Carter Street Lidcombe
Urban Activation Precinct

Appendix I
Odour Assessment

February 2014

Pacific Environment Limited

Consulting • Technologies • Monitoring • Toxicology

FINAL REPORT

CARTER STREET OLYMPIC PARK – ODOUR ASSESSMENT

Department of Planning & Infrastructure

Job No: **8266**

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Pacific Environment Limited

PROJECT TITLE: CARTER STREET OLYMPIC PARK – ODOUR ASSESSMENT

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PREPARED FOR: Department of Planning & Infrastructure

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EXECUTIVE SUMMARY

This report has been prepared by Pacific Environment for the NSW Department of Planning & Infrastructure (DP&I). The DP&I propose to rezone the Carter Street Urban Activation Precinct (UAP) in Sydney Olympic Park, NSW to permit a range of uses including residential. The proposed UAP is located adjacent to the existing Homebush Bay Liquid Waste Treatment Plant (LWTP).

This report has assessed the existing and proposed odorous impacts associated with the Homebush Bay LWTP on the proposed UAP. Local land use, terrain and meteorology have been considered in a quantitative odour impact assessment that was completed using the CALPUFF atmospheric dispersion model.

Four odour emission scenarios were modelled to capture the different operational scenarios at the Homebush Bay LWTP. The predicted odour levels at existing residential receptors are predicted to comply with the NSW EPA odour assessment criterion of 2 odour units (OU) in Scenario 1 when the Odour Control Furnace (OCF) is operating under normal conditions. For all other scenarios, under adverse meteorological conditions, odour concentrations are predicted to exceed the EPA assessment criterion at the nearby existing residences and over sections of the proposed UAP.

The percentage area that the proposed UAP is impacted under worst-case odour emission and dispersion scenarios is anticipated to be approximately 25%, with the impacted area being located to north west of the proposed UAP land release.

The study concludes that based on predicted zones of odour impact, it is possible to mitigate the potential for adverse odour impact through progressive development of the UAP. Appropriate planning for the UAP site would comprise of progressive development of the UAP from the south west to the north east, with final residential land releases only being available at the end of the useful life of the LWTP.

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This report has been prepared by Pacific Environment for the Department of Planning & Infrastructure (DP&I). DP&I propose to rezone the Carter Street Urban Activation Precinct (UAP) in Sydney Olympic Park, NSW to permit a range of uses including residential. The proposed UAP is located adjacent to the existing Homebush Bay Liquid Waste Treatment Plant (LWTP).

A Stage 1 review was completed based on the complaints history and the existing air quality / odour assessments relevant to the LWTP. As a result of the Stage 1 review, DP&I are seeking further clarity via a quantitative odour assessment to determine the potential odour impacts the LWTP may have on the proposed UAP.

This study has been completed in accordance with the NSW Environment Protection Authority's (EPA) "Approved methods for the modelling and assessment of air pollutants in NSW" (**NSW DEC, 2005**) (herein referred to as the Approved Methods) and the EPA document "Technical Framework: Assessment and management of odours from stationary sources in NSW" (**NSW DEC, 2006**).

2 PROJECT DESCRIPTION AND LOCAL SETTING

DP&I propose to rezone the Carter Street UAP located at Sydney Olympic Park, approximately 12 km west of Sydney. The existing Homebush Bay LWTP is located approximately 80 m north of the northern boundary of the proposed UAP (see **Figure 2.1**). The Homebush Bay LWTP is operated by Transpacific Industries Pty Ltd (Transpacific). The Auburn Resource Recovery Centre is operated by SITA Australia and is located adjacent to the Homebush Bay LWTP.

The local topography is predominantly flat with a few distinguishing features. The surrounding area is characterised by Sydney Olympic Park to the northeast of the proposed UAP and residential and commercial premises in other directions. Haslam Creek runs to the west of the proposed UAP and Parramatta River to the far northeast.

2.1.1 Odour Sources

The main odour sources near the proposed UAP are the existing Homebush Bay LWTP. The Auburn Resource Recovery Centre is also a potential source of odour but there have been no complaints or air assessments specific to the centre from the documentation provided by DP&I or EPA for the purposes of this assessment. On this basis, the potential for odour impacts from Auburn Resource Recovery Centre is considered to be low and not considered further in this assessment.

The Homebush Bay LWTP operates under Environment Protection Licence (EPL) 4560. Odorous emissions are controlled by the odour control furnace (OCF) and main thermal oil heater (MTOH). The OCF was installed in 2005 to replace the central thermal oxidiser and the residue processing plant thermal oxidiser. When the OCF is not in operation the carbon bed filter (S851) is used to treat odorous emissions along with the MTOH. In addition, previous odour investigations (**The Odour Unit; 2013**) indicate that odorous emissions are expected from the truck unloading bay and the residual bin.

Figure 2.1: Location of proposed UAP

3 AIR QUALITY GOALS

3.1 Odour Assessment Criteria

3.1.1 Measuring odour concentration

There are no instrument-based methods that can measure an odour response in the same way as the human nose. Therefore "dynamic olfactometry" is typically used as the basis of odour management by regulatory authorities.

Dynamic olfactometry is the measurement of odour by presenting a sample of odorous air diluted to the point where a trained panel of assessors cannot detect a change between the odour free air and the diluted sample. The concentration is then doubled until the difference is observed with certainty. The correlations between the dilution ratios and the panellists' responses are then used to calculate the number of dilutions of the original sample required to achieve the odour detection threshold. The units for odour measurement using dynamic olfactometry are "odour units" (ou) which are dimensionless and are effectively "dilutions to threshold". The detectability of an odour (i.e. whether someone smells it or not) is a sensory property that refers to the theoretical minimum concentration that produces an olfactory response or sensation. However, we note that the panellists used for this work are specially selected based on a reference odorant, n-Butanol.

The theoretical minimum concentration is referred to as the "odour threshold" and is the definition of 1 odour unit (ou). Therefore, an odour concentration of less than 1 ou would theoretically mean there is no odour.

3.1.2 Odour performance criteria

3.1.2.1 Introduction

The determination of air quality goals for odour and their use in the assessment of odour impacts is recognised as a difficult topic in air pollution science. The topic has received considerable attention in recent years and the procedures for assessing odour impacts using dispersion models have been refined considerably. There is still debate in the scientific community about appropriate odour goals as determined by dispersion modelling.

The EPA has developed odour goals and the way in which they should be applied with dispersion models to assess the likelihood of nuisance impact arising from the emission of odour.

There are two factors that need to be considered:

1. What "level of exposure" to odour is considered acceptable to meet current community standards in NSW; and
2. How can dispersion models be used to determine if a source of odour meets the goals which are based on this acceptable level of exposure.

The term "level of exposure" has been used to reflect the fact that odour impacts are determined by several factors the most important of which are (the so-called FIDOL factors):

- the **F**requency of the exposure
- the **I**ntensity of the odour
- the **D**uration of the odour episodes and
- the **O**ffensiveness of the odour
- the **L**ocation of the source

In determining the offensiveness of an odour it needs to be recognised that for most odours the context in which an odour is perceived is also relevant. Some odours, for example the smell of sewage, hydrogen sulfide, butyric acid, landfill gas etc., are likely to be judged offensive regardless of the context in which they occur. Other odours such as the smell of jet fuel may be acceptable at an airport, but not in a house, and diesel exhaust may be acceptable near a busy road, but not in a restaurant.

In summary, whether or not an individual considers an odour to be a nuisance will depend on the FIDOL factors outlined above and although it is possible to derive formulae for assessing odour annoyance in a community, the response of any individual to an odour is still unpredictable. Odour goals need to take account of these factors.

3.1.2.2 Complex mixtures of odorous air pollutants

The Approved Methods (**NSW EPA, 2005**) include ground-level concentration (glc) criteria for complex mixtures of odorous air pollutants. They have been refined by the EPA to take account of population density in a given area. Table 3.1 lists the odour glc criteria to be exceeded not more than 1% of the time, for different population densities.

The difference between odour criteria is based on considerations of risk of odour impact rather than differences in odour acceptability between urban and rural areas. For a given odour level there will be a wide range of responses in the population exposed to the odour. In a densely populated area there will therefore be a greater risk that some individuals within the community will find the odour unacceptable than in a sparsely populated area.

Table 3.1: Odour Performance Criteria for the Assessment of Odour

Population of affected community	glc criterion for complex mixtures of odorous air pollutants * (ou)
≤ ~2	7
~10	6
~30	5
~125	4
~500	3
Urban (2000) and/or schools and hospitals	2

* Nose response time average, 99th percentile

The closest suburb with residential receivers, Newington is located approximately 350 m northwest of the Homebush Bay LWTP. Therefore, as per **Table 3.1**, an impact assessment glc criterion of 2 ou is appropriate for this area, which is considered to be within the Sydney contiguous urban area.

