APPENDIX 7

Air Quality Assessment

AIR QUALITY ASSESSMENT
MANILDRA PARK
FUEL DISTRIBUTION AND BIODIESEL FACILITY
KOORAGANG ISLAND

October, 2007

Prepared for
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1 INTRODUCTION

This report has been prepared by Holmes Air Sciences on behalf of Umwelt (Australia) Pty Ltd who are acting on behalf of Manildra Park Pty Limited (Manildra Park). Manildra Park propose to construct and operate a marine fuel oil and diesel terminal and biodiesel production facility off Greenleaf Road, Kooragang Island. This report presents the air quality assessment of the proposed development.

Air emissions from the site during construction will be dust, while emissions during operations will be residual methanol from the methanol recovery system. Ethanol has very similar properties to methanol and may be used as a substitute product. In addition, there will be emissions associated with the 5 MW boiler (used for heating marine fuel oil and in the biodiesel production process), predominantly oxides of nitrogen and sulfur dioxide.

The assessment follows procedures outlined in the Department of Environment and Climate Change (DECC) document titled "Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW" (**DEC, 2005a)**.

The report provides information on the following.

- Proposed operations and local setting
- Air quality criteria that need to be met to protect the air quality environment
- Meteorological and climatic conditions in the area
- Existing air quality in the area
- Estimation of emissions from the facility and control methods used to reduce emissions
- Results of dispersion modelling to assess the impacts of these emissions and the potential cumulative impacts of the operations

2 LOCAL SETTING AND PROJECT DESCRIPTION

Figure 1 shows the study area and location of the proposed facility. **Figure 2** shows the local terrain of Kooragang Island and surrounds which is generally flat and has been considered so from the point of view of dispersion modelling. The surrounding area contains mainly industrial facilities and natural habitats. The nearest residential areas are Mayfield and Stockton, located approximately 1.6 and 0.6 kilometres from the proposed site.

The project is broken into three discrete construction and operational phases. It is anticipated that these will overlap during a 3 to 5 year period.

Phase I

Marine fuel oil and diesel will be received and distributed from the terminal. Marine fuel oil and diesel will be predominantly distributed by barge while road tankers will also distribute diesel to other users within the port and region. The two existing steel tanks each with a capacity of 25.5 megalitres (ML) will be refurbished as well as new floating roofs.

Phase II

Phase II involves the construction of 3 x 7 ML additional storage tanks within the Greenleaf Road terminal. Additional pipework infrastructure within the terminal will also be installed.

Phase III

Phase III will involve the establishment and operation of a biodiesel production and distribution facility with a production capacity of approximately 60 ML per annum. The layout of the overall facility is shown in **Figure 3**. The facility will convert oil into biodiesel via a transesterfication process where oils are mixed with methanol and a catalyst and heated. Unreacted methanol is recovered from this process.

A methanol recovery system has been incorporated into the biodiesel facility. This separation process removes methanol from the biodiesel and delivers it to a distillation column. The efficiency of the methanol recovery system is expected to be in the order of 80 – 90%. Emissions from the plant are discharged via a stack and it is assumed that 98 % of the methanol used in the process will be consumed. Of the remaining 2%, it has been assumed that 80% will be recovered and 20% will be discharged via this stack i.e. 0.016% and 0.004% of the total discharge respectively.

It is planned to operate the plant for 24-hours a day for 330 days of the year. Approximately 60 ML of biodiesel will be produced by the plant annually and approximately 6,000 tonnes of methanol will be used per year.

The main air emissions from the plant will be the combustion products from the boiler, controlled methanol emissions from the methanol recovery system stack and some fugitive emissions from the methanol storage tank. It has been assumed that emissions from the biodiesel tanks will be minimal due to the non-vaporous nature of the biodiesel product.

3 AIR QUALITY GOALS

When assessing any project where pollutant emissions are involved, it is necessary to compare the impacts with relevant air quality criteria. Air quality criteria are used to assess the potential for ambient air quality to give rise to adverse health or nuisance effects.

The products of combustion from the boiler will be predominantly carbon monoxide (CO), oxides of nitrogen (NO_x), sulfur dioxide (SO_2) and particulate matter less than 10 µm in diameter. **Table 1** summarises the current air quality assessment criteria noted by the DECC, for these pollutants. The air quality criteria relate to the total burden of pollutants in the air and not just the pollutants from the sources being modelled. In other words, some consideration of background levels needs to be made when using these criteria to assess impacts. The estimation of appropriate background levels will be discussed further in **Section 4.3**.

The other significant emission is methanol from the methanol recovery system. In this case the goal relates to the project emissions alone and does not take into account any existing background concentrations. The goal for methanol is based on its odorous properties and relates to the 99.9^{th} percentile prediction.

The primary air quality objective for most projects is to ensure that the air quality criteria listed in **Table 1** are not exceeded at any location where there is a possibility of human exposure for the time period relevant to the criterion. However, it is good environmental practice to pursue any opportunities that may exist to minimise exposure to these pollutants.

Table 1 : Air quality criteria relevant to this project

Pollutant	Criterion*	Averaging period	Agency
Carbon monoxide (CO)	25 ppm or 30 mg/m^3 9 ppm or 10 mg/m^3	1-hour maximum 8-hour maximum	DECC DECC
Nitrogen dioxide (NO_2)	0.12 ppm or 246 μg/m^3 0.03 ppm or 62 μg/m^3	1-hour maximum Annual mean	DECC DECC
Sulfur dioxide (SO_2)	20 pphm or 570 μg/m^3 8 pphm or 228 μg/m^3 2 pphm or 60 μg/m^3	1-hour maximum 24-hour maximum Annual mean	DECC DECC DECC
Particulate matter < 10 μm (PM_{10})	50 μg/m^3 30 μg/m^3	24-hour maximum Annual mean	DECC DECC
Methanol	2.4 ppm or 3.0 mg/m^3	1 hour 99.9th percentile	DECC
Ethanol	1.1 ppm or 2.1 mg/m^3	1 hour 99.9th percentile	DECC

** ppm = parts per million; pphm = parts per hundred million.*

4 EXISTING ENVIRONMENT

This section describes the dispersion meteorology, local climatic conditions and existing pollutant levels in the area.

4.1 Dispersion Meteorology

The Gaussian dispersion model used for this assessment, AUSPLUME, requires information about the dispersion characteristics of the area. In particular, the information required relates to wind speed, wind direction, atmospheric stability class[1] and mixing height[2]. Meteorological data collected in the study area are discussed below.

Meteorological data have been collected at the Port Waratah Coal Services (PWCS) Kooragang Island site by Pavel Zib and Associates. **Figure 4** shows the annual and seasonal wind-roses from 2004 and 2005 data. Annually, the most common winds are from the WNW and NW. Winds from the east are also common, but to a lesser extent. In the summer months winds from the east indicate the direction of the sea-breeze while winds in winter are predominantly from the WNW. This data set has been prepared into a form suitable for the AUSPLUME dispersion model.

Six years of meteorological information are also available for the Steel River Industrial Estate on the southern side of the Hunter River (south arm) (approximately 1 km from the Project). Steel River operates a weather station (see **Figure 1** for location) which collects 10-minute records of temperature, wind speed, wind direction and sigma-theta (a measure of the fluctuation of the horizontal wind direction). The pattern of winds from this site are consistent with the winds measured at the PWCS site.

1 In dispersion modelling stability class is used to categorise the rate at w hich a plume will disperse. In the Pasquill-Gifford stability class assignment scheme, as used in this study, there are six stability classes A through to F. Class A relates to unstable conditions such as might be found on a sunny day with light winds. In such conditions plumes will spread rapidly. Class F relates to stable conditions, such as occur when the sky is clear, the winds are light and an inversion is present. Plume spreading is slow in these circumstances. The intermediate classes B, C, D and E relate to intermediate dispersion conditions.

2 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.

Annual and seasonal windroses prepared from the 2001 to 2005 data are shown in **Figures 5** to **9** respectively. It can be seen from the windroses that, the wind patterns from year to year are quite similar to each other and to the PWCS data, especially in summer and winter. The 2004/2005 data from PWCS is therefore considered to be representative of wind patterns in the area.

To use the wind data to assess dispersion it is necessary to also have available data on atmospheric stability. A stability class was calculated for each hour of the meteorological data using sigma-theta (a measure of the fluctuation of the horizontal wind direction) according to the method recommended by the US EPA (**US EPA, 1986**). **Table 2** shows the frequency of occurrence of the stability categories expected in the area as well as a summary of statistics for each year of data available from the Steel River and PWCS site. The most common stability occurrences at the Steel River site were calculated to be D class stabilities, which occurred approximately 51 to 57% of the time. D class stability suggests that emissions will disperse rapidly. The PWCS site has a lower average wind speed, and a higher frequency of calms (wind speed less than 0.5 m/s) and stable atmospheric conditions (E and F class).

Table 2 : Comparison of PWCS and Steel River meteorological data

	Occurrence Percentage						
Meteorological station	Steel River						PWCS
Year	2000	2001	2002	2003	2004	2005	2004 /2005
Hours available for year	8477	8760	8612	8757	8594	8559	8519
Mean wind speed (m/s)	3.6	3.5	3.4	3.4	3.2	3.2	2.6
Winds less than or equal to 0.5 m/s (%)	0.8	1.8	0.8	0.7	0.6	0.7	11.2
Occurrence of A class stabilities (%)	1.9	2.8	2.7	3.8	6.4	2.7	25.0
Occurrence of B class stabilities (%)	1.8	2.1	2.0	2.9	3.2	2.6	8.5
Occurrence of C class stabilities (%)	5.9	5.5	6.3	7.0	6.7	7.7	4.6
Occurrence of D class stabilities (%)	54.5	53.9	54.3	52.7	51.3	57.1	17.9
Occurrence of E class stabilities (%)	29.1	28.5	27.3	25.8	23.4	23.3	10.7
Occurrence of F class stabilities (%)	6.7	7.2	7.4	7.7	8.9	6.7	33.3

Mixing height was determined using a scheme defined by **Powell** (**1976**) for day-time conditions and an approach described by **Venkatram** (**1980**) for night-time conditions. These two methods provide a good estimate of mixing height in the absence of upper air data.

Given the proximity of the PWCS site to the Project site, the PWCS data is considered to contain meteorological conditions that are representative of the conditions experienced at the Project site.

Wind speed, wind direction and stability class frequency tables for the PWCS 2004/2005 data are presented in **Appendix A**.

4.2 Local Climatic Conditions

The Bureau of Meteorology collects climatic information from the Nobbys Head Signal Station at Newcastle. The station averages for a range of meteorological parameters are presented in **Table 3** (**Bureau of Meteorology, 2006**).

Temperature data show that January is typically the warmest month with a mean daily maximum of 25.6°C. July is the coldest month with a mean daily minimum of 8.4°C. Rainfall data collected at Nobbys Head show that March is the wettest month with a mean rainfall of 122 millimetres (mm) over 12 rain days. Annually the area experiences, on average, 1,145 mm of rain per year.

Table 3 : Climate information for the study area

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean daily maximum temperature - deg C	25.6	25.4	24.7	22.8	19.9	17.4	16.7	18	20.1	22.1	23.5	24.9	21.8
Mean no. of days where Max Temp > = 40.0 deg C	0	0	0	0	0	0	0	0	0	0	0.1	0	0.1
Highest daily Max Temp - deg C	40.8	40.9	39	36.8	28.5	26.1	26.3	29.9	34.4	36.7	41	42	42
Mean daily minimum temperature - deg C	19.1	19.3	18.2	15.3	11.9	9.6	8.4	9.2	11.4	13.9	16	18	14.2
Mean no. of days where Min Temp < = 0.0 deg C	0	0	0	0	0	0	0	0	0	0	0	0	0
Lowest daily Min Temp - deg C	12	10.3	11.1	7.4	4.7	3	1.8	3.3	5	6.5	7.2	11	1.8
Mean 9am air temp - deg C	21.9	21.8	20.8	18	14.6	12	10.8	12.1	15	17.8	19.5	21.1	17.1
Mean 9am wet bulb temp – deg C	19.2	19.5	18.5	15.7	12.6	10.2	8.9	9.7	12.1	14.5	16.4	18.2	14.6
Mean 9am dew point - deg C	17.5	18.2	16.9	14.1	10.9	8.3	6.5	7	9	11.5	13.8	16.2	12.6
Mean 9am relative humidity - %	76	80	78	78	79	79	77	73	70	68	71	74	75
Mean 9am wind speed - km/h	21.2	21.2	21.1	21.6	23.9	26.9	26.9	26.1	25.6	24	23.5	21.9	23.7
Mean 3pm air temp - deg C	23.3	23.5	22.9	21.3	18.8	16.5	15.9	16.9	18.5	19.8	20.9	22.4	20.1
Mean 3pm wet bulb temp - deg C	19.9	20.3	19.5	17.3	14.9	12.7	11.7	12.3	13.9	15.6	17.2	18.8	16.2
Mean 3pm dew point - deg C	17.7	18.5	17.2	14.3	11.6	9.3	7.2	7.5	9.3	12.1	14.3	16.3	13
Mean 3pm relative humidity - %	72	74	72	66	64	63	59	56	59	64	68	71	66
Mean 3pm wind speed - km/h	33.9	33.2	31.1	28.3	26.6	28.9	29.5	31	34.7	35	36.1	35.9	32
Mean monthly rainfall – mm	91.4	105.6	121.9	115.9	118.6	117.8	97.2	76.2	73.7	74.3	69.5	82.4	1144.6
Median (5th decile) monthly rainfall – mm	72.2	84.4	95.6	90.9	103.4	84.8	80.8	59	57.4	63.7	63.3	62.7	1068
Mean no. of raindays	11.1	11.1	12.2	11.9	12.1	11.7	10.8	10.3	10	10.9	10.5	10.5	133
Highest monthly rainfall – mm	404	559.2	544.4	546.4	441.3	485.7	351.1	545.3	283.1	277.5	203.9	326.5	-
Lowest monthly rainfall – mm	2	0.5	2.8	0	2.1	3.6	0	0.8	1.6	4.6	2.4	4.6	-
Highest recorded daily rainfall – mm	144.8	252.7	283.7	231.1	181.9	190.3	118.6	168.9	157.5	96.5	103.7	177.5	283.7
Mean no. of clear days	6.3	5.3	6.4	7.4	6.9	7.5	9.7	10.8	9.3	7.4	5.5	6.3	88.7
Mean no. of cloudy days	12.4	12.1	11.7	10.7	11.9	11.7	9.5	8.3	9	12.1	12.3	11.7	133.4
Highest recorded wind gust - km/h	142.6	140.8	137.2	114.8	170.6	151.9	139	135.4	131.4	140.8	144.7	129.6	170.6

