

Guidance on the assessment of odour for planning

September 2026 (Version 2.0)



Institute of
Air Quality
Management

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The Institute of Air Quality Management (IAQM)

The IAQM aims to be the authoritative voice for air quality by maintaining, enhancing and promoting the highest standards of working practices in the field and for the professional development of those who undertake this work. Membership of IAQM is mainly drawn from practising air quality professionals working within the fields of air quality science, air quality assessment and air quality management.

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FOREWORD

The Institute of Air Quality Management (IAQM) is the professional body for air quality professionals and acts as the voice of air quality in the UK, through the development and publication of guidance on matters of air quality and emissions, including odours. The IAQM is committed to enhancing the understanding and development of the science behind air quality by promoting knowledge and understanding of best working practices. Membership of the IAQM is mainly made up of practising air quality professionals working within the fields of air quality science, air quality assessment and air quality management. Most, if not all, of the assessment approaches described here require some degree of professional judgement from a competent and suitably experienced air quality professional in order to reach a conclusion on the overall significance of the odour impact. Full membership of the IAQM – the only professional body specifically for air quality practitioners in the UK – can be evidence of such competence and experience. Membership of some other professional bodies having relevance to the practice of air quality assessment may also provide a degree of reassurance.

Odour is an issue that air quality professionals are frequently required to assess, particularly in respect to planning. Odour impacts may be assessed when considering a planning application for an activity that may release odours, or when a sensitive use is being proposed near to an existing odorous process (known as ‘encroachment’). Typical examples of potentially odorous activities are sewage works, intensive animal rearing, processing of animal remains, solid waste management (for example composting), commercial kitchens and some industrial processes (for example manufacturing).

Some guidance on odour assessment is already available from the Environment Agency (EA) and Natural Resources Wales (NRW), the Scottish Environmental Protection Agency (SEPA), and the Northern Ireland Environment Agency (NIEA). However, none of this specifically provides guidance applicable for planning purposes. This IAQM document has been prepared to assist practitioners involved in odour assessment for planning. It is not intended to replace existing guidance produced by the environment agencies for environmental permitting (EP) purposes, or where a specific assessment method is already provided within existing guidance.

The methodologies provided in this guidance could be used as part of the evidence of potential for Statutory Nuisance occurring, however, the occurrence of Statutory Nuisance can only be determined by a court or in relation to an investigation by an environmental regulator (e.g. Environment Agency or Local Authority).

The field of odour impact assessment is an evolving and subjective science. It should be noted that Inspectors’ decisions on past planning appeals, though useful and often setting precedents, will have been based solely on the evidence that was presented to them, which may have been incomplete or of a different standard to current best practice: caution should therefore be exercised. The evidence presented to justify a decision should be examined carefully, and the base science presented should be the main consideration when reviewing the outcome of an appeal. This guidance describes what the IAQM considers to be current best practice; it is hoped that this will assist with and inform current and future planning appeals and decisions.

This guidance is aimed primarily for use in the UK, where the vast majority of IAQM members work. However, it is recognised that the membership of IAQM is international and that the guidance may be applied elsewhere. Where this occurs, careful consideration needs to be given to its applicability where local approaches to odour assessment may be significantly different.

This edition (2026) is the first full revision of this guidance, which was originally published in 2014 with a minor update published in 2018. As experience of using the guidance develops and as further research relating to odour becomes available, it is anticipated

that further revisions of this document will become necessary.

The use of some odour assessment tools in the UK suffers due to the sparseness of published evaluation of both the relationship of effects/annoyance to exposure, and what level of exposure can be considered to be acceptable. The IAQM is particularly keen to hear of examples of the use of these tools so they can be further evaluated, and the presentation of such data to the air quality community will itself improve the practice of odour impact assessment.

1. INTRODUCTION

1.1 SCOPE AND PURPOSE OF THIS GUIDANCE

This guidance is for assessing odour impacts for planning purposes. This document is not intended to provide guidance on odour for environmental protection or regulatory purposes (e.g. Environmental Permitting, statutory nuisance investigations, etc.). Specific odour guidance documents are available from the EA¹, SEPA² and NIEA³ to provide guidance in relation to environmental regulation. Historically, Defra^{4,5,6} and the EA⁷ produced various other guidance documents on odour, but these were withdrawn in September 2017 and December 2025, respectively. A version of Defra's 2011 commercial kitchen guidance has since been prepared by one of the original authors for use.⁸ Guidance from those organisations also provides some background information on odours, details of how odours are measured and options for controlling odour emissions. These subject areas are not repeated in detail in this guidance document.

Odour can be an important issue for waste management developments, wastewater treatment works (WWTWs), commercial food preparation, some industrial processes, and rural activities (e.g. intensive livestock farming). The relevant Planning Authority must consider whether a proposed development (an odour source itself, or nearby new receptors such as residential dwellings) will be a suitable use of the land.

The planning system has the task of guiding development to the most appropriate locations: ideally, significant sources of odour should be separated from odour-sensitive users of the surrounding land (sensitive receptors), although the characteristics of an area should be considered on a case-by-case basis because distance alone is not the only factor. Failing this, it may be possible to employ control and mitigation measures to make a proposed development acceptable from a land-use

perspective. New proposals for such developments may require an odour impact assessment to be submitted, either as a standalone assessment or as part of an Environmental Impact Assessment (EIA), to accompany the planning application. This is often of particular relevance for applications involving the 'agent of change' principle, such as the redevelopment of former industrial areas to residential dwellings.

Following the granting of planning consent, some industrial or waste activities will operate under an Environmental Permit, whereby ongoing pollution control of many (though not always all) of the operations will be regulated by the EA or other agencies. National planning guidance requires that the Planning Authority works on the assumption that such pollution control regimes will operate effectively. However, even with effective operational pollution regulation in place, some residual odour can remain, and there may be some situations where such residual effects would make a development an unsuitable use of land at its proposed location. For sites that will be subject to an Environmental Permit it is still necessary, therefore, for the Planning Authority to consider at the planning stage whether the proposed development at the site will be a suitable use of the land; particularly in regard to the likely residual effects of odour on nearby sensitive users.

Finally, this guidance is limited to assessing the effects of odour on amenity, not on health. Strictly speaking, what we term odour is not really an air pollutant at all; rather, it is the human olfactory response (perception followed by psychological appraisal) to one, or more often a complex mixture of, chemical species in the air. Whilst such a psychological response may include a perception of impacts on health and wellbeing by individuals, these chemical species may, or may not, have health effects at the concentrations that trigger an odour

response; however, that is a separate matter and this document does not provide guidance on the health effects of odours.

1.2 A BASIC UNDERSTANDING OF ODOUR

1.2.1 The subjective nature of odour

Most odours are mixtures of many chemicals that interact to produce what we detect as a smell. A distinction should be made between odour-free air, containing no odorous chemicals; and fresh air, usually perceived as being air that contains no chemicals or contaminants that are unpleasant (i.e. air that smells 'clean'). Fresh air may contain odorous chemicals, but these odours will usually be pleasant in character, such as freshly mown grass or sea spray. Perceptions of an odour – whether it is found to be acceptable, objectionable or offensive – are partly innate and hard-wired, and partly determined through life experiences, and therefore can be subjective to the individual.

1.2.2 Odour exposure

Before an adverse effect (such as disamenity, annoyance, or nuisance) can occur, there must be odour exposure. For odour exposure to occur, all three links in the source-pathway-receptor chain must be present:

- a) An emission source – a means for the odour to get into the atmosphere;
- b) A pathway – for the odour to travel through the air to locations off site, noting that anything that increases dilution and dispersion of an odorous pollutant plume as it travels from source to receptor (such as increasing the pathway length) will reduce the concentration or intensity at the receptor; and
- c) The presence of receptors (people) that could experience an adverse effect, noting

that people vary in their sensitivities to odour.

These parameters for odour assessment are typically referred to as the 'FIDOL' or 'FIDOR' factors. The scale of exposure (the impact) is determined by the FIDO factors (Frequency, Intensity, Duration and Offensiveness, as described in Table 1.1). The magnitude of the effect experienced is determined by the scale of exposure (FIDO) and the sensitivity of the receptor (L or R), denoting the location or receptor, which is often taken to be a surrogate for the sensitivity, and incorporates the social and psychological factors that can be expected for a given community. Figure 1.1 depicts how the human appraisal of the FIDOL factors and social and psychological factors determines whether an odour has an adverse impact and an objectionable effect.

Different combinations of the FIDO factors can result in different exposures at a location. For example, odours may occur as a one-off, as frequent short bursts, or for longer, less-frequent periods, and may be said to give 'acute' or 'chronic' exposures respectively. The SEPA Odour guidance² also gives a framework for describing each of the FIDOL factors.

1.2.3 Adverse effects of odour

The odour effect we need to be concerned with is the negative appraisal by a human receptor of the odour exposure. This appraisal, occurring over a matter of seconds or minutes, involves many complex psychological and socio-economic factors. Once exposure to odour has occurred, the process can lead to adverse effects such as disamenity, annoyance, and nuisance (see the **Glossary** for definitions). As a response to these effects, it can also lead to complaints.

Disamenity could be considered a negative element that detracts from the overall character or enjoyment of an area, but it is important to emphasise the technical differences between annoyance and nuisance.⁹

- **Annoyance** – the adverse effect occurring from an immediate exposure.
- **Nuisance** – the adverse effect caused cumulatively, by repeated events of annoyance.

A complicating factor is that as well as the technical definition, nuisance is also a term in law (e.g. Statutory Nuisance). The legal use of Nuisance has preceded the technical definition of nuisance described here. The definition of Statutory Nuisance covers seven areas, and that which relates to odour is : “any dust, steam, smell or other effluvia arising on

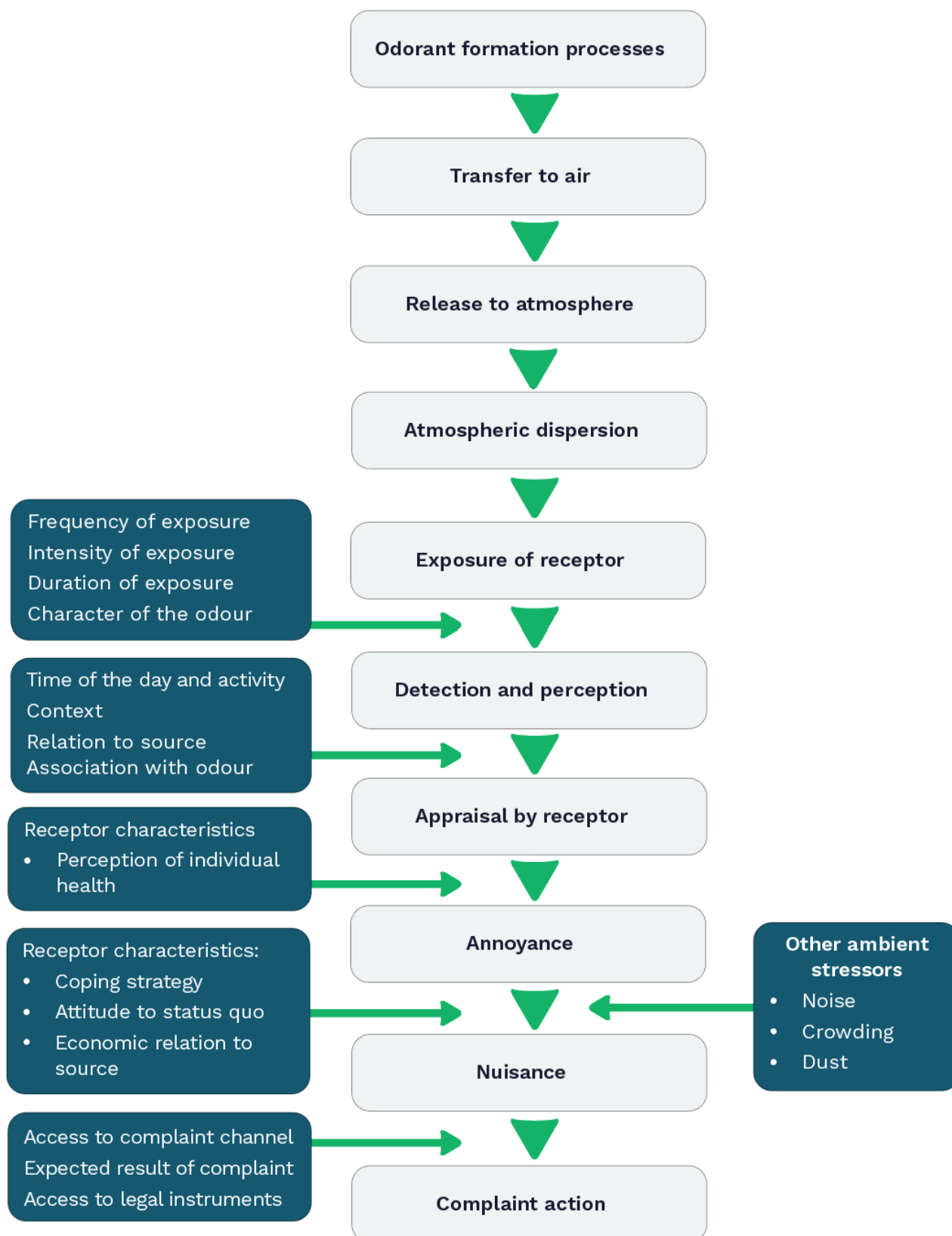
industrial, trade or business premises and being prejudicial to health or a nuisance”.¹⁰ The EPA 1990 contains no technical definitions of nuisance, such as maximum concentrations, frequencies or durations of odour in air and only the Court can decide whether a legal Nuisance is being caused. It should be noted that unless stated otherwise, this guidance uses the phrase “odour nuisance” in a general sense.

Planning policy⁹ requires that the effects of pollution on health, the natural environment or general amenity should be taken into account.

Table 1.1 Description of the FIDOL factors

Frequency	How often an individual is exposed to odour
Intensity	The individual’s perception of the strength of the odour
Duration	The overall duration that individuals are exposed to an odour over time
Odour offensiveness	Odour offensiveness describes the character of an odour as it relates to the ‘hedonic tone’ (which may be pleasant, neutral or unpleasant) at a given odour concentration or intensity. This can be measured in the laboratory as the hedonic tone, and when measured by the standard method and expressed on a standard nine-point scale, it is termed the hedonic score
Location	The type of land use and nature of human activities in the vicinity of an odour source. Tolerance and expectation of the receptor. The ‘Location’ factor can be considered to encompass the receptor characteristics, receptor sensitivity, and socio-economic factors

Figure 1.1 - From odour formation to complaint⁸



Loss of amenity or disamenity does not equate directly to nuisance, and loss of amenity will often occur at lower levels of odour exposure than would constitute a nuisance. However, at present there are no numerical standards or guidance that provide any framework to distinguish loss of amenity from nuisance.

