Advanced Environmental Dynamics

Specialist Consultants

GREENSPOT WETHERILL PARK

ODOUR ASSESSMENT

Report # 959516

Prepared for:

Bettergrow Pty Ltd

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Executive Summary

Advanced Environmental Dynamics Pty Ltd was commissioned by Bettergrow Pty Ltd to undertake an odour assessment of the Greenspot Wetherill Park (GWP) resource recycling and recovery centre located at 24 Davis Road, Wetherill Park, NSW.

Project Background

Up to 200,000 tonnes of various materials will be processed through GWP annually including:

- *60,000 tonnes of hydro-excavation and directional drilling muds/fluids for storage, separation and consolidation within the Drill mud and Hydro-excavation Fluids Processing Area (DHFPA);*
- *40,000 tonnes of various bulk landscaping products;*
- *70,000 tonnes of garden organics (GO) or food organics combined with garden organics (FOGO) to be processed and consolidated within the Organics Receival and Processing Building (ORPB) ; and*
- *30,000 tonnes of other source separated commercial and industrial organics (C&IO) to be processed and consolidated within the Food Depackaging Building (FDB)*

Odour Sources and Management Strategies

The potential for odour-related impacts to off-site receptors associated with the process and handling of the 70,000 tonnes of FO and FOGO within the ORPB and the 30,000 tonnes of C&IO within the FDB will be managed through the implementation of a variety of odour management strategies including (ZBE, 2017)

- *The use of 8 carbon filter (FC900) units (CFU) that will be located along the southern side of the ORPB. In order to maximise flexibility and system redundancy, odorous air from within the FDB will be ducted to the ORPB where it will be mixed and treated prior to release into the atmosphere through the stacks of the CFU at a height of 2 m above the roofline of the ORPB;*
- *The automated use of odour ameliation products during the entering/exiting of vehicles into the ORPB and/or FDB; and*
- *The use of odour ameliation products within the buildings as/if required.*

Odour Emission Scenarios

For the purposes of assessing odour impacts from GWP, a total of eight odour emission scenarios have been considered. In particular, four odour emission scenarios have been developed focusing on the emission of odour from the CFU:

1) *Normal Scenario: Considers the operation of 8 CFU operating at the manufacturer specified 99.9% odour elimination efficiency.*
2) *Normal (Reduced Efficiency) Scenario: Considers the operation of 8 CFU at a reduced odour elimination efficiency of 90%.*
3) *Worst Case (WC) (Reduced Efficiency) Scenario for receptors located to the east of GWP (i.e. WC East Scenario): Considers the operation of the eastern most 7 CFU at a reduced odour elimination efficiency of 90%.*
4) *Worst Case (Reduced Efficiency) Scenario for receptors located to the west of GWP (i.e. WC West Scenario): Considers the operation of the western most 7 CFU at a reduced odour elimination efficiency of 90%.*

Consideration has also been given to the potential for fugitive emissions associated with the movement of vehicles into/out of the ORPB and FDB. Vehicle access doors are estimated to remain open for less than 5 minutes per hour during peak hours. In particular, two vehicle movement scenarios have been considered corresponding to average and peak intake tonnages with:

A) *Average tonnages corresponding to:*
   - *Garden Organics / Food and Garden Organics 1350 tonnes per 5 day week*
   - *Food organics 580 tonnes per 5 day week*
B) *Peak tonnages corresponding to:*
   - *Garden Organics / Food and Garden Organics 1750 tonnes per 5 day week*
   - *Food organics 700 tonnes per 5 day week*

The eight odour scenarios considered includes a combination of CFU scenarios 1-4 and the two vehicle movement scenarios (A–B) (Table A).

Interpretation of Odour Impacts

Based on the 99th percentile 1-second average concentration of odour, results of the odour dispersion modelling have not highlighted any issues with the impact of emissions of odour from the GWP with levels not exceeding the regulatory criterion of 2 OU past the site boundary for all scenarios considered (Table A).

Table A: Results for the 99th Percentile 1-Second Average Concentration of Odour

Scenario	CFU Stack Scenario	Vehicle Movement Scenario	Meteorological Year	Maximum Outside Site Boundary (OU)
1A	Normal (8 CFU @ 99.9% efficiency)	Average	2013	0.7
			2014	0.7
			2015	0.7
2A	Normal (reduced efficiency) (8 CFU @ 90% efficiency)	Average	2013	1.3
			2014	1.2
			2015	1.3
3A	WC East (reduced efficiency) (7 CFU @ 90% efficiency)	Average	2013	1.3
			2014	1.2
			2015	1.3
4A	WCWest (reduced efficiency) (7 CFU @ 90% efficiency)	Average	2013	1.3
			2014	1.3
			2015	1.4
1B	Normal (8 CFU @ 99.9% efficiency)	Peak	2013	0.8
			2014	0.8
			2015	0.8
2B	Normal (reduced efficiency) (8 CFU @ 90% efficiency)	Peak	2013	1.3
			2014	1.3
			2015	1.4
3B	WC East (reduced efficiency) (7 CFU @ 90% efficiency)	Peak	2013	1.3
			2014	1.3
			2015	1.4
4B	WC West (reduced efficiency) (7 CFU @ 90% efficiency)	Peak	2013	1.3
			2014	1.3
			2015	1.4

Final Comments

Results of the odour assessment for GWP suggest that the proposed mitigation measures and management strategies proposed for the operation of the facility will be sufficient to meet the regulatory criterion for odour.

In practice, the management of air quality at all times within the ORPB and FDB will be key to ensuring that potential fugitive emissions during vehicle movements into/out of the building do not cause odour nuisance at off-site locations.

Details of the odour management strategies and operational procedures pertaining to odour can be found in the GWP's Environmental Management Plan (ZBE, 2017) prepared by Luke Zambelli of The LZ Environmental Company Pty Ltd.

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Abbreviations

AED	Advanced Environmental Dynamics Pty Ltd
AWS	All weather station
BoM	Bureau of Meteorology
c.	Circa (approximately)
CALMET	California Meteorological Model
CALPUFF	California Plume Dispersion Model
CFU	Carbon filter units
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DHFPA	Drill mud and Hydro-excavation fluids processing area
EMP	Environmental Management Plan
EPA	Environmental Protection Authority
FDB	Food depackaging building
FO	Food organics
FOGO	Combined food organics and garden organics
GO	Garden organics
GWP	Greenspot Wetherill Park
NASA	National Aeronautics and Space Administration
NSW	New South Wales
ORPB	Organics receival and processing building
OU	Odour units
P/M60	Peak to mean ratio based on one-hour average results from the dispersion model
S	Source
SOER	Specific odour emission rate
SRTM	Shuttle Radar Topography Mission
TAPM	The Air Pollution Model

Units

lps	Litres per second
m	metre
m^2	square meters
m^3	cubic meters
OU	Odour units
s	Second

1. Introduction

Advanced Environmental Dynamics Pty Ltd was commissioned by Bettergrow Pty Ltd (Bettergrow) to undertake an odour assessment of the Greenspot Wetherill Park resource recycling and recovery centre located at 24 Davis Road Wetherill Park, New South Wales (NSW).

This report contains a summary of the odour assessment methodology and findings of the assessment. Additional technical details are contained in the supporting appendices.

2. Project Background and Project Information

2.1 Project Description

AED understands that Bettergrow is seeking approval to develop a resource recovery and recycling centre at 24 Davis Road, Wetherill Park NSW (Lot 18, DP249417) referred to herein as Greenspot Wetherill Park (GWP) (Figure 1).

Figure 1: Site Location (GWP)

Source: Google Earth

Up to 200,000 tonnes of various materials will be processed through the facility annually including:

- 60,000 tonnes of hydro-excavation and directional drilling muds/fluids for storage, separation and consolidation within the Drill mud and Hydro-excavation Fluids Processing Area (DHFPA, Figure 2);
- 40,000 tonnes of various bulk landscaping products;
- 70,000 tonnes of garden organics (GO) or garden organics combined with food organics (FOGO) to be processed and consolidated within the Organics Receival and Processing Building (ORPB, Figure 3) ; and
- 30,000 tonnes of other source separated commercial and industrial organics (C&IO) to be processed and consolidated within the Food Depackaging Building (FDB, Figure 3)

Figure 2: Drill Mud and Hydro Excavation Area (southern portion of site)

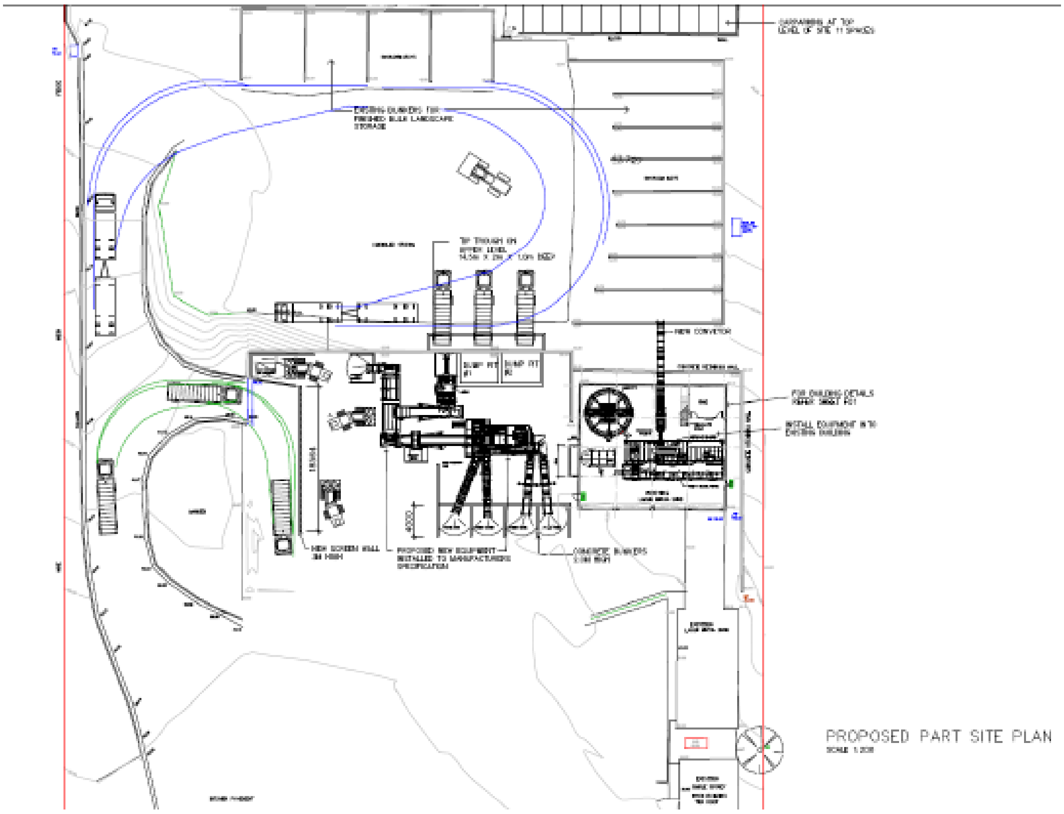
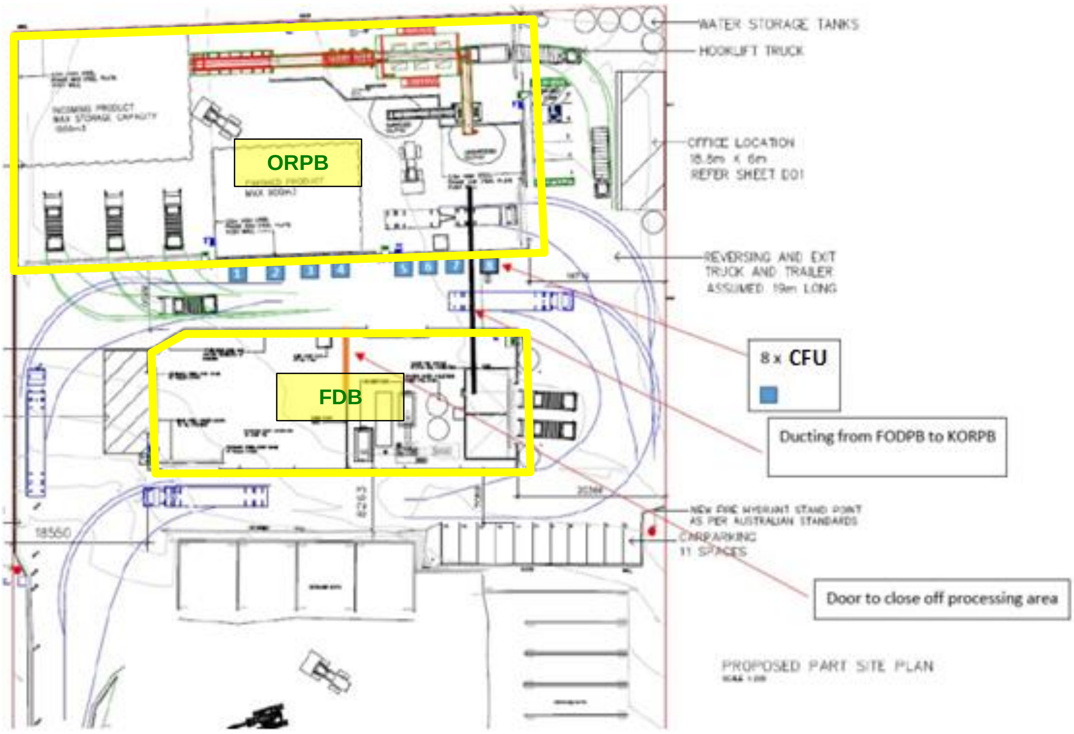
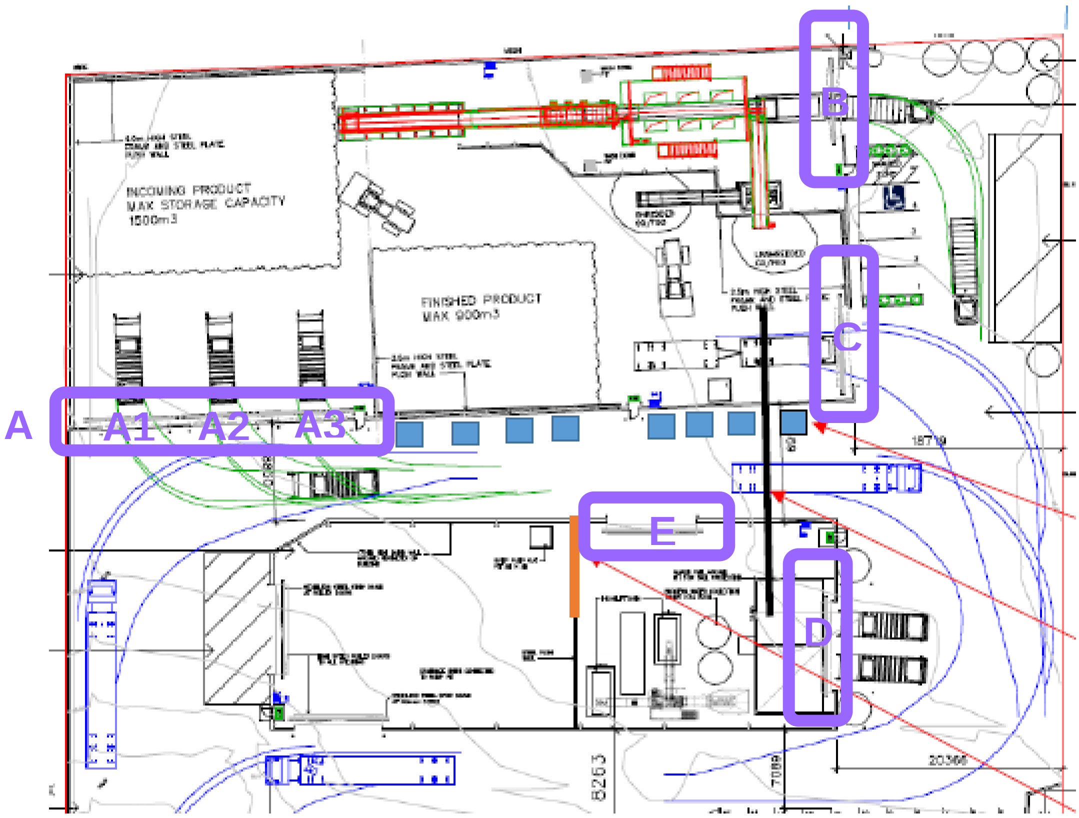


