AUSTRALIAN PORK LIMITED

Piggery Manure and Effluent Reuse Glovebox Guide

2015

PROJECT TITLE:

Piggery Manure and Effluent Management and Reuse Glovebox Guide 2015

PROJECT NUMBER:

2012/1028

RESEARCH ORGANISATION:

FSA Consulting

PRINCIPAL INVESTIGATOR:

Ms Robyn Tucker, FSA Consulting, Private Bag 260, Horsham Vic 3401

DISCLAIMER

This document should be cited as follows:

APL project 2012/1028, Piggery Manure and Effluent Management and Reuse Glovebox Guide 2015

Piggery Manure and Effluent Reuse Glovebox Guide

This Glovebox Guide provides information, worked examples and templates to determine nutrient removal by crops/pastures and application rates for effluent, manure and spent bedding for conventional and deep litter production systems. The Guide provides Rotational Outdoor production systems information, worked examples and templates to calculate the nutrient added to reuse areas as well as nutrient removal over the crop/forage/pasture phase. This can assist in determining stocking densities and rotations.

Piggery effluent, manure and compost can be valuable sources of nutrients and organic matter for improving soil properties and crop or pasture production. Good management is needed to gain the maximum benefit from these products while reducing potential environmental and amenity impacts. These benefits include: increased organic matter, enhanced soil structure, improved rainfall infiltration and water holding capacity of soil, enhanced soil fertility, reduced erosion, increased plant yields and reduced fertiliser costs.

It order to get the maximum benefit from reusing effluent and manure and to manage the nutrients in outdoor production systems, sustainable reuse practises should be developed that are based on mass balance principles and/or monitoring.

Nutrient budgeting is the cornerstone of sustainable reuse and managing outdoor production systems. Appropriate rates can be determined using a mass balance that considers: nutrient status of the soil, nutrients added to the land in manure and/or effluent, acceptable nutrient losses, P storage and nutrient removal via crop harvesting.

Further information on effluent and manure management and reuse, valuation of nutrients and duty of care statement for selling nutrient off site can be found in APL's Piggery Manure and Effluent Management and Reuse Guidelines 2015.

Reuse of Effluent and Manure

Calculate Nutrient Removal by Crop or Pasture

From the table below, select the crop or pasture. Use the expected dry matter (DM) yield, the DM nutrient content in the crop and the calculation template below the table to calculate the likely nitrogen (N), phosphorus (P) and potassium (K) removal rate (kg/ha).

Approximate Nutrient Removal Rates for Various Crops and Crop Yields

Crop	DM nutrient content (kg/t)[a]			Yield range (DM t/ha)[b]	Nutrient Removal Range (kg/ha)		
	Nitrogen	Phosphorus	Potassium		Nitrogen	Phosphorus	Potassium
Grazed Pasture[c]	20	3	15		7.1–19.0	0.9–2.2	0.1–0.6
Dry Land Pasture (cut)	20	3	15	1–4	20–80	3–12	15 – 60
Irrigated Pasture (cut)	20	3	15	8–20	160–400	24–60	120–300
Lucerne Hay (cut)	31	3	25	5–15	155–465	15–45	125–375
Maize Silage	22	3	20	10–25	220–550	30–75	200–500
Forage Sorghum	22	3	24	10–20	220–440	30–60	240–480
Winter Cereal Hay	20	3	16	1–20	200–400	30–60	160–320
Barley	19	3	4	2–5	38–95	6–15	8–20
Wheat	19	4	5	2–5	38–95	8–20	10–25
Triticale	19	4	6	1.5–3	29–57	6–12	9–18
Rice	14	3	4	4–8	56–112	12–24	16–32
Seed Oats	15	3	4	1–5	15–75	3–15	4–20
Grain Sorghum	20	3	3	2–8	40–160	6–24	6–24
Grain Maize	20	3	4	2–8	40–160	6–24	8–32
Chickpea	40	4	4	0.5–2	20–80	2–8	2–8
Cowpea	30	4	20	0.5–2	15–60	2–8	10–40
Faba Bean	40	4	12	1–3	40–120	4–12	12–36
Lupins	45	3	8	0.5–2	22.5–90	1.5–6	4–16
Navy Bean	40	6	12	0.5–2	20–80	3–12	6–24
Pigeon Peas	26	3	9	0.5–2	13–52	1.5–6	4.5–18
Cotton	20	4	8	2–5	40–100	8–20	16–40

a 1 kg/t is equivalent to 1 g/kg, 1000 mg/kg or 1000 ppm. Data in the dry matter nutrient content column (kg/ha) can be used to calculate approximate nutrient removal rates by multiplying by an appropriate dry matter yield (t/ha) for a given location.

b Yields may vary from these ranges (refer to historical data for the region for more accurate estimates).

c The grazed pasture example assumes a liveweight gain of 75–200 kg/ha/yr, with no ammonia volatilisation losses from the grazed animal's manure.

