Technical notes

Assessment and management of odour from stationary sources in NSW

November 2006

Department of Environment and Conservation NSW

Technical Framework

These Technical Notes are accompanied by a separate booklet, *Technical framework: assessment and management of odour from stationary sources in NSW*.

This document was prepared by the Air Policy Section of the Department of Environment and Conservation NSW.

From 24 September 2003 the Department of Environment and Conservation (DEC) incorporates the Environment Protection Authority (EPA), which is established in the Protection of the Environment Administration Act 1991 as the Authority responsible for administering the Protection of the Environment Operations Act 1997 (POEO Act). Statutory functions and powers in the POEO Act continue to be exercised in the name of the EPA.

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1 Classifying odour sources

1.1 Applying ground-level and odour assessment criteria to point and diffuse sources of odour

Activities scheduled under the *Protection of the Environment Operations Act 1997* (POEO Act) that may generate odour can generally be grouped into two categories:

- The **point source** category broadly contains activities that involve stack emissions of odour. Generally these can be relatively easily controlled using waste reduction, waste minimisation and cleaner production principles or conventional emission control equipment.
- The **diffuse source** category lists activities that are generally dominated by area or volume source emissions of odour, which can be more difficult to control (e.g. intensive agricultural activities).

Table 1.1 sets out which source categories should assess odour impacts against the ground-level concentration (glc) criteria and/or the odour assessment criteria, discussed later in Chapters 2 and 3 of this document. In practice, each odour impact assessment will entail determining which odorous sources are point or diffuse releases and whether individual or complex odours are being emitted, taking into account site-specific factors.

Table 1.1 Applicability of ground-level concentration criteria and odour assessment criteria to source category

Industry	Point source	Diffuse source
Agricultural produce industries	✓	✓
Bitumen pre-mix or hot-mix industries	✓	Not applicable
Breweries or distilleries	✓	Not applicable
Chemical industries or works	✓	Not applicable
Chemical storage facilities	✓	Not applicable
Composting and related reprocessing or treatment facilities	✓	✓
Contaminated soil treatment works	✓	✓
Drum or container reconditioning works	✓	Not applicable
Electricity generation works	✓	Not applicable
Livestock intensive industries	Not applicable	✓
Livestock processing industries	✓	✓
Mineral processing or metallurgical works	✓	✓
Paper, pulp or pulp products industries	✓	✓
Petroleum works	✓	Not applicable
Sewage treatment systems	✓	✓
Waste facilities	✓	✓
Wood or timber milling or processing works	✓	Not applicable
Wood preservation works	✓	Not applicable

2 Ground-level concentration (glc) criteria

2.1 Applying the ground-level concentration criteria

The ground-level concentration (glc) criteria are referred to in the document *Approved methods for the modelling and assessment of air pollutants in New South Wales*. These glc criteria should be used in the absence of industry-specific glc criteria agreed to with the Department of Environment and Conservation NSW.

The glc criteria are concerned with controlling odours to ensure offensive odour impacts will be effectively managed but are not intended to achieve ‘no odour’.

Impacts from many odorous air contaminants are related to health rather than amenity issues. Odorous air contaminants that also have the potential to generate amenity-related impacts should be managed as a complex mixture of pollutants and assessed against the odour assessment criteria (see Chapter 3).

Using the criteria

The glc criteria should be used routinely for the design and siting of a new facility, in addition to setting point-source emission limits. In addition, the glc criteria should be used during the ongoing management of a facility in order to develop odour mitigation strategies and point-source emission limits that may be required. For existing facilities, the Department of Environment and Conservation NSW will use the glc criteria on a case-by-case basis, in response to odour impact problems.

To quantitatively determine the frequency, intensity and duration of odours, the glc criteria should be reported as the **100**th percentile of dispersion model predictions for Level 2 odour impact assessments and the **99.9**th percentile for Level 3 odour impact assessments. For point source discharges, stack-emission concentration limits can be included in the environment protection licence. This will help to ensure compliance with the glc criteria.

The glc criteria shall be applied at and beyond the boundary of a facility as follows:

1. Impacts in mg/m^3 or ppm must be reported for an averaging period of **1 hour**.
2. For Level 2 impact assessments, impacts in mg/m^3 or ppm must be reported as the **100**th percentile of dispersion model predictions.
3. For Level 3 impact assessments, impacts in mg/m^3 or ppm must be reported as the **99.9**th percentile of dispersion model predictions.
4. For point sources, the results of the dispersion modelling shall be used as the basis for developing site-specific emission limits for individual odorous and toxic air pollutants.

2.2 Developing alternative ground-level concentration criteria

The following procedure (also set out in Figure 2.1) should be used for developing or modifying glc criteria for individual odorous pollutants so they are consistent with the olfactometry methods specified in the *Approved methods for the sampling and analysis of air pollutants in New South Wales* (**Note:** the Department of Environment and Conservation NSW should be contacted before undertaking development of alternative criteria.)

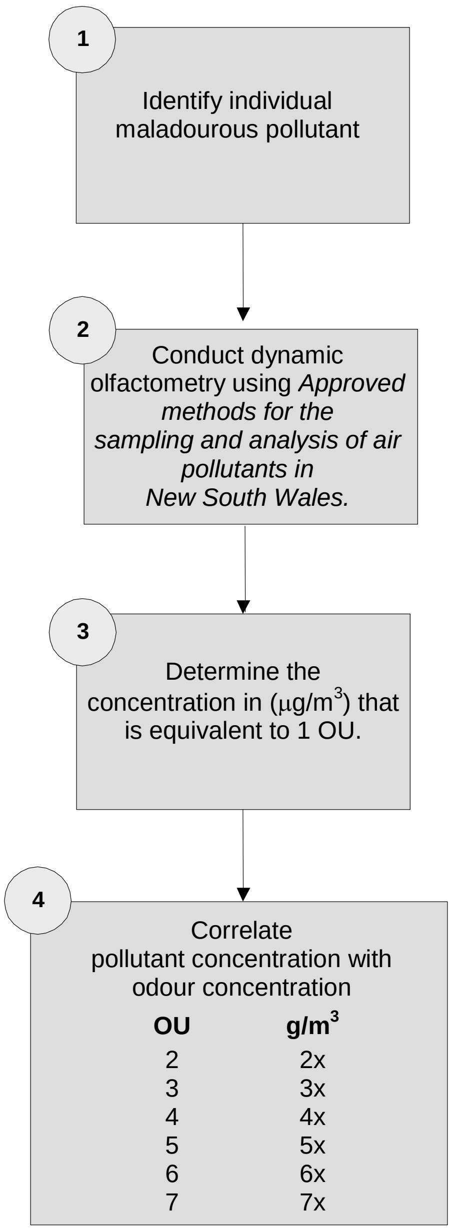
1 Identify the individual odorous pollutant that requires modified glc criteria.

2 Using known concentrations of the individual odorous pollutant, conduct dynamic olfactometry in accordance with the *Approved methods for the sampling and analysis of air pollutants in New South Wales*.

3 Develop a correlation between the concentration (e.g. $\mu g/m^3$) and dilution factor (ie. OU) of the individual odorous pollutant. Report the concentration (e.g. $\mu g/m^3$) that corresponds with 1 OU.

4 Determine the individual odorous pollutant concentration (e.g. $\mu g/ m^3$) that corresponds with the population-dependant odour assessment criteria (i.e. 2 OU to 7 OU). For example, if 1 $\mu g/ m^3$ corresponds to 1 OU, then 2 $\mu g/ m^3$ corresponds to 2 OU and so on.

Figure 2.1 Procedure for determining alternative ground-level concentration criteria



3 Odour assessment criteria

3.1 Applying the odour assessment criteria

The odour assessment criteria are referred to in the *Approved methods for the modelling and assessment of air pollutants in New South Wales*. These odour assessment criteria should be used in the absence of industry-specific odour assessment criteria agreed to with the Department of Environment and Conservation NSW.

The odour assessment criteria are concerned with controlling odours to ensure offensive odour impacts will be effectively managed but are not intended to achieve ‘no odour’.

Impacts from many odorous air contaminants are related to amenity rather than health issues. Odorous air contaminants that also have the potential to generate health-related impacts should be managed as individual pollutants and assessed against the glc criteria (see Chapter 2).

Odour threshold

The detectability of an odour is a sensory property that refers to the theoretical minimum concentration that produces an olfactory response or sensation. This point is called the odour threshold and defines one odour unit (OU).

Offensive odour

In practice, ‘offensive’ odour can only be judged by public reaction to the odour, preferably under similar social and regional conditions. The nuisance level can be as low as 2 OU and as high as 10 OU for less offensive odours. An odour assessment criterion of 7 OU is likely to represent the level below which ‘offensive’ odours should not occur. Therefore, the Technical Framework recommends that, as a design criterion, no individual should be exposed to ambient odour levels of greater than 7 OU (**99**th percentile, nose response time average).

Sensitive responses

The odour assessment criteria have been designed to take into account the range of sensitivity to odours within the community and to provide additional protection for individuals with a heightened response to odours. This is achieved by using a statistical approach, which depends upon population size. As the population density increases, the proportion of sensitive individuals is also likely to increase, indicating that more stringent criteria are necessary in these situations.

Cumulative impacts

The potential for cumulative odour impacts in relatively sparsely populated areas can be more easily defined and assessed than in highly populated urban areas. It is often not possible or practical to determine and assess the cumulative odour impacts of all odour sources that may impact on a receptor in an urban environment. Therefore, these odour assessment criteria allow for community expectations of amenity, for population density, cumulative impacts and anticipated odour levels during adverse meteorological conditions.

To ensure that offensive odour impacts are maintained within acceptable levels, the incremental increase in ambient odours due to emissions resulting from a facility's operations should be assessed against the odour assessment criteria. Where it is likely that two or more facilities with similar odour character will result in cumulative odour impacts, the combined odours due to emissions resulting from all nearby facilities should also be assessed against the odour assessment criteria.

Using the criteria

These criteria should be used routinely for the design and siting of a new facility, in addition to setting point-source emission limits. In addition, these criteria may be used during the ongoing management of a facility in order to develop odour mitigation strategies and point-source emission limits that may be required. For existing facilities, the Department of Environment and Conservation NSW will use the criteria on a case-by-case basis, in response to odour impact problems.

To quantitatively determine the frequency, intensity and duration of odours, the odour assessment criteria should be reported as the **100**th percentile of dispersion model predictions for Level 2 odour impact assessments and the **99**th percentile for Level 3 odour impact assessments. For point source discharges, stack-emission concentration limits can be included in the environment protection licence. This will help to ensure compliance with the odour assessment criteria.

The odour assessment criteria shall be applied at the nearest existing or likely future off-site sensitive receptor as follows:

1 Equation 3.1 shall be used to select the appropriate odour assessment criterion as a function of population density:

Equation 3.1

Odour assessment criterion (OU) = $(\log_{10}(\text{population}) - 4.5) / -0.6$

2 Impacts in OU must be reported as **peak concentrations** (i.e. approximately one second average).

3 For Level 2 impact assessments, impacts in OU must be reported as the 100th percentile of dispersion model predictions.

4 For Level 3 impact assessments, impacts in OU must be reported as the 99th percentile of dispersion model predictions.

5 For point sources, the results of the dispersion modelling shall be used as the basis for developing site-specific emission limits for odours.

3.2 Developing alternative odour assessment criteria

The following procedure (also set out in Figure 3.1) should be used for developing or modifying odour assessment criteria for complex odours. (Note: the Department of Environment and Conservation NSW should be contacted before undertaking development of alternative odour assessment criteria).

1 Identify the industry type requiring a variation to the generic odour assessment criteria.

2 Conduct odour sampling and dynamic olfactometry for all sources of odour on the site in accordance with the *Approved methods for the sampling and analysis of air pollutants in New South Wales*.

3 Install and operate a meteorological station in accordance with the procedures outlined in *Approved methods for the sampling and analysis of air pollutants in New South Wales*.

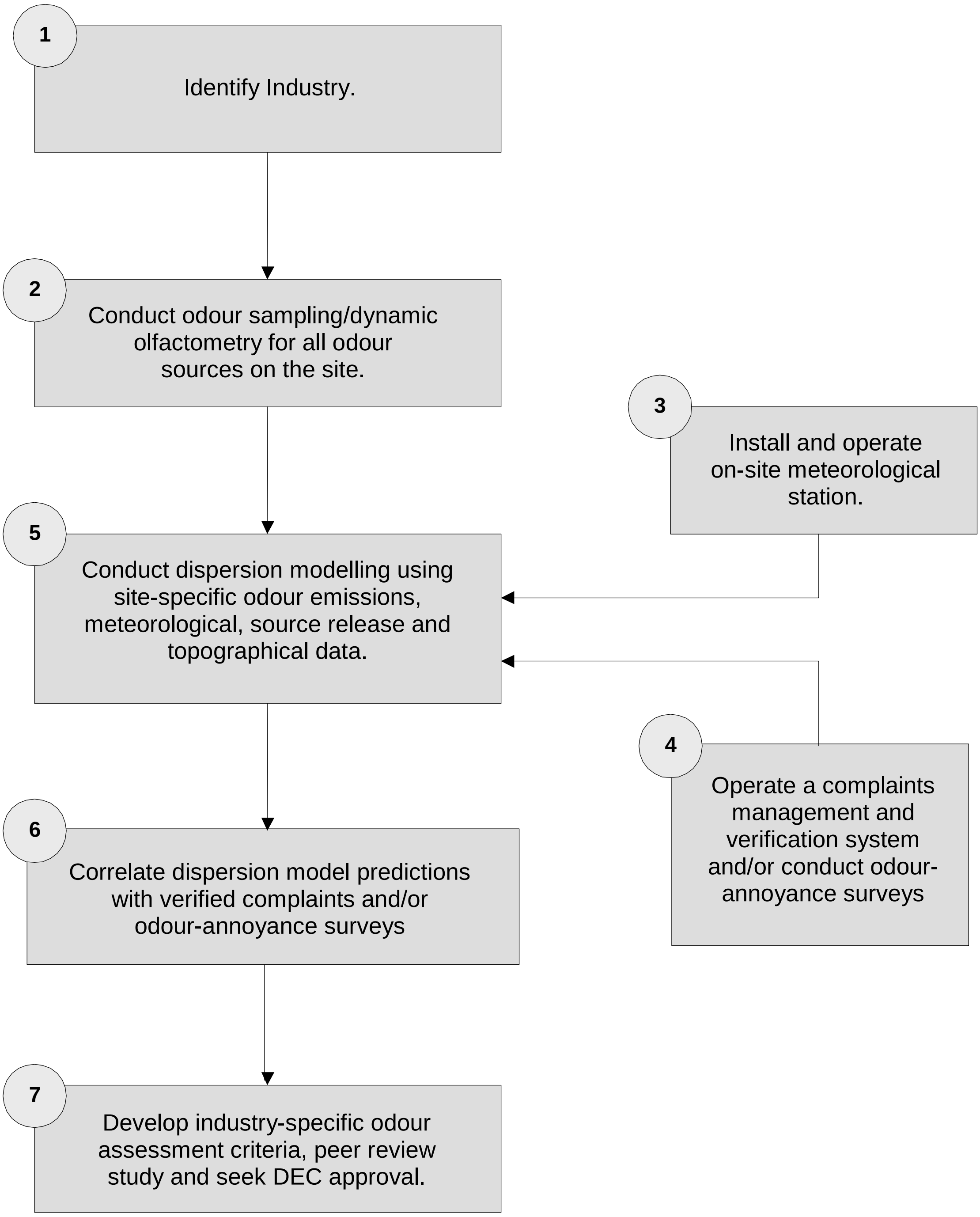
4 Design and implement a complaints management and verification system and/or carry out odour annoyance surveys.

