Appendix D: Air Quality Assessment

AIR QUALITY ASSESSMENT:
PROPOSED SAWT–BIOWISE FACILITY
ELIZABETH DRIVE, KEMPS CREEK

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Prepared for
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ABBREVIATIONS & GLOSSARY OF TERMS

AUSPLUME	a computer-based dispersion model
Biosolids	organic solid or semi-solid residue from digested sewage sludge. It is the settled product of microbial digestion in the wastewater purification process
ºC	degrees Celsius
DECC	NSW Department of Environment and Climate Change (regulatory arm)
EPA	NSW Environment Protection Authority (now DECC)
FIDOL	the **Frequency** of the exposure; the **Intensity** of the odour; the **Duration** of the odour episodes; the **Offensiveness** of the odour; and the **Location** of the source
$g/m^2/month$	grams per metre squared per month
kg	kilogram
kg/y	kilograms per year
kg/vehicle/km	kilograms per vehicle per kilometre
km	kilometre
m	Metre
m/s	metres per second
Offensive odour:	means an odour that a) by reason of its strength, nature, duration, character or quality, or the time at which it is emitted, or any other circumstances: (i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or (ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or b) that is of a strength, nature, duration, character or quality prescribed by the regulations or that is emitted at a time, or in other circumstances, prescribed by the regulations
OER	Odour Emission Rate
ou	odour units
$ou/s/m^2$	odour units per second per metre squared
PM_{10}	Particulate matter with equivalent aerodynamic diameter less than 10 micrometres
SAWT	SITA Advanced Waste Treatment
SITA	SITA Environmental Solutions
SOER	Specific Odour Emission Rate
TEOM	Tapered Element Oscillating Microbalance
TOER	Total Odour Emission Rate
t/y	tonnes per year
µg	micrograms
$\mu g/m^3$	micrograms per cubic metre
µm	micrometres

1. INTRODUCTION

This report has been prepared by Holmes Air Sciences for SITA Environmental Solutions (SITA). SITA has proposed a waste treatment facility on its existing landfill site at Elizabeth Drive, Kemps Creek in the Penrith Local Government area. The main purpose of this air quality report is to quantitatively assess potential odour impacts that may arise during the operation of the proposed facility. Dust issues associated with the operation of the facility are also addressed.

This air quality assessment is based on the use of a computer-based dispersion model, AUSPLUME, to predict off-site odour and dust levels due to the operation of the proposed facility. To assess the effect that potential odour and dust emissions could have on existing air quality, the dispersion model predictions have been compared to relevant regulatory air quality criteria.

The assessment is based on a conventional approach following the procedures outlined in the NSW Department of Environment and Climate Change's (DECC) document titled "Approved Methods for the Modelling and Assessment in NSW" (**DECC, 2005**).

In summary, this report provides information on the following:

- Proposed operations;
- Air quality criteria for odour and dust;
- Climatic and meteorological conditions in the area;
- Odour and dust sources and estimates of emissions;
- Methods used to predict off-site odour and dust levels from expected emissions from the site, and
- Expected dispersion patterns and predicted impacts.

2. LOCAL SETTING AND PROJECT DESCRIPTION

SITA currently owns and operates the Solid Waste Class 2 and Industrial Waste landfill at Kemps Creek and receives approximately 350,000 tonnes of commercial and industrial waste per year. SITA's proposal is the construction and operation of a waste treatment facility on the north-western corner of the landfill site. The proposed facility will use a SITA developed Advanced Waste Treatment, referred to as SAWT-Biowise. The SAWT-Biowise facility will recover material for processing into compost for sale off-site. The process will also recover recyclable materials from the Municipal Solid Waste (MSW) and Commercial and Industrial (C&I) waste streams and recover material that has no other end use at the present time but to be placed in landfill.

Figure 1 shows the study area and the proposed site. Also shown in the figure are the nearest residences. The closest residence to the proposed facility is approximately 1 kilometre (km) east-southeast of the site. The local landuse is predominantly rural-residential within the study area and the terrain is mostly flat, or with gentle hills.

SITA will accept MSW and C&I waste streams, including green waste and biosolids. When operating at maximum capacity there will be approximately 120,000 tonnes per year of MSW and C&I waste streams and 14,400 tonnes per year biosolids.

Since MSW and C&I waste streams will be the feedstock, the technology is designed to treat waste using a series of mechanical and biological processes. Ultimately, when the SAWT-Biowise operation reaches maximum capacity, it will operate for two shifts per day.

The main steps of the SAWT-Biowise process are:

- <u>Receival</u>: acceptance of waste from transport vehicles and initial large item recovery in an enclosed Receival Building;

- <u>Resource Recovery</u>: mechanical separation of organic and non-organic fractions and also recyclable material recovery;

- <u>Composting</u>: biological treatment of the organic fraction in composting tunnels and Biocells for several weeks;

- <u>Maturation</u>: final biological treatment of the product for several weeks on the Maturation Pad, located outdoors;

- <u>Refining</u>: screening of composted products with various technologies to improve product quality in a <u>Refining Building</u>; and

- <u>Landfilling</u>: disposal of the non-organic fraction and residual material to the landfill.

The various stages of the proposed operations are shown in **Figure 2** along with the layout of the facility. This assessment presents results from dispersion modelling based on the **Figure 2** layout.

The receival, resource recovery, composting tunnels and biocells areas will be enclosed with provisions for trucks to access the building to deposit waste on the building floor. A ventilation system will be operated which draws air from the building out through biofilters before being emitted to the atmosphere.

At maximum capacity, MSW and C&I waste streams will be received for 12 hours per day with the plant operating for up to 16 hours per day. SITA intends to process each day's waste receival on the same day to minimise the amount of waste left in the receival building overnight.

This assessment assumes that one of the main sources of odour from the operation will be the biofilters. There is also provision for an outdoor green waste hardstand area, a maturation area and leachate treatment pond which will contribute to total odour emissions. Biosolids to be fed into the process if required will be stored in a covered pit or tank with a hooded mixer. Details of the odour emissions from the facility are discussed further in **Section 5**.

Dust emissions will arise primarily from delivery trucks traveling on the access road to the facility.

3. AIR QUALITY ISSUES

3.1 Odour

This section evaluates odour in terms of measurement and air quality criteria that relate to odour. There is still considerable debate in the scientific community about appropriate odour criteria as determined by dispersion modelling.

3.1.1 Measurement of Odour

Odour is measured using panels of people who are presented with samples of odorous gas diluted with decreasing quantities of clean odour-free air. The panellists then note when the smell becomes detectable. Odour in the air is then quantified in terms of odour units which is the number of dilutions required to bring the odour to a level at which 50% of the panellists can just detect the odour. This process is known as olfactometry.

Olfactometry can involve a “forced-choice” end point or a “free choice” endpoint. The “forced-choice” method is where panellists identify from multiple sniffing ports, the one port where odour is detected, regardless of whether they are sure they can detect odour. The “free choice” endpoint is a “yes/no” decision where panellists are required to say whether or not they can detect odour from one sniffing port. Forced-choice olfactometry generally detects lower odour levels than free choice olfactometry.

In both the “forced-choice” and “free choice” cases, odorous air is presented to the panellists in increasing concentrations. For the forced-choice method, where there are multiple ports for each panellist, the concentration is increased until all panellists consistently distinguish the port with the sample from the blanks. For a yes/no olfactometer (which has only one sniffing port) one method used is to increase the concentration of odour in the sample until all panellists respond. The sample is then shut off and once all panellists cease to respond, the sample is introduced again at random dilutions and the panellists are asked whether they can detect the odour.

There are variations in the literature in the terminology for odour thresholds. The DECC has used the definition of the ***detection*** threshold as the lowest concentration which will elicit a response, but where the panellist is essentially <u>guessing</u> correctly. This corresponds to the first end point in the forced-choice olfactometry method. The odour ***recognition*** threshold is, by definition, the minimum concentration at which the panellist is <u>certain</u> they can detect the odour. This is also referred to as the certainty threshold and is the second endpoint in forced-choice olfactometry and similar to the first end point in yes/no olfactometry.

An Australian Standard (AS/NZS 4323.3.2001) for olfactometry has been developed which is consistent with the European Standard, CEN. This will enable results between laboratories to be more uniform. These standards have adopted the certainty threshold as the odour standard and referencing this to a concentration of butanol (40 ppb). The odour levels referred to in this report are the certainty odour levels (odour detected by 50% of panellists using the recognition threshold).

As with all sensory methods of identification there is variability between individuals. Consequently the results of odour measurements depend on the way in which the panel is selected and the way in which the panel responses are interpreted. The process by which these imprecise measurements are translated into regulatory criteria is still being refined. However, the DECC has recently published a Technical Framework for the assessment of odour from stationary sources, which includes recommendations for odour criteria (**DECC, 2006**). These are explained below and have been used for this assessment.

3.1.2 Odour Criteria

The determination of air quality criteria for odour and their use in the assessment of odour impact 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.

The DECC has in recent times attempted to refine odour criteria 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. However, as discussed above these procedures are still being developed and odour criteria are likely to be revised in the future.

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 criteria 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 factors (the so-called **FIDOL** factors) are:

- the **F**requency of the exposure
- the **I**ntensity of the odour
- the **D**uration of the odour episodes
- the **O**ffensiveness of the odour, and
- 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 sulphide, 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 criteria need to take account of these factors.

The DECC Technical Framework includes some recommendations for odour criteria. The criteria have been refined by DECC to take account of population density in the area. **Table 1** lists the odour certainty thresholds, 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.

The criteria assume that 7 odour units at the 99th percentile would be acceptable to the average person, but as the number of exposed people increases there is a chance that sensitive individuals would be exposed. The criterion of 2 odour units at the 99th percentile is considered to be acceptable for the whole population.

Table 1 : DECC odour assessment criteria

Population of affected community	Odour performance criteria (nose response odour certainty units at the 99th percentile)
Rural single residence (≤2)	7
~10	6
~30	5
~125	4
~500	3
Urban (>2000) and/or schools and hospitals	2

It is common practice to use dispersion models to determine compliance with odour criteria. This introduces a complication because Gaussian dispersion models are only able to directly predict concentrations over an averaging period of 3-minutes or greater. The human nose, however, responds to odours over periods of the order of a second or so. During a 3-minute 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 three-minute and longer period average concentrations (referred to as the peak-to-mean ratio) that might be predicted by a Gaussian dispersion model, the DECC (then EPA) commissioned a study by Katestone Scientific Pty Ltd (see **Katestone 1995** and **1998**). This study recommended peak-to-mean ratios for a range of source types. The ratio is also dependent on atmospheric stability and the distance from the source. A summary table of these ratios is presented in **Appendix A**.

The DECC Technical Framework (**DECC, 2006**) takes account of this peaking factor and the criteria shown in **Table 1** are based on nose-response time.

3.2 Dust

Table 2 and **Table 3** summarise the air quality assessment criteria for dust concentration and deposition. The air quality criteria relate to the total dust burden in the air and not just the dust from the project. In other words, some consideration of background levels needs to be made when using these criteria to assess impacts. The estimation of appropriate background levels will be discussed further in **Section 4.3**.

Table 2 : DECC criteria for particulate matter concentrations

Pollutant	Criteria	Averaging period	Agency
Total suspended particulate matter (TSP)	90 $\mu g/m^3$	Annual mean	National Health & Medical Research Council
Particulate matter < 10 μm (PM_{10})	50 $\mu g/m^3$	24-hour maximum	DECC
	30 $\mu g/m^3$	Annual mean	DECC long-term reporting goal
	50 $\mu g/m^3$	(24-hour average, 5 exceedances permitted per year)	National Environment Protection Council

In addition to health impacts, airborne dust also has the potential to cause nuisance impacts by depositing on surfaces. **Table 3** shows the maximum acceptable increase in dust deposition over the existing dust levels. The criteria for dust fallout levels are set to protect against nuisance impacts (**DECC, 2005**).

Table 3 : DECC criteria for dust fallout

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

4. EXISTING ENVIRONMENT

This section describes the dispersion meteorology and general climate in the locality of the SAWT-Biowise site. As well as information on prevailing wind patterns, historical data on temperature, humidity and rainfall are presented to give a more complete picture of the local climate.

4.1 Dispersion Meteorology

The Gaussian dispersion model used for this assessment, AUSPLUME, requires information about the dispersion characteristics of the area. In particular, data are required on wind speed, wind direction, atmospheric stability class[1] and mixing height[2]. Two sources of meteorological data have been reviewed for this study to determine the most suitable dataset for the site.

SITA collects meteorological data at its Elizabeth Drive landfill site and data for 2000 and 2005 were made available by SITA for the purpose of this assessment. These data consist of hourly records of wind speed, wind direction and sigma-theta (standard deviation of the horizontal wind direction). The 2000 meteorological data file contains 8,088 hours of valid data (92% of one year) and the 2005 file contains 8,736 hours (100% of one year) .

It should be noted that the 2000 meteorological data obtained from SITA contained two measurements of wind direction for each record of data. The creation of windroses using either one of the wind directions resulted in obvious errors in the wind direction patterns. For example, preparing a windrose from one of the wind direction records resulted in a windrose pattern which was mirrored along the north-south axis while for the second wind direction record there were no northerly directions recorded and poor correlation with other measurement sites. SITA believes that a fault in the weather recording system appears to be the likely explanation for the two wind directions, however, if each wind direction is considered to represent x and y components of the true wind direction, the windrose pattern becomes more consistent with observations at other weather stations in the area. The wind direction recording system was rectified in 2005.

Figures 3 and **4** present annual and seasonal windroses for the SITA data. Annually, it can be seen that the most common winds were from the SSW and S for both the 2000 and 2005 datasets.

Meteorological data have also been collected in 1980 by Robert Hyde at Fleurs Radio Observatory, approximately 2 km to the east of the landfill. Annual and seasonal windroses created from these data are presented in **Figure 5**. The most common winds at this site were also from the S although the winds are more evenly distributed around other sectors.

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

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

To use the wind data to assess dispersion, it is necessary to also have available data on atmospheric stability. For the Fleurs dataset, a stability class was assigned to each hour of the meteorological data using cloud cover information (Mascot) and the method of Turner (**Turner, 1970**). Stability for the SITA site data was determined using sigma-theta according to the method recommended by the US EPA (**US EPA, 1986**). **Table 4** shows the frequency of occurrence of the stability categories expected in the area from each meteorological dataset.

The most common stability occurrence for the SITA site was calculated to be F class for both years available. This would suggest that the dispersion conditions would be such that odour emissions would disperse slowly for a significant proportion of the time. At the Fleurs site, D-class was determined to be the most common stability.

Table 4 : Frequency of occurrence of stability in the SAWT-Biowise site locality

Stability Class	SITA Landfill 2000 (%)	SITA Landfill 2005 (%)	Fleurs (%)
A	30.3	28.4	11.7
B	4.3	4.9	7.2
C	3.6	4.9	12.4
D	6.4	12.2	36.5
E	5.0	13.1	16.5
F	50.4	36.5	15.7
Total	100	100	100

The differences in the percentages of stability classes is largely due to the measured wind speeds at each site. At the Fleurs site the mean wind speed was 2.9 m/s while at the SITA site the mean wind speed was much lower at 1.4 and 1.3 m/s in 2000 and 2005 respectively. A site inspection revealed that the anemometer at the SITA site is very much sheltered by surrounding trees to the west and north, thus leading to the lower wind speeds that have been measured. Wind data from the Fleurs site were therefore considered to be more representative of conditions that are important for the transportation of odour from the SAWT-Biowise facility in the local area.

The DECC has set minimum requirements for meteorological data used for air quality assessment purposes. These requirements include the following:

- At least one year of site-specific meteorological data
- The meteorological data must adequately describe the site under investigation
- Data must be at least 90% complete

The Fleurs site data were been chosen for use in the dispersion modelling. This is because its proximity to the area of interest ensures that it is representative of local conditions. The data would also satisfy the DECC minimum data requirements for meteorological data used for dispersion modelling purposes. As discussed, data from the SITA landfill weather station were not appropriate for the purposes of the dispersion modelling due to the sheltered nature of the site.

Joint wind speed, wind direction and stability class frequency tables for the Fleurs 1980 data are provided in **Appendix A**.

4.2 Local Climatic Conditions

Table 5 and **Table 6** present temperature, humidity and rainfall data for Badgerys Creek, located to the west of the study site and Liverpool, located to the east-southeast of the SAWT-Biowise site. These data are collect by the Bureau of Meteorology. Humidity data consist of monthly averages of 9 am and 3 pm readings for Liverpool with 9am readings only available for Badgerys Creek. Also presented are monthly averages of maximum and minimum temperatures. Rainfall data consist of average monthly rainfall and the average number of rain-days per month.

