

## RISK-ASSESSED ODOUR THRESHOLD

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### Statutory Limit

The SEPP (Air Quality Management) sets a design limit of 1 OU based on the 99.9 percentile prediction at 3-minute averaging. This is a very conservative criterion.

The urban community expects a high level of control against odour nuisance and thus the odour criterion is set at the 99.9 percentile level. This means that the predicted odour level must be within the odour criterion for 99.9 % of the hours in a year, as set out in the SEPP(AQM).

A 3-minute averaging period is used to ensure that short term peaks in odour levels are predicted and assessed. Methods to enable AERMOD to make predictions on a 3-minute averaging period have been set out earlier in this report.

The units for odour measurement using dynamic olfactometry are 'odour units' (OU), which are dimensionless and are effectively 'dilutions to threshold'. The procedure for measurement of odour is the Australian Standard —*Determination of Odour Concentration by Dynamic Olfactometry, AS4323.3:2001*. A panel of six or more persons determine when they can only just detect the difference between an odorous sample and a filtered, non-odorous air sample. Thus 1 OU corresponds to the situation where half the Panel members can detect an odour in a controlled odour-free laboratory atmosphere.

The 1 OU limit set by the EPA has not been adjusted for the more sensitive odour detection provided by the Australian Standard

Samples of ambient air with a low odour level (less than about 10 OU) cannot be measured accurately by the Panel method. Hence it is necessary to use a computer model to extrapolate odour predictions to the low concentration range.

### Risk Assessment

Section 16 of the SEPP (AQM) states that a Risk Assessment may be carried out to

- (a) *develop air quality objectives and design criteria;*
- (b) *establish air quality management priorities;*
- (c) *assess the environmental and health impacts of air pollution; and*
- (d) *identify the emissions or sources of greatest risk to beneficial uses.*

The outcome of a risk assessment is an appropriate odour criterion for a particular type of air contaminants (eg, odour from sewage treatment facilities).

### Community Expectations

There are five factors that influence odour perception:

1. Frequency of occurrence (maximum 8 events per year at 99.9 %);
2. Intensity or concentration in OU;
3. Duration of exposure (3 minutes in the SEPP);
4. Offensiveness or character – sewage being generally offensive;
5. Location of the odour (or expectation of no odour nuisance).

The offensiveness of an odour is subjective and relates to whether an odour is perceived as pleasant (bakery odour) or unpleasant (sewage odour). Such perceptions differ widely from person to person, and are strongly influenced by previous experience and by emotions at the time of odour perception.

Different people have different sensitivity to odour. Interviewing people in a street where all houses have been subjected to a high odour is likely to elicit the response that about one-third of people are very offended; about one-third detect the odour but are only mildly offended or not at all concerned; and one-third do not notice the odour. In response to this mixed reaction, odour standards are often more stringent in urban areas where the likelihood of encountering sensitive individuals sensitive to odour is high, compared to the situation of an isolated farmhouse where the risk of high sensitivity and the expectation of high odour amenity are lower.

### Odour Criteria in Australia

A comparison of the various State odour criterion is set out in the table below. It can be seen that for the 99.9 percentile, the odour criterion range from 1 OU (VIC) to 5 OU (NSW and WA), with an average of about 4 OU.

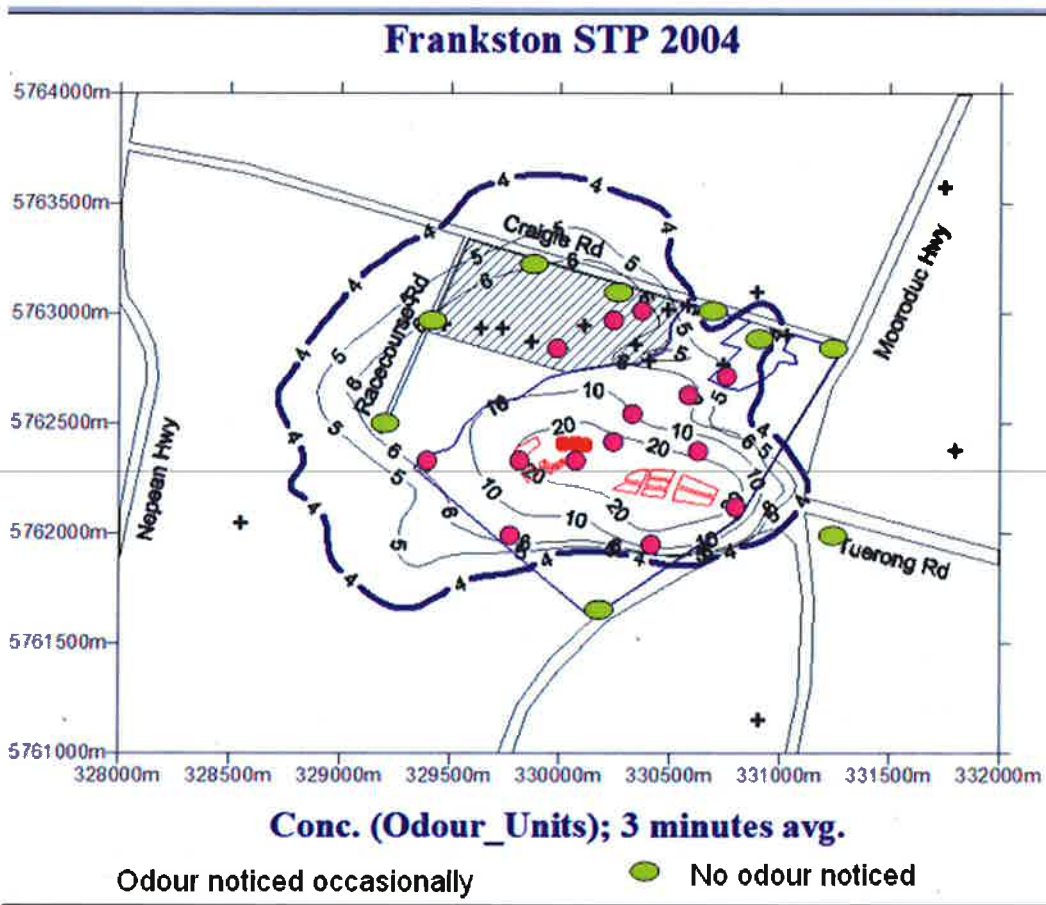
**Table 6-1. Comparison of Odour Criteria**

