June 2025

# PigBal 5 Technical Manual

## Version 1.0

This publication has been compiled by Eugene McGahan (Agricultural Engineering Consultant), Mary-Frances Copley (Integrity Ag), Sara Willis, of the Department of Primary Industries (Queensland) and Alan Skerman (formerly Department of Agriculture and Fisheries (Queensland).

The previous version (PigBal4) Technical Manual was compiled by Alan Skerman, Sara Willis and Brendan Marquardt of Agri-Science Queensland, Department of Agriculture and Fisheries (Queensland), and Eugene McGahan in 2013.

The original version of PigBal was developed by Ken Casey, Eugene McGahan, Michael Atzeni, Ted Gardner and R Frizzo in 1996. PigBal version 1.0 - A nutrient mass balance model for intensive piggeries, Department of Primary Industries (Queensland).

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# Overview

The original PigBal model was developed by Casey et al. (1996). In recent years, the industry identified a need to validate and upgrade the original version of the model. Consequently, Australian Pork Limited (APL) provided funding under Project No 2010/1011.334: Validation and development of the PigBal model – Stage 2, for replicated metabolic pen trials to gather data for the purpose of validating the model. Details of this research were reported by Skerman et al. (2013). The current version of the model (PigBal 5) was developed by McGahan et al. (2025). PigBal 5 supersedes the original version and all subsequent versions of the model.

The PigBal model uses a mass balance approach to estimate piggery waste production (solids and nutrients) based on detailed dietary data and pig production information entered by the user. It is a Microsoft® Excel spreadsheet model which operates effectively on personal computers (PCs) with Excel 2003 (or later) installed.

PigBal 5 modelling results are typically used for:

- Designing piggery effluent treatment and reuse systems.
- Calculating nutrient production rates at various stages of the collection and treatment system.
- Estimating the energy output to help calculate the economic viability of piggery biogas collection and reuse systems.
- Estimating piggery GHG emissions (Scope 1 and 2) for statutory reporting purposes.
- Preparing applications for new and expanding piggery developments.
- This manual provides:
- Background information and guidance to assist users in selecting appropriate data to be entered into the various sheets.
- Details of the calculations performed by the model.
- Technical references.

Each chapter of the manual refers to a specific sheet of the spreadsheet model, numbered 1 to 20. Users will generally progress through the sheets in numerical order, entering relevant data into the various sheets.

Navigation between the various sheets is achieved by clicking on the buttons provided on the menu sheet and each of the other sheets.

# Menu

The 'Menu' sheet provides general instructions on how to use the PigBal 5 model in addition to a Table of Contents to assist the user in navigating between the various sheets. No data entry is required on this sheet which has been reproduced below:

## PigBal 5

### A model for estimating piggery waste production

### General instructions:

The user can navigate through the various worksheets, numbered 1 to 20, by using the scroll bar below.

Alternatively, the user can click on the links in the Table of Contents below. A 'Menu' link is provided in the upper left-hand corner of the relevant worksheets, to allow the user to return to this menu worksheet and navigate to the next relevant tab using the Table of Contents.

Data may be entered in each of the worksheets having yellow or green highlighted labels.

Note the green tabs are new worksheets that have been added since the last version PigBal 4).

The worksheets having grey shading provide output data, graphs and details of some of the model calculations.

Most users will progress through the worksheets in numerical order, entering relevant data in the grey shaded cells, as shown to the right.

**Data entry cell**

All other cells are locked to prevent data entry and to protect the underlying calculations.

All cells with red triangles in the upper-right-hand corners, as shown to the right, contain explanatory comments to assist the user in selecting appropriate input values.

**Explanatory comments**

Some of the explanatory comments include typical / default data values and ranges.

The explanatory comments can be viewed by resting the pointer over these cells.

More comprehensive instructions are provided in the Technical manual (McGahan *et al.* , 2025).

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# 1. Cover

This sheet provides a general description of the model, an overview of typical uses and details regarding the model development. No data entry is required on this sheet.

Contact details are also provided for technical support purposes.

Technical enquiries about the model should be addressed to *DPI Customer Service Centre, phone 13 25 23 (cost of a local call within Queensland) or +61 7 3404 6999.*

Menu

Department of Primary Industries (Qld)

## 1. Cover

**PigBal 5**

**A model for estimating piggery waste production**

Version 5.00 - 13th June 2025

The PigBal 5 model uses a mass balance approach to estimate piggery waste production (solids and nutrients) based on detailed dietary data.

PigBal 5 modelling results are typically used for:

— Designing piggery effluent treatment and reuse systems.
— Estimating the energy output and economic viability of piggery biogas collection and use systems.
— Estimating piggery GHG emissions for statutory reporting purposes.
— Preparing applications for new and expanding piggery developments.

PigBal 5 was developed by Eugene McGahan (Agricultural Engineer) and Mary-Frances Copley (Integrity Ag) Sara Willis (DPI (Qld), and Alan Skerman (formerly DPI, Qld), with funding assistance from Australian Pork Limited (APL) under Project No 2025/0044: Future proofing PigBal. It supersedes PigBal 4.

PigBal 4 was developed by Alan Skerman, Sara Willis, Brendan Marquardt of DAF (Queensland), and Eugene McGahan (Agricultural Engineer).

PigBal 4 superseded the original version of the model which was developed by Casey, K.D., McGahan, E.J., Atzeni, M.A., Gardner, E.A. and Frizzo, R.E. (1996) PigBal version 1.0 - A nutrient mass balance model for intensive piggeries, DPI (Queensland).

Detailed guidance on the use of this model is provided in the User Manual (McGahan *et al*., 2025).

**Enquiries:**

Phone: DAF Customer Service Centre 13 25 23

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# 2. User licence

Details of the user licence are provided on this sheet, as outlined below:

### Acknowledgements


- PigBal 5 consists of an updated software program and user technical manual developed from the existing Queensland Government PigBal program (PigBal 4). PigBal 5 is jointly owned by the State of Queensland through the Department of Primary Industries (**DPI**) and Australian Pork Limited (APL) (together, the Joint Owners), and is distributed through the Joint Owners' websites.

- The Joint Owners would like to acknowledge the technical contribution to PigBal 5 by Mr Eugene McGahan (Agricultural Engineering Consultant) and Mary-Frances Copley (Integrity Ag).


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### Privacy

22. The Joint Owners are committed to protecting user privacy as specified under the *Information Privacy Act 2009 (Qld) and Privacy Act 1988 (Cth).* The Joint Owners understand and appreciate that users of PigBal are concerned about their privacy and the confidentiality and security of information they provide to the Joint Owners and will collect, use, disclose and handle your information in accordance with relevant privacy legislation.

# 3. Herd input

In this sheet, the user is required to enter data which defines the herd accommodated in the piggery. PigBal 5 calculates the numbers of pigs in the various classes, based on the total number of sows, breeding stock (gilts and boars purchased), mortality rates, pig sales data and various performance criteria entered by the user. The calculations cater for farrow-to-finish piggeries as well as specialised breeder and grower units. The calculated pig numbers for each class of pig accommodated in the piggery are shown on the 'Herd details' sheet. Users can override the PigBal 5 calculations by entering known numbers of pigs for the relevant classes on the 'Herd details' sheet. This includes the option to split the Gestating sows herd. This may be helpful if some dry sows are in conventional housing and others in deep litter.

**It is important to enter data as correctly as possible on this sheet and only make minor edits to calculated pig numbers on the 'Herd details' sheet.**

PigBal 5 allows for the entry of up to six classes of grower pigs between the weaner and finisher stages (inclusive). In general, separate classes should be assigned to groups of pigs that receive different diets, as defined in the 'Diet input' sheet. Names that are meaningful to the user can be assigned to each of these classes; e.g. weaner 1, weaner 2, grower 1, grower 2, finisher 1, finisher 2, porker, baconer, etc. The starting and finishing ages and live weights for each of these pig classes are defined by entering the pig ages and live weights at the ends of each growth stage. In lieu of any other specific data for the piggery being modelled, the pig classes, ages and live weights specified in Table 1, may be adopted.

*Table 1. Standard pig classes, liveweights and age.*

| Pig class | Live weight range (kg. pig$^{-1}$) | | Age range (weeks) | |
|---|---|---|---|---|
| | Entry | Exit | Entry | Exit |
| Gilt | 100 | 160 | 22 | 30 |
| Boar | 100 | 300 | 22 | 128 |
| Dry sow | 145 | 200 | | |
| Lac sow | 145 | 200 | | |
| Sucker | 1.4 | 7 | 0 | 3.5 |
| Weaner | 7 | 35 | 3.5 | 10 |
| Porker | 35 | 60 | 10 | 14 |
| Grower | 60 | 85 | 14 | 18 |
| Finisher | 85 | 110 | 18 | 22 |
| Heavy finisher | 110 | 130 | 22 | 26 |

To assist users who may not have the required live weight data for the various grower pig classes, PigBal 5 allows the entry of an average daily live weight gain (ADG), measured from birth to 100 kg live weight. Table 2, which appears in the in-cell explanatory comments built into the model, is intended to assist users in selecting a realistic ADG.

*Table 2. Average daily live weight gain (ADG) ratings (birth to 100 kg live weight).*

| Average daily gain (g. day-1) [Birth to 100 kg live weight] | Rating |
|---|---|
| < 600 | Poor |
| 600 – 650 | Fair |
| 650 – 700 | Average |
| 700 – 750 | Good |
| > 750 | Very good |

Based on the entered ADG value, PigBal 5 uses Equation 1, provided in Appendix A, to predict live weights at the ends of each of the growth stages previously entered into the model. This equation was developed from standard growth curves published in the Australian pig industry diary by Richards (2012), with updates from Willis (2025). The user may choose to enter the live weight values predicted by the model, or can enter alternative known values.

The numbers of pigs purchased annually for each of the grower pig classes must be entered in the 'Pig purchases' section of the sheet. In the case of specialised grower piggeries, the user needs to enter the number of weaner pigs purchased or imported annually from an external breeder unit.

PigBal 5 requires the user to enter the pre-weaning and post-weaning mortality rates. The pre-weaning mortality rate is used to calculate the number of sucker pigs that die prior to weaning. PigBal 5 distributes the post-weaning mortality rate, entered by the user, across the various classes of grower pigs, based on the length of time that the pigs spend in each of these classes.

The percentages of grower pigs sold at the end of each of the growth stages are entered in the 'Pig sales' section. In the case of a breeder unit, 100% of the pigs would normally be sold (or exported to an off-site grower unit) at the end of either the sucker or weaner stages.

PigBal 5 also allows for pigs to be sold at multiple live weights to supply a range of markets. For example, some producers may sell 50% of their grower pigs as porkers while retaining the remaining pigs until they reach a heavier bacon weight.

Table 3 provides descriptions, ranges and typical values of the input data for the 'Herd Input' sheet.

*Table 3. Description, range and average / typical values of data to be entered in the 'Herd input' sheet.*

| Input data | Description | Range | Average / typical value | Units |
|---|---|---|---|---|
| Number of sows | Number of breeding female pigs that have been served, including both lactating and dry (gestating) sows. | Variable | Variable | sows |
| Number of boars | Number of male pigs over 6 months of age intended for use in the breeding herd. | Variable | Variable | boars |
| Sow culling percentage | Number of sows culled from the herd, expressed as a percentage of | 40 – 76 | 50 | % |

| Input data | Description | Range | Average / typical value | Units |
|---|---|---|---|---|
| | the total number of sows in the herd. | | | |
| Boar working life | The working life of boars, from selection, generally at approx 6 months of age, to culling. | | 1.5 | years |
| Breeder mortalities | % of sows and boars that die annually. | 2.5 – 19.1 | 7.8% | % |
| Gilt waste rate | % of non-fertile gilts sold. | | 14% | % |
| Percent gilts purchased | % of young female pigs purchased from breeding companies, for breeding purposes. | Variable | | gilts |
| Percent boars purchased | % of young male pigs purchased from breeding companies, for breeding purposes. | Variable | | % |
| Farrowing rate | % of sows that farrow after mating. | 75 – 90 | 85% | % |
| Farrowing index | Average number of farrowings per mated sow annually. | 2.24 – 2.42 | 2.28 | farrowings |
| No of piglets born alive per litter | Average number of live pigs in a litter. | 10.3 – 14.2 | 11.8 | piglets |
| No of piglets stillborn per litter | Average number of fully-formed pigs that are born dead in a litter. | 0.7 - 1.2 | 0.9 | piglets |
| Gilt age at selection / purchase | Age of young female pigs selected from the grower herd, or purchased from breeding companies, for breeding purposes. | | 22 | weeks |
| Boar age at selection / purchase | Age of young male pigs selected from the grower herd, or purchased from breeding companies, for breeding purposes. | | 22 | weeks |
| Gilt age at mating | Age of young female pigs when they are first mated. | 30-32 | 30 | weeks |
| Sow live weight at mating | Average live weight of sows when they are mated. | 130 - 150 | 145 | kg. $pig^{-1}$ |
| Sow live weight at farrowing | Average live weight of sows when they farrow. | 190 - 255 | 200 | kg. $pig^{-1}$ |
| Boar live weight at turnoff | Average live weight of boars when they are culled. | | 300 | kg. $pig^{-1}$ |
| Average cull sow dressed weight | Dressed carcass weight of culled sows after processing, at the abattoir. | 130 -160 | 140 | kg. $pig^{-1}$ |
| Lactation duration | Average time period between farrowing and weaning. | 17 - 32 | 24 | days |
| Dressing percentage of progeny | Dressing percentage of progeny pigs after processing expressed as a percentage of liveweight. | 74 - 79 | 77 | % (Trim 1) |
| Pre-weaning mortality | Rate of deaths in sucker pigs, prior to weaning. | 5 – 17 | 12 | % |
| Post-weaning mortality | Rate of deaths in grower pigs, from weaning to finishing. | 3 - 7 | 5 | % |

Four macro buttons have been provided near the bottom of the herd input sheet. By clicking on one of the "1000 sow farrow to finish", "1000 sow breeder unit" or "Grower unit" buttons, PigBal 5 will automatically populate average data for that system. These standard scenarios are intended to provide a starting point and general reference to assist users in entering appropriate data to realistically model a range of piggery operations.

A fourth additional button ("Old PigBal 1000 sow farrow to finish") is provided if the user wishes to generate historical input data from the original version of PigBal.

# 4. Growth chart

On the 'Growth chart' sheet, PigBal 5 plots the pig age and live weight values entered in the 'Herd input' sheet, along with the predicted growth curve for the selected ADG. Standard growth curves for ADGs ranging from 600 to 750 g. day$^{-1}$ are also plotted on this chart for comparison purposes. These growth curves, originally derived from data presented by Richards (2012), have been updated with current data provided by Willis (2025), allow the user to evaluate whether the entered age and live weight values are realistic in comparison with typical growth curves.

In the example provided in Figure 1, the entered age and live weight values (blue triangular markers) closely follow the predicted growth curve (grey line) for the selected ADG value of 690 g. day$^{-1}$.

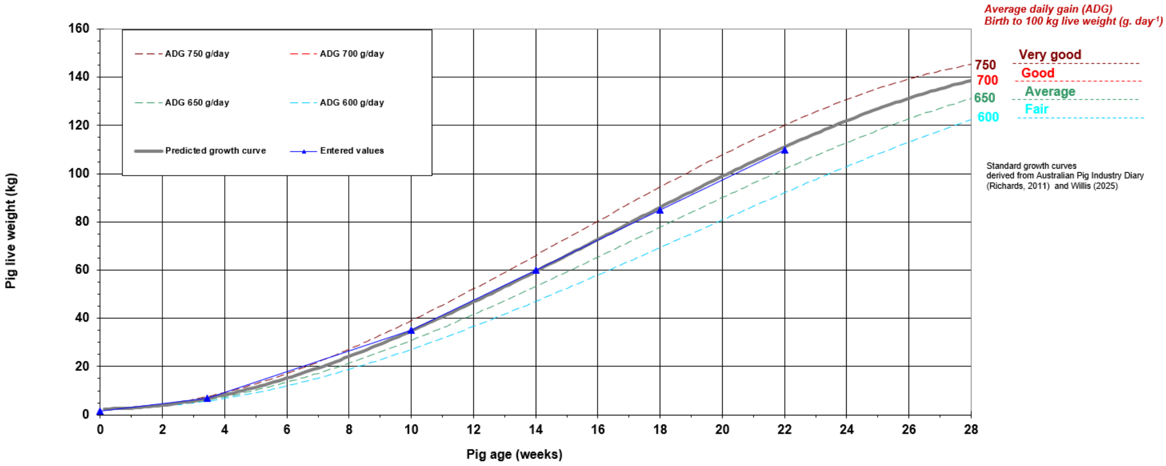


*Figure 1. 'Growth chart' example for a selected ADG value of 690 g. day$^{-1}$ and entered age and live weight values that closely follow the predicted growth curve.*

# 5. Herd details

The ‘Herd details’ sheet provides the numbers of pigs housed in the piggery at any point in time, calculated by the model, for each of the pig classes entered in the ‘Herd input’ sheet. On this sheet, the user has an opportunity to override the model calculations and enter known numbers of pigs for each of the classes. Note, an addition since PigBal 4 is that the Gestating sow herd can be spilt into two categories. This may be helpful if some dry sows are in conventional housing and some housed in deep litter.

The user is also required to enter the type of manure management system employed in the sheds housing the various classes of pigs. Drop-down lists for each pig class provide 3 choices; *viz.* ‘Flushing’, ‘Pull plug / Static pit’ or ‘Deep litter’, as briefly described below.

### Flushing sheds:

Flushing sheds have relatively shallow concrete channels running under the slatted floors. These channels are flushed at regular intervals (generally ranging from daily to twice weekly), to remove the manure and waste feed from the sheds into external drains or sumps, prior to pre-treatment or discharge into an effluent pond. Flushing is generally carried out by rapidly releasing relatively large quantities of water (or recycled effluent) from flushing tanks located near the ends of the sheds. Alternatively, sheds may be flushed using a high-capacity pump.

### Pull plug / Static pit sheds:

Pull plug sheds store manure, waste feed and hosing water in several concrete pits constructed beneath the slatted shed floors. The effluent is generally released by gravity, through individual pipe outlets located in the centre of each pit.

Static pits are relatively large concrete pits, commonly located under the slatted floors of older sheds. They are used to store manure, waste feed and hosing water. The shed effluent is generally released via a sluice gate or valve located at the end of each shed, at intervals up to several weeks.

### Deep litter sheds:

Deep litter sheds employ straw, sawdust, rice hulls or an alternative bedding material to absorb the manure excreted by the pigs. These sheds are not cleaned by hosing or flushing. The manure is generally removed from the concrete or compacted earth floor, along with the spent bedding material, after the removal of a batch of pigs, or at regular intervals.

### Standard pig units:

The SPU multipliers used for the grower herd are determined using a regression equation based on the average live weights of pigs in each class. This regression equation was developed using the standard SPU multipliers and live weights published in Table 5.2 of the National Environmental guidelines for Indoor Piggeries – Siting and Design, NEGIP-SD (Tucker et al. 2025), reproduced in Table 4. The regression equation (Equation 2) and a plot of the resulting SPU multipliers (Figure 4) are provided in Appendix A. The standard SPU multipliers outlined in Table 4 are used for the breeder herd.

*Table 4. Standard pig classes, live weights and SPU conversion factors published in Table 5.2 of the NEGIP-SD (2025).*

| Pig class | Start live weight (kg) | Finish live weight (kg) | Average live weight (kg) | SPU multiplier |
|---|---|---|---|---|
| Gilt | 100 | 160 | | 1.8 |
| Boar | 100 | 300 | | 1.6 |
| Gestating sow | 160 | 230 | | 1.6 |
| Lactating sow | 230 | 160 | | 2.5 |
| Sucker | 1.4 | 8.0 | 4.7 | 0.1 |
| Weaner | 8.0 | 25.0 | 16.5 | 0.5 |
| Grower | 25.0 | 55.0 | 40.0 | 1.0 |
| Finisher | 55.0 | 100.0 | 77.5 | 1.6 |
| Heavy finisher | 100.0 | 130.0 | 115.0 | 1.8 |

The ‘Herd details’ sheet summarises the ages, live weights, and numbers of standard pig units (SPU) for each class of pig, along with the pig purchases, mortalities and sales in terms of both pig numbers and live weight.

**The values at the bottom of this sheet should be carefully checked by the user to ensure they match the piggery being modelled to obtain the most accurate results. PigBal is a mass balance model and requires the mass of pigs going in and out to determine both fixed solids (used to calculate volatile solids) and nutrients excreted.**

# 6. Deep litter

**If 'Deep litter' is selected for any of the 'Shed types' in the 'Herd details' sheet, the user needs to specify the type and amount of bedding material added to the relevant shed(s).** A drop-down list provides the following alternatives for bedding materials: hardwood sawdust, softwood sawdust/shavings, rice hulls, barley straw, wheat straw and shredded paper. In reality, the choice of bedding material generally depends on the availability and cost of suitable materials in the vicinity of the piggery.

Typical solid and nutrient contents of common deep litter bedding materials are provided in Table 5. These values are used by PigBal 5 to estimate the composition of the spent deep litter and manure removed from the sheds.

*Table 5. Typical solid and nutrient contents (% wet basis) of common deep litter bedding materials.*

| Bedding Materials | TS | VS | Ash | N | P | K |
|---|---|---|---|---|---|---|
| Hardwood sawdust | 90.00 | 90.00 | 0.00 | 0.20 | 0.01 | 0.05 |
| Softwood sawdust/shavings | 90.00 | 90.00 | 0.00 | 0.13 | 0.01 | 0.03 |
| Rice Hulls | 92.00 | 87.00 | 5.00 | 0.49 | 0.07 | 1.21 |
| Barley straw | 91.00 | 85.00 | 6.00 | 0.63 | 0.06 | 2.16 |
| Wheat straw | 89.00 | 83.15 | 5.85 | 0.52 | 0.36 | 0.45 |
| Shredded paper | 90.00 | 90.00 | 0.00 | 0.00 | 0.01 | 0.00 |

To avoid animal welfare, production and environmental issues, piggery operators need to supply sufficient deep litter bedding material to maintain dry conditions. On average, this requires the addition of approximately 0.5 - 1.0 kg of bedding per SPU per day.

# 7. Assumptions

Table 6 outlines the fixed values used in PigBal 5 calculations. These values cannot be edited by the user. Some references are provided below the table.