Sources: Bach (2010), DAFF (2012), Birchall et al. (2008), DPI Victoria (2007), Falconer and Bowden (2005), GRDC (2008), Kaiser et al. (2004), National Research Council (2000) and Reuter and Robinson (1997).

Calculation Template

Crop type: Yield (DM t/ha)

Parameter	N	P	K
Nutrient content (kg/t)			
Nutrient removal rate (kg/ha)			

Worked Example

Crop type: barley Yield 3 DM t/ha

Parameter	N	P	K
Nutrient content (kg/t)	19	3	4
Nutrient removal rate (kg/ha)	19 kg/t x 3 t/ha = 57 kg/ha	3 x 3 t/ha = 9 kg/ha	4 kg/t x 3 t/ha = 12 kg/ha

Determine Target Nutrient Application Rates

Determine target nutrient application rates using the nutrient mass balance equation:

> Amount of nutrient applied (kg/ha) = nutrient removed by plant harvest (kg/ha) + acceptable nutrient losses to the environment (kg/ha) + nutrient safely stored in the soil (kg/ha)

This needs to be applied for N, P and K. The inputs are:

- Nutrient removed by plant harvest – determined in previous step.
  For the example this is:
  N 57 kg/ha
  P 9 kg/ha
  K 12 kg/ha
- Acceptable nutrient losses to the environment. This generally only applies for N where ammonia (NH_3) volatilisation losses occur on and after spreading or irrigation. They vary depending on the reuse method and the by-product type.
  As a percentage of N removed by the crop, these are typically:
  - spray/drip irrigation of effluent 20% of N
  - surface flow irrigation of effluent 10% of N
  - spreading of fresh bedding 20% of N
  - spreading of compost 10% of N

- Nutrient safely stored in the soil. This generally applies only to P. It varies with soil type and past land uses and should be determined by soil testing. If this testing is not done, assume that effluent reuse areas and areas spread with manure every year have no storage capacity. However, if solids are spread on an area every few years, P can be applied to meet crop requirements for the years between spreading.

Use the nutrient removed by plant harvest (previous step), an allowance for N volatilisation losses and soil P storage (if appropriate to complete the calculation template below for N, P and K. Worked examples for barley yielding 3 t/ha are provided.

Calculation Template

Amount of N applied (kg/ha)	=	N removed by plant harvest (kg/ha) + ammonia-N losses (% NH_3 loss x N removed by plant harvest (kg/ha))
Amount of N applied (kg/ha)	=	______kg/ha + (______% x ______kg/ha)
Amount of P applied (kg/ha)	=	P removed by plant harvest (kg/ha) + nutrient safely stored in the soil (kg/ha)
Amount of P applied (kg/ha)	=	______kg/ha + ______kg/ha
Amount of K applied (kg/ha)	=	K removed by plant harvest (kg/ha)
Amount of K applied (kg/ha)	=	_______kg/ha

Worked Example 1 – Barley Grown on an Effluent Reuse Area

It is assumed that soil P storage capacity is unknown. Because the land is used for effluent irrigation, only one year's P can be applied. A spray irrigation system is used so expected NH_3-N losses are 20% of the crop removal rate. Crop nutrient removal rates come from the previous step.

Amount of N applied (kg/ha) = N removed by plant harvest (kg/ha) + acceptable nutrient losses to the environment (% NH3-N loss X N removed by plant harvest (kg/ha))

Amount of N applied (kg/ha)	=	57 kg/ha + (20 % x 57 kg/ha)
	=	57 kg/ha + 11.4 kg/ha
	=	68.4 kg N/ha
Amount of P applied (kg/ha)	=	9 kg/ha + 0 kg/ha
	=	9 kg P/ha
Amount of K applied (kg/ha)	=	12 kg K/ha

Worked Example 2 – Barley Grown on a Reuse Area Spread with Spent Bedding Every Four Years.