3.1.2.3 Peak-to-mean ratios

It is a common practice to use dispersion models to determine compliance with odour goals. This introduces a complication because conventional Gaussian dispersion models are typically only able to directly predict concentrations over a one hour averaging period or greater. The human nose, however, responds to odours over periods of the order of a second or so. During a one hour period, odour levels can fluctuate significantly above and below the mean depending on the nature of the source.

To determine more rigorously the ratio between the one-second peak concentrations and longer period average concentrations (referred to as peak-to-mean, or P/M ratio) that might be predicted by a Gaussian dispersion model, EPA commissioned a study by **Katestone Scientific Pty Ltd (1995, 1998)**. This study recommended peak-to-mean ratio for a range of circumstances. The ratio is also dependent on atmospheric stability and the distance from the source. **Table 3.2** summarises the current P/M ratios used in NSW.

Near-field can be defined as the zone where the stack structure itself directly affects the dispersion and structure of the plume. This is typically 10 times the largest source dimension, in this case the 30 m height of the tallest stack (the main thermal oil heater) at the Homebush Bay LWTP. This leads to a near-field in the order of up to 300 m.

The term 'tall' point source usually refers to sources that protrude out of the surface boundary layer (e.g. over 30 to 50 m tall). A wake-affected point source is where nearby buildings interfere with the trajectory and growth of the plume, the source is called a wake-affected point source. A point source is wake-affected if stack height is less than or equal to 2.5 times the height of buildings located within a distance of 5L (where L is the lesser of the height or width of the building) from each release point.

Table 3.2: Factors for estimating peak concentrations on flat terrain

Source Type	Pasquil-Gifford stability class	Near field P/M60*	Far field P/M60
Area	A, B, C, D	2.5	2.3
	E, F	2.3	1.9
Line	A – F	6	6
Surface point	A, B, C	12	4
	D, E, F	25	7
Tall wake-free point	A, B, C	17	3
	D, E, F	35	6
Wake-affected point	A – F	2.3	2.3
Volume	A – F	2.3	2.3

*Ratio of peak 1-second average concentrations to mean 1-hour average concentrations

The Approved Methods take account of these P/M ratios and the goals shown in **Table 3.2** are based on nose-response time, which is effectively assumed to be 1 second (i.e. appropriate P/M ratios have been applied to all predictions).

4 EXISTING ENVIRONMENT

4.1 Meteorology

4.1.1 Local wind data

The Bureau of Meteorology (BoM) operates an Automatic Weather Station (AWS) at Sydney Olympic Park and Bankstown Airport which are located 0.9 km southeast and 10.5 km southwest of the Homebush Bay LWTP, respectively. It is noted that the Sydney Olympic Park AWS was relocated in 2011 due to obstruction from trees. Therefore, wind data from 2010 and 2011 is not considered valid from the Sydney Olympic Park AWS.

A representative meteorological dataset was chosen by analysing the most recent five years' worth of data from the two closest meteorological monitoring sites at Sydney Olympic Park and Bankstown Airport. Annual and seasonal wind roses were made for five years from 2008 to 2013 and are presented in **Appendix A**.

The wind roses at the relocated Sydney Olympic Park AWS show that dominant winds are from the west-northwest with a smaller percentage from the west and the east-northeast. In summer and spring the predominant wind direction is from the eastern quadrant with strong east-northeasterlies. In winter and autumn the predominant wind direction is from the western quadrant. The annual average percentage of calms (wind speeds less than 0.5 m/s) are recorded as being between 20% to 23 %.

Comparing to the BoM Bankstown Airport data, the percentage calms from 2008 to September 2013 are between 17% to 19 %. There are winds coming from all directions on an annual basis with a higher percentage from west-southwest. In summer the predominant wind direction is from the eastern quadrant and in winter from the west-northwestern quadrant. This is similar to the Sydney Olympic Park station.

The annual average wind speed (m/s) for the five years at both sites are presented in **Table 4.1**.

Table 4.1: Summary of available wind speed data at Sydney Olympic Park and Bankstown Airport

Year	Sydney Olympic Park			Bankstown Airport		
	Mean	Median	% complete	Mean	Median	% complete
2008 [1]	2.2	2.0	100%	3.2	2.8	100%
2009 [1]	2.1	1.8	81%	3.3	2.9	100%
2010	-	-	-	3.1	2.8	99%
2011	-	-	-	3.1	2.8	100%
2012	2.4	2.2	100%	3.0	2.8	100%
2013 [2]	2.3	2.1	72%	2.9	2.7	72%

NOTES: [1]BoM station at previous location with some obstruction by trees.
[2] Data only available to 19 September 2013.

Based on the review of wind data from the two BoM stations, wind data from Sydney Olympic Park for the period of September 2012 to August 2013 was chosen for odour dispersion modelling. This was the most contemporaneous period with 100% data capture at the station. There were also a high percentage of calms during this period which is more conservative for odour dispersion modelling. The Sydney Olympic Park station does not record cloud and sea level pressure data and these were sourced from the Bankstown Airport station.

Figure 4.1 shows the annual and seasonal wind roses for the modelling period of September 2012 to August 2013 at Sydney Olympic Park and the winds are predominantly from the west-northwest direction with a percentage calms of 19.5%. The annual average wind speed during this period was 2.4 m/s.

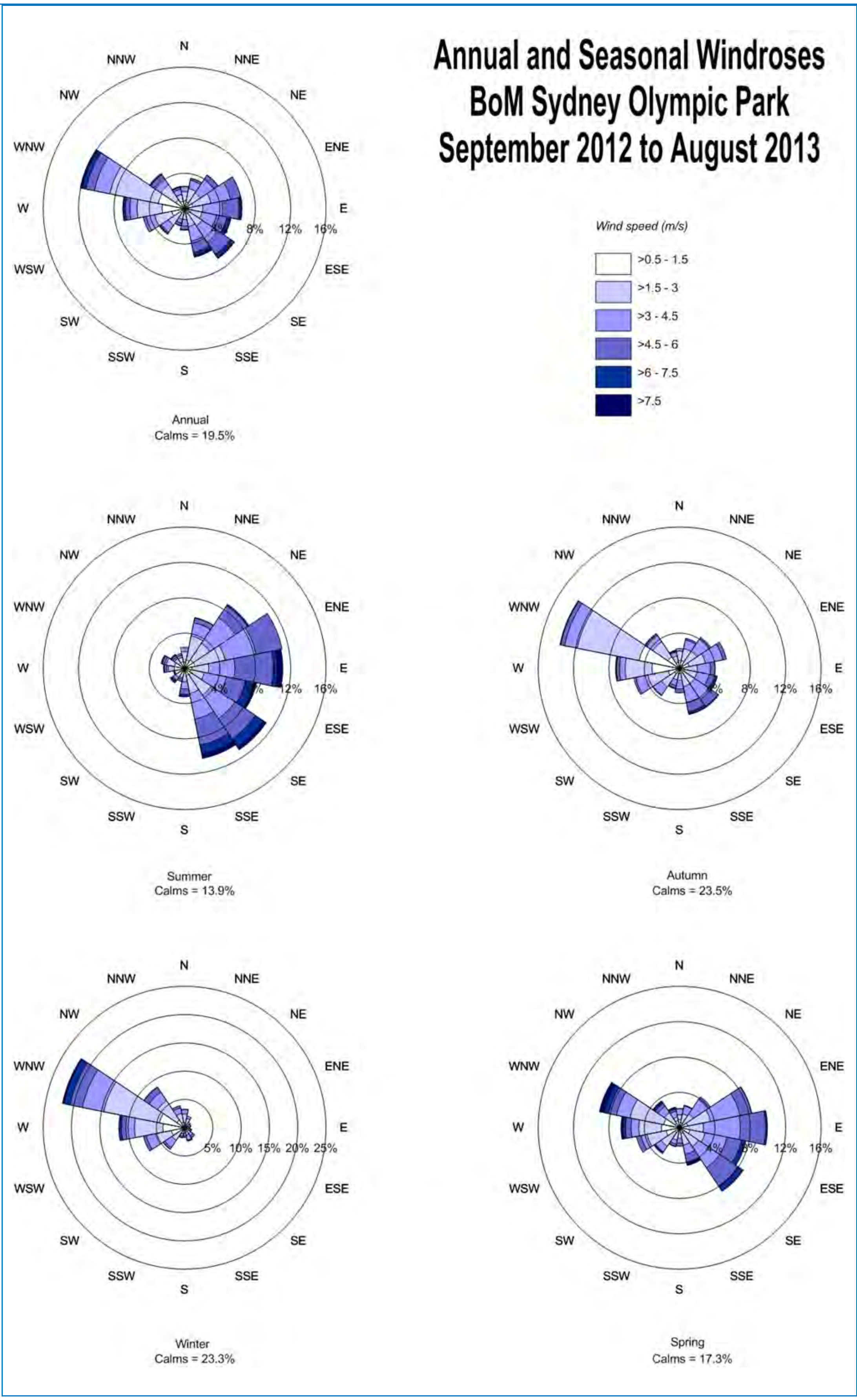

Figure 4.1: Wind Roses for BoM Sydney Olympic Park AWS Sept 2012 – Aug 2013

4.2 Local Climate

This section describes the general climate in the study area to give a more complete picture of the local meteorology.

