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Report

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AIR QUALITY ASSESSMENT – CARRATHOOL COTTON GIN

Rivcott Ltd

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1 INTRODUCTION

Rivcott are seeking approval to establish a Cotton Gin at Carrathool (south of Griffith), NSW. The proposed site is located on the corner of The Sturt Highway & Gum Creek Road (Conargo Road), south of Carrathool. Pacific Environment has been commissioned by Planning Matters to prepare an air quality impact assessment for the facility.

Pacific Environment has previously prepared a screening level assessment for the Carrathool Cotton Gin, however this assessment was reviewed by the NSW Environment Protection Authority (EPA) and was found to not adequately assess the potential air quality impacts. The key issues identified were:

- Not all emission sources were assessed.
- There is uncertainty regarding the meteorological data.
- Background dust levels were not included.
- The assessment currently predicts an exceedance of the EPA's impact assessment criteria for PM_{10}.

In response, a revised Level 2 air quality assessment has been prepared. The revised assessment is conducted in accordance with the NSW EPA document "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*" (EPA, 2005).

2 LOCAL SETTING AND PROJECT DESCRIPTION

The proposed development relates to the establishment & operation of an agricultural produce industry (cotton ginning facility) on Lots 66, 112 & 114, DP 750895, which is located on the corner of The Sturt Highway & Gum Creek Road (Conargo Road) south of Carrathool in NSW. The proposal comprises the construction of a ginning shed, bale storage sheds, seed storage sheds, workshop, water truck shed, oil shed, generator shed, cyclones cover, offices, amenities. It also includes the installation of gas & diesel storage tanks and construction of internal roadways, drainage channels, a stormwater detention basin, an enclosed trash storage area, internal roadways & drainage channels. Equipment to be installed in the facility includes but is not limited to blowers, dryers, feeders, cleaners, conveyors, augers, condensers, presses, fans, cyclones, etc.

Development consent is sought to process up to 150,000 bales of lint cotton per annum, which equates to less than 150,000 tonnes of raw product. Whilst the majority of activity will be undertaken during the ginning season, which extends over approximately 4-5 months of the year, reduced activity will be undertaken throughout the remainder of the year.

The 'Ginning' process involves removing foreign matter (leaves, dirt, burs, sticks etc.) from the seed cotton by pneumatic drying with heated air and mechanical cleaning with cylinder/saw cleaners. Seed is then removed from the cotton to produce lint fibre. The lint is then further cleaned with the remaining foreign matter being removed. Finally the lint is compressed into bales and packaged/bagged for distribution. The main gin building and associated infrastructure are shown in site plans presented in **Appendix A**. Also shown in **Appendix A** are the technical specifications for the cyclones servicing each component of the facility. A total of 50 cyclones used to de-dust air from each of the processes, as follows:

- Unloading / Pre-cleaning (1st, 2nd and 3rd stages) – 19 cyclones.
- Lint Cleaning – 18 cyclones.
- Mote System – 13 cyclones.

The cyclones are '1D-3D' cyclones, and are located in the main cyclone rack adjacent to the eastern side of the Gin Building.

2.1 Closest residences

The local area is agricultural and dominated by grazing land. There are no residential dwellings within 1.5 km of the facility, with the closest located 1.8 km to the north. The locations of the closest residences to the proposed facility are presented in **Table 2.1** and **Figure 2.1**. It is understood that R4 and R6 are Rivcott owned properties and R1, R2 and R3 are occupied by family members of the proponent. R5 is the only private residence not associated with the development.

Table 2.1: Nearest sensitive receptors

Resident ID	Location with respect to facility
R1	3.9km NW of the facility
R2	1.9km NW of the facility
R3	1.8km N of the facility
R4	2.0km N of the facility
R5	2.4km NE of the facility
R6	2.7km E of the facility

Figure 2.1: Locations of closest residences

3 AIR QUALITY ASSESSMENT CRITERIA

The Approved Methods specify impact assessment criteria relevant for assessing impacts from air pollution (**EPA, 2005**). The impact assessment criteria refer to the total pollutant load in the environment and impacts from new sources of these pollutants must be added to existing background levels for compliance assessment. In other words, consideration of background dust levels needs to be made when using these goals to assess potential impacts. The criteria are health-based, that is they are set at levels to protect against health effects, including for the most vulnerable in society. The EPA criteria are consistent with the National Environment Protection Measures for Ambient Air Quality (referred to as the Ambient Air-NEPM) (**NEPC, 1998**). However, the EPA's criteria includes averaging periods, which are not included in the Ambient Air-NEPM, and also references other measures of air quality, namely dust deposition and TSP. **Table 3.1** summarises the air quality goals for concentrations of particulate matter that are relevant to this study.

Table 3.1: EPA assessment criteria for particulate matter concentrations

Pollutant	Criterion	Averaging Period	Agency
Total suspended particulate (TSP)	90 µg/m³	Annual average	NH&MRC
Particulate matter < 10 µm (PM_{10})	50 µg/m³	24-hour average	NSW EPA
	30 µg/m³	Annual average	NSW EPA

In May 2003, the NEPC released a variation to the Ambient Air-NEPM (**NEPC, 2003**) to include advisory reporting standards for fine particulate matter with an equivalent aerodynamic diameter of 2.5 µm or less ($PM_{2.5}$) (**Table 3.2**). The purpose of the variation was to gather sufficient data nationally to facilitate the review of the Ambient Air-NEPM, which is currently underway.

Table 3.2: $PM_{2.5}$ advisory reporting standards

Pollutant	Criterion	Averaging Period
Particulate matter < 2.5 µm (PM2.5)	25 µg/m³	24-hour average
	8 µg/m³	Annual average

3.1 Clean air regulation limits

The NSW Protection of the Environment Operations (POEO) Clean Air Regulation specifies standards of concentration relevant to the emissions from activity or plant in NSW. **Table 3.3** summarises the concentration limits for particulate matter relevant to this study. The limits specified in **Table 3.3** for general activities (any activity or plant) and are applicable to the cyclones at the proposed facility.

Table 3.3: In-stack concentration criteria

Parameter	Limit (mg/m³) (Group 6)	Activity
Solid Particles (TSP)	50	Any activity or plant

Notes: mg/m³ – milligrams per cubic metre.

4 EXISITING ENVIRONMENT

4.1 Meteorology

Rural Farms Management (RFM) own and operate an on-site meteorological station located in Griffith, approximately 50 km southeast of the site. The other available automated weather station (AWS) are operated by the Bureau of Meteorology (BoM) at Griffith Airport located approximately 65 km east of the site and Hay Airport, located approximately 55km west of the site.

Although the separation distance to the site is significant, given the relatively flat terrain and consistent land use between Griffith and Carrathool, the use of the RFM data is considered suitable for assessment.

A representative meteorological dataset was chosen by analysing the most recent five years' worth of data from the RFM and Griffith Airport site. It is noted that years 2007-2011 were chosen as the RFM data is only available until February 2012. Wind patterns at the RFM site for years 2007 to 2011 are similar with dominant winds from the east-northeast and the southwest. The annual average percentage of calms (wind speeds less than 0.5 m/s) are between 2 and 2.4 % for all years. The annual average wind speed (m/s) for the five years is between 3.3 and 3.8 m/s.

The BoM Griffith Airport AWS site shows a strong easterly wind component with a higher percentage of stronger winds. This may be due to its location next to a ridge. There are also dominant northerly winds which are not dissimilar to the RFM data but are more pronounced. The annual average percentage of calms (wind speeds less than 0.5 m/s) are between 0.8 and 2.6 % for all years. The annual average wind speed (m/s) for the five years is between 4.3 and 4.7 m/s which is approximately 1 m/s higher at the lower and upper bounds than at the RFM site but is not surprising considering the station is located at an airport.

Comparative statistics for each year of RFM and BoM Griffith meteorological data are shown in **Table 4.1**. 2007 was chosen as a representative meteorological year for dispersion modelling due to low data recovery at the RFM site for the other years. The 2007 dataset has 98 % data recovery and is similar in wind patterns to other years.