Because spent bedding is spread every four years, four years nutrients are applied at each spreading. Hence, the amount of nutrient applied is multiplied by 4. Ammonia-N (NH_3-N) losses are 10% of the crop removal rate. Crop nutrient removal rates come from the previous step.

Amount of N applied (kg/ha)	=	4 x (57 kg/ha + (10% NH3-N loss X 57 kg/ha))
	=	4 x (57 kg/ha + 5.7 kg/ha)
	=	251 kg N/ha
Amount of P applied (kg/ha)	=	4 x (9 kg/ha + 0 kg/ha)
	=	36 kg P/ha
Amount of K applied (kg/ha)	=	4 x 12 kg/ha
	=	48 kg K/ha

Determine the Manure or Effluent Application Rate

The manure or effluent application rate is determined from the target nutrient application rate and the N, P and K concentration in the material. It is important to use recent, site-specific analysis results for the manure or effluent being spread, particularly for effluent. The nutrient producing the lowest application rate is the nutrient limited application rate and the maximum average annual application rate.

Typical nutrient analysis results for effluent, sludge and spent bedding are given below.

Typical N, P and K Concentrations of Effluent, Sludge and Spent Bedding				
Element	**DM Content**	**Nitrogen**	**Phosphorus**	**Potassium**
Effluent	–	600 mg/L (158–955 mg/L)	70 mg/L (19–175 mg/L)	500 mg/L (128–784 mg/L)
Sludge	13% (wb) (7–17% wb)	3.4% (2.84–4.02%)	4.69% (2.83–5.9%)	0.75% (0.27–1.33%)
Spent bedding	58% (52–64% wb)	0.8% (0.2–4.5%)	1% (0.2–2.6%)	0.4% (0.2–0.6%

For Effluent:

Effluent application rate (KL/ha) = nutrient application rate* (kg/ha) / (nutrient concentration in effluent (mg/L) / 1000)
= Kg/ha / kg/KL

For Manure:

Manure application rate (t/ha) = nutrient application rate (kg/ha)* / (nutrient concentration in wastes (mg/kg) / 1000)

* "amount of nutrient" from previous step.

Calculation Template – Effluent

Effluent application rate for N (KL/ha) = ______(kg/ha) / (______mg/L / 1000)

Effluent application rate for P (KL/ha) = ______(kg/ha) / (______mg/L / 1000)

Effluent application rate for K (KL/ha) = ______(kg/ha) / (______mg/L / 1000)

Calculation Template – Manure

Manure application rate (t/ha) for N = ______(kg/ha) / (______mg/kg / 1000)

Manure application rate (t/ha) for P = ______(kg/ha) / (______mg/kg / 1000)

Manure application rate (t/ha) for K = ______(kg/ha) / (______mg/kg / 1000)

Convert the DM spreading rate to as–spread by dividing it by 1–(dry matter % / 100).

Worked Example 1 – Effluent

For the purpose of this example, it is assumed the effluent contains 600 mg N/L, 50 mg P/L and 300 mg K/L. *It is very important to use recent, site-specific analysis results for the effluent being irrigated.*

Effluent application rate for N (KL/ha)	=	68.4 kg/ha / (600 mg/L / 1000)
	=	68.4 kg/ha / 0.6 kg/KL
	=	114 KL/ha
Effluent application rate for P (KL/ha)	=	9 kg/ha / (50 mg/L / 1000)
	=	9 kg/ha / 0.05 kg/KL
	=	180 KL/ha
Effluent application rate for K (KL/ha)	=	12 kg/ha / (300 mg/L / 1000)
	=	12 kg/ha / 0.3 kg/KL
	=	40 KL/ha

The lowest application rate (40 KL/ha) is for K; the limiting nutrient. Hence, the maximum application rate is 40 KL/ha.

1 KL/ha is equivalent to an irrigation depth of 0.1 mm. Hence, 40 KL/ha = 4 mm.

Effluent may need to be diluted for practical irrigation at this rate. A significantly higher rate would be possible if a silage or hay crop were grown.