5 Carry out a Level 3 odour impact assessment using site-specific odour emission rates, meteorological data, source release parameters, building-wake effect and topographical data and take into account any other site-specific peculiarities that may effect plume dispersion in accordance with the *Approved methods for the modelling and assessment of air pollutants in New South Wales*.

6 Correlate dispersion model predictions for a minimum period of one year with verified complaints and/or odour annoyance survey data for the same period.

7 Determine the predicted ground-level concentration of odour that corresponds with no complaints and/or annoyance, peer review the study and formally seek the Department of Environment and Conservation NSW approval to incorporate alternative odour assessment criteria for the specific industry into these Technical Notes.

Figure 3.1 Procedure for determining alternative odour assessment criteria



4 Point sources: Level 1 odour impact assessment

4.1 Introduction

The Level 1 odour impact assessment process is based on simple calculations. The assessment determines whether the proposed management practices and odour emission control equipment, in combination with the distance to the nearest sensitive receptor (and likely future sensitive receptors), the topography and meteorology of the site, will result in offensive odour impacts.

The Level 1 procedure specifically takes into account the following factors:

- type of odour (e.g. complex mixture or individual odorous pollutants)
- quantity of odour emissions
- proposed management practices
- proposed level of emission control
- local topography (which may effect plume dispersion)
- the presence of buildings (which may effect plume dispersion)
- worst case meteorology
- possibility of cumulative impacts (e.g. the presence of existing activities within an existing complex or at a nearby complex with a similar odour character).

The assessment is carried out to estimate potential compliance with the glc and/or odour assessment criteria (to minimise the likelihood of complaints).

This simple technique can be used to estimate the maximum allowable emission concentrations from existing stacks to ensure that offensive odours are not likely to occur. The affected zone can also be estimated.

Where new equipment is to be installed at a premises that already contains sources of similar air pollutants, the existing air quality should also be assessed. As maximum pollutant ground-level concentrations are additive, the sum total of all maximum ground-level concentrations should not exceed the glc and/or odour assessment criteria.

In situations where two or more stacks are to be located in close proximity, such that their separation is less than twice the uncorrected stack height, they may be regarded as a single source with mass emission rates equal to the sum of the individual sources.

The simple formulae, which follow, can be used as an initial ‘screening’ assessment for estimating odour impacts. This is an approximate method only. The required level of pollution control, stack height and licence limit conditions for glc pollutants and odours should be determined using either Level 2 or Level 3 dispersion modelling.

The procedures outlined contain estimates based on research but they need to be applied with care.

4.2 Overview of the Level 1 odour impact assessment procedure

1 Estimating the required stack height

Aims

For all **new and existing** point sources:

- determine whether management practices, emission control equipment and stack height are adequate
- estimate whether the glc and odour assessment criteria are likely to be met.

Step 1 (detailed in Section 4.3)

Step 1a Calculate the uncorrected stack height in **flat terrain**

- use Equation 4.1 for complex mixtures of odours
- use Equation 4.2 for glc pollutants.

Step 1b Adjust the stack height determined in step 1a for **hilly terrain**

- Use Equation 4.3 for either complex mixtures of odours or glc pollutants.

Step 1c Adjust the stack height determined in step 1b for **building-wake effects**

- Use Equations 4.4a or 4.4b for either complex mixtures of odours or glc pollutants.

2 Estimating the maximum recommended emission rate

Aims

For all **new and existing** point sources:

- determine whether management practices, emission control equipment and stack height are adequate
- determine if an existing stack will be adequate for dispersing odours from a new source
- estimate whether the glc and odour assessment criteria are likely to be met.

Step 2 (detailed in section 4.4)

Calculate the maximum recommended emission rate:

- use Equations 4.5a or 4.5b for complex mixtures of odours
- use Equations 4.6a or 4.6b for glc pollutants.

3 Estimating the maximum impingement concentrations on a building (e.g. airconditioning intakes)

Aims

For all **new and existing** point sources:

- determine whether management practices, emission control equipment and stack height are adequate
- estimate whether the glc and odour assessment criteria are likely to be met at elevated locations on a building (e.g. airconditioning intakes) or terrain feature, where there is a sensitive receptor (or likely future sensitive receptor).

Step 3 (detailed in section 4.5)

Calculate the maximum impingement concentration:

- use Equation 4.7 for complex mixtures of odours
- use Equation 4.8 for glc pollutants.

4 Estimating the affected zone

Aims

For all **new and existing** point sources:

- determine whether management practices, emission control equipment and stack height are adequate
- estimate whether the glc and odour assessment criteria are likely to be met within the existing separation distance to the nearest sensitive receptor (or likely future sensitive receptor).

Step 4 (detailed in section 4.6)

Calculate the affected zone:

- use Equation 4.9 for complex mixtures of odours
- use Equation 4.10 for glc pollutants.

4.3 Estimating the required stack height

Background to Step 1a: Calculate the uncorrected stack height in flat terrain

Make a first estimate of the uncorrected stack height h_u for an isolated stack in flat terrain.

Equation 4.1, for complex mixtures of odours

$$h_u = (0.5 \times D \times Q / oac)^{0.5}$$

h_u the uncorrected stack height in m

D odour emission concentration in OU

Q volumetric flow rate in m^3/s at 0 °C and 101.3 kPa

oac odour assessment criterion in OU, determined from *Approved Methods and Guidance for Modelling and Assessment of Air Pollutants in NSW* or Equation 3.1.

Equation 4.2, for glc pollutants

$$h_u = (0.1 \times M_o / glc)^{0.5}$$

h_u the uncorrected stack height in m

M_o mass emission rate of the glc pollutant in g/s

glc ground-level concentration criterion in g/m^3, selected from *Approved Methods and Guidance for Modelling and Assessment of Air Pollutants in NSW*.

In the unusual case where the stack has no buildings around it and is surrounded by flat terrain, h_u is the final height of the stack. If the stack is in flat terrain and there are buildings present, go to step 1c.

Background to Step 1b: Adjust the stack height (determined in step 1a) for hilly terrain

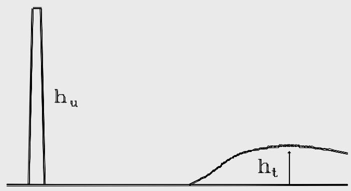
Any change in the terrain surrounding the stack, or any nearby building within a radius of ten isolated stack heights, means careful evaluation is needed. The presence of large obstacles such as hills near a stack will normally reduce the effective height of that stack. When compared to the isolated stack, maximum pollutant ground-level concentrations are higher and occur at distances nearer to the source.

This terrain correction procedure is not applicable to complex situations. In such situations, either Level 2 or Level 3 dispersion modelling will be required.

The simple terrain correction is undertaken by adding to the isolated stack h_u half the maximum increase in the height of hills or rising terrain h_t within a radius of ten stack heights from the location of the stack. This is called the terrain-corrected stack height h_{tc}.

Equation 4.3

$$h_{tc} = h_u + ½ \times h_t$$



h_{tc} terrain-corrected stack height in m

h_u uncorrected stack height in m

h_t terrain height within a radius of ten stack heights in m.

If there are no buildings present, this is the final height of the stack.

Background to Step 1c: Adjust the stack height (determined in step 1b) for building-wake effects

The presence of large obstacles such as buildings near a stack will normally reduce the effective height of that stack. When compared to the isolated stack, maximum pollutant ground-level concentrations are higher and occur at distances nearer to the source. The greatest effect occurs when the stack is attached to a building. The aerodynamic influence becomes less significant the further away the building is from the stack. For equivalent distances, a building causes greater downwash when it is upwind of the stack. In addition, the taller the stack in relation to the nearby building, the less significant the building effect. If the ratio of the stack height to the building height is greater than 2.5 to 1 the building effect is negligible. The building wake effect formulae provided represents the worst-case situation, where the stack is attached to a building. Therefore, the application of the formula to all cases will yield conservative results.

If the stack has a nearby building, the final height of the stack required to eliminate the aerodynamic effects of the building may be estimated from the following equation.

Equation 4.4a, for situations included in Table 4.1

$$h_{bw} = (A \times h_{tc}) + (B \times h_b)$$

h_{bw} stack height corrected for building-wake effect in m

htc terrain-corrected stack height in m.
When there are no terrain effects htc = hu

hb height of building to the roof ridge in m

A and B are selected from Table 4.1. and Figure 4.1, below.

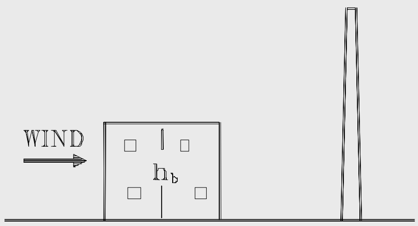
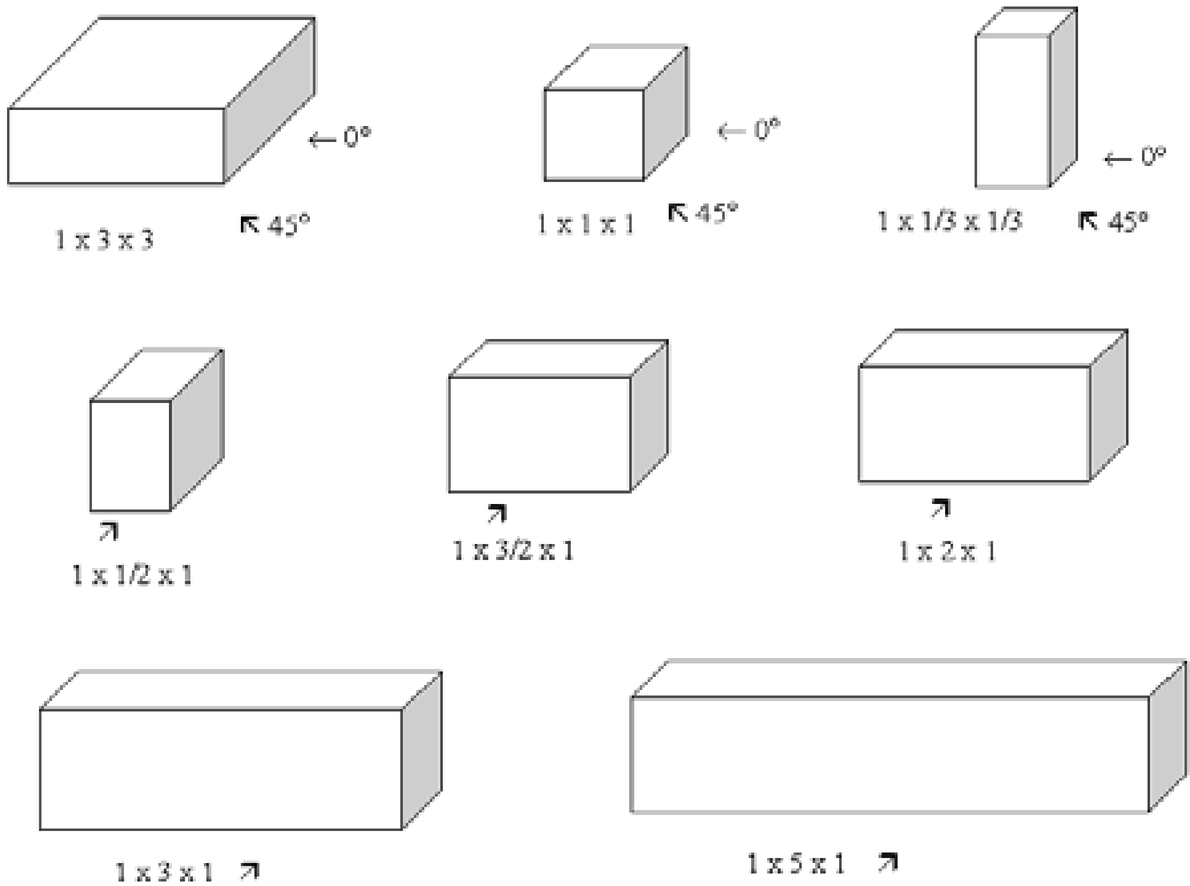


Table 4.1 Effective height coefficients

Building plan dimensions relative to h_b			Angle	A	B
W	**L**	**h_b**			
3	3	1	45	0.84	1.04
3	3	1	0	0.74	1.01
1	1	1	45	0.74	1.01
1	1	1	0	0.76	0.76
1/3	1/3	1	45	0.74	0.70
1/3	1/3	1	0	0.78	0.56
0.5	1	1	0	0.84	0.42
1.5	1	1	0	0.76	0.83
2	1	1	0	0.76	0.91
3	1	1	0	0.76	0.94
5	1	1	0	0.76	0.97
8	1	1	0	0.76	0.97
14	1	1	0	0.76	0.97

The building plan dimensions referred to above are the width-to-length (W:L) ratios relative to the building height (h_b). In all cases, the relative building height (h_b) has a value of 1. For a cluster of buildings, the dimensions of the envelope of that cluster should be used. The angle refers to the angle (in plan view) between the wind direction and the longitudinal axis of the building. That is, an angle of 0° denotes a wind direction normal to the building width (W) dimension. In most cases 0° should be used and 45° used when sensitive areas lie on the diagonal of the building.

Figure 4.1 Building shapes (height x width x length)



Equation 4.4b, for situations *not* included in Table 4.1

$h_{bw} = (0.56 \times C) + (0.375 \times h_b) + (0.625 \times h_{tc})$

h_{bw} stack height corrected for building-wake effect in m

C lesser of h_b and L in m

h_b height of building to the roof ridge in m

h_{tc} terrain-corrected stack height in m. When there are no terrain effects $h_{tc} = h_u$

L larger of the building width and length in m.

4.4 Estimating the maximum recommended emission rate

Background to Step 2

The following equations can be used to calculate the maximum emission rate to determine whether compliance with either the glc or the odour assessment criteria is likely.

