AgDSA

Revised S-Factor Assessment – Susco Piggery

Cefn Pty Ltd

28 May 2026

1 INTRODUCTION

Cefn Pty Ltd is proposing the expansion of the 11,500 standard pig unit (SPU) Susco Piggery to a maximum capacity of 24,500 SPU. The proposed expansion will incorporate a new covered anaerobic pond and the continued use of the existing effluent system as secondary and wet-weather ponds. A development application has been lodged to Toowoomba Regional Council (TRC) and referred to the State Assessment and Referral Agency (SARA).

TRC and SARA have issued separate information requests, both asking for more information on the odour assessment provided in the Development Assessment (DA) Report. This document has been prepared to address both requests. However, following discussions with the Department of Primary Industries (DPI), there have been changes to the assumptions in the S-Factor assessment, which have materially changed the outcome. There has been no change to the proposed capacity or covered anaerobic pond. The assessment also considered all nearby dwellings as sensitive receptors, regardless of their legal status.

To further support the proposed development, it is noted that the existing piggery has no history of odour complaints, and the proposed development is expected to emit less odour than the existing piggery.

2 SENSITIVE RECEPTORS

The nearest sensitive receptors surrounding the piggery site have been identified in Table 1, Figure 1, and Figure 2. The key receptors are R7 and R8 due to their separation distances and wind direction. R3 includes multiple dwellings with only the nearest one identified. However, this property is owned by Cefn. There are also various dwellings beyond R7. As they are further from the piggery in the same direction as R7, compliance with R7 ensures compliance with all receptors beyond it.

The building on Lots 2 and 3 RP162693 do not have any relevant building or planning approvals and are within the 1 km reverse amenity protection area under the TRC planning scheme. Historic imagery from 1988 (Figure 3), available from Q Imagery, shows that when the piggery was constructed, these buildings did not exist. While this protection does not guarantee that dwelling approval cannot be obtained, it is not supported by the planning scheme. The lack of support within the planning scheme is discussed below.

One of the purposes of the rural zone code is:

> *the viability of both existing and **future** rural uses and activities is protected from the intrusion of incompatible uses.*

Performance Outcome PO7 and Acceptable Outcome AO7.1 of the rural zone code further detail the protections provided for existing intensive animal industry uses. Compliance with AO7.1 requires dwellings to be located at least 1,000 m from an existing intensive animal industry. PO7 requires that a dwelling must not "compromise the continued operation of an existing or approved intensive animal industry". Any dwelling that does not comply with AO7.1 does not have as-of-right use and requires code-assessable planning approval. Until such time as a dwelling has obtained this approval, it has not met the legal requirements of the *Planning Act 2016*.

While a development application for a dwelling could be made for the nearby buildings, the rural zone code does not support approval. As such, there is no clear path to becoming legal dwellings. Under the *Guideline: Odour Impact Assessment from Developments*, the definition of a sensitive receptor includes a dwelling and "any place known or likely to become a sensitive place in the future". Approval could not be considered as 'likely' given the planning scheme does not support it.

The *National Environmental Guidelines for Indoor Piggeries* (NEGIP) only considers towns, rural residential areas, and legal houses as sensitive receptors. It also notes the need for legal houses to either have as-of-right use or building approvals to be considered a legal house. As per the above discussion, these buildings do not have as-of-right use, and a property search did not return any building approvals for dwellings on these properties. As such, they are not considered legal dwellings under the description in the NEGIP.

However, at the request of TRC, they have been considered in this revised assessment.

Table 1 – Sensitive Receptors

Receptor	Lot/Plan	Direction	Distance (m)
R1	23/SP206518	NNW	2,300
R2	47/N25528	NE	2,345
R3*	11/RP892911	ENE	1,740
R4	31/M341017	E	1,630
R5	111/M341017	SSW	1,200
R6	7/M341014	SW	990
R7	27/RP159844	W	1,360
R8	2/RP162693	SW	505
R9	3/RP162693	SW	780

*These receptors are owned by CEFN.

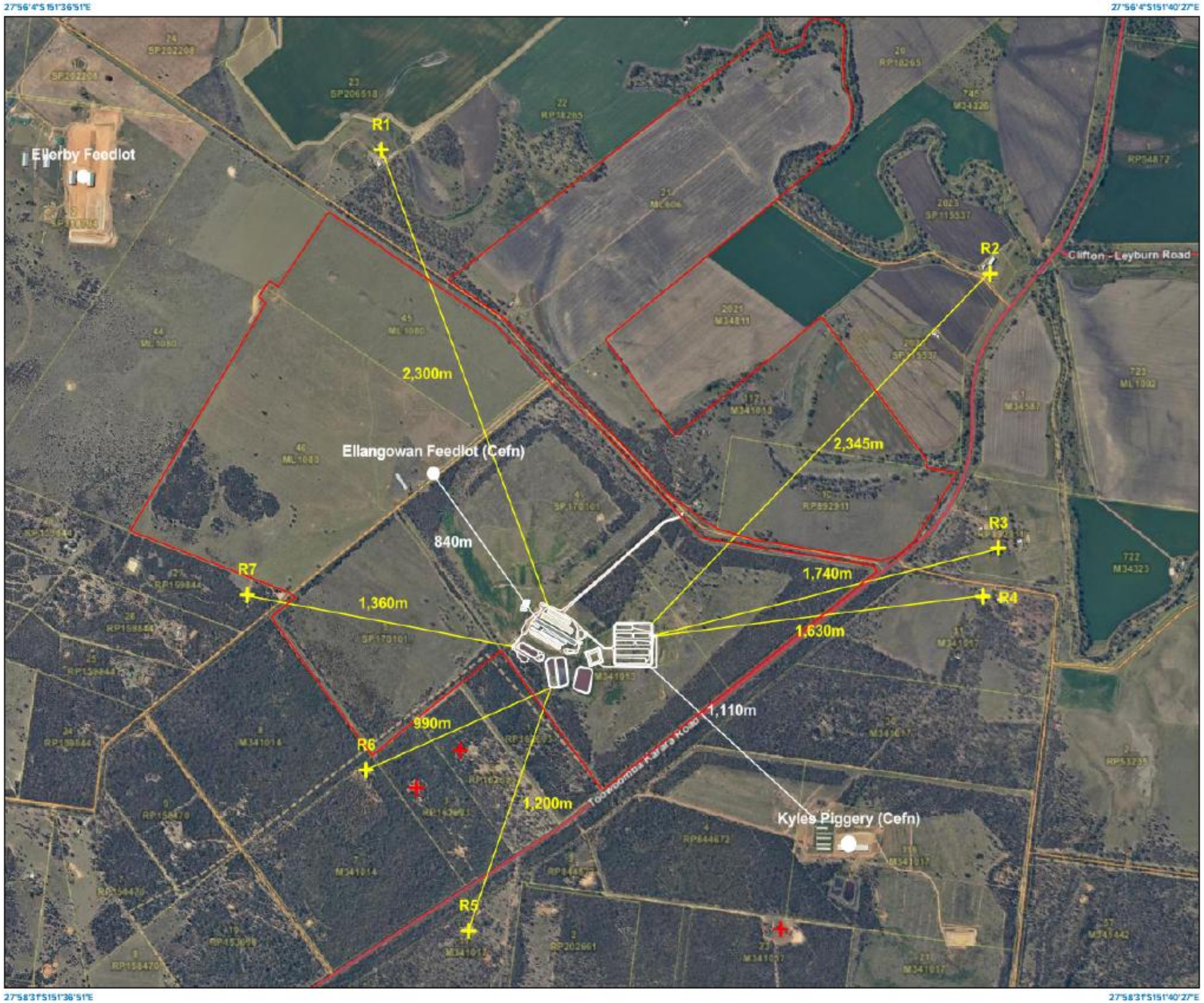

Figure 1 – Sensitive Receptors and Land Use (Source: DA Report)

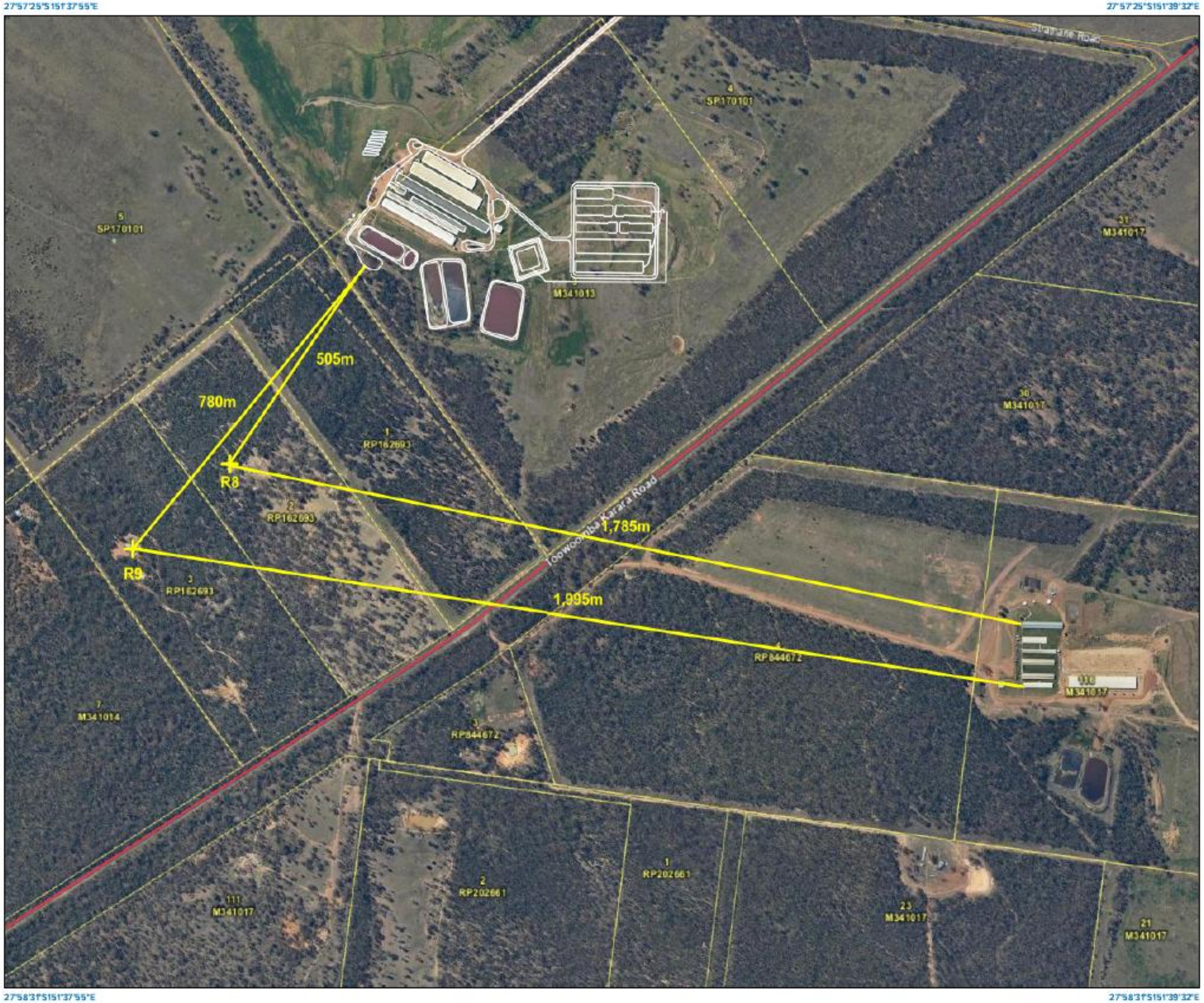

Figure 2 – Sensitive Receptors (R8 and R9)

Figure 3 – Historic imagery from 1988 (Source: Q Imagery)

3 PIGGERY ODOUR

Odour emissions from piggeries occur from the following key locations, which are considered to be part of the 'piggery complex':

- Buildings where pigs are housed and ancillary areas where they are loaded/unloaded;
- Sumps, ponds and other storages containing liquid effluent; and
- Areas where organic solids or manure are handled, treated, or stockpiled.