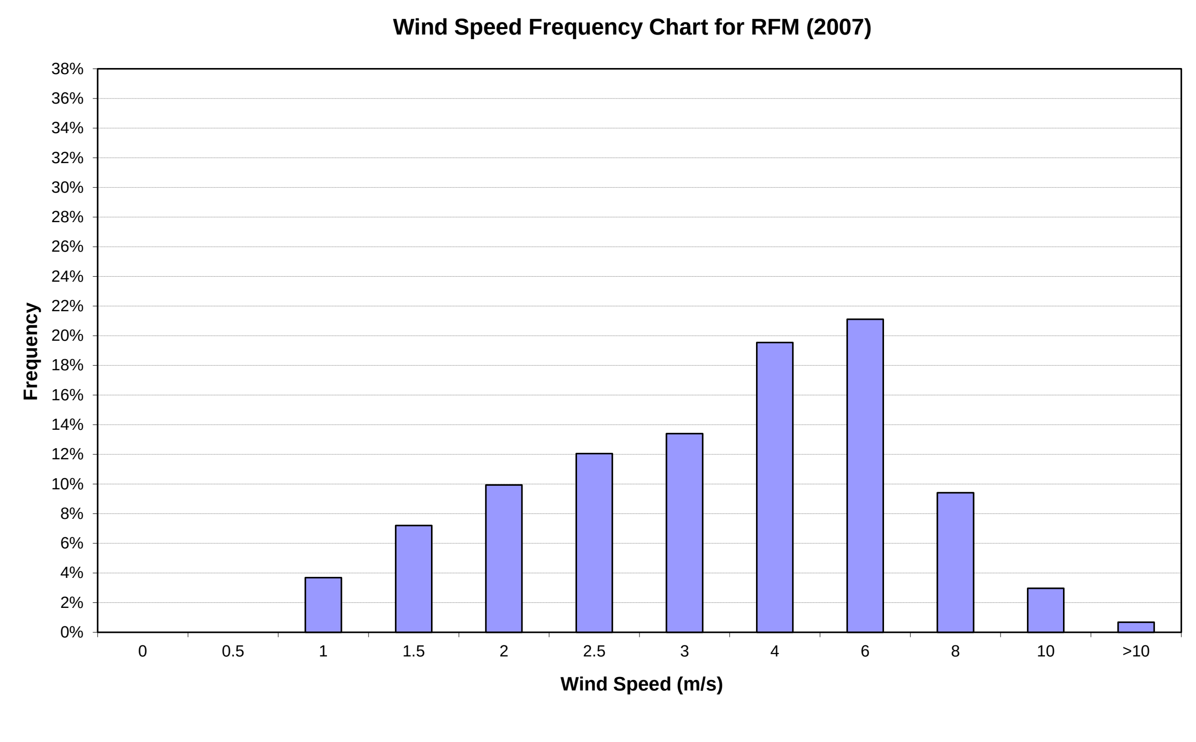
Figure 4.1 present frequency plots by hour of the day comparing wind speed. The wind speed frequency distribution shows a similar pattern between the two sites however with a much higher percentage of stronger winds (between 4 and 6 m/s) recorded at the BoM site.

Annual and seasonal windroses for both the RFM and BoM Griffith AWS for 2007 are presented in **Figure 4.2**. Also presented are windroses for Hay Airport (2012) for comparison. All sites show a general southwest northeast pattern, although the Griffith Airport site shows more easterly winds and Hay Airport shows more northerly winds.

In summary, it is concluded that the RFM data provides a good representation of the regional wind patterns and 2007 has been shown to be a representative year for modelling.

Table 4.1: Comparative Statistics for Meteorological Data

Year	% Calms		Average Wind Speed (m/s)		% Data Recovery	
	RFM	BoM Griffith	RFM	BoM Griffith	RFM	BoM Griffith
2007	2.4	11.2	3.6	4.1	98	99.9
2008	2.0	13.1	3.8	4.0	61	99.6
2009	2.3	12.4	3.8	4.2	54	99.9
2010	2.7	7.5	3.4	3.8	49	99.9
2011	3.9	7.5	3.3	4.1	76	99.9



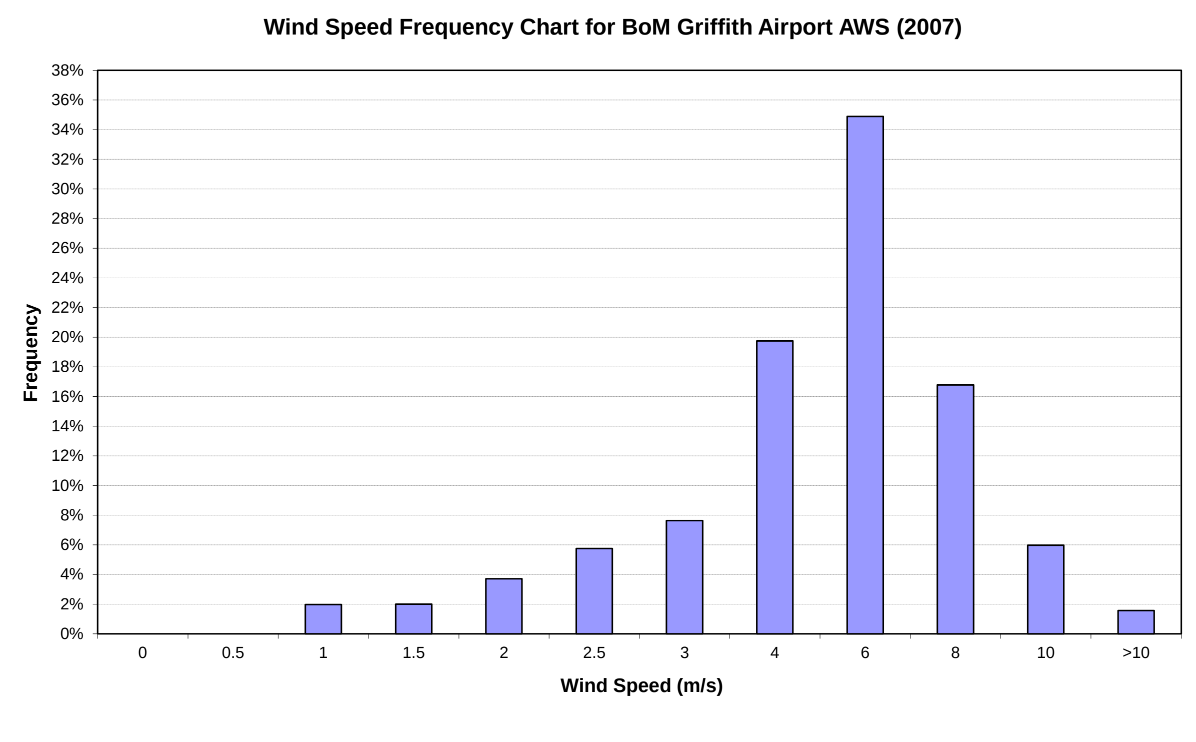


Figure 4.1: Wind speed frequency charts for the RFM and BoM Griffith Airport AWS monitoring stations, 2007