From temperature data recorded over 13 years for Badgerys Creek and 38 years for Liverpool, the annual average maximum temperatures experienced are 28.5°C (Badgerys Creek) and 28.2°C (Liverpool). The maximum monthly average temperature is recorded in January for both sites and also in December for Badgerys Creek. Average monthly minimum temperatures are 3.8°C (Badgerys Creek) and 4.7°C (Liverpool) with these minimums recorded in July for both sites.

The annual average humidity reading collected at 9 am is 72% for Badgerys Creek and 73% for Liverpool. The month with the highest 9 am humidity on average is June for both sites. At 3 pm the annual average humidity reading for Liverpool is 51%, with the highest average in February at 56%.

Rainfall data collected over 60 years for Badgerys Creek show that January is, on average, the wettest month with an average rainfall reading of 93.5 mm. January also has the highest average number of rain-days with 8.2. March is the wettest month for Liverpool with an average rainfall of 101.1 mm over an average of 11 rain-days. July is the driest month for both sites. Average rainfall for July is 33.5 mm over 5 rain-days for Badgerys Creek and 40.1 mm rainfall over 7 rain-days for Liverpool.

Table 5 : Climate information for Badgerys Creek

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Mean daily maximum temperature - deg C	28.5	28.5	26.7	24.1	20	17.3	17	18.7	21.2	23.8	25.9	28.5	23.2	13.1
Mean no. of days where Max Temp >= 40.0 deg C	0.7	0.4	0	0	0	0	0	0	0	0	0.3	0.6	2	13.7
Highest daily Max Temp - deg C	41.8	42.6	39.9	34.5	28.3	24.2	26.4	29.2	35	36.4	42.1	42	42.6	13.8
Mean daily minimum temperature - deg C	17.4	17.3	15.5	11.8	8.2	6	3.8	5.1	7.4	10.9	13	15.6	10.8	13.1
Mean no. of days where Min Temp <= 0.0 deg C	0	0	0	0	0.2	1.1	4	0.9	0.1	0	0	0	6.2	13.7
Lowest daily Min Temp - deg C	7.8	10.4	5.6	2.9	-1.1	-1.6	-4.9	-2.6	0	3	5	7.8	-4.9	13.8
Mean 9am air temp - deg C	22.4	22.2	21.1	18.1	14	11.1	9.4	11.7	15	17.9	19.5	21.5	16.9	13
Mean 9am wet bulb temp - deg C	19.1	19.4	17.9	15.1	12.2	9.3	7.9	9.2	11.3	14.2	15.5	17.7	14	11.1
Mean 9am dew point - deg C	17	17.7	15.7	12.6	10.3	7.2	5.5	6.1	7.5	10.7	12.6	15	11.5	11.1
Mean 9am relative humidity - %	74	77	73	72	78	78	76	71	63	65	68	69	72	11.1
Mean 9am wind speed - km/h	5.9	5.2	4.9	5.5	5.3	5.3	4.6	6.8	7.3	6.7	7.1	7	5.9	12.8
Mean monthly rainfall – mm	93.5	93.4	88.9	64.9	60	66.3	33.5	47.5	37.7	55.6	73.9	74.1	789.3	59.4
Mean no. of rain-days	8.2	8.4	8.3	6.2	6.7	6	4.7	5.5	5.5	7.1	7.7	6.9	81	59.2

Climate averages for station: 067068, BADGERYS CREEK MCMASTERS F.STN, Latitude 33.87 Deg Longitude 150.73 Deg Elevation 65 m

Source : Bureau of Meteorology (2004)

Table 6 : Climate information for Liverpool

Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years
Mean daily maximum temperature - deg C	28.2	27.9	26.4	23.9	20.5	17.8	17.3	18.9	21.5	23.7	25.3	27.5	23.2	38.5
Mean no. of days where Max Temp >= 40.0 deg C	0.5	0.3	0	0	0	0	0	0	0	0	0.1	0.3	1.2	38.7
Highest daily Max Temp - deg C	44.8	45.8	41	37.1	29.6	25.9	26.8	30.5	35.4	39.8	43.3	43.5	45.8	39.3
Mean daily minimum temperature - deg C	17.6	17.7	15.9	12.6	9.3	6.3	4.7	5.9	8.3	11.5	13.8	16.2	11.7	38.3
Mean no. of days where Min Temp <= 0.0 deg C	0	0	0	0	0.1	0.4	1.3	0.4	0	0	0	0	2.2	38.5
Lowest daily Min Temp - deg C	7.8	9.4	5	-3.2	-1.5	-2	-5	-3.4	-1.8	3.3	4.7	7.8	-5	39.2
Mean 9am air temp - deg C	21.8	21.5	20.2	17.2	13.2	10	8.9	11.1	14.6	17.8	19.1	21.1	16.3	38.9
Mean 9am wet bulb temp - deg C	18.7	18.9	17.7	14.6	11.4	8.5	7.2	8.7	11.4	14	15.5	17.4	13.7	35.5
Mean 9am dew point - deg C	16.6	17.2	16	12.7	9.8	6.9	5.1	6.1	8.1	10.8	12.8	14.9	11.5	37.1
Mean 9am relative humidity - %	73	77	77	76	81	82	78	72	66	65	68	68	73	35.3
Mean 9am wind speed - km/h	5.5	5.2	5.5	5.3	5.3	5.2	5.5	6.8	7.9	7.9	6.8	5.9	6.1	38.4
Mean 3pm air temp - deg C	26.7	26.6	25.1	22.8	19.5	17	16.5	17.9	20.1	22.2	23.7	25.9	22	38.4
Mean 3pm wet bulb temp - deg C	20.2	20.5	19.2	16.8	14.5	12.3	11.3	12	13.6	15.5	17.2	18.9	16	34.8
Mean 3pm dew point - deg C	16.1	16.7	15.2	12.3	10.2	7.8	5.7	5.6	7.3	9.9	12.3	14.3	11.2	36.6
Mean 3pm relative humidity - %	53	56	55	52	55	55	50	45	45	48	50	50	51	34.7
Mean 3pm wind speed - km/h	11.9	11.2	11.3	9.9	8.7	9.8	10.4	12.5	13.4	13.2	13.3	12.5	11.5	38.3
Mean monthly rainfall – mm	97.6	94.9	101.1	85.3	68.8	71.1	40.1	57.2	44.5	61.6	78.3	65.7	866.2	39.3
Mean no. of rain-days	10.7	10.4	10.9	8.3	9.3	8.6	7.1	7.5	7.9	9.2	10.4	8.9	109.3	39.3

Climate averages for station: 067035, Liverpool (Whitlam Centre), Latitude 33.93 Deg Longitude 150.91 Deg, Elevation 20 m

Source : Bureau of Meteorology (2004)

4.3 *Existing Air Quality*

This section describes the existing air quality, in terms of dust, based on data available from the DECC monitoring network. The two monitoring stations that are most representative of the SAWT-Biowise site locality are Liverpool and Bringelly. Data have been published by the DECC (**DECC, 2005**).

Measurements of particulate matter with an equivalent aerodynamic diameter less than 10 μm (PM_{10}) for 1998 to 2005 using a Tapered Element Oscillating Microbalance (TEOM) are summarised in **Table 7**. The annual average PM_{10} concentrations (particulate matter with equivalent aerodynamic diameter less than 10 micrometres) for both sites were below the DECC annual PM_{10} criterion of 30 $\mu g/m^3$ for all years.

Table 7 : Monitoring of PM_{10} by the DECC for past years

Year	TEOM annual average PM_{10} ($\mu g/m^3$)	
	Bringelly	Liverpool
1998	14.1	15.3
1999	15.0	16.4
2000	15.9	17.4
2001	17.8	19.3
2002	21.3	25.0
2003	18.2	21.0
2004	19.7	21.5
2005	19.4	21.3

Source : DECC, 2007

PM_{10} monitoring data for Liverpool and Bringelly (2005 – the most recent complete year available) are presented as monthly records, shown in **Table 8**. The monthly average and maximum 24-hour average PM_{10} are presented. The maximum 24-hour average PM_{10} concentrations exceeded the 50 $\mu g/m^3$ DECC criterion in January and June at Bringelly and in May and June at Liverpool. The cause of exceedances could not be determined from the monitoring data however, as DECC sites are generally located for measuring regional air quality, exceedances of the 50 $\mu g/m^3$ criterion are usually due to widespread events such as bushfires or dust storms.

Table 8 : Monitoring of PM_{10} by DECC for 2005

Date	TEOM PM_{10} ($\mu g/m^3$)			
	Bringelly		Liverpool	
	Monthly average	Maximum 24-hour value	Monthly average	Maximum 24-hour value
Jan-05	22	**53**	21	46
Feb-05	21	31	22	34
Mar-05	15	28	16	30
Apr-05	20	33	23	36
May-05	19	34	23	**51**
Jun-05	23	**54**	24	**55**
Jul-05	17	29	22	35
Aug-05	22	44	23	42
Sep-05	15	28	17	36
Oct-05	19	44	20	43
Nov-05	16	29	18	29
Dec-05	24	39	27	49
Annual	**19**	**54**	**21**	**55**

Source : DECC, 2007

Dust deposition has also been monitored in the area by SITA at several locations surrounding its landfill site. The location of the dust gauges are shown in **Figure 1**. **Table 9** shows the monthly deposition data for 2005 and summarises the annual average levels for recent years. The DECC criterion for dust deposition is 4 $g/m^2/month$, which is an annual average of the monthly dust deposition rates.

The highest annual average deposition rate was 4.9 $g/m^2/month$ at D2 in 2001. The DECC annual dust deposition criterion was also exceeded at D10 in 2003. There were no exceedances of the criterion in 2002, 2004 and 2005.

Table 9 : Monitoring of dust deposition around SITA landfill

Month	Dust deposition (Insoluble solids, $g/m^2/month$)											
	D2	D3	D4	D5	D6	D8	D10	D17	D20	D21	D22	D23
Jan-05	1.8	3.8	2.0	3.2	1.8	3.6	2.0	3.0	3.1	2.0	0.6	1.5
Feb-05	1.0	0.8	0.9	1.0	1.9	2.7	0.6	1.2	0.5	2.0	0.2	1.1
Mar-05	3.1	2.8	3.1	3.5	4.3	6.0	3.7	3.8	2.5	7.5	2.8	2.1
Apr-05	0.3	0.3	0.4	0.6	0.7	1.5	0.6	1.5	0.4	0.6	0.6	0.2
May-05	1.4	1.1	0.8	1.0	1.8	3.0	0.9	4.3	1.4	1.5	1.7	0.1
Jun-05	2.5	2.4	1.7	1.7	1.6	5.4	1.8	3.2	2.7	2.0	2.3	1.5
Jul-05	0.8	0.3	0.5	0.7	0.2	0.7	0.8	1.1	0.6	0.1	0.7	0.3
Aug-05	0.6	0.9	0.8	0.4	0.5	2.4	1.5	1.6	0.8	0.4	0.4	0.2
Sep-05	0.6	0.7	0.7	0.6	0.9	1.5	1.8	1.3	1.1	0.7	0.5	0.4
Oct-05	4.6	4.2	2.5	3.6	5.5	5.4	6.1	5.2	4.8	3.8	3.8	2.8
Nov-05	2.0	2.6	2.7	1.3	6.3	4.0	5.4	3.3	2.0	0.5	0.7	2.1
Dec-05	1.5	2.0	1.6	3.6	2.0	4.1	5.0	3.4	1.7	1.9	2.1	1.5
2005 Mean	**1.7**	**1.8**	**1.5**	**1.8**	**2.3**	**3.4**	**2.5**	**2.7**	**1.8**	**1.9**	**1.4**	**1.2**
2004 Mean	**1.9**	**2.2**	**1.8**	**1.8**	**1.9**	**3.4**	**3.4**	**2.8**	**1.7**	**2.0**	**2.5**	**1.9**
2003 Mean	**2.8**	**3.6**	**2.8**	**2.7**	**3.6**	**3.6**	**4.7**	**3.2**	**2.4**	**3.3**	**2.2**	**2.2**

Month	Dust deposition (Insoluble solids, g/m²/month)											
	D2	D3	D4	D5	D6	D8	D10	D17	D20	D21	D22	D23
2002 Mean	**1.9**	**2.0**	**1.6**	**1.5**	**2.2**	**2.2**	**2.3**	**3.1**	**1.9**	**2.1**	**1.6**	**1.4**
2001 Mean	**4.9**	**2.1**	**1.7**	**3.0**	**2.4**	**2.4**	**2.4**	**3.9**	**2.2**	**2.9**	**2.1**	**2.4**

Notes: D2, D3, D22 and D23 are offsite monitoring locations.

5. ESTIMATED EMISSIONS

As well as meteorological information which describes the dispersive capacity of the atmosphere, dispersion models require information on the emission sources. There are generally three main source types; point sources, area sources and volume sources. For point sources the dispersion model requires information on the source location, the stack height, internal stack tip diameter, temperature of emissions, exit velocity of emissions and the mass emission rate of the pollutants to be assessed. Area sources typically describe such things as ponds or exposed surfaces while volume sources can be used to represent emissions discharged from a single point, a building or horizontally. As well as the mass emission rate, area and volume sources require information on the dimensions of the source.

5.1 Odour

Odour emission rates from area sources are probably the most difficult to measure for a variety of reasons. Firstly the source is often heterogeneous. For example in the case of landfill sites, there will be different odour emission rates from different sections of the landfill. Secondly, unlike stack emissions, area emission rates are dependent upon atmospheric conditions including wind speed, degree of turbulence, temperature, etc. This clearly adds another level of complexity to odour assessments.

There are no comprehensive monitoring data available specifically for all odour sources associated with the proposed SAWT-Biowise facility. For one of the major odour sources at the site, the biofilters, the approach to this assessment was to use the building ventilation flow rate with the likely residual odour at the biofilters to determine the odour emission rates.

SITA have advised that the air flow rate through the each of the two biofilters would be approximately 89,000 and 111,000 m^3/hour. The combined size of the biofilters would be approximately 1,350 m^2 and the residual odour concentration has been taken to be 300 odour units (ou). This is based on the average average odour levels in downstream air from biofilters associated with alternate waste treatment processes (**The Odour Unit, 2006a**).

It is likely that the assumed emissions from the biofilters are conservative and include the inherent biofilter odour which would not be discernable from the vegetative sources in the area.

Specific odour emission rates for the maturation area were derived from a combination of measurements made by **The Odour Unit (2006b)** on similar, undisturbed product and measurements for 6 month old shredded mulch at Eastern Creek (**Holmes Air Sciences, 2003**). In addition, measurements made on “disturbed” product were used to simulate periodic turning of material. It was assumed that the turning of material could take place between 9 am and 5 pm every day.

It has been assumed that the leachate ponds will be kept in an aerobic condition.

There are limited odour emissions data available for Class 2 landfills. Measurements made for a non-putrescible landfill site after six months (**CEE, 1994**) have indicated levels of approximately 0.5 $ou.m^3/m^2/min$ (certainty units). Odours from the site will reach their maximum after a number of years (perhaps 4 years), when it is estimated that emissions may increase by a factor of 14. That is, to model for a worst-case scenario it is necessary to take into account the potential increase in odour over time to approximately 7 $ou.m^3/m^2/min$ (or 0.117 $ou.m^3/m^2/s$). These worst-case emissions however, will not occur over the whole area. As the landfill progresses, emissions from the previously filled cells will rise to a peak and then fall again.

This variation in emission rates may occur in a similar fashion to that suggested by the **Maunsell (1994)** model in **Figure 6**. Assuming that the peak for the Kemps Creek landfill will be approximately 0.117 $ou.m^3/m^2/s$, the profile of this landfill gas model was used to estimate the emissions for the time period specified on the graph (30 years). The landfill, as at 2008, was modelled as 5 different zones, each of varying age and with emissions consistent with the profile of the Maunsell model. Zones of 2, 5, 8, 11 and 14 years old have been represented with total odour emitting area of approximately 25 hectares.