Table 4.2 presents the temperature, humidity and rainfall data for the closest Bureau of Meteorology site which is located at Bankstown Airport AWS approximately 10.5 km southwest of the Homebush Bay LWTP. Also presented are monthly averages of maximum and minimum temperatures, 9 am and 3 pm temperatures and humidity. Rainfall data consist of mean monthly rainfall and the average number of rain days per month.

July is the coldest month, with an average minimum temperature of 5.1°C. January is the hottest month, with an average maximum temperature of 28.2°C.

Rainfall data show that February is on average the wettest month, with a mean rainfall reading of 108.1 mm, over 8.2 rain days. September is the driest month with an average rainfall of 44.6 mm, over an average of 5.4 rain days. The average annual rainfall is 872.2 mm and the average number of rain days annually is 82.8.

Table 4.2: Temperature, Humidity and Rainfall Data for Bankstown Airport AWS

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
9 am Mean Temperatures (°C) and Relative Humidity (%)													
Dry-bulb	22.2	21.6	20.2	17.4	13.8	10.7	9.6	11.6	15.1	18.2	19.3	21.4	16.8
Humidity	72	77	77	75	79	80	78	70	64	62	67	67	72
3 pm Mean Temperatures (°C) and Relative Humidity (%)													
Dry-bulb	26.8	26.4	25.0	22.6	19.5	17.0	16.4	18.0	20.2	22.1	23.5	25.9	22.0
Humidity	54	57	55	54	55	55	50	44	45	48	52	51	52
Daily Maximum Temperature (°C)													
Mean	28.2	27.8	26.2	23.6	20.4	17.7	17.2	18.9	21.6	23.7	25.2	27.3	23.1
Daily Minimum Temperature (°C)													
Mean	18.1	18.1	16.1	12.7	9.5	6.6	5.1	6.0	8.7	11.8	14.3	16.6	12.0
Rainfall (mm)													
Mean	91.7	108.1	99.3	84.8	69.3	76.4	44.9	47.9	44.6	60.7	77.7	67.4	872.2
Rain days (Number)													
Mean	8.1	8.2	8.5	6.7	7.0	6.9	5.3	4.6	5.4	6.8	8.2	7.1	82.8

Station Number 066137, Latitude: -33.92 South, Longitude: 150.99 East, Elevation: 7 m
Source: Bureau of Meteorology, 2013

5 APPROACH TO ASSESSMENT

The overall approach to the assessment follows the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2005** – Approved Methods) 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 proposals. The approach taken in this assessment follows as closely as possible the approaches suggested by the guidelines.

The air dispersion modelling conducted for this assessment is based on an advanced modelling system using the models TAPM and CALMET/CALPUFF (see **Figure B**.1). This system overcomes some of the limitations of steady-state Gaussian plume models such as AUSPLUME and ISC. Additionally CALPUFF is often used for odour-related assessments as it has been shown to effectively simulate odour impacts under low wind speed conditions.

The modelling system works as follows:

- TAPM is a prognostic meteorological model that generates gridded three-dimensional meteorological data for each hour of the model run period.
- CALMET, the meteorological pre-processor for the dispersion model CALPUFF, calculates fine resolution three-dimensional meteorological data based upon observed ground and upper level meteorological data, as well as observed or modelled upper air data generated for example, by TAPM.
- CALPUFF then calculates the dispersion of plumes within this three-dimensional meteorological field.
- CALPOST is used to post-process the results from CALPUFF to determine the predicted ground-level concentrations.

CALPUFF-CALMET is endorsed by the US EPA, and In March 2011 the NSW EPA published generic guidance and optional settings for the CALPUFF modelling system for inclusion in the Approved Methods (**TRC, 2011**). The model set up for this study has been completed in consideration of these guidelines. Details of the TAPM, CALMET and CALPUFF model set up and inputs can be found in **Appendix B.**

5.1 Dispersion meteorology

As discussed in **Section B.3**, a CALMET data file was generated for the modelling domain. To compare the wind field produced by the model with observed data, a meteorological dataset was extracted at Homebush Bay LWTP. Windroses for this CALMET generated file are shown in **Figure 5.1**. The CALMET generated windroses show very similar patterns to the observations at the BoM Sydney Olympic Park AWS (see **Figure 4.1**). The annual percentage of calms for the CALMET data is marginally higher than measured at the Sydney Olympic Park stations at 19.8%.

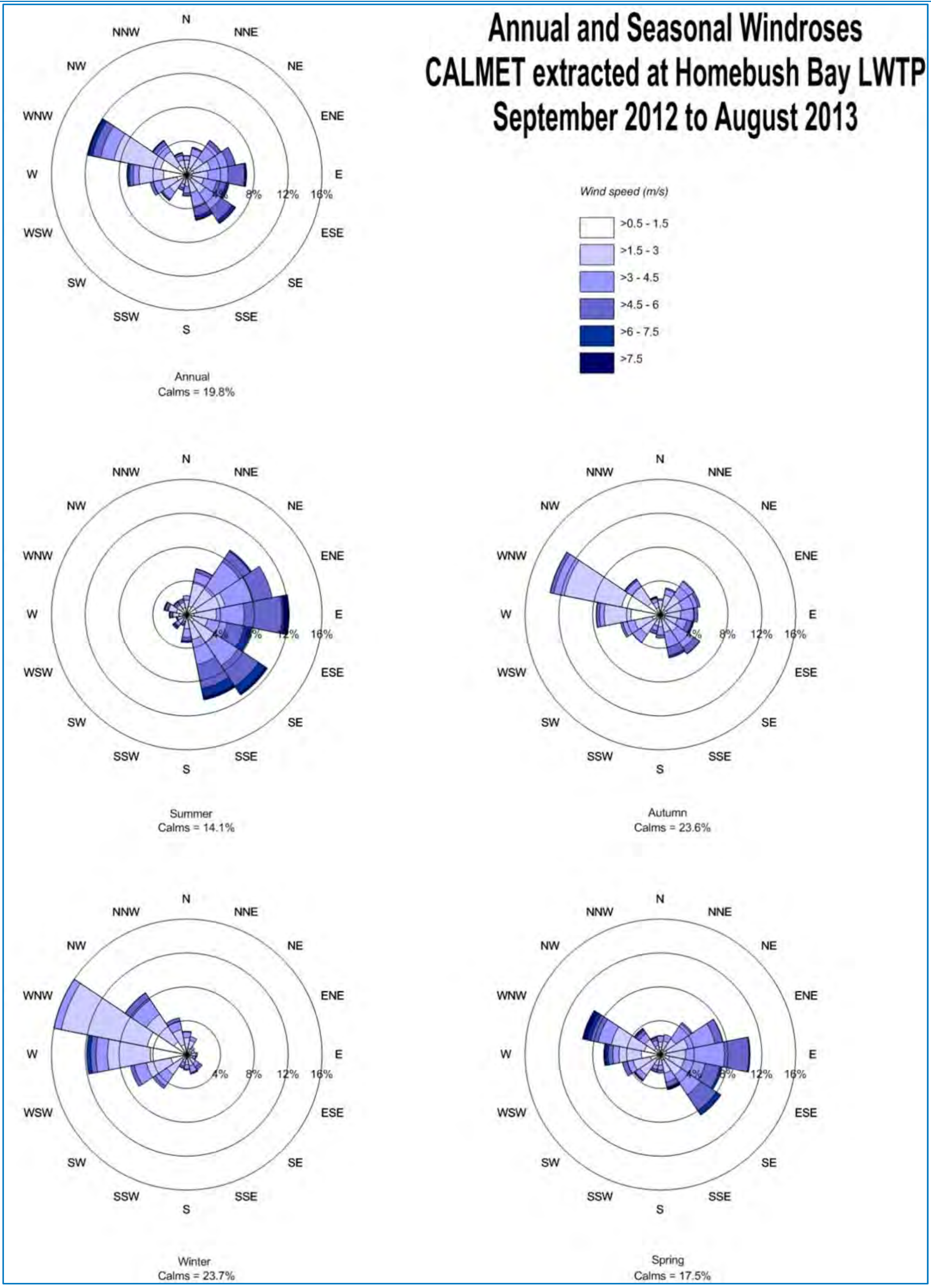

Figure 5.1: CALMET Generated Wind Roses for September 2012 to August 2013

6 EMISSION ESTIMATION

To capture the Homebush Bay LWTP when it is operating as normal and during worst case emissions, four scenarios were modelled. These scenarios include:

- Scenario 1 – Normal operations with OCF operating (S851 not operating)
- Scenario 2 – Worst case operations with OCF operating (S851 not operating)
- Scenario 3 – Normal operations with S851 operating (OCF not operating)
- Scenario 4 – Worst case operations with S851 operating (OCF not operating)

The OCF, MTOH and S851 are discharged via stacks and were therefore modelled as stack sources. The residual bin and the truck unloading bay are considered to be sources of fugitive emissions and were modelled as volume sources.

