REPORT

REVIEW OF AIR QUALITY ASSESSMENT ISSUES FOR POULTRY OPERATIONS IN QUEENSLAND

DEEDI

Job No: 5324

10 January 2011

A PEL Company

PROJECT TITLE:	**REVIEW OF AIR QUALITY ASSESSMENT ISSUES FOR POULTRY OPERATIONS IN QUEENSLAND**
JOB NUMBER:	5324
PREPARED FOR:	DEEDI
PREPARED BY:	Robin Ormerod
APPROVED FOR RELEASE:	Robin Ormerod
DISCLAIMER & COPYRIGHT:	This report is subject to the copyright statement located at www.paeholmes.com © Queensland Environment Pty Ltd trading as PAEHolmes ABN 86 127 101 642

DOCUMENT CONTROL			
VERSION	**DATE**	**PREPARED BY**	**REVIEWED BY**
01	10.01.11	Robin Ormerod	G Galvin

Queensland Environment Pty Ltd trading as
PAEHolmes ABN 86 127 101 642

BRISBANE:
Level 1, La Melba, 59 Melbourne Street South Brisbane Qld 4101
PO Box 3306 South Brisbane Qld 4101
Ph: +61 7 3004 6400
Fax: +61 7 3844 5858

SYDNEY

ADELAIDE

PERTH

Email: info@paeholmes.com

Website: www.paeholmes.com

DISCLAIMER

PAEHolmes acts in all professional matters as a faithful advisor to the Client and exercises all reasonable skill and care in the provision of its professional services.

Reports are commissioned by and prepared for the exclusive use of the Client. They are subject to and issued in accordance with the agreement between the Client and PAEHolmes. PAEHolmes is not responsible for any liability and accepts no responsibility whatsoever arising from the misapplication or misinterpretation by third parties of the contents of its reports.

Except where expressly stated, PAEHolmes does not attempt to verify the accuracy, validity or comprehensiveness of any information supplied to PAEHolmes for its reports.

Reports cannot be copied or reproduced in whole or part for any purpose without the prior written agreement of PAEHolmes.

Where site inspections, testing or fieldwork have taken place, the report is based on the information made available by the client or their nominees during the visit, visual observations and any subsequent discussions with regulatory authorities. The validity and comprehensiveness of supplied information has not been independently verified and, for the purposes of this report, it is assumed that the information provided to PAEHolmes is both complete and accurate. It is further assumed that normal activities were being undertaken at the site on the day of the site visit(s), unless explicitly stated otherwise.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

PAEHolmes was engaged by the Queensland Department of Employment, Economic Development and Innovation (DEEDI) to review and update the methodology for separation distance determination relating to meat chicken operations in Queensland, to provide recommendations on best practice approaches for assessments and to consider the issue of accreditation for practitioners.

The approach to assessing new meat chicken farms in Queensland allows for either a readily-applied separation distance formula approach (the 'S Formula' method) for simpler cases or detailed plume dispersion modelling, primarily focused on odour, for larger farms and more complex cases where the S Formula method is not adequate. Ensuring that the methodologies are suitable and assessments are of a reliable standard is a key concern to stakeholders including government, the poultry industry and communities potentially affected by emissions from poultry operations.

The methodology under review was originally developed by FSA Consulting Pty Ltd (FSA) in 2005 under contract to the Department of Environment and Resource Management. The original document, Best Practice Technical Guide for the Meat Chicken Industry in Queensland, included an appendix entitled Calculating Separation and Buffer Distances.

1.1 Scope of Work

The scope of work for this contract was to verify and adjust aspects of the methodology for calculating separation distances and buffer distances in relating to development of new and expansion of existing intensive meat chicken farms that are determined to be undertaking a material change of use. It included consideration of the following:

- Meteorological profiles for the areas where the industry may expand;
- A wind frequency reduction factor;
- A receptor factor based on population density;
- Replacing the farm management factor with a single factor of best practice design and operation; and
- Investigating the terrain weighting factor taking into account different meteorological areas in Queensland.

The work included:

- Considering changes to separation distance method put forward by Council of Mayors South East Queensland and Sustainable Poultry Alliance;
- Developing guidelines for best practice methodology for preparing meteorological data and odour modelling, and best practice guide for dispersion modelling;
- Preparing a list of requirements for accreditation of consultants with the necessary skills to advise new entrants to the chicken meat industry;
- Developing and delivering a workshop to industry on technical development and recommendations, and report summary findings to Poultry Roundtable; and
- Providing a report summarising the study findings.