It should be noted that the Class 2 emissions data described above are most relevant for landfills in the 1990s. Modern landfills will have considerable lower odour potential than historical landfills for two reasons. Firstly, a large proportion of materials can be recycled and/or recovered before going to landfill and the amount of potentially biodegradable material is significantly lower. Also, current landfill capping procedures are more stringent than in the past. Capping is planned with the DECC benchmark technique of a 2.1 m thick capping system, including a 300 mm gas collection layer. These practices were originally designed for putrescible waste landfills. Thus, modern landfills will have a much lower odour potential than historical landfills and on this basis, odour emissions from 2, 5, 8 and 11 year old sections have been reduced by 50%.

A further refinement to odour emissions from the landfill areas has been made, based on emission measurements reported by **Bowly (2003)**. The measurements indicated a specific odour emission rate of 0.002 $ou.m^3/m^2/s$ for covered landfills; 10% of the 11 year old landfill odour emission rate derived from the approach described above. Accordingly, landfill emissions have undergone this further refinement (that is, 10%) for the modelling. It was assumed that no odour will be generated from 14 year or older landfill sections, which will be fully capped.

Table 10 provides the quantitative information on each odour source used in the dispersion modelling. Odour emissions in the dispersion model have been multiplied by the recommended peak-to-mean ratios for different source types (see **Appendix A**) to predict odour levels for nose response times.

Peak-to-mean factors for the near-field have been applied for the purposes of this assessment. For area sources, these factors have numerical values of 2.5 for unstable and neutral atmospheric conditions and 2.3 for stable conditions. This is a conservative approach as the factors apply to the near field.

Table 10 : Odour sources and emissions used in the dispersion modelling

Area sources							
Description	**Area (m^2)**	**SOER (ou.m^3/s/m^2)**	**SOER (Neutral) (ou.m^3/s/m^2)**	**SOER (Stable) (ou.m^3/s/m^2)**	**TOER (Neutral) (ou.m^3/s)**	**TOER (Stable) (ou.m^3/s)**	**Comments**
Biofilter1	600	12.4	30.90	28.43	18,542	17,058	Determined from 89,000 m^3/hour and residual odour of 300 ou
Biofilter2	750	12.3	30.83	28.37	23,125	21,275	Determined from 111,000 m^3/hour and residual odour of 300 ou
Maturation area - fresh	3,000	2.7	6.750*	6.210	20,250	18,630	SOER from TOU measurements, taking average of 3 results for undisturbed product (**TOU, 2006**)
Maturation area - intermediate	3,000	1.37	3.434*	3.159	10,301	9,477	SOER = Average of maturation fresh and maturation old
Maturation area - old	4,000	0.047	0.118*	0.108	470	432	SOER from 6 month shredded mulch measurements at Eastern Creek (**Holmes Air Sciences, 2003**)
Leachate pond	1,200	0.1701	0.425	0.391	510	469	SOER from leachate treatment dam measurements at Eastern Creek (**Holmes Air Sciences, 2003**)
Greenwaste area	98	0.134	0.334	0.308	33	30	SOER from average of green waste measurements at Eastern Creek (**Holmes Air Sciences, 2003**)
2 year old area of 2008 landfill	40314	0.005	0.012	0.011	497	457	Emissions reduced by 50% since modern landfills are considered to be less odorous than past landfills. Further refinement of 10% of emission was also included. These are the reduced emissions.
5 year old area of 2008 landfill	79073	0.004	0.009	0.008	714	657	
8 year old area of 2008 landfill	38412	0.003	0.007	0.007	278	256	
11 year old area of 2008 landfill	33903	0.002	0.006	0.005	197	181	
14 year old area of 2008 landfill	57981	0.00	0.000	0.000	0	0	No odour emissions from 14 year or older landfill sections.

** Turning of material in the maturation area was simulated for the hours 9 am to 5 pm every day. The undisturbed SOER was increased by a factor of 15.9/2.7 (that is, the ratio of measured disturbed product to measured undisturbed product) during these hours.*

5.2 Dust

The main source of dust from the proposal will be trucks traveling to and from the facility over the access road. An estimate of the dust emissions due to this activity has been made and the calculations are provided below in **Table 11**. There is also potential for dust generation during the turning of windrows on the maturation pad and the loading of material on and off the maturation pad. There are no dust emission factors available for this type of operation and the characteristics of the emissions are different from those of road dust. For the purpose of this assessment, it has been assumed that dust emissions from windrows would need to be controlled to the extent that they do not constitute an off-site impact.

Table 11 : Estimated dust emissions due to proposed SAWT-Biowise operations

Activity description	Trucks traveling to and from site over (sealed) roads
Length of haul route	3 km return distance
Amount of material delivered	134,400 tonnes/year
Truck capacity	6.5 tonnes
Number of truck movements required	23,250 vehicles/year
Dust emission factor from this activity	0.2 kg/vehicle/km
Estimated dust generated per year	14,000 kg/year
Note: The actual number of truck movements required exceeds that calculated on the basis of truck capacity as it includes empty trucks and those traveling to the site for other purposes.	

Therefore, it is estimated that 14,000 kg of dust would be generated per year due to trucks delivering waste and exiting the proposed facility. The proposal to seal the access road to the site will significantly limit dust emissions from the operations and it should be relatively straight-forward to keep off-site dust concentrations and deposition levels to a minimum with this level of emission. If it were assumed that the access road is unsealed then the dust emission factor would increase by a factor of 5 (from 0.2 kg/VKT to, say 1 kg/VKT with watering of the access road), with a corresponding increase in the annual dust emission.

6. APPROACH TO ASSESSMENT

In August 2005, the DECC published guidelines for the assessment of air pollution sources using dispersion models (**DECC, 2005**). The guidelines specify how assessments based on the use of air dispersion models should be undertaken. They include guidelines for the preparation of meteorological data, emissions data and relevant air quality criteria. The approach taken in this assessment follows as closely as possible the approaches suggested by the guidelines.

Off-site odour and dust levels due to the proposed SAWT-Biowise facility have been predicted using AUSPLUME. AUSPLUME (Version 6.0) is an advanced Gaussian dispersion model developed on behalf of the Victorian EPA (**VEPA, 1986**) and is based on the United States Environmental Protection Agency's Industrial Source Complex (ISC) model. It is widely used throughout Australia and is regarded as a "state-of-the-art" model. AUSPLUME is the model required for use by the DECC unless project characteristics dictate otherwise (**DECC, 2005**).

Dust and odour levels have been predicted over an area 3.5 km by 3.5 km. Local terrain has been taken to be flat for the purposes of the modelling.

The modelling has been performed using the meteorological data discussed in **Section 4.1** and the dust and odour emission estimates from **Section 5**. Model predictions have been made at 225 gridded receptors (with grid spacing 250 m) and 61 special receptors have been added at the nearest residences and around the emission sources to provided greater model resolution where needed. The receptors have been chosen to provide finer resolution closer to the emission sources and nearby residences.

6.1 Odour

The way in which the model has been used in the odour assessment has been to predict the 1-hour average odour levels corrected to nose response times (expressed in odour units) at each receptor. The 1-hour averaging times have been used for consistency with the DECC odour criteria.

Odour sources have been located according to the SAWT-Biowise site layout. As an example of the way in which the model has been configured, the AUSPLUME model output file is provided in **Appendix C**.

Two modelling scenarios have been developed. These are as follows:

1. Impacts due to odour emissions from the SAWT-Biowise facility only; and

2. Impacts due to odour emissions from the SAWT-Biowise facility and landfill.

For the purposes of presenting the results, plots of odour levels at the 99th percentile have been compiled, showing the extent to which odours are predicted to occur for 99% of the time.

6.2 Dust

This section is provided so that technical reviewers can appreciate how the modelling of different particle size categories was carried out.

The modelling has been based on the use of three particle-size categories (0 to 2.5 µm - referred to as $PM_{2.5}$, 2.5 to 10 µm - referred to as CM (coarse matter) and 10 to 30 µm - referred to as the Rest). Emission rates of TSP have been calculated using emission factors developed both within NSW and by the US EPA.

The distribution of particles has been derived from measurements published by the **SPCC (1986)**. The distribution of particles in each particle size range is as follows:

- $PM_{2.5}$ (FP) is 4.7% of the TSP;
- $PM_{2.5-10}$ (CM) is 34.4% of TSP; and
- PM_{10-30} (Rest) is 60.9% of TSP.

Modelling was done using three AUSPLUME source groups with each group corresponding to a particle size category. Each source in the group was assumed to emit at the full TSP emission rate and to deposit from the plume in accordance with the deposition rate appropriate for particles with an aerodynamic diameter equal to the geometric mean of the limits of the particle size range, except for the $PM_{2.5}$ group, which was assumed to have a particle size of 1 μm. The predicted concentration in the three output files for each group were then combined according to the weightings in the dot points above to determine the concentration of PM_{10} and TSP.

The AUSPLUME model also has the capacity to take into account dust emissions that vary in time, or with meteorological conditions. This has proved particularly useful for simulating emissions at operations where wind speed is an important factor in determining the rate at which dust is generated.

For the current study, the operations were represented by a series of volume sources located according to the location of activities for the modelled scenario. **Figure 7** shows the location of the modelled dust sources.

Estimates of emissions for each source were developed on an hourly time step taking into account the activities that would take place at that location. Thus, for each source, for each hour, an emission rate was determined which depended upon the level of activity and the wind speed. It is important to do this in the AUSPLUME model to ensure that long-term average emission rates are not combined with worst-case dispersion conditions which are associated with light winds.

It has been assumed that the dust generating activities activity could occur for 24 hours per day.

7. ASSESSMENT OF IMPACTS

7.1 Odour

The dispersion model results have been presented as contour plots shown in **Figures 8** and **9**. Results show predicted odour levels at the 99th percentile (corrected for nose response times), for comparison with the DECC odour criteria.

Figure 8 shows the predicted odour levels at the 99th percentile for the proposed SAWT-Biowise facility only. At the residences to the east of the landfill the predicted odour levels are of the order of 4 odour units or less. Residences to the west of the site are also predicted to experience odour levels of 4 odour units or less due to the operation of the SAWT-Biowise facility.

For a single rural residence (that is, with population of 2 or less) the relevant odour criterion is 7 odour units at the 99th percentile (**DEC, 2006**). Although the adjacent landfill is classed as a Solid Waste Class 2 landfill and does not accept putrescible waste, some odours will be present. Thus, there is the potential for cumulative odour impacts to arise. In these circumstances the DEC recommend the use of a more stringent odour criterion to prevent offensive offsite odour (**DEC, 2006**) however the level to which the odour criterion should be reduced is not well defined. In this regard, the proposed facility could meet a more stringent criterion of 4 odour units at all residences, but not the most stringent DEC criterion of 2 odour units (refer to **Table 1**). Given the low odour generating nature of the landfill, it is suggested that the application of 4 odour units as the odour criterion is sufficient to ensure that offsite odour impacts would not be observed in a cumulative sense.

To further assess the potential cumulative odour impacts, the landfill has been explicitly modelled with the SAWT-Biowise facility. **Figure 9** shows the results from this scenario. It can be seen from this figure that the closest residences to the east are predicted to experience 4 odour units or less due to both the SAWT-Biowise facility and the landfill. Residences to the west would also experience around 4 odour units or less. This level of odour impact should be acceptable, based on application of the DECC odour criteria presented in **Table 1**.

Note that the landfill in **Figure 9** has been modelled assuming year 2008 operations, with varying ages of capped areas. To examine the changes in odour impacts as the landfill progress, an additional modelling scenario was developed which simulated the landfill assuming 2013 operations. In this scenario the landfill had progressed further to the north. **Figure 10** shows the predicted odour levels at the 99th percentile, including the SAWT-Biowise facility and the 2013 landfill. Off-site odour impacts with the 2013 landfill are predicted to be very similar to impacts with the 2008 landfill.

Future development, referred to as “Twin Creeks”, is planned for the area to the north of the SAWT-Biowise site. The development will comprise 177 residential acreage lots and a members only golf course[3]. The proposed extents of the “Twin Creeks” development is shown in **Figures 8, 9** and **10**. The dispersion modelling shows that 7 odour units at the 99th percentile could be experienced up to 500 m to the north of the site, encroaching into the planned development. The 2 odour unit contour extends approximately 2 km to the north.

The modelling has assumed that the building ventilation system and odour mitigation measures proposed, in particular the biofilters, will operate efficiently all the time. A disruption or failure in some part of the system could have the potential to cause odour levels higher than predicted in this study. This will be particularly important for the planned development to the north of the site, where the population density will be higher than in other parts of the study area. It will be important to minimise the occurrence of such events as much as practicable.

[3] From http://www.twincreeks.com.au/real_estate_masterplan.htm

7.2 Dust

Results from the dust dispersion modelling are presented in **Figure 11**. Relevant air quality criteria noted by the DECC are also shown on these plots.

At the nearest residences the increments from the modelled dust emissions are as follows:

- 5 $\mu g/m^3$ for maximum 24-hour average PM_{10}
- 0.5 $\mu g/m^3$ for annual average PM_{10}
- 1 $\mu g/m^3$ for annual average TSP
- 0.1 g/m^2/month for annual average dust deposition

The increments in dust levels shown above are unlikely to result in exceedances of the air quality criteria for dust concentration and deposition. It should be recognised that particulate matter concentrations arising from widespread events, such as bushfires, may continue to result in elevated levels on occasions.

As noted above, an unsealed access road would increase the dust emissions by a factor of approximately five. This would increase the results of the dust dispersion modelling by about five also and would increase the potential for adverse dust impacts to be observed at nearest residences, especially for 24-hour average PM_{10}. Therefore, a sealed access road would ensure that dust emissions are kept to a minimum.

It is recommended that regular inspections of dust emissions from truck movements be conducted in the early stages of the SAWT-Biowise operation to confirm the conclusions of this assessment.

8. CONCLUSIONS

This report provides a quantitative assessment of air quality impacts that might arise from the operation of a waste treatment facility at SITA's existing Elizabeth Drive site, Kemps Creek. Odour has been identified as the primary air quality issue associated with the proposal and dispersion modelling has been used to predict off-site odour levels due to the operation of the facility. Offsite dust levels have also been predicted. For assessment purposes the predicted odour and dust levels have been compared with relevant air quality criteria set by the DECC.

The dispersion modelling indicates that offsite odour levels due to the operation of the facility could be maintained at acceptable levels for the existing developments in the area. The modelling relies on effective odour mitigation measured and without these, there is some potential for adverse odour impacts to arise. Odour mitigation equipment and measures should be maintained to work at the highest efficiencies practicable. This study has adopted a conservative approach to assessing odour impacts.

It is recommended that source monitoring is undertaken once the plant is operational and that the impact footprint be refined.

In terms of dust impacts, a sealed access road should ensure that there are no adverse dust impacts observed at nearest residences.

