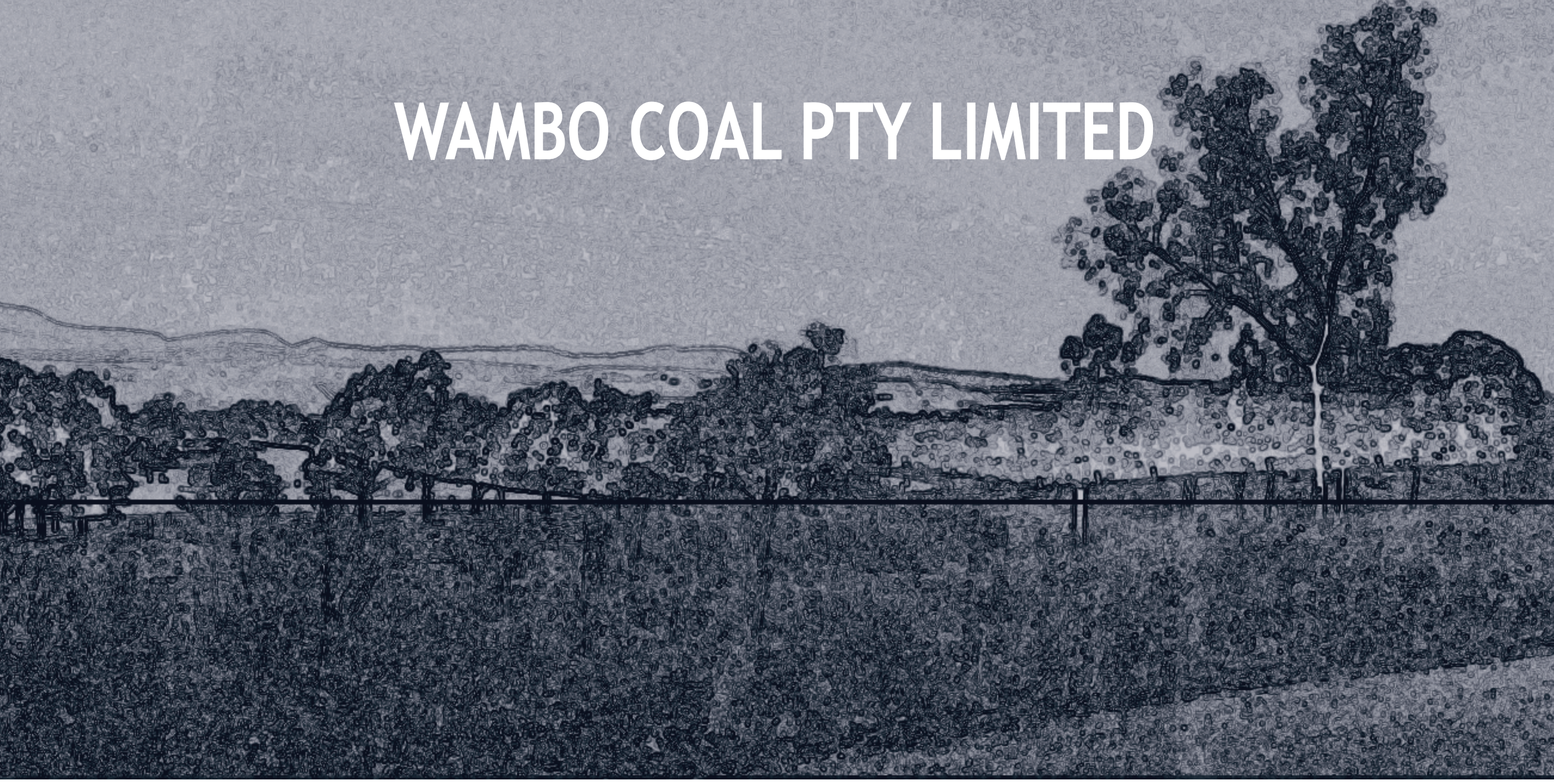
WAMBO COAL PTY LIMITED



SOUTH WAMBO UNDERGROUND MINE MODIFICATION

ENVIRONMENTAL ASSESSMENT

APPENDIX I

Air Quality and Greenhouse Gas Review

Peabody ENERGY

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21 March 2016

Wambo Coal Pty Limited
Steven Peart
Environment and Community Manager
PMB 1
Singleton NSW 2330

RE: Air Quality and Greenhouse Gas Review – South Wambo Underground Mine Modification

Dear Steven,

Todoroski Air Sciences has assessed the potential for air quality impacts associated with the proposed modification to the South Wambo Underground Mine (hereafter referred to as the Modification). This report investigates the change in dust emissions associated with the Modification relative to the approved operations, discusses the potential for dust emissions arising from the transport of product coal via rail and the anticipated change in greenhouse gas (GHG) emissions associated with the Modification.

Project background

Wambo Coal Mine (Wambo) is an open cut and underground coal mining operation which operates in accordance with Development Consent DA 305-7-2003. Wambo is owned and operated by Wambo Coal Pty Limited (WCPL), a subsidiary of Peabody Energy Australia Pty Limited.

Wambo is situated approximately 15 kilometres (km) west of Singleton, near the village of Warkworth, New South Wales (NSW). Wambo adjoins grazing land to the south, other coal mining operations to the east and north and the Wollemi National Park to the west and southwest (see **Figure 1**).

The maximum approved run-of-mine (ROM) coal production rate at Wambo is 14.7 million tonnes per annum (Mtpa) with an approved maximum underground mining rate of 7.5 Mtpa. Overall, production is approved for up to 11.3 Mtpa of thermal coal product, transported from the site by rail.

Figure 2 presents the location of Wambo in relation to the nearest privately-owned and mine-owned sensitive receptors of relevance to this assessment. The majority of privately-owned sensitive receptors are located to the northwest at Jerrys Plains and to the south at Bulga.