Annoyance and/or disamenity can lead to complaint action. However, a lack of complaints does not necessarily prove there is no annoyance, or loss of amenity. On the other hand, there needs to be an underlying level of annoyance before complaints are generated. Furthermore, people's annoyance responses can change over time. An individual's reaction to odours is influenced by a wide range of factors including history of exposure. This is important to bear in mind when interpreting odour complaints. The complaints can, in rare circumstances, represent a reaction to a single odour exposure event. However, complaints are generally a public expression of concern over odour exposure that has been experienced over a much longer period of time, leading to the incremental development of annoyance. Once someone reaches the point of annoyance, they may then start to complain about odours that would not normally bother other members of the population. The lesson is that complaints in the present are likely to be strongly associated with events in the past.



Oversized material at a green waste composting site.

2. ASSESSMENT OF ODOUR

2.1 CONTENT OF AN ODOUR ASSESSMENT FOR PLANNING

An assessment of the impact and resulting effects of an odour source on surrounding users of the land will usually contain the following major elements:

1. A description of existing baseline odour conditions (including complaints history) where relevant;*
2. A description of the location of receptors and their relative sensitivities to odour effects;
3. Details of potential odour sources (whether existing or proposed), including the activities and materials involved (including a brief outline of quantities, durations, methods of handling and storage, etc.) and the resulting potential for generating odours, covering fugitive sources, diffuse sources, and point sources as applicable;
4. A description of control/mitigation measures incorporated into the scheme (including management controls and, where appropriate, engineering controls);
5. A prediction or observation (or combination of both), using appropriate assessment tools, of the likely odour impact and resulting effects at relevant sensitive receptors, which should take into account:
 - a. The likely magnitude of odour emissions (after control by measures incorporated into the scheme, if applicable);
 - b. The likely meteorological characteristics at the site, particularly considering any local phenomena such as the potential for katabatic flows;
- c. The dispersion and dilution afforded by the pathway to the receptors and the resulting magnitude of odour that could result;
- d. the sensitivity of the receptors (See **Table 2.1**); and
- e. the potential cumulative odour effects with any odours of a similar character (e.g. if odours from kitchen waste are in addition to an existing municipal solid waste throughput).
6. Where odour modelling has been used, the reports should contain full details of the input data and modelling assumptions, settings and defaults used to allow a third party to reproduce the results;
7. Where odour effects are assessed as significant, details of appropriate further mitigation and control measures that could allow the proposal to proceed without causing significant loss of amenity;
8. The residual odour impacts and their effects (see **Box 2.1**); and
9. A conclusion on the significance of the residual effect, i.e. whether it is “significant” or “not significant”.

* Noting that odours are not usually additive in their impacts unless they are of a similar character.

Box 2.1 - Definitions of impacts and effects used in this guidance

It is helpful to differentiate the terms “impact” and “effect” when undertaking odour assessments. This is particularly valuable when an odour assessment is included in an EIA where it is required to provide an assessment of likely significant effects. In this IAQM guidance, the following definitions are used:

Impacts – these are changes to the environment attributable to the development proposal.

Effects – these are the results of the changes (impacts) on specific receptors, which account for tolerance (e.g. in rural settings, the tolerance of agricultural odours should be greater than in urban settings).

Receptors – are the users of the adjacent land, which may vary in their sensitivity to odour.

An increase in odour levels (the impact) to a level of annoyance (which considers the frequency and duration) would therefore cause a particular effect (e.g. loss of amenity) if the adjacent land use was residential, and perhaps a lesser effect if the adjacent land use was an industrial facility.

one odour assessment tool that takes the FIDOL factors into account. A number of odour assessment tools exist and will be considered later in this guidance. Atmospheric dispersion modelling has a very important role to play because it can (in appropriate situations) forecast odour exposure over a wide study area and over a long timeframe. However, there are other assessment tools that can complement modelling, or can – in certain circumstances – be more appropriate than modelling. Because the various assessment tools have different applications, strengths and limitations, they are often used in combination (see next section).

In the Methodology section of the report or ES chapter, the Practitioner should justify the following:

- Why the chosen odour assessment tools have been used and why they are suitable for the assessment in question; and
- That the approach used is of a depth and rigour consistent with the likely risk of adverse effects.

To make the predictions or observations in point 5 above, Air Quality Practitioners need to use at least

Table 2.1 - Receptor sensitivity to odours

For the sensitivity of people to odour, the IAQM recommends that the Air Quality Practitioner considers the following general principles to identify where on the spectrum between high and low sensitivity a receptor lies. In determining receptor sensitivity, examples below should not be taken as prescriptive, and professional judgement is required to explain and justify the sensitivity of receptors, taking account of the principles below and relevant local factors:

High sensitivity receptor

Surrounding land where:

- Users can reasonably expect enjoyment of a high level of amenity; and
- People would reasonably be expected to be present here continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land.

Examples may include residential dwellings including gardens, hospitals and schools/education sites.

Medium sensitivity receptor

Surrounding land where:

- Users would expect to enjoy a reasonable level of amenity, but wouldn't reasonably expect to enjoy the same level of amenity as in their home; or
- People wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land.

Examples may include offices, commercial premises which do not themselves represent a source of odours, retail premises, cemeteries and playing/recreation fields.

Low sensitivity receptor

Surrounding land where:

- The enjoyment of amenity would not reasonably be expected; or
- There is transient exposure, where the people would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land.

Examples may include commercial/light industrial premises which may themselves represent a source of odours, heavy industrial sites, farms, footpaths and roads.

2.2 GENERAL APPROACH TO ASSESSING ODOUR EFFECTS FOR PLANNING

Being able to use the assessment tools and understanding the meaning of the results are two distinct skills. Most of the odour assessment tools measure odour exposure (i.e. impact), or some other parameter; very few of the tools measure the resulting *effect* (e.g. annoyance or nuisance) directly, and none measure disamenity specifically. Nevertheless, planning policy^{9,11,12} requires that it is the *effects* of pollution on health, the natural environment, or general amenity that should be considered. Furthermore, the EIA regulations require that an assessment reaches a conclusion on the likely *significance* of the effect. Therefore, an assessment must go further than simply estimating the odour exposure/impact and attempt to gauge the *magnitude of the effect* resulting from that impact on a receptor of a particular sensitivity. This is a matter of judgement that cannot easily be defined by scientific methods alone, and ideally requires a wider societal or stakeholder consensus to be arrived at. It is generally agreed that a high sensitivity receptor subject to a large odour exposure will experience a substantial adverse effect, and a low sensitivity receptor subject to a small odour exposure will experience a negligible effect. However, between these extremes, the various combinations will give rise to a gradation of effects for which no descriptor terms have been universally agreed.

In this guidance, the IAQM describes a relationship between the level of odour exposure (impact) experienced by a receptor of a given sensitivity and the magnitude of adverse effect that is likely to result. This relationship for odour* impact is tailored to the individual assessment tools or methods (e.g. modelling, qualitative risk assessment, or sniff testing) that has been used. It is necessary to ensure that the result from whichever assessment tool is used is properly matched up to the correct

descriptor term (i.e. very large, large, medium, small, or negligible exposure) on the exposure/impact scale for that particular tool/method. The effects matrices for different tools will not necessarily be identical, and the overall effects should be considered for both individual tools and multiple tools, forming an overall judgement based on professional experience. This is covered in detail in the later sections and appendices of this guidance. The effects matrices will be kept under review to benefit from the feedback of affected or interested parties.

In each of the odour effects matrices within this guidance (see Section 4.5, Appendix 1 and Appendix 2), consistent terminology is used to describe the odour effects and allow consistent comparison of findings from different assessment tools and methods. The scale of odour effects defined in this guidance document is as follows:

- Negligible;
- Slight Adverse;
- Moderate Adverse; and
- Substantial Adverse.

Whilst the character of some odours may be considered to be 'pleasant', it is not considered appropriate to define an odour impact or effect from a pleasant odour as beneficial and hence the descriptors all default to adverse. For example, a receptor exposed to pleasant odours from a bakery would still be considered adverse if judged to be greater than negligible. The exception may be where an odour assessment examines reductions in odour impacts and effects resulting from a project, scheme or mitigation measure. In this case, the reduction in odour exposure may be assessed and described as 'beneficial' relative to the more odorous baseline position. In these cases, professional judgement should be applied to explain and justify the

* A different relationship may hold for other pollutants, e.g. dusts or chemical species. For example, exposure to very toxic

chemicals may cause a highly significant effect at even small levels of exposure.

judgement on the scale and significance of the beneficial odour effects.

The EIA regulations require an assessment to reach a conclusion on the likely significance of the predicted effect. Where the overall effect is greater than “slight adverse”, the effect is likely to be considered significant. Note that this is a binary judgement: either it is “significant” or it is “not significant”. Concluding that an effect is significant should not mean, of itself, that a development proposal is unacceptable and the planning application should be refused; rather, it should mean that careful consideration needs to be given to the consequences, scope for securing further mitigation, and the balance with any wider environmental, social and economic benefits that the proposal would bring.



Poultry sheds.

3. USING ODOUR ASSESSMENT TOOLS

3.1 THE NEED TO COMBINE ODOUR

ASSESSMENT TOOLS

The preference towards combining a number of assessment tools to inform an assessment for planning is a feature that often distinguishes odour assessments from conventional air quality assessments.

Some odour assessment tools are empirical – observing the current odour impacts or effects, by monitoring or by using community assessment techniques. In contrast, other tools make use of a “model” – a simplified version of the real situation – to predict what the impact might be or compare numerical outputs for different options. All odour assessment tools, whether models or empirical observations, have a degree of uncertainty associated with their estimates of impact.

Models can range from a simple qualitative representation of the Source-Pathway-Receptor (S-P-R) concept, through semi-quantitative look-up tables or screening nomographs, to quantitative atmospheric dispersion models. From this point, the term ‘modelling’ refers solely to the use of an advanced atmospheric dispersion model.

Modelling is a valuable tool and plays a major role in odour assessment. However, it is important to remember that models, even though quantitative, are a simplification of the real situation. If the model is a good representation of the system in operation (the odour release and its dispersion in the atmosphere) and the assumptions and input data are reasonable, then we can use models to make predictions of what might happen. On the other hand, if these criteria are not met (because, for example, odour impacts are dominated by unpredictable, unplanned, or

accidental releases), then we simply end up predicting the wrong answer very precisely! Even when the model is a good representation of the real situation and the assumptions and input data are reasonable, the uncertainty for predictions from dispersion modelling can be considerable. It is therefore useful to use empirical, observational tools where they are available and applicable, and combine these with modelling where appropriate. In some instances, results from observational tools can be used to corroborate or check the reasonableness of the predictions. However, it should be borne in mind that many of the empirical tools themselves also have considerable uncertainty associated with them.

Further drivers for using multiple assessment tools within a study are:

- The partly subjective nature of odour and the wide differences that exist in population response; and
- The fact that there is no “silver bullet” assessment tool that on its own provides an unequivocal answer – results from each of the different techniques tend to give information only on some limited aspect of the odour impact or effect.

Fortunately, these different assessment tools are not mutually exclusive and using them in combination can minimise individual limitations and increase confidence in the overall conclusion. Best practice is to use a multi-tool approach where practicable (**Box 3.1** provides an example).

3.2 OVERVIEW OF THE ODOUR ASSESSMENT

TOOLS AVAILABLE

In this guidance, the assessment tools have been grouped into either predictive or observational/empirical (Table 3.1). This grouping matches assessment requirements for the two main scenarios that practitioners will be called on to consider (i.e. a new odour source next to existing receptors, or new development in the vicinity of an existing odour source, which is commonly the case in 'agent of change' principle applications).

Appendix 1 provides further details on predictive tools; and Appendix 2 provides guidance on sniff testing, a key observational tool.

Each tool has its own strengths, limitations, and applications for which it is better suited. Using tools from both of these categories will usually improve confidence in the conclusions reached.

The observational/empirical tools, by definition, require some form of measurement of ambient odour levels at sensitive receptors local to the source. This is challenging due to:

- The nature of odour exposure – it is perceived over very short time periods (as short as a few seconds), making most conventional sampling periods (where the sample is averaged over hours to weeks) inappropriate;
- The complex nature of odour – which is likely to comprise a varying mixture of odorous compounds; and
- The difficulty of measuring odours in ambient air – no analytical techniques can currently match the sensitivity, speed of response and breadth of application of the human nose.

These difficulties strongly influence the choice of tools available to us to directly measure/observe odour levels at receptors. The observational/empirical measurement tools tend to fall into two categories:

- a) **Conventional monitoring approach**, where the Practitioner makes the odour measurements in the field, (e.g. using sniff tests or chemical compound analysis); and
- b) **Community assessment approach**, which uses public responses as raw data (e.g. odour diaries, community surveys, or complaints monitoring).

It should be noted that it is not possible to monitor ambient odour at receptors as the 98th percentile of 1-hour mean concentrations: concentration benchmarks expressed in this form are designed for use with predictive dispersion modelling, not monitoring.

Box 3.1 - Example of multi-tool odour assessment of site suitability

The benefits of the multi-tool assessment approach are illustrated by the following example – assessing the impact on proposed development land around an existing odour source:

- Monitoring (e.g. sniff tests) can give a subjective measure of odour at specific locations under the conditions prevailing at the times and days of the sampling (see **Appendix 2**);
- Complementing monitoring with dispersion modelling provides greater spatial and temporal coverage and the reasonableness of the estimates from the model can be compared with the observed (i.e. surveyed) levels; and
- Modelling (and in most situations monitoring) is only likely to characterise normal operations of the odour source, whereas it is known that unexpected events (e.g. breakdowns) and abnormal operations at some facilities can account for a significant proportion of high odour episodes. If there are receptors in the locality, analysis of historical complaints data can provide an alternative perspective on the impact that is inclusive of such unexpected events and abnormal operations.