*Table 6. Fixed values used in PigBal 5 calculations.*

| Parameter | Units | Value | TS | FS | VS | N | P | K |
|---|---|---|---|---|---|---|---|---|
| Carcass composition[1] | g. $kg^{-1}$ live weight | | 300.0 | 29.0 | 271.0 | 25.6 | 4.5 | 2.4 |
| Placenta | kg. sow $place^{-1}$. $farrowing^{-1}$ | 3 | 0.9000 | 0.0870 | 0.8130 | 0.0768 | 0.0135 | 0.0072 |
| Milk composition[2] | % | | 20.00 % | 1.00% | 19.00 % | 0.90% | 0.15% | 0.07% |
| Milk fed to suckers | kg. sow $place^{-1}$. $day^{-1}$ | 8 | 1.6000 | 0.0800 | 1.5200 | 0.0720 | 0.0120 | 0.0056 |
| | kg. sow $place^{-1}$. $farrowing^{-1}$ | 208 | 41.60 | 2.08 | 39.52 | 1.87 | 0.31 | 0.15 |
| Suckers | kg. sow $place^{-1}$. $farrowing^{-1}$ | 16.94 | 5.082 | 0.491 | 4.591 | 0.434 | 0.076 | 0.041 |
| Suckers + milk + placenta | kg. sow $place^{-1}$. $farrowing^{-1}$ | 227.94 | 47.58 | 2.66 | 44.92 | 2.38 | 0.40 | 0.19 |
| | kg. sow $place^{-1}$. $day^{-1}$ | 8.77 | 1.83 | 0.10 | 1.73 | 0.09 | 0.02 | 0.01 |
| Gestation period | days | 114 | | | | | | |
| Deep litter moisture content | % | 40% | | | | | | |
| Shed losses | | | | | | | | |
| Flushing | % | | 2% | 0% | 3% | 10% | 0% | 0% |
| Pull plug / Static pit | % | | 10% | 0% | 12% | 10% | 0% | 0% |
| Deep litter | % | | 20% | 0% | 25% | 17% | 0% | 0% |

*References:*
[1] *Mahan and Shields (1998), Field et al. (1974)*
[2.] *Hurley (1997), Csapó et al.(1996),* Lewis A.J. et al. *(1978), Eliasson and Isberg (2011)*

# 8. Feed details

### Feed conversion (birth to 100 kg liveweight):

To assist in estimating feed wastage, this sheet includes provision for the user to enter a known average feed conversion (FC) for the progeny pigs, calculated from birth to 100 kg live weight, which is a common turn-off liveweight.  The FC value is calculated by dividing the total feed fed, by the live weight gain (birth to 100 kg liveweight).  While it is expected that many pig producers will know the average FC values for their progeny pigs, the explanatory notes provides ratings for a range of progeny FC values (liveweight) that could be expected in the Australian pork industry.

### Feed wastage:

Feed wastage in piggeries is practically impossible to measure objectively and producers are generally unable to provide accurate, quantitative estimates.  However, feed wastage can have a major influence on the characteristics of the waste stream discharged from piggery sheds.  For example, McGahan *et al.* (2010) used PigBal modelling to demonstrate that a ± 5% variation in feed wastage, from a standard value of 10%, could result in a ± 30% variation in total solids and volatile solids production.

To assist users in estimating a realistic feed wastage value, a relationship was developed between feed wastage, the ADG value provided in the 'Herd input' sheet and the FCR value entered on this sheet.  This involved the development of Equations 3 to 7, which are included in Appendix A. PigBal 5 uses these equations to determine an estimated feed wastage value, which is shown directly above the table on the 'Feed details' sheet.

Feed wastage values must be entered by the user for each class of pig.  Users may choose to enter the calculated value for weaner, grower and finisher pigs.  Alternatively, default values are provided in the in-cell explanatory comments and users must enter these in the relevant cells.

### Feed consumption:

On this sheet, the user may enter either the daily feed ingested per pig for each pig class, or the total annual tonnage of feed fed to each pig class.  For many piggeries, the latter figure may be available from feed commodity delivery records.

Alternatively, if these cells are left blank, the default values for the breeder pigs, and the calculated values for the grower pigs (as described below), will be used.  Table 7 shows the default feed ingested values for breeder pigs and suckers.

*Table 7. Default feed ingested values for breeder pigs and suckers.*

| Pig class | Feed ingested |
|---|---|
| | (kg 'as-fed'. pig-1. day-1) |
| Gilts | 2.50 |
| Boars | 2.30 |
| Gestating sows | 2.30 |
| Lactating sows | 6.30 |
| Suckers 1 | 0.018 |

[1] *Includes average 0.8 L. day$^{-1}$ sow milk + 0.018 kg. day$^{-1}$ creep.*

Estimates of the daily feed ingested and annual feed fed for the grower pigs are provided in the columns labelled 'Calculated / default values'. These values are calculated using Equation 2 (Appendix A), which was derived by fitting a polynomial curve to feed intake data provided by Willis (2025), modelling. The calculated values may be overridden by entering data in the 'Entered values' column.

It should be noted that all feed intake data is expressed on an 'as-fed' basis, rather than on a 'dry matter' basis. This means that the masses of feed fed include the moisture contents of the diet ingredients.

Annual feed usage values for individual classes of pigs and the whole piggery are provided in the table on the 'Feed details' sheet.

Feed conversion ratio (FCR) of the growing herd (wean to finish), Whole Herd Feed Conversion (HFC), which is reported on a dressed weight basis, and feed usage by breeders and total growers are provided below the table on this sheet. To assist users in ensuring realistic FCR of the growing herd and HFC values are being calculated for the model run, a rating score is provided on the right based on current (2025) production data from Australian piggeries. These ratings are shown in Table 8.

*Table 8. Feed conversion ratio (FCR) - wean to finish and Whole Herd Feed Conversion (HFC) ratings.*

| Feed Conversion Ratio (FCR) (wean to finish) | Whole Herd Feed Conversion (HFC) (dressed weight basis) | Rating |
|---|---|---|
| < 1.95 | < 3.0 | very good |
| 1.95 - 2.35 | 3.0 – 3.45 | good |
| 2.35 – 2.55 | 3.45 – 3.85 | average |
| 2.55 - 2.75 | 3.85 – 4.2 | fair |
| 2.7 – 3.0 | 4.2 – 4.5 | poor |
| > 3.0 | > 4.5 | very poor |

# 9. Water

The 'Water' sheet in PigBal 5 is not directly used in estimating the piggery manure production. It has been included to assist users in estimating the total water use in the piggery; a very important consideration for planning new or expanding developments and in assessing the environmental footprint of new and existing piggeries.

PigBal 5 uses Equation 7 (Appendix A), which was developed by Wiedemann et al. (2012), to estimate water intake for each class of pig, based on average pig feed intakes.

Drinking water wastage is likely to be influenced by a number of factors including drinker design, environmental factors such as temperature, and a range of pig social/behavioural factors. Wiedemann et al. (2012) reported wastage rates of 15 - 42% of the total drinking water supplied, based on determinations made by Li *et al.* (2005), which appear to match observations from Australian piggeries. Consequently, an average drinking water wastage rate of 25% is suggested as a default value for use in PigBal 5. Individual drinking water wastage rates for the various pig classes can be entered into the 'Wastage' column of the 'Water' sheet.

PigBal 5 provides an estimate of the cooling water use, based on recommendations contained in *'Plan it – Build it'* (Taylor *et al.* 1994). This Australian publication suggests spray cooling water use rates of 300 mL. $pig^{-1}$. $hour^{-1}$ for dry sows, boars, grower and finisher pigs, and similar drip cooling rates for farrowing sows. A value of 65 mL. $pig^{-1}$. $hour^{-1}$ is suggested for weaners.

PigBal 5 requires the user to enter the average number of hours per year that spray or drip cooling is likely to be used. The default figure is 540 hr per year, which is equivalent to 6 hr per day, over 90 days (3 months).

Known shed flushing and hosing volumes may be entered by the user in the appropriate cells. In some cases, it may be relatively simple to measure the dimensions of flushing tanks to determine the relevant flushing volume. It may be more difficult to measure hosing water without the use of a water meter. Because the hosing and drinking water may be supplied from the same pipeline in many piggeries, it may be difficult or impossible to accurately apportion the appropriate volumes to each use.

In cases where the daily flushing and hosing volumes are unknown or difficult to measure accurately, the user can estimate the shed effluent volume by choosing one of three different shed cleaning systems; *viz.* high flush, medium flush and low flush, from the drop-down list. PigBal 5 estimates the volume of effluent discharged from conventional sheds using the estimated total solids (TS) output (manure + waste feed) from the sheds (calculated on the 'DMDAMP' sheet) and the typical TS concentrations shown in Table 9 for the selected type of shed cleaning system.

*Table 9. Typical total solids and volatile solids concentrations for a range of conventional shed cleaning systems.*

| Cleaning system | TS | VS |
|---|---|---|
| High flush | 1.0% | 0.7% |
| Medium flush | 2.0% | 1.4% |
| Low flush | 3.0% | 2.1% |

Estimates of the moisture contents of the waste feed and manure, and the waste drinking water volume, are subtracted from the total effluent volume to determine the total cleaning (flushing + hosing) volume.

The user is also required to enter the percentage of the total cleaning water (flushing + hosing) obtained from recycled effluent.  This is used to calculate the volume of clean (non-recycled effluent) water used for cleaning.

The total clean water volume required for the operation of the piggery is determined by adding the volumes of drinking water intake, waste drinking water, clean water used for shed cleaning and water used for cooling.

# 10. Effluent pre-treatment

The raw effluent discharged from conventional piggery sheds may be processed in a pre-treatment system, to remove some of the suspended solids and nutrients, prior to discharge into an effluent pond. PigBal 5 allows the user to select, from a drop-down list, one of seven types of pre-treatment system. The pre-treatment options available in the drop-down list are presented in Table 10, along with typical solids and nutrient removal rates.

There is also provision for the user to enter alternative removal rates if more accurate performance data is available, or if an alternative pre-treatment system is being used. If the 'Known pre-treatment removal rates' cells are left blank, the typical values from Table 10 are adopted.

*Table 10. Typical percentages of solids and nutrients removed from raw piggery effluent by a range of pre-treatment systems which may be used in the Australian pork industry.*

| Pre-treatment system | TS | VS | N | P | K | References |
|---|---|---|---|---|---|---|
| Settling Basin | 55 | 70 | 20 | 40 | 3 | Kruger *et al.* (1995) |
| SEPS | 77 | 82 | 36 | 89 | 4 | Payne *et al.* (2008) |
| Static rundown screen | 20 | 25 | 8 | 11 | 0 | Casey et al. (1996) & Skerman & Collman (2006) |
| Vibrating screen | 20 | 25 | 8 | 11 | 0 | Casey *et al.* (1996) & Skerman & Collman (2006) |
| Screw press separator | 32 | 37 | 37 | 41 | 8 | NEGIP-SD (Tucker et al. 2025) |
| Baleen filter screen | 30 | 37 | 12 | 17 | 0 | NEGIP-SD (Tucker et al. 2025) |
| Rotating screen | 15 | 20 | 5 | 10 | 0 | NEGIP-SD (Tucker et al. 2025) |

PigBal 5 subtracts the solids and nutrients removed by the pre-treatment system from the effluent loading entering the downstream effluent treatment pond. The total masses of separated solids and nutrients are provided on this sheet.

# 11. Pond design

PigBal 5 provides three options for selecting an appropriate anaerobic pond activity ratio (k) for the piggery site. The first option requires the user to select the Australian state and locality where the piggery is located, from the drop-down lists. PigBal 5 automatically selects a k value for this locality, based on values published in the original PigBal user manual (Casey *et al.* 1996), as shown in Appendix B.

In the second option, which is consistent with the approach used in the NEGIP-SD (Tucker *et al.* 2025), the user simply selects a climate type (cool, warm or hot), using the drop-down list. Table 11 provides example localities for these three climate descriptions, along with the corresponding anaerobic activity ratio (k) values, based on Table 12.2 of the NEGIP-SD (Tucker *et al.* 2025).

*Table 11. Climate descriptions, anaerobic pond activity ratio (k) values and example locations, based on Table 12.2 of the NEGIP-SD (2025).*

| Climate | Anaerobic activity ratio (k) | Example localities |
|---|---|---|
| Cool | 0.6 | Armidale NSW, Southern & central Vic, Southern SA and Tasmania |
| Warm | 0.8 | Most of inland NSW, South-East Qld, SA and Southern WA |
| Hot | 1.0 | Central & northern Qld, Moree NSW and Goondiwindi Qld |

The third option allows the user to enter a known k value for use in the model. The 'user selected' option overrides both of the previously described options.

The anaerobic activity ratio (k) value is multiplied by the volatile solids (VS) loading rate to give an adjusted VS loading rate that accounts for the climate at the piggery site. In this way, the suggested VS loading rates are lower for cooler localities, to account for the reduced biological activity at lower temperatures.

PigBal 5 calculates primary anaerobic pond volumes and dimensions based on three different design concepts, *viz.* 'conventional large – Barth (1985a)', 'maximum loading' and 'covered anaerobic pond', which may be selected from a drop-down list. Table 12 outlines the recommended baseline VS loading rates and the adjusted VS loading rates for the various combinations of climates and design concepts. These loading rates were obtained by multiplying the anaerobic activity ratios from Table 11, by the baseline loading rates provided in Table 12.

*Table 12. Recommended anaerobic pond volatile solids loading rates for the various combinations of design concepts and climates.*

| Pond design concept | VS loading rate (kg VS. m-3. d-1) | | | |
|---|---|---|---|---|
| | **Baseline** | **Cool** | **Warm** | **Hot** |
| Conventional large | 0.10 | 0.06 | 0.08 | 0.10 |
| Maximum loading | 0.75 | 0.45 | 0.60 | 0.75 |
| Covered anaerobic pond | 0.40 | 0.24 | 0.32 | 0.40 |

The recommended VS loading rates for the 'conventional large' and 'maximum loading' options are consistent with the loading rates outlined in Tables 12.2 and 12.3 of the NEGIP-SD (Tucker *et al.* 2025). The recommended baseline loading rate for covered anaerobic ponds, shown in Table 12 of 400 g VS. $m^{-3}$. $day^{-1}$ ) is consistent with current design practice.

The minimum active treatment volume, based on VS loading, is calculated by dividing the VS loading entering the pond, by the suggested adjusted maximum VS loading rate.

In addition to the VS loading rate, the hydraulic retention time (HRT) is an important measure for designing anaerobic ponds. The HRT is calculated by dividing the active treatment volume by the pond inflow value determined in the 'Water' sheet. For effective anaerobic treatment, a minimum HRT of 40 days is suggested.

PigBal 5 assumes a sludge accumulation rate of 0.00137 $m^3$ per kg of TS added which is consistent with the value given in the ASABE Standards 2011 (ASABE 2011). The user is required to enter a pond desludging interval which is generally between two and ten years, depending on the producer's preferred sludge management practice. Shorter desludging intervals (e.g. 0.5 – 1.0 years) may be appropriate for covered anaerobic ponds equipped with suitable sludge extraction pipes. The desludging interval is used to determine the required sludge storage volume to be provided in the primary anaerobic pond.

PigBal 5 calculates the suggested total pond volume, which is the sum of the suggested active treatment and sludge storage volumes, based on meeting both the suggested VS loading rate and HRT design criteria. The user may then enter a selected total pond volume and PigBal 5 provides the resulting maximum and minimum VS loading rates and HRT values. The maximum VS loading rate occurs when the pond is storing the maximum sludge volume and the minimum VS loading rate occurs when the pond is storing no sludge, such as when it is first commissioned or directly following desludging. Conversely, the maximum HRT occurs when the pond is storing no sludge and the minimum HRT occurs when the pond is storing the maximum sludge volume. If any of these values fall outside of the suggested ranges, the cells containing the non-compliant values are highlighted and a warning appears.

In order to determine the dimensions of a rectangular-shaped pond, the user is required to enter the total pond storage depth, batter gradient, freeboard, and one of the side dimensions of the pond, measured at the embankment crest. PigBal 5 determines the other relevant dimensions for the proposed pond design, as shown in Figure 2.

If the user selects physically impossible pond dimensions for the required pond volume, resulting in negative dimensions for the pond base, PigBal 5 provides a warning message near the bottom of the sheet.

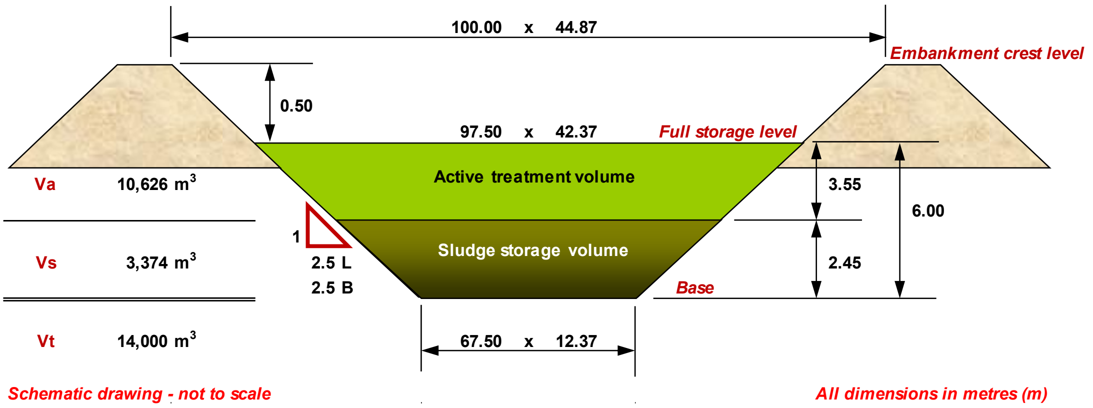


*Figure 2. An example of the schematic drawing of the primary anaerobic pond provided on the 'Anaerobic pond design' sheet of PigBal 5.*

## Secondary treatment / holding ponds

Effluent which overflows from primary anaerobic ponds is unsuitable for direct discharge into the environment or natural watercourses. Overflow from primary ponds should generally be directed into a secondary treatment or holding pond where the effluent is temporarily stored prior to carefully managed irrigation onto land growing crop or pasture. Most conventional piggeries require at least one anaerobic treatment pond and one secondary treatment or holding pond. In some cases, the overflow from the secondary pond may be directed into one or more subsequent ponds (connected in series) for further treatment or to provide additional effluent holding capacity. The final pond in the effluent treatment / storage system may be referred to as a wet weather storage pond.

In general, the second and any subsequent ponds should be designed to store all effluent discharged from the primary pond until the land is sufficiently dry to receive the irrigated effluent, or until agronomic conditions are favourable. In the winter-dominant rainfall areas of southern Australia, secondary / holding ponds may be required to store all effluent discharged from the primary pond for a period of up to six months, from late autumn until early spring. Secondary / holding ponds are generally designed using a (preferably daily) water balance approach, based on limiting overflows from secondary / holding ponds to a minimum interval of 10 years, on average, using historical rainfall and evaporation data for the piggery site. Various computer models may be used for this purpose. At environmentally sensitive sites, the minimum overflow interval may be increased to further reduce the potential for environmental harm.

# 12. Diet ingredient data

The ‘Diet ingredient data’ sheet is essentially a database providing the characteristics of a wide range of feed ingredients used in Australian pig diets. While a range of additional chemical concentrations and other data are provided on this sheet, PigBal 5 only uses the characteristics listed in Table 13 for estimating waste production. Various references for this data are listed at the bottom of the sheet.

*Table 13. Diet ingredient characteristics used by PigBal 5.*

| Characteristic | Abbreviation | Units | Calculation |
|---|---|---|---|
| Dry Matter | DM | % | |
| Gross Energy | GE | MJ/kg | |
| Digestible Energy | DE | MJ/kg | |
| Dry Matter Digestibility | DMD | % | DMD = DE / GE |
| Crude Protein | CP | % | |
| Nitrogen | N | % | N = CP / 6.25 |
| Ash (Fixed Solids) | Ash or FS | % | |
| Total Phosphorus | Total P | % | |
| Potassium | K | % | |

Two additional rows (shaded grey) are provided near the bottom of the sheet to allow users to enter data for extra diet ingredients that were not included in the original database.

# 13. Diet input

On the Diet input sheet, the user is required to enter the percentages of each ingredient included in the various diets fed to the pigs accommodated in the piggery. The proportions of each diet ingredient are entered as percentages of the 'as-fed' mass of the total diet for each class of pig. (The 'as-fed' mass, which includes the moisture content of each ingredient, is the feed mass generally used in diet formulation documentation produced by nutritionists and commercial feed companies.) The totals for each diet should add up to 100% and PigBal 5 gives a warning above any diet columns where this is not the case.

If the crude protein concentrations for any of the ingredients included in the diet formulation being entered into the model do not match the standard concentrations shown on the 'Diet input' sheet, alternate crude protein concentrations can be entered in the 'Alternate crude protein' column provided. For diet ingredients such as cereal grains, oilseed meals and animal and fish derived meals, crude protein percentages are commonly reported as a number following the diet ingredient name. For example, "sorghum 11", "soybean meal 46 solvent" and "fish meal 65" contain 11%, 46% and 65% crude protein, respectively. Crude protein levels entered in the 'Alternate crude protein' column override the standard values. The crude protein values are used to determine the nitrogen concentrations of the dietary ingredients, using the relationship outlined in Table 13.

Four standard diets have been incorporated into PigBal 5 for use in cases when detailed dietary data for a particular piggery may not be available for entry into the model. These diets developed by Willis (2025) from typical pig feed ingredient use around Australia. Full details of these diets are provided in Appendix C, while the main diet ingredients are summarised below:

- Diet A: wheat, barley, soybean meal – typical Southern Australia and general diets
- Diet B: barley, wheat, chick peas – typical Northern diets
- Diet C: barley, wheat, triticale, canola meal – typical South Australian diets
- Diet D: barley, wheat, lupins – typical Western Australia diets

Users can enter the standard diet data by clicking on one of the macro buttons provided at the top of the 'Diet input' sheet.

Standard diets A to D include data for suckers, weaners, porkers, growers, finishers, lactating sows, gestating sows and gilts. The gestating sow diet is also used for the boars, while the same sucker diet is used for each of the standard diets A to D.

PigBal 5 selects the standard diet for each class of grower pig, using the end live weights entered on the 'Herd input' sheet, based on the standard live weights outlined in Table 14.

*Table 14. Ages and live weights for the pig classes used in formulating standard diets A to D.*

| Diet | Pig age (weeks) | | Pig live weight (kg) | |
|---|---|---|---|---|
| | **Start** | **End** | **Start** | **End** |
| Sucker | 2 | 6 | 2 | 19 |
| Weaner | 6 | 10 | 19 | 35 |
| Porker | 10 | 14 | 35 | 60 |
| Grower | 14 | 18 | 60 | 85 |
| Finisher | 18 | 22 | 85 | 110 |

# 14. DMDAMP

Barth (1985b) proposed the Digestibility Approximation of Manure Production (DAMP) technique, which was arguably the first method used to predict the organic content of excreted manure from animal production data. This technique used the total digestible nutrient (TDN) content of the feed ingredients in its calculations.

Over time, it became apparent that the DAMP model needed improvement. Sinclair (1997) concluded that the DAMP technique, which used TDN values, was an inadequate means of providing accurate estimates of the basic manure characteristics of TS, VS and FS. van Sliedregt et al. (2000) developed a new digestibility model which used the dry matter digestibility (DMD) of each feed ingredient, rather than the TDN value. The DMD approximation of manure production (DMDAMP) predicts the amount of TS, VS and FS excreted by animals using DMD instead of TDN values of individual ingredients (McGahan *et al.* 2000, 2001; McGahan and van Sliedregt 2000; van Sliedregt *et al.* 2001) conducted measurements of manure production at a finisher section (500 finisher pigs) of a 2000 sow commercial piggery to test the developed DMDAMP model.

No data entries are required on the 'DMDAMP' sheet; however, the majority of calculations to determine the ingested feed, waste feed, excreted manure and total waste discharged from the sheds, are carried on this sheet using Equations 10 to 17, as shown in Appendix A.

# 15. Output summary

No data entries are required on this sheet.

The 'Output summary' sheet provides summaries of the masses of TS, FS, VS, N, P and K in the feed ingested, feed wasted, manure excreted, manure excreted plus waste feed (before shed losses), effluent discharged from conventional sheds, separated solids, effluent discharged to primary pond, deep litter added to sheds and spent litter removed from deep litter sheds.