2 BACKGROUND TO AIR QUALITY ASSESSMENT FOR POULTRY FARMS

Air quality assessment is a routine requirement for many development applications across a broad spectrum of industries. In the case of the poultry industry, most particularly the meat chicken industry, odour has been long recognised as a major limiting factor on farm size and siting in areas where land use conflicts can arise. In southeast Queensland especially, urban and rural residential populations are expanding rapidly in localities where meat chicken production has traditionally located close to processing plants. Increased production through larger and more numerous farms has been required to meet growing demand. Substantial pressures have consequently been applied to both the industry and sensitive land uses as available buffers have been challenged.

Hence, the determination of suitable planning controls and approval mechanisms to strike a suitable balance between industry and community concerns has been a requirement for many years and is now in need of review as the science advances and issues affecting sound decision-making remain.

Odour tends to be the most restrictive of the air quality issues relating to poultry farms, although dust is recognised as a significant issue as well. However, there is greater attention to odour modelling as it is generally the limiting factor. That is, if a farm complies with the relevant odour criteria normally it can comply with the dust criteria.

Often, odour modelling and assessment is required for proposals involving new or expanded farms. Dust modelling and assessment is sometimes required. A difficulty with this need for modelling-based assessments is that air quality modelling is technically specialised and complex, and consequently can be both difficult to do well and to explain clearly to a diverse group of stakeholders.

To enable rapid and simple assessments of impact, it is desirable to have a readily applied formula that does not require the time, expense and detailed work involved in modelling. However, such a simple, generalised method also needs to be conservative in order to avoid underestimating required separation distances in any circumstance. Also, with the increasing scale and complexity of meat chicken operations, a simple formula begins to fail and so above a certain farm size it is not feasible to use a generic approach. Hence, although a simple formula is useful it also has limitations that must be recognised.

The S Factor method was originally devised in Queensland for the feedlot industry and has been adopted for other intensive livestock industries in Queensland and some other states. In 2005, FSA Consulting was engaged by DERM to develop a Best Practice guidance document for the meat chicken industry, including the S Factor method (FSA_Consulting 2005).

This report addresses some of the details contained in the FSA report and provides updated recommendations based on review and analysis of aspect of the S Factor method conducted jointly by PAEHolmes and FSA.

We also include recommendations on best practice for odour modelling associated with meat chicken farms and on accreditation of consultants to provide some measure of assurance about the reliability and quality of assessments being performed on behalf of the industry.

3 S FACTOR METHOD REVIEW

3.1 Summary of Changes

The FSA report recommended the calculation of separation distances and buffer zones for each sensitive land use and property boundary in the form:

Separation Distance/Buffer Zone (D) = $N^{0.6}$ *x S1 x S2 x S3 x S4*

where:

N = Maximum number of birds divided by 1,000.

0.6 = Meat chicken farm exponent determined using the results of modelling.

S1= Meat chicken farm design and management factor for estimating the relative odour potential for the development.

S2 = Meat chicken farm sensitive land use/buffer zone factor for estimating the relative odour impact potential of a development.

S3 = Meat chicken farm surface roughness factor for estimating the potential changes to odour dispersion due to changes in the earths surface.

S4 = Terrain weighting factor for estimating the potential changes to odour dispersion in situations where meteorological conditions may be influenced by local terrain influences.

The general S Factor approach presented in the FSA report has been retained but details have been reviewed, in particular:

- the original S1 for farm design and management has been deleted and a constant value applied in its place on the basis that all new or expanded farms are expected to comply with the criteria for best practice detailed in the FSA report;
- S2, S3 and S4 have been replaced by new factors S1, S2 and S3, respectively;
- the land use factor (now S1) has been revised to remove the boundary buffer calculations to achieve consistency with the Queensland odour guideline (QEPA 2004);
- the land use factor (now S1) has been revised to reflect the need for adequate protection against nuisance in areas where the risk of odour nuisance is greatly increased by virtue of higher population densities and community expectations;
- the surface roughness factor (now S2) remains unchanged; and
- the terrain factor (now S3) has been examined through a process of dispersion modelling under a variety of topographic situations and has been revised;

The revised S Factor method is as follows:

Separation Distance (D) = $\boldsymbol{N^{0.63}}$ ***x S1 x S2 x S3***

where:

N = Maximum number of birds divided by 1,000.

0.63 = Exponent determined using the results of modelling.

S1 = Sensitive receptor factor for estimating the relative odour impact potential of a development.

S2 = Surface roughness factor for estimating the potential changes to odour dispersion due to changes in the earth's surface.

S3 = Terrain weighting factor for estimating the potential changes to odour dispersion in situations where meteorological conditions may be influenced by local terrain influences.

The revised values for S1 and S3 are contained in Table 3.1 and Table 3.2, respectively. The values of S1 reflect the results of dispersion modelling for various locations and also take into account risk-weighted impacts in a manner similar to that which applies in the New South Wales odour performance criteria. Effectively, the S1 value of 30 for a residence in a compatible zone is consistent with the Queensland Odour Guideline for general application, while the S1 value of 50 provides a form of protection equivalent to that which applies to urban populations in NSW.