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APPENDIX A
PEAK-TO-MEAN TABLE

Table A1 : Recommended factors for estimating peak concentrations for different source types, distances and stabilities

Source type	Stability	Near field				Far field			p
		i_{max}	x_{max}	P/M 60	P/M 3	i	P/M 60	P/M 3	
Area	Neutral, Convective	0.5	500 – 1000	2.5	1.9	0.4	2.3	1.7	0.15
	Stable	0.5	300 – 800	2.3	1.7	0.3	1.9	1.4	0.10
Line	Neutral, Convective	1.0	350	6	2.8	0.75	6	2.8	0.25
	Stable	1.0	250	6	2.8	0.65	6	2.8	0.25
Surface point	Neutral	2.5	200	25	10	1.2	5 - 7	3	0.2
	Stable	2.5	200	25	10	1.2	5 - 7	3	0.2
	Convective	2	1000	12	7	0.6	3 - 4	2.5	0.15
Tall point	Neutral, Stable	4.5	5 h	35	8	1.0	6	1.3	0.5
	Convective	2.3	2.5 h	17	4	0.5	3	1.1	0.5
Wake affected point	Neutral, Convective	0.4	-	2.3	1.4	-	2.3	1.4	0.1
Volume	Neutral, Convective	0.4	-	2.3	1.4	-	2.3	1.4	0.1

i_{max} is maximum centreline intensity of concentration
x_{max} is the approximation location of i_{max} in metres
P/M 60 is the peak-to-mean ratio for long averaging times (typically 1 hour), at a probability of 10^{-3}
P/M 3 is the best estimates of the peak-to-mean ratio for 3 minute averages, at probability 10^{-3}
p is the averaging time power law exponent
h is stack height

Source: **Katestone Scientific (1998)**

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

STATISTICS FOR FILE: C:\Jobs\SitaPen\metdata\Fleurs\FLEUR80R.AUS
MONTHS: All
HOURS : All
OPTION: Frequency

PASQUILL STABILITY CLASS 'A'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.002283	0.005708	0.002740	0.000000	0.000000	0.000000	0.000000	0.000000	0.010731
NE	0.002283	0.007078	0.001256	0.000000	0.000000	0.000000	0.000000	0.000000	0.010616
ENE	0.001598	0.003425	0.000685	0.000000	0.000000	0.000000	0.000000	0.000000	0.005708
E	0.001941	0.002397	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.004566
ESE	0.002169	0.001941	0.000685	0.000000	0.000000	0.000000	0.000000	0.000000	0.004795
SE	0.002055	0.003082	0.000685	0.000000	0.000000	0.000000	0.000000	0.000000	0.005822
SSE	0.003881	0.001941	0.000685	0.000000	0.000000	0.000000	0.000000	0.000000	0.006507
S	0.002740	0.002968	0.000913	0.000000	0.000000	0.000000	0.000000	0.000000	0.006621
SSW	0.003425	0.002740	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.006393
SW	0.003311	0.002169	0.000571	0.000000	0.000000	0.000000	0.000000	0.000000	0.006050
WSW	0.002055	0.003082	0.001370	0.000000	0.000000	0.000000	0.000000	0.000000	0.006507
W	0.002511	0.002511	0.000913	0.000000	0.000000	0.000000	0.000000	0.000000	0.005936
WNW	0.002626	0.005936	0.000799	0.000000	0.000000	0.000000	0.000000	0.000000	0.009361
NW	0.002854	0.007420	0.001484	0.000000	0.000000	0.000000	0.000000	0.000000	0.011758
NNW	0.002626	0.004680	0.000685	0.000000	0.000000	0.000000	0.000000	0.000000	0.007991
N	0.000913	0.002740	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.003767
CALM									0.003425
TOTAL	0.039269	0.059817	0.014041	0.000000	0.000000	0.000000	0.000000	0.000000	0.116553

MEAN WIND SPEED (m/s) = 1.92
NUMBER OF OBSERVATIONS = 1021

PASQUILL STABILITY CLASS 'B'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000457	0.001598	0.001598	0.000457	0.000114	0.000114	0.000000	0.000000	0.004338
NE	0.000799	0.002283	0.001941	0.000685	0.000342	0.000000	0.000000	0.000000	0.006050
ENE	0.000571	0.001027	0.000685	0.000228	0.000228	0.000114	0.000000	0.000000	0.002854
E	0.000228	0.001142	0.001484	0.000571	0.000571	0.000000	0.000000	0.000000	0.003995
ESE	0.000457	0.001027	0.001142	0.001027	0.000228	0.000342	0.000000	0.000000	0.004224
SE	0.001256	0.001941	0.002169	0.000799	0.000685	0.000000	0.000000	0.000000	0.006849
SSE	0.000457	0.001484	0.000685	0.000685	0.000000	0.000000	0.000000	0.000000	0.003311
S	0.001826	0.001256	0.001142	0.000228	0.000000	0.000000	0.000000	0.000000	0.004452
SSW	0.000913	0.001712	0.000799	0.000457	0.000228	0.000228	0.000342	0.000114	0.004795
SW	0.000799	0.001598	0.000571	0.000228	0.000799	0.000457	0.000114	0.000114	0.004680
WSW	0.001142	0.001370	0.001142	0.000685	0.000799	0.000114	0.000457	0.000228	0.005936
W	0.000342	0.000685	0.000571	0.000685	0.000571	0.000457	0.000342	0.000114	0.003767
WNW	0.000799	0.001027	0.000913	0.000114	0.000457	0.000342	0.000000	0.000000	0.003653
NW	0.000913	0.001712	0.000913	0.000571	0.000114	0.000114	0.000228	0.000000	0.004566
NNW	0.001142	0.002854	0.000685	0.000228	0.000000	0.000000	0.000114	0.000000	0.005023
N	0.000799	0.001142	0.000342	0.000228	0.000000	0.000000	0.000000	0.000000	0.002511
CALM									0.001370
TOTAL	0.012900	0.023858	0.016781	0.007877	0.005137	0.002283	0.001598	0.000571	0.072374

MEAN WIND SPEED (m/s) = 3.46
NUMBER OF OBSERVATIONS = 634

PASQUILL STABILITY CLASS 'C'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.001142	0.000571	0.002626	0.001484	0.001142	0.000228	0.000228	0.000000	0.007420
NE	0.000571	0.001142	0.002854	0.002283	0.003082	0.000913	0.000000	0.000000	0.010845
ENE	0.000685	0.000685	0.002283	0.000799	0.001027	0.001027	0.000228	0.000000	0.006735
E	0.000342	0.001370	0.002169	0.001826	0.001484	0.000799	0.000114	0.000000	0.008105
ESE	0.001256	0.000571	0.002169	0.002169	0.002626	0.002397	0.000228	0.000000	0.011416
SE	0.000799	0.001027	0.002055	0.001598	0.002055	0.000913	0.000228	0.000000	0.008676
SSE	0.001256	0.002055	0.001941	0.000342	0.000342	0.000114	0.000114	0.000000	0.006164
S	0.001370	0.001142	0.002169	0.001370	0.000342	0.000228	0.000000	0.000114	0.006735
SSW	0.001256	0.001826	0.001484	0.000799	0.000571	0.000799	0.000571	0.000228	0.007534
SW	0.000799	0.001484	0.001826	0.000685	0.001598	0.001370	0.000685	0.000228	0.008676
WSW	0.000457	0.001027	0.000913	0.001484	0.001142	0.001370	0.000571	0.000228	0.007192
W	0.001142	0.000457	0.000571	0.000913	0.001598	0.001142	0.000799	0.001941	0.008562
WNW	0.000685	0.001826	0.000799	0.000457	0.001484	0.001142	0.000457	0.000457	0.007306
NW	0.001598	0.001712	0.000685	0.000228	0.000114	0.000457	0.000228	0.000799	0.005822
NNW	0.001256	0.002283	0.001484	0.000685	0.000228	0.000342	0.000114	0.000000	0.006393
N	0.000571	0.000685	0.000685	0.000799	0.000913	0.000457	0.000342	0.000000	0.004452
CALM									0.001712
TOTAL	0.015183	0.019863	0.026712	0.017922	0.019749	0.013699	0.004909	0.003995	0.123744

MEAN WIND SPEED (m/s) = 4.84
NUMBER OF OBSERVATIONS = 1084

PASQUILL STABILITY CLASS 'D'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.001826	0.002740	0.005594	0.006963	0.004680	0.001027	0.000114	0.000114	0.023059
NE	0.002854	0.003539	0.005023	0.004338	0.004110	0.000457	0.000228	0.000000	0.020548
ENE	0.002968	0.005251	0.004566	0.003311	0.002397	0.001027	0.000114	0.000000	0.019635
E	0.003881	0.005708	0.008447	0.005822	0.003995	0.000571	0.000114	0.000000	0.028539
ESE	0.009018	0.005023	0.006735	0.004338	0.003767	0.001941	0.000457	0.000114	0.031393
SE	0.008676	0.009018	0.007648	0.003995	0.002511	0.000799	0.000457	0.000000	0.033105
SSE	0.008105	0.011187	0.007991	0.001370	0.000228	0.000342	0.000228	0.000000	0.029452
S	0.013014	0.008790	0.006393	0.002854	0.000571	0.000342	0.000000	0.000000	0.031963
SSW	0.006050	0.009247	0.005936	0.002968	0.002169	0.000799	0.000114	0.000000	0.027283
SW	0.004110	0.006279	0.005479	0.002283	0.001484	0.001142	0.000114	0.000000	0.020890
WSW	0.001712	0.002854	0.005023	0.003082	0.002740	0.001712	0.000457	0.000342	0.017922
W	0.001941	0.001370	0.002854	0.002740	0.003082	0.001826	0.000685	0.001712	0.016210
WNW	0.001598	0.001370	0.003311	0.003767	0.001712	0.002055	0.001370	0.001256	0.016438
NW	0.002169	0.002740	0.004566	0.002968	0.001712	0.001712	0.000228	0.000228	0.016324
NNW	0.002397	0.003196	0.004110	0.002397	0.000685	0.000685	0.000114	0.000114	0.013699
N	0.001484	0.001484	0.003082	0.002283	0.001256	0.000228	0.000114	0.000000	0.009932
CALM									0.008447
TOTAL	0.071804	0.079795	0.086758	0.055479	0.037100	0.016667	0.004909	0.003881	0.364840

MEAN WIND SPEED (m/s) = 3.74
NUMBER OF OBSERVATIONS = 3196

PASQUILL STABILITY CLASS 'E'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.001712	0.002169	0.000685	0.000114	0.000000	0.000000	0.000000	0.000000	0.004680
NE	0.003767	0.002397	0.000685	0.000228	0.000457	0.000000	0.000000	0.000000	0.007534
ENE	0.003767	0.002740	0.000685	0.000114	0.000000	0.000000	0.000000	0.000000	0.007306
E	0.004338	0.003995	0.001027	0.000571	0.000000	0.000000	0.000000	0.000000	0.009932
ESE	0.009361	0.003995	0.001027	0.000457	0.000342	0.000000	0.000000	0.000000	0.015183
SE	0.010274	0.006164	0.000799	0.000114	0.000000	0.000000	0.000000	0.000000	0.017352
SSE	0.013470	0.005594	0.000799	0.000000	0.000000	0.000000	0.000000	0.000000	0.019863
S	0.013470	0.008676	0.001256	0.000228	0.000342	0.000000	0.000000	0.000000	0.023973
SSW	0.008676	0.006621	0.000913	0.000457	0.000457	0.000114	0.000000	0.000000	0.017237
SW	0.004566	0.002968	0.000685	0.000114	0.000114	0.000000	0.000000	0.000000	0.008447
WSW	0.001484	0.001941	0.000913	0.000114	0.000000	0.000000	0.000000	0.000000	0.004452
W	0.001712	0.000799	0.000799	0.000114	0.000114	0.000000	0.000000	0.000000	0.003539
WNW	0.001712	0.001142	0.000457	0.000114	0.000342	0.000000	0.000000	0.000000	0.003767
NW	0.002626	0.001027	0.000799	0.000114	0.000114	0.000000	0.000114	0.000000	0.004795
NNW	0.001256	0.002283	0.000342	0.000114	0.000000	0.000000	0.000000	0.000000	0.003995
N	0.000913	0.000913	0.000799	0.000228	0.000000	0.000114	0.000000	0.000000	0.002968
CALM									0.010388
TOTAL	0.083105	0.053425	0.012671	0.003196	0.002283	0.000228	0.000114	0.000000	0.165411

MEAN WIND SPEED (m/s) = 1.73
NUMBER OF OBSERVATIONS = 1449

PASQUILL STABILITY CLASS 'F'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.002854	0.001598	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.004566
NE	0.004909	0.001712	0.000342	0.000114	0.000000	0.000000	0.000000	0.000000	0.007078
ENE	0.005479	0.001484	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.007192
E	0.006507	0.002854	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.009475
ESE	0.009018	0.002968	0.000228	0.000114	0.000000	0.000000	0.000000	0.000000	0.012329
SE	0.012100	0.004566	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.016667
SSE	0.014840	0.003196	0.000228	0.000000	0.000000	0.000000	0.000000	0.000000	0.018265
S	0.017123	0.004680	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.021918
SSW	0.008790	0.004338	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.013128
SW	0.005822	0.002626	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.008447
WSW	0.002511	0.002968	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.005594
W	0.002283	0.002283	0.000000	0.000114	0.000000	0.000000	0.000000	0.000000	0.004680
WNW	0.002968	0.000799	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.003881
NW	0.002626	0.001484	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.004224
NNW	0.002169	0.001027	0.000114	0.000114	0.000000	0.000000	0.000000	0.000000	0.003425
N	0.000799	0.001142	0.000457	0.000000	0.000000	0.000000	0.000000	0.000000	0.002397
CALM									0.013813
TOTAL	0.100799	0.039726	0.002283	0.000457	0.000000	0.000000	0.000000	0.000000	0.157078

MEAN WIND SPEED (m/s) = 1.26
NUMBER OF OBSERVATIONS = 1376

ALL PASQUILL STABILITY CLASSES

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.010274	0.014384	0.013356	0.009018	0.005936	0.001370	0.000342	0.000114	0.054795
NE	0.015183	0.018151	0.012100	0.007648	0.007991	0.001370	0.000228	0.000000	0.062671
ENE	0.015068	0.014612	0.009132	0.004452	0.003653	0.002169	0.000342	0.000000	0.049429
E	0.017237	0.017466	0.013470	0.008790	0.006050	0.001370	0.000228	0.000000	0.064612
ESE	0.031279	0.015525	0.011986	0.008105	0.006963	0.004680	0.000685	0.000114	0.079338
SE	0.035160	0.025799	0.013356	0.006507	0.005251	0.001712	0.000685	0.000000	0.088470
SSE	0.042009	0.025457	0.012329	0.002397	0.000571	0.000457	0.000342	0.000000	0.083562
S	0.049543	0.027511	0.011986	0.004680	0.001256	0.000571	0.000000	0.000114	0.095662
SSW	0.029110	0.026484	0.009361	0.004680	0.003425	0.001941	0.001027	0.000342	0.076370
SW	0.019406	0.017123	0.009132	0.003311	0.003995	0.002968	0.000913	0.000342	0.057192
WSW	0.009361	0.013242	0.009475	0.005365	0.004680	0.003196	0.001484	0.000799	0.047603
W	0.009932	0.008105	0.005708	0.004566	0.005365	0.003425	0.001826	0.003767	0.042694
WNW	0.010388	0.012100	0.006393	0.004452	0.003995	0.003539	0.001826	0.001712	0.044406
NW	0.012785	0.016096	0.008562	0.003881	0.002055	0.002283	0.000799	0.001027	0.047489
NNW	0.010845	0.016324	0.007420	0.003539	0.000913	0.001027	0.000342	0.000114	0.040525
N	0.005479	0.008105	0.005479	0.003539	0.002169	0.000799	0.000457	0.000000	0.026027
CALM									0.039155
TOTAL	0.323059	0.276484	0.159247	0.084932	0.064269	0.032877	0.011530	0.008447	1.000000

MEAN WIND SPEED (m/s) = 2.92
NUMBER OF OBSERVATIONS = 8760

FREQUENCY OF OCCURENCE OF STABILITY CLASSES

A : 11.7%
B : 7.2%
C : 12.4%
D : 36.5%
E : 16.5%
F : 15.7%

APPENDIX C
AUSPLUME MODEL OUTPUT FILE

Sita at Penrith (SAWT only)

Concentration or deposition	Concentration
Emission rate units	OUV/second
Concentration units	Odour_Units
Units conversion factor	1.00E+00
Constant background concentration	0.00E+00
Terrain effects	Egan method
Smooth stability class changes?	No
Other stability class adjustments ("urban modes")	None
Ignore building wake effects?	No
Decay coefficient (unless overridden by met. file)	0.000
Anemometer height	10 m
Roughness height at the wind vane site	0.300 m
Use the convective PDF algorithm?	No

DISPERSION CURVES

Horizontal dispersion curves for sources <100m high	Pasquill-Gifford
Vertical dispersion curves for sources <100m high	Pasquill-Gifford
Horizontal dispersion curves for sources >100m high	Briggs Rural
Vertical dispersion curves for sources >100m high	Briggs Rural
Enhance horizontal plume spreads for buoyancy?	Yes
Enhance vertical plume spreads for buoyancy?	Yes
Adjust horizontal P-G formulae for roughness height?	Yes
Adjust vertical P-G formulae for roughness height?	Yes
Roughness height	0.400m
Adjustment for wind directional shear	None

PLUME RISE OPTIONS

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

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

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

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

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

AVERAGING TIMES
1 hour

1

Sita at Penrith (SAWT)

SOURCE CHARACTERISTICS

STACK SOURCE: GEN1

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
292373	6250773	0m	12m	1.30m	557C	58.0m/s

Hourly additive factors will be used with the declared exit velocity (m/sec) and temperature (C).