Table 3.1 – Summary of odour assessment tools

Type	Approach	Tool		End results
Predictive	Qualitative	Risk-based assessments using Source-Pathway-Receptor concept		A relative risk score or descriptor (e.g. negligible, low, medium or high-risk impact)
	Semi-quantitative	Simplified modelling: Screening models, look-up tables and nomographs		Estimated concentration
	Quantitative	Atmospheric dispersion modelling with ADMS, AERMOD etc., using source terms that have been measured by Dynamic Dilution Olfactometry (DDO) or using literature values		Predicted concentrations (ou_E/m^3), usually as 98 th percentiles of 1-hour means
		Computational Fluid Dynamics (CFD) tools		Image representation of flow patterns or predicted concentrations (ou_E/m^3), usually as 98 th percentiles of 1-hour means
Observational /Empirical	Monitoring of odour in ambient air	Sensory	Sniff tests	Odour exposure inferred from measurements/observations of intensity, frequency, duration, offensiveness. See Appendix 2 for further guidance
		Compound measurements	e.g. H_2S , VOCs analysis	Measured concentration considering, measurement limitations
	Actively using the community as the “sensor”	Odour diaries		Days (%) on which odour detected above a given intensity
		Community surveys		% annoyed or % experiencing amenity loss
	Passively using the community as the “sensor”	Complaints analysis		Frequency of complaints taking into account validation of complaints and other factors (such as locations of complainants, odour release timings, meteorological conditions, etc.)

3.3 SELECTING THE APPROPRIATE ODOUR

ASSESSMENT TOOLS

In designing the odour assessment strategy, the Air Quality Practitioner needs to select odour assessment tools that suit the study situation. It is therefore normal practice for practitioners to consult with the Local Planning Authority (and/or its air quality specialists) and other statutory consultees to gain agreement on the approach and methodology that will be used. The air quality section of the National Planning Practice Guidance (NPPG) notes that “The scope and content of supporting information is best discussed and agreed between the local planning authority and applicant before it is commissioned.”¹³ For assessments of development site suitability around existing odorous activities, the process operator (e.g. a water company operating an existing wastewater treatment works) may also have an opinion (or their own guidance) on what should go into the assessment, if they are not to dispute the results and potentially object to the application at planning. Ultimately though, it is up to the Planning Applicant to decide on how much weight they wish to give to the views of third-party organisations on the approach they will be using, informed by the professional judgement of their Practitioner.

The following stepwise approach may be used as a guide:

Step 1 – Predictive tools alone, or predictive tools with empirical observations?

Some tools can only be used for certain scenarios, so the first point to consider is whether the assessment is of the impact of a proposed (i.e. future) odorous development on surrounding receptors, or whether the assessment is of the suitability of proposed development land (e.g. for residential dwellings) around an existing odour source:

- *For assessing the impact of a future odorous development:* No empirical observations will be available (unless from a similar “surrogate”

site that is currently operating) and odour effects will need to be forecast using predictive tools (e.g. qualitative risk-based assessments, dispersion modelling); and

- *For assessing site suitability of proposed development land (e.g. residential) around an existing odour source:* Where there is an existing odour source, the odour effect would normally be assessed using predictive methods (which may be qualitative or modelling) to complement observational methods. Ideally, where we could make many measurements spatially and temporally, empirical observations alone would suffice and would likely be preferred to a prediction. However, that is rarely practicable within the constraints of a planning application timetable and budget. The compromise is to use predictive methods (e.g. modelling) to improve the spatial and temporal coverage of limited empirical observations. Nevertheless, in most circumstances at least some observations (such as complaints analysis and sniff tests) can usually be accommodated even with the most time-constrained application timetable.

Step 2 – Select suitable assessment tools

Having narrowed the choice to either predictive assessment tools alone, or predictive plus empirical tools, the next step is to select which of the tools are well suited and to exclude any that are not suited or practically available. More detail on this is given in **Appendix 1** and **Appendix 2**.

Step 3 – Decide how many assessment tools are needed

Next, the Practitioner must decide how many of these tools are necessary to use in the assessment in

order to provide a robust body of evidence on which to base the conclusion of impact. This should be based on the potential of the proposed development to cause, or experience, adverse odour effects:

- If there is a lower likelihood (risk) of adverse odour effects, then a single assessment tool may suffice and/or it may be more qualitative than quantitative; or
- On the other hand, if there is a higher potential for adverse odour effects (e.g. there are sensitive receptors relatively close to a source of significant magnitude), then a combination of assessment tools is more likely to be required, to provide an adequate

body of evidence. The tools are also likely to include quantitative techniques.

This meets the requirements in the air quality section of the NPPG for assessments to “be proportionate to the nature and scale of development proposed and the potential impacts”.⁹

Deciding on the potential for adverse odour effects itself requires some initial assessment or professional judgement. Often, the best approach is to carry out a screening assessment (such as a qualitative risk assessment) before deciding whether a more detailed assessment is necessary, based on whether there is likely to be a significant risk of an odour impact

4. ODOUR BENCHMARK/ODOUR ASSESSMENT CRITERIA

4.1 INTRODUCTION

Benchmark criteria exist for a number of odour assessment tools. However, this section focuses on numerical (concentration) assessment criteria specifically for dispersion modelling studies and examines:

- Criteria that have been applied in the UK and Europe;
- Differences between amenity, annoyance and nuisance;
- Efficacy of absolute odour concentration limits and limits based upon concentration exceedance thresholds (the percentile approach);
- The underlying body of available technical evidence from the UK and Europe;
- Criteria established in other countries; and
- Recommendations for the use and application of criteria in odour assessments.

The latest EA odour guidance for permitting¹ does not include a requirement for modelling at regulated sites in preference of observational and risk-based approaches to assessment. Whilst this is appropriate for existing sources of odours, predictive modelling remains a valuable tool for odour assessments for planning, either to assess proposed odour sources which cannot be observed, or for odour sources in England not subject to EA regulation where there is a

well-established practice for use of models, such as wastewater treatment assets.

4.2 CRITERIA DEVELOPED IN THE UK & EUROPE

In 1993, during a Public Inquiry into a planning application, an odour criterion of 5-10 ou/m³, as a 98th percentile of hourly means over a calendar year* was proposed by the applicant and accepted by the Inquiry Inspector. This was based on Dutch odour units which were double the standard European odour unit. The inspector stated, as follows: “*There are no guidelines against which to assess odour emissions. However, the technique (olfactometry) defines a “faint odour” as one lying within the range of 5-10 ou/m³. While a particularly sensitive person could detect an emission level as low as 2 ou/m³, it seems to me that adoption of a level of 5 ou/m³ for the appeal site proposals is both reasonable and cautious*”.¹⁴

This criterion was proposed based upon data from 200 sites in the Netherlands and it is not clear what the original source reference for this is.

The wording of the Inspector’s endorsement is perhaps indicative of the relative novelty of odour assessment at that time, in that it would appear that the concept of the 98th percentile metric has not been appreciated. While it is acknowledged that 5 ou/m³ is designated as a faint odour, it can be the 2% of hourly average odour concentrations above that level that largely determine a population response.

* What this means in simple terms is that an odour concentration of 5 ou/m³ should not be exceeded for more than 2% of the

hours in a year at any sensitive receptor outside the site boundary, equivalent to approximately 175 hours per annum.

This was the first example of odour impacts being discussed at length at a planning appeal. Since this time, there have been a great number of planning appeal case examples where odour impacts were considered and discussed. Whilst some precedent can be made from such decisions, each will have considered odour impacts on an individual case basis. As such, use of historic appeal decisions as evidence or precedent in current odour impact assessments should be applied with caution.

Results of studies and criteria published prior to the publication and wider application of the CEN Standard method (BSEN13725:2003) on olfactometry should also be interpreted cautiously. There is an important difference between the panel olfactory results obtained using the Dutch “pre-standard” and results obtained using current day olfactometric procedures based upon the CEN Standard. Therefore, with the implementation of the European standard on olfactometry, the odour criterion unit has changed to ou_E/m^3 .

In practical terms, the scientific method of determining a relationship between odour concentration, frequency of occurrence and annoyance or nuisance is to carry out an exposure-response study, where the odour emissions from a facility can be quantified, the local population is interviewed, and their reactions to the odour are characterised (such as those described in **Appendix 2**). It is then possible to postulate a relationship between odour exposure (the concentration of odour experienced by a member of the population) and their response to it, in terms of annoyance.

Miedema & Ham¹⁵ carried out an initial exposure-response study, where odours arising from three different types of sources (rapeseed oil production, electrical wire insulation plant and a pig farm) were considered. In this study, exposure was determined by measurement of emissions and use of a dispersion model, calculating the 98th percentile (C98) value of hourly average odour concentrations. This was combined with a questionnaire survey of the

affected populations in the vicinity of the three odour sources, which classified the degree of annoyance felt by the respondent into five categories:

- Not annoying;
- Just not annoying;
- Just annoying;
- Annoying; and
- Very annoying.

A mathematical relationship was then established between the level of odour exposure calculated by the dispersion modelling and the percentage of the interviewed population annoyed. The research concluded the following:

- At a C_{98} of $5 \text{ ou}_E/\text{m}^3$, approximately 10% of the interviewed population was annoyed or very annoyed;
- Differences in the nature of the odours from the three sources had no effect upon the level of annoyance;
- Different responses to the character of odours under previous laboratory test conditions were not replicated in this study, indicating that in the real world, differences between odours may not be important;
- It was concluded that, from the results of the questionnaire survey, every industrial odour was considered by respondents to be out of place in residential areas; and
- To set an odour standard, it was necessary to decide what level of odour is just acceptable.

Subsequent work in this area by Miedema *et al*¹⁶ set out to determine the relationship between odour “pleasantness” and odour annoyance response, using 12 different odour sources. This study identified, using

two separate pleasantness scoring techniques, that there were definite differences in response, in terms of the levels of annoyance felt by respondents between the odours.

Taking all 12 odours into account, a relationship between the percentage of the population “highly annoyed” and the C_{98} value was determined by various mathematical models, with regression coefficients (r^2) of between 0.838 and 0.897 (where 1 is a perfect match).

When the pleasantness scores were incorporated into a model, the regression coefficients increased to between 0.921 to 0.945, at C_{98} odour concentrations from 10 to 59 ou/m³.

The key conclusions were:

- The percentage of the population highly annoyed (%HA) by odours increases as a quadratic function of the log of C_{98} and the rate of increase in %HA was higher for the less pleasant odours; and
- It was therefore concluded that further work was required to more closely define the relationship between odour annoyance and odour pleasantness.

A study of 2,300 residents exposed to odours from pig farms in the Netherlands was reported by Bongers *et al.*¹⁷ in which residents were subdivided into three categories in order to incorporate contextual factors into the odour dose-response relationship. The subdivisions were those living in:

- “Non-concentration areas”, where the number of pig farms was small;
- “Concentration areas”, with no connection with the pig production industry, where the number of long-established pig farms was high; and
- “Concentration areas” with a direct connection with the pig production industry.

In summary, the study found that, perhaps unsurprisingly, the population in non-concentration areas were the most sensitive to odours, whilst those who had an economic connection with the activity were least sensitive.

The findings of this research were subsequently used in the formulation of policy for the control of odours from pig farming in Ireland,¹⁸ where the following odour criteria were proposed, having previously been developed and reported in 2002 Environment Agency Guidance.^{19,20}

- Target value: C_{98} , 1-hour ≤ 1.5 ouE/m³. The target value provides a general level of protection against odour annoyance for the general public, aiming to limit the percentage of people experiencing some form of odour-induced annoyance to 10% or less;
- C_{98} , 1-hour ≤ 3.0 ouE/m³ – Limit value for new pig production units; and
- C_{98} , 1-hour ≤ 6.0 ouE/m³ – Limit value for existing pig production units.

It should be noted that in the UK, a criterion of 3.0 ouE/m³ is typically applied to intensive livestock installations (e.g. pigs, poultry).

4.3 POLLUTION CONTROL REGULATION AND GUIDANCE

The original study outputs were also used to inform the odour guidance for the EPR permitting regime in England and Wales. However, in this case, the above differential criteria were extended to apply as benchmarks for a wide range of odours other than those from pig farming. The means by which this transformation was achieved is reported in an Environment Agency R&D report.¹⁸ This involved the categorisation of the hedonic tones of a range of odours and relating these back to pig farm odours.

The guidance also contained advice to the effect that the indicative criteria could be tightened, depending upon local conditions (such as if the local population has already become desensitised), by reducing the criteria by $0.5 \text{ ou}_E/\text{m}^3$ in each case, although the technical basis for this is not clear. Whilst not explicitly mentioned in the document, it would appear that the criteria could also be relaxed, depending on local conditions. These criteria were then carried forward into the EA's Science Report.²¹ It is useful to note that the C_{98} , 1-hour benchmark concentrations were described as Indicative Odour Exposure Standards, to be used as defaults where no sector- or site-specific dose response relationships had been carried out to provide more specific benchmarks. In SEPA's 2025 odour guidance² they are referred to as "indicative" criteria. However, in the final version of the EA's H4 odour guidance⁷ (now withdrawn), the "indicative" label was not used, and the criteria were simply referred to as Benchmark Levels to help inform a judgement of unacceptable pollution.

The annoyance potential of an unpleasant odour at a given concentration will, in most cases, be higher than that for neutral or pleasant odours. Practitioners therefore may wish to consider specific characteristics (e.g. hedonic tone and sensitivity of the population) when determining an appropriate odour impact benchmark.

4.4 WATER INDUSTRY GUIDANCE

Several water companies have set their own assessment benchmarks and provided guidance on odour assessment for their assets. These have usually either adopted the 1.5 or $3.0 \text{ ou}_E/\text{m}^3$ standard. Their guidance also often sets specific requirements for modelling, including the need for on-site odour audits and field odour surveys.

Practitioners should liaise with the appropriate water company to ensure that its requirements have been considered when completing an odour assessment, as well as the most appropriate up-to-date science.

Table 4.1 – Example 98th percentile odour benchmarks and offensiveness

Criterion, $C_{98} \text{ ou}_E/\text{m}^3$	Offensiveness	Odour Emission Sources
1.5	Most Offensive	Processes involving decaying animal or fish remains Processes involving septic effluent or sludge Biological landfill odours
3.0	Moderately Offensive	Intensive livestock rearing Fat frying (food processing) Sugar beet processing Well-aerated green waste composting
6.0	Less Offensive	Brewery Confectionery Coffee
* In the context of offensiveness, 'most', 'moderately' and 'less' do not refer to the number of occurrences of an offensive odour but rather the combined effect of all the FIDOL factors in terms of offence to the senses.		