Table 3.1: Values of S1 Receptor Factor

Sensitive Receptor Type	Value
Sensitive receptor (compatible zone)	30
Sensitive receptor (non compatible zone)	50

The terrain weighting factors have been considered on the basis of dispersion modelling using CALPUFF. Model results for a variety of locations reveal that there is so much site-specific variability in dispersion patterns that it is not possible to reliably assign S3 values to more detailed terrain descriptions than those provided in Table 3.2 below.

The proposed S3 values are broadly consistent with the long-standing factors developed for feedlots, but provide some additional refinement in relation to valley drainage zones and do not allow for a reduction factor (i.e., S3 of less than 1.0), to avoid the possibility of non-conservative estimates from the S Factor calculation.

Table 3.2: Values of S3 Terrain Weighting Factor

Description of Terrain	Downslope	Upslope
Flat	1.0	1.0
Valley drainage zone – level 1 (Broad valley >10 km and/or a valley or gully with low side walls, where the average slope from centre of valley/gully to confining ridgeline is <2%)	1.2	1.0
Valley drainage zone – level 2 (Average slope from centre of valley/gully to confining ridgeline is 2 - 5%)	1.5	1.0
Valley drainage zone – level 3 (Average slope from centre of valley/gully to confining ridgeline is >5%)	2.0	1.0
Low relief at > 2% from farm site (Not in a valley drainage zone, but the source lies above the receptor at an average grade of more than 2%)	1.2	-
All other situations	1.0	1.0

3.2 Application of S Formula

The FSA report of 2005 recommended that the S Factor method not be applied to farms in excess of 320,000 bird capacity. We recommend this limit be reduced slightly to 300,000 birds, since beyond that size the farm layout departs too much from the assumed 'point source' inherent in the S Formula. Further, the increase in emissions and extent of emission points with larger farms means that the potential impact distance from the sheds is increased and may involve more complex dispersion factors, e.g., air moving along curved cold air drainage paths or around hills, which are best handled by suitable dispersion models.

Based on evaluation of results from the revised factors and modelling, the S Factor approach is expected to be conservative to very conservative in a wide variety of situations: the risk of a specific application of the formula yielding a result less conservative than an appropriate modelling-based assessment is considered to be extremely low.

Initial planning for farms less than 300,000 using the S factor method may indicate inadequate separation. Modelling is an accepted way to refine the estimation of separation requirements, provided that it follows appropriate procedures. For farms larger than 300,000 birds, it is recommended that modelling be the default approach, for reasons explained above. No guarantees can be given that the S formula would be conservative for all farms greater than 300,000 although in general it is likely to be increasingly conservative.

Modelling of odour from meat chicken farms is relatively complex and critically dependent on factors such as model selection, emissions estimation, meteorological data quality and interpretation of results. These issues are considered in the recommendations on best practice for modelling that have been prepared for this project.

4 GUIDANCE ON MODELLING FOR MEAT CHICKEN FARMS

4.1 Background

Often, odour modelling and assessment is required for proposals involving new or expanded farms. Dust modelling and assessment is sometimes required. A difficulty with this is that air quality modelling is technically specialised and complex, and consequently can be both difficult to do well and difficult to explain clearly to a diverse group of stakeholders.

A dispersion model takes information on emissions and the meteorological conditions that dictate how those emissions are dispersed in the atmosphere. Typically a full year of hourly data is used and for each hour the model calculates the plume concentrations at points affected under the specific weather conditions at that time. The assessment of impacts uses statistical summaries of the hourly model calculations for the whole year.

There is no standard methodology for poultry farm odour or dust modelling, so there can be confusing differences between one assessment and another. The main aspects of modelling and assessment are:

- selecting and applying a dispersion model;
- identifying and defining emission sources;
- estimating emission rates;
- defining the local terrain and ground cover;
- developing a meteorological dataset to use in the model; and
- comparing model results to assessment criteria, such as those set out in regulatory odour guidelines.

In relation to the first item above, model selection is an important issue in most cases, because the two models most commonly used in Australia, AUSPLUME and CALPUFF, have very different methods of calculating plume behaviour. These differences become critically important in conditions of very light wind and temperature inversions, which are common in most parts of southeast Queensland.

Defining emission sources, i.e., poultry sheds, is not done uniformly by all consultants. Recent research has demonstrated that under some conditions the plumes emitted from sheds can rise to some extent when they are warmer than the surrounding air (Dunlop 2010). Consequently, a modelling approach that takes plume buoyancy into account would be more realistic than the alternative approach which ignores this effect. Both approaches are in use.