While the NEGIP includes feedmills and feed storage areas in the piggery complex, depending on the milling process, this infrastructure does not generate substantial odour. In the context of Susco, there is only the storage of feed in silos, which does not produce odour. Feedmills are considered part of the piggery complex as they can be sources of dust and noise.

While areas for the reuse of effluent and manure can generate intermittent odour, these areas are not considered part of the piggery complex. The reason for this is that odour from these sources can be limited through management of effluent irrigation and manure spreading.

According to the NEGIP, of all the odour sources at a piggery, two contribute the majority of odour. The pond system contributes approximately 75 % of piggery odour and sheds contribute 25 %. This is based on historic odour research undertaken by Australian Pork Limited (APL), with the Queensland DPI a key contributor to historic piggery odour research. Of the pond odour contribution, the primary pond contributes approximately 90 %, equating to 67.5 % of overall piggery odour. As such, odour reduction strategies targeted at reducing or eliminating odour from the primary pond are most effective.

The simplest way to eliminate odour from the primary pond is to cover it with an impermeable pond cover, capture the gas, and flare it to destroy the methane and associated odour. This also provides benefits for the reduction of carbon emissions from the piggery. A covered anaerobic pond has been implemented at the Strathane Piggery, west of the Susco Piggery. The odour reduction from covering ponds is integrated into the S-Factor methodology to determine the appropriate separation from the piggery to the nearest sensitive receptors.

4 S-FACTOR ASSESSMENT

The S-Factor method is an industry-developed method to determine the appropriate separation distances from the piggery complex to the nearest sensitive receptors. It is described in the NEGIP and incorporated into the DPI Piggery Assessment Spreadsheet. It is endorsed by the DPI as an appropriate method of minimising the potential for odour impacts from new or expanding piggeries. This method has been accepted for previous piggery development applications in the TRC region. Other intensive livestock industries, such as feedlots and poultry farms, also have an industry-specific S-Factor calculation.

The S-Factor method considers the following aspects of the piggery and surrounding landscape to determine the appropriate separation distance:

- Piggery size, defined as the number of SPU in the complex;

- Piggery design, particularly the shed type and the effluent or manure removal and management processes used at the piggery; and
- Piggery siting:
    - Receptor type and location (e.g. town, rural residential, legal house)
    - Topography between the piggery and the receptor
    - Vegetation/surface roughness between the piggery complex and the receptor
    - Terrain effects around the site, particularly the effects of terrain features on meteorology of the area
    - Wind speed and direction (Level 1.5 only).

The S-Factor can be used for individual piggeries but can also consider the cumulative impacts of other nearby piggeries or other intensive livestock activities (e.g. feedlots). There are two ways to consider the cumulative impact.

If two facilities are in close proximity to each other, they can be considered as one activity and their required distances added. The piggeries have to be less than half the minimum required separation distance to be considered under this cumulative method. In the case of the Susco Piggery, the Ellangowan Feedlot and Kyles Piggery are not close enough to be considered under this cumulative method.

The second cumulative method, which is relevant to this application, is to apply a 120 % factor to the required separation distances for each piggery or feedlot (Figure 4). If the 120 % distance from both activities overlaps a sensitive receptor, then the assessment fails at that receptor. However, if a receptor is within the 120 % buffer of one site and not the other, then the assessment passes.

While discussed in more detail below, this second outcome is what occurs at two receptors. As such, the piggery expansion passes the S-Factor assessment.

Figure A.5 Two facilities within 120% of the shortest individual separation distance

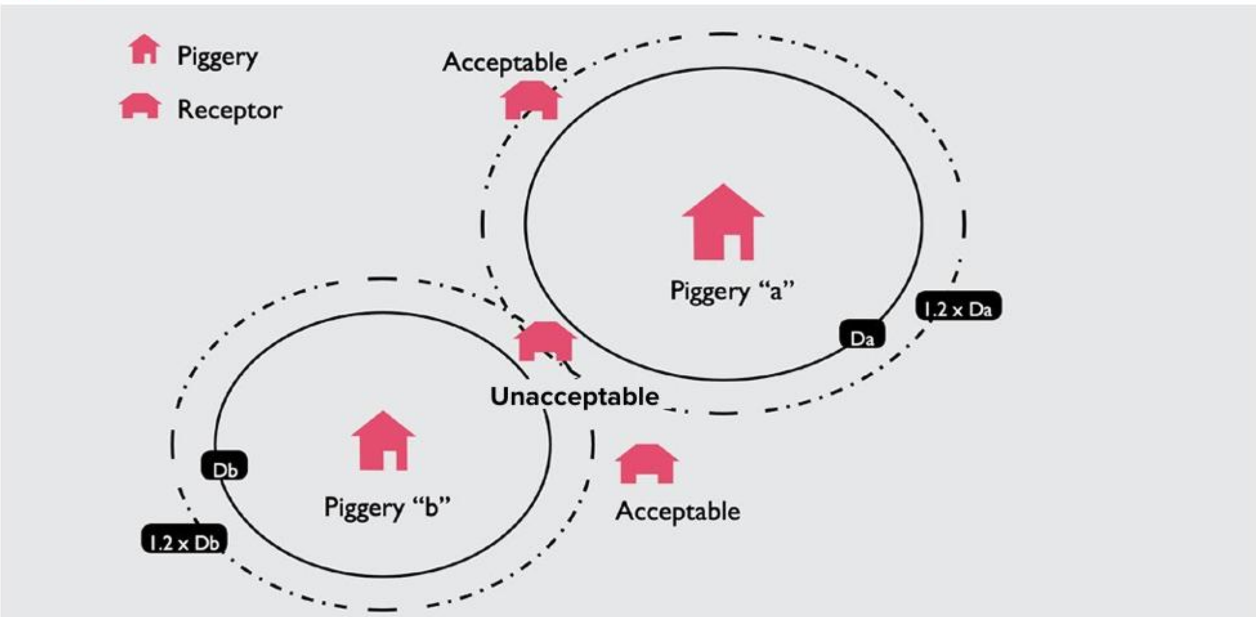

Figure 4 – 120 % cumulative S-Factor Assessment

4.1 SUSCO ASSESSMENT

A Level 1.5 S-Factor assessment has been completed to show compliance with the NEGIP (Table 2). The assessment was competed for both the existing piggery and the proposed piggery to show the reduction in odour impact that will occur with the incorporation of a covered anaerobic pond as part of the expansion.

The assessment of the existing piggery shows that there is a potential for odour impacts to occur to the nearest sensitive receptors. However, the existing piggery has been operating since the 1980s and has not received complaints from the key receptors in close proximity. The buildings in close proximity were constructed after the original piggery. The S-Factor assessment for the existing piggery has been undertaken to show the reduction in required separation distance that has occurred with the expansion and covering of the pond. The reduction of separation distances is correlated to the reduction in potential odour impacts. R7 and R8 fail using existing assumptions but pass with the proposed expansion.

Using 'The Air Pollution Model' (TAPM) and data from the Strathane weather station, S4 values have been generated for the site by Astute Environmental Consulting (Appendix A).

Table 2 – S-Factor Assessment (Susco)

Receptor	Lot/Plan	Direction	Available (m)	Required (m) Existing	Required (m) Proposed	Cumulative (120 %)
R1	23/SP206518	NNW	2,300	874	662	794
R2	47/N25528	NE	2,365	1,228	931	1,117
R3*	11/RP892911	ENE	1,740	978	741	889
R4	31/M341017	E	1,630	914	693	832
R5	111/M341017	SSW	1,200	380	288	346
R6	7/M341014	SW	920	620	470	805
R7	27/RP159844	W	1,360	1,772	1,342	1,610
R8	2/RP162693	SW	505	620	470	564
R9	3/RP162693	SW	780	620	470	564

Legend

- Complies
- Does not comply with cumulative (120 %) impact (Refer to Table 3 and/or Table 4)
- Does not comply

Assumptions:

- $S1_T$ – Effluent and manure management
  - 1.0 – Uncovered pond with no pre-treatment (existing)
  - 0.5 – Covered anaerobic pond (proposed)
- $S2_S$ – Surface roughness (vegetation)
  - 1.0 – Crops (R1 & R2)
  - 0.9 – Open Grassland (R3, R4 & R7)
  - 0.6 – Open Forest (R5, R6, R8 & R9)
- S3 – Terrain
  - 1.2 – Gently sloping (1-2 %) with receptor downslope (R1-R4)
  - 1.0 – Flat – R7 (Figure 5)

- 0.7 – Sloping (>2 %) with receptor upslope (R5, R6, R8 & R9)
- S4 – As per Appendix A

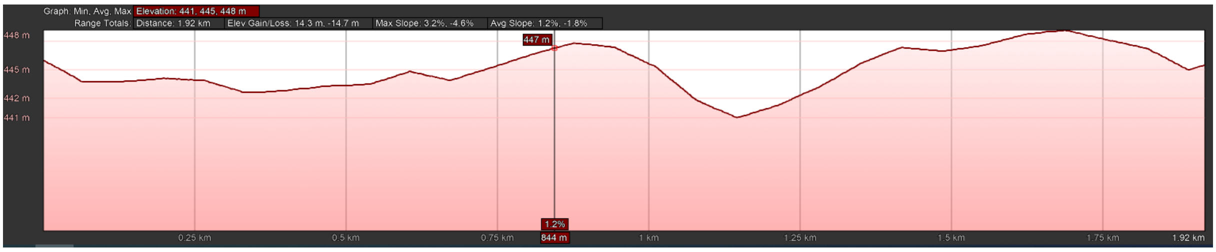

Figure 5 – Elevation profile between the piggery and R7 (Source: Google Earth)

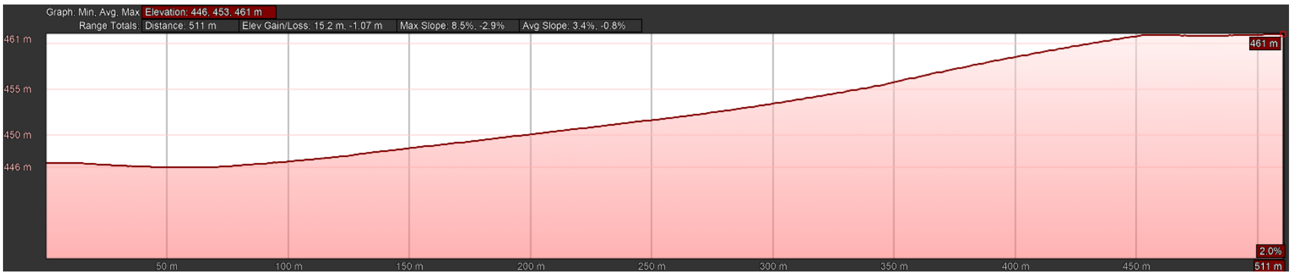

Figure 6 – Elevation profile between the piggery and R8 (Source: Google Earth)

4.2 CUMULATIVE ASSESSMENT

The region has several intensive animal industry activities including two other Cefn piggeries (Kyles and Strathane), the 5,000 standard cattle unit (SCU) Ellerby feedlot, and the Cefn-owned, 1,000 SCU Ellangowan Feedlot. As the distances between the piggery and all other nearby intensive livestock activities are greater than half the minimum required distance for the Susco Piggery, a cumulative factor (120 %) was applied. R7 and R8 were within this 120 % distance of the Susco Piggery and, as such, a cumulative S-Factor assessment was completed for the Ellangowan Feedlot and Kyles Piggery. All other Susco receptors were beyond their respective 120 % separation distance and, therefore, compliant with the cumulative assessment.

