Local Government Air Quality Toolkit

Module 1: The science of air quality

Part 4: Odour assessment

NSW GOVERNMENT

Acknowledgement of Country

Department of Climate Change, Energy, the Environment and Water acknowledges the Traditional Custodians of the lands where we work and live.

We pay our respects to Elders past, present and emerging.

This resource may contain images or names of deceased persons in photographs or historical content.

The Local Government Air Quality Toolkit has been developed by Department of Climate Change, Energy, the Environment and Water in collaboration with the NSW Environment Protection Authority, the NSW Department of Planning, Housing and Infrastructure, Local Government NSW and local councils.

Cover photo: Intensive indoor piggery. Chris Gill/EPA

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1. Odours

Community complaints about odours are more frequent than for any other type of air pollution. Many of the air quality issues associated with local government controlled industries and businesses relate to odours.

There is a high degree of subjectivity associated with odour assessment and this makes odour a significant problem for local government.

A practical approach is recommended for local council officers in the first instance, especially for small facilities. Careful use of documented odour observations by officers and others, coupled with an analysis of the suspect process and complaint patterns, can sometimes lead to practical solutions at a cost comparable to the cost of a scientific assessment. This approach is explained further in the Local Government Air Quality Toolkit – Module 4, *Practical regulation of air pollution*.

Chapter 3 of the Local Government Air Quality Toolkit – *Resource pack* also contains checklists for odour surveys and inspections.

1.1 Easily recognisable odours

Some substances have distinctive odours as pure compounds, such as hydrogen sulfide (H_2S, or 'rotten egg' gas), acetone (or nail polish remover) and hypochlorous acid (the 'chlorine' smell from swimming pool chemicals). These are quite familiar to many people even if they do not know their chemical names.

Odours come from mixtures of many compounds. The biological processes in the food industry and waste treatment industry characteristically generate families of odorous compounds rather than one or 2 such compounds. Most rotting material contains hydrogen sulfide, although it is not recognisable as such in the mixture.

2. The human sense of smell

Certain volatile substances and mixtures stimulate the olfactory nerve in a person's nose to produce a sensation of odour or smell. Odours are transported from source to nose by the wind. Many odours are not toxic at readily detectable concentrations. As everyone is equipped with a sensitive detector (nose), the primary issue is amenity. Figure 1 presents the key features of the human sense of smell.

