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Full hand feeding of sheep – quantities

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The quantity of feed required for full hand feeding depends on the size and stage of production of the animal and also the quality of the intended feed stuff. It is impossible to offer glib rules of thumb as to the feeding rates for animals without some knowledge of the quality of the feed being used.

Nutrients

Sheep, whether being fed for maintenance or production, need a balanced supply of nutrients. Nutrients divide broadly into:

- energy
- protein
- minerals
- vitamins.

Although water is not considered a nutrient, an adequate supply of drinkable water is also vital for livestock survival, particularly during drought.

Energy requirements for maintenance

Energy is needed by animals for all body functions. Energy is measured in megajoules (MJ). Animal requirements are assessed as megajoules of metabolisable energy (MJ.ME). Energy in feed is assessed as megajoules of metabolisable energy per kilogram of dry matter (MJ.ME/kg feed dry matter or simply M/D).

In drought, energy will always be the most limiting nutrient. Addressing this need is the first requirement in a drought feeding program.

Sheep requirements for energy depend on:

- liveweight
- energy concentration of the feed (M/D)
- pregnancy
- lactation
- growth
- weather conditions.

The first step in addressing the energy needs of adult sheep is to calculate the amount of feed needed to provide sufficient energy to maintain liveweight, assuming the sheep are neither pregnant nor lactating. Adjustments for pregnancy and lactation are discussed in the next section.

To calculate the maintenance feed requirement you must know the energy content of the ration to be used. A guide to the energy contained in various feeds can be found at the end of this Primefact. Feeds will vary dramatically in both energy and protein and the values contained in the guide are average values only. Whenever possible, a feed analysis is recommended so that rations can be calculated accurately. Your local livestock officer can provide information on testing laboratories.

Once the energy content of the feed is known, use Figure 1 (at the end of this Primefact) to predict the amount of feed needed to meet maintenance requirements. If several feeds are being fed concurrently the following procedure is used to calculate the energy content of the mixed ration. Use the M/D of the mix to calculate rates from Figure 1.

For example a ration containing 80% wheat (13 M/D) and 20% clover hay (9 M/D). The calculation is as follows:

$$\frac{(80 \times 13) + (20 \times 9)}{100} = 12.2 \text{ M/D}$$

Find the appropriate value for ‘Shorn empty liveweight (kg)’ for your sheep and place a ruler intersecting this liveweight and 12.2 on the Feed M/D line. The point where the ruler cuts the right hand line indicates how much dry matter needs to be fed to maintain liveweight. For a 45 kg sheep and 12.2 M/D the feeding rate is 500g/hd/day of dry matter.

All feeds contain some water. Hay and grain are typically 90% dry matter so to determine the quantity of the ration ‘as fed’, multiply the dry

matter feeding rate by 100 and divide by the dry matter percentage.

For our example:

$$\frac{500 \times 100}{90} = 555 \text{ g/h/d of the mix}$$

Note that as the energy value of feeds declines below about 7.5 M/D, it is likely that a dry sheep will be unable to consume sufficient quantities to achieve maintenance. For pregnant and lactating ewes a feed below 9.5 and 11 M/D respectively is unlikely to be sufficient.

Table 1. Allowances for pregnancy and lactation.

	Factor	Minimum* crude protein %
Dry ewe or wether	1.0	6
Ewe flock to last month of pregnancy	1.0	6
Ewe flock during the last month of pregnancy	1.7**	8
Ewe flock – first month of lactation	2.5	12
Ewe flock – second and third months of lactation	1.8	12

* These minimum values are shown as a guide for maintenance feeding in circumstances where feeding costs need to be minimised. For any diet, but especially one based on grain, crude protein must be adequate (see Table 3).
** Feeding levels should be gradually increased to this allowance from 6 weeks before lambing.

Energy requirement for pregnancy and lactation

Once the feed requirements for a dry sheep have been calculated, allowances can be made for the increased requirements for pregnancy and lactation. This is achieved by multiplying the maintenance requirement by the appropriate factor in Table 1.

The requirements indicated in Table 1 for late pregnancy and lactation are average requirements and assumes a flock consisting of both single-bearing (70–80%) and twin-bearing (20–30%) ewes. Individual ewe requirements vary around this average. For example, ewes at the peak of lactation rearing twins need about 3.3 times maintenance but within a flock, ewes vary in their stage of pregnancy and lactation and the factors in Table 1 are the best indication of flock needs.

Energy requirements for weaners

Both energy and protein will be important to achieve adequate performance from weaned lambs

Table 2 predicts the daily amount of feed of a specific M/D required to achieve a given growth rate in merino weaners. The minimum crude protein requirement for each situation is also shown.