______ Effective building dimensions (in metres) ______

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	146	139	129	114	99	97	117	134	146	155	158	156
Effective building height	10	10	10	10	10	10	10	10	10	10	10	10
Along-flow building length	154	158	156	150	139	128	139	146	148	146	139	129
Along-flow distance from stack	-71	-81	-88	-92	-93	-94	-106	-115	-120	-122	-120	-115
Across-flow distance from stack	49	50	50	48	44	32	27	20	13	6	-2	-10

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	150	139	128	139	146	148	146	139	129	114	99	97
Effective building height	10	10	10	10	10	10	10	10	10	10	10	10
Along-flow building length	114	99	97	117	134	146	154	158	156	150	139	128
Along-flow distance from stack	-106	-94	-81	-85	-87	-86	-83	-77	-69	-58	-46	-34
Across-flow distance from stack	-17	-24	-30	-36	-42	-46	-49	-50	-50	-49	-44	-32

Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	117	134	146	154	157	156	150	139	128	139	146	148
Effective building height	10	10	10	10	10	10	10	10	10	10	10	10
Along-flow building length	139	146	148	146	140	129	114	99	97	117	134	146
Along-flow distance from stack	-33	-31	-28	-24	-20	-14	-9	-6	-17	-32	-47	-60
Across-flow distance from stack	-27	-20	-13	-6	2	10	17	24	30	36	42	46

(Constant) emission rate = 0.00E+00 OUV/second

Hourly multiplicative factors will be used with
this emission factor.
No gravitational settling or scavenging.

STACK SOURCE: GEN2

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
292375	6250769	0m	12m	1.30m	557C	58.0m/s

Hourly additive factors will be used with the
declared exit velocity (m/sec) and temperature (C).

______ Effective building dimensions (in metres) ______

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	146	139	129	114	99	97	117	134	146	155	158	156
Effective building height	10	10	10	10	10	10	10	10	10	10	10	10
Along-flow building length	154	158	156	150	139	128	139	146	148	146	139	129
Along-flow distance from stack	-68	-78	-85	-90	-92	-93	-106	-116	-122	-125	-123	-118
Across-flow distance from stack	52	53	54	53	48	37	31	24	17	9	1	-7

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	150	139	128	139	146	148	146	139	129	114	99	97
Effective building height	10	10	10	10	10	10	10	10	10	10	10	10
Along-flow building length	114	99	97	117	134	146	154	158	156	150	139	128
Along-flow distance from stack	-110	-98	-85	-89	-91	-90	-86	-80	-71	-60	-48	-35
Across-flow distance from stack	-15	-23	-29	-37	-43	-48	-52	-54	-54	-53	-48	-36

Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	117	134	146	154	157	156	150	139	128	139	146	148
Effective building height	10	10	10	10	10	10	10	10	10	10	10	10
Along-flow building length	139	146	148	146	140	129	114	99	97	117	134	146
Along-flow distance from stack	-33	-30	-26	-21	-16	-11	-5	-1	-12	-28	-43	-56
Across-flow distance from stack	-31	-24	-17	-9	-1	7	15	23	29	37	43	48

(Constant) emission rate = 0.00E+00 OUV/second

Hourly multiplicative factors will be used with
this emission factor.
No gravitational settling or scavenging.

INTEGRATED POLYGON AREA SOURCE: REFIN

X0(m)	Y0(m)	Ground El	No. Vertices	Ver. spread	Height
292322	6250693	0m	4	2m	2m

Integrated Polygon Area Source Vertice Locations (in metres)

No.	X	Y	No.	X	Y
1	292322	6250693	2	292349	6250712
3	292366	6250688	4	292337	6250669

(Constant) emission rate = 1.00E+00 OUV/second per square metre

Hourly multiplicative factors will be used with
this emission factor.
No gravitational settling or scavenging.

INTEGRATED POLYGON AREA SOURCE: BIO1

X0(m)	Y0(m)	Ground El	No. Vertices	Ver. spread	Height
292324	6250863	0m	4	2m	2m

Integrated Polygon Area Source Vertice Locations (in metres)

No.	X	Y	No.	X	Y
1	292324	6250863	2	292347	6250879
3	292363	6250855	4	292339	6250841

(Constant) emission rate = 1.00E+00 OUV/second per square metre

Hourly multiplicative factors will be used with
this emission factor.

```
                 No gravitational settling or scavenging.


                  INTEGRATED POLYGON AREA SOURCE: BIO2

  X0(m)   Y0(m)  Ground El  No. Vertices  Ver. spread  Height
 292242 6250810         0m             4           2m      2m


          Integrated Polygon Area Source Vertice Locations (in metres)
                  No.       X       Y       No.       X       Y
                    1  292242 6250810         2  292264 6250822
                    3  292277 6250802         4  292255 6250790
             (Constant) emission rate = 1.00E+00 OUV/second per square metre

         Hourly multiplicative factors will be used with
         this emission factor.
                 No gravitational settling or scavenging.


                  INTEGRATED POLYGON AREA SOURCE: MATUR

  X0(m)   Y0(m)  Ground El  No. Vertices  Ver. spread  Height
 292345 6250666         0m             4           2m      2m


          Integrated Polygon Area Source Vertice Locations (in metres)
                  No.       X       Y       No.       X       Y
                    1  292345 6250666         2  292425 6250722
                    3  292419 6250652         4  292345 6250655
             (Constant) emission rate = 1.00E+00 OUV/second per square metre

         Hourly multiplicative factors will be used with
         this emission factor.
                 No gravitational settling or scavenging.


                  INTEGRATED POLYGON AREA SOURCE: LEACH

  X0(m)   Y0(m)  Ground El  No. Vertices  Ver. spread  Height
 292252 6250696         0m             4           2m      2m


          Integrated Polygon Area Source Vertice Locations (in metres)
                  No.       X       Y       No.       X       Y
                    1  292252 6250696         2  292268 6250706
                    3  292311 6250673         4  292249 6250673
             (Constant) emission rate = 1.00E+00 OUV/second per square metre

         Hourly multiplicative factors will be used with
         this emission factor.
                 No gravitational settling or scavenging.


                  INTEGRATED POLYGON AREA SOURCE: GRNWST

  X0(m)   Y0(m)  Ground El  No. Vertices  Ver. spread  Height
 292396 6250802         0m             4           2m      2m


          Integrated Polygon Area Source Vertice Locations (in metres)
                  No.       X       Y       No.       X       Y
                    1  292396 6250802         2  292405 6250808
                    3  292410 6250800         4  292401 6250795
             (Constant) emission rate = 1.00E+00 OUV/second per square metre

         Hourly multiplicative factors will be used with
         this emission factor.
                 No gravitational settling or scavenging.


                  INTEGRATED POLYGON AREA SOURCE: LNDFIL

  X0(m)   Y0(m)  Ground El  No. Vertices  Ver. spread  Height
 292238 6250051         0m             7           2m      2m


          Integrated Polygon Area Source Vertice Locations (in metres)
                  No.       X       Y       No.       X       Y
                    1  292238 6250051         2  292225 6250491
                    3  292449 6250476         4  292541 6250790
                    5  292820 6250624         6  292766 6250341
                    7  292716 6249943
             (Constant) emission rate = 0.00E+00 OUV/second per square metre

         Hourly multiplicative factors will be used with
         this emission factor.
                 No gravitational settling or scavenging.
```

```
                 INTEGRATED POLYGON AREA SOURCE: LF2

 X0(m)   Y0(m)  Ground El  No. Vertices  Ver. spread  Height
292181 6250255         0m            4           2m      2m


         Integrated Polygon Area Source Vertice Locations (in metres)
                 No.       X       Y       No.       X       Y
                   1  292181 6250255         2  292169 6250153
                   3  292553 6250099         4  292552 6250209
            (Constant) emission rate = 0.00E+00 OUV/second per square metre

      Hourly multiplicative factors will be used with
      this emission factor.
                No gravitational settling or scavenging.


                 INTEGRATED POLYGON AREA SOURCE: LF5

 X0(m)   Y0(m)  Ground El  No. Vertices  Ver. spread  Height
292900 6250298         0m            4           2m      2m


         Integrated Polygon Area Source Vertice Locations (in metres)
                 No.       X       Y       No.       X       Y
                   1  292900 6250298         2  292586 6250344
                   3  292554 6250099         4  292870 6250051
            (Constant) emission rate = 0.00E+00 OUV/second per square metre

      Hourly multiplicative factors will be used with
      this emission factor.
                No gravitational settling or scavenging.


                 INTEGRATED POLYGON AREA SOURCE: LF8

 X0(m)   Y0(m)  Ground El  No. Vertices  Ver. spread  Height
292855 6249872         0m            4           2m      2m


         Integrated Polygon Area Source Vertice Locations (in metres)
                 No.       X       Y       No.       X       Y
                   1  292855 6249872         2  292643 6249896
                   3  292659 6250078         4  292869 6250052
            (Constant) emission rate = 0.00E+00 OUV/second per square metre

      Hourly multiplicative factors will be used with
      this emission factor.
                No gravitational settling or scavenging.


                 INTEGRATED POLYGON AREA SOURCE: LF11

 X0(m)   Y0(m)  Ground El  No. Vertices  Ver. spread  Height
292329 6249943         0m            4           2m      2m


         Integrated Polygon Area Source Vertice Locations (in metres)
                 No.       X       Y       No.       X       Y
                   1  292329 6249943         2  292354 6250129
                   3  292168 6250154         4  292146 6249980
            (Constant) emission rate = 0.00E+00 OUV/second per square metre

      Hourly multiplicative factors will be used with
      this emission factor.
                No gravitational settling or scavenging.


                 INTEGRATED POLYGON AREA SOURCE: LF14

 X0(m)   Y0(m)  Ground El  No. Vertices  Ver. spread  Height
292643 6249896         0m            4           2m      2m


         Integrated Polygon Area Source Vertice Locations (in metres)
                 No.       X       Y       No.       X       Y
                   1  292643 6249896         2  292659 6250078
                   3  292355 6250131         4  292329 6249944
            (Constant) emission rate = 0.00E+00 OUV/second per square metre

      Hourly multiplicative factors will be used with
      this emission factor.
                No gravitational settling or scavenging.


                 INTEGRATED POLYGON AREA SOURCE: MAT2

 X0(m)   Y0(m)  Ground El  No. Vertices  Ver. spread  Height
292344 6250654         0m            4           2m      2m
```

```
           Integrated Polygon Area Source Vertice Locations (in metres)
                   No.      X       Y       No.      X       Y
                     1  292344 6250654        2  292419 6250650
                     3  292416 6250609        4  292341 6250615
              (Constant) emission rate = 1.00E+00 OUV/second per square metre

        Hourly multiplicative factors will be used with
        this emission factor.
                  No gravitational settling or scavenging.


                   INTEGRATED POLYGON AREA SOURCE: MAT3

   X0(m)   Y0(m)  Ground El  No. Vertices  Ver. spread  Height
  292341 6250613        0m            4           2m      2m


           Integrated Polygon Area Source Vertice Locations (in metres)
                   No.      X       Y       No.      X       Y
                     1  292341 6250613        2  292416 6250608
                     3  292412 6250561        4  292335 6250568
              (Constant) emission rate = 1.00E+00 OUV/second per square metre

        Hourly multiplicative factors will be used with
        this emission factor.
                  No gravitational settling or scavenging.
```

1

Sita at Penrith (SAWT)

RECEPTOR LOCATIONS

```
 The Cartesian receptor grid has the following x-values (or eastings):
 290000.m  290250.m  290500.m  290750.m  291000.m  291250.m  291500.m
 291750.m  292000.m  292250.m  292500.m  292750.m  293000.m  293250.m
 293500.m

 and these y-values (or northings):
6248000.m 6248250.m 6248500.m 6248750.m 6249000.m 6249250.m 6249500.m
6249750.m 6250000.m 6250250.m 6250500.m 6250750.m 6251000.m 6251250.m
6251500.m 6252000.m 6252500.m 6253000.m
```

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	292278	6250855	0.0	0.0	32	292133	6250688	0.0	0.0
2	292336	6250862	0.0	0.0	33	292089	6250840	0.0	0.0
3	292387	6250884	0.0	0.0	34	292242	6250992	0.0	0.0
4	292430	6250869	0.0	0.0	35	293054	6250441	0.0	0.0
5	292496	6250869	0.0	0.0	36	293076	6250317	0.0	0.0
6	292546	6250862	0.0	0.0	37	293134	6250056	0.0	0.0
7	292568	6250811	0.0	0.0	38	293025	6249954	0.0	0.0
8	292561	6250753	0.0	0.0	39	292945	6249947	0.0	0.0
9	292525	6250724	0.0	0.0	40	292880	6249853	0.0	0.0
10	292474	6250695	0.0	0.0	41	292720	6249599	0.0	0.0
11	292481	6250651	0.0	0.0	42	292612	6249540	0.0	0.0
12	292503	6250600	0.0	0.0	43	293214	6249504	0.0	0.0
13	292503	6250542	0.0	0.0	44	291240	6250847	0.0	0.0
14	292430	6250513	0.0	0.0	45	291218	6250702	0.0	0.0
15	292365	6250506	0.0	0.0	46	291247	6250586	0.0	0.0
16	292336	6250528	0.0	0.0	47	291284	6250484	0.0	0.0
17	292263	6250579	0.0	0.0	48	291327	6250012	0.0	0.0
18	292271	6250644	0.0	0.0	49	291124	6250266	0.0	0.0
19	292256	6250717	0.0	0.0	50	291160	6250179	0.0	0.0
20	292242	6250775	0.0	0.0	51	292321	6249432	0.0	0.0
21	292205	6250862	0.0	0.0	52	292808	6249214	0.0	0.0
22	292300	6250934	0.0	0.0	53	292619	6249221	0.0	0.0
23	292416	6250949	0.0	0.0	54	293069	6249141	0.0	0.0
24	292510	6250934	0.0	0.0	55	292075	6249286	0.0	0.0
25	292619	6250898	0.0	0.0	56	291842	6249308	0.0	0.0
26	292655	6250782	0.0	0.0	57	291552	6249374	0.0	0.0
27	292590	6250651	0.0	0.0	58	290819	6249461	0.0	0.0
28	292604	6250550	0.0	0.0	59	290601	6250034	0.0	0.0
29	292517	6250455	0.0	0.0	60	289977	6247885	0.0	0.0
30	292372	6250419	0.0	0.0	61	293824	6251733	0.0	0.0
31	292205	6250499	0.0	0.0					

METEOROLOGICAL DATA : Fluers 1980 - Original dates corrected for AUSPLUME
(

HOURLY VARIABLE EMISSION FACTOR INFORMATION

The input emission rates specfied above will be multiplied by hourly varying factors entered via the input file:
C:\Jobs\SitaPen\ausplume\07_SAWT_M3WAY\emiss_1.src
For each stack source, hourly values within this file will be added to each declared exit velocity (m/sec) and temperature (K).