Stacked bar graphs show the proportions of waste feed and manure TS, FS, VS, N, P and K in the shed effluent. A second set of bar graphs compares the TS, FS, VS, N, P and K in the excreted manure plus the waste feed deposited in the sheds (excluding shed losses) predicted by the model, with values predicted by PigBal 5 using a 10,000 sow farrow to finish example using Diet A.

# 16. Nutrient and solids flow

On the Nutrients and solids flow sheet, the user is required to enter a number of percentages that are either loss rates or partitioning of nutrients and solids at various stages of treatment and management for effluent, separated solids, pond sludge, and spent deep litter.

The purpose of this sheet is to provide the user with estimates of the amount of nutrients and solids available for various by-products generated at a piggery, depending on the housing system and treatment/management processes.

This sheet uses the production of nutrients and solids from the 'Output summary' sheet. Typical solids and nutrients partitioning, loss rates and moisture content then used to estimate the amount and nutrient composition of the various by-products generated from the scenario piggery.

Table 15 provides the user with typical solids and nutrients partitioning, loss rates and moisture contents along the treatment and utilisation processes. These values are pre-entered in PigBal but can be changed. Users should justify any major variations from the values provided.

*Table 15. Typical solids and nutrients partitioning, loss rates and moisture contents along the treatment and utilisation processes.*

| Input variable (%) | m/c[1] | TS | VS | N | P | K | Notes/References |
|---|---|---|---|---|---|---|---|
| **Separated solids** | | | | | | | |
| Moisture content | 30 | | | | | | Piggery assessment spreadsheet (Skerman 2019) |
| Spreading loss rates | - | Calc[2] | 20 | 20 | 0 | 0 | Piggery assessment spreadsheet (Skerman 2019) |
| **Fresh effluent** | | | | | | | |
| Irrigation loss rates | - | Calc[2] | 10 | 20 | 0 | 0 | NEGIP-SD (Tucker *et al.* 2025) |
| Loss rates from soil surface | - | 0 | 0 | 20 | 0 | 0 | Piggery assessment spreadsheet (Skerman 2019) |
| **Primary pond sludge** | | | | | | | |
| Partitioned to sludge | - | 13.1 | 6.9 | 23.5 | 85 | 5 | Casey et al. (1996) |
| Removal/storage/drying/compost loss | - | Calc[2] | 20 | 60 | 0 | 0 | Piggery assessment spreadsheet (Skerman 2019) |
| Moisture content | 30 | | | | | | Piggery assessment spreadsheet (Skerman 2019) |
| Spreading loss rates | - | Calc[2] | 10 | 20 | 0 | 0 | Piggery assessment spreadsheet (Skerman 2019) |
| **Pond supernatant** | | | | | | | |
| Evaporative pond loss rate[3] | 20 | | | | | | This value is site dependent and can be calculated from water balance modelling |
| Gaseous pond loss rate | - | Calc[2] | 70 | 60 | 0 | 0 | Piggery assessment spreadsheet (Skerman 2019) |
| Irrigation loss rates | - | Calc[2] | 10 | 20 | 0 | 0 | Piggery assessment spreadsheet (Skerman 2019) |
| Loss rates from soil surface | - | 0 | 0 | 20 | 0 | 0 | Piggery assessment spreadsheet (Skerman 2019) |
| **Deep litter sheds/shelters** | | | | | | | |
| Stockpile/compost loss | - | Calc[2] | 10 | 30 | 0 | 0 | NEGIP-SD (Tucker *et al.* 2025) |
| Application loss rate | - | Calc[2] | 10 | 20 | 0 | 0 | Piggery assessment spreadsheet (Skerman 2019) |
| Moisture content | 40 | | | | | | NEGIP-SD (Tucker *et al.* 2025) |

*Notes:*

*1 - m/c = moisture content*

*2 Calc = Calculated from VS loss and VS:TS ratio*

*3 Evaporative pond loss rate = The nett evaporation loss, which is Pan evaporation minus rainfall.*

# 17. GHG input

On the GHG Input sheet the user is required to input energy use and transport values, as well as manure management (both solids and effluent) in order to calculate both the Scope 1 and 2 greenhouse gas (GHG) emissions for the piggery.

Scope 1 emissions are the direct GHG emissions from sources a company/business it owns or controls. The main Scope 1 emissions for a piggery are those associated with manure management. Other Scope 1 emissions include the consumption (burning) of fossil fuels in stationary engines and transportation, including the transportation of pigs to processing plants.

Scope 2 emissions are those from the purchase of electricity. Although these emissions occur at the facility where energy is generated (e.g. power station), they are attributed to the company/business that consumes the energy.

The location (state) the farm is located is important, as each state electricity supply has a different GHG emission profile. If the farm is in one state and the electricity is supplied from a neighbouring state (e.g., the piggery is located on / very near to a State border), enter the state where the electricity is purchased from.

Ensure energy purchase values enter are in the correct units. Electricity consumption must be entered as kWh (these values should be available from invoices).

For the transport of pigs to processing plants, this may be contracted to commercial suppliers and the volume of diesel consumed unknown. If this is the case, enter the typical vehicle type (e.g. B-double, semi-trailer) and the average distance (one-way) from the farm to the processing plant. The amount of diesel used annually will then be estimated.

The secondary management of effluent / spent litter also generates Scope 1 emissions, including the stockpiling and composting of solids and the irrigation of liquid effluent. Land application of solid manure by-products is not considered a Scope 1 emission for the piggery enterprise, as these emissions are attributable to the crop or pasture that is grown on the utilisation area and this activity does not occur within the core pig production system.

# 18. GHG output – Scope 1 & 2

No data entries are required on this sheet.

The 'GHG Output – Scope 1 & 2' sheet provides a summary of the piggery operation's Scope 1 and 2 GHG emissions. These emissions are split into:

- Enteric methane
- Manure management methane
- Manaure management nitrous oxide, and
- Piggery services

A stacked bar graph is also provided that shows the Scope 1 and 2 GHG emissions graphically.

Total Scope 1 and 2 emissions, also referred to as a **carbon account,** represent the total amount of GHG emissions arising from a business over a twelve-month period, and are typically reported in tonnes of carbon dioxide equivalent (t $CO_2$-e). The carbon account covers emissions associated with the activities within a business' control. For a piggery, this includes emissions from gas, electricity, and fuel use, enteric methane from pigs, and emissions from housing and manure management systems. It does not include emissions that occur outside the piggery boundary (e.g., crop production).

A **carbon footprint** measures the GHG emissions associated with a product across its lifecycle. A carbon footprint of pig production is typically reported as kg $CO_2$-e/kg liveweight. The carbon footprint of pig production would include all emissions that occur at the piggery, as well as 'upstream' and 'downstream' emissions (Scope 3). An example of an upstream emissions are emissions from feed grain production. An example of downstream emissions are emissions associated with meat processing. A carbon footprint includes all emissions relating to the production of the pigs, from extraction of raw materials up to the point where the pigs leave the producer's operation control. **PigBal 5 does not provide a carbon footprint.0**

# 19. Covered pond GHG abatement and potential

The ‘CAP Methane Potential’ sheet performs the calculations to determine the potential GHG abatement by installing impermeable covers on uncovered anaerobic effluent treatment ponds (or lagoons) to capture the biogas emissions from the pond surface.

To achieve the abatement requires the installation and operation of covers and gas capture and combustion equipment for existing uncovered treatment lagoons or, alternatively, the replacement of conventional lagoons with covered lagoon systems or engineered digesters. Piggery operators can use the captured biogas to produce heat and electricity, or destroy it through the use of flares.

PigBal 5 can assist proponents by determining the potential volume of methane abatement and the equivalent tonnage of carbon dioxide equivalent [CO2-e] that would be released from the operation of an uncovered anaerobic treatment lagoon.

Provision has been included on this sheet to enter the current value of the global warming potential of methane (GWPCH4) specified in the National Greenhouse Accounts Factors . This value is used to calculate the carbon dioxide equivalence value of the estimated methane abatement. The current (April 2025) value is 28; however, this value may change from time to time. Consequently, it is the user's responsibility to ensure that the current value is entered in this cell.

PigBal also calculates the maximum theoretical methane potential generated from a CAP or digester.

# 20. References


ASABE (2011) Design of Anaerobic Lagoons for Animal Waste Management ASAE ANSI/ASAE EP403.4 (R2020). St. Joseph, Michigan.

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# Appendix A Key equations used in PigBal 5

## A.1 'Herd input' sheet

Based on the entered ADG value, PigBal 5 uses Equation 1 to calculate predicted live weights at the ends of each of the growth stages previously entered into the model. This equation was originally developed from standard growth curves published in the Australian pig industry diary (Richards 2012). These have been modified with data provided by Willis (2025) to match current pork production.

$$Live\ weight = (-0.00003006 \times ADG + 0.01248448506) \times Age^3 + (-0.000000811 \times ADG^2 + 0.002090904273 \times ADG - 0.6502866461) \times Age^2 + (0.000000029 \times ADG^3 - 0.000042999 \times ADG^2 + 0.0194860819 \times ADG - 2.5845091041) \times Age + (-0.0000000384 \times ADG^3 + 0.000053716 \times ADG^2 - 0.0223500993 \times ADG + 4.9852264783) \quad \textbf{Equation 1}$$

Where:

*Live weight* = pig live weight (kg. $pig^{-1}$)

*ADG* = pig average daily live weight gain (g. $day^{-1}$) [birth to 100 kg live weight]

*Age* = pig age (weeks)

The predicted growth curve for the selected ADG is plotted along with standard growth curves for a range of ADG values on the 'Growth chart' sheet. Figure A-1 shows the growth curves predicted using Equation 1 for a range of typical ADG values.

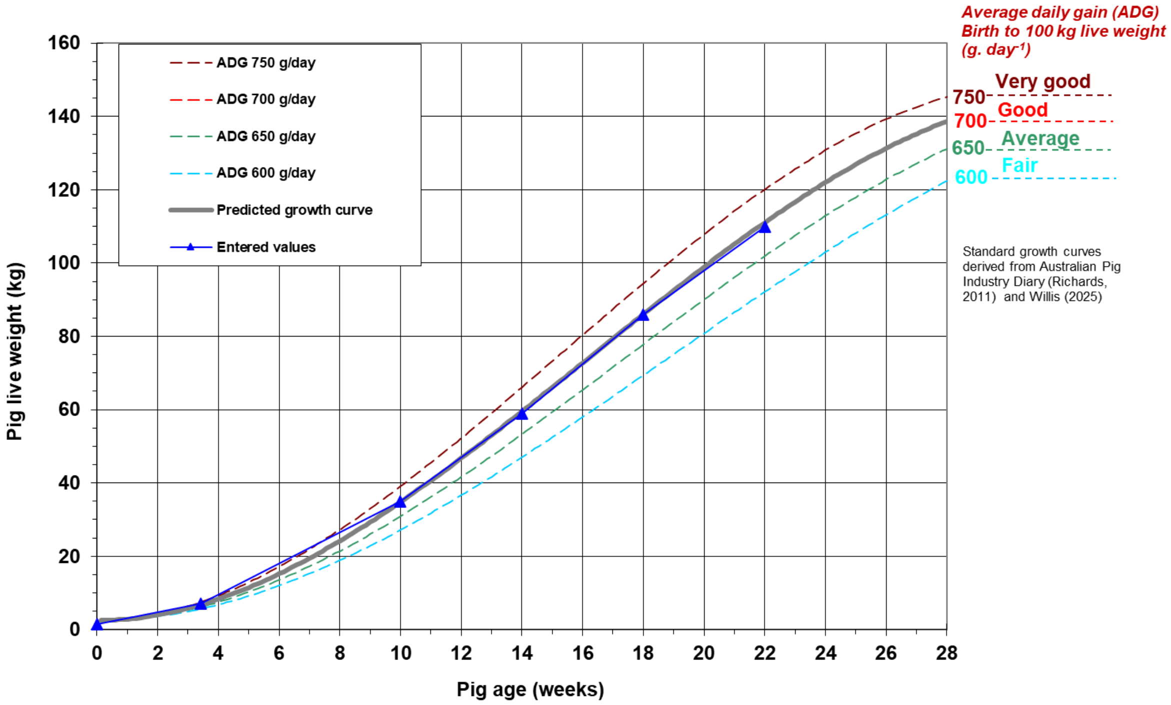


*Figure A-1. Growth curves predicted using Equation 1 for a range of typical ADG values*

## A.2 'Herd details' sheet

The 'Herd details' sheet includes SPU calculations using the standard SPU factors published in Table 5.2 of the NEGIP-SD (Tucker *et al.* 2025). Two methods are used for selecting the SPU factors for the grower herd. The first method uses the end live weight for each class of pig, while the second method uses a regression equation (Equation 2) developed using the average live weights of pigs in each class. Figure A-2 is a plot of this relationship.

$$SPU\ factor = 0.0000001837 \times Live\ weight^3 - 0.0001685623 \times Live\ weight^2 + 0.0329143124 \times Live\ weight - 0.0333791203 \quad \textbf{Equation 2}$$

Where:

*SPU factor* = SPU factor (SPU. $pig^{-1}$)

*Live weight* = pig live weight (kg. $pig^{-1}$)

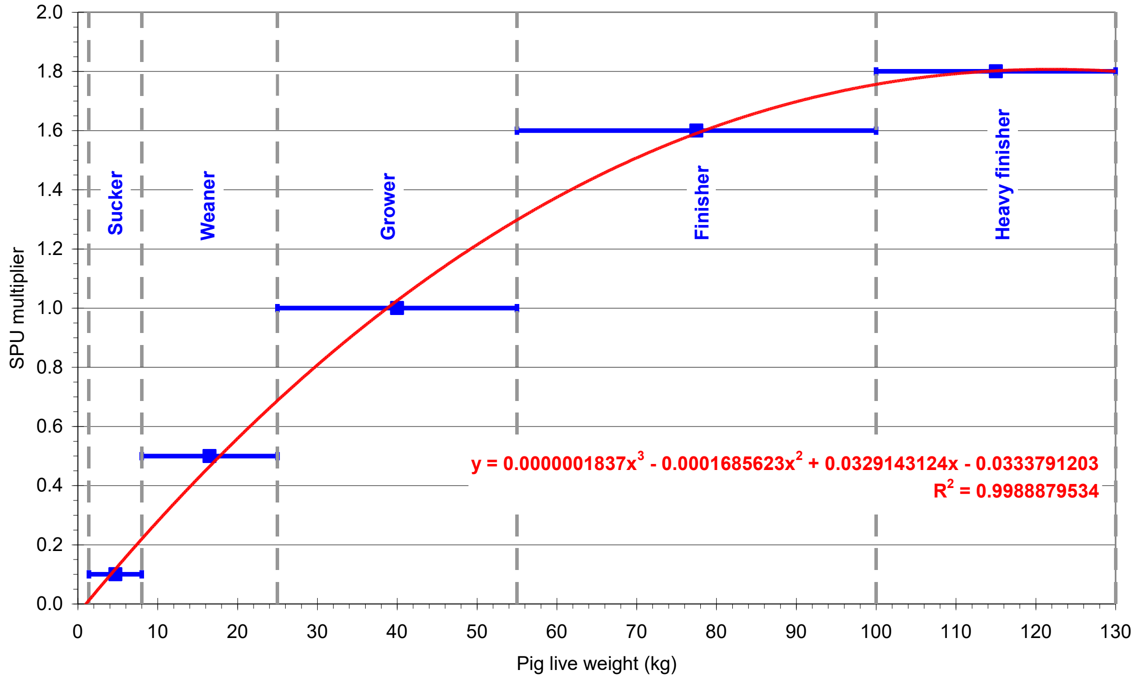


*Figure A-2. Plot of regression equation developed for determining SPU multipliers, based on average live weights for standard grower pig classes.*

## A.3 'Feed details' sheet

Estimates of the feed ingested by the grower pigs are calculated using Equation 3, which was derived by fitting a polynomial curve to feed intake data provided by Willis (2025) based on AUSPIG (Davies *et al.* 1998) modelling. Figure A-3 is a graphical representation of this relationship.

*Feed intake = -0.00006 x live weight² + 0.0334 x live weight + 0.1301* ............................ ***Equation 3***

$$\text{Feed intake} = -0.00006 \times \text{live weight}^2 + 0.0334 \times \text{live weight} + 0.1301$$

Where:

*Feed intake* = feed ingested (kg 'as-fed'. $pig^{-1}$. $day^{-1}$)

*live weight* = pig live weight (kg. $pig^{-1}$)

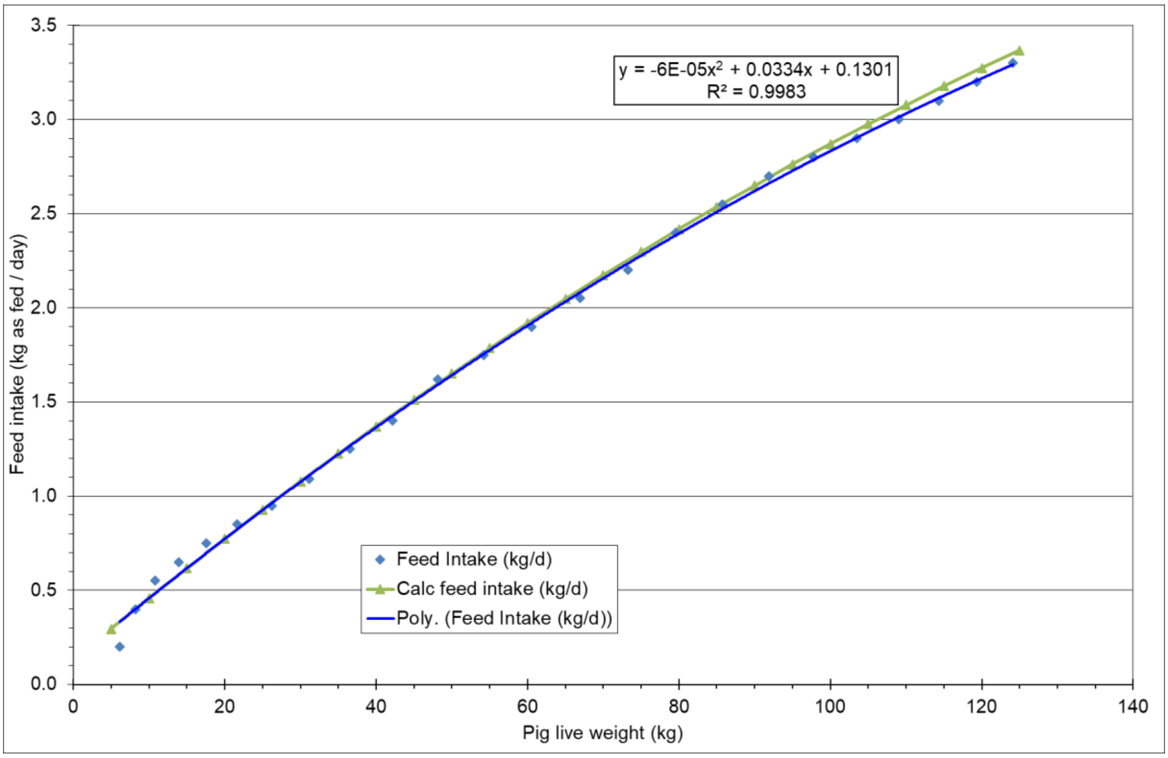


*Figure A-3. Relationship between feed intake and live weight, developed from data provided by* Willis (2025)*, based on AUSPIG modelling.*

To assist users in estimating a realistic feed wastage value, a relationship was developed between feed wastage, the ADG value entered in the 'Herd input' sheet and the FCR value entered on the 'Feed details' sheet. The first step in developing this relationship involved using equations 1 and 3 to develop equation 4, which can be used to calculate feed intake for selected ADG and age values. This relationship has been plotted in Figure A-4 for a range of ADG values.

$$Feed\ intake = (0.000000000071189 \times ADG^2 - 0.00000002477377 \times ADG - 0.000004038661444) \times Age^4 + (-0.000000001002912 \times ADG^2 - 0.000002881954697 \times ADG + 0.001438856666767) \times Age^3 + (-0.000000060875126 \times ADG^2 + 0.000145742239164 \times ADG - 0.047938044293907) \times Age^2 + (0.000000001800819 \times ADG^3 - 0.000002774275076 \times ADG^2 + 0.001272505833082 \times ADG - 0.171629578799318) \times Age + (-0.000000002188792 \times ADG^3 + 0.000003175842546 \times ADG^2 - 0.001355216082386 \times ADG + 0.304300173002773)$$ ........................................................ **Equation 4**

Where:

*Feed intake* = Feed ingested by pigs (kg. $pig^{-1}$. $day^{-1}$)

*ADG* = Average daily live weight gain (g. $day^{-1}$) [birth to 100 kg live weight]

*Age* = pig age (weeks)

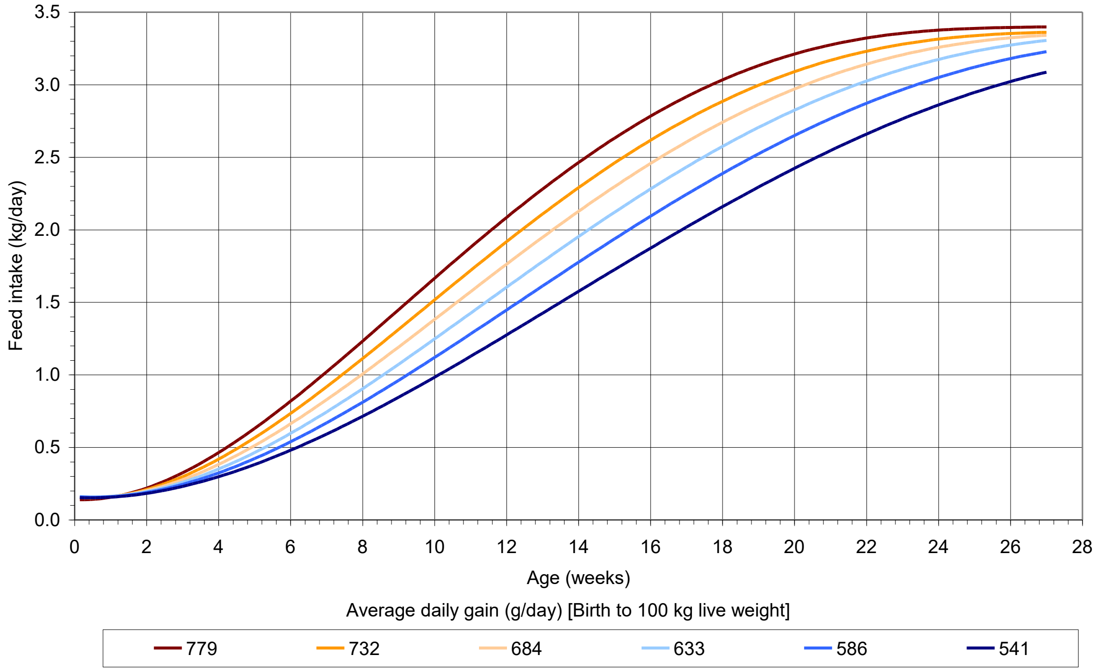


*Figure A-4. Relationship between feed intake and age at a range of average daily gains, based on Equation 4.*

The total feed intake from birth to 100 kg live weight can be determined by integrating the graphs shown in Figure A-4 between birth (age = 0 weeks) and the age at which the pigs reach a live weight of 100 kg, which can be calculated using Equation 5. Equation 6 can then be used to determine the total feed intake from birth to 100 kg live weight.

$$Age_{100} = (((100 - 1.4) \times 1000) / ADG) / 7 \quad \textbf{Equation 5}$$

Where:

$Age_{100}$ = Pig age at 100 kg live weight (weeks)

1. $ADG$ = average daily live weight gain ($g.\ day^{-1}$) [birth to 100 kg live weight]

$$Total\ feed\ intake = (((0.000000000071189 \times ADG^2 - 0.00000002477377 \times ADG - 0.000004038661444) \times Age_{100}^5) / 5 + ((-0.000000001002912 \times ADG^2 - 0.000002881954697 \times ADG + 0.001438856666767) \times Age_{100}^4) / 4 + ((-0.000000060875126 \times ADG^2 + 0.000145742239164 \times ADG - 0.047938044293907) \times Age_{100}^3) / 3 + ((0.000000001800819 \times ADG^3 - 0.000002774275076 \times ADG^2 + 0.001272505833082 \times ADG - 0.171629578799318) \times Age_{100}^2) / 2 + (-0.000000002188792 \times ADG^3 + 0.000003175842546 \times ADG^2 - 0.001355216082386 \times ADG + 0.304300173002773) \times Age_{100}) \times 7 \quad \textbf{Equation 6}$$

Where:

*Total feed intake* = Total feed intake from birth to 100 kg live weight ($kg.\ pig^{-1}$)

$ADG$ = average daily live weight gain ($g.\ day^{-1}$) [birth to 100 kg live weight]

$Age_{100}$ = Pig age at 100 kg live weight (weeks)

The total feed wasted can be calculated from Equation 7.

