# Rushes Creek Poultry Production Farm

SSD 7704

# SUPPLEMENTARY RESPONSE TO SUBMISSIONS

Prepared for:
ProTen Tamworth Pty Limited

November 2019

Prepared by:
EME advisory

# SUPPLEMENTARY RESPONSE TO SUBMISSIONS

Prepared under Part 4 of the *Environmental Planning and Assessment Act 1979*

## PREPARED BY


| | |
|---|---|
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## APPLICANT

| | |
|---|---|
| Company: | ProTen Tamworth Pty Limited |
| Address: | PO Box 1746, North Sydney NSW 2060 |

## DEVELOPMENT

| | |
|---|---|
| Title: | Rushes Creek Poultry Production Farm, SSD 7704 |
| Description: | Intensive Livestock Agriculture - poultry broiler production farm |
| Development Site: | Lot 1 DP 44215; Part Lot 1 DP 1108119; Lot 1 DP 1132298; Lots 26, 85, 86, 101, 118, 165, 166 and 171 DP 752169; Part Lot 143 DP 752189; Lot 1 DP 1132078; Lot 1 DP 1141148; and an unformed Council public road traversing through Lot 171 DP 752169 |

## DECLARATION

We confirm that we have prepared the contents of this document and to the best of our knowledge it is true in all material particulars and does not materially mislead by its presentation or omission of information.

**EME Advisory**

Eryn Bath
26 November 2019

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# 1 INTRODUCTION

## 1.1 Background

ProTen Tamworth Pty Limited (ProTen) is seeking development consent to construct and operate an intensive poultry broiler production farm within a rural area known as Rushes Creek in the Tamworth Regional Local Government Area. In summary, the Rushes Creek Poultry Production Farm (the "Development") will comprise a total of 54 poultry sheds and house a combined population of 3,051,000 broiler birds.

The Development is classified as State significant development (SSD 7704) under the provisions of Division 4.7 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and in accordance with the *State Environmental Planning Policy (State and Regional Development) 2011*. It will require development consent from the Minister (or their delegate) under Part 4 of the EP&A Act, along with the following secondary approvals:

- An environment protection licence under Chapter 3 of the *Protection of the Environment Operations Act 1997* from the Environment Protection Authority (EPA); and
- Consent under section 138 of the *Roads Act 1993* from Tamworth Regional Council (Council).

Please refer to the following documents for a detailed description of the Development, specialist environmental impact assessments undertaken and the comprehensive list of development design, mitigation measures and best management practices committed to by ProTen to avoid, mitigate and/or manage the potential impacts of the Development:

- *Rushes Creek Poultry Production Farm, SSD 7704, Environmental Impact Statement* (SLR Consulting Australia [SLR] 2018) (EIS); and
- *Rushes Creek Poultry Production Farm, SSD 7704, Response to Submissions* (EME Advisory [EME] 2019) (RTS), which was prepared to respond to the issue raised within the submissions received from government agencies, the community and special interest groups following exhibition of the EIS.

## 1.2 Document Purpose

This Supplementary Response to Submissions (Supplementary RTS) has been prepared to respond to the issues and requests raised within the submissions received from the following government agencies after their review of the RTS:

- Environment Protection Authority (EPA) in relation to odour; and
- Department of Industry – Lands and Water (Lands & Water) (now part of DPIE) in relation to groundwater.

The responses provided in this Supplementary RTS have been prepared by ProTen and EME, with specialist input and assessment work undertaken by Astute Environmental Consulting (Astute) to assist in responding to the odour issues raised by the EPA.

The submissions received from other consulted government agencies following the RTS, including the Roads and Maritime Services, Office of Environment and Heritage (OEH), WaterNSW and Tamworth Regional Council, did not raise any issues requiring further response.

# 2 ODOUR

Pacific Environment Limited (PEL) (now part of ERM) prepared the *Air Quality Assessment* (2018) (AQA) for the EIS in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (EPA 2016) (the Approved Methods) and *Assessment and Management of Odours from Stationary Sources in NSW* (EPA 2006) and following significant engagement with the EPA (as outlined in the EIS).

In response to the submissions received following exhibition of the EIS, particularly the submissions from the EPA and the community, Astute was engaged to provide additional specialist input and assessment in relation to odour. As detailed in the *Response to Air Quality Issues* (Astute 2019) that formed part of the RTS, Astute demonstrated that a suitable and appropriately conservative air quality assessment was performed by PEL (2018). The emissions modelled are higher than actual measured emissions at modern poultry farms and represent the upper range of potential emissions from the Development.

Following review of the RTS, the EPA requested further information to relation to odour to "enable it to make a transparent and robust decision on the project". In response, the following activities have been undertaken:

**EPA Consultation**

A meeting was arranged and attended by representatives from the EPA, DPIE, ProTen, EME and Astute on 16 July 2019 to discuss each issue raised and agree on the work required to satisfactorily address each issue.

**Additional Odour Testing**

ProTen commissioned additional odour testing at their relatively new Narrandera poultry broiler farm in south-western NSW, which was undertaken on 20 August 2019, and sourced odour test data from two other very similar and relatively new poultry broiler farms in south-western NSW in order to provide further real-world test data. Refer to **Section 2.1** for further details.

**Additional Specialist Assessment**

Astute was engaged to complete the specialist work required to address the EPA's outstanding issues. The responses to the individual issues are summarised in the below sub-sections, however Astute's *Response to Letter: 14 June 2019 SSD 7704* (2019b) in **Appendix A** should be read in full.

## 2.1 Additional Odour Testing

**EPA requested in the submission (Issue 4) and during the meeting on 16 July 2019 that test data be provided from an existing poultry farm in the Tamworth region where the Development is proposed. EPA specifically raised ProTen's Murrami farm in the meeting.**

ProTen has not commissioned odour testing at any of its three poultry broiler farms in the Tamworth region, being Bective, Gidley and Murrami, as they are older facilities and not representative of new modern poultry farm developments. The industry has come a long way in last 10 years driven by environmental legislation, government policy and community expectations and there have been significant improvements in development design and control, farm management, animal husbandry and environmental management. Combined, this has significantly reduced odour emissions from newer poultry farm developments.

To put ProTen's three Tamworth-based farms in to perspective:

- Bective – the Bective poultry farm was established in 1994, some 25 years ago. It is currently being re-developed in order to meet current industry best practice and remain operational.
- Gidley – it is not known when the Gidley poultry farm was first established, however consent was granted in 1997 to expand the facility. On this basis, it is at least 22 years old.
- Murrami – the Murrami poultry farm was established in 2006 and is therefore 13 years old. While it is the newer of the three farms, the sheds are not representative of new modern poultry sheds constructed to meet current best practice standards. Specifically:
    - The Murrami sheds have semi-sealed flooring, whereas modern poultry broiler sheds have fully-sealed concrete flooring, which is easier to manage in relation to cleaning, sanitisation and moisture levels; and
    - Poultry shed insulation, sealing and ventilation has significantly improved since Murrami was constructed 13 years ago. Modern sheds are constructed using materials with higher insulation properties and improved computer-control systems enabling the operator to provide close to optimum conditions for bird health, comfort, growth and performance throughout the year, with less air exchange. Modern sheds allow continuous monitoring of lighting, temperature, humidity and static pressure and these parameters can be automatically adjusted to suit conditions, which reduces the need for as much air exchange.

Tamworth is one of the few areas in Australia that does not currently operate to RSPCA standards, meaning that the poultry litter quality is potentially poorer and the shed stocking densities are potentially higher. Baiada Poultry has confirmed that Tamworth will move to RSPCA standards once the new poultry processing plant is constructed and commissioned. Until this time, ProTen's three Tamworth-based farms are not representative of the wider industry or modern poultry farm developments. As committed to in the EIS, the Rushes Creek development will be constructed, operated and managed in accordance with relevant RSPCA standards.

In conclusion, given that there are no modern poultry farms constructed in recent years and operating to RSPCA standards in the Tamworth region, additional test data was obtained from modern poultry farms in south-western NSW (see below).

**The EPA indicated during the meeting on 16 July 2019 that any additional relevant odour test data would be beneficial.**

The odour modelling undertaken by PEL (2018) considered years of real-world odour test data from a variety of meat chicken farms. Additional odour testing was undertaken in July 2018 as part of the works undertaken for the RTS at ProTen's relatively new Narrandera poultry broiler farm in south-western NSW to demonstrate that worst-case emissions were modelled by PEL (2018). Narrandera was approved by the (now) DPIE in November 2015 (SSD 6882) with the same odour impact assessment methodology as that used by PEL (2018) for the proposed Rushes Creek development and it has been operational since April 2016. The poultry sheds and poultry production units (PPUs) proposed at Rushes Creek are very similar in design, scale and layout to those at Narrandera and will have near identical operational and management procedures.

To further bolster the available data for this Supplementary RTS, ProTen commissioned another round of odour testing in two sheds at their Narrandera farm in August 2019 just before the first bird pick-up, when bird numbers and bird density were both at maximum. **Table 1** summarises the results from the testing undertaken at Narrandera in July 2018 and August 2019 (the test reports are attached to Astute's response in **Appendix A**).

## Table 1 Odour Test Results - Narrandera

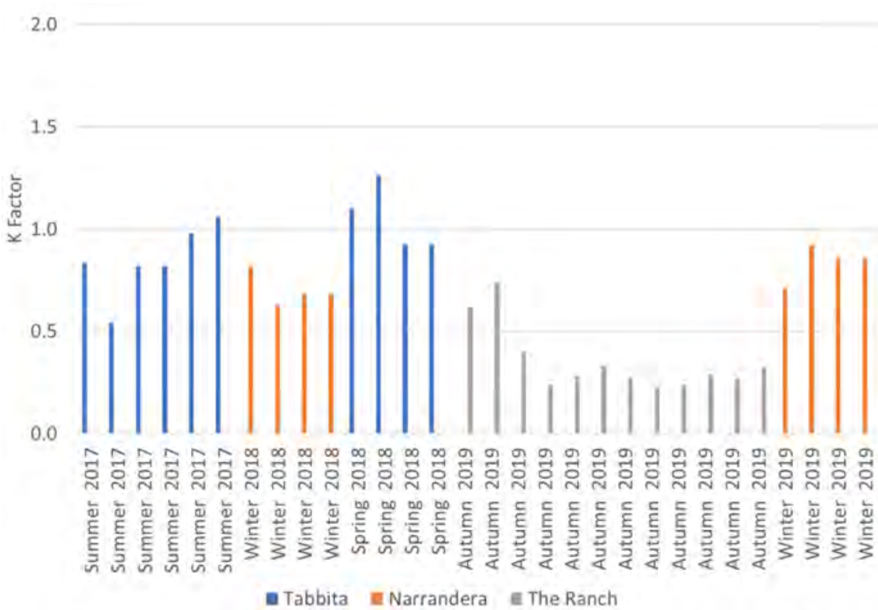
| Location | Sample No. | Bird Age (days) | OER (ou/s) | Floor Area ($m^2$) | Number of Birds | Average Bird Weight (kg) | Ventilation Rate (STP[1]) ($m^3/s$) | K Factor |
|---|---|---|---|---|---|---|---|---|
| **July 2018** | | | | | | | | |
| Farm 75, Shed 1 | 1 | 29 | 10,677 | 2,720 | 46,298 | 1.60 | 49.7 | 0.8 |
| | 2 | 29 | 8,207 | 2,720 | 46,298 | 1.60 | 49.7 | 0.6 |
| Farm 75, Shed 2 | 1 | 29 | 8,297 | 2,720 | 46,332 | 1.60 | 49.3 | 0.7 |
| | 2 | 29 | 8,927 | 2,720 | 46,332 | 1.60 | 49.3 | 0.7 |
| | | | | | | | **Average K Factor** | **0.7** |
| **August 2019** | | | | | | | | |
| Farm 76, Shed 6 | 1 | 28 | 11,077 | 2,720 | 46,938 | 1.70 | 61.2 | 0.7 |
| | 2 | 28 | 14,382 | 2,720 | 46,938 | 1.70 | 61.2 | 0.9 |
| Farm 76, Shed 7 | 1 | 28 | 11,985 | 2,720 | 46,564 | 1.68 | 51.0 | 0.9 |
| | 2 | 28 | 11,985 | 2,720 | 46,564 | 1.68 | 51.0 | 0.9 |
| | | | | | | | **Average K Factor** | **0.8** |

N.B. values in this table are slightly different to those in the test reports as a result of the number of decimal places used in the calculations.
1 – standard temp and pressure

The measured K factors listed in **Table 1** from ProTen's Narrandera farm are significantly lower than the recommended K factor in *Best Practice Guidance for the Queensland Poultry Industry - Plume Dispersion Modelling and Meteorological Processing* (PAEHolmes 2011, cited in Astute 2019a) and significantly lower than the conservative K factor of 2.0 adopted by PEL (2018) for the Development. They are also consistent with test data from other poultry farms in NSW and Queensland, were an average K factor of 1.1 has been demonstrated (as reported in the RTS).

Further odour test data was sourced from two relatively new poultry farms (The Ranch and Tabbita) being operated by other growers in south-western NSW near Tabbita. Astute (2019b) collated this data and presented it with the test data from ProTen's Narrandera farm by season in **Figure 1**. The data is also summarised further in **Table 2**.

## Figure 1 Odour Test Results – Narrandera, The Ranch and Tabbita



### Table 2 Odour Test Results – Narrandera, The Ranch and Tabbita

| Poultry Farm | Average K Factor | Bird Age (days) | Testing and Analysis |
|---|---|---|---|
| Narrandera | 0.8 ± 0.1 | 28 and 29 | The Odour Unit |
| The Ranch | 0.4 ± 0.2 | 32 and 34 | Collected by SLR, with analysis by The Odour Unit |
| Tabitta | 0.8 ± 0.2 | 19, 23, 27 and 30 | The Odour Unit |

Emissions from the poultry broiler industry have been decreasing over time. This is linked to improved feed conversion, reduced poultry litter waste and RSPCA shed management, including reduced stocking density and improved bedding material management. The odour test data presented above again demonstrates that well managed modern broiler farms are operating with significantly lower K factors than K=2 (as adopted in the AQA for Rushes Creek) and have lower emissions than older farms.

The average K factor of 0.8 at ProTen's Narrandera farm demonstrates that ProTen's newer farms are very well designed and managed and operate with low odour emissions. Astute (2019b) confirms the conclusion made in the RTS, being that the K factor of 2.0 adopted by PEL (2018) for Rushes Creek is suitably conservative and represents a realistic worst-case emission value. The K factor method used in the AQA (PEL 2019) predicts higher emissions than measured at modern poultry farms.

## 2.2 Issues 1 and 2 - Additional Odour Mitigation Measures

**EPA requested that ProTen provide further feasible odour mitigation measures that could achieve compliance with an odour performance criterion of 3 odour units (ou), if required.**

**EPA also requested that ProTen provide additional odour mitigation measures that could be implemented should odour impacts occur once operational.**

Based on the conservatism incorporated in to the odour modelling, the sparse population density in the rural area surrounding the Development Site and the short-term transient population at the Lake Keepit Sport and Recreation Centre (all three detailed in the RTS), along with the additional odour test data presented in **Section 2.1**, Astute (2019) once again concludes that the adopted odour criterion of 5 ou is applicable and appropriate. If a lower K factor was applied based on the real-world test data from modern poultry farms, modelled odour emissions would be notably reduced and the number of receptors within the 2 ou contour would reduce (Astute 2019b).

While there are some odour control technology options available, they generally come from Europe where separation distances like those available for this Development are not possible (Astute 2019a). The combination of appropriate separation distances and vegetation screens represent current best practice for odour mitigation for intensive poultry farms (Astute 2019a). Vegetation screens induce additional turbulence as the ventilation air from the sheds passes through the permeable barrier and this enhances odour dispersion. Vegetation screens also act to partially remove fine dust from the ventilation air giving a corresponding percentage reduction in odour levels. A range of literature values exist in relation to the potential reduction in odour impacts associated with vegetative buffers (for pig and poultry farms), including Parker et. al. 2012 at 66%, Hernandez 2012 at 40 to 60%, Patterson 2009 at 37% and Malone 2008 at 26% (Astute 2019b).

As detailed in the EIS, ProTen has committed to establishing vegetation screens a minimum of 40 metres (m) wide around the perimeter of each PPU. These screens were not included in the odour modelling and, as such, represent a further conservatism and mitigation measure.

The Rushes Creek development will generally be constructed, operated and managed in accordance with current industry best practice standards, including the relevant requirements/recommendations in:

- *RSPCA Approved Farming Scheme Standards – Meat Chickens* (RSPCA Australia 2013); and
- *Best Practice Management for Meat Chicken Production in NSW* (Department of Primary Industries 2012).

The proposed Rushes Creek development should not be prejudiced by older poultry farms, including Murrami (as specifically raised by the EPA), that are not representative of new modern poultry farm developments and are not operating to RSPCA standards. Rushes Creek will have the same design, operation and management as ProTen's newer Narrandera, Jeanella and Jeanella South farms and will also be the same/very similar to The Ranch and Tabbita poultry farms. These farms have all been modelled with the same methodology as Rushes Creek and there is a consistent lack of issues and complaints.

This request was discussed in the meeting with the EPA and DPIE on 16 July 2019. Based on this discussion, the information presented in the RTS, the additional odour test data presented in **Section 2.1** and the information above, no further consideration is warranted. The odour emissions modelled are higher than actual measured emissions at modern poultry farms and additional odour mitigation measures (in addition to the adoption of current industry best practice and vegetation screens, which were not included in the modelling) are not warranted. To reiterate, if a lower K factor was applied based on the real-world test data from modern poultry farms, modelled odour emissions would be notably reduced and the number of receptors within the 2 ou contour would reduce (Astute 2019b).

## 2.3 Issue 3 - CALMET Evaluation

**EPA requested that ProTen provide further evaluation of the CALMET generated data as recommended in *Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for inclusion into the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW, Australia* (OEH 2011). EPA advised that this analysis, and any other relevant data, should be used to assess the influence of the wind direction errors on predicted odour concentrations.**

**Background**

The *Response to Air Quality Issues* (Astute 2019a) prepared for the RTS summarised the results from several statistical tests used to compare the prognostic and observed data. The statistical benchmarks were taken from Hurley et. al. (2002, cited in Astute 2019a and 2019b) and other publications.

The most widely referred to report for meteorological statistical benchmarks is *Enhanced Meteorological Modelling and Performance Evaluation for Two Texas Ozone Episodes* (Emery, et al., 2001, cited in Astute 2019b). This report notes that the purpose of the benchmarks is not necessarily to give a passing or failing grade to any one particular application, but rather to put the results into context and assess the relative accuracy of the dataset as a whole (Astute 2019b).

The report *Air Quality Modelling Study Meteorological Model Performance Evaluation: 2009-2013 BOEM Arctic WRF Dataset* (Ramboll Environ 2016, cited in Astute 2019b) noted that the benchmarks of Emery et. al. were developed by analysing well-performing meteorological model evaluation results for simple, mostly flat terrain conditions and simple meteorological conditions. It also noted that Kemball-Cook et. al. (2005, cited in Astute 2019b) proposed a series of benchmarks for model performance under complex conditions, with the most relevant for the Peel Valley being a gross error benchmark of less than 55 degrees (<55°) for wind direction.

Complex terrain is defined by the American Meteorological Society (2012, cited in Astute 2019b) as "a region having irregular topography, such as mountains or coastlines. Complex terrain can also include variations in land use, such as urban, rural, irrigated, and unirrigated".

On this basis, if the model performance is close to that required for simple terrain areas, being less than or equal to 30 degrees (≤30°) and simple meteorological conditions, the performance of the model can be considered as appropriate (Astute 2019b).

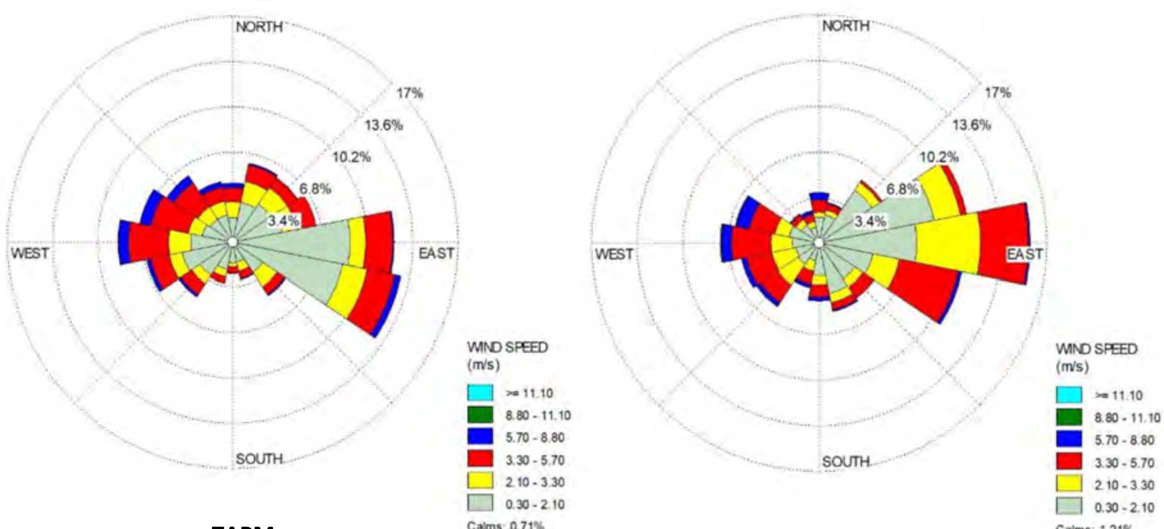
**Response**

The *Response to Air Quality Issues* (Astute 2019a) included statistical measures applied to hourly data and a radar plot showing the frequency of winds from each direction. The EPA requested further information the form of wind roses, scatter plots, quantile-quantile plots and further statistical tests (mean, bias, gross error, root mean square error and index of agreement).

Wind Roses

The wind roses prepared by Astute (2019b) showing the predicted winds (based on TAPM) and observed winds at Moana for 2016 are presented in **Figure 2**.

**Figure 2 Wind Roses – TAPM and Moana 2016**




**TAPM** **Moana**

A 1 km TAPM grid was selected as this is what was used in the AQA (PEL 2018). CALMET was used to refine the windfield to the 100 m CALMET grid. Astute (2019b) advises that this can result in slight differences in winds between where the model is extracted and the weather station location.

The general shape of the wind roses in **Figure 2** are consistent in that they show dominant easterly winds, with a noticeable westerly component. The range of wind speeds in the light category (i.e. less than 3 metres per second [<3 m/s]) is marginally higher for the TAPM/CALMET data (i.e. 68% compared to 66%), however, as previously shown by the BIAS, RMSE and IO values, the overall difference is within an acceptable range (Astute 2019b).

The critical directions for the Development are winds from the northwest towards receptor R25 and west towards receptor R24 (i.e. the nearest receptors). **Figure 2** shows that the TAPM data includes more winds from the northwest and a similar frequency of winds from the west, meaning that the modelling captures winds from these directions adequately (Astute 2019b).

Scatter Plots and Quantile-Quantile Plots

Scatter and quantile-quantile plots are graphical representations of the datasets. The statistical benchmarks detailed in Emery et. al. (2001), as used by Astute, are considered a more robust method for comparing the data (Astute 2019b). Nevertheless, Astute (2019b) prepared quantile-quantile plots for wind direction, wind speed and temperature, as provided below in **Figures 3**, **4** and **5**, respectively. Note that there were large gaps in the temperature dataset provided for Moana and, therefore, the comparison is based on the available data.

**Figure 3 Quantile-Quantile Plot for Wind Speed**

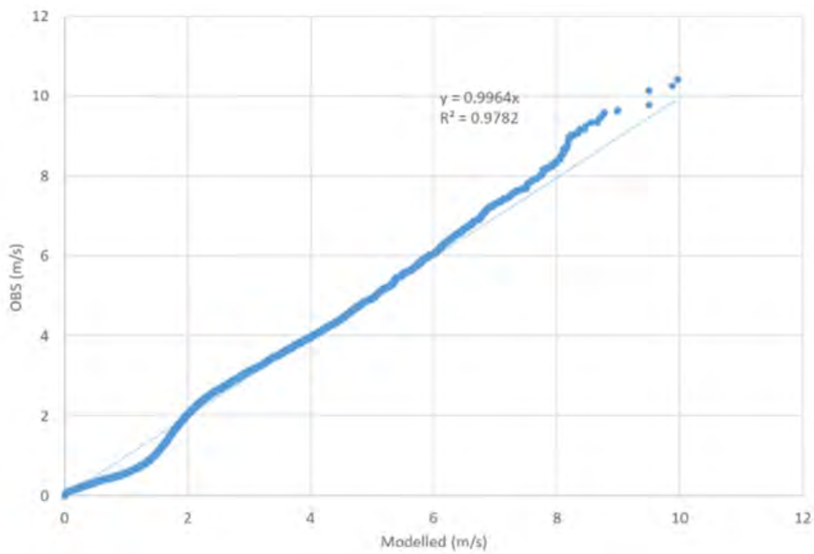



**Figure 4 Quantile-Quantile Plot for Wind Direction**

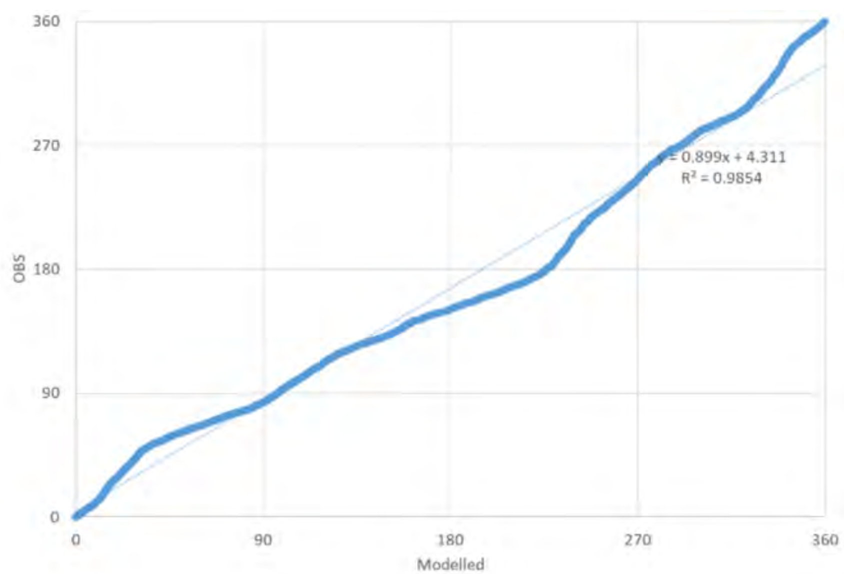
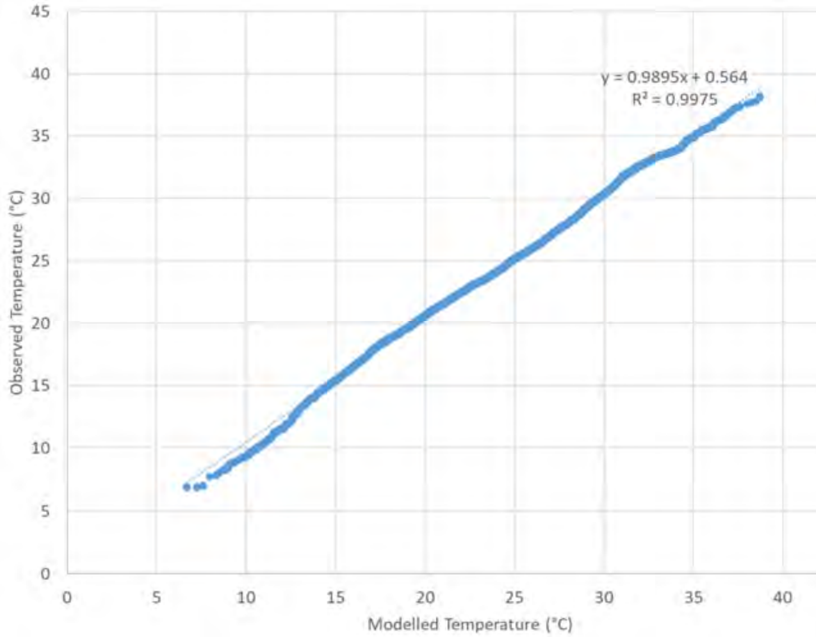


**Figure 5 Quantile-Quantile Plot for Temperate**




**Figures 3**, **4** and **5** each show a reasonable relationship over the range of values examined with the gradient being close to 1 and the lines-of-best-fit going close to the origin (Astute 2019b).