6.1 Basis of Odour Emissions Data

Odour emission rates (OERs) for this assessment have been estimated using a modelling approach based on data from monitoring data at the Homebush Bay LWTP from 2009 to 2013. Odour monitoring data was available from the Transpacific quarterly monitoring reports and the previous odour assessment (**The Odour Unit, 2013**).

The monitoring data include the OCF, the MTOH, S851, the residual bin and the trucks unloading bay. The monitoring obtained via the monitoring reports referenced in the previous odour assessment is presented in **Table 6.1**.

Table 6.1: Odour Monitoring at Homebush Bay LWTP

Report	Sampling Date	Sludge Residue Bin (OUV/s)	MTOH (OU)	OCF Outlet (OU)	S851 Outlet (OU)	Comments
EML N85029	15/12/2009	93		10,000		
EML N85373	18/03/2010	170	410	2,000		
EML N85736	1/06/2010	370	1,000	1,400		
EML N86194	15/09/2010	280	650	2,000		
EML N86554	18/11/2010	60	340	14,000		OCF malfunction
EML N87729	23/06/2011	260	850	370		
EML N88245	5/10/2011			31,000		OCF malfunction
EML N88349	25/10/2011			14,000		OCF malfunction
EML N88717	15/03/2012	230	20,000		64,000	OCF not operating
EML N89349	5/06/2012	500	410		14,000	OCF not operating
EML N89643	14/08/2012				64,000	OCF not operating
EML N90262	4/12/2012				83,000	OCF not operating
	6/12/2012				7,100	OCF not operating
	12/12/2012				44,000	OCF not operating
EML N90355	8/01/2013				29,000	OCF not operating

NOTE: Monitored concentration not used in emissions calculations due to OCF malfunction highlighted in red.

6.2 Building Wakes

Wind flow is often disrupted in the immediate vicinity of buildings. Plumes emitted are assumed to be unaffected by building wakes if they reach building height plus 1.5 times the lesser of building height or projected building width. If this is not the case, pollutants can be brought to ground within a highly turbulent, generally recirculating cavity region in the immediate lee of the building and/or be subject to plume downwash and enhanced dispersion in a turbulent region which extends further downwind behind the building (**EPAV, 1999**).

The building wake algorithm calculates heights and corner locations of buildings in the vicinity of the plume to simulate the effective height and width of the structures. The downwash algorithm calculates effective building dimensions relative to the plume, resolved down to ten degree intervals. CALPUFF then calculates the impact of these buildings on plume dispersion and consequently on ground level concentrations.

The heights of the nearby buildings were estimated from Google earth. All tanks were assumed to have a height of 4 m and the buildings were assumed to be 7 m. A three dimensional layout of the building profiles included in the dispersion modelling are displayed in **Figure 6.1**.

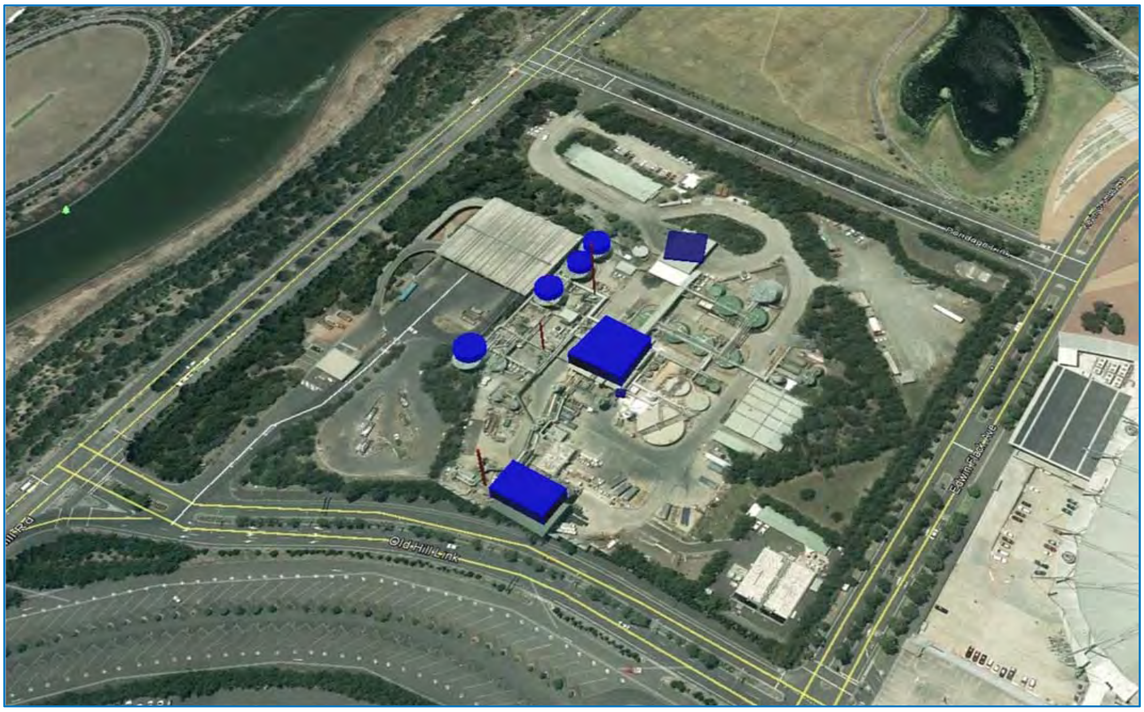

Figure 6.1: Location and Dimensions of Buildings incorporated within the Modelling

6.2.1 Odour Emissions Estimation

For the normal operations scenario (Scenario 1) an average of all the monitoring data was used to develop an OER and for worst case emissions the maximum monitored concentration was used. Emissions from truck unloading were obtained from the previous air assessment as 1,700 OUV/s (**Odour Unit, 2013**). The odour concentration used in the air dispersion modelling are summarised in **Table 6.2**.

Table 6.2: Odorous Emissions for Modelling

Scenario	Sludge Residue Bin (OUV/s)	MTOH (OU)	OCF Outlet (OU)	S851 Outlet (OU)	Truck Unloading (OU)
Scenario 1 – OCF normal operations	245	728	3,154	-	1,700
Scenario 2 – OCF worst case	500	1,000	10,000	-	1,700
Scenario 3 – S851 normal operations	245	6,917	-	43,586	1,700
Scenario 4 – S851 worst case	500	20,000	-	83,000	1,700

The effective height of discharge is composed of the physical stack height plus the plume rise due to its buoyancy and exit velocity. Generally, higher effective height of discharge (i.e. higher velocity and/or stack height) results in better dispersion of odorous emissions. Therefore, for the worst case scenarios, velocity was assumed to be the lowest monitored value.

A peak to mean ratio of 2.3 was applied to the OERs to convert mean 1-hour predicted concentrations to peak (1 second) nose-response averages. The peak to mean ratio is consistent with volume sources and wake-affect point sources shown in **Table 3.2**. The modelled parameters are presented in **Table** 6.3.

Table 6.3: Modelling Emission Rates for the Site

Parameters	Sludge Residue Bin	MTOH	OCF Outlet	S851 Outlet	Truck Unloading
x coordinate (centre)	320460	320439	320417	320424	320475
y coordinate (centre)	6253455	6253508	6253404	6253474	6253540
z coordinate	9.4	7.5	8.0	8.3	7.7
Temperature (K)	-	360	469	304	-
Height of source (m)	1	30	23	17	2
Diameter (m)	-	0.75	1.19	0.3	-
Scenario 1 – OCF normal operations					
Velocity (m/s)	-	9.4	11.7	-	-
OER (OUV/s)	564	6,917	94,599	-	3,910
Scenario 2 – OCF worst case					
Velocity (m/s)	-	7.5	7.8	-	-
OER (OUV/s)	1,150	7,621	199,529	-	3,910
Scenario 3 – S851 normal operations					
Velocity (m/s)	-	9.4	-	9.3	-
OER (OUV/s)	564	65,763	-	66,103	3,910
Scenario 4 – S851 worst case					
Velocity (m/s)	-	7.5	-	7.2	-
OER (OUV/s)	1,150	152,416	-	97,156	3,910

7 ASSESSMENT OF IMPACTS

This section presents an assessment of the air quality impacts of the project by comparing the predicted odour levels with the odour assessment criterion presented in **Section 3**.