Climate averages for Station: 061055 Newcastle Nobbys Signal station. Commenced: 1862; Last record: 2004; Latitude (deg S): 32.9185; Longitude (deg E): 151.7985; State: NSW

Source: Bureau of Meteorology (2006)

4.3 Existing Air Quality

Air quality standards and goals refer to pollutant levels which include the Project and existing sources. To fully assess impacts against all the relevant air quality standards and goals (see **Section 3**) it is necessary to have information on or estimates of existing pollutant concentrations in the area in which the Project is likely to contribute to these levels.

The DECC operate air quality monitoring stations at Beresfield, Newcastle and Wallsend. Historical data for gaseous pollutants at Newcastle and Wallsend are summarised in **Table 4. (DECC, 2005b)**

Table 4 Summary of DECC monitoring data in Project area

		Pollutant			
		Carbon monoxide	Nitrogen dioxide		Sulfur dioxide
Goal		8-hour 9 ppm	1-hour -12 pphm Annual average 6 pphm		1-hour -20 pphm 24-hour 8 pphm Annual average 2 pphm
		Site			
Year		**Newcastle**	**Newcastle**	**Wallsend**	**Wallsend**
2000	Maximum Average	3.1	4.4 0.9	5.4 0.8	4.1 1.0 0.2
2001	Maximum Average	4.0	4.0 0.9	4.4 0.9	4.9 1.3 0.2
2002	Maximum Average	3.2	4.7 0.9	4.3 0.9	4.5 1.2 0.2
2003	Maximum Average	2.8	3.9 0.8	5.0 0.8	4.7 1.1 0.2
2004	Maximum Average	2.4	4.4 0.9	4.1 0.8	6.7 1.4 0.2
2005	Maximum Average	1.9	4.1 0.9	5.8 0.8	4.8 0.7 0.1

The highest measured values have been used as conservative estimates of background concentrations for assessment purposes.

Monitoring of PM_{10} from the three DECC monitoring locations since 2000 are shown below in **Table 5**.

At Beresfield the annual average PM_{10} concentration by HVAS has ranged between 18 and 25 $\mu g/m^3$ for the years 2000 to 2003. Using a TEOM the range was between 18 and 26 $\mu g/m^3$. The Beresfield site is located at a school, approximately 10 km to the northwest of the Project site.

At Newcastle the annual average PM_{10} concentration by HVAS has ranged between 20 and 23 $\mu g/m^3$, for all complete years, and has been 22 $\mu g/m^3$ since monitoring using a TEOM commenced in October 2004. The Newcastle site is located at the athletics field, approximately 6 km to the south of the Project site.

At Wallsend the annual average PM_{10} concentration has ranged between 17 and 21 $\mu g/m^3$ using both the HVAS and TEOM. The Wallsend site is located near the Wallsend swimming pool, approximately 7 km to the southwest of the Project site.

All annual averages for complete years were below the DECC air quality goal of 30 $\mu g/m^3$.

Maximum 24-hour average PM_{10} concentrations have been above the DECC 50 $\mu g/m^3$ goal on several occasions at all three monitoring locations using either the HVAS or TEOM. The highest 24-hour average PM_{10} concentrations were generally measured in the warmer months of the year. This trend could be because the summer months are generally when bushfires prevail. For example, several bushfires in the Hunter Valley in late 2002 would have contributed to exceedances during this period.

For the purposes of this report, it has been conservatively assumed that the highest annual average PM_{10} concentration represents background levels. In the case of 24-hour PM_{10} concentrations, where there are already exceedances of the goal, the highest measured value which did not exceed the goal was used to represent background.

Table 5 : Summary of PM_{10} monitoring in the Newcastle area

Month	Beresfield (µg/m³)				Newcastle (µg/m³)				Wallsend (µg/m³)			
	HVAS		TEOM		HVAS		TEOM		HVAS		TEOM	
	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
Jan-00	21.0	21.0	17.0	-	24	32	-	-	26	31	18	-
Feb-00	25.0	33.0	20.0	-	29	40	-	-	18	32	19	-
Mar-00	18.0	24.0	18.0	-	20	27	-	-	16	19	17	-
Apr-00	15.0	17.0	16.0	-	17	20	-	-	14	17	15	-
May-00	18.0	30.0	17.0	-	17	26	-	-	15	26	15	-
Jun-00	17.0	22.0	16.0	-	18	26	-	-	17	25	13	-
Jul-00	15.0	22.0	16.0	-	14	22	-	-	14	19		-
Aug-00	14.0	31.0	15.0	-	16	25	-	-	12	20		-
Sep-00	19.0	35.0	24.0	-	23	41	-	-	17	31		-
Oct-00	18.0	33.0	19.0	-	20	42	-	-	16	34		-
Nov-00	15.0	18.0	17.0	-	19	25	-	-	15	17	15	-
Dec-00	20.0	35.0	20.0	-	24	40	-	-	21	33	20	-
Annual Ave	**17.9**		**17.9**	**-**	**20.1**		-	**-**	**16.8**		**16.5**	**-**
Annual Max		**35.0**				**42.0**				**34.0**		
Jan-01	23.0	44.0	21.0	-	24	33	-	-	24	34	22	-
Feb-01	14.0	24.0	19.0	-	19	28	-	-	15	24	20	-
Mar-01	20.0	30.0	19.0	-	26	36	-	-	22	33	19	-
Apr-01	16.0	23.0	21.0	-	18	26	-	-	15	19	18	-
May-01	14.0	19.0	17.0	-	14	19	-	-	13	17	15	-
Jun-01	21.0	31.0	22.0	-	23	34	-	-	19	28	16	-
Jul-01	22.0	33.0	18.0	-	17	24	-	-	14	22	13	-
Aug-01	17.0	26.0	21.0	-	14	19	-	-	14	22	15	-
Sep-01	18.0	35.0	20.0	-	16	23	-	-	15	19	16	-
Oct-01	16.0	20.0	30.0	-	15	24	-	-	12	16	15	-
Nov-01	23.0	50.0	22.0	-	22	30	-	-	16	24	18	-
Dec-01	24.0	38.0	30.0	-	33	**68**	-	-	27	**52**	27	-
Annual Ave	**19.0**		**21.7**	**-**	**20.1**		-	**-**	**17.2**		**17.8**	**-**
Annual Max		**50.0**				**68.0**				**52.0**		
Jan-02	25	43	27	**59**	22	34	-	-	19	25	24	**64**

Month	Beresfield ($\mu g/m^3$)				Newcastle ($\mu g/m^3$)				Wallsend ($\mu g/m^3$)			
	HVAS		TEOM		HVAS		TEOM		HVAS		TEOM	
	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
Feb-02	20	25	16	25	20	24	-	-	19	24	16	23
Mar-02	27	41	23	**55**	25	36	-	-	26	33	19	38
Apr-02	14	15	18	35	18	20	-	-	12	14	15	22
May-02	18	23	19	38	15	19	-	-	14	17	15	24
Jun-02	14	25	20	**51**	20	33	-	-	18	23	17	**51**
Jul-02	25	34	26	47	16	23	-	-	18	28	19	30
Aug-02	19	26	23	36	19	24	-	-	16	23	18	24
Sep-02	25	31	26	**52**	23	36	-	-	21	34	19	41
Oct-02	30	45	41	**149**	29	43	-	-	23	36	29	45
Nov-02	54	**81**	40	**83**	43	**57**	-	-	39	**54**	33	**60**
Dec-02	29	**58**	31	**166**	29	**52**	-	-	22	39	30	**157**
Annual Ave	**25.0**		**25.8**		**23.3**		-	-	**20.6**		**21.2**	
Annual Max		**81.0**		**166.0**		**57.0**				**54.0.**		**157.0**
Jan-03	27	38			32	45	-	-	20	30	31	**89**
Feb-03	25	35	20	39	26	35	-	-	15	25	21	49
Mar-03	25	**53**	19	**59**	25	43	-	-	16	31	17	41
Apr-03	17	31	16	34	19	32	-	-	11	18	11	17
May-03	17	22	16	30	20	25	-	-	13	18	13	21
Jun-03	20	28	18	31	20	34	-	-	14	21	14	24
Jul-03	18	29	17	27	15	19	-	-	13	18	13	19
Aug-03	19	35	20	35	18	26	-	-	17	21	18	31
Sep-03	26	41	25	**51**	27	40	-	-	21	32	21	44
Oct-03	29	**82**	17	**88**	29	**72**	-	-	24	**76**	17	**105**
Nov-03	21	45	17	49	21	42	-	-	18	34	17	37
Dec-03	16	24	20	34	18	22	-	-	15	19	19	32
Annual Ave	**21.7**		**18.6**		**22.5**		-	-	**16.4**		**17.7**	
Annual Max		**82.0**		**88.0**		**72.0**				**76.0**		**105.0**
Jan-04	-	-	20	33	-	-	-	-	-	-	22	29
Feb-04	-	-	25	44	-	-	-	-	-	-	24	43
Mar-04	-	-	22	40	-	-	-	-	-	-	21	34
Apr-04	-	-	22	48	-	-	-	-	-	-	19	34

Month	Beresfield (µg/m³)				Newcastle (µg/m³)				Wallsend (µg/m³)			
	HVAS		TEOM		HVAS		TEOM		HVAS		TEOM	
	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
May-04	-	-	28	44	-	-	-	-	-	-	20	38
Jun-04	-	-	19	34	-	-	-	-	-	-	15	20
Jul-04	-	-	19	38	-	-	-	-	-	-	15	25
Aug-04	-	-	17	33	-	-	-	-	-	-	15	29
Sep-04	-	-	16	30	-	-	-	-	-	-	15	29
Oct-04	-	-	18	49	-	-	20	26	-	-	18	43
Nov-04	-	-	22	38	-	-	22	44	-	-	19	36
Dec-04	-	-	22	**56**	-	-	25	47	-	-	21	**53**
Annual Ave	**-**	**-**	**20.8**		**-**	**-**	**22.3**		**-**	**-**	**18.7**	
Annual Max				**56.0**				**47.0**				**53.0**
Jan-05	-	-	20	35	39	-	22	**85**	-	-	21	35
Feb-05	-	-	25	**53**	43	-	26	**189**	-	-	24	36
Mar-05	-	-	16	30	29	-	20	**93**	-	-	15	26
Apr-05	-	-	20	46	38	-	24	**149**	-	-	18	28
May-05	-	-	20	40	32	-	21	**93**	-	-	16	25
Jun-05	-	-	20	38	39	-	21	**91**	-	-	17	28
Jul-05	-	-	-	-	-	-	-	-	-	-	-	-
Aug-05	-	-	-	-	-	-	-	-	-	-	-	-
Sep-05	-	-	-	-	-	-	-	-	-	-	-	-
Oct-05	-	-	-	-	-	-	-	-	-	-	-	-
Nov-05	-	-	-	-	-	-	-	-	-	-	-	-
Dec-05	-	-	-	-	-	-	-	-	-	-	-	-
Annual Ave	**-**	**-**	**20.2**		**36.7**	**-**	**22.3**		**-**	**-**	**18.5**	
Annual Max				**53.0**				**189.0**				**36.0**

5 ESTIMATED EMISSIONS

The AUSPLUME dispersion model requires information on the source location, the source height, internal source tip diameter, temperature of emissions, exit velocity of emissions and the mass emission rate of the pollutants to be assessed. Temperature, exit velocity and mass emission rates can be provided to the model as hourly records for an entire year (variable emissions) or as constant emissions.

Information used to calculate emission estimates for the stack serving the proposed boiler and the methanol recovery system were provided by Manildra Park. The National Pollutant Inventory Emission Estimation Technique Manual for Combustion in Boilers (**NPI, 2003)** was used to estimate the boiler emissions based on the use of low sulfur (500 ppm) diesel as fuel, assuming consumption of 3000 litres in 24 hours. Biodiesel may also be used as fuel, but would have negligible sulfur emissions.