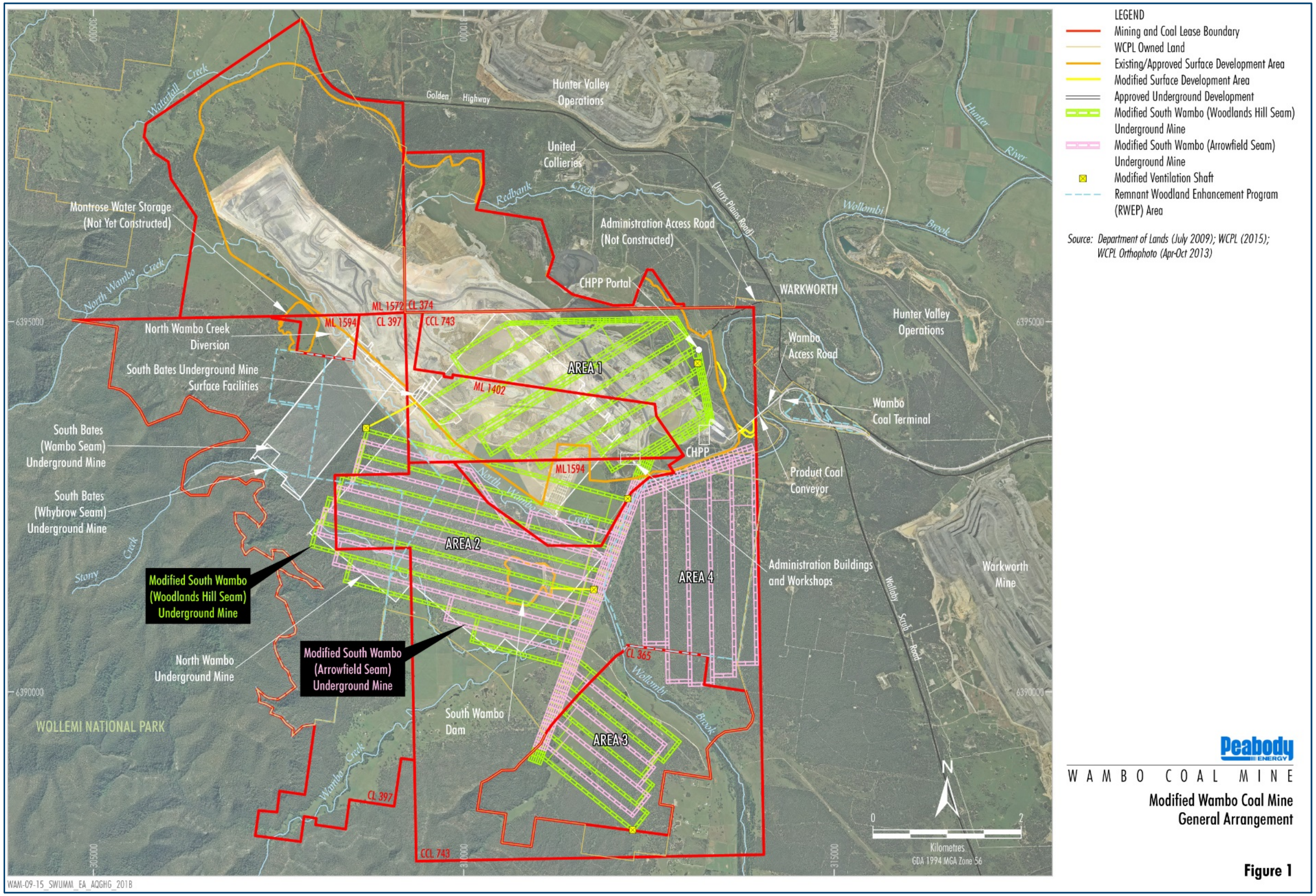

Figure 1: Modified Wambo Coal Mine general arrangement

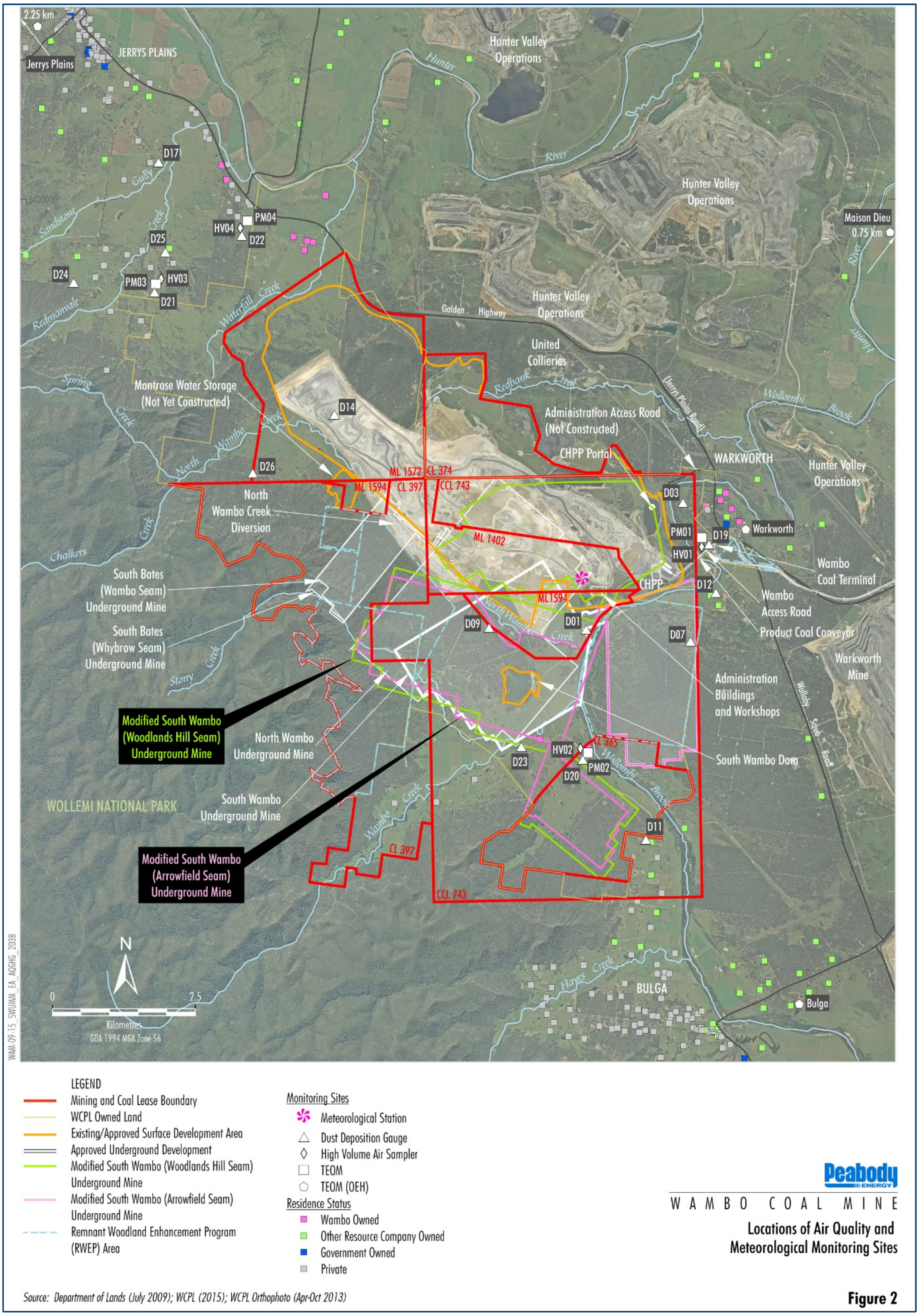

Figure 2: Monitoring stations near Wambo

Modification description

The key features associated with the Modification include:

- Realignment and extension/relocation of the approved South Wambo (Arrowfield Seam) Underground Mine longwall panels (**Figure 1**);
- Mining of the Woodlands Hill Seam rather than the Bowfield Seam;
- Minor extension of approved surface development area;
- Extension of the approved mine life by 7 years (i.e. to 2032);
- Underground ROM coal production rate increase from 7.5 to 9.75 Mtpa. The approved total ROM coal production rate of 14.7 Mtpa would not change;
- Extension of the approved open cut mining operations by 3 years (i.e. up to and including 2020). The Modification would not include any change to the approved total open cut ROM coal production limit; and,
- No change to North Wambo Underground Mine or South Bates Underground Mine.

Figure 3 presents the indicative surface infrastructure layout for the Modification. Underground ROM coal would be transported from the underground mine portal via a conveyor system and stockpiled at the proposed ROM stockpile located north of the existing Coal Handling Processing Plant (CHPP).

ROM coal would then be transported by trucks on an internal haul road from the ROM coal stockpile to the CHPP. Coal may also be transported by overland conveyor from the ROM coal stockpile to the CHPP should financial circumstances permit. This would replace truck haulage.

The realignment and extension/relocation of the longwall panels would also require additional ventilation shafts. These would be staged with the progression of mining and may be used as upcast shafts (including installation of fans) or downcast shafts, depending on the location of mining.

Mining of the South Wambo Underground Mine is planned to commence after the completion of mining the South Bates Underground Mine in 2018.

As described above, the Modification would include an extension of open cut mining operations by approximately 3 years (i.e. up to and including 2020). The Modification would not alter the approved open cut mining methods, open cut extent, open cut maximum ROM coal production rate, open cut mine fleet, open cut blasting operations or waste rock management practices. The open cut ROM coal production during this proposed extension of the open cut life would be consistent with the approved Mining Operations Plan (**WCPL, 2015**).