Statistical Tests

Astute (2019b) calculated the daily gross error for wind direction by vector averaging the hourly wind speed and direction data to determine daily vector averaged wind speed and direction data. This resulted in a gross error of 34°, with the benchmark for simple meteorological conditions being ≤30°. As outlined above, a higher benchmark (i.e. ≤55°) is appropriate in areas of complex terrain. However, this is largely irrelevant in this instance given the difference between the simple conditions benchmark and that calculated is considered minor.

Astute (2019b) advises that additional statistical tests without recognised benchmarks will not add any value to the assessment of the datasets. Astute (2019b) confirmed that the wind roses and statistical analyses undertaken show that the model performed reasonably for wind direction. To consider this further, the batch staging modelling undertaken by PEL (2018) needs to be considered and understood.

If one single model run were performed over a year, the model results would be dependent on the periods where worst case meteorology matched periods of elevated emissions. The sensitivity of the results to this risk as a function of wind direction was assessed by changing bird placement (start date) to Days 1, 14 and 28 of the modelled year, which moved the peaks forward to different meteorological periods not included in the previous start date. As such, the odour impact of the Development was assessed three times. The modelling results presented in the AQA (PEL 2018) showed that changing the placement changed the odour impacts only slightly, meaning the influence of the differences in wind direction is unlikely to be significant (Astute 2019b). Moreover, as demonstrated above in **Section 2.1**, the adopted K factor of 2 is higher than the recent test data collected at similar modern poultry farms, meaning the predicted odour concentrations are conservative (Astute 2019b).

Summary

Astute (2019b) sums up by advising:

- The wind roses show similar frequencies to the radar plot provided in the *Response to Air Quality Issues* (Astute 2019a) and the wind frequencies are consistent with the statistical analysis, which showed an acceptable bias towards the observed winds having slightly lower speeds than the measured winds.
- The statistical benchmarks and results previously provided are those recommended for wind speed, direction and temperature and are considered more relevant and appropriate than scatter plots.
- The addition of further statistical tests without recognised benchmarks will not add any value to the assessment of the datasets.
- The modelling of batch staging, as undertaken by PEL (2018), reduces the risks of the modelled period not assessing worst case impacts in all directions if a low frequency of winds occurs from one direction.

## 2.4 Issue 4 - Ventilation Rates

**EPA requested ProTen provide an additional ventilation rate validation study that (as a minimum):**

- **Uses measured ventilation rate data from an existing farm in the Tamworth region;**
- **Covers the range of environmental conditions expected at the site (summer, autumn, winter, spring); and**
- **Includes the full growth cycle.**

**EPA advised that ProTen could alternatively provide the following:**

- **A sensitivity analysis that uses the Dunlop and Duperouzel (2014) empirical equations and other available data to demonstrate the range in potential odour impacts; or**
- **An alternative validation study (for example, odour emission rate) covering the full range of environmental conditions at the site and the full growth cycle.**

The request to provide data from an existing poultry farm in the Tamworth region is addressed in **Section 2.1**. In summary, given that there are no modern poultry farms constructed in recent years and operating to RSPCA standards in the Tamworth region, additional test data was obtained from modern poultry farms in south-western NSW. The test reports are attached to Astute's response in **Appendix A**.

In the meeting with the EPA and DPIE on 16 July 2019, the EPA advised that an odour emission rate (OER) validation study (i.e. final dot point in their request) would be satisfactory to address this issue. As such, the below information summarises Astute's (2019b) OER validation study findings.

Astute (2019b) advises that the "Georgia" ventilation method does on occasion produce different ventilation estimates compared to the Dunlop and Duperouzel (DD) method, however the key question relates to whether or not the estimates of odour emissions are comparable to that of the real-world sampling data. Tables 3-7 and 3-8 in the *Response to Air Quality Issues* (Astute 2019a) showed that when K=2 the predicted emissions were often higher than those measured.

Astute (2019b) processed the newly available test data summarised above in **Section 2.1** and calculated the predicted OERs using the following methods:

1. Method 1 - emissions calculated using measured/recorded test data, K=2;
2. Method 2 - Georgia method, K=2; and
3. Method 3 - DD models 1 and 2, K=2.

The measured emissions are compared to predicted emissions in **Table 3** by farm and season.

## Table 3 Measured Versus Predicted Emissions (K=2)

| Farm | Season | Bird Age (days) | Measured OER (ou/s) | Predicted OER (ou/s) | | | | Ratio Georgia to Measured | Ratio DD Models to Measured |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Using Test Data | Georgia Method | DD Model 1 | DD Model 2 | | |
| Tabbita | Summer 2017 | 27 | 13,392 | 35,261 | 37,989 | 48,053 | 48,053 | 2.8 | 3.6 |
| | | 27 | 8,701 | 35,261 | 37,989 | 48,053 | 48,053 | 4.4 | 5.5 |
| | | 23 | 10,338 | 27,768 | 23,173 | 36,269 | 37,413 | 2.2 | 3.6 |
| | | 23 | 10,338 | 27,768 | 23,173 | 36,269 | 37,413 | 2.2 | 3.6 |
| | | 19 | 10,104 | 22,745 | 20,502 | 29,459 | 30,414 | 2.0 | 3.0 |
| | | 19 | 10,961 | 22,745 | 20,502 | 29,459 | 30,414 | 1.9 | 2.7 |
| Narrandera | Winter 2018 | 29 | 10,677 | 28,711 | 14,494 | 47,026 | 45,295 | 1.4 | 4.3 |
| | | 29 | 8,244 | 28,711 | 14,494 | 47,026 | 45,295 | 1.8 | 5.6 |
| | | 29 | 8,927 | 28,634 | 26,139 | 49,133 | 48,984 | 2.9 | 5.5 |
| | | 29 | 8,927 | 28,634 | 26,139 | 49,133 | 48,984 | 2.9 | 5.5 |
| Tabbita | Spring 2018 | 30 | 24,743 | 49,490 | 53,319 | 67,444 | 67,444 | 2.2 | 2.7 |
| | | 30 | 28,434 | 49,490 | 53,319 | 67,444 | 67,444 | 1.9 | 2.4 |
| | | 27 | 21,480 | 51,104 | 42,647 | 67,932 | 69,642 | 2.0 | 3.2 |
| | | 27 | 21,480 | 51,104 | 42,647 | 67,932 | 69,642 | 2.0 | 3.2 |
| The Ranch Farm 941 | Autumn 2019 | 37 | 8,844 | 17,232 | 14,250 | 38,703 | 35,763 | 1.6 | 4.2 |
| | | 37 | 8,844 | 17,232 | 14,250 | 38,703 | 35,763 | 1.6 | 4.2 |
| | | 27 | 19,418 | 106,641 | 41,706 | 108,214 | 115,085 | 2.1 | 5.7 |
| | | 27 | 11,501 | 106,612 | 41,706 | 108,214 | 115,085 | 3.6 | 9.7 |
| | | 34 | 13,471 | 106,680 | 72,781 | 114,336 | 118,850 | 5.4 | 8.7 |
| | | 34 | 15,953 | 106,680 | 72,781 | 114,336 | 118,850 | 4.6 | 7.3 |
| The Ranch Farm 95 | Autumn 2019 | 34 | 7,927 | 64,283 | 39,365 | 61,841 | 64,197 | 5.0 | 7.9 |
| | | 34 | 6,606 | 64,283 | 39,365 | 61,841 | 64,197 | 6.0 | 9.5 |
| | | 32 | 7,927 | 64,283 | 50,820 | 64,283 | 64,283 | 6.4 | 8.1 |
| | | 32 | 6,606 | 64,283 | 50,820 | 64,283 | 64,283 | 7.7 | 9.7 |
| | | 32 | 7,506 | 68,909 | 54,478 | 68,909 | 68,909 | 7.3 | 9.2 |
| | | 32 | 9,007 | 68,909 | 54,478 | 68,909 | 68,909 | 6.0 | 7.7 |
| Narrandera | Winter 2019 | 32 | 8,208 | 66,890 | 52,881 | 66,890 | 66,890 | 6.4 | 8.1 |
| | | 32 | 9,728 | 66,890 | 52,881 | 66,890 | 66,890 | 5.4 | 6.9 |
| | | 28 | 11,077 | 34,333 | 15,010 | 46,470 | 43,818 | 1.4 | 4.1 |
| | | 28 | 14,382 | 34,333 | 15,010 | 46,470 | 43,818 | 1.0 | 3.1 |
| Average Ratio (positive to over-prediction) | | | | | | | | **3.3** | **5.5** |

1 - ventilation rates provided with The Ranch Autumn 2019 Farm 94 data were significantly higher than expected. The cause is unknown, however, as the K factor equation is relatively insensitive to ventilation rate (as measured) the results are still considered relevant.

The data shows that the predicted emissions using the Georgia method are on average three times higher than the measured emissions, with the predicted emissions using the DD method higher again (Astute 2019b). The Georgia method combined with the K factor method (K=2) produces, at worst, emissions that are equal to realistic/measured emission rates and for most of the time higher emissions than measured (i.e. conservative).

EPA also queried plume momentum in the event that ventilation rates were underpredicted but the odour emissions were accurate. Astute (2019b) advised that the standard modelling methodology is to set a “quasi” source at the end of the shed, generally a point source the width of the shed. The ventilation rate is then varied via the source file, along with the “rainhat” option in CALPUFF that turns off momentum associated with the velocity used for the point source. Astute (2019b) provides the following example – an 18 m wide shed would have a point source with a diameter of 18 m diameter and an area of 254 $m^2$. For a hypothetic flow rates of 150 $m^3$/s, and 100 $m^3$/s, the vertical velocity would be set to 0.6 m/s and 004 m/s, respectively, based on the following equation:

Velocity (m/s) = flow rate ($m^3$/s) divided by area ($m^2$).

The point source is used to represent the emissions exiting the shed along with thermal buoyancy. As the vertical momentum is turned off by using the rainhat switch (FMFAC = 0) the mixing due to turbulence is also limited (Astute 2019b).

To test this, Astute (2019b) compared a standard model run where the velocity from the point source varied with ventilation rate to the situation where the velocity was left at maximum for the model run. Using the above example, the velocity would have been set to the maximum of 0.62 m/s (as an example) rather than being variable. Astute’s (2019b) results are shown in **Table 4** for the Rushes Creek Farm 2 Day 18 model run. These results show that when all things are kept the same, a higher velocity from the point source would lead to lower predicted concentrations (Astute 2019b).

## Table 4 Farm 2 Day 18 Model Run – Variable and Full Momentum, Rainhat On

| Receptor | Predicted 99th Percentile 1-second odour concentration | | | |
|---|---|---|---|---|
| | EIS Methodology | Fixed Velocity 0.62 m/s | Difference | % Difference |
| R1 | 0.2 | 0.1 | -0.1 | -50% |
| R2 | 0.4 | 0.1 | -0.3 | -75% |
| R3 | 0.2 | 0.1 | -0.1 | -50% |
| R4 | 0.3 | 0.1 | -0.2 | -67% |
| R5 | 0.3 | 0.2 | -0.1 | -33% |
| R6 | 0.3 | 0.2 | -0.1 | -33% |
| R7 | 0.5 | 0.3 | -0.2 | -40% |
| R8 | 0.5 | 0.3 | -0.2 | -40% |
| R9 | 0.3 | 0.1 | -0.2 | -67% |
| R10 | 0.3 | 0.1 | -0.2 | -67% |
| R11 | 0.4 | 0.2 | -0.2 | -50% |
| R12 | 0.3 | 0.2 | -0.1 | -33% |
| R13 | 0.4 | 0.2 | -0.2 | -50% |
| R14 | 0.5 | 0.2 | -0.3 | -60% |
| R15 | 0.4 | 0.3 | -0.1 | -25% |
| R16 | 0.6 | 0.4 | -0.2 | -33% |
| R17 | 0.5 | 0.3 | -0.2 | -40% |
| R18 | 0.7 | 0.2 | -0.5 | -71% |
| R19 | 0.7 | 0.4 | -0.3 | -43% |
| R20 | 0.6 | 0.3 | -0.3 | -50% |
| R21 | 0.7 | 0.4 | -0.3 | -43% |
| R22 | 1.1 | 0.7 | -0.4 | -36% |
| R23 | 1.0 | 0.7 | -0.3 | -30% |
| R24 | 2.3 | 1.6 | -0.7 | -30% |
| R25 | 0.6 | 0.5 | -0.1 | -17% |
| R26 | 0.5 | 0.3 | -0.2 | -40% |
| R27 | 0.4 | 0.3 | -0.1 | -25% |
| R28 | 0.4 | 0.2 | -0.2 | -50% |
| R29 | 0.4 | 0.2 | -0.2 | -50% |
| R30 | 0.4 | 0.2 | -0.2 | -50% |
| R31 | 0.3 | 0.2 | -0.1 | -33% |
| R32 | 0.6 | 0.3 | -0.3 | -50% |
| R33 | 0.9 | 0.5 | -0.4 | -44% |
| R34 | 0.3 | 0.2 | -0.1 | -33% |
| R35 | 0.3 | 0.2 | -0.1 | -33% |
| R36 | 0.4 | 0.4 | 0 | 0% |

## 2.5 Issue 5 - Non-Recommended Values in CALMET

**EPA requested that ProTen provide justification for using non-recommended IKINE and THRESHL values in CALMET and undertake a sensitivity analysis for IKINE and THRESHL to demonstrate the impact of assumed values on predicted odour concentrations.**

**IKINE**

The setting IKINE is used to include or remove kinematic effects, which refer to the influence of wind flow associated with objects (i.e. terrain). OEH (2011) recommends that IKINE is turned off to not calculate terrain forced vertical velocity in the initial guess wind field based on the justification - *This option is normally turned off, especially when using fine resolution due to occasional non-convergence of algorithm producing anomalous wind speeds in Layer 2* (OEH 2011, cited in Astute 2019b).

IKINE was set to 1 (i.e. “on”) in the modelling completed by PEL (2018) based on advice from Dr Peter D’Abreton who holds a doctorate in meteorology and worked at PEL when the modelling was undertaken. Astute (2019b) advises that Dr D’Abreton’s justification was based on:

- Switching IKINE “on” allows the model to better include the influence of terrain;
- Hills and valleys in the Peel Valley create flow divergence and convergence as the wind moves around the natural obstacles. A better representation of vertical velocity is required to maintain mass consistency and to more accurately represent plume diversion around terrain; and
- The modelling makes use of a M3D file (NOOBS) and, therefore, divergence associated with observed and prognostic data in layer 2 are unlikely to occur as no observed data was used.

Astute (2019b) further advises that the use of IKINE=1 is supported by Radonjic et al (2010) who showed that the application of the CALMET pre-processor demonstrated kinematic effects that result in increased wind speeds above mountains.

**THRESHL**

The THRESHL setting is the threshold buoyancy flux required to sustain convective mixing height growth overland with the units of W/m$^3$. OEH (2011) recommends that it be set to 0 W/m$^3$.

Astute (2019b) advises that THRESHL was set to 0.05 W/m$^3$ in the modelling completed by PEL (2018) in order to produce more accurate outputs for mixing height. It was not used at 0.0 W/m$^3$ based on the work of Ken Rayner (Western Australia Department of Environment and Conservation, CALPUFF issue summary 28 April 2011 and CALPUFF issue summary 20 May 2011), who showed that using 0.0 W/m$^3$ results in spurious outputs for mixing height near dawn and dusk (Astute 2019b).

Based on the above justifications, sensitivity analysis IKINE and THRESHL were not considered necessary.

# 3 GROUNDWATER

**Lands & Water recommended a groundwater monitoring program combined with a contingency plan be imposed to enable verification of any groundwater impacts and to address any unacceptable impacts.**

As detailed in Section 8.5 of the EIS and Section 16 of the RTS, the potential for adverse impact to the groundwater source as a result of the Development is low. Key points include:

- Broiler production farms are largely dry operations, with no effluent generated as a result of the poultry-rearing itself.
- Each poultry shed will have fully-sealed concrete flooring and will be surrounded by a 400 millimetre (mm) high dwarf concrete bund wall.
- There will be a low frequency of shed cleaning (roughly 5.6 times per year) and a relatively low volume of wash down water will be generated. The poultry litter will be removed from the sheds at the end of each production and immediately transported off-site and the sheds will be thoroughly blown and swept (i.e. dry-cleaned) before being washed using high-pressure low-volume sprays.
- Wash down water, along with rainfall runoff from the shed roofs and surrounding surfaces, will be captured in the engineered surface water management system at each PPU, with the grassed swales acting to uptake nutrients. Excess water in the surface water management systems will flow in to a detention dam at each PPU. The water captured in the detention dams should have relatively low nutrient levels and should be free of any other significant pollutants/contaminants.
- The shallow alluvial groundwater source is confined to the Namoi River channel itself and does not extend in to the Development Site.
- The deeper fractured rock groundwater source is generally between 10 and 20 metres below ground level (mbgl) across the Development Site.
- The conceptual understanding of the regolith layer is that it measures 0.5 to 3 m thick, sits approximately 2 m below ground level and exists across the Development Site (and the regional area) acting as an aquitard.

Given the controlled environment in which this modern poultry farm will operate and the local groundwater conditions, in particular no shallow aquifer and the regolith layer, no detectable groundwater impact is expected. As such, a groundwater monitoring and contingency plan is unwarranted and ProTen ask that such a plan not be imposed as a condition of consent.

The development design features, best management practices and mitigation measures committed to in the listed in Sections 8.5.3 and 9 of the EIS will be implemented to ensure negligible risk to groundwater resources throughout the life of the Development.

**Lands & Water recommended lining of the detention dams due to the proposed retention of nutrient-laden water on-site.**

The above dot points should be referred to and considered in relation to this recommendation.

Irrespective, as already confirmed in Sections 4.17, 8.5.5 and 9 of the EIS and Section 16.2 of the RTS, ProTen has made the following commitment:

> *The internal surfaces of the detention dams will be compacted or lined to provide an impermeable surface.*

The dams will be lined with one of the following two options:

(a) Clay material won on-site during excavation works (test pits will be undertaken to ensure appropriate material is available);

or

(b) If appropriate material is not available on-site, a synthetic liner.

ProTen ask that the condition of consent be worded to allow for either option.

# 4 REFERENCES

Astute Environmental Consulting (2019a) *Rushes Creek Poultry Production Farm SSD 7704, Response to Letter: 14 June 2019 SSD 7704*

Astute Environmental Consulting (2019b) *Rushes Creek Poultry Production Farm SSD 7704, Response to Air Quality Issues*

Department of Primary Industries (2012) *Best Practice Management for Meat Chicken Production in NSW*

Environment Protection Authority (2006) *Assessment and Management of Odours from Stationary Sources in NSW*

Environment Protection Authority (2016) *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*

Office of Environment and Heritage (2011) *Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for inclusion into the Approved methods for the Modeling and Assessment of Air Pollutants in NSW*

Pacific Environment Limited (2018) *ProTen Rushes Creek Poultry Production Complex - Air Quality Assessment*

RSPCA Australia (2013) *RSPCA Approved Farming Scheme Standards – Meat Chickens*

SLR Consulting Australia (2018) *Rushes Creek Poultry Production Farm, SSD 7704, Environmental Impact Statement*

SLR Consulting Australia (2019) *Rushes Creek Poultry Production Farm, SSD 7704, Response to Submissions*

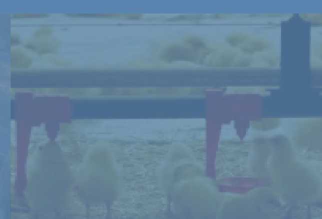
# 5 ABBREVIATIONS

| | |
|---|---|
| Approved Methods | *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* |
| AQA | Air Quality Assessment |
| Astute | Astute Environmental Consulting |
| DPIE | Department of Planning, Industry and Environment |
| EIS | Environmental Impact Statement |
| EME | EME Advisory |
| EPA | Environment Protection Authority |
| EP&A Act | *Environmental Planning and Assessment Act 1979* |
| kg | kilogram |
| km | kilometre |
| Lands & Water | Department of Industry – Lands and Water (now part of DPIE) |
| m | metre |
| m/s | metres per second |
| $m^2$ | square metre |
| $m^3$ | cubic metre |
| $m^3/s$ | cubic metre per second |
| mbgl | metres below ground level |
| mm | millimetre |
| m/s | metres per second |
| OEH | Office of Environment and Heritage |
| OER | odour emission rate |
| ou | odour unit |
| PEL | Pacific Environment Limited (now part of ERM) |
| PPU | poultry production unit |
| ProTen | ProTen Tamworth Pty Limited |
| RSPCA Standards | *RSPCA Approved Farming Scheme Standards – Meat Chickens* |
| RTS | Response to Submissions |
| SLR | SLR Consulting Australia Pty Ltd |
| SSD | State significant development |
| TAPM | The Air Pollution Model |

# Appendix A

## Response to Letter: 14 June 2019 SSD 7704

### (Astute Environmental Consulting)



Rushes Creek Poultry Production Farm SSD 7704

# Response to Letter: 14 June 2019 SSD 7704

ProTen Tamworth Pty Limited

Astute Environmental Consulting

**Job: 18-165**

**Date: 1 November 2019**

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| **Job Number** | 18-165 |
| **Client** | ProTen Tamworth Pty Limited |
| **Approved for release by** | G. Galvin |
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**Document Control**

| Version | Date | Author | Reviewer |
|---|---|---|---|
| D1-1 | 02/10/19 | G. Galvin | W. Shillito |
| R1-1 | 01/11/19 | G. Galvin | G. Galvin |

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# 1 INTRODUCTION

ProTen Tamworth (ProTen) engaged Astute Environmental (Astute) to prepare a response in relation to the letter from NSW EPA to Department of Planning & Environment (now DPIE) regarding SSD 7704 (ref SF16/24271; DOC19/440090) dated 14 June 2019 ("the letter").

The letter noted a number of outstanding issues as follows:

> *Outstanding issues with the air quality impact assessments provided in the Response to Submissions are detailed in Attachment A together with a request for information to address each issue. In summary, the EPA requests:*
>
> - *That the applicant provides further feasible odour mitigation measures that could achieve compliance with an odour performance criterion of 3 OU, if required.*
> - *That the applicant identify additional odour mitigation measures that could be implemented should odour impacts occur once operational.*
> - *That the applicant provides further evaluation of the CALMET generated data as recommended in OEH (2011)1. This analysis, and any other relevant data, should be used to assess the influence of the wind direction errors on predicted odour concentrations.*
> - *That the applicant provides further validation studies for ventilation rate or odour emission rate.*
> - *That the applicant provides a justification for the use of non-recommended values in CALMET. This should be supported by a sensitivity analysis for IKINE and THRESHL to demonstrate the impact of the assumed values on predicted odour concentrations.*

Recent odour testing results from ProTen's Narrandera Poultry Production Farm and Astute's responses to the issues raised in the abovementioned issues are provided below.

# 2 FURTHER ODOUR TESTING

Additional odour testing has been performed by ProTen since the finalisation of the previous Astute report (Response to Air Quality Issues R1-1 28 February 2019).

The testing was performed at ProTen's Narrandera Poultry Production Farm (SSD 6882) in south western NSW, which was approved by the Department of Planning and Environment (now DPIE) in November 2015.

Testing was performed by The Odour Unit in two sheds just before bird pickup during August 2019. Testing was performed at this point in time as both the bird numbers and bird density is at maximum.

The results are summarised in Table 2-1 and the test report is attached to this document. It can be seen in Table 2-1 that the measured K factors were significantly lower than the recommended K factor in PAEHolmes (2011) and significantly lower than the conservative K factor adopted in the odour assessment for Narrandera by Pacific Environment (2015) and subsequent assessment work.

**Table 2-1: Narrandera Test Results – August 2019**

| Location | Sample Number | Bird Age (days) | OER (ou/s) | Floor Area ($m^2$) | Number of Birds | Average Weight (kg) | Ventilation Rate (STP) ($m^3/s$) | K Factor |
|---|---|---|---|---|---|---|---|---|
| Narrandera Shed 6 | 1 | 28 | 11,077 | 2,720 | 46,938 | 1.70 | 61.2 | 0.7 |
| | 2 | 28 | 14,382 | 2,720 | 46,938 | 1.70 | 61.2 | 0.9 |
| Narrandera Shed 7 | 1 | 28 | 11,985 | 2,720 | 46,564 | 1.68. | 51 | 0.9 |
| | 2 | 28 | 11,985 | 2,720 | 46,564 | 1.68 | 51 | 0.9 |
| **Average K Factor** | | | | | | | | **0.8** |

Note: Values in this table are slightly different to that in the reports from TOU. This is due to the number of decimal places used in the calculations. The data above are calculated based on the one decimal place reported in TOUs report.

For this report, we were also provided with odour test data from the Tabbita poultry farm at Tabbita and The Ranch poultry farm near Tabbita. The data from The Ranch and Tabbita farms, as well as ProTen's Narrandera test data from July 2018 and August 2019, is summarised in Figure 2-1 by season. Note that the first and second data points are sample 1 and sample 2 from one shed, the third and fourth are sample 1 and sample 2 from another shed and so forth. The data is summarised further in Table 2-2.

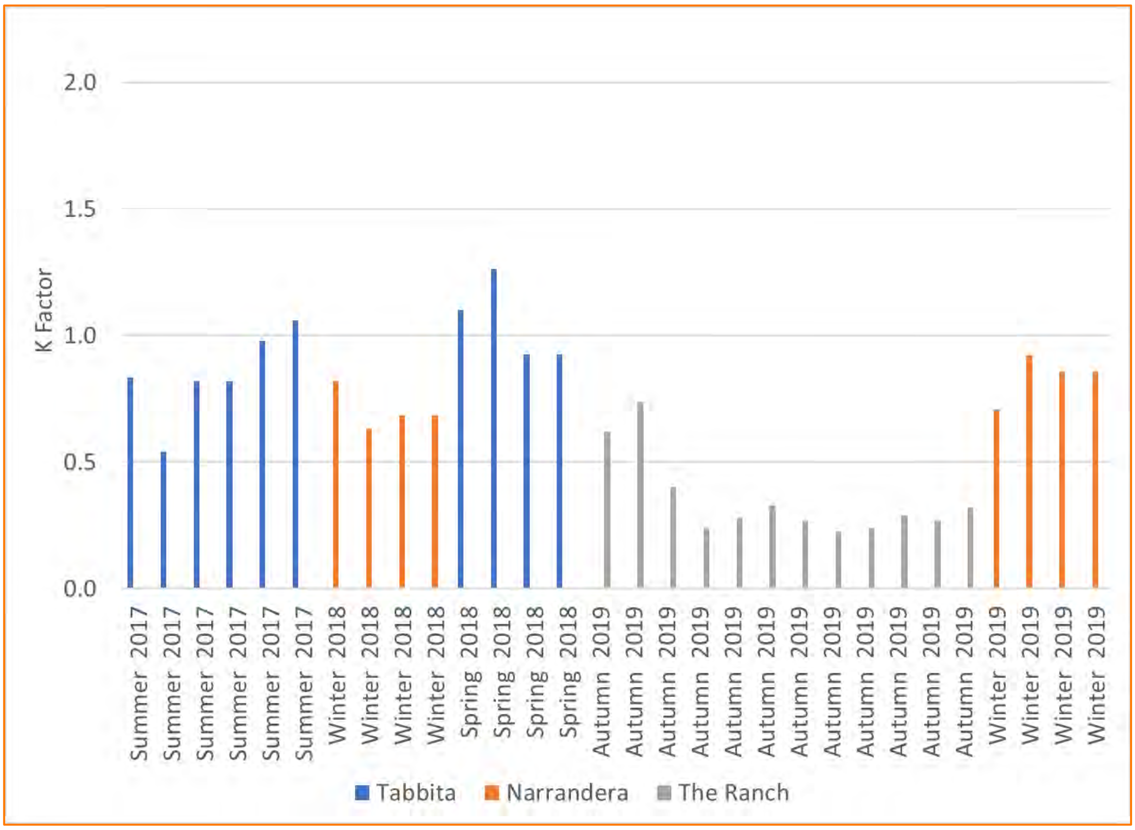


**Figure 2-1: NSW Farm Data –December 2017 to Present**

**Table 2-2: Summary of Test Data**

| Site | Average K Factor | Bird Ages Tested (Days) | Testing and Analysis |
|---|---|---|---|
| ProTen | 0.8 ± 0.1 | 28 and 29 | The Odour Unit |
| The Ranch | 0.4 ± 0.2 | 32 and 34 | SLR, analysis The Odour Unit |
| Tabbita | 0.8 ± 0.2 | 19, 23, 27, 30 | The Odour Unit |

The measured average K factors listed in Table 2-2 are significantly lower than the K factor of 2.0 adopted in the odour assessment for Rushes Creek. The average K factor of 0.8 at Narrandera demonstrates that ProTen's newer farms are very well designed and managed and operate with low odour emissions. The K factor of 2.0 adopted for Rushes Creek is suitably conservative and represents a realistic worst-case emission value.