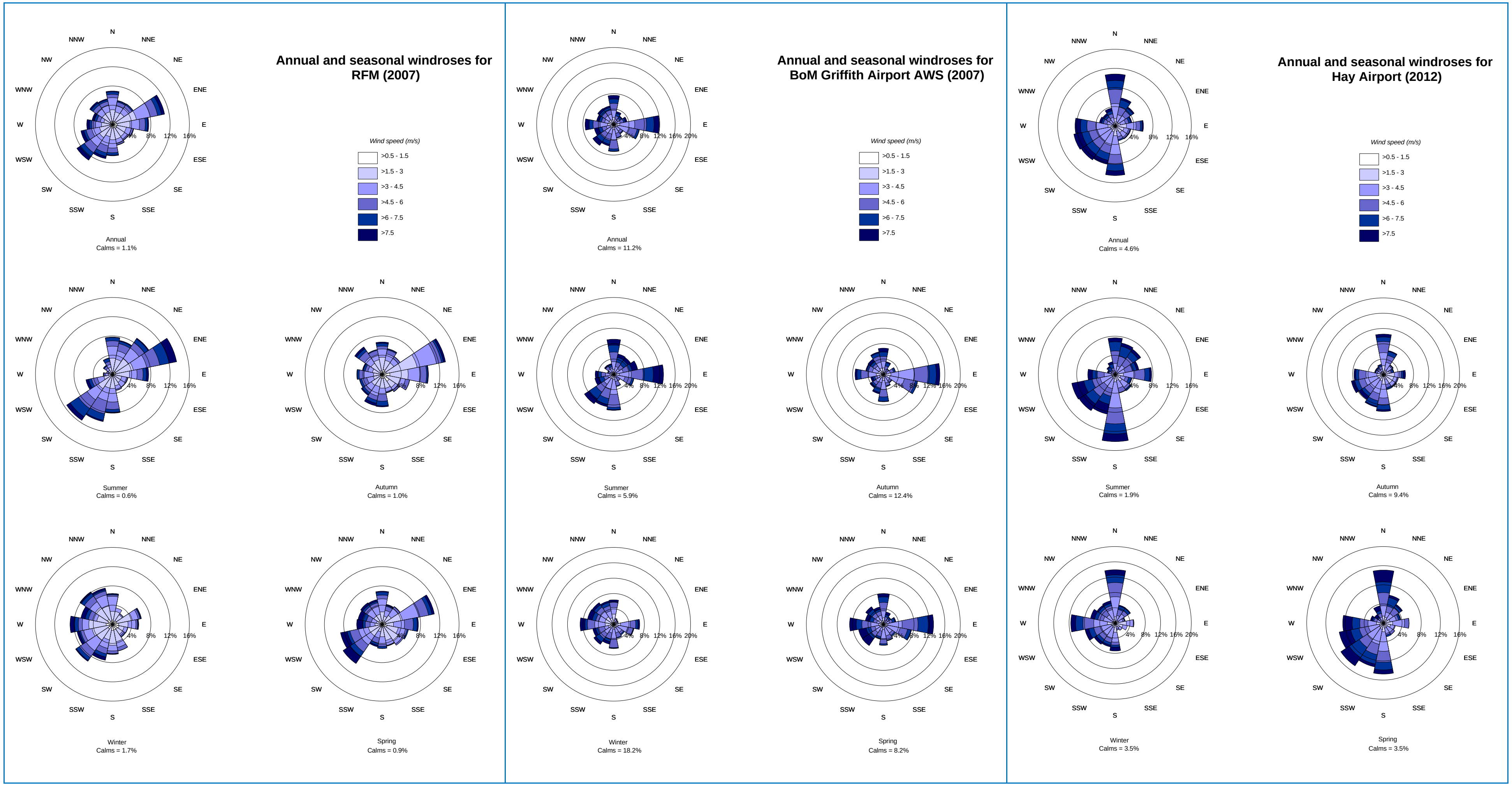


Figure 4.2: Annual and Seasonal Windroses for RFM weather station and BoM Griffith AWS, 2007

4.2 Existing Air Quality

No air quality measurements have been made specifically for the Project and there are no EPA monitoring sites located in the vicinity. However, as the Project Site is situated in a rural area with no major sources of air pollution, the local air quality is likely to be good and concentrations of pollutants are unlikely to exceed any of the air quality criteria. Although there are no available monitoring data in the vicinity of the Project Site, it is useful to assess the nearest available monitoring data and/or data from a similar land-use site to gain an understanding of what current pollutant levels may be around or near the Project Site.

The air quality on and surrounding the Project Site is likely to be similar to other rural areas in NSW. The EPA collects PM_{10} data in the rural areas of Albury, Bathurst, Tamworth and Wagga Wagga. These data were collected using a TEOM (Tapered Element Oscillating Microbalance), which provides continuous recordings of PM_{10} concentrations. PM_{10} concentrations in rural areas are heavily influenced by agricultural activities and the use of solid fuel heaters. From the rural EPA monitoring sites, the Albury site is considered to be a suitable representative site for the project area. Bathurst and in particular Wagga Wagga sites are known to be strongly influenced by local sources and activities.

Table 4.2 presents a summary of recent PM_{10} data collected at the Albury EPA monitoring station. The annual average PM_{10} concentrations across the last six years of monitoring is 16 µg/m^3 which is well below the EPA annual average impact assessment criterion of 30 µg/m^3.

Table 4.2: PM_{10} TEOM data from the EPA Albury monitoring station

Year	Annual Average (µg/m^3)
2007	21
2008	17
2009	19
2010	13
2011	12
2012	14
Annual average over all years	**16**

The Albury measurements also show that exceedances of the 24-hour impact assessment criteria of 50µg/m^3 occur from time to time. The high annual average in 2007 is a result of a number of high dust events. The median for 2007 (15.2µg/m^3) is closer to the 6 year average and adopted for use in this assessment. There are no $PM_{2.5}$ data available for Albury, however monitoring data at Wagga Wagga indicates that $PM_{2.5}$ is approximately 45% of PM_{10} and this relationship is adopted for this assessment.

Similarly, in the absence of background data for TSP, reference is made to monitoring data from areas in the Hunter Valley, where co-located TSP and PM_{10} monitors have been operated for reasonably long periods of time. These data indicate that long term average PM_{10} concentrations are approximately 40% of the corresponding long-term TSP concentration (**NSW Minerals Council, 2000**). This ratio is likely to be similar in other rural areas of NSW, and in the absence of any other information, a value of 38µg/m^3 for annual average TSP has been derived from the median PM_{10} concentration (15.2 µg/m^3).

In summary, from the available monitoring data it has been assumed that the following background concentrations apply in the vicinity of the project:

- 24-hour average PM_{10} – varies daily.
- Annual average PM_{10} of 15.2 µg/m^3.
- 24-hour average $PM_{2.5}$ – varies daily (45% of PM_{10}).
- Annual average $PM_{2.5}$ of 7.1 µg/m^3.
- Annual average TSP of 38 µg/m^3.

5 APPROACH TO ASSESSMENT

5.1 Introduction

The approach taken for the dust assessment was as follows:

- Estimate worst case 24-hour 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.
- Compare predicted concentrations with relevant air quality criteria.

The assessment follows a conventional approach commonly used for air quality assessment in Australia and outlined in the "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*" (**EPA, 2005**).

5.2 Modelling approach

The overall approach to the assessment follows the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**EPA, 2005**) 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 the Project.

Preliminary dispersion modelling was completed using the CALPUFF dispersion model with single station meteorology (2-D mode). Given the flat terrain and uniform land use, spatial variability in the meteorological field is not expected to be significant and CALPUFF in single station mode was deemed suitable. The meteorological input file used to drive CALPUFF was generated from the RFM meteorological data with mixing height[a] extracted from The Air Pollution Model (TAPM)[b] at the same location of the RFM site.

However, this approach resulted in unrealistically high ground level concentrations on 1-2 days of the year. The high modelling predictions occur as a result of very stable atmospheric conditions combined with an unrealistically low mixing height (~25m) in the meteorological input file for those days.

A more refined modelling approach was therefore chosen, based on the more convensional approach of running CALMET/CALPUFF in 3-D mode.

5.2.1 TAPM

The Air Pollution Model, or TAPM, is a three dimensional meteorological and air pollution model developed by the CSIRO Division of Atmospheric Research. Detailed description of the TAPM model and its performance is provided in **Hurley (2008)** and **Edwards et al (2008)**.

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[a] The term mixing height refers to the height of the turbulent layer of air near the earth's surface into which ground-level emissions will be rapidly mixed. A plume emitted above the mixed-layer will remain isolated from the ground until such time as the mixed-layer reaches the height of the plume. The height of the mixed-layer is controlled mainly by convection (resulting from solar heating of the ground) and by mechanically generated turbulence as the wind blows over the rough ground.

[b] The Air Pollution Model, or TAPM, is a three dimensional meteorological and air pollution model developed by the CSIRO Division of Atmospheric Research. Detailed description of the TAPM model and its performance is provided in (Hurley 2008; Hurley, Edwards et al., 2009).