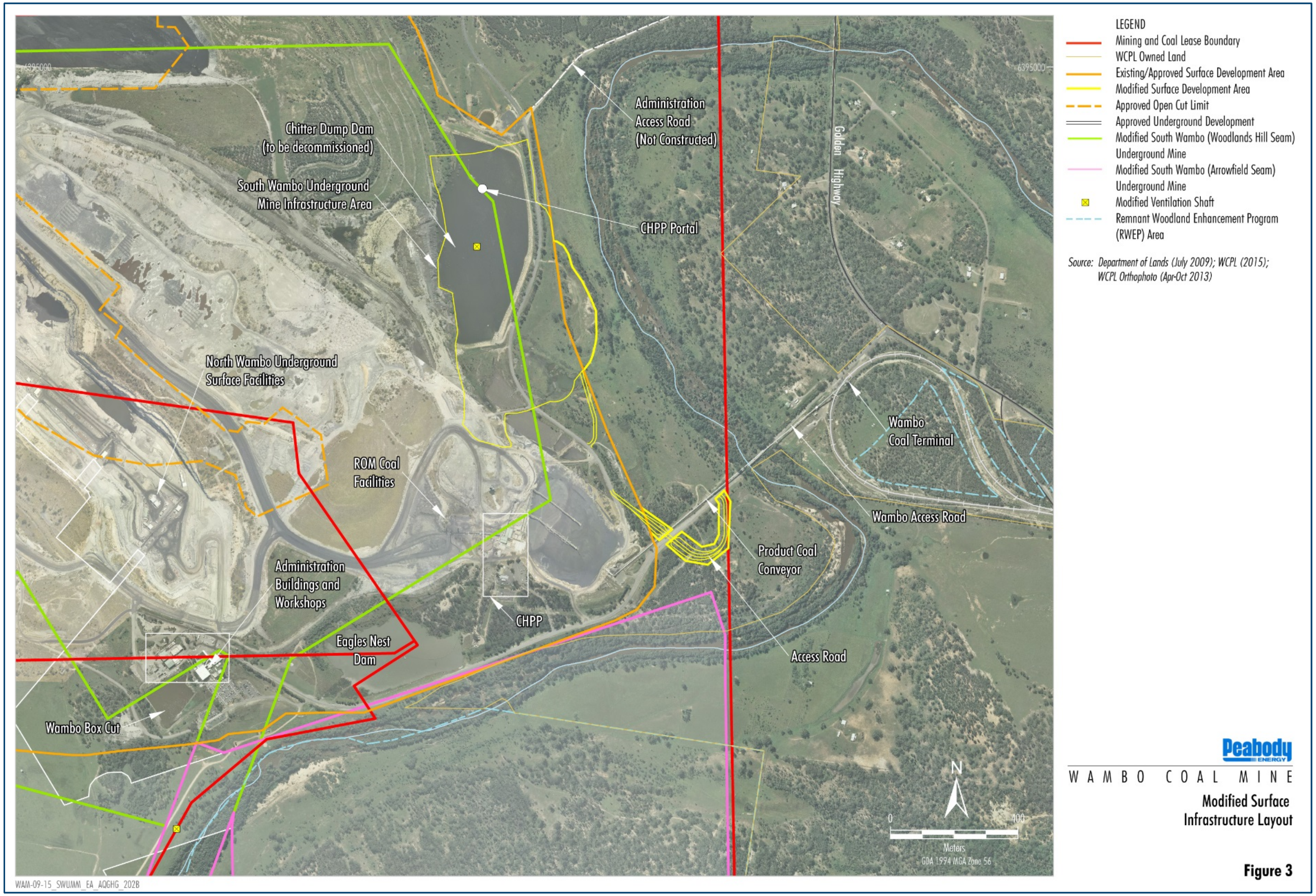

Figure 3: Modified surface infrastructure layout

Existing environmental conditions

This section describes the existing environment including the climate and ambient air quality in the general area surrounding Wambo.

Local climate

Long-term climatic data from the Bureau of Meteorology (BoM) weather station at Jerrys Plains Post Office (Site No. 061086) were analysed to characterise the local climate in the proximity of Wambo. The weather station at Jerrys Plains Post Office is located approximately 10km northwest of Wambo and has since closed on the 17 April 2014.

Table 1 and **Figure 4** present a summary of data from the Jerrys Plains Post Office collected over an approximate 52 to 128-year period for the various meteorological parameters.

Table 1: Monthly climate statistics summary – Jerrys Plains Post Office

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Temperature													
Mean max. temperature (°C)	31.8	30.9	28.9	25.3	21.3	18.0	17.4	19.4	22.9	26.3	29.1	31.2	25.2
Mean min. temperature (°C)	17.2	17.1	15.0	11.0	7.4	5.3	3.8	4.4	7.0	10.3	13.2	15.7	10.6
Rainfall													
Rainfall (mm)	77.1	73.1	59.7	44.0	40.7	48.1	43.4	36.1	41.7	51.9	61.9	67.5	645.9
Mean No. of rain days (≥1mm)	6.4	6.0	5.8	4.9	4.9	5.5	5.2	5.2	5.2	5.8	6.3	6.3	67.5
9am conditions													
Mean temperature (°C)	23.4	22.7	21.2	18.0	13.6	10.6	9.4	11.4	15.3	19.0	21.1	23.0	17.4
Mean relative humidity (%)	67	72	72	72	77	80	78	71	65	59	60	61	70
Mean wind speed (km/h)	9.6	9.0	8.8	8.6	9.0	9.4	10.6	11.0	11.7	10.9	10.5	9.9	9.9
3pm conditions													
Mean temperature (°C)	29.8	28.9	27.2	24.1	20.1	17.1	16.4	18.2	21.2	24.2	26.9	29.0	23.6
Mean relative humidity (%)	47	50	49	49	52	54	51	45	43	42	42	42	47
Mean wind speed (km/h)	13.2	13.0	12.4	11.3	11.0	11.5	13.0	14.3	14.7	14.1	14.2	14.2	13.1

Source: **Bureau of Meteorology, 2015 (accessed 16 December 2015)**
°C = degrees Celsius
mm = millimetres
% = percent
km/h = kilometres per hour

The data indicate that on average January is the hottest month with a mean maximum temperature of 31.8°C and July as the coldest month with a mean minimum temperature of 3.8°C.

Rainfall peaks during the summer months and declines during the winter months, with an annual average rainfall of 645.9 mm over 67.5 days. The data show January is the wettest month with an average rainfall of 77.1 mm over 6.4 days and August is the driest month with an average rainfall of 36.1 mm over 5.2 days.

Humidity levels exhibit variability over the day and seasonal fluctuations. Mean 9am humidity levels range from 59% in October to 80% in June. Mean 3pm humidity levels vary from 42% in October, November and December to 54% in June.

As expected, wind speeds during the warmer months have a greater spread between the 9am and 3pm conditions compared to the colder months. The mean 9am wind speeds range from 8.6 km/h in April to 11.7 km/h in September. The mean 3pm wind speeds vary from 11.0 km/h in May to 14.7 km/h in September.

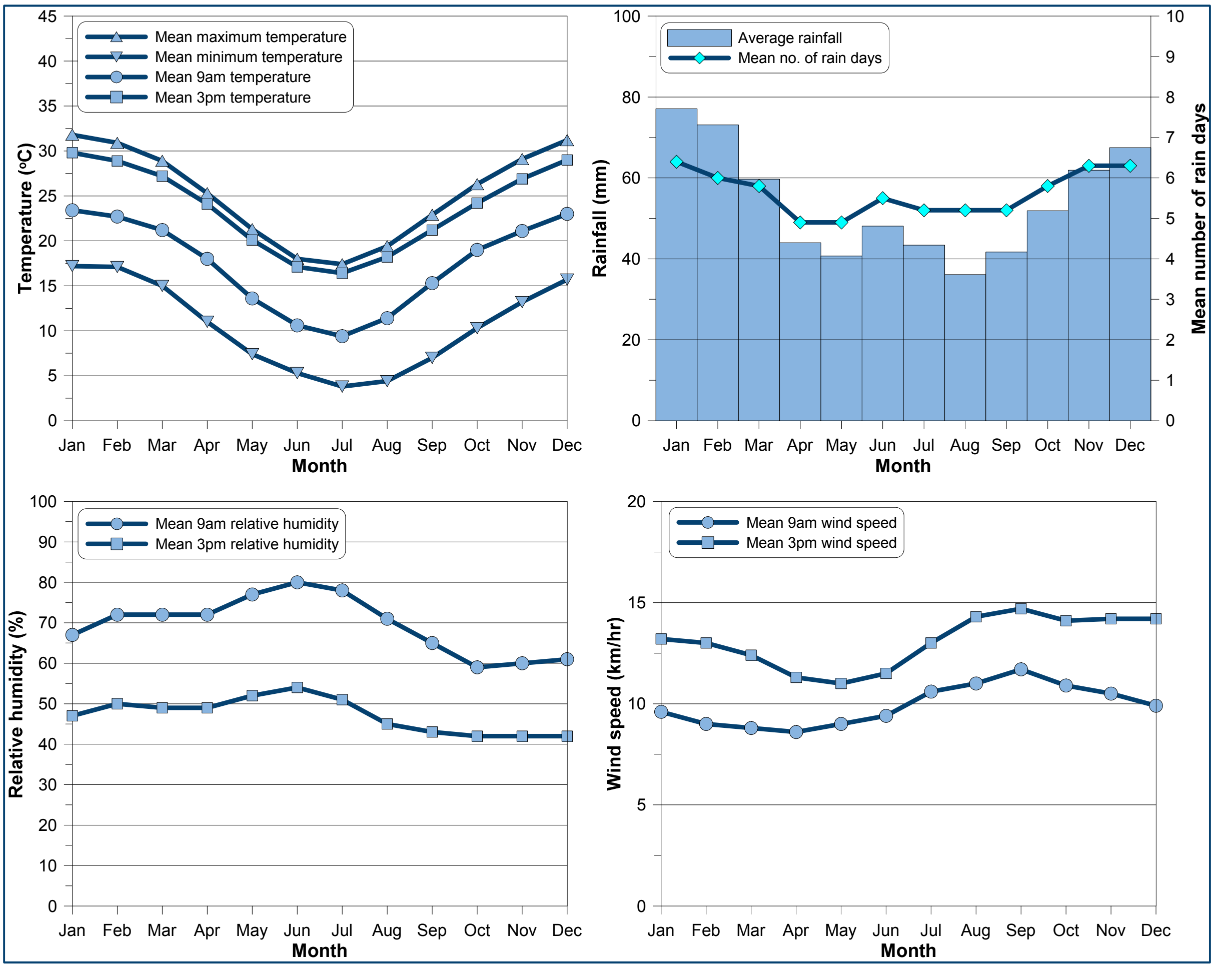

Figure 4: Monthly climate statistics summary – Jerrys Plains Post Office

<u>Local meteorological conditions</u>

Wambo operates a 10 metre (m) weather station to assist with the environmental management of site operations. Annual and seasonal windroses prepared from data collected during the 2014 calendar period are presented in **Figure 5**.