Worked Example 2 – Manure

For the purpose of this example, it is assumed the spent bedding contains 0.8% N, 1.1% P and 1.6% K on a DM basis; or 8000 mg N/kg, 11,000 mg P/kg and 16,000 mg K/kg. *If data are available, use recent, site-specific analysis results for the manure being spread.*

Manure application rate (t/ha) for N	=	251 kg/ha / 8000 mg/kg / 1000)
	=	251 kg/ha / 8 kg/t
	=	31 t/ha
Manure application rate (t/ha) for P	=	36 kg/ha / 11,000 mg/kg / 1000)
	=	36 kg/ha / 11 kg/t
	=	3 t/ha
Manure application rate (t/ha) for K	=	48 kg/ha / 16,000 mg/kg / 1000)
	=	48 kg/ha / 16 kg/t
	=	3 t/ha

The lowest application rate (3 dry t/ha) is for P and K; the limiting nutrients. Hence, the maximum application rate is 3 dry t/ha. If the moisture content of the spent bedding is 40%, the application rate will need to be 5 t/ha (i.e. 3t/(1–0.4)). Additional N will need to be applied to the crop.

Rotational Outdoor Piggeries

Calculate Nutrients Added to Reuse Area

The amount of nutrients added during the pig phase is the sum of nutrients in manure and any bedding that is left on the paddocks after the pig phase. N, P and K added need to be determined for each separate paddock area.

To calculate nutrients added to each paddock, first multiply the number of pigs/ha in each class by the amount of nutrients in the manure they produce to obtain the annual nutrient application rate. (Use the N after NH_3-N losses value). This then needs to be multiplied by the time (years) that the pig phase lasts e.g. 0.5 for a 6 month pig phase, 2 for a 2 year pig phase.

Second, calculate the nutrients added by bedding by multiplying the mass of bedding (kg/ha/yr) by the nutrient content (%).

If it is expected that additional fertilisers will be used during the crop/forage/pasture phase, the nutrients these must also be included.

Sum all the nutrient additions to obtain a total.

Tables of nutrients added by each class of pig and bedding, a calculation template and an example are provided overleaf.

Nutrients Added by Each Class of Pig

Class of Pigs	Nutrients (kg/hd/yr)			
	Nitrogen	Nitrogen after NH_3-N losses*	Phosphorus	Potassium
Gilts	12.0	9.0	4.6	4.0
Boars	15.0	11.3	5.3	3.8
Gestating sows	13.9	10.4	5.2	3.7
Lactating sows	27.1	20.3	8.8	9.8
Suckers	2.3	1.7	0.4	0.1
Sow and litter	50.0	37.5	13.0	11.0
Weaner pigs	3.9	2.9	1.1	1.1
Grower pigs	9.2	6.9	3.0	2.4
Finisher pigs	15.8	11.9	5.1	4.1

* NH_3-N losses are assumed to be 25%

Nutrients in Bedding Materials

Bedding Materials	Content (% dry matter)				Content (% fresh basis)		
	Total Solids	Nitrogen	Phosphorus	Potassium	Nitrogen	Phosphorus	Potassium
Hardwood Sawdust[a]	90	0.22	0.01	0.05	0.20	0.01	0.05
Softwood Sawdust[a]	90	0.14	0.01	0.03	0.13	0.01	0.03
Rice Hulls[b]	92	0.53	0.08	1.32	0.49	0.07	1.21
Barley Straw[b]	91	0.69	0.07	2.37	0.63	0.06	2.16
Wheat Straw[b]	89	0.58	0.05	1.42	0.52	0.04	1.26

[a] *based on unpublished data from Department of Primary Industries* and Fisheries – Queensland.

[b] based on data from National Research Council (1984).

Calculation Template

This template needs to be completed for each separate paddock area.

Nutrients Added by Pigs

Class of Pig	Stocking density (pigs/ha)	Nutrients added per pig (kg/pig/yr)			Nutrients addition rate (kg/ha/yr)			Nutrient addition rate over pig phase(kg/ha)		
		N	P	K	N	P	K	N	P	K
Total										

Nutrients Added by Bedding

Class of pig	Stocking density (pigs/ ha)	Bedding use rate (kg/pig/ yr)	Bedding use rate (kg/ha/ yr)	Nutrients in bedding (%)			Nutrients added per hectare (kg/ha/yr)			Nutrients added to area over pig phase (kg/ha/yr)		
				N	P	K	N	P	K	N	P	K
Sow & litter												
Total												

Nutrients Added by Fertiliser over Crop/Forage/Pasture Phase:

__________ N/ha, _________ P/ha, _________ K/ha

Total Nutrients Added

Source	N (kg/ha)	P (kg/ha)	K (kg/ha)
Pigs			
Bedding			
Fertiliser			
Total			

Worked Example

Lactating sows are stocked at 16 sows/ha. The pig phase is 18 months. Bedding is barley straw.