The rate required varies according to the M/D of the feed, the current weight of the lamb and the required weight gain.

Example: for a 15 kg weaner to achieve 100 g/hd/day weight gain on a ration with 12 M/D the required feeding rate will be 460 g/hd/day at a minimum crude protein requirement of 17%

If a feed M/D is not shown in the table it means that feed of that energy concentration would be unsuitable for the intended liveweight and weight gain. This is because weaners of that weight would reach their intake limit before sufficient ME is consumed to achieve that growth rate target.

Young weaners also need roughage as part of their diet to encourage continued rumen development. This should comprise at least 20% of the total ration, and preferably be a high-quality legume hay.

Energy allowance for chill

Chill (the combination of wind, low temperatures or rain, or both) can significantly increase the energy requirements of sheep. For example, freshly shorn sheep will need at least double the calculated feed requirements if wind conditions approach 15 km/h and daily minimum and maximum temperatures are in the range of 0–10°C.

The same sheep, in calm conditions experiencing similar temperatures, require only 60% more than the calculated feed requirement.

For sheep off-shears, 20% additional feed will be a minimum requirement even in relatively mild conditions. Chill can significantly influence energy requirements until fleece length exceeds 3 cm.

Good-quality hay is the best source of extra feed during cold stress periods as there is no risk of grain poisoning from increased feeding rates, and digestion occurs over a longer time frame, raising body temperature for longer. Ad lib feeding is necessary to achieve maximum intake.

Lupins are the only grain which can be fed at rapidly increased quantities without risk of acidosis (grain poisoning).

Table 2. Predicted feed and minimum protein requirements for merino weaners

Weaner Liveweight											
		10 kg		15 kg		20 kg		25 kg		30 kg+	
Growth target	M/D	Feed g/d	Protein %	Feed g/d	Protein %	Feed g/d	Protein %	Feed g/d	Protein %	Feed g/d	Protein g/d
Maintain weight	8	Feeding to maintain weaners below 20 kg is not recommended				510	8.7	590	8.7	680	8.7
	9					440	9.5	510	9.5	590	9.5
	10					380	10.0	450	10.0	510	10.0
	11					340	10.8	400	10.8	450	10.8
	12					300	11.5	350	11.5	400	11.5
	13					270	12.5	320	12.5	360	12.5
50 g/d	10	350	14.5	450	13.0	560	11.8	610	11.1	770	10.4
	11	300	16.3	400	14.0	490	12.9	580	12.0	660	11.6
	12	260	18.7	350	15.4	430	14.0	510	13.0	580	12.5
	13	240	19.5	310	16.7	380	15.2	450	14.1	510	13.6
100 g/d	11	420	17.9	540	15.1	660	13.5	780	12.3	880	11.7
	12	360	20.2	460	17.0	570	14.9	670	13.6	760	12.8
	13	330	22.4	410	18.4	500	16.3	590	14.7	670	13.8
150 g/d	12	470	20.5	590	17.5	710	15.5	840	13.8	950	11.8
	13	420	23.4	510	19.5	620	16.9	730	15.1	830	13.9

Protein

Rapidly growing sheep or lambs, and ewes in late pregnancy and through lactation, have greater needs for protein than do animals just maintaining weight. The amount of protein required must also balance the energy content of the diet if rumen fermentation is to have the greatest efficiency.

Much of the protein in feed is reduced to ammonia in the rumen. Ammonia is then used as a nitrogen source by rumen microbes to construct new protein. It is the flow of microbial protein to the true stomach and intestine that provides the majority of digestible protein to ruminant animals.

The minimum crude protein requirements for various classes of mature sheep are listed in Table 1; the requirements for weaners are listed in Table 2. The guide at the end of this Primefact shows average protein levels for various types of feeds.

If more than one feed is being fed the following procedure is used to calculate the protein content of the mixed ration. For example a ration containing 80% wheat (14% protein) and 20% lucerne hay (16% protein).

The calculation is as follows:

$$\frac{(80 \times 14) + (20 \times 16)}{100} = 14.4\% \text{ protein}$$

Although Table 1 indicates relatively low minimum protein requirements for various types of sheep, it may be financially viable to use feeds with a better balance between energy and protein. To do this, you may need to increase the protein proportion of some diets according to the suggested protein contents in Table 3. Oat grain is a common feed which is often unbalanced for protein. Oat grain can often be at least 11 M/D but only 8% crude protein (CP). Referring to Table 3 it is clear that these oats would need to be 14% CP in order to be balanced. Some other source of protein or nitrogen could be mixed with the oats to raise the CP of the diet. Lupins are often fed with oats for this purpose.