Equation 4.5a, for complex mixtures of odours and situations included in Table 4.1

$$E_{OU} = oac \times ((h_{bw} – B \times h_b)/ A - ½ \times h_t)^2 / 0.5$$

Equation 4.5b, for complex mixtures of odours and situations *not* included in Table 4.1

$$E_{OU} = oac \times ((h_{bw} – 0.56 \times C – 0.375 \times h_b)/ 0.625 - ½ \times h_t)^2 / 0.5$$

Equation 4.6a for glc pollutants and situations included in Table 4.1

$$M_o = glc \times ((h_{bw} – B \times h_b)/ A - ½ \times h_t)^2 / 0.1$$

Equation 4.6b for glc pollutants and situations *not* included in Table 4.1

$$M_o = glc \times ((h_{bw} – 0.56 \times C – 0.375 \times h_b)/ 0.625 - ½ \times h_t)^2 / 0.1$$

E_{OU} odour emission rate in $OU.m^3/s$

h_{bw} stack height corrected for building-wake effect in m

h_b height of building to the roof ridge in m

h_t terrain height within a radius of ten stack heights in m

C lesser of h_b and L in m

oac odour assessment criterion in OU, determined from *Approved Methods and Guidance for Modelling and Assessment of Air Pollutants in NSW* or Equation 3.1

M_o mass emission rate of the odorous gas in g/s

glc ground-level concentration criterion in g/ m^3, selected from *Approved Methods and Guidance for Modelling and Assessment of Air Pollutants in NSW*.

A and B are selected from Table 4.1.

4.5 Estimating the maximum impingement concentrations on a building

Background to Step 3

Impingement may occur and produce high concentrations on the face of a building or on hills at a considerable distance downwind of the stack, especially under stable conditions.

A plume may impinge on a building downwind of a stack. If the following formula yields a value of greater than 1, then offensive odour problems may occur at the point of impingement.

Equation 4.7, for complex mixtures of odours

$$K = (35 \times E_{OU} / (oac \times X^2))$$

Equation 4.8, for glc pollutants

$$K = (7 \times M_o / (glc \times X^2))$$

K	impingement criterion (i.e. greater than 1 indicates that offensive odour impacts are likely)
E_{OU}	odour emission rate in $OU.m^3/s$. E_{OU} will need to be calculated using Equations 4.5a or 4.5b
X	distance from the stack in m
oac	odour assessment criterion in OU, determined from *Approved Methods and Guidance for Modelling and Assessment of Air Pollutants in NSW* or Equation 3.1
M_o	mass emission rate of the odorous gas in g/s. M_o will need to be calculated using equations 4.6a or 4.6b
glc	ground-level concentration criterion in g/m^3, selected from *Approved Methods and Guidance for Modelling and Assessment of Air Pollutants in NSW*.

The impingement formula contains the emission rate and separation distance alone and is independent of the height of the building. The assumption is that the centre of the plume impinges on the building. Again, this is the worst-case situation, yielding the most conservative result.

4.6 Estimating the affected zone

Background to Step 4

The maximum distance from a source at which either the glc or odour assessment criteria will not be met can be estimated from the following formula.

Equation 4.9, for complex mixtures of odours

$$d = (11.0 \times E_{OU} / oac)^{0.6}$$

Equation 4.10 for glc pollutants

$$d = (2.2 \times M_o / glc)^{0.6}$$

d	radius of the affected zone in m
E_{OU}	odour emission rate in $OU.m^3/s$. E_{OU} will need to be calculated using equations 4.5a or 4.5b
oac	odour assessment criterion in OU, determined from *Approved Methods and Guidance for Modelling and Assessment of Air Pollutants in NSW* or Equation 3.1
M_o	mass emission rate of the odorous gas in g/s. M_o will need to be calculated using equations 4.6a or 4.6b
glc	ground-level concentration criterion in g/m^3, selected from *Approved Methods and Guidance for Modelling and Assessment of Air Pollutants in NSW*.

4.7 Worked examples

Example 1

The following worked example is presented for a hypothetical food-processing plant using the emissions data shown in Table 4.2. The plant is located in an urban area. From Table 3.5 in *Approved methods and guidance for modelling and assessment of air pollutants in New South Wales* the appropriate odour assessment criterion is 2 OU.

Table 4.2 Emissions data for Example 1

Odour concentration (OU)	2000	D
Stack diameter (m)	0.4	–
Stack velocity (m/s)	2	–
Volumetric flow rate (m^3/s)	0.25	Q
Odour emission rate ($OU.m^3/s$)	503	E_{OU}
Building length (m)	30	–
Building width (m)	15	–
Building height (m)	15	h_b

In the following example, steps 1a, 1b, 1c, 3 and 4 are based on the data shown in Table 4.2 for a proposed development. Step 2 is based on an existing premises.

1a Estimate the uncorrected stack height in flat terrain using Equation 4.1

$h_u = (0.5 \times D \times Q / oac)^{0.5}$

$h_u = (0.5 \times 2000 \times 0.25 / 2)^{0.5}$

$h_u = 11.2$ m

1b Adjust the stack height determined in step 1a for hilly terrain, using Equation 4.3

$h_{tc} = h_u + ½ \times h_t$

The terrain is flat so no adjustment is required.

$h_{tc} = 11.2 + ½ \times 0$

$h_{tc} = 11.2$ m

1c Adjust the stack height determined in step 1b for building-wake effects, using Equation 4.4a

$h_{bw} = (A \times h_{tc}) + (B \times h_b)$

The building has a length-to-width ratio relative to h_b of 2:1 (30 m/15 m:15 m/15m). For this example, the most appropriate values of A and B from Table 4.2 are 0.76 and 0.91, respectively.

$h_{bw} = (0.76 \times 11) + (0.91 \times 15)$

$h_{bw} = 8.5 + 13.7$

$h_{bw} = 22.2$ m

The stack should extend 7.2 m beyond the height of the building.

2 Estimate the maximum desirable odour emission rate, using Equation 4.5a

Assume an existing food manufacturing plant has a stack 10 m tall that is not influenced by terrain or building-wake effects and the plant is located in an urban area.

E_{OU} = oac x ((h_{bw} – B x h_b) / A – ½ x h_t)^2 / 0.5

Since there are no terrain or building-wake effects, h_b = 0, h_t = 0, h_{bw} = h_u and A = 1.

E_{OU} = oac x ((h_u – B x 0) / A – ½ x 0)^2 / 0.5

E_{OU} = oac x h^2 / 0.5

E_{OU} = 2 x $(10)^2$ / 0.5

E_{OU} = 400 OU.m^3/s

The maximum odour emission rate for this stack should be approximately 400 OU.m^3/s.

3 Estimate the maximum impingement concentrations of odour on nearby buildings, using Equation 4.7

K = (35 x E_{OU}/(oac x X^2))

The nearest airconditioning intakes are located on a building approximately 100 m from the stack.

K = (35 x 503/ (2 x 100^2))

K = 0.88

Since K is less than 1, offensive odours should not occur.

4 Estimate the zone affected by offensive odour, using Equation 4.9

d = (11.0 x E_{OU} / oac)$^{0.6}$

d = (11.0 x 503 / 2)$^{0.6}$

d = 116 m

These simple calculations indicate that a stack height of at least 22 m would be a reasonable starting point for further design considerations. The affected zone would be approximately 116 m. Therefore, to ensure offensive odour impacts are minimised, there should be no sensitive receptors (or likely future sensitive receptors) located within 116 m.

Example 2

A proponent wishes to build a pipe-coating facility and will need to design the fume-extraction system to extract paint vapours. The major constituent present in the vapours that is likely to cause an odour problem is toluene. The plant is located in relatively flat terrain but will be subject to building-wake effects. All data is included in Table 4.3.

Table 4.3 Emissions data for Example 2

Emission rate (g/s)	10.5	M_o
Stack diameter (m)	1.6	–
Stack temperature (°K)	298	–
Stack velocity (m/s)	15	–
Building length (m)	50	–
Building width (m)	10	–
Building height (m)	10	h_b
glc (g/m^3)	$6.5x10^{-4}$	glc

In the following example, steps 1a, 1b, 1c, 3 and 4 are based on the data shown in Table 4.3 for a proposed development. Step 2 is based on an existing premises.

1a Estimate the uncorrected stack height in flat terrain, using Equation 4.2

$h_u = (0.1 \times M_o / glc)^{0.5}$

$h_u = (0.1 \times 10.5 / 6.50 \times 10^{-4})^{0.5}$

$h_u = 40.19$ m

1b Adjust the stack height determined in step 1a for hilly terrain, using Equation 4.3

$h_{tc} = h_u + ½ \times h_t$

The terrain is flat so no adjustment is required.

$h_{tc} = 40.19 + ½ \times 0$

$h_{tc} = 40.19$ m

1c Adjust the stack height determined in step 1b for building-wake effects, using Equation 4.4a

$h_{bw} = (A \times h_{tc}) + (B \times h_b)$

The building has a length-to-width ratio relative to h_b of 5:1 (50 m/10 m:10 m/10m). For this example, the most appropriate values of A and B from Table 4.2 are 0.76 and 0.97, respectively.

$h_{bw} = (0.76x40.19)+(0.97x10)$

$h_{bw} = 30.54 + 9.7$

$h_{bw} = 40.24$ m

2 Estimate the maximum desirable toluene emission rate, using Equation 4.6a

Assume an existing plant has a stack 50 m tall that is not influenced by terrain or building-wake effects.

$M_o = glc \times ((h_{bw} - B \times h_b) / A - ½ \times h_t)^2 / 0.1$

Since there are no terrain or building-wake effects $h_b = 0$, $h_t = 0$, $h_{bw} = h_u$ and $A = 1$.

$M_o = glc \times h^2 / 0.1$

$M_o = 6.5\times10^{-4} \times (50)^2 / 0.1$

$M_o = 16.25$ g/s

The maximum toluene emission rate should be approximately 16.25 g/s.

3 Estimate the maximum impingement concentrations of toluene on nearby buildings, using Equation 4.8

$K = (7 \times M_o / (glc \times X^2))$

The nearest air conditioning intakes are located on a building approximately 400 m from the stack.

$K = (7\times16{,}154/400^2)$

$K = 0.71$

Since K is less than 1, offensive odours due to toluene should not occur.

4 Estimate the zone affected by offensive odour, using Equation 4.10

$d = (2.2 \times M_o / glc)^{0.6}$

$d = (2.2 \times 16/154)^{0.6}$

$d = 537$ m

These simple calculations indicate that a stack height of at least 40 m would be a reasonable starting point for further design considerations. The affected zone would be approximately 550 m. Therefore, to ensure offensive odour impacts are minimised, there should be no sensitive receptors (or likely future sensitive receptors) located within 550 m.

5 Broiler chicken farms: Level 1 odour impact assessment

5.1 Introduction

This chapter sets out how to calculate separation distances for proposed broiler chicken farms that would use current standard production technology. The prescribed distances have been found to lead to an acceptable air quality impact on the amenity of the local environment.

The composite site factors and the resultant separation distances are applicable for a range of situations that would include most existing broiler chicken farms and management practices. The separation distances calculated here could be adjusted if new technology is used and it can be demonstrated and quantified that the technology will reduce odour.

This methodology allows broiler chicken shed numbers to be varied according to the management standards proposed and achieved. The distance between the broiler chicken sheds and impact areas is not increased proportionally to the number of broiler chicken sheds but is more in accordance with the probable pattern of odour dispersion. This means that large broiler chicken farms are not sited unnecessarily long distances away from impact areas.

Adopting this separation distance and broiler chicken shed numbers system will help to minimise the air quality impact associated with broiler chicken farms.

Objectives of the impact assessment

The impact assessment aims to ensure that offensive odours do not cause unreasonable interference to the community.

Acceptable impact standard

A broiler chicken farm should not have an unreasonable impact on the amenity of the local environment and should comply with the provisions for offensive odours contained in section 129 of the POEO Act.

Approved operating practices

The most effective way of reducing offensive odour impacts is by implementing good design, good management practices and appropriate separation distances.

Environmental pollution, such as offensive odours, can be controlled by good broiler chicken shed design, good management practices, restricting broiler chicken shed numbers and maintaining suitable separation distances between broiler chicken sheds and impact areas.

All activities that are likely to increase emissions of odours, such as manure cleaning and manure spreading, should be performed at a time of day and in weather conditions which cause least odour emission and impact on neighbouring properties.

Separation distances

Variable separation distances are measured from the closest odour emission point of the broiler chicken farm to the closest point of a receptor.

Variable separation distances are based on the dispersion of odours from the source. They are used to determine the allowable numbers of broiler chicken sheds and the management practices necessary to satisfy air quality objectives. A weighting factor allows for different types of premises.

5.2 Variable separation distances

Calculating the number of broiler chicken sheds or the size of the separation distance

The following equations assume that broiler chicken sheds are all approximately 100 m by 13 m in size and contain 22,000 chickens.

The equations provide estimates of the allowable broiler chicken shed numbers (N) at any one time, for a site at distance D metres from a receptor, or the distance required for a specified number of broiler chicken sheds.

Equation 5.1 is for calculating broiler chicken shed numbers for a given separation distance. Conversely, Equation 5.2 is for calculating separation distance for a given number of broiler chicken sheds.

Equation 5.1, Allowable broiler chicken shed numbers, given the distance

$$N = (D \div S)^{1.4}$$

Equation 5.2, Separation distance, given the number of broiler chicken sheds

$$D = (N)^{0.71} \times S$$

N Number of standard broiler chicken shed units (SBCSU) (1 SBCSU is equivalent to 22,000 broiler chickens)

D Separation distance in metres between the closest points of the broiler chicken sheds and the most sensitive receptor or impact location

S Composite site factor = S1 x S2 x S3 x S4 x S5. Site factors S1, S2, S3, S4 and S5 relate to shed design, receptor, terrain, vegetation and wind frequency. See Tables 5.1 to 5.5.

5.3 Composite site factor

The value of S to apply in Equations 5.1 or 5.2 depends on site-specific information pertaining to the proposed shed type, receptor, terrain, vegetation and wind frequency, as set out in the following tables.

Shed factor, S1

The shed factor S1 depends on how the shed is ventilated and is determined from Table 5.1. If some sheds will have controlled fan ventilation and some have natural ventilation, S1 is proportional to the numbers of each type of shed.

Table 5.1 Shed factor, S1

Shed type	Value
Controlled fan ventilation without barriers [1]	980
Controlled fan ventilation with barriers	690
Natural ventilation	690

Receptor factor, S2

The receptor factor S2 varies depending on the likely impact area and is determined from Table 5.2.

Impact location may be a neighbour's house, small town or large town that may be affected by odour generated at the broiler chicken sheds. Any likely future receptor locations should also be considered.

For a town, the distance is measured from the closest point of the proclaimed town boundary. For a rural farm residence, the distance is the closest part of the residence itself, excluding any yards.