# 3 OUTSTANDING ISSUES

## 3.1 Request 1 - Feasible Mitigation Measures

The letter requested that "That the applicant provides further feasible odour mitigation measures that could achieve compliance with an odour performance criterion of 3 OU, if required".

Based on the conservatism already incorporated in to the modelling, the population density in this rural area, the short-term transient population at the Lake Keepit Sport and Recreation Centre and the recent odour test data presented above in Section 2, an odour criterion of $C_{99\ 1sec}$ = 5 ou is considered applicable and appropriate. If a lower K factor was applied based on the test data in Section 2 above, the number of receptors above $C_{99\ 1sec}$ = 2 ou would decrease.

ProTen has committed to vegetation plantings of at least 40 metres wide around the perimeter of each PPU. The combination of appropriate separation distances and vegetative screen represents current best practice for odour mitigation for intensive poultry farms. A range of literature values exist with regard to the potential reduction in odour impacts associated with vegetative buffers (for pig and poultry farms) including Malone (2008) (26%), Patterson (2009) (34%), Parker et. al. (2012) (66%) and Hernandez (2012) (40-60%). The vegetation screens committed to by ProTen were not included in the modelling and, therefore, represent a further conservatism and mitigation measure.

Based on the discussion of this matter during the meeting with the EPA and DPIE on 16 July 2019 and the above information, no further consideration is warranted.

## 3.2 Request 2 - Additional Odour Mitigation Measures

The letter requested "That the applicant identify additional odour mitigation measures that could be implemented should odour impacts occur once operational".

Based on the discussion of this matter during the meeting with the EPA and DPIE on 16 July 2019 and the information presented above in Sections 2 and 3.1 and also below in Sections 3.3 to 3.5, no further consideration is warranted. The predicted odour concentrations are conservative and compliance is predicted.

## 3.3 Request 3 - CALMET Evaluation

The EPA letter stated:

*That the applicant provides further evaluation of the CALMET generated data as recommended in OEH (2011). This analysis, and any other relevant data, should be used to assess the influence of the wind direction errors on predicted odour concentrations.*

### 3.3.1 Background

The previous Astute Report included Table 3-2 which summarised the results from a number of statistical tests used to compare the prognostic and observed data. As noted in the previous report, the statistical benchmarks were taken from Hurley et. al. (2002) and other publications.

The most widely referred to report with regard to the meteorological statistical benchmarks is Enhanced Meteorological Modelling and Performance Evaluation for Two Texas Ozone Episodes (Emery, et al., 2001).

The benchmarks of Emery et. al. have been widely used both in the United States and Australia as the basis for assessing meteorological model performance (Hurley, et al., 2002; Tesche, et al., 2002; Alpine Geophysics, 2010; AECOM, 2013; Johnson, 2019; Monk, et al., 2019). However, when using the benchmarks Emery et. al. (2001) noted that the purpose of the benchmarks is not necessarily to give a passing or failing grade to any one particular application, but rather to put the results into context. In other words, by assessing a variety of benchmarks for wind speed, direction and temperature, the relative accuracy of the dataset as a whole can be assessed.

While Emery et. al. (2001) listed some of the benchmarks as being applicable to hourly or daily values, the report *The MMIFstat Statistical Analysis Package Version 1* (Alpine Geophysics, 2010) notes that the final daily benchmarks based on Emery et. al. were as follows:

- Wind Speed
  - RMSE ≤ 2 m/s;
  - Bias ≤ ± 0.5 m/s;
  - IOA ≥ 0.6;
- Wind Direction
  - Gross Error ≤ 30°;
  - Bias ≤ ± 10°;
- Temperature
  - Gross Error ≤2°;
  - Bias ≤±0.5°; and
  - IOA ≥0.8.

A recent report, *Meteorological Model Performance Evaluation of an Annual 2002 MM5 (version 3.6.3) Simulation* (Johnson, 2019) prepared by Iowa DNR notes that the statistical measures appropriate for wind speed, wind direction and temperature were as detailed in Alpine Geophysics (2010). Johnson (2019) noted that hourly values could be used for the assessment of wind speed, temperature and direction (bias only), however Gross Error calculations were to be performed on daily data. We note that calculations for temperature and wind speed are similar for daily and hourly values as the values can be arithmetically (as opposed to vector) averaged.

In the report *Air Quality Modeling Study Meteorological Model Performance Evaluation: 2009-2013 BOEM Arctic WRF Dataset* (Ramboll Environ, 2016) it was noted that the benchmarks of Emery et. al. were developed by analysing well-performing meteorological model evaluation results for simple, mostly flat terrain conditions and simple meteorological conditions. As noted in Ramboll Environ (2016), Kemball-Cook et. al. (2005) proposed a series of benchmarks for model performance under complex conditions, the most relevant for the Peel Valley being a gross error benchmark of <55° for wind direction.

Complex terrain (conditions) is defined by the American Meteorological Society as: *"A region having irregular topography, such as mountains or coastlines. Complex terrain can also include variations in land use, such as urban, rural, irrigated, and unirrigated"* (American Meteorlogical Society , 2012).

Therefore, if the model performance is close to that required for simple terrain areas (≤30°) and simple meteorological conditions, the performance of the model can be considered as appropriate.

### 3.3.2 Response

In the Astute report, the statistical measures were all applied to hourly data. It also included Figure 3-11 which was a radar plot. Radar plots show the frequency of winds from each direction. They are different to wind roses in that they do not break the frequency down by wind speed but just show frequency.

The EPA letter requested further information the form of:

- Wind roses;
- Scatter plots;
- Quantile-quantile plots; and
- Applying all statistical tests (mean, bias, gross error, root mean square error and index of agreement) to all parameters (wind speed, temperature and wind direction).

Wind roses showing the predicted winds (based on TAPM) and observed winds at Moana are shown in Figure 3-1. With regard to Figure 3-1 note:

- The left windrose is based on TAPM (full year) 1km grid into CALMET;
- The right windrose is based on observed data for the same year (missing ~60 hours);

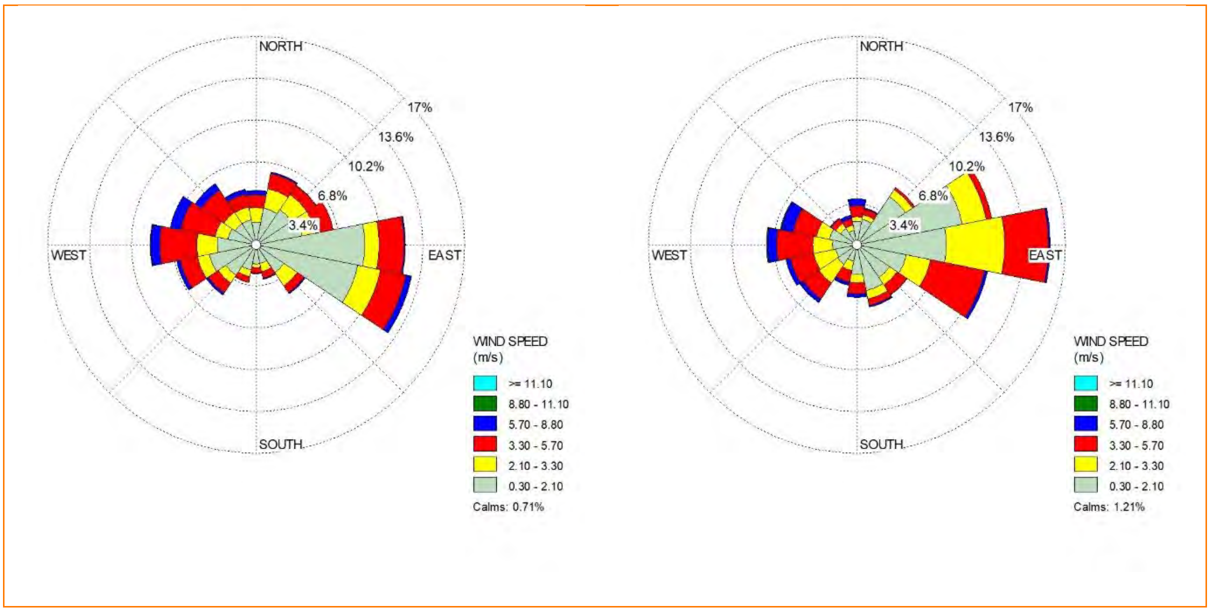


**Figure 3-1: Wind Roses – TAPM (left) – Moana (right) - 2016**

As a 1km TAPM grid is used to drive CALMET, some differences would be expected. A 1km grid was selected as this is what was used in the Pacific Environment report included in the EIS. The 1km output from TAPM was used due to the size of the domain. CALMET was then used to refine the windfield to the 100m CALMET grid. This can result in slight differences in winds between where the model is extracted (closest) grid and the weather station location.

The general shape of the windroses in Figure 3-1 are consistent in that they show dominant easterly winds, with a noticeable westerly component. The range of wind speeds in the light category (< 3m/s) is marginally higher for the TAPM/CALMET data (68% compared to 66%) however as previously shown by the BIAS, RMSE and IO values the overall difference is within an acceptable range.

The critical direction for the project relates to the nearest receptors, which are Receptor 25 to the south-southeast and Receptor 24 to the east. Therefore, winds from the northwest and west are critical. It can be seen in Figure 3-1 that the TAPM data shows more winds from the northwest, and a similar frequency of winds from the west meaning that the modelling captures winds from these directions adequately.

With regard to scatter and quantile-quantile plots, these are graphical representations of the datasets. The use of the statistical benchmarks detailed in Emery et. al. (2001), as used here, are considered a more robust method for comparing the data. For example Hurley et. al. (2002) used QQ plots for concentration. QQ plots are ranked pairings of predicted and observed values, such that any given quantile of the predicted value is plotted against the same quantile of the observed concentrations (Paine, et al., 1998).

QQ plots for wind direction, wind speed and temperature are shown below in Figure 3-2 and Figure 3-3. We note that there were large gaps in the temperature dataset provided for Moana primarily over winter. Therefore, the comparison is based on the available data. Both figures show a reasonable relationship over the range of values examined with the gradient being close to 1 and the lines of best fit going close to the origin of the figure.

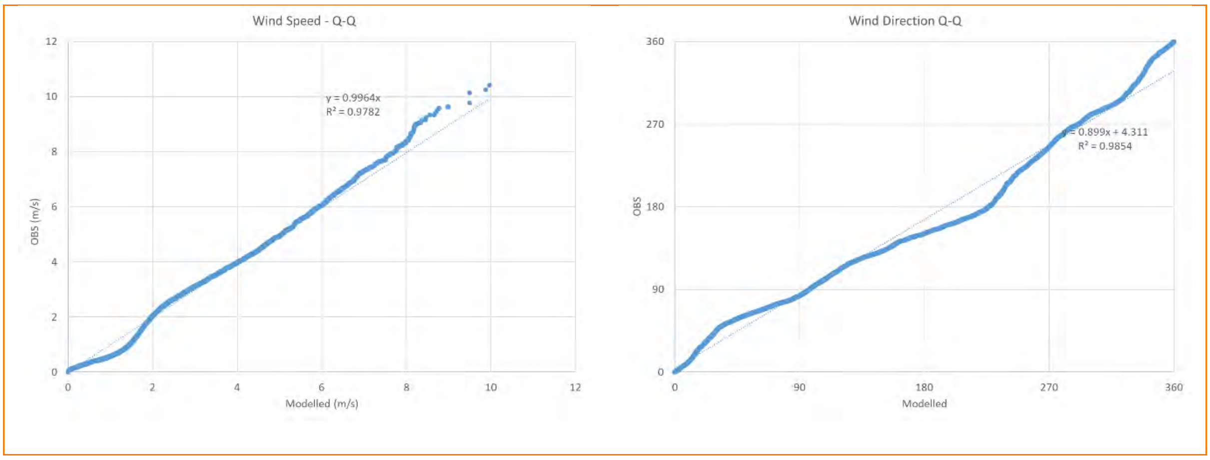


**Figure 3-2: Quantile Quantile Plots – Wind Speed (left) and Wind Direction (right)**

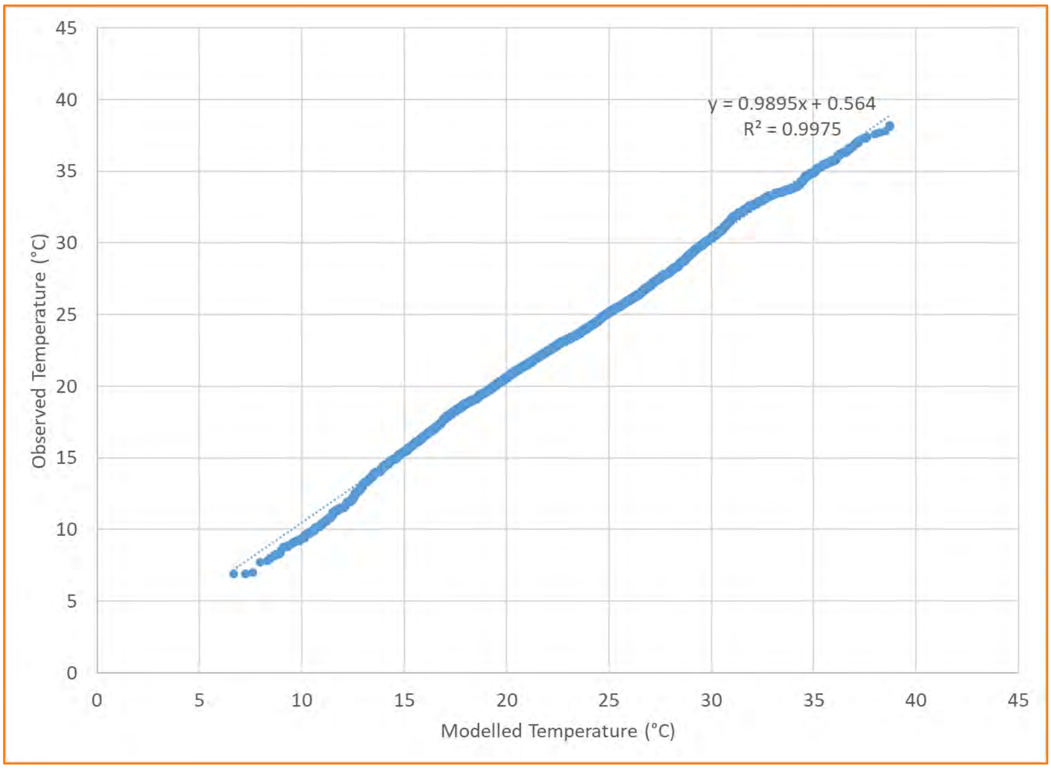

**Figure 3-3: Quantile Quantile Plot – Temperature**

Based on Johnson (2019), we calculated the daily Gross Error for wind direction. This was done by vector averaging the hourly wind speed and direction data to determine daily vector averaged wind speed and direction data. For wind direction, the Gross Error was found to be 34° (benchmark was ≤30° for simple meteorological conditions). As proposed by Tesche, in areas of complex terrain, a higher benchmark is appropriate (≤55°), however given that the difference between the simple conditions benchmark and that calculated, the difference is considered minor.

With regard to the aforementioned data, the letter stated "*These additional analysis techniques could also be used to provide further information regarding the error in the predicted wind direction. This information can then be used to assess the influence of the wind direction error on predicted odour concentrations*".

As shown in the wind roses and statistical analyses, the model performed reasonably for wind direction. However, to consider this further, the batch staging modelling needs to be considered and understood.

If a single model run were performed over a year, the model results would be dependent on the periods where worst case meteorology matched periods of elevated emissions. This is relevant as poultry farms are cyclical where elevated emissions typically occur for a maximum of 3 to 4 weeks out of every 10-week period.

The sensitivity of the results to this risk as a function of wind direction has previously been assessed by changing bird placement to Days 1, 14 and 28 of the modelled year. By changing the start date, the peaks are moved forward to different meteorological periods which were not included in the previous start date. This means that the odour impact of the proposed development has been assessed three times[1]. The results in Table 6-1 in the PEL report in the EIS ($C_{99\ 1sec}$[2]) showed that changing the placement changed the results only slightly, meaning the influence of the differences in wind direction is unlikely to be significant. Moreover, as shown above in Section 2, the adopted K factor of 2 is higher than the recent test data at modern farms meaning that the predicted concentrations are conservative.

In summary:

- the wind roses show similar frequencies to the radar plot in the previous report and the wind frequencies are consistent with the statistical analysis which showed an acceptable bias towards the observed winds having slightly lower speeds than the measured winds;
- the statistical benchmarks and results previously provided are those recommended for wind speed, direction and temperature which are considered more relevant and appropriate than scatter plots;
- the addition of further statistical tests without recognised benchmarks will not add any value to the assessment of the datasets; and

[1] However rather than assess the 99th percentile for the entire period assessed each year was assessed separately.
[2] 99th percentile – top 88 hours.

- the modelling of batch staging reduces the risks of the modelled period not assessing worst case impacts in all directions if a low frequency of winds occurs from one direction.

## 3.4 Request 4 - Validation Studies for Ventilation Rate or Odour Emission Rate

The letter requested that "the applicant provides further validation studies for ventilation rate or odour emission rate". The letter requested:

> That the applicant provides an additional ventilation rate validation study. The ventilation rate validation study must, as a minimum:
>
> - Use measured ventilation rate data from an existing farm in the Tamworth region
> - cover the range of environmental conditions expected at the site (summer, autumn, winter and spring)
> - include the full growth cycle.
>
> Alternatively, the applicant could provide:
>
> - a sensitivity analysis that uses the Dunlop and Duperouzel (2014) empirical equations and other available data (such as measured ventilation rates) to demonstrate the range in potential odour impacts or
> - an alternative validation study (for example, odour emission rate), covering the full range of environmental conditions at the project site and the full growth cycle (as required for the ventilation rate validation study). This alternative validation study would need to be supported by a sensitivity analysis demonstrating the impact of inaccuracies in velocity (due to inaccuracies in ventilation rate) on predicted impacts.

During the meeting with the EPA and DPIE on 16 July 2019, the EPA indicated that the final dot point (odour emission rate validation study) could be supplied to EPA confirming that the emission estimation methodology provides a realistic estimation of emissions.

Whilst the "Georgia" ventilation method does on occasion produce different ventilation estimates compared to the Dunlop and Duperouzel method, the key question relates to whether or not the estimates of odour emissions are comparable to that of the sampling data.

Table 3-7 and Table 3-8 of the previous Astute report showed that when K=2 was used the predicted emissions were often higher than measured.

Available test data summarised above in Figure 2-1 was processed and odour emission rates were calculated as follows:

- Method 1 - odour emissions based on measured and recorded values (i.e. flow rate, weight etc[3]), K=2 – K Factor equation;

[3] Where test data is referred to, emissions were calculated using the data measured on the day with a K factor of 2. For example, flow rate, density, ventilation rate were used, and a new emission rate was calculated using the K factor equation.

- Method 2 – odour emissions - Georgia ventilation method (ventilation estimated using Georgia method), measured density and weights, K=2; and
- Method 3 - predicted ventilation using Dunlop and Duperouzel methods 1 and 2, K factor method, K=2.

We note that as most of the test reports didn't include inputs such as target temperatures at the time of testing nor ambient temperature, these were assumed for a number of the calculation points based on Cobb birds and ambient temperatures on the day of testing.

The estimated emissions are compared to the measured emissions in Table 3-1 and Table 3-2. The table was split in two as there was too much data to show on a single page.

The data shows that on average, the predicted emissions using the Georgia method are three times higher than measured (with the Dunlop and Duperouzel method higher again) and at worst equal to measured. One important input here is ventilation rate, with the data showing that the ventilation methodology adopted for the modelling assessment (i.e. Georgia method) would produce at worst emissions equal to that which could be occurring, and typically conservative emissions (on average three times higher). This means that the Georgia method combined with the K factor method (K=2) produces at worst realistic emission rates and for most of the time higher emissions than measured.

**Table 3-1: Test Data from Figure 2-1 – Measured and Predicted Emissions – K=2 (ou/s) – Part 1**

| Farm | Season | Age (days) | OER based on Test data (ou/s) | OER based on DD Model 1 (ou/s) | OER based on DD Model 2 (ou/s) | OER based on Georgia (ou/s) | Measured OER (ou/s) | Ratio Georgia to Measured | Ratio DD Model 1/2 to Measured |
|---|---|---|---|---|---|---|---|---|---|
| Tabbita | Summer 2017 | 27 | 35,261 | 48,053 | 48,053 | 37,989 | 13,392 | 2.8 | 3.6 |
| | | 27 | 35,261 | 48,053 | 48,053 | 37,989 | 8,701 | 4.4 | 5.5 |
| | | 23 | 27,768 | 36,269 | 37,413 | 23,173 | 10,338 | 2.2 | 3.6 |
| | | 23 | 27,768 | 36,269 | 37,413 | 23,173 | 10,338 | 2.2 | 3.6 |
| | | 19 | 22,745 | 29,459 | 30,414 | 20,502 | 10,104 | 2.0 | 3.0 |
| | | 19 | 22,745 | 29,459 | 30,414 | 20,502 | 10,961 | 1.9 | 2.7 |
| Narrandera | Winter 2018 | 29 | 28,711 | 47,026 | 45,295 | 14,494 | 10,677 | 1.4 | 4.3 |
| | | 29 | 28,711 | 47,026 | 45,295 | 14,494 | 8,244 | 1.8 | 5.6 |
| | | 29 | 28,634 | 49,133 | 48,984 | 26,139 | 8,927 | 2.9 | 5.5 |
| | | 29 | 28,634 | 49,133 | 48,984 | 26,139 | 8,927 | 2.9 | 5.5 |
| Tabbita | Spring 2018 | 30 | 49,490 | 67,444 | 67,444 | 53,319 | 24,743 | 2.2 | 2.7 |
| | | 30 | 49,490 | 67,444 | 67,444 | 53,319 | 28,434 | 1.9 | 2.4 |
| | | 27 | 51,104 | 67,932 | 69,642 | 42,647 | 21,480 | 2.0 | 3.2 |
| | | 27 | 51,104 | 67,932 | 69,642 | 42,647 | 21,480 | 2.0 | 3.2 |

**Table 3-2: Test Data from Figure 2-1 – Measured and Predicted Emissions – K=2 (ou/s) – Part 2**

| Farm | Season | Age (days) | OER based on Test data (ou/s) | OER based on DD Model 1 (ou/s) | OER based on DD Model 2 (ou/s) | OER based on Georgia (ou/s) | Measured OER (ou/s) | Ratio Georgia to Measured | Ratio DD Model 1/2 to Measured |
|---|---|---|---|---|---|---|---|---|---|
| The Ranch Farm 94 | Autumn 2019 | 37 | 17,232 | 38,703 | 35,763 | 14,250 | 8,844 | 1.6 | 4.2 |
| | | 37 | 17,232 | 38,703 | 35,763 | 14,250 | 8,844 | 1.6 | 4.2 |
| | | 27 | 106,641 | 108,214 | 115,085 | 41,706 | 19,418 | 2.1 | 5.7 |
| | | 27 | 106,612 | 108,214 | 115,085 | 41,706 | 11,501 | 3.6 | 9.7 |
| | | 34 | 106,680 | 114,336 | 118,850 | 72,781 | 13,471 | 5.4 | 8.7 |
| | | 34 | 106,680 | 114,336 | 118,850 | 72,781 | 15,953 | 4.6 | 7.3 |
| The Ranch Farm 95 | Autumn 2019 | 34 | 64,283 | 61,841 | 64,197 | 39,365 | 7,927 | 5.0 | 7.9 |
| | | 34 | 64,283 | 61,841 | 64,197 | 39,365 | 6,606 | 6.0 | 9.5 |
| | | 32 | 64,283 | 64,283 | 64,283 | 50,820 | 7,927 | 6.4 | 8.1 |
| | | 32 | 64,283 | 64,283 | 64,283 | 50,820 | 6,606 | 7.7 | 9.7 |
| | | 32 | 68,909 | 68,909 | 68,909 | 54,478 | 7,506 | 7.3 | 9.2 |
| | | 32 | 68,909 | 68,909 | 68,909 | 54,478 | 9,007 | 6.0 | 7.7 |
| Narrandera | Winter 2019 | 32 | 66,890 | 66,890 | 66,890 | 52,881 | 8,208 | 6.4 | 8.1 |
| | | 32 | 66,890 | 66,890 | 66,890 | 52,881 | 9,728 | 5.4 | 6.9 |
| | | 28 | 34,333 | 46,470 | 43,818 | 15,010 | 11,077 | 1.4 | 4.1 |
| | | 28 | 34,333 | 46,470 | 43,818 | 15,010 | 14,382 | 1.0 | 3.1 |
| Overall Average Ratio (positive is over prediction) | | | | | | | | 3.3 | 5.5 |

Note: Ventilation rates provided with The Ranch March 2019 Farm 94 data were significantly higher than expected. The cause of this is unknown, however, as the K factor equation is relatively insensitive to ventilation rate (as measured) the results are still considered relevant.

A question was also raised by the EPA with regard to plume momentum in the event that ventilation rates were underpredicted but the odour emissions were correct.

The standard modelling methodology is to set a “quasi” source at the end of the shed. This is point source generally the width of the shed. The ventilation rate is then varied via the source file, along with the rainhat option in CALPUFF. The rainhat options turns off momentum associated with the velocity used for the point source. For example, an 18 m wide shed would have a point source with an 18 m diameter and an area of 254 $m^2$. For a hypothetic flow rate of 150 $m^3/s$, the vertical velocity would be set to 0.6 m/s and for 100 $m^3/s$, the vertical velocity would be set to 0.4 m/s as described in the equation:

*Velocity (m/s) = flow rate ($m^3/s$) divided by area ($m^2$).*

In other words, the point source is used to represent the emissions exiting the shed along with thermal buoyancy. As the vertical momentum is turned off by using the rainhat switch (FMFAC = 0) the mixing due to turbulence is also limited.

To test the effect of this, we compared a standard model run where the velocity from the point source varied with ventilation rate to the situation where the velocity from the point source was left at maximum for the model run. Based on the above example, the velocity would have been set to the maximum velocity of 0.62 m/s (as an example) rather than being variable. The results are shown below in Table 3-3 for the Day 18 for Farm 2 only (see Figure 1-1 in Pacific Environment (2018) AQU-QD-006-21099).

Table 3-3 shows that when all things are kept the same, a higher velocity from the point source would lead to lower predicted concentrations.