Analysis of the windroses shows the most common winds on an annual basis are from the west-northwest and south-southeast with a lesser portion of winds ranging the east. Very few winds originate from the north and north-northeast and west-southwest sectors. This wind distribution pattern is as expected of the local area considering the location of the station in relation to the terrain features.

During summer, winds are typically from the southeast quadrant dominated by winds from the east-southeast, southeast and east. The autumn wind distribution is similar to the annual pattern and shows overall lower wind speeds and fewer winds from the west-northwest. The winter distribution is dominated by winds from the west-northwest, with relatively few winds from other directions. Spring has a varied wind distribution pattern with winds occurring from the south-southwest ranging to the east-northeast and other winds from the west-northwest and northwest sectors.

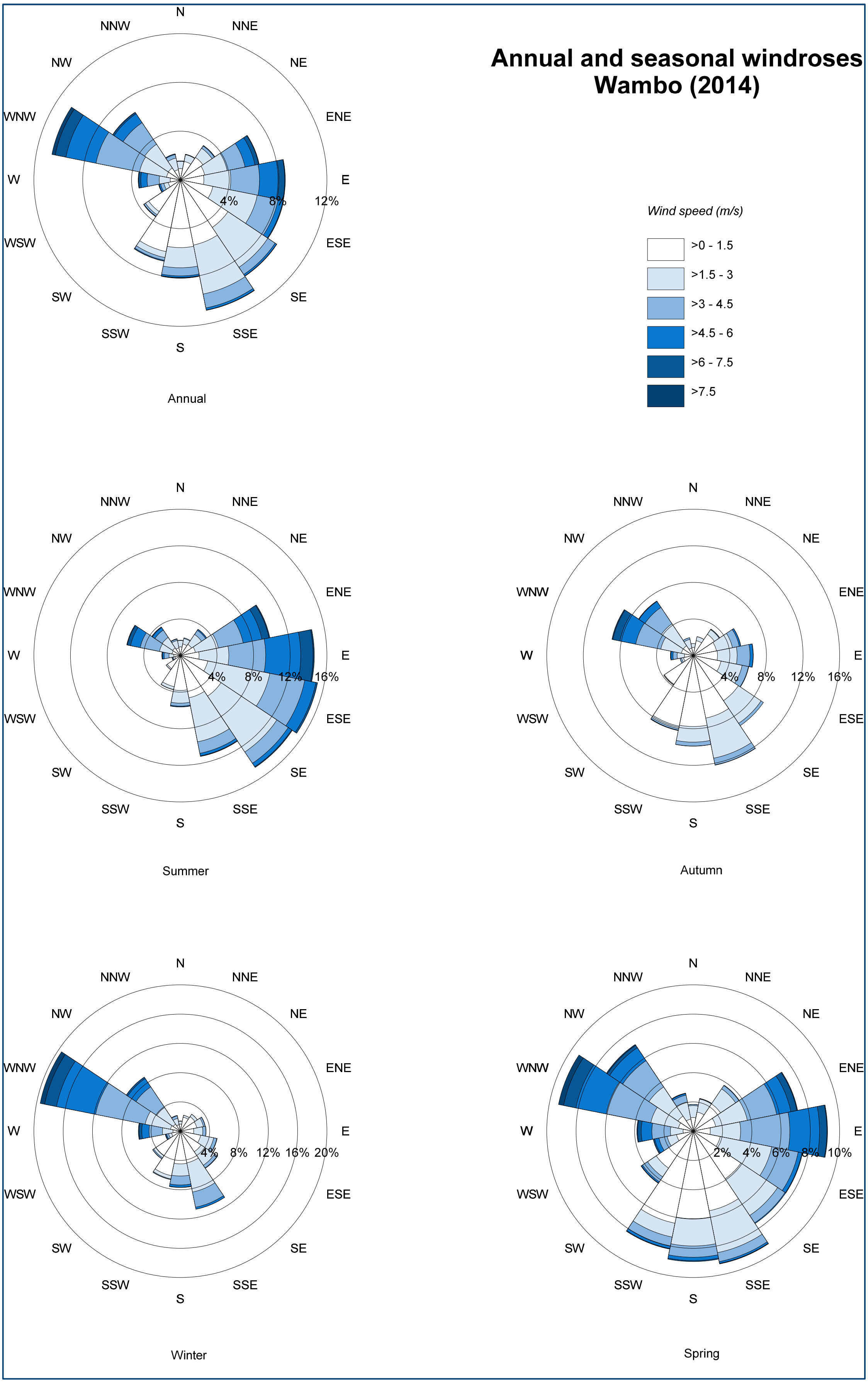

Figure 5: Annual and seasonal windroses – Wambo (2014)

Local air quality conditions

The main sources of particulate matter in the wider area around Wambo include active mining (open cut and underground), agricultural activities, emissions from local anthropogenic activities such as motor vehicle exhausts and domestic wood heaters, urban activity and various other commercial and industrial activities.

This section reviews the monitoring data collected from a number of ambient monitoring locations in the vicinity of Wambo including those operating as part of the existing air quality monitoring network for Wambo and by the NSW Office of Environment and Heritage (OEH) as part of the Upper Hunter Air Quality Monitoring Network (UHAQMN). The locations of the ambient air quality monitors reviewed in this assessment are shown in **Figure 2**.

Ambient PM_{10} monitoring using tapered element oscillating microbalances (TEOMs) is conducted by Wambo and OEH at various locations surrounding Wambo. The location of each of these monitors is shown in **Figure 2**. The monitoring data would include contributions from all emission sources in the vicinity of Wambo.

A summary of the data collected from the Wambo monitors from January 2011 to November 2015 is presented in **Table 2**. The recorded 24-hour average PM_{10} concentrations are presented graphically in **Figure 6**.

Table 2 indicates that the annual average PM_{10} concentrations for each of the monitoring stations were below the relevant criterion from the Development Consent (DA 305-7-2003) of 30 micrograms per cubic metre (µg/m^3) for the monitoring period, indicating that overall, air quality is good in relation to PM_{10} levels.

The maximum 24-hour average PM_{10} concentrations were on occasion above 50µg/m^3 on days during the monitoring period. It can be seen from **Figure 6** that PM_{10} concentrations are nominally highest in the spring and summer months with the warmer weather raising the potential for drier ground elevating the occurrence of windblown dust, bushfires and pollen levels. The monitors located on Wambo-owned land (i.e. AQ01 – Coralie and AQ02 – Wambo Road) are used primarily for management purposes and are not representative of air quality levels at privately-owned sensitive receptor locations and typically show higher levels compared to the other monitors. With respect to the elevated 24-hour average PM_{10} concentration for the monitors on privately-owned land (i.e. AQ03 – Thelander and AQ04 – Muller), details regarding these periods are described in the Annual Environmental Management Reports (AEMR) for Wambo and summarised below.

During 2011, there were two days when the maximum 24-hour average PM_{10} concentration was recorded above the 50µg/m^3 at AQ03 occurring on the 5 January 2011 and 4 February 2011. The recorded exceedances were investigated and it was found that, based on the prevailing wind conditions, Wambo may have contributed to the elevated level on the 5 January 2011. An analysis of the prevailing winds on the 4 February 2011 found a predominance of winds from the southwest which indicates the monitor was outside the influence of Wambo.

In 2012, there were no recorded 24-hour average PM_{10} levels above the relevant criterion at the AQ03 and AQ04 monitors with the maximum 24-hour average PM_{10} concentration recorded at these monitors being 47.3µg/m^3 and 44.8µg/m^3 respectively. There were three days of elevated 24-hour PM_{10} levels recorded at monitors on privately-owned land in 2013 and 2014. The investigation into the cause for these elevated periods of dust concentrations determined that regional dust events occurred on each of these days as indicated by elevated levels at other OEH monitors in the wider area.