4.5 RECOMMENDED ODOUR ASSESSMENT CRITERIA FOR PLANNING

Odour assessment methodology, as it has developed in Europe and UK over the last 40 years, has become well-established. The predictive, quantitative approach involves obtaining estimates of the odour source emission rate, use of the emissions in a dispersion model to predict 98th percentile of 1-hour mean concentrations at sensitive receptors, and comparison of these with criteria that have evolved from research and survey work. At the present time, this remains an accepted technique and the IAQM supports this.

What is not entirely clear from the scientific data is the level at which the odour concentration should be set, and whether different concentrations should be set for different odours and in different settings. In addition, it appears that the C_{98} metric is predicated on the basis of a constant odour emission, whereas many odour emissions are intermittent or only occur for certain periods within a calendar year. In this case,

the situation can arise where, over the year, a C_{98} concentration of, say, $3 \text{ ou}_E/\text{m}^3$ may be complied with but, over the period for which the odour is emitted, it may be exceeded.

The body of research that supports the adoption of numerical odour assessment criteria is incomplete, in that appropriate and reliable dose-response survey work has not been carried out in the UK and the criteria that have been used by practitioners have been derived from source-specific work carried out on a limited range of odour-emitting processes, notably in the Netherlands, using older-generation dispersion models.

In the absence of comprehensive dose-response information to allow the derivation of exact C_{98} concentration metrics for different types of odour, the IAQM is of the opinion that the Air Quality Practitioner should observe, from the various scientific studies, case law and practical examples of the investigation of odour annoyance cases. In any specific case, an appropriate criterion could lie somewhere in the range of 1 to $10 \text{ ou}_E/\text{m}^3$ as a 98th percentile of hourly mean odour concentrations.

In deciding upon what constitutes an appropriate criterion, account should be taken of the underlying exposure-response studies that have led to the EA recommended indicative criteria and more recent research work from Germany.

Due regard should be given to the offensiveness (i.e. hedonic tone) of the odour produced by the facility and that the use of the type of industry (for example 'Brewery' as in EA¹⁹ and SEPA² guidance) may be unhelpful as an industrial source may emit a wide range of odours.

Taking into account the available scientific evidence and the collective experience of IAQM members involved in drafting this guidance (and previous versions), the odour concentration change descriptors together with impact descriptors in **Table 4.2** are proposed for an odour at the offensive end of the spectrum. These adopt the C_{98} as the appropriate

frequency metric, encompass the 1 to $10 \text{ ou}_E/\text{m}^3$ concentration range referred to above, and also take into account the potential sensitivity of different receptors. It is also consistent in format and concept with other guidance in the air quality field. Examples of receptors that fall into the above sensitivity categories are contained in **Table 4.1**.

For odours that are less unpleasant, the level of odour exposure required to elicit the same effect may be somewhat higher, requiring professional judgement to be applied. For example, odours from a sewage treatment works plant operating normally, i.e. non-septic conditions, would not be expected to be at the 'most offensive' end of the spectrum (**Table 4.2**) and can be considered on par with 'moderately offensive' odours such as intensive livestock rearing. **Table 4.3** shows the impact descriptors proposed for a 'moderately offensive' odour.

It is incumbent on the responsible Air Quality Practitioner to exercise good professional judgement in selecting an appropriate odour assessment criterion for any particular case and provide justification for that selection. Practitioners are also recommended to exercise such judgement in appreciating other factors which govern human responses to odour. It is not simply the presence of odours that govern the responses of individual population members to malodour, but many other socio-psychological factors,²² including the existence of health conditions, beliefs regarding the alleged harmfulness of the odorants, individual coping behaviours, other demographic and social factors, and the variation in the sensitivity of sense of smell in the general population.

This could result in the application of odour exposure criteria that may appear, on the basis of the studies carried out to date, to be erroneous. Such a case has occurred, as reported in a Defra publication²³ (see Case Study Box 4, pp. 24-25). Here, a concerted and comprehensive odour emission sampling and modelling campaign revealed C_{98} concentrations well below the most stringent $1.5 \text{ ou}_E/\text{m}^3$ criterion, but

regardless, up to 50 odour-related complaints arose per day. Similarly, another study found numerical

odour criteria did not predict complaints around sewage works.²⁴

Table 4.2 – Proposed odour effect descriptors for impacts predicted by modelling – “Most Offensive” odours

Odour Exposure Level $C_{98}, ou_E/m^3$	Receptor Sensitivity		
	Low	Medium	High
≥ 10	Moderate Adverse	Substantial Adverse	Substantial Adverse
$5 - < 10$	Moderate Adverse	Moderate Adverse	Substantial Adverse
$3 - < 5$	Slight Adverse	Moderate Adverse	Moderate Adverse
$1.5 - < 3$	Negligible	Slight Adverse	Moderate Adverse
$0.5 - < 1.5$	Negligible	Negligible	Slight Adverse
< 0.5	Negligible	Negligible	Negligible

It should be noted that the Table applies equally to cases where there are decreases in odour exposure as a result of the development, in which case “adverse” would be replaced by “beneficial”.

Table 4.3 – Proposed odour effect descriptors for impacts predicted by modelling – “Moderately Offensive” odours

Odour Exposure Level C_{98} , ou_E/m^3	Receptor Sensitivity		
	Low	Medium	High
≥ 10	Moderate Adverse	Substantial Adverse	Substantial Adverse
5-<10	Slight Adverse	Moderate Adverse	Moderate Adverse
3-<5	Negligible	Slight Adverse	Moderate Adverse
1.5-<3	Negligible	Negligible	Slight Adverse
<1.5	Negligible	Negligible	Negligible

It should be noted that the Table applies equally to cases where there are decreases in odour exposure as a result of the development, in which case “adverse” would be replaced by “beneficial”.

5. DRAWING CONCLUSIONS FROM ASSESSMENT RESULTS

The conclusion on the overall significance of likely odour effects should involve the Practitioner drawing together the findings of several odour assessment tools, having explained and considered their own inherent strengths, limitations and uncertainties.* This “weight-of-evidence” approach differs from conventional air quality assessments, where the conclusion is usually based on the results of one (or a couple at most) assessment tools to which considerable precision and accuracy (i.e. certainty) is ascribed.

When coming to a well-reasoned and balanced conclusion on overall odour impact, the Practitioner also needs to apply appropriate weight to the results provided by each tool according to how well suited it is to the study scenario in question. This should include the Practitioner:

- Describing the assumptions, limitations and uncertainties of the assessment tools;
- Explaining how these may impact on the conclusions; and
- Justifying their conclusions in light of any assumptions, limitations or uncertainty.

For instance, where the assessment is of an existing activity or process, empirical observations of what is happening on the ground may be possible: considerable weight may be given to the observational findings of community-based tools (complaints analysis, community surveys and odour

diaries) and sensory assessments (such as sniff tests), should the quality of the tools be sufficient to justify the weight. These may be supported by the results of dispersion modelling (or perhaps ambient air monitoring for specific compounds) if these add tangible value to the study, e.g. if they provide wider spatial or temporal coverage than observations alone.

However, it should be emphasised that the results from a model should not be used to try to “prove” the absence of an existing adverse odour effect (e.g. nuisance) when strong empirical evidence from complaints analysis, community response data, and sensory tests (by appropriately trained persons) show otherwise. To do so would be to mistake the model for the reality of the situation, rather than a simplified version of it.

* This is assessment uncertainty in a wider sense than just the modelling or monitoring uncertainty. For example, a monitoring method may have excellent precision and accuracy, but if only a few measurements are carried out then the temporal and spatial

uncertainties will probably be considerable. This may be good enough for what is required, but it needs to be recognised when using professional judgement to arrive at the conclusion on effects.



Solid floor cattle housing.

6. ODOUR MANAGEMENT PLANS

6.1 THE ODOUR MANAGEMENT PLAN AS A CONTROL MEASURE

The preceding sections have concentrated on assessing the odour impact. However, for many new developments that themselves are a potential source of odours, there is a need to develop Odour Management Plans (OMPs) to ensure that odours are effectively managed and controlled. OMPs may be developed before an Environmental Permit is granted, or conditioned by Local Authorities. Some control measures are best suited to point sources and others best suited to fugitive sources; OMPs can be relevant to both. They are an essential tool for controlling odour at sites dominated by fugitive emissions. However, they can also complement engineered control measures such as abatement systems* on sites with point-source emissions, where there is a significant risk of impacts associated with plant or process failure, and external factors outside of the control of the operator.¹

OMPs are recommended in a number of official guidance documents (see **Section 6.3**), but these share no common definition and they show some differences on what OMPs should contain. Notwithstanding these differences, there is general agreement on what an OMP is and its main purpose, as summarised in **Box 6.1**.

6.2 OMPs AND PLANNING

Following the granting of planning consent, some potentially odorous new developments may be

Box 6.1 – What is an Odour Management Plan?

- An OMP is a live working document that formalises and describes how odour issues will be managed on site. An OMP forms part of the operational management system (indeed it may form part of a site's wider Environmental Management System or Integrated Management System).
- An OMP should show how odours will be managed and controlled to prevent or minimise impact. As well as covering normal operations, it should anticipate and plan for abnormal events and foreseeable accidents and incidents.
- It is *not* an impact assessment; it is a mitigation/control measure.
- It should not be complex; simple plans are needed that can be easily actioned by the site operatives.

required to operate under an Environmental Permit, whereby ongoing pollution control of many (though not always all) of the operations will be regulated by environmental regulatory bodies or the Local Authority. In such cases, planning authorities should work on the assumption that such pollution control regimes will operate effectively. However, it should be recognised that some residual odour is likely to remain, and there may be situations where associated effects would make a development an unsuitable use of land at its proposed location. For sites that will be subject to an Environmental Permit, it is necessary for the planning authority to consider at the planning stage whether the proposed development at the site will be a suitable use of the land – in particular, with

* This guidance document does not provide advice on engineered control measures and abatement systems and the reader should refer to other guidance on that subject.

regard to the likely effects of odour on nearby sensitive users. If an OMP is being proposed as the means of control to make the residual impact acceptable for users of the surrounding land, then the planning authority will expect the submitted OMP to meet the standards of current good practice. These standards are summarised in the following sections.

6.3 GUIDANCE ON OMPs

OMP's are described in several existing guidance documents, such as:

- The EA technical guidance, *Odour management: comply with your environmental permit (2025)*²⁵;
- The SEPA *Odour Guidance (2025)*²; and
- Scotland & Northern Ireland Forum for Environmental Research (Sniffer)'s *Odour Monitoring and Control on Landfill Sites (2013)*.²⁶

It should be noted that the above documents vary in what they require from an OMP, i.e. no single guidance document covers all the aspects that the other documents consider good practice.

Furthermore, none of the documents are aimed at planners needing to decide whether proposed control measures are likely to make the residual impact acceptable for users of the surrounding land. The IAQM has therefore brought together the

requirements from the different guidance documents to help planning authorities have confidence that OMP's submitted for planning purposes meet the standards of current good practice.

6.4 RECOMMENDED CONTENT OF OMPs FOR PLANNING PURPOSES

An OMP should follow basic management system principles:

- **Plan** – identify potential releases (normal and abnormal conditions) and document the specific control measures for each;
- **Do** – apply the specific control measures (routine and additional);
- **Check** – verify if the measures are working well enough; and
- **Act** – review and revise to keep effective.

This is an iterative process which, if followed properly, should be self-regulating and should require little detailed intervention from outside. It requires the operator to take the appropriate action to bring any problems under control or else modify or suspend operations. Therefore, if there's an odour problem, this should be picked up by checks (through monitoring, complaints system, etc.) and the control processes should be reviewed and tightened to deliver the objective, which is no significant odour impact off-site.

Figure 6.1 - Plan, do, check, act framework

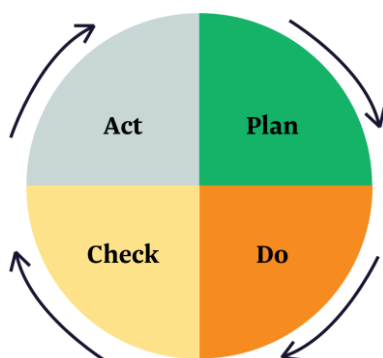


Table 6.1 summarises the recommended content of an OMP for planning purposes. As this has been consolidated from the requirements of existing guidance documents from the environment agencies, an OMP covering the areas described in this table should also meet the basic requirements of the various pollution regulatory control regimes as they stand at the time of writing. Further detailed advice on how to address each of these points in the OMP can be found in the aforementioned guidance documents.

When developing OMPs, it is often appropriate to give considerable attention to inventory (including feedstock) and process controls. This approach is particularly important for waste sites where loss of these controls can result in pollution which cannot be effectively mitigated by dispersion or abatement.

It is also good practice for commitments rather than expressions of intent to be made. For example, 'we will clear waste from the reception area at the end of each day' is a commitment, whereas 'we will aim to minimise the holding time of waste in the reception area' is an unenforceable and non-specific expression of intent.

6.5 RECOMMENDED LEVEL OF OMP DETAIL FOR PLANNING

For planning purposes, the IAQM fully supports the stance that an OMP should be risk-based with the

level of depth, complexity and sophistication being dependent on both the complexity of the activity to be carried out at the proposed development, and the potential impact of the odour on neighbouring premises. Where a proposed development has the potential to produce particularly offensive odours, the OMP will need to be detailed and thorough. Conversely, for a process with a lower potential odour impact, a simpler OMP will usually suffice. It should be stressed that an OMP is merely a wrapper document for the management procedures and specific mitigation/control measures it contains. The OMP will only be of benefit if the underlying mitigation and control measures are robust and effective, and can be easily implemented and maintained at the site.

It is recognised that at the planning application stage, some of the detailed design features of the proposed development scheme may not yet be available. This could mean that all the areas recommended in **Table 6.1** cannot be described in the OMP in the level of detail likely to be eventually required in order to ensure the required level of control. This should not be a significant problem for developments that once operational will be subject to ongoing pollution regulatory control (e.g. under the Environmental Permitting Regulations), as planning authorities should work on the assumption that such pollution control regimes will operate effectively. For proposed developments that will not be subject to such ongoing pollution regulatory control, the planning authority may decide to make a pre-commencement planning condition requiring the fully detailed OMP to be submitted for approval before operations begin. Use of planning conditions to secure an OMP should not prevent or preclude production of an outline or framework OMP as part of the planning application process to support the odour assessment and decision-making processes for such developments.