The estimation of emission rates is done in a number of different ways, some of which attempt a more detailed simulation of the variations in emissions over the hours of the year than others. Although it is evident from recent research that some of the variation in emissions cannot be readily explained with current data, there is nevertheless a broad and useful relationship between odour emissions and several key factors including bird mass, bird age, ambient temperature and shed ventilation rate (Dunlop, Gallagher et al. 2010), consistent with the general basis of some emissions estimation models in use.

Terrain, land use and vegetation information is used in the two main models in different ways. The information is used to account for ways in which the land surface affects the behaviour of air flowing over it. Terrain features sufficient to steer the airflow, such as in valley cold air drainage conditions, cannot be simulated in AUSPLUME but can in CALPUFF. Although not important in every case, this is often a factor in determining critical odour impacts.

Meteorological data is a fundamental driver of a dispersion model and must be as accurate and representative as possible for best results. There are substantial differences between the meteorological data requirements for AUSPLUME and CALPUFF. AUSPLUME requires a relatively simple set of hourly data for a single site representative of the area under consideration. On the other hand, CALPUFF[a] uses a 3-dimensional grid of data across the whole area under consideration, at levels ranging from the surface to thousands of metres above the ground. Clearly, such detailed data cannot be measured directly and methods that blend data from measurements with sophisticated meteorological modelling, such as TAPM (Hurley 2008), are often used to generate the required data.

4.2 Model Selection

Selecting the most suitable model is an important step and needs to take into account the most relevant factors. The following factors are considered to be most important in the selection process:

- **Very light wind conditions**. The Gaussian plume equation that forms the basis of AUSPLUME calculates downwind concentration as a function of the inverse of the wind speed, so when wind speed is low, the result can be unrealistically high. CALPUFF does not suffer from this limitation, although like any model the accurate treatment of dispersion in very light winds remains problematic in certain respects. Comparison of the two models shows that in southeast Queensland there are many areas where the frequency of very light winds is high and AUSPLUME results differ widely from those of CALPUFF, which is technically better formulated for these conditions.
- **Effects of terrain on plume behaviour**. Plumes are transported and dispersed by the wind, so wind behaviour is a critical factor. AUSPLUME is a steady-state model, which does not allow for the variation of wind direction or speed over the modelled area at a given time, whereas CALPUFF can simulate the diversion of plumes due to drainage flows or hills, provided that input data is of a suitable quality. Hence, in areas where terrain affects are likely to be significant CALPUFF is a more suitable model. Further, AUSPLUME relies on data for a single point in space, which may be a weather station remote from the site. Consequently, the data used in AUSPLUME may not reflect the details of the site-specific conditions. On the other hand, a well-constructed meteorological model (used to run CALPUFF) can incorporate localised flow features.

---

[a] CALPUFF can in fact be run in a mode which uses the simple AUSPLUME meteorological file, but generally this mode is not used and instead the 3-D capabilities of CALPUFF are employed.

- **Plume buoyancy**. The emissions from tunnel ventilated sheds are at times warmer than the ambient air and hence are positively buoyant. Although temperature excess may be only a few degrees, it can be sufficient to lead to plume rise, which is a factor in plume dispersion (Dunlop 2010). Because the endwall fans usually direct air horizontally, buoyant plumes do not behave as they would from a vertical stack. The formulation of CALPUFF enables this to be simulated, but AUSPLUME does not (yet) have the appropriate 'switch', requiring some manipulation of the source data to achieve the best result. It is relevant to note also that plume rise will only be significant under very light wind conditions.

Considering these most relevant factors, we recommend that CALPUFF be regarded as the 'default' model for use in odour assessments for meat chicken farms. The use of AUSPLUME may be suitable in locations where the frequency of very light winds (<2 m/s) is low.

4.3 Meteorological Inputs

The input of meteorological data to a dispersion model is a critical requirement. Data must be complete, quality assured and representative of the modelled area, in both time and space. The accompanying report 'Best Practice Guidance for the Queensland Poultry Industry – Plume Dispersion Modelling and Meteorological Processing' details regulatory and other guidance on the selection of meteorological data.

In locations where the nearest weather station may not be representative of the site it is preferable to use a prognostic meteorological model to create a dataset for use in a model. Models such as TAPM (Hurley 2008), MM5 (Grell, Dudhia et al. 1994) and WRF (Michalakes, Dudhia et al. 2004) are used for this purpose and are recommended, subject to input settings being suitable.

An important aspect of meteorological data is demonstration that it is either a representative set of measurements, or that model results are validated against nearby weather station data.

Increasingly, regulatory guidance on modelling refers to the need for consideration of multi-year periods to account for changes from year to year in weather conditions. If one year is selected, as is the usual practice, it is highly desirable to provide an analysis to indicate whether that year is typical or atypical and to consider the implications for predicted odour levels.

It is noted that at the time of writing this report, a draft technical recommendation on meteorological data preparation for CALPUFF has been prepared for the NSW Department of Environment, Climate Change and Water (DECCW)[b] by the developers of CALPUFF. We would recommend that once this guidance is finalised (expected to be early 2011) it be used as a primary reference for this purpose.