*Total feed wasted = Total feed fed – Total feed intake*
*= FCR x (100-1.4) – Total feed intake* ................................................ ***Equation 7***

Where:

*Total feed wasted* = Total feed wasted (kg. pig$^{-1}$) [birth to 100 kg live weight]

*Total feed fed* = Total feed intake from birth to 100 kg live weight (kg. pig$^{-1}$) from Eqn 4

*FC* = Feed conversion (birth to 100 kg live weight)

The total feed wastage (%) can be calculated from Equation 8.

*Total feed wastage = (Total feed wasted / Total feed fed) x 100*...................................... ***Equation 8***

Where:

*Total feed wastage* = Total feed wastage (%)

*Total feed wasted* = Total feed wasted (kg. pig$^{-1}$) from Eqn 6

*Total feed fed* = *Total feed wasted* + *Total feed intake* (kg. pig$^{-1}$)

Figure A-5 is a graph showing the resulting relationship between feed wastage and FCR for a range of ADG values. PigBal uses the equations described above to determine the estimated feed wastage, which is shown directly above the table on the 'Feed details' sheet.

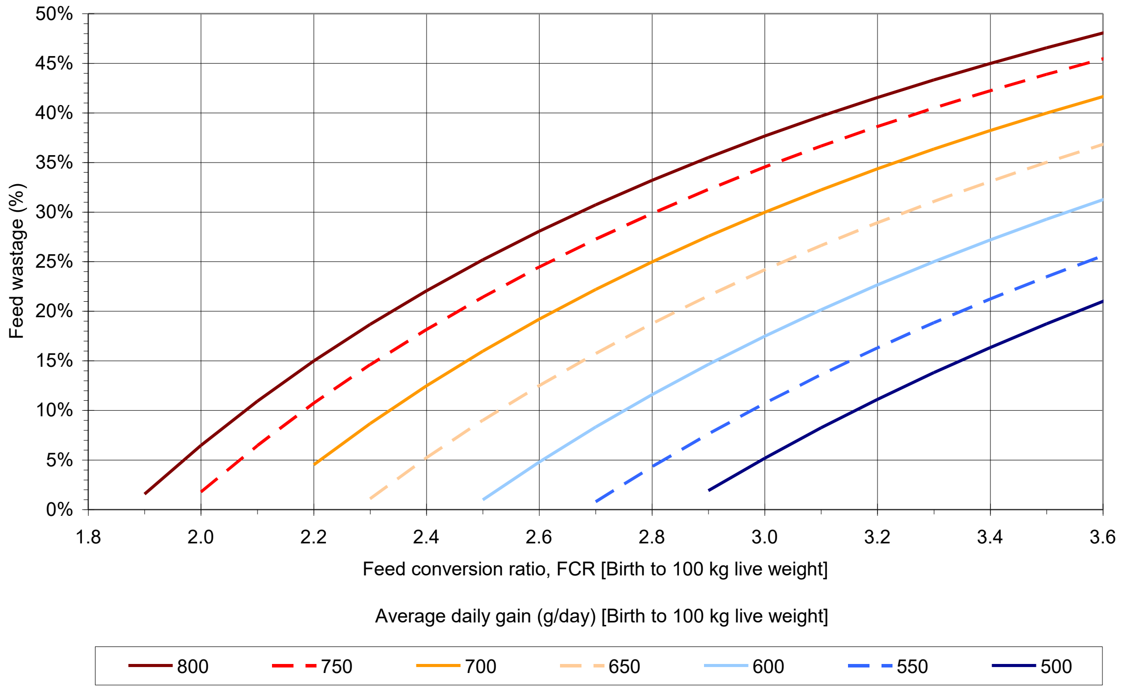


*Figure A-5. Generalised plot of feed wastage versus feed conversion for a range of ADG values.*

## A.4 'Water' sheet

PigBal 5 uses Equation 7, which was developed by Wiedemann et al. (2012), to estimate water intake for each class of pig, using the average pig feed intakes entered or calculated on the 'Feed details' sheet.

$WI = FI \times Wf \times Tf$ ........................................................................................................ **Equation 9**

Where:

*WI* = Water Intake (L. $pig^{-1}$. $day^{-1}$)

*FI* = Feed intake (kg 'as-fed'. $pig^{-1}$. $day^{-1}$)

*Wf* = Water Intake factor, (2.5 for growing pigs, 2.8 for gestating/lactating sows)

*Tf* = Temperature factor, (1.6 for lactating sows, 1.2 for all other pigs)

Wiedemann et al. (2012) provide the following explanation regarding the development of this equation:

> *Water use can be particularly variable in response to climate. This makes prediction quite difficult. However, for the purposes of this study a simple predictive formula was developed based on feed intake, with a climate adjustment factor. This formula varied for different classes of pigs based on data from a number of studies. For grower-finisher pigs, the ratio of water intake to feed was taken to be 2.5 after Braude et al. cited in National Research Council (1998).*
>
> *For dry sows, the ratio of water intake to feed was taken to be 2.8 after Van der Peet-Schwering et. al. cited in Froese et al. (2001), who suggested a water to feed ratio of 2.8 : 1 is sufficient for pregnant sows. Mroz et al. (1995) suggested that water consumption for lactating sows is at least 40% higher than that of non-lactating sows.*
>
> *All the available review data were sourced from northern hemisphere countries where ambient temperature is considerably lower than in Australia. To account for this, a factor of 1.2 was used in the drinking water equation for Australian conditions. This factor was derived from the Australian temperature response data in Vajrabukka et al. cited in National Research Council (1998).*

*Wf* (Water Intake factor) and *Tf* (Temperature factor) have been updated in PigBal 5 from further data provided by Willis (2025) and data collection of water usage at Australian piggeries by the authors over the last 10 years. These updated values (PigBal 5) and previous values (PigBal 4) are provided in Table A-1.

*Table A-1. Previous and updated Wf (Water Intake factor) and Tf (Temperature factor).*

| | **PigBal 4 values** | | **PigBal 5 values** | |
|---|---|---|---|---|
| | Wf | Tf | Wf | Tf |
| Gilts | 2.5 | 1.2 | 2.5 | 1.2 |
| Boars | 2.5 | 1.2 | 2.5 | 1.2 |
| Gestating sows | 2.8 | 1.2 | 2.8 | 1.5 |
| Lactating sows | 2.8 | 1.6 | 4.5 | 1.6 |
| Suckers | 2.5 | 1.2 | 4.0 | 1.0 |
| Weaner | 2.5 | 1.2 | 3.0 | 1.0 |
| Porker | 2.5 | 1.2 | 2.5 | 1.2 |
| Grower | 2.5 | 1.2 | 2.5 | 1.4 |
| Finisher | 2.5 | 1.2 | 2.5 | 1.4 |
| Unallocated | 2.5 | 1.2 | 2.5 | 1.4 |
| Unallocated | 2.5 | 1.2 | 2.5 | 1.4 |

## A.5 'DMDAMP' sheet

On this sheet, the following calculations are performed for each diet ingredient, and the results are added to determine total values for each pig class.

*TS ingested = % fed weight x Ingredient DM% x 100*...................................................... **Equation 10**

Where:

*TS ingested* = Total solids ingested by pigs (kg TS. 100 kg fed$^{-1}$)

*% fed weight* = ('as-fed' mass of ingredient / mass of total diet) x 100 (%)

(entered on '13. Diet input sheet')

*Ingredient DM%* = Dry matter (or total solids) content of each ingredient (%)

(from '12. Diet ingredient data' sheet.

*FS ingested = % fed weight x Ingredient FS% x 100*...................................................... **Equation 11**

Where:

*FS ingested* = Fixed solids ingested by pigs (kg FS. 100 kg fed$^{-1}$)

*% fed weight* = ('as-fed' mass of ingredient / mass of total diet) x 100 (%)

(entered on '13. Diet input sheet')

*Ingredient FS%* = Fixed solids (or ash) content of each ingredient (%) (from '12. Diet ingredient data' sheet.

*VS ingested = TS ingested – FS ingested*........................................................................ **Equation 12**

Where:

VS ingested = Volatile solids ingested by pigs (kg VS. 100 kg fed$^{-1}$)

*N ingested = % fed weight x Ingredient N % x 100*.......................................................... **Equation 13**

Where:

*N ingested* = Nitrogen ingested by pigs (kg N. 100 kg fed$^{-1}$)

*% fed weight* = ('as-fed' mass of ingredient / mass of total diet) x 100 (%)

(entered on '13. Diet input sheet')

*Ingredient N %* = Nitrogen content of each ingredient (%)

(from '12. Diet ingredient data' sheet.

Similar calculations are performed to determine phosphorus (P) and potassium (K) ingested values.

*TS excreted = TS ingested x (1 – DMD)*............................................................................ **Equation 14**

Where:

*TS excreted* = Total solids excreted by pigs (kg TS. 100 kg fed$^{-1}$)

*TS ingested* = Total solids ingested by pigs (kg TS. 100 kg fed$^{-1}$) (from Equation 10)

$DMD$ = Dry matter digestibility of each ingredient (%)

(Calculated as Digestible energy (DE) / Gross energy (GE) on '12. Diet ingredient data' sheet)

The majority of calculations to determine the ingested feed, waste feed, excreted manure and total waste discharged from the sheds, are carried out on the 'DMDAMP' sheet, using a range of equations to provide results in various units. The basic forms of the equations are outlined below, without specific units or conversion factors.

The amount of FS excreted is calculated by mass balance, as the difference between the amount in the ingested feed and the amount retained by the animal as live weight gain.

*FS excreted = FS ingested – FS retained* ........................................................................ ***Equation 15***

Where:

*FS excreted* = Fixed solids (or ash) excreted by pigs

*FS ingested* = Fixed solids (or ash) ingested by pigs

*FS retained* = Fixed solids retained by pigs as live weight gain

= Live weight gain x pig carcass fixed solids composition

The amount of VS excreted is calculated as the difference between TS and FS.

*VS excreted = TS excreted – FS excreted* ........................................................................ ***Equation 16***

The masses of nutrients (N, P and K) excreted are calculated by mass balance, as the difference between the amount in the ingested feed and the amount retained by the animal as live weight gain.

*Nutrient excreted = Nutrient ingested - Nutrient retained* ................................................ ***Equation 17***

Where:

*Nutrient ingested* = Mass of N, P or K ingested

= Mass of feed ingested x Feed N, P or K content

*Nutrient retained* = Mass of N, P or K retained by pigs as live weight gain

= Live weight gain x pig carcass N, P or K composition

## A.6 'GHG Output – Scope 1 & 2' sheet

The following calculations are performed by PigBal 5 to determine the direct (Scope 1 and 2) emissions for a piggery.

### Enteric Methane emissions

*$M = I / 1,000 \times 18.6 \times 0.007 / F \times GWP_{CH4}$* ***Equation 18*** *(Equation 3.A.3_1, p 221 NIR Vol. 1 (2024a))*

Where:

*M* = mass of enteric methane from swine in tonnes of $CO_2$-e ($tCO_2$-e).

*I* = quantity of feed ingested in kilograms of dry matter.

*18.6* = the assumed megajoules of gross energy per kilogram of swine for swine weighing 60 kg (MJ GE $kg^{-1}$).

*0.007* = methane conversion of gross energy intake.

*F* = Megajoules per kilogram of methane (MJ $kg^{-1}$ $CH_4$). The F value is 55.22 MJ $kg^{-1}$ $CH_4$ (Brouwer 1965).

$GWP_{CH4}$ = The global warming potential of methane. At time of publication, Australia used IPCC Fifth Assessment Report (AR5) GWPs in the NGAF (2024). This value is used for determining carbon dioxide equivalence of methane.

Note: Dividing I by 1,000 is necessary when reporting M in tonnes of $CO_2$-e, as ingested feed is reported in kilograms in PigBal 5.

### Manure methane emissions

*$M = VS \times Bo \times MCF \times \rho$* ***Equation 19*** *(Equation 3.B.3_1, p 238 NIR Vol. 1 (2024a))*

Where:

*M* = mass of methane that would be released from a manure management system in kilograms (kg $CH_4$) at standard conditions.

*VS* = quantity of volatile solids in kilograms.

*Bo* = the maximum methane-producing capacity from VS, in units of cubic metres of methane per kilogram of VS ($m^3$ $CH_4$. kg $VS^{-1}$). The Bo factor for pigs is 0.45 as cited in the NIR (2024a).

*MCF* = methane conversion factor which reflects the portion of Bo that is achieved under temperature and treatment specifications.

For uncovered anaerobic ponds lagoons and outdoor systems ,MCF is variable depending on the state or territory (Table A5.5.5.7 from the NIR Vol II (2024b)).

For CAPs and digester, MCF is 0.9 from the NIR Vol II (2024b)), which assumes 10% of methane is lost from CAPs and digesters.

For deep litter, stockpile (solid storage), and sHRT systems, MCF is 0.04, 0.02 and 0.03, respectively, from the NIR Vol II (2024b)).

$\rho$ = Density of methane at standard conditions (p = 0.6784 $kg.m^{-3}$) (NIR (2024a).

$E = GWP_{CH4} \times M / 1,000$ **Equation 20** (Equation 3.B.3_2, p 238 NIR Vol. 1 (2024a)

Where:

$E$ = methane emissions released from a piggery manure management system, in tonnes of $CO_2$-e.

$M$ = mass of methane released from a manure management system in kilograms (kg $CH_4$) at standard conditions, calculated using Equation 3.B.3_1.

$GWP_{CH4}$ = The global warming potential of methane. At time of publication, Australia used IPCC Fifth Assessment Report (AR5) GWPs in the NGAF (2024). This value is used for determining carbon dioxide equivalence of methane.

Note: Dividing M by 1,000 is necessary when reporting E in tonnes of $CO_2$-e, as M is reported in kilograms.

### Manure direct nitrous oxide emissions

$Total_{MMS}$ = AE / 1,000 x NOF x Cg x $GWP_{N2O}$ **Equation 21** (Equation 3.B.3_4, p 239 NIR Vol. 1 (2024a))

Where:

$Total_{MMS}$ = mass of nitrous oxide released from a manure management system at standard conditions, in tonnes of $CO_2$-e.

*AE* = nitrogen from swine manure and waste feed in kilograms.

*NOF* = nitrous oxide emissions factor for swine, dependent on the type of manure management system at the piggery, specified in Table A5.5.5.8 of the NIR, Vol II (2024a).

*Cg* = factor to convert elemental mass of nitrous oxide to molecular mass (44/28).

$GWP_{N2O}$ = The global warming potential of nitrous oxide ($N_2O$) At time of publication, Australia used IPCC Fifth Assessment Report (AR5) GWPs NGAF (2024). This value is used for determining carbon dioxide equivalence of $N_2O$.Note: Dividing by 1,000 is necessary when reporting $Total_{MMS}$ in tonnes of $CO_2$-e, as AE is reported in kilograms.

### Services GHG emissions

Scope 1 – stationary combustion of gaseous and liquid fuels:

*t $CO_2$-e = (Q x EC x EF) / 1,000.**Equation 22** (p 22 National Greenhouse Accounts Factors - NGAF (2024))*

Where:

*t $CO_2$-e* = emissions of each gas type, from each fuel type, in tonnes of $CO_2$-e.

*Q* = the quantity of fuel used (e.g. tonnes, cubic metres, gigajoules or kilolitres).

*EC* = the energy content factor of the fuel (gigajoules per unit of fuel type) according to Tables 5 and 8 of the NGAF (2024) for gaseous and liquid fuels, respectively.

*EF* = the combined Scope 1 emission factor, in kilograms of $CO_2$-e per gigajoule, for each gas and fuel type as per Table 5 and 8 of the NGAF (2024).

Note: If Q is specified in gigajoules, then EC is 1. Dividing by 1,000 is necessary when reporting in tonnes of $CO_2$-e, as EFs are reported in kg $CO_2$-e.

Scope 1 – combustion of transport fuels.

*t $CO_2$-e = (Q x EC x EF) / 1,000...................................................... **Equation 22** (p 22 NGAF (2024))*

Where:

*t $CO_2$-e* = emissions of each gas and fuel type, in tonnes of $CO_2$-e.

$Q$ = the quantity of fuel used, measured in kilolitres or gigajoules, and combusted for transport energy purposes.

$EC$ = the energy content factor of the fuel type (gigajoules per kilolitre or per cubic metre) used for transport energy purposes, according to Table 9 of the NGAF (2024)

$EF$ = the combined Scope 1 emission factor, in kilograms of $CO_2$-e per gigajoule, for each gas and fuel type as per Table 9 of the NGAF (2024).

Note: If Q is specified in gigajoules, then EC is 1. Dividing by 1,000 is necessary when reporting in tonnes of $CO_2$-e, as EFs are reported in kg $CO_2$-e.

Scope 2:

$t\ CO_2\text{-}e = (Q \times EF) / 1{,}000$ ***Equation 23*** *(p 10 NGAF (2024))*

Where:

$t\ CO_2\text{-}e$ = emissions from purchased grid electricity, in tonnes of $CO_2$-e.

$Q$ = the quantity of electricity purchased and consumed during the year, in kilowatt hours (kWh).

$EF$ = the Scope 2 emission factor, in kilograms of $CO_2$-e emissions per kWh, as per Table 1 of the NGAF (2024).

Note: Dividing by 1,000 is necessary when reporting in tonnes of $CO_2$-e, as EFs are reported in kg $CO_2$-e.

## A.7 'Covered Pond Methane Abatement and Potential' sheet

The following calculations are performed by PigBal 5 to provide information for piggery operators in determining both the likely GHG abatement potential if installing a new covered anaerobic pond (CAP) at a proposed or existing piggery development, as well as the maximum methane that could be generated from a CAP or digester. The variables have been described for consistency with the NIR, Vol 1 (2024a), and cross references for the equation numbers are provided.

The equations for abatement potential are:

$M_{UC} = VS \times Bo \times MCF_{UC} \times \rho$ .................. **Equation 24** *(Equation 3.B.3_1, p 238 NIR Vol. 1 (2024a))*

Where:

$M_{UC}$ = mass of methane released from an uncovered anaerobic treatment lagoon in kilograms (kg $CH_4$) at standard conditions.

*VS* = quantity of volatile solids in kilograms.

*Bo* = the maximum methane-producing capacity from VS, in units of cubic metres of methane per kilogram of VS ($m^3$ $CH_4$. kg $VS^{-1}$). The Bo factor for pigs is 0.45 (NIR (2024a)).

$MCF_{UC}$ = methane conversion factor which reflects the portion of Bo that is achieved under temperature and treatment specifications.

For uncovered anaerobic ponds / lagoons this is variable depending on the state or territory.

ρ = Density of methane at standard conditions. This is 0.6784 in kg.$m^{-3}$ (NIR (2024a)).

$E = GWP_{CH4} \times M_{UC}$ .................... / 1000 **Equation 25** *((Equation 3.B.3_2, p 238 NIR Vol. 1 (2024a))*

Where:

*E* = methane emissions released from an uncovered anaerobic treatment lagoon, in tonnes of $CO_2$-e.

$M_{UC}$ = mass of methane released from an uncovered anaerobic treatment lagoon in kilograms (kg $CH_4$) at standard conditions.

$GWP_{CH4}$ = The global warming potential of methane. At time of publication, Australia used IPCC Fifth Assessment Report (AR5) GWPs in the NGAF (2024). This value is used for determining carbon dioxide equivalence of methane.

Similar calculations are used to estimate the methane generation potential for a CAP or digester:

$M_{CAP} = VS \times Bo \times MCF_{CAP} \times \rho$ ............... **Equation 26** *(Equation 3.B.3_1, p 238 NIR Vol. 1 (2024a))*

Where:

$M_{CAP}$ = mass of methane released from a CAP or digester in kilograms (kg $CH_4$) at standard conditions.

*VS* = quantity of volatile solids in kilograms.

*Bo* = the maximum methane-producing capacity from VS, in units of cubic metres of methane per kilogram of VS ($m^3$ $CH_4$. kg $VS^{-1}$). The Bo factor for pigs is 0.45 (NIR (2024a)).

$MCF_{CAP}$ = methane conversion factor which reflects the portion of Bo that is achieved under temperature and treatment specifications.

For CAPs and digester, MCF is 0.1 (NIR (2024b)), assuming 10% of methane is lost from CAPs and digesters.

ρ = Density of methane at standard conditions. This is 0.6784 in $kg.m^{-3}$ (NIR (2024a)).

$E = GWP_{CH4} \times M_{CAP}$................... / 1000 ***Equation 27*** *((Equation 3.B.3_2, p 238 NIR Vol. 1 (2024a))*

Where:

$E$ = methane emissions released from an CAP or digester, in tonnes of $CO_2$-e.

$M_{CAP}$ = mass of methane released from a CAP or digester in kilograms (kg $CH_4$) at standard conditions.

$GWP_{CH4}$ = The global warming potential of methane. At time of publication, Australia used IPCC Fifth Assessment Report (AR5) GWPs of the NGAF (2024). This value is used for determining carbon dioxide equivalence of methane.

