Draft report

Irrigation Way, Wumbulgal – Air Quality Assessment

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Table of contents

List of Figures

List of Tables

1 Introduction

Pacific Environment has been commissioned by Planning Matters Development Services to undertake an air quality assessment for the proposed operation of a railway freight terminal (the Proposal) on Lots 4 & 5 in DP1201358, The Irrigation Way, Wumbulgal, NSW (the Site).

TO BE REVISED.

The railway freight terminal currently operates out of premises in Griffith's CBD, approximately 16 km north-east of the Proposal.

This assessment uses the computer-based dispersion model, AERMOD, to predict off-site dust levels associated with emissions from vehicles travelling on unsealed roads. To assess the effect that potential emissions could have on existing air quality, the dispersion model predictions have been compared to relevant regulatory air quality criteria.

GM Advises Road to Be Sealed?

This assessment is based on a conventional approach following the procedures outlined in the NSW Environment Protection Authority's (EPA) document titled "*Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW*" (**NSW EPA, 2016**), hereafter referred to as the 'Approved Methods'.

In summary, this report provides information on the following:

- Summary of operations;
- Summary of air quality criteria;
- Meteorological conditions in the area;
- Emission sources and estimates of these emissions;
- Methods used to predict off-site impact levels from expected emissions from the site; and
- Expected dispersion patterns and predicted impacts.

2 Local Setting and Project Description

The Proposal is to be located on Lots 4 & 5 DP1201358, The Irrigation Way, Wumbulgal, NSW, as shown in **Figure 2-1**. Also shown on the figure are fifteen isolated residences identified within 10 km of the site. Details of these residences are provided in **Table 2-1.**

The proposed site layout is shown in **Figure 2-2**. As shown in **Figure 2-2**, the subject land also comprises a number of other businesses including a grain storage and handling facility, a hay storage and processing facility, a cotton module storage and pressing facility and a mainline loading facility for containers and bulk grain from silos.

When considering the potential for air quality impacts due to dust from vehicles travelling on unsealed roads at the subject site, it is pertinent to note that the existing businesses are seasonal, with different peak periods to each other during the year (see **Section 6.1**).

Figure 2-1: Site Location and receptors

Table 2-1: Location of sensitive receptors assessed

Receptor ID	Easting (m)	Northing (m)
	MGA Zone 55	
1	430729	6195023
2	431375	6195737
3	432031	6195476
4	432731	6196399
5	434039	6195853
6	433566	6195227
7	432173	6192196
8	427823	6193101
9	423610	6195219
10	426500	6196648
11	426650	6197316
12	427483	6199023
13	428028	6199217
14	427904	6200072
15	429877	6198713

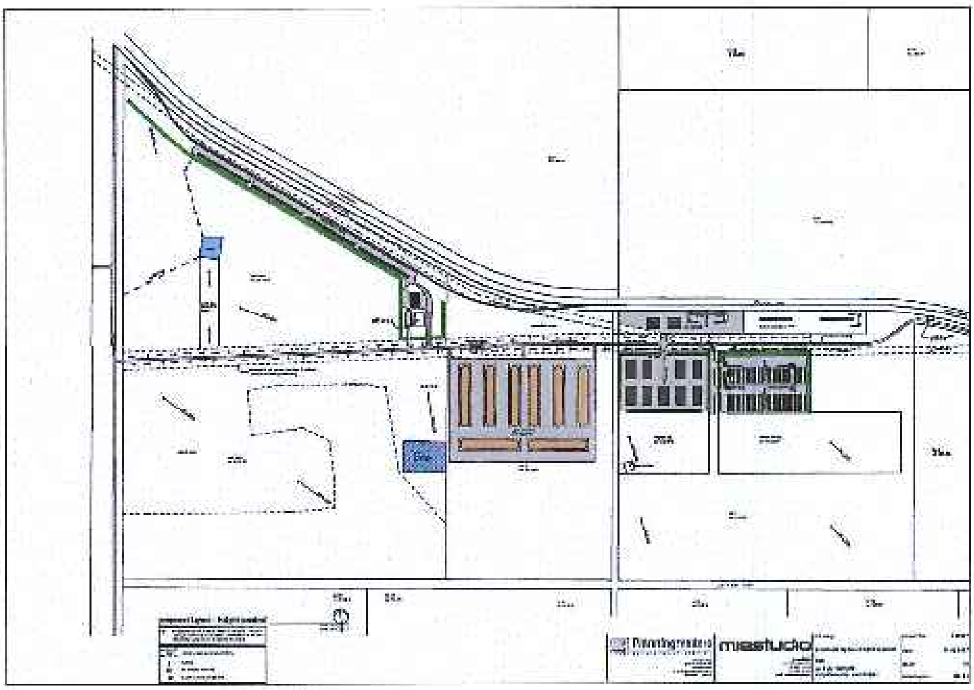


Figure 2-2: Proposed Site Layout

3 Air Quality Criteria

The Approved Methods (**NSW EPA, 2016**) specifies air quality assessment criteria relevant for assessing impacts from air pollution.

These criteria are health-based (i.e. they are set at levels to protect against health effects) and for PM_{10} and $PM_{2.5}$ are consistent with Amended National Environment Protection Measure for Ambient Air Quality (Ambient Air-NEPM) (**NEPC, 2016**). In addition, the Approved Methods include other measures of air quality, namely dust deposition and Total Suspended Particulates (TSP) which are not stated in the Ambient Air-NEPM. The Approved Methods were updated at the end of 2016 to make the annual average PM_{10} criterion equivalent to the NEPM (25 µg/m^3), prior to this the criterion was 30 µg/m^3. The updated Approved Methods also introduced criteria for 24-hour average and annual average $PM_{2.5}$.

Table 3-1 presents the air quality criteria for pollutants that are relevant to this study. It is important to note that the criteria are applied to the cumulative impacts due to the Project and other sources.

Table 3-1: NSW EPA Impact Assessment Criteria for Particulate Matter Concentrations

Pollutant	Standard	Averaging Period	Source
TSP	90 µg/m^3	Annual	NSW EPA (2016)
PM_{10}	50 µg/m^3 25 µg/m^3	24-Hour Annual	NSW EPA (2016)
$PM_{2.5}$	25 µg/m^3 8 µg/m^3	24-Hour Annual	NSW EPA (2016)

Notes: µg/m^3 – micrograms per cubic metre.

In addition to health impacts, airborne dust also has the potential to cause nuisance effects by depositing on surfaces, including vegetation. Larger particles do not tend to remain suspended in the atmosphere for long periods of time and will fall out relatively close to source. Dust deposition can soil materials and generally degrade aesthetic elements of the environment, and are assessed for nuisance or amenity impacts.

Table 3-2 shows the maximum acceptable increase in dust deposition over the existing dust levels from an amenity perspective. These criteria for dust deposition levels are set to protect against nuisance impacts (**NSW EPA, 2016**).

Table 3-2: NSW EPA Impact Assessment Criteria for Dust (Insoluble Solids) Fallout

Pollutant	Averaging period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited dust	Annual	2 g/m^2/month	4 g/m^2/month

4 Existing Environment

4.1 Local Climatic Conditions

Table 4-1 presents the temperature, humidity and rainfall data for the BoM site located at Griffith Airport (Site number 075041), approximately 19 km north west of the site. Humidity data consist of monthly averages of 9 am and 3 pm readings. Also presented are monthly averages of maximum and minimum temperatures. Rainfall data consist of mean monthly rainfall and the average number of rain days per month.

The annual average maximum and minimum temperatures recorded at Griffith Airport are 23.9 ℃ and 10.1 ℃ respectively. On average, January is the hottest month, with an average maximum temperature of 33.0 ℃. July is the coldest month, with average minimum temperature of 3.5 °C. The annual average relative humidity reading collected at 9am from the Griffith Airport is 66% and at 3pm the annual average is 43%. The month with the highest relative humidity on average is July with a 9am average of 88% and the month with the lowest relative humidity is January with a 3pm average of 28%.

Rainfall data collected at Griffith Airport shows that 64.9 rain days. The average annual rainfall is 402.2 mm with an average of 75.3 rain days per year.

Table 4-1: Climate Averages for Griffith Airport

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
9am Mean Dry-bulb and Wet-bulb Temperatures (°C) and Relative Humidity (%)													
Dry-bulb	23.0	21.7	18.5	15.3	10.6	7.9	6.9	9.0	12.3	16.8	18.8	21.3	15.2
Humidity	49	58	60	66	78	87	88	79	70	56	56	49	66
3pm Mean Dry-bulb and Wet-bulb Temperatures (°C) and Relative Humidity (%)													
Dry-bulb	30.6	30.2	27.0	22.8	18.2	14.3	13.3	15.5	18.9	22.8	26.0	28.6	22.4
Humidity	28	34	37	41	53	63	62	54	47	37	35	31	43
Daily Maximum Temperature (°C)													
Mean	33.0	32.3	28.7	24.0	19.2	15.4	14.5	16.5	19.9	24.1	28.2	30.9	23.9
Daily Minimum Temperature (° C)													
Mean	17.1	17.4	14.3	10.2	7.1	4.6	3.5	3.9	5.9	9.0	12.7	15.3	10.1
Rainfall (mm)													
Mean	34.0	29.0	35.8	27.8	35.5	36.0	34.3	35.9	34.0	38.0	33.9	32.7	402.2
Rain days (Number)													
Mean	4.5	4.1	4.2	4.7	6.8	8.0	9.9	9.0	7.5	6.4	5.4	5.0	75.3

*Source: **BoM (2017a)** Climate averages for Station: 075041; Commenced: 1970 – Last Record April 2017; Latitude: 34.25°S; Longitude: 146.07°E*

4.2 Local Meteorology

4.2.1 Wind Speed and Direction

Air quality impacts are influenced by meteorological conditions, primarily in the form of gradient wind flow regimes, and by local conditions that are generally driven by topographical features and interactions with coastal influences, such as the sea breeze. Wind speed, wind direction, temperature and relative humidity all affect the potential dispersion and transport of plumes and are basic input retirements for dispersion modelling.

Figure 4-1 shows the annual wind roses for the period January to December 2013 compiled from hourly averages of 1-minute data collected at the Bureau of Meteorology station at Griffith AWS located approximately 18 km north-east of the Site.

On annual basis, there are similar proportions of winds from most directions, with the most predominant from the east and east-southeast. In summer the predominant wind direction is from the southwest quadrant. Autumn winds are similar to the annual winds, with the most predominant from the east and east-southeast. The predominant wind direction in winter is form the north-eastern quadrant and in spring from the west-north-west.

The annual average wind speed for the 2013 period is 3.96 m/s with calms (wind speeds less than 0.5 m/s) occurring approximately 8.4% of the time.