[b] Now the NSW Office of Environment & Heritage (OEH)

4.4 Emission Inputs

4.4.1 Principles

Emission sources for dispersion modelling must be identified by location and type (point source, volume source, area source or line source). For each source, data on physical characteristics (dimensions, flow rates, etc.) must be entered and emission rates assigned.

Odour emissions from meat chicken farms are highly variable (Dunlop, Gallagher et al. 2010) but there are several readily quantified factors controlling a large part of the variation, i.e., bird mass and age, ambient temperature and shed ventilation rate. Because routine modelling requires hourly input data, it is possible and desirable to estimate odour emissions on an hourly basis and so emissions models that simulate the changing effects of those factors over time are the best way to model odour impacts as accurately as possible.

The separate report on Modelling Guidance provides details of a recommended approach to emissions estimation that has been used and accepted for several years. The model is not perfect, as variability in emissions due to other factors has been identified (Dunlop, Gallagher et al. 2010). This has been addressed by recommending that the baseline emissions for estimation purposes assumes that a best practice farm equates to a K factor of 2. The K factor was originally developed by PAEHolmes in an attempt to account for inter-farm variations in design and management and was originally thought to be around 1 for the best case. Results of odour sampling from modern well managed farms since then have usually returned values between 1 and 2. Occasional higher (and lower) values should be considered in light of the quite large uncertainty in odour data, arising simply from the method of measurement.

4.4.2 Outline of Odour Emissions Estimation

The estimation of odour emissions is a key part of any odour assessment. For poultry farms key factors that should be included in the emissions estimation include:

- Number of birds placed
- Batch length
- Cleanout days
- Thinning regime
- The weight of the birds through the batch
- Maximum ventilation rate and changes in ventilation over a batch
- Design and management practices.

A typical grow-out cycle will consist of a 6 – 8 week growing period (dependent on the bird size required for market) followed by a 1 – 2 week clean-out of the sheds, disinfecting and maintenance. Normally, four to six batches of birds are raised each year. During the grow-out period, some birds are removed, usually once or twice, at or after day 30. This is to both meet market requirements for bird size and also to manage the bird density in line with industry standards.

The odour emission rate, the key factor in determining potential downwind impact, is the product of the in-shed odour concentration and the ventilation rate. The concentration of odour in the shed tends to increase as the birds grow and is minimised by tight control of litter moisture and bird health. A review of both existing farms and those proposed indicates that most farms ventilate at a maximum ventilation rate of about10 m^3/hr/bird.

Ventilation is used to mange internal shed temperatures. Optimal shed temperature decreases with bird age, ranging from about 31-34°C when chickens are first brought into the shed down to about 18-21°C (apparent temperature[c]) by week 5 (Jiang and Sands 2000). While very young, the chickens will normally be restricted to no more than 50% of the shed (brooding section) until old enough to maintain body temperature. Heaters are required to maintain optimal temperatures during the brooding phase.

Changes in ventilation are linked to ambient temperature, so the ventilation at a point in time in a batch can be readily estimated. At present, a common method for estimating ventilation rate is based on data from the University of Georgia (USA). It is summarised below in Table 4.1. Note, however, that actual ventilation performance can vary from farm to farm and so the data in Table 4.1 are generalised and may be modified if sufficient site-specific data is available.

Table 4.1: Shed Ventilation as a Percentage of Maximum Ventilation

Bird Age (weeks)	1	2	3	4	5	6	7	8
Temperature (°C) above Target	Ventilation Rate (as a Percentage of the Maximum)							
<1	1.28	2.55	5.11	7.66	9.79	11.49	17.03	17.03
1	1.28	12.5	12.5	25	25	25	25	25
2	1.28	25	25	37.5	37.5	37.5	37.5	37.5
3	1.28	37.5	37.5	50	50	50	50	50
4	1.28	37.5	37.5	50	50	50	50	50
6	1.28	37.5	37.5	62.5	75	75	75	75
7	1.28	37.5	37.5	62.5	75	75	87.5	100
8	1.28	62.5	62.5	62.5	75	75	100	100
9	1.28	62.5	62.5	87.5	100	100	100	100

Based on data from the University of Georgia www.poultryventilation.com

If relevant data is considered in an assessment, the input data will follow a number of trends. As an example, the PAEHolmes emissions method (Ormerod and Holmes 2005) has been compared below with real world data in Figure 4-1. The blue dots in Figure 4-1 represent the odour concentrations over a year predicted by this method using a K factor of 2 and the green triangles represent samples collected from farms which had calculated K factors of 2 or less. The data shows that the emissions estimation methods can be consistent with real world samples.