# Appendix B Appendix B – Anaerobic pond activity ratios

*Table B-1. Anaerobic pond activity ratios (k) for locations throughout Australia. (Casey et al. 1996)(Casey et al. 1996)(Casey et al. 1996)*

| State / Territory | Locality | Latitude | Longitude | K value | Climate |
|---|---|---|---|---|---|
| Australian Capital | Canberra | -35.20 | 149.10 | 0.58 | Cool |
| Australian Capital | Gudgenby | -35.45 | 148.59 | 0.40 | Cool |
| New South Wales | Albury | -36.05 | 146.55 | 0.75 | Warm |
| New South Wales | Ardlethan | -34.21 | 146.54 | 0.74 | Warm |
| New South Wales | Armidale | -30.31 | 151.38 | 0.61 | Cool |
| New South Wales | Badgerys Creek | -33.52 | 150.44 | 0.78 | Warm |
| New South Wales | Balranald PO | -34.38 | 143.34 | 0.78 | Warm |
| New South Wales | Baradine Forest | -30.57 | 149.04 | 0.82 | Warm |
| New South Wales | Barraba PO | -30.23 | 150.36 | 0.73 | Warm |
| New South Wales | Bathurst | -33.25 | 149.34 | 0.62 | Cool |
| New South Wales | Bega | -36.40 | 149.50 | 0.70 | Warm |
| New South Wales | Bellangry Brie | -31.20 | 152.35 | 0.84 | Warm |
| New South Wales | Bellingen PO | -30.27 | 152.54 | 0.89 | Warm |
| New South Wales | Berrigan PO | -35.39 | 145.48 | 0.73 | Warm |
| New South Wales | Bingara PO | -29.52 | 150.34 | 0.87 | Warm |
| New South Wales | Black Spring SF | -33.51 | 149.44 | 0.44 | Cool |
| New South Wales | Blayney PO | -33.32 | 149.16 | 0.48 | Cool |
| New South Wales | Bombala (Chusan) | -36.54 | 149.14 | 0.48 | Cool |
| New South Wales | Bourke | -30.06 | 145.57 | 0.99 | Hot |
| New South Wales | Brewarrina | -29.57 | 146.52 | 0.96 | Hot |
| New South Wales | Broken Hill | -31.57 | 141.25 | 0.84 | Warm |
| New South Wales | Broken Hill Aero | -31.54 | 141.36 | 0.83 | Warm |
| New South Wales | Burrinjuck Dam | -35.00 | 148.36 | 0.65 | Cool |
| New South Wales | Cabramurra (SMC) | -35.56 | 148.23 | 0.33 | Cool |
| New South Wales | Campbelltown | -34.05 | 150.49 | 0.77 | Warm |
| New South Wales | Cessnock PO | -32.50 | 151.21 | 0.86 | Warm |
| New South Wales | Clarence Heads | -29.26 | 153.22 | 0.92 | Hot |
| New South Wales | Cobar | -31.30 | 145.49 | 0.89 | Warm |
| New South Wales | Coffs Harbour | -30.19 | 153.08 | 0.86 | Warm |
| New South Wales | Collarenebri | -29.33 | 148.35 | 0.98 | Hot |
| New South Wales | Condobolin PO | -33.05 | 147.09 | 0.82 | Warm |
| New South Wales | Coolah Bowl Club | -31.50 | 149.43 | 0.67 | Cool |
| New South Wales | Coolongalook SF | -32.12 | 152.12 | 0.77 | Warm |
| New South Wales | Cooma | -36.14 | 149.07 | 0.52 | Cool |
| New South Wales | Coonabarabran | -31.16 | 149.17 | 0.70 | Warm |
| New South Wales | Coonamble | -30.57 | 148.24 | 0.92 | Hot |
| New South Wales | Cootamundra | -34.39 | 148.02 | 0.70 | Warm |
| New South Wales | Corowa | -35.00 | 146.39 | 0.70 | Warm |
| New South Wales | Cowra PO | -33.54 | 148.42 | 0.72 | Warm |
| New South Wales | Crookwell PO | -34.28 | 149.29 | 0.50 | Cool |
| New South Wales | Cumberland SF | -33.45 | 151.00 | 0.78 | Warm |
| New South Wales | Dalkeith | -32.00 | 149.58 | 0.72 | Warm |
| New South Wales | Deepwater PO | -29.27 | 151.50 | 0.59 | Cool |
| New South Wales | Deniliquin | -35.32 | 144.58 | 0.76 | Warm |
| New South Wales | Deniliquin | -35.22 | 145.03 | 0.73 | Warm |
| New South Wales | Dubbo | -32.15 | 148.36 | 0.82 | Warm |
| New South Wales | Dunedoo | -32.01 | 149.24 | 0.76 | Warm |

| State / Territory | Locality | Latitude | Longitude | K value | Climate |
|---|---|---|---|---|---|
| New South Wales | Dungog | -32.24 | 151.46 | 0.81 | Warm |
| New South Wales | Euston PO | -34.35 | 142.44 | 0.75 | Warm |
| New South Wales | Forbes | -33.23 | 148.00 | 0.81 | Warm |
| New South Wales | Frogmore PO | -34.16 | 148.50 | 0.63 | Cool |
| New South Wales | Gilgandra | -31.42 | 148.42 | 0.81 | Warm |
| New South Wales | Glen Innes | -29.44 | 151.44 | 0.59 | Cool |
| New South Wales | Glenfield Vet Rs | -33.58 | 150.54 | 0.79 | Warm |
| New South Wales | Glenorie | -33.36 | 151.00 | 0.78 | Warm |
| New South Wales | Goodooga PO | -29.07 | 147.27 | 0.99 | Hot |
| New South Wales | Goulburn | -34.45 | 149.43 | 0.62 | Cool |
| New South Wales | Grafton | -29.41 | 152.56 | 0.99 | Hot |
| New South Wales | Green Cape | -37.16 | 150.03 | 0.66 | Cool |
| New South Wales | Grenfell PO | -33.54 | 148.10 | 0.72 | Warm |
| New South Wales | Griffith | -34.71 | 146.03 | 0.77 | Warm |
| New South Wales | Griffith Res Stn | -34.17 | 146.02 | 0.73 | Warm |
| New South Wales | Gulgong PO | -32.22 | 149.32 | 0.70 | Warm |
| New South Wales | Gunnedah | -30.59 | 150.15 | 0.86 | Warm |
| New South Wales | Gurnang | -34.00 | 150.06 | 0.39 | Cool |
| New South Wales | Guyra PO | -30.13 | 151.40 | 0.48 | Cool |
| New South Wales | Harden PO | -34.33 | 148.22 | 0.66 | Cool |
| New South Wales | Harrington PO | -31.52 | 152.42 | 0.84 | Warm |
| New South Wales | Harwood Sugar Mill | -29.26 | 153.15 | 0.90 | Hot |
| New South Wales | Hay | -34.30 | 144.50 | 0.78 | Warm |
| New South Wales | Hillston PO | -33.29 | 145.32 | 0.82 | Warm |
| New South Wales | Hume Reservoir | -36.06 | 147.02 | 0.69 | Cool |
| New South Wales | Inverell | -29.47 | 151.07 | 0.71 | Warm |
| New South Wales | Ivanhoe | -32.54 | 144.18 | 0.85 | Warm |
| New South Wales | Jerrys Plains PO | -32.30 | 150.55 | 0.82 | Warm |
| New South Wales | Jervis Bay | -35.08 | 150.42 | 0.77 | Warm |
| New South Wales | Jervis Bay | -35.06 | 150.48 | 0.77 | Warm |
| New South Wales | Junee | -34.52 | 147.35 | 0.72 | Warm |
| New South Wales | Katoomba | -33.42 | 150.18 | 0.53 | Cool |
| New South Wales | Kempsey West | -31.05 | 152.50 | 0.89 | Warm |
| New South Wales | Kendall Forestry | -31.36 | 152.42 | 0.82 | Warm |
| New South Wales | Kirkconnell Prison | -33.25 | 149.50 | 0.44 | Cool |
| New South Wales | Kulnura (Boots R) | -33.14 | 151.12 | 0.73 | Warm |
| New South Wales | Lake Victoria | -34.03 | 141.16 | 0.78 | Warm |
| New South Wales | Leeton Soldier C | -34.33 | 146.25 | 0.77 | Warm |
| New South Wales | Lismore | -28.48 | 153.16 | 0.92 | Hot |
| New South Wales | Lithgow | -33.29 | 150.09 | 0.50 | Cool |
| New South Wales | Mathoura SF | -35.49 | 144.54 | 0.71 | Warm |
| New South Wales | Menindie | -32.24 | 142.25 | 0.86 | Warm |
| New South Wales | Molong | -33.06 | 148.52 | 0.64 | Cool |
| New South Wales | Monkstadt | -29.08 | 151.27 | 0.82 | Warm |
| New South Wales | Montague Island | -36.15 | 150.14 | 0.75 | Warm |
| New South Wales | Moree | -29.28 | 149.50 | 0.95 | Hot |
| New South Wales | Moruya Heads | -35.55 | 150.10 | 0.71 | Warm |
| New South Wales | Moss Vale PO | -34.33 | 150.22 | 0.56 | Cool |
| New South Wales | Moulamein PO | -35.05 | 144.02 | 0.77 | Warm |
| New South Wales | Mt Mitchell Aff | -29.39 | 152.06 | 0.57 | Cool |
| New South Wales | Mt Victoria | -33.55 | 150.15 | 0.50 | Cool |
| New South Wales | Mt Victoria | -33.36 | 150.15 | 0.49 | Cool |
| New South Wales | Mudgee | -32.36 | 149.35 | 0.68 | Cool |
| New South Wales | Mungindi PO | -28.59 | 149.00 | 0.97 | Hot |
| New South Wales | Murrurundi | -31.46 | 150.50 | 0.72 | Warm |
| New South Wales | Muswellbrook | -32.15 | 150.53 | 0.77 | Warm |
| New South Wales | Nalbaugh SF | -37.04 | 149.21 | 0.48 | Cool |
| New South Wales | Naradhan PO | -33.37 | 146.19 | 0.79 | Warm |

| State / Territory | Locality | Latitude | Longitude | K value | Climate |
|---|---|---|---|---|---|
| New South Wales | Narara (Gosford) | -33.24 | 151.20 | 0.77 | Warm |
| New South Wales | Narrabri | -30.19 | 149.47 | 0.91 | Hot |
| New South Wales | Narranderra PO | -34.45 | 146.33 | 0.80 | Warm |
| New South Wales | Nelson Bay (RSL) | -32.43 | 152.09 | 0.86 | Warm |
| New South Wales | Nerriga PO | -35.07 | 150.05 | 0.56 | Cool |
| New South Wales | Newcastle | -32.57 | 151.45 | 0.84 | Warm |
| New South Wales | Newnes Prison Cp | -33.21 | 150.15 | 0.48 | Cool |
| New South Wales | Nimmitabel PO | -36.31 | 149.17 | 0.40 | Cool |
| New South Wales | Nowa | -37.43 | 148.06 | 0.61 | Cool |
| New South Wales | Nowra Ranas | -34.57 | 150.32 | 0.73 | Warm |
| New South Wales | Nyngan | -31.34 | 147.11 | 0.86 | Warm |
| New South Wales | Oberon PO | -34.01 | 149.51 | 0.41 | Cool |
| New South Wales | Oberon PO | -33.43 | 149.52 | 0.45 | Cool |
| New South Wales | Orange PO | -33.17 | 149.06 | 0.60 | Cool |
| New South Wales | Parkes PO | -33.08 | 148.11 | 0.78 | Warm |
| New South Wales | Peak Hill | -32.42 | 148.12 | 0.83 | Warm |
| New South Wales | Picton | -34.10 | 150.37 | 0.72 | Warm |
| New South Wales | Pilliga | -30.21 | 148.54 | 0.85 | Warm |
| New South Wales | Port Kembla | -34.28 | 150.55 | 0.83 | Warm |
| New South Wales | Port Macquarie | -31.28 | 152.56 | 0.82 | Warm |
| New South Wales | Quambone PO | -30.56 | 147.52 | 0.91 | Hot |
| New South Wales | Richmond Aero | -33.36 | 150.42 | 0.81 | Warm |
| New South Wales | Riverview | -33.50 | 151.09 | 0.81 | Warm |
| New South Wales | Scone | -32.05 | 150.50 | 0.80 | Warm |
| New South Wales | Seven Hills Exp | -33.43 | 150.47 | 0.81 | Warm |
| New South Wales | Smoky Cape | -30.55 | 153.05 | 0.93 | Hot |
| New South Wales | Sydney | -33.53 | 151.12 | 0.83 | Warm |
| New South Wales | Tamworth | -31.06 | 150.59 | 0.84 | Warm |
| New South Wales | Taralga PO | -34.24 | 149.49 | 0.50 | Cool |
| New South Wales | Taree Radio Stn | -31.54 | 152.29 | 0.84 | Warm |
| New South Wales | Temora | -34.26 | 147.32 | 0.70 | Warm |
| New South Wales | Tenterfield | -29.03 | 152.00 | 0.66 | Cool |
| New South Wales | Tibooburra | -29.26 | 142.00 | 0.99 | Hot |
| New South Wales | Tocumwal PO | -35.49 | 145.34 | 0.74 | Warm |
| New South Wales | Trangie (Exp Fm) | -31.59 | 147.57 | 0.80 | Warm |
| New South Wales | Tullamore PO | -32.38 | 147.34 | 0.79 | Warm |
| New South Wales | Tumbarumba PO | -35.47 | 148.01 | 0.53 | Cool |
| New South Wales | Urana | -35.20 | 146.16 | 0.77 | Warm |
| New South Wales | Wagga | -35.07 | 147.22 | 0.76 | Warm |
| New South Wales | Wagga Aero | -35.06 | 147.30 | 0.69 | Cool |
| New South Wales | Walcha | -31.00 | 151.36 | 0.52 | Cool |
| New South Wales | Walgett | -30.01 | 148.07 | 0.94 | Hot |
| New South Wales | Wallangarra PO | -28.55 | 151.56 | 0.64 | Cool |
| New South Wales | Wallangra (Stat) | -29.15 | 150.54 | 0.79 | Warm |
| New South Wales | Wallaroo SF | -32.36 | 151.48 | 0.75 | Warm |
| New South Wales | Warialda | -29.33 | 150.34 | 0.80 | Warm |
| New South Wales | Wauchope SF | -31.28 | 152.44 | 0.85 | Warm |
| New South Wales | Wellington | -32.33 | 148.57 | 0.79 | Warm |
| New South Wales | Wentworth | -34.06 | 141.55 | 0.82 | Warm |
| New South Wales | White Cliffs PO | -30.51 | 143.05 | 0.94 | Hot |
| New South Wales | Willcannia | -31.34 | 143.23 | 0.92 | Hot |
| New South Wales | Williamtown Aero | -32.48 | 151.50 | 0.81 | Warm |
| New South Wales | Woolbrook PO | -30.58 | 151.21 | 0.54 | Cool |
| New South Wales | Wyalong PO | -33.56 | 147.15 | 0.75 | Warm |
| New South Wales | Yarras (Mt Seav) | -31.23 | 152.15 | 0.81 | Warm |
| New South Wales | Yass | -34.51 | 148.56 | 0.59 | Cool |
| New South Wales | Yenda PO | -34.15 | 146.11 | 0.79 | Warm |
| New South Wales | Young PO | -34.19 | 148.18 | 0.66 | Cool |

| State / Territory | Locality | Latitude | Longitude | K value | Climate |
|---|---|---|---|---|---|
| Northern Territory | Alice Springs | -23.50 | 133.53 | 1.00 | Hot |
| Northern Territory | Avon Downs | -20.02 | 137.29 | 1.26 | Hot |
| Northern Territory | Barrow Creek PO | -21.30 | 133.54 | 1.22 | Hot |
| Northern Territory | Borroloola | -16.05 | 136.20 | 1.37 | Hot |
| Northern Territory | Brunette Downs | -18.39 | 135.57 | 1.34 | Hot |
| Northern Territory | Cape Don Light | -11.19 | 131.46 | 1.40 | Hot |
| Northern Territory | Charlotte Waters | -25.55 | 134.55 | 1.06 | Hot |
| Northern Territory | Croker Island | -11.09 | 132.35 | 1.39 | Hot |
| Northern Territory | Curtain Springs | -25.19 | 131.45 | 1.03 | Hot |
| Northern Territory | Daly Waters | -16.15 | 133.22 | 1.39 | Hot |
| Northern Territory | Darwin | -12.28 | 130.50 | 1.44 | Hot |
| Northern Territory | Elcho Island | -11.55 | 135.45 | 1.41 | Hot |
| Northern Territory | Finke PO | -25.35 | 134.34 | 1.11 | Hot |
| Northern Territory | Goulburn Is Sound | -11.39 | 133.23 | 1.42 | Hot |
| Northern Territory | Groote Eylandt | -13.59 | 136.28 | 1.33 | Hot |
| Northern Territory | Hooker Creek | -18.20 | 130.38 | 1.35 | Hot |
| Northern Territory | Inverway Stn | -17.50 | 129.39 | 1.31 | Hot |
| Northern Territory | Katherine | -14.18 | 132.28 | 1.39 | Hot |
| Northern Territory | Katherine PO | -14.28 | 132.16 | 1.41 | Hot |
| Northern Territory | Larrimah PO | -15.35 | 133.13 | 1.39 | Hot |
| Northern Territory | Maningrida | -12.03 | 134.14 | 1.36 | Hot |
| Northern Territory | Middle Point | -12.27 | 131.17 | 1.39 | Hot |
| Northern Territory | Millingimbi | -12.06 | 134.54 | 1.36 | Hot |
| Northern Territory | Newcastle Waters | -17.22 | 133.25 | 1.39 | Hot |
| Northern Territory | Noonamah | -12.35 | 131.05 | 1.38 | Hot |
| Northern Territory | Oenpelli | -12.20 | 133.04 | 1.43 | Hot |
| Northern Territory | Port Keats Mission | -14.14 | 129.34 | 1.36 | Hot |
| Northern Territory | Ringwood Stn | -23.50 | 134.57 | 1.07 | Hot |
| Northern Territory | Roper River Mission | -14.44 | 134.44 | 1.43 | Hot |
| Northern Territory | Snake Bay | -11.25 | 130.40 | 1.39 | Hot |
| Northern Territory | Tempe Downs | -24.23 | 132.26 | 1.03 | Hot |
| Northern Territory | Tennant Creek | -19.39 | 134.12 | 1.29 | Hot |
| Northern Territory | Victoria River | -16.24 | 131.00 | 1.44 | Hot |
| Northern Territory | Wave Hill | -17.29 | 130.57 | 1.39 | Hot |
| Northern Territory | Wonarah | -19.54 | 136.20 | 1.30 | Hot |
| Northern Territory | Yirrkala Mission | -12.15 | 136.55 | 1.37 | Hot |
| Northern Territory | Yuendumu | -22.16 | 131.48 | 1.12 | Hot |
| Queensland | Adavale | -25.55 | 144.36 | 1.09 | Hot |
| Queensland | Atherton | -17.16 | 145.29 | 0.98 | Hot |
| Queensland | Ayr | -19.35 | 147.24 | 1.18 | Hot |
| Queensland | Baralaba PO | -24.11 | 149.49 | 1.10 | Hot |
| Queensland | Barcaldine | -23.34 | 145.17 | 1.14 | Hot |
| Queensland | Beaudesert Shire | -27.48 | 153.00 | 0.94 | Hot |
| Queensland | Biloela | -24.24 | 150.30 | 0.98 | Hot |
| Queensland | Birdsville | -25.55 | 139.22 | 1.15 | Hot |
| Queensland | Blackall | -24.25 | 145.28 | 1.11 | Hot |
| Queensland | Bollon | -28.02 | 147.29 | 1.00 | Hot |
| Queensland | Boulia | -22.55 | 139.54 | 1.26 | Hot |
| Queensland | Bowen | -20.01 | 148.14 | 1.21 | Hot |
| Queensland | Brisbane | -27.28 | 153.02 | 1.00 | Hot |
| Queensland | Bulburin (Forest) | -24.32 | 151.28 | 0.88 | Warm |
| Queensland | Bundaberg | -24.52 | 152.21 | 1.04 | Hot |
| Queensland | Burketown | -17.44 | 139.33 | 1.33 | Hot |
| Queensland | Bustard Head | -24.02 | 151.45 | 1.07 | Hot |
| Queensland | Cairns | -16.55 | 145.47 | 1.24 | Hot |
| Queensland | Caloundra (Sig) | -26.48 | 153.09 | 1.00 | Hot |
| Queensland | Cambooya | -27.43 | 151.52 | 0.79 | Warm |
| Queensland | Camooweal | -19.55 | 138.07 | 1.29 | Hot |

| State / Territory | Locality | Latitude | Longitude | K value | Climate |
|---|---|---|---|---|---|
| Queensland | Cape Capricorn | -23.30 | 151.14 | 1.07 | Hot |
| Queensland | Cape Cleveland | -19.11 | 147.02 | 1.24 | Hot |
| Queensland | Cape Moreton | -27.02 | 153.25 | 1.00 | Hot |
| Queensland | Cardwell | -18.16 | 146.02 | 1.16 | Hot |
| Queensland | Casino PO | -28.52 | 153.03 | 0.98 | Hot |
| Queensland | Charleville | -26.24 | 146.15 | 1.04 | Hot |
| Queensland | Charters Towers | -20.06 | 146.16 | 1.18 | Hot |
| Queensland | Childers | -25.15 | 152.16 | 1.04 | Hot |
| Queensland | Clermont | -22.49 | 147.38 | 1.09 | Hot |
| Queensland | Cloncurry | -20.43 | 140.30 | 1.34 | Hot |
| Queensland | Coen | -13.56 | 143.12 | 1.26 | Hot |
| Queensland | Coen Aero | -13.46 | 143.07 | 1.31 | Hot |
| Queensland | Collinsville | -20.33 | 147.50 | 1.13 | Hot |
| Queensland | Consuelo | -24.48 | 148.00 | 0.85 | Warm |
| Queensland | Cooktown | -15.26 | 145.15 | 1.30 | Hot |
| Queensland | Coolangatta Aero | -28.10 | 153.30 | 0.95 | Hot |
| Queensland | Crohamhurst | -26.49 | 152.50 | 0.92 | Hot |
| Queensland | Cronulla | -25.24 | 151.24 | 1.06 | Hot |
| Queensland | Croydon | -18.13 | 142.42 | 1.41 | Hot |
| Queensland | Croydon PO | -18.12 | 142.15 | 1.41 | Hot |
| Queensland | Cunnamulla | -28.16 | 145.49 | 1.04 | Hot |
| Queensland | Cunnamulla | -28.04 | 145.41 | 1.03 | Hot |
| Queensland | Dalby | -27.11 | 151.16 | 0.91 | Hot |
| Queensland | Donors Hill | -18.43 | 140.33 | 1.35 | Hot |
| Queensland | Double Is Point | -25.56 | 153.11 | 1.03 | Hot |
| Queensland | Emerald | -23.37 | 148.10 | 1.11 | Hot |
| Queensland | Fairview | -15.33 | 144.19 | 1.30 | Hot |
| Queensland | Gatton | -27.33 | 152.17 | 0.96 | Hot |
| Queensland | Gayndah | -25.38 | 151.36 | 1.00 | Hot |
| Queensland | Georgetown | -18.18 | 143.32 | 1.29 | Hot |
| Queensland | Girard SF | -28.54 | 152.18 | 0.68 | Cool |
| Queensland | Gladstone | -23.51 | 151.15 | 1.09 | Hot |
| Queensland | Goondiwindi | -28.33 | 150.19 | 0.95 | Hot |
| Queensland | Gympie | -26.11 | 152.40 | 0.98 | Hot |
| Queensland | Hayman Island | -20.03 | 148.54 | 1.24 | Hot |
| Queensland | Herberton | -17.24 | 145.28 | 0.96 | Hot |
| Queensland | Heron Island | -23.26 | 151.55 | 1.17 | Hot |
| Queensland | Hughendon | -20.51 | 144.12 | 1.21 | Hot |
| Queensland | Imbil Forest | -26.28 | 152.40 | 0.98 | Hot |
| Queensland | Injune | -25.51 | 148.33 | 0.93 | Hot |
| Queensland | Innisfail | -17.32 | 146.02 | 1.17 | Hot |
| Queensland | Ipswich | -27.37 | 152.46 | 0.99 | Hot |
| Queensland | Iron Range Aero | -12.47 | 143.18 | 1.28 | Hot |
| Queensland | Isisford PO | -24.15 | 144.26 | 1.15 | Hot |
| Queensland | Julia Creek PO | -20.40 | 141.45 | 1.30 | Hot |
| Queensland | Kalpower Res | -24.42 | 151.18 | 0.89 | Warm |
| Queensland | Killarney | -28.20 | 152.18 | 0.76 | Warm |
| Queensland | Kingaroy | -26.32 | 151.50 | 0.82 | Warm |
| Queensland | Kingaroy PO | -26.32 | 151.32 | 0.84 | Warm |
| Queensland | Lady Elliot Is | -24.07 | 152.43 | 1.15 | Hot |
| Queensland | Longreach | -23.27 | 144.15 | 1.16 | Hot |
| Queensland | Low Isles | -16.23 | 145.34 | 1.33 | Hot |
| Queensland | Mackay Sugar | -21.10 | 149.13 | 1.08 | Hot |
| Queensland | Mapoon | -11.58 | 141.54 | 1.44 | Hot |
| Queensland | Mareeba | -17.01 | 145.25 | 1.13 | Hot |
| Queensland | Maryborough | -25.32 | 152.42 | 1.04 | Hot |
| Queensland | Mein | -13.15 | 142.50 | 1.32 | Hot |
| Queensland | Miles | -26.40 | 150.11 | 0.94 | Hot |