TAPM solves the fundamental fluid dynamics and scalar transport equations to predict meteorology and pollutant concentrations. It consists of coupled prognostic meteorological and air pollution concentration components. The model predicts airflow important to local scale air pollution, such as sea breezes and terrain induced flows, against a background of larger scale meteorology provided by synoptic analyses.

TAPM was previously set up for another project in the area using with 3 domains, composed of 40 grids points along the x axis and 25 along the y axis, centred on -34˚9.5' Latitude and 146˚2.5' Longitude. Each nested domain had a grid resolution of 30 km, 10 km and 3 km respectively. This TAPM domain overlapped the domain for modelling of the Carrathool Gin and was considered suitable for this assessment. An upper air file was extracted from TAPM at the location of the RFM meteorological station so that surface and upper air data were available from the same location. This is then used to drive the CALMET model.

5.2.2 CALMET

CALMET is a meteorological pre-processor that includes a wind field generator containing objective analysis and parameterised treatments of slope flows, terrain effects and terrain blocking effects. The pre-processor produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables to produce the three-dimensional meteorological fields that are utilised in the CALPUFF dispersion model (i.e. the CALPUFF dispersion model requires meteorological data in three dimensions). CALMET uses the meteorological inputs in combination with land use and geophysical information for the modelling domain to predict gridded meteorological fields for the region.

CALMET was run with a grid domain of 10 km x 10 km, centred near the Project area, with a 100 m grid resolution. Observed hourly surface data were incorporated into the modelling from the RFM site for 2007 and with any missing data filled in from the TAPM meteorological data which was extracted over this location. As described above, upper air information was also extracted from TAPM at the RFM site.

Although the RFM site is located at a considerable distance from the project site, given the flat terrain and uniform land use between Griffith and Carrathool, the use of the RFM data is considered suitable for assessment. The RFM meteorological station was specifically installed for the collection of data for modelling and given the high level of confidence in the data, the model is set up such that this meteorological dataset is given a considerable weighting across the entire 10 km x 10 km modelling domain.

Terrain for this area was derived from 90 m NASA SRTM data. Land use for the domain was determined by aerial photography from Google Earth. The land-use types in the modelling domain consisted of agricultural land, streams/lakes and forestland.

The CALMET generated winds are compared with the measured data and presented in **Figure 5.1**. As expected (due to the high weighting) the CALMET wind rose displays very similar characteristics to the measured data with dominant winds from the east north-east and southwest. The average wind speed from CALMET (3.6 m/s) is the same as the measured data at the RFM station. The percentage occurrence of annual calm conditions (defined as wind speeds <0.5m/s) are also the same with 1.1% recorded for both.

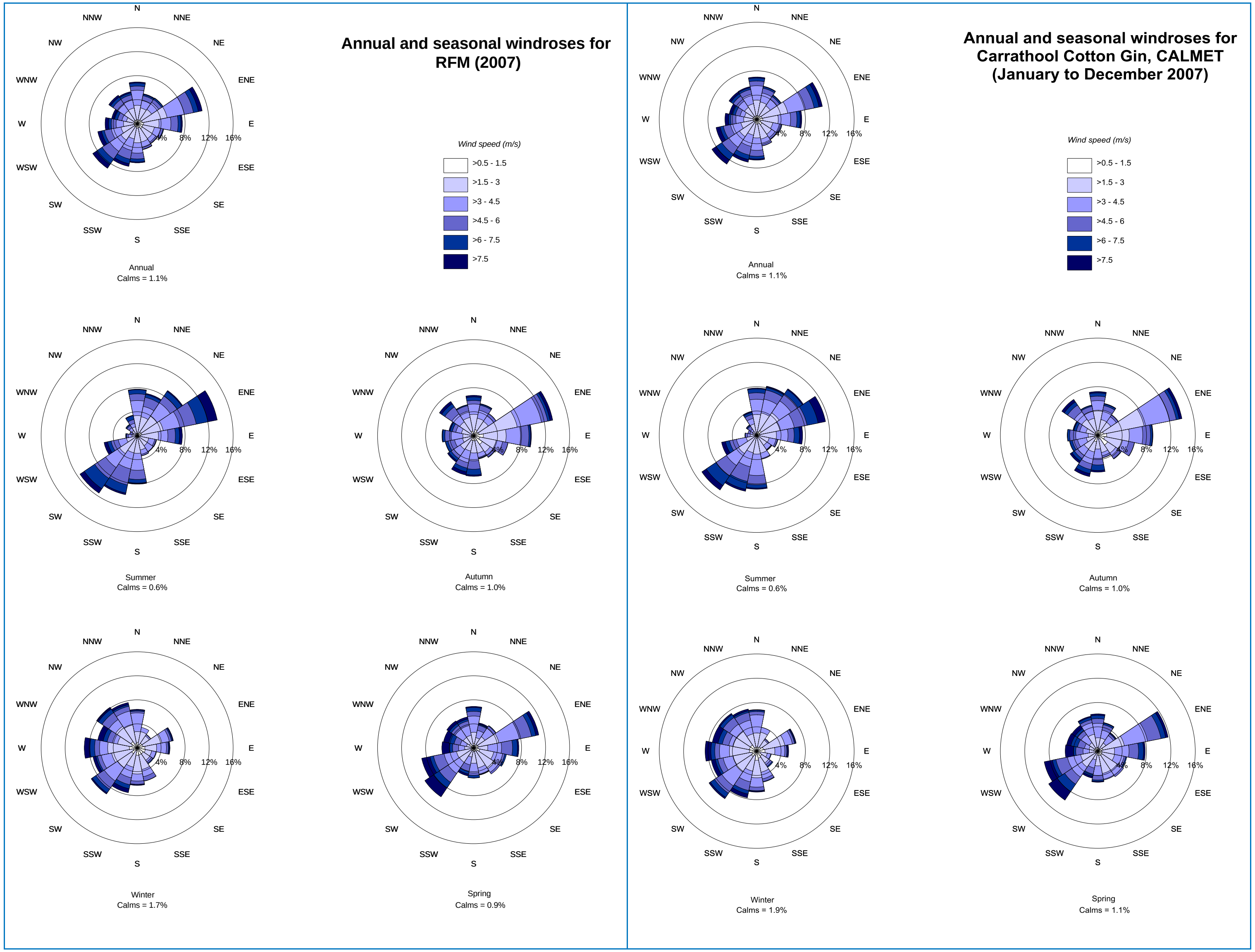

Figure 5.1: Annual and Seasonal Windroses for the RFM Station and the Project Site extracted from CALMET, 2007

5.2.3 CALPUFF

CALPUFF (**Scire *et al.*, 2000a**) is a multi-layer, multi-species, non-steady state puff dispersion model that can simulate the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal. The model contains algorithms for near-source effects such as building downwash, partial plume penetration, sub-grid scale interactions as well as longer-range effects such as pollutant removal, chemical transformation, vertical wind shear and coastal interaction effects. The model employs dispersion equations based on a Gaussian distribution of pollutants across the puff and takes into account the complex arrangement of emissions from point, area, volume, and line sources.

5.3 Emission estimates

An estimate of the in-stack emission concentration from the operating cyclones has been calculated using a spreadsheet developed by the Texas Commission on Environmental Quality (TCEQ). The TCEQ emission factors are based on the so called "Seven Gin Study" (**Buser et al., 2012, Buser et al., 2013**(a-i)) which aimed to update emission factors for cotton ginning following the implementation of a more stringent National Ambient Air Quality Standard for $PM_{2.5}$ by the US EPA. The final emissions factors were a combination of the stack sampling data combined with the PM_{10} and $PM_{2.5}$ data developed using particle size distribution (PSD) data (**Buser et al., 2013**(j-u)).

The objectives of the Seven Gin Study were to:

- Develop $PM_{2.5}$ emission factors.
- Verify existing US EPA AP43 emission factors for PM_{10} and TSP.
- Characterise the particle size distribution (PSD) of the PM emitted.
- Collect field data to quantify the uncertainty (oversampling rates) of the current reference method for stack sampling of cyclones.

The outcome of the study was a robust set of emission factors for cotton ginning, for processing including pre-cleaning, lint cleaning, trash handling and mote cleaning.