---

[c] The temperature that is 'felt' with the inclusion of wind chill. Typically, a fully ventilated shed might result in an apparent temperature 4-6°C lower than the temperature measured by a standard thermometer.

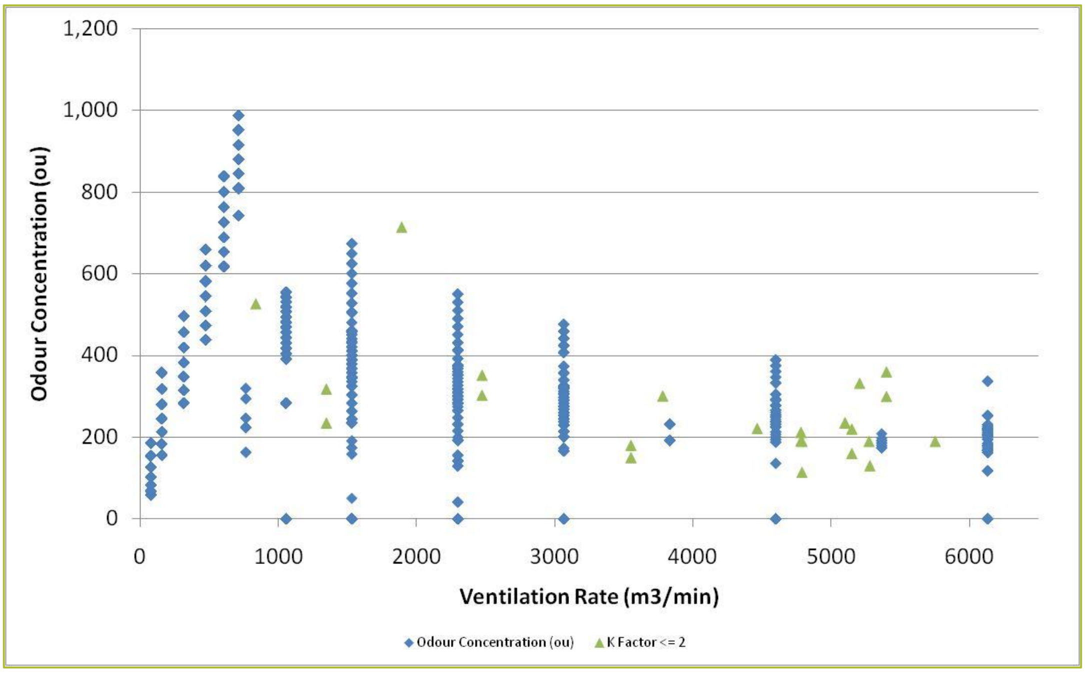

Figure 4-1: Example of Emissions Estimation and Sample Data

An example of predicted odour emissions during a typical batch is shown below in Figure 4-2. From the data it can be seen that the batch length is approximately 56 days with thinning occurring at around days 34, 40 and 48. The hourly emissions data should show a general increase as total mass increases, some small reductions with thinning, as well as daily variation reflecting hour-to-hour changes in ventilation.