Table 6 outlines the stack characteristics and emissions that were used as input into AUSPLUME.

Table 6 : Stack characteristics and emissions used for the dispersion modelling

Stack characteristics		
	Boiler	Methanol Recovery System
Location (MGA coordinates, easting and northing, m)	386042 6359597	386079 6359698
Height (m)	10	17
Base elevation (m)	0	0
Internal tip diameter (m)	0.58	0.1
Exhaust temperature (deg C)	200	25
Exhaust velocity (m/s)	15	2.5
Pollutant emissions (g/s)		
CO	0.0208	-
NO_x	0.0833	-
SO_2	0.0295	-
PM_{10}	0.0042	-
Methanol	-	0.80

In addition, an estimate was made of fugitive emissions from the methanol storage tank. The calculation was undertaken using the TANKS programs, which is a model developed by the US EPA and is designed to calculate air pollutant emissions from organic liquid storage tanks. This is discussed later in **Section 7**.

6 APPROACH TO ASSESSMENT

In August 2005 the DECC published new guidelines for the assessment of air pollution sources using dispersion models (**DEC, 2005a)**. The guidelines specify how assessments based on the use of air dispersion models should be undertaken. They include guidelines for the preparation of meteorological data to be used in dispersion models, the way in which emissions should be estimated and the relevant air quality criteria for assessing the significance of predicted concentration and deposition rates from the proposal. This assessment has been undertaken in accordance with the new DECC guidelines.

The modelling has been performed with AUSPLUME (**VEPA, 1986)** using the meteorological data discussed in **Section 4.1**, the existing air quality data discussed in **Section 4.3** and the emission estimates from **Section 5**. Emissions have been modelled for 24 hours per day, using one year of meteorological data. Model predictions have been made at a set of gridded receptors with 100 m spacing and over the area shown in **Figure 1**. Building information was included in the model with the PRIME algorithm selected.

As an example the AUSPLUME model output file is provided in **Appendix C**.

7 ASSESSMENT OF IMPACTS

Construction Phase

Dust emissions during the construction phases are the dominant source of air emissions associated with the construction of the facility. The dust emissions can be effectively managed through routine construction management techniques, such that their impact is expected to be negligible.

Operational Phase

Combustion product emissions from the boiler and odorous volatile organic compounds (VOC) emissions associated with the biodiesel plant are the primary air quality impacts associated with the operation of the facility.

Combustion Products

Figures 10 to **18** present the predicted concentrations for carbon monoxide, oxides of nitrogen sulfur doxide and particulate matter due to emissions from the proposed boiler. **Table 7** summarises the highest predicted ground level pollutant concentrations with an estimate of background levels making a total concentration which includes project contribution and the existing background. There are no predicted exceedances of the relevant air quality assessment criteria. All the predicted concentrations are substantially below the goal. Emissions from the boiler are therefore not considered further in this assessment.

It should be noted that all NO_X has been conservatively estimated to be converted to NO_2. In practice, the proportion of NO_2 in NO_X will be 5 – 10% at the point of emission with further conversion to NO_2 depending on the presence of oxidants such as ozone.

Table 7 : Highest predicted ground-level pollutant concentrations for CO, NO_x SO_2 and PM_{10}

Pollutant and averaging time	Assessment criteria	Boiler stack emissions	Existing levels (refer Section 4.3)	Total (project contribution + existing)
Maximum 1-hour average CO (mg/m^3)	30	0.006	4.5	4.506
Maximum 8-hour average CO (mg/m^3)	10	0.004	4.5	4.504
Maximum 1-hour average NO_x ($\mu g/m^3$)	246	23.0	116	139
Annual average NO_x ($\mu g/m^3$)	62	0.5	16	16.5
Maximum 1-hour average SO_2 ($\mu g/m^3$)	570	8.5	192	200.5
Maximum 24-hour average SO_2 ($\mu g/m^3$)	228	2.3	40	42.3
Annual average SO_2 ($\mu g/m^3$)	60	0.2	6	6.2
Maximum 24-hour average PM_{10} ($\mu g/m^3$)	50	0.3	47	47.3
Annual average PM_{10} ($\mu g/m^3$)	30	0.02	25	25.02

VOC Emissions

Odour emissions from the storage of diesel, marine fuel oil, biodiesel and associated feedstock oils will be minimal due to the low vapour pressure characteristics of these substances i.e. $<$2mm Hg @ 25°C – which is the DECC definition of a VOC. These products therefore do not require vapour emission controls.

The storage tanks used to store these substances are fitted with floating roofs which will assist in minimising vapour emissions and a pressure relief valve. Consequently, emissions from the tank will only occur when the pressure inside the tank exceeds the design value of the tank. Emissions will be vented directly to the atmosphere under this situation. While emissions to the atmosphere are considered unlikely due to the floating roof arrangement, it may occur during the hotter months when the tanks are at maximum capacity, that is, full and thermal expansion of air in the tank head space occurs. The emissions, if detected, are expected to be inoffensive due to their low odour strength.

The transfer, storage and loading of these products has therefore not been considered.

An option to use tallow as a feedstock is also being considered. Although the production of tallow is an odorous process, tallow itself that is the finished product is unlikely have any significant emissions during storage or in the biodiesel production process, as any odorous compounds are expected to have been liberated during the making of the tallow leaving a pure product.

Methanol however, has a vapour pressure of 127mm Hg @ 25°C and is odorous. Methanol vapour emissions therefore have the potential to cause off-site odour impacts, be it from the storage tank and / or the biodiesel production process.

To minimise methanol vapour emission from the biodiesel plant, all vessels that contain any level of methanol are sealed and blanketed using nitrogen. An estimate of the fugitive emissions from the methanol storage tank was undertaken using the TANKS program. Details of the emission calculation are shown in **Appendix B.** The annual emissions were estimated to be 793 kg which equates to a short-term emission rate of 0.025 g/s. This was considered to be minor compared to the stack emissions.

The biodiesel production process, which includes a Methanol Recovery System (MRS) to recover unused methanol, is undertaken in a closed system. 98 % of the methanol used in the process is consumed in the reaction process, the remaining 2% is recovered by the MRS. The MRS is a separation process that removes the unused methanol from the biodiesel and delivers it to a distillation column. The efficiency of the MRS system is expected to be in the order of 80 to 90%. The maximum ground level concentration of methanol emitted from the MRS is shown in **Table 8**, while **Figure 19** presents the predicted concentrations of methanol from the MRS.

Table 8 : Highest predicted ground-level pollutant concentrations for methanol

Pollutant and averaging time	Assessment criteria	Methanol emissions	Total (project contribution)
99.9th percentile 1-hour methanol (mg/m^3)	3.0	0.8	0.8

As seen in **Table 8,** the predicted methanol concentrations do not exceed air quality assessment criteria and are substantially below the DECC goal. Ethanol, which may be used as an alternative to methanol, has a lower assessment criterion of 2.1 mg/m^3. Predicted concentrations would still be well within air quality goals if ethanol were used as a substitute solvent.

8 CONCLUSIONS

This report has assessed the air quality impacts associated with the construction and operation of the proposed marine fuel, diesel and biodiesel production facility at Kooragang Island.

Construction

The facility is not expected to significantly contribute to the existing dust background concentrations during construction, as dust generating activities are expected to be minor and can be readily managed via routine dust suppression techniques. Dust emissions are also not expected to be an issue during operation, as there are no potential dust emission sources.

Operation

Dispersion modelling has been used to predict ground-level pollutant concentrations of combustion products associated with the operation of a boiler and methanol emissions associated with its storage and use within the biodiesel production process.

The modelling results showed that there would be no exceedances of either short term or annual average goals for relevant pollutants taking account of conservative estimates of background concentrations. Similarly no air quality impacts are expected to occur from the storage, transfer and / or loading of marine fuel or diesel products.

9 REFERENCES

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APPENDIX A
JOINT WIND SPEED, WIND DIRECTION AND STABILITY CLASS FREQUENCY TABLES

STATISTICS FOR FILE: C:\Jobs\Manildra PArk\met\PWCS0405_rev.aus
MONTHS: All
HOURS : All
OPTION: Frequency

PASQUILL STABILITY CLASS 'A'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000822	0.002817	0.001174	0.000352	0.000000	0.000000	0.000000	0.000000	0.005165
NE	0.002230	0.002700	0.001291	0.000352	0.000000	0.000000	0.000000	0.000000	0.006574
ENE	0.001878	0.005987	0.010799	0.001409	0.000000	0.000000	0.000000	0.000000	0.020073
E	0.003287	0.014908	0.007513	0.000235	0.000000	0.000000	0.000000	0.000000	0.025942
ESE	0.003287	0.019838	0.009626	0.000235	0.000000	0.000000	0.000000	0.000000	0.032985
SE	0.002935	0.011152	0.010095	0.002817	0.000000	0.000000	0.000000	0.000000	0.026998
SSE	0.001291	0.006926	0.007043	0.004578	0.000000	0.000000	0.000000	0.000000	0.019838
S	0.000822	0.001409	0.002113	0.002935	0.000000	0.000000	0.000000	0.000000	0.007278
SSW	0.000704	0.002348	0.002113	0.003522	0.000000	0.000000	0.000000	0.000000	0.008686
SW	0.001056	0.001291	0.001291	0.000587	0.000000	0.000000	0.000000	0.000000	0.004226
WSW	0.000704	0.001996	0.001526	0.001056	0.000000	0.000000	0.000000	0.000000	0.005282
W	0.001996	0.002935	0.003287	0.001409	0.000000	0.000000	0.000000	0.000000	0.009626
WNW	0.003639	0.007747	0.013264	0.005752	0.000000	0.000000	0.000000	0.000000	0.030403
NW	0.002348	0.009156	0.008686	0.004461	0.000000	0.000000	0.000000	0.000000	0.024651
NNW	0.001761	0.003991	0.002348	0.000704	0.000000	0.000000	0.000000	0.000000	0.008804
N	0.000822	0.002817	0.000822	0.000117	0.000000	0.000000	0.000000	0.000000	0.004578
CALM									0.009273
TOTAL	0.029581	0.098016	0.082991	0.030520	0.000000	0.000000	0.000000	0.000000	0.250382

MEAN WIND SPEED (m/s) = 2.94
NUMBER OF OBSERVATIONS = 2133

PASQUILL STABILITY CLASS 'B'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000235	0.002348	0.000939	0.000000	0.000000	0.000000	0.000000	0.000000	0.003522
NE	0.000704	0.002582	0.001526	0.000352	0.000000	0.000000	0.000000	0.000000	0.005165
ENE	0.000117	0.003522	0.009039	0.002113	0.000000	0.000000	0.000000	0.000000	0.014790
E	0.000470	0.003052	0.003756	0.000000	0.000000	0.000000	0.000000	0.000000	0.007278
ESE	0.000000	0.003404	0.000470	0.000117	0.000000	0.000000	0.000000	0.000000	0.003991
SE	0.000117	0.002348	0.001174	0.000000	0.000000	0.000000	0.000000	0.000000	0.003639
SSE	0.000352	0.002700	0.003287	0.001526	0.000000	0.000000	0.000000	0.000000	0.007865
S	0.000587	0.001409	0.001526	0.000352	0.000000	0.000000	0.000000	0.000000	0.003874
SSW	0.000117	0.000939	0.001409	0.000939	0.000000	0.000000	0.000000	0.000000	0.003404
SW	0.000235	0.000235	0.000587	0.000117	0.000000	0.000000	0.000000	0.000000	0.001174
WSW	0.000000	0.000117	0.000587	0.001056	0.000000	0.000000	0.000000	0.000000	0.001761
W	0.001056	0.000587	0.001761	0.000822	0.000000	0.000000	0.000000	0.000000	0.004226
WNW	0.001174	0.002465	0.003639	0.003287	0.000000	0.000000	0.000000	0.000000	0.010565
NW	0.001291	0.002935	0.002113	0.000587	0.000000	0.000000	0.000000	0.000000	0.006926
NNW	0.000117	0.001878	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001996
N	0.000704	0.001761	0.000117	0.000000	0.000000	0.000000	0.000000	0.000000	0.002582
CALM									0.002465
TOTAL	0.007278	0.032281	0.031929	0.011269	0.000000	0.000000	0.000000	0.000000	0.085221