The background, method and results of the study can be found in the supporting documentation for the study (**Buser et al., 2012, Buser et al., 2013** (a-u)).

The gins sampled in the 'Seven Gin Study' were equipped with '1D-3D' cyclones, identical to those proposed for the Carrathool Cotton Gin. As the ginning process terminology differs slightly between the US and Australian cotton industry, Rivoctt has matched the US Emission Factors to the appropriate activities / cyclones for the Carrathool Cotton gin, as show in **Table 5.1**.

Rivcott also provided air flow volumes for each cyclone which were used to derive the in-stack concentrations for comparison to the Clean Air Regulations.

The proposed production for the Gin is 150,000 bales per annum which equates to up to 60 bales per hour. However, while certain machines in the process can handle up to 60 bales per hour, the expected maximum throughput is 50 bales per hour. In response to a requested from the EPA, further explanation of the varying hourly throughput is provided in **Section** Error! Reference source not found.. **REF _Ref382822723 \h * MERGEFORMAT Table 5.1** shows the production rate for each cyclone.

It is also noted that the Riverina cotton has a high moisture content, as evidenced by higher propane used to dry the cotton in the Carrathool Gin (6 litres/bale compared to the more usual 2 litres/bale). Therefore the use of the US EPA emission factors is considered conservative, as these emission factors are based on lower moisture cotton. Emissions from propane firing in the dryers has been estimated using emission factors published by the US EPA AP-42 (**US EPA, 1998b**) and have been assigned to each cyclone based on the bale rate. All cyclones are assumed to emit at 10m above ground level with a stack diameter of 2 m and exit velocity of 10 m/s.

Table 5.1: Estimated emission rates

Rivcott Cyclones		Rivcott Air Flow		TEQ Emission Point (to match to Rivcott Cyclone)	Bales /hr	Emission Factor (lb/bale)			Emission Rate (g/s)			Cyclone in-stack concentration (mg/m3)
Cyclone	Stage / Process	CFM	m3/s			TSP	PM10	PM2.5	TSP	PM10	PM2.5	TSP
2 x 1A PULL	Unloading / 1st Stage (4)	40,000	18.8	Unloading Fan	25	0.2960	0.1930	0.0152	0.9334	0.6089	0.0488	49.6
2 x 1B PULL		40,000	18.8		25	0.2960	0.1930	0.0152	0.9334	0.6089	0.0488	49.6
2 x 2A PULL	2nd Stage (6)	24,000	11.3	2nd dryer cleaner	17	0.1290	0.0530	0.0027	0.2773	0.1145	0.0068	24.6
2 x 2B PULL		24,000	11.3		17	0.1290	0.0530	0.0027	0.2773	0.1145	0.0068	24.6
2 x 2C PULL		24,000	11.3		17	0.1290	0.0530	0.0027	0.2773	0.1145	0.0068	24.6
2 x 3A PULL	3rd Stage (6)	24,000	11.3	3rd dryer cleaner	17	0.0520	0.0300	0.0026	0.1124	0.0652	0.0065	10.0
2 x 3B PULL		24,000	11.3		17	0.0520	0.0300	0.0026	0.1124	0.0652	0.0065	10.0
2 x x3C PULL		24,000	11.3		17	0.0520	0.0300	0.0026	0.1124	0.0652	0.0065	10.0
A OFLO	Overflow (2)	8,000	3.8	Overflow	10	0.0630	0.0160	0.0011	0.0795	0.0202	0.0015	21.1
B OFLO		8,000	3.8		10	0.0630	0.0160	0.0011	0.0795	0.0202	0.0015	21.1
FEED DUST	Feeder Dust (1)	13,500	6.3	#2 Mote	50	0.0430	0.0175	0.0010	0.2743	0.1136	0.0097	43.2
SCAV	Scavanger Sys (1)	11,000	5.2	#2 Mote	3	0.0430	0.0175	0.0010	0.0165	0.0069	0.0006	3.2
MOTE LC1	Mote Cleaning (5)	16,000	7.5	#1 Mote	1	0.1050	0.0365	0.0020	0.0133	0.0047	0.0003	1.8
MOTE LC2		14,000	6.6	#2 Mote	1	0.0430	0.0175	0.0010	0.0055	0.0023	0.0002	0.8
MOTE BC		11,500	5.4	#2 Mote	1	0.0430	0.0175	0.0010	0.0055	0.0023	0.0002	1.0
MOTE TRASH		16,000	7.5	Mote Trash	1	0.0390	0.0080	0.0007	0.0050	0.0011	0.0002	0.7
MOTE PKG BC		11,500	5.4	#2 Mote	1	0.0430	0.0175	0.0010	0.0055	0.0023	0.0002	1.0
MOTE ROBBER	Mote Robber Cyclones (2)	22,000	10.3	Mote Robber	1	0.1110	0.0370	0.0028	0.0141	0.0047	0.0004	1.4
1A LC	A Lint Cleaners (5)	13,500	6.3	1st lint cleaner	12	0.1585	0.0421	0.0027	0.2406	0.0645	0.0050	37.9
2A LC		13,500	6.3		12	0.1585	0.0421	0.0027	0.2406	0.0645	0.0050	37.9
3A LC		13,500	6.3		12	0.1585	0.0421	0.0027	0.2406	0.0645	0.0050	37.9
4A LC		13,500	6.3		12	0.1585	0.0421	0.0027	0.2406	0.0645	0.0050	37.9
5A LC		13,500	6.3		12	0.1585	0.0421	0.0027	0.2406	0.0645	0.0050	37.9
1B LC	B Lint Cleaners (5)	13,500	6.3	2nd lint cleaner	12	0.1585	0.0421	0.0027	0.2406	0.0645	0.0050	37.9
2B LC		13,500	6.3		12	0.1585	0.0421	0.0027	0.2406	0.0645	0.0050	37.9
3B LC		13,500	6.3		12	0.1585	0.0421	0.0027	0.2406	0.0645	0.0050	37.9
4B LC		13,500	6.3		12	0.1585	0.0421	0.0027	0.2406	0.0645	0.0050	37.9
5B LC		13,500	6.3		12	0.1585	0.0421	0.0027	0.2406	0.0645	0.0050	37.9
A BATT CON	B Batt Con (4)	41,300	19.4	Battery condenser	30	0.0700	0.0165	0.0009	0.2670	0.0648	0.0058	13.8
B BATT CON	A Batt Con (4)	41,300	19.4		30	0.0700	0.0165	0.0009	0.2670	0.0648	0.0058	13.8
2 x A MOTE	Lint Cleaner Motes (4)	27,500	12.9	#1 Mote	42	0.1050	0.0365	0.0020	0.5537	0.1940	0.0129	42.8
2 x B MOTE		27,500	12.9	#2 Mote	42	0.04	0.02	0.00	0.2282	0.0943	0.0077	17.7

5.4 Operational limits of cyclones

The annual production of 150,000 bales per annum equates to an hourly maximum rate of 60 bales per hour. However, not all machines will operate at this hourly production. While certain machines or processes can theoretically handle 60 bales per hour, others will operate at a maximum 50 bales per hour (i.e. unloading, 2nd stage and 3rd stage). Further explanation on hourly throughput has been provided by the proponent as follows:

- Each lint cleaner has a capacity of 20 bales per hour theoretically; however the cotton splits and half goes to each cleaner, resulting in 10 bales per hour into each lint cleaner for a total of 50 bales per hour for the five (5) A and B lint cleaners.
- The theoretical capacity for the lint cleaners and battery condenser is 60 bales per hour but the entire system has the capacity of sitting on 50 bales per hour when it is all working at the same time. We have assigned 12 bales per hour for each A and B lint cleaner, equating to the 60 bales per hour maximum throughput.
- Overflow: Separators handle only a fraction of the cotton since they handle only the overflow.
- Feeder dust. Very little product comes out of this system as it is at the end of the cleaning line but they do handle all the gins.
- Trash makes up 11% of what is received and only about half of the cyclones go to the scavenger.

