which includes:

- In-field maintenance: Unit-Train-Maintenance (UTM) includes a regular, comprehensive inspection of whole trains to detect and correct issues.
- Workshop maintenance: Individual wagons have comprehensive maintenance schedules. This periodic regime includes testing door tolerances against specification and repairing door mechanisms where necessary. Maintenance tasks occur according to documented maintenance manuals.

3. **Out of schedule workshop maintenance and in-field maintenance to respond to identified wagon door issues**

Out of schedule workshop maintenance or in-field maintenance is undertaken to respond to issues identified in the field in the event of incidents, reported poor door performance, or the identification of defects during in-field inspections.

4. **Wagon door performance data collection to identify systemic issues**

Train operators collect wagon door performance data where manual interventions occur, to determine wagon class and individual wagon issues. These wagons or classes will be identified to undertake unplanned maintenance to correct problems.

Where longer-term performance issues are identified, improvements may be made through modification, capital improvements or changes to maintenance programs.

5. **Continual improvements to new wagon design**

Design specifications are applied to new wagons to ensure coal unloading and door function is optimised. Design is continually improved to maximise the efficiency of coal haulage and to reduce the potential for leakage or spills[xxii].

Commissioning of new wagons to determine door performance includes closure load and cyclic testing. Prior to new wagons entering service, dump station testing is conducted to ensure correct operation.

6. **Ongoing investigations into reducing coal on the exterior of wagons**

Coal can be deposited on the exterior of wagons as a result of overfilling and spillage during loading, or coal ploughing during unloading. A Queensland study estimated that coal on the exterior of wagons represented the smallest contributor to potential coal dust emissions from coal trainsxxiii . However, it is the subject of community concern.

The industry's focus is on preventing coal deposition on the exterior of wagons by focusing on coal wagon design, wagon maintenance practices, loading practices and unloading practices. While some coal on wagon exteriors is removed during regular maintenance activities, it is not a focus of the maintenance programs.

3.4 Coal export terminals

- ***The NSW Environment Protection Authority found that the coal export terminals have adequate controls in place to minimise dust generation during unloading and to minimise the risk of 'coal ploughing'.***
- ***The coal export terminals are investigating the potential for residual coal remaining in wagons after unloading to emit dust through the tops of wagons on the return journey.***
- ***The coal export terminals are investigating the relationship between unloading processes and coal deposition on departure tracks from the export terminals.***
- ***The coal export terminals are reporting on loading issues identified on trains arriving at the terminals so that the loading point can be notified and loading issues resolved.***

In the Hunter Valley coal chain, coal transported by rail for export is unloaded at the coal export terminals at the Port of Newcastle. During unloading, the trains travel slowly (less than 2 kilometres per hour) through the unloading point, with the speed varying depending on factors such as wagon type, coal type and unloading station throughput capacity.

As each wagon travels through the unloading station, triggers located next to the track open the wagon doors and the coal unloads through the bottom of the wagons, passing through steel grates and into unloading bins beneath, then onto a conveyor for stockpiling. As the train exits the unloading station, a second set of triggers closes the wagon doors automatically.

Figure 7: Train unloading at coal unloading terminal (Source: Pacific National)

In addition to a visual inspection carried out by the train operator, the coal export terminal operators closely monitor the wagon unloading process to ensure wagons are unloading effectively. Unloading practices can influence potential coal dust emissions from unloaded trains as they travel back to mines. The port operators are taking steps to improve these practices, as well as reporting back to mines when trains arrive at the ports exhibiting potential issues with the loading process.

1. **Reporting on loading issues identified on trains arriving at the coal export terminals so that the loading point can be notified and loading issues resolved**

Starting on 1 February 2016, the Newcastle coal export terminals have procedures in place to identify any trains arriving at the ports that exhibit potential loading issues such as spillage over the sides of wagons, so that loading facilities can be notified and corrective action taken. This system is formalised through the terminals' Environment Protection Licences and reports will also be provided to the NSW Environment Protection Authority.