| State / Territory | Locality | Latitude | Longitude | K value | Climate |
|---|---|---|---|---|---|
| Queensland | Millaroo | -20.03 | 147.17 | 1.18 | Hot |
| Queensland | Mitchell | -26.29 | 147.58 | 0.93 | Hot |
| Queensland | Mitchell River Miss | -15.28 | 141.45 | 1.38 | Hot |
| Queensland | Monto PO | -24.51 | 151.01 | 0.96 | Hot |
| Queensland | Moreton | -12.27 | 142.38 | 1.31 | Hot |
| Queensland | Mornington Island | -16.42 | 139.12 | 1.44 | Hot |
| Queensland | Mt Isa PO | -20.44 | 139.28 | 1.29 | Hot |
| Queensland | Mt Morgan | -23.39 | 150.23 | 1.04 | Hot |
| Queensland | Mt Surprise | -18.09 | 144.19 | 1.17 | Hot |
| Queensland | Mungindi PO | -28.59 | 149.00 | 0.97 | Hot |
| Queensland | Musgrave | -14.47 | 143.30 | 1.30 | Hot |
| Queensland | Nanango | -26.40 | 152.00 | 0.82 | Warm |
| Queensland | Normanton | -17.40 | 141.05 | 1.40 | Hot |
| Queensland | Ormiston Redland | -27.35 | 153.16 | 0.95 | Hot |
| Queensland | Palmerville | -16.00 | 144.05 | 1.32 | Hot |
| Queensland | Palmerville | -15.49 | 144.05 | 1.30 | Hot |
| Queensland | Pine Islet | -21.39 | 150.13 | 1.19 | Hot |
| Queensland | Pineapple Rsh St | -26.38 | 152.56 | 0.93 | Hot |
| Queensland | Pittsworth | -27.43 | 151.39 | 0.84 | Warm |
| Queensland | Pomona (Como) | -26.12 | 152.55 | 0.97 | Hot |
| Queensland | Port Douglas | -16.29 | 145.28 | 1.22 | Hot |
| Queensland | Proserpine PO | -20.24 | 148.35 | 1.17 | Hot |
| Queensland | Quilpie | -26.37 | 144.16 | 1.11 | Hot |
| Queensland | Richmond | -20.43 | 143.08 | 1.26 | Hot |
| Queensland | Rockhampton | -23.23 | 150.30 | 1.14 | Hot |
| Queensland | Roma | -26.35 | 148.48 | 0.98 | Hot |
| Queensland | Roseberry SF | -28.29 | 152.55 | 0.89 | Warm |
| Queensland | Samford (CSIRO) | -27.22 | 152.53 | 0.91 | Hot |
| Queensland | Sandgate | -27.20 | 153.05 | 0.97 | Hot |
| Queensland | Sandy Cape | -24.50 | 153.17 | 1.11 | Hot |
| Queensland | Sandy Cape | -24.44 | 153.13 | 1.09 | Hot |
| Queensland | Somerset Dam | -27.06 | 152.35 | 0.95 | Hot |
| Queensland | Southport | -27.57 | 153.27 | 0.97 | Hot |
| Queensland | Springsure | -24.07 | 148.05 | 1.06 | Hot |
| Queensland | St George | -28.02 | 143.35 | 0.99 | Hot |
| Queensland | St George PO | -28.02 | 148.35 | 1.01 | Hot |
| Queensland | St Lawrence | -22.21 | 149.31 | 0.96 | Hot |
| Queensland | Stanthorpe | -28.40 | 151.57 | 0.69 | Cool |
| Queensland | Surat | -27.10 | 149.04 | 0.98 | Hot |
| Queensland | Tambo | -24.53 | 146.15 | 1.02 | Hot |
| Queensland | Tamborine | -27.53 | 153.08 | 0.81 | Warm |
| Queensland | Taroom PO | -25.39 | 149.48 | 1.00 | Hot |
| Queensland | Tewantin PO | -26.23 | 153.02 | 1.01 | Hot |
| Queensland | Texas PO | -28.51 | 151.11 | 0.87 | Warm |
| Queensland | Thargomindah | -28.00 | 143.49 | 1.07 | Hot |
| Queensland | Theodore Iwsc | -24.57 | 150.04 | 1.05 | Hot |
| Queensland | Thursday Island | -10.35 | 142.13 | 1.39 | Hot |
| Queensland | Toorak Field Stn | -21.02 | 141.48 | 1.24 | Hot |
| Queensland | Toowoomba | -27.33 | 151.58 | 0.79 | Warm |
| Queensland | Townsville | -19.14 | 146.51 | 1.24 | Hot |
| Queensland | Twin Hills | -21.57 | 146.59 | 1.16 | Hot |
| Queensland | Urandangie | -21.37 | 138.19 | 1.24 | Hot |
| Queensland | Urbenville SF | -28.28 | 152.33 | 0.79 | Warm |
| Queensland | Wallangarra PO | -28.55 | 151.56 | 0.64 | Cool |
| Queensland | Warwick | -28.14 | 152.00 | 0.82 | Warm |
| Queensland | Westwood | -23.37 | 150.10 | 1.02 | Hot |
| Queensland | Willis Island | -16.18 | 150.00 | 1.32 | Hot |
| Queensland | Windorah | -25.26 | 142.39 | 1.15 | Hot |

| State / Territory | Locality | Latitude | Longitude | K value | Climate |
|---|---|---|---|---|---|
| Queensland | Winton | -22.24 | 143.02 | 1.24 | Hot |
| Queensland | Yeppoon | -23.06 | 150.42 | 1.07 | Hot |
| Queensland | Yuleba | -26.37 | 149.23 | 0.95 | Hot |
| South Australia | Adelaide | -34.56 | 138.36 | 0.80 | Warm |
| South Australia | Angorichina | -31.05 | 138.45 | 0.83 | Warm |
| South Australia | Berri | -34.17 | 140.36 | 0.77 | Warm |
| South Australia | Bundaleer Forest | -33.17 | 138.35 | 0.66 | Cool |
| South Australia | Cape Borda | -35.45 | 136.35 | 0.64 | Cool |
| South Australia | Cape De Couedie | -36.04 | 136.42 | 0.64 | Cool |
| South Australia | Cape | -38.04 | 140.40 | 0.59 | Cool |
| South Australia | Cape Willoughby | -35.51 | 138.07 | 0.66 | Cool |
| South Australia | Ceduna | -32.08 | 133.40 | 0.77 | Warm |
| South Australia | Clare | -33.50 | 138.37 | 0.66 | Cool |
| South Australia | Cleve PO | -33.42 | 136.30 | 0.76 | Warm |
| South Australia | Coober Pedy | -29.01 | 134.45 | 1.00 | Hot |
| South Australia | Cook PO | -30.37 | 130.25 | 0.86 | Warm |
| South Australia | Elliston | -33.39 | 134.53 | 0.75 | Warm |
| South Australia | Ernabella | -26.17 | 132.08 | 0.95 | Hot |
| South Australia | Euduna | -34.11 | 139.05 | 0.66 | Cool |
| South Australia | Farina | -30.04 | 138.17 | 0.94 | Hot |
| South Australia | Fowlers Bay | -31.59 | 132.34 | 0.78 | Warm |
| South Australia | Georgetown PO | -33.22 | 138.24 | 0.73 | Warm |
| South Australia | Hawker PO | -31.53 | 138.25 | 0.82 | Warm |
| South Australia | Kadina | -33.58 | 137.43 | 0.77 | Warm |
| South Australia | Kapunda PO | -34.21 | 138.55 | 0.71 | Warm |
| South Australia | Keith | -36.06 | 140.21 | 0.70 | Warm |
| South Australia | Kimba PO | -33.09 | 136.25 | 0.76 | Warm |
| South Australia | Kingscote | -35.40 | 137.38 | 0.67 | Cool |
| South Australia | Kyancutta | -33.08 | 135.34 | 0.79 | Warm |
| South Australia | Kybybolite | -36.54 | 141.00 | 0.59 | Cool |
| South Australia | Lameroo PO | -35.20 | 140.31 | 0.70 | Warm |
| South Australia | Leigh Creek | -30.28 | 138.26 | 0.93 | Hot |
| South Australia | Loxton | -34.27 | 140.34 | 0.74 | Warm |
| South Australia | Lucindale PO | -36.59 | 140.22 | 0.65 | Cool |
| South Australia | Maitland PO | -34.23 | 137.40 | 0.72 | Warm |
| South Australia | Maralinga | -30.09 | 131.35 | 0.89 | Warm |
| South Australia | Marree | -29.39 | 138.04 | 0.97 | Hot |
| South Australia | Meningie | -35.23 | 138.58 | 0.68 | Cool |
| South Australia | Minnipa Seed Farm | -32.50 | 135.10 | 0.80 | Warm |
| South Australia | Mount Gambier | -37.50 | 140.46 | 0.59 | Cool |
| South Australia | Mt Barker | -35.04 | 138.52 | 0.59 | Cool |
| South Australia | Mt Burr Forest | -37.33 | 140.26 | 0.59 | Cool |
| South Australia | Mt Crawford For | -34.43 | 138.57 | 0.56 | Cool |
| South Australia | Murray Bridge | -35.07 | 139.17 | 0.73 | Warm |
| South Australia | Myponga | -35.24 | 138.28 | 0.58 | Cool |
| South Australia | Naracoorte PO | -36.58 | 140.44 | 0.63 | Cool |
| South Australia | Neptune Island | -35.21 | 136.07 | 0.71 | Warm |
| South Australia | Nonning | -32.31 | 136.30 | 0.80 | Warm |
| South Australia | Nuriootpa Viticu | -34.29 | 139.01 | 0.65 | Cool |
| South Australia | Oodnadatta | -27.33 | 135.28 | 1.06 | Hot |
| South Australia | Parafield Plant | -34.46 | 138.38 | 0.76 | Warm |
| South Australia | Parndana East | -35.47 | 137.21 | 0.61 | Cool |
| South Australia | Port Augusta | -32.30 | 137.46 | 0.90 | Hot |
| South Australia | Port Augusta Stn | -33.32 | 137.46 | 0.90 | Hot |
| South Australia | Port Lincoln | -34.44 | 135.52 | 0.73 | Warm |
| South Australia | Port Pirie | -33.11 | 138.00 | 0.87 | Warm |
| South Australia | Price | -34.18 | 138.00 | 0.76 | Warm |
| South Australia | Renmark PO | -34.11 | 140.45 | 0.82 | Warm |

| State / Territory | Locality | Latitude | Longitude | K value | Climate |
|---|---|---|---|---|---|
| South Australia | Rennick | -37.50 | 140.59 | 0.57 | Cool |
| South Australia | Robe | -37.11 | 139.45 | 0.62 | Cool |
| South Australia | Roseworthy | -34.32 | 138.44 | 0.75 | Warm |
| South Australia | Serviceton | -36.22 | 140.59 | 0.63 | Cool |
| South Australia | Snowtown PO | -33.47 | 138.13 | 0.75 | Warm |
| South Australia | Stirling West | -35.00 | 138.43 | 0.55 | Cool |
| South Australia | Strathalbyn | -35.16 | 138.54 | 0.68 | Cool |
| South Australia | Streaky Bay | -32.48 | 134.13 | 0.81 | Warm |
| South Australia | Tailem Bend | -35.16 | 139.27 | 0.74 | Warm |
| South Australia | Tarcoola | -30.41 | 134.33 | 0.88 | Warm |
| South Australia | Turretfield Res | -34.33 | 138.50 | 0.72 | Warm |
| South Australia | Victor Harbour | -35.33 | 138.37 | 0.71 | Warm |
| South Australia | Waikerie (Lands) | -34.11 | 139.59 | 0.80 | Warm |
| South Australia | Wanbi | -34.46 | 140.18 | 0.71 | Warm |
| South Australia | Warooka PO | -34.59 | 137.25 | 0.73 | Warm |
| South Australia | Whyalla PO | -33.02 | 137.35 | 0.85 | Warm |
| South Australia | Woomera | -31.12 | 136.48 | 0.89 | Warm |
| South Australia | Yongala | -33.02 | 138.45 | 0.65 | Cool |
| South Australia | Yudjapinna | -32.08 | 137.09 | 0.87 | Warm |
| South Australia | Yunta PO | -32.35 | 139.34 | 0.76 | Warm |
| | | | | | |
| Tasmania | Bicheno | -41.53 | 148.18 | 0.57 | Cool |
| Tasmania | Bothwell | -42.23 | 147.01 | 0.40 | Cool |
| Tasmania | Bridport PO | -41.00 | 147.24 | 0.55 | Cool |
| Tasmania | Bronte Park | -42.08 | 146.30 | 0.33 | Cool |
| Tasmania | Burnie | -41.06 | 145.54 | 0.52 | Cool |
| Tasmania | Bushy Park | -42.42 | 147.02 | 0.49 | Cool |
| Tasmania | Bushy Park (Hops) | -42.43 | 146.53 | 0.47 | Cool |
| Tasmania | Butlers Gorge | -42.17 | 146.16 | 0.31 | Cool |
| Tasmania | Cape Bruni | -43.29 | 147.08 | 0.45 | Cool |
| Tasmania | Cape Sorell | -42.12 | 145.10 | 0.49 | Cool |
| Tasmania | Cradle Valley | -41.38 | 145.57 | 0.27 | Cool |
| Tasmania | Cressy Research | -41.43 | 147.05 | 0.46 | Cool |
| Tasmania | Currie | -39.56 | 143.50 | 0.54 | Cool |
| Tasmania | Deloraine | -41.32 | 146.40 | 0.40 | Cool |
| Tasmania | Devonport East | -41.11 | 146.22 | 0.51 | Cool |
| Tasmania | Eddystone Point | -41.00 | 148.21 | 0.56 | Cool |
| Tasmania | Erriba | -41.27 | 146.07 | 0.33 | Cool |
| Tasmania | Grove Research | -42.59 | 147.06 | 0.45 | Cool |
| Tasmania | Hastings Chalet | -43.25 | 146.53 | 0.43 | Cool |
| Tasmania | Hobart | -42.55 | 147.20 | 0.51 | Cool |
| Tasmania | Hobart Airport | -42.50 | 147.32 | 0.51 | Cool |
| Tasmania | Hythe | -43.25 | 146.04 | 0.44 | Cool |
| Tasmania | Lake St Clair | -42.06 | 146.13 | 0.31 | Cool |
| Tasmania | Launceston | -41.25 | 147.08 | 0.54 | Cool |
| Tasmania | Launceston Aero | -41.33 | 147.13 | 0.47 | Cool |
| Tasmania | Low Head | -41.04 | 146.48 | 0.51 | Cool |
| Tasmania | Maatsuyker Is | -43.41 | 146.17 | 0.42 | Cool |
| Tasmania | Maydena | -42.46 | 146.36 | 0.40 | Cool |
| Tasmania | Miena | -41.59 | 146.44 | 0.25 | Cool |
| Tasmania | Oatlands | -42.18 | 147.22 | 0.41 | Cool |
| Tasmania | Orford PO | -42.34 | 147.52 | 0.52 | Cool |
| Tasmania | Pats River | -40.06 | 148.01 | 0.56 | Cool |
| Tasmania | Port Davey | -43.20 | 145.57 | 0.45 | Cool |
| Tasmania | Redpa | -40.56 | 144.45 | 0.48 | Cool |
| Tasmania | Risdon | -42.48 | 147.20 | 0.52 | Cool |
| Tasmania | Ross (Ellinthorp) | -42.00 | 147.19 | 0.45 | Cool |
| Tasmania | Rossarden | -41.39 | 147.44 | 0.38 | Cool |

| State / Territory | Locality | Latitude | Longitude | K value | Climate |
|---|---|---|---|---|---|
| Tasmania | Scottsdale (Kraft) | -41.09 | 147.31 | 0.48 | Cool |
| Tasmania | Sheffield | -41.23 | 146.20 | 0.42 | Cool |
| Tasmania | Smithton PO | -40.51 | 145.08 | 0.51 | Cool |
| Tasmania | St Helens | -41.20 | 148.15 | 0.53 | Cool |
| Tasmania | Stanley | -40.46 | 145.18 | 0.52 | Cool |
| Tasmania | Swansea | -42.08 | 148.04 | 0.52 | Cool |
| Tasmania | Tasman Island | -43.15 | 148.00 | 0.41 | Cool |
| Tasmania | Tewkesbury Res | -41.14 | 145.42 | 0.38 | Cool |
| Tasmania | Waratah | -41.27 | 145.32 | 0.30 | Cool |
| Tasmania | Wynyard Aeradio | -41.00 | 145.42 | 0.46 | Cool |
| Tasmania | Zeehan PO | -41.53 | 145.20 | 0.41 | Cool |
| Victoria | Aberfeldy | -37.42 | 146.22 | 0.36 | Cool |
| Victoria | Alexandra PO | -37.12 | 145.43 | 0.58 | Cool |
| Victoria | Ararat | -37.17 | 142.56 | 0.58 | Cool |
| Victoria | Aspendale (CSIRO) | -38.02 | 145.06 | 0.63 | Cool |
| Victoria | Avoca | -37.05 | 143.29 | 0.60 | Cool |
| Victoria | Bairnsdale | -37.50 | 147.38 | 0.59 | Cool |
| Victoria | Ballan (Fiskville) | -37.36 | 144.12 | 0.50 | Cool |
| Victoria | Ballarat | -37.33 | 143.52 | 0.51 | Cool |
| Victoria | Beechworth | -36.22 | 146.43 | 0.78 | Warm |
| Victoria | Benalla | -36.33 | 145.59 | 0.67 | Cool |
| Victoria | Bendigo | -36.46 | 144.16 | 0.66 | Cool |
| Victoria | Beulah PO | -35.57 | 142.25 | 0.70 | Warm |
| Victoria | Birchip PO | -35.59 | 142.54 | 0.70 | Warm |
| Victoria | Bogong | -36.48 | 147.14 | 0.50 | Cool |
| Victoria | Boort | -36.06 | 143.42 | 0.71 | Warm |
| Victoria | Brighton East | -37.56 | 145.01 | 0.65 | Cool |
| Victoria | Camperdown | -38.14 | 143.10 | 0.59 | Cool |
| Victoria | Cann River Forest | -37.34 | 149.09 | 0.62 | Cool |
| Victoria | Cape Otway | -38.51 | 143.31 | 0.57 | Cool |
| Victoria | Cape Schanck | -38.30 | 144.53 | 0.59 | Cool |
| Victoria | Casterton (Clim) | -37.35 | 141.24 | 0.61 | Cool |
| Victoria | Charlton | -36.16 | 143.21 | 0.68 | Cool |
| Victoria | Clunes | -37.18 | 143.47 | 0.54 | Cool |
| Victoria | Clunes PO | -37.24 | 143.48 | 0.54 | Cool |
| Victoria | Colac | -38.20 | 143.35 | 0.57 | Cool |
| Victoria | Corryong Forest | -36.12 | 147.54 | 0.61 | Cool |
| Victoria | Creswick For Sch | -37.25 | 143.54 | 0.53 | Cool |
| Victoria | Dookie | -36.20 | 145.42 | 0.71 | Warm |
| Victoria | Durdidwarrah | -37.49 | 144.13 | 0.53 | Cool |
| Victoria | Echuca | -36.08 | 144.45 | 0.72 | Warm |
| Victoria | Erica State Forest | -38.00 | 146.24 | 0.53 | Cool |
| Victoria | Essendon Airport | -37.44 | 144.54 | 0.62 | Cool |
| Victoria | Euroa | -36.46 | 145.33 | 0.67 | Cool |
| Victoria | Forrest SF | -38.32 | 143.43 | 0.52 | Cool |
| Victoria | Gabo Island | -37.34 | 149.55 | 0.66 | Cool |
| Victoria | Geelong | -38.09 | 144.21 | 0.63 | Cool |
| Victoria | Gellibrand For | -38.32 | 143.32 | 0.52 | Cool |
| Victoria | Hamilton | -37.45 | 142.02 | 0.55 | Cool |
| Victoria | Heathcote PO | -36.56 | 144.42 | 0.61 | Cool |
| Victoria | Heywood For Off | -38.08 | 141.38 | 0.57 | Cool |
| Victoria | Horsham | -36.43 | 142.12 | 0.67 | Cool |
| Victoria | Jeparit PO | -36.08 | 141.59 | 0.71 | Warm |
| Victoria | Kerang | -35.42 | 143.54 | 0.73 | Warm |
| Victoria | Kyabram | -36.19 | 145.03 | 0.64 | Cool |
| Victoria | Kyneton PO | -37.15 | 144.27 | 0.49 | Cool |
| Victoria | Lake Eildon | -37.14 | 145.55 | 0.61 | Cool |
| Victoria | Leongatha | -38.29 | 145.57 | 0.59 | Cool |