MEAN WIND SPEED (m/s) = 3.10
NUMBER OF OBSERVATIONS = 726

PASQUILL STABILITY CLASS 'C'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000117	0.000939	0.000117	0.000000	0.000000	0.000000	0.000000	0.000000	0.001174
NE	0.000000	0.000117	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000117
ENE	0.000000	0.000352	0.000470	0.000000	0.000000	0.000000	0.000000	0.000000	0.000822
E	0.000000	0.000470	0.000352	0.000117	0.000000	0.000000	0.000000	0.000000	0.000939
ESE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SE	0.000000	0.000000	0.000117	0.000000	0.000000	0.000000	0.000000	0.000000	0.000117
SSE	0.000000	0.000352	0.001174	0.001056	0.000000	0.000000	0.000000	0.000000	0.002582
S	0.000117	0.000470	0.001174	0.001291	0.000000	0.000000	0.000000	0.000000	0.003052
SSW	0.000000	0.000117	0.000587	0.000939	0.000000	0.000000	0.000000	0.000000	0.001643
SW	0.000117	0.000587	0.000235	0.000235	0.000000	0.000000	0.000000	0.000000	0.001174
WSW	0.000000	0.000000	0.000117	0.000117	0.000000	0.000000	0.000000	0.000000	0.000235
W	0.000117	0.000587	0.000587	0.001174	0.000000	0.000000	0.000000	0.000000	0.002465
WNW	0.001878	0.003756	0.005634	0.005400	0.000000	0.000000	0.000000	0.000000	0.016669
NW	0.000822	0.003639	0.003169	0.001409	0.000000	0.000000	0.000000	0.000000	0.009039
NNW	0.000939	0.002113	0.000352	0.000000	0.000000	0.000000	0.000000	0.000000	0.003404
N	0.000000	0.000587	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000587
CALM									0.001878
TOTAL	0.004108	0.014086	0.014086	0.011738	0.000000	0.000000	0.000000	0.000000	0.045897

MEAN WIND SPEED (m/s) = 3.31
NUMBER OF OBSERVATIONS = 391

PASQUILL STABILITY CLASS 'D'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000470	0.002935	0.001996	0.000000	0.000000	0.000117	0.000000	0.000000	0.005517
NE	0.000000	0.001056	0.002700	0.000000	0.000000	0.000000	0.000000	0.000000	0.003756
ENE	0.000000	0.000939	0.003052	0.000470	0.000000	0.000000	0.000000	0.000000	0.004461
E	0.000117	0.000000	0.001174	0.000117	0.000000	0.000000	0.000000	0.000000	0.001409
ESE	0.000000	0.000000	0.001056	0.000000	0.000000	0.000000	0.000000	0.000000	0.001056
SE	0.000000	0.000117	0.001878	0.000939	0.000235	0.000000	0.000000	0.000000	0.003169
SSE	0.000000	0.000587	0.005752	0.004578	0.002465	0.000470	0.000000	0.000000	0.013851
S	0.000470	0.001526	0.004930	0.003991	0.002817	0.000704	0.000117	0.000000	0.014556
SSW	0.000117	0.000939	0.004226	0.003874	0.003169	0.000822	0.000822	0.000117	0.014086
SW	0.000587	0.003287	0.004578	0.000704	0.000939	0.000352	0.000117	0.000000	0.010565
WSW	0.000000	0.000587	0.001996	0.001174	0.000587	0.000470	0.000235	0.000000	0.005048
W	0.000352	0.002113	0.004108	0.001643	0.001878	0.000235	0.000000	0.000000	0.010330
WNW	0.002113	0.011152	0.014556	0.008804	0.010799	0.005634	0.002700	0.000117	0.055875
NW	0.001761	0.005048	0.007395	0.002817	0.003052	0.001174	0.000235	0.000000	0.021481
NNW	0.001526	0.004930	0.001291	0.000235	0.000117	0.000000	0.000000	0.000000	0.008100
N	0.000822	0.000587	0.000235	0.000587	0.000117	0.000000	0.000000	0.000000	0.002348
CALM									0.003404
TOTAL	0.008334	0.035802	0.060923	0.029933	0.026177	0.009978	0.004226	0.000235	0.179012

MEAN WIND SPEED (m/s) = 4.38
NUMBER OF OBSERVATIONS = 1525

PASQUILL STABILITY CLASS 'E'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.002817	0.006339	0.000587	0.000000	0.000000	0.000000	0.000000	0.000000	0.009743
NE	0.002230	0.003639	0.000235	0.000000	0.000000	0.000000	0.000000	0.000000	0.006104
ENE	0.000587	0.002935	0.000939	0.000000	0.000000	0.000000	0.000000	0.000000	0.004461
E	0.000117	0.001056	0.000822	0.000000	0.000000	0.000000	0.000000	0.000000	0.001996
ESE	0.000822	0.000704	0.001056	0.000000	0.000000	0.000000	0.000000	0.000000	0.002582
SE	0.000117	0.001643	0.002817	0.000000	0.000000	0.000000	0.000000	0.000000	0.004578
SSE	0.000235	0.001761	0.001996	0.000000	0.000000	0.000000	0.000000	0.000000	0.003991
S	0.001291	0.002817	0.001643	0.000000	0.000000	0.000000	0.000000	0.000000	0.005752
SSW	0.000704	0.001643	0.001643	0.000000	0.000000	0.000000	0.000000	0.000000	0.003991
SW	0.000822	0.003052	0.001291	0.000000	0.000000	0.000000	0.000000	0.000000	0.005165
WSW	0.000117	0.000235	0.000470	0.000000	0.000000	0.000000	0.000000	0.000000	0.000822
W	0.002935	0.002935	0.000704	0.000000	0.000000	0.000000	0.000000	0.000000	0.006574
WNW	0.006221	0.009039	0.005869	0.000000	0.000000	0.000000	0.000000	0.000000	0.021129
NW	0.004578	0.003756	0.001409	0.000000	0.000000	0.000000	0.000000	0.000000	0.009743
NNW	0.003052	0.003052	0.000587	0.000000	0.000000	0.000000	0.000000	0.000000	0.006691
N	0.001409	0.001174	0.000352	0.000000	0.000000	0.000000	0.000000	0.000000	0.002935
CALM									0.010330
TOTAL	0.028055	0.045780	0.022420	0.000000	0.000000	0.000000	0.000000	0.000000	0.106585

MEAN WIND SPEED (m/s) = 2.05
NUMBER OF OBSERVATIONS = 908

PASQUILL STABILITY CLASS 'F'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.010212	0.006456	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.016669
NE	0.014673	0.010447	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.025120
ENE	0.007513	0.007747	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.015260
E	0.005987	0.007747	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.013734
ESE	0.007395	0.009391	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.016786
SE	0.008100	0.012560	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.020660
SSE	0.004930	0.006456	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.011386
S	0.004930	0.005517	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.010447
SSW	0.003874	0.003639	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.007513
SW	0.003169	0.003287	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.006456
WSW	0.003404	0.002230	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005634
W	0.010447	0.005752	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.016199
WNW	0.016786	0.018312	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.035098
NW	0.011621	0.013734	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.025355
NNW	0.008334	0.005752	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.014086
N	0.005752	0.002465	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.008217
CALM									0.084282
TOTAL	0.127128	0.121493	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.332903

MEAN WIND SPEED (m/s) = 1.29
NUMBER OF OBSERVATIONS = 2836

ALL PASQUILL STABILITY CLASSES

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.014673	0.021834	0.004813	0.000352	0.000000	0.000117	0.000000	0.000000	0.041789
NE	0.019838	0.020542	0.005752	0.000704	0.000000	0.000000	0.000000	0.000000	0.046836
ENE	0.010095	0.021481	0.024299	0.003991	0.000000	0.000000	0.000000	0.000000	0.059866
E	0.009978	0.027233	0.013617	0.000470	0.000000	0.000000	0.000000	0.000000	0.051297
ESE	0.011504	0.033337	0.012208	0.000352	0.000000	0.000000	0.000000	0.000000	0.057401
SE	0.011269	0.027820	0.016082	0.003756	0.000235	0.000000	0.000000	0.000000	0.059162
SSE	0.006808	0.018782	0.019251	0.011738	0.002465	0.000470	0.000000	0.000000	0.059514
S	0.008217	0.013147	0.011386	0.008569	0.002817	0.000704	0.000117	0.000000	0.044958
SSW	0.005517	0.009626	0.009978	0.009273	0.003169	0.000822	0.000822	0.000117	0.039324
SW	0.005987	0.011738	0.007982	0.001643	0.000939	0.000352	0.000117	0.000000	0.028759
WSW	0.004226	0.005165	0.004695	0.003404	0.000587	0.000470	0.000235	0.000000	0.018782
W	0.016903	0.014908	0.010447	0.005048	0.001878	0.000235	0.000000	0.000000	0.049419
WNW	0.031811	0.052471	0.042963	0.023242	0.010799	0.005634	0.002700	0.000117	0.169738
NW	0.022420	0.038267	0.022773	0.009273	0.003052	0.001174	0.000235	0.000000	0.097195
NNW	0.015730	0.021716	0.004578	0.000939	0.000117	0.000000	0.000000	0.000000	0.043080
N	0.009508	0.009391	0.001526	0.000704	0.000117	0.000000	0.000000	0.000000	0.021247
CALM									0.111633
TOTAL	0.204484	0.347459	0.212349	0.083461	0.026177	0.009978	0.004226	0.000235	1.000000

MEAN WIND SPEED (m/s) = 2.59
NUMBER OF OBSERVATIONS = 8519

FREQUENCY OF OCCURENCE OF STABILITY CLASSES

A : 25.0%
B : 8.5%
C : 4.6%
D : 17.9%
E : 10.7%
F : 33.3%

APPENDIX B
OUTPUT FROM TANKS PROGRAM

TANKS 4.0
Emissions Report - Summary Format
Tank Identification and Physical Characteristics

Identification

User Identification:	methanol
City:	Williamtown RAAF
State:	NSW
Company:	Manildra Park
Type of Tank:	Internal Floating Roof Tank
Description:	Methanol storag tsnk

Tank Dimensions

Diameter (ft):	33.00
Volume (gallons):	113,594.00
Turnovers:	17.82
Self Supp. Roof? (y/n):	Y
No. of Columns:	0.00
Eff. Col. Diam. (ft):	0.00

Paint Characteristics

Internal Shell Condition:	Gunite Lining
Shell Color/Shade:	White/White
Shell Condition:	Good
Roof Color/Shade:	White/White
Roof Condition:	Good

Rim-Seal System

Primary Seal:	Vapor-mounted
Secondary Seal:	None

Deck Characteristics

Deck Fitting Category:	Typical
Deck Type:	Welded

Deck Fitting/Status	Quantity
Access Hatch (24-in. Diam.)/Unbolted Cover, Ungasketed	1
Automatic Gauge Float Well/Unbolted Cover, Ungasketed	1
Roof Leg or Hanger Well/Adjustable	11

TANKS 4.0
Emissions Report - Summary Format
Tank Identification and Physical Characteristics

Sample Pipe or Well (24-in. Diam.)/Slit Fabric Seal 10% Open	1
Vacuum Breaker (10-in. Diam.)/Weighted Mech. Actuation, Gask.	1

Meteorological Data used in Emissions Calculations: Williamtown RAAF, NSW (Avg Atmospheric Pressure = 14.73 psia)

TANKS 4.0
Emissions Report - Summary Format
Liquid Contents of Storage Tank

		Daily Liquid Surf. Temperatures (deg F)			Liquid Bulk	Vapor Pressures (psia)			Vapor	Liquid	Vapor		
Mixture/Component	Month	Avg.	Min.	Max.	Temp. (deg F)	Avg.	Min.	Max.	Mol. Weight	Mass Fract.	Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Methyl alcohol	All	65.71	60.46	70.96	63.67	1.7223	N/A	N/A	32.0400			32.04	Option 2: A=7.897, B=1474.08, C=229.13

TANKS 4.0
Emissions Report - Summary Format
Individual Tank Emission Totals

Annual Emissions Report

	Losses(lbs)				
Components	Rim Seal Loss	Withdrawal Loss	Deck Fitting Loss	Deck Seam Loss	Total Emissions
Methyl alcohol	220.15	1,369.41	154.43	0.00	1,743.99

APPENDIX C
AUSPLUME MODEL OUTPUT FILE

1

Manildra Park Methanol

Concentration or deposition	Concentration
Emission rate units	grams/second
Concentration units	milligrams/m3
Units conversion factor	1.00E+03
Constant background concentration	0.00E+00
Terrain effects	None
Smooth stability class changes?	No
Other stability class adjustments ("urban modes")	None
Ignore building wake effects?	No
Decay coefficient (unless overridden by met. file)	0.000
Anemometer height	10 m
Roughness height at the wind vane site	0.500 m
Use the convective PDF algorithm?	No

DISPERSION CURVES

Horizontal dispersion curves for sources <100m high	Pasquill-Gifford
Vertical dispersion curves for sources <100m high	Pasquill-Gifford
Horizontal dispersion curves for sources >100m high	Briggs Rural
Vertical dispersion curves for sources >100m high	Briggs Rural
Enhance horizontal plume spreads for buoyancy?	Yes
Enhance vertical plume spreads for buoyancy?	Yes
Adjust horizontal P-G formulae for roughness height?	Yes
Adjust vertical P-G formulae for roughness height?	Yes
Roughness height	0.800m
Adjustment for wind directional shear	None

PLUME RISE OPTIONS

Gradual plume rise?	Yes
Stack-tip downwash included?	Yes
Building downwash algorithm:	PRIME method.
Entrainment coeff. for neutral & stable lapse rates	0.60,0.60
Partial penetration of elevated inversions?	No
Disregard temp. gradients in the hourly met. file?	No

and in the absence of boundary-layer potential temperature gradients given by the hourly met. file, a value from the following table (in K/m) is used:

Wind Speed Category	Stability Class A	B	C	D	E	F
1	0.000	0.000	0.000	0.000	0.020	0.035
2	0.000	0.000	0.000	0.000	0.020	0.035
3	0.000	0.000	0.000	0.000	0.020	0.035
4	0.000	0.000	0.000	0.000	0.020	0.035
5	0.000	0.000	0.000	0.000	0.020	0.035
6	0.000	0.000	0.000	0.000	0.020	0.035

WIND SPEED CATEGORIES

Boundaries between categories (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Urban" values (unless overridden by met. file)

AVERAGING TIMES

1 hour

1

Manildra Park Methanol

SOURCE CHARACTERISTICS

STACK SOURCE: SCRUB

X(m) Y(m) Ground Elev. Stack Height Diameter Temperature Speed

386079	6359698	0m	17m	0.10m	25C	2.5m/s

______ Effective building dimensions (in metres) ______

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	0	0	10	10	10	0	0	0	0	0	0	0
Effective building height	0	0	6	6	6	0	0	0	0	0	0	0
Along-flow building length	0	0	12	12	13	0	0	0	0	0	0	0
Along-flow distance from stack	0	0	-38	-38	-38	0	0	0	0	0	0	0
Across-flow distance from stack	0	0	5	-1	-7	0	0	0	0	0	0	0

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	0	0	0	0	0	0	0	0	0	0	0	0
Effective building height	0	0	0	0	0	0	0	0	0	0	0	0
Along-flow building length	0	0	0	0	0	0	0	0	0	0	0	0
Along-flow distance from stack	0	0	0	0	0	0	0	0	0	0	0	0
Across-flow distance from stack	0	0	0	0	0	0	0	0	0	0	0	0

Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	0	0	0	0	0	0	0	0	0	0	0	0
Effective building height	0	0	0	0	0	0	0	0	0	0	0	0
Along-flow building length	0	0	0	0	0	0	0	0	0	0	0	0
Along-flow distance from stack	0	0	0	0	0	0	0	0	0	0	0	0
Across-flow distance from stack	0	0	0	0	0	0	0	0	0	0	0	0

(Constant) emission rate = 8.50E-01 grams/second
No gravitational settling or scavenging.

1

Manildra Park Methanol

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):

```
380000.m  380100.m  380200.m  380300.m  380400.m  380500.m  380600.m
380700.m  380800.m  380900.m  381000.m  381100.m  381200.m  381300.m
381400.m  381500.m  381600.m  381700.m  381800.m  381900.m  382000.m
382100.m  382200.m  382300.m  382400.m  382500.m  382600.m  382700.m
382800.m  382900.m  383000.m  383100.m  383200.m  383300.m  383400.m
383500.m  383600.m  383700.m  383800.m  383900.m  384000.m  384100.m
384200.m  384300.m  384400.m  384500.m  384600.m  384700.m  384800.m
384900.m  385000.m  385100.m  385200.m  385300.m  385400.m  385500.m
385600.m  385700.m  385800.m  385900.m  386000.m  386100.m  386200.m
386300.m  386400.m  386500.m  386600.m  386700.m  386800.m  386900.m
387000.m  387100.m  387200.m  387300.m  387400.m  387500.m  387600.m
387700.m  387800.m  387900.m  388000.m  388100.m  388200.m  388300.m
388400.m  388500.m  388600.m  388700.m  388800.m  388900.m  389000.m
389100.m  389200.m  389300.m  389400.m  389500.m  389600.m  389700.m
389800.m  389900.m  390000.m
```

and these y-values (or northings):

```
6356000.m 6356100.m 6356200.m 6356300.m 6356400.m 6356500.m 6356600.m
6356700.m 6356800.m 6356900.m 6357000.m 6357100.m 6357200.m 6357300.m
6357400.m 6357500.m 6357600.m 6357700.m 6357800.m 6357900.m 6358000.m
6358100.m 6358200.m 6358300.m 6358400.m 6358500.m 6358600.m 6358700.m
6358800.m 6358900.m 6359000.m 6359100.m 6359200.m 6359300.m 6359400.m
6359500.m 6359600.m 6359700.m 6359800.m 6359900.m 6360000.m 6360100.m
6360200.m 6360300.m 6360400.m 6360500.m 6360600.m 6360700.m 6360800.m
6360900.m 6361000.m 6361100.m 6361200.m 6361300.m 6361400.m 6361500.m
6361600.m 6361700.m 6361800.m 6361900.m 6362000.m 6362100.m 6362200.m
6362300.m 6362400.m 6362500.m 6362600.m 6362700.m 6362800.m 6362900.m
6363000.m 6363100.m 6363200.m 6363300.m 6363400.m 6363500.m 6363600.m
6363700.m 6363800.m 6363900.m 6364000.m 6364100.m 6364200.m 6364300.m
6364400.m 6364500.m 6364600.m 6364700.m 6364800.m 6364900.m 6365000.m
6365100.m 6365200.m 6365300.m 6365400.m 6365500.m 6365600.m 6365700.m
6365800.m 6365900.m 6366000.m
```

METEOROLOGICAL DATA : PWCS (Met MANAGER)

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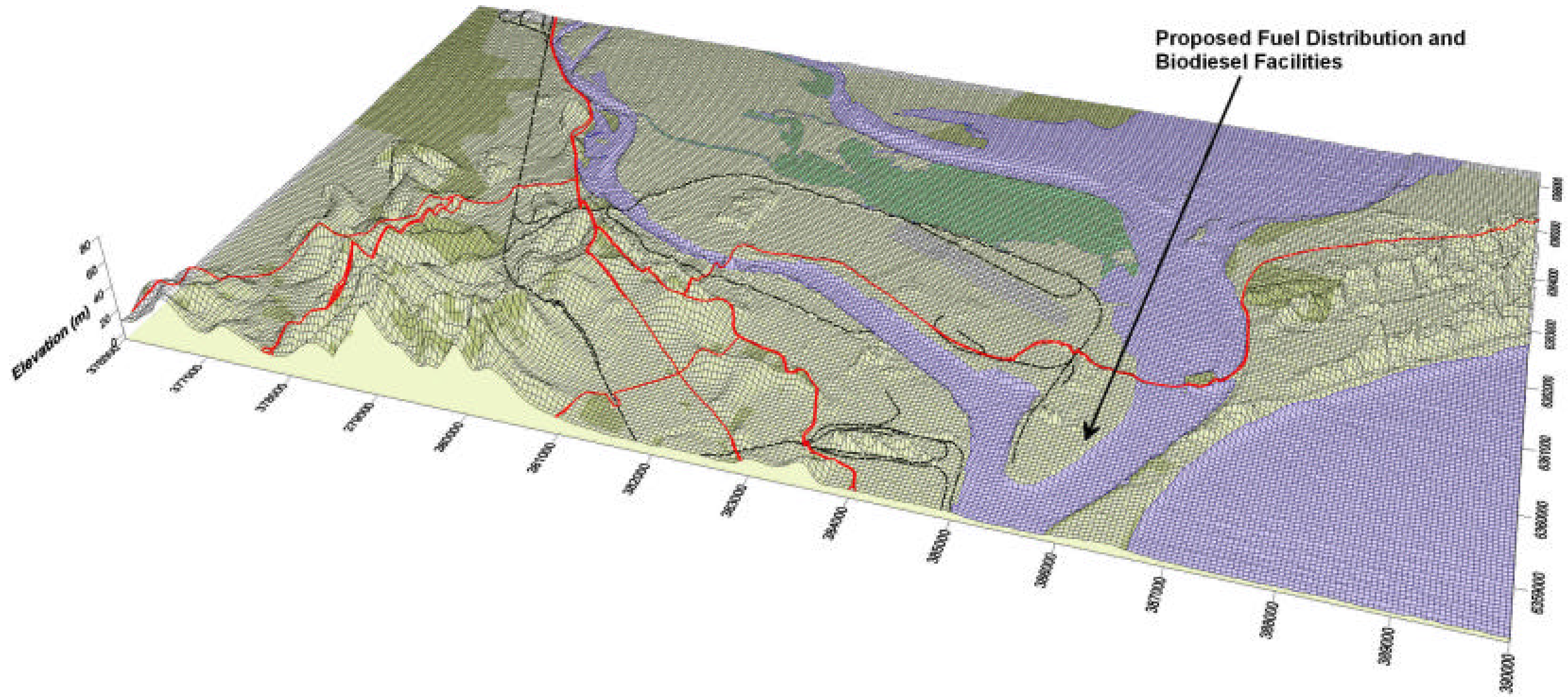
1 Peak values for the 100 worst cases (in milligrams/m3)
Averaging time = 1 hour

Rank	Value	Time Recorded hour,date	Coordinates (* denotes polar)
1	3.22E-01	08,25/02/05	(386100, 6359600, 0.0)
2	3.20E-01	07,28/09/04	(386100, 6359800, 0.0)
3	3.11E-01	08,23/03/05	(386100, 6359800, 0.0)
4	3.03E-01	09,23/03/05	(386100, 6359800, 0.0)
5	2.82E-01	06,26/02/05	(386200, 6359800, 0.0)
6	2.81E-01	03,06/02/05	(386200, 6359600, 0.0)
7	2.73E-01	24,25/11/04	(386200, 6359600, 0.0)
8	2.71E-01	10,27/03/05	(386200, 6359700, 0.0)
9	2.70E-01	07,01/11/04	(386100, 6359600, 0.0)
10	2.68E-01	21,01/08/04	(386100, 6359500, 0.0)
11	2.67E-01	03,25/03/05	(386200, 6359600, 0.0)
12	2.66E-01	06,12/02/05	(386200, 6359600, 0.0)
13	2.61E-01	08,11/07/04	(386200, 6359700, 0.0)
14	2.61E-01	07,14/02/05	(386200, 6359700, 0.0)
15	2.61E-01	08,28/03/05	(386200, 6359700, 0.0)
16	2.60E-01	10,23/03/05	(386100, 6359800, 0.0)
17	2.53E-01	12,23/03/05	(386100, 6359800, 0.0)
18	2.52E-01	07,24/08/04	(386200, 6359600, 0.0)
19	2.51E-01	24,26/03/05	(386200, 6359800, 0.0)
20	2.49E-01	07,25/09/04	(386200, 6359700, 0.0)
21	2.48E-01	06,04/02/05	(386200, 6359500, 0.0)
22	2.48E-01	23,22/05/04	(386300, 6359600, 0.0)
23	2.48E-01	22,24/04/05	(386300, 6359600, 0.0)
24	2.48E-01	22,15/07/04	(386200, 6359500, 0.0)
25	2.47E-01	02,23/05/04	(386300, 6359600, 0.0)
26	2.47E-01	23,02/07/04	(386300, 6359600, 0.0)
27	2.47E-01	03,15/02/05	(386200, 6359500, 0.0)
28	2.47E-01	01,22/10/04	(386300, 6359700, 0.0)
29	2.47E-01	05,06/02/05	(386300, 6359700, 0.0)
30	2.46E-01	03,04/02/05	(386200, 6359500, 0.0)
31	2.45E-01	11,23/03/05	(386100, 6359800, 0.0)
32	2.45E-01	24,21/10/04	(386300, 6359700, 0.0)
33	2.45E-01	05,22/10/04	(386300, 6359700, 0.0)
34	2.45E-01	02,22/10/04	(386300, 6359700, 0.0)
35	2.44E-01	02,16/09/04	(386300, 6359600, 0.0)
36	2.44E-01	04,15/11/04	(386300, 6359600, 0.0)
37	2.44E-01	07,28/03/05	(386300, 6359600, 0.0)
38	2.44E-01	22,05/02/05	(386000, 6359500, 0.0)
39	2.43E-01	07,18/11/04	(386200, 6359600, 0.0)
40	2.42E-01	08,09/04/05	(386100, 6359600, 0.0)
41	2.42E-01	08,10/04/05	(386200, 6359600, 0.0)
42	2.42E-01	09,09/04/05	(386100, 6359600, 0.0)
43	2.40E-01	22,23/04/05	(385900, 6359500, 0.0)
44	2.40E-01	06,18/11/04	(386300, 6359600, 0.0)
45	2.40E-01	01,01/04/05	(386300, 6359600, 0.0)
46	2.40E-01	02,12/10/04	(386300, 6359600, 0.0)
47	2.39E-01	24,05/02/05	(385900, 6359500, 0.0)
48	2.39E-01	06,07/10/04	(386300, 6359600, 0.0)
49	2.39E-01	02,15/11/04	(386300, 6359600, 0.0)
50	2.39E-01	05,28/03/05	(386300, 6359600, 0.0)
51	2.39E-01	05,04/02/05	(386200, 6359500, 0.0)
52	2.38E-01	02,06/02/05	(386300, 6359600, 0.0)
53	2.38E-01	03,19/12/04	(386200, 6359500, 0.0)
54	2.38E-01	08,04/01/05	(386200, 6359700, 0.0)
55	2.37E-01	04,08/02/05	(386200, 6359500, 0.0)
56	2.37E-01	05,12/02/05	(386200, 6359500, 0.0)
57	2.37E-01	06,11/01/05	(386100, 6359900, 0.0)
58	2.36E-01	01,08/02/05	(386200, 6359500, 0.0)
59	2.36E-01	03,15/11/04	(386300, 6359600, 0.0)
60	2.36E-01	04,20/08/04	(386300, 6359700, 0.0)
61	2.36E-01	02,11/02/05	(386300, 6359700, 0.0)
62	2.36E-01	03,01/04/05	(386300, 6359700, 0.0)
63	2.36E-01	05,24/08/04	(386300, 6359700, 0.0)
64	2.36E-01	05,13/04/05	(386300, 6359700, 0.0)
65	2.35E-01	18,16/07/04	(386100, 6359500, 0.0)
66	2.34E-01	24,02/07/04	(386300, 6359600, 0.0)
67	2.33E-01	19,01/08/04	(386000, 6359500, 0.0)
68	2.33E-01	24,21/04/05	(386300, 6359600, 0.0)