Table 6.1 – Recommended content of an OMP for planning purposes**Essential site details**

A process description, particularly describing odorous, or potentially odorous, activities or materials used (inventory).

Identification of all potential release points to air for each of the activities (plan/map).

Identification of the sensitive receptors within the area of influence that could be impacted (plan/map).

A description of the prevailing meteorological conditions at the site, especially wind direction. A wind rose (from a nearby representative meteorological station or from site sensors if installed) is an ideal format.

Routine controls under normal conditions

A description of the *routine* mitigation/control measures that would be used day-to-day under normal operating conditions in the absence of any unusual risk factors. Examples of routine control measures include receipt, inspection, acceptance/rejection of materials, storage, containment, handling, treatment and timing of activities. It may also include regular sniff testing for sites of higher risk.

A detailed list of the controls/actions and who is responsible for carrying them out.

Reasonably foreseeable abnormal conditions and additional controls

Identification of possible risk factors (e.g. adverse weather conditions) and anticipation of reasonably foreseeable odour-related incidents and accidents (e.g. abnormal situations, spillages, power failure, breakdown of doors, equipment or abatement) and an explanation of the consequences of the risk factors with respect to odour emissions and potential impacts.

A description of the *additional* measures (e.g. additional control measures and modifications to site operations, such as diverting odorous waste loads to facilities with less sensitive surroundings during adverse weather conditions) that will be applied during these periods to deal with the risks and any reasonably foreseeable incidents and accidents. It should be stated that if any of the measures are shown not to be sufficient, they will need to be tightened further, or there may be the requirement for odorous operations to reduce or cease.

A detailed list of the actions and who is responsible for carrying them out.

Triggers for additional controls and checks on effectiveness

A description of what would trigger further action/additional measures, such as:

- The results of planned routine checks/inspections/surveys on site;
- The results of on-site measurements of process parameters and surrogate measurements for odour (e.g. pH, temperature, oxygen, etc) exceeding defined trigger levels;
- Other metrics, such as particular meteorological conditions (e.g. temperature above a certain value, wind blowing in a particular direction, or calms); and
- Odour monitoring on and/or off-site, including:
 - Odour complaints monitoring (which should be carried out for all sites);
 - Monitoring carried out on-site, showing non-compliance with any emission limit values (ELVs) set for controlled point source releases; and
 - Monitoring carried out off-site (e.g. by sniff testing, odour diary surveys, etc.), showing non-compliance with any action levels for ambient odour levels.

Management good practice

Details of how the following will be carried out, and who has been assigned managerial and operational responsibilities for them:

- Implementing and maintaining the OMP;
- Responding to odour-related incidents and any elevated odour levels from the aforementioned checks/inspections/surveys, monitoring, or on receipt of complaints of odour. Details of the procedures for carrying out investigations and taking appropriate remedial action to prevent recurrence, as well as the associated persons responsible, should also be provided;
- Planned maintenance and repair and the keeping of essential odour-critical spares;
- Regular review (at least once per year) of the effectiveness of odour controls, including the OMP itself. This should take account of complaints, monitoring results, inspections, surveys and any other information and feedback received. This interval may be shorter if there have been complaints or relevant changes to your operations or infrastructure;
- Engaging with neighbours and communicating with relevant interested parties (e.g. local community and local authority) to provide necessary information and minimise concerns and complaints, including methods used, content and frequency of communication; and
- Keeping records of all activities and actions relating to odour and the OMP.

APPENDIX 1 – PREDICTIVE ASSESSMENT TOOLS

A1.1 OVERVIEW OF PREDICTIVE ODOUR ASSESSMENT TOOLS

Defra's *Green Leaves III* guidance²³ provides generic guidelines for the assessment and management of environmental risks. The Source-Pathway-Receptor (S-P-R) concept presents the hypothetical relationship between the source (S) of the odour, the pathway (P) by which exposure might occur, and the receptor (R) that could be adversely affected.

We can predict, using the S-P-R concept, the ambient odour exposure at ground-level local receptors. We need estimates (measurements or approximations) of emissions of odour from the source (e.g. heap, stockpile, tank, vent, chimney, etc.) and a technique to forecast how the odour will disperse and dilute in the air and what the resultant ambient odour exposure is likely to be at ground level at the local receptors. These predictive techniques vary in their sophistication, cost and in how quantitative the predictions will be. They include:

- Qualitative, risk-based odour assessments;
- Simplified modelling, such as screening models, look-up tables and nomographs; and
- Fully quantitative atmospheric dispersion modelling.

None of these assessment tools forecast disamenity, annoyance or nuisance effects directly. They allow odour impact (the exposure) to be estimated, but the magnitude of the odour *effect* experienced by the receptors needs to be gauged as described in Section 2.2.

A1.1.1 Qualitative risk-based assessments

A1.1.1.1 Basis of qualitative risk-based odour assessments

Some qualitative assessments of effects rely solely on subjective judgement, or comparison with a consensus view for a particular scenario. These are not covered by this guidance: here, we are concerned with qualitative assessments that make a prediction informed by risk.

The basic concept of risk assessment is that the overall risk depends on the probability* of the event together with the likely consequence if that event were to transpire. For odour assessments (and indeed environmental assessments in general) the probability can be considered to be the likelihood of exposure (impact), and the consequence considered to be the effect on the receptor if that exposure (impact) took place. These two facets are neatly pulled together by the S-P-R concept.

Behind the S-P-R concept is the fundamental relationship:

$$\text{Effect} \approx \text{Dose} \times \text{Response}$$

In the specific case of odour assessments, the dose can be considered equivalent[†] to the odour exposure; or in other words, the impact (another way of thinking about the exposure is that it is the amount, pattern and character of odour that is available for perception by an individual). The impact will be determined by FIDO of the

* Qualitative risk-based odour assessments look at the probability (i.e. the likelihood or chance) of an impact occurring at a location and the likely magnitude of the effect resulting from the exposure; they do not predict with certainty that any given impact/exposure will occur

at a particular time (this feature they share with quantitative modelling assessments).

[†] This simplification is valid for odour; but does not apply to toxic chemicals, where exposure and dose are different (with dose being the amount of substance actually absorbed into the body).

FIDOL factors. The effect is the result of the changes at specific receptors (people, in the case of odour) taking into account their sensitivities (i.e. responsiveness to odour); the L (location) in FIDOL is to categorise the sensitivity.

A1.1.1.2 Main applications of qualitative odour assessments

A qualitative risk-based approach is appropriate for:

- a) Screening of odour impacts;
- b) Development proposals likely to have a low risk of adverse effects;
- c) Situations where there is insufficient information to carry out detailed predictive dispersion modelling;
- d) Situations where the information has wide uncertainties and its use as input to a detailed predictive dispersion model would be at best a waste of time, money and effort, or, at worst, would lead to an illusory and false impression of accuracy and precision in the numbers generated; and
- e) When the model is not able to properly represent the reality of the situation being assessed, e.g. if the odour effects are likely to be significantly influenced by accidental, unexpected or unknown releases. In such instances, a qualitative estimate may be more appropriate, on the basis that it is better to be broadly correct than precisely wrong.

Many (though not all) fugitive/diffuse sources fall into the last three categories, and it may not be practicable to model these because reliable quantitative emissions data are often not available.

There is a need, therefore, to carry out qualitative odour assessments. There are some existing published methods for certain specific applications:

- **Anglian Water Odour Risk Assessment.** Anglian Water has adopted a risk-based assessment approach that includes a useful screening tool to assess the risks of odour from their operational sites affecting nearby locations proposed for residential use. This uses the capacity of the works, expressed as the population serviced, and the distance of proposed development from their sites to determine zones of potential risks (low, medium and high).²⁷ This is a simple screening tool, and where a potential risk is identified, a more detailed assessment would be required using dispersion modelling.
- **Odour impacts of commercial kitchens, restaurants and food premises.** Non-statutory guidance was provided by Defra⁵ for estimating the odour risk, taking into account the stack/exhaust height, the size of the kitchen (i.e. number of covers), the type of kitchen, and proximity to sensitive receptors. This guidance was withdrawn in 2017, but an updated version known as the EMAQ+ guidance was prepared by one of the original authors in 2022 and is now widely applied.⁶

For other general applications, there is no standard method for qualitative risk-based odour assessment. The IAQM recommends that such assessments are based clearly on the S-P-R concept, taking into account the odour potential of the emission source, the prevailing wind direction relative to the locations and distances of the proposed residential receptors, and their sensitivity to the type of odour in question. The IAQM considers the following example approach, which explicitly demonstrates the source-pathway-receptor relationship and provides a suitable framework* for assessments for planning purposes.

* This qualitative odour assessment framework follows the same principles as the method used for fugitive dust in other guidance published by the IAQM, *Assessment of dust from demolition and construction*, 2023.

The underlying Source-Pathway-Receptor conceptual approach to a qualitative odour assessment will be applicable to virtually all scenarios, but the “calibration” of the effect predicted from the factors may require modification for some scenarios.

Table A1.1 – Risk factors for odour source and pathway effectiveness

Source Odour Potential				
Parameter	Small source odour potential  Very large source odour potential			
Magnitude of odour emissions	Odour emissions <2,000 OU _E /s	Odour emissions 2,000-10,000 OU _E /s	Odour emissions 10,000-50,000 OU _E /s	Odour emissions >50,000 OU _E /s
	It may often be the case that the magnitude of odour emissions for a particular site is not known. Practitioners may be able to estimate these using previous published assessments and other published odour emissions inventories, databases and resources, but should demonstrate working and judgement in the reporting process.			
Odour control	All odour sources treated with odour control	Main odour sources treated with odour control	No or limited odour control on main sources	No odour controls
	Best practice odour management procedures		Good practice odour management procedures	No odour management procedures
Odour containment	All odorous sources and processes contained within well-sealed buildings or structures.	Main odorous processes and sources contained within well-sealed buildings or structures	Some odour sources and processes contained, or containment in structures with open/slatted sides	No odorous sources and processes contained
	Consideration of odour controls and containment should lead to a judgement on the residual odours after control and containment which will determine the appropriate source odour potential. For example, contained sources which have centralised ventilation with an odour control unit will be of much lower source odour potential than containment in buildings with open/slatted sidewalls and no odour control.			
Material handling	Small throughput of odorous material. No material movement or disturbance. Odorous material stored on site for short periods	Moderate throughput of odorous material. Limited material movement or disturbance. Odorous material stored on site for short periods	Large throughput of odorous material. Frequent material movement or disturbance. Odorous material stored on site for long periods	Very large throughput of odorous material. Continuous or prolonged periods of material movement or disturbance. Odorous material stored on site for long periods

Process activities	The assessment of source odour potential should consider specific activities associated with the odour source and their effect on odour releases. This might include, for example, consideration to the frequency of odour releases for sources that are not continuous.			
Occasional events	The assessment of source odour potential should consider any occasional events or activities which may result in elevated odour releases which may increase the source odour potential of an odour source (e.g. cleanout of a livestock unit between rearing cycles, storm overflow of wastewater, etc.).			
Odour character/offensiveness (hedonic tone)	The character (i.e. offensiveness) of the odour can be considered in defining the source odour potential. For example, it may be appropriate to reduce the overall source odour potential for sources with low or positive hedonic scores, provided this is appropriately justified.			
Pathway Effectiveness				
Parameter	Ineffective pathway  Extremely effective pathway			
Distance from source	Receptors remote from source. >400 m from source of odours	Receptors moderately displaced from source. Typically 200–400 m from source of odours	Receptors local to source. Typically 20–200 m from source of odours	Receptors immediately adjacent to source. <20 m from source of odours
Relationship to release Type of release	High-level vertically directed release		Mixture of high- and low-level releases	Low-level releases and fugitive releases
	Main odour releases at high level		Main odour releases at low level	
	Unimpeded stack or flue, high temperature/high velocity release		Capped or cowled flue/release point, low temperature/low velocity release	
	High-level release with low level receptors	Receptor heights/position similar to the odour releases		Receptor height/position adjacent to odour releases

Direction to source Prevailing weather conditions	Low frequency of winds from source to receptor (typically <3%)	Moderate frequency of winds from source to receptor (typically 3–10%). Sustained periods in which receptor is downwind of source	High frequency of winds from source to receptor (typically 10–20%). Receptor regularly downwind of source at times when peak odours likely to occur	Very high frequency of winds from source to receptor (typically >20%)
	It is good practice, when considering prevailing weather and wind frequencies, to not only consider the frequency with which a receptor is downwind of the source, but also consider the nature of these occurrences (e.g. isolated hours versus prolonged periods downwind) and how occurrences relate to the relative odour emissions (e.g. considering seasonal trends), including taking account of potential exposure during calm conditions. Where a source has a wide geography and a receptor may be downwind across a range of wind sectors, the relationship between each sector and specific odour sources/distances should also be considered. Analysis should ideally be undertaken with five years of meteorological data in line with good practice for dispersion modelling.			
	Strong breeze or windier (>11 m/s)*	Moderate breeze to fresh breeze (6–11 m/s)*	Light air to gentle breeze (1–5 m/s)*	Calm (<1 m/s)*
Dispersion environment	*The guidance on wind speeds above relates to the fact that higher wind speeds have higher turbulence and disperse odours more effectively than at low wind speeds and calm conditions. However, stronger winds are also capable of transporting odours over greater distances. It is therefore important to consider the relationship between source, receptor and wind speed, as, for example, distant receptors from a large odour source might be greater effected at higher wind speeds than low wind speeds. It is thus good practice for practitioners to consider the relationship of downwind receptor distances to prevailing wind direction. It is also important to consider the effect of wind speed in relation to the nature of the release as low level and elevated releases may be affected differently.			
	It may be appropriate to take account of local factors affecting the dispersion, dilution and transport of odours from source to receptor. Such factors may include the presence of building massing increasing pathway length, building wake effects in the proximity to elevated releases, slopes and local topography, or other features. The influence of any such factors on the effectiveness of the odour pathway should be appropriately justified.			
	In determining appropriate pathway effectiveness, practitioners should consider the use of simplified dispersion modelling as a tool to assist with the overall judgement. Simplified modelling involves basic input parameters, simplified source terms and (often) assumed or estimated odour emission rates.			