**Table 3-3: Day 18 Scenario Receptor Run – variable and full momentum rain hat on – Farm E (PEL)**

| Receptor | Predicted 99th percentile 1-second odour concentration ($C_{99}$ 1 second) | | | |
|---|---|---|---|---|
| | Day 18 – EIS methodology | Day 18 – 0.62 m/s fixed velocity | OU difference | % difference |
| 1 | 0.2 | 0.1 | -0.1 | -50% |
| 2 | 0.4 | 0.1 | -0.3 | -75% |
| 3 | 0.2 | 0.1 | -0.1 | -50% |
| 4 | 0.3 | 0.1 | -0.2 | -67% |
| 5 | 0.3 | 0.2 | -0.1 | -33% |
| 6 | 0.3 | 0.2 | -0.1 | -33% |
| 7 | 0.5 | 0.3 | -0.2 | -40% |
| 8 | 0.5 | 0.3 | -0.2 | -40% |
| 9 | 0.3 | 0.1 | -0.2 | -67% |
| 10 | 0.3 | 0.1 | -0.2 | -67% |
| 11 | 0.4 | 0.2 | -0.2 | -50% |
| 12 | 0.3 | 0.2 | -0.1 | -33% |
| 13 | 0.4 | 0.2 | -0.2 | -50% |
| 14 | 0.5 | 0.2 | -0.3 | -60% |
| 15 | 0.4 | 0.3 | -0.1 | -25% |
| 16 | 0.6 | 0.4 | -0.2 | -33% |
| 17 | 0.5 | 0.3 | -0.2 | -40% |
| 18 | 0.7 | 0.2 | -0.5 | -71% |
| 19 | 0.7 | 0.4 | -0.3 | -43% |
| 20 | 0.6 | 0.3 | -0.3 | -50% |
| 21 | 0.7 | 0.4 | -0.3 | -43% |
| 22 | 1.1 | 0.7 | -0.4 | -36% |
| 23 | 1.0 | 0.7 | -0.3 | -30% |
| 24 | 2.3 | 1.6 | -0.7 | -30% |
| 25 | 0.6 | 0.5 | -0.1 | -17% |
| 26 | 0.5 | 0.3 | -0.2 | -40% |
| 27 | 0.4 | 0.3 | -0.1 | -25% |
| 28 | 0.4 | 0.2 | -0.2 | -50% |
| 29 | 0.4 | 0.2 | -0.2 | -50% |
| 30 | 0.4 | 0.2 | -0.2 | -50% |
| 31 | 0.3 | 0.2 | -0.1 | -33% |
| 32 | 0.6 | 0.3 | -0.3 | -50% |
| 33 | 0.9 | 0.5 | -0.4 | -44% |
| 34 | 0.3 | 0.2 | -0.1 | -33% |
| 35 | 0.3 | 0.2 | -0.1 | -33% |
| 36 | 0.4 | 0.4 | 0 | 0% |

## 3.5 Request 5 - Non recommended Model Settings

In the letter EPA noted that non recommended values in CALMET were used for:

- IKINE; and
- THRESHL.

The setting IKINE is used to include or remove kinematic effects. Kinematic effects refer to the influence of wind flow associated with objects i.e. terrain.

OEH (2011) recommends that IKINE is turned off to not calculate terrain forced vertical velocity in the initial guess wind field based on the justification: "*This option is normally turned off, especially when using fine resolution due to occasional non-convergence of algorithm producing anomalous wind speeds in Layer 2*". IKINE was set to 1 (on) in the modelling.

The original selection of INKINE =1 (on) was based on advice from Dr Peter D'Abreton (who holds a doctorate in meteorology and at the time worked at Pacific Environment) based on:

- IKINE on allows the model to better include the influence of terrain;
- Hills and valleys in the Peel Valley create flow divergence and convergence as the wind moves around the natural obstacles. A better representation of vertical velocity is required to maintain mass consistency and to more accurately represent plume diversion around terrain; and
- The modelling makes use of a M3D file (NOOBS) therefore divergence associated with observed and prognostic data in layer 2 are unlikely to occur as no observed data was used.

This use of IKINE = 1 is supported by a paper by Radonjic et al (2010) who showed that the application of the CALMET pre-processor demonstrated kinematic effects that result in increased wind speeds above mountains. This effect was confirmed by the measurements with the sonic anemometers mounted on a TV tower in the study area (Radonjic, et al., 2010).

EPA also noted that THRESHL was not set to 0 as recommended in OEH (2011). The setting is the threshold buoyancy flux required to sustain convective mixing height growth overland with the units of $W/m^3$.

A setting of 0.0 $W/m^3$ was not used based on the work of Rayner (Ken Rayner. WA DEC, CALPUFF issue summary 28 April 2011 and CALPUFF issue summary 20 May 2011) who showed that using 0.0 $W/m^3$ results in spurious outputs for mixing height near dawn and dusk. Therefore, THRESHL was set to 0.05 $W/m^3$ to produce more accurate outputs for mixing height.

# 4 REFERENCES


AECOM, 2013. *Utah Air Resource Management Strategy Modeling Project: Meteorological Model Performance Evaluation,* Fort Collins, Colorado, USA: AECOM .

Alpine Geophysics, 2010. *The MMIFstat Statistical Analysis Package Version 1,* Arvada, Colorado, USA: Alpine Geophysics.

American Meteorlogical Society , 2012. *Glossary of Meteorlogy - Complex Terrain.* [Online]
Available at: http://glossary.ametsoc.org/wiki/Complex_terrain
[Accessed 13 September 2019].

Emery, C., Tai, E. & Yarwood, G., 2001. *Enhanced Meteorological Modelling and Performance Evaulation for Two Texas ozone Episodes. Report to the Texas Natural Resource Conservation Commission, College Station, TX, USA. ,* Novato, CA, USA: Environ.

Hernandez, G. et al., 2012. Odor mitigation with tree buffers: Swine production case study. *Agriculture, Ecosystems and Environment,* pp. 149 (2012) 154-163.

Hurley, P. J., Physick, W. L. & Luhar, A. k., 2002. *The Air Pollution Model (TAPM) Version 2. Part 2: Summary of Some Verification Studies.,* Canberra: CSIRO.

Johnson, M. T., 2019. *Meteorological Model Performance Evaluation of an Annual 2002 MM5 (version 3.6.3) Simulation,* Iowa: Iowa Department of Natural Resources.

Kemball-Cook, S., JIa, Y., Emery, C. & Morris, R., 2005. *Alaska MM5 Modeling for the 2002 Annual Period to Support Visibility Modeling. Prepared for the Western Regional Air Partnership,* Novat, CA, SUA: ENVIRON Corporation.

Malone, G., VanWicklen, G. & Collier, S., 2008. *Efficacy of vegetative environmental buffers to mitigate emissions from tunnel-ventilated poultry houses',.* Ames, Iowa, Mitigating Air Emissions from Animal Feeding Operations, ASABE.

Monk, K. et al., 2019. Evaluation of Regional Air Quality Models over Sydney and Australia: Part 1—Meteorological Model Comparison. *Atmosphere,* 10(3714).

NSW EPA, 2016. *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales,* Sydney: Environment Protection Authority.

PAEHolmes, 2011. *Best Practice Guidance for the Queensland Poultry Industry - Plume Dispersion Modelling and Meteorological Processing,* Brisbane: PAEHolmes.

Paine, R. et al., 1998. *Model Evaluation Results for AERMOD,* Washington DC: USEPA.

Parker, D. B., Malone, G. W. & Walter, W. D., 2012. Vegetative environmental buffers and exhaust fan deflectors for reducing downwind odor and VOCs from Tunnel Ventilated Swine Barns. *Transactions of the ASABE,* 55(1), pp. 227-240.

Patterson, P. H. et al., 2009. The potential for plants to trap odors from farms with laying hens. *Journal of applied poultry research,* E suppl. 1(88), pp. 9-10.

Radonjic, Z., Telenta, B., Chambers, D. & Janjic, Z., 2010. WRF-NMM MesoscaleWeather Forecast Model and CALMET Meteorological PreprocessorWind Simulations over the Mountaneous Region. *Geophysical Research Abstracts,* Volume Vol 2 EGU 2010-2941-1.

Ramboll Environ, 2016. *Air Quality Modeling Study Meteorological Model Performance Evaluation: 2009-2013 BOEM Arctic WRF Dataset OCS Study BOEM 2015-049 ,* Lynnwood WA, USA: Ramboll Environ.

Tesche, T. W., McNally, D. E. & Tremback, C., 2002. *Draft Protocol - Operational Evaluation Of The MM5 Meteorological Model Over The Continental United States: Protocol For Annual And Episodic Evaluation (Task Order 4TCG-68027015 AG-TS-90/158),* Ft Wright, KY: Alpine GEophysics LLC.

**Attached** – Odour Test Reports for ProTen, Tabbita and The Ranch.

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Accreditation Number: 14974

## Odour Concentration Measurement Results

The measurement was commissioned by:

| | | | |
|---|---|---|---|
| Organisation | Tabbita Poultry Ltd | Telephone | - |
| Contact | Rod Fenwick | Facsimile | - |
| Sampling Site | Griffith NSW | Email | rwfenwick@bigpond.com |
| Sampling Method | Drum & Pump | Sampling Team | TOU (J.Schulz) |

Order details:

| | | | |
|---|---|---|---|
| Order requested by | R. Fenwick | Order accepted by | J. Schulz |
| Date of order | 6/12/2017 | TOU Project # | N1796L |
| Order number | Refer to correspondence | Project Manager | J. Schulz |
| Signed by | R. Fenwick | Testing operator | A. Schulz |

**Investigated Item** — Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.

**Identification** — The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.

**Method** — The odour concentration measurements were performed using dynamic olfactometry according to the Australian Standard 'Determination of Odour Concentration by Dynamic Olfactometry' AS/NZS4323.3:2001. The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Accredited for compliance with ISO/IEC 17025 – Testing. This report shall not be reproduced, except in full. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.

**Measuring Range** — The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting $2^{17}$. This is specifically mentioned with the results.

**Environment** — The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained between 22ºC and 25ºC.

**Measuring Dates** — The date of each measurement is specified with the results.

**Instrument Used** — The olfactometer used during this testing session was:
ODORMAT SERIES V02

**Instrumental Precision** — The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the Australian Standard AS/NZS4323.3:2001.
ODORMAT SERIES V02: $r = 0.1366$ (Aug - Oct 2017) Compliance – Yes

**Instrumental Accuracy** — The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the Australian Standard AS/NZS4323.3:2001.
ODORMAT SERIES V02: $A = 0.2128$ (Aug - Oct 2017) Compliance – Yes

**Lower Detection Limit (LDL)** — The LDL for the olfactometer has been determined to be 16 ou (4 times the lowest dilution setting)

**Traceability** — The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

Date: Monday, 9th January 2018 Panel Roster Number: SYD20171221_085

**J. Schulz**
NSW Laboratory Coordinator

**A. Schulz**
Authorised Signatory

**Odour Sample Measurement Results**
**Panel Roster Number: SYD20171221_085**

| Sample Location | TOU Sample ID | Sampling Date & Time | Analysis Date & Time | Panel Size | Valid ITEs | Nominal Sample Dilution | Actual Sample Dilution (Adjusted for Temperature) | Sample Odour Concentration (as received, in the bag) (ou) | Sample Odour Concentration (Final, allowing for dilution) (ou) | Specific Odour Emission Rate (ou.m$^3$/m$^2$/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| Farm 82 – Shed #1 (1 of 2) | SC17565 | 20/12/2017 1154hrs | 21/12/2017 1100hrs | 4 | 8 | - | - | 197 | 197 | -- |
| Farm 82 – Shed #1 (2 of 2) | SC17566 | 20/12/2017 1154hrs | 21/12/2017 1130hrs | 4 | 8 | - | - | 128 | 128 | -- |
| Farm 82 – Shed #20 (1 of 2) | SC17567 | 20/12/2017 1209hrs | 21/12/2017 1203hrs | 4 | 8 | - | - | 118 | 118 | -- |
| Farm 82 – Shed #20 (2 of 2) | SC17568 | 20/12/2017 1209hrs | 21/12/2017 1239hrs | 4 | 8 | - | - | 118 | 118 | -- |
| Farm 83 – Shed #20 (1 of 2) | SC17569 | 20/12/2017 1305hrs | 21/12/2017 1458hrs | 4 | 8 | - | - | 118 | 118 | -- |
| Farm 83 – Shed #20 (2 of 2) | SC17570 | 20/12/2017 1305hrs | 21/12/2017 1531hrs | 4 | 8 | - | - | 128 | 128 | -- |

**Note:** Where parties other than The Odour Unit perform the dilution of samples, the result that has been modified by the dilution factor is not covered by The Odour Unit's NATA accreditation.

## Odour Panel Calibration Results

| Reference Odorant | Reference Odorant Panel Roster Number | Concentration of Reference gas (ppb) | Panel Target Range for n-butanol (ppb) | Measured Concentration (ou) | Measured Panel Threshold (ppb) | Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No) |
|---|---|---|---|---|---|---|
| n-butanol | SYD20171221_085 | 51,500 | $20 \leq \chi \leq 80$ | 724 | 71 | Yes |

Comments: Odour characters (non-NATA accredited) as determined by odour laboratory panel:

- SC17565 Musty, Ammonia
- SC17566 Musty, Ammonia
- SC17567 Musty, Ammonia
- SC17568 Musty, Ammonia
- SC17569 Musty, Ammonia
- SC17570 Musty, Ammonia

Disclaimer: Parties, other than TOU, responsible for collecting odour samples hereby certify that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Ltd for the purpose of odour testing. The collection of odour samples by parties other than The Odour Unit Pty Ltd relinquishes The Odour Unit Pty Ltd from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.

Note: This report shall not be reproduced, except in full, without written approval of The Odour Unit Pty Ltd. Any attachments to this Report are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd.

**END OF DOCUMENT**

# THE ODOUR UNIT (QLD) PTY LTD

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ABN: 87 102 255 765

Accreditation Number: 14974

## Odour Concentration Measurement Report

The measurement was commissioned by:

| | | | |
|---|---|---|---|
| Organisation | Astute Environmental Consulting | Telephone | 0429304644 |
| Contact | Geordie Galvin | Facsimile | -- |
| Sampling Site | ProTen, Narrandera | Email | geordie.galvin@astute-environmental.com.au |
| Sampling Method | ASNZS4323.3:2001 | Sampling Team | The Odour Unit - S. Munro |

Order details:

| | | | |
|---|---|---|---|
| Order requested by | Geordie Galvin | Order accepted by | S. Munro |
| Date of order | 04 July 2018 | TOU Project # | Q2200_06 |
| Order number | Email | Project Manager | S. Munro |
| Signed by | Email | Testing operator | A. Schulz |

| | |
|---|---|
| Investigated Item | Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag. |
| Identification | The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required. |
| Method | The odour concentration measurements were performed using dynamic olfactometry according to the Australian Standard 'Determination of Odour Concentration by Dynamic Olfactometry AS/NZS4323.3:2001. The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report. |
| Measuring Range | The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting $2^{17}$. This is specifically mentioned with the results. |
| Environment | The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained at 22 °C ±3 °C. |
| Measuring Dates | The date of each measurement is specified with the results. |
| Instrument Used | The olfactometer used during this testing session was:<br>TOU-OLF-004 |
| Instrumental Precision | The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the Australian Standard AS/NZS4323.3:2001.<br>TOU-OLF-004: $r = 0.101$ (January 2018), Compliance – Yes |
| Instrumental Accuracy | The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the Australian Standard AS/NZS4323.3:2001.<br>TOU-OLF-004: $A = 0.212$ (January 2018) Compliance – Yes |
| Lower Detection Limit (LDL) | The LDL for the olfactometer has been determined to be 16 ou (4 times the lowest dilution setting) |
| Traceability | The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen. |

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Date: Friday, 3 August 2018

Panel Roster Number: SYD20180801_052

**S. Munro**
Authorised Signatory

**J. Schulz**
Authorised Signatory

**Odour Sample Measurement Results**
**Panel Roster Number: SYD20180801_052**

| Sample Location | TOU Sample ID | Sampling Date & Time | Analysis Date & Time | Panel Size | Valid ITEs | Sample Odour Concentration FINAL (ou) | Odour Emission Rate - Standard Conditions*1 (ou.m³/s) | K-Factor*2 Geometric Mean of Shed |
|---|---|---|---|---|---|---|---|---|
| Farm 75 Shed 1 Sample 1 | SC18333 | 31/07/2018 10:28 | 01/08/2018 10:32 | 4 | 8 | 220 | 11,000 | 0.7 |
| Farm 75 Shed 1 Sample 2 | SC18336 | 31/07/2018 10:33 | 01/08/2018 12:05 | 4 | 8 | 170 | 8,200 | |
| Farm 75 Shed 2 Sample 1 | SC18334 | 31/07/2018 11:32 | 01/08/2018 11:04 | 4 | 8 | 180 | 8,900 | 0.7 |
| Farm 75 Shed 2 Sample 2 | SC18335 | 31/07/2018 11:36 | 01/08/2018 11:35 | 4 | 8 | 180 | 8,900 | |

*1 Odour emission rates calculated from the total airflow per shed
*2 K-Factor calculation table appended to this report

**Note:** Where parties other than The Odour Unit perform the dilution of samples, the result that has been modified by the dilution factor is not covered by The Odour Unit's NATA accreditation.

## Process, Sampling and Gas Flow Conditions
## Panel Roster Number: BNE20180626_025

| Sample location | TOU sample ID | Sampling position | Sampling plane dimensions (mm) | Gas velocity (m/s) | Volume flow rate – actual conditions ($m^3/s$) | Gas temp. ($^0C$) | Volume flow rate – standard conditions ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| Farm 75 Shed 1 Fan 4 | SC18333 SC18336 | **Upstream of disturbance:** <2D **Type:** Outlet **Downstream of Disturbance:** <6D **Type:** Fan Outlet **Traverse no.:** 2 **Point no.:** 12 **Compliance:** Non-compliant | ∅ 1,250 | 8.5 | 10.4 | 20.0 | 9.7 |
| Farm 75 Shed 2 Fan 5 | SC18334 SC18335 | **Upstream of disturbance:** <2D **Type:** Outlet **Downstream of Disturbance:** <6D **Type:** Fan Outlet **Traverse no.:** 2 **Point no.:** 12 **Compliance:** Non-compliant | ∅1,250 | 7.8 | 9.6 | 20.3 | 8.9 |

**Notes:**

1. **Sampling position: r**efers to location of in-duct gas velocity, temperature and static pressure sample points. Odour samples collected in-duct at ¼ diameter along a single traverse, or equivalent.
2. NATA accreditation does not cover the performance of these services;
   a. Selection of sampling positions by the methods of AS 4323.1,
   b. Measurement and calculation of volume flow rate by the methods of ISO 10780.
   c. K-Factor calculation
3. **Sampling conditions:** Daily Weather Observations for the nearest Bureau of Meteorology station are attached to this report or made available on request.

## Odour Panel Calibration Results

| Reference Odorant | Reference Odorant Panel Roster Number | Concentration of Reference gas (ppb) | Panel Target Range for n-butanol (ppb) | Measured Concentration (ou) | Measured Panel Threshold (ppb) | Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No) |
|---|---|---|---|---|---|---|
| n-butanol | SYD20180801_052 | 51,400 | $20 \le \chi \le 80$ | 724 | 71 | Yes |

Comments

Air flow measurements as reported on page 3 are for the fan from which the samples were collected. A table of airflow measurements from all fans is appended to this report.
Total of 24 fans, 20 tunnel fans, 2 side fans and 2 rear fans.
6 in operation, 2 tunnel fans, 2 side fans and 2 rear fans. Same for Shed 1 and Shed 2.
Bird age: 29 days
Ambient temperature: Shed 1 - 17 $^{o}$C, Shed 2 - 20.0 $^{o}$C

Disclaimer

Parties, other than TOU, responsible for collecting odour samples hereby certify that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Ltd for the purpose of odour testing. The collection of odour samples by parties other than The Odour Unit Pty Ltd relinquishes The Odour Unit Pty Ltd from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.

Note



**END OF DOCUMENT**


Fan 4
FARM 75
SHED 1
Fan 5
FARM 75
SHED 2

# ODOUR EMISSION RATE CALCULATION TABLE

**Client:** *Astute Environemental Consulting*
**Client Contact:** *Geordie Galvin*
**Site Location:** *ProTen, Narrandera*

| SAMPLE LOCATION | TOU SAMPLE NUMBER | SAMPLING DATE | TIME OF DAY | ODOUR CONCENTRATION (ou) | CIRCULAR DUCT DIAMETER (mm) | CROSS SECTIONAL AREA ($m^2$) | SOURCE GAS VELOCITY (m/s) | SOURCE GAS VOLUMETRIC FLOW RATE ($m^3/s$) | DUCT TEMPERATURE ($^oC$) | ATMOSPHERIC PRESSURE (hPa) | VOLUMETRIC FLOW RATE TO STD. CONDITIONS ($m^3/s$) | ODOUR EMISSION RATE TO STD. CONDITIONS ($ou.m^3/s$) RAW | ODOUR EMISSION RATE TO STD. CONDITIONS ($ou.m^3/s$) 2 SIG. FIG. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm 75 Shed 1 Sample 1 Fan 4 | SC18333 | 31/07/18 | 10:28 | 215 | 1250 | 1.227 | 8.5 | 10.41 | 20.0 | 1013.0 | 9.70 | 2084.679262 | **2100** |
| Farm 75 Shed 1 Sample 1 Fan 5 | SC18333 | 31/07/18 | 10:28 | 215 | 1250 | 1.227 | 8.0 | 9.81 | 20.0 | 1013.0 | 9.14 | 1964.220201 | **2000** |
| Farm 75 Shed 1 Sample 1 Fan 21 | SC18333 | 31/07/18 | 10:28 | 215 | 1250 | 1.227 | 7.3 | 9.01 | 20.0 | 1013.0 | 8.39 | 1804.427569 | **1800** |
| Farm 75 Shed 1 Sample 1 Fan 22 | SC18333 | 31/07/18 | 10:28 | 215 | 1250 | 1.227 | 7.3 | 8.97 | 20.0 | 1013.0 | 8.36 | 1797.052525 | **1800** |
| Farm 75 Shed 1 Sample 1 Fan 23 | SC18333 | 31/07/18 | 10:28 | 215 | 1250 | 1.227 | 6.2 | 7.57 | 20.0 | 1013.0 | 7.05 | 1516.800831 | **1500** |
| Farm 75 Shed 1 Sample 1 Fan 24 | SC18333 | 31/07/18 | 10:28 | 215 | 1250 | 1.227 | 6.1 | 7.53 | 20.0 | 1013.0 | 7.02 | 1509.425787 | **1500** |
| Total all fans | | | | 215 | | | | | | | 49.66 | 10676.60618 | **11000** |
| Farm 75 Shed 1 Sample 2 Fan 4 | SC18336 | 31/07/18 | 10:33 | 166 | 1250 | 1.227 | 8.5 | 10.41 | 20.0 | 1013.0 | 9.70 | 1609.566314 | **1600** |
| Farm 75 Shed 1 Sample 2 Fan 5 | SC18336 | 31/07/18 | 10:33 | 166 | 1250 | 1.227 | 8.0 | 9.81 | 20.0 | 1013.0 | 9.14 | 1516.560714 | **1500** |
| Farm 75 Shed 1 Sample 2 Fan 21 | SC18336 | 31/07/18 | 10:33 | 166 | 1250 | 1.227 | 7.3 | 9.01 | 20.0 | 1013.0 | 8.39 | 1393.185937 | **1400** |
| Farm 75 Shed 1 Sample 2 Fan 22 | SC18336 | 31/07/18 | 10:33 | 166 | 1250 | 1.227 | 7.3 | 8.97 | 20.0 | 1013.0 | 8.36 | 1387.491717 | **1400** |
| Farm 75 Shed 1 Sample 2 Fan 23 | SC18336 | 31/07/18 | 10:33 | 166 | 1250 | 1.227 | 6.2 | 7.57 | 20.0 | 1013.0 | 7.05 | 1171.11134 | **1200** |
| Farm 75 Shed 1 Sample 2 Fan 24 | SC18336 | 31/07/18 | 10:33 | 166 | 1250 | 1.227 | 6.1 | 7.53 | 20.0 | 1013.0 | 7.02 | 1165.417119 | **1200** |
| Total all fans | | | | 166 | | | | | | | 49.66 | 8243.33314 | **8200** |
| Farm 75 Shed 2 Sample 1 Fan 4 | SC18334 | 31/07/18 | 11:32 | 181 | 1250 | 1.227 | 7.8 | 9.61 | 20.3 | 1013.0 | 8.94 | 1618.82845 | **1600** |
| Farm 75 Shed 2 Sample 1 Fan 5 | SC18334 | 31/07/18 | 11:32 | 181 | 1250 | 1.227 | 6.8 | 8.39 | 20.3 | 1013.0 | 7.81 | 1414.148991 | **1400** |
| Farm 75 Shed 2 Sample 1 Fan 21 | SC18334 | 31/07/18 | 11:32 | 181 | 1250 | 1.227 | 6.9 | 8.52 | 20.3 | 1013.0 | 7.93 | 1434.823684 | **1400** |
| Farm 75 Shed 2 Sample 1 Fan 22 | SC18334 | 31/07/18 | 11:32 | 181 | 1250 | 1.227 | 7.6 | 9.27 | 20.3 | 1013.0 | 8.62 | 1560.93931 | **1600** |
| Farm 75 Shed 2 Sample 1 Fan 23 | SC18334 | 31/07/18 | 11:32 | 181 | 1250 | 1.227 | 6.9 | 8.44 | 20.3 | 1013.0 | 7.86 | 1422.418868 | **1400** |
| Farm 75 Shed 2 Sample 1 Fan 24 | SC18334 | 31/07/18 | 11:32 | 181 | 1250 | 1.227 | 7.1 | 8.76 | 20.3 | 1013.0 | 8.16 | 1476.17307 | **1500** |
| Total all fans | | | | 181 | | | | | | | 49.32 | 8927.332374 | **8900** |
| Farm 75 Shed 2 Sample 2 Fan 4 | SC18335 | 31/07/18 | 11:36 | 181 | 1250 | 1.227 | 7.8 | 9.61 | 20.3 | 1013.0 | 8.94 | 1618.82845 | **1600** |
| Farm 75 Shed 2 Sample 2 Fan 5 | SC18335 | 31/07/18 | 11:36 | 181 | 1250 | 1.227 | 6.8 | 8.39 | 20.3 | 1013.0 | 7.81 | 1414.148991 | **1400** |
| Farm 75 Shed 2 Sample 2 Fan 21 | SC18335 | 31/07/18 | 11:36 | 181 | 1250 | 1.227 | 6.9 | 8.52 | 20.3 | 1013.0 | 7.93 | 1434.823684 | **1400** |
| Farm 75 Shed 2 Sample 2 Fan 22 | SC18335 | 31/07/18 | 11:36 | 181 | 1250 | 1.227 | 7.6 | 9.27 | 20.3 | 1013.0 | 8.62 | 1560.93931 | **1600** |
| Farm 75 Shed 2 Sample 2 Fan 23 | SC18335 | 31/07/18 | 11:36 | 181 | 1250 | 1.227 | 6.9 | 8.44 | 20.3 | 1013.0 | 7.86 | 1422.418868 | **1400** |
| Farm 75 Shed 2 Sample 2 Fan 24 | SC18335 | 31/07/18 | 11:36 | 181 | 1250 | 1.227 | 7.1 | 8.76 | 20.3 | 1013.0 | 8.16 | 1476.17307 | **1500** |
| Total all fans | | | | 181 | | | | | | | 49.32 | 8927.332374 | **8900** |

| K Factor Calculation Table - ProTen, Narrandera | | | | | | | |
|---|---|---|---|---|---|---|---|
| Location | OER ($ou.m^3/s$) | Shed floor area ($m^2$) | Bird number | Bird weight (kg) | Bird density ($kg/m^2$) | Ventilation rate - STP ($m^3/s$) | K-factor |
| Farm 75 - Shed 1 Sample 1 | 10,677 | 2,720 | 46,298 | 1.60 | 27.2 | 49.7 | 0.8 |
| Farm 75 - Shed 1 Sample 2 | 8,207 | 2,720 | 46,298 | 1.60 | 27.2 | 49.7 | 0.6 |
| **Farm 75 - Shed 1 Geometric Mean** | **9,361** | **2,720** | **46,298** | **1.60** | **27.2** | **49.7** | **0.7** |
| Farm 75 - Shed 2 Sample 1 | 8,927 | 2,720 | 46,332 | 1.60 | 27.3 | 49.3 | 0.7 |
| Farm 75 - Shed 2 Sample 2 | 8,927 | 2,720 | 46,332 | 1.60 | 27.3 | 49.3 | 0.7 |
| **Farm 75 - Shed 2 Geometric Mean** | **8,927** | **2,720** | **46,332** | **1.60** | **27.3** | **49.3** | **0.7** |

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A C N 091 165 061
A B N 53 091 165 061

Rod Fenwick
Lockwood Valley

6 November 2018

by email: rod.fenwick@lockwoodvalley.onmicrosoft.com

**ODOUR & PHYSICAL MEASUREMENT RESULTS FOR 2,245 TABBITA LANE, TABBITA, NSW: 31 OCTOBER 2018**

Dear Rod,

Please find **appended** the odour and physical measurement results from our visit to the poultry farm facility located at 2245 Tabbita Lane, Tabbita, NSW, on 31 October 2018 (**the Poultry Facility**). A summary of the odour emission and k-factor results are presented in **Table 1**. Please note that the results presented in **Table 1** reflect Shed 1 & Shed 20 at the Poultry Facility, with seven (7) fans in operation during the collection of odour samples.