69	2.32E-01	01,02/04/05	(386300,	6359600,	0.0)
70	2.31E-01	19,13/08/04	(386100,	6359500,	0.0)
71	2.31E-01	08,10/02/05	(386100,	6359800,	0.0)
72	2.31E-01	04,02/04/05	(386300,	6359500,	0.0)
73	2.30E-01	01,07/05/04	(386300,	6359500,	0.0)
74	2.30E-01	18,29/05/04	(386300,	6359500,	0.0)
75	2.30E-01	06,12/01/05	(386300,	6359500,	0.0)
76	2.30E-01	23,13/10/04	(386100,	6359500,	0.0)
77	2.29E-01	23,16/08/04	(386300,	6359700,	0.0)
78	2.29E-01	03,21/01/05	(386300,	6359700,	0.0)
79	2.29E-01	05,05/02/05	(386300,	6359700,	0.0)
80	2.28E-01	07,23/03/05	(386100,	6360000,	0.0)
81	2.27E-01	07,19/01/05	(386200,	6359600,	0.0)
82	2.26E-01	22,14/09/04	(386300,	6359600,	0.0)
83	2.26E-01	07,19/02/05	(386100,	6359600,	0.0)
84	2.25E-01	06,08/09/04	(386300,	6359500,	0.0)
85	2.25E-01	21,02/06/04	(386100,	6359400,	0.0)
86	2.23E-01	24,11/10/04	(386200,	6359400,	0.0)
87	2.22E-01	21,12/10/04	(386200,	6359400,	0.0)
88	2.22E-01	06,08/02/05	(386200,	6359500,	0.0)
89	2.21E-01	02,12/04/05	(386100,	6359900,	0.0)
90	2.21E-01	10,04/01/05	(386100,	6359600,	0.0)
91	2.19E-01	04,04/02/05	(386300,	6359500,	0.0)
92	2.18E-01	23,08/10/04	(386300,	6359600,	0.0)
93	2.18E-01	04,11/01/05	(386200,	6360000,	0.0)
94	2.17E-01	24,31/03/05	(386400,	6359600,	0.0)
95	2.16E-01	07,11/07/04	(386400,	6359600,	0.0)
96	2.14E-01	17,09/11/04	(386000,	6359700,	0.0)
97	2.14E-01	09,24/02/05	(386000,	6359700,	0.0)
98	2.14E-01	05,08/04/05	(385800,	6359500,	0.0)
99	2.13E-01	11,05/03/05	(386000,	6359700,	0.0)
100	2.13E-01	03,26/11/04	(386400,	6359600,	0.0)

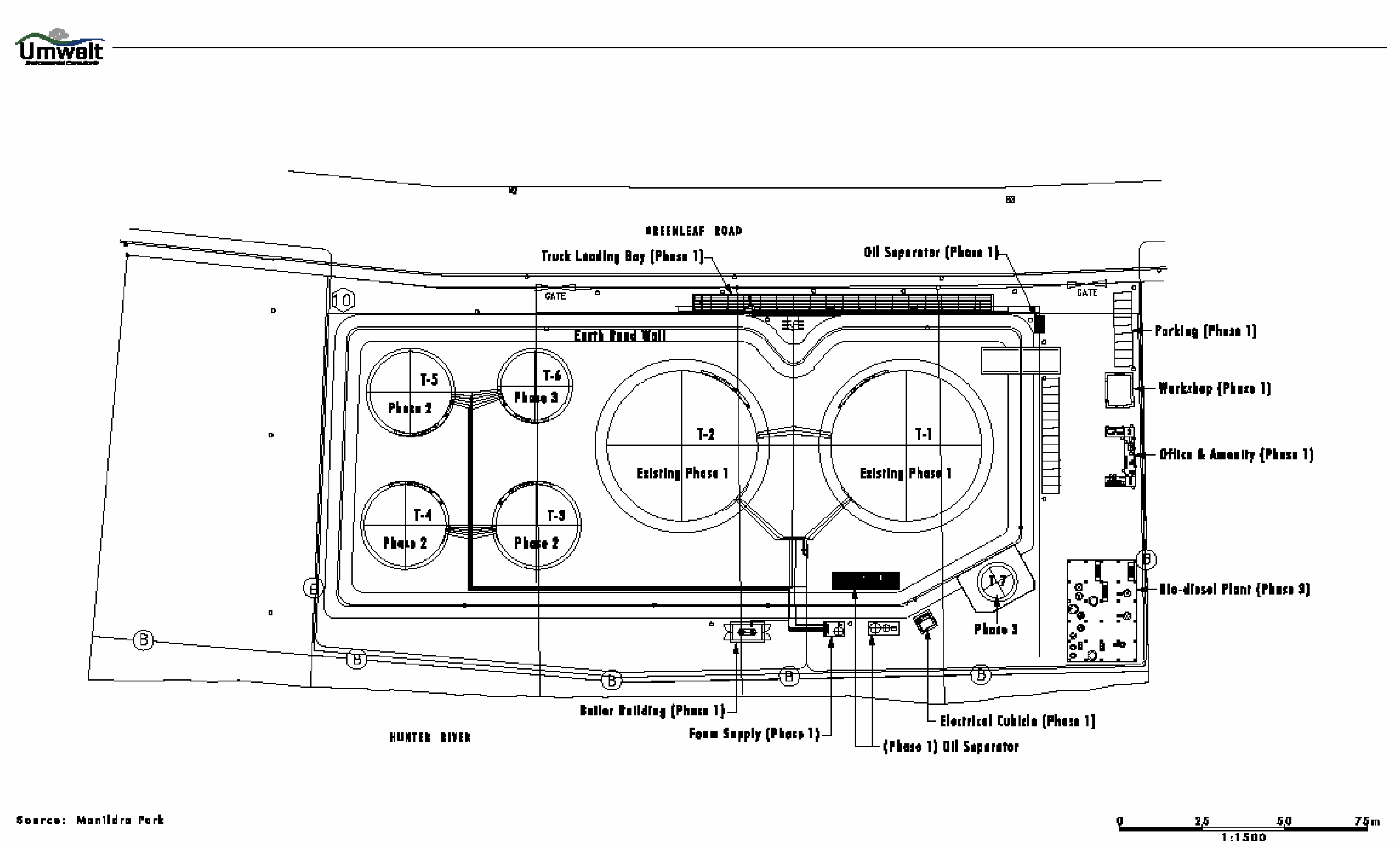
FIGURES

Location of study area



Pseudo 3-dimensional representation of terrain in the study area

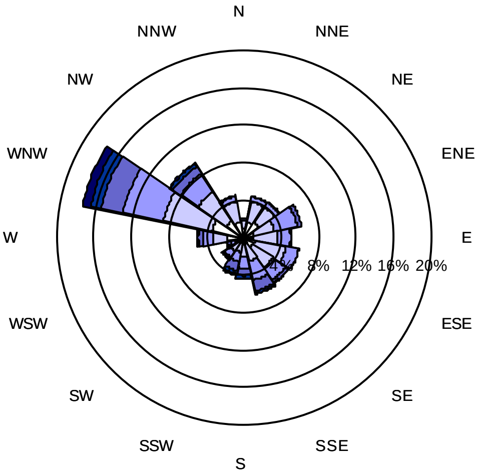
FIGURE 2



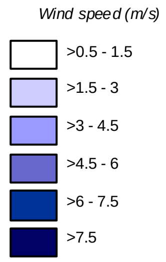
SITE LAYOUT

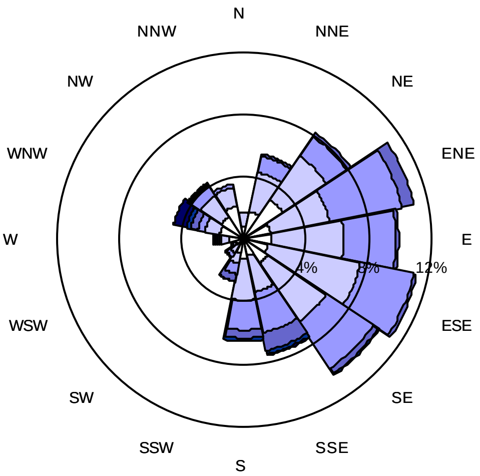
FIGURE 3

Annual and seasonal windroses for PWCS - Kooragang Island (2004/2005)