The first step in the assessment is to estimate the odour- generating potential of the site activities, termed the “Source Odour Potential”, which takes into account two primary factors:

- i. The scale (magnitude) of the release from the odour source, taking into account the effectiveness of any odour control or mitigation measures that are already in place. This involves judging the relative size of the release rate* after mitigation and taking account of any pattern of release (e.g. intermittency). At this stage, reference should be made to published information/databases of odour emission rates for the processes being considered to inform the decision; and
- ii. The relative pleasantness/unpleasantness† of the odour. Lists of relative pleasantness of different substances are published by the EA²¹ and in more detail in the SEPA document *Odour Guidance 2025*.² However, it should be noted that even pleasant odours can result in unacceptable odour conditions and the relative offensiveness of an odour can depend on its concentration.

Using the guidance in **Table A1.1**, the Source Odour Potential can be categorised as small, medium, large or very large.

Next, the effectiveness of the pollutant pathway as the transport mechanism for odour through the air to the receptor, versus the dilution/dispersion in the atmosphere, needs to be estimated. Any factor that increases dilution and dispersion of the odorous pollutant plume as it travels from source (e.g. processes and plant) to receptor will reduce the

concentration at the receptor, and hence reduce exposure. Important factors to consider here are:

- i. The distance of sensitive receptors from the odour source;
- ii. Odour episodes often tend to occur during stable atmospheric conditions with low wind speed, which gives poor dispersion and dilution. Receptors close to the source in *all* directions around it can be affected under these conditions. When conditions are not calm, it will be the downwind receptors that are affected. Overall, therefore, receptors that are downwind with respect to the prevailing wind direction tend to be at higher risk of odour impact, but it should be recognised that adverse odour conditions can result (even with relatively infrequent exposures and dispersion modelling) in a more effective method of identifying which areas are at greater risk than simple examination of wind direction frequencies;
- iii. The effectiveness of the point of release in promoting good dispersion, e.g. releasing the emissions from a high stack will – all other things being equal – reduce the pathway effectiveness owing to improved dilution and dispersion; and
- iv. The topography and terrain between the source and the receptor. The presence of topographical features such as hills and valleys, trees/woodland, or urban terrain features such as buildings, can affect air flow and therefore increase or inhibit dispersion and dilution.

* It is unlikely that actual odour release rates (in units of ou_E/s) will be available if a qualitative assessment is being carried out.

† This can be measured in the laboratory as the hedonic tone, and when measured by the standard method and expressed on a standard nine-point scale it is termed the ‘hedonic score’.

Using the risk factors in **Table A1.1**, the pollutant pathway from source to receptor can be categorised as ineffective, moderately effective, highly effective or extremely effective.

It is not intended that any single factor in **Table A1.1** is used in isolation to define the source odour potential or pathway effectiveness. Rather, factors may be considered which slide the relative source odour potential up and down the scale and then should be defined using the descriptors in **Table A1.2**.

Practitioners should use professional judgement to apply weight to the various factors within any specific application to arrive at a reasoned conclusion as to the source odour potential for each relevant odour source, and pathway effectiveness for each receptor. Where there is substantial debate regarding the source odour potential or pathway effectiveness, it may be appropriate to assign more than one category and provide a range of impacts as a sensitivity test. In reporting, the assessor should

include clear explanation, rationale and justification for the determination of source odour potential and pathway effectiveness. Examples are provided in **Table A1.4** and **Table A1.5**.

In the third step, the estimates of Source Odour Potential and the Pathway Effectiveness are considered together to evaluate the risk of odour exposure (impact) at the receptor location, as shown by the matrix in **Table A1.2**.

The next step is to estimate the effect of that odour impact on the exposed receptor, taking into account its sensitivity (see **Table 2.1** for guidance on receptor sensitivity), as shown by the matrix in **Table A1.3**. The odour effects may range from negligible, through slight adverse and moderate adverse, up to substantial adverse.

Table A1.2 - Risk of odour exposure (impact) at the specific receptor location

	Source Odour Potential			
Pathway Effectiveness	Small	Medium	Large	Very Large
Extremely effective pathway	Medium Risk	High Risk	High Risk	High Risk
Highly effective pathway	Low Risk	Medium Risk	High Risk	High Risk
Moderately effective pathway	Negligible Risk	Low Risk	Medium Risk	Medium Risk
Ineffective pathway	Negligible Risk	Negligible Risk	Negligible Risk	Low Risk

Table A1.3 Likely magnitude of odour effect at the specific receptor location

	Receptor Sensitivity		
Risk of Odour Exposure	Low	Medium	High
High Risk of Odour Exposure	Slight Adverse	Moderate Adverse	Substantial Adverse
Medium Risk of Odour Exposure	Negligible	Slight Adverse	Moderate Adverse
Low Risk of Odour Exposure	Negligible	Negligible	Slight Adverse
Negligible Risk of Odour	Negligible	Negligible	Negligible

This procedure results in a prediction of the likely odour effect at each sensitive receptor. Often, there will be numerous receptors around the odour source, and whilst a single source odour potential is likely to be applicable to most sources, it is likely that each individual receptor will require a judgement on pathway effectiveness.

It is important for practitioners to carefully report justification, reasoning and judgement in assessments to explain how the relevant source odour potential, pathway effectiveness, receptor sensitivity and resultant odour effects have been determined. This requires the competent and suitably experienced Air Quality Practitioner to apply professional judgement. Table A1.4 and Table A1.5 provide examples of such

evidence and judgement in relation to source odour potential (Table A1.4) and pathway effectiveness (Table A1.5). The examples in Table A1.4 and Table A1.5 are provided as worked examples and should not be used to justify a judgement around any other specific assessment or project.

Where possible, it is recommended to supplement an odour risk assessment with other assessment tools (see Section 3). Where odours are determined as having a potentially moderate or substantial adverse effect (for example where highly sensitive receptors are within 400 m of a large or very large odour source), a more detailed assessment would normally be expected.

Table A1.4 – Example summary explanation for assessment of source odour potential

Parameter	Example 1: Sewage treatment works serving population equivalent of 10,000	Example 2: Poultry farm with 400,000 broilers	Example 3: Fish and chip takeaway
Magnitude of odour emissions	Approximate odour emission rate 5,000-10,000 OU _E /s.	Approximate peak emissions >50,000 OU _E /s, but early in rearing cycle and in lower temperatures, much lower odour emissions likely.	Odour emissions likely to be <1,000 OU _E /s.
Odour control	Inlet works and sludge processing treated with well-maintained odour control units discharged through 15 m stack.	No odour control technology, but operates in accordance with OMP.	Kitchen extraction system fitted with baffle grease filters and electrostatic precipitator plus carbon filtration and discharged through high level flue.
Odour containment	Open settlement tanks, storm tanks and aeration lanes. Inlet and sludge processing contained in building.	All poultry housed in sheds. Poultry sheds ventilated with high velocity roof fans. Discharges vertically 6 m above ground.	n/a
Material handling	Works serves relatively small population equivalent of 10,000. Wastewater processed in <24 hours under dry weather flow.	Approx. 1,000 m ³ of poultry litter removed from site per annum.	n/a
Process activities	Ferric dosing on primary settlement reduces odour potential of primary process.	Cyclic activity results in changing emission profile with time.	Busiest periods early evenings.

Occasional events	Storm events lead to use of on-site storm tanks, with water pumped to inlet works once inflows reduce.	Rearing cycle circa. 36 days followed by cleanout and 10-day empty period. Total seven cycles per year. Odours heightened during shed clean out (approx. 2-3 hours).	n/a
Odour character/offensiveness (hedonic tone)	Moderately offensive odours as more offensive processes (inlet and sludge processing) are treated with odour control unit (OCU).	Moderately offensive odours.	Grease/cooking odours. Relatively low hedonic score (-1.41 ref SEPA 2010).
Overall Source Odour Potential	Medium – estimated odour emissions magnitude moderate. OCU and ferric dosing reduce offensiveness of the most odorous processes. Modern, well run sewage treatment works.	Large – large intensive livestock farm. Odour emissions magnitude changes through rearing cycle and seasons depending on bird size and ambient temperatures. Peak emissions likely to be very large, but typical odour emissions much lower. EA regulated so operates in accordance with OMP.	Small – small commercial takeaway operating with odour control system in place. Odours of relatively low offensiveness.

Table A1.5 Example summary explanation for assessment of pathway effectiveness

Receptor	Description	Pathway effectiveness
1 – Church House	Receptor 50 m from source boundary. Receptor and odour sources at ground level. Undeveloped open ground between source and receptor. Prevailing weather conditions from source towards receptor. Historic meteorological data shows frequent calm/stable conditions, during which odours have potential to affect the receptor due to short distance to source.	Highly effective pathway
2 – Holly Bush Farm	Receptor 150 m from source boundary but separated from the source by large warehouse buildings likely to increase pathway length and dispersion. Receptor and source at ground level. Five-year weather analysis shows weather from source to receptor (northerly winds) occur 3–7% of the time year by year, but most of these occurrences are in winter months where odour emissions are lower (assuming an odour source with high summer and low winter emissions due to temperature dependency).	Moderately effective pathway
3 – 1-15 High Street	Receptors 380–450 m from source boundary. Receptors and odour sources at ground level. Open ground between source and receptors. Five-year weather analysis shows weather from source to receptor (westerly winds) occur 12–20% of the time year by year.	Moderately effective pathway
4 – Parkside School	Receptor boundary (playing fields) 700 m from source boundary. School buildings further set back (850 m) from source boundary. Receptor separated from source by woodland and industrial buildings, likely to increase air turbulence, pathway length and dispersion. Source and receptor at ground level. Five-year weather analysis shows weather from source to receptor (southerly winds) occur 10–15% of the time year by year.	Ineffective pathway

As noted earlier in **Section 2.2**, the EIA regulations require that an assessment reaches a conclusion on the likely significance of the effects. Where the overall effect is greater than “slight adverse”, the effect is likely to be considered significant. This is a binary judgement: either it is “significant” or “not significant”.

A1.2 DISPERSION MODELLING

Dispersion modelling is a widely applied tool in odour assessment and in combination with agreed numerical assessment criteria (see **Section 4**) they can be a useful tool. However, it should always be considered in an odour assessment that there are some types of odour source that may exist that are not easily modelled (e.g. diffuse sources, fugitive emissions or intermittent sources) and so model results may not give a complete picture of the odour

risk on site. Taking short-term events for example, the Practitioner would need to carefully explain and justify how this has been modelled, including setting out the uncertainties of such modelling.

Where dispersion modelling is applicable

Dispersion modelling can be applied when:

- The sources of odour are clearly identifiable;
- Where the source characteristics are clearly defined i.e. physical size, emission characteristics such as temperature and efflux velocity are known (this is less of a limitation if receptors are distant to the source as precise source characteristics have more effect on near-field dispersion);
- Odour emission rates can be reasonably determined;
- Odour emission rates and any diurnal or seasonal variations are known or within predictable range/variation;
- The area does not have other relevant odour sources that may be difficult to model; and
- The area is suitable for dispersion modelling, i.e. there are no extremes of terrain height, appropriate meteorological data is available, and there are no local features that would mean dispersion modelling results are unreliable.

Some odour sources can be difficult to define; they may emit odour from a wide area or have large fluctuations in odour emissions. An example may be a composting site where the windrows are turned occasionally, increasing odour emissions.

Which model to select

Odour assessment uses criteria that have been derived in a different manner compared with other environmental standards. Normally, measurements are taken of the concentration of a pollutant, and

these are compared with standards based on a dose-response relationship. The odour standards currently used have not been derived in this manner, rather they have been derived from community surveys of perceived annoyance that have been compared with modelled 98th percentile odour concentrations, and custom and practice. The models used to derive these relationships are not widely used in the UK and consequently alternatives are used. Odour assessments are almost exclusively undertaken in the UK using the AERMOD or ADMS models, but other models may be used if appropriate.

A1.3 MODELLING THE DISPERSION OF ODOURS

There are numerous good practice guidance documents setting out how odours should be modelled. Some examples include the EA's guidance on air dispersion modelling reports²⁸, an ADMLC review,²⁹ the International Handbook on the Assessment of Odour Exposure using Dispersion Modelling,³⁰ and the wastewater operator guidance notes. When undertaking assessments, the Practitioner should carefully consider all relevant guidance and should give justification for the modelling approach adopted in the assessment report. As such, this guidance does not provide any specific guidelines on dispersion modelling.

APPENDIX 2 – SNIFF TESTING

A2.1 MONITORING OF AMBIENT ODOURS – SENSORY TESTING

An adverse effect of odour exposure, such as annoyance or loss of amenity, is subjective and is not something that can be wholly defined or assessed by quantitative predictive methods alone. An assessment can therefore be strengthened by including a subjective assessment of prevailing odour conditions by those directly affected or by experienced, trained observers.*

Sensory testing techniques use the human nose as the analytical sensor to enable the magnitude (as an intensity), frequency, duration and offensiveness of the odour to be recorded at a particular location at a specific time. This is a sound approach considering that (currently) no analytical instrument can give a unified measure of a complex mixture of compounds that quantifies it as a whole in the same way that a human experiences odour (sensory testing also allows the character of the odour to be assessed, which is a great benefit when there are a number of different odour sources).

Subjective sensory tests such as the sniff test should certainly not automatically be considered inferior to

quantitative ambient monitoring. When carried out to a rigorous, well-designed methodology, the results of such sensory surveys can be expected to be robust and reproducible.

Although the argument may be put forward that sensory testing results can't be compared directly with the exposure benchmarks for modelling set as C_{98} , 1-hour concentrations (ouE/m), it should be borne in mind that the latter are just surrogate exposure indicators for the actual effect of annoyance.[†] Sniff tests also give an estimate of exposure; this is just expressed in a different way to modelling output. The main difference is that for modelling, a consensus has been reached on what levels correspond to annoyance, whereas for sensory tests this consensus has not yet been achieved.

Sniff testing needs to be carried out on sufficient occasions to represent the an appropriate range of likely odour emissions and in meteorological conditions favourable to odour detection for a particular site (e.g. light wind and stable conditions). The number and frequency of tests will therefore be project specific and must be justified by the assessor in each case.

* Although amongst a group of individuals, whilst not all will agree, a consensus can emerge about what could reasonably be considered as an adverse odour effect.