7.1 Odour Impacts

Contour plots of the 99th percentile odour concentrations are presented in **Figure 7.1** to **Figure 7.4**. The results at the residences in Newington and the proposed UAP are summarised in **Table 7.1**. The results indicate that except when the OCF is operating under normal conditions, all other scenarios are predicted to exceed 2 OU at nearby existing residences and the proposed UAP. This outcome is consistent with the odour complaints history summarised in the Stage 1 report.

It is noted Transpacific has advised DP&I that the new OCF has been installed and commissioned on 30 April 2013. The new OCF is achieving efficiencies greater than 95%. The dispersion modelling for the normal operations scenario in this report is likely to be conservative compared to the operations of the new OCF. However, the potential impacts due to normal operations of the new OCF are expected to be similar (or lower than) to the predicted concentrations for Scenario 1 which was below the EPA odour criterion of 2 OU.

The percentage of UAP expected to be impacted based on area as a result of Scenarios 2, 3 and 4 range from 5% to 25%.

Table 7.1: Odour Dispersion Modelling Results

Scenario	Compliance with EPA criterion of 2 OU?		
	Newington residences	Proposed UAP	Percentage of UAP affected
Scenario 1 – OCF normal operations	Yes	Yes	N/A
Scenario 2 – OCF worst case	No	No	10%
Scenario 3 – S851 normal operations	No	No	5%
Scenario 4 – S851 worst case	No	No	25%

Figure 7.1: Predicted 99th percentile nose-response average ground level odour concentrations – Scenario 1

Figure 7.2: Predicted 99th percentile nose-response average ground level odour concentrations – Scenario 2

Figure 7.3: Predicted 99th percentile nose-response average ground level odour concentrations – Scenario 3

Figure 7.4: Predicted 99th percentile nose-response average ground level odour concentrations – Scenario 4

7.2 Cumulative Impacts

It is not always practical to assess the cumulative odour impact of all odour sources that may impact on discrete receptors. However, it is common in odour assessments to assess the incremental increase in odour from an existing or proposed activity against the assessment criteria, particularly where no other sources of similar odour character are present. There are no other sources of similar odour character present in the Homebush Bay area and therefore a cumulative assessment is not required.

8 CONCLUSIONS

This report has assessed the existing and proposed odorous impacts associated with the Homebush Bay LWTP on the proposed UAP. Local land use, terrain and meteorology have been considered in the assessment and dispersion modelling was completed using CALPUFF.

Four scenarios were modelled to capture the different operational scenarios at the Homebush Bay LWTP. The predicted odour levels at the private receptors are predicted to comply with the NSW EPA assessment criterion of 2 OU in Scenario 1 when the OCF is operating under normal conditions. For all other scenarios, the predicted odour levels are predicted to exceed the EPA assessment criterion at the nearby residence and the proposed UAP.

The percentage area that the proposed UAP is impacted under worst-case odour emission scenarios is anticipated to be approximately 25%, principally located in to the north west of the proposed UAP land release.

It is therefore possible, with appropriate planning, to develop the UAP progressively from the south west, therefore mitigating the potential for adverse odour impacts, predicted to occur in the north western area, until the end of the useful life of the LWTP.

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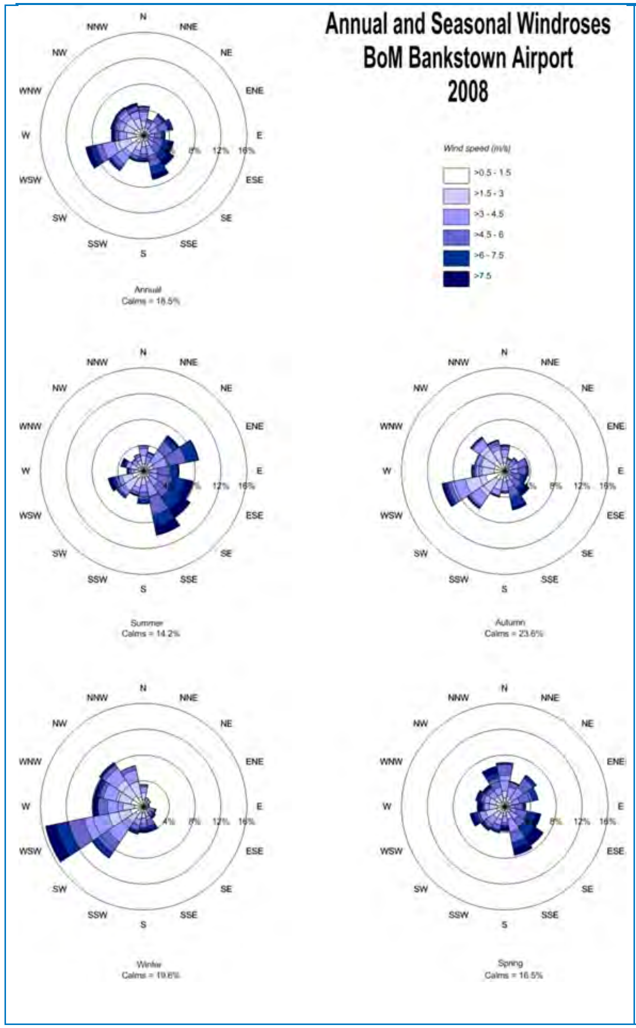
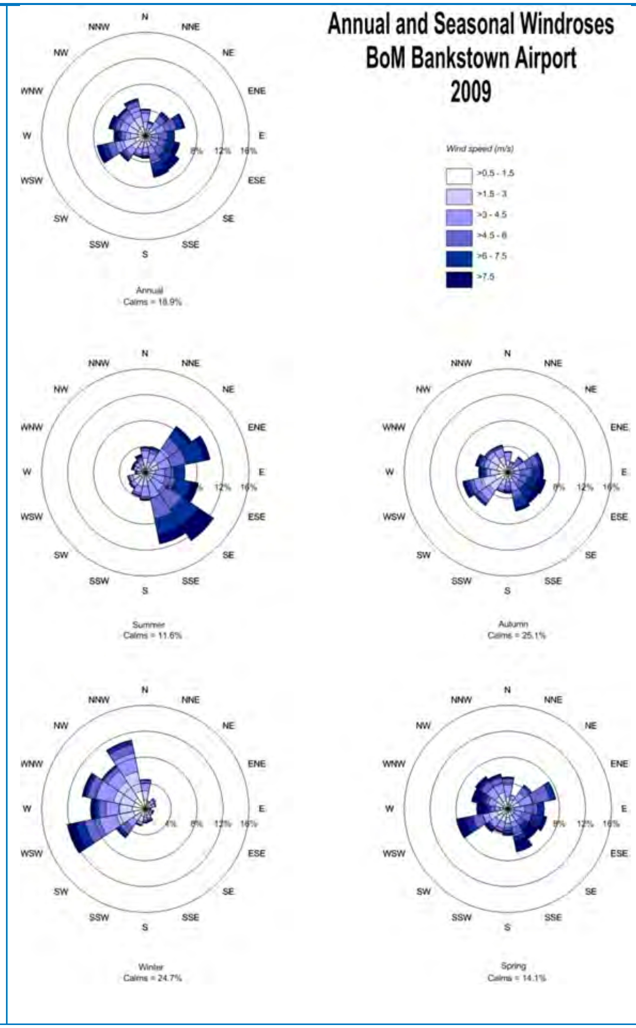
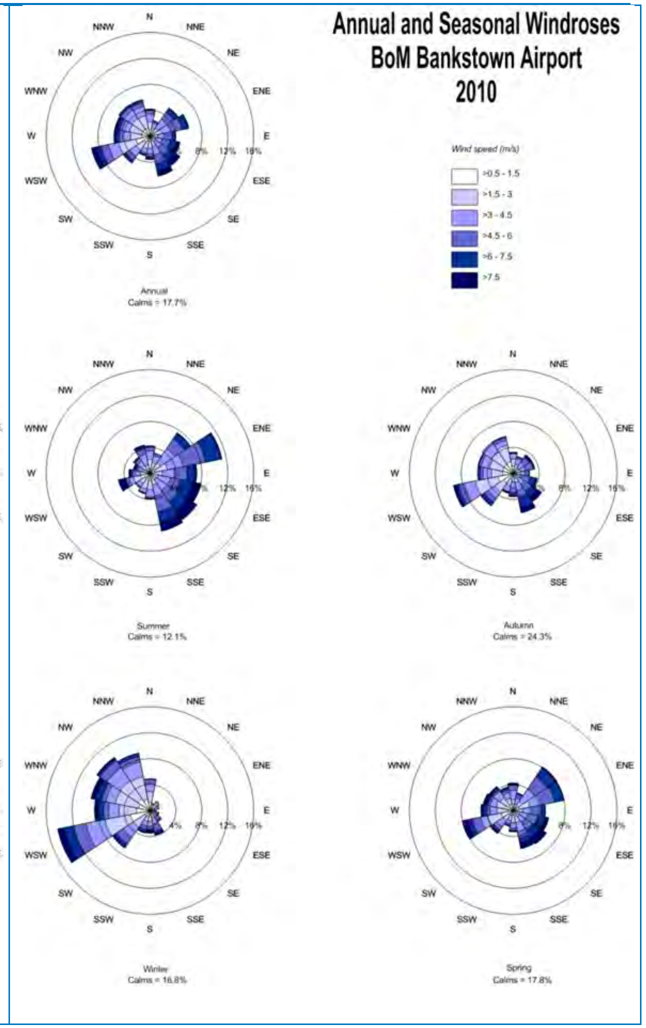
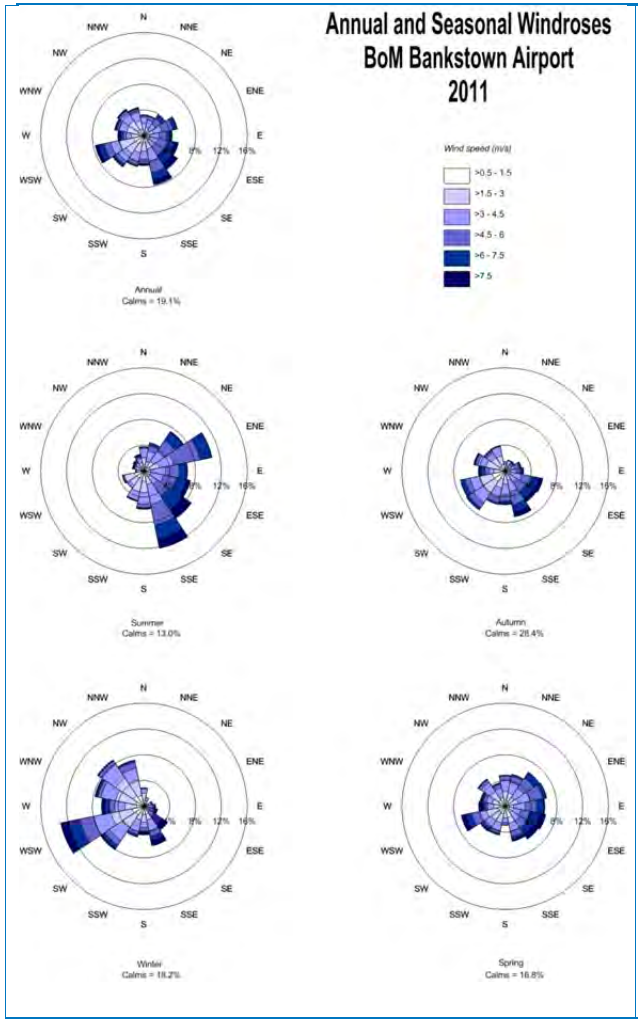
Appendix A - ANNUAL AND SEASONAL WINDROSES FOR SYDNEY OLYMPIC PARK AND BANKSTOWN AIRPORT METEOROLOGICAL STATIONS (2008-2013)