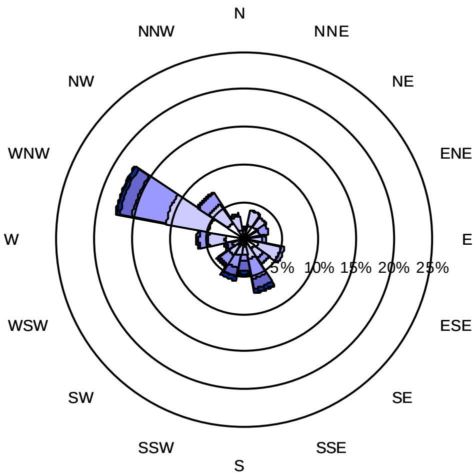


Annual
Calms = 9.4%

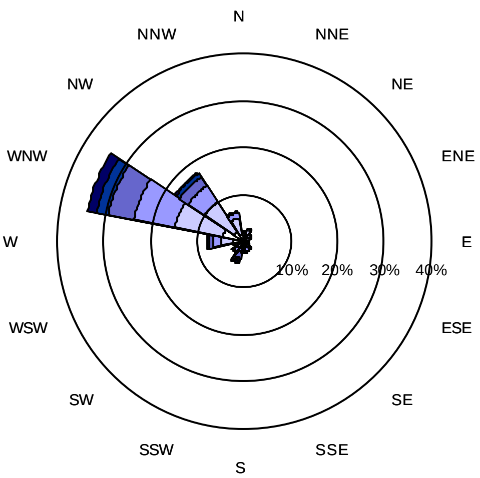




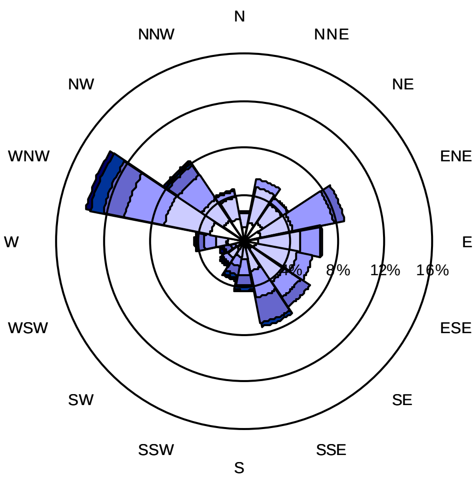
Summer
Calms = 8.2%



Autumn
Calms = 15.2%



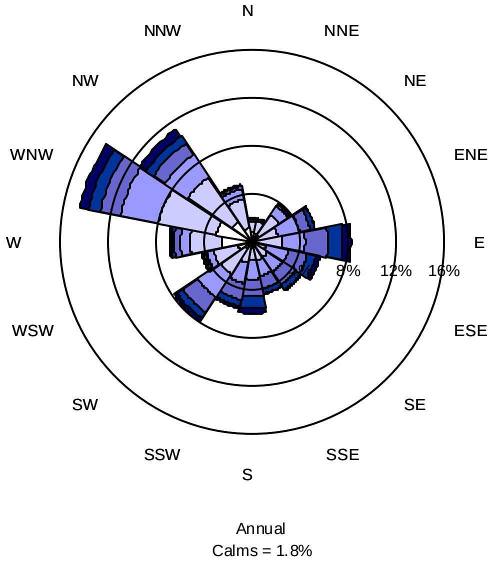
Winter
Calms = 6.1%

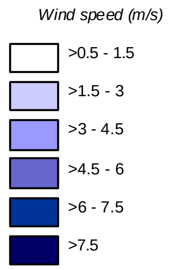


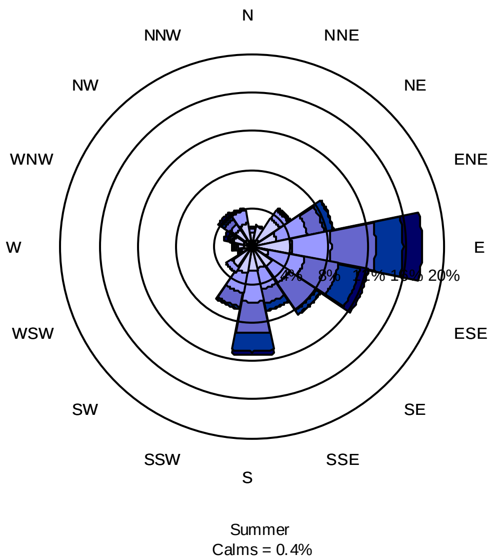
Spring
Calms = 8.7%

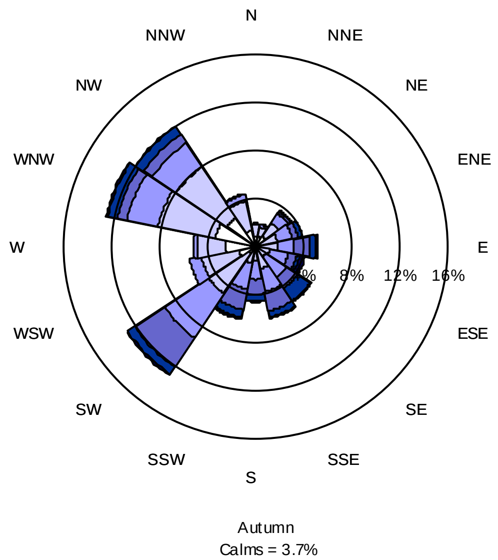
FIGURE 4

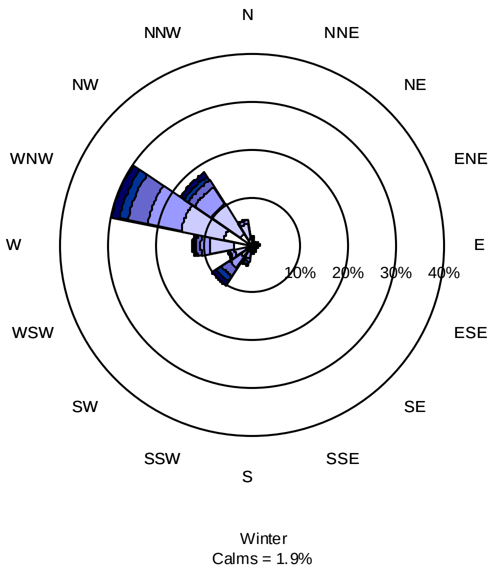
Annual and seasonal windroses for Steel River (2001)











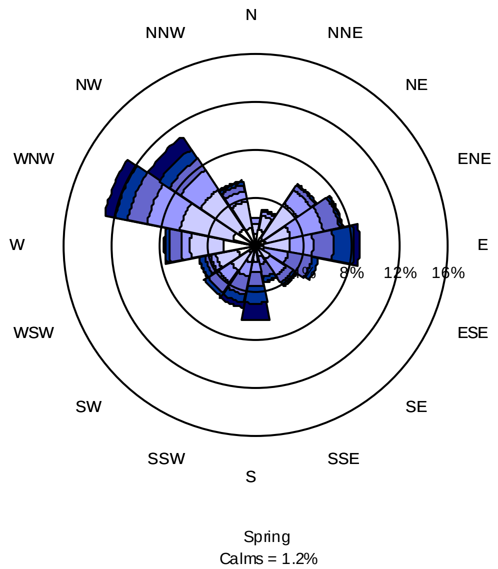
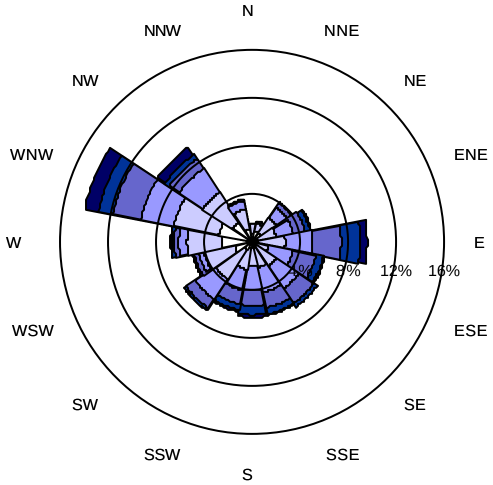
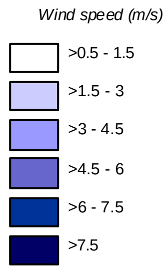


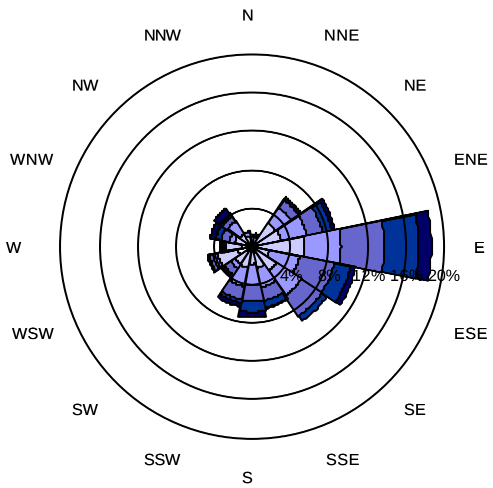
FIGURE 5

Annual and seasonal windroses for Steel River (2002)

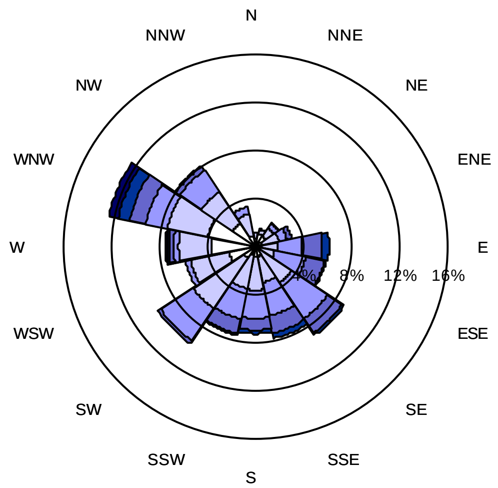


Annual
Calms = 0.8%

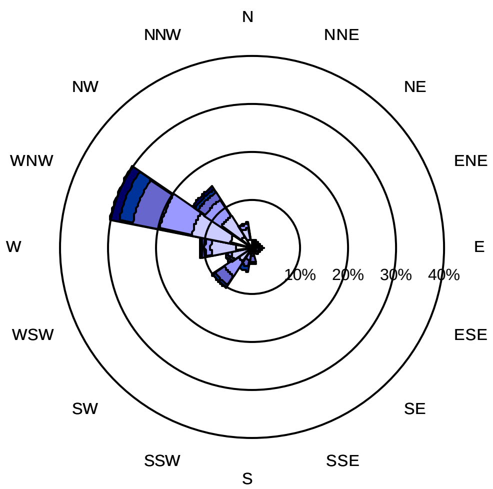




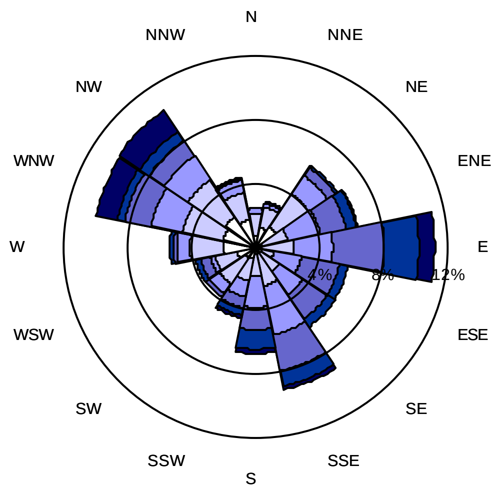
Summer
Calms = 0.2%



Autumn
Calms = 1.1%



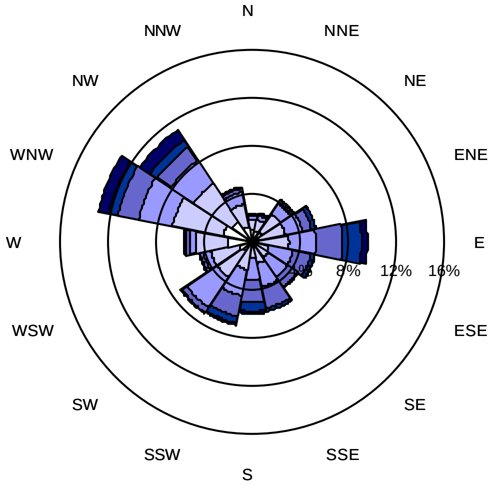
Winter
Calms = 0.9%



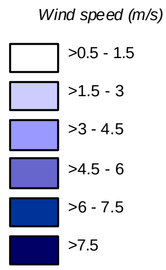
Spring
Calms = 0.7%

FIGURE 6

Annual and seasonal windroses for Steel River (2003)



Annual
Calms = 0.7%



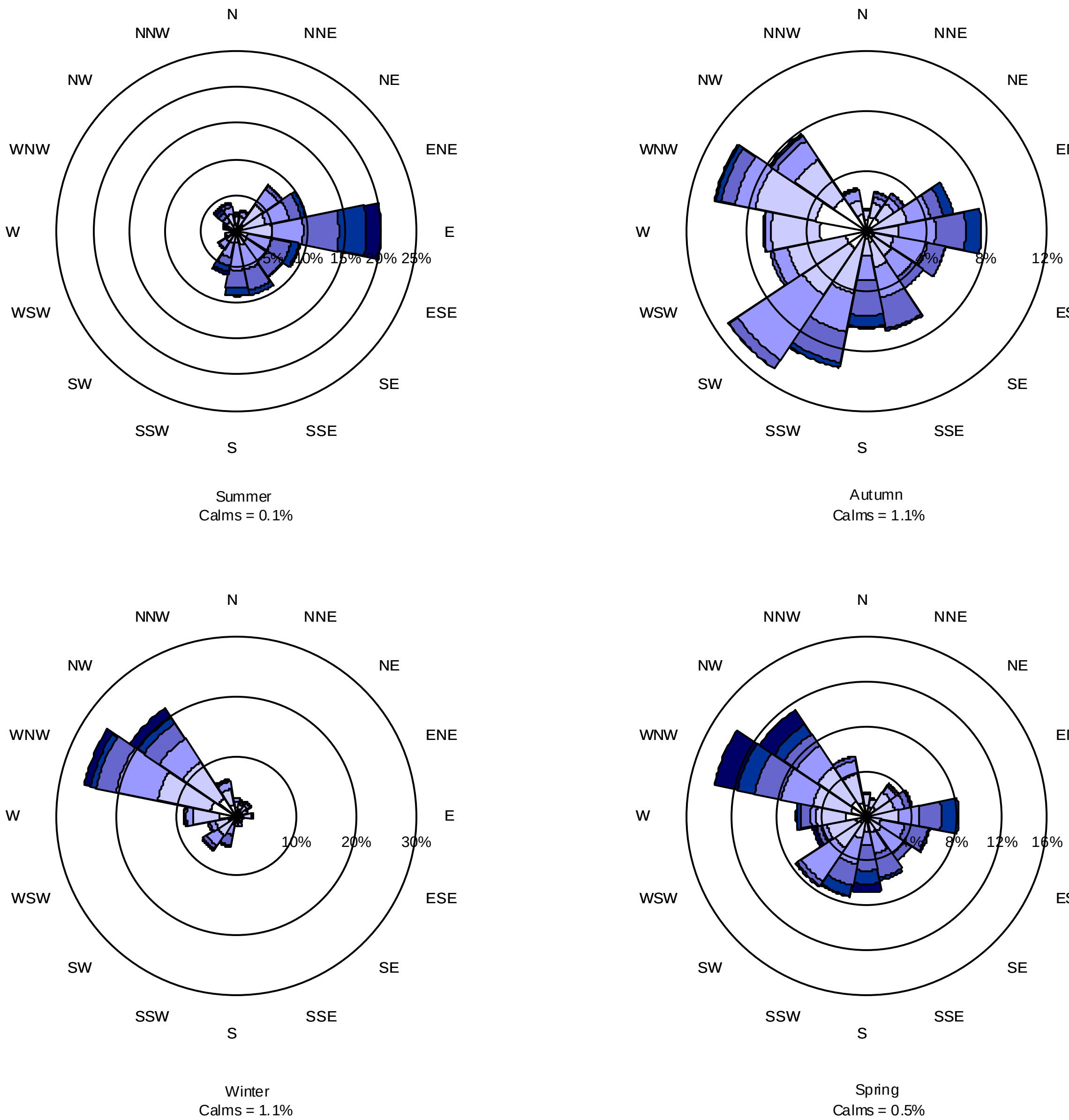
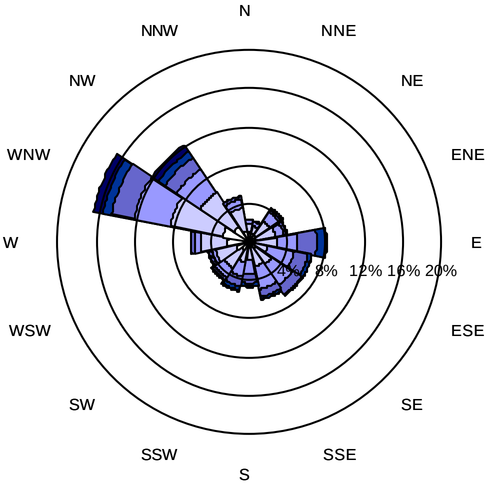
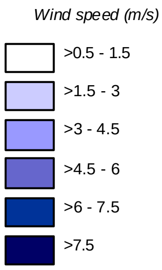