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|---|---|---|---|---|---|
| Victoria | Lismore PO | -37.58 | 143.21 | 0.59 | Cool |
| Victoria | Longerenong | -36.42 | 142.18 | 0.64 | Cool |
| Victoria | Macedon State Nr | -37.25 | 144.34 | 0.48 | Cool |
| Victoria | Maffra | -37.58 | 146.59 | 0.61 | Cool |
| Victoria | Maldon | -37.00 | 144.06 | 0.60 | Cool |
| Victoria | Mangalore Aero | -36.54 | 145.10 | 0.64 | Cool |
| Victoria | Maryborough | -37.03 | 143.44 | 0.63 | Cool |
| Victoria | Melbourne | -37.50 | 145.00 | 0.66 | Cool |
| Victoria | Mildura | -34.12 | 142.09 | 0.81 | Warm |
| Victoria | Mitta Mitta | -36.32 | 147.22 | 0.59 | Cool |
| Victoria | Mornington | -38.12 | 145.00 | 0.66 | Cool |
| Victoria | Mount Eliza | -38.12 | 145.06 | 0.66 | Cool |
| Victoria | Mt Buffalo | -36.47 | 146.46 | 0.35 | Cool |
| Victoria | Mt St Leonard | -37.36 | 145.30 | 0.48 | Cool |
| Victoria | Myrtleford | -36.33 | 146.44 | 0.62 | Cool |
| Victoria | Nhill | -36.21 | 141.39 | 0.65 | Cool |
| Victoria | Numurkah | -36.06 | 145.24 | 0.72 | Warm |
| Victoria | Olsons Bridge | -38.29 | 146.19 | 0.48 | Cool |
| Victoria | Omeo | -37.06 | 147.36 | 0.47 | Cool |
| Victoria | Omeo | -37.06 | 147.86 | 0.48 | Cool |
| Victoria | Orbost | -37.42 | 148.27 | 0.60 | Cool |
| Victoria | Ouyen | -35.06 | 142.18 | 0.76 | Warm |
| Victoria | Portland | -38.21 | 141.36 | 0.59 | Cool |
| Victoria | Portsea Quarantine | -38.19 | 144.42 | 0.61 | Cool |
| Victoria | Powelltown | -37.52 | 145.45 | 0.56 | Cool |
| Victoria | Rainbow PO | -35.54 | 142.00 | 0.72 | Warm |
| Victoria | Rochester | -36.21 | 144.42 | 0.69 | Cool |
| Victoria | Rubicon Sec | -37.20 | 145.52 | 0.47 | Cool |
| Victoria | Rutherglen | -36.03 | 146.28 | 0.66 | Cool |
| Victoria | Rutherglen Exp F | -36.06 | 146.36 | 0.64 | Cool |
| Victoria | Sale | -38.06 | 147.04 | 0.62 | Cool |
| Victoria | Scoresby | -37.52 | 145.14 | 0.62 | Cool |
| Victoria | Seymour | -37.02 | 145.08 | 0.65 | Cool |
| Victoria | Shepparton | -36.23 | 145.24 | 0.70 | Warm |
| Victoria | St Arnaud | -36.37 | 143.16 | 0.64 | Cool |
| Victoria | Stawell | -37.06 | 142.48 | 0.65 | Cool |
| Victoria | Swan Hill | -35.21 | 143.34 | 0.75 | Warm |
| Victoria | Tanjil Bren | -37.48 | 146.12 | 0.44 | Cool |
| Victoria | Tatura Res Stn | -36.26 | 145.16 | 0.65 | Cool |
| Victoria | Terang | -38.12 | 142.54 | 0.57 | Cool |
| Victoria | Tidal River | -39.02 | 146.19 | 0.60 | Cool |
| Victoria | Tooradin | -38.12 | 145.24 | 0.58 | Cool |
| Victoria | Wail | -36.31 | 142.10 | 0.66 | Cool |
| Victoria | Walpeup | -35.08 | 142.02 | 0.73 | Warm |
| Victoria | Wangaratta | -36.21 | 146.19 | 0.68 | Cool |
| Victoria | Warragul PO | -38.10 | 145.56 | 0.60 | Cool |
| Victoria | Warrnambool | -38.23 | 142.29 | 0.57 | Cool |
| Victoria | Watsonia (Loyola) | -37.42 | 145.05 | 0.63 | Cool |
| Victoria | Werribee | -37.54 | 144.40 | 0.62 | Cool |
| Victoria | Wilsons Prom | -39.01 | 146.28 | 0.58 | Cool |
| Victoria | Wilsons Promont | -39.08 | 146.25 | 0.58 | Cool |
| Victoria | Woods Point | -37.35 | 146.15 | 0.43 | Cool |
| Victoria | Woohlpooer | -37.20 | 142.09 | 0.57 | Cool |
| Victoria | Yallourn Sec | -38.11 | 146.22 | 0.58 | Cool |
| Victoria | Yarrawonga | -36.01 | 146.01 | 0.73 | Warm |
| Western Australia | Albany | -35.02 | 117.52 | 0.70 | Warm |
| Western Australia | Anna Plains | -19.11 | 121.37 | 1.35 | Hot |
| Western Australia | Balladonia | -32.28 | 123.52 | 0.78 | Warm |

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|---|---|---|---|---|---|
| Western Australia | Bencubbin | -30.48 | 117.51 | 0.86 | Warm |
| Western Australia | Beverley | -32.06 | 116.54 | 0.81 | Warm |
| Western Australia | Booylgoo | -27.45 | 119.55 | 0.99 | Hot |
| Western Australia | Boyup Brook PO | -33.50 | 116.23 | 0.69 | Cool |
| Western Australia | Bridgetown | -33.57 | 116.07 | 0.67 | Cool |
| Western Australia | Brookton PO | -32.22 | 117.01 | 0.76 | Warm |
| Western Australia | Broome | -17.57 | 122.14 | 1.37 | Hot |
| Western Australia | Bunbury | -33.20 | 115.38 | 0.78 | Warm |
| Western Australia | Busselton | -33.39 | 115.21 | 0.76 | Warm |
| Western Australia | Camballin | -17.58 | 124.06 | 1.48 | Hot |
| Western Australia | Cape Leeuwin | -34.22 | 115.08 | 0.78 | Warm |
| Western Australia | Cape Leveque | -16.24 | 122.55 | 1.38 | Hot |
| Western Australia | Cape Naturaliste | -33.32 | 115.01 | 0.76 | Warm |
| Western Australia | Carnamah | -29.50 | 115.53 | 0.92 | Hot |
| Western Australia | Carnamah | -29.41 | 115.53 | 0.93 | Hot |
| Western Australia | Carnarvon | -24.52 | 113.38 | 1.08 | Hot |
| Western Australia | Cashmere Downs | -28.57 | 119.35 | 1.01 | Hot |
| Western Australia | Chapman Res Stn | -28.28 | 114.46 | 0.94 | Hot |
| Western Australia | Collie | -33.22 | 116.09 | 0.69 | Cool |
| Western Australia | Coolgardie | -30.57 | 121.10 | 0.85 | Warm |
| Western Australia | Corrigin PO | -32.20 | 117.52 | 0.77 | Warm |
| Western Australia | Cossack | -20.50 | 117.12 | 1.34 | Hot |
| Western Australia | Cue | -27.25 | 117.54 | 1.06 | Hot |
| Western Australia | Cunderdin | -31.39 | 117.14 | 0.85 | Warm |
| Western Australia | Dallwallinu | -30.17 | 116.39 | 0.90 | Hot |
| Western Australia | Denmark Res Stn | -34.56 | 117.20 | 0.67 | Cool |
| Western Australia | Derby | -17.18 | 123.38 | 1.44 | Hot |
| Western Australia | Donnybrook | -33.44 | 115.49 | 0.73 | Warm |
| Western Australia | Donnybrook PO | -33.34 | 115.49 | 0.76 | Warm |
| Western Australia | Dwellingup | -32.44 | 116.04 | 0.67 | Cool |
| Western Australia | Eclipse Is | -35.11 | 117.53 | 0.69 | Cool |
| Western Australia | Errabiddy | -25.27 | 117.11 | 1.18 | Hot |
| Western Australia | Esperance | -33.51 | 121.53 | 0.75 | Warm |
| Western Australia | Esperance Downs | -33.36 | 121.48 | 0.73 | Warm |
| Western Australia | Eucla | -31.43 | 128.52 | 0.81 | Warm |
| Western Australia | Fitzroy Crossing | -18.11 | 125.35 | 1.44 | Hot |
| Western Australia | Forrest | -30.52 | 128.06 | 0.81 | Warm |
| Western Australia | Gascoyne Junction | -25.03 | 115.13 | 1.21 | Hot |
| Western Australia | Geraldton | -28.46 | 114.36 | 0.96 | Hot |
| Western Australia | Geraldton Met | -28.48 | 114.42 | 0.94 | Hot |
| Western Australia | Giles | -25.02 | 128.18 | 1.12 | Hot |
| Western Australia | Goomaling PO | -31.18 | 116.49 | 0.84 | Warm |
| Western Australia | Halls Creek | -18.16 | 127.46 | 1.31 | Hot |
| Western Australia | Halls Creek | -18.14 | 127.40 | 1.39 | Hot |
| Western Australia | Hamelin Pool | -26.26 | 114.11 | 1.07 | Hot |
| Western Australia | Hyden PO | -32.27 | 118.52 | 0.77 | Warm |
| Western Australia | Kalamunda PO | -32.00 | 116.04 | 0.78 | Warm |
| Western Australia | Kalgoolie | -30.45 | 121.28 | 0.89 | Warm |
| Western Australia | Kalumburu | -14.18 | 126.38 | 1.40 | Hot |
| Western Australia | Karridale | -34.13 | 115.05 | 0.69 | Cool |
| Western Australia | Katanning | -33.42 | 117.33 | 0.71 | Warm |
| Western Australia | Kellerberrin | -31.38 | 117.43 | 0.84 | Warm |
| Western Australia | Kimberley Res Stn | -15.47 | 128.42 | 1.44 | Hot |
| Western Australia | Kojonup PO | -33.50 | 117.09 | 0.67 | Cool |
| Western Australia | Kondinin PO | -32.30 | 118.16 | 0.79 | Warm |
| Western Australia | La Grange Mission | -18.41 | 121.46 | 1.38 | Hot |
| Western Australia | Lake Grace | -33.07 | 118.28 | 0.76 | Warm |
| Western Australia | Laverton | -28.38 | 122.25 | 0.98 | Hot |

| State / Territory | Locality | Latitude | Longitude | K value | Climate |
|---|---|---|---|---|---|
| Western Australia | Leonora | -28.53 | 121.19 | 1.03 | Hot |
| Western Australia | Madura Motel | -31.54 | 127.00 | 0.86 | Warm |
| Western Australia | Mandora Homestead | -19.45 | 120.51 | 1.37 | Hot |
| Western Australia | Mandurah | -32.32 | 115.43 | 0.84 | Warm |
| Western Australia | Manjimup | -34.14 | 116.09 | 0.63 | Cool |
| Western Australia | Marble Bar | -21.11 | 119.44 | 1.47 | Hot |
| Western Australia | Mardie | -21.12 | 115.57 | 1.33 | Hot |
| Western Australia | Margaret River | -33.57 | 115.04 | 0.72 | Warm |
| Western Australia | Meekatharra | -26.36 | 118.29 | 1.09 | Hot |
| Western Australia | Menzies | -29.41 | 121.02 | 0.92 | Hot |
| Western Australia | Merredin Agr Rs | -31.29 | 118.17 | 0.83 | Warm |
| Western Australia | Merredin Shire | -31.29 | 118.11 | 0.82 | Warm |
| Western Australia | Mingenew | -29.11 | 115.26 | 0.97 | Hot |
| Western Australia | Moora Shire Council | -30.38 | 116.00 | 0.85 | Warm |
| Western Australia | Morawa PO | -29.13 | 116.00 | 0.95 | Hot |
| Western Australia | Mount Barker | -34.38 | 117.40 | 0.63 | Cool |
| Western Australia | Mt Magnet | -28.04 | 117.51 | 1.06 | Hot |
| Western Australia | Mullewa | -28.33 | 115.30 | 1.00 | Hot |
| Western Australia | Mundiwindi | -23.50 | 120.10 | 1.13 | Hot |
| Western Australia | Mundrabilla | -31.51 | 127.51 | 0.86 | Warm |
| Western Australia | Muresk | -31.45 | 116.40 | 0.81 | Warm |
| Western Australia | Murgoo | -27.22 | 116.26 | 1.05 | Hot |
| Western Australia | Narembeen | -32.06 | 118.24 | 0.81 | Warm |
| Western Australia | Narrogin | -32.56 | 117.10 | 0.71 | Warm |
| Western Australia | Norseman PO | -32.12 | 121.47 | 0.81 | Warm |
| Western Australia | Nullagine | -21.53 | 120.06 | 1.25 | Hot |
| Western Australia | Nyang Wogoola | -23.00 | 115.00 | 1.36 | Hot |
| Western Australia | Ongerup PO | -33.58 | 118.28 | 0.69 | Cool |
| Western Australia | Onslow Aero | -21.40 | 115.07 | 1.29 | Hot |
| Western Australia | Peak Hill | -25.48 | 118.43 | 1.12 | Hot |
| Western Australia | Pearce Aerodrome | -31.40 | 116.00 | 0.87 | Warm |
| Western Australia | Pemberton Forest | -34.27 | 116.01 | 0.67 | Cool |
| Western Australia | Perth | -31.59 | 115.50 | 0.85 | Warm |
| Western Australia | Perth Guildford | -31.55 | 115.58 | 0.85 | Warm |
| Western Australia | Perth Regional | -31.57 | 115.51 | 0.88 | Warm |
| Western Australia | Pingelly | -32.32 | 117.05 | 0.75 | Warm |
| Western Australia | Port George IV | -15.25 | 124.43 | 1.35 | Hot |
| Western Australia | Port Hedland | -20.23 | 118.37 | 1.35 | Hot |
| Western Australia | Port Hedland | -20.19 | 118.03 | 1.34 | Hot |
| Western Australia | Ravensthorpe | -33.35 | 120.03 | 0.75 | Warm |
| Western Australia | Rawlinna | -31.00 | 125.15 | 0.84 | Warm |
| Western Australia | Rottnest Island | -32.00 | 115.30 | 0.87 | Warm |
| Western Australia | Salmon Gums Res | -32.59 | 121.39 | 0.74 | Warm |
| Western Australia | Sandstone | -27.59 | 119.17 | 0.98 | Hot |
| Western Australia | Southern Cross | -31.13 | 119.19 | 0.84 | Warm |
| Western Australia | Swan Upper | -31.45 | 116.06 | 0.84 | Warm |
| Western Australia | Three Rivers | -25.08 | 119.10 | 1.12 | Hot |
| Western Australia | Troughton Island | -13.45 | 126.09 | 1.45 | Hot |
| Western Australia | Turkey Creek | -17.02 | 128.12 | 1.46 | Hot |
| Western Australia | Vlaming Head | -21.48 | 114.06 | 1.21 | Hot |
| Western Australia | Wagin PO | -33.18 | 117.20 | 0.73 | Warm |
| Western Australia | Wandering | -32.40 | 116.41 | 0.71 | Warm |
| Western Australia | Watheroo | -30.17 | 116.04 | 0.82 | Warm |
| Western Australia | Wiluna | -26.36 | 120.13 | 1.05 | Hot |
| Western Australia | Winning Pool | -23.09 | 114.01 | 1.26 | Hot |
| Western Australia | Wittenoom Gorge | -22.18 | 118.18 | 1.36 | Hot |
| Western Australia | Wokalup | -33.08 | 115.53 | 0.80 | Warm |
| Western Australia | Wongan Hills RF | -30.53 | 116.43 | 0.83 | Warm |

| State / Territory | Locality | Latitude | Longitude | K value | Climate |
|---|---|---|---|---|---|
| Western Australia | Wyalkatchem | -31.12 | 117.24 | 0.85 | Warm |
| Western Australia | Wyndham | -15.28 | 128.06 | 1.54 | Hot |
| Western Australia | Yalgoo | -28.20 | 116.41 | 1.02 | Hot |
| Western Australia | Yampi Sound | -16.06 | 123.36 | 1.45 | Hot |
| Western Australia | York PO | -31.53 | 116.46 | 0.83 | Warm |

# Appendix C Appendix C – Details of standard diets A - D

*Table C-1. Percentages of ingredients (% as-fed) for standard diet A.*

| Ingredient | Default crude protein | Sucker | Lac sow | Dry sow | Gilts | Boars | Weaner | Porker | Grower | Finisher |
|---|---|---|---|---|---|---|---|---|---|---|
| | (%) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) |
| **Cereal Grains** | | | | | | | | | | |
| Barley | 10.0% | 1.50% | 30.00% | 70.00% | 70.00% | 85.92% | 15.00% | 20.00% | 40.00% | 70.00% |
| Maize 8 | 8.0% | | | | | | 5.25% | | | |
| Wheat 10 | 10.0% | 5.19% | 50.74% | 16.47% | 16.89960% | | 54.03% | 54.08% | 45.78% | 12.86% |
| **Pulses** | | | | | | | | | | |
| Lupins, augustifolius | 30.5% | | 5.00% | 4.00% | 4.00% | 5.00% | | | | 7.00% |
| **Oilseed Meals** | | | | | | | | | | |
| Canola meal Cold Pressed 34 | 34.0% | | 5.00% | 2.26% | 2.00% | 2.00% | 2.50% | 6.80% | 4.00% | 5.00% |
| Soybean Meal 46 Solvent | 46.0% | | | | | | 10.00% | 12.50% | 4.25% | |
| Selecta Soy/X-Soy 600 | 60.0% | 0.50% | | | | | | | | |
| **Animal & Fish products** | | | | | | | | | | |
| Blood meal 90 | 90.0% | 0.15% | 1.20% | | | | 2.50% | 0.50% | | |
| Blood Plasma | 78.0% | 0.30% | | | | | | | | |
| Fishmeal 65 | 65.0% | 0.25% | 2.00% | | | | 2.50% | | | |
| Meat & bone meal 50 | 50.0% | 0.45% | 3.10% | 6.00% | 5.25% | 6.00% | 4.00% | 3.75% | 3.50% | 3.50% |
| Milk, whey powder | 12.5% | 1.00% | | | | | | | | |
| **Fats** | | | | | | | | | | |
| Vegetable oil | 0.0% | 0.14% | 0.50% | | | | 2.10% | 0.50% | 0.50% | |
| **Minerals** | | | | | | | | | | |
| Choline Chloride | 0.0% | | | | | | | | 0.06% | 0.07% |
| Limestone | 0.0% | | 0.60% | | 0.50% | 0.46% | | 0.50% | 0.60% | 0.60% |
| Potassium Choride | 0.0% | | 0.40% | 0.30% | | | | | | |
| Salt | 0.0% | 0.04% | 0.40% | 0.40% | 0.40% | 0.40% | 0.25% | 0.25% | 0.25% | 0.25% |

| Ingredient | Default crude protein | Sucker | Lac sow | Dry sow | Gilts | Boars | Weaner | Porker | Grower | Finisher |
|---|---|---|---|---|---|---|---|---|---|---|
| Zinc Oxide | 0.0% | 0.03% | | | | | 0.30% | | | |
| **Synthetic amino acids** | | | | | | | | | | |
| L-Isoleucine | 62.5% | 0.01% | | | | | 0.08% | | 0.04% | |
| L-Lysine HCL | 95.4% | 0.05% | 0.33% | 0.05% | 0.31% | 0.02% | 0.45% | 0.45% | 0.45% | 0.30% |
| DL-Methionie | 58.4% | 0.02% | 0.02% | | 0.04% | | 0.18% | 0.08% | 0.08% | 0.05% |
| L-Threonine | 73.1% | 0.02% | 0.09% | | 0.13% | | 0.18% | 0.13% | 0.13% | 0.05% |
| L-Tryptophan | 85.3% | 0.01% | 0.01% | | 0.01% | | 0.03% | 0.01% | 0.02% | 0.02% |
| **Micellaneous ingredients** | | | | | | | | | | |
| Lactose | 0.0% | 0.25% | | | | | | | | |
| **Vitamin/mineral premixes** | | | | | | | | | | |
| Breeder premix | 0.0% | | 0.20% | 0.20% | 0.20% | 0.20% | | | | |
| Grower premix | 5.0% | | | | | | | 0.20% | 0.20% | 0.20% |
| Weaner premix | 0.0% | 0.02% | | | | | 0.20% | | | |
| **Enzymes** | | | | | | | | | | |
| Axtra Phy | 0.0% | 0.00% | 0.01% | 0.01% | 0.01% | 0.01% | 0.01% | 0.01% | 0.01% | 0.01% |
| Axtra XB | 0.0% | | | 0.01% | | | | | | |
| Rovabio Excel premix | 0.0% | 0.01% | 0.05% | | | | 0.05% | 0.05% | 0.05% | 0.05% |
| **Toxin Binders** | | | | | | | | | | |
| Formi Acid | 0.0% | | | | | | | | | |
| Mycofix | 0.0% | 0.02% | 0.20% | 0.20% | 0.20% | | | | | |
| Elitox | 0.0% | | | | | | 0.10% | 0.10% | 0.10% | |
| Mastersorb | 0.0% | | | | | | | | | 0.05% |
| **Acidifiers** | | | | | | | | | | |
| Top3 | 0.0% | | | | | | 0.15% | | | |
| VevoVital | 0.0% | 0.05% | | | | | | | | |
| **Other Additives** | | | | | | | | | | |
| Krave | 0.0% | 0.00% | | | | | 0.04% | | | |
| Betaine | 0.0% | 0.01% | 0.15% | 0.10% | 0.05% | | 0.10% | 0.10% | | |
| **Additional ingredients** | | | | | | | | | | |
| Sow milk | 5.6% | 90.00% | | | | | | | | |

| Ingredient | Default crude protein | Sucker | Lac sow | Dry sow | Gilts | Boars | Weaner | Porker | Grower | Finisher |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| **Totals** | | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** |