4.2.1 KYLES PIGGERY

The Kyles Piggery was recently approved for an expansion to 13,800 SPU and the approved manure and effluent management did not include any pre-treatment or covered anaerobic pond. The outcome of the S-Factor assessment used in that application is provided for R8 in Table 3.

Table 3 – S-Factor Assessment (Kyles)

Receptor	Lot/Plan	Direction	Available (m)	Required (m)	Cumulative (120 %)
R8	2/RP162693	W	1,785	913	1,096

Legend

(green)	Complies
(yellow)	Does not comply with cumulative (120 %) impact
(orange)	Does not comply

Assumptions:

- $S2_S$ – 0.6 – Open forest
- S3 – 0.7 – Sloping (>2%) with the receptor upslope (Figure 5)
- S4 – 1.0 as per Appendix A

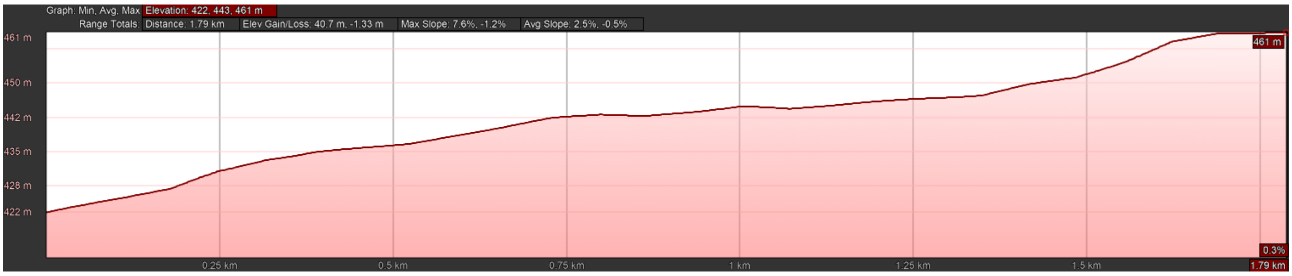

Figure 7 – Elevation profile between the Kyles piggery and R8 (Source: Google Earth)

4.2.2 ELLANGOWAN FEEDLOT

The Ellangowan Feedlot is owned by Cefn and has an approved capacity of 1,000 SCU. However, it is infrequently used for cattle grazed across the broader Cefn-owned properties in the region. The key receptor for this cumulative assessment is R7. As it is compliant with the 120 % distance from the Ellangowan Feedlot, it is also compliant with the cumulative assessment for the Susco Piggery.

Table 4 –S-Factor Calculation (Ellangowan)

Receptor	Lot/Plan	Direction	S1	S2	S3	S4	S5	Separation Distances		
								Required	Cumulative (120 %)	Available
R7	27/RP159844	WSW	52	0.3	1.0	1.0	1.0	745	894	975

- S1 – When full, the feedlot would have a stocking density of 15 m^2/SCU and average rainfall for the area is less than 750 mm/year
- S2 – 0.3 - Single rural dwelling
- S3 – R7 is uphill from the feedlot but, for a conservative assessment, the ‘flat’ terrain factor was used
- S4 – To ensure a conservative assessment, the crops only vegetation factor was used
- S5 – The meteorological data in Appendix A does not indicate the potential for high frequency wind towards the receptor

APPENDIX A – METEOROLOGICAL DATA

Memorandum

To:	Benn Hall			
From:	Geordie Galvin			
Re:	TAPM vs Observed data at Strathane			
Document Control				
Version	**Date**	**Author**	**Reviewer**	**Comments**
M1-1	20/07/21	G. Galvin	W. Shillito	Initial

1 INTRODUCTION

As part of calculations for the "Kyles" piggery, CEFN require data to enable them to calculate a S4 (wind) factor for use in calculating separation distances.

We previously provided CEFN with a S4 factor, including a 20% safety factor based on TAPM/CALMET wind data. The S4 factor was calculated based on the method detailed in the *National Environmental Guidelines for Indoor Piggeries (Third Edition)* (Tucker, 2018)[1].

This memo summarises the results of a comparison between observed data from the 10 metre weather station at the Strathane piggery and data generated by TAPM at the same location.

2 METHODOLOGY

2.1 Modelling

TAPM v4 (Hurley, 2008; Hurley, et al., 2008) was centred as close to the weather station location as practicable and run for the year 2020 with a weeks spin up. Grids of 30, 10, 3, 1 and 0.3 km were run with default TAPM terrain and landuse data which is consistent with the methodology detailed in DEC NSW (2006)

Once complete, hourly data was extracted at the grid point closest to the weather station location and the data was compared to the weather station data.

The hourly data is shown below as a wind rose in Figure 2-1.

[1] The "NEGIP"

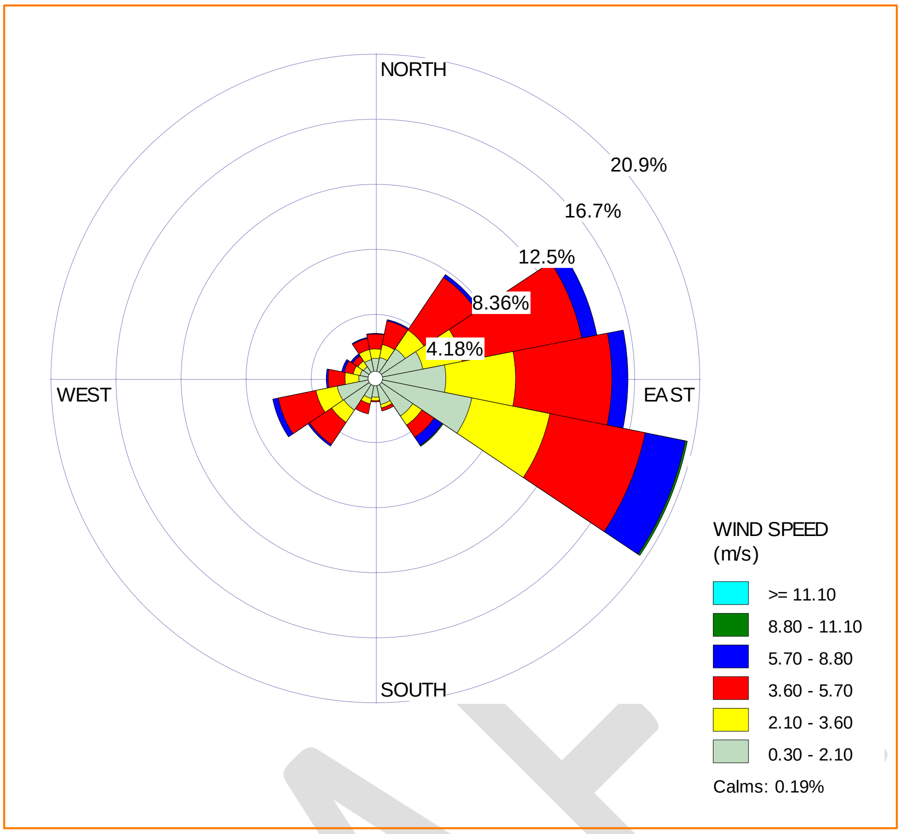

Figure 2-1: TAPM Windrose – Site - 2020

2.2 Observed Data

The on-site weather station uses a Vaisala WXT536 sensor package and reports 5-minute vector and scalar averaged wind speed, vector wind direction and average temperature (including other variables such as humidity, rainfall and barometric pressure, which are not reported here).

The five minute data was averaged to hourly values using the methodology detailed in USEPA (2000). There were only two missing hours for the year. These were consecutive hours and were filled with data from the preceding and following hour respectively.

The observed data is shown as a wind rose in Figure 2-2 below. It can be seen that compared to the TAPM data, the observed data is more easterly.

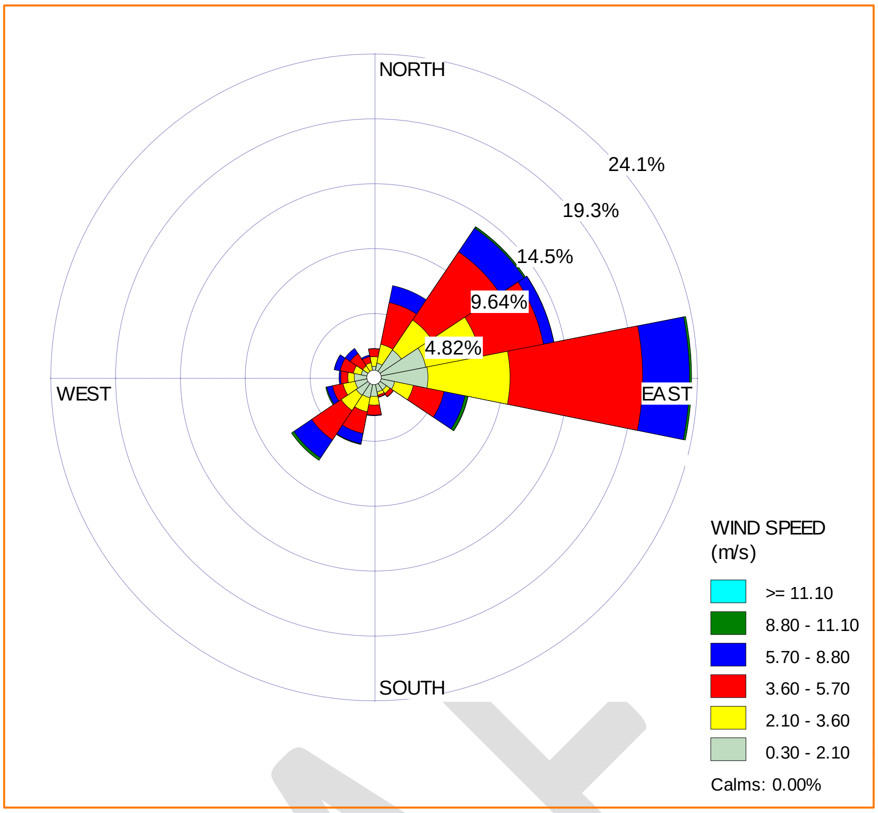

Figure 2-2: Weather Station Windrose – 2020

3 RESULTS

3.1 Data Comparison

The paired hourly data from the weather station and the model were analysed using the methodology detailed in Emery et al. (2001) with the exception that daily wind direction analysis was also performed in line with Johnson (2019) who recommended daily gross error checks for direction as opposed to hourly.