Figure 3: Organics Receival & Processing Building and Food Depackaging Building (northern portion of site)



Both the ORPB and the FDB will be enclosed with the loading and unloading of materials undertaken inside the buildings. Both buildings will be equipped with high-speed roller doors and an automated door-closure system as well as an automated system for the delivery of odour ameliation products in order to minimise the potential for fugitive emissions of odour associated with vehicle movements. Highlighted in Figure 4 are the locations of the vehicle access doors into the ORPB and FDB with the dimensions of the doors provided in Table 1.

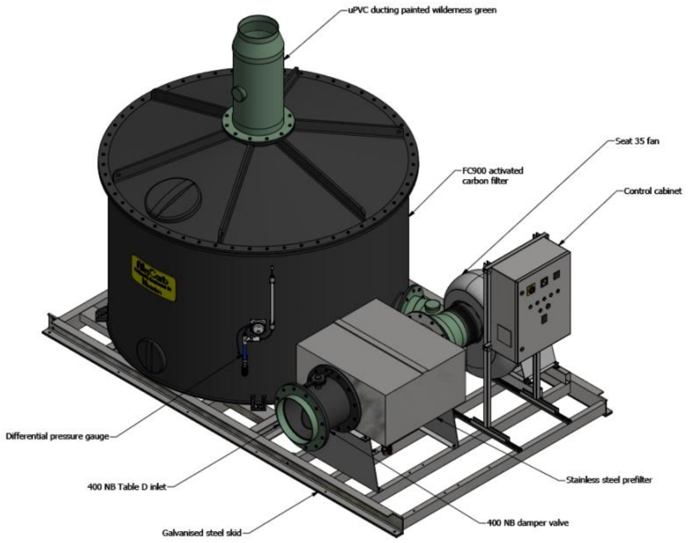
Figure 4: Vehicle Access into ORPB and FPB



The ORPB will be equipped with 8 carbon filter (FC900) units (CFU, Figure 5). Although the CFU units will all be located along the southern side of the ORPB (Figure 3) the air intakes will be distributed (via internal ducting) at strategic odour-management locations within the building. With a per unit flow rate of 900 litres per second (lps) there will be an estimated minimum one building exchange of air per hour. It is noted that the manufacture-specified odour removal efficiency of the CFU is 99.9%. The release height of the efflux gas from the CFU will be c. 11.25 m above ground level and 2 m above the roofline of the ORPB.

Material handling of C&IO will be limited to within the eastern portion of the FDB. In order to maximise flexibility and CFU redundancy, potentially odorous air from within the FDB will be ducted to the ORPB where it will be mixed and treated by the CFU prior to release into the atmosphere.

Figure 5: OdourPro FC 900 Carbon Filter Unit



2.2 Odour Emission Sources

Potential odour emission sources associated with the intake, handling, processing and/or storage of FO, FOGO and C&IO on site include:

- Vehicles delivering and/or removing material from site;
- The release of fugitive odour emissions during the opening and/or closing of the high-speed roller doors; and
- The release of emissions of odour via the CFU stacks.

2.3 Summary of Key Project Information

A summary of key project information relevant to this odour assessment is provided in Table 1 and includes the surface area of materials within the ORPB and FDB as well as the source characteristics of the CFU.

Table 1: Key Project Information

ORPB	
Item	**Description**
Height of building	9.25 m
Surface area of stockpiles	
Unprocessed product (maximum)	c. 701.82 m^2
Finished product (maximum)	c. 561.7 m^2
Odour Management	
FC900 Carbon Filter Unit	8 units in total oriented east-west along southern end of ORPB (Figure 3)
CFU Source Characteristics	
Flow Rate	900 lps (litres per second)
Release height	11.25 m
Stack diameter	0.2 m (at release height)
Odour removal efficiency	99.9%
Efflux gas temperature	Assumed equivalent to ambient
Vehicle access doors (width x height)	
Door A (A1, A2, A3)	6 m x 8 m
Door B	6 m x 5.5 m
Door C	7 m x 5.5 m
FDB	
Item	**Description**
Surface area of potential emission sources	
Stored within Pits	c. 173.8 m^2
Turbo shredder (maximum)	c. 2 m^2
Stored in hook lift bins (maximum)	c. 12 m^2
Odour Management	Building air will ducted to the ORPB and managed through the 8 x FC900 CFU
Vehicle access doors (width x height)	
Door D	8 m x 8 m
Door E	8 m x 5 m

3. Odour Assessment Methodology

3.1 Odour Assessment Criteria

Assessment criteria related to complex odorous emissions (as measured in odour units OU) as prescribed in NSW (2005) is dependent on the scale of the affected population with criterion ranging from 2 OU to 7 OU (Table 2). In general, which assessment criterion is appropriate will depend on the extent of the population that is predicted to be impacted upon (i.e. exposed to an odour impact greater than 2 OU).

For this odour assessment, it has been assumed that the results of the dispersion modelling will be assessed against the 2.0 OU odour criterion at all locations beyond the boundaries of the facility based on a nose-response-time (i.e. 1-second) average 99th percentile (i.e. 87th highest). Note that the use of the 99th percentile (as opposed to maximum) predicted odour concentration of 2.0 OU, allows for perceptible levels of odour (i.e. greater than 1.0 OU) to be predicted at off-site locations on an infrequent basis whilst still complying with regulatory assessment requirements.

Table 2: Population Based Odour Criteria (NSW, 2005)

Table 7.5: Impact assessment criteria for complex mixtures of odorous air pollutants (nose-response-time average, 99th percentile) (EPA 2001)

Population of affected community	Impact assessment criteria for complex mixtures of odorous air pollutants (OU)
Urban (≥~2000) and/or schools and hospitals	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
Single rural residence (≤~2)	7.0

3.2 Odour Emissions Inventory

As noted in Section 2.2, the key odorous emission sources associated with activities at the GWP include:

- The emission of odour from the stacks of the CFU; and
- Potential for fugitive emissions during the opening and closing of the doors (trucks).

Minimal odour impacts are expected in association with the drill mud and hydro-excavation fluids processing area located within the southern end of the site, of particular interest to this assessment are the two organics processing buildings i.e. ORPB and FDB, located at the northern end and middle section of the site respectively (Figure 3).

Odour dispersion modelling has been undertaken to assess the potential for adverse impacts of odour from the CFU (Section 3.3.1) as well as fugitive emissions of odour associated with vehicle movements (Section 0).

Specific odour emission rates (SOERs) considered and/or used in this assessment are summarised in Table 3.

Table 3: Specific Odour Emission Rates

Odour Source	SOERs $(OUm^3/((m^2))(sec)$
Green waste (shredded, uncovered)	2.37[(1)]
Solid food processing wastes	2.5-5.0
Green waste (storage)	2.37[(1)]
Directional drilling muds	0.001

Note (1): GHD Pty Ltd, 2003: Camden Soil Mix Composting and Recycling Facility Local Environmental Study – Air Quality Assessment.

3.3 Odour Emission Scenarios

A number of odour emission scenarios have been considered in relation to activities at GWP:

- Four scenarios associated with the emission of air from the ORPB and FDB through the eight CFU located along the southern end of the ORPB and
- Two vehicle movement scenarios corresponding to average and peak intake tonnages.

The details of the scenarios for the CFU are provided in Section 3.3.1 with those associated with vehicle movements into/out of the ORPB and the FDB provided in Section 3.3.2

3.3.1 Carbon Filter Units

Four odour emissions scenarios have been considered representing typical and potential worst-case emissions of odour associated with the discharge of efflux gas from the CFU. The number of operating units, the assumed odour removal efficiency and the modelled odour emission rate (per unit) for each of the scenarios are provided in Table 4 with the CFU identification (ID) number as per Figure 3. Specifically,

1) Normal Scenario: Considers the operation of 8 CFU operating at the manufacturer specified 99.9% odour elimination efficiency.

2) Normal (Reduced Efficiency) Scenario: Considers the operation of 8 CFU at a *reduced odour elimination efficiency of 90%.*

3) *Worst Case (WC) (Reduced Efficiency) Scenario for receptors located to the east of GWP (i.e. WC East Scenario): Considers the operation of the eastern most 7 CFU at a reduced odour elimination efficiency of 90%.*

4) *Worst Case (Reduced Efficiency) Scenario for receptors located to the west of GWP (i.e. WC West Scenario): Considers the operation of the western most 7 CFU at a reduced odour elimination efficiency of 90%.*

For all scenarios considered, a conservative approach has been adopted whereby it has been assumed that an SOER value of 5.0 is associated with activities within both the ORPB and the FDB (Table 3). A total surface area of odorous material of 1263.5 m^2 within the ORPB and 187.8 m^2 within the FDB (Table 1), combined with an SOER of 5.0, results in a total odour emission rate of 7,256.5 ou/s. Recall that potentially odorous air from within the FDB will be ducted into the ORPB and treated by the CFU prior to release into the surrounding environment via the CFU stacks.

Note that for the CFU reduced efficiency scenarios assume an odour reduction efficiency of 90% as opposed to the manufacturer provided 99.9% efficiency. However, in practice, the CFU efficiency would be monitored and management strategies implemented as required to ensure that the units operate effectively (Section 4.3).

Table 4: CFU Stacks Odour Emissions Scenarios

Scenario	Description	Source ID	Number of units	FC900 Efficiency	Odour Emission Rate (OU/s)
1	Normal	S1-S8	8	99.9%	0.91 per unit
2	Normal with reduced CFU efficiency	S1-S8	8	90%	90.7 per unit
3	Worst Case East (reduced CFU efficiency)	S1-S7(1)	7	90%	103.7 per unit
4	Worst Case West (reduced CFU efficiency)	S2-S8(1)	7	90%	103.7 per unit

Note (1): Assumes one unit is off line.

3.3.2 Vehicle Movements

In relation to the potential for fugitive emissions when the access doors into either the ORPB or the FDB are open, two scenarios have been considered:

A) **The average tonnage scenario**: Daily total vehicle movements were provided for the GWP based on average tonnages corresponding to:

- Garden Organics / Food and Garden Organics 1350 tonnes per 5 day week
- Food organics 580 tonnes per 5 day week

The hourly distribution of vehicle movements was inferred from those provided for the peak tonnage scenario.

B) **The peak tonnage scenario**: Vehicle movements per hour were provided for the GWP based on peak tonnages corresponding to:

- Garden Organics / Food and Garden Organics 1750 tonnes per 5 day week
- Food organics 700 tonnes per 5 day week

Presented in Table 5 is a summary the vehicle movement information for the project including the estimated number of vehicle movements associated with the average tonnage scenario and the peak tonnage scenario. Included in the table is a reference to the relevant access door into either the ORPB or FDB (Table 1, Figure 4).

A breakdown of vehicle movements per hour associated with the peak tonnage scenario is provided in Table 7 highlighting the hours of 7 am through to 10 am and 1 pm through to 4 pm as being associated with the largest number of vehicle movements.

Hourly varying odour emission rates for the average tonnage scenario (Table 10) and peak tonnage scenario (Table 11) were developed for each door based on the following assumptions:

- Dimensions of vehicles are as per Table 6 and assumed maximum legal road width and height.
- A ventilation inlet to a CFU will be located above the doors in order to maximise the draw of air into the building whilst the doors are open.
- The use of odour suppressing sprays located above the door openings will result in a 60% reduction of odours within the fugitive air stream whilst the door is open.
- Hourly distribution of vehicles associated with average tonnage scenario is equivalent to those for peak tonnage scenario times the percentage-of-peak as indicated in Table 5.

- The high speed roller doors will take c. 5 seconds to open and c. 5 seconds to close.
- Vehicle movements into/out of the building will be occur at approximately 10 km/hr.
- The time per vehicle movement that a door will remain open will be determined by the speed of the roller door, length of the vehicle plus 4 meters (2 meters clearance on either side of the doors) and the speed of the vehicles as follows:
  - 6 or 8 wheeler with hook lift bin: 14.5 seconds per movement
  - Truck and dog 32 t pay load: 18.3 seconds per movement
  - Side arm kerbside collection garbage trucks: 13.2 seconds per movement
  - 19 m B' Doubles: 18.3 seconds per movement
- Estimates of the total time per hour that the doors will remain open (Table 8) highlight door A (consisting of doors A1, A2 and A3) as remaining open for a total of 2.5 minutes per hour during peak vehicle movement hours of between 7 am to 9 am and 1 pm to 3 pm.
- The number of vehicles per hour through door A will be distributed evenly between doors A1, A2 and A3. In practice however, preference will be given to the use of door A3, A2 and A1 respectively in order to maximise the distance between potential fugitive emissions of odour and the site boundary.
- Volume of indoor air that escapes as fugitive emissions whilst a vehicle is moving into or out of the building (Table 9) will be the result of the displacement of air within the building and possible entrainment of air into or out of the building. In practice entrainment of air into/out of the building can be minimised by reducing the velocity of vehicles. However, the requirement to minimise entrainment of air will necessarily be balanced against minimising the duration that the door(s) are open.
- The volume of fugitive emissions that is emitted from the building whilst the door is open is assumed to be at most equal to twice the volume of the vehicle.