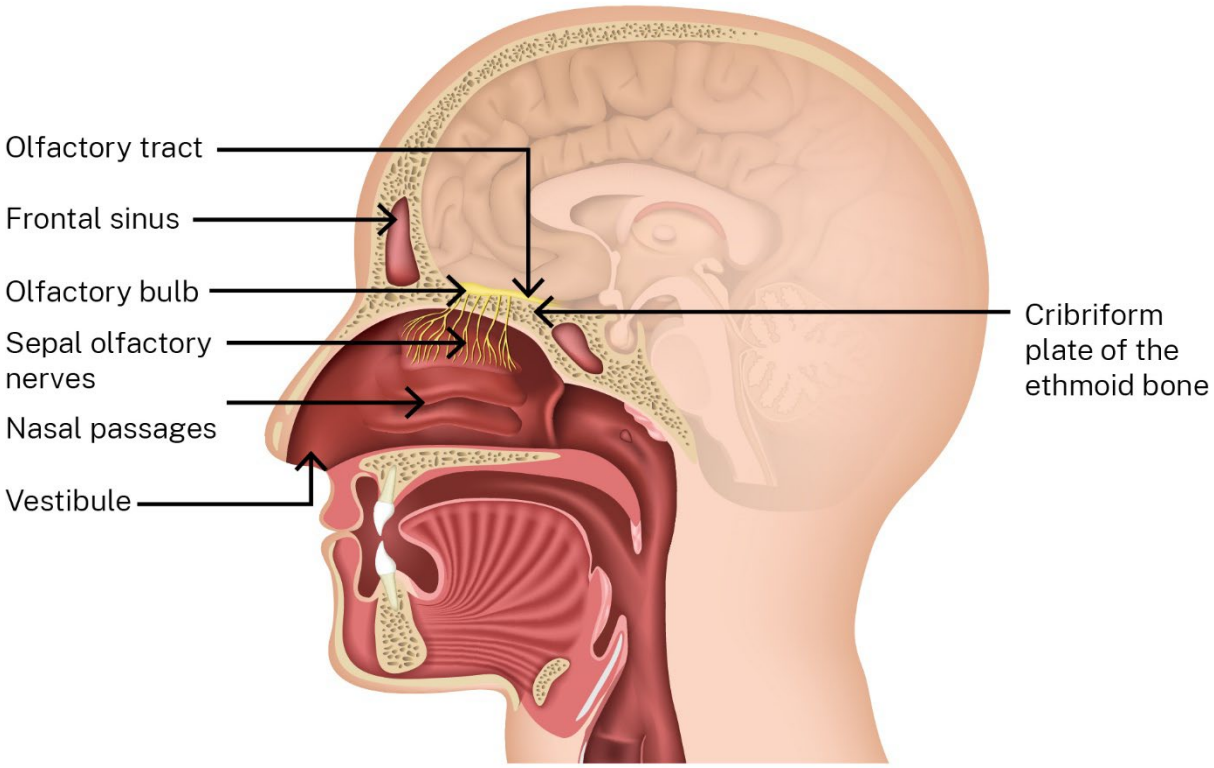

Figure 1 **Features of the human sense of smell**

Odours:

- are individual compounds, or mixtures of compounds, that stimulate the olfactory nerve causing a sensation of smell
- are not easily defined as chemical compounds
- are transported by air from source to nose
- are detected with differing sensitivities
- impact on amenity
- are often not toxic at the intensity they are detectable (even if a 'nasty smell').

2.1 Human sensitivity to odour

Human perceptions of odour vary widely and therefore odours are difficult to measure reliably. Where only one compound is present the chemical concentration can be determined and related to odour intensity, discussed below. When multiple compounds are present, which tends to be the more common situation, the odour intensities of the individual components cannot simply be added together to arrive at the intensity of the mixture.

The odour intensity is based on how easy it is to recognise an odour. The criteria developed by Environment Protection Authority Victoria (EPA VIC 2022) could be used for determining odour intensity (reproduced in Table 1). This table and supporting odour related resources are provided in Chapter 3 of the Local Government Air Quality Toolkit – *Resource pack*.

Table 1 **Odour intensity descriptors**

Source: EPA VIC (2022)

Descriptor	Description
Obvious	The odour is easily recognised, can be described and may be attributed to a source. The assessor can smell it without any effort or focus on it.
Subtle	The odour can be recognised only when focusing; for example, by standing still, inhaling slowly and concentrating.
No odour	No odour, or odour is not strong enough to be recognised.

3. Measurement of odour

Odour sampling may be required under the following circumstances:

- to verify complaints
- to determine compliance with odour criteria or project-specific criteria
- for post-commissioning performance testing
- as part of a pollution reduction program or prevention notice
- to determine the need for mitigation
- as part of a project's operating conditions.

Odour samples can be taken from one or multiple sources at a site. Sources can include point, area, volume and fugitive sources and each one comes with different sampling techniques.

Sampling is usually done by a specialist using a variety of methods, including a vacuum container attached to a drum and pump, wind tunnels, sampling hoods and sampling bags.

Dynamic olfactometry is typically used by regulatory authorities as the basis for odour management as there are not currently any instrument-based methods that can suitably quantify an odour response.

This method involves presenting odorous air to a panel of people with progressively decreasing quantities of clean odour-free air; that is, an increasing concentration of odour. The panellists note when the odour becomes detectable to them. 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 detection threshold. The units for odour measurement using dynamic olfactometry are odour units (OU), which are dimensionless. The determined OU can then be used to assess the odour against odour criteria (see following sections).

> The number of odour units in a sample is the number of dilutions required for the sample to reach the threshold of detection by the human nose.

There are Australian standards (AS 4323.3:2001) for odour measurement by dynamic olfactometry, both of which are recommended by the NSW Environment Protection Authority (EPA) in the *Technical Framework: Assessment and management of odour from stationary sources in NSW* (DEC 2006a).

3.1 Factors in odour assessment

The key factors identified as determining community responses to odours are referred to as 'FIDOL':

- **F**requency of exposure (F)
- **I**ntensity of exposure (I)
- **D**uration of exposure (D)
- **O**ffensiveness of the odour (the so-called 'hedonic tone') (O)
- **L**ocation in which the exposure occurs (L).

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

Whether an individual considers an odour to be a nuisance or not, 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.

Despite these shortcomings, considerable progress has been made in odour assessment and control. The following documents provide extensive guidance on odour assessment and control:

- *Technical Framework: Assessment and management of odour from stationary sources in NSW* (DEC 2006a)
- *Technical Notes: Assessment and management of odour from stationary sources in NSW* (DEC 2006b).