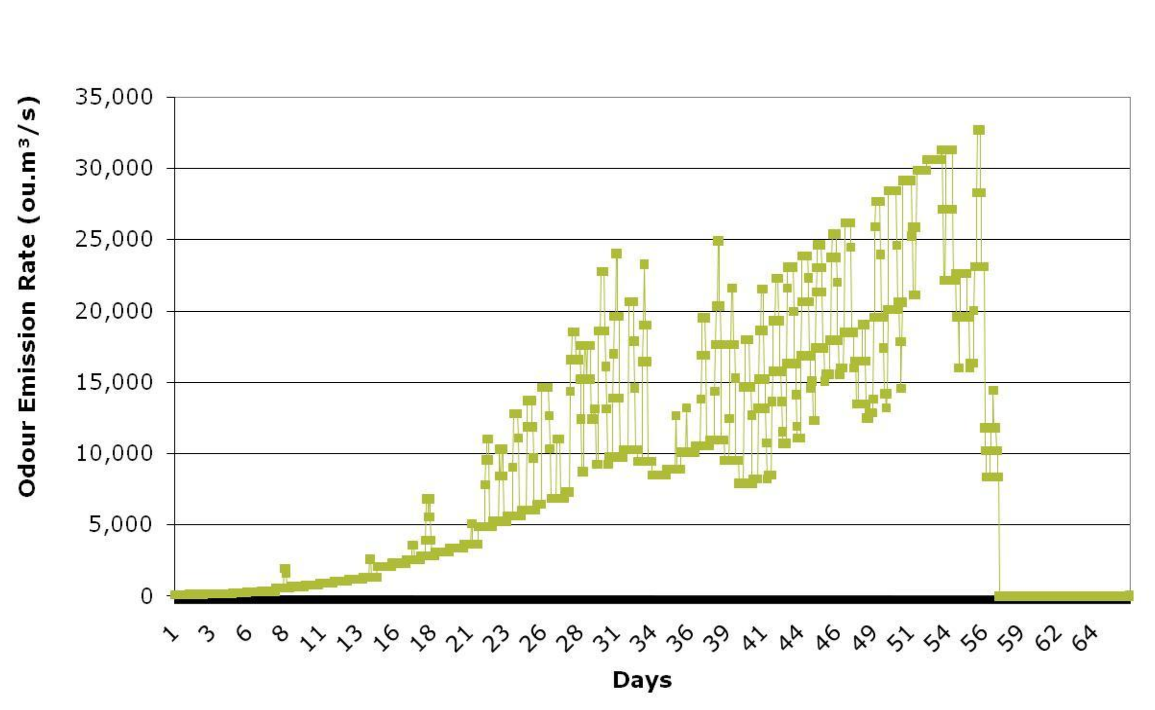

Figure 4-2: Example of Emissions Profile (10 m^3/hr/bird and K = 2. No. of birds = 40,000 at placement)

4.5 Geophysical Data

Geophysical inputs for models include terrain information, land use or surface roughness data and other information, depending on the model employed. For best results, these data need to be as accurate as possible and suitably resolved in spatial terms. In some cases, default databases of terrain data and vegetation or land use are not of adequate resolution or accuracy to bring out local features that might influence meteorology and plume behaviour, and so it is important that terrain is resolved to 100 metres or better. On-line databases, e.g. satellite-derived terrain from NASA, are available and recommended. Databases for land use or vegetation type and soil type which may be required are recommended for optimum model performance.

Improved data sources and data settings for these types of model inputs continue to be developed and it is recommended that improvements be tracked to ensure best practice approaches are used.

4.6 Receptor Data

The receptors in models are the locations of points of interest, usually residences and other sensitive sites as described regulatory guidance. It is important that all sensitive receivers are accurately identified and incorporated into the model. Models are run on the basis of a regular grid of receptor points but these points may not coincide with all sensitive locations. Separate discrete receptors can and should be included in model setup.

4.7 Assessment Criteria

Modelled odour levels should be assessed against the following criteria:

- 2.5 OU, 99.5%, 1 hour average for a sensitive receptor in a compatible zone;
- 1.0 OU, 99.5%, 1 hour average for a sensitive receptor in a non-compatible zone.

The 1 OU recommendation for sensitive receptors in a non-compatible zone is more stringent than the default of 2.5 OU set out in the Queensland Odour Guideline (QEPA 2004). It takes into account a risk-based odour assessment procedure, such as that used in New South Wales. The value of 1 OU (99.5%, 1 hour average) is approximately equivalent to the odour performance criterion for urban areas in New South Wales (2 OU, 99%, 1 second).

Odour has been identified as the principal community amenity concern for meat chicken farms. Hence the focus of separation distance determination is the limiting of the potential for nuisance odours. Both experience in the southeast Queensland region and the scientific literature in recent years have identified the fact that sensitivity to odour in some communities, particularly those not traditionally associated with livestock production, may not be adequately addressed by existing assessment criteria.

The Queensland Odour Guideline is generally regarded as a very useful reference point for odour assessment in the State and the criteria have been applied successfully in many instances. However, there is some evidence that for meat chicken farms compliance with the default criteria, whether in fact or because of modelling errors, does not always seem to satisfy the aim of avoiding undue annoyance.

Growing population, changing demographics and lifestyle expectations have all contributed to increasing pressures on odour-generating activities such as meat chicken farming in the region. Accordingly, the recommended odour criteria for meat chicken farms are aimed at taking a long-term protective view of environmental values for residents near meat chicken farm developments and providing some buffering for model uncertainty.

4.8 Outputs and Reporting

The separate Modelling Guidance report provides recommendations on output formatting and interpretation, as well as basic requirements for reporting. It is important that the rationale for selection of a methodology, details of model inputs and clear explanation of results and their implications is included in a report. It is also highly desirable that model input files or summaries of inputs are provided for verification by third parties.

Refer to the Modelling Guidance report for specific details and recommendations.

5 ACCREDITATION OF CONSULTANTS

5.1 Background

Air quality modelling for poultry farms is technically specialised and complex, and consequently can be both demanding to do well and difficult to explain clearly to a diverse group of stakeholders. Further, odour and other environmental issues are often contentious and assessments are often challenged in legal appeals, which are expensive. Hence, it is important that assessments are as technically robust as possible. This requires that assessments are prepared by suitably qualified and experienced practitioners so that they meet the needs of stakeholders with minimum dispute and cost.