2. **Procedures to avoid coal ploughing during unloading, to reduce the risk of large volumes of coal being caught on the underside of wagons**

During unloading, coal can build up between the bottom of the wagons and the grates above the unloading bins. If large volumes of coal build up, the coal can get caught on equipment in the lower sections of the wagons including doors, springs, axels and platforms, which is known as coal ploughing. There is the potential for some of this coal to be deposited in the rail corridor during transport.

The NSW Environment Protection Authority conducted audits of the port facilities that found that they have effective controls in place to prevent coal ploughing during unloading, stating that *"All of the terminals were minimising or preventing the deposition of coarse coal particles and lumps of coal on wagon bogies. Controls were in place to prevent overfilling of hoppers and subsequent ploughing of coal."*[xxiv]

3. **Water mist sprays beneath trains to minimise dust generation during unloading**

Each unloading station has fine mist sprays beneath the unloading trains that can add moisture to the coal as it is unloaded. Adding water helps minimise the generation of dust that might otherwise deposit on the outside of wagons, which could be released during transport. Most water is entrained with the coal and any excess water is managed within the coal export terminals' water management systems.

4. **Investigating residual coal remaining in wagons after unloading**

Audits conducted by the NSW Environment Protection Authority showed that the ports have good controls in place to identify and remove large volumes (i.e. tonnes to tens of tonnes of coal per wagon) of residual coal left in wagons after they are unloaded.

Smaller amounts of residual coal (i.e. kilograms of coal per wagon) in unloaded wagons are more complex to remove. Residual coal is still visible in wagons when they return to mine load points, so it is not all lost from wagons during transport. However, there is the potential for some of this residual coal to fall through gaps in the wagon doors or be emitted through the top of the wagon during transport.

Previous trials of wagon cleaning have identified significant issues. Cleaning of wagons with high pressure water consumes water resources, can have safety implications for electronic braking systems, and can create difficult waste water management including the removal of finer coal material. High pressure air creates additional dust and noise that can be a hazard or nuisance for workers or the community.

The coal export terminals are considering what options there are to evaluate the significance of residual coal in terms of air quality and, if needed, whether there are viable ways for the industry to address it.

5. Investigating relationship between unloading processes and coal deposition on outbound rail tracks

In close consultation with the track manager and train operators, the coal export terminals are investigating the relationship between unloading processes and coal deposition on departure tracks from the export terminals.

4. Next steps

4.1 Ongoing work

The industry continues to focus on improvements to current management practices across all aspects of its operations, including potential coal dust emissions from trains.

This document outlines several monitoring programs that are in place to ensure that management controls are being applied effectively. The results of this monitoring will be regularly reviewed, along with other air quality monitoring data, to assess whether the controls are effective.

This document also outlines also further investigative works that are underway, and the results of these and any other relevant studies will continue to inform refinements to management practices. The NSW Chief Scientist and Engineer has also been tasked with reviewing coal train dust issues, and the results of the review will be assessed by the industry.

4.2 Contacts

NSW Minerals Council

Questions about this document can be directed to the NSW Minerals Council at information@nswmining.com.au

Train, track and port operators

All coal chain operators in the Hunter Valley have dedicated community contact points and record and investigate all enquiries and complaints.

Operator	Community enquiry phone	Community enquiry email
Aurizon		community@aurizon.com.au
Australian Rail Track Corporation	1300 550 402	enviroline@artc.com.au
Freightliner		info@freightlineraustralia.com.au
Pacific National		www.asciano/com.au/contact/complaints
Port Waratah Coal Services	(02) 4907 2280	http://www.pwcs.com.au/contact-us/community-enquiry/
Newcastle Coal Infrastructure Group	1800 016 304	enquiries@ncig.com.au
Southern Shorthaul Railroad		http://www.southernshorthaulrailroad.com.au/contact-us

Upper Hunter coal mines

The contact details for Upper Hunter mining operations can be found on this webpage: http://www.nswmining.com.au/dialogue/contacts

NSW Environment Protection Authority

The NSW Environment Protection Authority is the primary regulator concerning environmental issues around the coal chain. To contact the NSW Environment Protection Authority, call 131 555.

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