Table 5.2 Receptor factor, S2

Receptor type	Value
Large towns, greater than 2000 persons	1.05
Medium towns, 500–2000 persons	0.75
Medium towns, 125–500 persons	0.55
Small towns, 30–125 persons	0.45
Small towns, 10–30 persons	0.35
Single rural residence	0.30
Public area (occasional use)	0.05*

* The value for a public area would apply to areas subject to occasional use. Higher values may be appropriate for public areas used frequently or sensitive in nature, such as frequently used halls and recreation areas. These should be assessed individually.

Terrain factor, S3

The terrain factor S3 varies according to topography and its ability to disperse odours and is determined from Table 5.3.

Flat is regarded as less than 10% upslope, 2% downslope and not in a valley drainage zone.

High relief is regarded as upslope terrain or a hill that projects above the 10% rising slope from the broiler chicken sheds. Thus the receptor location will be either uphill from the broiler chicken sheds, behind a significant obstruction or have significant hills and valleys between the sheds and the receptor.

Low relief is regarded as terrain which is generally below the 2% falling slope from the broiler chicken sheds. Thus the receptor will be downhill from the broiler chicken sheds.

Undulating hills is regarded as terrain where the topography consists of continuous rolling, generally low level hills and valleys with minimal vegetation cover, but without sharply defined ranges, ridges or escarpments.

A **valley drainage zone** has topography at low relief (as above) with significant confining sidewalls.

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[1] Barriers – walls, berms and other structures designed to mitigate dust and odour emissions from controlled fan ventilated sheds.

Topographical features at the selected site may adversely affect the odour impact under certain circumstances. During the early evening or night time, under low wind speed conditions, population centres located in a valley at a lower elevation than a broiler chicken farm may be subject to higher odour concentrations as a result of down-valley wind or the occurrence of low-level inversions. Unless site-specific information has been gathered under conditions dominated by low wind speeds, the value for the factor S3 given in Table 5.3 should apply.

Table 5.3 Terrain factor, S3

Terrain	Value
Valley drainage zone	2.0
Low relief	1.2
Flat	1.0
Undulating country between broiler chicken farm and receptor	0.9
High relief or significant hills and valleys between broiler chicken farm and receptor	0.7

Vegetation factor, S4

The vegetation factor S4 varies according to vegetation density, as shown in Table 5.4. The vegetation density is assessed by the effectiveness with which the vegetation stand will reduce odour by dispersion. Tree cover should be maintained, as far as practicable, for the life of broiler chicken sheds.

Few trees, long grass is regarded as open country with a permanent covering of grass or pasture of around l m or more in height and with a light scattering of timber which is distributed continuously across the buffer area. Topography would be predominantly flat to slightly undulating. Isolated clumps of trees would not be sufficient to attract this concession. Land being actively cropped would not attract this concession because of the extended periods when it is bare or carrying only very low ground cover.

Wooded country is regarded as open forest country with tree density not sufficient to provide a continuous canopy, but sufficiently dense to influence air movement. There would be little or no lower storey vegetation. The density needs to be such that the vegetation can be considered as a contiguous belt and isolated clumps would not attract this concession. The minimum tree height is 4 m and the minimum extent in the direction of the receptor is 400 m.

Heavy timber is regarded as tall forest areas with dense timber stands providing a continuous canopy. There is limited understorey vegetation, mainly associated with regrowth. The minimum tree height is 4 m and the minimum extent in the direction of the receptor is 400 m.

Heavy forest, upper and lower storey is regarded as dense layers of taller timber with an interlocking canopy and with extensive amounts of lower storey vegetation of various species resulting in almost complete ground cover and a dense upper canopy. Examples are uncleared brigalow areas and dense eucalypt forests where little or no clearing or harvesting have occurred. The minimum tree height is 4 m and the minimum extent in the direction of the receptor is 400 m.

The values suggested for S4 given in Table 5.4 should be used with care. No concession should be given for an *intention* to plant a barrier and should a premises fail to maintain a stipulated barrier then a reduction in the allowed number of broiler chicken sheds would be necessary.

To improve visual amenity and odour dispersion, premises should be encouraged to plant and maintain upper- and lower-storey vegetation that would not cast shadows on the broiler chicken sheds.

Table 5.4 Vegetation factor, S4

Vegetation	Value
Crops only, no tree cover	1.0
Few trees, long grass	0.9
Wooded country	0.7
Heavy timber	0.6
Heavy forest (both upper and lower storey)	0.5

Wind frequency factor, S5

The wind frequency factor S5 is determined from Table 5.5. The wind speed and direction varies annually and diurnally (that is by the season and by the hour of the day). Although there is generally one direction that is the most frequently observed (prevailing wind), the wind direction usually blows from all directions at some time.

The wind can be classed as **high frequency** towards the receptor if the wind is blowing towards the receptor (± 40 degrees) with a frequency of at least 60 % of the time for all hours over a whole year.

The wind can be classed as **low frequency** towards the receptor if the wind is blowing towards the receptor (± 40 degrees) with a frequency of less than 5 % of the time for all hours over a whole year.

Table 5.5 Wind frequency factor, S5

Wind frequency	Value
High frequency towards receptor (greater than 60%)	1.5
Normal wind conditions	1.0
Low frequency towards receptor (less than 5%)	0.7

Applying the equations

Waste and manure stockpiles

When working out separation distances, all waste and manure/litter stockpile areas should be regarded as part of the broiler shed complex until evidence dictates otherwise.

Large broiler chicken farms or complex sites

If a proponent of a broiler chicken farm can demonstrate a clear ‘pass’ at Level 1 odour impact assessment, there is no need to undertake Level 2 or 3 assessment, regardless of the size of the development, unless there are special risk factors.

Special risk factors include:

- topographic or meteorological features (eg katabatic drift) that may funnel the odour plume or cause it to accumulate;
- a populated area located just outside the calculated separation distance.

It is the proponent’s responsibility to justify the adequacy of level 1 assessment in a particular circumstance. Where doubt exists, the proponent should seek advice from the consent authority responsible for the particular development. For all scheduled developments (more than 250,000 birds) advice should be sought from the EPA.

5.4 Two broiler chicken farms in close proximity

The following applies to separation distances, as determined by Equation 5.2.

Where a second broiler chicken farm is proposed (whether on the same or another property) the two broiler chicken farms may need to be considered as one or separate broiler chicken farms depending on their distance from each other and their distance from the receptor in question. Further, if they are considered as separate entities, the separation distance between the second broiler chicken farm and a receptor may need to be modified.

Two broiler chicken farms considered as one

For calculating the separation distance to a receptor, the two broiler chicken farms can be considered as one single broiler chicken farm if they are closer than **half the shortest separation distance** from each broiler chicken farm to the receptor.

For example, if two broiler chicken farms have individual separation distances of 400 metres and 600 metres from a receptor, then they shall be assumed to be one broiler chicken farm for the purpose of calculating separation distances if they are closer than 200 metres from one another. If the broiler chicken farms are further apart than 200 metres, they shall be treated as separate broiler chicken farms.

Two broiler chicken farms considered separately

Where the two broiler chicken farms are considered as separate entities, a 20% increase in separation distance may apply to the proposed second broiler chicken farm. For each broiler chicken farm:

1 add 20% to the required separation distance

2 consider this distance as the radius of a ‘separation zone’

3 determine whether the two zones overlap.

If the zones overlap, the added 20% applies to the separation distance of the second broiler chicken farm. If the zones don’t overlap, the ‘normal’ separation distance applies and the separation distance of the existing broiler chicken farm is not affected for its current level of operation. This situation is illustrated in Figure 5.1.

These calculations would need to be undertaken for all types of sensitive receptors (and likely future sensitive receptors) to ensure that appropriate separation distances are provided.

5.5 Report requirements

The report of the Level 1 odour impact assessment must contain the information specified below. The information required for each category, in particular Shed Factor (S1), focuses on identifying and managing potential odour sources, not general operation and pollution control.

Variable separation distance calculation

- Number of standard broiler chicken shed units (SBCSU).
- Calculated separation distance using equation 5.2.

Shed factor, S1

- Layout of the site clearly showing all operations carried out on the premises.
- A detailed discussion of all potential odour generating operations carried out on the site.
- Descriptions that clearly identify and explain all pollution control equipment and management practices for all potential odour generating operations on the premises.
- A description of all aspects of any odour controls, with particular regard to any fugitive emission capture systems (e.g. hooding, ducting), treatment systems (e.g. scrubbers, bio-filters) and discharge systems (e.g. stack, volume or area).

Receptor factor, S2

- Layout of the site clearly showing:
  - all emissions sources
  - plant boundary, and
  - sensitive receptors (e.g. nearest residences, towns etc).

Terrain factor, S3

- Description of the terrain including:
  - site-specific survey supported by report, or
  - 3-dimensional contour plot, or
  - topographical map, or
  - orthophotomap, or
  - 2-dimensional cross-section between odour sources and receptors.

Vegetation factor, S4

- Description of the vegetation including:
  - site-specific survey supported by report, or
  - vegetation map, or
  - aerial photograph.

Wind frequency factor, S5

- Description of the prevailing dispersion meteorology at the proposed site including:
  - wind rose diagrams, or
  - joint frequency distribution of wind speed and wind direction, or
  - 1 year of site-representative records of hourly average wind speed and wind direction.

5.6 Example separation distance calculations

Example 1: Two standard broiler chicken sheds

Scenario

A broiler chicken farm with two standard size sheds, full natural ventilation, flat topography, no significant trees and normal wind conditions.

Site data

S1	690	(Table 5.1, Natural ventilation)
S2	0.3 for a house and 0.55 for a town > 125 people (Table 5.2)	
S3	1.0	(Table 5.3, Flat topography)
S4	1.0	(Table 5.4, No tree cover)
S5	1.0	(Table 5.5, Normal wind frequency)

Equation 5.2

$D = (N)^{0.71} \times S$

Calculation

The minimum distance from a rural residence is:

$(2)^{0.71} \times 690 \times 0.3 \times 1.0 \times 1.0 \times 1.0 = 339$ m

The minimum distance from a town >125 people is:

$(2)^{0.71} \times 690 \times 0.55 \times 1.0 \times 1.0 \times 1.0 = 621$ m

Example 2: Five standard broiler chicken sheds

Scenario

A broiler chicken farm with five standard size sheds, full natural ventilation, flat topography, no significant trees and normal wind conditions.

Site data

S1	690	(Table 5.1, Natural ventilation)
S2	0.3 for a house and 0.55 for a town > 125 people (Table 5.2)	
S3	1.0	(Table 5.3, Flat topography)
S4	1.0	(Table 5.4, No tree cover)
S5	1.0	(Table 5.5, Normal wind frequency)

Equation 5.2

$D = (N)^{0.71} \times S$

Calculation

The minimum distance from a rural residence is:

$(5)^{0.71} \times 690 \times 0.3 \times 1.0 \times 1.0 \times 1.0 = 649$ m

The minimum distance from a town >125 people is:

$(5)^{0.71} \times 690 \times 0.55 \times 1.0 \times 1.0 \times 1.0 = 1190$ m

Example 3: Five standard broiler chicken sheds

Scenario

A broiler chicken farm with five standard size sheds, full natural ventilation, significant hills between the farm and a neighbouring house, wooded country and high frequency of winds towards the house.

Site data

S1	690	(Table 5.1, Natural ventilation)
S2	0.3 for a house and 0.55 for a town > 125 people (Table 5.2)	
S3	0.7	(Table 5.3, High relief topography)
S4	0.7	(Table 5.4, Wooded country)
S5	1.5	(Table 5.5, High wind frequency towards house)

Equation 5.2

$D = (N)^{0.71} \times S$

Calculation

The minimum distance from a rural residence is:

$(5)^{0.71} \times 690 \times 0.3 \times 0.7 \times 0.7 \times 1.5 = 477$ m

The minimum distance from a town >125 people is:

$(5)^{0.71} \times 690 \times 0.55 \times 0.7 \times 0.7 \times 1.5 = 875$ m

Example 4: Two non-standard sheds of 40,000 birds

Scenario

A broiler chicken farm with two sheds each containing 40,000 birds, full natural ventilation, significant hills between the farm and a neighbouring house, heavy timber and normal winds to a neighbouring house and small town.

Site data

S1	690	(Table 5.1, Natural ventilation)
S2	0.3 for a house and 0.55 for a town > 125 people (Table 5.2)	
S3	0.7	(Table 5.3, High relief topography)
S4	0.6	(Table 5.4, Heavy timber)
S5	1.0	(Table 5.5, Normal wind conditions)

Equation 5.2

$D = (N)^{0.71} \times S$

Calculation

The number of standard sheds is:

2 x 40,000/22,000 = 80,000/22,000 = 3.63 standard sheds

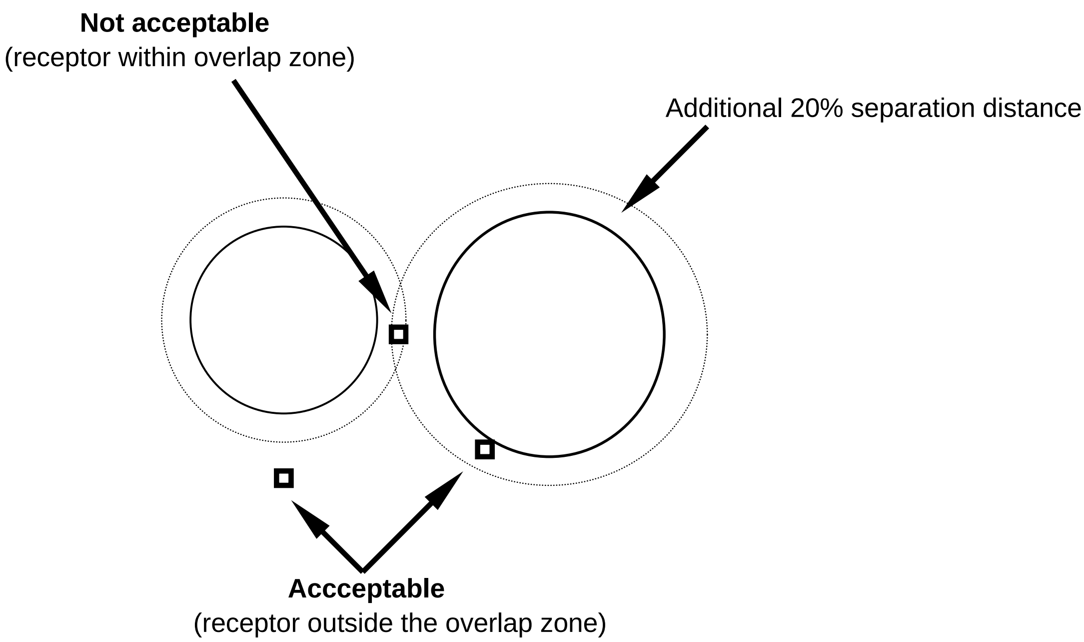
The minimum distance from a rural residence is:

$(3.63)^{0.71} \times 690 \times 0.3 \times 0.7 \times 0.6 \times 1.0 = 217$ m

The minimum distance from a town >125 people is:

$(3.63)^{0.71} \times 690 \times 0.55 \times 0.7 \times 0.6 \times 1.0 = 399$ m

Figure 5.1 Two broiler chicken farms considered separately



6 Intensive piggeries: Level 1 odour impact assessment

6.1 Introduction

This chapter sets out how to calculate separation distances for proposed piggeries that would use current standard production technology. The prescribed distances have been found to lead to an acceptable impact on the amenity of the local environment.