Table 5: Summary of Daily Vehicle Movements and Door Access

ORPB						
Vehicle Type	**Peak**		**Average**		**% of Peak**	**Door**
	in	**out**	**in**	**out**		
6 or 8 wheeler with Hook lift bin	1.5	1.5	1	1	67%	B
Truck and Dog 32 t pay load	7.5	7.5	6	6	80%	C
Side arm kerbside collection garbage trucks	42	42	32	32	76%	A
19m B' Doubles	2	2	2	2	100%	C
FDB						
Vehicle Type	**Peak**		**Average**		**% of Peak**	**Door**
	in	**out**	**in**	**out**		
6 or 8 wheeler Hook lift bin or murrels	10	10	8	8	80%	D
Wheeler Hook Lift Bin (finished product)	1	1	1	1	100%	E to C
Side arm kerbside collection garbage trucks	3	3	2	2	67%	D

Table 6: Summary of Assumed Vehicle Dimensions

Vehicle Type	Length (m)	Width(1) (m)	Height(2) (m)
6 or 8 wheeler with Hook lift bin	8.5	2.5	4.3
Truck and Dog 32 t pay load	19	2.5	4.3
Side arm kerbside collection garbage trucks	5	2.5	4.3
19m B' Doubles	19	2.5	4.3

Note(1): Assumed maximum legal height
Note(2): Assumed maximum legal width

Table 7: Peak Tonnage Scenario Vehicle Movements including a Breakdown of Movements per Hour

ORPB																											
Vehicle Type	**Peak**		**Total Movements**	**Monday to Friday a.m.**												**Monday to Friday p.m.**											
	in	**out**		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
6 or 8 wheeler with Hook lift bin	1.5	1.5	3	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-
Truck and Dog 32 t pay load	7.5	7.5	15	-	-	-	-	-	4	3	-	-	1	2	-	2	1	-	-	2	-	-	-	-	-	-	-
Side arm kerbside collection garbage trucks	42	42	84	-	-	-	-	-	4	15	15	10	-	-	-	15	15	10	-	-	-	-	-	-	-	-	-
19m B' Doubles	2	2	4	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
FDB																											
Vehicle Type	**Peak**		**Total Movements**	**Monday to Friday a.m.**												**Monday to Friday p.m.**											
	in	**out**		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
6 or 8 wheeler Hook lift bin or murrels	10	10	20	-	-	-	2	3	-	-	-	-	-	-	4	4	4	2	1	-	-	-	-	-	-	-	-
Wheeler Hook Lift Bin	1	1	2	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Side arm kerbside collection garbage trucks	3	3	6	-	-	-	-	-	-	1	2	1	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-

Table 8: Peak Tonnage Scenario: Estimated Total Time Doors are Open per Hour (Minutes)

Door	Monday to Friday a.m.												Monday to Friday p.m.											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
A (total)	-	-	-	-	-	0.7	2.5	2.5	1.7	-	-	-	2.5	2.5	1.7	-	-	-	-	-	-	-	-	-
B	-	-	-	-	-	-	-	-	-	-	0.3	0.2	-	-	-	-	-	-	-	-	-	-	-	-
C	-	-	-	-	0.6	1.0	0.7	-	-	0.2	0.5	-	0.5	0.2	-	-	0.5	-	-	-	-	-	0.6	-
D	-	-	-	0.5	0.7	-	0.2	0.4	0.2	-	-	1.0	1.2	1.2	0.5	0.2	-	-	-	-	-	-	-	-
E	-	-	-	-	-	-	-	-	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 9: Peak Tonnage Scenario: Estimated Volume of Air Released (m^3) per Hour

Door	Monday to Friday a.m.												Monday to Friday p.m.											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
A (total)	-	-	-	-	-	328	1229	1229	819	-	-	-	1229	1229	819	-	-	-	-	-	-	-	-	-
B	-	-	-	-	-	-	-	-	-	-	244	122	-	-	-	-	-	-	-	-	-	-	-	-
C	-	-	-	-	817	1307	980	-	-	327	654	-	654	327	-	-	654	-	-	-	-	-	817	-
D	-	-	-	292	439	-	72	143	72	-	-	585	656	656	292	146	-	-	-	-	-	-	-	-
E	-	-	-	-	-	-	-	-	-	-	366	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 10: Average Tonnage Scenario Odour Emission Rate (OU/s)

Door	Monday to Friday a.m.												Monday to Friday p.m.											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
A (total)	-	-	-	-	-	40	150	150	100	-	-	-	150	150	100	-	-	-	-	-	-	-	-	-
B	-	-	-	-	-	-	-	-	-	-	30	15	-	-	-	-	-	-	-	-	-	-	-	-
C	-	-	-	-	100	159	120	-	-	40	80	-	80	40	-	-	80	-	-	-	-	-	100	-
D	-	-	-	30	45	-	7	15	7	-	-	60	67	67	30	15	-	-	-	-	-	-	-	-
E	-	-	-	-	-	-	-	-	-	-	37	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 11: Peak Tonnage Scenario Odour Emission Rate (OU/s)

Door	Monday to Friday a.m.												Monday to Friday p.m.											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
A (total)	-	-	-	-	-	52	197	197	131	-	-	-	197	197	131	-	-	-	-	-	-	-	-	-
B	-	-	-	-	-	-	-	-	-	-	45	22	-	-	-	-	-	-	-	-	-	-	-	-
C	-	-	-	-	100	199	149	-	-	50	100	-	100	50	-	-	100	-	-	-	-	-	100	-
D	-	-	-	37	56	-	11	22	11	-	-	75	86	86	37	19	-	-	-	-	-	-	-	-
E	-	-	-	-	-	-	-	-	-	-	37	-	-	-	-	-	-	-	-	-	-	-	-	-

3.4 Summary of the Odour Dispersion Modelling Methodology

This odour assessment has been undertaken in consideration of and/or in accordance with:

- (NSW DEC, 2005)*: Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DEC).
- *Technical Framework: Assessment and Management of Odour from Stationary Sources in NSW (DEC).*
- *Technical Notes: Assessment and Management of Odour from Stationary Sources in NSW (DEC).*

Additionally it is noted:

- Odour dispersion modelling has been undertaken using a combination of the US EPA approved CALMET/CALPUFF modelling system (Scirer, 2000a) with numerically simulated upper air data based on TAPM. Regional, three-dimensional wind fields that are used as input into the dispersion model were prepared using a combination of The Air Pollution Model (TAPM) developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) (Hurley, 2008), and CALMET, the meteorological pre-cursor for CALPUFF (Scirer, 2000b).
- A total of three years of ½ hourly meteorology was developed corresponding to years 2013, 2014 and 2015.
- Half-hourly meteorological data from the Bureau of Meteorology (BoM) Horsely Park all weather station (AWS) has been incorporated into the numerically simulated wind fields that were generated using CALMET.
- Odour emission sources associated with the GWP have been represented in the dispersion model using:
  - Point emission sources for the CFU stacks and
  - Volume sources for the fugitive emissions associated with the opening of the doors into the ORPB and the FDB.

  Source characteristics for the CFU are summarised in Table 1 with emission rates summarised in Table 4. Additional details are provided in Appendix C.

  Volume sources used to represent fugitive emissions from the vehicle access doors were assumed to be located at a distance of c. ½ of the vehicle length in front of the relevant access door. A summary of the hourly varying applied odour emission rate is provided in Table 10 and Table 11. Additional details are provided in Appendix C

- Building wake affects associated with the CFU adjacent to the ORPB have been included in the dispersion modelling. As per the CALPUFF default options, stack tip downwash and transitional plume rise have also been included.

- When applying a peak to mean ratio to the results of the dispersion model which is based on hourly averages, consideration was given to Table 6.1 of the NSW DEC (2005) which is reproduced below as Table 12.

  It is important to note that the concept of 'near-field' and 'far-field' is as much a property of the receiver as it is the source. It is the distance between the source and the receiver that will determine whether or not the receptor is located within the near-field or far-field influences of the source region. This is further complicated by the fact that the determination of whether or not a receptor lies within the far-field or near-field region may be influenced by atmospheric stability. Thus, even in circumstances of flat-terrain, the application of these peak-to-mean ratios is not necessarily straight-forward.

  It is further noted, that the values of the peak-to-mean ratio included in Table 12 are considered representative for flat terrain. Thus for this assessment, a conservative approach was adopted whereby a peak to mean ratio of 2.5 has been applied to all receptor locations under all atmospheric stability class conditions (Table 12, highlighted cell).

Table 12: Peak-to Mean Ratios for Flat Terrain (Source: NSW DEC (2005))

Table 6.1: Factors for estimating peak concentrations in flat terrain (Katestone Scientific 1995 and 1998)

Source type	Pasquill–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 wake-free 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

Additional information pertaining to the technical set up of the models is provided in Appendix A and Appendix C. Presented in Appendix B is a summary of the site-specific meteorology developed for the study region.

4. Results from the Odour Modelling

4.1 Maximum Odour Impacts Outside the Site Boundary

Presented in Table 13 is the maximum 99th percentile 1-second average concentration of odour that is predicted to occur within the study region. Results of the odour modelling suggest that the maximum odour impact at the boundary will be 1.4 OU. Note that the minimum perceptible level of odour is 1.0 OU and the regulatory criterion is 2 OU.

Table 13: Results for the 99th Percentile 1-Second Average Concentration of Odour

Scenario	CFU Stack Scenario	Vehicle Movement Scenario	Meteorological Year	Maximum Outside Site Boundary (OU)
1A	Normal (8 CFU @ 99.9% efficiency)	Average	2013	0.7
			2014	0.7
			2015	0.7
2A	Normal (reduced efficiency) (8 CFU @ 90% efficiency)	Average	2013	1.3
			2014	1.2
			2015	1.3
3A	WC East (reduced efficiency) (7 CFU @ 90% efficiency)	Average	2013	1.3
			2014	1.2
			2015	1.3
4A	WC West (reduced efficiency) (7 CFU @ 90% efficiency)	Average	2013	1.3
			2014	1.3
			2015	1.4
1B	Normal (8 CFU @ 99.9% efficiency)	Peak	2013	0.8
			2014	0.8
			2015	0.8
2B	Normal (reduced efficiency) (8 CFU @ 90% efficiency)	Peak	2013	1.3
			2014	1.3
			2015	1.4
3B	WC East (reduced efficiency) (7 CFU @ 90% efficiency)	Peak	2013	1.3
			2014	1.3
			2015	1.4
4B	WC West (reduced efficiency) (7 CFU @ 90% efficiency)	Peak	2013	1.3
			2014	1.3
			2015	1.4

4.2 Contour Plots

When interpreting results presented as contour plots, it is important to note that the figure does not represent a snapshot at any given time. Instead, it presents the 99th percentile (i.e. 87th highest) 1-second odour concentration at each location in the study region which for each receptor may occur at different times of the year and under different atmospheric conditions.

Presented in Figure 6 through Figure 8 are contour plots of the 99th percentile, 1-second average concentration of odour as predicted using the CALPUFF dispersion model for meteorological years 2013 through 2015 for the average tonnage scenario. Note that the contours are colour coded with:

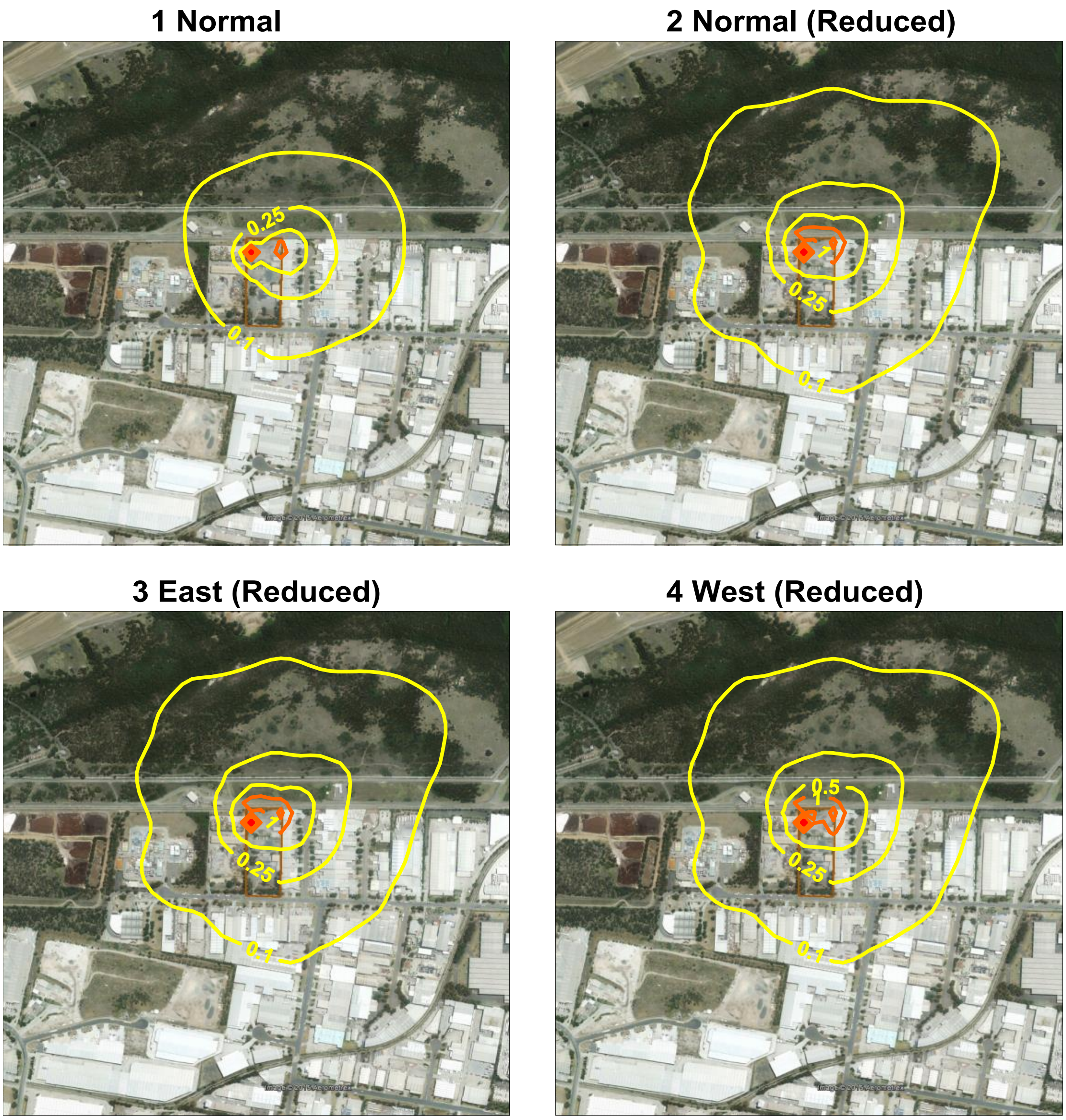
- green contours associated with an odour concentration less than 0.1 OU,
- yellow contours for values between 0.1 OU and 1.0 OU,
- orange contours for values between 1.0 OU and 2.0 OU and
- red contours for values over the minimum regulatory criterion of 2 OU.