**Table 1** – Odour emission and k-factor results: 31 October 2018

| Shed No. | Mean Odour concentration (ou) | Mean Odour Emission Rate (ou.m$^3$/s) | Bird density (kg/m$^2$) | Ventilation rate (m$^3$/s) | K-factor |
|---|---|---|---|---|---|
| Shed 1 | 158 | 19,730 | 23.4 | 124.9 | 0.9 |
| Shed 20 | 194 | 26,530 | 22.6 | 136.7 | 1.2 |

Yours sincerely,

James Schulz
NSW Laboratory Coordinator & Consultant

**Attachments:**

- Odour laboratory results report: 1 November 2018;
- Shed 1 & 20: Physical measurement results worksheet: 31 October 2018; and
- Shed 1 & 20: Odour intensity charts.

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Internet: www.odourunit.com.au
ABN: 53 091 163 061

Accreditation Number: 14974

## Odour Concentration Measurement Report

The measurement was commissioned by:

| | | | |
|---|---|---|---|
| Organisation | Lockwood Valley | Telephone | 0432 357 227 |
| Contact | R. Fenwick | Facsimile | - |
| Sampling Site | Tabbita, NSW | Email | rwfenwick@bigpond.com |
| Sampling Method | Drum & Pump | Sampling Team | TOU (J. Schulz) |

Order details:

| | | | |
|---|---|---|---|
| Order requested by | R. Fenwick | Order accepted by | J. Schulz |
| Date of order | 29/10/2018 | TOU Project # | N2200L |
| Order number | Refer to correspondence | Project Manager | J. Schulz |
| Signed by | Refer to correspondence | Testing operator | A. Schulz |

| | |
|---|---|
| Investigated Item | Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag. |
| Identification | The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required. |
| Method | The odour concentration measurements were performed using dynamic olfactometry according to the Australian/New Zealand Standard: Stationary source emissions – Part 3: 'Determination of odour concentration by dynamic olfactometry AS/NZS4323.3:2001. The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report. |
| Measuring Range | The measuring range of the olfactometer is $2^2 \le \chi \le 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting $2^{17}$. This is specifically mentioned with the results. |
| Environment | The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained at 22 ºC ±3 ºC. |
| Measuring Dates | The date of each measurement is specified with the results. |
| Instrument Used | The olfactometer used during this testing session was:<br>ODORMAT V04. |
| Instrumental Precision | The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \le 0.477$ in accordance with the Australian/New Zealand Standard AS/NZS4323.3:2001.<br>ODORMAT V04: *r* = 0.101 (January 2018) Compliance – Yes |
| Instrumental Accuracy | The accuracy of this instrument for a sensory calibration must be $A \le 0.217$ in accordance with the Australian/New Zealand Standard AS/NZS4323.3:2001.<br>ODORMAT V04: *A* = 0.212 (January 2018) Compliance – Yes |
| Lower Detection Limit (LDL) | The LDL for the olfactometer has been determined to be 16 ou, which is 4 times the lowest dilution setting. |
| Traceability | The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen. |

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Date: Tuesday, 6 November 2018

Panel Roster Number: SYD20181101_075

**J. Schulz**
NSW Laboratory Coordinator

**A. Schulz**
Authorised Signatory

## Odour Sample Measurement Results
## Panel Roster Number: SYD20181101_075

| Sample Location | TOU Sample ID | Sampling Date & Time | Analysis Date & Time | Panel Size | Valid ITEs | Nominal Sample Dilution | Actual Sample Dilution (Adjusted for Temperature) | Sample Odour Concentration (as received, in the bag) (ou) | Sample Odour Concentration (Final, allowing for dilution) (ou) | *Specific Odour Emission Rate (ou.m³/m²/s) (See Note:1)* |
|---|---|---|---|---|---|---|---|---|---|---|
| Shed #20 - 1 of 2 (duplicate) | SC18498 | 31.10.2018 0910hrs | 01.11.2018 1028hrs | 4 | 8 | - | - | 181 | 181 | - |
| Shed #20 - 2 of 2 (duplicate) | SC18499 | 31.10.2018 0910hrs | 01.11.2018 1111hrs | 4 | 8 | - | - | 208 | 208 | - |
| Shed #1 - 1 of 2 (duplicate) | SC18500 | 31.10.2018 1015hrs | 01.11.2018 1148hrs | 4 | 8 | - | - | 158 | 158 | - |
| Shed #1 - 2 of 2 (duplicate) | SC18501 | 31.10.2018 1015hrs | 01.11.2018 1225hrs | 4 | 8 | - | - | 158 | 158 | - |

**Samples Received in Laboratory** – From: Tabbita Date: 1 November 2018 Time: 0900 hrs

**Note:** The following are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd:

1. The collection of Isolation Flux Hood (IFH) samples and the calculation of the Specific Odour Emission Rate (SOER).
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit Pty Ltd have performed the dilution of samples.

## Odour Panel Calibration Results

| Reference Odorant | Reference Odorant Panel Roster Number | Concentration of Reference gas (ppb) | Panel Target Range for n-butanol (ppb) | Measured Concentration (ou) | Measured Panel Threshold (ppb) | Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No) |
|---|---|---|---|---|---|---|
| n-butanol | SYD20181101_075 | 51,400 | $20 \leq \chi \leq 80$ | 724 | 71 | Yes |

Comments

Odour characters (non-NATA accredited) as determined by odour laboratory panel:

SC18498 poultry, ammoniacal, pungent
SC18499 poultry, ammoniacal, pungent
SC18500 poultry, ammoniacal, pungent
SC18501 poultry, ammoniacal, pungent

Disclaimers

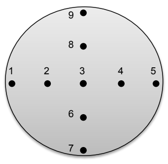
1. Parties, other than The Odour Unit Pty Ltd, responsible for collecting odour samples have advised that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Ltd for the purpose of odour testing.
2. The collection of odour samples by parties other than The Odour Unit Pty Ltd relinquishes The Odour Unit Pty Ltd from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.
3. Any comments included in, or attachments to, this Report are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd.
4. This report shall not be reproduced, except in full, without written approval of The Odour Unit Pty Ltd.

**END OF DOCUMENT**

**Document title:** Shed #1 - Physical Measurements Results
**Measurement date:** 31-Oct-18
**Farm Address:** Tabbita
**Shed Number:** 1

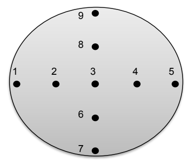
| Fan #1 | |
|---|---|
| **Physical measurement results** | |
| **Time of measurement** | 1007 hrs - 1045 hrs |
| **Relative Humidity (%)** | 43 |
| **Fan Location No.** | **Measured fan exit velocity (m/s)** |
| Fan Location 1 | 8.6 |
| Fan Location 2 | 9.5 |
| Fan Location 3 | 1.6 |
| Fan Location 4 | 2.7 |
| Fan Location 5 | 9.1 |
| Fan Location 6 | 7.7 |
| Fan Location 7 | 11.8 |
| Fan Location 8 | 6.9 |
| Fan Location 9 | 10.1 |
| **Statistical measured exit velocity results (m/s)** | |
| Mean | 7.5 |
| Minimum | 1.6 |
| Maximum | 11.8 |

**Fan exit velocity nominal measurement locations**



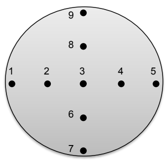

| Fan #2 | |
|---|---|
| **Physical measurement results** | |
| **Time of measurement** | 1007 hrs - 1045 hrs |
| **Relative Humidity (%)** | 43 |
| **Fan Location No.** | **Measured fan exit velocity (m/s)** |
| Fan Location 1 | 12.4 |
| Fan Location 2 | 10.4 |
| Fan Location 3 | 1.8 |
| Fan Location 4 | 3.0 |
| Fan Location 5 | 6.3 |
| Fan Location 6 | 8.0 |
| Fan Location 7 | 9.5 |
| Fan Location 8 | 11.6 |
| Fan Location 9 | 12.8 |
| **Statistical measured exit velocity results (m/s)** | |
| Mean | 8.4 |
| Minimum | 1.8 |
| Maximum | 12.8 |

**Fan exit velocity nominal measurement locations**



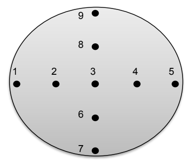

| Fan #3 | |
|---|---|
| **Physical measurement results** | |
| **Time of measurement** | 1007 hrs - 1045 hrs |
| **Relative Humidity (%)** | 43 |
| **Fan Location No.** | **Measured fan exit velocity (m/s)** |
| Fan Location 1 | 12.5 |
| Fan Location 2 | 8.3 |
| Fan Location 3 | 1.9 |
| Fan Location 4 | 6.0 |
| Fan Location 5 | 12.1 |
| Fan Location 6 | 8.4 |
| Fan Location 7 | 12.8 |
| Fan Location 8 | 9.4 |
| Fan Location 9 | 10.6 |
| **Statistical measured exit velocity results (m/s)** | |
| Mean | 9.1 |
| Minimum | 1.9 |
| Maximum | 12.8 |

**Fan exit velocity nominal measurement locations**



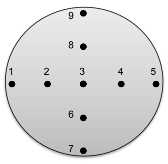

| Fan #4 | |
|---|---|
| **Physical measurement results** | |
| **Time of measurement** | 1007 hrs - 1045 hrs |
| **Relative Humidity (%)** | 43 |
| **Fan Location No.** | **Measured fan exit velocity (m/s)** |
| Fan Location 1 | 11.4 |
| Fan Location 2 | 7.8 |
| Fan Location 3 | 2.1 |
| Fan Location 4 | 5.0 |
| Fan Location 5 | 8.3 |
| Fan Location 6 | 7.5 |
| Fan Location 7 | 10.6 |
| Fan Location 8 | 9.4 |
| Fan Location 9 | 10.6 |
| **Statistical measured exit velocity results (m/s)** | |
| Mean | 8.1 |
| Minimum | 2.1 |
| Maximum | 11.4 |

**Fan exit velocity nominal measurement locations**



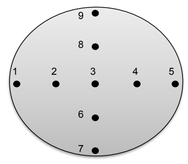

| Fan #5 | |
|---|---|
| **Physical measurement results** | |
| **Time of measurement** | 1007 hrs - 1045 hrs |
| **Relative Humidity (%)** | 43 |
| **Fan Location No.** | **Measured fan exit velocity (m/s)** |
| Fan Location 1 | 11.1 |
| Fan Location 2 | 6.7 |
| Fan Location 3 | 1.8 |
| Fan Location 4 | 7.1 |
| Fan Location 5 | 12.5 |
| Fan Location 6 | 11.3 |
| Fan Location 7 | 12.0 |
| Fan Location 8 | 9.5 |
| Fan Location 9 | 9.1 |
| **Statistical measured exit velocity results (m/s)** | |
| Mean | 9.0 |
| Minimum | 1.8 |
| Maximum | 12.5 |

**Fan exit velocity nominal measurement locations**



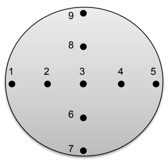

| Fan #6 | |
|---|---|
| **Physical measurement results** | |
| **Time of measurement** | 1007 hrs - 1045 hrs |
| **Relative Humidity (%)** | 43 |
| **Fan Location No.** | **Measured fan exit velocity (m/s)** |
| Fan Location 1 | 12.7 |
| Fan Location 2 | 5.1 |
| Fan Location 3 | 2.4 |
| Fan Location 4 | 8.8 |
| Fan Location 5 | 10.3 |
| Fan Location 6 | 12.3 |
| Fan Location 7 | 12.1 |
| Fan Location 8 | 8.9 |
| Fan Location 9 | 9.8 |
| **Statistical measured exit velocity results (m/s)** | |
| Mean | 9.1 |
| Minimum | 2.4 |
| Maximum | 12.7 |

**Fan exit velocity nominal measurement locations**



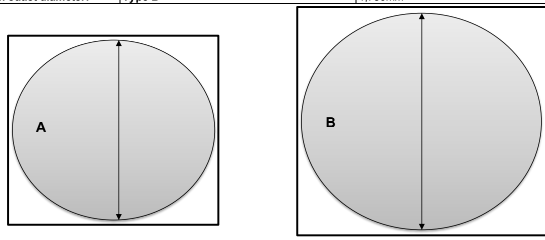

| Fan #7 | |
|---|---|
| **Physical measurement results** | |
| **Time of measurement** | 1007 hrs - 1045 hrs |
| **Relative Humidity (%)** | 43 |
| **Fan Location No.** | **Measured fan exit velocity (m/s)** |
| Fan Location 1 | 11.1 |
| Fan Location 2 | 6.2 |
| Fan Location 3 | 1.4 |
| Fan Location 4 | 6.1 |
| Fan Location 5 | 4.5 |
| Fan Location 6 | 8.1 |
| Fan Location 7 | 10.5 |
| Fan Location 8 | 11.0 |
| Fan Location 9 | 12.4 |
| **Statistical measured exit velocity results (m/s)** | |
| Mean | 7.9 |
| Minimum | 1.4 |
| Maximum | 12.4 |

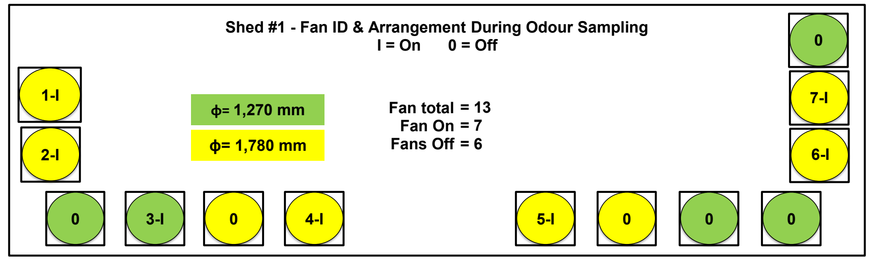
**Fan exit velocity nominal measurement locations**



| | |
|---|---|
| **Document title:** | Shed #1 - Physical Measurements Results |
| **Measurement date:** | 31-Oct-18 |
| **Farm Address:** | Tabbita |
| **Shed Number:** | 1 |

| Fan Outlet Details | | |
|---|---|---|
| **Shed fan description:** | Axial flow | |
| **Measured fan outlet diameter:** | **Type A** | 1,270mm |
| **Measured fan outlet diameter:** | **Type B** | 1,780mm |




| Shed Operating Conditions | |
|---|---|
| **Shed ID** | 1 |
| **Number of birds** | 52,427 |
| **Average weight per bird (kg)** | 1.52 |
| **Shed area ($m^2$)** | 3,400 |
| **Mean shed temperature ($^{o}C$)** | 24.8 |

| Ambient Conditions | | |
|---|---|---|
| **Time of measurement** | 0820hrs | 1007hrs |
| **Relative Humidity (%)** | -- | 13 |
| **Ambient Temperature ($^{o}C$)** | 24.6 | 29.5 |
| **Weather Conditions** | Sunny, Clear | Sunny, Clear |

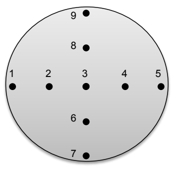
**Document title:** Shed #20 - Physical Measurements Results
**Measurement date:** 31-Oct-18
**Farm Address:** Tabbita
**Shed Number:** 20

## Fan #1

Physical measurement results

| | |
|---|---|
| **Time of measurement** | 0800hrs - 0910hrs |
| **Relative Humidity (%)** | 42.4 |
| **Fan Location No.** | **Measured fan exit velocity (m/s)** |
| Fan Location 1 | 10.8 |
| Fan Location 2 | 9.6 |
| Fan Location 3 | 1.9 |
| Fan Location 4 | 2.1 |
| Fan Location 5 | 13.0 |
| Fan Location 6 | 8.8 |
| Fan Location 7 | 11.3 |
| Fan Location 8 | 8.2 |
| Fan Location 9 | 9.0 |
| **Statistical measured exit velocity results (m/s)** | |
| Mean | 8.3 |
| Minimum | 1.9 |
| Maximum | 13.0 |

**Fan exit velocity nominal measurement locations**

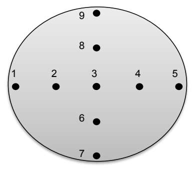



## Fan #2

Physical measurement results

| | |
|---|---|
| **Time of measurement** | 0800hrs - 0910hrs |
| **Relative Humidity (%)** | 42.4 |
| **Fan Location No.** | **Measured fan exit velocity (m/s)** |
| Fan Location 1 | 10.9 |
| Fan Location 2 | 9.3 |
| Fan Location 3 | 2.4 |
| Fan Location 4 | 2.4 |
| Fan Location 5 | 10.1 |
| Fan Location 6 | 8.6 |
| Fan Location 7 | 10.8 |
| Fan Location 8 | 9.3 |
| Fan Location 9 | 10.5 |
| **Statistical measured exit velocity results (m/s)** | |
| Mean | 8.3 |
| Minimum | 2.4 |
| Maximum | 10.9 |

**Fan exit velocity nominal measurement locations**

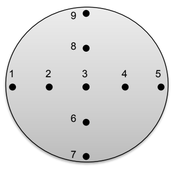



## Fan #3

Physical measurement results

| | |
|---|---|
| **Time of measurement** | 0800hrs - 0910hrs |
| **Relative Humidity (%)** | 42.4 |
| **Fan Location No.** | **Measured fan exit velocity (m/s)** |
| Fan Location 1 | 11.5 |
| Fan Location 2 | 8.3 |
| Fan Location 3 | 1.5 |
| Fan Location 4 | 6.3 |
| Fan Location 5 | 11.1 |
| Fan Location 6 | 7.7 |
| Fan Location 7 | 11.3 |
| Fan Location 8 | 9.3 |
| Fan Location 9 | 10.7 |
| **Statistical measured exit velocity results (m/s)** | |
| Mean | 8.6 |
| Minimum | 1.5 |
| Maximum | 11.5 |

**Fan exit velocity nominal measurement locations**

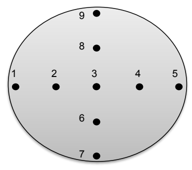



## Fan #4

Physical measurement results

| | |
|---|---|
| **Time of measurement** | 0800hrs - 0910hrs |
| **Relative Humidity (%)** | 42.4 |
| **Fan Location No.** | **Measured fan exit velocity (m/s)** |
| Fan Location 1 | 11.7 |
| Fan Location 2 | 9.1 |
| Fan Location 3 | 2.3 |
| Fan Location 4 | 7.2 |
| Fan Location 5 | 11.9 |
| Fan Location 6 | 7.7 |
| Fan Location 7 | 10.3 |
| Fan Location 8 | 9.8 |
| Fan Location 9 | 11.9 |
| **Statistical measured exit velocity results (m/s)** | |
| Mean | 9.1 |
| Minimum | 2.3 |
| Maximum | 11.9 |

**Fan exit velocity nominal measurement locations**

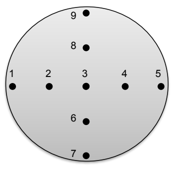



## Fan #5

Physical measurement results

| | |
|---|---|
| **Time of measurement** | 0800hrs - 0910hrs |
| **Relative Humidity (%)** | 42.4 |
| **Fan Location No.** | **Measured fan exit velocity (m/s)** |
| Fan Location 1 | 11.1 |
| Fan Location 2 | 7.9 |
| Fan Location 3 | 2.0 |
| Fan Location 4 | 4.2 |
| Fan Location 5 | 10.3 |
| Fan Location 6 | 7.9 |
| Fan Location 7 | 10.6 |
| Fan Location 8 | 10.3 |
| Fan Location 9 | 12.3 |
| **Statistical measured exit velocity results (m/s)** | |
| Mean | 8.5 |
| Minimum | 2.0 |
| Maximum | 12.3 |

**Fan exit velocity nominal measurement locations**

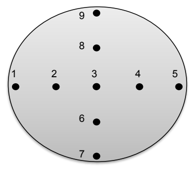



## Fan #6

Physical measurement results

| | |
|---|---|
| **Time of measurement** | 0800hrs - 0910hrs |
| **Relative Humidity (%)** | 42.4 |
| **Fan Location No.** | **Measured fan exit velocity (m/s)** |
| Fan Location 1 | 11.1 |
| Fan Location 2 | 7.7 |
| Fan Location 3 | 2.0 |
| Fan Location 4 | 3.4 |
| Fan Location 5 | 10.0 |
| Fan Location 6 | 7.6 |
| Fan Location 7 | 11.4 |
| Fan Location 8 | 8.9 |
| Fan Location 9 | 10.0 |
| **Statistical measured exit velocity results (m/s)** | |
| Mean | 8.0 |
| Minimum | 2.0 |
| Maximum | 11.4 |

**Fan exit velocity nominal measurement locations**

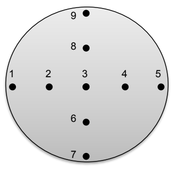



## Fan #7

Physical measurement results

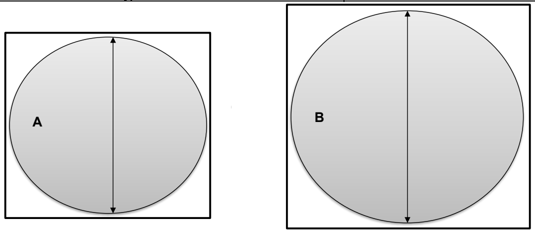
| | |
|---|---|
| **Time of measurement** | 0800hrs - 0910hrs |
| **Relative Humidity (%)** | 42.4 |
| **Fan Location No.** | **Measured fan exit velocity (m/s)** |
| Fan Location 1 | 12.0 |
| Fan Location 2 | 8.4 |
| Fan Location 3 | 1.9 |
| Fan Location 4 | 10.0 |
| Fan Location 5 | 9.8 |
| Fan Location 6 | 9.8 |
| Fan Location 7 | 11.7 |
| Fan Location 8 | 10.5 |
| Fan Location 9 | 10.8 |
| **Statistical measured exit velocity results (m/s)** | |
| Mean | 9.4 |
| Minimum | 1.9 |
| Maximum | 12.0 |

**Fan exit velocity nominal measurement locations**



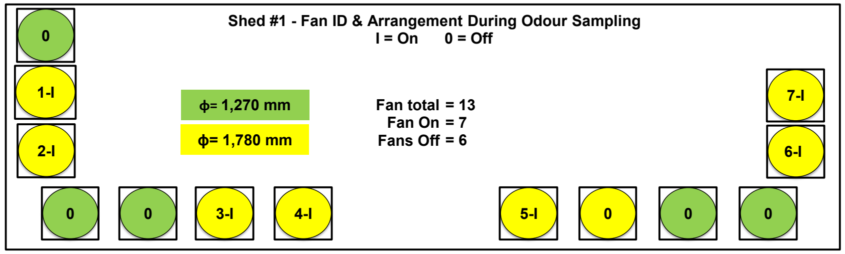
| | |
|---|---|
| **Document title:** | Shed #20 - Physical Measurements Results |
| **Measurement date:** | 31-Oct-18 |
| **Farm Address:** | Tabbita |
| **Shed Number:** | 20 |

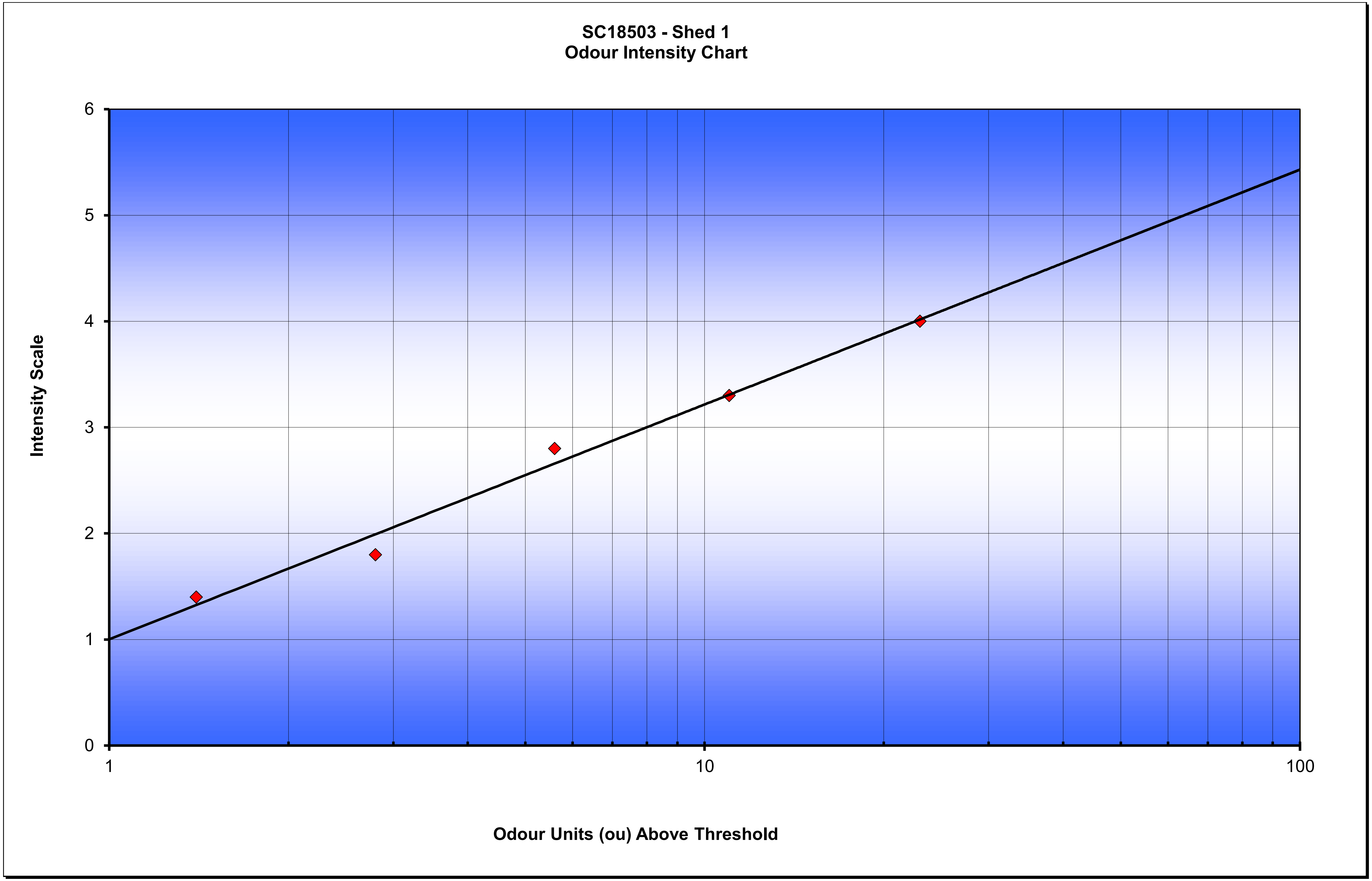
| Fan Outlet Details | | |
|---|---|---|
| **Shed fan description:** | | Axial flow |
| **Measured fan outlet diameter:** | **Type A** | 1,270mm |
| **Measured fan outlet diameter:** | **Type B** | 1,780mm |