Table 3-1: Wind Speed Statistics

Variable	Calculated Value	Criteria	Meets Criteria?
Bias	-0.4	±0.5	Yes
RMSE	1.6	≤2	Yes
IO	0.8	≥0.6	Yes
SkillE	0.8	≤1	Yes
SkillR	0.7	≤1	Yes
SkillV	0.9	Close to 1	Yes

Table 3-2: Wind Direction Statistics

Variable	Calculated Value	Criteria	Meets Criteria?
Bias (hourly)	8.4	±10	Yes
Gross Error (hourly)	34	≤30[2]	No. See below.
Bias (daily)	9.7	±10	Yes
Gross Error (daily)	20	≤30	Yes

Table 3-2 shows that the hourly gross error was 34° as opposed to the criteria of <30°. As recommended by Johnson (2019) , we also performed daily checks, which showed as pass for gross error for wind direction.

When using the benchmarks above, 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 and direction, the relative accuracy of the dataset as a whole can be assessed.

Considering the results in Table 3-1 and Table 3-2, it is concluded that for dispersion modelling, the model TAPM v4 produces a dataset of a suitable quality for the area.

This is discussed with regard to the calculation of S4 factors in Section 3.2 below

3.2 S4 Factors

The S4 factor is used to modify calculated separation distances while having regard to prevailing winds.

A period of 12 months of meteorological data is analysed where all winds above 3 m/s are removed from the dataset. The frequency of winds blowing from a direction, towards a receptor are then calculated in line with the methodology in the NEGIP.

The calculated factors without the 20% safety factor recommended in the NEGIP and with the safety factor are shown below in Table 3-3 below.

[2] Kemball-Cook et. al. (2005) proposed a series of benchmarks for model performance under complex conditions including areas with variable terrain heights and land uses. Kemball-Cook et al. suggested a gross error benchmark of ≤55° for wind direction and a bias benchmark of ≤20° for areas with complex features. These benchmarks were subsequently adopted in USEPA (2015) and USEPA (2020). The American Meteorological Society (2012) defines complex terrain 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”.

Table 3-3: Calculated S4 Factors (Weather Station)

Direction	Without Factor	With 20% Factor
N	24%	44%
NNE	30%	50%
NE	32%	52%
ENE	26%	46%
E	23%	43%
ESE	18%	38%
SE	13%	33%
SSE	13%	33%
S	18%	38%
SSW	26%	46%
SW	55%	75%
WSW	84%	100%
W	100%	100%
WNW	33%	53%
NW	18%	38%
NNW	17%	37%

4 DISCUSSION

The results shown above indicate that TAPM and the observed data compared well. This is consistent with our experience on the Darling Downs. When modelling, as percentiles are used (i.e. ranked values) the differences between the two data sets, as demonstrated by the statistics wouldn't be considered significant.

However, it is important to note that the S4 factor doesn't compare the same data, as it only uses winds below 3 m/s. The bias value Table 3-1 above indicates that the modelled wind speeds were typically below (albeit by a small amount) the observed data for the same hour at roughly the same location (i.e. both at or near the weather station site). The wind speeds are compared in Figure 4-1 below which shows that the frequency of observed winds under 3 m/s is lower than modelled, as the observed dataset has more higher speed wind events.

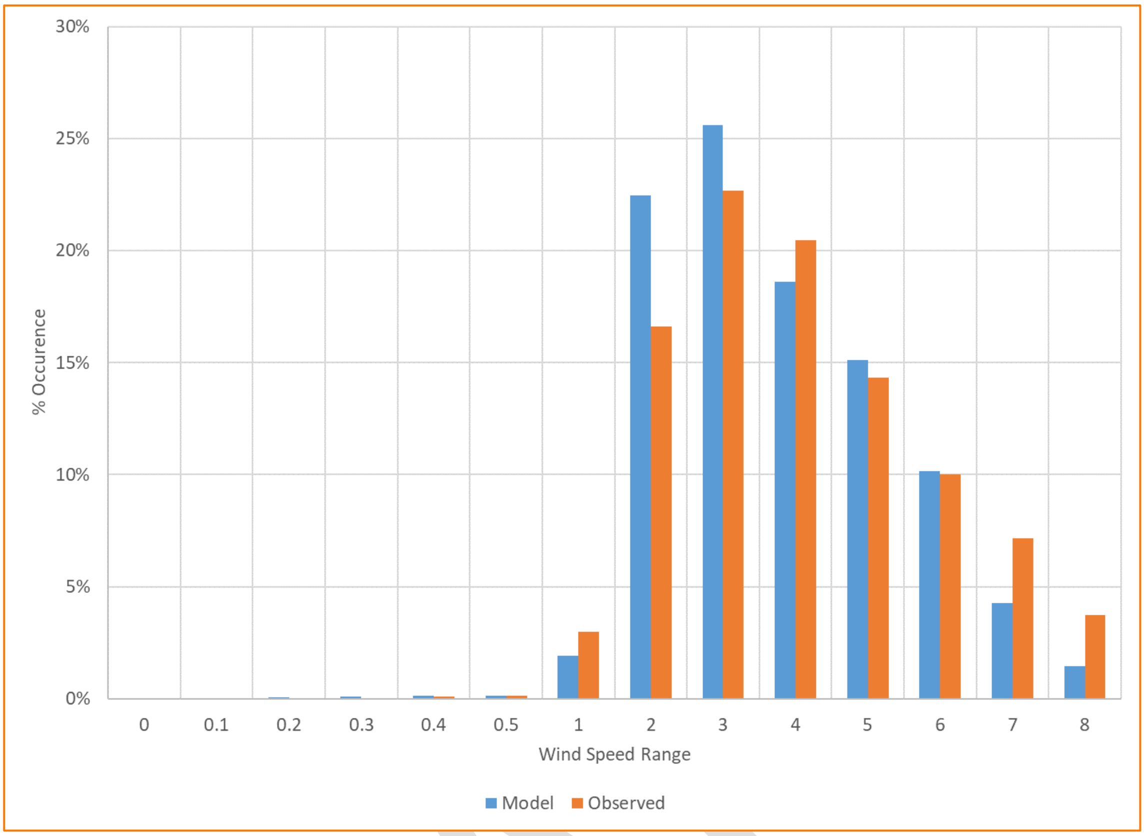

Figure 4-1: Modelled and Observed Wind Speeds

The difference in wind speeds, along with the subtle direction differences shown in Figure 2-1 and Figure 2-2 means that the S4 factors will be different. To analyse this, we plotted the factors using a spider plot (including the 20% safety factor) for the TAPM data and observed data at the weather station site. This is shown in Figure 4-2 below.

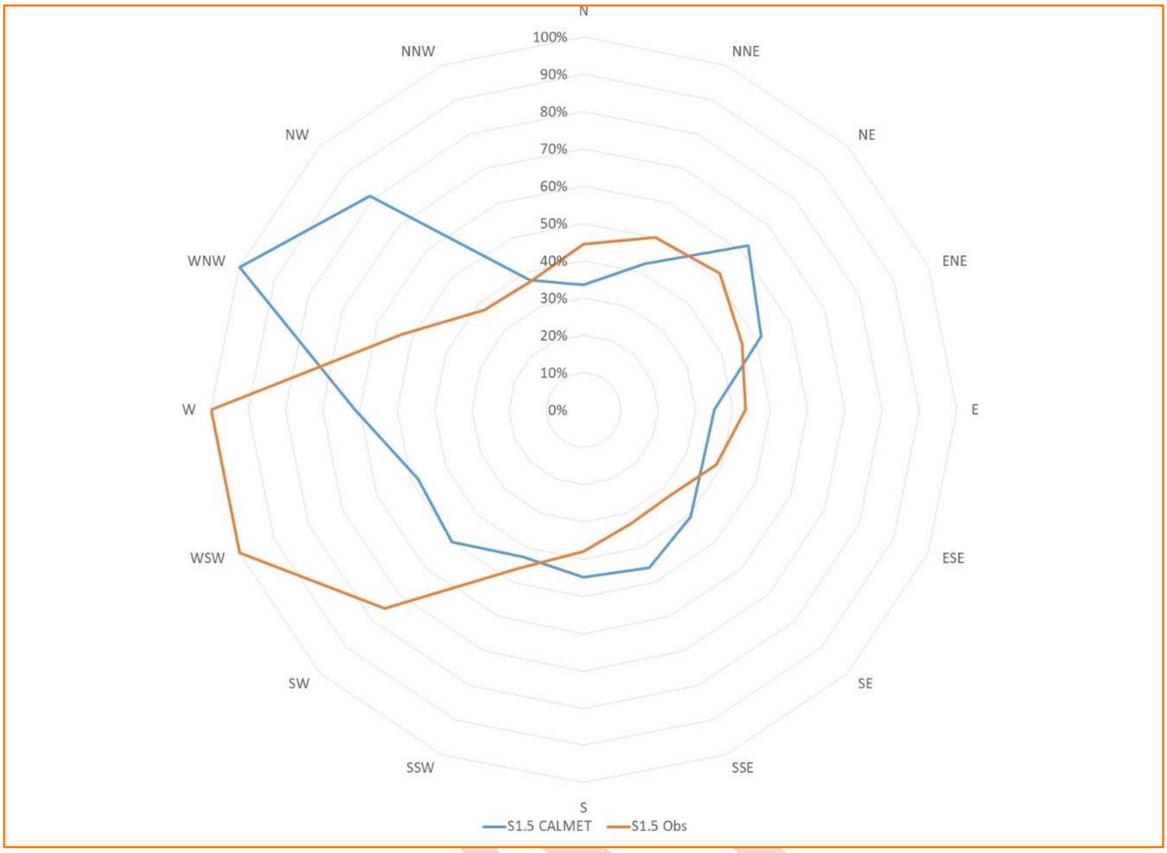

Figure 4-2: S4 Factors Weather Station (Orange) and TAPM (Blue) – 20% Factor

Figure 4-2 shows that the dominant wind direction (which is show by the maximum S4 value) is different in both datasets. Whilst there are slight differences to the north, east and south, there are quite significant differences to the west, in that the maximum buffer changes by around 12.5° - 25°. This is only significant if there are receptors in this area.

Whilst the weather station is located away from the Kyles site, it is recommended that both sets of S4 values be used for future calculations and the maximum distance in each direction used.

5 REFERENCES

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15 March 2022

CEFN Pty Ltd
C/- Matt Norton
Agdsa
PO Box 292
TOOWOOMBA QLD 4350

Dear Matt

Re: Information Request - Toowoomba-Karara Road – 31 January 2022

I refer to the information request relating to the proposed extension to the existing "Kyles" piggery located on Toowoomba-Karara Road at Leyburn.

This letter has been prepared to address the following information request:

- Discuss why higher wind speeds (>3 m/s) are not included in the S-Factor calculations;
- Discuss how often wind speeds >3 m/s occur and what odour impact this will have on each receptor;
- Perform S-Factor calculations for both observed data and CALMET data; and
- If S-Factor inputs cannot account for higher wind speed, then modelling of odour impacts will be required.

The winds used to generate the factors are sumamrised below in Figure 1 for all hours, and Figure 2 for hours where winds were below 3 m/s. In total 5,210 hours were below 3 m/s.