The wind data for 2013 were found to be generally representative of the larger data set in terms of average wind speed, percentage of calms and directional patterns, and were therefore chosen to represent the meteorology in the analysis.

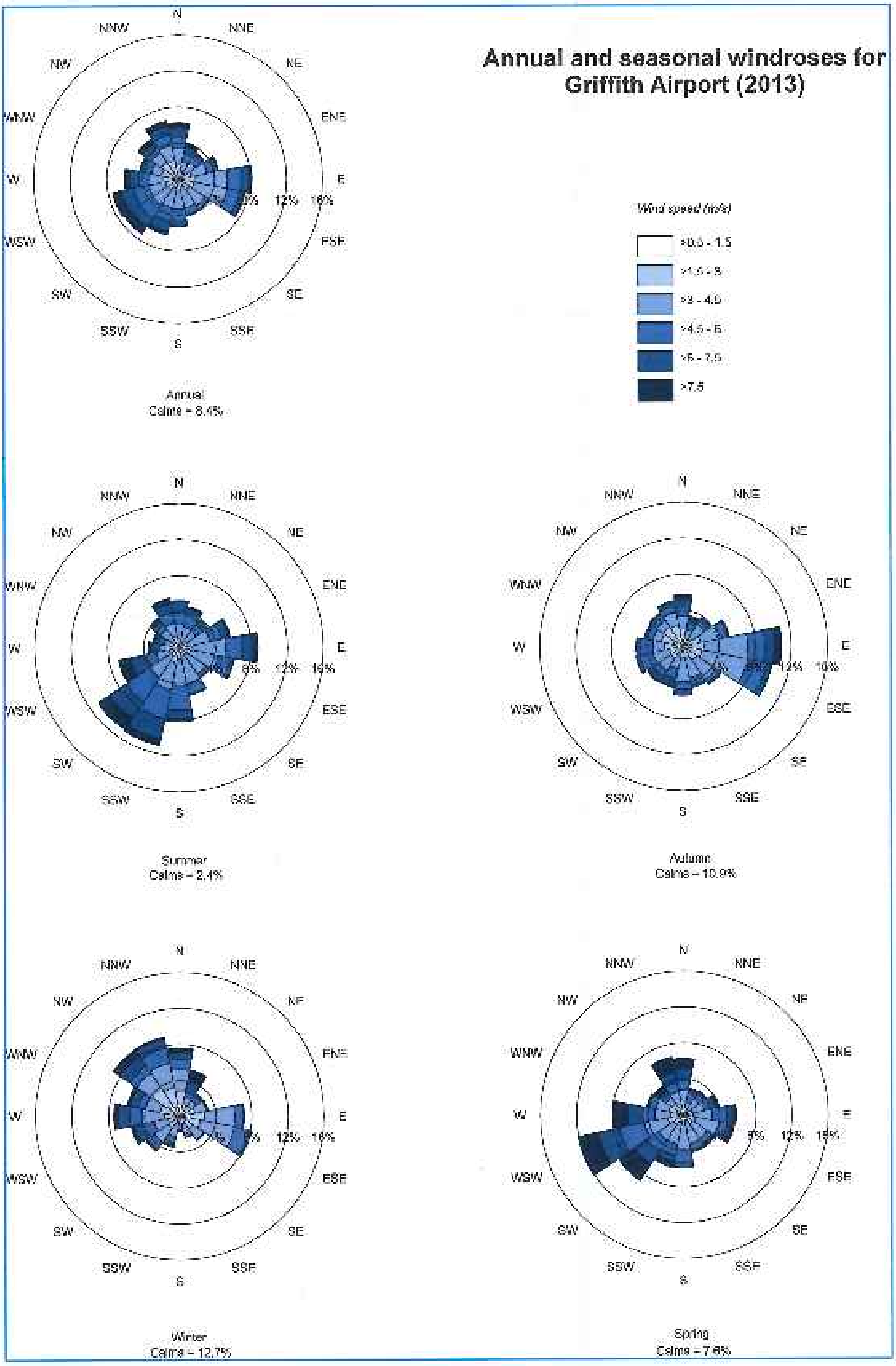


Figure 4-1: Windroses for Griffith Airport

4.2.2 Atmospheric Stability

An important aspect of pollutant dispersion is the level of turbulence in the lowest 1 km or so of the atmosphere, known as the planetary boundary layer (PBL). Turbulence controls how effectively a plume is diffused into the surrounding air and hence diluted. It acts by increasing the cross-sectional area of the plume due to random motions. With stronger turbulence, the rate of plume diffusion increases. Weak turbulence limits diffusion and contributes to high plume concentrations downwind of a source.

Turbulence is generated by both thermal and mechanical effects to varying degrees. Thermally driven turbulence occurs when the surface is being heated, in turn transferring heat to the air above by convection. Mechanical turbulence is caused by the frictional effects of wind moving over the earth's surface, and depends on the roughness of the surface as well as the flow characteristics.

Turbulence in the boundary layer is influenced by the vertical temperature gradient, which is one of several indicators of stability. Plume models use indicators of atmospheric stability in conjunction with other meteorological data to estimate the dispersion conditions in the atmosphere.

Stability can be described across a spectrum ranging from highly unstable through neutral to highly stable. A highly unstable boundary layer is characterised by strong surface heating and relatively light winds, leading to intense convective turbulence and enhanced plume diffusion. At the other extreme, very stable conditions are often associated with strong temperature inversions and light winds, which commonly occur under clear skies at night and in the early morning. Under these conditions plumes can remain relatively undiluted for considerable distances downwind. Neutral conditions are linked to windy and/or cloudy weather, and short periods around sunset and sunrise, when surface rates of heating or cooling are very low.

The stability of the atmosphere plays a large role in determining the dispersion of a plume and it is important to have it correctly represented in dispersion models. Current air quality dispersion models (such as AERMOD and CALPUFF) use the Monin-Obukhov Similarity Theory (MOST) to characterise turbulence and other processes in the PBL. One of the measures of the PBL is the Monin-Obukhov length (L), which approximates the height at which turbulence is generated equally by thermal and mechanical effects (**Seinfeld and Pandis 2006**). It is a measure of the relative importance of mechanical and thermal forcing on atmospheric turbulence.

Because values of L diverge to + and - infinity as stability approaches neutral from the stable and unstable sides, respectively, it is often more convenient to use the inverse of L (i.e., 1/L) when describing stability.

Figure 4-2 shows the hourly averaged 1/L for the site computed from all data in the AERMET surface file. This plot indicates that the PBL is stable overnight and becomes unstable as radiation from the sun heats the surface layer of the atmosphere and drives convection. The changes from positive to negative occur at the shifts between day and night. This indicates that the diurnal patterns of stability are realistic.

Table 4-2: Inverse of the Monin-Obukhov length L with respect to atmospheric stability

1/L	Atmospheric Stability
Negative	Unstable
Zero	Neutral
Positive	Stable

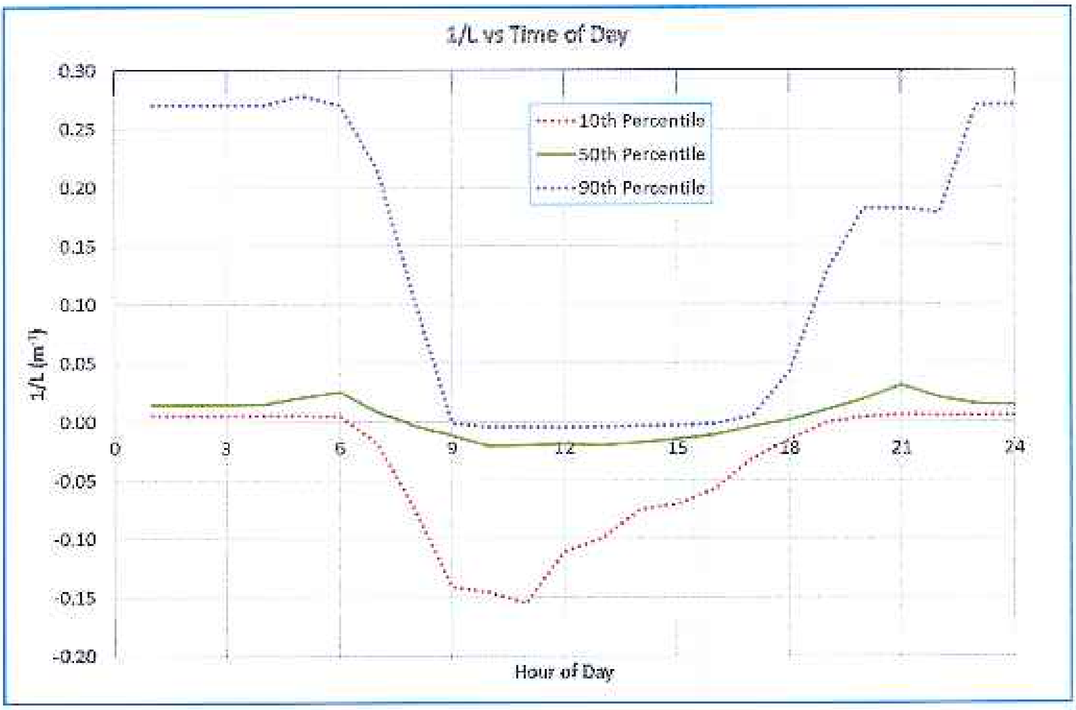


Figure 4-2: Annual statistics of 1/L by hour of the day

4.3 Existing Air Quality

4.3.1 Introduction

Air quality standards and goals refer to pollutant levels which include the contribution from proposed projects as well as other sources. To fully assess impacts against all the relevant air quality standards and goals it is necessary to have information or estimates on existing dust concentration and deposition levels in the area in which the Proposal is likely to contribute to these levels.

No air quality data are collected in the immediate vicinity of the Proposal. The closest monitoring stations, operated by the NSW Office of Environment and Health (OEH), are located at Wagga Wagga North and Albury, approximately 130 km south-east and 200 km south of the site, respectively.

The data collected at these sites are considered to be a conservative representation of existing PM_{10} and $PM_{2.5}$ concentration of the subject site for the Proposal, as the OEH monitors are located within residential areas, compared with rural location of the Proposal site.

4.3.2 PM_{10} concentrations

The OEH monitoring sites at Wagga Wagga North and Albury measure concentrations of PM_{10} using a Tapered Element Oscillating Microbalance (TEOM).

Figure 4-3 presents the 24-hour average PM_{10} data from the OEH sites at Wagga Wagga North and Albury for the period January 2012 to December 2016.

