

Clarification of some of the terms from ‘Odour Impact Assessment for Cambridge Water Recycling Centre’ (October 2018) by Odournet

Explanation of term OU_E/m^3 – European odour units per cubic metre of air

OU_E/m^3 is an objective measure of odour concentration. Concentration is the amount of odour present in a given volume of air. 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/m³ or µg/m³). **For odours that are mixtures of compounds, concentration is measured in ouE/m^3 .**

This 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 in a dynamic dilution olfactometry (**the measurement of odour concentration using human subjects as the ‘sensor’**). Determination is to the CEN standard BS EN 13725 ‘Air quality. Determination of odour concentration by dynamic olfactometry’.

Why is ‘lower’ worse in Table 1 (page 10) of the Odournet Study?

Table 1: Odour impact criteria

Relative offensiveness	Indicative criterion	Typical processes
Most offensive	1.5 ouE/m^3 98 th percentile (hourly average)	Processes involving decaying animals or fish remains; septic effluent or sludge; biological landfill odours
Moderately offensive	3 ouE/m^3 98 th percentile (hourly average)	Intensive livestock rearing; sugar beet processing; fat frying (food processing); well aerated green waste composting
Less offensive	6 ouE/m^3 98 th percentile (hourly average)	Brewery; coffee roasting; confectionary; bakery

These indicative criteria were introduced in the Horizontal Guidance Note for Odour Management - H4 issued by the Environment Agency and define three different levels of exposure at which odour impact or annoyance could potentially be expected to occur, for odours with high, moderate and low offensiveness.

For the most offensive odours they are detected at lower concentrations hence the number of OU_E/m^3 are lower for more offensive odours.

Explanation of term Hedonic tone (Pleasantness of an Odour)

Hedonic tone is the degree to which an odour is perceived as pleasant, neutral or unpleasant. A subjective ranking system where a panel of human assessors is exposed to a given sample and asked to rank it on a scale, with pleasant odours being assigned a positive value and unpleasant odours a negative value.

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 – ‘Olfactometry - Determination of

hedonic odour tone'. Hedonic tone is scored on a typical nine-point scale ranging from very pleasant (score of +4, e.g. bakery smell) through neutral (score of 0) to highly unpleasant (score of -4, e.g. rotting flesh).

Explanation of ‘Turbulence Factor’ in Table 6 of Odournet Study

In defining emission rates for odour sources / processes consideration is given to the frequency and duration of any intermittent activities, and any turbulence/agitation of aspects of the process handling odorous liquid and solid material. Offensive odour emissions are caused when volatile compounds are released from solution by evaporation or agitation.

Turbulent flow conditions will produce more emissions and such activities that lead to increase in the surface area of odorous material exposed to the atmosphere (e.g. due to turbulence generated by sewage handling processes and agitation of sludge) will inevitably lead to an increase in the magnitude of odour released.

For turbulent sources, a multiplier was applied to the emission rate to reflect the elevation in emissions that occurs due to the increase in surface area exposed to the atmosphere as a result of agitation.

The following turbulence factors were used which are based on Odournet’s broader experience in the wastewater sector and the findings of research:

Table 7: Turbulence factors

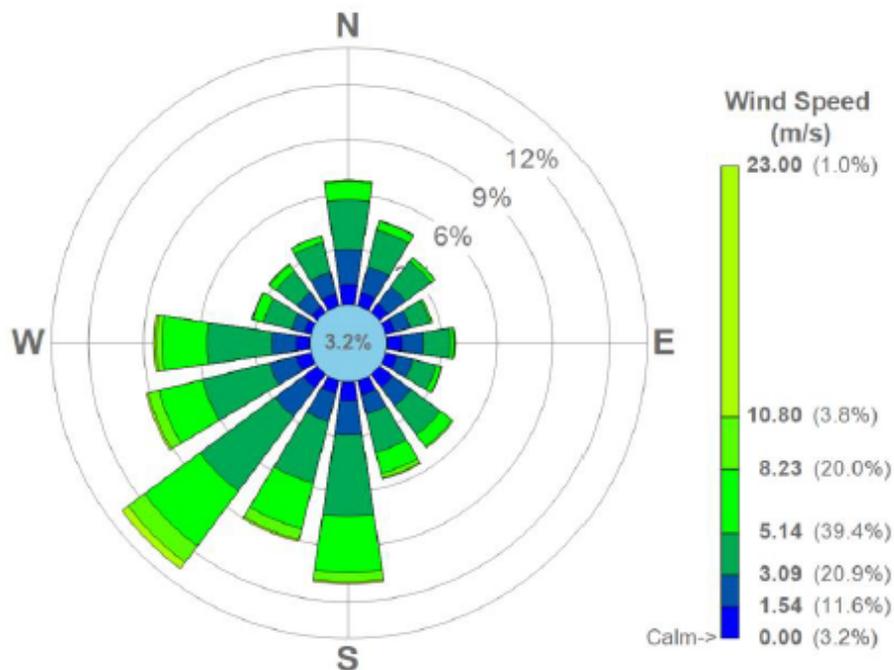
Level of turbulence	Turbulence multiplier
Low	3
Medium	6
High	12
Extreme	20

This results in increased odour emission rates in the model.

Clarifying wind is source not direction

This is in relation to Figure 2, Page 26 of the Odournet Study, which shows a windrose.

Figure 4: Windrose for Cambridge Airport (with missing data imported from RAF Mildenhall) for 2012 to



This wind rose is the meteorological data used by the model to simulate the dispersion and dilution effects generated by the atmosphere.

It shows distribution of wind speed & wind direction from one location. Presented in a circular format, the wind rose shows the frequency of winds blowing usually **from particular directions**. Each "spoke" around the circle is related to the frequency that the wind blows from a particular direction per unit time and includes wind speed %.

This shows that most of the wind comes from the South West 12 to 14% of the time.

Glossary of terms relating to Odour

Extracts from the glossary in 'Guidance on the assessment of odour for planning' by the Institute of Air Quality Management (2018)

Annoyance	<p>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.</p> <p>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.</p>
Character (of an odour)	<p>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.</p>
Concentration (of an odour)	<p>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/m³ or µg/m³). For odours that are mixtures of compounds, concentration is measured in ouE/m³.</p>
FIDOL factors	<p>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.</p>
Hedonic tone (of an odour)	<p>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.</p>
Nuisance	<p>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:</p> <ol style="list-style-type: none"> i. the appraisal of the odour is negative; ii. the perception occurs repeatedly;

	<p>iii. it is difficult to avoid perception of the odour; and iv. the odour is considered a negative effect on their well-being.</p> <p>Nuisance is not caused by short-term exposure, and it is not alleviated by relatively short periods (months) of absence of the ambient stressor.</p>
--	--

Abbreviations and acronyms

BS EN	British Standard European Norm
CWRC	Cambridge Water Recycling Centre
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
FIDOL	Frequency, intensity, duration, offensiveness and location
FSTs	Final settlement tanks
H ₂ S	Hydrogen sulphide
IAQM	Institute of Air Quality Management
ISO	International Quality Standard
l/s	litres per second
mg/m ³	milligrams per cubic metre
OCU	Odour control unit
OU _E /m ³	European odour units per cubic metre of air
ppb	parts per billion
ppm	parts per million
PSTs	Primary settlement tanks
SAS	Surplus activated sludge
Ug/m ³	micrograms per cubic metre
VOCs	Volatile organic compounds
WRC	Water Recycling Centre
WWTW	Waste Water Treatment Works