One way of helping to achieve such a situation is to require consultants preparing odour and air quality assessments for poultry farms to be accredited by a suitable responsible body. There are various accreditation and certification programs for scientists and engineers who provide consulting services. These programs cover a wide range of complexity and requirements for entry but are generally run by professional bodies such as Engineers Australia (EA), the Clean Air Society of Australia & New Zealand (CASANZ), the American Meteorological Society (AMS) and many others. Within each of these organisations there are different levels of recognition of a practitioner’s professional status.

Membership of a professional organisation is a necessary but not sufficient requirement to attain a status such as a Chartered Engineer (EA), Accredited Professional (CASANZ) or Certified Consulting Meteorologist (AMS). The Victorian branch of CASANZ plans to develop an accreditation system specifically for dispersion modellers.

Common to many accreditation schemes are the following elements:

- Need for suitable tertiary qualifications
- Membership of a relevant professional body
- Demonstration of relevant knowledge and experience provided via a written test or assignment and interview
- References from other practitioners or parties acceptable to the accreditation body, with reference to both technical and ethical standards
- Demonstration of ongoing involvement in relevant activities to maintain accreditation
- Sanction and appeal processes relating to misconduct or disqualification.

5.2 Proposal

It is proposed that the accreditation program for air quality practitioners submitting assessments for poultry farms to responsible authorities in Queensland be as simple and effective as can be reasonably achieved[d]. The suggested approach is as follows:

- Establish a small panel responsible for the accreditation process. Potential membership could be from DEEDI, DERM, local government, industry, community and relevant professional organisation, or some combination of these. Membership of three people would probably be sufficient given the scope.

---

[d] Note that many assessments are prepared by a small team of consultants. It is proposed that only the ‘lead consultant’ representing the work need be accredited.

- Establish accreditation scope. It is suggested that this be defined around the capability of a consultant to competently, independently and ethically deal with odour (and other air quality) assessment needs for the poultry industry, acting impartially for any party that might require the expertise of the consultant.
- Establish entry requirements. It is suggested that these include the following:
    - Science or engineering Bachelors degree or higher, with substantial components relating to at least three of: atmospheric science, mathematics, physics, computer modelling, chemistry, livestock production and/or their applications (e.g., chemical engineering in the case of chemistry);
    - At least 5 years' experience in air quality consulting, including a substantial involvement in odour and air quality assessments in the intensive livestock industry, or, at least 2 year's consulting experience if there has also been at least 4 years of regulatory or research involvement in intensive livestock odour assessment;
    - Nomination of two referees, at least one being a peer from outside the applicant's organisation;
    - Membership of the Clean Air Society of Australia & New Zealand and its Odour Special Interest Group, or another body that has a substantial and recognised role for professionals that is relevant and equivalent;
    - Completion of a written task demonstrating relevant competence and judgement, either a body of consulting reports or a small thesis assignment on the topic of odour assessment for poultry. This work may be subject to independent review at the discretion of the panel;
    - Attendance at an interview with the accreditation panel (or a quorum thereof) if deemed necessary by the panel;
    - Panel endorsement based on the evidence presented by the above.
- Establish grounds for revoking accreditation and an appeals process. The grounds may include professional misconduct or unethical behaviour that compromises the confidence in work produced by the consultant.
- Establish a process for renewal of accreditation, based on demonstrating a minimum level of involvement in relevant consulting work (or in a regulatory or research role if the consultant has spent time outside consulting in the period since previous renewal or initial accreditation). It is suggested that a 3-year renewal period apply.

6 REFERENCES

Dunlop, M., Duperouzel, D., Pott, L. (2010). Separation Distances for Broiler Farms: Verifying methods including the effects of thermal buoyancy, Rural Industries Research and Development Corporation.

Dunlop, M., E. Gallagher, et al. (2010). "Odour emissions from tunnel-ventilated broiler sheds: case study of nine Queensland farms." Animal Production Science **50**(6): 546-551.

FSA_Consulting (2005). Best practice guide for the meat chicken industry in Queensland - Final Draft.

Grell, G., J. Dudhia, et al. (1994). A description of the fifth-generation Penn State/NCAR Mesoscale Model (MM5). NCAR Tech. Note TN-398+ STR**:** 122.

Hurley, P. (2008). TAPM V4. Part 1: Technical Description, CSIRO Marine and Atmospheric Research Paper.

Jiang, J. and J. Sands (2000). "Odour and ammonia emission from broiler farms." RIRDC Pub. 00/2, Barton, ACT: Rural Industries Research and Development Corporation.

Michalakes, J., J. Dudhia, et al. (2004). The weather research and forecast model: Software architecture and performance, Citeseer.

Ormerod, R. and G. Holmes (2005). Description of PAE Meat Chicken Farm Odour Emissions Model. PAEHolmes_Brisbane.

QEPA (2004). Odour Impact Assessment for Developments. State of Queensland, Environmental Protection Agency and Queensland Parks and Wildlife Service.