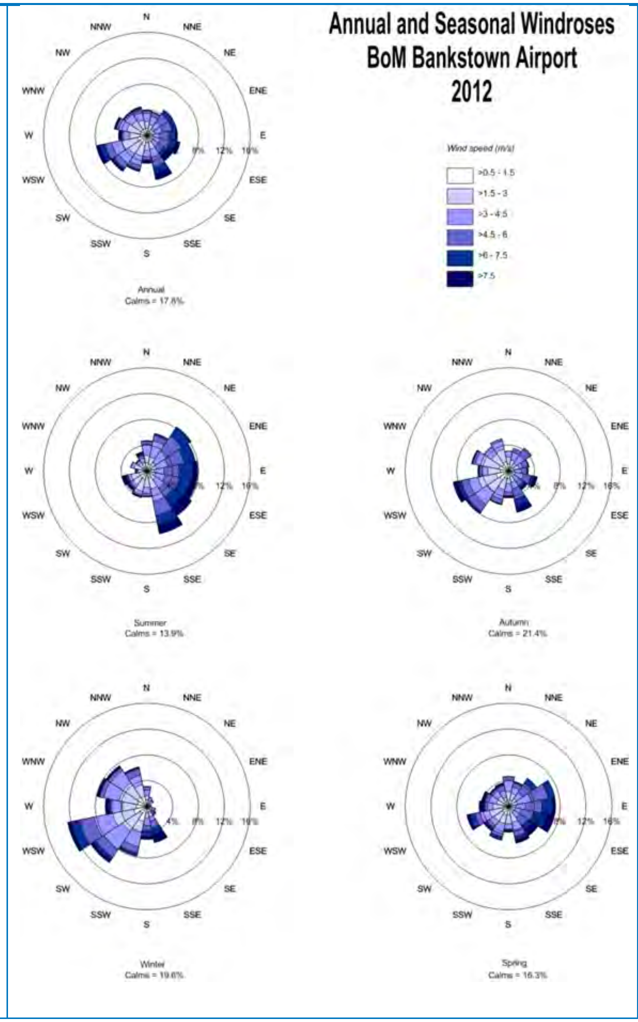
Pacific Environment Limited

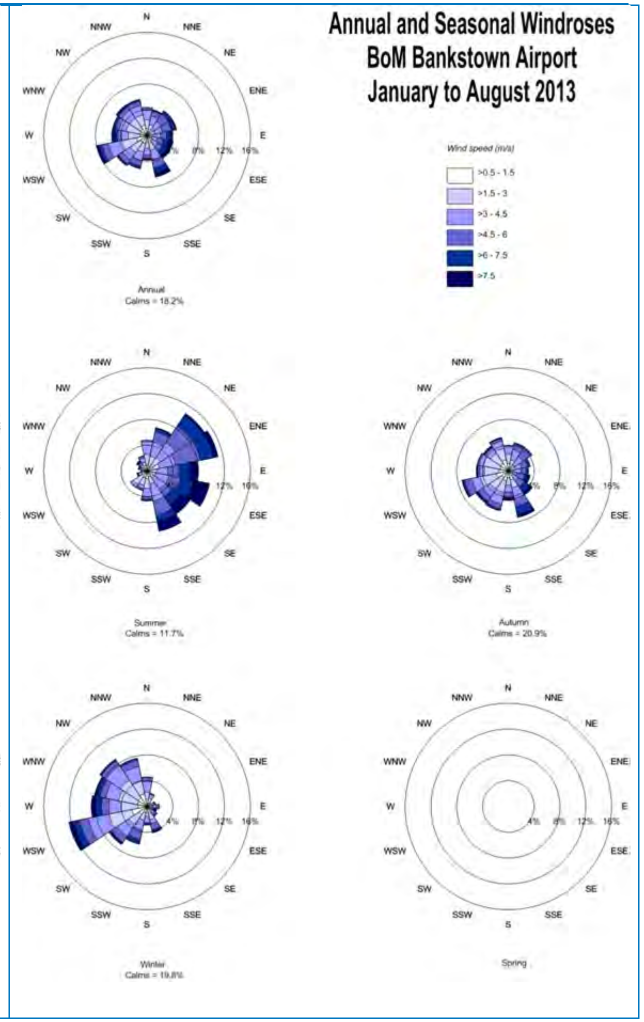


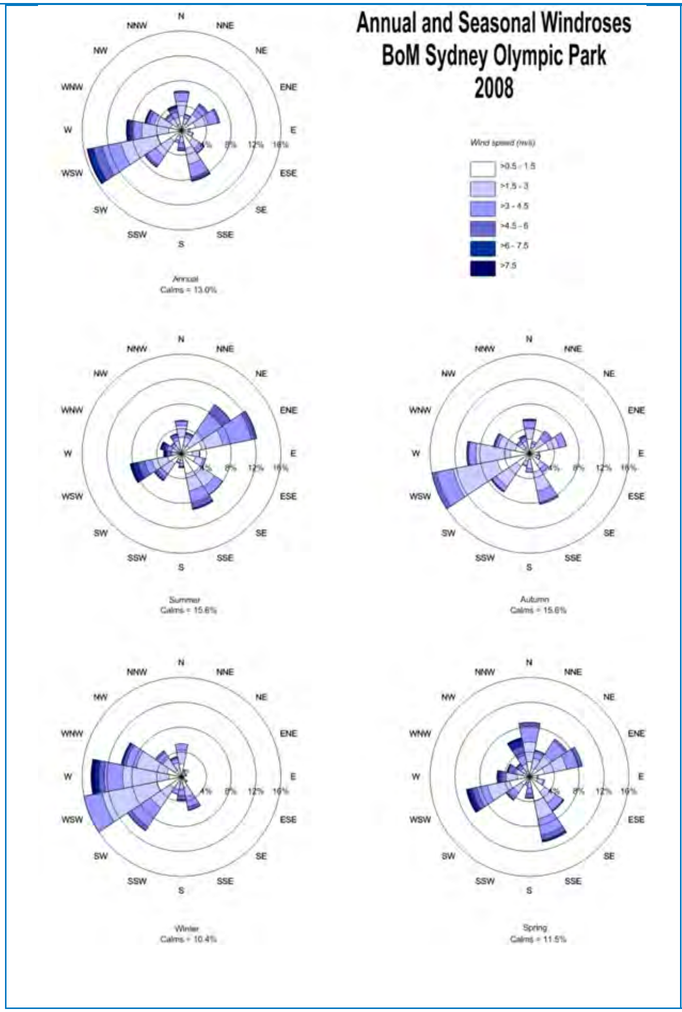


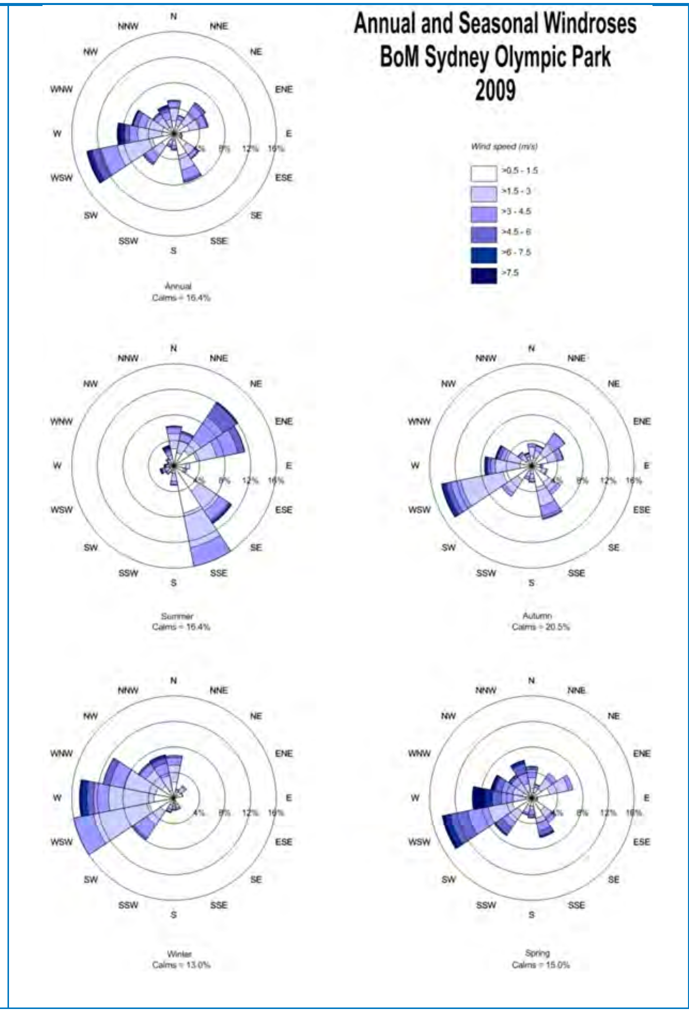



Annual and Seasonal Windroses
BoM Bankstown Airport
2011
Wind speed (m/s)
>0.5 - 1.5
>1.5 - 3
>3 - 4.5
>4.5 - 6
>6 - 7.5
>7.5
Annual
Summer
Autumn
Winter
Spring

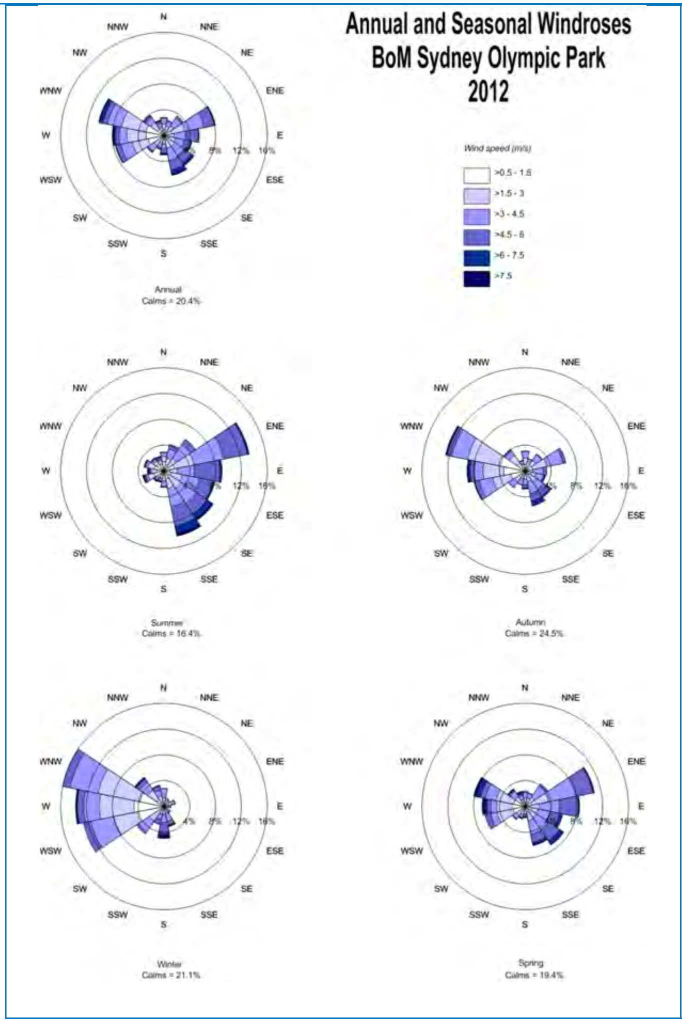

Annual and Seasonal Windroses