Results for the peak tonnage scenario are provided in Figure 9 through Figure 11.

In general, no significant issues are indicated by the results of the dispersion modelling at any off-site location for any of the scenarios considered with odour impacts predicted to be less than the regulatory criterion of 2 OU.

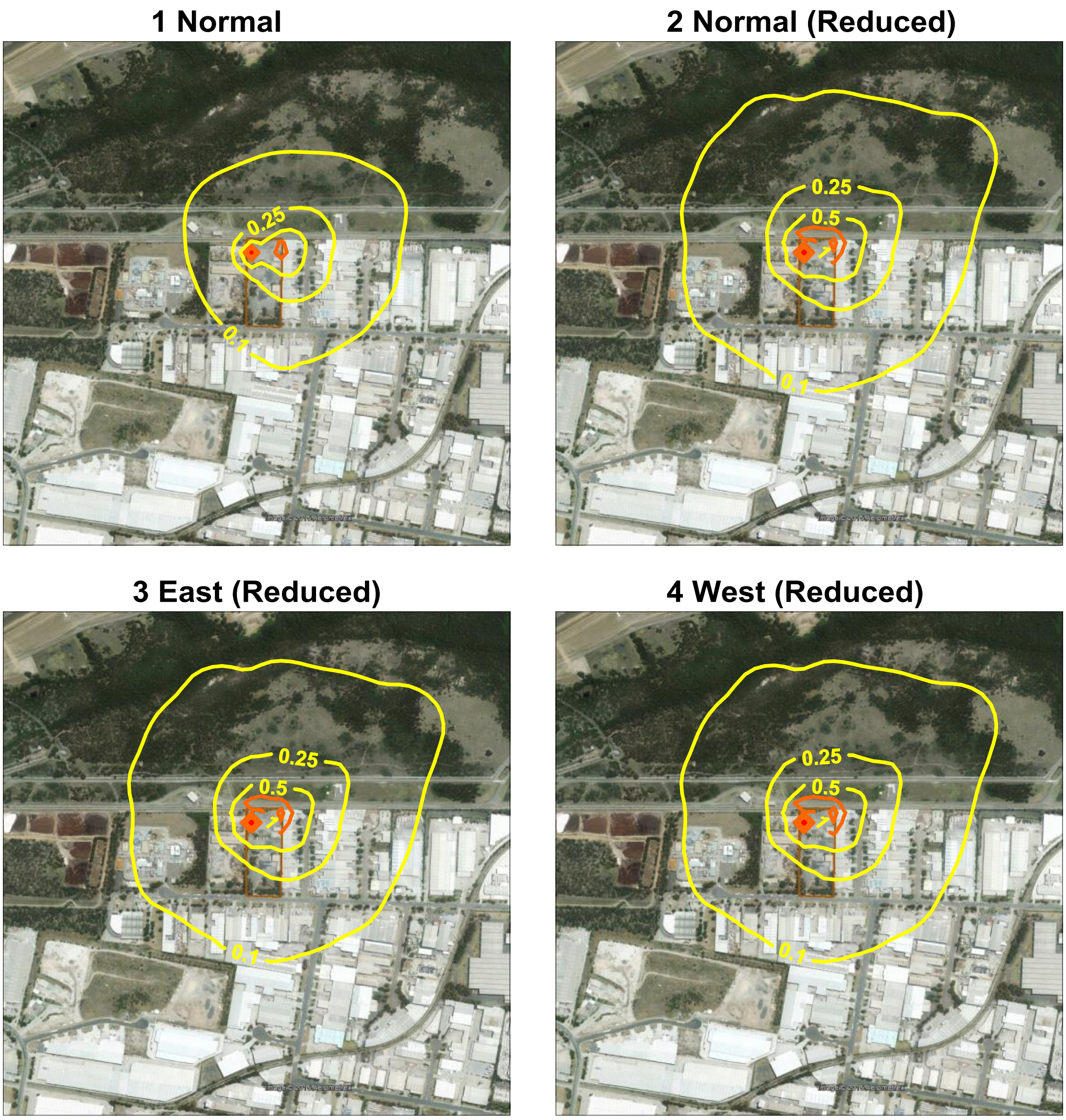
Results of the dispersion modelling suggest that the proposed odour mitigation measures associated with the operation of the GWP will be sufficient to manage odour impacts at off-site locations.

Figure 6: Average Tonnage Scenario: The 99th Percentile 1-Second Average Concentration of Odour (OU) based on Meteorology for 2013



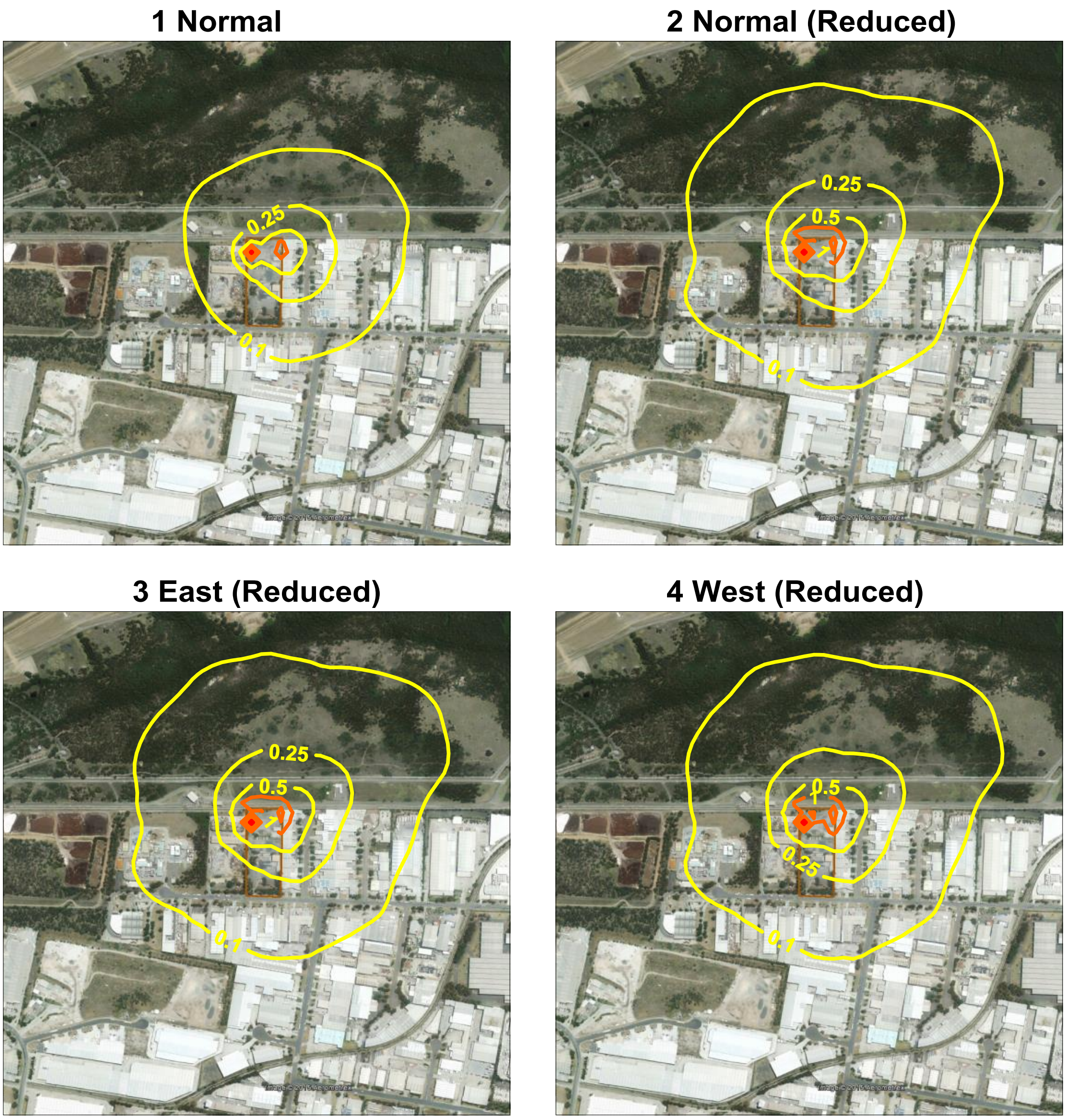
Scenario: As labelled		**Sources included:** CFU Stacks and Open Doors	
Pollutant:	Odour	Averaging Period:	1-second
Background-level:	N/A	Rank:	99th percentile based on 2013 meteorology
Project Goal:	2 OU	Contour level(s):	0.001, 0.0025, 0.005 (green), 0.1, 0.25, 0.5 (yellow), 1, 1.5 (orange), 2 (red) OU

Figure 7: Average Tonnage Scenario: The 99th Percentile 1-Second Average Concentration of Odour (OU) based on Meteorology for 2014



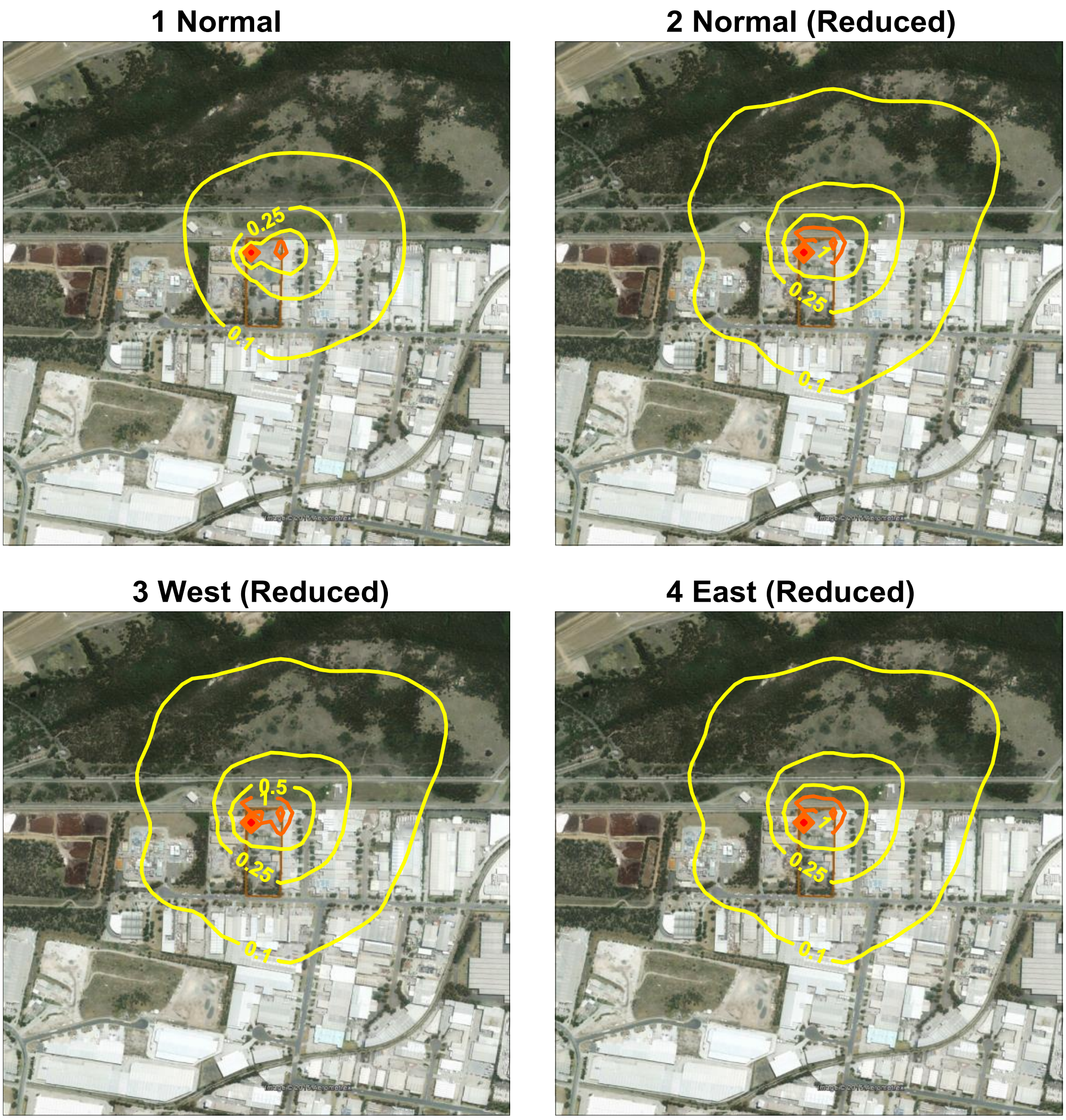
Scenario: As labelled		**Sources included:** CFU Stacks and Open Doors	
Pollutant:	Odour	Averaging Period:	1-second
Background-level:	N/A	Rank:	99th percentile based on 2014 meteorology
Project Goal:	2 OU	Contour level(s):	0.001, 0.0025, 0.005 (green), 0.1, 0.25, 0.5 (yellow), 1, 1.5 (orange), 2 (red) OU

Figure 8: Average Tonnage Scenario: The 99th Percentile 1-Second Average Concentration of Odour (OU) based on Meteorology for 2015