Between 2012 and 2016 there were 11 occasions when the 24-hour average PM_{10} criterion of 50 µg/m^3 was exceeded at Albury, and 52 occasions at Wagga Wagga North. This represents less than 1 % of the five year period at Albury and 2.4 % of the last five years at Wagga Wagga North.

The annual average PM_{10} concentrations summarised in **Table 4-3** show that there have been no exceedances of the criterion of 25 µg/m^3.

As the data from Wagga Wagga North are considered highly conservative due to the positioning of the monitoring station within a residential area, the average of data from both sites (17.8 µg/m^3) was assumed for the existing background.

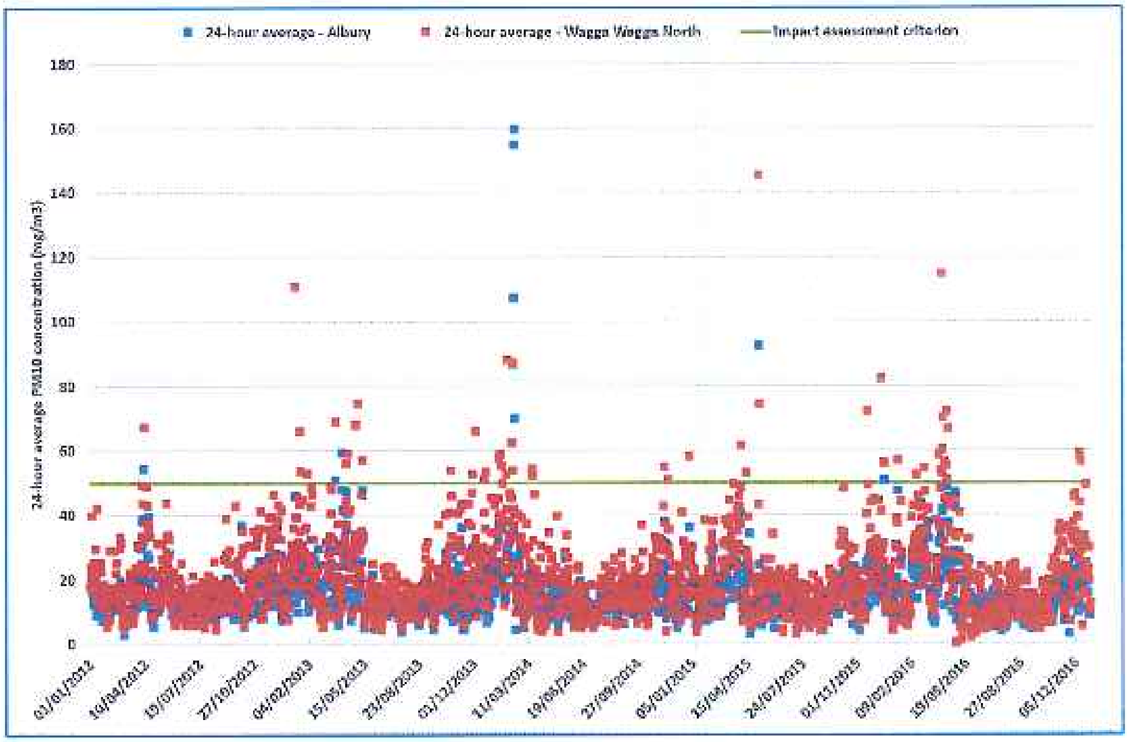


Figure 4-3: Measured 24-hour average PM_{10} concentrations at Wagga Wagga North and Albury OEH (2012-2016)

Table 4-3: Annual average PM_{10} and $PM_{2.5}$ concentrations – OEH Wagga Wagga North and Albury

Year	Annual Average (µg/m³)	
	PM_{10}	
	Albury	Wagga Wagga North
2012	14.3	18.8
2013	15.8	22.1
2014	15.9	20.7
2015	14.6	19.9
2016	15.1	20.6
Average by site	15.1	20.4
Average both sites	17.8	

4.3.4 $PM_{2.5}$ concentrations

Concentrations of $PM_{2.5}$ are measured at Wagga Wagga North using a Beta Attenuation Monitor (BAM).

Figure 4-4 and **Table 4-4** summarise the last five years of data (2012 to 2016).

Data from this site are considered highly conservative due to the positioning of the monitoring station within a residential area in Wagga Wagga North due to contribution from higher numbers of vehicles and wood-heater use (particularly in winter months).

The data in **Figure 4-4** show that measured 24-hour average $PM_{2.5}$ concentrations at the Wagga Wagga North monitoring stations in the last five years have been predominantly well below the assessment criterion of 25 µg/m_3. There were only seven occasions where the impact assessment criterion was exceeded at this site (less than 0.5% of the data).

The annual average $PM_{2.5}$ data shown in **Table 4-4** show that the annual average standard of 8 µg/m^3 was exceeded at the Wagga Wagga North monitoring station in 2012 and was close to the standard in every other year. It is noted that annual average $PM_{2.5}$ concentrations do not vary significantly across the state, with all OEH monitoring stations that measure $PM_{2.5}$ concentrations, recording annual average concentrations close to, or above the criteria.

An annual average $PM_{2.5}$ concentration of 7.8 µg/m^3 (the average of data for 2012 to 2016) has been conservatively adopted for this assessment.

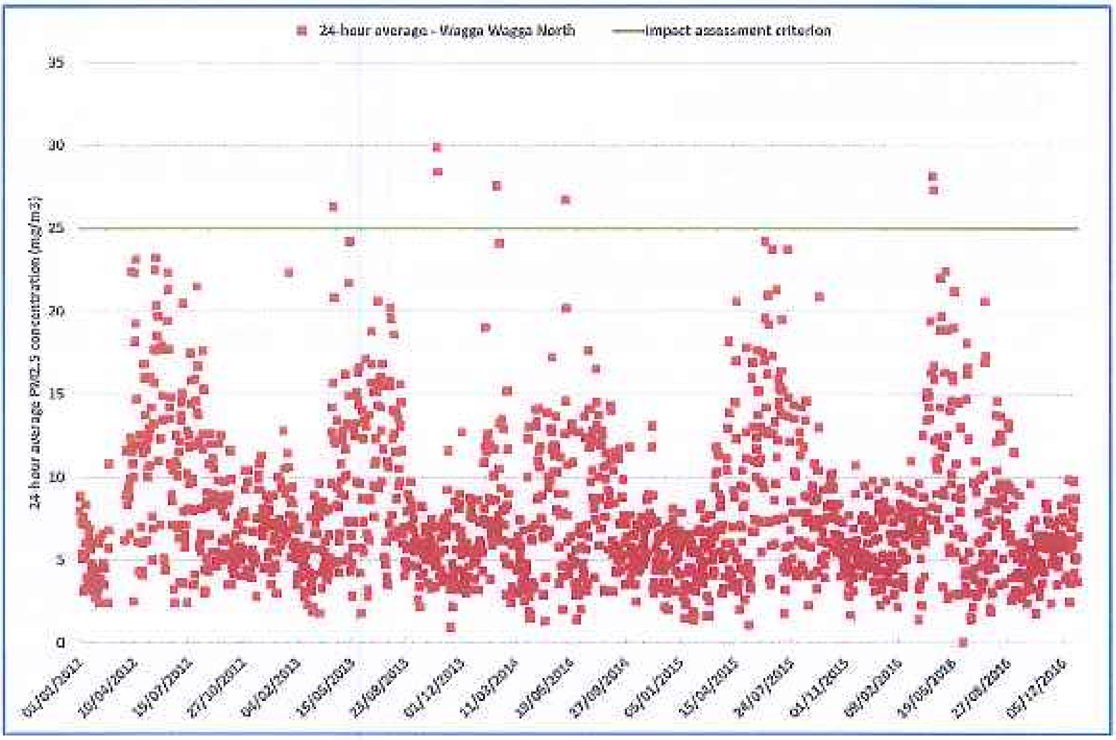


Figure 4-4: Measured 24-hour average $PM_{2.5}$ concentrations at Wagga Wagga North (2012-2016)

Table 4-4: Annual average $PM_{2.5}$ concentrations – OEH Wagga Wagga North

Year	Annual Average (µg/m³) $PM_{2.5}$ Wagga Wagga North
2012	8.7
2013	7.9
2014	7.5
2015	7.6
2016	7.4
Average	7.8

4.3.5 TSP concentrations

There are no measurements of TSP available in the vicinity of the site. Estimates of annual average TSP concentrations can be made from the PM_{10} measurements by assuming that 40% of the TSP is PM_{10}. This relationship was obtained from data collected by co-located TSP and PM_{10} monitors operated for long periods of time in the Hunter Valley (**NSW Minerals Council, 2000**). Although this ratio is based on Hunter Valley data, in the absence of site specific data this provides an indicative estimate of the ambient TSP. Use of this relationship on the adopted PM_{10} annual average of 17.8 µg/m³ gives an existing annual average TSP concentration of approximately 45 µg/m³.

4.3.6 Dust deposition

No site specific dust deposition data are available, therefore annual average dust deposition has been conservatively taken to be 2 g/m²/month.

4.3.7 Summary of background data

The background concentrations adopted for this assessment, based on the available monitoring data described above, are presented in **Table 4.5**.

Table 4.5: Adopted background concentrations/levels

Air quality parameter	Averaging period	Assessment criteria/standard	Adopted background concentration
Dust deposition	Annual	4 g/m²/month	2 g/m²/month
TSP annual	Annual	90 µg/m³	45 µg/m³
PM_{10}	Annual	30 µg/m³	17.8 µg/m³
PM_{10}	24 hour	50 µg/m³	Daily varying
$PM_{2.5}$	Annual	8 µg/m³	7.8 µg/m³
$PM_{2.5}$	24 hour	25 µg/m³	Daily varying

5 Approach to Assessment

5.1 Introduction

The approach taken for the dust assessment was as follows:

- Estimate annual average dust emissions;
- Collate suitable meteorological data into a suitable format for modelling;
- Use a computer-based dispersion model to predict dust concentrations at nearest sensitive receptors; and
- Compare predicted concentrations with relevant air quality criteria.

5.2 Overview of Dispersion Model

The overall approach to the assessment generally follows the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW DEC, 2016**) using the Level 2 assessment methodology. The Approved Methods specify how assessments based on the use of air dispersion models should be completed. They include guidelines for the preparation of meteorological data to be used in dispersion models and the relevant air quality criteria for assessing the significance of predicted concentration and deposition rates from projects.

AERMOD was chosen as the most suitable model due to the source types, location of nearest receptors and nature of local topography. AERMOD is the US-EPA's recommended steady-state plume dispersion model for regulatory purposes. AERMOD replaced the Industrial Source Complex (ISC) model for regulatory purposes in the US in December 2006 as it incorporates more recent, and potentially more accurate, algorithms to represent both meteorological interactions and air quality dispersion.