BoM Bankstown Airport
2012
Wind speed (m/s)
>0.5 - 1.5
>1.5 - 3
>3 - 4.5
>4.5 - 6
>6 - 7.5
>7.5
Annual
Summer
Autumn
Winter
Spring

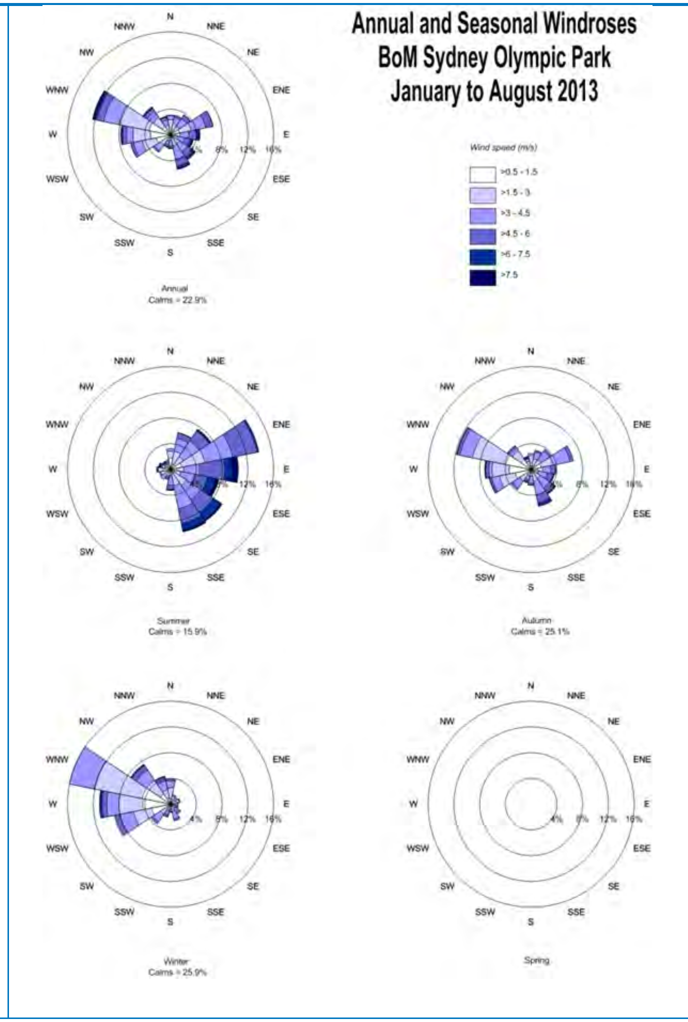

Annual and Seasonal Windroses
BoM Bankstown Airport
January to August 2013
Wind speed (m/s)
>0.5 - 1.5
>1.5 - 3
>3 - 4.5
>4.5 - 6
>6 - 7.5
>7.5
Annual
Summer
Autumn
Winter
Spring





NOTE: Sydney Olympic Park station prior to relocation in July 2011.