The composite site factors and the resultant separation distances are applicable for a range of situations that would include most existing piggeries, effluent management systems and management practices. The separation distances calculated here could be adjusted if new technology is used and it can be demonstrated and quantified that the technology will reduce odour.

This methodology allows pig numbers to be varied according to the management standards proposed and achieved. The distance between the piggery and impact areas is not increased proportionally to the number of pigs but is more in accordance with the probable pattern of odour dispersion. This means that large piggeries are not sited unnecessarily long distances away from impact areas.

Adopting this separation distance and pig numbers system will help to minimise the air quality impact associated with piggeries.

Objectives of the impact assessment

The impact assessment aims to ensure that offensive odours do not cause unreasonable interference to the community.

Acceptable impact standard

A piggery should not have an unreasonable impact on the amenity of the local environment and should comply with the provisions for offensive odours contained in section 129 of the POEO Act.

Approved operating practices

The most effective way of reducing odour potential is by implementing good design, good management practices and appropriate separation distances.

Environmental pollution, such as offensive odours, can be controlled by good piggery design, good management practices, by restricting pig numbers and maintaining suitable separation distances between piggeries and impact areas.

All activities that are likely to increase emissions of odours, such as manure spreading or effluent irrigation, should be performed at a time of day and in weather conditions which cause least odour emission and impact on neighbouring properties.

Separation distances

Variable separation distances are measured from the closest odour emitting point of the piggery to the closest point of a receptor.

Variable separation distances are based on the dispersion of odours from the source. They are used to determine the allowable numbers of pigs and the management practices necessary to satisfy air quality objectives. A weighting factor allows for different types of premises.

6.2 Variable separation distances

Calculating the number of pigs or the size of the separation distance

The equations provide estimates of the allowable pig numbers (N) at any one time for a site at distance D metres from a receptor, or the distance for a specified number of pigs.

Equation 6.1 is for calculating pig numbers for a given separation distance. Conversely, Equation 6.2 is for calculating separation distance for a given number of pigs.

Equation 6.1, Allowable pig numbers, given the distance

$$N = (D / (50 \times S))^2$$

Equation 6.2, Separation distance, given the pig numbers

$$D = \sqrt{N} \times 50 \times S$$

N Number of standard pig units (SPU). A standard pig unit is defined as a grower pig of 26–60 kilograms live weight. See Table 6.1 for converting other types and weights of pig to SPU

D Separation distance in metres between the closest points of the piggery and the most sensitive receptor or impact location

S Composite site factor = S1 x S2 x S3 x S4 x S5. Site factors S1, S2, S3, S4 and S5 are determined according to site-specific information relating to shed design, maintenance schedule, receptor, terrain, vegetation and wind factor. See Tables 6.2 to 6.7.

Standard pig units (SPUs)

Piggeries either have a range of pigs, from farrowing to finisher, or only one type of pig (e.g. growers). Larger pigs usually produce more manure and hence have a greater potential for odour production. For a piggery growing from farrowing to finishers, the number of standard pig units (SPU) can be estimated by multiplying the total number of sows by ten. Table 6.1 can be used for more refined calculations.

Table 6.1 Standard pig units conversion table

Type of pig	Approximate weight range (kg)	Number of standard pig units (SPU)
Lactating sows	160–250	2.5
Gestating sow	160–250	1.8
Gilt	100–160	1.8
Heavy finisher	100-125	1.8
Boar	100–250	1.6
Finisher	61–100 (75)	1.6
Grower	26–60 (40)	1.0
Weaners	8–25 (16)	0.5
Suckers/early weaners	1.4–8	0.1

Final pig numbers are calculated from Table 6.1 using the approximate live weight and type. Total standard pig numbers are calculated by multiplying the number of pigs in each class by the above conversion factors and then adding the totals.

Worked example, SPU conversion factors

For a piggery with 330 weaners, 250 growers and 250 finishers the total number of SPU is:

(330 x 0.5) + (250 x 1) + (250 x 1.6) = 815 SPU.

6.3 Composite site factor

The value of S to apply in Equations 6.1 or 6.2 depends on site-specific information pertaining to the proposed shed design, maintenance schedule, receptor, terrain, vegetation and wind frequency, as set out in the following tables.

Odour potential factor, S1

The odour potential factor S1, for each class of piggery, varies with the shed design and maintenance schedule. It can be determined from Table 6.2 by multiplying the factors together ie. A x B x C x D x E. The S1 factor can be no lower than 0.5.

The reduction factor could be adjusted if there is a new technology that can be demonstrated and quantified to reduce the odour.

Table 6.2 Odour potential factor, S1

	Odour potential factors	Value
A	**Type of building**	
	1 Slatted floor and deep pit	1.0
	2 Partly slatted floor and shallow pit or open drain with regular flushing	0.9
	3 Partly slatted floor and sloping floor and regular flushing	0.8
	4 Partly slatted floor and 'pull plug' and recharge system	0.6
B	**Ventilation of buildings**	
	1 Limited ridge and side-ventilators (or side only) or limited forced (fan) ventilation	1.0
	2 Ridge ventilators which are at least 90% of the roof length and are at least 10% of the roof width and side ventilators are at least 90% of the length of the two long sides of the building and at least 30% of the side wall height, with roof and walls insulated	0.9
	3 Fan forced ventilated shed with well designed uniform ventilation throughout shed	0.9
C	**Effluent collection frequency within all pig buildings**	
	1 Faeces, urine and other biological material removed from the confines of the buildings every 24 hours or less often	1.0
	2 Faeces, urine and other biological material removed from the confines of the buildings while essentially aerobic but in no case less often than 24 hours	0.9
D	**Effluent treatment system (within the piggery compound)**	
	1 Anaerobic lagoon(s) (including all inlet pipes/channels)	1.0
	2 Series lagoons anaerobic/aerobic (or facultative) and evaporation lagoons	1.0
	3 Facultative lagoon(s) (including all inlet pipes/channels)	0.95
	4 Aerated lagoon(s) (aerobic surface layer over entire lagoon)	0.75
	5 Aerobic lagoon(s)	0.6
	6 No effluent storage within at least 500 m of the piggery	0.6
E	**Feeding**	
	1 Conventional feeding	1.0
	2 Phase feeding	0.9
	3 Phase feeding with optimal protein	0.8

Note about S1 factor

- S1 = A x B x C x D x E
- Assumes a reasonably high standard at all piggeries, which is achieved by good management and control of odour-generating procedures. Table 6.2 gives factors which relate to the odour potential for different shed types and effluent management systems. Generally the factors would be 1.0 and lower. Hence if 1.0 is used the separation distances will be the maximum. Separation distances would be less for developments with lower potential odour emissions.
- The S1 factor can be no lower than 0.5.
- The S1 factor could be adjusted if there is new technology, which can be demonstrated and quantified to reduce the odour.
- Where different production systems, as set out in Table 6.2, apply within the piggery, several S1 factors should be selected according to the SPU within each production system.

Litter-based systems

The S1 factor for litter-based systems stocked at recommended rates with good management practices is 0.5. Where stocked at higher rates and/or without good management the S1 factor is 0.75.

For litter-based systems the odour potential depends on the stocking density. When calculating the space required, consideration must always be given to the final or outgoing weight and age of the pigs. For a guide to minimum stocking densities see the following table. As new research data and further experience with litter-based systems is gained then these stocking densities may be adjusted.

Table 6.3 Litter-based system stocking densities

Pig age (weeks)	Pig weight (kg)	Stocking area (m^2/pig)
3	6	0.2
6	13	0.3
9	24	0.4
12	35	0.5
15	50	0.7
18	65	0.8
21	82	0.9
24	102	1.0
>52	>160	3.0

Receptor factor, S2

The receptor factor S2 varies depending on the likely impact area and is determined from Table 6.4.

Impact location may be a neighbour's house, small town or large town that may be affected by odour generated at the piggery. Any likely future receptor locations should also be considered.

For a town, the distance is measured from the closest point of the proclaimed town boundary. For a rural farm residence, the distance is the closest part of the residence itself, excluding any yards.

Table 6.4 Receptor factor, S2

Receptor type	Value
Large towns, greater than 2000 persons	1.6
Medium towns, 500–2000 persons	1.2
Medium towns, 125–500 persons	1.1
Small towns, 30–125 persons	1.0
Small towns, 10–30 persons	0.6
Single rural residence	0.3
Public area (occasional use)	0.05*

* The value for a public area would apply to areas subject to occasional use. Higher values may be appropriate for public areas used frequently or sensitive in nature, such as frequently used halls and recreation areas. These should be assessed individually.

Terrain factor, S3

The terrain factor S3 varies according to topography and its ability to disperse odours and is determined from Table 6.5.

Flat is regarded as less than 10% upslope, 2% downslope and not in a valley drainage zone.

High relief is regarded as upslope terrain or a hill that projects above the 10% rising slope from the piggery. Thus the receptor location will be either uphill from the piggery, be behind a significant obstruction or have significant hills and valleys between the piggery and the receptor.

Low relief is regarded as terrain which is generally below the 2% falling slope from the piggery. Thus the receptor will be downhill from the piggery.

Undulating hills is regarded as terrain where the topography consists of continuous rolling, generally low level hills and valleys with minimal vegetation cover, but without sharply defined ranges, ridges or escarpments.

A **valley drainage zone** has topography at low relief (as above) with significant confining sidewalls.

Topographical features of the selected site may adversely affect the odour impact under certain circumstances. During the early evening or night time under low wind speed conditions, population centres located in a valley complex at a lower elevation than a piggery may be subject to higher odour concentrations as a result of down-valley wind or the occurrence of low-level inversions. Unless site-specific information has been gathered under conditions dominated by low wind speeds, the value for the factor S3 given in Table 6.5 should apply.

Table 6.5 Terrain factor, S3

Terrain	Value
Valley drainage zone	2.0
Low relief	1.2
Flat	1.0
Undulating country between piggery and receptor	0.9
High relief or significant hills and valleys between piggery and receptor	0.7

Vegetation factor, S4

The vegetation factor S4 varies according to vegetation density and is determined from Table 6.6. The vegetation density is assessed by the effectiveness with which the vegetation stand will reduce odour by dispersion.

Few trees, long grass is regarded as open country with a permanent covering of grass or pasture of around l m or more in height and with a light scattering of timber which is distributed continuously across the buffer area. Topography would be predominantly flat to slightly undulating. Isolated clumps of trees would not be sufficient to attract this concession. Land being actively cropped would not attract this concession because of the extended periods when it is bare or carrying only very low ground cover.

Wooded country is regarded as open forest country with tree density not sufficient to provide a continuous canopy, but sufficiently dense to influence air movement. There would be little or no lower storey vegetation. The density needs to be such that the vegetation can be considered as a contiguous belt and isolated clumps would not attract this concession. The minimum tree height is 4 m and the minimum extent in the direction of the receptor is 400 m.

Heavy timber is regarded as tall forest areas with dense timber stands providing a continuous canopy. There is limited understorey vegetation, mainly associated with regrowth. The minimum tree height is 4 m and the minimum extent in the direction of the receptor is 400 m.

Heavy forest, upper and lower storey is regarded as dense layers of taller timber with an interlocking canopy and with extensive amounts of lower storey vegetation of various species resulting in almost complete ground cover and a dense upper canopy. Examples are uncleared brigalow areas and dense eucalypt forests where little or no clearing or harvesting have occurred. The minimum tree height is 4 m and the minimum extent in the direction of the receptor is 400 m.

The tree cover should be maintained, as far as practicable, during the life of the piggery.

The values suggested for S4 given in Table 6.6 should be used with care. No concession should be given for an *intention* to plant a barrier and should an occupier fail to maintain a stipulated barrier then a reduction in the allowed number of pigs would be necessary.

Operators should be encouraged to plant and maintain upper-storey and lower-storey vegetation, which would not cast shadows on the piggery. This will improve visual amenity and odour dispersion.

Table 6.6 Vegetation factor, S4

Vegetation	Value
Crops only, no tree cover	1.0
Few trees, long grass	0.9
Wooded country	0.7
Heavy timber	0.6
Heavy forest (both upper and lower storey)	0.5

Wind frequency factor, S5

The wind frequency S5 factor is determined from Table 6.7. Wind speed and direction varies by the season and by the hour of the day. Although there is generally one direction that is the most frequently observed (prevailing wind), the wind direction usually blows from all directions at some time.

The wind can be classed as **high frequency** towards the receptor if the wind is blowing towards the receptor (± 40 degrees) with a frequency of at least 60 % of the time for all hours over a whole year.

The wind can be classed as **low frequency** towards the receptor if the wind is blowing towards the receptor (± 40 degrees) with a frequency of less than 5 % of the time for all hours over a whole year.

Table 6.7 Wind frequency factor, S5

Wind frequency	Value
High frequency towards receptor (greater than 60%)	1.5
Normal wind conditions	1.0
Low frequency towards receptor (less than 5%)	0.7

Applying the equations

Waste and manure stockpiles

When working out separation distances, all waste and manure stockpile areas should be regarded as part of the piggery, until evidence dictates otherwise.

Large piggeries or complex sites

If a proponent of a piggery can demonstrate a clear 'pass' at Level 1 odour impact assessment, there is no need to undertake Level 2 or 3 assessment, regardless of the size of the development, unless there are special risk factors.

Special risk factors include:

- topographic or meteorological features (eg katabatic drift) that may funnel the odour plume or cause it to accumulate;
- a populated area located just outside the calculated separation distance.

It is the proponent's responsibility to justify the adequacy of level 1 assessment in a particular circumstance. Where doubt exists, the proponent should seek advice from the consent authority responsible for the particular development. For all scheduled developments (more than 2000 pigs or 200 breeding sows) advice should be sought from the EPA.

6.4 Two piggeries in close proximity

The following applies to separation distances, as determined by Equation 6.2.

Where a second piggery is proposed (whether on the same or another property) the two piggeries may need to be considered as one or separate piggeries, depending on their distance from each other and their distance from the receptor in question. Further, if they are considered as separate entities, the separation distance between the second piggery and a receptor may need to be modified.

Two piggeries considered as one

For calculating the separation distance to a receptor, the two piggeries can be considered as one single piggery if they are closer than **half the shortest separation distance** from each piggery to the receptor.

For example, if two piggeries have individual separation distances of 400 metres and 600 metres from a receptor, then they shall be assumed to be one piggery for the purpose of calculating separation distances if they are closer than 200 metres from one another. If the piggeries are further apart than 200 metres, they shall be treated as separate piggeries.