A significant feature of AERMOD is that the Pasquill-Gifford stability based dispersion is replaced with a turbulence-based approach that uses the Monin-Obukhov length scale to account for the effects of atmospheric turbulence based dispersion.

The AERMOD system includes AERMET, used for the preparation of meteorological input files and AERMAP, used for the preparation of terrain data.

Terrain data was sourced from NASA's Shuttle Radar Topography Mission (SRTM) Data (1 arc-second, or ~30 m resolution) and processed within AERMAP to create the necessary input files.

AERMET requires surface and upper air meteorological data as input. Surface data was sourced from the Bureau of Meteorology (BoM) meteorological station at Griffith Airport located approximately 19 km north-west of the site.

Appropriate values for three surface characteristics are required for AERMET as follows:

- Surface roughness, which is the height at which the mean horizontal wind speed approaches zero, based on a logarithmic profile;
- Albedo, which is an indicator of reflectivity of the surface, and;

- Bowen ratio, which is an indicator of surface moisture.

Values of surface roughness, Bowen ratio and albedo were estimated based on a review of aerial photography for a radius of 3 km centred on the site. Default values for cultivated land use were chosen to represent the surrounding area.

6 Emissions

6.1 Introduction

Dust emissions from vehicles travelling on unsealed roads have been estimated for the following:

- current operations at the site
- proposed operations at the site

As discussed in **Section 2**, there are a number of other businesses already operating at the site, namely, a grain storage and handling facility, a hay storage and processing facility, a cotton module storage and pressing facility and a mainline loading facility for containers and bulk grain from silos, and the peak operating periods of these do not all overlap.

Table 6.1 identifies the operating periods for each business and summarises the vehicle trips per day. The values in bold are those used in the emission estimation. It has conservatively been assumed that all these activities occur 365 days per year.

Table 6.1: Summary of vehicle movements – existing and proposed operations

Activity		Operating periods		Vehicle trips per day Light vehicles	Heavy vehicles
Existing operations					
Cotton Module Storage & Pressing Facility		Peak	March to July	30	20
Hay Storage & Processing Facility		Main peak	October to December	15	30
		Secondary peak	January to March	15	15
		Off-peak	April to September	15	10
Grain Storage & Handling Facility	Delivered to bunkers	Peak	November to December	20	100
		Off-peak	January to October	10	15
	Bunkers to silos	All year		-	100
Proposed operations					
Railway freight terminal		All year		30	125
			TOTAL	135!	415!

TSP, PM_{10} and $PM_{2.5}$ emission rates were calculated using emission factors derived from **US EPA (1995)**. A summary of the estimated dust emissions for are presented in **Table 6-2** (existing operations) and **Table 6-3** (proposed operations). Detailed emissions inventories are presented in **Appendix A.**

Whilst there may be some vehicles entering the railway freight terminal during night-time hours, it has conservatively been assumed that all activities and emissions occur between 6am and 7pm, seven days per week.

Figure 6-1 and

Table *6-4* provide information on the location of sources for each activity as used in the dispersion modelling for the existing operations, and the information for the proposed operations is provided in **Figure 6-2** and **Table 6-5**.

Table 6-2: Estimated Dust Emissions – existing operations

Existing operations	Emissions (kg/y)		
	TSP	PM_{10}	$PM_{2.5}$
Cotton Module Facility			
Cotton Module Facility -Heavy vehicles - unsealed	27,128	6,914	691
Cotton Module Facility Light vehicles - unsealed	12,981	3,308	331
Hay Processing Facility			
Hay Processing Facility - Heavy vehicles - unsealed	34,431	8,775	878
Hay Processing Facility - Light vehicles - unsealed	5,492	1,400	140
Grain Storage Facility			
Grain Storage Facility - Heavy vehicles - delivery to bunkers - unsealed	114,771	29,251	2,925
Grain Storage Facility - Heavy vehicles - bunkers to silos - unsealed	93,904	23,933	2,393
Grain Storage Facility - Light vehicles - unsealed	7,323	1,866	187
TOTAL EMISSIONS - EXISTING (kg/y)	**296,030**	**75,447**	**7,545**

Table 6-3: Estimated Dust Emissions – proposed operations

Proposed operations	Emissions (kg/y)		
	TSP	PM_{10}	$PM_{2.5}$
Cotton Module Facility			
Cotton Module Facility -Heavy vehicles - unsealed	33,388	8,509	851
Cotton Module Facility Light vehicles - unsealed	15,977	4,072	407
Hay Processing Facility			
Hay Processing Facility - Heavy vehicles - unsealed	43,822	11,169	1,117
Hay Processing Facility - Light vehicles - unsealed	6,990	1,781	178
Grain Storage Facility			
Grain Storage Facility - Heavy vehicles - delivery to bunkers - unsealed	114,771	29,251	2,925
Grain Storage Facility - Heavy vehicles - bunkers to silos - unsealed	125,205	31,910	3,191
Grain Storage Facility - Light vehicles - unsealed	7,323	1,866	187
Railway Freight Terminal			
Freight Terminal - Heavy vehicles - unsealed	143,464	36,564	3,656
Freight Terminal - Light vehicles - unsealed	10,984	2,799	280
TOTAL EMISSIONS - PROPOSED (kg/y)	**501,924**	**127,922**	**12,792**

Figure 6-1: Source Locations – Existing Operations

Table 6-4: Source Locations – Existing Operations

Activity	Source IDs			
Cotton Module Facility -Heavy vehicles - unsealed	1 - 15	33	37 - 45	
Cotton Module Facility Light vehicles - unsealed	1 - 15	33	37 - 39	44 - 45
Hay Processing Facility - Heavy vehicles - unsealed	1 - 17	36		
Hay Processing Facility - Light vehicles - unsealed	1 - 17			
Grain Storage Facility - Heavy vehicles - delivery to bunkers - unsealed	1 - 14	18 - 32		
Grain Storage Facility - Heavy vehicles - bunkers to silos - unsealed	15			
Grain Storage Facility - Light vehicles - unsealed	1 - 14			

Figure 6-2: Source Locations – Proposed Operations

Table 6-5: Source Locations – Proposed Operations

ACTIVITY	SOURCE IDS		
Cotton Module Facility -Heavy vehicles - unsealed	1 - 15	33 -48	
Cotton Module Facility Light vehicles - unsealed	1 - 15	33	
Hay Processing Facility - Heavy vehicles - unsealed	1 - 17	43 - 48	
Hay Processing Facility - Light vehicles - unsealed	1 - 17		
Grain Storage Facility - Heavy vehicles - delivery to bunkers - unsealed	1 - 14	18 - 32	
Grain Storage Facility - Heavy vehicles - bunkers to silos - unsealed	9 - 14	18 - 32	43 - 48
Grain Storage Facility - Light vehicles - unsealed	1 - 14		
Freight Terminal - Heavy vehicles - unsealed	1 - 8	43 - 48	
Freight Terminal - Light vehicles - unsealed	1 - 8	43 - 48	

6.2 Dust control measures

In terms of dust control measures, there is adequate water available on-site for watering of the unsealed roads. A control of 80% has been calculated based on application of the following **Buonicore and Davis (1992)** empirical equation:

$$C = 100 - \frac{0.8pdt}{i}$$

Where:

C = average control efficiency (%)

p = potential average hourly daytime evaporation rate (mm/h)

= 0.40 mm/h calculated from daily evaporation at Griffith Airport for the period (2009 – 2016) (**BoM, 2017b**)

d = average daily hourly daytime traffic rate (vehicles/per hour)

= 34 vehicles per hour

i = application intensity (L/ m^2)

= 1.8 L/m2 every 2 hours

t = time between applications (hours)

= 2 hoursWhilst the calculation assumed application every two hours (during daylight hours and when not raining), in practice watering would occur more frequently if required.

7 Assessment of Impacts

7.1 Introduction

The modelling predictions due to dust from vehicles traveling on unsealed roads for both the existing and proposed operations are presented in the sections below. The contour plots are indicative of the concentrations that could potentially be reached under the new conditions modelled. It is important to note that the isopleth figures are presented to provide a visual representation of the predicted impacts. To produce the isopleths, it is necessary to make interpolations between predicted concentrations, and as a result the isopleths will not always match exactly with predicted impacts at any specific location.

In the case of maximum 24-hour average concentrations, it is also important to note that individual contour plots do not represent one moment in time, but rather the maximum 24-hour average that could potentially occur at a sensitive receptor over the period of a year. Cumulative 24-hour average concentrations are presented in **Section 7.3.2**.

7.2 Annual average concentrations

Table 7-1 to **Table 7-4** present the predicted annual average concentrations and levels at each of the sensitive receptor locations for both the existing and proposed operations alone and when including existing background concentrations. The assumed background concentrations have been outlined previously in **Section 4.3.7**.

Contour plots of the predicted annual average concentrations due to the Project alone and cumulatively are presented in **Figure 7-1** to **Figure 7-8**.

The results show that there are no sensitive receptors predicted to experience annual average concentrations above the relevant impact assessment criterion for PM_{10}, $PM_{2.5}$, TSP or dust deposition, either due to the project or when including existing background concentrations.