Table 2: PM_{10} levels from Wambo TEOM monitoring (µg/m^3)

Year	Annual average					Maximum 24-hour average				
	AQ01 - Coralie	AQ02 - Wambo Road	AQ03 - Thelander	AQ04 - Muller	Criterion	AQ01 - Coralie	AQ02 - Wambo Road	AQ03 - Thelander	AQ04 - Muller	Criterion
2011	16.8	17.2	16.7	16.2	30	49.4	82.5	57.3	42.7	50
2012	21.0	21.1	16.6	18.3	30	47.3	76	47.3	44.8	50
2013	19.3	22.6	16.5	16.8	30	65	96.6	71	65.4	50
2014	18.0	19.0	15.3	17.7	30	55.2	70.2	50.5	55.5	50
2015*	14.9	15.1	12.2	15.6	30	51.6	52.8	42.9	51.4	50

*Data until November 2015

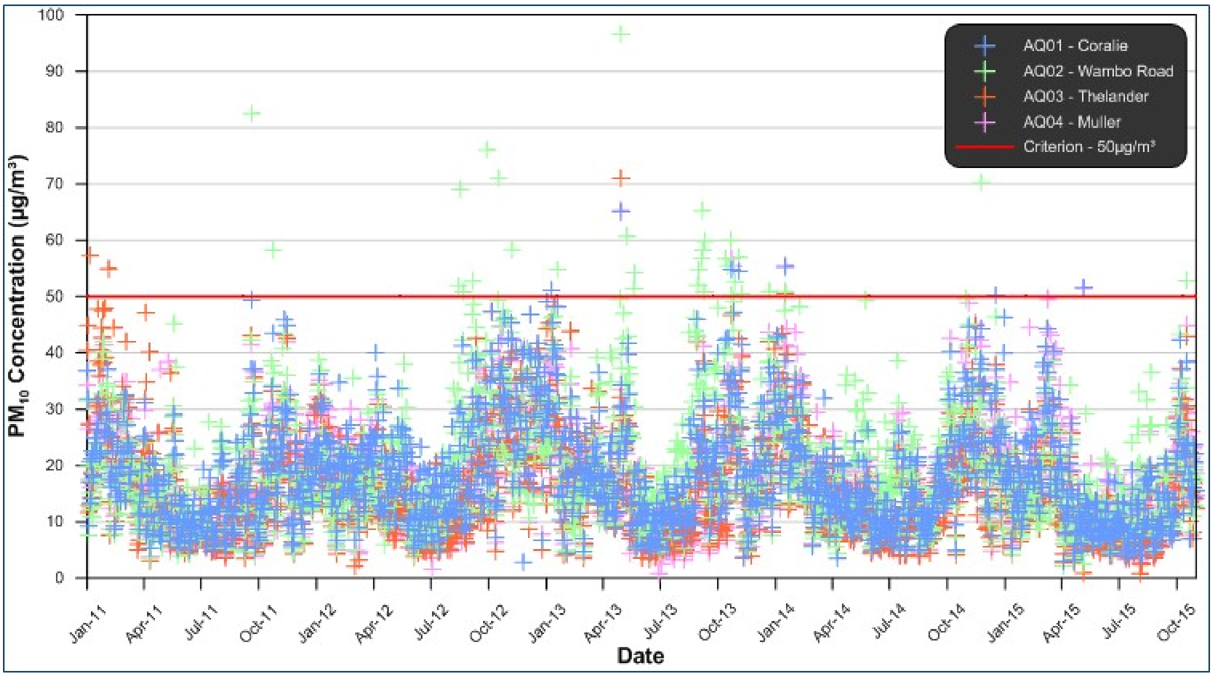

Figure 6: TEOM 24-hour average PM_{10} concentrations at Wambo monitors

A summary of the available data from the OEH monitoring stations is presented in **Table 3**. The recorded 24-hour average PM_{10} concentrations are presented graphically in **Figure 7**.

A review of **Table 3** indicates that the annual average PM_{10} concentrations for each of the monitoring stations were below the relevant criterion of 30µg/m^3. The maximum 24-hour average PM_{10} concentrations recorded at these stations were found to exceed the relevant criterion of 50µg/m^3 at times during the review period.

Table 3: PM_{10} levels from NSW OEH TEOM monitoring (µg/m³)

Year	Annual average					Maximum 24-hour average				
	Maison Dieu	Bulga	Warkworth	Jerrys Plains	Criterion	Maison Dieu	Bulga	Warkworth	Jerrys Plains	Criterion
2011	22.1	-	-	-	30	78.3	-	-	-	50
2012	25.8	18.7	21.1	10.8	30	87.7	55.1	49.9	43.7	50
2013	25.8	19.2	21.4	18.6	30	84.2	88.4	65.4	63.3	50
2014	22.7	17.7	20.6	18.2	30	63.7	54.3	67.9	64.4	50
2015	20.6	15.0	18.2	15.4	30	77.3	60.6	68.2	70.0	50

µg/m³ = micrograms per metre cubed

Figure 7 shows a relatively similar trend to the Wambo monitoring station data (shown in **Figure 6**) with similar peaks occurring during the spring and summer periods. Variations between the monitoring site data are largely attributed to the proximity of these monitors to various dust sources located in the surrounding area.

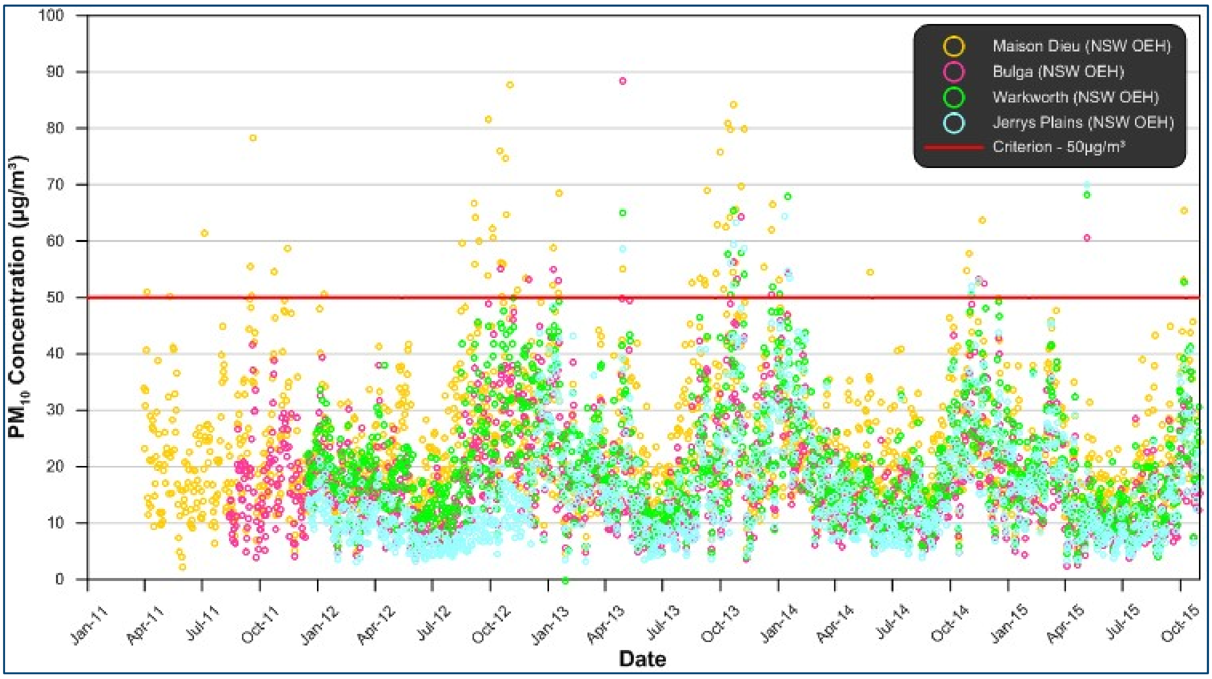

Figure 7: TEOM 24-hour average PM_{10} concentrations at OEH monitors

Total suspended particulate (TSP) monitoring data are collected by Wambo using four high volume air sampler (HVAS) monitors. The monitoring data collected between January 2011 and November 2015 are summarised in **Table 4** and **Figure 8**.

The monitoring data in **Table 4** indicate that the annual average TSP concentrations for the monitoring station are well below the criterion of 90µg/m³. **Figure 8** shows that the recorded 24-hour average TSP concentrations at each monitor are generally consistent and follow a similar trend which reflects the seasonal trend as seen in the PM_{10} concentrations. It should be noted that unlike PM_{10}, there is no applicable air quality criteria for 24-hour average TSP concentrations. The TSP dust metric is only assessed on an annual basis.