Nutrients Added by Pigs (see table on page 11)

Class of Pig	Stocking density (pigs/ha)	Nutrients added per pig (kg/pig/yr)			Nutrients addition rate (kg/ha/yr)			Nutrient addition rate over pig phase(kg/ha)		
		N	P	K	N	P	K	N	P	K
Sow & litter	16	37.5	13.0	11.0	600	208	176	900	312	264

Nutrient addition rate (kg/ha/yr) is the product of stocking density (pigs/ha) and nutrient addition rate. For example, for N it is 16 pigs/ha X 37.5 kg N/pig/yr = 600 kg N/ha/.

The nutrient addition rate over the pig phase (kg/ha) is the nutrient addition rate (kg/ha/yr) multiplied by the length of the pig phase in years. For example, 600 kg N/ha/yr X 1.5 years = 900 kg N/ha.

Nutrients added by Bedding

Class of pig	Stocking density (pigs/ha)	Bedding use rate (kg/pig/yr)	Bedding use rate (kg/ha/yr)	Nutrients in bedding (%)			Nutrient addition rate (kg/ha/yr)			Nutrients added over pig phase (kg/ha)		
				N	P	K	N	P	K	N	P	K
Sow & litter	16	300	4800	0.63	0.06	2.16	30	3	104	45	4	156

Bedding use rate (kg/ha/yr) is the product of stocking density (pigs/ha) and bedding use rate (kg/pig/yr); in this case 16 pigs/ha X 300 kg/pig/yr = 4800 kg/ha/yr.

Nutrient addition rates (kg/ha/yr) are the product of bedding use rate (kg/ha/yr) and nutrients in bedding (%). In this case, for N, it is 4800 kg/ha/yr X 0.63% = 30 kg N/ha/yr. Nutrients added over the pig phase are the product of the nutrient addition rate (kg/ha/yr) and the length of the pig phase (yrs). In this case, for N, this is 30 kg/ha/yr X 1.5 years = 45 kg/ha.

Nutrients Added by Fertiliser During Crop/Forage/Pasture Phase

Nil

Total Nutrients Added

Source	N (kg/ha)	P (kg/ha)	K (kg/ha)
Pigs	900	312	264
Bedding	45	4	156
Fertiliser	0	0	0
Total	945	316	420

Total nutrients added are the sum of the amounts from the previous steps.

Calculate Nutrient Removal over Crop/Forage/Pasture Phase

From the table below, select the crop, forage and pastures that will be grown over the entire rotation. Use the expected dry matter (DM) yield, the DM nutrient content in the crop and the calculation template below the table to calculate the likely nitrogen (N), phosphorus (P) and potassium (K) removal rate (kg/ha).

Crop	DM nutrient content (kg/t)			Yield range (DM t/ha)	Nutrient Removal Range (kg/ha)		
	Nitrogen	Phosphorus	Potassium		Nitrogen	Phosphorus	Potassium
Grazed Pasture	20	3	15		7.1–19.0	0.9–2.2	0.1–0.6
Dry Land Pasture (cut)	20	3	15	1–4	20–80	3–12	15–60
Irrigated Pasture (cut)	20	3	15	8–20	160–400	24–60	120–300
Lucerne Hay (cut)	31	3	25	5–15	155–465	15–45	125–375
Maize Silage	22	3	20	10–25	220–550	30–75	200–500
Forage Sorghum	22	3	24	10–20	220–440	30–60	240–480
Winter Cereal Hay	20	3	16	10–20	200–400	30–60	160–320
Barley	19	3	4	2–5	38–95	6–15	8–20
Wheat	19	4	5	2–5	38–95	8–20	10–25
Triticale	19	4	6	1.5–3	29–57	6–12	9–18
Rice	14	3	4	4–8	56–112	12–24	16–32
Seed Oats	15	3	4	1–5	15–75	3–15	4–20
Grain Sorghum	20	3	3	2–8	40–160	6–24	6–24
Grain Maize	20	3	4	2–8	40–160	6–24	8–32
Chickpea	40	4	4	0.5–2	20–80	2–8	2–8
Cowpea	30	4	20	0.5–2	15–60	2–8	10–40
Faba Bean	40	4	12	1–3	40–120	4–12	12–36
Lupins	45	3	8	0.5–2	22.5–90	1.5–6	4–16
Navy Bean	40	6	12	0.5–2	20–80	3–12	6–24
Pigeon Peas	26	3	9	0.5–2	13–52	1.5–6	4.5–18
Cotton	20	4	8	2–5	40–100	8–20	16–40