Table 7-1: Predicted annual average TSP concentrations due to Project-alone and cumulatively

Receptor ID	Existing operations only	Proposed operations only	Existing plus background	Proposed plus background
	Annual average TSP (µg/m³)			
	Assessment criteria = N/A		*Assessment criteria = 90 µg/m³*	
1	0.6	0.8	45.6	45.8
2	0.4	0.6	45.4	45.6
3	0.2	0.4	45.2	45.4
4	0.2	0.3	45.2	45.3
5	0.1	0.1	45.1	45.1
6	0.1	0.2	45.1	45.2
7	0.1	0.2	45.1	45.2
8	0.2	0.3	45.2	45.3
9	0.1	0.2	45.1	45.2
10	0.9	1.8	45.9	46.8
11	0.6	1.4	45.6	46.4
12	0.2	0.3	45.2	45.3
13	0.2	0.4	45.2	45.4
14	0.1	0.2	45.1	45.2
15	0.2	0.5	45.2	45.5

Table 7-2: Predicted annual average PM_{10} concentrations due to Project-alone and cumulatively

Receptor ID	Existing operations only	Proposed operations only	Existing plus background	Proposed plus background
	Annual average PM_{10} (µg/m³)			
	Assessment criteria = N/A		*Assessment criteria = 25 µg/m³*	
1	0.7	0.9	18.5	18.7
2	0.4	0.6	18.2	18.4
3	0.3	0.4	18.1	18.2
4	0.2	0.3	18.0	18.1
5	0.1	0.2	17.9	18.0
6	0.1	0.2	17.9	18.0
7	0.2	0.3	18.0	18.1
8	0.2	0.3	18.0	18.1
9	0.1	0.2	17.9	18.0
10	0.8	1.7	18.6	19.5
11	0.4	0.8	18.2	18.6
12	0.2	0.4	18.0	18.2
13	0.2	0.4	18.0	18.2
14	0.1	0.3	17.9	18.1
15	0.1	0.2	17.9	18.0

Table 7-3: Predicted annual average $PM_{2.5}$ concentrations due to Project-alone and cumulatively

Receptor ID	Existing operations only	Proposed operations only	Existing plus background	Proposed plus background
	Annual average $PM_{2.5}$ ($\mu g/m^3$)			
	Assessment criteria = N/A		*Assessment criteria = 8 $\mu g/m^3$*	
1	0.1	0.1	7.9	7.9
2	0.1	0.1	7.9	7.9
3	0.0	0.1	7.8	7.9
4	0.0	0.1	7.8	7.9
5	0.0	0.0	7.8	7.8
6	0.0	0.0	7.8	7.8
7	0.0	0.1	7.8	7.9
8	0.0	0.1	7.8	7.9
9	0.0	0.0	7.8	7.8
10	0.1	0.2	7.9	8.0
11	0.1	0.1	7.9	7.9
12	0.0	0.1	7.8	7.9
13	0.0	0.1	7.8	7.9
14	0.0	0.1	7.8	7.9
15	0.0	0.0	7.8	7.8

Table 7-4: Predicted annual average dust deposition levels due to Project-alone and cumulatively

Receptor ID	Existing operations only	Proposed operations only	Existing plus background	Proposed plus background
	Annual average dust deposition ($g/m^2/month$)			
	Assessment criteria = 2 $g/m^2/month$		*Assessment criteria = 4 $g/m^2/month$*	
1	0.07	0.09	2.07	2.09
2	0.05	0.07	2.05	2.07
3	0.03	0.04	2.03	2.04
4	0.03	0.04	2.03	2.04
5	0.01	0.02	2.01	2.02
6	0.01	0.02	2.01	2.02
7	0.01	0.02	2.01	2.02
8	0.02	0.03	2.02	2.03
9	0.01	0.02	2.01	2.02
10	0.10	0.21	2.10	2.21
11	0.06	0.15	2.06	2.15
12	0.02	0.04	2.02	2.04
13	0.02	0.04	2.02	2.04
14	0.01	0.03	2.01	2.03
15	0.04	0.07	2.04	2.07

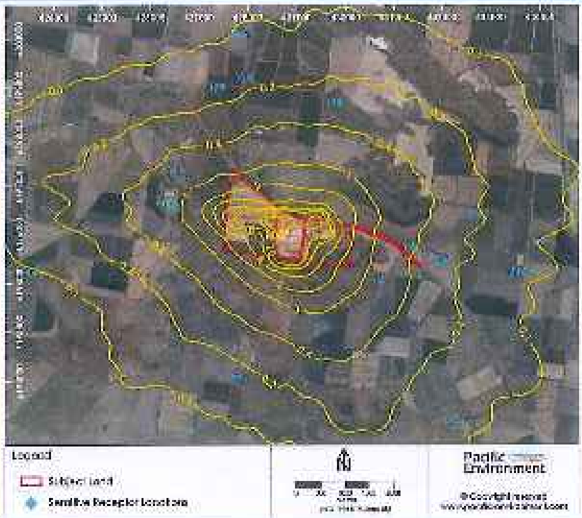


Figure 7-1: Predicted annual average TSP concentrations – existing operations (µg/m³)

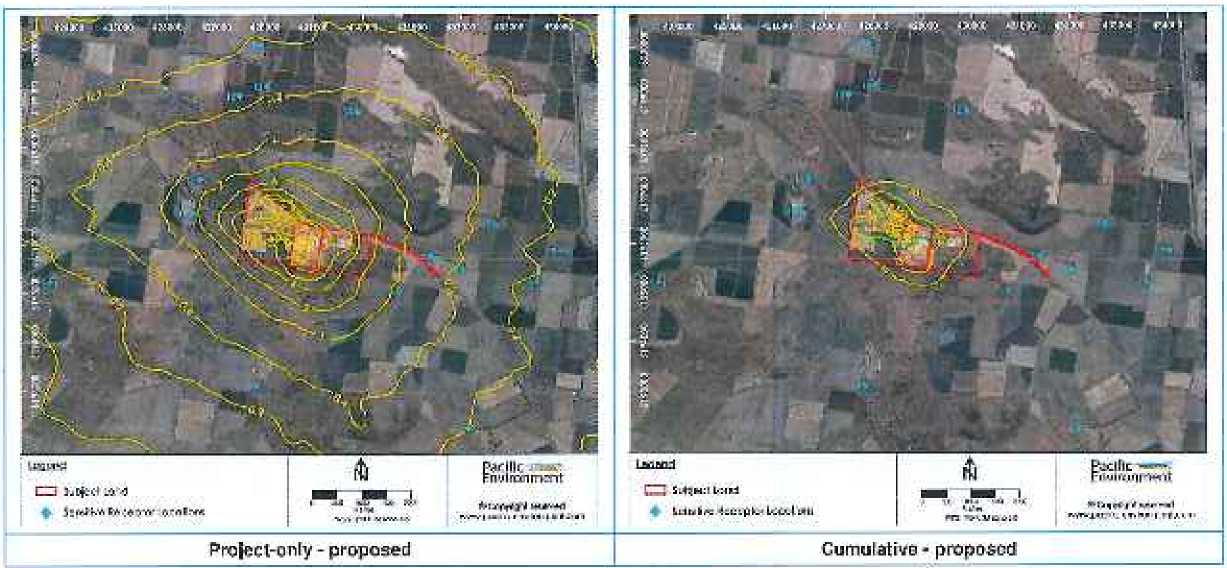


Figure 7-2: Predicted annual average TSP concentrations – proposed operations (µg/m³)

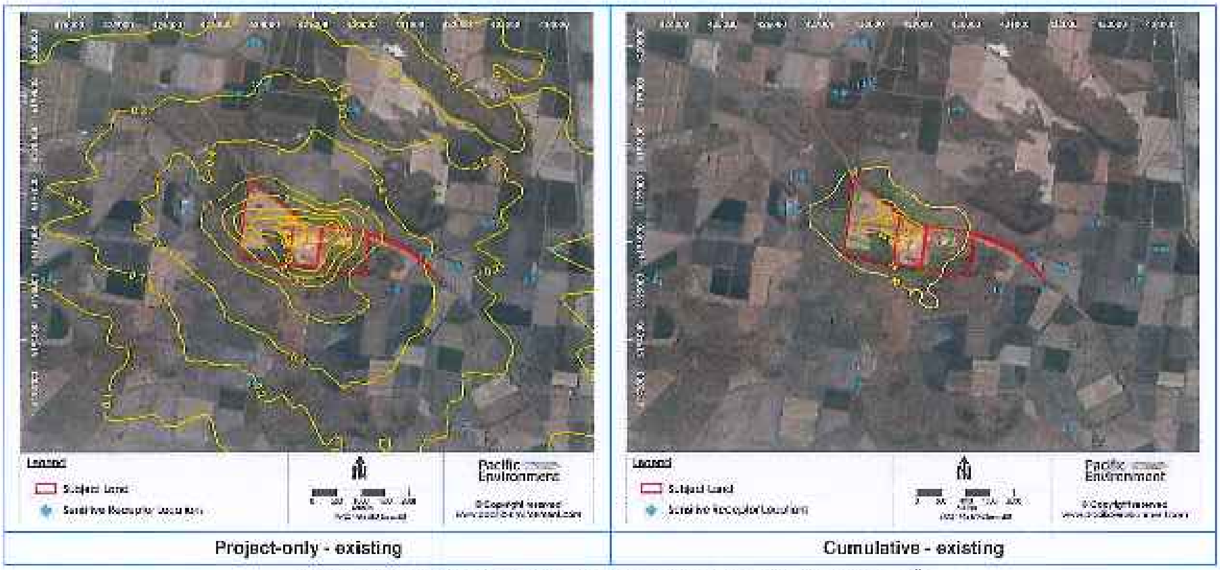


Figure 7-5: Predicted annual average PM_{10} concentrations – existing operations (µg/m³)

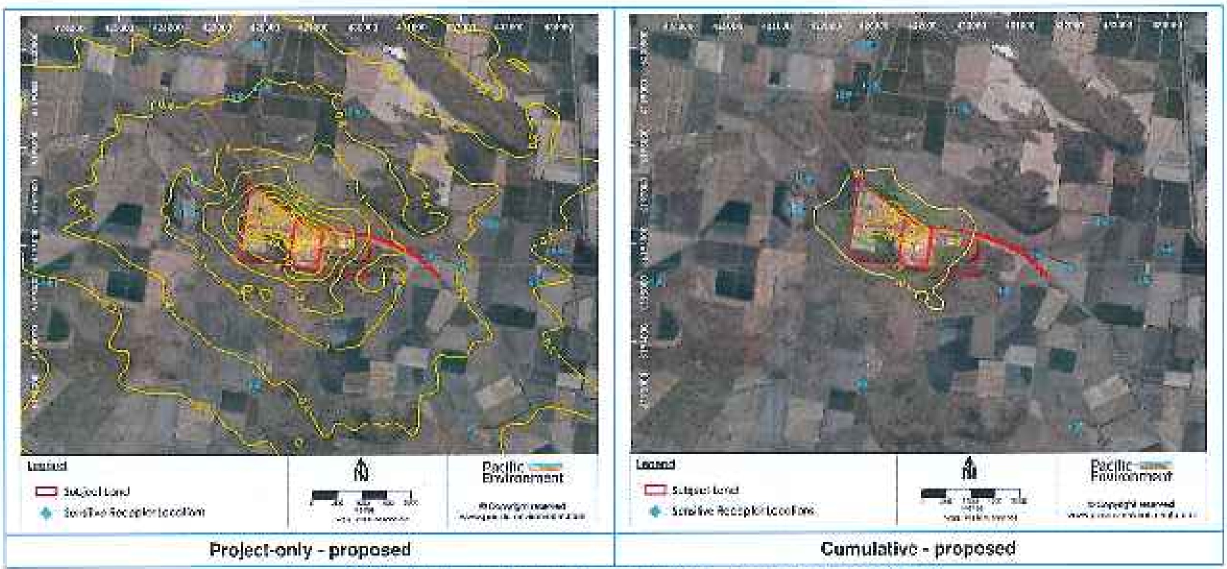


Figure 7.4: Predicted annual average PM_{10} concentrations – proposed operations ($\mu g/m^3$)