Title of input hourly emission factor file is:
SitaPenrith

HOURLY EMISSION FACTOR SOURCE TYPE ALLOCATION

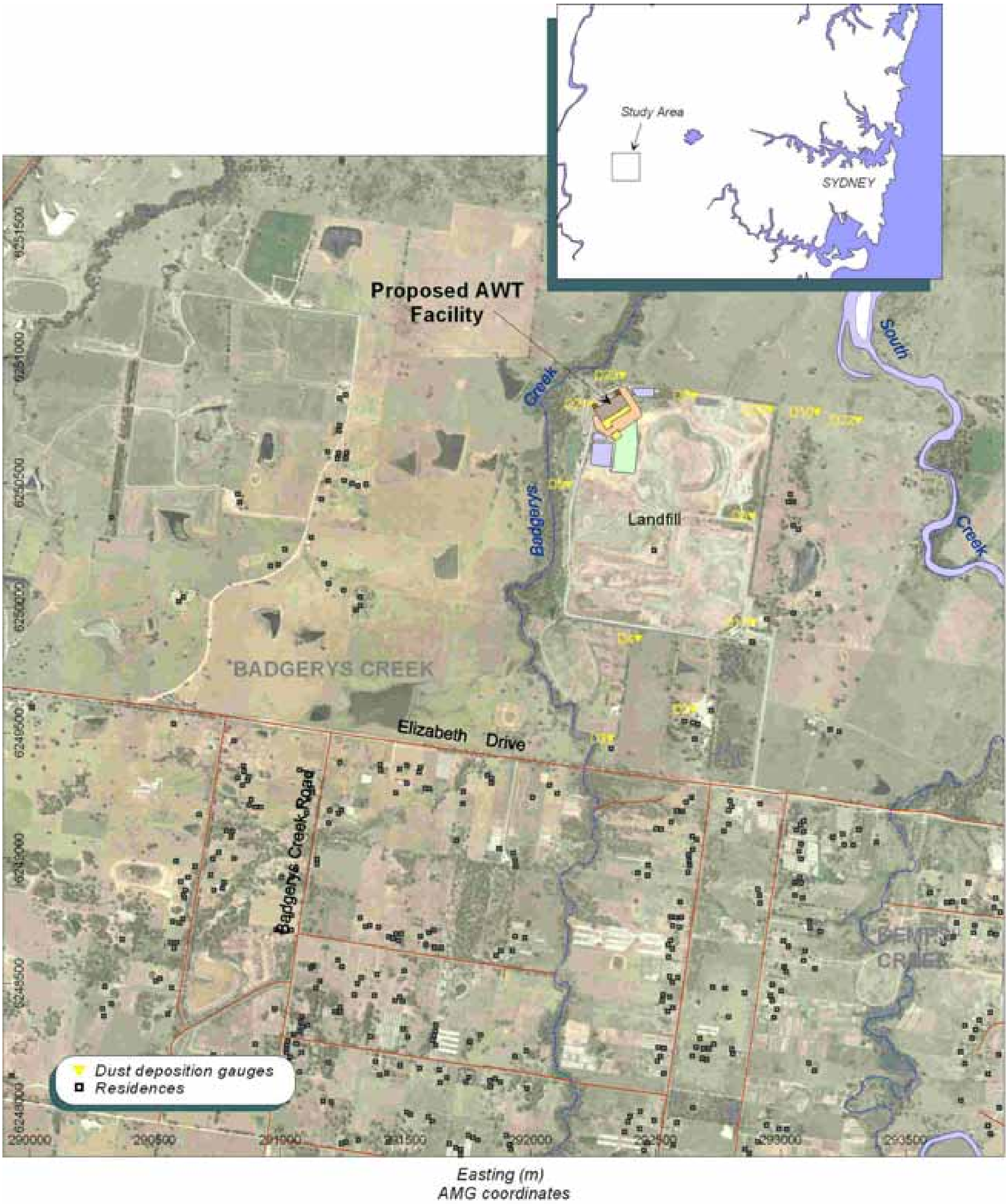
```
Prefix REFIN  allocated: REFIN
Prefix BIO1   allocated: BIO1
Prefix BIO2   allocated: BIO2
Prefix MATUR  allocated: MATUR
Prefix LEACH  allocated: LEACH
Prefix GRNWST allocated: GRNWST
Prefix LNDFIL allocated: LNDFIL
Prefix GEN1   allocated: GEN1
Prefix GEN2   allocated: GEN2
Prefix LF2    allocated: LF2
Prefix LF5    allocated: LF5
Prefix LF8    allocated: LF8
Prefix LF11   allocated: LF11
Prefix LF14   allocated: LF14
Prefix MAT2   allocated: MAT2
Prefix MAT3   allocated: MAT3
```

1 Peak values for the 100 worst cases (in Odour_Units)
Averaging time = 1 hour

Rank	Value	Time Recorded hour,date	Coordinates (* denotes polar)
1	7.69E+02	09,08/07/80	(292474, 6250695, 0.0)
2	4.78E+02	14,10/08/80	(292474, 6250695, 0.0)
3	4.51E+02	06,25/01/80	(292387, 6250884, 0.0)
4	4.51E+02	02,31/03/80	(292387, 6250884, 0.0)
5	4.43E+02	04,14/09/80	(292387, 6250884, 0.0)
6	4.31E+02	23,23/08/80	(292387, 6250884, 0.0)
7	4.22E+02	09,20/07/80	(292481, 6250651, 0.0)
8	4.16E+02	07,23/04/80	(292387, 6250884, 0.0)
9	3.99E+02	02,08/07/80	(292387, 6250884, 0.0)
10	3.87E+02	05,16/03/80	(292387, 6250884, 0.0)
11	3.82E+02	04,30/09/80	(292387, 6250884, 0.0)
12	3.69E+02	07,25/05/80	(292387, 6250884, 0.0)
13	3.53E+02	10,21/04/80	(292481, 6250651, 0.0)
14	3.42E+02	06,22/04/80	(292242, 6250775, 0.0)
15	3.42E+02	07,20/07/80	(292242, 6250775, 0.0)
16	3.41E+02	02,24/03/80	(292242, 6250775, 0.0)
17	3.40E+02	05,07/07/80	(292242, 6250775, 0.0)
18	3.36E+02	24,25/08/80	(292242, 6250775, 0.0)
19	3.36E+02	01,26/08/80	(292242, 6250775, 0.0)
20	3.32E+02	24,10/08/80	(292278, 6250855, 0.0)
21	3.32E+02	06,21/05/80	(292278, 6250855, 0.0)
22	3.31E+02	06,02/08/80	(292242, 6250775, 0.0)
23	3.31E+02	24,06/07/80	(292387, 6250884, 0.0)
24	3.31E+02	01,07/07/80	(292387, 6250884, 0.0)
25	3.30E+02	04,19/07/80	(292242, 6250775, 0.0)
26	3.23E+02	21,11/07/80	(292387, 6250884, 0.0)
27	3.18E+02	05,29/04/80	(292278, 6250855, 0.0)
28	3.18E+02	20,17/08/80	(292278, 6250855, 0.0)
29	3.16E+02	04,15/12/80	(292387, 6250884, 0.0)
30	3.16E+02	19,20/07/80	(292387, 6250884, 0.0)
31	3.15E+02	01,19/12/80	(292242, 6250775, 0.0)
32	3.15E+02	04,23/06/80	(292387, 6250884, 0.0)
33	3.15E+02	22,11/02/80	(292242, 6250775, 0.0)
34	3.12E+02	05,07/06/80	(292278, 6250855, 0.0)
35	3.10E+02	23,22/09/80	(292387, 6250884, 0.0)
36	3.10E+02	05,23/01/80	(292278, 6250855, 0.0)
37	3.08E+02	03,31/03/80	(292278, 6250855, 0.0)
38	3.08E+02	03,05/06/80	(292278, 6250855, 0.0)
39	3.08E+02	07,18/05/80	(292387, 6250884, 0.0)
40	3.05E+02	07,22/04/80	(292278, 6250855, 0.0)
41	3.04E+02	03,26/10/80	(292387, 6250884, 0.0)
42	2.95E+02	04,19/03/80	(292250, 6250750, 0.0)
43	2.94E+02	01,06/06/80	(292278, 6250855, 0.0)
44	2.90E+02	22,15/06/80	(292387, 6250884, 0.0)
45	2.89E+02	06,20/07/80	(292278, 6250855, 0.0)
46	2.87E+02	20,30/09/80	(292387, 6250884, 0.0)
47	2.84E+02	22,30/09/80	(292242, 6250775, 0.0)
48	2.83E+02	06,11/09/80	(292250, 6250750, 0.0)

49	2.78E+02	03,08/06/80	(292205,	6250862,	0.0)
50	2.77E+02	06,13/11/80	(292278,	6250855,	0.0)
51	2.77E+02	04,13/07/80	(292242,	6250775,	0.0)
52	2.77E+02	10,27/05/80	(292503,	6250600,	0.0)
53	2.76E+02	02,15/12/80	(292242,	6250775,	0.0)
54	2.76E+02	06,15/03/80	(292205,	6250862,	0.0)
55	2.76E+02	02,03/05/80	(292205,	6250862,	0.0)
56	2.76E+02	03,07/07/80	(292205,	6250862,	0.0)
57	2.75E+02	02,17/08/80	(292300,	6250934,	0.0)
58	2.75E+02	05,26/03/80	(292242,	6250775,	0.0)
59	2.75E+02	24,18/12/80	(292242,	6250775,	0.0)
60	2.74E+02	06,10/08/80	(292300,	6250934,	0.0)
61	2.74E+02	07,14/08/80	(292205,	6250862,	0.0)
62	2.74E+02	04,26/10/80	(292205,	6250862,	0.0)
63	2.72E+02	20,18/03/80	(292242,	6250775,	0.0)
64	2.72E+02	05,02/06/80	(292242,	6250775,	0.0)
65	2.72E+02	05,26/10/80	(292242,	6250775,	0.0)
66	2.72E+02	02,12/12/80	(292387,	6250884,	0.0)
67	2.71E+02	02,25/02/80	(292242,	6250775,	0.0)
68	2.70E+02	23,23/09/80	(292300,	6250934,	0.0)
69	2.70E+02	23,12/12/80	(292300,	6250934,	0.0)
70	2.69E+02	07,11/07/80	(292242,	6250775,	0.0)
71	2.69E+02	04,18/11/80	(292430,	6250869,	0.0)
72	2.68E+02	06,29/09/80	(292278,	6250855,	0.0)
73	2.67E+02	03,25/04/80	(292205,	6250862,	0.0)
74	2.66E+02	04,04/04/80	(292278,	6250855,	0.0)
75	2.66E+02	19,21/06/80	(292278,	6250855,	0.0)
76	2.65E+02	22,17/04/80	(292278,	6250855,	0.0)
77	2.64E+02	03,06/06/80	(292300,	6250934,	0.0)
78	2.64E+02	06,18/03/80	(292300,	6250934,	0.0)
79	2.64E+02	04,13/08/80	(292430,	6250869,	0.0)
80	2.63E+02	23,11/05/80	(292242,	6250775,	0.0)
81	2.63E+02	04,01/08/80	(292242,	6250775,	0.0)
82	2.62E+02	22,11/09/80	(292242,	6250775,	0.0)
83	2.61E+02	05,29/09/80	(292278,	6250855,	0.0)
84	2.60E+02	04,06/06/80	(292387,	6250884,	0.0)
85	2.57E+02	20,14/09/80	(292278,	6250855,	0.0)
86	2.56E+02	05,25/01/80	(292278,	6250855,	0.0)
87	2.56E+02	22,07/03/80	(292242,	6250775,	0.0)
88	2.56E+02	11,27/06/80	(292256,	6250717,	0.0)
89	2.56E+02	07,13/09/80	(292242,	6250775,	0.0)
90	2.54E+02	06,11/05/80	(292387,	6250884,	0.0)
91	2.54E+02	24,23/06/80	(292387,	6250884,	0.0)
92	2.54E+02	01,24/06/80	(292387,	6250884,	0.0)
93	2.54E+02	06,22/03/80	(292278,	6250855,	0.0)
94	2.52E+02	02,10/08/80	(292205,	6250862,	0.0)
95	2.52E+02	24,09/10/80	(292205,	6250862,	0.0)
96	2.51E+02	24,30/07/80	(292387,	6250884,	0.0)
97	2.50E+02	04,27/11/80	(292242,	6250775,	0.0)
98	2.49E+02	20,16/08/80	(292387,	6250884,	0.0)
99	2.45E+02	05,12/11/80	(292205,	6250862,	0.0)
100	2.45E+02	23,25/02/80	(292300,	6250934,	0.0)

FIGURES



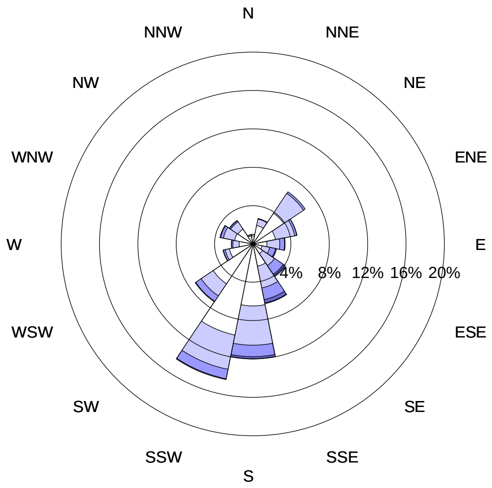
Location of study area

FIGURE 1

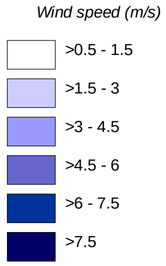
Proposed layout of facilities

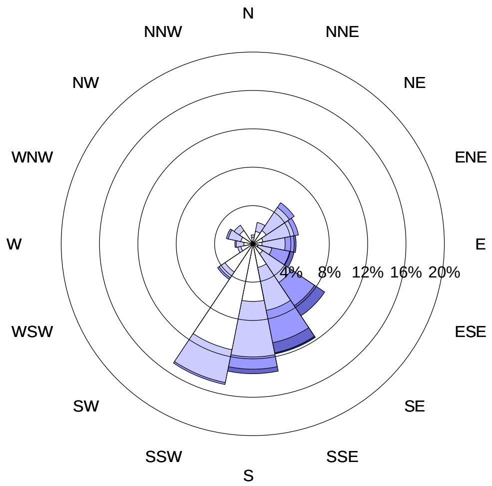
FIGURE 2

Annual and seasonal windroses for SITA (2000)

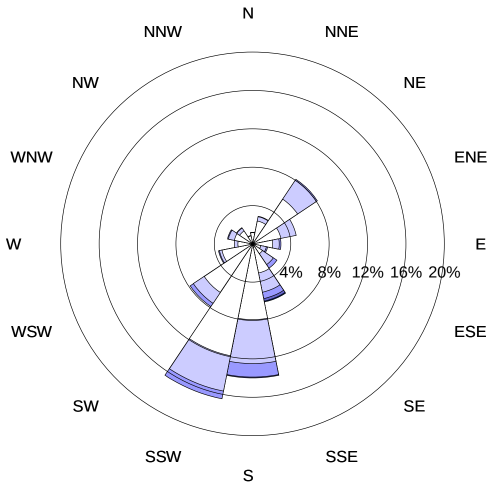


Annual
Calms = 22.2%

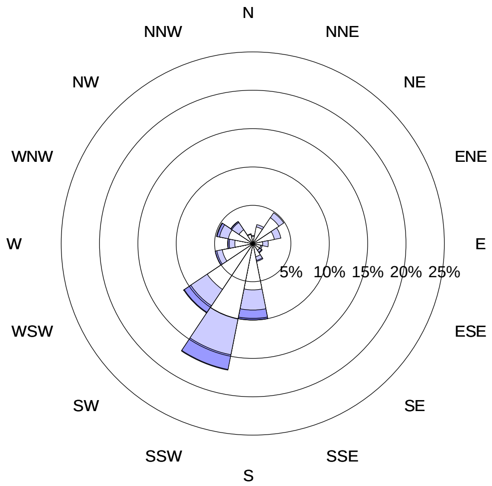




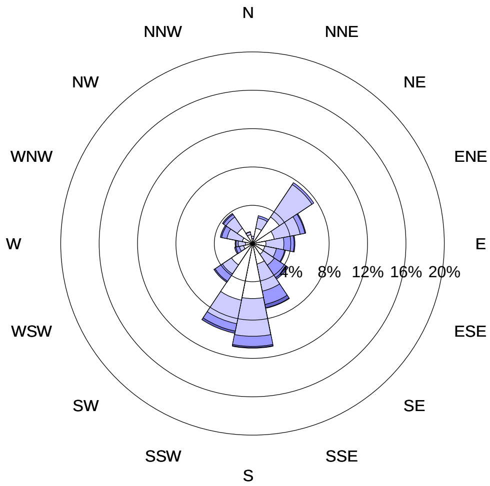
Summer
Calms = 15.3%



Autumn
Calms = 20.0%



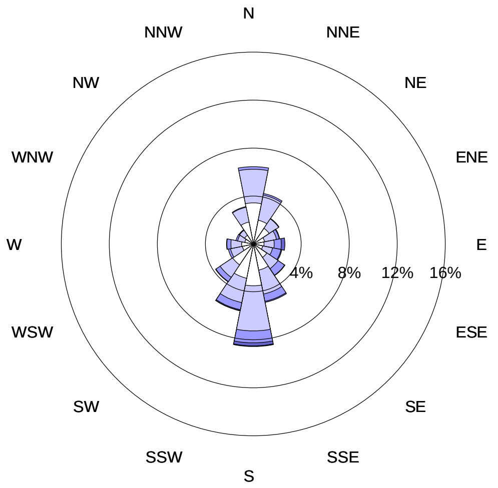
Winter
Calms = 25.2%



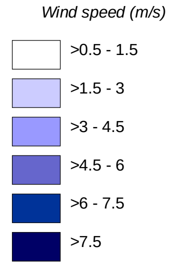
Spring
Calms = 26.2%

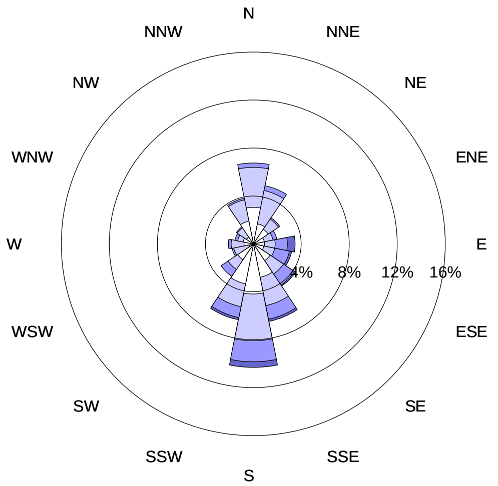
FIGURE 3

Annual and seasonal windroses for SITA (2005)