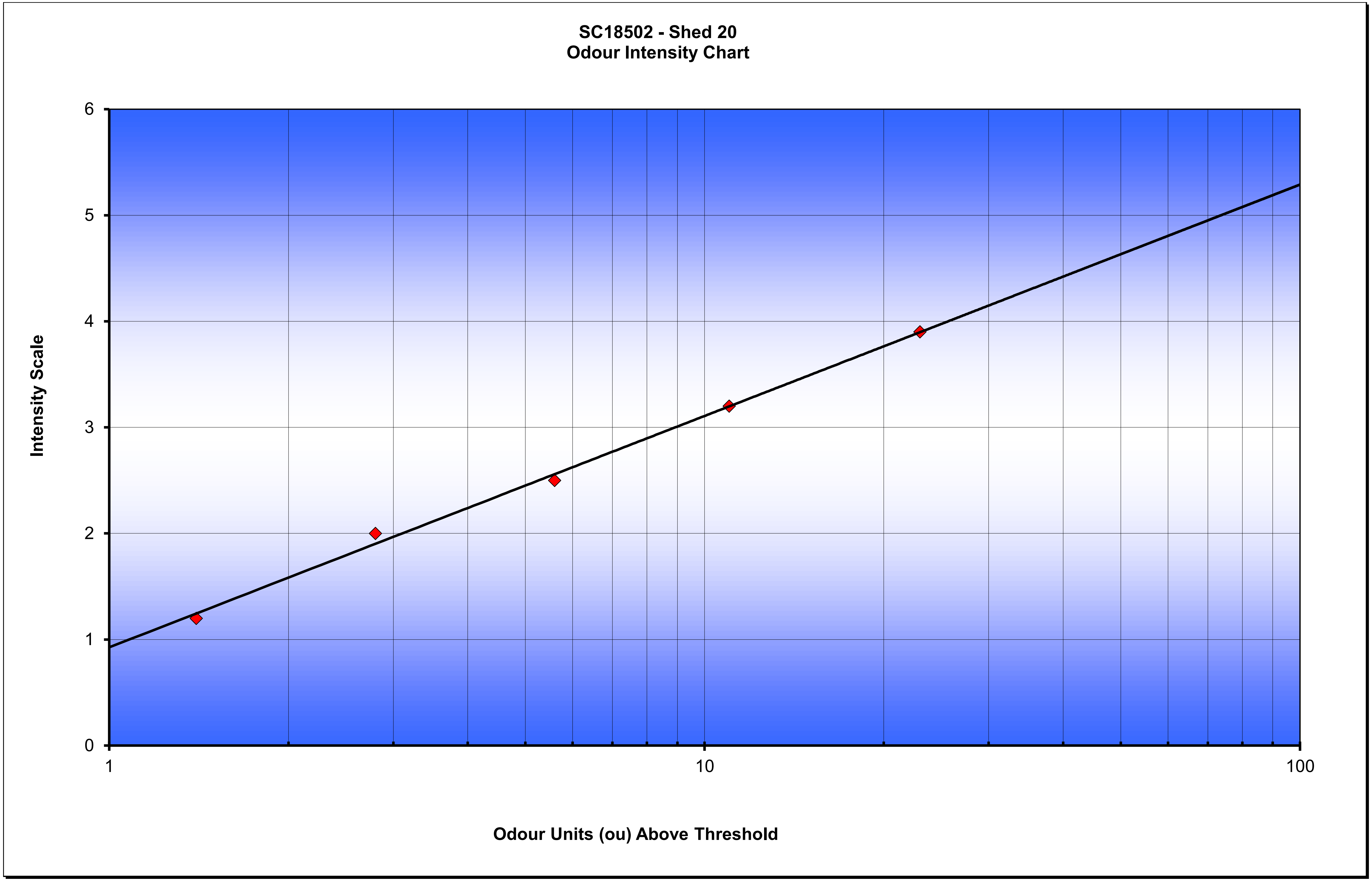



| Shed Operating Conditions | |
|---|---|
| **Shed ID** | 20 |
| **Number of birds** | 51,652 |
| **Average weight per bird (kg)** | 1.49 |
| **Shed area ($m^2$)** | 3,400 |
| **Mean shed temperature ($^oC$)** | 26.3 |

| Ambient Conditions | | |
|---|---|---|
| **Time of measurement** | 0820hrs | 1007hrs |
| **Relative Humidity (%)** | -- | 13 |
| **Ambient Temperature ($^oC$)** | 24.6 | 29.5 |
| **Weather Conditions** | Sunny, Clear | Sunny, Clear |




SC18503 - Shed 1
Odour Intensity Chart
Intensity Scale
0
1
2
3
4
5
6
1
10
100
Odour Units (ou) Above Threshold


SC18502 - Shed 20
Odour Intensity Chart
Intensity Scale
0
1
2
3
4
5
6
1
10
100
Odour Units (ou) Above Threshold

# Test Report 630.11565.00500-TR1R0

## 1 CLIENT DETAILS

| | |
|---|---|
| **Organisation:** | VOAG 2 Pty Ltd |
| **Company Contact:** | Robert Vojtkiv |
| **Site Address:** | The Ranch Poultry Complex, Tabbita NSW 2652 |
| **Postal Address:** | 131 Fogarty Road, Tynong North VIC 3813 |
| **Telephone Number:** | +61 419 576 786 |
| **Email Address:** | robert.vojtkiv@voag.com.au |

## 2 PROJECT DETAILS & SCOPE OF WORK REQUESTED

| | |
|---|---|
| **Project Number:** | 630.11565.00500 |
| **Project Name:** | Poultry Odour Monitoring |
| **Project Manager:** | Michael Brecko |
| **Monitoring Date(s):** | 13 March 2019 |
| **Reasons for the Work:** | Post Commissioning Testing |
| **Production/Operational Conditions:** | Typical daily operations – all exhaust fans operating |
| **Parameters Requested:** | Odour and Character |
| **Sample Locations:** | Farm 94; Shed 1, Shed 2 and Shed 3 |
| **Sample Identification Numbers:** | Refer to Appendix C (7988, 7999, 7800, 7801, 7802, 7803) |

Signatory

Michael Brecko

Issue Date: 12 April 2019

Accredited for Compliance with
ISO/IEC 17025 - Testing.

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# Test Report 630.11565.00500-TR1R0

## 3 NOMENCLATURE

| | |
|---|---|
| * | Not part of SLR scope of accreditation |
| º | degrees |
| > | greater than |
| ≥ | greater than or equal to |
| < | less than |
| ≤ | less than or equal to |
| % | percentage |
| AESTD | Australian Eastern Standard Time Daylight Savings |
| AEST | Australian Eastern Standard Time |
| ALS | Australian Laboratory Services |
| AM | Ambient Method |
| Avg | Average |
| AS | Australian Standard |
| AS/NZS | Australian Standards/New Zealand Standards |
| $CO_2$ | Carbon dioxide |
| CO | Carbon monoxide |
| CSC | Certified Span Concentration |
| Conc. | Concentration |
| ºC | degrees Celsius |
| D | Duct Diameters |
| EPA | Environment Protection Agency |
| EPL | Environment Protection Licence |
| F | Fluoride |
| g/g mole | grams per gram mole |
| HCl | Hydrogen chloride |
| hr | hour |
| ID | Identification |
| K | kelvin |
| $kg/m^3$ | kilograms per cubic metre of air |
| kPa | kilopascals |
| LOR | Limit of Reporting |
| Max | Maximum |
| m | metre |
| m/s | metres per second |
| $m^2$ | metres square |
| $m^3$ | cubic metres |
| $m^3/s$ | cubic metre of air per second |
| $\mu g/m^3$ | micrograms per cubic metre of air |
| $mg/m^3$ | milligrams per cubic metre of air |
| Min | Minimum |
| min | minutes |
| NA | Not Applicable |
| NATA | National Association of Testing Authorities |
| NSW | New South Wales |
| NM | Not Measured |
| No. | Number |
| $NO_x$ | Oxides of nitrogen |
| ou | odour units |
| OEH | Office of Environment and Heritage |
| OM | Other Method |
| $O_2$ | Oxygen |
| $PM_{10}$ | Particulate matter less than 10 microns |
| $PM_{2.5}$ | Particulate matter less than 2.5 microns |
| ppb | parts per billion |
| ppm | parts per million |
| POEO | Protection of the Environment and Operations (Clean Air) Regulations 2010 |
| Qld | Queensland |
| SLR | SLR Consulting Australia Pty Ltd |
| $SO_2$ | Sulphur dioxide |
| $SO_3/H_2SO_4$ | Sulphur trioxide / sulphuric acid mist |
| TM | Test Method |
| TSP | total suspended particulate |
| UNSW | University of New South Wales |
| USEPA M | United States Environment Protection Agency Method |
| UTM | Universal Transverse Mercator |

# Test Report 630.11565.00500-TR1R0

## 4 PROCESS EMISSIONS MONITORING - PARAMETER, SAMPLING AND ANALYSIS METHOD AND ANALYSIS LABORATORY

### 4.1 Test Methods and Analysis References

All sampling and monitoring was performed by SLR unless otherwise specified. The following table outlines for each parameter requested to be tested, the relevant test method for sampling and analysis and the NATA Accredited Laboratory that completed the analysis.

All associated NATA endorsed Test Reports/Certificates of Analysis are provided separately in Appendix B.

#### 4.1.1 Point Source Emissions

| Parameter | Test Method Number for Sampling and Analysis | NATA Laboratory Analysis By: NATA Accreditation No. & Report No. |
|---|---|---|
| Sampling location | TM-1, AS/NZS 4323.1, USEPA M1 | SLR Consulting Australia Pty Ltd<br>NATA No.3130<br>Report No. 630.11565.00500-TR1 |
| Velocity | TM-2, USEPA M2, 2C, ISO10780 | SLR Consulting Australia Pty Ltd<br>NATA No.3130<br>Report No. 630.11565.00500-TR1 |
| Duct temperature | TM-2, USEPA M2, 2C | SLR Consulting Australia Pty Ltd<br>NATA No.3130<br>Report No. 630.11565.00500-TR1 |
| Volumetric flow rate | TM-2, USEPA M2, 2C | SLR Consulting Australia Pty Ltd<br>NATA No.3130<br>Report No. 630.11565.00500-TR1 |
| Dry gas density | TM-23, USEPA M3 | SLR Consulting Australia Pty Ltd<br>NATA No.3130<br>Report No. 630.11565.00500-TR1 |
| Moisture | TM-22, USEPA M4 | SLR Consulting Australia Pty Ltd<br>NATA No.3130<br>Report No. 630.11565.00500-TR1 |
| Odour | OM-7, AS4323.3 | The Odour Unit<br>NATA No. 14974<br>Report No. SYD20190314_023 |

### 4.2 Deviations from Test Methods

There were deviations to the specified test reference methodologies as detailed below

- Sampling Plane did not comply with the minimum distance for upstream disturbances. SLR adopted additional sample points to improve the accuracy of the measurements.

### 4.3 Sampling Times

As per the relevant test reference method or State requirement.

# Test Report 630.11565.00500-TR1R0

## 4.4 Reference Conditions

As per relevant test reference method, State requirement, or Environment Protection Licence or equivalent.

## 4.5 Identification

All samples are individual labelled with reference number, location, sampling date and times.

## 4.6 Sample Plane Requirements

Ideal sampling positions: In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exit at 7-8 diameters downstream and 2-3 diameters upstream from a flow disturbance. However, in most cases, a suitable sampling plane will be a position fitting the minimum criteria specified in Table 1 of AS/NZS 4323.1.

Non Ideal sampling position: If the measurement near a bend is unavoidable, the sampling position shall be greater than one duct diameter upstream of the bend or greater than two duct diameters downstream of the bend. When the criteria in Table 1 of AS/NZS 4323.1 cannot be met, a greater number of sampling points shall be used in order to retain as much accuracy as is practicable.

**Section 5** summaries the sample plane records and provides photographs of each location.

# Test Report 630.11565.00500-TR1R0

## 5 SAMPLING PLANE RECORDS

### 5.1 Poultry Shed Exhaust Fans

The sample location for each poultry shed exhaust fan did not meet ideal sampling plane requirements for upstream and downstream distance requirements. Refer to **Table 1** for detailed summary of the sample location recordings and illustrative representation of each location.

**Table 1 Summary of Sample Location Recordings – Poultry Shed No.1, 2 and 3**

| Location | Shed No. 1, 2 and 3 Fan Exhaust |
|---|---|
| Large Duct/Fan Diameter (m) | 2.3m (W) x 2.3m (L) |
| Small Duct/Fan Diameter (m) | 1.6m (W) x 1.6m (L) |
| **Upstream Requirements** | |
| Type of Disturbance | Exhaust / Exit |
| Distance to Disturbance (m) | Fan |
| No. of Duct Diameters | 0D |
| Ideal Minimum Distance Criteria | 2D |
| Diameters less than Ideal Criteria | 2D |
| Sampling Factor | 1.15 |
| **Downstream Requirements** | |
| Type of Disturbance | Fan |
| Distance to Disturbance (m) | > 20m |
| No. of Duct Diameters | > 8D |
| Ideal Minimum Distance Criteria | 8D |
| Diameters less than Ideal Criteria | 0D |
| Sampling Factor | 0 |
| **Number of sampling points for manual isokinetic sampling** | |
| Minimum No. of Sampling Traverses | 4 |
| Minimum No. of Access Holes | 4 |
| Minimum No. of Sampling Points | 16 |
| Combined Sampling Factor | 1.15 |
| Total No. of Sampling Points required | 20 |
| Comments | Nil |
| Additional Comments | Release height from ground level is approximately 1m from bottom of fan and 3.3m from top of fan. Box enclosure is approximately 3.6m (W) by 18m (L) with a wall height of 4.6m (H) All fans operating during sample collection. |

**Photograph 1** Shed No.1 Exhaust Fan Release Point (at sampling ports/fan face)

**Photograph 2** Shed No.1 Exhaust Fan Release Point (at ground level)

**Photograph 3** Poultry Shed No.1 (view of shed length)

# Test Report 630.11565.00500-TR1R0

## 6 RESULTS

Monitoring of all parameters was performed on the following dates;

- Farm 94; Shed No.1, No.2 and No.3 was tested on 13 March 2019.

Refer to **Table 3** for detailed summaries of the measured test results.

**Appendix A** presents detailed results of the exhaust flow rates and mass odour emission rates measured for each test.

**Appendix B** presents the laboratory certificates of analysis.

### 6.1 Operating Conditions

On the day of testing, all three poultry sheds were considered to be operating under normal conditions. The following production details were provided during the monitoring period;

| Parameter | Units | Farm 94; Shed No.1 | Farm 94; Shed No.2 | Farm 94; Shed No.3 |
|---|---|---|---|---|
| Testing Date | -- | 13-Mar-2019 | 13-Mar-2019 | 13-Mar-2019 |
| Bird Age | -- | 34 days | 34 days | 34 days |
| Average bird weight | kg | 2.101 | 2.141 | 2.147 |
| Number of Birds per Shed | -- | 48,041 | 47,757 | 47,982 |
| Total Number of Exhaust Vents per Shed | -- | 6 (x4 Large, x2 Small) | 6 (x4 Large, x2 Small) | 6 (x4 Large, x2 Small) |
| Operating conditions considered Normal / Typical on the day of testing | -- | Yes | Yes | Yes |

# Test Report 630.11565.00500-TR1R0

## 6.2 Odour Emission Test Results

Results are presented at actual conditions unless otherwise stated. All volumes and concentrations are reported as dry at temperature of $0^oC$ and at absolute pressure of 101.3 kPa unless otherwise stated. Where measured values have been corrected to reference conditions (i.e. 'normalised' or 'standardised') the measured values are reported prefixed with an "N" (e.g. $N.m^3$).

**Table 2 Summary of Measured Concentration Results – Farm 94; Shed No.1, No.2 and No.3**

| | | Farm 94 | | | |
|---|---|---|---|---|---|
| **Location** | **Unit** | **Shed No.1** | **Shed No.2** | **Shed No.3** | **Average** |
| Date Tested | -- | 13-Mar-19 | 13-Mar-19 | 13-Mar-19 | 13-Mar-19 |
| Average Temperature | $^oC$ | 24.0 | 24.1 | 24.0 | 24.0 |
| Average Velocity (Large Vents) | m/s | 13.80 | 14.28 | 13.81 | 13.96 |
| Average Velocity (Small Vents) | m/s | 17.12 | 16.25 | 17.12 | 16.83 |
| Average Volumetric Flow per Shed (actual) | $m^3/s$ | 384.76 | 390.58 | 384.90 | 386.75 |
| **Average Odour Concentration** | **ou** | **91** | **43** | **42** | **42** |
| Average Mass Odour Emission Rate (Actual) (wet) | $ou.m^3/s$ | 35,013 | 16,795 | 15,973 | 22,594 |
| Average Mass Odour Emission Rate (STP) (wet) | $ou.m^3/s$ | 32,248 | 15,465 | 14,713 | 20,808 |
| Laboratory calculated k-factor | -- | 0.65 | 0.3 | 0.3 | 0.42 |

## 6.3 Instrument Calibration Details

| **Asset No.** | **Instrument Description** | **Date Last Calibrated** | **Calibration Due Date** |
|---|---|---|---|
| 1789 | Digital Barometer | 11/03/2019 | 11/03/2020 |
| 1808 | Manometer (Digital) | 15/12/2018 | 15/12/2019 |
| 1834 | Pitot Tube | 28/06/2013 | Visual inspection for damage, defects or blockages on use – Satisfactory for use |
| 1960 | Tape Measure (Retractable) | 09/03/2018 | 09/03/2021 |
| 2371 | Thermocouple | 11/03/2019 | 11/03/2020 |
| 2371 | Thermometer (Digital) | 11/03/2019 | 11/03/2020 |
| i-phone | Timepiece | NA | Synchronized with Global Positioning Satellite |
| 2474 | Anemometer | 03/01/2019 | 03/01/2020 |
| 2006, 2002 | Sample Pumps | 11/09/2018 | 11/09/2019 |

# Test Report 630.11565.00500-TR1R0

## 6.4 Measurement Uncertainty

| Parameter | Associated Test Method | Uncertainty |
|---|---|---|
| Odour | OM-7, AS4323.3 | ± 50 - 124% (based upon a single determination) |
| Temperature | TM-2, USEPA M2C | $\pm 2^{o}C$ |
| Velocity | TM-2, AS 4323.1, USEPA M2A, 2C | ± 5% |

# Test Report 630.11565.00500-TR1R0

## APPENDIX A – DETAILED TABULATED RESULTS

### Table 3 Summary of Measured Concentration Results – Farm 94; Shed No.1

| **Location** | | **Shed 1** | | |
|---|---|---|---|---|
| Run No | | **1** | **2** | **Average** |
| Date Tested | | 13-Mar-19 | 13-Mar-19 | 13-Mar-19 |
| **Parameter** | **Unit** | **Average Result** | **Average Result** | **Average Result** |
| Sampling Start Time | AEST | 15:35 | 15:50 | -- |
| Sampling Finish Time | AEST | 15:50 | 16:05 | -- |
| Large Vents Diameter | m | 2.32m x 2.32m | 2.32m x 2.32m | 2.32m x 2.32m |
| Small Vents Diameter | m | 1.6m x 1.6m | 1.6m x 1.6m | 1.6m x 1.6m |
| Source / Shed Diameter | m | 18m x 172m | 18m x 172m | 18m x 172m |
| Large Vents Cross Sectional Area | $m^2$ | 5.382 | 5.382 | 5.382 |
| Small Vents Cross Sectional Area | $m^2$ | 2.560 | 2.560 | 2.560 |
| Temperature | $^oC$ | 24.0 | 24.0 | 24.0 |
| Velocity (Large Vents) | m/s | 13.80 | 13.80 | 13.80 |
| Velocity (Small Vents) | m/s | 17.12 | 17.12 | 17.12 |
| Total Shed Volumetric Flow (actual) | $m^3/s$ | 384.76 | 384.76 | 384.76 |
| Total Shed Volumetric Flow (dry) | $N.m^3/s$ | 354.37 | 354.37 | 354.37 |
| Total Shed Volumetric Flow (wet) | $N.m^3/s$ | 354.37 | 354.37 | 354.37 |
| Atmospheric Pressure | kPa | 101.49 | 101.49 | 101.49 |
| Molecular Weight Dry Stack Gas | g/g-mole | 28.836 | 28.836 | 28.836 |
| Dry Gas Density | $kg/m^3$ | 1.287 | 1.287 | 1.287 |
| Oxygen | % | 20.9 | 20.9 | 20.9 |
| Odour | ou | 83 | 99 | 91 |
| Mass Odour Emission Rate (Actual) (wet) | $ou.m^3/s$ | 31,935 | 38,092 | 35,013 |
| Mass Odour Emission Rate (STP) (dry) | $ou.m^3/s$ | 29,413 | 35,083 | 32,248 |
| Mass Odour Emission Rate (STP) (wet) | $ou.m^3/s$ | 29,413 | 35,083 | 32,248 |
| Number of Birds in Shed | -- | 48,041 | 48,041 | 48,041 |
| Specific Odour Emission Rate | ($ou.m^3/s$ per bird) | 1.50 | 1.26 | 1.38 |
| Odour Character | -- | chicken, feathers | chicken, feathers | -- |
| Laboratory k-factor reported | -- | 0.60 | 0.70 | 0.65 |

# refer to **Section 4.2** for further details (Non ideal sampling location)

# Test Report 630.11565.00500-TR1R0

**Table 4 Summary of Measured Concentration Results – Farm 94; Shed No.2**

| **Location** | | **Shed 2** | | |
|---|---|---|---|---|
| Run No | | **1** | **2** | **Average** |
| Date Tested | | 13-Mar-19 | 13-Mar-19 | 13-Mar-19 |
| **Parameter** | **Unit** | **Average Result** | **Average Result** | **Average Result** |
| Sampling Start Time | AEST | 15:30 | 15:45 | -- |
| Sampling Finish Time | AEST | 15:45 | 16:00 | -- |
| Large Vents Diameter | m | 2.32m x 2.32m | 2.32m x 2.32m | 2.32m x 2.32m |
| Small Vents Diameter | m | 1.6m x 1.6m | 1.6m x 1.6m | 1.6m x 1.6m |
| Source / Shed Diameter | m | 18m x 172m | 18m x 172m | 18m x 172m |
| Large Vents Cross Sectional Area | $m^2$ | 5.382 | 5.382 | 5.382 |
| Small Vents Cross Sectional Area | $m^2$ | 2.560 | 2.560 | 2.560 |
| Temperature | $^oC$ | 24.1 | 24.1 | 24.1 |
| Velocity (Large Vents) | m/s | 14.28 | 14.28 | 14.28 |
| Velocity (Small Vents) | m/s | 16.25 | 16.25 | 16.25 |
| Total Shed Volumetric Flow (actual) | $m^3/s$ | 390.58 | 390.58 | 390.58 |
| Total Shed Volumetric Flow (dry) | $N.m^3/s$ | 359.64 | 359.64 | 359.64 |
| Total Shed Volumetric Flow (wet) | $N.m^3/s$ | 359.64 | 359.64 | 359.64 |
| Atmospheric Pressure | kPa | 101.49 | 101.49 | 101.49 |
| Molecular Weight Dry Stack Gas | g/g-mole | 28.836 | 28.836 | 28.836 |
| Dry Gas Density | $kg/m^3$ | 1.287 | 1.287 | 1.287 |
| Oxygen | % | 20.9 | 20.9 | 20.9 |
| Odour | ou | 54 | 32 | 43 |
| Mass Odour Emission Rate (Actual) (wet) | $ou.m^3/s$ | 21,091 | 12,499 | 16,795 |
| Mass Odour Emission Rate (STP) (dry) | $ou.m^3/s$ | 19,421 | 11,509 | 15,465 |
| Mass Odour Emission Rate (STP) (wet) | $ou.m^3/s$ | 19,421 | 11,509 | 15,465 |
| Number of Birds in Shed | -- | 47,757 | 47,757 | 47,757 |
| Specific Odour Emission Rate | ($ou.m^3/s$ per bird) | 2.26 | 3.82 | 3.04 |
| Odour Character | -- | chicken, feathers | chicken, feathers | -- |
| Laboratory k-factor reported | -- | 0.40 | 0.20 | 0.30 |

# refer to **Section 4.2** for further details (Non ideal sampling location)

# Test Report 630.11565.00500-TR1R0

**Table 5 Summary of Measured Concentration Results – Farm 94; Shed No.3**

| Location | | Shed 1 | | |
|---|---|---|---|---|
| Run No | | **1** | **2** | **Average** |
| Date Tested | | 13-Mar-19 | 13-Mar-19 | 13-Mar-19 |
| **Parameter** | **Unit** | **Average Result** | **Average Result** | **Average Result** |
| Sampling Start Time | AEST | 16:10 | 16:15 | -- |
| Sampling Finish Time | AEST | 16:25 | 16:30 | -- |
| Large Vents Diameter | m | 2.32m x 2.32m | 2.32m x 2.32m | 2.32m x 2.32m |
| Small Vents Diameter | m | 1.6m x 1.6m | 1.6m x 1.6m | 1.6m x 1.6m |
| Source / Shed Diameter | m | 18m x 172m | 18m x 172m | 18m x 172m |
| Large Vents Cross Sectional Area | $m^2$ | 5.382 | 5.382 | 5.382 |
| Small Vents Cross Sectional Area | $m^2$ | 2.560 | 2.560 | 2.560 |
| Temperature | $^oC$ | 24.0 | 24.0 | 24.0 |
| Velocity (Large Vents) | m/s | 13.81 | 13.81 | 13.81 |
| Velocity (Small Vents) | m/s | 17.12 | 17.12 | 17.12 |
| Total Shed Volumetric Flow (actual) | $m^3/s$ | 384.90 | 384.90 | 384.90 |
| Total Shed Volumetric Flow (dry) | $N.m^3/s$ | 354.52 | 354.52 | 354.52 |
| Total Shed Volumetric Flow (wet) | $N.m^3/s$ | 354.52 | 354.52 | 354.52 |
| Atmospheric Pressure | kPa | 101.49 | 101.49 | 101.49 |
| Molecular Weight Dry Stack Gas | g/g-mole | 28.836 | 28.836 | 28.836 |
| Dry Gas Density | $kg/m^3$ | 1.287 | 1.287 | 1.287 |
| Oxygen | % | 20.9 | 20.9 | 20.9 |
| Odour | ou | 38 | 45 | 42 |
| Mass Odour Emission Rate (Actual) (wet) | $ou.m^3/s$ | 14,626 | 17,320 | 15,973 |
| Mass Odour Emission Rate (STP) (dry) | $ou.m^3/s$ | 13,472 | 15,953 | 14,713 |
| Mass Odour Emission Rate (STP) (wet) | $ou.m^3/s$ | 13,472 | 15,953 | 14,713 |
| Number of Birds in Shed | -- | 47,982 | 47,982 | 47,982 |
| Specific Odour Emission Rate | ($ou.m^3/s$ per bird) | 3.28 | 2.77 | 3.03 |
| Odour Character | -- | chicken, feathers | chicken, feathers | -- |
| Laboratory k-factor reported | -- | 0.30 | 0.30 | 0.30 |

# refer to **Section 4.2** for further details (Non ideal sampling location)

# Test Report 630.11565.00500-TR1R0

# APPENDIX B – CERTIFICATES OF ANALYSIS

**THE ODOUR UNIT PTY LTD**
Level 3 Suite 12
56 Church Avenue
MASCOT NSW 2020
Phone: +61 2 9209 4420
www.odourunit.com.au

A C N 091 165 061
A B N 53 091 165 061

Michael Brecko
SLR Consulting Australia Pty Ltd
2 Lincoln Street
LANE COVE NSW 2066

1 April 2019

By email: mbrecko@slrconsulting.com

**ODOUR & K-FACTOR CALCULATION RESULTS SHEET – 14 MARCH 2019 (REV1)**

Dear Michael,

Please find **appended** the odour testing results from the samples analysed at The Odour Unit's Sydney Laboratory on 14 March 2019. A summary of the odour emission and k-factor results are presented in **Table 1**.

**Table 1** – Odour emission and k-factor results: 14 March 2019 ^

| Shed No. | Odour concentration (ou) | Odour Emission Rate (ou.m$^3$/s) | Bird density (kg/m$^2$) | Ventilation rate per shed at STP ^^ (m$^3$/s) | k-factor |
|---|---|---|---|---|---|
| Shed 1 Run 1 | 83 | 28,800 | 46.5 | 346.5 | 0.6 |
| Shed 1 Run 2 | 99 | 34,300 | | | 0.7 |
| Shed 2 Run 1 | 54 | 18,700 | | | 0.4 |
| Shed 2 Run 2 | 32 | 11,100 | | | 0.2 |
| Shed 3 Run 1 | 38 | 13,200 | | | 0.3 |
| Shed 3 Run 2 | 45 | 15,600 | | | 0.3 |

^ Shed floor area as provided by SLR Consulting = 172 metres by 18 metres width
^^ STP = standard temperature and pressure, at 0ºC, 101.325 kPa

Yours sincerely,

James Schulz
NSW Laboratory Coordinator & Consultant

**Attachments:**

- Odour laboratory results report: 14 March 2019.