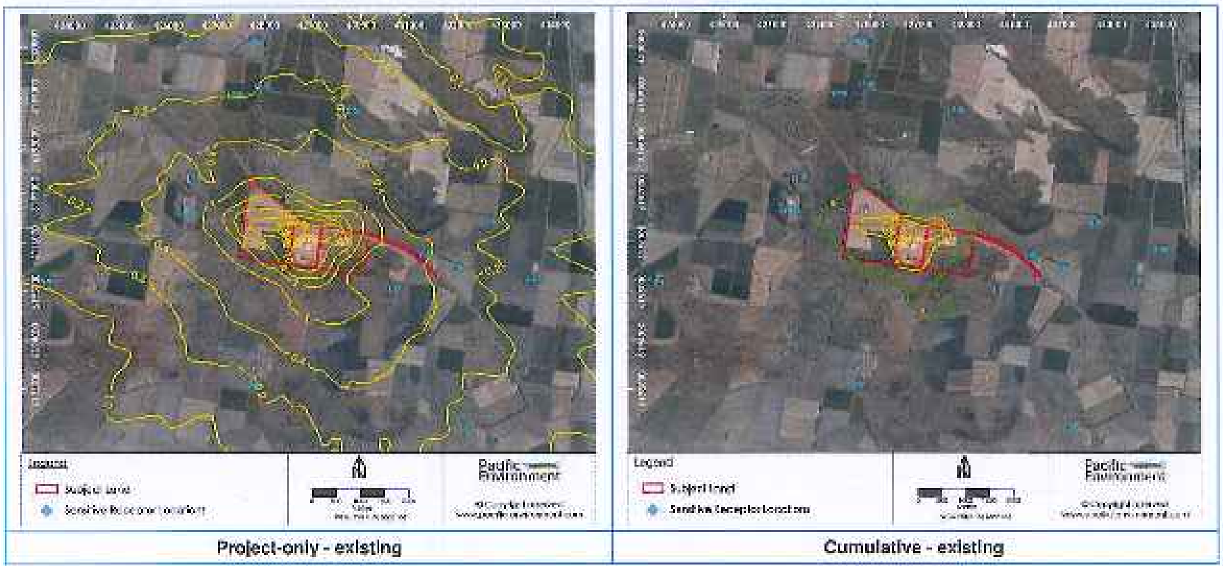
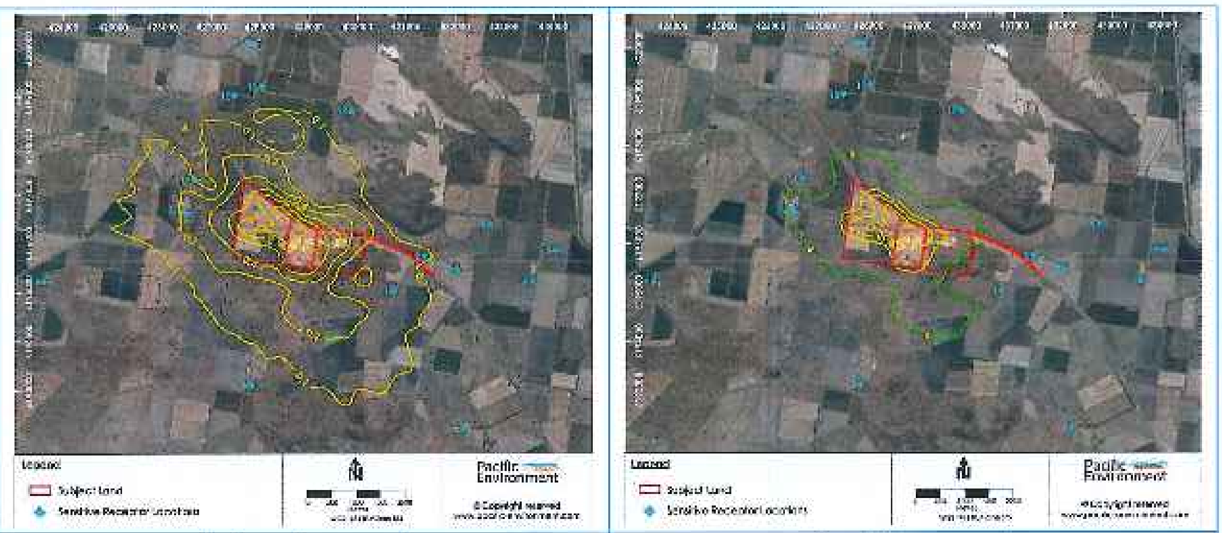
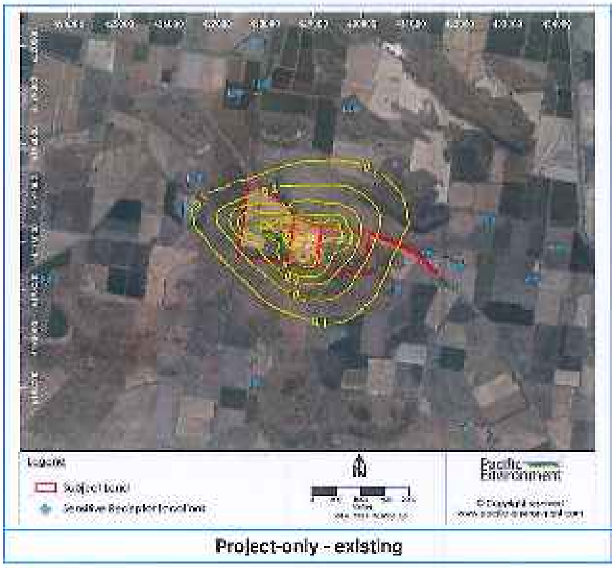


Figure 7.5: Predicted annual average $PM_{2.5}$ concentrations – existing operations (µg/m³)



Project-only - proposed	Cumulative - proposed

Figure 7-6: Predicted annual average $PM_{2.5}$ concentrations – proposed operations ($\mu g/m^3$)



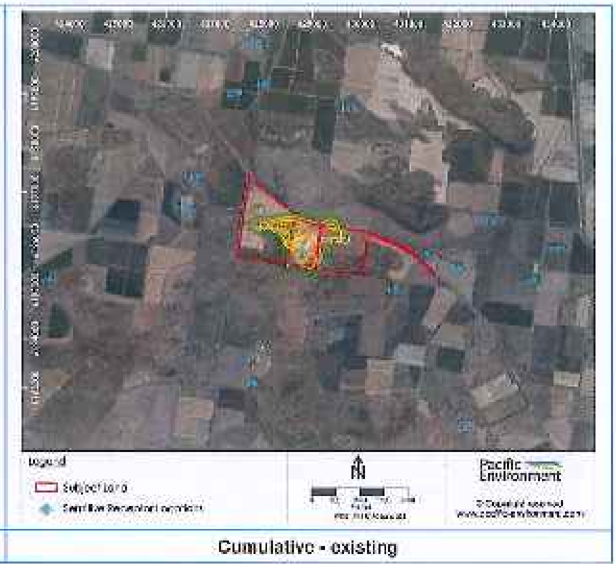


Figure 7.7: Predicted annual average dust deposition levels – existing operations (g/m²/month)

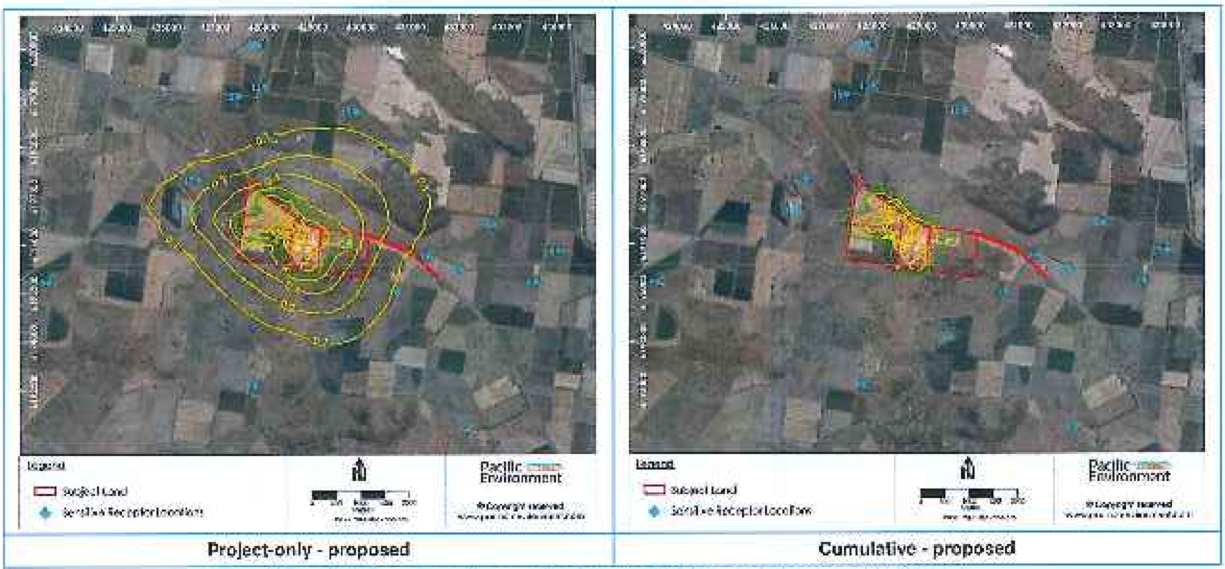


Figure 7.8: Predicted annual average dust deposition levels – proposed operations (g/m²/month)

7.3 24-hour average concentrations

7.3.1 Project-only

Table 7-5 and **Table 7-6** present the maximum predicted 24-hour average concentrations of PM_{10} and $PM_{2.5}$ at each of the sensitive receptor locations due to the Project alone for both existing and proposed operations.