Table 4: TSP levels from HVAS monitoring (µg/m³)

Year	HV01 - Coralie	HV02 - Wambo Road	HV03 - Thelander	HV04 - Muller	Criterion
2011	56.7	48.4	49.0	41.0	90
2012	64.8	61.4	38.9	58.6	90
2013	61.5	61.5	40.9	48.8	90
2014	66.6	68.1	48.3	62.3	90
2015*	50.6	48.5	37.7	56.4	90

*Data until November 2015

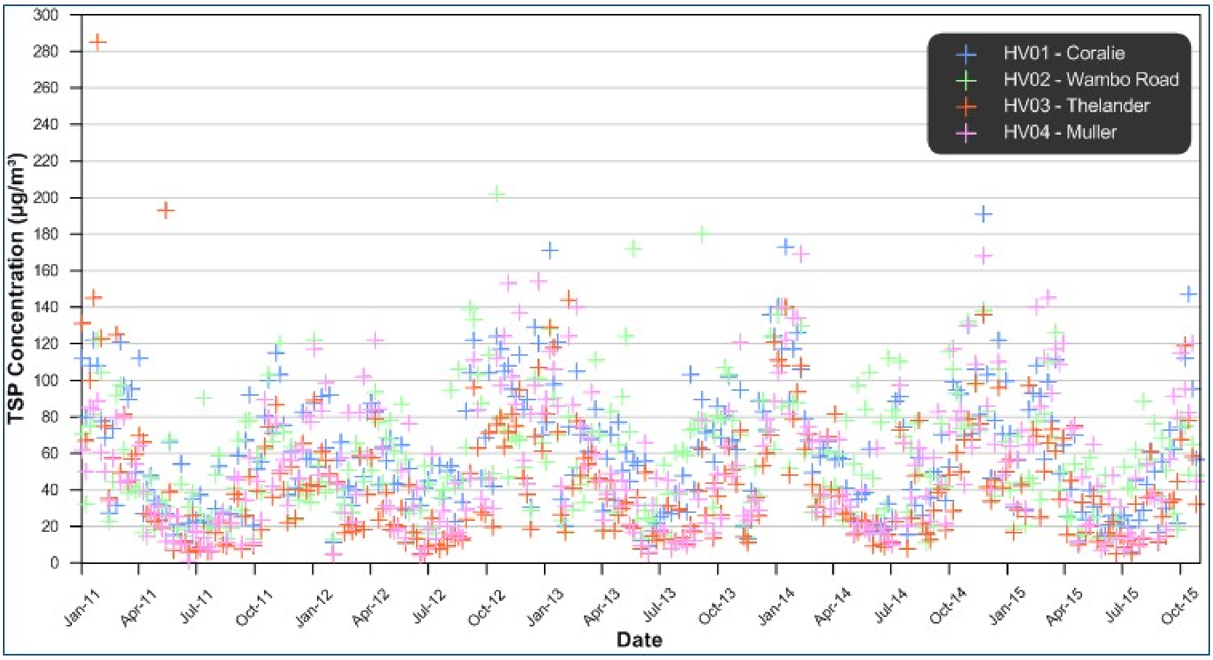

Figure 8: HVAS 24-hour average TSP concentrations

Figure 2 shows the location of the dust deposition gauge monitoring network operated by WCPL. The gauges are located on both privately-owned land and Wambo-owned land. The locations in closest proximity to dust sources such as mining activity would likely show the highest levels of deposited dust.

Table 5 shows the annual average dust deposition level at each gauge between 2011 and 2014. The majority of dust gauges recorded annual average insoluble solid deposition levels below the criterion of 4 grams per square metre per month (g/m²/month), with the exception of D01, D07 and D09 which are located within the mining lease area (see **Figure 2**).

Table 5: Annual average dust deposition ($g/m^2/month$)

DDG	2011	2012	2013	2014	Criterion
Privately-owned land					
D11	2.0	2.2	2.2	2.5	4.0
D17	1.4	1.7	2.8	1.8	4.0
D21	1.2	1.4	1.9	1.9	4.0
D22	1.2	1.4	2.0	2.2	4.0
D24	1.1	1.0	1.1	1.4	4.0
D25	1.6	2.2	2.7	2.7	4.0
Wambo-owned land					
D01	**8.1**	**15.8**	**8.8**	2.9	4.0
D03	3.0	2.2	2.8	3.0	4.0
D07	**5.2**	**5.0**	**5.0**	**6.0**	4.0
D09	3.7	**4.5**	3.9	2.0	4.0
D12	2.8	3.2	2.9	3.3	4.0
D19	2.5	2.9	3.1	2.9	4.0
D20	1.4	1.7	1.7	1.8	4.0
D23	2.0	1.8	1.8	2.1	4.0
D26	1.2	1.6	1.3	2.0	4.0

DDG = dust deposition gauge

Assessment of potential air quality impacts

To investigate the potential effect that the Modification may have on dust levels in the surrounding environment, a qualitative analysis is made of the proposed change in dust levels associated with the Modification relative to the approved dust levels assessed as part of the Wambo Development Project Environmental Impact Statement (**WCPL, 2003**).

Aspects of the Modification that would generate dust emissions include the construction activities, the operational activities and transport of product coal. Each of these activities are assessed in the following sections.

<u>Potential construction dust emissions</u>

The Modification would utilise the existing surface infrastructure and supporting services at Wambo, however would still require construction of some infrastructure components (see **Figure 3**). Construction and development activities which are required to support the Modification would occur progressively in parallel with ongoing mining operations and include:

- Approved CHPP portal box cut;
- South Wambo Underground Mine infrastructure area;
- Ventilation shafts and ancillary infrastructure;
- Gas management infrastructure; and,
- Additional access road.

Additional mobile equipment would be required for short periods during the construction and development activities. Construction activities would generally be undertaken during daytime hours.

The potential construction dust emissions would be primarily generated from the handling of material, vehicle movements, exhaust emissions from vehicles and plant and windblown dust generated from exposed areas. The potential impact due to these activities is difficult to accurately quantify on any given day due to the temporary and sporadic nature of these activities. As the South Wambo Underground Mine construction phase already forms part of the approved Wambo, this construction phase has not been considered in detail in this assessment.

However, the total amount of dust generated from the construction activities is unlikely to be significant relative to the total amount of dust currently generated from the mining activities. As such any potential dust impacts related to construction activities would be unlikely to be discernible beyond the existing levels of dust in the area surrounding Wambo. Given that the activities would occur for a limited period, no significant or prolonged effect at any off-site receptor is predicted to arise as a result of construction activities.

To minimise dust generation and the potential for off-site impacts during the construction activities, appropriate operational and physical mitigation measures would be implemented in accordance with the Air Quality and Greenhouse Gas Management Plan (**WCPL, 2014**).

Potential operational dust emissions

The following are components of the Modification that would likely affect the quantum of dust emissions produced at Wambo:

- Underground ROM coal production rate increase from 7.5 to 9.75 Mtpa;
- Minor changes to South Wambo Underground Mine ROM coal handling on the surface; and,
- Additional South Wambo Underground Mine ventilation shafts.

Three indicative mine plan years have been analysed and represent the key stages of the Modification:

- Scenario 1 (2019) – includes South Wambo Underground Mine production (6.0 Mtpa), open cut production (3.02 Mtpa[1]) and operation of South Wambo Underground Mine Ventilation Shaft 1;
- Scenario 2 (2023) – includes South Wambo Underground Mine production (9.75 Mtpa) and operation of the South Wambo Underground Mine Ventilation Shaft 2 and Bleeder 1; and,
- Scenario 3 (2028) – includes South Wambo Underground Mine production (9.75 Mtpa) and operation of South Wambo Underground Mine Ventilation Shaft 3 and Bleeder 2.

[1] Consistent with the open cut ROM coal production rate included in the approved Mining Operations Plan (**WCPL, 2015**).

The rate of dust emission has been calculated by analysing the various dust generating activities from the modified South Wambo Underground Mine for these three stages and applying suitable emission factors. For the purpose of comparing the potential change in dust emissions associated with the Modification and the approved operations, a similar methodology for estimating dust emissions to that used in the **Holmes Air Sciences (HAS) (2003)** assessment has been applied.

The open cut dust emissions in Scenario 1 have been estimated for the anticipated open cut ROM coal production rate in the approved Mining Operations Plan (**WCPL, 2015**). The estimated total open cut dust emissions for the approved activity for Year 9 in **HAS (2003)** have been scaled proportionally for this scenario.

A summary of the total dust emissions from the dust generating activities associated with the three stages of the Modification are presented in **Table 6**. Detailed dust emissions inventories are presented in **Appendix A**.

Table 6: Summary of estimated TSP emission rate for the Modification

ACTIVITY	TSP emission (kg/y)		
	Scenario 1	Scenario 2	Scenario 3
Open cut operations	1,503,384	-	-
Conveyor transfer to U/G ROM coal stockpile (x4)	3,504	3,504	3,504
Wind erosion from U/G ROM coal stockpile	1,643	1,643	1,643
Loading U/G ROM coal to haul trucks (Front End Loader)	60,000	97,500	97,500
Haulage from U/G ROM coal stockpile to hopper at CHPP	66,667	108,333	108,333
Unloading U/G ROM coal at CHPP hopper	30,000	48,750	48,750
Rehandle U/G ROM coal at CHPP hopper	9,000	14,625	14,625
Dozers pushing ROM coal at stockpile	95,922	155,873	155,873
Dozers pushing product coal at stockpile	37,776	61,387	61,387
Handling coal at CHPP	1,682	2,734	2,734
Loading product coal to stockpile	708	1,150	1,150
Wind erosion from product coal stockpile	1,085	1,085	1,085
Loading product coal to train	708	1,150	1,150
Ventilation shaft – Fan Shaft	49,068	50,555	43,121
Ventilation shaft – Bleeder Fan Shaft	-	9,665	9,665
Total TSP emissions (kg/y)	**1,861,147**	**557,953**	**550,518**

U/G = underground
kg/y = kilograms per year

The estimated total dust emissions from the modified Wambo would be greatest while the open cut is still operational (i.e. Scenario 1) and would then decrease after the cessation of open cut operations in 2020 (i.e. Scenarios 2 and 3). The estimated total dust emissions for each of the three stages have been compared against the total dust emission estimates for the approved Wambo included in **HAS** (**2003**) and these are shown in **Table 7**.