# THE ODOUR UNIT PTY LTD

THE ODOUR UNIT

Level 3, 12/56
Church Avenue
MASCOT NSW 2020

Phone: +61 2 9209 4420
Email: info@odourunit.com.au
Internet: www.odourunit.com.au
ABN: 53 091 163 061

NATA
Accreditation Number:
14974

## Odour Concentration Measurement Report

The measurement was commissioned by:

| | | | |
|---|---|---|---|
| Organisation | SLR Consulting | Telephone | +61 2 9428 8100 |
| Contact | Michael Brecko | Facsimile | +61 2 9427 8200 |
| Sampling Site | Undisclosed | Email | mbrecko@slrconsulting.com |
| Sampling Method | Undisclosed | Sampling Team | SLR Consulting |

Order details:

| | | | |
|---|---|---|---|
| Order requested by | M. Brecko | Order accepted by | J. Schulz |
| Date of order | 12 March 2019 | TOU Project # | N1869R |
| Order number | 25907 | Project Manager | J. Schulz |
| Signed by | M. Brecko | Testing operator | A. Schulz |

**Investigated Item** — Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.

**Identification** — The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.

**Method** — The odour concentration measurements were performed using dynamic olfactometry according to the Australian/New Zealand Standard: Stationary source emissions – Part 3: '*Determination of odour concentration by dynamic olfactometry* (**AS/NZS4323.3:2001**). The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.

**Measuring Range** — The measuring range of the olfactometer is $2^2 \le \chi \le 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting $2^{17}$. This is specifically mentioned with the results.

**Environment** — The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained at 22 °C ±3 °C.

**Measuring Dates** — The date of each measurement is specified with the results.

**Instrument Used** — The olfactometer used during this testing session was:
ODORMAT V04.

**Instrumental Precision** — The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \le 0.477$ in accordance with the AS/NZS4323.3:2001.
ODORMAT V04: $r = 0.101$ (January 2018) Compliance – Yes

**Instrumental Accuracy** — The accuracy of this instrument for a sensory calibration must be $A \le 0.217$ in accordance with the AS/NZS4323.3:2001.
ODORMAT V04: $A = 0.212$ (January 2018) Compliance – Yes

**Lower Detection Limit (LDL)** — The LDL for the olfactometer has been determined to be 16 ou, which is 4 times the lowest dilution setting.

**Traceability** — The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

**Accredited for compliance with ISO/IEC 17025 - Testing.**
**This report shall not be reproduced, except in full.**

Date: 19 March 2019

Panel Roster Number: SYD20190314_023

**J. Schulz**
NSW Laboratory Coordinator

**A. Schulz**
Authorised Signatory

# THE ODOUR UNIT PTY LTD

Accreditation Number: 14974

**Odour Sample Measurement Results**
**Panel Roster Number: SYD20190314_023**

| Sample Location | TOU Sample ID | Sampling Date & Time | Analysis Date & Time | Panel Size | Valid ITEs | Nominal Sample Dilution | Actual Sample Dilution (Adjusted for Temperature) | Sample Odour Concentration (as received, in the bag) (ou) | Sample Odour Concentration (Final, allowing for dilution) (ou) | *Specific Odour Emission Rate (ou.m³/m²/s) (See Note:1)* |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample 1 - Shed 1 Run 1 (7998) | SC19173 | 13.03.2019 1550 hrs | 14.03.2019 1356 hrs | 4 | 8 | -- | -- | 83 | 83 | -- |
| Sample 2 - Shed 1 Run 2 (7999) | SC19174 | 13.03.2019 1605 hrs | 14.03.2019 1424 hrs | 4 | 8 | -- | -- | 99 | 99 | -- |
| Sample 3 - Shed 2 Run 1 (7800) | SC19175 | 13.03.2019 1545 hrs | 14.03.2019 1508 hrs | 4 | 8 | -- | -- | 54 | 54 | -- |
| Sample 4 - Shed 2 Run 2 (7801) | SC19176 | 13.03.2019 1600 hrs | 14.03.2019 1528 hrs | 4 | 8 | -- | -- | 32 | 32 | -- |
| Sample 5 - Shed 3 Run 1 (7802) | SC19177 | 13.03.2019 1625 hrs | 14.03.2019 1547 hrs | 4 | 8 | -- | -- | 38 | 38 | -- |
| Sample 6 - Shed 3 Run 2 (7803) | SC19178 | 13.03.2019 1630 hrs | 14.03.2019 1605 hrs | 4 | 8 | -- | -- | 45 | 45 | -- |

**Samples Received in Laboratory –** From: SLR Date: 14 March 2019 Time: 1000 hrs

**Note:** The following are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd:

1. The collection of Isolation Flux Hood (**IFH**) samples and the calculation of the Specific Odour Emission Rate (**SOER**).
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit Pty Ltd have performed the dilution of samples.

## Odour Panel Calibration Results

| Reference Odorant | Reference Odorant Panel Roster Number | Concentration of Reference gas (ppb) | Panel Target Range for n-butanol (ppb) | Measured Concentration (ou) | Measured Panel Threshold (ppb) | Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No) |
|---|---|---|---|---|---|---|
| n-butanol | SYD20190314_023 | 51,400 | $20 \leq \chi \leq 80$ | 861 | 60 | Yes |

Comments

Odour characters (non-NATA accredited) as determined by odour laboratory panel:

| | | | |
|---|---|---|---|
| SC19173 | chicken, feathers | SC19176 | chicken, feathers |
| SC19174 | chicken, feathers | SC19177 | chicken, feathers |
| SC19175 | chicken, feathers | SC19178 | chicken, feathers |

Disclaimers

1. Parties, other than The Odour Unit Pty Ltd, responsible for collecting odour samples have advised that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Ltd for the purpose of odour testing.
2. The collection of odour samples by parties other than The Odour Unit Pty Ltd relinquishes The Odour Unit Pty Ltd from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.
3. Any comments included in, or attachments to, this Report are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd.
4. This report shall not be reproduced, except in full, without written approval of The Odour Unit Pty Ltd.

**END OF DOCUMENT**

SLR CONSULTING AUSTRALIA PTY LTD
2 LINCOLN STREET, LANE COVE NSW 2066
TELEPHONE: 02 9428 8100

# Test Report 630.11565.00500-TR2R0

## 1 CLIENT DETAILS

| | |
|---|---|
| **Organisation:** | VOAG 2 Pty Ltd |
| **Company Contact:** | Robert Vojtkiv |
| **Site Address:** | The Ranch Poultry Complex, Tabbita NSW 2652 |
| **Postal Address:** | 131 Fogarty Road, Tynong North VIC 3813 |
| **Telephone Number:** | +61 419 576 786 |
| **Email Address:** | robert.vojtkiv@voag.com.au |

## 2 PROJECT DETAILS & SCOPE OF WORK REQUESTED

| | |
|---|---|
| **Project Number:** | 630.11565.00500 |
| **Project Name:** | Poultry Odour Monitoring |
| **Project Manager:** | Michael Brecko |
| **Monitoring Date(s):** | 20 May 2019 |
| **Reasons for the Work:** | k-factor Testing |
| **Production/Operational Conditions:** | Typical daily operations – all exhaust fans operating |
| **Parameters Requested:** | Odour and Character |
| **Sample Locations:** | Farm 95; Shed 5, Shed 6 and Shed 7 |
| **Sample Identification Numbers:** | Refer to Appendix C (8403, 8404,8405, 8406, 8407,8408) |

Signatory

Michael Brecko

Issue Date: 07 June 2019

Accredited for Compliance with
ISO/IEC 17025 - Testing.

# Test Report 630.11565.00500-TR2R0

## 3 NOMENCLATURE

| | |
|---|---|
| * | Not part of SLR scope of accreditation |
| º | degrees |
| > | greater than |
| ≥ | greater than or equal to |
| < | less than |
| ≤ | less than or equal to |
| % | percentage |
| AESTD | Australian Eastern Standard Time Daylight Savings |
| AEST | Australian Eastern Standard Time |
| ALS | Australian Laboratory Services |
| AM | Ambient Method |
| Avg | Average |
| AS | Australian Standard |
| AS/NZS | Australian Standards/New Zealand Standards |
| $CO_2$ | Carbon dioxide |
| CO | Carbon monoxide |
| CSC | Certified Span Concentration |
| Conc. | Concentration |
| ºC | degrees Celsius |
| D | Duct Diameters |
| EPA | Environment Protection Agency |
| EPL | Environment Protection Licence |
| F | Fluoride |
| g/g mole | grams per gram mole |
| HCl | Hydrogen chloride |
| hr | hour |
| ID | Identification |
| K | kelvin |
| $kg/m^3$ | kilograms per cubic metre of air |
| kPa | kilopascals |
| LOR | Limit of Reporting |
| Max | Maximum |
| m | metre |
| m/s | metres per second |
| $m^2$ | metres square |
| $m^3$ | cubic metres |
| $m^3/s$ | cubic metre of air per second |
| $\mu g/m^3$ | micrograms per cubic metre of air |
| $mg/m^3$ | milligrams per cubic metre of air |
| Min | Minimum |
| min | minutes |
| NA | Not Applicable |
| NATA | National Association of Testing Authorities |
| NSW | New South Wales |
| NM | Not Measured |
| No. | Number |
| $NO_x$ | Oxides of nitrogen |
| ou | odour units |
| OEH | Office of Environment and Heritage |
| OM | Other Method |
| $O_2$ | Oxygen |
| $PM_{10}$ | Particulate matter less than 10 microns |
| $PM_{2.5}$ | Particulate matter less than 2.5 microns |
| ppb | parts per billion |
| ppm | parts per million |
| POEO | Protection of the Environment and Operations (Clean Air) Regulations 2010 |
| Qld | Queensland |
| SLR | SLR Consulting Australia Pty Ltd |
| $SO_2$ | Sulphur dioxide |
| $SO_3/H_2SO_4$ | Sulphur trioxide / sulphuric acid mist |
| TM | Test Method |
| TSP | total suspended particulate |
| UNSW | University of New South Wales |
| USEPA M | United States Environment Protection Agency Method |
| UTM | Universal Transverse Mercator |

# Test Report 630.11565.00500-TR2R0

## 4 PROCESS EMISSIONS MONITORING - PARAMETER, SAMPLING AND ANALYSIS METHOD AND ANALYSIS LABORATORY

### 4.1 Test Methods and Analysis References

All sampling and monitoring was performed by SLR unless otherwise specified. The following table outlines for each parameter requested to be tested, the relevant test method for sampling and analysis and the NATA Accredited Laboratory that completed the analysis.

All associated NATA endorsed Test Reports/Certificates of Analysis are provided separately in Appendix B.

#### 4.1.1 Point Source Emissions

| Parameter | Test Method Number for Sampling and Analysis | NATA Laboratory Analysis By: NATA Accreditation No. & Report No. |
|---|---|---|
| Sampling location | TM-1, AS/NZS 4323.1, USEPA M1 | SLR Consulting Australia Pty Ltd<br>NATA No.3130<br>Report No. 630.11565.00500-TR2R0 |
| Velocity | TM-2, USEPA M2, 2C, ISO10780 | SLR Consulting Australia Pty Ltd<br>NATA No.3130<br>Report No. 630.11565.00500-TR2R0 |
| Duct temperature | TM-2, USEPA M2, 2C | SLR Consulting Australia Pty Ltd<br>NATA No.3130<br>Report No. 630.11565.00500-TR2R0 |
| Volumetric flow rate | TM-2, USEPA M2, 2C | SLR Consulting Australia Pty Ltd<br>NATA No.3130<br>Report No. 630.11565.00500-TR2R0 |
| Dry gas density | TM-23, USEPA M3 | SLR Consulting Australia Pty Ltd<br>NATA No.3130<br>Report No. 630.11565.00500-TR2R0 |
| Moisture | TM-22, USEPA M4 | SLR Consulting Australia Pty Ltd<br>NATA No.3130<br>Report No. 630.11565.00500-TR2R0 |
| Odour | OM-7, AS4323.3 | The Odour Unit<br>NATA No. 14974<br>Report No. SYD20190521_040 |

### 4.2 Deviations from Test Methods

There were deviations to the specified test reference methodologies as detailed below

- Sampling Plane did not comply with the minimum distance for upstream disturbances. SLR adopted additional sample points to improve the accuracy of the measurements.

### 4.3 Sampling Times

As per the relevant test reference method or State requirement.

# Test Report 630.11565.00500-TR2R0

### 4.4 Reference Conditions

As per relevant test reference method, State requirement, or Environment Protection Licence or equivalent.

### 4.5 Identification

All samples are individual labelled with reference number, location, sampling date and times.

### 4.6 Sample Plane Requirements

Ideal sampling positions: In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exit at 7-8 diameters downstream and 2-3 diameters upstream from a flow disturbance. However, in most cases, a suitable sampling plane will be a position fitting the minimum criteria specified in Table 1 of AS/NZS 4323.1.

Non Ideal sampling position: If the measurement near a bend is unavoidable, the sampling position shall be greater than one duct diameter upstream of the bend or greater than two duct diameters downstream of the bend. When the criteria in Table 1 of AS/NZS 4323.1 cannot be met, a greater number of sampling points shall be used in order to retain as much accuracy as is practicable.

**Section 5** summaries the sample plane records and provides photographs of each location.

# Test Report 630.11565.00500-TR2R0

## 5 SAMPLING PLANE RECORDS

### 5.1 Poultry Shed Exhaust Fans

The sample location for each poultry shed exhaust fan did not meet ideal sampling plane requirements for upstream and downstream distance requirements. Refer to **Table 1** for detailed summary of the sample location recordings and illustrative representation of each location.

**Table 1 Summary of Sample Location Recordings – Poultry Shed No.5, 6 and 7**

| **Location** | **Shed No. 5, 6 and 7 Fan Exhaust** |
|---|---|
| Large Duct/Fan Diameter (m) | 1.80m |
| Small Duct/Fan Diameter (m) | NA |
| **Upstream Requirements** | |
| Type of Disturbance | Exhaust / Exit |
| Distance to Disturbance (m) | Fan |
| No. of Duct Diameters | 0D |
| Ideal Minimum Distance Criteria | 2D |
| Diameters less than Ideal Criteria | 2D |
| Sampling Factor | 1.15 |
| **Downstream Requirements** | |
| Type of Disturbance | Fan |
| Distance to Disturbance (m) | > 20m |
| No. of Duct Diameters | > 8D |
| Ideal Minimum Distance Criteria | 8D |
| Diameters less than Ideal Criteria | 0D |
| Sampling Factor | 0 |
| **Number of sampling points for manual isokinetic sampling** | |
| Minimum No. of Sampling Traverses | 4 |
| Minimum No. of Access Holes | 4 |
| Minimum No. of Sampling Points | 16 |
| Combined Sampling Factor | 1.15 |
| Total No. of Sampling Points required | 20 |
| Comments | Nil |
| Additional Comments | Release height from ground level is approximately 1m from bottom of fan and 3.3m from top of fan.<br>Box enclosure is approximately 3.6m (W) by 18m (L) with a wall height of 4.6m (H)<br>Majority fans operating during sample collection. |

**Photograph 1** Shed No.5 Exhaust Fan Release Point (at sampling ports/fan face)

**Photograph 2** Shed No.5 Exhaust Fan Release Point (at ground level)

**Photograph 3** Poultry Shed No.5 (view of shed length)

# Test Report 630.11565.00500-TR2R0

## 6 RESULTS

Monitoring of all parameters was performed on the following dates;

- Farm 95; Shed No.5, No.6 and No.7 was tested on 20 May 2019.

Refer to **Table 3** for detailed summaries of the measured test results.

**Appendix A** presents detailed results of the exhaust flow rates and mass odour emission rates measured for each test.

**Appendix B** presents the laboratory certificates of analysis.

### 6.1 Operating Conditions

On the day of testing, all three poultry sheds were considered to be operating under normal conditions. The following production details were provided during the monitoring period;

| Parameter | Units | Farm 95; Shed No.5 | Farm 95; Shed No.6 | Farm 95; Shed No.7 |
|---|---|---|---|---|
| Testing Date | -- | 20-May-2019 | 20-May-2019 | 20-May-2019 |
| Bird Age | -- | 32 days | 32 days | 32 days |
| Average bird weight | kg | 1.770 | 1.780 | 1.810 |
| Number of Birds per Shed | -- | 54,500 | 54,500 | 54,500 |
| Total Number of Exhaust Vents per Shed | -- | 10<br>(x10 Large, x0 Small) | 10<br>(x10 Large, x0 Small) | 10<br>(x10 Large, x0 Small) |
| Operating conditions considered Normal / Typical on the day of testing | -- | Yes | Yes | Yes |

# Test Report 630.11565.00500-TR2R0

## 6.2 Odour Emission Test Results

Results are presented at actual conditions unless otherwise stated. All volumes and concentrations are reported as dry at temperature of 0°C and at absolute pressure of 101.3 kPa unless otherwise stated. Where measured values have been corrected to reference conditions (i.e. 'normalised' or 'standardised') the measured values are reported prefixed with an "N" (e.g. N.m$^3$).

**Table 2 Summary of Measured Concentration Results – Farm 95; Shed No.5, No.6 and No.7**

| | | Farm 95 | | | |
|---|---|---|---|---|---|
| **Location** | **Unit** | **Shed No.5** | **Shed No.6** | **Shed No.7** | **Average** |
| Date Tested | -- | 20-May-19 | 20-May-19 | 20-May-19 | 20-May-19 |
| Average Temperature | °C | 25.2 | 25.2 | 25.5 | 25.3 |
| Average Velocity (Large Vents) | m/s | 7.36 | 7.46 | 7.20 | 7.20 |
| Average Velocity (Small Vents) | m/s | NA | NA | NA | NA |
| Average Volumetric Flow per Shed (actual) | m$^3$/s | 146.77 | 166.76 | 151.99 | 155.17 |
| **Average Odour Concentration** | **ou** | **50** | **50** | **59** | **53** |
| Average Mass Odour Emission Rate (Actual) (wet) | ou.m$^3$/s | 7,265 | 8,254 | 8,967 | 8,162 |
| Average Mass Odour Emission Rate (STP) (wet) | ou.m$^3$/s | 6,607 | 7,507 | 8,217 | 7,443 |
| Laboratory calculated k-factor | -- | 0.25 | 0.25 | 0.30 | 0.27 |

## 6.3 Instrument Calibration Details

| Asset No. | Instrument Description | Date Last Calibrated | Calibration Due Date |
|---|---|---|---|
| 1789 | Digital Barometer | 11/03/2019 | 11/03/2020 |
| 1808 | Manometer (Digital) | 15/12/2018 | 15/12/2019 |
| 1834 | Pitot Tube | 28/06/2013 | Visual inspection for damage, defects or blockages on use – Satisfactory for use |
| 1960 | Tape Measure (Retractable) | 09/03/2018 | 09/03/2021 |
| 2371 | Thermocouple | 11/03/2019 | 11/03/2020 |
| 2371 | Thermometer (Digital) | 11/03/2019 | 11/03/2020 |
| i-phone | Timepiece | NA | Synchronized with Global Positioning Satellite |
| 2474 | Anemometer | 03/01/2019 | 03/01/2020 |
| 2006, 2002 | Sample Pumps | 11/09/2018 | 11/09/2019 |

# Test Report 630.11565.00500-TR2R0

## 6.4 Measurement Uncertainty

| Parameter | Associated Test Method | Uncertainty |
|---|---|---|
| Odour | OM-7, AS4323.3 | ± 50 - 124% (based upon a single determination) |
| Temperature | TM-2, USEPA M2C | ±2°C |
| Velocity | TM-2, AS 4323.1, USEPA M2A, 2C | ± 5% |

# Test Report 630.11565.00500-TR2R0

## APPENDIX A – DETAILED TABULATED RESULTS

### Table 3 Summary of Measured Concentration Results – Farm 95; Shed No.5

| Location | | Shed 5 | | |
|---|---|---|---|---|
| Run No | | 1 | 2 | Average |
| Date Tested | | 20-May-19 | 20-May-19 | 20-May-19 |
| **Parameter** | **Unit** | **Average Result** | **Average Result** | **Average Result** |
| Sampling Start Time | AEST | 12:50 | 13:05 | -- |
| Sampling Finish Time | AEST | 13:00 | 13:15 | -- |
| Large Vents Diameter | m | 1.800 | 1.800 | 1.800 |
| Small Vents Diameter | m | 1.800 | 1.800 | 1.800 |
| Source / Shed Diameter | m | 18m x 172m | 18m x 172m | 18m x 172m |
| Large Vents Cross Sectional Area | $m^2$ | 2.545 | 2.545 | 2.545 |
| Small Vents Cross Sectional Area | $m^2$ | 2.545 | 2.545 | 2.545 |
| Temperature | $^oC$ | 25.2 | 25.2 | 25.2 |
| Velocity (Large Vents) | m/s | 7.06 | 7.06 | 7.06 |
| Velocity (Small Vents) | m/s | 7.65 | 7.65 | 7.65 |
| Total Shed Volumetric Flow (actual) | $m^3/s$ | 146.77 | 146.77 | 146.77 |
| Total Shed Volumetric Flow (dry) | $N.m^3/s$ | 133.47 | 133.47 | 133.47 |
| Total Shed Volumetric Flow (wet) | $N.m^3/s$ | 133.47 | 133.47 | 133.47 |
| Atmospheric Pressure | kPa | 100.62 | 100.62 | 100.62 |
| Molecular Weight Dry Stack Gas | g/g-mole | 28.836 | 28.836 | 28.836 |
| Dry Gas Density | $kg/m^3$ | 1.287 | 1.287 | 1.287 |
| Oxygen | % | 20.9 | 20.9 | 20.9 |
| Odour | ou | 54 | 45 | 50 |
| Mass Odour Emission Rate (Actual) (wet) | $ou.m^3/s$ | 7,926 | 6,605 | 7,265 |
| Mass Odour Emission Rate (STP) (dry) | $ou.m^3/s$ | 7,207 | 6,006 | 6,607 |
| Mass Odour Emission Rate (STP) (wet) | $ou.m^3/s$ | 7,207 | 6,006 | 6,607 |
| Number of Birds in Shed | -- | 54,500 | 54,500 | 54,500 |
| Specific Odour Emission Rate | ($ou.m^3/s$ per bird) | 6.88 | 8.25 | 7.56 |
| Odour Character | -- | chicken, feathers, pungent | chicken, feathers, pungent | -- |
| Laboratory k-factor reported | -- | 0.30 | 0.20 | 0.25 |

# refer to **Section 4.2** for further details (Non ideal sampling location)

Note; Large Vents and Small vents are the same diameter and average shed volumetric flows have been calculated averaging these two results.

# Test Report 630.11565.00500-TR2R0

### Table 4 Summary of Measured Concentration Results – Farm 95; Shed No.6

| Location | | Shed 6 | | |
|---|---|---|---|---|
| Run No | | **1** | **2** | **Average** |
| Date Tested | | 20-May-19 | 20-May-19 | 20-May-19 |
| **Parameter** | **Unit** | **Average Result** | **Average Result** | **Average Result** |
| Sampling Start Time | AEST | 12:50 | 13:05 | -- |
| Sampling Finish Time | AEST | 13:00 | 13:15 | -- |
| Large Vents Diameter | m | 1.800 | 1.800 | 1.800 |
| Small Vents Diameter | m | 1.800 | 1.800 | 1.800 |
| Source / Shed Diameter | m | 18m x 172m | 18m x 172m | 18m x 172m |
| Large Vents Cross Sectional Area | $m^2$ | 2.545 | 2.545 | 2.545 |
| Small Vents Cross Sectional Area | $m^2$ | 2.545 | 2.545 | 2.545 |
| Temperature | $^oC$ | 25.2 | 25.2 | 25.2 |
| Velocity (Large Vents) | m/s | 7.14 | 7.14 | 7.14 |
| Velocity (Small Vents) | m/s | 7.79 | 7.79 | 7.79 |
| Total Shed Volumetric Flow (actual) | $m^3/s$ | 166.76 | 166.76 | 166.76 |
| Total Shed Volumetric Flow (dry) | $N.m^3/s$ | 151.65 | 151.65 | 151.65 |
| Total Shed Volumetric Flow (wet) | $N.m^3/s$ | 151.65 | 151.65 | 151.65 |
| Atmospheric Pressure | kPa | 100.62 | 100.62 | 100.62 |
| Molecular Weight Dry Stack Gas | g/g-mole | 28.836 | 28.836 | 28.836 |
| Dry Gas Density | $kg/m^3$ | 1.287 | 1.287 | 1.287 |
| Oxygen | % | 20.9 | 20.9 | 20.9 |
| Odour | ou | 45 | 54 | 50 |
| Mass Odour Emission Rate (Actual) (wet) | $ou.m^3/s$ | 7,504 | 9,005 | 8,254 |
| Mass Odour Emission Rate (STP) (dry) | $ou.m^3/s$ | 6,824 | 8,189 | 7,507 |
| Mass Odour Emission Rate (STP) (wet) | $ou.m^3/s$ | 6,824 | 8,189 | 7,507 |
| Number of Birds in Shed | -- | 54,500 | 54,500 | 54,500 |
| Specific Odour Emission Rate | ($ou.m^3/s$ per bird) | 7.26 | 6.05 | 6.66 |
| Odour Character | -- | chicken, feathers, pungent | chicken, feathers, pungent | -- |
| Laboratory k-factor reported | -- | 0.20 | 0.30 | 0.25 |

$^\#$ refer to **Section 4.2** for further details (Non ideal sampling location)

Note; Large Vents and Small vents are the same diameter and average shed volumetric flows have been calculated averaging these two results

# Test Report 630.11565.00500-TR2R0

### Table 5 Summary of Measured Concentration Results – Farm 95; Shed No.7

| Location | | Shed 7 | | |
|---|---|---|---|---|
| Run No | | 1 | 2 | Average |
| Date Tested | | 20-May-19 | 20-May-19 | 20-May-19 |
| **Parameter** | **Unit** | **Average Result** | **Average Result** | **Average Result** |
| Sampling Start Time | AEST | 13:25 | 13:40 | -- |
| Sampling Finish Time | AEST | 13:35 | 13:50 | -- |
| Large Vents Diameter | m | 1.800 | 1.800 | 1.800 |
| Small Vents Diameter | m | 1.800 | 1.800 | 1.800 |
| Source / Shed Diameter | m | 18m x 172m | 18m x 172m | 18m x 172m |
| Large Vents Cross Sectional Area | $m^2$ | 2.545 | 2.545 | 2.545 |
| Small Vents Cross Sectional Area | $m^2$ | 2.545 | 2.545 | 2.545 |
| Temperature | $^oC$ | 25.5 | 25.5 | 25.5 |
| Velocity (Large Vents) | m/s | 6.52 | 6.52 | 6.52 |
| Velocity (Small Vents) | m/s | 7.06 | 7.06 | 7.06 |
| Total Shed Volumetric Flow (actual) | $m^3/s$ | 151.99 | 151.99 | 151.99 |
| Total Shed Volumetric Flow (dry) | $N.m^3/s$ | 139.26 | 139.26 | 139.26 |
| Total Shed Volumetric Flow (wet) | $N.m^3/s$ | 139.26 | 139.26 | 139.26 |
| Atmospheric Pressure | kPa | 101.49 | 101.49 | 101.49 |
| Molecular Weight Dry Stack Gas | g/g-mole | 28.836 | 28.836 | 28.836 |
| Dry Gas Density | $kg/m^3$ | 1.287 | 1.287 | 1.287 |
| Oxygen | % | 20.9 | 20.9 | 20.9 |
| Odour | ou | 54 | 64 | 59 |
| Mass Odour Emission Rate (Actual) (wet) | $ou.m^3/s$ | 8,208 | 9,727 | 8,967 |
| Mass Odour Emission Rate (STP) (dry) | $ou.m^3/s$ | 7,520 | 8,913 | 8,217 |
| Mass Odour Emission Rate (STP) (wet) | $ou.m^3/s$ | 7,520 | 8,913 | 8,217 |
| Number of Birds in Shed | -- | 54,500 | 54,500 | 54,500 |
| Specific Odour Emission Rate | ($ou.m^3/s$ per bird) | 6.64 | 5.60 | 6.12 |
| Odour Character | -- | chicken, feathers, pungent | chicken, feathers, pungent | -- |
| Laboratory k-factor reported | -- | 0.30 | 0.30 | 0.30 |

# refer to **Section 4.2** for further details (Non ideal sampling location)

Note; Large Vents and Small vents are the same diameter and average shed volumetric flows have been calculated averaging these two results

# Test Report 630.11565.00500-TR2R0

# APPENDIX B – CERTIFICATES OF ANALYSIS

**THE ODOUR UNIT PTY LTD**
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Phone: +61 2 9209 4420
www.odourunit.com.au

A C N 091 165 061
A B N 53 091 165 061

Michael Brecko
SLR Consulting Australia Pty Ltd
2 Lincoln Street
LANE COVE NSW 2066

7 June 2019

by email: mbrecko@slrconsulting.com

**ODOUR & K-FACTOR CALCULATION RESULTS SHEET – 21 MAY 2019**

Dear Michael,

Please find **appended** the odour testing results from the samples analysed at The Odour Unit's Sydney Laboratory on 21 May 2019. A summary of the odour emission and k-factor results are presented in **Table 1**.