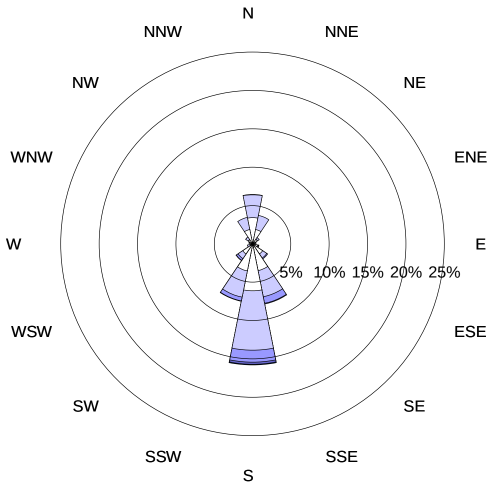


Annual
Calms = 42.8%

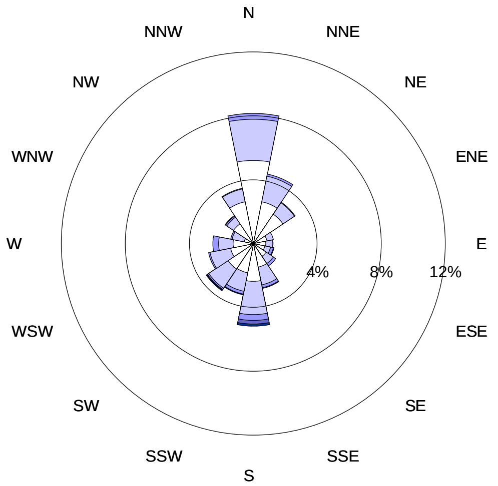




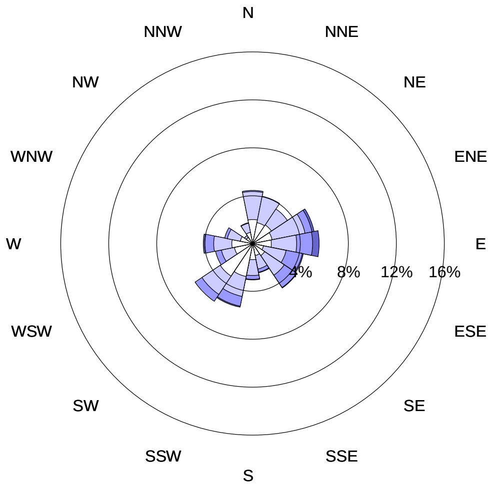
Summer
Calms = 35.1%



Autumn
Calms = 44.9%



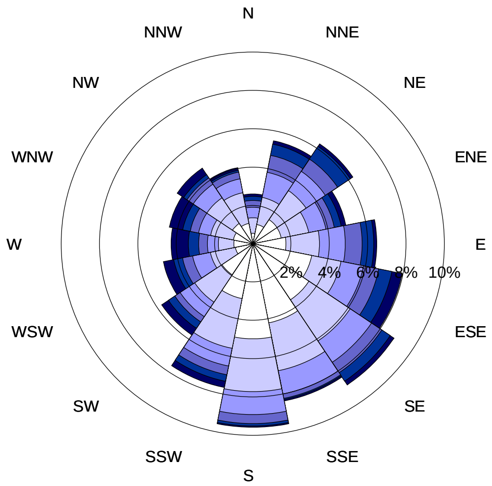
Winter
Calms = 51.5%



Spring
Calms = 39.6%

FIGURE 4

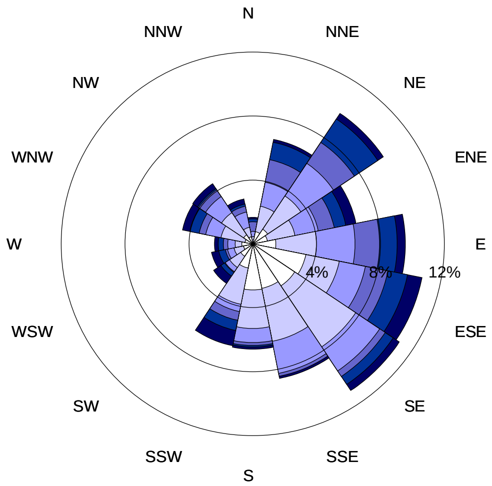
Annual and seasonal windroses for Fleurs (1980)



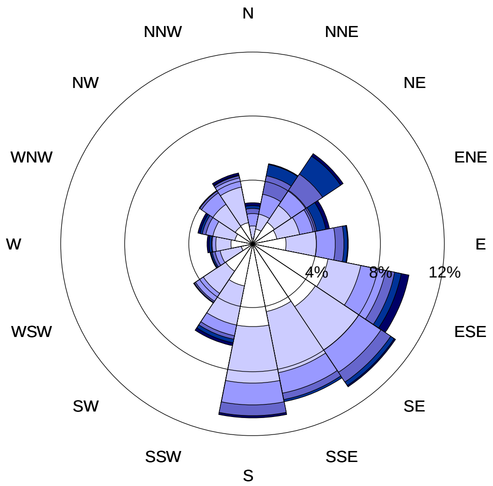
Annual
Calms = 3.9%

Wind speed (m/s)

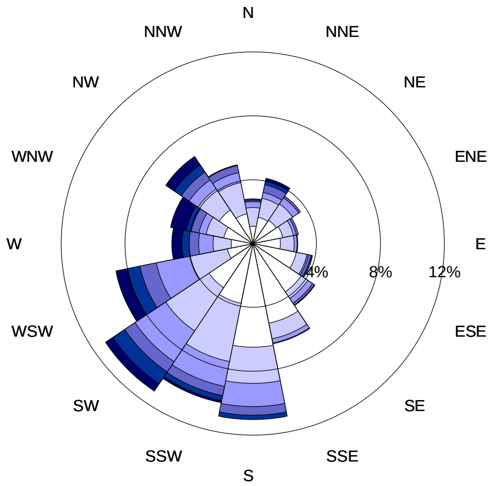
- >0.5 - 1.5
- >1.5 - 3
- >3 - 4.5
- >4.5 - 6
- >6 - 7.5
- >7.5



