

## Odour assessment using odour source modelling

Updated April 2007\*

*EPA 373/07: This guideline provides criteria for the management of odour emissions, particularly for new or expanding developments. It specifically addresses the use of computer modelling and the determination of appropriate separation distances.*

### Introduction

The Environment Protection Authority (EPA) expects proponents of developments with odorous emissions to include best practice odour management. Computer modelling is a useful tool in assessing the potential odour impact of a proposed development.

Odour criteria in South Australia are based in principle on compliance with the general environmental duty to avoid environmental nuisance using 'best available technology economically achievable' (BATEA).

The modelling process should not be seen as a substitute for BATEA; best practice principles must be applied regardless of the outcome of any modelling undertaken. Nor should modelling be the only method used to assess the potential odour impacts of a development; other tools are:

- complaint history
- previous practical experience with the activity
- consultation outcomes
- community odour diaries and surveys
- assessment of emission control proposals.

To assist the planning process, these guidelines provide consistency in assessing a new development. When an industry complies with the recommended separation distances, there are

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\* Updates to 'Further reading' and 'Further information'

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generally few complaints under normal operating conditions, allowing for some plant upset and equipment or power failure.

Modelling assessment should be undertaken by someone with the necessary experience and appropriate training in the particular model used. More detailed information on the assessment of odour is available in the references listed.

## Legislation

The principal legislation dealing with odour in South Australia is the *Environment Protection Act 1993* (the Act). In particular, Section 25 imposes the general environmental duty on all persons undertaking an activity that may emit odour to take all reasonable and practicable measures to prevent or minimise any resulting environmental harm. In addition, causing an odour may constitute environmental nuisance, an offence under Section 82 of the Act.

## Consultation

This guideline was prepared by the EPA with the cooperation of Business SA, the Engineering Employers Association (SA), the Foundry Council, and a selection of licensees under the Act who employ processes with the potential to produce odour.

## Application of this guide to new or expanding developments

When assessing proposals that may have unacceptable odour impacts at odour sensitive premises, the EPA will consider the following:

### *Best Available Technology Economically Achievable (BATEA)*

If odour impacts associated with the development of a new industrial facility (taken in the widest possible sense) are likely, the new facility should be designed using best practicable engineering design, and operated using best practice management systems.

### *Odour minimisation*

The general environmental duty referred to above means that, when preparing the proposal, the proponents should consider alternative sites, technologies or management systems that may reduce or eliminate odour impacts on sensitive land uses.

### *Public expectation*

The community expects levels of odour to meet, or better, an accepted community standard or criterion (as given by this guideline). As a regulator, the EPA needs to know:

- why the proposed site was chosen in favour of some alternative site
- what processes exist and why certain technologies were chosen
- what management procedures (including emergency procedures) are in place to minimise odour emissions
- what impact odour emissions associated with the project will have on the amenity and health of people in the area.

These issues need to be addressed in submissions to the EPA.

### *Management objectives*

The overall objectives in the management of odorous industries or facilities are to:

- minimise odour emissions and their impacts
- ensure that the proposed industry or facility does not expose neighbouring land users to an unacceptable level of odorous emission
- ensure that the industry continues to operate in such a manner that the odour emissions are managed within the accepted criteria
- apply principles of ongoing risk evaluation and management, given the evolving understanding of odours and their potential health effects.

### *Odour assessment of new industry and facilities*

If the EPA believes that a project involves a significant probability of odour impacts, it will require a quantitative odour assessment at an early stage of the assessment process. The need for such an assessment will be determined on a case-by-case basis and will depend on the nature of the project and the sensitivity of the surrounding land use.

As the scope and extent of the odour assessment will vary from project to project, the EPA will provide specific advice to each proponent. In general, the EPA requires that an odour assessment be carried out as outlined within this guide, undertaken and certified to the EPA's satisfaction by a competent and reputable analyst accepted by the EPA, at the proponent's expense. This process requires the analyst to satisfy the EPA that the assessment was done objectively and independently.

In conjunction with the quantitative odour assessment, the EPA expects the proponent, as part of an environmental management plan, to recognise and address the public's perceptions and concerns about the emitted odours. Community consultation in the decision-making process is important in the management of odour.

## **Odour measurement**

Unfortunately, there are no instrument-based methods that can measure an odour response in the same way as the human nose. Dynamic olfactometry, as it is known, is the basis of odour management and is the method approved by the EPA. Dynamic olfactometry is the measurement of odour by presenting a sample of odorous air to an independent panel, in a range of dilutions, and seeking responses from the panellists on whether they can detect the odour. The correlations between the known dilution ratios and the panellists' responses are then used to calculate the number of dilutions of the original sample required to achieve the odour threshold. The units for odour measurement using dynamic olfactometry are 'odour units' (OU), which are dimensionless and are effectively 'dilutions to threshold'.