*Table C-2. Percentages of ingredients (% as-fed) for standard diet B*

| Ingredient | Default crude protein | Sucker | Lac sow | Dry sow | Gilts | Boars | Weaner | Porker | Grower | Finisher |
|---|---|---|---|---|---|---|---|---|---|---|
| | (%) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) |
| **Cereal Grains** | | | | | | | | | | |
| Barley | 10.0% | 1.50% | 30.00% | 60.00% | 60.00% | 76.38% | 15.00% | 15.00% | 15.20% | 44.55% |
| Wheat 10 | 10.0% | 5.19% | 41.53% | 14.08% | 14.94% | | 60.29% | 65.21% | 65.66% | 31.80% |
| **Cereal by-products** | | | | | | | | | | |
| Millrun | 15.0% | | 10.00% | 10.00% | 10.00% | 10.00% | | | | 10.00% |
| **By-products** | | | | | | | | | | |
| Molasses | 4.0% | | | | | 1.00% | | | | |
| **Pulses** | | | | | | | | | | |
| Chick Peas | 20.0% | | 5.00% | 5.00% | 5.00% | | | | 5.00% | 5.00% |
| **Oilseed Meals** | | | | | | | | | | |
| Canola Meal 37 Solvent | 37.0% | | | 6.75% | 5.50% | 7.50% | | 9.25% | 9.00% | 3.00% |
| Soybean Meal 46 Solvent | 46.0% | | 5.00% | | | | 10.00% | 2.50% | | |
| Selecta Soy/X-Soy 600 | 60.0% | 0.50% | | | | | 1.25% | | | |
| **Animal & Fish products** | | | | | | | | | | |
| Blood meal 90 | 90.0% | 0.15% | 0.70% | | | | 2.50% | 2.40% | | |
| Blood Plasma | 78.0% | 0.30% | | | | | | | | |
| Fishmeal 65 | 65.0% | 0.25% | 2.00% | | | | 2.00% | | | |
| Meat & bone meal 45 | 45.0% | | | | | | 5.25% | | | |
| Meat & bone meal 50 | 50.0% | 0.45% | 3.25% | 2.75% | 2.75% | 3.75% | | 3.25% | 3.25% | 4.00% |
| Milk, whey powder | 12.5% | 1.00% | | | | | | | | |

| Ingredient | Default crude protein | Sucker | Lac sow | Dry sow | Gilts | Boars | Weaner | Porker | Grower | Finisher |
|---|---|---|---|---|---|---|---|---|---|---|
| **Fats** | | | | | | | | | | |
| Vegetable oil | 0.0% | 0.14% | 0.50% | | | | 1.85% | 0.50% | | |
| **Minerals** | | | | | | | | | | |
| Choline Chloride | 0.0% | | | | | | | | | 0.03% |
| Limestone | 0.0% | | 0.60% | 0.50% | 0.50% | 0.60% | | 0.50% | 0.60% | 0.60% |
| Salt | 0.0% | 0.04% | 0.40% | 0.40% | 0.40% | 0.40% | 0.25% | 0.25% | 0.25% | 0.25% |
| Zinc Oxide | 0.0% | 0.03% | | | | | | | | |
| **Synthetic amino acids** | | | | | | | | | | |
| L-Isoleucine | | 0.01% | | | | | 0.07% | 0.02% | 0.02% | |
| L-Lysine HCL | 95.4% | 0.05% | 0.28% | 0.01% | 0.27% | | 0.45% | 0.45% | 0.45% | 0.33% |
| DL-Methionie | 58.4% | 0.02% | 0.02% | | 0.07% | 0.02% | 0.18% | 0.07% | 0.07% | 0.05% |
| L-Threonine | 73.1% | 0.02% | 0.08% | | 0.12% | | 0.18% | 0.13% | 0.13% | 0.08% |
| L-Tryptophan | 85.3% | 0.01% | 0.00% | | 0.00% | | 0.03% | 0.02% | 0.02% | 0.01% |
| **Micellaneous ingredients** | | | | | | | | | | |
| Lactose | 0.0% | 0.25% | | | | | | | | |
| **Vitamin/mineral premixes** | | | | | | | | | | |
| Breeder premix | 0.0% | | 0.20% | 0.20% | 0.20% | 0.20% | | | | |
| Grower premix | 5.0% | | | | | | | 0.20% | 0.20% | 0.20% |
| Weaner premix | 0.0% | 0.02% | | | | | 0.20% | | | |
| **Enzymes** | | | | | | | | | | |
| Axtra Phy | 0.0% | 0.00% | 0.01% | 0.01% | 0.01% | 0.01% | 0.01% | 0.01% | 0.01% | 0.01% |
| Rovabio Excel premix | 0.0% | 0.01% | 0.05% | | | | 0.05% | 0.05% | 0.05% | 0.05% |
| **Toxin Binders** | | | | | | | | | | |
| Formi Acid | 0.0% | | 0.04% | | | | 0.00% | | | |
| Mycofix | 0.0% | 0.02% | 0.20% | 0.20% | 0.15% | 0.15% | 0.15% | | | |
| Elitox | 0.0% | | | | | | | 0.10% | 0.10% | |
| Mastersorb | 0.0% | | | | | | | | | 0.05% |
| **Acidifiers** | | | | | | | | | | |
| Top3 | 0.0% | | | | | | 0.15% | | | |
| VevoVital | 0.0% | 0.05% | | | | | | | | |

| Ingredient | Default crude protein | Sucker | Lac sow | Dry sow | Gilts | Boars | Weaner | Porker | Grower | Finisher |
|---|---|---|---|---|---|---|---|---|---|---|
| **Other Additives** | | | | | | | | | | |
| Krave | 0.0% | 0.00% | | | | | 0.03% | | | |
| Betaine | 0.0% | 0.01% | 0.15% | 0.10% | 0.10% | | 0.10% | 0.10% | | |
| **Additional ingredients** | | | | | | | | | | |
| Sow milk | 5.6% | 90.00% | | | | | | | | |
| | | | | | | | | | | |
| **Totals** | | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** |

*Table C-3. Percentages of ingredients (% as-fed) for standard diet C.*

| Ingredient | Default crude protein | Sucker | Lac sow | Dry sow | Gilts | Boars | Weaner | Porker | Grower | Finisher |
|---|---|---|---|---|---|---|---|---|---|---|
| | (%) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) |
| **Cereal Grains** | | | | | | | | | | |
| Barley | 10.0% | 1.50% | 40.00% | 60.05% | 65.65% | 75.76% | 15.00% | 12.00% | 15.00% | 50.00% |
| Triticale 11 | 11.0% | | | 25.00% | 20.00% | 10.00% | | 20.00% | 20.00% | 20.00% |
| Wheat 10 | 10.0% | 5.19% | 41.97% | | | | 60.29% | 44.08% | 46.69% | 16.86% |
| **Oilseed Meals** | | | | | | | | | | |
| Canola Meal 37 Solvent | 37.0% | | 5.00% | 10.25% | 9.00% | 9.00% | | 10.75% | 12.00% | 7.75% |
| Soybean Meal 46 Solvent | 46.0% | | 5.00% | | | | 10.00% | 5.00% | 1.50% | |
| Selecta Soy/X-Soy 600 | 60.0% | 0.50% | | | | | 1.25% | | | |
| **Animal & Fish products** | | | | | | | | | | |
| Blood meal 90 | 90.0% | 0.15% | 0.65% | | | | 2.50% | 1.75% | | |
| Blood Plasma | 78.0% | 0.30% | | | | | | | | |
| Fishmeal 65 | 65.0% | 0.25% | 2.00% | | | | 2.00% | | | |
| Meat & bone meal 45 | 45.0% | | | | | | 5.25% | | | |
| Meat & bone meal 50 | 50.0% | 0.45% | 3.00% | 3.25% | 3.50% | 3.75% | | 5.00% | 3.00% | 3.75% |
| **Fats** | | | | | | | | | | |

| Ingredient | Default crude protein | Sucker | Lac sow | Dry sow | Gilts | Boars | Weaner | Porker | Grower | Finisher |
|---|---|---|---|---|---|---|---|---|---|---|
| Vegetable oil | 0.0% | 0.14% | 0.50% | | | | 1.85% | | | |
| **Minerals** | | | | | | | | | | |
| Choline Chloride | 0.0% | | | | | 0.05% | | | | |
| Limestone | 0.0% | | 0.60% | 0.50% | 0.50% | 0.60% | | | 0.60% | 0.60% |
| Salt | 0.0% | 0.04% | 0.40% | 0.40% | 0.40% | 0.40% | 0.25% | 0.25% | 0.25% | 0.25% |
| Zinc Oxide | 0.0% | 0.03% | | | | | | | | |
| **Synthetic amino acids** | | | | | | | | | | |
| L-Isoleucine | 62.5% | 0.01% | | | | | 0.07% | 0.06% | 0.00% | |
| L-Lysine HCL | 95.4% | 0.05% | 0.29% | 0.05% | 0.31% | 0.03% | 0.45% | 0.45% | 0.45% | 0.37% |
| DL-Methionie | 58.4% | 0.02% | | | 0.07% | | 0.18% | 0.07% | 0.05% | 0.04% |
| L-Threonine | 73.1% | 0.02% | 0.06% | | 0.11% | | 0.18% | 0.13% | 0.10% | 0.07% |
| L-Tryptophan | 85.3% | 0.01% | | | 0.00% | | 0.03% | 0.01% | 0.01% | 0.01% |
| **Micellaneous ingredients** | | | | | | | | | | |
| Lactose | 0.0% | 0.25% | | | | | | | | |
| **Vitamin/mineral premixes** | | | | | | | | | | |
| Breeder premix | 0.0% | | 0.20% | 0.20% | 0.20% | 0.20% | | | | |
| Grower premix | 5.0% | | | | | | | 0.20% | 0.20% | 0.20% |
| Weaner premix | 0.0% | 0.02% | | | | | 0.20% | | | |
| **Enzymes** | | | | | | | | | | |
| Axtra Phy | 0.0% | 0.00% | 0.01% | 0.01% | | | 0.01% | 0.01% | 0.01% | 0.01% |
| Axtra XB | 0.0% | | | | 0.01% | 0.01% | | | | |
| Rovabio Excel premix | 0.0% | 0.01% | 0.05% | | | | 0.05% | 0.05% | 0.05% | 0.05% |
| **Toxin Binders** | | | | | | | | | | |
| Mycofix | 0.0% | 0.02% | | 0.20% | 0.15% | 0.20% | 0.15% | | | |
| Elitox | 0.0% | | 0.15% | | | | | 0.10% | 0.10% | 0.05% |
| **Acidifiers** | | | | | | | | | | |
| Top3 | 0.0% | | | | | | 0.15% | | | |
| VevoVital | 0.0% | 0.05% | | | | | | | | |
| **Other Additives** | | | | | | | | | | |
| Krave | 0.0% | 0.00% | 0.03% | | | | 0.03% | | | |

| Ingredient | Default crude protein | Sucker | Lac sow | Dry sow | Gilts | Boars | Weaner | Porker | Grower | Finisher |
|---|---|---|---|---|---|---|---|---|---|---|
| Betaine | 0.0% | 0.01% | 0.10% | 0.10% | 0.10% | | 0.10% | 0.10% | | |
| **Additional ingredients** | | | | | | | | | | |
| Sow milk | 5.6% | 90.00% | | | | | | | | |
| **Totals** | | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** |

*Table C-4. Percentages of ingredients (% as-fed) for standard diet D.*

| Ingredient | Default crude protein | Sucker | Lac sow | Dry sow | Gilts | Boars | Weaner | Porker | Grower | Finisher |
|---|---|---|---|---|---|---|---|---|---|---|
| | (%) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) | (% fed weight) |
| **Cereal Grains** | | | | | | | | | | |
| Barley | 10.0% | 1.50% | 30.00% | 60.05% | 60.00% | 82.87% | 15.00% | 20.00% | 31.50% | 50.00% |
| Wheat 10 | 10.0% | 5.19% | 46.21% | 24.30% | 20.27% | | 60.29% | 52.97% | 46.03% | 28.18% |
| **Cereal by-products** | | | | | | | | | | |
| Millrun | 15.0% | | | | | | | | | |
| **By-products** | | | | | | | | | | |
| Molasses | 4.0% | | | | | | | | | |
| **Legumes** | | | | | | | | | | |
| Lupins, augustifolius | 30.5% | | 15.00% | 5.00% | 15.00% | 10.00% | | 10.00% | 15.00% | 15.00% |
| Chick Peas | 20.0% | | | | | | | | | |
| **Oilseed Meals** | | | | | | | | | | |
| Canola Meal 37 Solvent | 37.0% | | | 6.50% | | 2.00% | | | 1.50% | 2.00% |
| Canola meal Cold Pressed 34 | 34.0% | | | | | | | | | |
| Soybean Meal 46 Solvent | 46.0% | | | | | | 10.00% | 10.50% | | |
| Selecta Soy/X-Soy 600 | 60.0% | 0.50% | | | | | 1.25% | | | |
| **Animal & Fish products** | | | | | | | | | | |
| Blood meal 90 | 90.0% | 0.15% | 0.80% | | | | 2.50% | 0.75% | | |
| Blood Plasma | 78.0% | 0.30% | | | | | | | | |
| Fishmeal 65 | 65.0% | 0.25% | 2.00% | | | | 2.00% | | | |
| Meat & bone meal 45 | 45.0% | | | | | | 5.25% | | | |
| Meat & bone meal 50 | 50.0% | 0.45% | 3.25% | 3.00% | 3.00% | 3.60% | | 3.75% | 3.50% | 3.25% |
| Milk, whey powder | 12.5% | 1.00% | | | | | | | | |
| **Fats** | | | | | | | | | | |
| Vegetable oil | 0.0% | 0.14% | 0.70% | | | | 1.85% | | 0.50% | |
| **Minerals** | | | | | | | | | | |
| Choline Chloride | 0.0% | | | | | | | | 0.08% | 0.07% |

| Ingredient | Default crude protein | Sucker | Lac sow | Dry sow | Gilts | Boars | Weaner | Porker | Grower | Finisher |
|---|---|---|---|---|---|---|---|---|---|---|
| Limestone | 0.0% | | 0.60% | 0.50% | 0.50% | 0.70% | | 0.60% | 0.60% | 0.60% |
| Potassium Choride | 0.0% | | | | | | | | | |
| Salt | 0.0% | 0.04% | 0.40% | 0.40% | 0.40% | 0.40% | 0.25% | 0.25% | 0.25% | 0.25% |
| Zinc Oxide | 0.0% | 0.03% | | | | | | | | |
| **Synthetic amino acids** | | | | | | | | | | |
| L-Isoleucine | 62.5% | 0.01% | | | | | 0.07% | | | |
| L-Lysine HCL | 95.4% | 0.05% | 0.31% | 0.04% | 0.26% | 0.02% | 0.45% | 0.45% | 0.44% | 0.26% |
| DL-Methionie | 58.4% | 0.02% | 0.04% | | 0.05% | | 0.18% | 0.12% | 0.10% | 0.06% |
| L-Threonine | 73.1% | 0.02% | 0.08% | | 0.10% | | 0.18% | 0.13% | 0.12% | 0.03% |
| L-Tryptophan | 85.3% | 0.01% | 0.02% | | 0.01% | | 0.03% | 0.02% | 0.03% | 0.01% |
| **Micellaneous ingredients** | | | | | | | | | | |
| Lactose | 0.0% | 0.25% | | | | | | | | |
| **Vitamin/mineral premixes** | | | | | | | | | | |
| Breeder premix | 0.0% | | 0.20% | 0.20% | 0.20% | 0.20% | | | | |
| Grower premix | 5.0% | | | | | | | 0.20% | 0.20% | 0.20% |
| Weaner premix | 0.0% | 0.02% | | | | | 0.20% | | | |
| **Enzymes** | | | | | | | | | | |
| Axtra Phy | 0.0% | 0.00% | 0.01% | 0.01% | 0.01% | 0.01% | 0.01% | | 0.01% | 0.01% |
| Axtra XB | 0.0% | | | | | | | | | |
| Ronozyme P 5000 (150g dose) | 0.0% | | | | | | | 0.01% | | |
| Rovabio Excel premix | 0.0% | 0.01% | 0.05% | | | | 0.05% | 0.05% | 0.05% | 0.05% |
| **Toxin Binders** | | | | | | | | | | |
| Formi Acid | 0.0% | | | | | | | | | |
| Mycofix | 0.0% | 0.02% | 0.20% | | 0.15% | 0.20% | 0.15% | | | |
| Elitox | 0.0% | | | | | | | 0.10% | 0.10% | 0.05% |
| Mastersorb | 0.0% | | | | | | | | | |
| **Acidifiers** | | | | | | | | | | |
| Top3 | 0.0% | | | | | | 0.15% | | | |
| VevoVital | 0.0% | 0.05% | | | | | | | | |
| **Other Additives** | | | | | | | | | | |

| Ingredient | Default crude protein | Sucker | Lac sow | Dry sow | Gilts | Boars | Weaner | Porker | Grower | Finisher |
|---|---|---|---|---|---|---|---|---|---|---|
| Krave | 0.0% | 0.00% | 0.04% | | | | 0.03% | | | |
| Betaine | 0.0% | 0.01% | 0.10% | | 0.05% | | 0.10% | 0.10% | | |
| **Additional ingredients** | | | | | | | | | | |
| Sow milk | 5.6% | 90.00% | | | | | | | | |
| | | | | | | | | | | |
| **Totals** | | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** |

# Glossary of terms

| | |
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| **Ash (fixed solids)** | The quantity of total solids remaining after the volatile solids component of a material is driven off or burnt by heating the material to 600°C for 1 hour. The ash or fixed solids component of a material is the non-organic component which is not readily biodegradable. |
| **Average daily gain (ADG)** | The total weight gain of the pig divided by the number of days that the weight gain was measured over, generally expressed in with the units g. day$^{-1}$. In PigBal 5, this term is used to refer to live weight gain (rather than dressed weight gain), measured over the period from birth to the time when the pig grows to a live weight of 100 kg. ADG is often expressed as an average for a group of pigs. |
| **Backfatter** | Culled breeding pig sold for meat; usually refers specifically to a culled sow, but is sometimes used in reference to boars. |
| **Baconer pig** | Pigs within a variable weight-range (typically 65 - 80kg dressed weight, 85 – 105 kg live weight) which are sold for meat to serve the requirements of a particular market desiring heavier pigs. |
| **Boar** | Male pig over 6 months of age selected for use in the breeding herd, from either the grower herd or elsewhere. |
| **Breeder piggery** | A unit where breeding stock are kept, along with sucker pigs, which are raised to weaner weight prior to transfer off-site to a grower piggery. |
| **Conventional piggery** | These typically house pigs within steel or timber framed sheds with corrugated iron or sandwich panel roofing and walls made from preformed concrete panels, concrete blocks, corrugated iron or sandwich panel (or some combination of these), sometimes with shutters or nylon curtains depending on the ventilation system. A fully environmentally controlled shed has enclosed walls with extraction fans and cooling pads providing ventilation and climate control. Conventional sheds have a concrete base, often with concrete under-floor effluent collection pits or channels. The flooring is usually partly or fully slatted, and spilt feed, water, urine and faeces fall through the slats into the underfloor channels or pits. These are regularly flushed or drained to remove effluent from the sheds. Sheds without slatted flooring usually include an open channel dunging area which is cleaned by flushing or hosing (Tucker *et al.* 2025). |
| **Creep** | Highly palatable, easily digested feed offered to piglets while suckling, and for the first week post-weaning. |
| **Deep litter piggery** | A housing system in which pigs are typically accommodated within a series of hooped metal frames covered in a waterproof fabric, similar to the plastic greenhouses used in horticulture. However, skillion-roof sheds and converted conventional housing may also be used. Deep litter housing may be established on a concrete base or a compacted earth floor. Pigs are bedded on straw, sawdust, rice hulls or similar loose material that absorbs manure, eliminating the need to use water for cleaning. The used bedding is generally removed and replaced when the batch of the pigs is removed, or on a regular basis (Tucker *et al.* 2025). |

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| **Desludging** | Removing settled solids from the bottom of an effluent pond. |
| **Dressed weight** | The dressed weight refers to the whole body weight of a pig slaughtered in an abattoir and passed as suitable for human consumption by a meat inspector after bleeding, removal of hair, scurf, toenails, ears eyelids/lashes, tongue, kidneys and kidney fat, and evisceration of all internal, digestive, respiratory, excretory and reproductive organs. |
| **Farrow to finish piggery** | Operation in which pigs are raised on-site from birth through all subsequent growth stages, culminating in sale to market. |
| **Farrowing** | Production of a litter of one or more live or dead pigs. |
| **Feed conversion (FC)** | The total weight of air-dry feed (as-fed weight) fed to a pig or group of pigs, divided by the weight gain over a given period. In PigBal 5 the FC refers to the weight of feed fed to a group of pigs, over the period from birth to the time when the pig or pigs achieve a live weight of 100 kg. |
| **Feed conversion ratio (FCR)** | The total weight of air-dry feed (as-fed weight) fed to a pig or group of pigs, divided by the weight gain over a given period. In PigBal 5 the FCR refers to the weight of feed fed to a group of pigs, over the period from wean to the time when the pig or pigs reach finish weight. |
| **Finisher pig** | A grower pig over 70 kg live weight, which is in the final production phase before sale to market at a pre-defined finishing weight (typically approximately 100kg). |
| **Fixed solids (ash)** | The quantity of total solids remaining after the volatile solids component of a material is driven off or burnt by heating the material to 600°C for 1 hour. The fixed solids or ash component of a material is the non-organic component which is not readily biodegradable. |
| **Flushing sheds** | Flushing sheds have relatively shallow concrete channels running under the slatted floors. The channels are flushed regularly (generally daily to twice weekly) to remove the manure and waste feed from the sheds into drains or sumps, prior to pre-treatment or discharge into an effluent pond. Flushing is generally carried out by rapidly releasing relatively large quantities of water (or recycled effluent) from flushing tanks located near the ends of the sheds. Alternatively, sheds may be flushed using a high-capacity pump. |
| **Gestating sow** | Impregnated sow (also referred to as a “dry” or non-lactating sow), prior to reaching the farrowing stage. |
| **Gilt** | Young female pig that has not been mated, selected for use in the breeding herd, from either the on-site grower herd or following purchase from another herd. |
| **Grower pig** | Any pig between weaning and sale or transfer to the breeding herd, sold for slaughter or killed for rations. |

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| **Grower piggery** | Operation in which weaner pigs are sourced from other units (such as breeder piggeries) to be "grown out" to a pre-defined finishing weight before sale to market. |
| **Herd Feed Conversion (HFC)** | The total weight of air-dry feed (as-fed weight) fed to the whole pig herd, divided by the total dressed weight of carcasses over a given period. In PigBal 5 the HFC refers to the weight of feed fed to a all pigs, over the period from dressed (processed) weight of pig meat produced after processing. |
| **Lactating sow** | A sow that has given birth to a litter of piglets, and is producing milk to feed the piglets. |
| **Manure** | Faeces plus urine. |
| **Parity** | The number of litters a sow has carried, including the current pregnancy e.g. a second parity sow is either in pig, suckling or has just weaned her second litter. |
| **Porker pig** | Market pigs between approximately 30 and 55 kg dressed weight (40 – 70 kg live weight). |
| **Pull plug sheds** | Pull plug sheds store manure, waste feed and hosing water in several concrete pits constructed beneath the slatted shed floors. The effluent is generally released by gravity, through individual pipe outlets located in the centre of each pit. |
| **Run-down screen** | A screen comprised of finely spaced stainless steel bars held on an incline by a steel frame. When effluent is poured onto the screen, the liquid and fine solids pass through, while the larger solids are retained on the screen before falling onto a solids collection vessel or bunk. |
| **Screw press** | A cylindrical screen with a screw-conveyor in the centre. The conveyor presses the solids against the screen to remove moisture. The conveyor also moves solids from one end of the press to the other, to a collection area. |
| **Sedimentation** | The process of settling entrained solids from an effluent stream through the influence of gravity. A sedimentation system may be a pond, basin or terrace that discharges to a holding pond or evaporation system. |
| **SEPS** | A Sedimentation and Evaporation Pond System (SEPS) is an effluent treatment system consisting of two or three long, narrow, shallow, trafficable earthen channels, designed to settle out solids and store effluent. Each channel is designed to receive effluent for a six to twelve month period. At the end of this time, another channel is activated and the liquid is drained or siphoned from the first channel, allowing the settled solids to dry prior to removal. |
| **Sow** | A breeding female pig that has been served; term refers to both lactating and "dry" (gestating) sows. |
| **Static pit sheds** | Static pit sheds are commonly older sheds which store manure, waste feed and hosing water in concrete pits located under the slatted floors. The effluent is generally released via a sluice gate or valve located at the end of each shed, at intervals up to several weeks. |

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| **Stillborn piglet** | A piglet which is deceased at time of delivery. |
| **Standard pig unit (SPU)** | One standard pig unit (SPU) has a manure volatile solids production rate equivalent to a standard grower pig with a live weight of 40 kg. |
| **Sucker** | A pig which is in a growth stage between birth and weaning. |
| **Total solids (TS)** | The dry matter content of a compound. |
| **Volatile solids (VS)** | The quantity of total solids burnt or driven off when a material is heated to 600°C for 1 hour.  Volatile solids is a measure of the biodegradable organic solids content of a material. |
| **Weaner pig** | Pig which has been removed from the lactating sow and fed a solid/semi-solid diet, up to a maximum live weight of approximately 30 kg. |
| **Weaning** | The time at which piglets are removed from the lactating sow and introduced to solid/semi-solid feed. |

# Document Information

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