State	OU limit	Averaging time, min	Percentile	Equivalent at 99.9 %
VIC – EPA	1 OU	3 min	99.9 %	1 OU
WA-WC	5 OU urban	60 min	99.9 %	5 OU
NSW	2 OU urban 7 OU rural	60 min	99.0 %	5 OU
ACT	2 OU	3 min	99.9 %	2 OU
QLD	2.5 OU	60 min	99.5 %	4 OU
SA	2 OU urban 10 OU rural	3 min	99.9 %	2 OU
TAS	2 OU	60 min	99.5 %	3.5 OU

Check in 2004 at Frankston WWTP

In 2004, a comparison was made of the odour levels predicted using the *Ausplume* model (at 99.9 percentile and 3-minute averaging) with observations of odour by local residents and the auditors of the treatment plant and adjacent recycling sites. The results are summarised in Figure 1 which shows the various odour contours and the sites with noticeable odour (pink dots) and no noticeable odour (green dots).

Figure 1. Comparison of Odour Criteria with 4 OU Contour – Frankston



From this comparison, it was concluded that the predicted 4 OU contour encompassed the areas with noticeable odour.

A similar comparison for the Broome, Halls Head and Woodman Point treatment plant sites is reported in Wallis and Oma (2009) and they concluded that the WA Water standard of 5 OU at 99.9 percentile was satisfactory. Figures 2 and 3 show the comparison of model and odour complaints data for Broome and Halls Head.

In summary, experience shows that at 4 OU there is a low risk of odour complaints, bearing in mind that at 1 OU only half the Panel members can detect any odour in a controlled odour-free laboratory atmosphere.

### AERMOD and Ausplume

The comparisons summarised above were based on the use of the Ausplume dispersion model, local wind files, a specific averaging period (3-minutes) and percentile (99.9 %) and a conservative estimate of odour emissions. From that comparison, the predicted 4 OU contour provides a reasonably conservative estimate of the extent of nuisance odour.

It is apparent, however, that the AERMOD and Ausplume dispersion models provide similar results. In our experience, for the same set of emissions and meteorological conditions and dispersion settings, the odour at a specified receptor is typically at the following relative levels:

- CALPUFF predicts 0.85 OU
- Ausplume predicts 1.0 OU
- AERMOD predicts 1.15 OU

Thus, the same 4 OU criterion can be applied with all models, within the accuracy of emission estimates.

### Conclusion

The outcome of this risk assessment is the appropriate odour criterion for odour from sewage treatment facilities is 4 OU, based on 3-minute averaging and 99.9 percentile frequency.

### References

1. Guidance notes for using the regulatory air pollution model AERMOD in Victoria EPA Publication 1551 October 2013
2. EPA Regulatory Model Transition and beyond, EPAV\_Model Transition V4
3. W. Qian and A. Venkatram (2010) Performance of Steady-State Dispersion Models Under Low Wind-Speed Conditions
4. B. Paine and J. Connors, AERMOD Low Wind Speed Issues: Review of New Model Release US EPA Conference 2014
5. S. Hanna and B. Chowdhury "Minimum turbulence assumptions and  $u^*$  and L estimation for dispersion models during low-wind stable conditions" 4/23/2013 EPA 2013 Modeling Workshop Presentation
6. US EPA 1998 "A Comparison of CALPUFF with ISC3" EPA website
7. I. Wallis and R. Oma, "Integrated Odour Management at Western Australian Wastewater Treatment Plants" Third International Conference on Odour Management, Barcelona, 2009
8. Standards Australia, 2015, "Determination of Odour Concentration by Dynamic Olfactometry", AS4323.3.
9. I Wallis, 2016. "Report on 1-hour Average Minimum Wind Speed at Wind Monitoring Site near Perth Airport", Report to DER WA.

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Figure 2. Comparison of Odour Criteria with 5 OU Contour – Broome

Broome - Existing WWTP - February 2007



● Odour Complaint

Figure 3. Comparison of Odour Criteria with 5 OU Contour – Halls Head