The results indicate that the estimated total dust emissions from the modified Wambo would result in an approximate 56% to 87% decrease in total dust emissions relative to the total dust emission estimates for the approved Wambo included in **HAS (2003)**.

Table 7: Comparison of estimated TSP emission rate for the Modification

Scenario	U/G ROM	OC ROM	Total ROM	U/G Emissions	OC Emissions	Total Emissions	Percent change in total emissions
	Mtpa			kg/yr			
Approved operation[1]	6.70	8.00	14.70	203,606	3,982,474	4,186,080	-
Scenario 1	6.00	3.02	9.02	357,763	1,503,384	1,861,147	-56%
Scenario 2	9.75	0.00	9.75	557,953	-	557,953	-87%
Scenario 3	9.75	0.00	9.75	550,518	-	550,518	-87%

[1] **HAS (2003)**

[2] Excludes emissions already included in the HAS (2003) emission estimates

OC = open cut

Overall, the actual change arising from the Modification is likely to reduce the level of approved emissions, given that the Modification does not seek any change to the total production of ROM coal. Achieving the proposed increase in underground ROM production would require a similar reduction in the open cut mine ROM production rate and in turn a reduction in the total dust emissions.

As the Modification is likely to reduce the level of approved emissions, no significant cumulative air quality impacts are expected as a result of the Modification.

Given the above, it is considered that no air dispersion modelling in accordance with the *Approved Method for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW DEC, 2005**) is required.

<u>Potential coal dust emissions from train wagons</u>

The coal produced by the Modification would be transported off-site via rail. There is potential for coal dust emissions to occur during this transportation.

However, the Modification does not seek any change in the total product coal transported from Wambo or any change to the approved rail movements, and as such it is not anticipated that there would be any change to existing air quality levels due to this activity.

Notwithstanding the above, for the purposes of this assessment, the potential impacts associated with coal dust emissions from train wagons have been investigated to ensure there is no significant impact due to the already approved levels of rail activity for Wambo.

Coal dust emissions from train wagons have the potential to originate from the coal surface of loaded wagons, leakage from wagon doors, re-suspension and wind erosion of coal spilled in the rail corridor, residual coal in unloaded wagons, and parasitic load on sills, shear plates and bogies of wagons.

A study conducted for the Australian Rail Track Corporation (ARTC) (**Ryan and Wand, 2014**) analysed ambient monitoring data which measured dust emissions along a rail corridor in the Hunter Valley. The study indicated that for trains travelling on the Hunter Valley network, there was no significant difference in the particulate matter measurements for passing freight trains and coal trains (loaded and unloaded). The study hypothesised that the significant increase of smaller measured particles ($PM_{2.5}$ and PM_1) associated with rail movements indicates that the elevated particulate matter levels were mostly due to diesel particles associated with locomotive emissions as opposed to coal dust which tends to be in the larger particle range.

This ambient monitoring data has recently been re analysed in combination with additional data in the form of the number of locomotives on each passing train and the precipitation data for the general area (**Malecki and Ryan, 2015**). The reanalysis suggests that the number of locomotives on each passing train has little influence on particulate levels which indicates that diesel particles are not a significant source. The effect of rainfall on the previous day was found to have a significant impact on particulate levels the following day. This finding indicates that the key mechanism for the increased particulate levels was due to passing trains stirring up existing dust particles that had settled previously on the tracks and nearby ground and that the influence on particulate levels was the same regardless of the type of train that was passing.

The findings of these studies indicate that the potential for any adverse air quality impacts associated with coal dust generated during rail transport would be low and would not make any appreciable difference to air quality. As the Modification is not seeking any increase in product coal transported from Wambo or any change to rail movements, there would not be any change to the air quality due to this activity.

Greenhouse Gas Assessment

The Modification would generate GHG emissions predominantly through the combustion of diesel fuel, the consumption of electricity and from the release of gases within the coal seam. The amount of GHG emissions likely to be generated due to the Modification have been estimated based on the maximum projected ROM coal production rate combined with estimates presented in the most recent National Greenhouse and Energy Reporting document for Wambo (**Peabody, 2015**). In addition, fugitive emissions have been estimated based on gas quantity and quality testing conducted for the modified South Wambo Underground Mine (**GeoGas, 2016**). This approach provides a reasonable worst case approximation of the potential GHG emissions and is considered conservative. It is also considered to be a better method of estimating GHG emissions at Wambo compared to adopting the generic emission factors in the National Greenhouse Accounts Factors (**Department of the Environment, 2015c**).

Table 8 summarises the estimated amount of carbon dioxide equivalent (CO_2-e) material likely to be generated for the Modification.

Table 8: Summary of estimated GHG emissions for the Modification

Year	OC ROM	U/G ROM	Fugitive emissions OC	Fugitive emissions U/G	Fuel Combustion	Electricity	Total (Scope 1 +2)
	Mt	Mt	Mt CO_2-e				
2016	4.39	4.21	0.03	0.79	0.09	0.07	0.97
2017	3.55	4.67	0.02	0.87	0.08	0.07	1.05
2018	3.60	4.13	0.02	0.77	0.08	0.07	0.94
2019	3.05	6.00	0.02	0.73	0.09	0.08	0.91
2020	1.05	6.20	0.01	1.63	0.07	0.06	1.77
2021	-	6.20	-	1.63	0.06	0.05	1.75
2022	-	6.30	-	1.65	0.06	0.05	1.77
2023	-	9.75	-	2.77	0.10	0.08	2.95
2024	-	9.75	-	2.77	0.10	0.08	2.95
2025	-	9.25	-	2.72	0.09	0.08	2.89
2026	-	8.75	-	2.72	0.09	0.07	2.89
2027	-	9.75	-	2.72	0.10	0.08	2.90
2028	-	9.75	-	1.49	0.10	0.08	1.67
2029	-	7.70	-	1.90	0.08	0.07	2.05
2030	-	7.70	-	1.18	0.08	0.07	1.32
2031	-	7.70	-	1.18	0.08	0.07	1.32
2032	-	2.50	-	1.18	0.03	0.02	1.22

Mt CO2-e = million tonnes of carbon dioxide equivalent

In comparison, the **HAS (2003)** assessment estimated that over the life of the mine an annual average amount of approximately 2.16 Mt CO2-e is likely to be generated. The estimates in **Table 8** for the proposed maximum ROM coal product rate indicate levels would be lower than previously estimated for the approved operations with an annual average amount of 1.84 Mt CO2-e and therefore no significant change to the existing amount of GHG emissions generated from Wambo is expected.

The estimated annual greenhouse emissions for Australia for the period February 2014 to March 2015 was 545.1 Mt CO_2-e (**Department of the Environment, 2015b**). Therefore, the average annual contribution of greenhouse emissions in comparison to the Australian greenhouse emissions is conservatively estimated to be approximately 0.34 per cent. At a state level, the estimated greenhouse emissions for NSW in the 2013 period was 141.8 Mt CO_2-e (**Department of the Environment, 2015a**). The annual average contribution of greenhouse emissions from the Modification in comparison to the NSW greenhouse emissions for the 2013 period is conservatively estimated to be approximately 1.30 per cent.

WCPL would continue to utilise various mitigation measures to minimise the overall generation of GHG emissions. These measures would include developing a basis for identifying and implementing energy efficiency opportunities and mitigation measures for various activities.

Some examples of various GHG management practices employed at Wambo include (**WCPL, 2014**):

- Investigating ways to reduce energy consumption during project planning phases and reviewing energy efficient alternatives.
- Regular maintenance of equipment and plant.
- Real-time gas (methane and carbon dioxide) monitoring at the ventilation shafts.
- Sealing completed longwall panels to reduce fugitive methane emissions.
- Monitoring the consumption of fuel and regularly maintaining diesel powered equipment to ensure operational efficiency.
- Monitoring the total site electricity consumption and investigating avenues to minimise the requirement.

Summary and conclusions

This assessment has examined the likely air quality effects resulting from the Modification.