Two piggeries considered separately

Where the two piggeries are considered as separate entities, a 20% increase in separation distance may apply to the proposed second piggery. For each piggery:

1. add 20% to the required separation distance
2. consider this distance as the radius of a 'separation zone'
3. determine whether the two zones overlap.

If the zones overlap, the added 20% applies to the separation distance of the second piggery. If the zones don't overlap, the 'normal' separation distance applies and the separation distance of the existing piggery is not affected for its current level of operation. This situation is illustrated in Figure 6.1.

These calculations would need to be undertaken for all types of sensitive receptors (and likely future sensitive receptors) to ensure that appropriate separation distances are provided.

6.5 Report requirements

The report of the Level 1 odour impact assessment must contain the information specified below. The information required for each category, in particular Shed Factor (S1), focuses on identifying and managing potential odour sources, not general operation and pollution control.

Variable separation distance calculation

- Number of standard pig units (SPU).
- Calculated separation distance using equation 6.2.

Shed factor, S1

- Layout of the site clearly showing all operations carried out on the premises.
- A detailed discussion of all potential odour generating operations carried out on the site.
- Descriptions that clearly identify and explain all pollution control equipment and management practices for all potential odour generating operations on the premises.
- A description of all aspects of any odour controls, with particular regard to any fugitive emission capture systems (e.g. hooding, ducting), treatment systems (e.g. scrubbers, bio-filters) and discharge systems (e.g. stack, volume or area).

Receptor factor, S2

- Layout of the site clearly showing:
  - all emissions sources
  - plant boundary, and
  - sensitive receptors (e.g. nearest residences, towns etc).

Terrain factor, S3

- Description of the terrain including:
  - site-specific survey supported by report, or
  - 3-dimensional contour plot, or
  - topographical map, or
  - orthophotomap, or
  - 2-dimensional cross-section between odour sources and receptors.

Vegetation factor, S4

- Description of the vegetation including:
  - site-specific survey supported by report, or
  - vegetation map, or
  - aerial photograph.

Wind frequency factor, S5

- Description of the prevailing dispersion meteorology at the proposed site including:
  - wind rose diagrams, or
  - joint frequency distribution of wind speed and wind direction, or
  - 1 year of site-representative records of hourly average wind speed and wind direction.

6.6 Example separation distance calculations

Example 1: New grow-out piggery

Scenario

A new grow-out piggery has 3000 growers and 2000 finishers. The piggery has pull-plug and recharge flushing, full ridge and side ventilation and phase feeding. The piggery is near a rural residence, on a flat site with some tree cover and normal winds.

Site data

The piggery is equivalent to 6200 standard pig units (Table 6.1)

The site factors are:

S1	0.5	(Table 6.2)
S2	0.3	(Table 6.4, Rural farm residence)
S3	1.0	(Table 6.5, Flat topography)
S4	0.9	(Table 6.6, Light tree cover)
S5	1.0	(Table 6.7, Normal wind frequency)

Equation 6.2

$D = \sqrt{N} \times 50 \times S$

Calculation

The minimum distance of the piggery from a rural residence is:

$D = \sqrt{6200} \times 50 \times 0.5 \times 0.3 \times 1.0 \times 0.9 \times 1.0$

$= 531$ m

Example 2: Farrow to finish piggery

Scenario

A farrow to finish piggery has a partly slatted and sloping floor with regular flushing and full ridge and side ventilation. It is 2500 metres from a town of between 500 and 2000 people and on flat terrain with few trees and normal wind conditions.

Site data

S1	0.72	(Table 6.2)
S2	1.2	(Table 6.4, Town of between 500 and 2000 persons)
S3	1.0	(Table 6.5, Flat topography)
S4	0.9	(Table 6.6, Few trees)
S5	1.0	(Table 6.7, Normal wind frequency)

Equation 6.1

$N = (D / (50 \times S))^2$

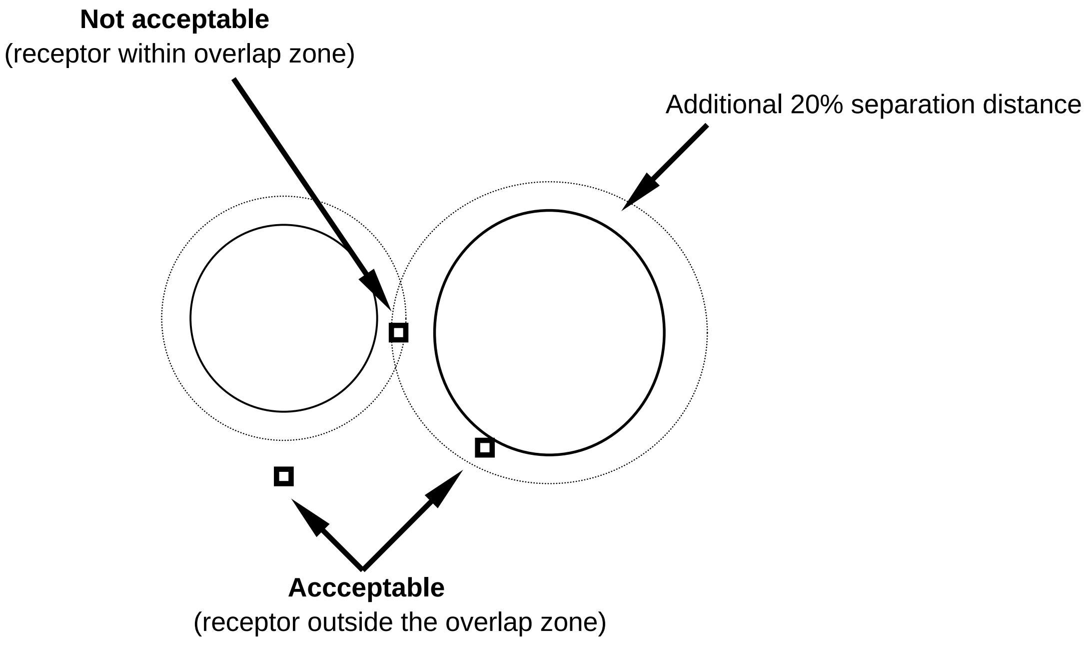
Calculation

The maximum number of pigs allowed is:

$N = [2500 / (50 \times 0.72 \times 1.2 \times 1.0 \times 0.9 \times 1.0)]^2$

= 4135 standard pig units or 414 sows.

Figure 6.1 Two piggeries considered separately



7 Cattle feedlots: Level 1 odour impact assessment

7.1 Introduction

This chapter sets out how to calculate separation distances for proposed cattle feedlots that would use current standard production technology. The prescribed distances have been found to lead to an acceptable impact on the amenity of the local environment.

The composite site factors and the resultant separation distances are applicable for a range of situations that would include most existing cattle feedlots, effluent management systems and management practices. The separation distances calculated here could be adjusted if new technology is used and it can be demonstrated and quantified that the technology will reduce odour.

This methodology allows cattle numbers to be varied according to the management standards proposed and achieved. The distance between the cattle feedlot and impact areas is not increased proportionally to the number of cattle but is more in accordance with the probable pattern of odour dispersion. This means that large cattle feedlots are not sited unnecessarily long distances away from impact areas.

Adopting this separation distance and cattle numbers system will help to minimise the air quality impact associated with cattle feedlots.

Objectives of the impact assessment

The impact assessment aims to ensure that offensive odours do not cause unreasonable interference to the community.

Acceptable impact standard

A cattle feedlot should not have an unreasonable impact on the amenity of the local environment and should comply with the provisions for offensive odours contained in section 129 of the POEO Act.

Approved operating practices

The most effective way of reducing odour potential is by implementing good design, good management practices and appropriate separation distances.

Environmental pollution, such as offensive odours, can be controlled by good cattle feedlot design, good management practices, restricting cattle numbers and maintaining suitable separation distances between cattle feedlots and impact areas.

All activities that are likely to increase emissions of odours, such as manure spreading or effluent irrigation, should be performed at a time of day and in weather conditions, which cause least odour emission and impact on neighbouring properties.

Variations in impact

Because of differences in climatic conditions and population densities, different feedlots have a varying effect on impact areas. To accommodate these variations, these guidelines define a range of feedlot classes. Odour control requirements vary for each class, according to the feedlot's size, location, design, management and likely effects on impact areas.

For all feedlots, in any class, it is essential to prevent effluent from discharging into watercourses.

Separation distances

Variable separation distances are measured from the closest odour emitting point of the cattle feedlot to the closest point of a receptor.

Variable separation distances are based on the dispersion of odours from the source. They are used to determine the allowable numbers of cattle and the management practices necessary to satisfy air quality objectives. A weighting factor allows for different types of premises.

7.2 Feedlot classes

As cattle feedlots vary considerably in their size, animal density, design and operational standards, feedlot classes have been developed to aid in their management. Standards become progressively more stringent moving from Class 4 to Class 1. For a more detailed explanation of the feedlot classes refer to the Reference Manual for Establishment and Operation of Beef Cattle Feedlots in Queensland (Queensland Department of Primary Industries, 2000).

Class 1

This represents the highest standard of design, operation, maintenance, pad management and cleaning frequency. Since this category has the potential to carry large numbers of cattle relatively close to impact areas, any conditions, which could lead to excessive odour production, cannot be tolerated. Class 1 feedlots have a maximum manure pad depth of 50mm, and the following maximum time between pen cleaning:

Maximum weeks between pen cleaning	Stocking density (m^3/SCU)
7	10
10	15
14	20

Class 1 feedlots must have appropriately prepared pen foundations. The requirement is for removal of topsoil, grading to an even surface and replacement of topsoil with acceptable material of a nominated moisture content which is compacted to a specified degree. In addition, pen slopes must be between 2.5 % to 4.0 %.

Class 2

The generally accepted standard for a well designed, constructed and maintained feedlot, with a high standard of operation. This is the reference standard for all classes. Class 2 feedlots have a maximum manure pad depth of 100mm, and the following maximum time between pen cleaning:

Maximum weeks between pen cleaning	Stocking density (m^3/SCU)
14	10
20	15
26	20

Class 2 feedlots must have appropriately prepared pen foundations. The requirement is for removal of topsoil, grading to an even surface and replacement of topsoil with acceptable material of a nominated moisture content which is compacted to a specified degree. In addition, pen slopes must be between 2.5 % to 4.0 %.

Class 3

Well-designed, well-constructed and operated with higher standards than Class 4 for pad preparation, maintenance and pen cleaning. Class 3 feedlots have a maximum pad depth of 200 mm, and a maximum time between pen cleaning of 26 weeks for all stocking densities.

The pen foundations of Class 3 feedlots must be prepared by removing the topsoil and grading to a durable even surface. Allowed pen slopes range from 2 % to 6 %.

Class 4

Generally a small feedlot with basic management and development standards and having fewer than 250 SCU. Class 4 feedlots have a maximum pad depth of 200 mm, and a maximum time between pen cleaning of 26 weeks for all stocking densities.

The pen foundations of Class 4 feedlots must be prepared by removing the topsoil and grading to a durable even surface. Allowed pen slopes range from 2 % to 6 %.

7.3 Variable separation distances

Calculating the number of cattle or the size of the separation distance

The equations provide estimates of the allowable cattle numbers (N) at any one time for a site at distance D metres from an impact distance, or the distance for a specified number of cattle.

Equation 7.1 estimates the allowable cattle numbers (N) for a site at distance D metres from a receptor. Conversely, Equation 7.2 gives the separation distance required for a specified number of cattle.

Equation 7.1, Allowable cattle numbers, given the distance

$$N = (D \div S)^2$$

Equation 7.2, Separation distance, given the number of cattle

$$D = \sqrt{N} \times S$$

N Number of standard cattle units (SCU). A standard cattle unit is defined as a bovine wieghing 600 kilograms live weight at exit from feedlot. See Table 7.1 for converting other types and weights of cattle to SCU

D Separation distance in metres from pens and stockpiles

S Composite site factor = S1 x S2 x S3 x S4 x S5. Site factors S1, S2, S3, S4 and S5 are determined according to site-specific information relating to stocking density, feedlot class, receptor, terrain, vegetation and wind factor. See Tables 7.1 to 7.6.

Standard cattle units

Cattle feedlots may have a range of cattle types, with an animal weight range from 350 kg to 750 kg. For a cattle feedlot, the number of SCU can be calculated by using the data included in Table 7.1. It allows the manure and odour potential of different weight cattle to be derived from SCU.

Table 7.1 Standard cattle units conversion table

Cattle liveweight at exit (turnoff) (kg)	Number of standard cattle units (SCU)
750	1.18
700	1.12
650	1.06
600	**1.00**
550	0.94
500	0.87
450	0.81
400	0.74
350	0.67

Final cattle numbers are calculated from Table 7.1 using the approximate live weight. Total standard cattle numbers are calculated by multiplying the number of cattle in each class by the above conversion factors and then adding the totals.

Worked example, SCU conversion factors

For a cattle feedlot with 300 trade cattle with an average live weight of 400 kg and 500 Jap Ox with an average live weight of 550 kg the total number of SCU is:

$$(300 \times 0.74) + (500 \times 0.94) = 692 \text{ SCU}$$

7.4 Composite site factor

Stocking density factor, S1

The stocking factor S1, for each class of feedlot, varies with the minimum stocking density proposed. Stocking factor is determined from Table 7.2a or Table 7.2b, depending on annual rainfall.

Moisture content and the rate of deposition of manure are major factors influencing odour production rate from the manure pack.

Values of S1 have been derived for selected stocking densities. Data collected in field trials and field observations was used to identify the relationship between odour production rate and the stocking density. The values were derived using field trial relationships between odour generation rates and stocking density for the various feedlot categories (defined by pad moisture content) and with model predicted odour levels at impact locations (calibrated using the observed odour impact at some existing feedlots).

Table 7.2a Stocking density factor, S1, average annual rainfall *less* than 750 mm

	Stocking density (m^2/beast)		
Feedlot class	**10**	**15**	**20**
1	65	52	40
2	95	78	58
3	128	103	78
4	158	127	96

Table 7.2b Stocking factor, S1, average annual rainfall *greater* than 750 mm

	Stocking density (m^2/beast)		
Feedlot class	**15**	**20**	**25**
1	65	52	40
2	95	78	58
3	128	103	78
4	158	127	96

Receptor factor, S2

The receptor factor S2 varies depending on the likely impact area and is determined from Table 7.3. Impact location may be a neighbour’s house, small town or a large town that may be affected by odour generated at the feedlot.

The separation distances to impact locations are usually the key factors, which limit the number of cattle, which could be accommodated on a particular site. Where environmental impact assessment is carried out, each of the critical separation distances may be assessed to determine if the adopted odour objective is applicable to that impact location.