[†] The Environment Agency's exposure benchmark levels were originally derived from the correlation between modelled exposure around a Dutch piggery and the resulting annoyance

effects as measured by a community questionnaire survey. A level of 10% annoyed was chosen as the lowest level that would be statistically significant, based on the "background noise" for measurement of annoyance using questionnaires plus two times the standard deviation.

Table A2.1 Odour intensity scale*

Intensity Level	Description
0 – No odour	You definitely cannot smell the source you are trying to identify ('the odour').
1 – Very faint	There is a large doubt as to whether the odour is present. There may be an inkling the odour is present, but you will be unable to identify the source or describe its character.
2 – Faint	You are in some doubt as to whether you can recognise the presence of the odour, and you would struggle to describe its character.
3 – Identifiable	The odour is recognisable, the character can be described and the source likely identifiable, but it is considered to be weak.
4 – Distinct	The odour is easily recognisable, and you can describe the source without any doubt.
5 – Very strong	The odour is very strong and may elicit a physical reaction (such as nose wrinkling).
6 – Extreme	The odour intensity is extreme, and most individuals would want to remove themselves from the situation (in ambient sniff testing, odours at this intensity are very rare).



Sludge processing tanks at a sewage treatment works

* VDI 3940 sets out that in a clean odour laboratory an Odour Detection Threshold (ODT) of 1 OU_E/m³ represents the minimum concentration for which odours may be detectable and that the recognition threshold is generally 3-10 times higher than the odour detection threshold (i.e. 3-10 OU_E/m³). As this is defined for a laboratory environment, it cannot be directly aligned with intensity levels in ambient air, for which odours at the ODT would typically not be detectable in the field.

A2.1.1 Sensory testing by the “sniff test”

There are two main methods of sniff test: a so-called “objective” method and a “subjective” method. The “objective” approach, popular in the US and documented in ASTM E544-99, involves the assessor gauging the magnitude of the environmental odour against a numerical scale based on a series of standard “sniffing sticks” containing different concentrations of 1-butanol.

In Europe the “subjective” sniff test is more widely used, where the assessor allocates the intensity of the environmental odour against a numerical scale linked to qualitative descriptions such as “not perceptible”, “weak”, “strong”, etc. There is currently no UK national standard method for subjective sniff tests; however, a German national standard exists: VDI 3940: 1993, *Determination of Odorants in Ambient Air by Field Inspection*.³¹ The VDI standard intensity (I) scale ranges from 0 (no odour), through 1 (slight/very weak), to 6 (extremely strong).

The VDI 3940 method²⁷ is very comprehensive but requires a full year’s worth of measurements (unlikely to be compatible with a planning application timetable) and can require multi-person “sniffing squads”. A CEN standard on assessing odour in ambient air has been prepared (EN 16841-1:2016)³² which covers the German grid approach. A dynamic plume assessing approach is also available (EN 16841-2:2016)³³ that describes a plume method for determining the extent of the downwind odour plume of a source.

The challenge for practitioners is how to design a sniff test survey and interpret the results in a way that allows the odour effects on the surrounding land-users to be gauged for planning purposes. In the absence of a definitive standard method for this application, the IAQM has provided an illustrative example of how the subjective sniff test can be used.

The main principles of the sensory assessment are:

Step 1 – Conduct the sniff testing

The sniff test technique is used to gather information on odour intensity (following the scale set out in **Table A2.1**), character, unpleasantness, frequency and duration at the test locations of interest (usually at sensitive receptors or at an installation boundary) according to the procedure in **Box A2.1**. The number of test locations and their exact locations should be selected taking into account the number of sensitive receptors, their distance to the source, and orientation in relation to the prevailing wind direction. This should always include downwind locations. Where available, other existing data (e.g. complaints records, any atmospheric dispersion modelling predictions, stack heights, etc.) should also be considered.

The test locations should be clearly marked on the area map showing the site, key community features, and the extent of the odour survey. The odour assessor should start the survey at those test locations that are upwind of the site activities, starting with those furthest away and moving progressively to those closer to the site. Only then should tests be carried out at the downwind test locations, again starting with those furthest away and moving progressively to those closer to the site. Assessors should justify the survey route used and how it is appropriate for the survey, and detail when rest periods were undertaken and why the approach was appropriate.

The survey strategy and its development should be stated, and justification given for how it is appropriate. The extent of sniff testing, including the number of surveys and repeat tests, must be justified. For each survey there needs to be a clear statement about limitations. Although not exhaustive, relevant considerations are set out in **Box A2.2**.

Where there are access limitations, it may be appropriate to utilise sniff tests from alternative downwind directions to infer conditions at the area of interest. The appropriateness of this should be justified by the Practitioner and take account of how other factors could influence the dispersion of odour.

Step 2 – Estimate odour exposure at the test location

The results are then interpreted to assess the odour impact at the time and place of sampling. The Odour Exposure experienced at each location will be dependent on the frequency, intensity, duration and unpleasantness of the odour and different combinations of the FIDOL factors can result in different exposures: for example, odours may occur frequently in short bursts ('acute' exposures), or for longer periods ('chronic' exposures). **Table A2.2** is one example of how the intensity, frequency and duration can be considered together.

Box A2.1 – Example of sniff test sampling procedure

The sensory test is carried out at each test location over a standard observation time, typically 3–5 minutes. Test durations shorter or longer than this may be appropriate for some sniff testing campaigns but should be robustly justified. Testing should start from locations affected by the least intense odours, to avoid olfactory fatigue. For each test location, the start time of the observation period and the attributes of the odour over the observation period are recorded as follows:

1. The assessor breathes normally, inhaling ambient air samples through the nose at regular intervals (say, every 10 seconds, to give 30 samples over typically a 3–5 minute observation period). If the odour levels are either constant or intense then the odour assessor should avoid olfactory fatigue/desensitisation by alternating each sample sniff of ambient air with a sniff of odour-free air from an ori-nasal face mask fitted with carbon filters.
2. For each sample, the odour intensity (0–6) is considered and those of intensity of 3 or more should be recorded.
3. At the end of the observation period at the test location, the odour unpleasantness or pleasantness of all odours detected are noted down by classifying them as unpleasant, neutral (neither pleasant nor unpleasant) or pleasant. This assumes that at least some of the 30 samples were of intensity 3 or more (i.e. the odour is at least “identifiable”).
4. The odour descriptor should also be noted: odours can be objectively described using standardised categories and reference vocabulary. It is useful to provide odour assessors with standard descriptor terms, which are organised with similar terms in categories and groups either as a list or as an “odour wheel”.
5. Next, the pervasiveness/extent of the odour at this test location is assessed. This can be calculated as the percentage odour time, $t_{I \geq 3}$, which is the number of samples where odour was identifiable divided by the total number of samples (i.e. 30). Note that “identifiable odour” is where the odour strength exceeds the recognition threshold and is definitely identifiable by the assessor, i.e. the assessor is capable of definitely identifying its quality/character, which corresponds to intensity of 3 or more.
6. The average odour intensity of samples of intensity 3 or more, I_{mean} , over the test period is calculated. The maximum intensity observed may also be noted if relevant for interpretation of the results.

The above procedure is then repeated at the next test location, remembering that the character of an odour mixture can change over distance, as the particular components may become diluted below their individual detection thresholds at different distances.

A record should be kept of the meteorological conditions at the time of testing (including wind strength and direction, rainfall, and temperature), together with information relating to the operations and activities being undertaken on site and in the surrounding area. Practitioners should carefully consider the frequency of recording meteorological conditions; this will typically involve recording conditions either per sniff test or per sample and should involve appropriate meteorological instruments where relevant.

Box A2.2 – Sniff testing considerations

There are a number of considerations that should be accounted for when planning and conducting sniff tests. This includes:

- The source/aim of the test;
- The frequency of odour releases and how they vary over time;
- The likely offensiveness of the odours;
- Local meteorological conditions, including temperature inversions;
- The time/day/season and how this can affect odour intensities;
- Whether there are other relevant odour sources;
- What an appropriate number of tests would be;
- The land ownership and any restrictions on access;
- The risk judgement for the visit; and
- Any other limitations/uncertainties.

The number of surveys necessary will vary depending on the above and justification should be set out in the assessment report.

Table A2.2 – Matrix to assess the odour exposure (neutral and unpleasant odours) at time and place of sampling

Average intensity (I_{mean})	Percentage odour time ($t_{\geq 3}$) during the test						
	<10%	11–20%	21–30%	31–40%	41–60%	61–80%	>81%
6	Large	Large	Very Large	Very Large	Very Large	Very Large	Very Large
5	Medium	Medium	Large	Large	Very Large	Very Large	Very Large
4	Small	Small	Small	Medium	Medium	Large	Large
3	Negligible	Negligible	Small	Small	Small	Medium	Medium

Notes: I_{mean} and $t_{\geq 3}$ should both be rounded to the nearest whole number.

The following overriding considerations affect the scoring of the odour annoyance impact:

if $I_{\text{mean}} = 3$ but $t_{\geq 3} < 20\%$, then the odour effect can for practical purposes be considered negligible.

Consideration when assigning intensity should be given to the ability of the local community becoming hypersensitive or desensitised to nuisance odours in comparison to a practitioner undertaking a sniff test.

The relative unpleasantness of an odour is probably its most subjective attribute. It is also complicated by the interdependence with intensity and frequency/duration: some odours may be pleasant when weak but unpleasant when strong, or when exposure is frequent. The assessor should record comments on the pleasantness/unpleasantness, taking account of standard odour descriptors (such as “odour wheels”).

Step 3 – Bring together the results of repeated tests and receptor sensitivity to judge the odour effect

Measuring the exposure at a particular place (receptor) and time using the sniff test technique, is (relatively) straightforward. However, the frequency that odour episodes occur is thought to be at least as important as the magnitude of the individual odours. The real challenge, therefore, is:

- i. to evaluate how the sample results* can inform a methodology for a larger campaign aiming to understand how odour is experienced in the wider area (covering any variations in source activity, and differences due to time of day, season and weather conditions); and
- ii. how to combine the resulting probability of impact with the sensitivity of the receptor to gauge the effect that is taking place.

This requires professional judgement, and it is difficult to be prescriptive because different approaches may be suited to different situations. Consideration should be given to **Box A2.2** when

* Although a snapshot might be good enough to confirm an adverse impact (if you're lucky enough to catch it), numerous repeat surveys will usually be required to show with a reasonable degree of certainty that there is an absence of adverse impact. In general, the greater the number of surveys carried out, the higher the confidence in the conclusion drawn.

† The certainty and reliability of the conclusion is likely to be affected mainly by how well the monitoring campaign captures

determining appropriate surveys. However, some general guidance is offered below.

If many repeated sniff tests had been carried out to cover the majority of meteorological (including wind direction) conditions and source variations that are likely to occur, then there will be multiple estimates of odour exposure (impact) at each receptor. It is relatively straightforward to then make a judgement on the *overall* odour exposure (impact) and then combine this with the sensitivity of the receptor to gauge the effect. However, surveys need not be so prescriptive when the objective can be achieved in fewer sniff tests. The Practitioner should justify the approach used, taking account of the considerations set out in **Box A2.2**. **Table A2.3** has been included to provide guidance on how these factors might be considered together. The matrix is not prescriptive, but it is hoped that it may help a consensus emerge on how practitioners describe the magnitude of adverse odour effects. Despite the understandable perception that the subjective nature of the sniff test is somehow inaccurate or imprecise,[†] such extended surveys can arguably provide some of the best evidence on odour impact out of all the tools at our disposal.

If far fewer tests had been carried out, the Air Quality Practitioner would need to consider carefully how those snapshots of exposure/impact could be used to come to a conclusion on *overall* odour impact/exposure (and then onwards to estimate the effects). This would be likely to require consideration of the meteorological conditions at the time of the tests and how frequently these occur over the longer term. If the source also varies, then carrying out few

the spatial and temporal variability of the odour. This is likely to be driven more by the variation in the magnitude of odour sources, and the differences in dispersion and dilution that occur with different meteorological conditions (such as wind speed and direction, insolation, atmospheric stability and precipitation) than by the measurement uncertainty.

tests is unlikely to be an acceptable approach and tests during a range of emissions conditions should be carried out, including during worst-case emissions.

When considering the overall significance of results, professional judgement should be used to consider whether additional sniff-testing is needed to robustly reach a judgement, taking into account the application of FIDOL, and include any relevant supporting additional narrative in reaching and justifying an overall judgement. Practitioners should clearly explain and justify conclusions in assessment reports.

QA/QC for sniff testing

With a subjective approach such as the sniff test, general quality assurance/quality control (QA/QC) issues assume a huge importance. The main QA/QC factors are: having a robust protocol; the sensitivity

of the assessor being “normal” (see **Box A2.3**); and adequate training. The QA/QC approach should be justified in assessment reports by practitioners. For example, there may be situations where tests carried out by a high sensitivity assessor is valid. A credible programme of sensory monitoring is considered to require four main components:³⁴

1. Suitably qualified and trained odour assessors (See **Box A2.3**);
2. Objective methods of describing and measuring odours;
3. Standard monitoring practices, e.g. routine survey routes; and
4. Standard data collection and reporting forms.

Table A2.3 – Highly Offensive Odours: Matrix to assess the odour effect at individual receptors during the sampling period

Overall Odour Exposure	Receptor Sensitivity (refer to Table 2.1)		
	Low	Medium	High
Very Large	Moderate Adverse	Substantial Adverse	Substantial Adverse
Large	Slight Adverse	Moderate Adverse	Substantial Adverse
Medium	Negligible	Slight Adverse	Moderate Adverse
Small	Negligible	Negligible	Slight Adverse
Negligible	Negligible	Negligible	Negligible

A further application of professional judgement then needs to be applied to conclude the significance of the odour effect on, or from, the development as a whole, taking into account the possibly different magnitudes of effects that occur at different receptors.

Table A2.4 – Moderately Offensive Odours: Matrix to assess the odour effect at individual receptors during the sampling period

Overall Odour Exposure	Receptor Sensitivity (refer to Table 3.1)		
	Low	Medium	High
Very Large	Moderate Adverse	Substantial Adverse	Substantial Adverse
Large	Slight Adverse	Moderate Adverse	Moderate Adverse
Medium	Negligible	Slight Adverse	Moderate Adverse
Small	Negligible	Negligible	Slight Adverse
Negligible	Negligible	Negligible	Negligible

A further application of professional judgement then needs to be applied to conclude the significance of the odour effect on, or from, the development as a whole, taking into account the possibly different magnitudes of effects that occur at different receptors.