The assessment finds that the estimated dust emissions from the Modification may result in a maximum decrease in total dust up to 87% of the level of approved emissions after the cessation of open cut operations in 2020. As the Modification would not increase the maximum total approved ROM coal production rate, in order for the underground mine to operate at the maximum proposed rate, the open cut mine would have to operate at a rate lower than is approved. In this case the Modification would likely result in a large decrease in total emissions and it could be expected that there would be an improvement in air quality.

Therefore it is reasonable to conclude that overall, the Modification is unlikely to cause any discernible negative impact at any surrounding sensitive receptor locations relative to the approved operations.

Relative to the overall mining operations, the quantity of dust emissions generated as a result of the proposed construction activity would be small, and therefore, provided that reasonable construction dust controls are implemented and managed, there would be no adverse impacts expected to arise.

As there is no proposed change to the amount of coal produced or changes to the approved rail movements at Wambo, there would be no change to existing air quality levels associated with this activity.

Similarly, as the total annual quantity of coal produced is not proposed to change, the estimated GHG emissions generated from the Modification would be of a similar scale to that previously assessed. With ongoing improvement and management of the generation of GHG emissions at Wambo, it is expected that the total GHG emissions may reduce over time.

Please feel free to contact us if you need to discuss (or require clarification on) any aspect of this report.

Yours faithfully,

Todoroski Air Sciences

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Philip Henschke

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Appendix A
Emissions Inventories

Table A-1: Emissions inventory - 2019

ACTIVITY	TSP emission (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 6	Units
Conveyor transfer to U/G ROM coal stockpile (x4)	3,504	6,000,000	tonnes/year	0.00028	kg/t	1.102	(ws/2.2)^1.3 in m/s	6	moisture content in %			90	% Control
Wind erosion from U/G ROM coal stockpile	1,643	3.6	ha	904	kg/ha/year	87	average nmber of raindays	5	silt content in %	5.0	% winds above 5.4m/s	50	% Control
Loading U/G ROM to haul trucks (Front End Loader)	60,000	6,000,000	tonnes/year	0.01000	kg/t								
Haulage from U/G ROM coal stockpile to hopper at CHPP	66,667	6,000,000	tonnes/year	0.02222	kg/t	180	tonnes/load	1.0	km/return trip	4.0	kg/VKT	50	% Control
Unloading U/G ROM coal at CHPP hopper	30,000	6,000,000	tonnes/year	0.01000	kg/t							50	% Control
Rehandle U/G ROM coal at CHPP hopper	9,000	1,800,000	tonnes/year	0.01000	kg/t							50	% Control
Dozers pushing ROM coal at stockpile	95,922	4,011	hours/year	23.9	kg/h	5	silt content in %	6	moisture content in %				
Dozer pushing Product coal at stockpile	37,776	4,011	hours/year	9.4	kg/h	4	silt content in %	10	moisture content in %				
Handling coal at CHPP	1,682	6,000,000	tonnes/year	0.00028	kg/t	1.102	(ws/2.2)^1.3 in m/s	6	moisture content in %				
Loading product coal to stockpile	708	5,160,000	tonnes/year	0.00014	kg/t	1.102	(ws/2.2)^1.3 in m/s	10	moisture content in %				
Wind erosion from Product coal stockpile	1,085	3.0	ha	723	kg/ha/year	87	average nmber of raindays	4	silt content in %	5.0	% winds above 5.4m/s	50	% Control
Loading product coal to train	708	5,160,000	tonnes/year	0.00014	kg/t	1.102	(ws/2.2)^1.3 in m/s	10	moisture content in %				
Ventilation shaft - Fan Shaft 1	49,068	4.715	mg/m3	330	m3/sec	31536000	sec/year						
Total TSP emissions (kg/yr)	**357,762**												
ROM (tpa)	**6,000,000**												

Table A-2: Emissions inventory - 2023

ACTIVITY	TSP emission (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 6	Units
Conveyor transfer to U/G ROM coal stockpile (x4)	3,504	9,750,000	tonnes/year	0.00028	kg/t	1.102	(ws/2.2)^1.3 in m/s	6	moisture content in %			90	% Control
Wind erosion from U/G ROM coal stockpile	1,643	3.6	ha	904	kg/ha/year	87	average nmber of raindays	5	silt content in %	5.0	% winds above 5.4m/s	50	% Control
Loading U/G ROM to haul trucks (Front End Loader)	97,500	9,750,000	tonnes/year	0.01000	kg/t								
Haulage from U/G ROM coal stockpile to hopper at CHPP	108,333	9,750,000	tonnes/year	0.02222	kg/t	180	tonnes/load	1.0	km/return trip	4.0	kg/VKT	50	% Control
Unloading U/G ROM coal at CHPP hopper	48,750	9,750,000	tonnes/year	0.01000	kg/t							50	% Control
Rehandle U/G ROM coal at CHPP hopper	14,625	2,925,000	tonnes/year	0.01000	kg/t							50	% Control
Dozers pushing ROM coal at stockpile	155,873	6,519	hours/year	23.9	kg/h	5	silt content in %	6	moisture content in %				
Dozer pushing Product coal at stockpile	61,387	6,519	hours/year	9.4	kg/h	4	silt content in %	10	moisture content in %				
Handling coal at CHPP	2,734	9,750,000	tonnes/year	0.00028	kg/t	1.102	(ws/2.2)^1.3 in m/s	6	moisture content in %				
Loading product coal to stockpile	1,150	8,385,000	tonnes/year	0.00014	kg/t	1.102	(ws/2.2)^1.3 in m/s	10	moisture content in %				
Wind erosion from Product coal stockpile	1,085	3.0	ha	723	kg/ha/year	87	average nmber of raindays	4	silt content in %	5.0	% winds above 5.4m/s	50	% Control
Loading product coal to train	1,150	8,385,000	tonnes/year	0.00014	kg/t	1.102	(ws/2.2)^1.3 in m/s	10	moisture content in %				
Ventilation shaft - Fan Shaft 2	50,555	4.715	mg/m3	340	m3/sec	31536000	sec/year						
Ventilation shaft - Bleeder Fan Shaft 1	9,665	4.715	mg/m4	65	m3/sec	31536000	sec/year						
Total TSP emissions (kg/yr)	**557,953**												
ROM (tpa)	**9,750,000**												

Table A-3: Emissions inventory - 2028

ACTIVITY	TSP emission (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 6	Units
Conveyor transfer to U/G ROM coal stockpile (x4)	3,504	9,750,000	tonnes/year	0.00028	kg/t	1.102	(ws/2.2)^1.3 in m/s	6	moisture content in %			90	% Control
Wind erosion from U/G ROM coal stockpile	1,643	3.6	ha	904	kg/ha/year	87	average nmber of raindays	5	silt content in %	5.0	% winds above 5.4m/s	50	% Control
Loading U/G ROM to haul trucks (Front End Loader)	97,500	9,750,000	tonnes/year	0.01000	kg/t								
Haulage from U/G ROM coal stockpile to hopper at CHPP	108,333	9,750,000	tonnes/year	0.02222	kg/t	180	tonnes/load	1.0	km/return trip	4.0	kg/VKT	50	% Control
Unloading U/G ROM coal at CHPP hopper	48,750	9,750,000	tonnes/year	0.01000	kg/t							50	% Control
Rehandle U/G ROM coal at CHPP hopper	14,625	2,925,000	tonnes/year	0.01000	kg/t							50	% Control
Dozers pushing ROM coal at stockpile	155,873	6,519	hours/year	23.9	kg/h	5	silt content in %	6	moisture content in %				
Dozer pushing Product coal at stockpile	61,387	6,519	hours/year	9.4	kg/h	4	silt content in %	10	moisture content in %				
Handling coal at CHPP	2,734	9,750,000	tonnes/year	0.00028	kg/t	1.102	(ws/2.2)^1.3 in m/s	6	moisture content in %				
Loading product coal to stockpile	1,150	8,385,000	tonnes/year	0.00014	kg/t	1.102	(ws/2.2)^1.3 in m/s	10	moisture content in %				
Wind erosion from Product coal stockpile	1,085	3.0	ha	723	kg/ha/year	87	average nmber of raindays	4	silt content in %	5.0	% winds above 5.4m/s	50	% Control
Loading product coal to train	1,150	8,385,000	tonnes/year	0.00014	kg/t	1.102	(ws/2.2)^1.3 in m/s	10	moisture content in %				
Ventilation shaft - Fan Shaft 3	43,121	4.715	mg/m3	290	m3/sec	31536000	sec/year						
Ventilation shaft - Bleeder Fan Shaft 1	9,665	4.715	mg/m4	65	m3/sec	31536000	sec/year						
Total TSP emissions (kg/yr)	**550,518**												
ROM (tpa)	**9,750,000**												