The EPA has updated its criterion for measurement of odour to the Australian Standard *Stationary Source Emissions—Determination of odour concentration by dynamic olfactometry*, AS4323.3:2001, Standards Australia.

## Odour guidelines

Odour complaints occur when individuals consider the odour to be unacceptable and are sufficiently annoyed by it to take action. As well as an individual's sensitivity, there are five factors that influence odour complaints:

- frequency of occurrence
- intensity
- duration of exposure
- offensiveness
- location of the odour.

The offensiveness of an odour is very subjective and relates closely to an odour's hedonic tone—the degree to which an odour is perceived as pleasant or unpleasant. Such perceptions differ widely from person to person, and are strongly influenced by previous experience and by emotions at the time of odour perception.

Odour offensiveness is also related to its character—what the odour smells like. Character allows one to distinguish between different odours; for example, ammonia gas has a pungent and irritating smell. The character of an odour may also change with dilution. For these reasons, odour offensiveness is difficult to quantify; however, the other four factors are quantifiable and can be built into a regulatory guideline.

Once the data for estimated odour emissions is available for the proposal, dispersion modelling can be used to predict the area likely to be affected by the odour. There are many dispersion models available that can predict odour impacts, of which 'Ausplume' is generally favoured for regulatory use. When matched to a post-processor program, Ausplume can provide graphical representations that are useful in illustrating the impacts associated with a given project.

Ausplume may not be suitable for dispersion modelling in cases where complex terrain may cause wind channelling, or where slope flows, recirculation or sea breezes may affect dispersion. In these cases, other models such as the diagnostic model 'Calpuff' and prognostic model 'TAPM' may help in making a valid assessment of likely odour dispersion.

The perception of the human nose typically occurs over a time scale of seconds. Ausplume typically models a one-hour period with adjustments for three minutes. To estimate the effects of fluctuations in concentrations perceived by the human nose, it is possible to multiply model predictions by a conversion factor called the 'peak-to-mean ratio'. This process is discussed in the NSW draft *Odour Policy*, with further reference to the scientific work performed to validate the approach.

### *Odour emissions*

The units of odour measurement, as determined by the Australian standard, are to be used for the estimates of odour levels. The odour levels must represent full production under normal operation as well as increased odour emissions from abnormal operation. An estimate of background odour concentrations may also be required. Industries can have periods of higher emissions due to maintenance, cleaning, equipment failure, abnormal events and outages. It may be appropriate to use the higher emission levels to give greater protection from odour nuisance at surrounding sensitive receptors.

### *The model and input data*

The model to be used generally is Ausplume version 5. Normally at least 12 months of representative hourly meteorological data is needed. Variation from this minimum shall be permitted only with the agreement of the EPA.

While the EPA has some meteorological data sets in the Ausplume format that may be suitable, major developments may need to acquire their own on-site meteorological data over a representative time period to use in the modelling program. Other factors representative of the surrounding site and associated topography are needed for modelling dispersion of the odour. In complex terrain that may cause wind channeling, and where slope flows, recirculation or sea breezes could affect dispersion, other models may be required. It may also be necessary to consider the peak-to-mean ratios.

### *Odour criteria*

Odour criteria are population dependent—as the population density increases, the increased possibility of sensitive individuals raises the potential for odour complaints, and more stringent criteria are necessary. The predicted odour levels (three-minute means) must not exceed the following odour levels 99.9% of the time at sensitive receptors, not including houses on the property of the development (see table).

Number of people	Odour units (3-minute average, 99.9%)
2000 or more	2
350 or more	4
60 or more	6
12 or more	8
Single residence (less than 12)	10

In making an odour assessment, the number of people in a defined area or cluster must be determined. Differing situations may require the use of more than one criterion so good judgement may be required to determine the best criteria to use. For an area or cluster, the potential growth of the area and the boundaries of the associated zones as detailed in the appropriate development plans must be considered. Where sensitive receptors exist, adjacent to each other, over a series of planning zones, they would normally be considered as one single area for the purpose of this guideline.

Some examples:

- If an odour source is in an area with a rural residence to the north and a town of 500 people to the south, then the appropriate criterion is 10 odour units for the single residence and 4 odour units for the town and adjoining houses.
- If a rural odour source has individual 4 houses nearby, one in each direction, then the appropriate criterion is 10 odour units at each house as they are each considered single residences.