The benefits of balancing the protein in the ration would come from either increased productivity from the same amount fed, or feeding less for the same level of productivity. For maintenance feeding, the required rate may only be reduced by 10% so the financial viability of adding another source of protein to the grain will depend on the relative cost

of feeds (particularly protein-rich feeds). If high levels of production are expected (e.g. finishing lambs), the viability of adding extra protein is likely to be better due to the higher value the product. Each circumstance needs to be evaluated on its individual merit. Your local NSW Department of Primary Industries Sheep and Wool Adviser can provide assistance in this task.

Table 3. Crude protein required to maintain a balance between energy and protein

Energy content of diet (M/D)	Crude protein requirement* (%)
13	16
12	15
11	14
10	13
9	11.5
8	10
7	9

* Assumes 70 per cent rumen degradability.

Urea as a protein supplement

Urea, while not a protein, will form ammonia for use by rumen micro-organisms.

Adding 1% of urea by ration weight to the diet will increase the overall crude protein by 2.6%.

Warning: urea is toxic if fed at too high a rate.

Sheep should receive a maximum of 3 g of urea per 10 kg of liveweight so the percentage added to the ration will be determined by the intended feeding rate. A dry sheep of 50 kg may only need 500 g of feed per day and can safely consume up to 15 g of urea. This equates to 15 g in 500 g or 3%. A 25 kg weaner can only consume 7.5 g of urea per day and if eating 800 g of feed per day the appropriate maximum urea concentration would be only 1%. If allowed ad lib access that same weaner may eat up to 1200 g per day and the safe urea rate would be limited to around 0.6%.

Urea concentrations above 2% are likely to depress diet intake. Urea supplementation will only be effective if:

- there is a good supply of energy, and protein is limiting;
- sheep are fed daily or through self-feeders.

Urea is toxic, so it is important that it be properly mixed into the feed, as concentrated pockets of urea will kill stock. The preferred method of mixing urea with feed is to dissolve it in hot water and spray the solution onto grain when augering or filling the feed bin. The rate will depend on the concentration of the solution and the speed and size of the auger.

Minerals

Six major minerals and seven minor minerals are recognised as being important to sheep production. However, only two – calcium and sodium – are needed as additional supplements during drought feeding.

Calcium is deficient when diets consist mainly of cereal grain. To prevent calcium deficiency, add 1.5% by weight of ration of finely ground agricultural limestone (calcium carbonate) to cereal grain. That is, for every 100 kg of grain, add 1.5 kg of limestone. Do not use builders lime, burnt lime or slaked lime.

Spread lime onto grain when filling the feed-out bin. Lime is not lost when feeding-out as the fine particles stick to the grain.

Sodium is also deficient in most grains. Add 0.5% of fine salt to grain diets to prevent a deficiency.

Water can often be a source of sodium. Additional amounts of salt are not needed if the water has high salt levels. The likelihood of any other mineral being deficient is low.

Vitamins

Two vitamins, A and E, are the only vitamins likely to be deficient as a direct result of drought feeding. Vitamin A is obtained from green pasture, hay with good green colour and yellow maize. Even a short green pick will supply adequate quantities of the vitamin. Vitamin A is stored in the liver. Young sheep usually experience deficiencies when they have been without green pasture, green hay or yellow maize for 6 months, and adults will be deficient after 12 months. Symptoms are night blindness, eye discharges and ill-thrift.

An inter-relationship exists between vitamin E and selenium. Grains and hays are fair to good sources of vitamin E, although there is considerable variation.

A vitamin E deficiency induces symptoms similar to selenium deficiency (that is, stillborn lambs, and older lambs that suffer from a stiff, stilted gait, lameness and arch back). If you suspect a deficiency, seek veterinary advice for confirmation and dose rates.

The most efficient solution to both problems is to administer a Vitamin A, D, E injection which will alleviate the problems for some months.