Table 7.3 Receptor factor, S2

Receptor type	Value
Large towns, greater than 2000 persons	1.6
Medium towns, 500–2000 persons	1.2
Medium towns, 125–500 persons	1.1
Small towns, 30–125 persons	1.0
Small towns, 10–30 persons	0.6
Single rural residence	0.3
Public area (occasional use)	0.05*

* The value for a public area would apply to areas subject to occasional use. Higher values may be appropriate for public areas used frequently or sensitive in nature, such as frequently used halls and recreation areas. These should be assessed individually.

Terrain factor, S3

The terrain factor S3 varies according to topography and is determined from Table 7.4.

Flat is regarded as less than 10% upslope, 2% downslope and not in valley drainage zone.

High relief is regarded as up-slope terrain of a hill that projects above the 10% rising grade line from the feedlot. Thus the receptor location will be either uphill from the feedlot or be behind a significant obstruction.

Low relief is regarded as terrain, which is generally below the 2% falling grade line from the feedlot. Thus the receptor will be downhill from the feedlot.

Undulating hills is regarded as terrain where the topography consists of continuous rolling, generally low level hills and valleys with minimal vegetation cover, but without sharply defined ranges, ridges or escarpments.

A **valley drainage zone** has topography at low relief (as above) with significant confining sidewalls.

Topographical features of the selected site may adversely affect the odour impact under certain circumstances. During the early evening or night time under low wind speed conditions, population centres located in a valley complex at a lower elevation than a feedlot may be subject to higher odour concentrations as a result of down-valley wind or the occurrence of low-level inversions. Unless site-specific information has been gathered under conditions dominated by low wind speeds, the value for the factor S3 given in Table 7.4 should apply.

Table 7.4 Terrain factor, S3

Terrain	Value
Valley drainage zone	2.0
Low relief	1.2
Flat	1.0
Undulating country between cattle feedlot and receptor	0.9
High relief or significant hills and valleys between cattle feedlot and receptor	0.7

Vegetation factor, S4

The vegetation factor S4 varies according to vegetation density and is determined from Table 7.5. The vegetation density is assessed by the effectiveness with which the vegetation stand will reduce odour by dispersion.

Few trees, long grass is regarded as open country with a permanent covering of grass or pasture of around l m or more in height and with a light scattering of timber which is distributed continuously across the buffer area. Topography would be predominantly flat to slightly undulating. Isolated clumps of trees would not be sufficient to attract this concession. Land being actively cropped would not attract this concession because of the extended periods when it is bare or carrying only very low ground cover.

Wooded country is regarded as open forest country with tree density not sufficient to provide a continuous canopy, but sufficiently dense to influence air movement. There would be little or no lower storey vegetation. The density needs to be such that the vegetation can be considered as a contiguous belt and isolated clumps would not attract this concession. The minimum tree height is 4 m and the minimum extent in the direction of the receptor is 400 m.

Heavy timber is regarded as tall forest areas with dense timber stands providing a continuous canopy. There is limited understorey vegetation, mainly associated with regrowth. The minimum tree height is 4 m and the minimum extent in the direction of the receptor is 400 m.

Heavy forest, upper and lower storey is regarded as dense layers of taller timber with an interlocking canopy and with extensive amounts of lower storey vegetation of various species resulting in almost complete ground cover and a dense upper canopy. Examples are uncleared brigalow areas and dense eucalypt forests where little or no clearing or harvesting have occurred. The minimum tree height is 4 m and the minimum extent in the direction of the receptor is 400 m.

The tree cover should be maintained, as far as practicable, during the life of the cattle feedlot.

The values suggested for S4 given in Table 7.5 should be used with care by regulatory bodies and a number of provisions should qualify an approval given on this basis. For example, no concession should be given for an *intention* to plant a barrier and should an occupier fail to maintain a stipulated barrier then a reduction in the allowed number of cattle would be necessary.

Operators should be encouraged to plant and maintain upper-storey and lower-storey vegetation, which would not cast shadows on the cattle feedlot. This will improve visual amenity and odour dispersion.

The vegetation factor S4 varies according to vegetation density and is determined from Table 7.5.

Table 7.5 Vegetation factor, S4

Vegetation	Value
Crops only, no tree cover	1.0
Few trees, long grass	0.9
Wooded country	0.7
Heavy timber	0.6
Heavy forest (both upper and lower storey)	0.5

Wind frequency factor, S5

The wind frequency S5 factor is determined from Table 7.6. Wind speed and direction varies by the season and by the hour of the day. Although there is generally one direction that is the most frequently observed (prevailing wind), the wind direction usually blows from all directions at some time.

The wind can be classed as **high frequency** towards the receptor if the wind is blowing towards the receptor (± 40 degrees) with a frequency of at least 60% of the time for all hours over a whole year.

The wind can be classed as **low frequency** towards the receptor if the wind is blowing towards the receptor (± 40 degrees) with a frequency of less than 5% of the time for all hours over a whole year.

Table 7.6 Wind frequency factor, S5

Wind frequency	Value
High frequency towards receptor (greater than 60%)	1.5
Normal wind conditions	1.0
Low frequency towards receptor (less than 5%)	0.7

Applying the equations

Waste and manure stockpiles

When working out separation distances, all waste and manure stockpile areas should be regarded as part of the cattle feedlot, until evidence dictates otherwise.

Large cattle feedlots or complex sites

If a proponent of a cattle feedlot can demonstrate a clear 'pass' at Level 1 odour impact assessment, there is no need to undertake Level 2 or 3 assessment, regardless of the size of the development, unless there are special risk factors.

Special risk factors include:

- topographic or meteorological features (eg katabatic drift) that may funnel the odour plume or cause it to accumulate;
- a populated area located just outside the calculated separation distance.

It is the proponent's responsibility to justify the adequacy of level 1 assessment in a particular circumstance. Where doubt exists, the proponent should seek advice from the consent authority responsible for the particular development. For all scheduled developments (more than 1000 head of cattle) advice should be sought from the EPA.

7.5 Two cattle feedlots in close proximity

The following applies to separation distances, as determined by Equation 7.2.

Where a second cattle feedlot is proposed (whether on the same or another property) the two cattle feedlots may need to be considered as one or separate cattle feedlots, depending on their distance from each other and their distance from the receptor in question. Further, if they are considered as separate entities, the separation distance between the second cattle feedlot and a receptor may need to be modified.

Two cattle feedlots considered as one

For calculating the separation distance to a receptor, the two cattle feedlots can be considered as one single cattle feedlot if they are closer than **half the shortest separation distance** from each cattle feedlot to the receptor.

For example, if two cattle feedlots have individual separation distances of 1000 metres and 2000 metres from a receptor, then they shall be assumed to be one cattle feedlot for the purpose of calculating separation distances if they are closer than 500 metres from one another. If the cattle feedlots are further apart than 500 metres, they shall be treated as separate cattle feedlots.

Two cattle feedlots considered separately

Where the two cattle feedlots are considered as separate entities, a 20% increase in separation distance may apply to the proposed second cattle feedlot. For each cattle feedlot:

1 add 20% to the required separation distance

2 consider this distance as the radius of a ‘separation zone’

3 determine whether the two zones overlap.

If the zones overlap, the added 20% applies to the separation distance of the second cattle feedlot. If the zones don’t overlap, the ‘normal’ separation distance applies and the separation distance of the existing cattle feedlot is not affected for its current level of operation. This situation is illustrated in Figure 7.1.

These calculations would need to be undertaken for all types of sensitive receptors (and likely future sensitive receptors) to ensure that appropriate separation distances are provided.

7.6 Report requirements

The report of the Level 1 odour impact assessment must contain the information specified below. The information required for each category, in particular Shed Factor (S1), focuses on identifying and managing potential odour sources, not general operation and pollution control.

Variable separation distance calculation

- Number of standard cattle units (SCU).
- Calculated separation distance using equation 7.2.

Shed factor, S1

- Layout of the site clearly showing all operations carried out on the premises.
- A detailed discussion of all potential odour generating operations carried out on the site.
- Descriptions that clearly identify and explain all pollution control equipment and management practices for all potential odour generating operations on the premises.

Receptor factor, S2

- Layout of the site clearly showing:
  - All emissions sources
  - Plant boundary, and
  - Sensitive receptors (e.g. nearest residences, towns etc).

Terrain factor, S3

- Description of the terrain including:
  - site-specific survey supported by report, or
  - 3-dimensional contour plot, or
  - topographical map, or
  - orthophotomap, or
  - 2-dimensional cross-section between odour sources and receptors.

Vegetation factor, S4

- Description of the vegetation including:
  - site-specific survey supported by report, or
  - vegetation map, or
  - aerial photograph.

Wind frequency factor, S5

- Description of the prevailing dispersion meteorology at the proposed site including:
  - wind rose diagrams, or
  - joint frequency distribution of wind speed and wind direction, or
  - 1 year of site-representative records of hourly average wind speed and wind direction.

7.7 Example separation distance calculations

Example 1: New cattle feedlot

Scenario

A new Class 2 cattle feedlot proposes to rear 20,000 head. The cattle feedlot is located in an area with rainfall less than 750 mm, has a stocking density of 15 m^2 per beast, near a rural residence, on a flat site with few trees and normal winds.

Site data

The cattle feedlot is equivalent to 20000 standard cattle units (Table 7.1)

The site factors are:

S1	78	(Table 7.2a)
S2	0.3	(Table 7.3, Rural farm residence)
S3	1.0	(Table 7.4, Flat topography)
S4	0.9	(Table 7.5, Few trees)
S5	1.0	(Table 7.6, Normal wind frequency)

Equation 7.2

D = √ N x S

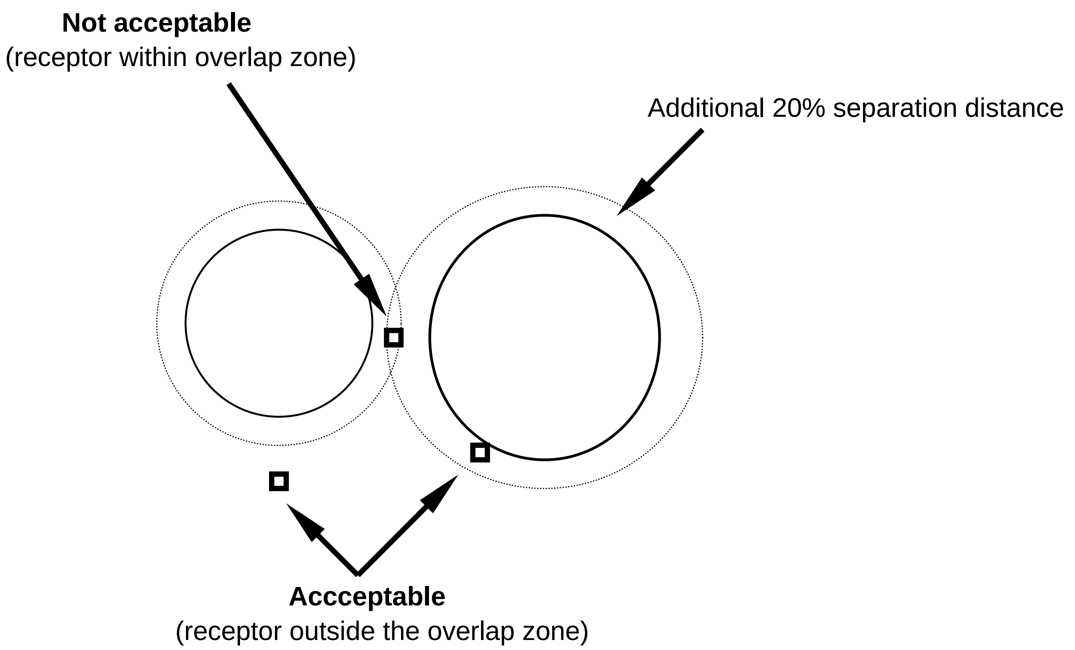
Calculation

The minimum distance of the cattle feedlot from a rural residence is:

D = √ 20000 x 78 x 0.3 x 1.0 x 0.9 x 1.0

= 2978 m

Figure 7.1 Two cattle feedlots considered separately



8 Odour sampling and analysis

8.1 Sampling and analysis methods for point sources

The sampling and analysis methods included *in Approved methods for the sampling and analysis of air pollutants in New South Wales* (referenced by the Protection of the Environment Operations (Clean Air) Regulation) must be used at all times. Where there is no approved sampling and analysis method for a particular pollutant or parameter, the licensee must submit a proposed sampling and analysis method to the Department of Environment and Conservation NSW and seek written approval from the Department to use this method.

Approved methods for the sampling and analysis of air pollutants in New South Wales refers to the methods listed in Table 8.1.

Table 8.1 Sampling and analysis methods for point sources

Pollutant	**Method**
Hydrogen sulfide	TM-5 or CEM-7
Odour (dynamic olfactometry)	OM-7
Odour (sampling from point sources)	OM-7
Total reduced sulfides	CEM-5
Volatile organic compounds	TM-34 (formerly OM-2) or CEM-8, CEM-9 & CEM-10
Parameter	**Method**
Carbon dioxide	TM-24 or CEM-3
Dry gas density	TM-23
Moisture content	TM-22
Molecular weight	TM-23
Oxygen	TM-25 or CEM-3
Temperature	TM-2 & TM-15
Velocity	TM-2 or CEM-6
Volumetric flow rate	TM-2 or CEM-6
Other	Method
Selection of sampling positions	TM-1

8.2 Sampling and analysis methods for diffuse sources

The sampling and analysis methods included *in Approved methods for the sampling and analysis of air pollutants in New South Wales* must be used at all times. Where there is no approved sampling and analysis method for a particular pollutant or parameter, the licensee must submit a proposed sampling and analysis method to the Department of Environment and Conservation NSW and seek written approval from the Department to use this method.

Approved methods for the sampling and analysis of air pollutants in New South Wales refers to the methods listed in Table 8.2.

Table 8.2 Sampling and analysis methods for diffuse sources

Pollutant	Method
Odour (dynamic olfactometry)	OM-7
Odour (sampling from diffuse sources)	OM-8

8.3 Environment protection licence monitoring conditions

Example concentration limits, volume/mass limits and monitoring conditions have been provided below for inclusion in an environment protection licence. Licence conditions that refer to concentration or volume/mass limits are prefixed with an 'L', while those referring to monitoring requirements are prefixed with an 'M'. The numbering used in the examples below is to illustrate the format but numbering of individual licences may vary. You should consult with the Air Technical Advisory Services Unit of the Department of Environment and Conservation NSW for specific requirements.

A typical format for a licence condition specifying concentration limits:

L3 Concentration Limits

L3.1 For each monitoring/discharge point or utilisation area specified below (by a Point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table.

Point 1

Pollutant	Units of measure	100 percentile concentration limit[1]	Reference conditions[2]	Averaging period
Hydrogen sulfide	mg/m^3	5 or site-specific emission limit	Dry, 273 K, 101.3 kPa	Rolling 1 hour
Odour	OU	Site-specific emission limit	Dry, 298 K, 101.3 kPa	Block 1 hour
Total reduced sulfides	mg/m^3	Site-specific emission limit	Dry, 273 K, 101.3 kPa	Rolling 1 hour
Volatile organic compounds	mg/m^3	77 or site-specific emission limit	Dry, 273 K, 101.3 kPa, n-propane equivalent	Rolling 1 hour

1 Site-specific emission limits must be calculated in accordance with *Approved methods for the modelling and assessment of air pollutants in New South Wales*.