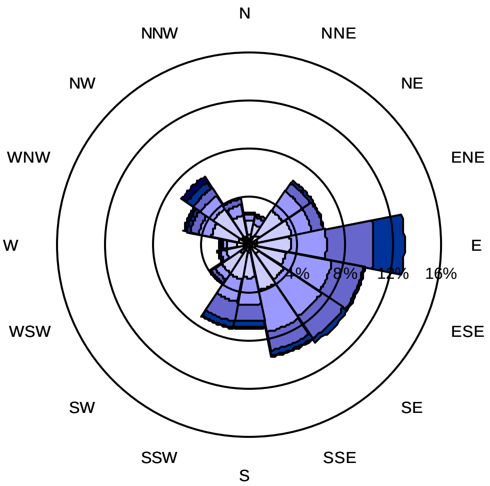
FIGURE 7

Annual and seasonal windroses for Steel River (2004)

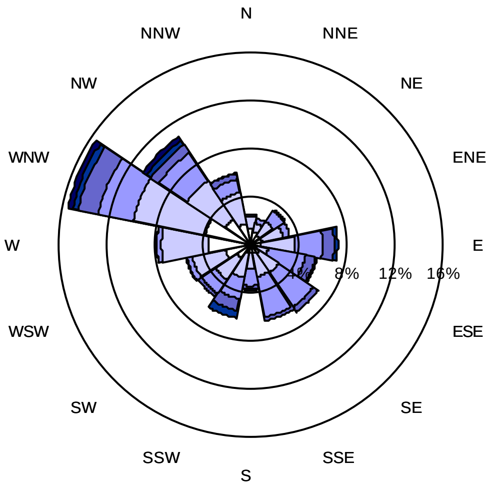


Annual
Calms = 0.6%

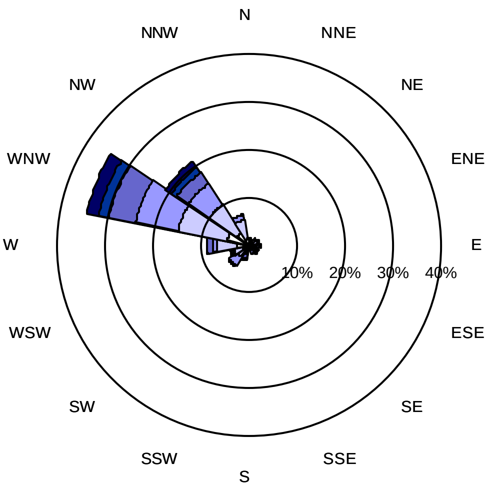




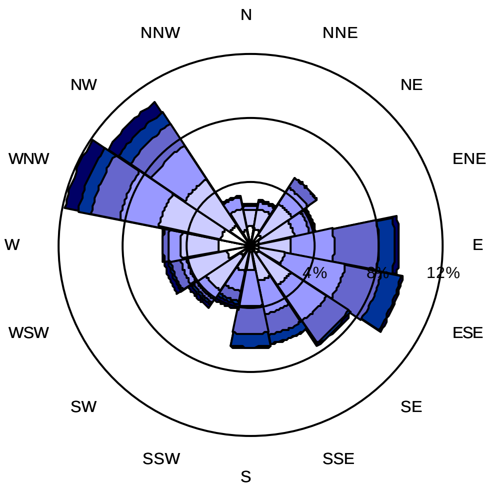
Summer
Calms = 0.2%



Autumn
Calms = 1.2%



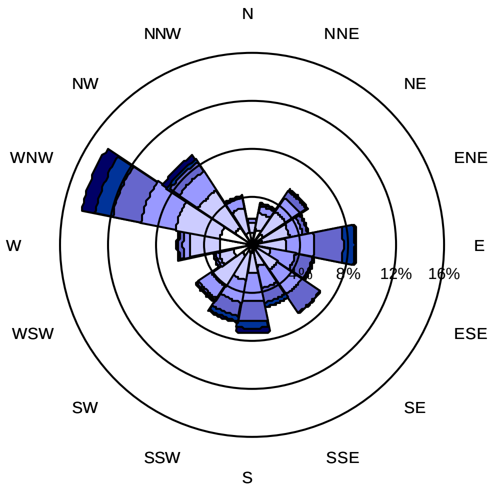
Winter
Calms = 0.8%



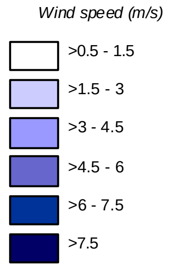
Spring
Calms = 0.3%

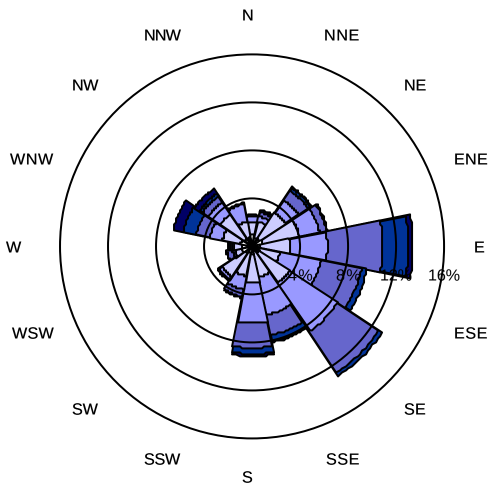
FIGURE 8

Annual and seasonal windroses for Steel River (2005)

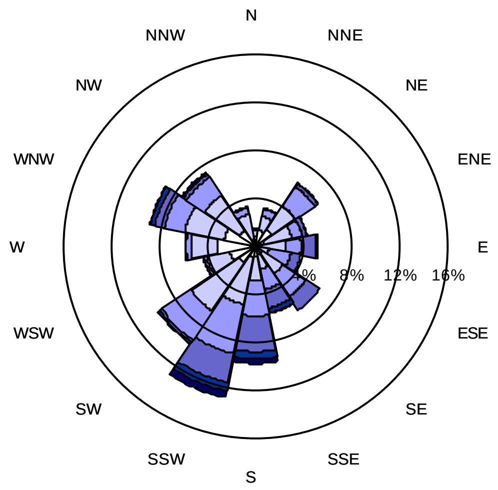


Annual
Calms = 0.7%

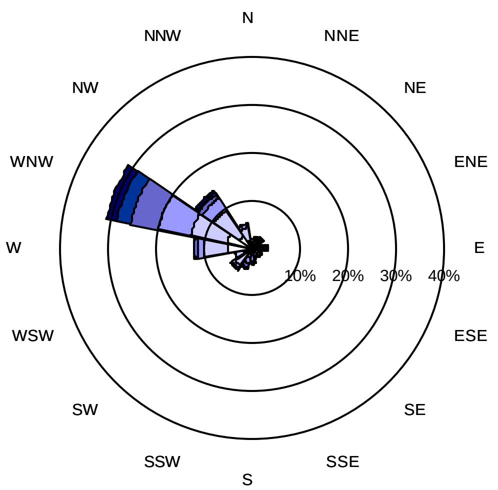




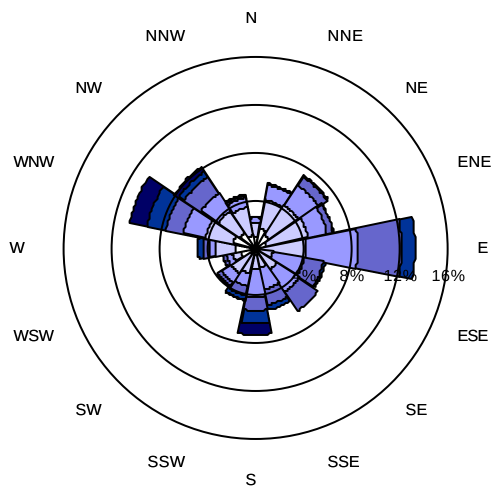
Summer
Calms = 0.2%



Autumn
Calms = 0.8%

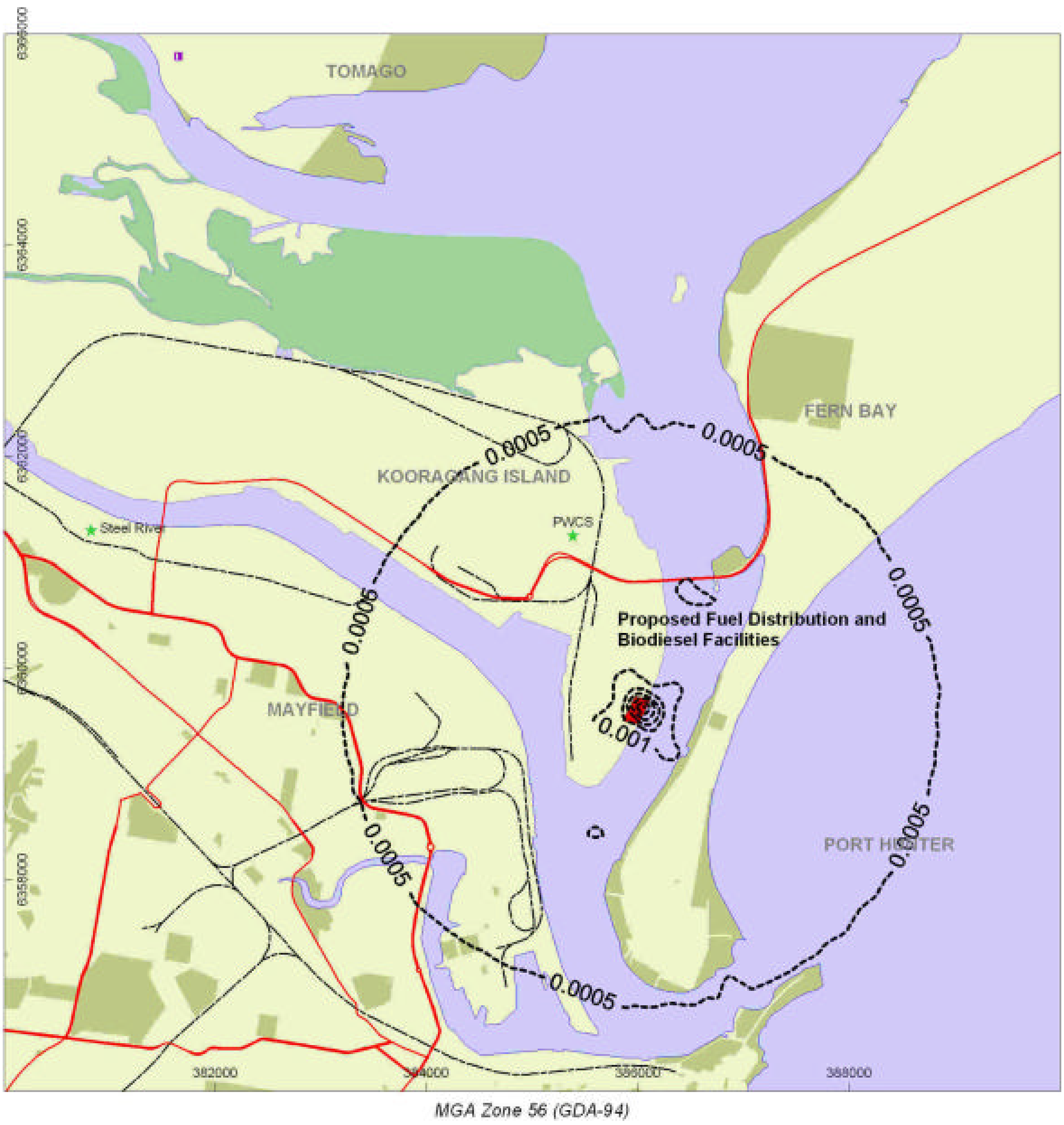


Winter
Calms = 1.2%



Spring
Calms = 0.6%

FIGURE 9



MGA Zone 56 (GDA-94)

Predicted maximum 1-hour average carbon monoxide concentration (mg/m^3)

DECC goal – 30 mg/m^3

FIGURE 10

Predicted maximum 8-hour average carbon monoxide concentration (mg/m³)

DECC goal – 10 mg/m³

Predicted maximum 1-hour average nitrogen dioxide concentration (mg/m³)

DECC goal – 246 mg/m³

FIGURE 12

Predicted annual average nitrogen dioxide concentration (mg/m³)

DECC goal – 62 mg/m³

FIGURE 13

Predicted maximum 1-hour average sulfur dioxide concentration (μg/m^3)

DECC goal – 570 μg/m^3

FIGURE 14

Predicted maximum 24-hour average sulfur dioxide concentration (mg/m³)

DECC goal – 228 mg/m³

FIGURE 15

Predicted annual average sulfur dioxide concentration (mg/m³)

DECC goal – 60 mg/m³

FIGURE 16

Predicted maximum 24-hour average PM_{10} concentration (mg/m[3])

DECC goal – 50 mg/m[3]

FIGURE 17

Predicted annual average PM_{10} concentration ($\mu g/m^3$)

DECC goal – 30 $\mu g/m^3$

FIGURE 18

Predicted 99.9th percentile 1-hour average methanol concentration – mg/m³

DECC goal – 3 mg/m³

FIGURE 19