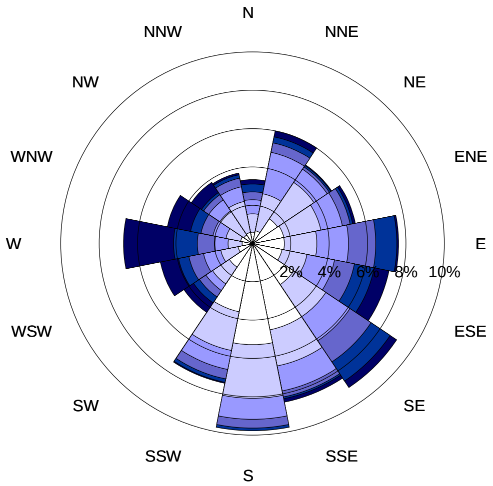
Summer
Calms = 2.4%



Autumn
Calms = 4.5%

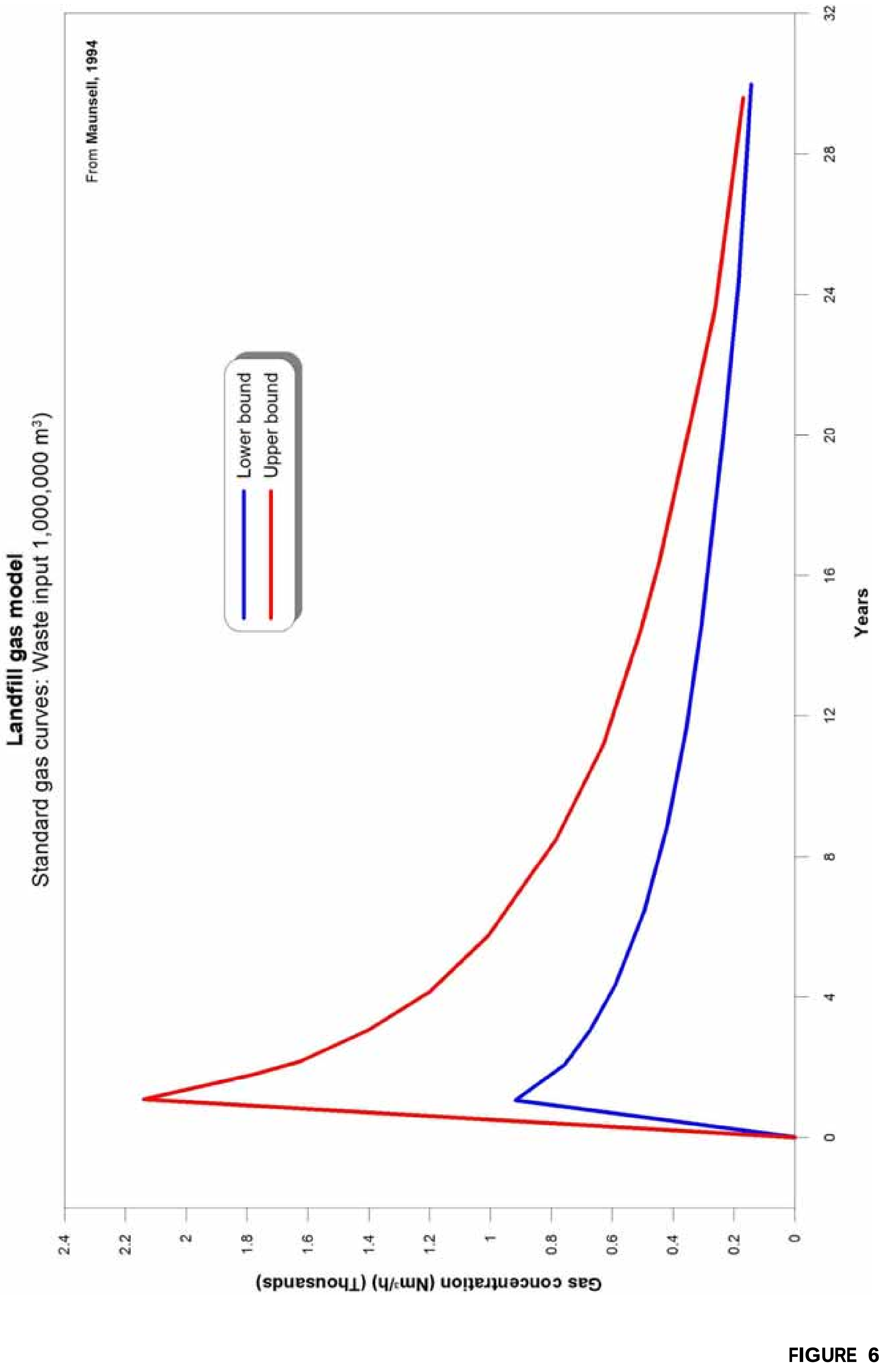


Winter
Calms = 6.0%



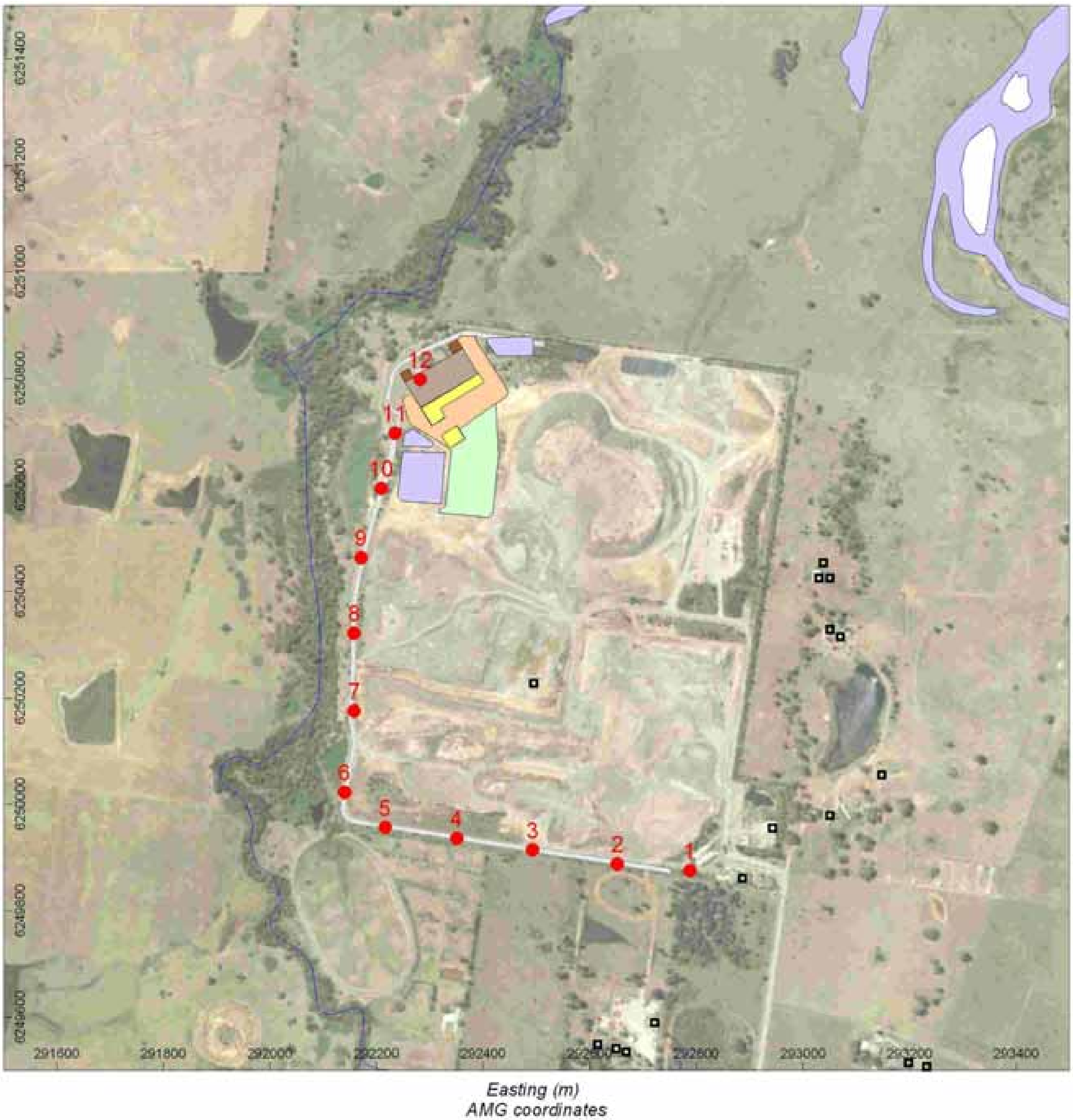
Spring
Calms = 2.7%

FIGURE 5



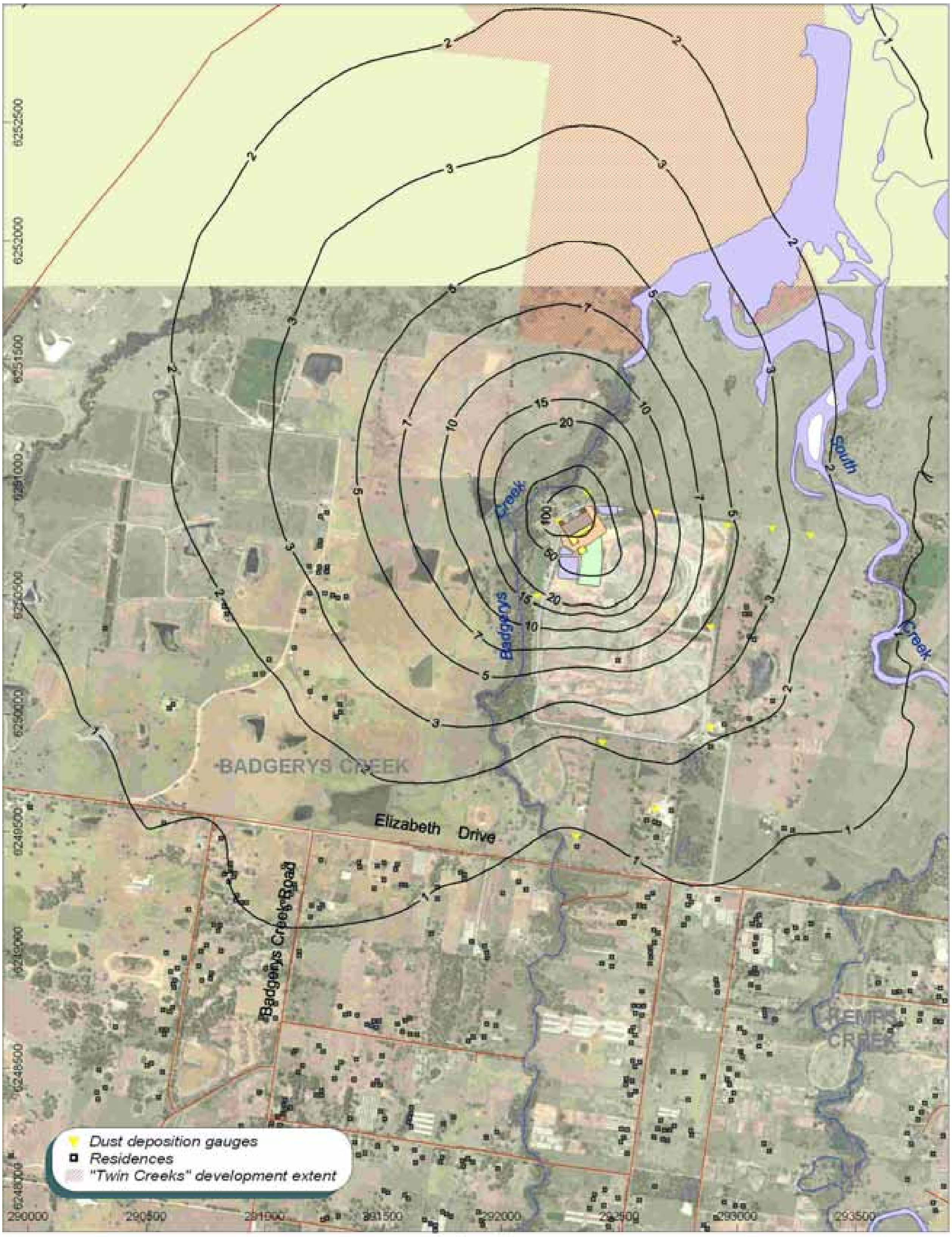
Landfill gas model
Standard gas curves: Waste input 1,000,000 m³
From Maunsell, 1994
Lower bound
Upper bound
Gas concentration (Nm³/h) (Thousands)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
Years
0
4
8
12
16
20
24
28
32

FIGURE 6



Location of modelled dust sources

FIGURE 7

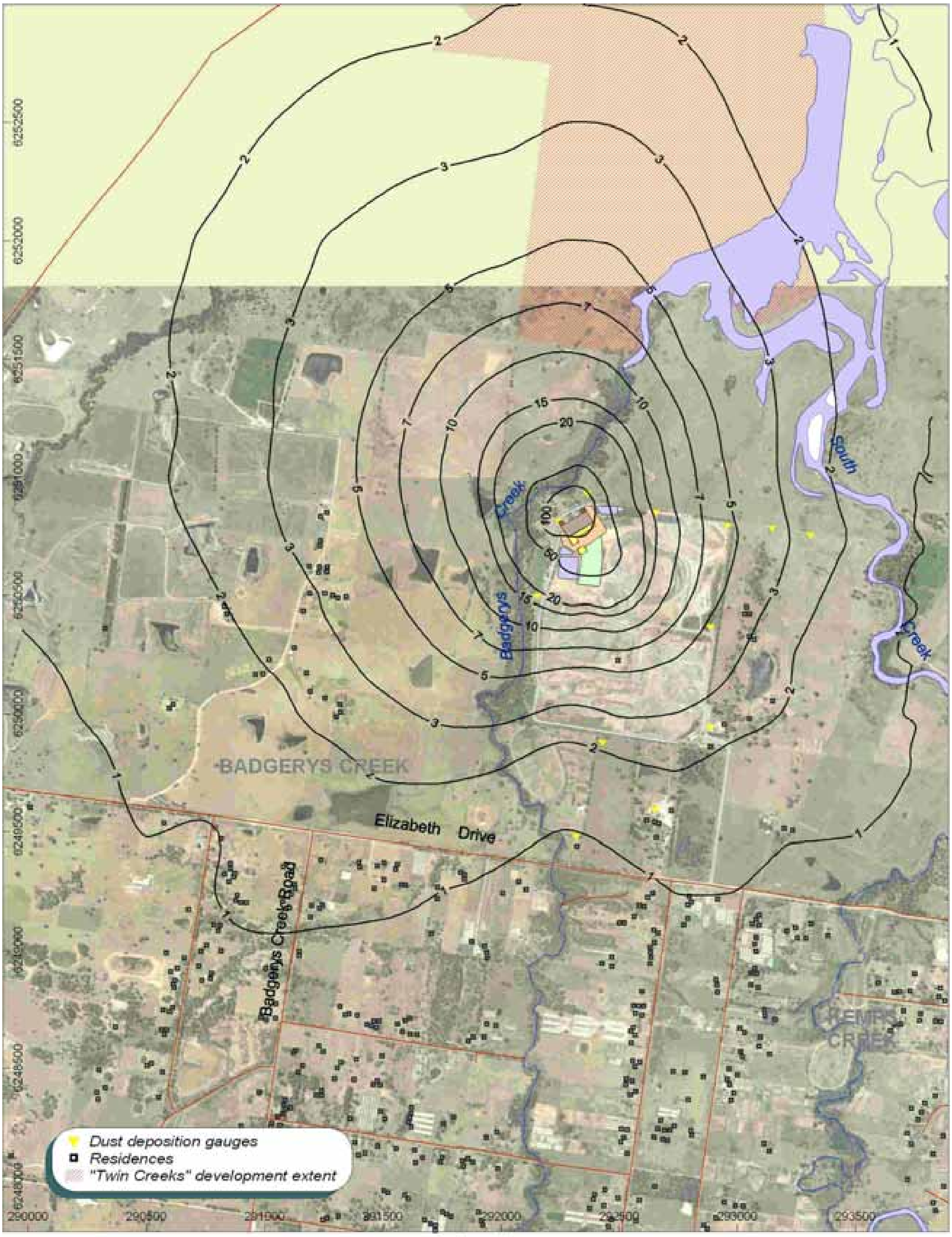


Easting (m)
AMG coordinates

Predicted 99th percentile odour levels due to SAWT-Biowise facility (odour units)

10,000 m2 maturation area emitting at 3 possible emission rates

FIGURE 8

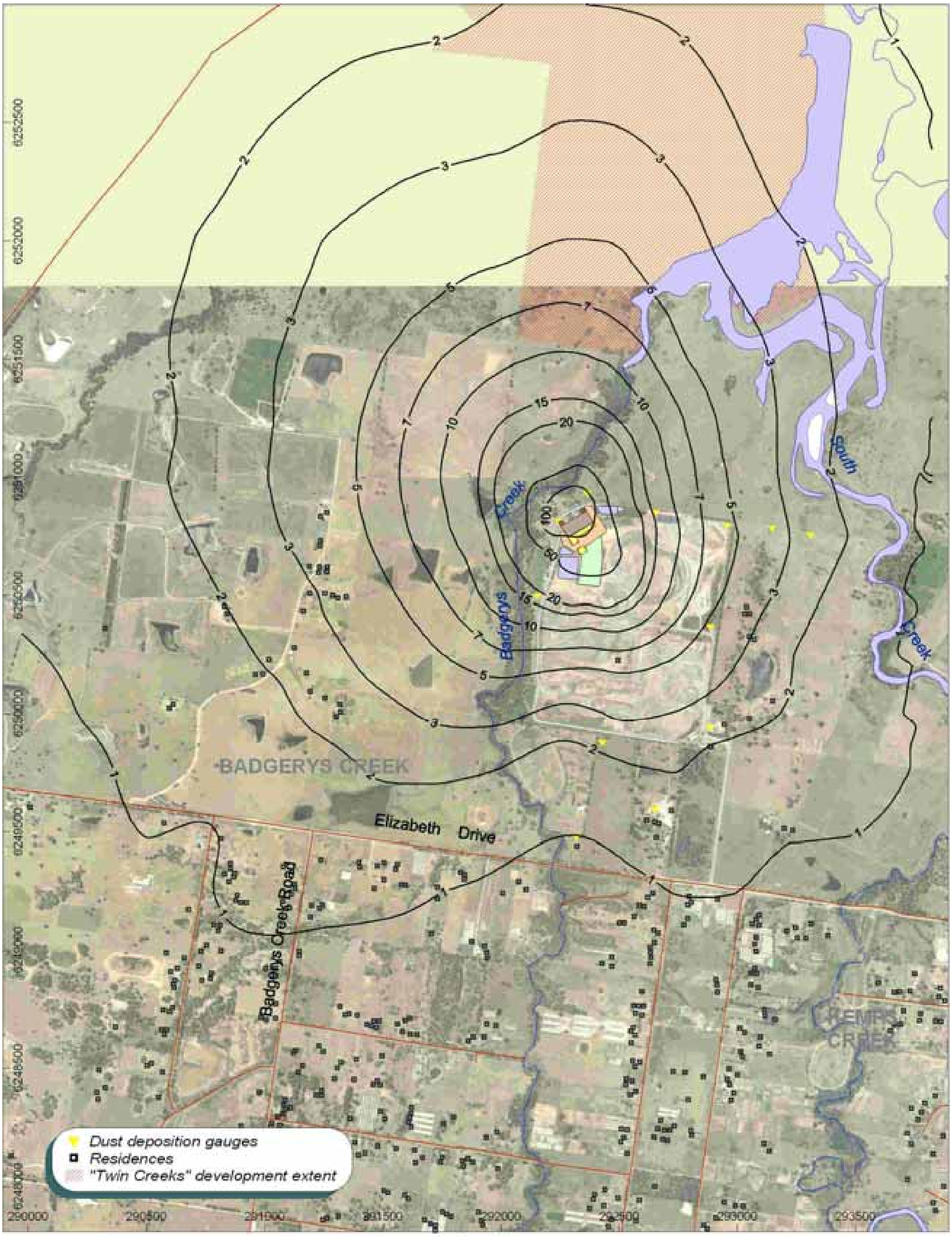


Easting (m)
AMG coordinates

Predicted 99th percentile odour levels due to SAWT-Biowise facility and 2008 landfill (odour units)

10,000 m2 maturation area emitting at 3 possible emission rates

FIGURE 9

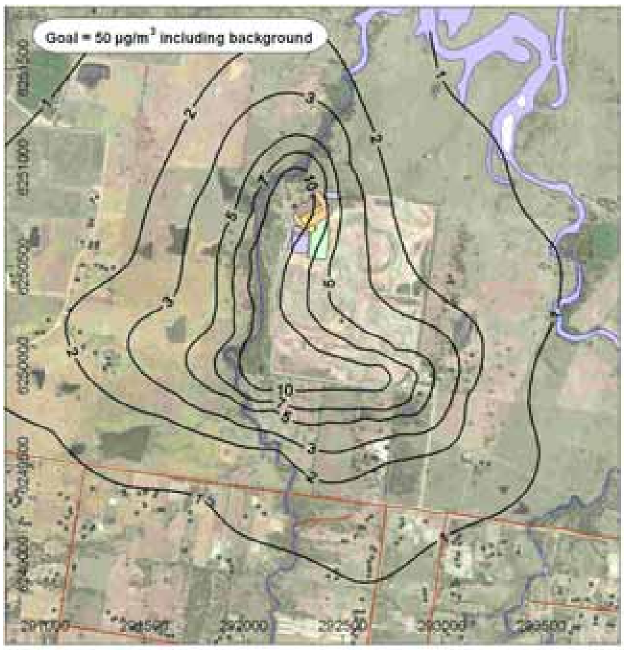


Easting (m)
AMG coordinates

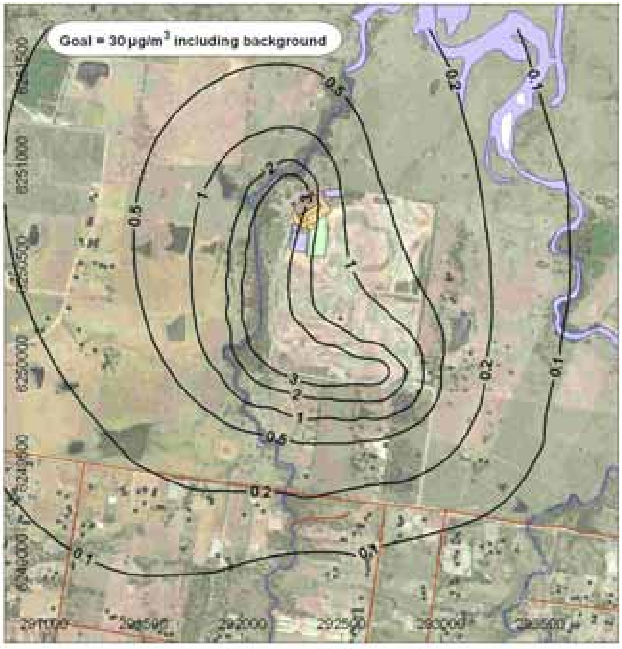
Predicted 99th percentile odour levels due to SAWT-Biowise facility and 2013 landfill (odour units)

10,000 m2 maturation area emitting at 3 possible emission rates

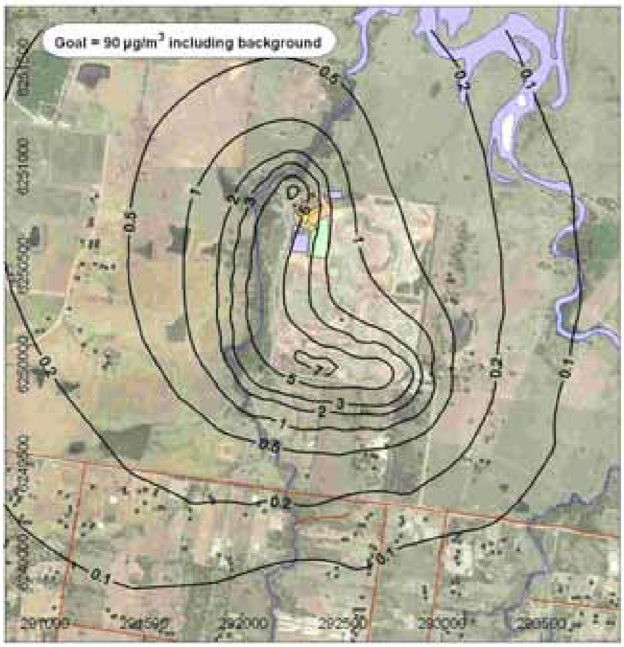
FIGURE 10



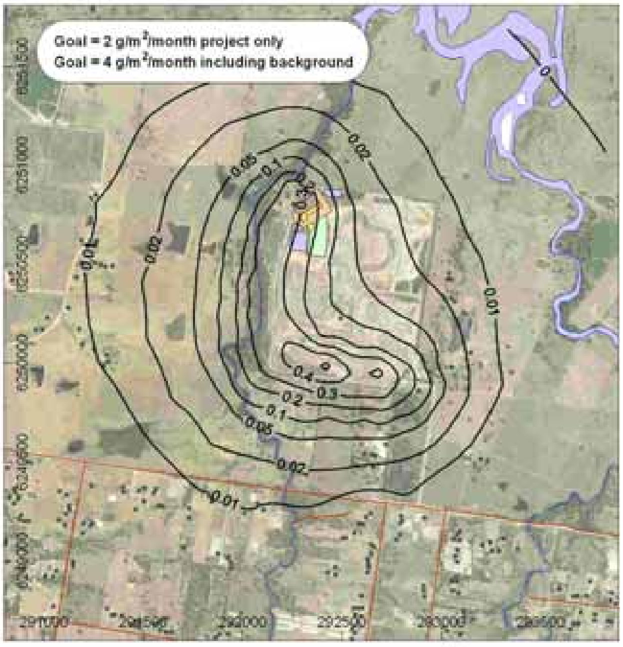
Maximum 24-hour average PM_{10} - µg/m³



Annual average PM_{10} - µg/m³



Annual average TSP - µg/m³



Annual average dust deposition - g/m²/month

Predicted dust concentrations and deposition levels

FIGURE 11