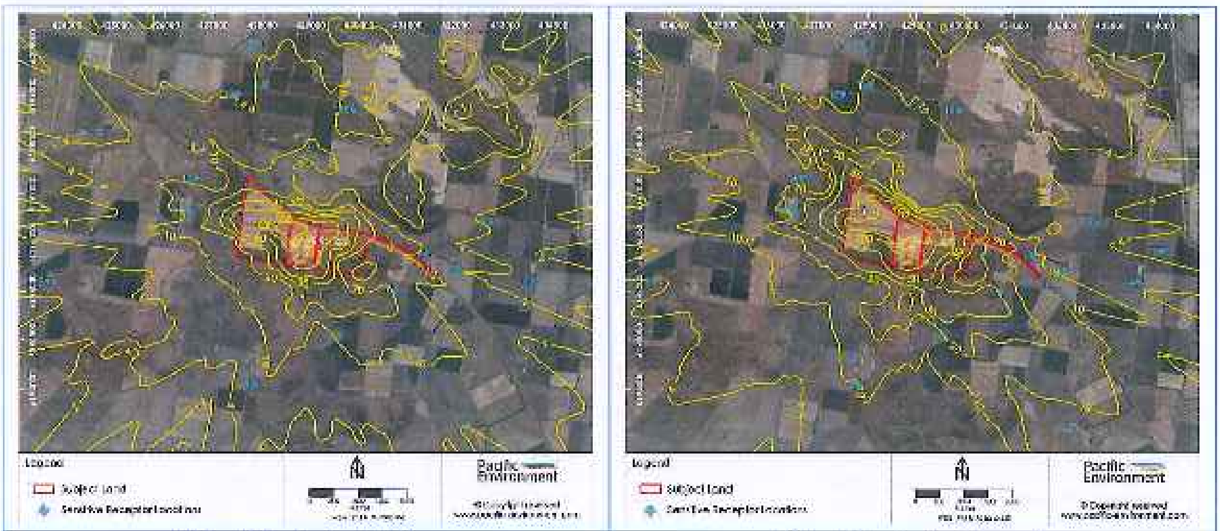
Contour plots of the maximum predicted 24-hour average concentrations of PM_{10} and $PM_{2.5}$ due to the Project alone are presented in **Figure 7-9** and **Figure 7-10**.

Table 7-5: Maximum predicted 24-hour average PM_{10} concentrations due to Project-alone

Receiver ID	Existing operations only	Proposed operations only
	Maximum 24-hour average PM_{10} ($\mu g/m^3$)	
	Assessment criteria = N/A	
1	18.4	26.3
2	8.1	10.9
3	4.6	6.7
4	3.3	6.2
5	2.0	2.6
6	3.6	5.3
7	3.8	8.1
8	5.7	10.0
9	2.8	3.6
10	13.8	27.1
11	6.8	15.9
12	3.8	6.9
13	5.0	11.6
14	3.8	7.9
15	2.7	6.4

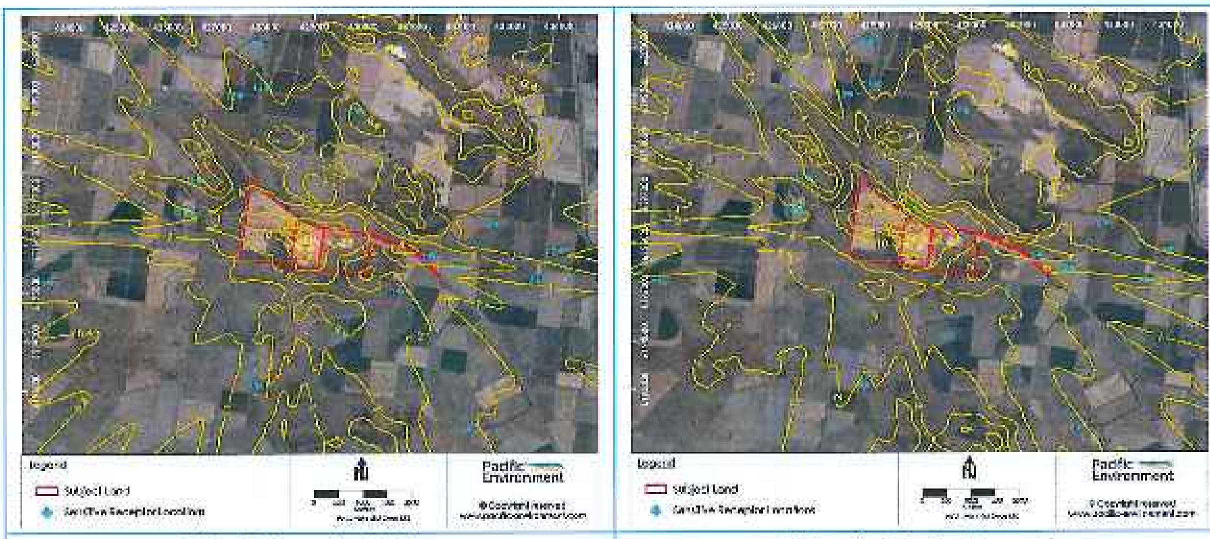
Table 7-6: Maximum predicted 24-hour average $PM_{2.5}$ concentrations due to Project-alone

Receiver ID	Existing operations only	Proposed operations only
	Maximum 24-hour average $PM_{2.5}$ ($\mu g/m^3$)	
	Assessment criteria = N/A	
1	2.4	3.5
2	3.7	5.6
3	1.8	2.4
4	0.7	1.2
5	0.5	0.9
6	1.3	2.0
7	1.2	2.6
8	1.4	1.8
9	0.6	0.8
10	2.0	3.7
11	1.0	1.9
12	1.4	3.5
13	1.0	1.8
14	0.6	1.3
15	0.3	0.7



PM_{10} – Project only - Existing | **PM_{10} – Project only - Proposed**

Figure 7-9: Maximum predicted 24-hour average PM_{10} concentrations – Project only – Existing and Proposed Operations



$PM_{2.5}$ – Project only - Existing	$PM_{2.5}$ – Project only - Proposed

Figure 7-10: Maximum predicted 24-hour average $PM_{2.5}$ concentrations – Project only – Existing and Proposed Operations

7.3.2 Cumulative

It is important to note that it is not possible to accurately predict cumulative 24-hour average concentrations many years into the future using dispersion modelling, principally due to the variability in ambient levels and spatial and temporal variation in any day to day anthropogenic activity, combined with the variability of activities at the site. Experience shows that the worst-case 24-hour PM_{10} concentrations are strongly influenced by other sources in the area, such as bushfires and dust storms, which are essentially unpredictable.

In addition, as discussed in **Section 4.3**, the measured concentrations at the OEH site in Wagga Wagga North are considered to be a very conservative estimate of the existing air quality in the vicinity of the site. The emission estimation also conservatively assumes all activities occur 365 days per year.

As shown in **Table 7-5**, the <u>maximum</u> predicted 24-hour average PM_{10} concentration at the closest residence (ID 1) is 18.4 µg/m³ (compared with the cumulative impact assessment criteria of 50 µg/m³) and in **Table 7-6** the maximum predicted 24-hour average $PM_{2.5}$ concentration at ID 1 is 2.4 µg/m³ (compared with the cumulative impact assessment criteria of 25 µg/m³).

In order to estimate the cumulative concentrations, the predicted 24-hour average PM_{10} and $PM_{2.5}$ concentrations for each day for all receptors were added to the existing 24-hour average concentrations from Wagga Wagga North OEH station measured on the same day. The Wagga Wagga North data for 2013 (the year that matched the meteorological data used in the dispersion modelling), contains 15 days that exceeded the assessment criteria of 50 µg/m³.

A summary of the additional predicted exceedances of the 24-hour average PM_{10} assessment criteria is presented in **Table 7-7.**

Table 7-7: Summary of additional predicted exceedance of 24-hour average PM_{10} assessment criteria

Receptor ID	Date of occurrence	Project contribution (µg/m³)	Background contribution (µg/m³)	Cumulative concentration (µg/m³)
		Existing		
10	12/04/2013	12.5	44.6	57.1
		Proposed		
7	8/02/2013	1.7	48.6	50.3
10	12/04/2013	24.6	44.6	69.2
11	10/05/2013	46.0	5.8	51.8
13	12/01/2013	6.0	45.4	51.4
14	12/01/2013	5.0	45.4	50.4

As shown in **Table 7-7**, for the existing operations, only one receptor (ID 10) showed the potential for any additional exceedances of the 24-hour average PM_{10} assessment criterion. This occurred on 12 April 2013 when the measured concentrations at Wagga Wagga North was already 44.6 µg/m³. The existing operations were predicted to contribute 12.5 µg/m³.

For the proposed operations, there are four more predicted exceedances at receptors 7, 11, 13 and 14 (in addition to the existing exceedance at ID 10).Other than at receptor 11, all these predicted exceedances occur when the existing background concentrations are approximately 45 µg/m^3 or more.

For $PM_{2.5}$, only one receptor (ID 10) is predicted to exceed the 24-hour average $PM_{2.5}$ assessment criterion of 25 µg/m^3 for both the existing and proposed operations. This occurred on 11 May 2013 when the measured background concentration was 24.2 µg/m^3. The existing operations were predicted to contribute an additional 1.3 µg/m^3 and the proposed operations were predicted to contribute an additional 2.4 µg/m^3.

8 Conclusion

Pacific Environment has completed an air quality assessment to predict off-site dust levels associated with vehicles travelling on unsealed roads.

A worst case operational scenario based on peak vehicle movements for both existing and proposed operations has been modelled. Further conservatism was incorporated by assuming all movements occur 365 per year.

The results of the modelling indicate that the predicted increment and cumulative annual average concentrations of PM_{10}, $PM_{2.5}$, TSP and dust deposition at the closest sensitive receptors all comply with the impact assessment criteria.

A cumulative assessment of 24-hour average PM_{10} and $PM_{2.5}$ concentrations, incorporating background concentrations from Wagga Wagga, indicates that there is potential for additional exceedances of relevant impact assessment criteria at the closest sensitive receptors. However, when considering the conservative approach taken in the emission estimation (that the peak activity rates occur simultaneously across all businesses for all 365 days per year), and the conservative assumption that the existing air quality is similar to that in Wagga Wagga, it is considered unlikely that any exceedances will occur in practice. Further analysis of the meteorological conditions resulting in these exceedances could be undertaken to be included in the management plan for the Site.

Condition(s) around dust to include
a dust review 12 months from operation date.