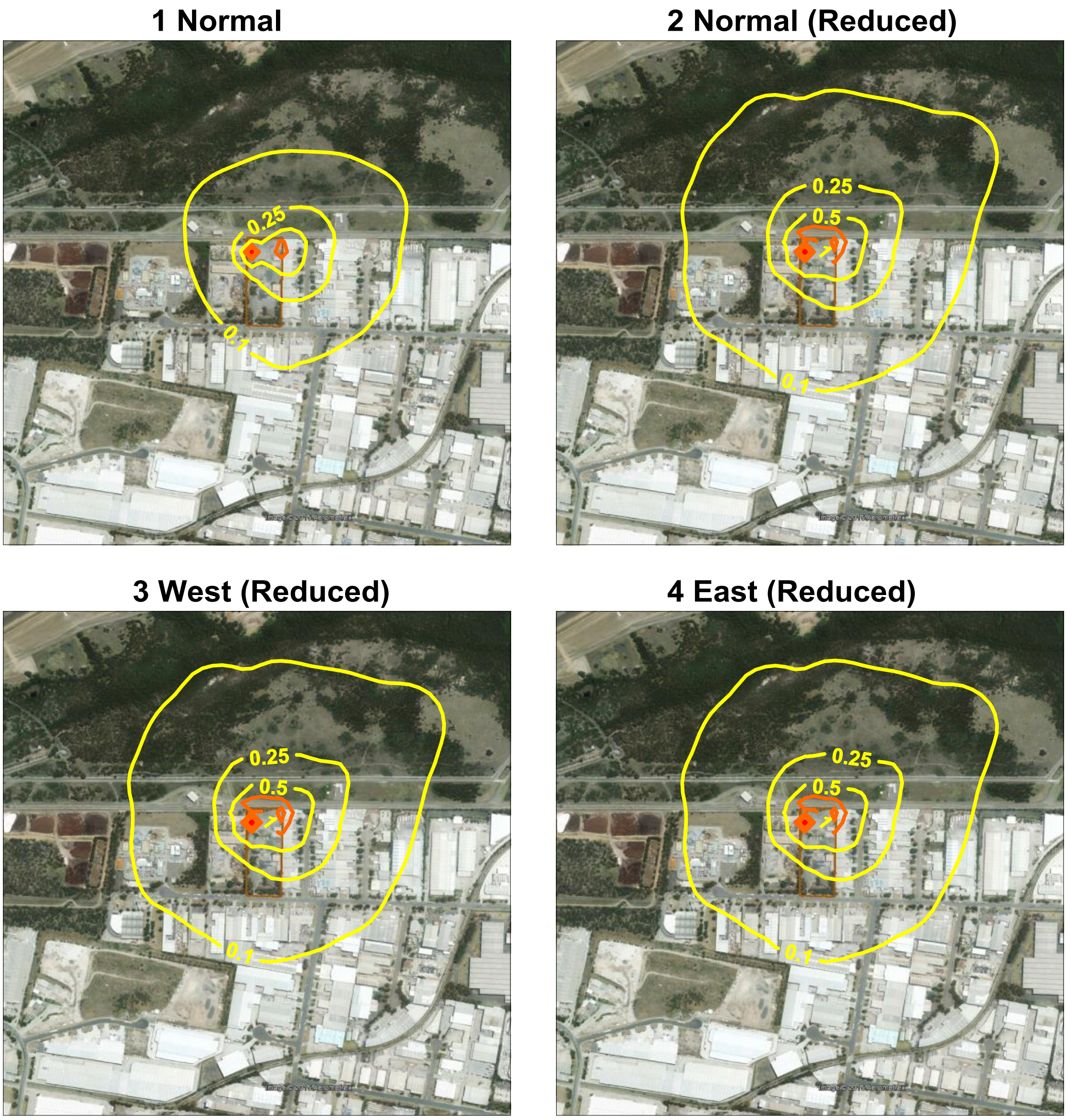
Scenario: As labelled		**Sources included:** CFU Stacks and Open Doors	
Pollutant:	Odour	Averaging Period:	1-second
Background-level:	N/A	Rank:	99th percentile based on 2015 meteorology
Project Goal:	2 OU	Contour level(s):	0.001, 0.0025, 0.005 (green), 0.1, 0.25, 0.5 (yellow), 1, 1.5 (orange), 2 (red) OU

Figure 9: Peak Tonnage Scenario: The 99th Percentile 1-Second Average Concentration of Odour (OU) based on Meteorology for 2013



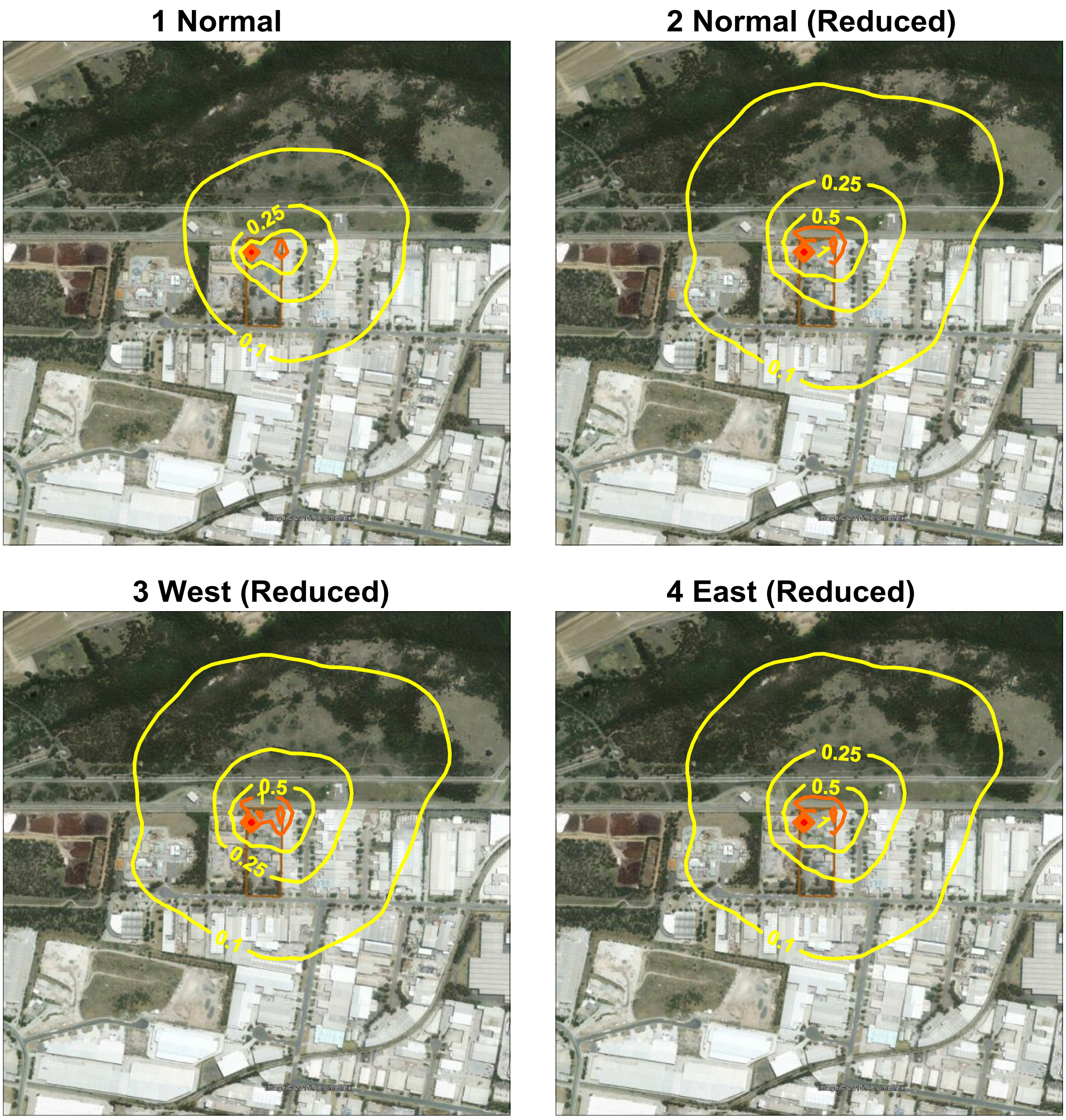
Scenario: As labelled		**Sources included:** CFU Stacks and Open Doors	
Pollutant:	Odour	Averaging Period:	1-second
Background-level:	N/A	Rank:	99th percentile based on 2013 meteorology
Project Goal:	2 OU	Contour level(s):	0.001, 0.0025, 0.005 (green), 0.1, 0.25, 0.5 (yellow), 1, 1.5 (orange), 2 (red) OU

Figure 10: Peak Tonnage Scenario: The 99th Percentile 1-Second Average Concentration of Odour (OU) based on Meteorology for 2014



Scenario: As labelled		**Sources included:** CFU Stacks and Open Doors	
Pollutant:	Odour	Averaging Period:	1-second
Background-level:	N/A	Rank:	99th percentile based on 2014 meteorology
Project Goal:	2 OU	Contour level(s):	0.001, 0.0025, 0.005 (green), 0.1, 0.25, 0.5 (yellow), 1, 1.5 (orange), 2 (red) OU

Figure 11: Peak Tonnage Scenario: The 99th Percentile 1-Second Average Concentration of Odour (OU) based on Meteorology for 2015



Scenario: As labelled		**Sources included:** CFU Stacks and Open Doors	
Pollutant:	Odour	Averaging Period:	1-second
Background-level:	N/A	Rank:	99th percentile based on 2015 meteorology
Project Goal:	2 OU	Contour level(s):	0.001, 0.0025, 0.005 (green), 0.1, 0.25, 0.5 (yellow), 1, 1.5 (orange), 2 (red) OU

4.3 Assumptions and Implications

This odour assessment has naturally included a range of assumptions that will have varying degrees of impact on the results obtained.

Some of the key assumptions and implications as well as corrective management options are summarised in Table 14

Table 14: Modelling Assumptions and Implications

Item	Category	Assumption	Implication and Management
1	Odour emissions	Air is well mixed within the ORPB and FDB	Internal variations in odour could result in short-term odour ‘spikes’ associated with fugitive emissions. Management procedures including the use of odour ameliation products directly on the odour source(s) and the use of sprays above the doors during vehicle movements into/out of the buildings will minimise the risk of odour ‘spikes’ occurring
2	Odour emissions	Maximum volumes within the ORPB and FDB at all times, 24/7,365 days per year.	Conservative
3	Odour emissions	Applied SOER of 5 OU/m^2/s for all odour emission sources within the ORPB and FDB	Have also assumed maximum volumes within the ORPB and FDB at all times. These assumptions correspond to an odour emission rate of 26 million OU per hour. Note that the results of the modelling suggest that odour impacts will not exceed 1.4 OU (based on the 99th percentile). Thus extrapolation of results suggest that the regulatory criterion of 2 OU at the boundary would be associated with an odour emission rate of c. 37 million OU/hour suggesting an SOER of c. 7 (all other assumptions remaining the same). Management procedures including the use of odour ameliation products at the source will minimise the risk of the SOER of odorous emission sources exceeding 5.
4	Fugitive emissions	During vehicle movements into/out of the buildings, at most twice the volume of the trucks amount of indoor air is released as fugitive emissions.	The volume of indoor air that escapes as fugitive emissions whilst a vehicle is moving into or out of the building will be the result of the displacement of air within the building and possible entrainment of air into or out of the building. In practice it is likely that the amount of air escaping through the doors during vehicle movements into the building will be less than that during exiting of the building when the entrainment of indoor air out of the building is more likely. Equal volumes of air during entering and exiting the buildings have been

			assumed. Entrainment of air into/out of the building can be minimised by reducing the velocity of vehicles. However, the requirement to minimise entrainment of air will necessarily be balanced against minimising the duration that the door(s) are open. The level of conservatism in the assumed volume of fugitive emissions is considered conservative however the level of conservatism would not be able to be assessed without direct measurement. Assuming an SOER of 5, results of the dispersion modelling also suggest that an assumption of c. 3 times the truck volume of air being released as fugitive emissions will not exceed c. 2.1 OU at the boundary.
5	Fugitive emissions	Doors A3, A2 and A1 will be utilised equally	In practice, distances between vehicle movements and the site boundary should be maximised as far as practical. Should odour levels within the ORPB or FDB exceed acceptable levels, corrective measures must be taken to reduce odour levels prior to the opening of any of the vehicle access doors.
6	CFU efficiency	Assumed 99.9% (normal) and 90% (reduced efficiency)	As the CFU will be equipped with VOC breakthrough detection which will trigger the requirement to service/change the CFU medium, the use of a 90% reduced efficiency is considered conservative. In the unlikely event of a power failure, operational procedures will require that all doors be closed. Although the CFU fans will not be operational, without natural ventilation building air will be required to pass through the CFU filter medium prior to release through the CFU stacks albeit at a significantly reduced velocity. Without forced ventilation it is unlikely that a significant amount of indoor air will be released into the ambient environment under these conditions. However, without forced ventilation, there is potential for odours to accumulate within the buildings during a power outage. However, the manual application of odour ameliation products as required will be sufficient to ensure that odour levels do not cause an issue once the power is restored.

5. Odour Management

The potential for odour-related impacts to off-site receptors will be managed through the adopted odour reduction measures that form part of the GWP's Environmental Management Plan (EMP) (Section 6.1.2. of GWP EMP (LZE, 2017)). The following has been extracted directly from LZE (2017):

- *All incoming consignments are to be unloaded within the ORPB or the FDB;*
- *No GO, FOGO or C&IO is to be stored outside the ORPB or the FDB;*
- *Any movement of processed C&IO to the ORPB for consolidation must be contained or covered so that fugitive emissions are not released during the transfer. Moreover, prior to the movement of C&IO, proprietary inoculums must be applied to the material to suppress any volatile odour;*
- *When doors are opened to receive incoming GO, FOGO, or C&I, air extraction must be in operation to direct odours to one of the designated high grade activated carbon filters installed. Moreover, when doors are opened, the outdoor misting sprays positioned above the door openings must be operated whereby a proprietary inoculum will be dispersed into the air to suppress any fugitive volatile odour emissions;*
- *All plant and equipment utilised for the processing of organic material must be regularly cleaned down so that they do not become a point source of pollution. Proprietary inoculum must be utilised to deodorise equipment;*
- *If FOGO is displaying elevated levels of volatile organic compounds, then spray with inoculum;*
- *When the breakthrough sensor attached to the high grade activated carbon filter indicates that VOC concentration is > 2 ppm, filter media must be changed within 24 hours;*
- *Enough high grade activated carbon filter media (filter media) must be stored on site so as to be able to exchange two units; and*
- *Spent filter media must be incorporated into the consignment of FOGO that is to be* removed from the facility.

Further to the above, all stormwater improvement devices must be regularly maintained and serviced such that anaerobic conditions do not occur. If for some reason stormwater improvement devices become a point source of odour, microbial inoculums, oxidising agents *(recommended as hydrogen peroxide 30%) or pH adjusters must be considered. However, before application occurs, consultation with an appropriately qualified person must occur to ensure that environmental harm does not occur to the receiving environment from such addition.*

Any odorous (prohibited) wastes unintentionally received and observed after the offending transporter has vacated the site must be promptly dealt with and placed into a receptacle for prompt removal off site. Offending material must be treated with a suitable proprietary product to ensure odour nuisance is not created. No such waste will be allowed to remain on site.

If at the time of unloading, prohibited waste is observed, then the offending transporter must remove the said material from the site promptly.

If in the unlikely chance drill mud received is odorous the use of proprietary products will occur to minimise or eliminate the said odour.