Further information

The NSW Department of Primary Industries website has a wealth of information available at www.dpi.nsw.gov.au/drought

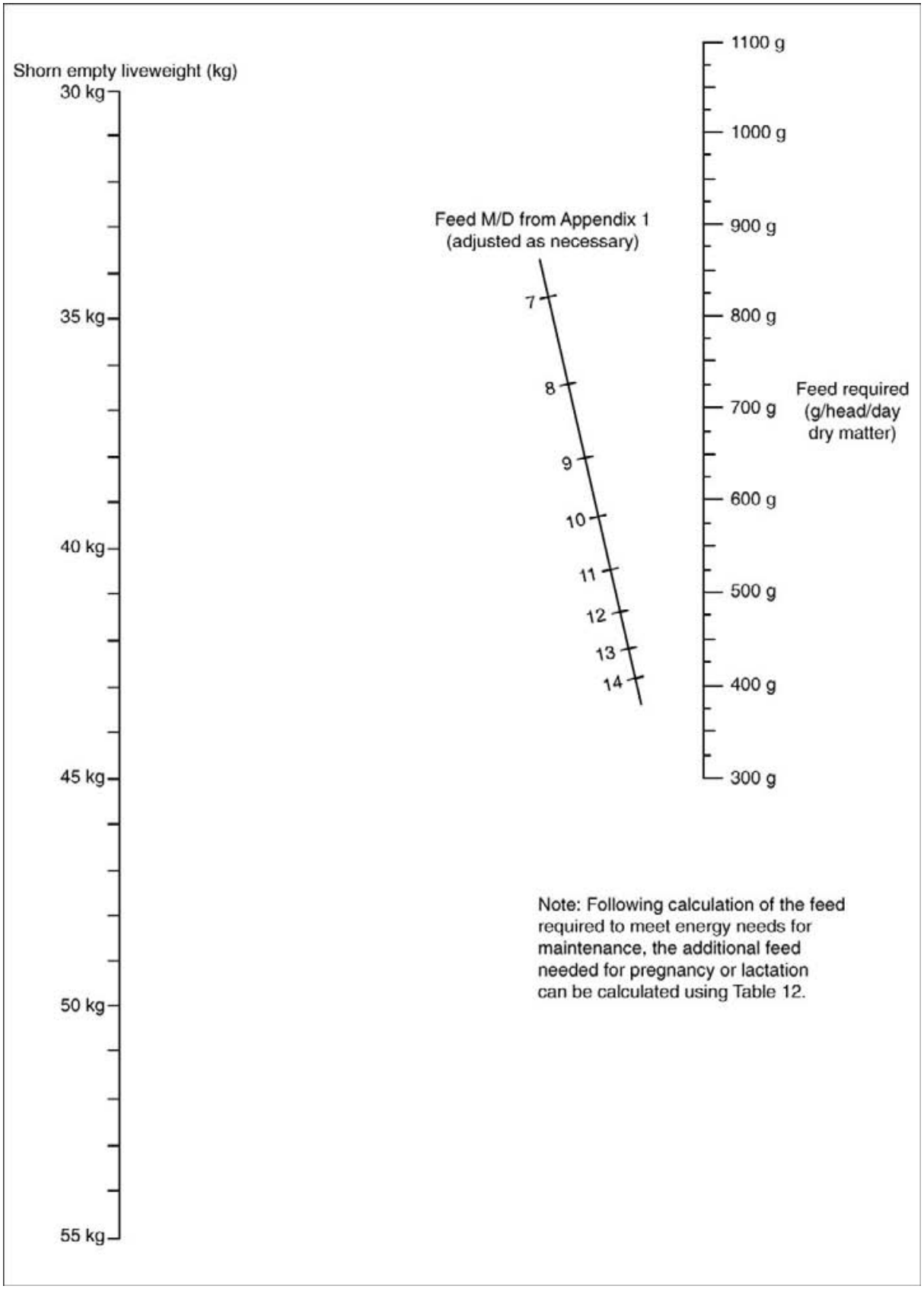
Most likely dry matter (DM), metabolisable energy and crude protein content of feeds