9 References

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Appendix A: Emission Inventories

TSP - Existing

ACTIVITY	TSP (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Control	Units	Control Assumption
Cotton Module Facility												
Cotton Module Facility-Heavy vehicles - unsealed	27,030	47,490	VKT/y	2.88	kg/VKT	37	Mean Vehicle Mass (t)	4.8	% silt content	80	% control	Water application
Cotton Module Facility-Light vehicles - unsealed	10,290	72,455	VKT/y	0.71	kg/VKT	4.5	Mean Vehicle Mass (t)	4.8	% silt content	80	% control	Water application
Hay Processing Facility												
Hay Processing Facility - Heavy vehicles - unsealed	24,402	42,365	VKT/y	2.88	kg/VKT	37	Mean Vehicle Mass (t)	4.8	% silt content	80	% control	Water application
Hay Processing Facility - Light vehicles - unsealed	5,499	38,713	VKT/y	0.71	kg/VKT	4.5	Mean Vehicle Mass (t)	4.8	% silt content	80	% control	Water application
Grain Storage Facility												
Grain Storage Facility - Heavy vehicles - delivery to bunkers - unsealed	114,771	199,290	VKT/y	2.88	kg/VKT	37	Mean Vehicle Mass (t)	4.8	% silt content	80	% control	Water application
Grain Storage Facility - Heavy vehicles - bunkers to silos - unsealed	53,906	104,990	VKT/y	2.88	kg/VKT	60	Mean Vehicle Mass (t)	4.8	% silt content	80	% control	Water application
Grain Storage Facility - Light vehicles - unsealed	7,200	49,150	VKT/y	0.71	kg/VKT	4.5	Mean Vehicle Mass (t)	4.8	% silt content	80	% control	Water application
TOTAL EMISSIONS - EXISTING (kg/y)	[illegible]											

TSP – Proposed

ACTIVITY	TSP (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Control	Units	Control Assumption
Cotton Module Facility												
Cotton Module Facility-Heavy vehicles - unsealed	30,388	38,480	VKT/y	3.95	kg/VKT	57	Mean Vehicle Mass (t)	4.8	% silt content	80	% control	Water application
Cotton Module Facility-Light vehicles - unsealed	15,570	40,500	VKT/y	0.41	kg/VKT	2.5	Mean Vehicle Mass (t)	4.8	% silt content	80	% control	Water application
Hay Processing Facility												
Hay Processing Facility - Heavy vehicles - unsealed	43,822	76,080	VKT/y	2.88	kg/VKT	57	Mean Vehicle Mass (t)	4.8	% silt content	80	% control	Water application
Hay Processing Facility - Light vehicles - unsealed	6,580	38,705	VKT/y	0.41	kg/VKT	2.5	Mean Vehicle Mass (t)	4.8	% silt content	80	% control	Water application
Grain Storage Facility												
Grain Storage Facility - Heavy vehicles - delivery to bunkers - unsealed	114,771	199,250	VKT/y	2.88	kg/VKT	37	Mean Vehicle Mass (t)	4.8	% silt content	80	% control	Water application
Grain Storage Facility - Heavy vehicles - bunkers to silos - unsealed	128,225	217,000	VKT/y	2.88	kg/VKT	57	Mean Vehicle Mass (t)	4.8	% silt content	80	% control	Water application
Grain Storage Facility - Light vehicles - unsealed	7,328	40,150	VKT/y	0.91	kg/VKT	2.5	Mean Vehicle Mass (t)	4.8	% silt content	80	% control	Water application
Freight Terminal												
Freight Terminal - Heavy vehicles - unsealed	145,464	250,985	VKT/y	2.88	kg/VKT	57	Mean Vehicle Mass (t)	4.8	% silt content	80	% control	Water application
Freight Terminal - Light vehicles - unsealed	10,954	60,225	VKT/y	0.91	kg/VKT	2.5	Mean Vehicle Mass (t)	4.8	% silt content	80	% control	Water application
TOTAL EMISSIONS - PROPOSED (kg/y)	501,524											

PM_{10} – existing

ACTIVITY	PM10 (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Control	Units	Control Assumption
Cotton Module Facility												
Cotton Module Facility - Heavy vehicles - unsealed	2,514	47,450	VKT/y	0.73	kg/VKT	57	Mean Vehicle Mass (t)	4.0	% silt content	90	% control	Water application
Cotton Module Facility - Light vehicles - unsealed	3,208	71,175	VKT/y	0.23	kg/VKT	4.3	Mean Vehicle Mass (t)	4.0	% silt content	90	% control	Water application
Hay Processing Facility												
Hay Processing Facility - Heavy vehicles - unsealed	5,775	63,225	VKT/y	0.73	kg/VKT	57	Mean Vehicle Mass (t)	4.0	% silt content	90	% control	Water application
Hay Processing Facility - Light vehicles - unsealed	1,400	30,112	VKT/y	0.23	kg/VKT	4.3	Mean Vehicle Mass (t)	4.0	% silt content	90	% control	Water application
Grain Storage Facility												
Grain Storage Facility - Heavy vehicles - delivery to bunkers - unsealed	27,281	300,750	VKT/y	0.73	kg/VKT	57	Mean Vehicle Mass (t)	4.0	% silt content	90	% control	Water application
Grain Storage Facility - Heavy vehicles - bunkers to silos - unsealed	22,539	124,390	VKT/y	0.73	kg/VKT	57	Mean Vehicle Mass (t)	4.6	% silt content	90	% control	Water application
Grain Storage Facility - Light vehicles - unsealed	1,564	40,150	VKT/y	0.23	kg/VKT	4.7	Mean Vehicle Mass (t)	4.6	% silt content	90	% control	Water application
TOTAL EMISSIONS - EXISTING (kg/y)	75,447											

PM_{10} – proposed

ACTIVITY	PM10 (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Control	Units	Control Assumption
Cotton Module Facility												
Cotton Module Facility - Heavy vehicles - unsealed	8,527	38,800	VKT/y	0.73	kg/VKT	57	Mean Vehicle Mass (t)	4.0	% silt content	90	% control	Water application
Cotton Module Facility - Light vehicles - unsealed	4,002	87,000	VKT/y	0.23	kg/VKT	4.3	Mean Vehicle Mass (t)	4.0	% silt content	90	% control	Water application
Hay Processing Facility												
Hay Processing Facility - Heavy vehicles - unsealed	11,107	70,830	VKT/y	0.73	kg/VKT	57	Mean Vehicle Mass (t)	4.0	% silt content	90	% control	Water application
Hay Processing Facility - Light vehicles - unsealed	1,281	38,325	VKT/y	0.23	kg/VKT	4.3	Mean Vehicle Mass (t)	4.0	% silt content	90	% control	Water application
Grain Storage Facility												
Grain Storage Facility - Heavy vehicles - delivery to bunkers - unsealed	27,281	300,750	VKT/y	0.73	kg/VKT	57	Mean Vehicle Mass (t)	4.0	% silt content	90	% control	Water application
Grain Storage Facility - Heavy vehicles - bunkers to silos - unsealed	31,510	213,000	VKT/y	0.73	kg/VKT	57	Mean Vehicle Mass (t)	4.0	% silt content	90	% control	Water application
Grain Storage Facility - Light vehicles - unsealed	1,565	40,150	VKT/y	0.23	kg/VKT	4.3	Mean Vehicle Mass (t)	4.0	% silt content	90	% control	Water application
Freight Terminal												
Freight Terminal - Heavy vehicles - unsealed	36,744	332,510	VKT/y	0.73	kg/VKT	57	Mean Vehicle Mass (t)	4.0	% silt content	90	% control	Water application
Freight Terminal - Light vehicles - unsealed	2,797	42,223	VKT/y	0.23	kg/VKT	4.3	Mean Vehicle Mass (t)	4.0	% silt content	90	% control	Water application
TOTAL EMISSIONS - PROPOSED (kg/y)	124,529											

$PM_{2.5}$ – existing

Activity	PM2.5 (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Control	Units	Control Assumption
Cotton Module facility												
Cotton Module facility – Heavy vehicles – unsealed	[illegible]	47,430	VKT/y	0.07	kg/VKT	57	Mean Vehicle Mass (t)	4.8	% silt content	75	% control	Water application
Cotton Module facility – Light vehicles – unsealed	207	71,175	VKT/y	0.02	kg/VKT	4.8	Mean Vehicle Mass (t)	4.8	% silt content	75	% control	Water application
Hay Processing facility												
Hay Processing facility – Heavy vehicles – unsealed	378	20,225	VKT/y	0.07	kg/VKT	57	Mean Vehicle Mass (t)	4.8	% silt content	75	% control	Water application
Hay Processing facility – Light vehicles – unsealed	140	30,113	VKT/y	0.02	kg/VKT	4.8	Mean Vehicle Mass (t)	4.8	% silt content	75	% control	Water application
Grain Storage facility												
Grain Storage facility – Heavy vehicles – delivery to bunkers – unsealed	2,025	201,750	VKT/y	0.07	kg/VKT	57	Mean Vehicle Mass (t)	4.8	% silt content	75	% control	Water application
Grain Storage facility – Heavy vehicles – bunkers to silos – unsealed	2,752	164,350	VKT/y	0.07	kg/VKT	57	Mean Vehicle Mass (t)	4.8	% silt content	75	% control	Water application
Grain Storage facility – Light vehicles – unsealed	150	43,190	VKT/y	0.02	kg/VKT	4.8	Mean Vehicle Mass (t)	4.8	% silt content	75	% control	Water application
TOTAL EMISSIONS – EXISTING (kg/y)	7,345											

$PM_{2.5}$ - proposed

Activity	PM2.5 (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Control	Units	Control Assumption
Cotton Module facility												
Cotton Module facility – Heavy vehicles – unsealed	551	[illegible]	VKT/y	0.07	kg/VKT	57	Mean Vehicle Mass (t)	4.8	% silt content	75	% control	Water application
Cotton Module facility – Light vehicles – unsealed	457	[illegible]	VKT/y	0.06	kg/VKT	4.8	Mean Vehicle Mass (t)	4.8	% silt content	75	% control	Water application
Hay Processing facility												
Hay Processing facility – Heavy vehicles – unsealed	[illegible]	[illegible]	VKT/y	0.07	kg/VKT	57	Mean Vehicle Mass (t)	4.8	% silt content	75	% control	Water application
Hay Processing facility – Light vehicles – unsealed	170	[illegible]	VKT/y	0.06	kg/VKT	4.8	Mean Vehicle Mass (t)	4.8	% silt content	75	% control	Water application
Grain Storage facility												
Grain Storage facility – Heavy vehicles – delivery to bunkers – unsealed	[illegible]	[illegible]	VKT/y	0.07	kg/VKT	57	Mean Vehicle Mass (t)	4.8	% silt content	75	% control	Water application
Grain Storage facility – Heavy vehicles – bunkers to silos – unsealed	[illegible]	[illegible]	VKT/y	0.07	kg/VKT	57	Mean Vehicle Mass (t)	4.8	% silt content	75	% control	Water application
Grain Storage facility – Light vehicles – unsealed	187	[illegible]	VKT/y	0.06	kg/VKT	4.8	Mean Vehicle Mass (t)	4.8	% silt content	75	% control	Water application
Freight Terminal												
Freight Terminal – Heavy vehicles – unsealed	[illegible]	[illegible]	VKT/y	[illegible]	kg/VKT	57	Mean Vehicle Mass (t)	4.8	% silt content	75	% control	Water application
Freight Terminal – Light vehicles – unsealed	251	[illegible]	VKT/y	[illegible]	kg/VKT	[illegible]	Mean Vehicle Mass (t)	4.8	% silt content	75	% control	Water application
TOTAL EMISSIONS – PROPOSED (kg/y)	13,752											