Our responses are provided below.

Astute Environmental Consulting

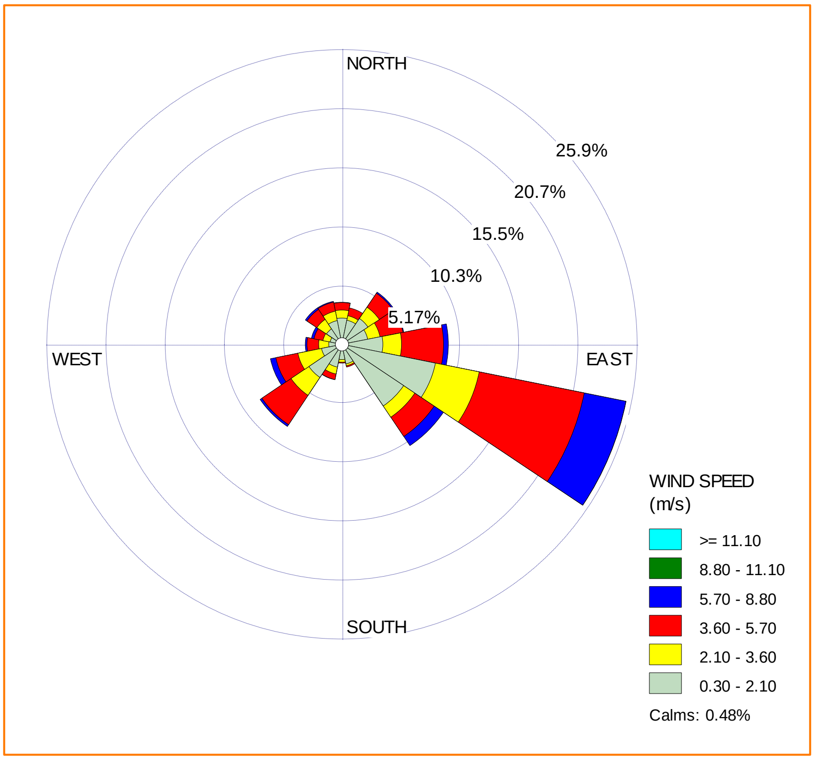

Figure 1: Wind Rose – All Hours

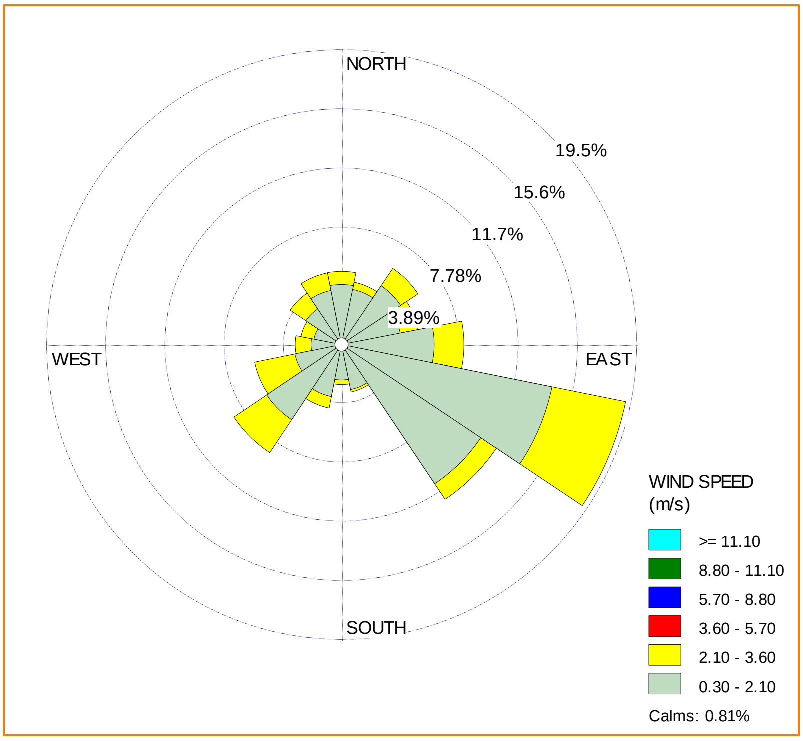

Figure 2: Wind Rose – Winds < 3m/s

Discuss why higher wind speeds (>3m/s) are not included in the S-Factor calculations

Typicaly odour assessments either make use of a S Factor (buffer equation) or dispersion modelling. Over time several reports have examined the original S Factor methodology of McGahan et al. (2000) as later published in documents including Nicholas & McGahan (2003). This method uses various factors that cover inputs including receptor type, terrain, landuse the number of pigs. The resultant output is a buffer in metres which varies in each direction subject to receptor type, terrain and landuse.

More recent work by Tonkin Consulting examined the use of the nasal ranger for assessing buffers, and also the buffers estimated based on modelling (see Tonkin Consulting (2008a)). A second report examined whether wind speed and direction data could be filtered to better adjust predicted buffers to account for dominant winds (See Tonkin Consulting (2008b)).

Concerning Tonkin Consulting (2008b), in simple terms, they examined if removing stronger winds from a dataset would produce a frequency of winds (as a S4 wind factor) that matched odour model contour shapes. Based on their work the wind frequency factor was adopted in in National Environmental Guidelines for Indoor Piggeries[1] (Third Edition) (Australian Pork Limited, 2018). In terms of limiting winds to 3 m/s, this finding was not surprising in that wind speed is directly linked to atmospheric stabiily, which defines how a plume will disperse. Moreover, the finding of Tonkin Consulting is consistent with the gaussian equation used in Ausplume whereby winds under 1 m/s lead to the biggest predictions as when the concentration is dividied by a wind speed less than 1 m/s, the predicted concentration rises.

This means that the fixed buffer method can be adjusted for dominant winds whereby the dominant wind direction remains at the maximum predicted buffer, and less frequent winds result in a lower buffer distance. It is recommended in the NEGIP that a 20% safety factor be included to account for errors in the wind dataset.

As such, winds greater than 3 m/s are not included when following the NEGIP.

Discuss how often wind speeds >3 m/s occur and what odour impact this will have on each receptor

Based on the CALMET output, wind speeds above 3 m/s occur 41% of the time. Looking at Figure 1 and Figure 2 above it can be seen that the general frequency of wind direction (as opposed to speed) is somewhat similar irrespective of wind speed.

Typically winds above 3 m/s during the day offer good dispersion, and at night lead to neutral conditions. Lighter winds (i.e. below 3 m/s) at night are those that typically lead to worst case predictions (based on SRDT stability methodology). Interestingly the average daytime wind speed is appxoraimtely 3.5 m/s and the average night time wind speed is approximately 2.5 m/s therefore the atmosphere, as expected, is typically more stable at night.

To examine this further, a spider plot was prepared where winds were palced in 22.5° brackets, i.e. 337.5-11.25, 11.2.5 to 33.75 and so on. This mimics the formatting of the windroses and enables a direct comparision. This is shown in Figure 3 below. It can be seen that the shapes are generally

[1] NEGIP

similar indicating that the full dataset and the dataset with winds only below 3 m/s are directionally similar.

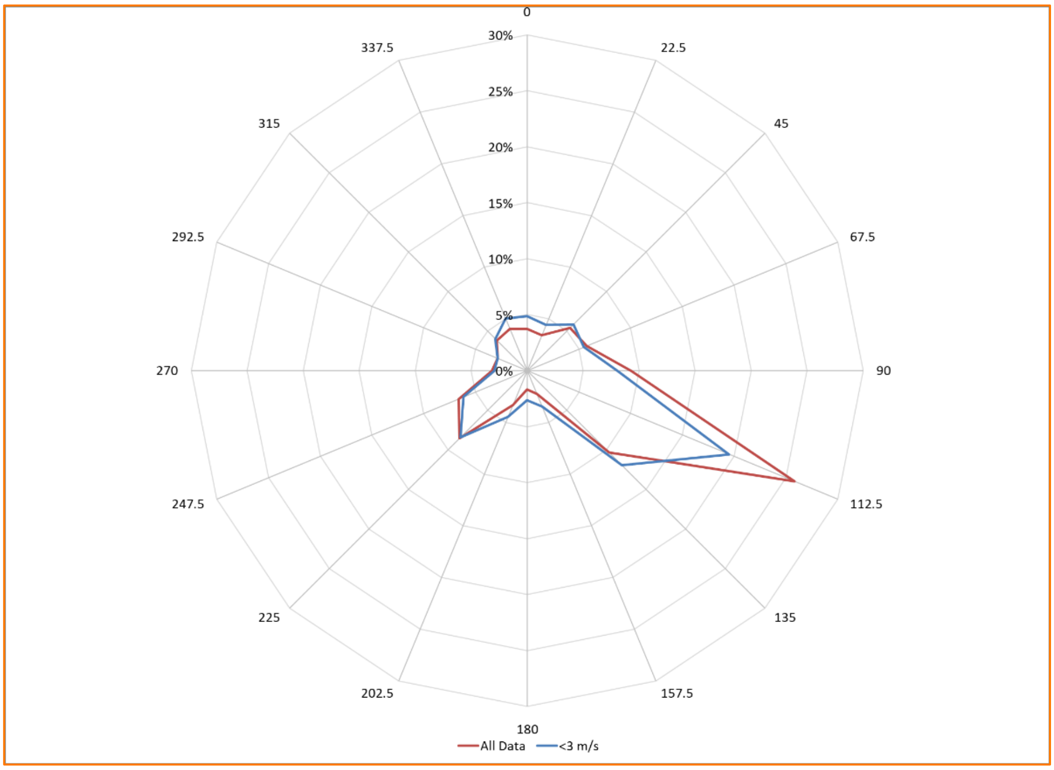

Figure 3: Spider Plot Both Datasets Wind Direction

Perform S-Factor calculations for both observed data and CALMET data; and

To examine the influence of all winds on the S4 factors, we calculated the S4 factors for all data using the method in the NEIGP. The original factors are compared to the all data factors (with a safety factor of 20%) in Figure 4 below. The data are also provided in Table 1.