All general waste generated at the Facility must be contained in an appropriate waste receptacle and be removed from the site regularly. Waste must not become a point where vectors such as birds or vermin are attracted.

5.1 Results of the Dispersion Modelling and Implications for Odour Management

The results of the dispersion modelling highlight the importance of the following odour management practices in order to minimise the potential for address impacts of odour at locations past the site boundaries:

- The timely maintenance of CFU to ensure that odour removal efficiency exceeds 90%.
- The use of odour suppressants directly onto odorous sources within the ORPB and FDB as required to minimise the potential for odour build-up within the building and to ensure that the SOER of the intake streams does not exceed 5 (OUm^3/((m^2))(sec).
- Minimising the duration that vehicle and/or pedestrian access points into the ORPB and/or the FDB remain open.
- Monitoring of vehicle speeds into/out of the ORPB and FDB in order to minimise entrainment of air into/out of the buildings.
- The automated application of misting sprays including odour suppressants to be located above the vehicle access doors and continuously applied whilst the door is open.

6. Summary

AED has conducted an assessment of the impact of odorous emissions associated with Greenspot Wetherill Park located at 24 Davis Road, Wetherill Park, NSW.

The key potential odour emission sources are associated with the intake, handling and processing of FO and FOGO within the ORPB as well as C&IO within the FDB.

The focus of the odour assessment has been on the emission of odour from the site's eight carbon filter units that will treat the efflux gas from the ORPB and the FDB prior to release into the atmosphere and the potential for fugitive emissions associated with vehicle movements into/out of the ORPB and FDB vehicle access points.

Four CFU odour emission scenarios have been considered based on the operation of either 8 or 7 of the CFU with the latter allowing for one of the units to be off-line (e.g. for maintenance). Odour reduction efficiency of both the manufacturer specified 99.9% and a conservative 90% has been incorporated into the scenarios considered.

Two vehicle movement scenarios have been considered in order to assess the potential for adverse impacts associated with fugitive emissions of odour whilst the access doors to the ORPB and FDB are open. The two scenarios correspond to an average tonnage scenario and a peak tonnage scenario. The doors to the ORPB and the FDB are estimated to be open less than 5 minutes in total in any one hour.

Results of the odour dispersion modelling for the eight odour emission scenarios considered has not highlighted any issues with impacts along the site boundary with odour levels not predicted to exceed the regulatory criterion of 2 OU. Nonetheless, prioritising the use of door A3, door A2 and lastly door A1 in practice will assist in managing odour from the facility by maximise the distance between potential fugitive emissions during vehicle movements into/out of the ORPB and the site boundary.

The risk of fugitive emissions as a result of other potential odour emission sources will be minimised through the strict adherence to the odour management strategies outlined in Section 6.1.2 of the GWP EMP (ZBE, 2017).

In summary, results of the odour assessment of the GWP suggest that the mitigation measures and management strategies proposed for the operation of the facility will be sufficient to comply with regulatory requirements for odour.

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8. References

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Appendix A Development of Numerically Simulated Meteorological Fields

Dispersion modelling typically requires a meteorological dataset representative of the local airshed on an hourly timescale. Parameters required include wind speed, wind direction, temperature, atmospheric stability and mixing height. In general, meteorological observations recorded by weather stations include hourly wind speed, wind direction, temperature, rainfall and humidity. However additional parameters like atmospheric stability class and mixing height are difficult to measure and are often generated through the use of meteorological models.

A.1 TAPM

The meteorological model 'The Air Pollution Model' (TAPM) developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) was used to predict initial three-dimensional meteorology for the local airshed. TAPM is a prognostic model used to predict three dimensional meteorological observations, with no local inputs required. The model predicts meteorological dataset consisting of parameters like wind speed, wind direction, temperature, water vapour, cloud, rain, mixing height, atmospheric stability classes etc. that are required for dispersion modelling.

Additionally TAPM includes the option to assimilate local observations (of wind speed and wind direction) in order to nudge the predicted solution towards the observed records. For this assessment, only the upper air data of TAPM is used in CALMET i.e. data assimilation functionality of TAPM was not used.

Technical details of the model equations, parameterisations and numerical methods are described in the technical paper by Hurley (2008).

The details of the TAPM configuration are summarised in Table 1.

Table 1: TAPM Configuration

Parameter	Units	Value
TAPM version	-	v4.0.5
Years modelled	-	2013, 2014 & 2015
Grid centre	Lat, Lon (Degrees)	-33.83 150.90
Number of nested grids	-	4
Grid dimensions (nx, ny)	-	25,25
Number of vertical grid levels (nz)	-	25
Grid 1 spacing (dx, dy)	Km	30,30

Parameter	Units	Value
Grid 2 spacing (dx, dy)	Km	10,10
Grid 3 spacing (dx, dy)	Km	3,3
Grid 3 spacing (dx, dy)	Km	1,1
Local hour	-	GMT + 10
Local Met Assimilation	-	No
Surface vegetation database	-	Default TAPM V4 database at 3-minute grid spacing (Australian vegetation and soil type data provided by CSIRO Wildlife and Ecology.
Terrain database	-	Default TAPM V4 database at 9-second grid spacing (Australian terrain height data from Geoscience Australia)

A.2 CALMET

CALMET (version 6.334) was used to simulate meteorological conditions for the local airshed. CALMET is a diagnostic three dimensional meteorological pre-processor for the CALPUFF modelling system (developed by Earth Tech, Inc.).

Prognostic output from TAPM was used as input into the CALMET model. Using high resolution geophysical datasets, CALMET then adjusts the initial guess field for the kinematic effects of terrain, slope flows, blocking effects and 3-dimensional divergence minimisation as well as differential heating and surface roughness associated with different land uses across the modelling domain.

A single resolution CALMET grid was developed to derive meteorological fields at 100 m resolution. The domain size and grid resolution are specified in Table 4. The extent of the domains is shown in Figure 1.

Table 2: CALMET Domain Specifications

CALMET Grid Resolution	Domain Size	Number of Nodes	Grid Spacing (m)
100 m	9.8 km x 7.6 km	99 x 77	100 x 100

The development of the CALMET grid requires input datasets along with the control file where the CALMET run parameters are specified. These input datasets include:

- Geophysical data
- Upper air meteorological data
- Surface meteorological data

The CALMET inputs are discussed in detail in the following sections.

Figure 1: Areal Extent of CALMET Domain (Site Indicated by Yellow Rectangle)

A.2.1 The 100 Meter Resolution CALMET Grid

Geophysical dataset

The terrain for the 100 m resolution CALMET grid was extracted from 3-arc second (90m) spaced elevation data obtained via NASA's Shuttle Radar Topography Mission (SRTM) in 2000.

Terrain data at 100 m resolution overlayed over the base map is shown in Figure 2.

The land use or land cover data for the modelling domain was derived manually using aerial imagery. The Geotechnical parameters for the land use classification were adopted from a combination of closest CALMET and AERMET land use categories.

User defined land use classification and geotechnical parameters used in CALMET are presented in Table 3 and Figure 3.

Figure 2: Terrain data for CALMET Geophysical Dataset

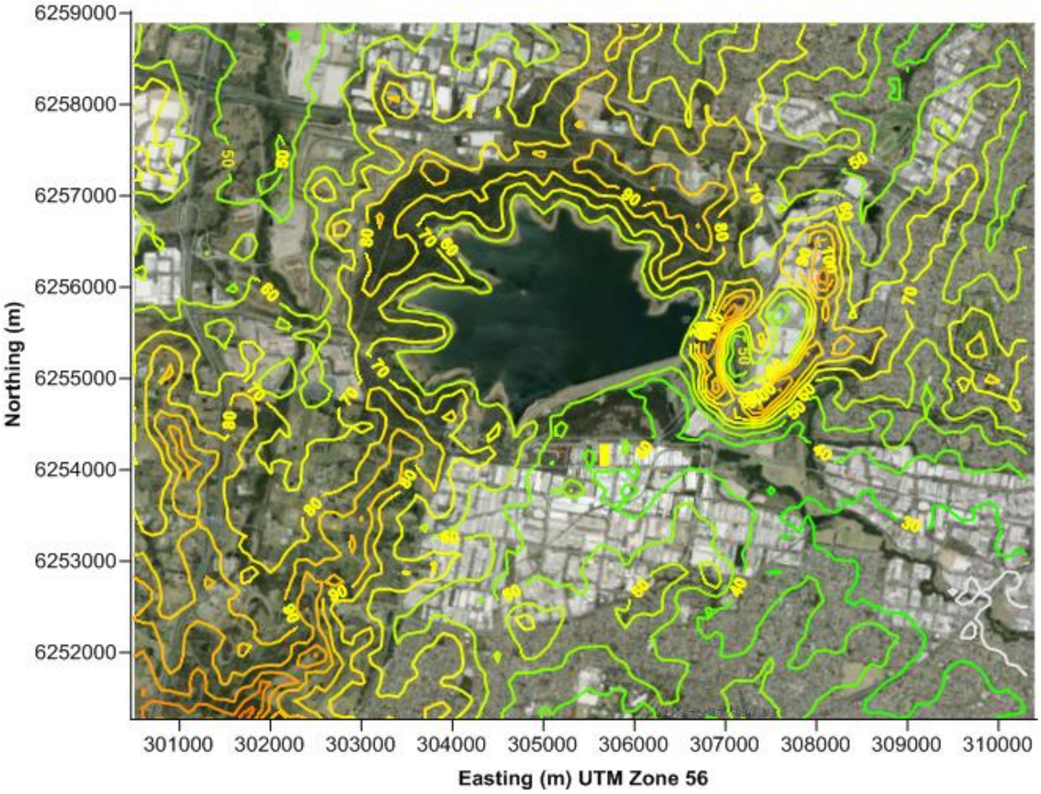


Figure 3: User Defined Land Use Categories for CALMET Modelling domain

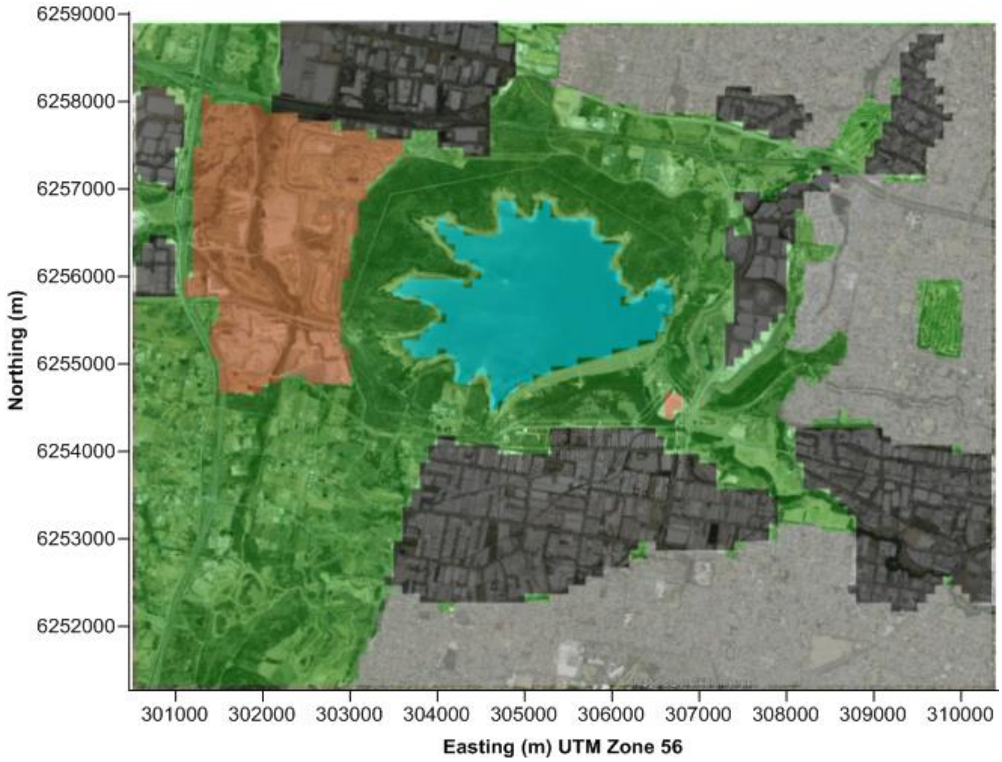


Table 3: Geotechnical Parameters for User Defined CALMET Land Use Classification

CALMET User defined Category	Description	Aermet Category	Surface roughness (a)	Bowen ratio (a)	Albedo (a)	Soil heat flux parameter (b)	Anthropogenic heat flux (b)	Leaf Area Index (b)
1	Urban areas	Light Industrial	0.54	0.8	0.16	0.25 (Calmet – Urban)	0	0.2 (Calmet – Urban)
2	Urban areas	Low intensity residential	0.54	0.8	0.16	0.25 (Calmet – Urban)	0	0.2 (Calmet – Urban)
3	Grassland / Herbaceous	Grassland / Herbaceous	0.1	0.8	0.18	0.15 (Calmet – Rangeland)	0	0.5 (Calmet – Rangeland)
4	Small water bodies	-------------	0.001 (Calmet – Bays & Estuaries)	0 (Calmet –Bays & Estuaries)	0.01 (Calmet –Bays & Estuaries))	1 (Calmet –Bays & Estuaries)	0 (Calmet –Bays & Estuaries)	0 (Calmet –Bays & Estuaries)
5	Quarries/Mine	Quarries/strip mine/gravel	0.3	1.5	0.2	0.15 (Calmet –Barren)	0	0.05 (Calmet –Barren)

(a) EPA (2008) , *AERSURFACE User's Guide*, developed by the Air Quality Modelling Group, USEPA office of Air Quality Planning and Standards.
(b) CALPUFF version 6, USER guide.