5.5 Other fugitive sources

The only additional source of dust emissions is from trucks travelling along the unsealed (gravel) roads onsite. Seed sheds and trash storage are assumed to be enclosed. Estimates of dust emissions from the internal haul roads have been made using US EPA AP42 emission factors (**US EPA, 1998c.** The assumptions used in estimate emissions are:

- A total of 72 trucks per day, comprising:
  - 50 module trucks
  - 14 bale trucks
  - 8 seed trucks
- The following travel distances are assumed, based on measurements of internal haul roads:
  - 5 km return trip for each module truck
  - 2 km return trip for each bale truck
  - 2 km return trip for each seed truck
- 75% control achieved through the use of an onsite water cart

A summary of the emissions used in the air dispersion modelling is provided in **Table 5.2**.

Table 5.2: Haul road emissions

ACTIVITY	Emissions		Intensity	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units
	kg/day	g/s												
Module Trucks TSP	147.6	1.7	50	trucks per day	35	Vehicle gross mass (t)	5.0	km/return trip	2.4	kg/VKT	5	% silt content	75	% control
PM10	37.9	0.4	50	trucks per day	35	Vehicle gross mass (t)	5.0	km/return trip	0.61	kg/VKT	5	% silt content	75	% control
PM2.5	3.8	0.04	50	trucks per day	35	Vehicle gross mass (t)	5.0	km/return trip	0.06	kg/VKT	5	% silt content	75	% control
Bale Trucks TSP	17.8	0.2	14	trucks per day	41	Vehicle gross mass (t)	2.0	km/return trip	2.5	kg/VKT	5	% silt content	75	% control
PM10	4.6	0.1	14	trucks per day	41	Vehicle gross mass (t)	2.0	km/return trip	0.65	kg/VKT	5	% silt content	75	% control
PM2.5	0.5	0.01	14	trucks per day	41	Vehicle gross mass (t)	2.0	km/return trip	0.07	kg/VKT	5	% silt content	75	% control
Seed trucks TSP	11.6	0.1	8	trucks per day	55	Vehicle gross mass (t)	2.0	km/return trip	2.9	kg/VKT	5	% silt content	75	% control
PM10	3.0	0.03	8	trucks per day	55	Vehicle gross mass (t)	2.0	km/return trip	0.74	kg/VKT	5	% silt content	75	% control
PM2.5	0.3	0.003	8	trucks per day	55	Vehicle gross mass (t)	2.0	km/return trip	0.07	kg/VKT	5	% silt content	75	% control

6 IMPACT ASSESSMENT

6.1 Clean Air Regulation Limits

The estimated in-stack concentration for each cyclone is presented in **Table 5.1**. Comparing the emission concentrations with the prescribed limits in **Table 3.3** demonstrates that the total PM emissions (TSP), released from each emission point are less than the Clean Air Regulation limit of 50 mg/m^3.

6.2 Modelling results

The results of the modelling are presented in **Table 6.1**. Cumulative concentrations are also presented based on the assumed background, as discussed in **Section 4.2**. The maximum predicted incremental 24-hour PM_{10} concentration is below the relevant criteria at all residences. When the background concentration is added for cumulative assessment all residences are below the relevant criteria except Receptor 4, which shows an exceedance of the criterion on one day in the year.

Additional analysis of the cumulative 24-hour PM_{10} is presented for each residence as time-series plots (**Figure 6-1** to **Figure 6-6**) The time-series shows that generally the project contributes a small amount to existing background. Also evident from the time-series plots is that the predicted exceedance at Residence 4 occurs outside the ginning season (April to September). Also, on this day, the existing background is already elevated (48 µg/m^3). It is also noted the modelling presents a conservative high prediction of impact and, on this basis, the risk of the facility resulting in non-compliance of the air quality goals is considered to be low.

Table 6.1: Modelling results

	TSP	PM_{10}		$PM_{2.5}$	
	Annual Ave Goal = 90µg/m^3	Annual Ave Goal = 30µg/m^3	24-Hour Max Goal = 50 µg/m^3	Annual Ave Goal = 8 µg/m^3	24-Hour Max Goal = 25 µg/m^3
Incremental					
R1	0.4	0.4	6.9	0.0	0.4
R2	1.1	1.0	8.3	0.1	0.8
R3	1.2	1.1	15.5	0.1	0.8
R4	1.2	1.0	10.1	0.1	0.8
R5	1.0	0.9	10.3	0.1	0.6
R6	0.6	0.5	7.7	0.1	0.4
Cumulative					
R1	38.4	15.6	50.0	6.8	22.3
R2	39.1	16.2	50.0	6.9	22.3
R3	39.2	16.3	50.5	6.9	22.3
R4	39.2	16.2	52.9 (1)	6.9	22.3
R5	39.0	16.1	49.8	6.9	22.3
R6	38.6	15.7	49.4	6.9	22.2

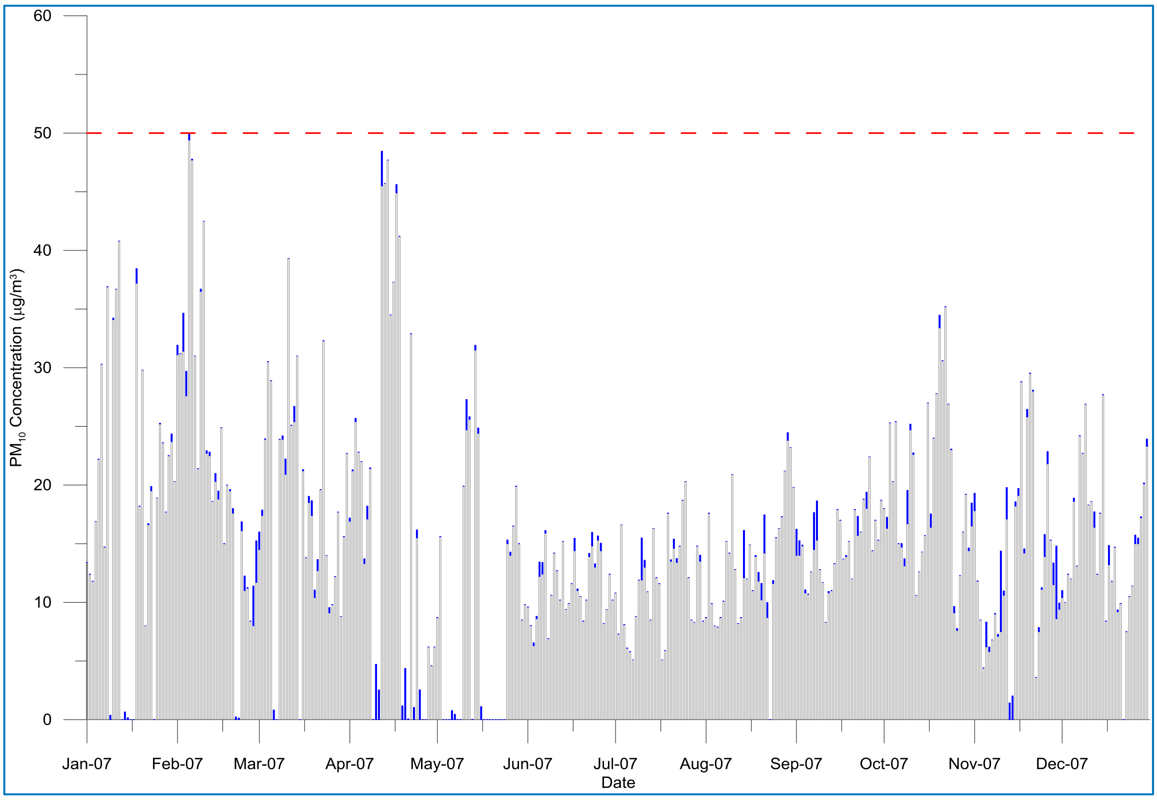

Figure 6-1: Times series plot of 24-hour average PM_{10} concentration at Residence 1