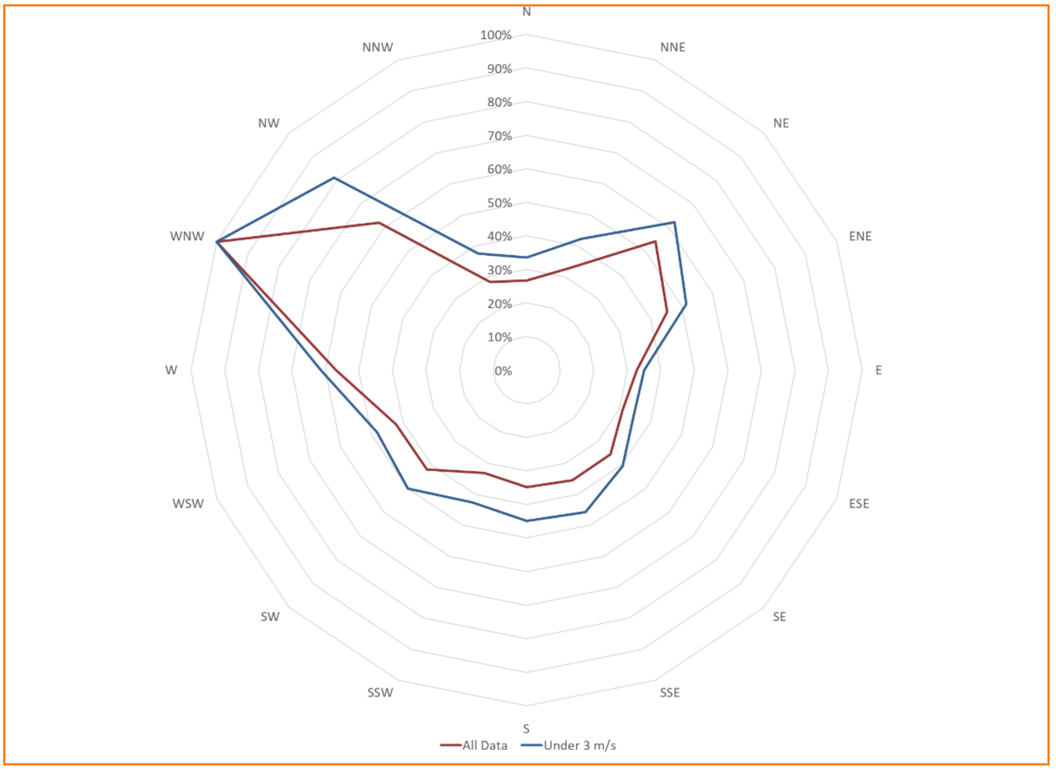

Figure 4: S4 Factors with 20% Safety – All Data (red) and Under 3 m/s (blue)

Table 1: All Hours S4 Factors

Direction	Number of Hours	Factor Raw	Factor Raw (%)	Factor + 20%
N	151	0.07	7%	27%
NNE	285	0.13	13%	33%
NE	764	0.34	34%	54%
ENE	565	0.25	25%	45%
E	288	0.13	13%	33%
ESE	246	0.11	11%	31%
SE	343	0.15	15%	35%
SSE	347	0.16	16%	36%
S	332	0.15	15%	35%
SSW	294	0.13	13%	33%
SW	490	0.22	22%	42%
WSW	494	0.22	22%	42%
W	822	0.37	37%	57%
WNW	2233	1.00	100%	100%
NW	941	0.42	42%	62%
NNW	189	0.08	8%	28%

Figure 4 shows that the under 3 m/s factors are higher than the all data factors. This is because the dominant wind direction was from the east south east (Figure 1 above) and therefore the percentage occurance from other directions was lower under the all data scenario. By removing above 3 m/s winds (Figure 2 above) the dominant wind direction reduces from ~26% to ~20% which results in larger factors for the other directions. Or in other words, if using all hours and following the NEGIP method, the factors are smaller and buffer would be smaller.

If you have any questions, please contact me.

Yours sincerely

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B.Eng (Env Eng) M.Eng (Env) MIEAust A.AirQual
Principal Environmental Engineer

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APPENDIX B – DPI PIGGERY ASSESSMENT SPREADSHEET

Department of Agriculture and Fisheries

Piggery assessment spreadsheet

To assist in preparing applications for new and expanding piggery developments

Version 12.35 - May 2019

This spreadsheet is designed to assist pig producers, consultants and industry advisors with the preparation of development approval applications for new and expanding indoor piggeries. It automates several of the calculations required for preparing these applications and assists in documenting proposed piggery design characteristics and management practices. The calculations and guidance included in this spreadsheet are generally consistent with the standards and methods presented in the APL National Environmental Guidelines for Indoor Piggeries - 3rd Edition (Tucker, 2018). This spreadsheet can also help producers to make more effective use of the valuable water and nutrient resources contained in piggery effluent and solid by-products, while avoiding adverse impacts on the environment and community amenity.

Access to this spreadsheet is provided for preliminary assessment purposes only and DAF does not give any warranty in relation to its use. This spreadsheet necessarily incorporates a number of assumptions that may not be valid in all situations. It is the user's responsibility to ensure that the spreadsheet input data is appropriate for the specific situation. Professional guidance may be required to assist in selecting appropriate input values and for the interpretation of results.

Enquiries:

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Legend:

	Enter values in the grey shaded cells on the various worksheets.
Scroll over these cells.	For assistance with the selection of appropriate input data, scroll over the cells that have red triangles in the upper right corner to view explanatory comments.

Queensland Government

1 - Piggery identification details

Piggery identification details

Landholder's name(s):	**Strathane Holdings**
Piggery name:	**Susco**
Property identification code (PIC):	
Piggery Address:	
Piggery locality:	
Piggery State:	
Postcode:	
Piggery Local Government Area:	**TRC**
Piggery site latidude (dec degrees):	**-27.9691**
Piggery site longitude (dec degrees):	**151.6555**
Closest locality:	Ellangowan
Distance from piggery site to closest locality (km):	3.672
Bearing from piggery site to closest locality (dec deg):	41
General direction from piggery site to closest locality:	NE
Closest locality Local Government Area:	Toowoomba (Regional Council)
Closest locality State:	QLD
Closest locality Postcode:	4361
Name of person completing spreadsheet:	
Assessment identification:	
Assessment date:	

Typical piggery examples

Example 1 - 1000 sow farrow to finish piggery

Example 2 - 8760 SPU grow-out unit

Development program

Is it intended to develop the proposed piggery in stages?	
Stage 1	
Stage 1 pig capacity (SPU)	
Shed numbers (as per attached plan)	
Anticipated completion date	
Stage 2	
Stage 2 pig capacity (SPU)	
Shed numbers (as per attached plan)	
Anticipated completion date	
Stage 3	
Pig capacity per stage (SPU)	
Shed numbers (as per attached plan)	
Anticipated completion date	

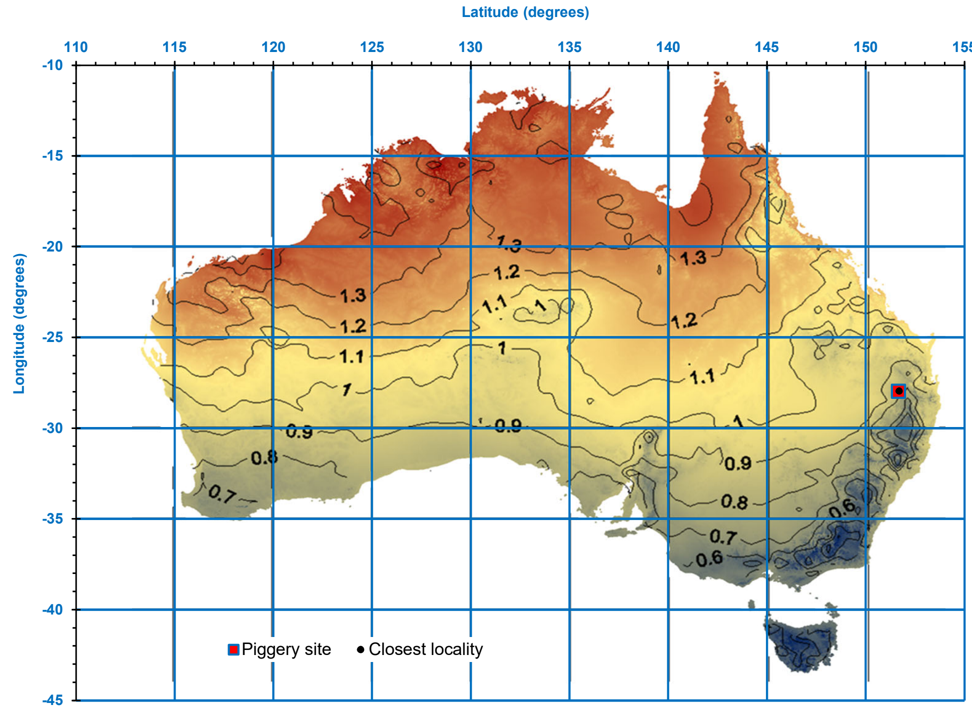


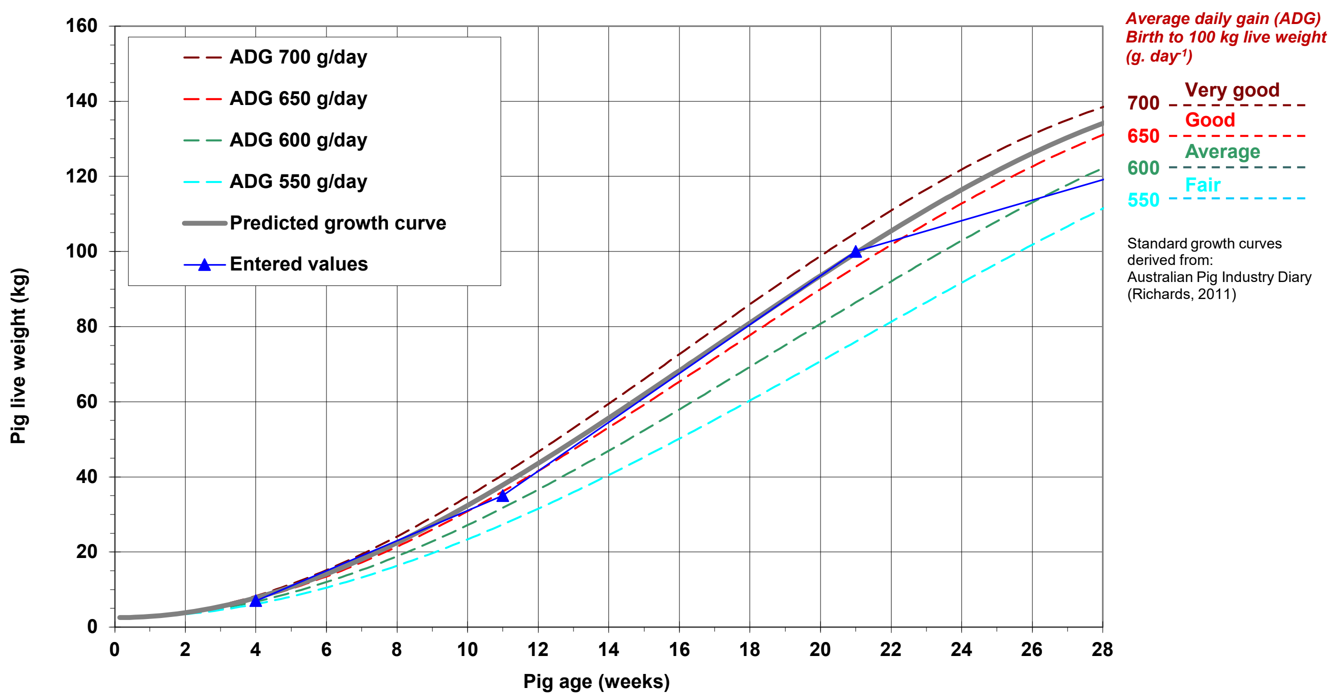
Figure 1. Map showing the location of the piggery site, the closest locality and the anaerobic pond activity ratio (k) values for Australia.