NOTE: Relocated Sydney Olympic Park station

Appendix B – MODEL SETUP

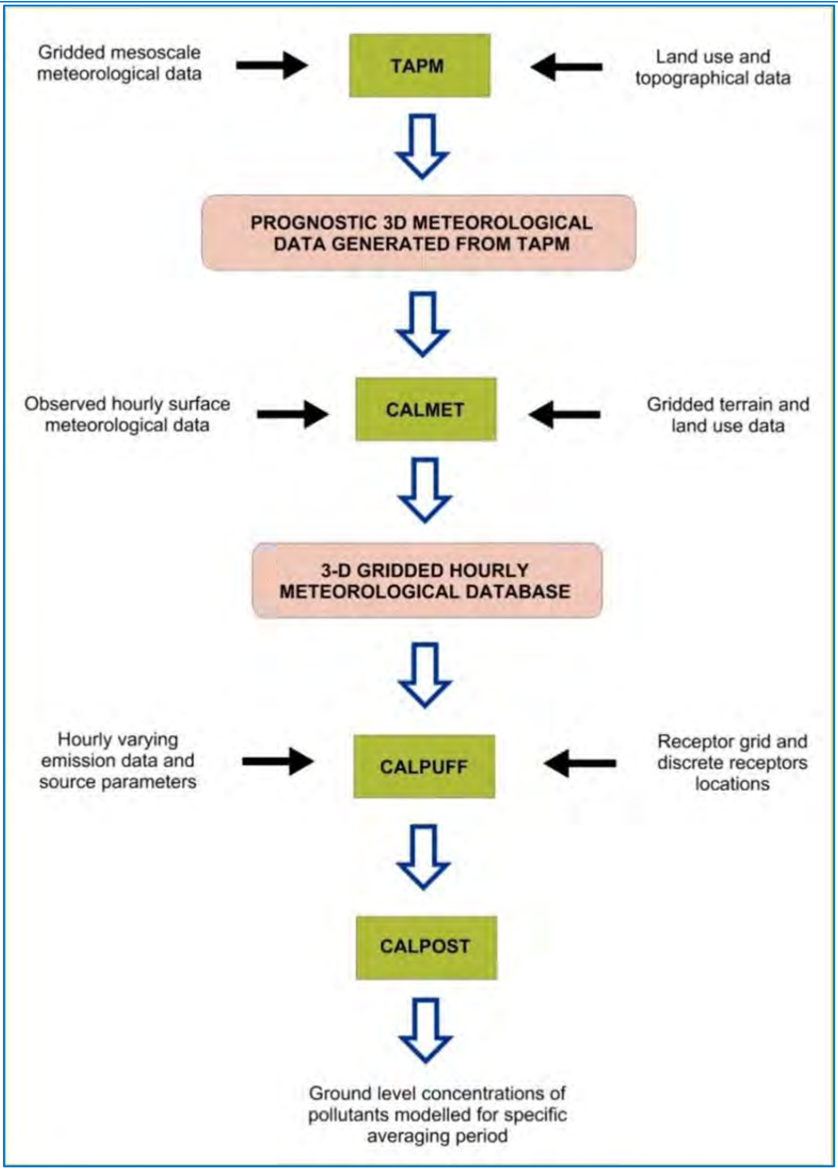


Figure B.1: Modelling methodology used in this study

Outputs from TAPM, plus regional observational weather station data were entered into CALMET. From this, a 1-year representative meteorological dataset suitable for use in the 3-dimensional plume dispersion model, CALPUFF, was compiled. Details on the model configuration and data inputs are provided in the following sections.

B.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 descriptions of the TAPM model and its performance can be found in **Hurley (2008**) and **Hurley et al. (2009)**.

TAPM utilises fundamental fluid dynamics and scalar transport equations to predict meteorology and (optionally) pollutant concentrations. It consists of coupled prognostic meteorological and air pollution concentration components. The model predicts airflows 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.

For the assessment of the Proposal, TAPM v4.0.5 was set up with three domains, composing of 30 grids along both the X and the Y axes, centred on -31˚ 59' Latitude and 151˚ 44.5' Longitude (284.342km, 6570.057km), to capture both the inner and outer modelling domains. Each nested domain had a grid resolution of 30 km, 10 km, 3 km and 1 km respectively.

Default TAPM terrain values are based on a global 30-second resolution (approximately 1 km) dataset provided by the US Geological Survey, Earth Resources Observation Systems (EROS). Default land use and soils datasets for TAPM were used.

TAPM was used to generate gridded prognostic data (3D.dat) for the CALMET modelling domain.

B.2 CALMET

The choice of the CALMET/CALPUFF modelling system for this study was based on the fact that simple Gaussian dispersion models such as ISC assume that the meteorological conditions are uniform spatially over the entire modelling domain for any given hour. While this may be valid for some applications, in reality variable flow situations typically exist across an area and the meteorological conditions are more accurately simulated using a wind field model such as CALMET.

CALMET v 6.333 was run with an domain covering a 5 km x 5 km area, with the origin (SW corner) at 317.9 km Easting and 6250.9 km Northing (UTM Zone 56S). This consisted of 50 x 50 grid points, with a 0.1km resolution along both the X and Y axes.

Observed hourly surface wind speed, wind direction, temperature and relative humidity data from the Sydney Olympic Park weather station, as well as cloud and sea level pressure data from Bankstown airport were used as input for CALMET. The location for the BoM Sydney Olympic Park station is shown in **Figure 2.1**.

Land use for the modelling domain was determined by aerial photography from Google Earth. Terrain for this area was derived from 90 m terrain (DEM) data sourced from NASA.

B.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.

As with any air dispersion model, CALPUFF requires inputs in three major areas:

- Meteorology (described in **Section 5.1**).
- Emission rates and source details (described in **Section 6**).
- Terrain and geophysical data (terrain, land use), as well as specification of specific receptor locations (incorporated into CALMET and CALPUFF).

CALPUFF v6.42 was run with hourly emissions derived based on information in **Section 6** and input settings presented in the following tables. The CALPUFF domain was nested at 50 m to provide better resolution around the proposed UAP.

Table B.1: TAPM and CALMET setup Options used

TAPM (v 4.0.5)	
Number of grids (spacing)	30 km, 10 km, 3 km, 1km
Number of grid points	25 x 25 x 35
Year of analysis	September 2012 – August 2013
Centre of domain	-30°59' S, 150°44.5' E
	320449m E, 6253448m N
Surface meteorological stations	Sydney Olympic Park AWS (BoM, Station No. 066212)
	- Wind speed
	- Wind direction
	- Temperature
	- Relative humidity
	Bankstown Airport AWS (BoM, Station No. 066317)
	- Ceilometer cloud amount
	- Ceilometer cloud height
	- Sea level pressure
CALMET (v. 6.333)	
Meteorological grid domain	5 km x 5 km
Meteorological grid resolution	0.1 km
3D.dat	Data extracted from 1 km TAPM

Table B.2: CALMET Model Options used

Flag	Descriptor	Default	Value Used
IEXTRP	Extrapolate surface wind observations to upper layers	Similarity theory	Similarity theory
BIAS (NZ)	Relative weight given to vertically extrapolated surface observations versus upper air data	NZ * 0	-1, -0.5, -0.25, 0 for all other layers
TERRAD	Radius of influence of terrain	No default (typically 5- 15km)	5 km
RMAX1 and RMAX2	Maximum radius of influence over land for observations in layer 1 and aloft	No Default	5
R1 and R2	Distance from observations in layer 1 and aloft at which observations and Step 1 wind fields are weighted equally	No Default	4

Table B.3: CALPUFF Model Options used – version 6.42

Flag	Flag Descriptor	Value Used	Value Description
MCHEM	Chemical Transformation	0	Not modelled
MDRY	Dry Deposition	0	No
MTRANS	Transitional plume rise allowed?	1	Yes
MTIP	Stack tip downwash?	1	Yes
MRISE	Method to compute plume rise	1	Briggs plume rise
MSHEAR	Vertical wind Shear	0	Vertical wind shear not modelled
MPARTL	Partial plume penetration of elevated inversion?	1	Yes
MSPLIT	Puff Splitting	0	No puff splitting
MSLUG	Near field modelled as slugs	0	Not used
MDISP	Dispersion Coefficients	2	Based on micrometeorology
MPDF	Probability density function used for dispersion under convective conditions	1	Yes
MROUGH	PG sigma y, z adjusted for z	0	No
MCTADJ	Terrain adjustment method	3	Partial Plume Adjustment