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- If a cluster of houses with a population of 70 people is near an odour source, the appropriate criterion is 6 odour units. If there is a discreet zone of 2000 or more people, the appropriate criterion is 2 odour units. If there is a single residence at the edge of the zone, the appropriate criteria for this house is also 2 odour units.

Accurate odour modelling is highly dependent on the quality of the meteorological and emission data used. Consequently, it is strongly advised that proponents of any new development use the best data available, and allow substantial margin for error in their odour modelling.

As a general guide, if the predicted odour levels illustrated in the modelling are half the acceptable level published in this guide, then the proponent can reasonably expect that the final development will remain within acceptable odour levels in most circumstances. If the predicted odour levels illustrated in the modelling are double the acceptable levels in this guide, then the whole concept of the development would probably need to be re-examined. Predicted odour levels between half and double the published acceptable levels would warrant a general re-examination of the proposed odour control systems and of the modelling itself.

## Draft separation distance guidelines under development

The EPA has issued a consultation draft *Guidelines for Separation Distances* (August 2000). This document <[www.epa.sa.gov.au/pdfs/sepguidepcd.pdf](http://www.epa.sa.gov.au/pdfs/sepguidepcd.pdf)> defines and recommends separation distances for a range of industries. Generally, the distances do not depend on the size or throughput of the industry but are based on experience with typical sized facilities using current best available technology, including odour control equipment.

The separation distances would help protect nearby sensitive receptors from a range of air quality issues, including odour, but are not designed as a substitute for good odour control using BATEA principles. There may still be a requirement to use modelling as a tool to assess the potential odour impacts, particularly if there are site-specific circumstances (local topography, sensitivity of the receiving environment, size of proposed operation).

For some industries, such as piggeries and cattle feedlots, there are no defined separation distances, but there is a reference to industry specific guidelines developed to address the range of sizes in feedlots and the management techniques likely to be in use.

## Presentation of results

In presenting odour source modelling, sufficient information must be provided to allow a full understanding of the results and how they were derived. Reference should be made to the *EPA Guidelines: Air pollution modelling—presentation of results* (EPA 578/05, February 2005).

## Further reading

CSIRO Marine & Atmosphere Research 2005, *The Air Pollution Model (TAPM)*, viewed 24 March 2007, <[www.dar.csiro.au/res/aq/tapm](http://www.dar.csiro.au/res/aq/tapm)>.

Earth Tech Atmospheric Studies Group 2007, *Calpuff*, viewed 24 March 2007, <[www.src.com/calpuff/calpuff1.htm](http://www.src.com/calpuff/calpuff1.htm)>.

New South Wales Environment Protection Authority 2001, *Draft policy: Assessment and management of odour from stationary sources in NSW*, viewed 24 March 2007, <[www.epa.nsw.gov.au/air/odour.htm](http://www.epa.nsw.gov.au/air/odour.htm)>.

New Zealand Ministry for the Environment 2003, Good practice guide for assessing and managing odour in New Zealand, viewed 24 March 2007, <[www.mfe.govt.nz/publications/air/odour-guidelines-jun03/index.html](http://www.mfe.govt.nz/publications/air/odour-guidelines-jun03/index.html)>.

South Australian Environment Protection Authority 2000, *Draft guideline for separation distances*, viewed 24 March 2007, <[www.epa.sa.gov.au/pdfs/sepguidepcd.pdf](http://www.epa.sa.gov.au/pdfs/sepguidepcd.pdf)>.

—2005, *Air pollution modelling—presentation of results*, viewed 24 March 2007, <[http://www.epa.sa.gov.au/pdfs/guide\\_apm.pdf](http://www.epa.sa.gov.au/pdfs/guide_apm.pdf)>.

## Currency of these guidelines

These guidelines offer advice to assist with compliance with the general environmental duty and specific environmental policies. They are subject to amendment and persons relying on the information should check with the EPA to ensure that it is current at any given time.

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## FURTHER INFORMATION

### *Legislation*

Legislation may be viewed on the internet at: <[www.legislation.sa.gov.au](http://www.legislation.sa.gov.au)>

Copies of legislation are available for purchase from:

Service SA Government Legislation Outlet	Telephone:	13 23 24
101 Grenfell Street	Fax:	(08) 8204 1909
Adelaide SA 5000	Internet:	< <a href="http://shop.service.sa.gov.au">shop.service.sa.gov.au</a> >
	Email:	< <a href="mailto:servicesa@saugov.sa.gov.au">servicesa@saugov.sa.gov.au</a> >

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