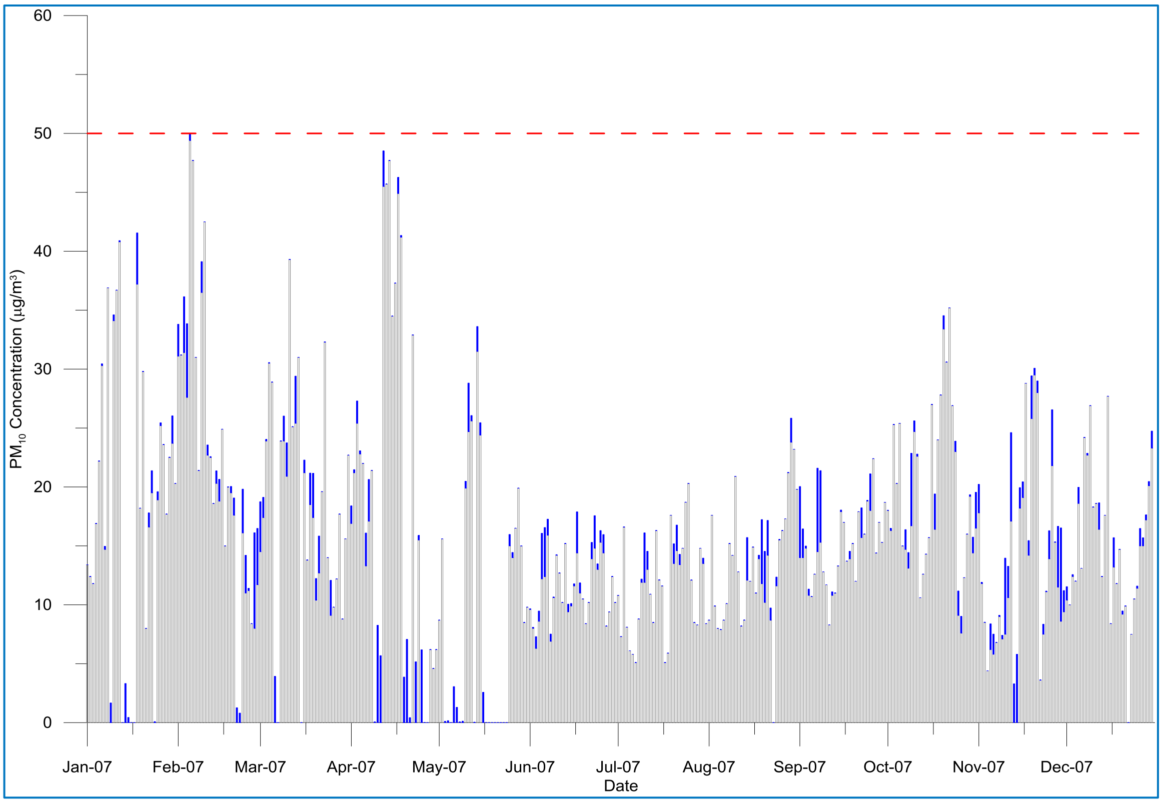

Figure 6-2: Times series plot of 24-hour average PM_{10} concentration at Residence 2

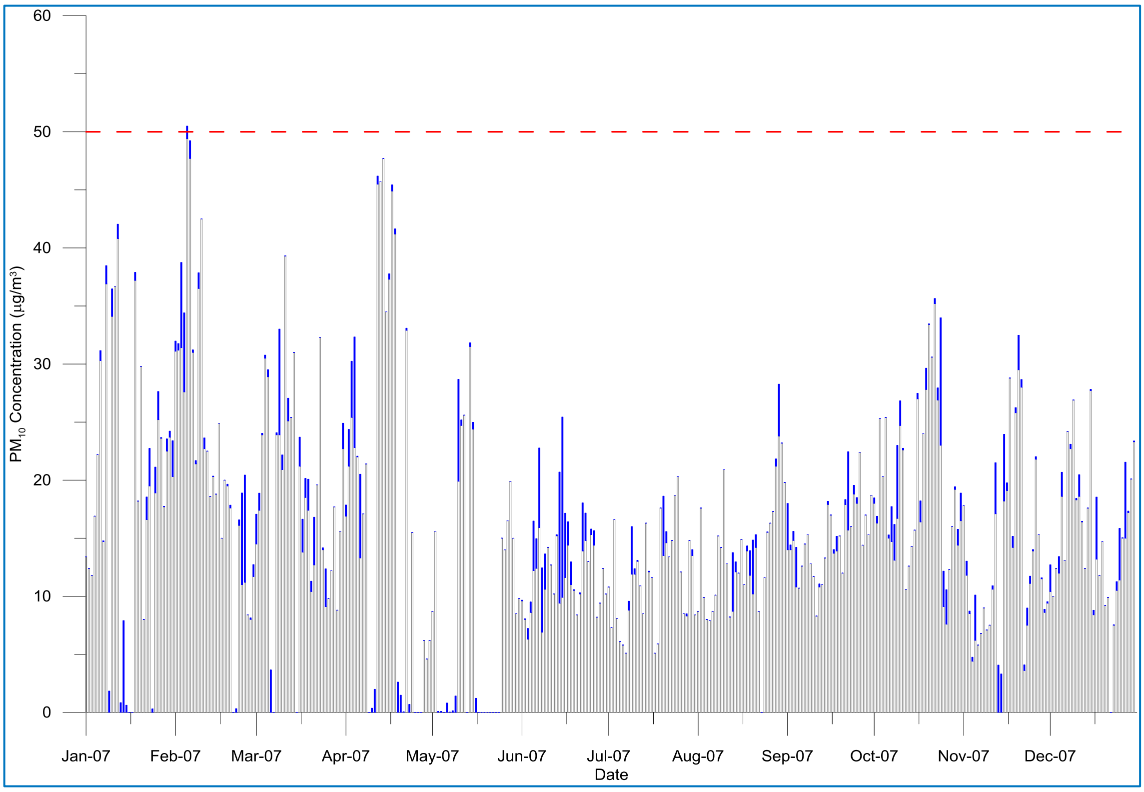

Figure 6-3: Times series plot of 24-hour average PM_{10} concentration at Residence 3

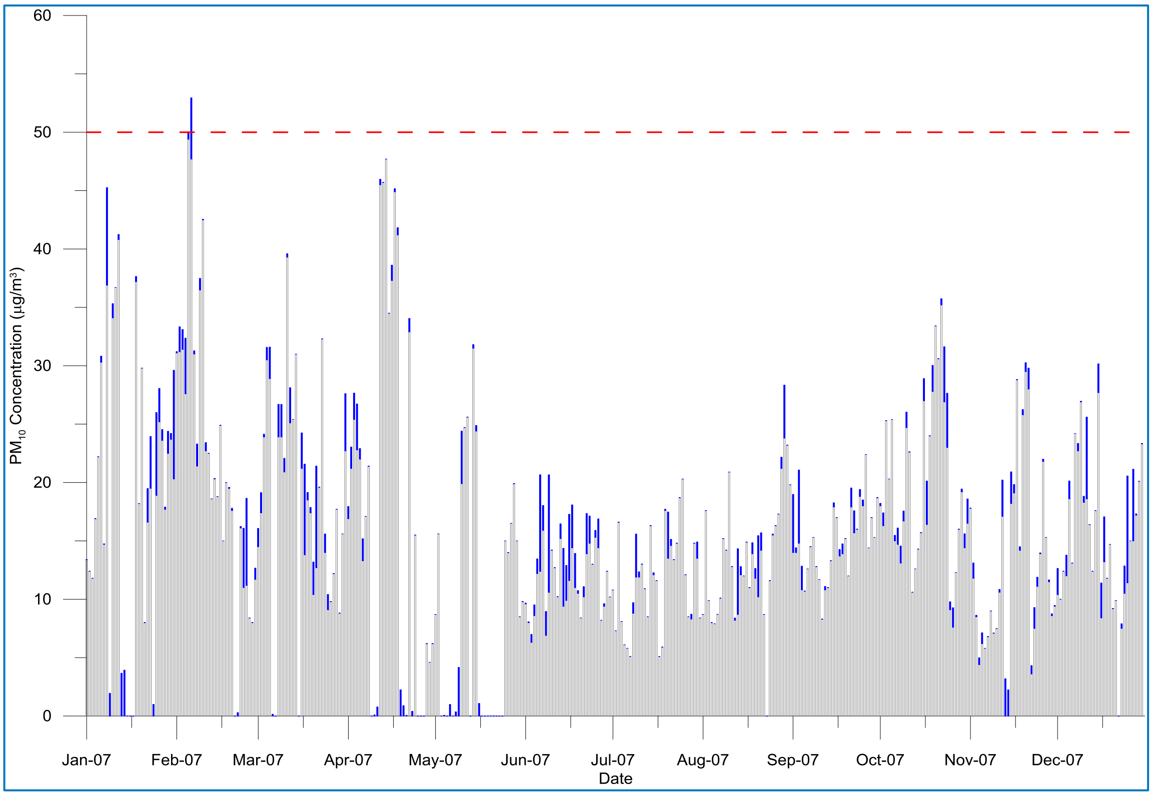

Figure 6-4: Times series plot of 24-hour average PM_{10} concentration at Residence 4