Foodstuff	Dry matter (%)*	ME (MJ/kg DM, or M/D)		Crude protein %DM	
		Average*	Tested range	Average*	Tested range
Low protein dry roughages					
Oaten hay	90	9.3	(8.5–9.5)	5.8	–
Wheaten hay	90	8.0	–	6.0	–
Pasture hay (mostly grass)	85–90	8.3	–	6.0	–
Oat, barley or wheat straw	90	5.0	(4.5–5.5)	3.0	–
Sorghum stubble	90	7.0	(6.5–8.0)	3.6	–
Cottonseed hulls	90	5.15	(2.9–6.3)	7.7	(4.0–11.5)
Rice hulls	90	2.4	–	2.0–3.1	–
Corn stubble	90	5.5	(4.5–6.5)	4.8	(2–7)
Soybean stubble	90	5.5	(4.0–6.5)	5.5	(4–6.5)
Peanut hulls	90	3.6	–	3.3	–
Oat hulls	90	5.3	(5.3–5.4)	3.8	–
Sorghum (failed crop)	90	9.0	(8.5–9.5)	7.4	–
Peanut hay	90	8.5	(8.0–9.0)	9.3	(7.6–10.7)
Soybean hay (mature)	90	6.0	(5.5–6.5)	8.1	–
Wheat stubble	90	5.1	(4.8–8.2)	–	–
Barley stubble	90	5.5	(5.1–6.2)	–	–
Rice stubble	90	5.7	(5.3–6.6)	–	–
Oat stubble	90	4.6	–	–	–
High-protein dry roughages					
Lucerne hay	90	8.5	(8–9.8)	15–20	–
Clover hay	85–90	9.0	(8.3–10.9)	13	–
Pasture hay (mostly clover)	85–90	8.3	–	11	–
Cowpea and field pea	90	9.5	–	16	–
Soybean hay (full pods)	90	9.5	(9–10)	13–14	–
Soybean hay (75% pods)	90	8.5	(8–9)	17	–
Low protein wet roughages					
Maize silage	25–30	8.5	(7.5–9.5)	6.9–9.0	–
Sorghum silage	25–30	8.0	(8.0–8.5)	6.9–7.5	–
Oat, wheat, barley or rye green fodder or silage (cut at flowering stage)	25–30	8.5	(8.3–8.7)	6.0–8.0	–
High-protein wet roughages					
Lucerne green fodder	25	8.3	–	16	–

Lucerne silage	25–30	8.4	–	15	–
Pasture fodder (mixed grass & clover)	25	10.3	–	17.5	–
Pasture silage (mixed grass & clover)	20	8.2	–	16	–
Young oats, wheat, barley, rye, or millet grazing	25	9.3	–	10	–
Grains					
Maize	90	13.5	(13–14)	9.5	(9.0–10)
Grain sorghum	90	13	–	9	(5–11)
Wheat	90	13	(12.5–13.5)	12	(11–13)
Barley	90	13	(12.5–13)	11	(10–12)
Oats	90	12.5	(11–13)	10.5	(10–11)
Pulse grains					
Faba beans	90	12.5	–	25.6	–
Field peas	90	13	–	25	–
Lupins	90	13	–	32	–
Cereal grain by-products					
Wheat pollard	90	11	–	15	–
Wheat bran	90	12	–	15	–
Oat bran	90	9	–	8.0	–
Hominy	90	12.6	–	11	(10–12)
Rice bran	90	11	–	14	–
Protein-rich concentrates					
Soybean meal	90	12	–	50	–
Safflower meal	90	11	–	40–55	–
Peanut meal	90	11	–	42	–
Cottonseed meal (decorticated)	90	10.5	–	41	28–43
Linseed meal	90	11.5	–	30–35	–
Sunflower meal	90	10.5	–	40–45	–
Coconut meal (6% fat)	90	12.5	–	21	–
Milk powder (cow's whole)	90	17	–	26.5	–
Milk powder (cow's skimmed)	90	12.8	(12.6–13)	36	–
Urea (46% nitrogen)	90	–	–	Equivalent to about 280	–
Miscellaneous					
Brewers grains (dry)	90	9.5	–	20	–
Molasses	75	13	–	3.5	–
white cotton seed	90	13	–	20	12–22
Sheep and cattle nuts	90	11	(9–13)	15	–

* This figure should be used as a guide only because of the wide variation between samples – laboratory testing of feeds is recommended.

Figure 2. Daily feed (dry matter) required for maintenance of sheep



NSW Department of Primary Industries laboratory testing services

NSW DPI operates a network of laboratories across the state which offer a wide range of testing services to support rural and other enterprises. All laboratories are fully accredited by NATA to international standards and use the latest methods and equipment.

Services available include:

Chemical residues: Tests include organophosphates, organochlorides, pyrethroids, and most other pesticides in a range of materials including water, soil, animal products, fodder and other produce.

Animal feeds: A full range of testing is available on pastures, silages, grains and by-products.

Water testing: Tests are tailored for agricultural uses and include pH, conductivity (salinity), alkalinity, hardness, chloride and trace metals.

Veterinary testing: Tests are available for diagnostic, market assurance and stock health monitoring purposes, as well as health certification for export purposes. Where possible, submit your samples through your veterinary practitioner or district veterinarian.
WormTest kits are available through DPI offices.

For information on our services please visit our website at
www.dpi.nsw.gov.au/aboutus/services/diagnostic_and_inspection/diagnostic_and_laboratory services

Further information:
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Feed testing (02) 6938 1957 (Wagga Wagga)
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