Calculation Template

Year 1 of Crop/Forage/Pasture Phase

Crop type: Yield (DM t/ha)

Parameter	N	P	K
Nutrient content (kg/t)			
Nutrient removal rate (kg/ha)			

Year 2 of Crop/Forage/Pasture Phase

Crop type: Yield (DM t/ha)

Parameter	N	P	K
Nutrient content (kg/t)			
Nutrient removal rate (kg/ha)			

Year 3 of Crop/Forage/Pasture Phase

Crop type: Yield (DM t/ha)

Parameter	N	P	K
Nutrient content (kg/t)			
Nutrient removal rate (kg/ha)			

Worked Example

Year 1

Crop type: winter cereal hay   Yield (DM t/ha) 15

Parameter	N	P	K
Nutrient content (kg/t)	20	3	16
Nutrient removal rate (kg/ha)	20 kg/t x 15 t/ha = 300	3 kg/t x 15 t/ha = 45	16 kg/t x 15 t/ha = 240

Year 2

Crop type: winter cereal hay   Yield (DM t/ha) 15

Parameter	N	P	K
Nutrient content (kg/t)	20	3	16
Nutrient removal rate (kg/ha)	20 kg/t x 15 t/ha = 300	3 kg/t x 15 t/ha = 45	16 kg/t x 15 t/ha = 240

Year 3

Crop type: barley   Yield 3 DM t/ha

Parameter	N	P	K
Nutrient content (kg/t)	19	3	4
Nutrient removal rate (kg/ha)	19 kg/t x 3 t/ha = 57	3 x 3 t/ha = 9	4 kg/t x 3 t/ha = 12

Year 4

Crop type: winter cereal hay   Yield (DM t/ha) 15

Parameter	N	P	K
Nutrient content (kg/t)	20	3	16
Nutrient removal rate (kg/ha)	20 kg/t x 15 t/ha = 300	3 kg/t x 15 t/ha = 45	16 kg/t x 15 t/ha = 240

Year 5

Crop type: barley Yield 3 DM t/ha

Parameter	N	P	K
Nutrient content (kg/t)	19	3	4
Nutrient removal rate (kg/ha)	19 kg/t x 3 t/ha = 57 kg/ha	3 x 3 t/ha = 9 kg/ha	4 kg/t x 3 t/ha = 12 kg/ha

TOTAL

Year	N	P	K
1	300	45	240
2	300	45	240
3	57	9	12
4	300	45	240
5	57	9	12
TOTAL	**1014**	**153**	**744**

Confirm Nutrient Balance

Subtract the nutrients removed from the nutrients added to confirm that the system is in balance. If this is not the case, modify management to achieve a balance e.g. shorten the length of the pig phase, lighten the stocking density, grow forage or pasture crops that remove more nutrients, irrigate the crops to increase yield, lengthen the crop/forage pasture phase, or a combination of these actions.

Template

Process	N	P	K
Nutrients added (kg/ha/yr)			
Nutrients removed (kg/ha/yr)			
Net nutrient position (kg/ha/yr)			

Worked Example

Process	N	P	K
Nutrients added (kg/ha/yr)	945	316	420
Nutrients removed (kg/ha/yr)	1014	153	744
Net nutrient position (kg/ha/yr)	-69	163	-324

In this example, P is still in surplus at the end of the crop/forage/pasture phase. Changes to management would be needed to achieve a P balance. There is a modest N deficit and a significant K deficit. It may be necessary to apply fertilisers to ensure good crop yields. Lower crop yields will reduce nutrient removal.

Useful Conversions

1 acre	0.405 ha		
1 ha	2.47 ha		
1%	10,000 mg/g	10 g/kg	10 kg/t
10,000 mg/L	10 g/L	10 kg/KL	
1000 mg/kg	1 g/kg	0.001 kg/t	
1 ML	1000 KL	1000 m^3	
1 ML/ha	100 mm		
1 KL/ha	0.1 mm		

AUSTRALIAN PORK LIMITED

ABN 83 092 783 728

Level 2, 2 Brisbane Avenue Barton ACT 2600
PO Box 4746 Kingston ACT 2604 Australia

P: 02 6285 2200 F: 02 6285 2288
E: apl@australianpork.com.au

www.australianpork.com.au