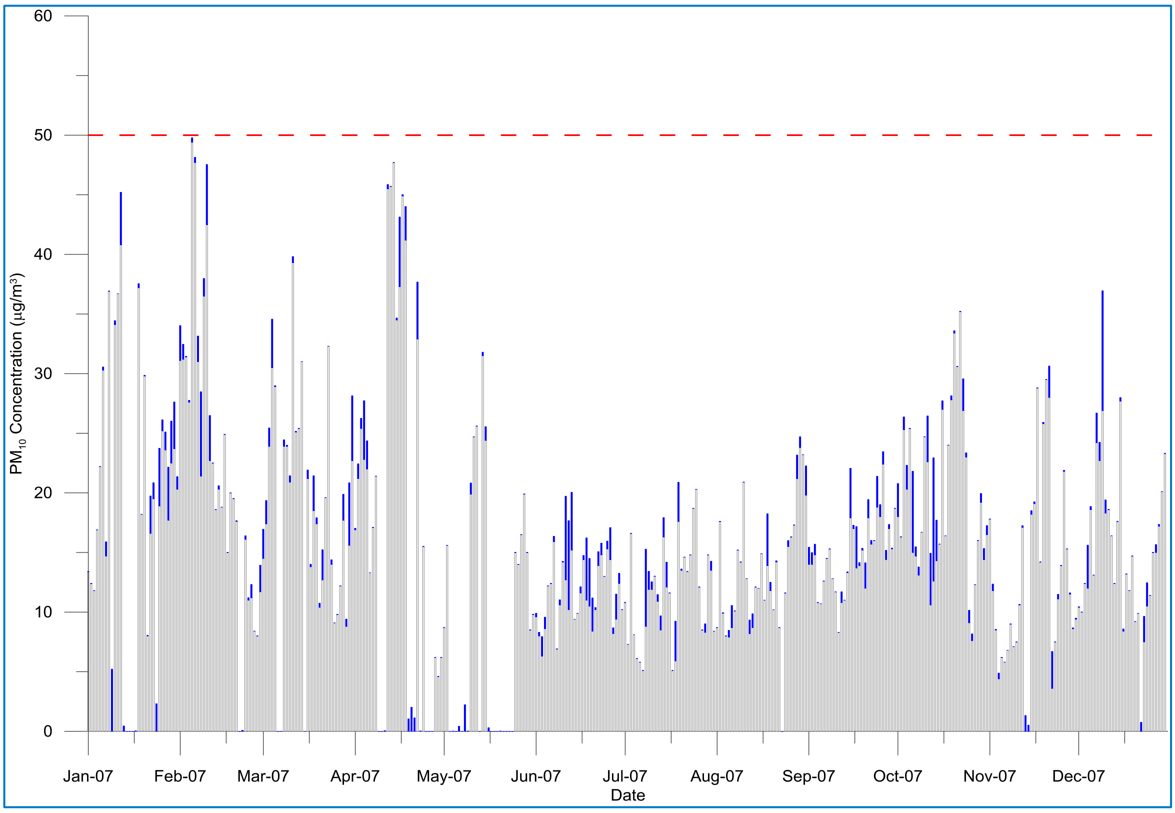

Figure 6-5: Times series plot of 24-hour average PM_{10} concentration at Residence 5

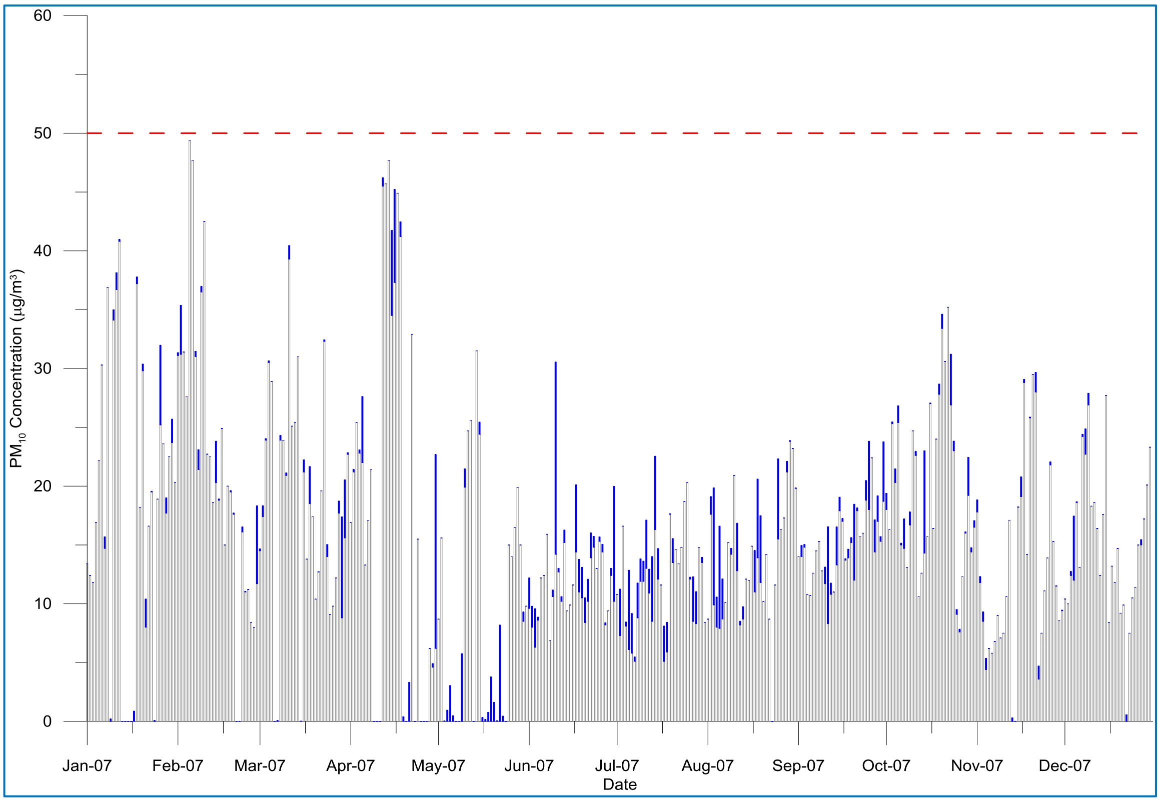

Figure 6-6: Times series plot of 24-hour average PM_{10} concentration at Residence 6

7 CONCLUSION

Dispersion model predictions were completed using emissions based on US EPA emission factors for cotton ginning. The modelling demonstrates compliance with the relevant air quality standards for annual average TSP, PM_{10} and $PM_{2.5}$, at all nearby sensitive receptors due to the project alone.

Cumulative 24-hour PM_{10} impacts were also considered, taking into account the cotton gin and existing background. The cumulative assessment found that all residences are below the relevant criteria except Receptor 4, which shows an exceedance of the criterion on one day in the year. However, time-series plots of cumulative impacts show that the predicted exceedance at Residence 4 occurs outside the ginning season (April to September) and on a day when the existing background is already elevated. The risk of the facility resulting in non-compliance of the 24-hour PM_{10} goal is therefore considered to be low.

The estimated cyclone emission concentrations comply with the in-stack concentration limits of 50 mg/m^3 prescribed under the *Protection of the Environment Operations (Clean Air) Regulation 2010*.

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Appendix A SITE PLAN