2 Oxygen reference conditions as % O_2 should also be included in the reference conditions which are consistent with the specific process. Consult with the Air Technical Advisory Services Unit of the Department of Environment and Conservation NSW for an appropriate oxygen reference value.

A typical format for a licence condition specifying volume/mass limits:

L4 Volume and Mass Limits

L4.1 For each discharge point or utilisation area specified below (by a point number), the volume/mass of:

a liquids discharged to water, or

b gases discharged to air, or

c solids or liquids applied to the area

must not exceed the volume/mass limit specified for that discharge point or area.

Point 2

Pollutant	**Units of measure**	**100 percentile volume/mass limit**[1]	**Averaging period**
Hydrogen sulfide	g/s	Site-specific emission limit	Rolling 1 hour
Odour	$OU.m^3/s$	Site-specific emission limit	Block 1 hour
Total reduced sulfides	g/s	Site-specific emission limit	Rolling 1 hour
Volatile organic compounds	g/s	Site-specific emission limit	Rolling 1 hour

1 Site-specific emission limits must be calculated in accordance with *Approved methods for the modelling and assessment of air pollutants in New South Wales*.

A typical format for a licence condition specifying monitoring requirements:

M3 Requirement to Monitor Concentration and/or Volume/Mass of Pollutants Discharged (and Parameters)

M3.1 For each monitoring/discharge point or utilisation area specified below (by a Point number), the licensee must **monitor** (by sampling and obtaining results by analysis) the concentration and/or volume/mass of each pollutant and parameter specified in the first column. The licensee must use the sampling method, units of measure, and sample at the frequency and for the duration specified in subsequent columns.

Point 4

Pollutant	**Units of measure**	**Frequency**[1]	**Duration**[1]	**Method**[1]
Hydrogen sulfide	mg/m^3 or g/s	Quarterly or annual	1, 8 or 24 hour	TM-5
Hydrogen sulfide	mg/m^3 or g/s	Continuous	Continuous	CEM-7
Odour	OU or $OU.m^3/s$	Quarterly or annual	1 hour	OM-7
Total reduced sulfides	mg/m^3 or g/s	Continuous	Continuous	CEM-5
Volatile organic compounds	mg/m^3 or g/s	Quarterly or annual	1, 8 or 24 hour	TM-32 (formerly OM-2)
Volatile organic compounds	mg/m^3 or g/s	Continuous	Continuous	CEM-8, CEM-9 or CEM-10

Parameter	Units of measure	Frequency[1]	Duration[1]	Method
Carbon dioxide	%	Quarterly or annual	1, 8 or 24 hour	TM-24
Carbon dioxide	%	Continuous	Continuous	CEM-3
Dry gas density	kg/m^3	Quarterly or annual	1, 8 or 24 hour	TM-23
Moisture content	%	Quarterly, annual or continuous	1, 8, 24 hour or continuous	TM-22
Molecular weight	g/g-mole	Quarterly or annual	1, 8 or 24 hour	TM-23
Oxygen	%	Quarterly or annual	1, 8 or 24 hour	TM-25
Oxygen	%	Continuous	Continuous	CEM-3
Temperature	K	Quarterly, annual or continuous	1, 8, 24 hour or continuous	TM-2 & TM-15
Velocity	m/s	Quarterly or annual	1, 8 or 24 hour	TM-2
Velocity	m/s	Continuous	Continuous	CEM-6
Volumetric flow rate	m^3/s	Quarterly or annual	1, 8 or 24 hour	TM-2
Volumetric flow rate	m^3/s	Continuous	Continuous	CEM-6

Other	Units of measure	Frequency[1]	Duration[1]	Method
Selection of sampling positions	–	–	–	TM-1

1 Consult with the Air Technical Advisory Services Unit of the EPA for the appropriate frequency, duration and method.

8.4 Analytical report requirements

The results of any sampling and analysis must be provided as a summary report signed by the licence holder or, where there is no licence, by the person required to provide the report. The summary report must provide the information for each pollutant and parameter, in accord with the Section 4 of the *Approved methods for the sampling and analysis of air pollutants in New South Wales*.

9 Meteorological data

9.1 Introduction

When conducting either a Level 2 or Level 3 odour impact assessment, the meteorological data requirements in *Approved methods for the modelling and assessment of air pollutants in New South Wales* should be adhered to. This document covers:

- minimum data requirements
- siting and operating meteorological monitoring equipment
- preparation of Level 2 meteorological data
- preparation of Level 3 meteorological data
- availability of meteorological processing software and guidance documents.

Note that Level 2 and 3 odour impact assessments in this Technical Notes document are equivalent to Level 1 and 2 odour impact assessment respectively in the *Approved methods for the modelling and assessment of air pollutants in New South Wales* document.

9.2 Environment protection licence monitoring conditions

Example monitoring conditions have been provided below for inclusion in an environment protection licence. You should consult with the Air Technical Advisory Services Unit of the Department of Environment and Conservation NSW for specific requirements.

A typical format for a licence condition specifying meteorological monitoring requirements:

M4 Requirement to Monitor Meteorological Parameters in Licence Conditions

M4.1 The applicant must monitor (by sampling and obtaining results by analysis) the parameters specified in column 1. The applicant must use the sampling method, units of measure, averaging period, and frequency, specified in subsequent columns:

Parameter	Units of measure	Averaging Period	Frequency	Method
Rainfall	mm/hr	1 hour	Continuous	AM-4
Sigma theta @ 10 m	°	1 hour	Continuous	AM-2
Siting	-	-	-	AM-1
Temperature @ 10 m	K	1 hour	Continuous	AM-4
Temperature @ 2 m	K	1 hour	Continuous	AM-4
Total solar radiation @ 10 m	W/m^2	1 hour	Continuous	AM-4
Wind direction @ 10 m	°	1 hour	Continuous	AM-2
Wind speed @ 10 m	m/s	1 hour	Continuous	AM-2

10 Dispersion modelling

10.1 Introduction

When conducting either a Level 2 or Level 3 odour impact assessment, the dispersion modelling requirements in *Approved methods for the modelling and assessment of air pollutants in New South Wales* should be adhered to. This document covers:

- ground-level concentration (glc) criteria for individual odorous and toxic air pollutants
- glc criteria for hydrogen sulfide
- odour assessment criteria for complex mixtures of odours
- impact assessment methodology based on dispersion modelling
- the procedure for developing site-specific emission limits.

Note that Level 2 and 3 odour impact assessments in this *Technical Notes* document are equivalent to Level 1 and 2 odour impact assessments respectively in the *Approved methods for the modelling and assessment of air pollutants in New South Wales* document.

11 Odour complaints management system

11.1 Introduction

For facilities where offensive odour is a major ongoing feature of operations or there is doubt as to the adequacy of selected mitigation strategies, an operator-run odour complaints management system can be made a condition of the environment protection licence, or can be requested by local council for non-scheduled premises. This could be a beneficial management tool, allowing involvement of the community in the performance review of a development (e.g. in relation to the effect of implementing a Pollution Reduction Program). It would also enable the operator to respond immediately to a complaint and take necessary action to reduce the impact of offensive odour. Such a system would not replace EPA or local council investigation of complaints but it would be a useful reactive management tool for facilities seeking to maintain performance in difficult areas.

An operator-run complaints management system might incorporate the following elements:

- a complaints hotline to record complaints regarding the premises
- a system for logging complaints and dealing with them
- records of complaints and operators' responses or actions that are readily accessible to the community and regulatory authorities
- a system for providing feedback to the community (e.g. this could be in the form of regular meetings with affected residents or a newsletter).

A complaints system could help to provide the community with a sense of involvement and to build an amicable relationship between the community and the operator. It could also provide a useful mechanism for reviewing the performance of the premises.

11.2 Odour complaints management system

After an odour complaint has been received by the operator, the following tasks should be undertaken by the operator:

- Contact the complainant to discuss the complaint. Obtain information regarding the character of the odour, the frequency, duration and intensity of observations of odour and whether impacts of offensive odours are currently occurring.
- If impacts are currently occurring, take immediate action to reduce the impact.
- Conduct an investigation of the odour complaint as soon as practicable after the complaint has been received.
- Record details of the odour complaint and subsequent investigation and make these records readily accessible to regulatory authorities and the community.
- Contact the complainant and provide details of the action taken in response to the complaint.

If offensive odour impacts are occurring at the time of complaint, then the complaint response should begin with the investigation of the suspected source of offensive odours.

Complaint interview

The following information should be acquired by the operator:

- location of where the complainant detected the odour
- description of problem and its frequency
- time of day the offensive odour was first noticed
- duration of offensive odour at each occurrence
- whether the odour problem is occurring now and if not when it ceased
- names and addresses of persons affected
- location and extent of property damage, if any
- description and frequency of any illness alleged to have resulted from the odour;all reported symptoms such as nausea, vomiting, headache, sore throat, cough, eye irritation or medical examinations should be reported
- description of odours
- any other information the complainant may have that will relate the offensive odour to a specific location or piece of equipment.

Inspection of the alleged source

It is important that odours detected outside the premises can be linked to the premises. If possible, the specific source within the facility (whether a particular piece of plant, process or location) should also be isolated and positively identified.

When investigating the source the operator should:

- carry out an inspection of the site to determine the source of the odour
- use site representative meteorological data to determine wind direction at the time of the complaint.

Complaint confirmation

A confirmed complaint means that an EPA or local council officer, complainant or operator has been able to confirm that a particular operation or combination of operations is the source of odour. Confirmation may be accomplished through:

- results of a complainant interview
- tracing the odour from the complainant’s residence or place of business to the alleged source (if an odour is detected at the complainant’s property, the wind direction can be determined for the purpose of tracing the odour to its source)
- identifying an operation as the source by correlating meteorological data with the time of the complaint.

Meteorological monitoring must be conducted in accordance with the *Approved methods for the sampling and analysis of air pollutants in New South Wales*. For guidance on siting, operating and maintaining meteorological equipment as well as processing meteorological data for dispersion modelling purposes, see Chapter 9.

All meteorological stations that are used to collect data for odour complaint verification and modelling should use an anemometer which has a stall speed of equal to or less than 0.5 m/s. For the purposes of complaints confirmation, wind speed and wind direction are the most important meteorological parameters to measure. Sigma theta is derived from wind speed and wind direction measurements. This parameter can be recorded without additional equipment costs

The ability to measure short-term average wind statistics is important for complaint confirmation, particularly in situations where receptors are located in close proximity to the source.

There are many air quality consultants with experience in the siting, operation and management of meteorological equipment in NSW. The Clean Air Society of Australia and New Zealand (CASANZ) publication *Directory of Air Pollution & Environmental Consultants* contains contact details for several consulting companies operating throughout Australia (for further details see http://www.casanz.org.au).

If there is an existing meteorological station that is representative of the site in question, this will be adequate. However, if a meteorological station is not available, then one may need to be installed for a period of time sufficient to confirm if the particular site is the cause of a chronic problem.

Sample complaint forms

Attached are examples of two forms which can be used to record and investigate odour complaints received by a facility. There are two complaint forms: the Odour Complaint Initial Contact Report (1 page) and Plant Operator Odour Complaint Report (2 pages).

The **Odour Complaint Initial Contact Report** should be completed by the operator's complaints hotline. This form records the initial contact from a complainant and the details necessary for the plant operator to initiate an investigation.

The **Plant Operator Odour Complaint Report** is to be completed by the plant operator during the investigation of an odour complaint. Both pages of this form should contain the header Plant Operator Odour Complaint Report and the same incident number. The complaint number of the Initial Contact Report should be recorded at the place provided on the Plant Operator Odour Complaint Report, so that the operator response can be cross-referenced with the initial complaint.

Odour complaint initial contact report

Complaint no: _______

Complainant

Name: or Anonymous* ☐

Address:

Suburb/Town: Postcode:

Phone number (H): (W):

**Note: It is important to obtain from an anonymous complainant an approximate location of the odour occurrence.*

Description of odour complaint

Type of pollutant:

☐ Odour ☐ Dust ☐ Smoke

☐ Soot ☐ Irritant ☐ Corrosion

☐ Other

Occurrence date: Occurrence time: am / pm

Additional details of occurrence: (e.g. frequency, duration, etc.)

Odour description: (e.g. character, intensity, etc)

Reported effects on complainant:

Referrals

Responsible officer:

Name: Position:

Copies to: (e.g. Operations Manager, Dept Environment & Conservation, etc.)

Name: Position:

Organisation: Details:

Name: Position:

Organisation: Details:

Name: Position:

Organisation: Details:

Plant operator odour complaint report

Complaint no.: _______

Incident no.: _______

Complainant

Name: or Anonymous* ☐

Address:

Suburb/Town: Postcode:

Phone number (H): (W):

**Note: It is important to obtain from an anonymous complainant an approximate location of the odour occurrence.*

Description of odour

Occurrence date: Occurrence time: am / pm

Additional details of occurrence: (e.g. frequency, duration, etc.)

Odour description: (e.g. character, intensity, etc)

Reported effects on complainant:

Off-site inspection

Inspection date: Inspection time: am / pm

Inspector: Position:

Are odours observed at:
a) the plant boundary? ☐ Yes ☐ No Description:

b) at complainants residence? ☐ Yes ☐ No Description:

Comments:

Plant inspection/complaint investigation

Inspection date: Inspection time: am / pm

Inspector: Position:

Plant operations during complaint: ☐ Normal ☐ Abnormal ☐ Start-up ☐ Shut-down

Details (describe any operating circumstances, e.g. plant failure, that may have resulted in the odour complaint):

Plant operator odour complaint report

Incident no.: _______ (page 2)

Meteorological conditions during complaint**

Wind speed: Wind direction: Sigma-theta:

Bearing (degrees) from complainant to plant:

Is the plant a potential source under prevailing meteorology?

☐ Highly likely ☐ Probable ☐ Possible ☐ Unlikely

Comments:

***Note: Attach relevant time series data for wind speed, wind direction and sigma-theta.*

Action

Likely cause of complaint/odour release source:

☐ On-site odour release ☐ Start-up emissions ☐ Shut-down emissions

☐ Equipment failure ☐ Fugitive release ☐ Stack emissions

☐ External source ☐ Unknown

Other:

Comments/discussion:

Actions taken to reduce/minimise/stop the emission of odours:

Further actions required to minimise the risk of ongoing impacts of odour:

Follow-up:

Has complainant been advised of actions taken? ☐ Yes ☐ No

Have impacts due to odour ceased? ☐ Yes ☐ No

Does complainant have any additional comments to add?

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