Nearby localities:	Closest	2nd closest	3rd closest	4th closest	5th closest
Locality	Ellangowan	Leyburn	Old Talgai	Sandy Camp	Felton South
Distance from piggery site (km)	3.7	8.9	9.0	12.9	14.5
Bearing from piggery site (dec deg)	41	232	131	90	31
General direction from piggery site	NE	SW	SE	E	NNE
Anaerobic pond activity ratio, k	0.839	0.829	0.824	0.835	0.843
Latitude (dec deg)	-27.94	-28.02	-28.02	-27.97	-27.86
Longitude (dec deg)	151.68	151.58	151.72	151.79	151.73

2 - Grower herd

Weaning age	28	days
Average daily live weight gain (ADG)	670	g. day^{-1} [birth to 100 kg live weight]
Weight gain rating	Good	
Average age at 100 kg live weight	21.02	weeks

Pig class	Pig age (weeks)		Pig live weight (kg/pig)				SPU mult.
	Start	End	Start	End	Predicted	Average	(SPU/pig)
Sucker	0.0	4.0	1.4	7.0	7.8	4.2	0.10
Weaners	4.0	11.0	7.0	35.0	37.9	21.0	0.59
Replacement Gilts	11.0	21.0	35.0	100.0	99.6	67.5	1.48
Replacement Gilts	21.0	32.0	100.0	130.0	143.5	115.0	1.80



Standard growth curves derived from: Australian Pig Industry Diary (Richards, 2011)

3 - Pig herd and shed details

Pig class	Live weight (kg) Start	End	SPU multiplier (SPU/pig)	Shed 1	Shed 2	Shed 3	Shed 4	Shed 5	Shed 6	Shed 7	Shed 8	Shed 9	Shed 10	Total (pigs)	(SPU)
Shed description				Existing	Existing	Proposed	Proposed								
				Enter the number of pigs of the various classes housed in each shed.											
Gilts	100	160	1.80											**0**	**0**
Boars	100	300	1.60											**0**	**0**
Gestating sows	160	230	1.60	**1,980**		**2,140**								**4,120**	**6,592**
Lactating sows	160	230	2.50		**360**		**465**							**825**	**2,063**
Suckers	1.4	7.0	0.10		**4,300**		**4,650**							**8,950**	**912**
Weaners	7.0	35.0	0.59		**7,700**		**8,000**							**15,700**	**9,187**
Replacement Gilts	35.0	100.0	1.48	**830**		**1,000**								**1,830**	**2,703**
Replacement Gilts	100	130	1.80	**680**		**1,000**								**1,680**	**3,027**
														0	**0**
														0	**0**
														0	**0**
Total pigs:				**3,490**	**12,360**	**4,140**	**13,115**	**0**	**0**	**0**	**0**	**0**	**0**	**33,105**	
Total SPU:				**5,619**	**5,844**	**6,703**	**6,318**	**0**	**0**	**0**	**0**	**0**	**0**		**24,484**

Shed details

	Shed 1	Shed 2	Shed 3	Shed 4	Shed 5	Shed 6	Shed 7	Shed 8	Shed 9	Shed 10
Typical shed area (m^2)	5,773	6,002	6,652	6,804	0	0	0	0	0	0
Shed width (m)										
Typical shed length (m)										
Shed length (m)										
Effluent removal system Refer to Table A.2, p 118 of the NEGIP (Tucker, 2018).	**Conventional shed – flushing system.**	**Conventional shed – static pit or pull plug system.**	**Conventional shed – flushing system.**	**Conventional shed – static pit or pull plug system.**						
Effluent treatment system Refer to Table A.2, p 118 of the NEGIP (Tucker, 2018).	**Impermeable pond cover.**	**Impermeable pond cover.**	**Impermeable pond cover.**	**Impermeable pond cover.**						
Flushing / removal system water use rating	**Medium flush**	**Low flush**	**Medium flush**	**Low flush**						
Assumed shed effluent TS concentration (%)	2%	3%	2%	3%						
% flushing / pit recharge / hosing water recycled (%)	**90%**	**90%**	**90%**	**90%**						

	Shed 1	Shed 2	Shed 3	Shed 4	Shed 5	Shed 6	Shed 7	Shed 8	Shed 9	Shed 10	Total
Daily shed effluent volume (L/day)	103,115	65,660	123,002	70,983	0	0	0	0	0	0	**362,760**
Annual shed effluent volume (ML/yr)	37.663	23.982	44.926	25.926	0.000	0.000	0.000	0.000	0.000	0.000	**132.498**
Daily shed moisture volume (L/day)	101,053	63,691	120,542	68,853	0	0	0	0	0	0	**354,139**
Manure + waste feed moisture content (%)	90%										
Manure + waste feed moisture (L/day)	18,561	17,728	22,140	19,165	0	0	0	0	0	0	**77,595**
Waste drinking water - conventional (L/day)	5,708	6,034	5,708	6,034	0	0	0	0	0	0	**23,484**
Flushing / pit recharge / hosing volume (L/day)	76,784	39,928	92,694	43,654	0	0	0	0	0	0	**253,060**
Recycled flushing / pit recharge / hosing vol (L/day)	69,106	35,935	83,424	39,288	0	0	0	0	0	0	**227,754**
Fresh flushing / pit recharge / hosing vol (L/day)	7,678	3,993	9,269	4,365	0	0	0	0	0	0	**25,306**

[1] Tucker, RW (2018) National Environmental Guidelines for Indoor Piggeries - Third Edition, APL Project 2015-2221, Australian Pork Limited, Kingston, ACT, Australia.

S1 factors - *National Environmental Guidelines for Indoor Piggeries (Tucker, 2018)*

Effluent removal system	$S1_R$	SPU										
Conventional shed – flushing system.	1.00	5,619	0	6,703	0	0	0	0	0	0	0	12,322
Conventional shed – static pit or pull plug	1.00	0	5,844	0	6,318	0	0	0	0	0	0	12,162
Deep litter system, pigs on single batch of bedding ≤ 7 weeks.	0.63	0	0	0	0	0	0	0	0	0	0	0
Deep litter system, pigs on single batch of bedding > 7 weeks.	1.00	0	0	0	0	0	0	0	0	0	0	0
Composite $S1_R$ factor	1.00											24,484

Effluent treatment	$S1_T$	SPU										
Pond with > 40% separation of volatile solids before pond.	0.80	0	0	0	0	0	0	0	0	0	0	0
Pond with 25 – 40% separation of volatile solids before pond.	0.90	0	0	0	0	0	0	0	0	0	0	0
Pond with < 25% separation of volatile solids before pond.	1.00	0	0	0	0	0	0	0	0	0	0	0
Permeable pond cover.	0.63	0	0	0	0	0	0	0	0	0	0	0
Impermeable pond cover.	0.50	5,619	5,844	6,703	6,318	0	0	0	0	0	0	24,484
Deep litter system – spent bedding stockpiled / composted on-site.	0.63	0	0	0	0	0	0	0	0	0	0	0
No manure treatment or storage on-site – effluent / bedding removed from site.	0.50	0	0	0	0	0	0	0	0	0	0	0
Composite $S1_T$ factor	0.50											24,484

SPU

Conventional sheds - flushing	SPU	5,619	0	6,703	0	0	0	0	0	0	0	12,322
Conventional sheds - pit	SPU	0	5,844	0	6,318	0	0	0	0	0	0	12,162
Deep litter sheds	SPU	0	0	0	0	0	0	0	0	0	0	0
Total	SPU	5,619	5,844	6,703	6,318	0	0	0	0	0	0	24,484

In-shed losses

TS	%	2%	10%	2%	10%	0%	0%	0%	0%	0%	0%	
VS	%	3%	12%	3%	12%	0%	0%	0%	0%	0%	0%	
N	%	10%	10%	10%	10%	0%	0%	0%	0%	0%	0%	

Conventional Sheds

Manure excreted + waste feed												
TS	kg/yr	768,631	799,415	916,866	864,215	0	0	0	0	0	0	3,349,127
VS	kg/yr	638,236	663,798	761,324	717,605	0	0	0	0	0	0	2,780,962
N	kg/yr	64,392	66,971	76,810	72,399	0	0	0	0	0	0	280,572
P	kg/yr	14,918	15,515	17,795	16,773	0	0	0	0	0	0	65,000
K	kg/yr	14,602	15,187	17,418	16,418	0	0	0	0	0	0	63,625
Effluent out of shed												
TS	kg/yr	753,258	719,473	898,529	777,794	0	0	0	0	0	0	3,149,054
VS	kg/yr	619,089	584,142	738,484	631,492	0	0	0	0	0	0	2,573,207
N	kg/yr	57,953	60,274	69,129	65,159	0	0	0	0	0	0	252,515
P	kg/yr	14,918	15,515	17,795	16,773	0	0	0	0	0	0	65,000
K	kg/yr	14,602	15,187	17,418	16,418	0	0	0	0	0	0	63,625
Separated solids												
TS	kg/yr	0	0	0	0	0	0	0	0	0	0	0
VS	kg/yr	0	0	0	0	0	0	0	0	0	0	0
N	kg/yr	0	0	0	0	0	0	0	0	0	0	0
P	kg/yr	0	0	0	0	0	0	0	0	0	0	0
K	kg/yr	0	0	0	0	0	0	0	0	0	0	0
Effluent discharged into primary pond												
TS	kg/yr	753,258	719,473	898,529	777,794	0	0	0	0	0	0	3,149,054
VS	kg/yr	619,089	584,142	738,484	631,492	0	0	0	0	0	0	2,573,207
N	kg/yr	57,953	60,274	69,129	65,159	0	0	0	0	0	0	252,515
P	kg/yr	14,918	15,515	17,795	16,773	0	0	0	0	0	0	65,000
K	kg/yr	14,602	15,187	17,418	16,418	0	0	0	0	0	0	63,625
Primary pond sludge												
Sludge accumulation rate	m^3/kg TS	0.00137										
Typical sludge density	kg/m^3	1,000										
Typical sludge TS	%	13.10%										
Typical sludge VS	%	6.90%										
Typical sludge N partitioning rate	%	23.50%										
Typical sludge P partitioning rate	%	90.00%										
Typical sludge K partitioning rate	%	5.00%										
Sludge volume	m^3/yr	1,032	986	1,231	1,066	0	0	0	0	0	0	4,314
TS	kg/yr	135,187	129,124	161,259	139,591	0	0	0	0	0	0	565,161
VS	kg/yr	71,205	68,012	84,938	73,525	0	0	0	0	0	0	297,680
N	kg/yr	13,619	14,164	16,245	15,312	0	0	0	0	0	0	59,341
P	kg/yr	13,426	13,964	16,015	15,095	0	0	0	0	0	0	58,500
K	kg/yr	730	759	871	821	0	0	0	0	0	0	3,181
Primary pond supernatant												
TS	kg/yr	618,071	590,350	737,270	638,203	0	0	0	0	0	0	2,583,893
VS	kg/yr	547,883	516,130	653,546	557,967	0	0	0	0	0	0	2,275,527
N	kg/yr	44,334	46,109	52,884	49,847	0	0	0	0	0	0	193,174
P	kg/yr	1,492	1,552	1,779	1,677	0	0	0	0	0	0	6,500
K	kg/yr	13,872	14,428	16,547	15,597	0	0	0	0	0	0	60,444

Deep litter sheds

Manure excreted + waste feed												
TS	kg/yr	0	0	0	0	0	0	0	0	0	0	0
VS	kg/yr	0	0	0	0	0	0	0	0	0	0	0
N	kg/yr	0	0	0	0	0	0	0	0	0	0	0
P	kg/yr	0	0	0	0	0	0	0	0	0	0	0
K	kg/yr	0	0	0	0	0	0	0	0	0	0	0
Deep litter composition												
TS	kg/yr	#N/A										
VS	kg/yr	#N/A										
N	kg/yr	#N/A										
P	kg/yr	#N/A										
K	kg/yr	#N/A										
Deep litter added												
TS	kg/yr	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
VS	kg/yr	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
N	kg/yr	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
P	kg/yr	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
K	kg/yr	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Manure excreted + waste feed + deep litter added to shed												
TS	kg/yr	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
VS	kg/yr	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
N	kg/yr	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
P	kg/yr	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
K	kg/yr	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Spent deep litter removed from shed												
TS	kg/yr	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
VS	kg/yr	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
N	kg/yr	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
P	kg/yr	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
K	kg/yr	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

4a - Odour assessment factors

Level 1 and 1.5 odour assessments - National Environmental Guidelines for Indoor Piggeries, 3rd Edition, (Tucker, 2018)[1]

Enter surface roughness, receptor elevation, terrain and wind frequency analysis data for the 16 compass points surrounding the piggery site.