The following are additional factors to safeguard the quality of sensory assessments:

- The odour assessor should not carry out the assessment if they have a cold, sore throat, sinus trouble, etc.;
- The odour assessor should not be hungry or thirsty;
- The odour assessor should not smoke, vape or consume strongly flavoured food or drink, including coffee, for at least half an hour before the field odour survey is carried out, or during the survey;
- Scented toiletries, such as perfume/aftershave/suncream should not be used on the day of the field odour survey;
- The vehicle used during the field odour survey should not contain any deodorisers;
- If the odour assessor has had to travel a long distance, then a rest period should be taken before starting the survey;
- To reduce the likelihood of odour fatigue, assessors should always carry out the field odour survey *before* making any works site visit, inspection or walk-through survey; and
- For sources with odour releases which have short-term variability, there may be a need to conduct more than one set of sniff tests during each site visit day; the assessor should remove themselves to a place well away from the odour source for the periods between sniff tests.

Box A2.3 – Checking the sensitivity of odour assessors

A wide natural variation of olfactory sensitivities exists in the population. Practitioners who carry out field odour assessments of ambient odour using sensory tests should have a normal sense of smell and it is expected that practitioners have their odour acuity (sensitivity) quantified. It is not required that they are within the strict sensitivity range (of between 20–80 ppb to n-butanol) and repeatability range that qualifies someone to act as a laboratory panellist for dynamic dilution olfactometry to method EN13725. Just as many of the population would fall outside these ranges, so too would many practitioners; the logic and practicability of excluding them (when they can be considered as surrogates for the majority of the population) and their opinions/observations from the assessment process cannot really be justified. Sensitivity testing therefore tends to be used in most countries simply to demonstrate the assessor is neither anosmic (unable to smell) nor highly sensitive, i.e. that the assessor has the ability to detect odours that is neither very poor, nor very good. This balance is important given the differing perspectives of the owners of an odour-emitting activity and the potentially impacted community. In the US, sensitivity is checked using standard n-butanol pens, the aim being to identify anyone who is very insensitive or hypersensitive (defined as by falling in the upper or lower 5% tails of the normal distribution curve).

GLOSSARY

Abatement: An end-of-pipe control measure to reduce odour levels in the exhaust gas of a source, usually a controlled point source.

Adaptation: The long-term process that can occur when communities become increasingly tolerant of a particular source of odour, which is primarily a psychological response to the situation. For example, where odours are associated with a local industry that is considered to be important for the well-being of the local community and the industry maintains a good relationship with community members, then adaptation to the odour effects can occur over time.

Amenity: *“A positive element or elements that contribute to the overall character or enjoyment of an area. For example, open land, trees, historic buildings and the inter-relationship between them, or less tangible factors such as tranquillity.”*³⁵

Annoyance: Odour annoyance can be considered the expression of disturbed well-being induced by adverse olfactory perception in environmental settings. Odour annoyance occurs when a person exposed to an odour perceives the odour as unwanted. Annoyance is the complex of human reactions that occurs as a result of an immediate exposure to an ambient stressor (odour) that, once perceived, causes negative cognitive appraisal that requires a degree of coping. Annoyance may, or may not, lead to nuisance and to complaint action.

Annoyance potential: Annoyance potential is the attribute of a specific odour (or mixture of odorants) to cause a negative appraisal in humans that requires coping behaviour when perceived as an ambient odour in the living environment. It is an attribute of an odour that can cause annoyance and may lead to nuisance and complaint. Annoyance potential indicates the magnitude of the ability of a specific odorant (mixture), relative to other odorants (mixtures), to cause annoyance in humans when

repeatedly exposed in the living environment to odours classified as ‘weak’ to ‘distinct odour’ on the scale of perceived intensity (see VDI 3882:1997, part 1). Annoyance potential is likely to be function of both hedonic tone and odour character/quality. Whether annoyance potential of an odour does, or does not, cause annoyance depends on location and receptor factors.

Character (of an odour): Odour character or quality is basically what the odour smells like. It is the property that identifies an odour and differentiates it from another odour of equal intensity. For example, ammonia gas has a pungent and irritating smell. The character of an odour may change with dilution.

Chemical analysis: A variety of instruments can be used as sensors to measure the concentration of one or more odorous chemical compounds. The compound concentration can then be compared to the odour threshold to see if an odour is likely to be detected (odour detection threshold) or recognised (odour recognition threshold). The mass concentration of the compound can be converted approximately into odour concentration units (OU_E/m^3) by expressing it in multiples of the compound's ODT.

Community surveys: Measuring the odour impact (e.g. annoyance) directly in the local population by survey methods (e.g. quality of life surveys).

Complaints: Odour complaints occur when individuals consider the odour to be unacceptable and are sufficiently annoyed by the odour to take action.

Concentration (of an odour): Concentration is the amount of odour present in a given volume of air. We measure and model odour concentration, not odour intensity. For a known, specific chemical species this can be expressed either as the volume of that compound per unit volume of air (e.g. ppm or ppb) or the mass of that compound per unit volume of air (e.g. mg/m^3 or ng/m^3). For odours that are

mixtures of compounds, concentration is measured in ou_E/m^3 .

Descriptor (of an odour): The odour character is assessed by either the degree of its similarity to a set of reference odours or the degree to which it matches a scale of various ‘descriptor’ terms. Numerous standard odour descriptors, in list form or as “odour wheels” (with the general descriptors placed at the centre of the wheel and more specific characters towards the wheel rim) have been developed for use as a reference vocabulary by assessors.

Desensitisation (of individuals to odour): This can, like sensitisation, result from exposure to an odour. A person may become unable to detect the odour, or there is a reduction in the perceived odour intensity and/or effect, even though the odorous chemical is still present in the air.

Dilutions to threshold ratio: A measure of the number of dilutions (with carbon-filtered air) needed to make the odorous ambient air non-detectable. D/T is similar to the units of ou_E/m^3 used in dynamic dilution olfactometry, although the two are not interchangeable or directly comparable.

Disamenity: The government Planning Portal does not define disamenity, but its literal meaning would be “impaired amenity” and from its definition of amenity could be considered to be a negative element or elements that detract from the overall character or enjoyment of an area. The Oxford English Dictionary defines disamenity as “*the unpleasant quality or character of something*”.

Duration: The duration of the odour occurrence is how long an individual is exposed to odour in the ambient environment.

Dynamic dilution olfactometry: The measurement of odour concentration using human subjects as the ‘sensor’. The CEN standard has been adopted by practitioners in most of the world and has become the de facto international standard for laboratory

dynamic dilution olfactometry (DDO). The concentration of the odour sample is measured in ou_E/m^3 , which is equivalent to the number of repeated dilutions with a fixed amount of odour-free air or nitrogen that are needed until the odour is just detectable to 50% of a panel of trained observers. DDO is a valuable objective measure of odour concentration. It is limited in application to air samples having odorant concentrations at many times above the detection threshold (usually at least $50 \text{ ou}_E/\text{m}^3$).

Empirical dose-response approach: The approach to obtaining an odour modelling guideline value from an empirical dose-response study relating modelled exposures to community responses (e.g. annoyance). European odour units per cubic metre of air (ou_E/m^3) Equivalent to the number of repeated dilutions with a fixed amount of odour free air or nitrogen that are needed until the odour is just detectable to 50% of a panel of trained observers in a DDO determination to the CEN standard BS EN 13725.

Exposure: The result of an exposure chain, consisting of an odour source, a transport mechanism and a receptor. Magnitude of odour exposure is determined by the FIDOL factors. Once exposure to odour has occurred, the process can lead to annoyance, nuisance and possibly complaints.

FIDOL factors: The perception of the impact of odour involves not just the strength of the odour but also its frequency, intensity, duration and offensiveness (the unpleasantness at a particular intensity) and the location of the receptors. These attributes are known collectively as the FIDOL factors.

Frequency: The frequency of the odour occurrence is how often an individual is exposed to odour in the ambient environment.

Fresh air: Air perceived as being air that contains no chemicals or contaminants that could cause harm, or air that smells ‘clean’. Fresh air may contain some

odour, but these odours will usually be pleasant in character or below the human detection limit.

Hedonic scores: Quantitative values assigned to the unpleasantness of source emission samples, by measurement in the laboratory by a panel of trained assessors in an odour panel following the German method VDI 3882 Part 2. Hedonic tone is scored on a nine-point scale ranging from very pleasant (score of +4, e.g. bakery smell) through neutral to highly unpleasant (score of -4, e.g. rotting flesh).

Hedonic tone (of an odour): Hedonic tone is 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 emotions at the time of odour perception. Hedonic tone is related to (but not synonymous with) the relative pleasantness or unpleasantness of an odour.

Intensity (of an odour): How strong an odour is perceived to be. Odour intensity describes the relative magnitude of an odour sensation as experienced by a person.

Nuisance: Nuisance is the cumulative effect on humans, caused by repeated events of annoyance over an extended period of time, that leads to modified or altered behaviour. This behaviour can be active (e.g. registering complaints, closing windows, keeping 'odour diaries', avoiding use of the garden) or passive (only made visible by different behaviour in test situations, e.g. responding to questionnaires or different responses in interviews).

Odour nuisance can have a detrimental effect on our sense of well-being, and hence a negative effect on health. Nuisance occurs when people are affected by an odour they can perceive in their living environment (home, work environment, recreation environment) and:

- i. the appraisal of the odour is negative;
- ii. the perception occurs repeatedly;

- iii. it is difficult to avoid perception of the odour; and
- iv. the odour is considered a negative effect on their well-being.

Nuisance is not caused by short-term exposure, and it is not alleviated by relatively short periods (months) of absence of the ambient stressor.

Numerical benchmark criteria: The collective term used for odour exposure limits from different sources and agencies, such as World Health Organization (WHO) guideline values, the Environment Agency's Indicative Odour Exposure Standards, UK Health Security Agency (UKHSA) VOC odour criteria, and custom and practice benchmarks.

Odour annoyance threshold approach: Odour modelling guidelines derived from an essentially theory-based analysis of odour definitions from first principles. This approach was used as the basis for the interim criteria that were recommended as New Zealand's first national odour concentration guideline values for all types of odour sources.

Odour detection threshold: The ODT is the lowest concentration of any specific chemical or mixture at which it can be ascertained that an odour is present, i.e. the level that produces the first sensation of odour.

Odour-free air: Air containing no odorous chemicals at all.

Odour modelling guideline value: Numerical benchmark criteria used specifically for relating the occurrence of adverse effects, such as annoyance, with the concentrations of odour at various receptor sites as predicted by atmospheric dispersion modelling.

Offensiveness (of an odour): A lack of agreed terminology has resulted in there being two meanings in common use of the term offensiveness of an odour, which can be confusing. On the one hand, offensiveness is sometimes used to describe the

character and unpleasantness of an odour at a particular intensity, so it is related to the hedonic tone – one of the FIDOL factors. When used in this context, the term relative offensiveness is sometimes used. However, offensiveness is also used in the context of overall impact in terms of ‘offence to the senses’. Here it has a much broader meaning, encapsulating the combined effect of most or all the FIDOL factors. To avoid this confusion of terms, this document has used the term odour unpleasantness to describe the character of an odour as it relates to the hedonic tone. The term offensiveness has been used solely to describe the combined effect of all the FIDOL factors in terms of ‘offence to the senses’.

Olfaction: The human ability for the sensing of smell.

Olfactory fatigue: The term sometimes used to describe desensitisation that occurs on a short-term basis.

Quality (of an odour): What an odour is perceived to be like. See Character (of an odour).

Recognition threshold: The concentration, at some point above the odour detection threshold, at which the odour is recognised as having a characteristic odour quality. The concentration at which the character and hedonic tone of the odorant is recognisable.

Relative unpleasantness (of an odour): The degree to which one odour is perceived as being more or less pleasant or unpleasant than another odour under similar conditions.

Sensitisation (of individuals to odours): This may occur after acute exposure events or as a result of repeated exposure to nuisance levels of odours.

Sensitisation changes a person’s threshold of acceptability for an odour. This can result in a high level of complaint over the long term and a general distrust within the community of those perceived as responsible for the odour.

Sensitivity (of individuals to odours): Different life experiences and natural variation in the population can result in different sensations and emotional responses by individuals to the same odorous compounds.

Sensitivity (of the receiving environment): The type of land use and nature of human activities in the vicinity of an odour source and also the tolerance and expectation of the receptor. The ‘Location’ factor in FIDOL can be considered to encompass the receptor characteristics, receptor sensitivity and socio-economic factors.

Sensory analysis: Using the human nose as the sensor in an analytical measurement, a technique termed olfactometry.

Sensory testing: Using the human nose as a detector in tests for odour. In this context the tests are usually field tests for the assessment of odour impact (often called ‘sniff tests’).

Sniff test: This tool – also called a direct sensory test, subjective testing or simplified olfactometry – gives a subjective measure of odour impact based on the assessor’s opinion on the FIDOL factors at the receptors which are compared with descriptive (or sometimes numerical) guidelines.

Strength (of an odour): The magnitude of an odour – the odour strength – can be described in two ways, by its intensity and its concentration.

ABBREVIATIONS AND ACRONYMS

ASTM – American Society for Testing and Materials (method)

BAT – Best Available Techniques

CEN – Comité Européen de Normalisation/European Committee for Standardisation

CFD – Computational Fluid Dynamics

DDO – dynamic dilution olfactometry

DCLG – Department for Communities and Local Government

Defra – Department for Environment, Food and Rural Affairs

D/T – dilutions to threshold

EA – Environment Agency

ELV – emission limit value (at source)

EPA – Environmental Protection Agency

EPR – the Environmental Permitting Regulations

EROM – European Reference Odour Mass

FIDOL – frequency, intensity, duration, offensiveness and location

GC-MS – gas chromatography separation stage combined with mass spectrometry detection stage

mg/m³ – milligrams per cubic metre

µg/m³ – micrograms per cubic metre

NIEA – Northern Ireland Environment Agency

OCI – odour concentration–intensity (relationship)

ODT – odour detection threshold

ou/m³ – odour units per cubic metre of air

ou_E/m³ – European odour units per cubic metre of air

PIR – Process Industry Regulation

ppb – parts per billion

ppm – parts per million

SEPA – Scottish Environmental Protection Agency

UKAS – United Kingdom Accreditation Service

UKWIR – UK Water Industry Research (limited)

VDI – Verein Deutscher Ingenieure (standards)

WHO – World Health Organization

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