3.2 Size of the population exposed

To allow for the likelihood of more sensitive individuals being present in larger populations, the EPA criteria take account of the size of the population exposed. They are based on a 1 second averaging time, the typical response time of the olfactory nerve to a stimulus. They also assume that the ambient odour exposure criteria are met for 99% of the time.

Models can only make predictions at averaging times of 1-hour or more, so emission rates / model predictions need to be adjusted to account for this. This is done through the application of peak-to-mean ratios, and these are described in the *Approved methods for modelling and assessment of air pollutants in NSW* (EPA 2022).

3.3 Odour assessment criteria

The odour concentration criteria adopted in New South Wales range from 2 OU for urban areas with a population of more than 2,000 people exposed, to 7 OU for a single dwelling (Table 2). Applying odour criteria in odour assessment is described in more detail in the *Technical Framework* (DEC 2006a) and *Technical Notes* (DEC 2006b).

Table 2 Odour assessment criteria adopted in New South Wales

Population of affected community	Odour assessment criteria (OU)
Single, rural residence (≤2)	7.0
~10	6.0
~30	5.0
~125	4.0
~500	3.0
Urban area (≥2,000) and/or schools and hospitals	2.0

4. Three-tiered exposure assessment

The *Technical Framework: Assessment and management of odour from stationary sources in NSW* (DEC 2006a) allows for a 3-tiered exposure assessment using simple dispersion calculations at the initial assessment level, and increasingly sophisticated emission inputs and dispersion modelling techniques at the higher levels. These are summarised below:

- **Level 1** is a simple screening-level technique used to assess site suitability and odour mitigation measures. It is particularly suitable for smaller developments in sparsely populated areas with no existing or likely future sensitive receptors located nearby.
- **Level 2** is a screening-level dispersion modelling technique using worst case emission and meteorological data and is used to assess site suitability and odour mitigation measures. For example, it is suitable to determine whether a proposed upgrade of a sewage treatment plant would result in odour impacts on local residents.
- **Level 3** is a refined-level dispersion modelling technique that uses site-specific input data. It may be used to assess site suitability and odour mitigation measures. For example, it can be used to assess whether proposed mitigation strategies would be adequate to reduce odour impacts from a waste oil processing facility.

Other inputs such as odour sampling data and odour surveys may be used to inform the assessment. Calculated or predicted (using dispersion modelling) odour levels can then be compared against odour criteria to assess compliance.

Even at the screening assessment level, dispersion modelling requires a specialist skill set, and it is unlikely that council officers would attempt it directly. Chapter 6 of the Local Government Air Quality Toolkit – *Resource pack* therefore includes a list of things to look out for when reviewing air quality assessments that include dispersion modelling.

4.1 Responding to odour from existing premises

In response to a complaint of odour from existing premises, council officers may specify in a prevention or clean up notice that an assessment be undertaken using dispersion modelling, which may include sampling. In doing so they should be aware of the:

- likely expense of a study involving odour sampling and dispersion modelling
- accuracy of the sampling and analysis
- difficulty of measuring and analysing diffuse sources
- limitations of modelling in the sort of topography and building interference often encountered in urban situations.

5. References and other resources

All documents and webpages that are part of the Local Government Air Quality Toolkit are available from the EPA website.

DEC (Department of Environment and Conservation) (2006a) *Technical Framework: Assessment and management of odour from stationary sources in NSW*, NSW Department of Environment and Conservation, Sydney South NSW, www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/air/20060440framework.pdf [PDF 259 KB].

DEC (2006b) *Technical Notes: Assessment and management of odour from stationary sources in NSW*, NSW Department of Environment and Conservation, Sydney South NSW, www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/air/20060441notes.pdf [PDF 254 KB].

EPA (Environment Protection Authority) (2021) *Guide to conducting field odour surveys*, NSW Environment Protection Authority, www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/air/22p3820-guide-field-odour-surveys.pdf [PDF 376 KB].

EPA (2022) *Approved methods for the modelling and assessment of air pollutants in NSW*, NSW Environment Protection Authority, Parramatta NSW, www.epa.nsw.gov.au/your-environment/air/industrial-emissions/approved-methods-for-the-modelling-and-assessment-of-air-pollutants.

EPA VIC (Environment Protection Authority Victoria) (2022) *Guidance for assessing odour*, Environment Protection Authority Victoria, Carlton VIC, www.epa.vic.gov.au/about-epa/publications/1883.