**Table 1** – Odour emission and k-factor results: 21 May 2019 ^

| Shed No. | Odour concentration (ou) | Odour Emission Rate ($ou.m^3/s$) | Bird density ($kg/m^2$) | Ventilation rate per shed at STP ^^ ($m^3/s$) | k-factor |
|---|---|---|---|---|---|
| Sample 1 - Shed 5 Run 1 (8403) | 54 | 7,210 | 31.2 | 133.5 | 0.3 |
| Sample 2 - Shed 5 Run 2 (8404) | 45 | 6,010 | | | 0.2 |
| Sample 3 - Shed 6 Run 1 (8405) | 45 | 6,820 | 31.3 | 151.6 | 0.2 |
| Sample 4 - Shed 6 Run 2 (8406) | 54 | 8,190 | | | 0.3 |
| Sample 5 - Shed 7 Run 1 (8407) | 54 | 7,530 | 31.9 | 139.5 | 0.3 |
| Sample 6 - Shed 7 Run 2 (8408) | 64 | 8,930 | | | 0.3 |

^ Shed floor area as provided by SLR Consulting (172 metres by 18 metres width). Ventilation rate based on the number of fans operating at the time of sampling (Shed 5 = 8/10, Shed 6 = 9/10, Shed 7 = 9/10).
^^ STP = standard temperature and pressure, at $0^oC$, 101.325 kPa

Yours sincerely,

James Schulz
NSW Laboratory Coordinator & Consultant

**Attachments:** Odour laboratory results report: 21 May 2019

# THE ODOUR UNIT PTY LTD

THE ODOUR UNIT

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MASCOT NSW 2020

Phone: +61 2 9209 4420
Email: info@odourunit.com.au
Internet: www.odourunit.com.au
ABN: 53 091 163 061

NATA
Accreditation Number: 14974

## Odour Concentration Measurement Report

The measurement was commissioned by:

| | | | |
|---|---|---|---|
| Organisation | SLR Consulting | Telephone | +61 2 9428 8100 |
| Contact | Michael Brecko | Facsimile | +61 2 9427 8200 |
| Sampling Site | Undisclosed | Email | mbrecko@slrconsulting.com |
| Sampling Method | Undisclosed | Sampling Team | SLR Consulting |

Order details:

| | | | |
|---|---|---|---|
| Order requested by | M. Brecko | Order accepted by | A. Schulz |
| Date of order | 20 May 2019 | TOU Project # | N1869R |
| Order number | 26272 | Project Manager | A. Schulz |
| Signed by | M. Brecko | Testing operator | A. Schulz |

Investigated Item — Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag.

Identification — The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.

Method — The odour concentration measurements were performed using dynamic olfactometry according to the Australian/New Zealand Standard: Stationary source emissions – Part 3: '*Determination of odour concentration by dynamic olfactometry* (**AS/NZS4323.3:2001**). The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.

Measuring Range — The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting $2^{17}$. This is specifically mentioned with the results.

Environment — The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained at 22 ºC ±3 ºC.

Measuring Dates — The date of each measurement is specified with the results.

Instrument Used — The olfactometer used during this testing session was:
ODORMAT V04.

Instrumental Precision — The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the AS/NZS4323.3:2001.
ODORMAT V04: $r = 0.101$ (January 2018) Compliance – Yes

Instrumental Accuracy — The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the AS/NZS4323.3:2001.
ODORMAT V04: $A = 0.212$ (January 2018) Compliance – Yes

Lower Detection Limit (LDL) — The LDL for the olfactometer has been determined to be 16 ou, which is 4 times the lowest dilution setting.

Traceability — The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

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Date: Monday, 27 May 2019

Panel Roster Number: SYD20190521_040

**J. Schulz**
NSW Laboratory Coordinator

**A. Schulz**
Authorised Signatory

## Odour Sample Measurement Results
## Panel Roster Number: SYD20190521_040

| Sample Location | TOU Sample ID | Sampling Date & Time | Analysis Date & Time | Panel Size | Valid ITEs | Nominal Sample Dilution | Actual Sample Dilution (Adjusted for Temperature) | Sample Odour Concentration (as received, in the bag) (ou) | Sample Odour Concentration (Final, allowing for dilution) (ou) | *Specific Odour Emission Rate (ou.m³/m²/s) (See Note:1)* |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample 1 - Shed 5 Run 1 (8403) | SC19295 | 20.05.2019 1250 hrs | 21.05.2019 1041 hrs | 4 | 8 | -- | -- | 54 | 54 | -- |
| Sample 2 - Shed 5 Run 2 (8404) | SC19296 | 20.05.2019 1315 hrs | 21.05.2019 1112 hrs | 4 | 8 | -- | -- | 45 | 45 | -- |
| Sample 3 - Shed 6 Run 1 (8405) | SC19297 | 20.05.2019 1300 hrs | 21.05.2019 1143 hrs | 4 | 8 | -- | -- | 45 | 45 | -- |
| Sample 4 - Shed 6 Run 2 (8406) | SC19298 | 20.05.2019 1315 hrs | 21.05.2019 1209 hrs | 4 | 8 | -- | -- | 54 | 54 | -- |
| Sample 5 - Shed 7 Run 1 (8407) | SC19299 | 20.05.2019 1335 hrs | 21.05.2019 1313 hrs | 4 | 8 | -- | -- | 54 | 54 | -- |
| Sample 6 - Shed 7 Run 2 (8408) | SC19300 | 20.05.2019 1350 hrs | 21.05.2019 1337 hrs | 4 | 8 | -- | -- | 64 | 64 | -- |

**Samples Received in Laboratory –** From: SLR Date: 21 May 2019 Time: 0930 hrs

**Note:** The following are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd:

1. The collection of Isolation Flux Hood (**IFH**) samples and the calculation of the Specific Odour Emission Rate (**SOER**).
2. Final results that have been modified by the dilution factors where parties other than The Odour Unit Pty Ltd have performed the dilution of samples.

## Odour Panel Calibration Results

| Reference Odorant | Reference Odorant Panel Roster Number | Concentration of Reference gas (ppb) | Panel Target Range for n-butanol (ppb) | Measured Concentration (ou) | Measured Panel Threshold (ppb) | Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No) |
|---|---|---|---|---|---|---|
| n-butanol | SYD20190521_040 | 51,400 | $20 \leq \chi \leq 80$ | 861 | 60 | Yes |

Comments

Odour characters (non-NATA accredited) as determined by odour laboratory panel:

| | | | |
|---|---|---|---|
| SC19295 | chicken, feathers, pungent | SC19298 | chicken, feathers, pungent |
| SC19296 | chicken, feathers, pungent | SC19299 | chicken, feathers, pungent |
| SC19297 | chicken, feathers, pungent | SC19300 | chicken, feathers, pungent |

Disclaimers

1. Parties, other than The Odour Unit Pty Ltd, responsible for collecting odour samples have advised that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Ltd for the purpose of odour testing.
2. The collection of odour samples by parties other than The Odour Unit Pty Ltd relinquishes The Odour Unit Pty Ltd from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.
3. Any comments included in, or attachments to, this Report are not covered by the NATA Accreditation issued to The Odour Unit Pty Ltd.
4. This report shall not be reproduced, except in full, without written approval of The Odour Unit Pty Ltd.

**END OF DOCUMENT**

# THE ODOUR UNIT (QLD) PTY LTD

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Internet: www.odourunit.com.au
ABN: 87 102 255 765

Accreditation Number: 14974

## Odour Concentration Measurement Report

The measurement was commissioned by:

| | | | |
|---|---|---|---|
| Organisation | Astute Environmental Consulting | Telephone | 0429304644 |
| Contact | Geordie Galvin | Facsimile | -- |
| Sampling Site | ProTen, Narrandera – Farm 76 | Email | geordie.galvin@astute-environmental.com.au |
| Sampling Method | ASNZS4323.3:2001 | Sampling Team | The Odour Unit - Stephen Munro |

Order details:

| | | | |
|---|---|---|---|
| Order requested by | Geordie Galvin | Order accepted by | S. Munro |
| Date of order | July 2019 | TOU Project # | Q2200_06 |
| Order number | Email | Project Manager | S. Munro |
| Signed by | Email | Testing operator | A. Schulz |

| | |
|---|---|
| Investigated Item | Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag. |
| Identification | The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required. |
| Method | The odour concentration measurements were performed using dynamic olfactometry according to the Australian Standard 'Determination of Odour Concentration by Dynamic Olfactometry AS/NZS4323.3:2001. The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report. |
| Measuring Range | The measuring range of the olfactometer is $2^2 \le \chi \le 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting $2^{17}$. This is specifically mentioned with the results. |
| Environment | The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained at 22 °C ±3 °C. |
| Measuring Dates | The date of each measurement is specified with the results. |
| Instrument Used | The olfactometer used during this testing session was: TOU-OLF-004 |
| Instrumental Precision | The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \le 0.477$ in accordance with the Australian Standard AS/NZS4323.3:2001. TOU-OLF-004: $r = 0.154$ (February 2019), Compliance – Yes |
| Instrumental Accuracy | The accuracy of this instrument for a sensory calibration must be $A \le 0.217$ in accordance with the Australian Standard AS/NZS4323.3:2001. TOU-OLF-004: $A = 0.189$ (February 2019) Compliance – Yes |
| Lower Detection Limit (LDL) | The LDL for the olfactometer has been determined to be 16 ou (4 times the lowest dilution setting) |
| Traceability | The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen. |

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Date: Monday, 26 August 2019

Panel Roster Number: SYD20190821_063

**S. Munro**
Authorised Signatory

## Odour Sample Measurement Results
## Panel Roster Number: SYD20190821_063

| Sample Location | TOU Sample ID | Sampling Date & Time | Analysis Date & Time | Panel Size | Valid ITEs | Sample Odour Concentration FINAL (ou) | Odour Emission Rate - Standard Conditions*1 ($ou.m^3/s$) | K-Factor*2 Geometric Mean of Shed |
|---|---|---|---|---|---|---|---|---|
| Farm 76, Shed 6 Sample 1 (day) | SC19444 | 20/08/2019 13:15 | 21/08/2019 09:55 | 4 | 8 | 181 | 11,000 | 0.8 |
| Farm 76, Shed 6 Sample 2 (day) | SC19445 | 20/08/2019 13:19 | 21/08/2019 10:20 | 4 | 8 | 235 | 14,000 | |
| Farm 76, Shed 7 Sample 1 (day) | SC19446 | 20/08/2019 13:29 | 21/08/2019 10:47 | 4 | 8 | 235 | 12,000 | 0.9 |
| Farm 76, Shed 7 Sample 2 (day) | SC19447 | 20/08/2019 13:34 | 21/08/2019 11:15 | 4 | 8 | 235 | 12,000 | |

*1 Odour emission rates calculated from the total airflow per shed
*2 K-Factor calculation table appended to this report

**Note:** Where parties other than The Odour Unit perform the dilution of samples, the result that has been modified by the dilution factor is not covered by The Odour Unit's NATA accreditation.

## Process, Sampling and Gas Flow Conditions
## Panel Roster Number: SYD20190821_063

| Sample location | TOU sample ID | Sampling position | Sampling plane dimensions (mm) | Gas velocity (m/s) | Volume flow rate – actual conditions ($m^3/s$) | Gas temp. ($^0C$) | Volume flow rate – standard conditions ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| Farm 76 Shed 6 Fan 9 | SC19444 SC19445 | **Upstream of disturbance:** <2D **Type:** Outlet **Downstream of Disturbance:** <6D **Type:** Fan Outlet **Traverse no.:** 2 **Point no.:** 12 **Compliance:** Non-compliant | ∅ 1,250 | 7.3 | 9.0 | 17.4 | 8.6 |
| Farm 76 Shed 7 Fan 9 | SC19446 SC19447 | **Upstream of disturbance:** <2D **Type:** Outlet **Downstream of Disturbance:** <6D **Type:** Fan Outlet **Traverse no.:** 2 **Point no.:** 12 **Compliance:** Non-compliant | ∅1,250 | 6.1 | 7.4 | 19.5 | 7.0 |

**Notes:**
1. **Sampling position: r**efers to location of in-duct gas velocity, temperature and static pressure sample points. Odour samples collected in-duct at ¼ diameter along a single traverse, or equivalent.
2. NATA accreditation does not cover the performance of these services;
   a. Selection of sampling positions by the methods of AS 4323.1,
   b. Measurement and calculation of volume flow rate by the methods of ISO 10780.
   c. K-Factor calculation
3. **Sampling conditions:** Daily Weather Observations for the nearest Bureau of Meteorology station are attached to this report or made available on request.

## Odour Panel Calibration Results

| Reference Odorant | Reference Odorant Panel Roster Number | Concentration of Reference gas (ppb) | Panel Target Range for n-butanol (ppb) | Measured Concentration (ou) | Measured Panel Threshold (ppb) | Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No) |
|---|---|---|---|---|---|---|
| n-butanol | SYD20190821_063 | 51,400 | $20 \le \chi \le 80$ | 724 | 71 | Yes |

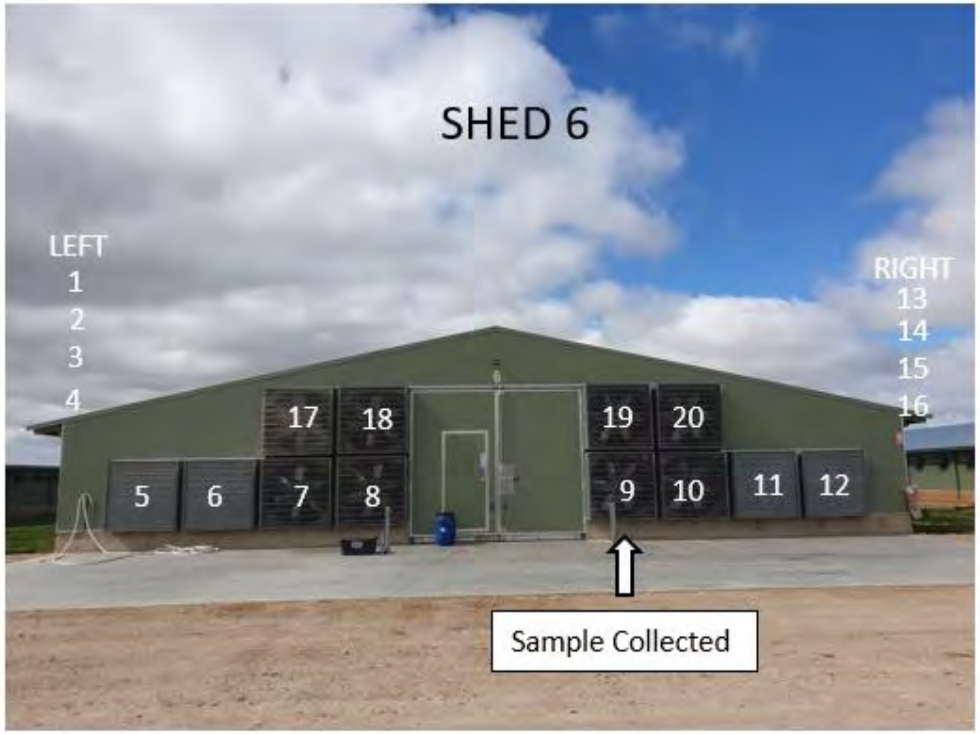
Comments
Air flow measurements, as reported on page 3, are for the fan from which the samples were collected.
A table of airflow measurements from all fans is appended to this report.
Total of 24 fans, 20 tunnel fans, 2 side fans and 2 rear fans.
8 tunnel fans in operation (Tunnel). Same for Shed 6 and Shed 7.

| Location | Live bird numbers | Live bird age | Live bird weight |
|---|---|---|---|
| Farm 76, Shed 6 | 46,938 | 28 days | 1.70 |
| Farm 76, Shed 7 | 46,564 | 28 days | 1.68 |

Disclaimer
Parties, other than TOU, responsible for collecting odour samples hereby certify that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Ltd for the purpose of odour testing. The collection of odour samples by parties other than The Odour Unit Pty Ltd relinquishes The Odour Unit Pty Ltd from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.

Note


**END OF DOCUMENT**



SHED 6
LEFT
1
2
3
4
RIGHT
13
14
15
16
17
18
19
20
5
6
7
8
9
10
11
12
Sample Collected


SHED 7
Sample Collected

| K Factor Calculation Table - ProTen, Narrandera | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Location** | **OER ($ou.m^3/s$)** | **Shed floor area ($m^2$)** | **Bird number** | **Bird weight (kg)** | **Bird density ($kg/m^2$)** | **Ventilation rate - STP ($m^3/s$)** | **K-factor** |
| Farm 76 - Shed 6 Sample 1 | 11,072 | 2,720 | 46,938 | 1.70 | 29.3 | 61.2 | 0.7 |
| Farm 76 - Shed 6 Sample 2 | 14,375 | 2,720 | 46,938 | 1.70 | 29.3 | 61.2 | 0.9 |
| **Farm 76 - Shed 6 Geometric Mean** | **12,616** | **2,720** | 46,938 | 1.70 | **29.3** | 61.2 | **0.8** |
| Farm 76 - Shed 7 Sample 1 | 11,979 | 2,720 | 46,564 | 1.68 | 28.8 | 51.0 | 0.9 |
| Farm 76 - Shed 7 Sample 2 | 11,979 | 2,720 | 46,564 | 1.68 | 28.8 | 51.0 | 0.9 |
| **Farm 76 - Shed 7 Geometric Mean** | **11,979** | **2,720** | 46,564 | 1.68 | **28.8** | 51.0 | **0.9** |

# ODOUR EMISSION RATE CALCULATION TABLE

**Client:** *Astute Environemental Consulting*
**Client Contact:** *Geordie Galvin*
**Site Location:** *ProTen, Narrandera*

| SAMPLE LOCATION | TOU SAMPLE NUMBER | SAMPLING DATE | TIME OF DAY | ODOUR CONCENTRATION (ou) | CIRCULAR DUCT DIAMETER (mm) | CROSS SECTIONAL AREA ($m^2$) | SOURCE GAS VELOCITY (m/s) | SOURCE GAS VOLUMETRIC FLOW RATE ($m^3/s$) | DUCT TEMPERATURE ($^oC$) | ATMOSPHERIC PRESSURE (hPa) | VOLUMETRIC FLOW RATE TO STD. CONDITIONS ($m^3/s$) | ODOUR EMISSION RATE TO STD. CONDITIONS ($ou.m^3/s$) RAW | ODOUR EMISSION RATE TO STD. CONDITIONS ($ou.m^3/s$) 2 SIG. FIG. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Farm 76 Shed 6 Sample 1 Fan 7 | SC19144 | 20/08/19 | 13:15 | 181 | 1250 | 1.227 | 8.0 | 9.83 | 18.3 | 1025.0 | 9.32 | 1687.165091 | **1700** |
| Farm 76 Shed 6 Sample 1 Fan 8 | | | | 181 | 1250 | 1.227 | 6.7 | 8.16 | 17.3 | 1025.0 | 7.77 | 1405.530126 | **1400** |
| Farm 76 Shed 6 Sample 1 Fan 9 | | | | 181 | 1250 | 1.227 | 7.3 | 9.01 | 17.4 | 1025.0 | 8.57 | 1550.83287 | **1600** |
| Farm 76 Shed 6 Sample 1 Fan 10 | | | | 181 | 1250 | 1.227 | 6.7 | 8.19 | 17.4 | 1025.0 | 7.79 | 1409.271831 | **1400** |
| Farm 76 Shed 6 Sample 1 Fan 17 | | | | 181 | 1250 | 1.227 | 7.0 | 8.60 | 17.6 | 1025.0 | 8.18 | 1480.089431 | **1500** |
| Farm 76 Shed 6 Sample 1 Fan 18 | | | | 181 | 1250 | 1.227 | 4.5 | 5.56 | 17.7 | 1025.0 | 5.28 | 956.1339067 | **960** |
| Farm 76 Shed 6 Sample 1 Fan 19 | | | | 181 | 1250 | 1.227 | 7.2 | 8.88 | 18.8 | 1025.0 | 8.41 | 1522.365131 | **1500** |
| Farm 76 Shed 6 Sample 1 Fan 20 | | | | 181 | 1250 | 1.227 | 5.0 | 6.19 | 18.6 | 1025.0 | 5.86 | 1060.494856 | **1100** |
| Total all fans | | | | 181 | | | | | | | 61.17 | 11071.88324 | **11000** |
| | | | | | | | | | | | | | |
| Farm 76 Shed 6 Sample 2 Fan 7 | SC19145 | 20/08/19 | 13:19 | 235 | 1250 | 1.227 | 8.0 | 9.83 | 18.3 | 1025.0 | 9.32 | 2190.518212 | **2200** |
| Farm 76 Shed 6 Sample 2 Fan 8 | | | | 235 | 1250 | 1.227 | 6.7 | 8.16 | 17.3 | 1025.0 | 7.77 | 1824.859556 | **1800** |
| Farm 76 Shed 6 Sample 2 Fan 9 | | | | 235 | 1250 | 1.227 | 7.3 | 9.01 | 17.4 | 1025.0 | 8.57 | 2013.512289 | **2000** |
| Farm 76 Shed 6 Sample 2 Fan 10 | | | | 235 | 1250 | 1.227 | 6.7 | 8.19 | 17.4 | 1025.0 | 7.79 | 1829.717571 | **1800** |
| Farm 76 Shed 6 Sample 2 Fan 17 | | | | 235 | 1250 | 1.227 | 7.0 | 8.60 | 17.6 | 1025.0 | 8.18 | 1921.663073 | **1900** |
| Farm 76 Shed 6 Sample 2 Fan 18 | | | | 235 | 1250 | 1.227 | 4.5 | 5.56 | 17.7 | 1025.0 | 5.28 | 1241.389326 | **1200** |
| Farm 76 Shed 6 Sample 2 Fan 19 | | | | 235 | 1250 | 1.227 | 7.2 | 8.88 | 18.8 | 1025.0 | 8.41 | 1976.551413 | **2000** |
| Farm 76 Shed 6 Sample 2 Fan 20 | | | | 235 | 1250 | 1.227 | 5.0 | 6.19 | 18.6 | 1025.0 | 5.86 | 1376.885586 | **1400** |
| Total all fans | | | | 235 | | | | | | | 61.17 | 14375.09703 | **14000** |
| | | | | | | | | | | | | | |
| Farm 76 Shed 7 Sample 1 Fan 7 | SC19446 | 20/08/19 | 13:29 | 235 | 1250 | 1.227 | 6.6 | 8.05 | 18.1 | 1025.0 | 7.64 | 1795.21501 | **1800** |
| Farm 76 Shed 7 Sample 1 Fan 8 | | | | 235 | 1250 | 1.227 | 6.2 | 7.63 | 19.1 | 1025.0 | 7.22 | 1696.342974 | **1700** |
| Farm 76 Shed 7 Sample 1 Fan 9 | | | | 235 | 1250 | 1.227 | 6.1 | 7.44 | 19.5 | 1025.0 | 7.02 | 1650.44703 | **1700** |
| Farm 76 Shed 7 Sample 1 Fan 10 | | | | 235 | 1250 | 1.227 | 4.6 | 5.63 | 19.4 | 1025.0 | 5.32 | 1250.518595 | **1300** |
| Farm 76 Shed 7 Sample 1 Fan 17 | | | | 235 | 1250 | 1.227 | 5.2 | 6.36 | 21.1 | 1025.0 | 5.97 | 1403.103061 | **1400** |
| Farm 76 Shed 7 Sample 1 Fan 18 | | | | 235 | 1250 | 1.227 | 3.8 | 4.61 | 20.7 | 1025.0 | 4.34 | 1019.855718 | **1000** |
| Farm 76 Shed 7 Sample 1 Fan 19 | | | | 235 | 1250 | 1.227 | 6.8 | 8.37 | 20.6 | 1025.0 | 7.87 | 1850.474736 | **1900** |
| Farm 76 Shed 7 Sample 1 Fan 20 | | | | 235 | 1250 | 1.227 | 4.8 | 5.92 | 19.5 | 1025.0 | 5.59 | 1312.731796 | **1300** |
| Total all fans | | | | 235 | | | | | | | 50.97 | 11978.68892 | **12000** |
| | | | | | | | | | | | | | |
| Farm 76 Shed 7 Sample 2 Fan 7 | SC19447 | 20/08/19 | 13:34 | 235 | 1250 | 1.227 | 6.6 | 8.05 | 18.1 | 1025.0 | 7.64 | 1795.21501 | **1800** |
| Farm 76 Shed 7 Sample 2 Fan 8 | | | | 235 | 1250 | 1.227 | 6.2 | 7.63 | 19.1 | 1025.0 | 7.22 | 1696.342974 | **1700** |
| Farm 76 Shed 7 Sample 2 Fan 9 | | | | 235 | 1250 | 1.227 | 6.1 | 7.44 | 19.5 | 1025.0 | 7.02 | 1650.44703 | **1700** |
| Farm 76 Shed 7 Sample 2 Fan 10 | | | | 235 | 1250 | 1.227 | 4.6 | 5.63 | 19.4 | 1025.0 | 5.32 | 1250.518595 | **1300** |
| Farm 76 Shed 7 Sample 2 Fan 17 | | | | 235 | 1250 | 1.227 | 5.2 | 6.36 | 21.1 | 1025.0 | 5.97 | 1403.103061 | **1400** |
| Farm 76 Shed 7 Sample 2 Fan 18 | | | | 235 | 1250 | 1.227 | 3.8 | 4.61 | 20.7 | 1025.0 | 4.34 | 1019.855718 | **1000** |
| Farm 76 Shed 7 Sample 2 Fan 19 | | | | 235 | 1250 | 1.227 | 6.8 | 8.37 | 20.6 | 1025.0 | 7.87 | 1850.474736 | **1900** |
| Farm 76 Shed 7 Sample 2 Fan 20 | | | | 235 | 1250 | 1.227 | 4.8 | 5.92 | 19.5 | 1025.0 | 5.59 | 1312.731796 | **1300** |
| Total all fans | | | | 235 | | | | | | 1025.0 | 50.97 | 11978.68892 | **12000** |


Astute Environmental Consulting - ProTen, Narrandera. Farm 76, Shed 6, Sample 1
Odour Intensity Chart
Intensity Scale
0
1
2
3
4
5
6
1
10
100
Odour Units (ou) Above Threshold

Astute Environmental Consulting - ProTen, Narrandera.  Farm 76, Shed 6, Sample 2
Odour Intensity Chart
Intensity Scale
0
1
2
3
4
5
6
1
10
100
Odour Units (ou) Above Threshold


Astute Environmental Consulting - ProTen, Narrandera. Farm 76, Shed 7, Sample 1
Odour Intensity Chart
Intensity Scale
0
1
2
3
4
5
6
1
10
100
Odour Units (ou) Above Threshold

Astute Environmental Consulting - ProTen, Narrandera.  Farm 76, Shed 7, Sample 2
Odour Intensity Chart
Intensity Scale
6
5
4
3
2
1
0
1
10
100
Odour Units (ou) Above Threshold