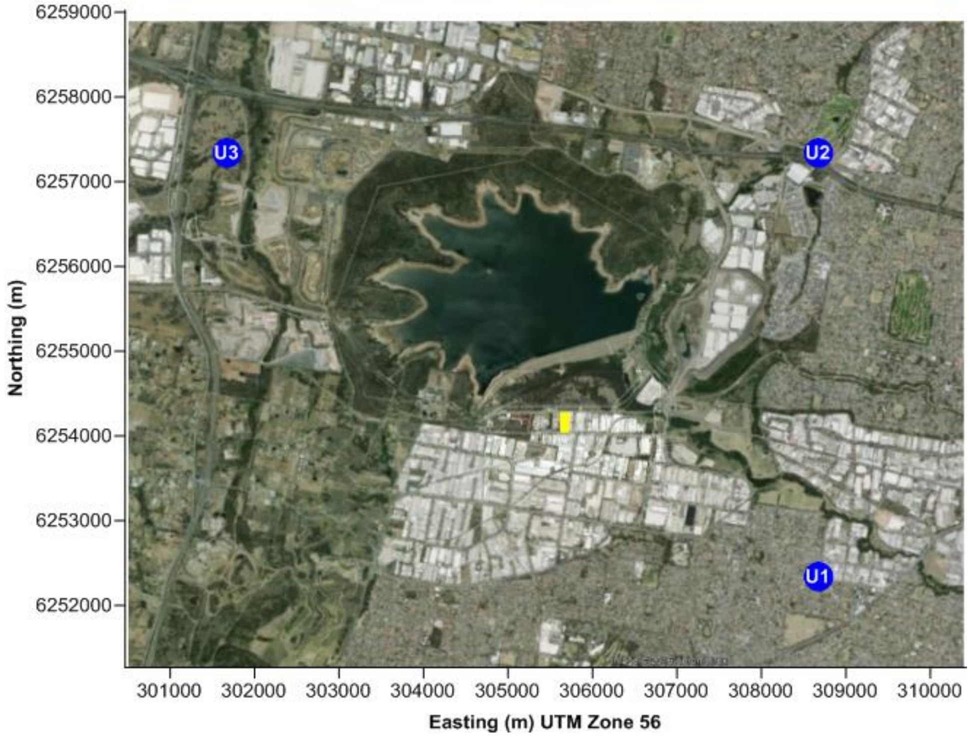
Upper air dataset

Upper air data were extracted from TAPM for the innermost grid at three locations corresponding to that illustrated in Figure 4. Coordinates of the upper air stations are presented in Table 4.

Table 4: Coordinates of Upper Air Stations Included in CALMET

Station Name	Source	Easting(m) UTM 56	Northing (m) UTM 56
UP1	TAPM	308,675	6,252,340
UP2	TAPM	308,675	6,257,340
UP3	TAPM	301,675	6,257,340

Figure 4: Location of Upper Air Stations



Surface Observations Dataset

Hourly surface observations at one location were extracted from the innermost TAPM grid (1 km).

Additionally, ½ hourly data from the Bureau of Meteorology's Horsely Park All Weather Station was incorporated into CALMET.

Figure 5 illustrates the location of the surface stations. Coordinates and source of these surface stations are presented in Table 5.

Figure 5: Location of Surface Stations

Table 5: Coordinates of Surface Observation Stations Included in CALMET

Station ID	Station Name	Source	Height (m)	Easting (m) UTM 56	Northing (m) UTM 56
20001	S1	TAPM	10	308,675	6,252,340
20002	Horsley Park	BoM	10	301,708	6,252,287

CALMET Configuration

Details of the CALMET configuration are presented in Table 6.

Table 6: CALMET Configuration

Parameter	Units	Value
CALMET version	-	V6.334
Years modelled	-	2012, 2013 & 2014
No. X grid cells (NX)	-	99
No. Y grid cells (NY)	-	77
Grid spacing (DGRIDKM)	Km	0.1
X coordinate (XORIGKM)	Km	300.5
Y coordinate (YORIGKM)	Km	6251.273
No. of vertical layers (NZ)	-	10
Number of surface stations	-	2
Number of upper air stations	-	3
Maximum radius of influence over land in the surface layer (RMAX1)	Km	3
Maximum radius of influence over land aloft (RMAX2)	Km	6
Maximum radius of influence over water (RMAX3)	Km	1
Radius of influence of terrain features (TERRAD)	Km	1
Land use database	-	Manually generated land use based on aerial imagery
Terrain database	-	3-arc second (90m) spaced elevation data obtained via NASA's Shuttle Radar Topography Mission (SRTM) in 2000
Minimum overland mixing height (ZIMIN)	m	50
Maximum overland mixing height (ZIMAX)	m	3000
UTC time zone (ABTZ)	Hours	UTC+1000

Appendix B Existing Meteorological Environment

B.1 Wind Roses

Numerically simulated wind fields (CALMET) for the three-year period (2013 through 2015) were developed for the study area. The wind rose for the three-year period is presented in Figure 6. Predominant winds are light air (0.5 m/s to 1.5 m/s) to moderate breeze (5.5 m/s to 8 m/s) from the southwest.

There is some seasonality suggested by the middle row of wind roses. During summer months light to gentle breezes are predicted from the east through to south while the predominance of the southeast wind is indicated throughout the remainder of the year.

Variability of the winds as a function of the time of day is indicated by the wind roses in the bottom row of the figure(s).

The wind roses for the Horsely Park (BoM) monitoring station are similar to those for the project site with predominantly southeast winds highlighted.

Figure 6: Wind Roses – All, Annual, Seasonal, Hour of Day (CALMET: 2013-2015)

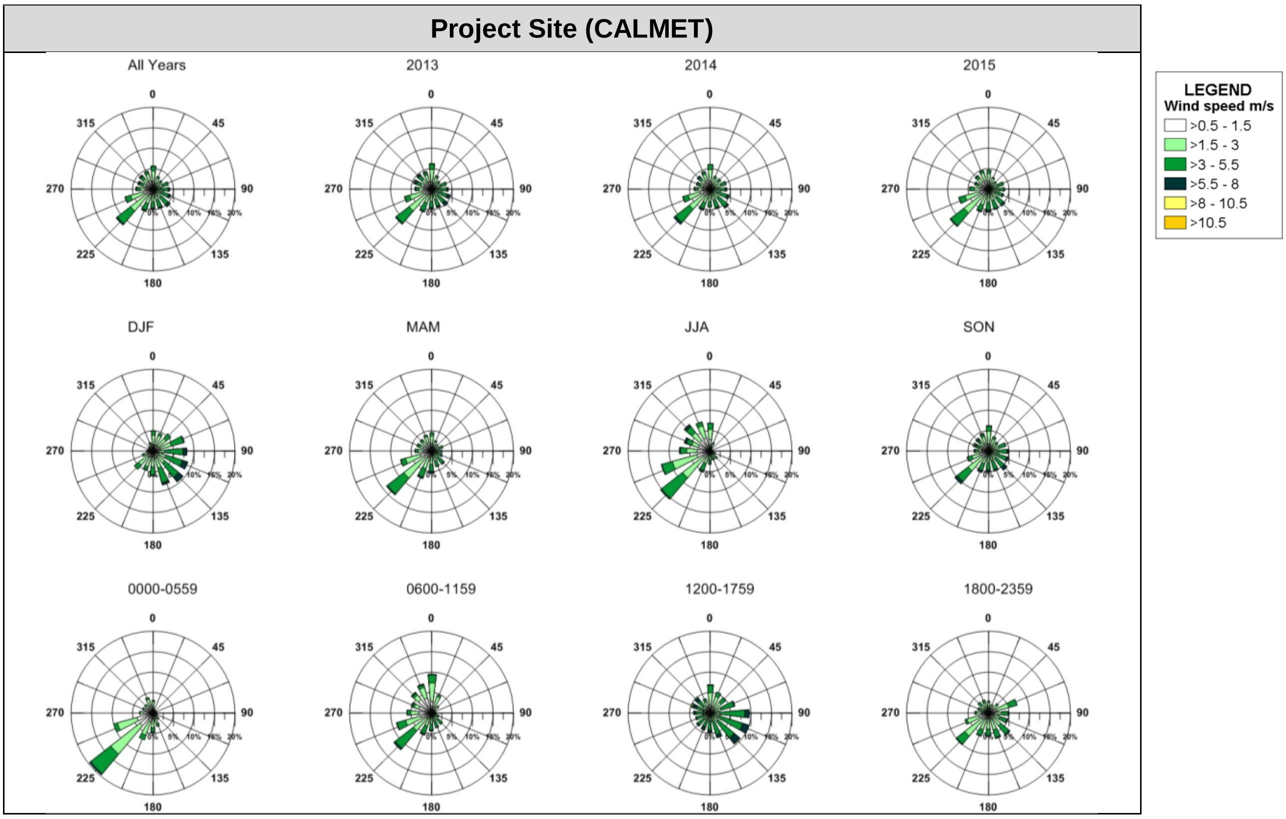
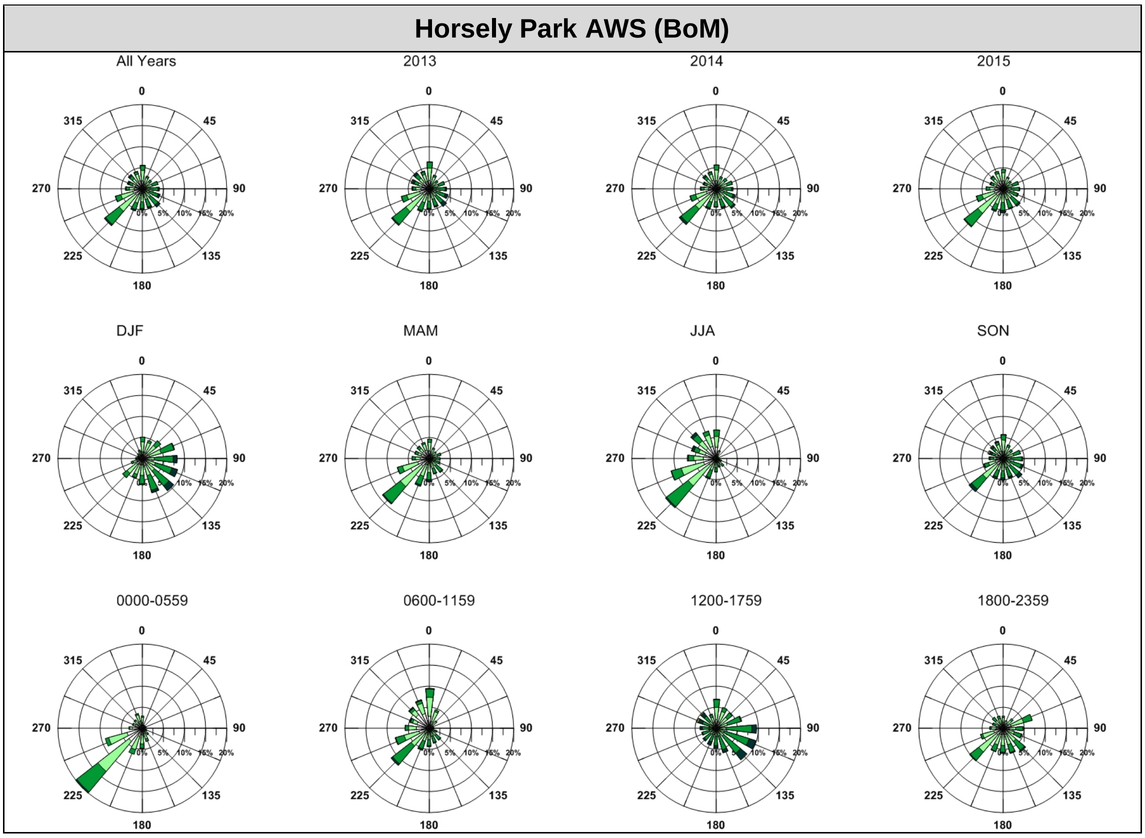


Figure 7: Wind Roses – All, Annual, Seasonal, Hour of Day (BoM: 2013-2015)



B.2 Stability Class

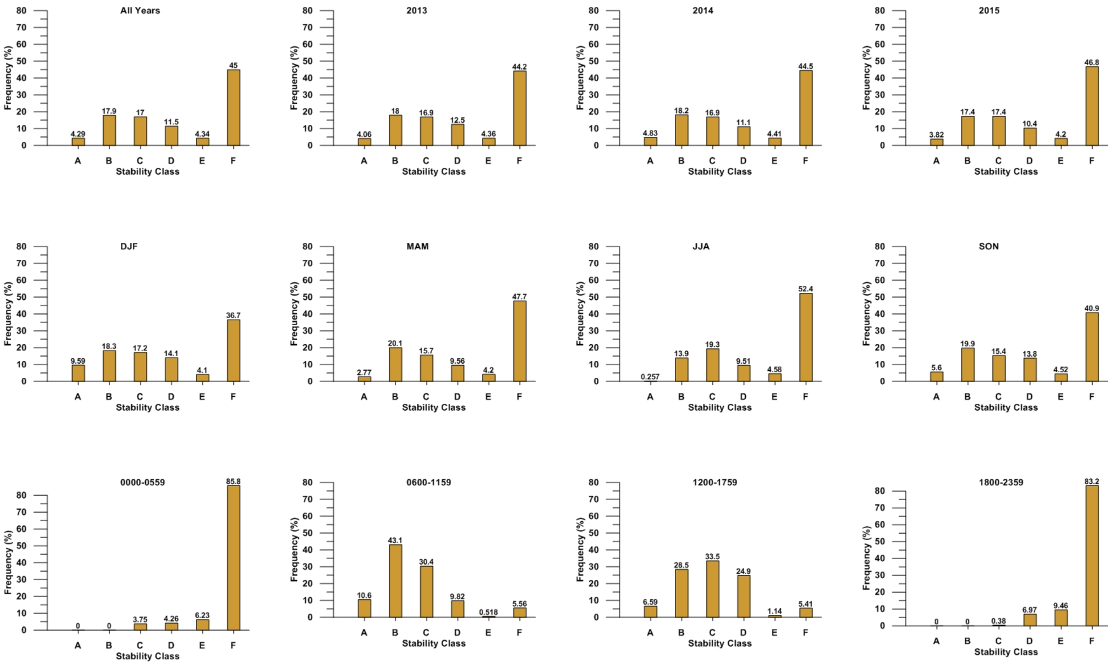
Stability of the atmosphere is determined by a combination of horizontal turbulence caused by the wind and vertical turbulence caused by the solar heating of the ground surface. Stability cannot be measured directly and instead it must be inferred from available data, either measured or numerically simulated.

The Pasquill-Gifford scale defines stability on a scale from A to G, with stability class A being the least stable, occurring during strong daytime sun and stability class G being the most stable condition, occurring during low wind speeds at night. For any given wind speed the stability category may be characterised by two or three categories depending on the time of day and the amount of cloud present. In meteorological models such as CALMET, the stability classes F and G are combined.

A summary of the numerically simulated hourly stability class data for three years (2013 through to 2015) is presented in Figure 8. Stability class F is predicted to occur most frequently indicating that the dominant conditions are moderately to very stable, with very little diffusion. The frequency of strongly convective (unstable) conditions at the study area, represented by stability class A, is relatively low at five per cent of hours during the three years simulated.

Seasonal and hourly variability is highlighted by the breakdown of stability class frequency in the middle and lower rows of the figure respectively. Not surprisingly, stable conditions are most frequent during the night time and early morning hours.

Figure 8: Frequency of Stability Class - CALMET 2013 - 2015



Appendix C Dispersion Modelling Methodology

This appendix presents an overview of the dispersion modelling methodology.