Direction (from piggery)	Surface roughness features ($S2_S$)	Receptor elevation (from piggery)	Terrain	$S2_S$	S3	Murgon	Dalby1	Dalby2	Dalby3	Mt Gambier	Murray Bridge	Padthaway	Renmark	Roseworthy	Strathalbyn		Kyles	
					Data source	TAPM Model	BOM	BOM	BOM	NEGIP 2018	NEGIP 2018	NEGIP 2018	NEGIP 2018	NEGIP 2018	NEGIP 2018		AEC	
					Station No	N/A	41522	41522	41522								Strathane	
					Start date	1/01/2008	6/07/2006	1/01/2007	1/11/2009									
					End date	31/12/2009	7/11/2011	31/12/2010	31/10/2011									
						S4												
N				#N/A		0.53	0.98	0.96	1.00	1.00	1.00	0.84	0.87	0.91	0.82		0.44	
NNE				#N/A		0.48	0.66	0.66	0.70	0.75	0.98	0.75	0.87	0.91	0.79		0.50	
NE	Crops.	Receptor downslope of site.	Gently sloping (1-2%).	1.00	1.20	0.34	0.65	0.67	0.67	1.00	0.83	0.65	0.92	0.87	1.00		0.52	
ENE	Open grassland (grass, scattered trees).	Receptor downslope of site.	Gently sloping (1-2%).	0.90	1.20	0.30	0.64	0.64	0.67	0.95	0.65	0.74	1.00	0.75	0.90		0.46	
E	Open grassland (grass, scattered trees).	Receptor downslope of site.	Gently sloping (1-2%).	0.90	1.20	0.29	0.73	0.72	0.71	0.98	0.57	0.77	1.00	0.62	0.86		0.43	
ESE				#N/A		0.27	0.55	0.55	0.50	0.83	0.50	0.81	0.73	0.61	0.96		0.38	
SE				#N/A		0.28	0.61	0.60	0.53	0.94	0.50	0.82	0.52	0.74	1.00		0.33	
SSE				#N/A		0.33	0.65	0.62	0.61	1.00	0.69	0.83	0.38	0.67	1.00		0.33	
S				#N/A		0.42	1.00	1.00	0.92	1.00	1.00	1.00	0.52	0.85	1.00		0.38	
SSW	Open forest (canopy cover 30-70%).	Receptor upslope of site.	Sloping (>2% slope).	0.60	0.70	0.76	0.56	0.56	0.54	0.99	0.97	0.66	0.60	0.86	0.80		0.46	
SW	Open forest (canopy cover 30-70%).	Receptor upslope of site.	Sloping (>2% slope).	0.60	0.70	0.83	0.66	0.65	0.67	1.00	0.44	0.57	0.84	1.00	0.72		0.75	
WSW				#N/A		0.78	0.77	0.77	0.79	0.72	0.32	0.55	0.85	1.00	0.59		1.00	
W	Open grassland (grass, scattered trees).	Receptor upslope of site.	Flat (0-1% slope).	0.90	1.00	0.96	1.00	1.00	1.00	0.73	0.34	0.48	0.84	1.00	0.64		1.00	
WNW				#N/A		1.00	1.00	1.00	1.00	0.73	0.41	0.61	0.75	0.99	0.47		0.53	
NW				#N/A		1.00	1.00	1.00	1.00	0.95	0.50	1.00	0.74	0.70	0.60		0.38	
NNW	Crops.	Receptor downslope of site.	Gently sloping (1-2%).	1.00	1.20	0.70	0.91	0.86	0.98	0.77	0.76	1.00	0.74	0.87	0.63		0.37	

[1] Tucker, R.W. (2018) National Environmental Guidelines for Indoor Piggeries - Third Edition, APL Project 2015-2221, Australian Pork Limited, Kingston, ACT, Australia.

Hyperlink: National Environmental Guidelines for Piggeries

4b - Level 1 and 1.5 odour assessments

National Environmental Guidelines for Indoor Piggeries, 3rd Edition (Tucker, 2018) [1]

Assessment level: 1.5

S4 Factor wind data site: Kyles

Receptor number	Receptor name	Bearing (degrees from true North)	Direction (from piggery)	Receptor type	$S1_R$	$S1_T$	$S2_R$	$S2_S$	S3	S4	Separation distances (m)				Comment	Max pig capacity [3] (SPU)
											Available	Required Level 1	Required Level 1.5	Minimum[2]		
R1	23/SP206518	339	NNW	Legal house.	1.00	0.50	11.5	1.00	1.20	0.37	2,300	1,790	662	250	OK	235,581
R2	47/N25528	45	NE	Legal house.	1.00	0.50	11.5	1.00	1.20	0.52	2,365	1,790	931	250	OK	133,480
R3	11/RP892911	75	ENE	Legal house.	1.00	0.50	11.5	0.90	1.20	0.46	1,740	1,611	741	250	OK	115,635
R4	31/M341017	81	E	Legal house.	1.00	0.50	11.5	0.90	1.20	0.43	1,630	1,611	693	250	OK	116,085
R5	111/M341017	198	SSW	Legal house.	1.00	0.50	11.5	0.60	0.70	0.46	1,200	626	288	250	OK	327,692
R6	7/M341014	235	SW	Legal house.	1.00	0.50	11.5	0.60	0.70	0.75	935	626	470	250	OK	85,590
R7	27/RP159844	280	W	Legal house.	1.00	0.50	11.5	0.90	1.00	1.00	1,360	1,342	1,342	250	OK	25,080
R8	2/RP162693	234	SW	Legal house.	1.00	0.50	11.5	0.60	0.70	0.75	505	626	470	250	OK	27,927
R9	3/RP162693	221	SW	Legal house.	1.00	0.50	11.5	0.60	0.70	0.75	780	626	470	250	OK	61,561

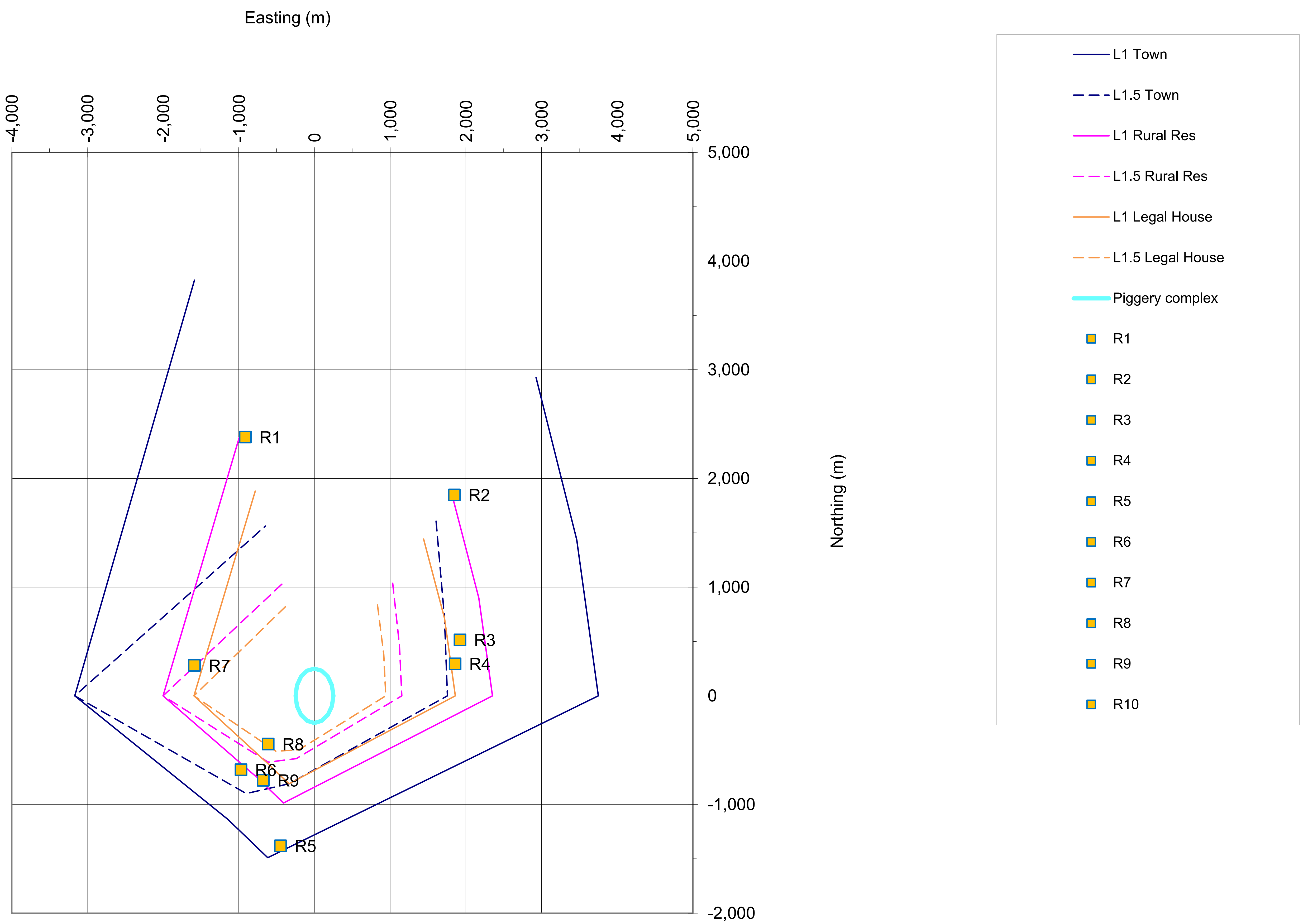
Diameter of circle enclosing piggery complex (m): 500 m

Overall max capacity (SPU): 25,080

Method used for determining available separation distance and bearing:

Overall Comment: *OK*

[1] Tucker, R.W. (2018) National Environmental Guidelines for Indoor Piggeries - Third Edition, APL Project 2015-2221, Australian Pork Limited, Kingston, ACT, Australia.



Easting (m)
-4,000
-3,000
-2,000
-1,000
0
1,000
2,000
3,000
4,000
5,000
5,000
4,000
3,000
2,000
1,000
0
-1,000
-2,000
Northing (m)
R1
R2
R3
R4
R5
R6
R7
R8
R9
L1 Town
L1.5 Town
L1 Rural Res
L1.5 Rural Res
L1 Legal House
L1.5 Legal House
Piggery complex
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10