C.1 Dispersion Model

Odour dispersion modelling was undertaken using the US EPA approved CALPUFF model for three years of meteorological conditions at 0.1 km resolution wind fields developed using CALMET. General run control parameters and technical options that were selected are presented in Table 7. Defaults were used for all other options.

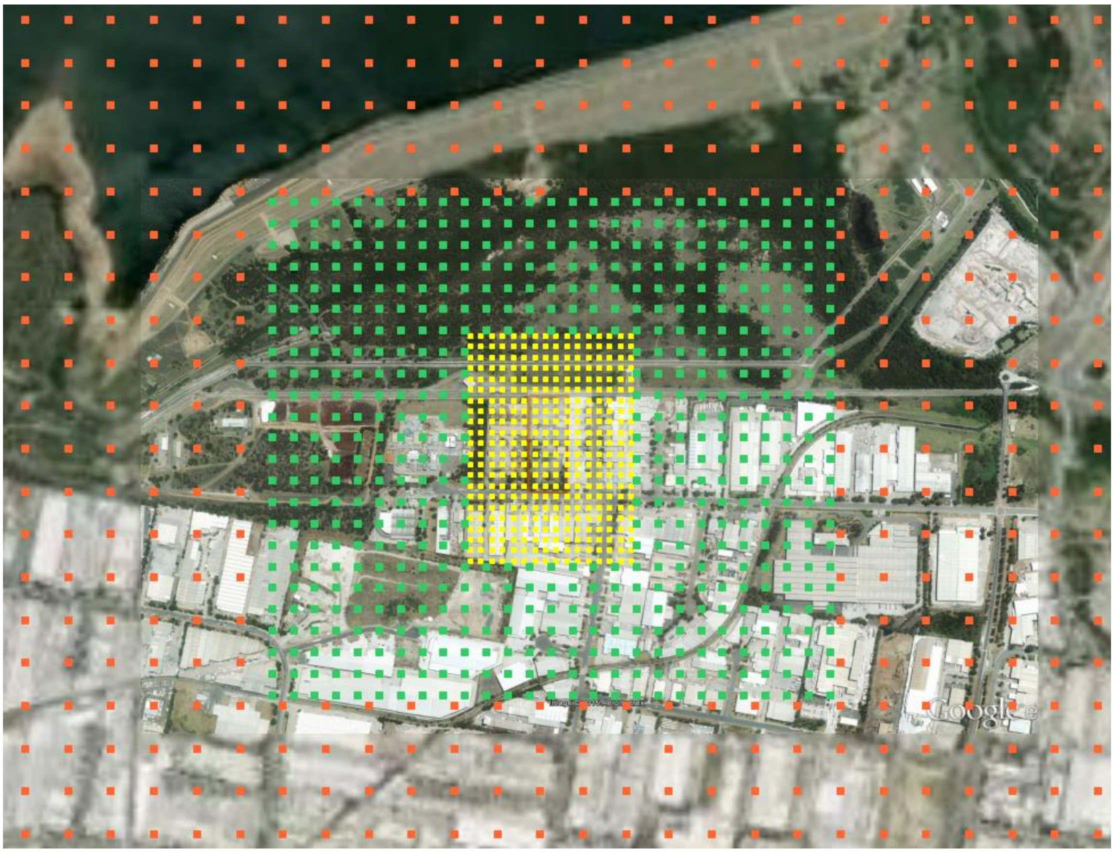
Table 7: CALPUFF Configuration

Parameter	Units	Value
CALPUFF version	-	V6.42
Years modelled	-	2013, 2014 & 2015
No. X grid cells (NX)	-	99
No. Y grid cells (NY)	-	77
Grid spacing (DGRIDKM)	Km	0.1
X coordinate (XORIGKM)	Km	300.500
Y coordinate (YORIGKM)	Km	6251.273
No. of vertical layers (NZ)	-	10
UTC time zone (XBTZ)	Hours	UTC+1000
Model Time step	sec	1800
Transitional Plume Rise	-	True
Stack Tip Downwash	-	True
Method used to compute dispersion coefficient (MDISP)	-	2 (internally calculated sigma v, sigma w using micrometeorology)
Computational grid size and resolution	-	Identical to CALMET grid
Discrete receptors modelled	-	1307
Discrete receptors height above ground	m	1.5
Wet deposition	-	False
Dry deposition	-	False
Building wake affects	-	Included (BPIP)

C.2 Discrete Project Receptors

A total of 1307 receptor locations were included in the CALPUFF model at a spacing of 25 m (yellow), 50 m (green) and 200 m (orange).

Figure 9: The Location of Variable Spaced Receptors Surrounding the Project Site



C.3 Odour Emission Source Characteristics

C.3.1 CFU

The location of the CFU along the southern end of the KORPB is shown in Figure 10 with source characteristics of the CFU summarised in Table 8.

The variation in efflux gas temperature which is assumed equivalent to ambient temperature is depicted in Figure 11.

Table 8: CFU Source Characteristics

Source ID	Source Category	Stack Diameter (m)	Flow Rate (lps)	Effective Height (m)	Easting (m)	Northing (m)	Efflux Temperature
S1	Carbon Filter Unit	0.2	900	11.25	305656.2	6254237.8	½ Hourly varying based on ambient temperature
S2	Carbon Filter Unit	0.2	900	11.25	305661.4	6254238.0	½ Hourly varying based on ambient temperature
S3	Carbon Filter Unit	0.2	900	11.25	305666.0	6254238.2	½ Hourly varying based on ambient temperature
S4	Carbon Filter Unit	0.2	900	11.25	305670.2	6254238.4	½ Hourly varying based on ambient temperature
S5	Carbon Filter Unit	0.2	900	11.25	305678.9	6254238.7	½ Hourly varying based on ambient temperature
S6	Carbon Filter Unit	0.2	900	11.25	305682.4	6254238.9	½ Hourly varying based on ambient temperature
S7	Carbon Filter Unit	0.2	900	11.25	305685.9	6254238.9	½ Hourly varying based on ambient temperature
S8	Carbon Filter Unit	0.2	900	11.25	305690.6	6254239.1	½ Hourly varying based on ambient temperature

Figure 10: Location of Odorous Emission Sources

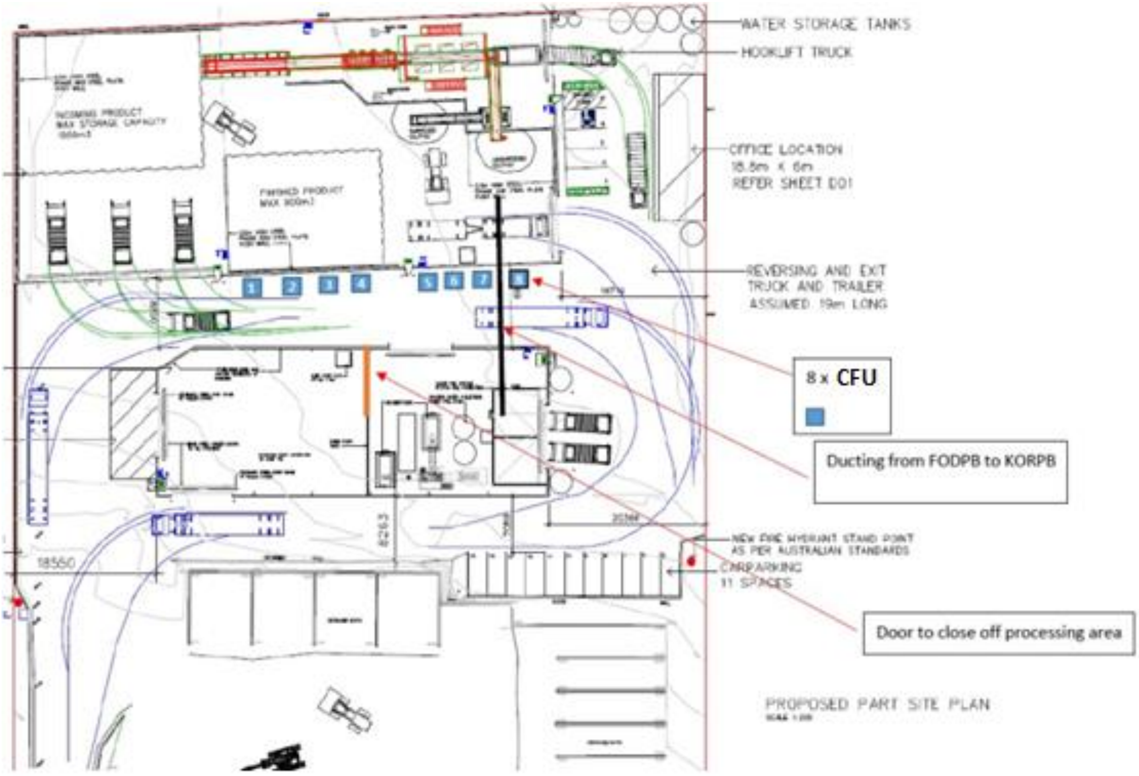
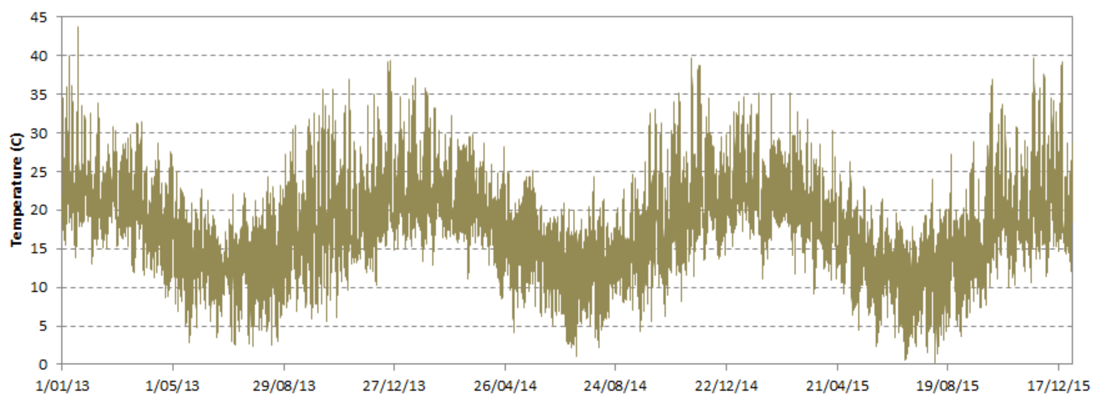


Figure 11: Half-Hourly Varying Efflux Gas Temperature (assumed same as ambient – CALMET 2013-2015)



C.3.2 Fugitive Emissions from the Vehicle Access Doors

Volume sources used to represent fugitive emissions from the vehicle access doors were assumed to be located at a distance of c. ½ of the vehicle length in front of the relevant access door (Figure 12) with a release height of ½ of the height of the access door. The initial horizontal and vertical dispersion was assumed equal to ½ the length of the vehicle and ½ of the effective release height respectively. The applied hourly varying odour emission rates for both the peak tonnages scenario and the average tonnages scenario were provided in Section 3.3.2. Additional information is provided in Table 9.

Figure 12: Approximate Location of Odour Emission Sources Associated with Vehicle Access into ORPB and FPB (blue diamonds)

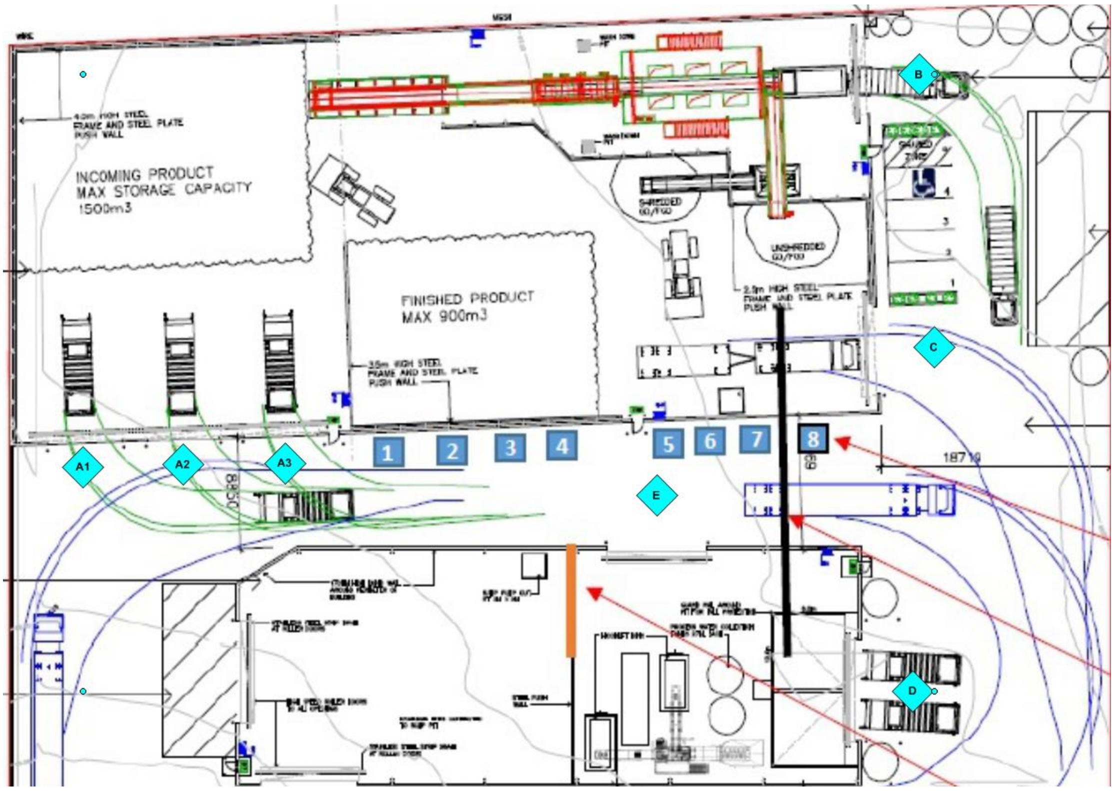


Table 9: Vehicle Access Doors Source Characteristics

Source ID	Source Type	Effective Release Height	σ_y	σ_z	Easting (m)	Northing (m)	Odour Emission Rate
A1	Volume	4	2.5	2	305631.7	6254236.9	Hourly varying
A2	Volume	4	2.5	2	305639.7	6254237.1	Hourly varying
A3	Volume	4	2.5	2	305647.9	6254237.2	Hourly varying
B	Volume	2.75	4.25	1.375	305698.9	6254268.4	Hourly varying
C	Volume	2.75	9.5	1.375	305700.1	6254246.5	Hourly varying
D	Volume	4	4.25	2	305698.4	6254218.9	Hourly varying
E	Volume	2.5	4.25	1.25	305677.8	6254234.6	Hourly varying