BEEF CATTLE FEEDLOTS:
WASTE MANAGEMENT AND UTILISATION

4. Liquid wastes

CONTENTS

Drains direct runoff into a sedimentation system or holding pond.

A weir filters effluent runoff and allows solids to settle in a sedimentation basin.

Cattle washing and vehicle washing can contribute to the effluent load.

Introduction

The main liquid waste from cattle feedlots is the effluent resulting from storm water runoff from the pens. This waste must be properly contained and managed as it is rich in nutrients and also has a significant microbial load.

Runoff control facilities

All feedlots must sit within a controlled drainage area (CDA). The design of the CDA must incorporate

- Drains or similar structures that capture contaminated runoff from within the feedlot complex and divert it to a sedimentation system and then holding ponds.
- A sedimentation system that removes entrained settlable solids and organic nutrients from the effluent. When significant solid material accumulates, the sedimentation system should be cleaned out. In wetter climates, having two sedimentation systems in parallel will allow one to be dried and cleaned while the other is in operation.
- A holding pond or ponds large enough to store runoff from the CDA without spilling or overtopping at an unacceptable frequency (e.g. an acceptable average spill recurrence interval might be 10, 20 or 50 years depending on the site). These ponds store stormwater runoff until it can be spread on land or evaporates.
- Appropriately-designed weirs, by-washes and channels to capture excess runoff during overtopping or spill events in the sedimentation system and holding pond.
- Diversion banks or drains placed immediately upslope of the feedlot complex to divert ‘clean’ storm water around the complex.

Details of the cleaning and maintenance of these facilities are provided in Section 1.

Quantity of effluent produced

The major source of effluent is runoff from the CDA of the feedlot, with volume depending on the size of the CDA, the intensity and amount of rainfall and manure management.

The MEDLI model (see Glossary) has been used by Tucker et al. (2010)to simulate the effluent yield for model feedlots located in the five main lotfeeding regions of Australia

- central Queensland (Comet)
- southern Queensland/northern New South Wales (Dalby)
- central New South Wales (Quirindi)
- Riverina (south-western NSW/north-western Victoria) (Charlton)
- south-west Western Australia (Mt Barker).

For each location Table 4.1, Table 4.2 and Table 4.3 show the feedlot pond water balance, including runoff yield, of 5,000 SCU, 10,000 SCU and 25,000 SCU feedlots.

Additional effluent is generated in feedlots that wash cattle. Water use for cattle washing typically ranges from 800 L/head to 2,600 L/head depending on the dirtiness of the cattle and the requirements of the abattoir.

A small amount of wastewater is created by cleaning water troughs to remove feed and algae that can foul the water and reduce cattle intake. The amount of water used for trough cleaning depends on cleaning frequency, trough size and clean water inflow during cleaning but is typically 0.1–3 L/head each month.

Cleaning induction and hospital areas can use around 1.3 L of water/head/month while vehicle washing facilities can use around 1.2 L/head/month.

Table 4.1 Feedlot pond water balance for a 5,000 SCU feedlot

Long-term annual average		Comet	Dalby	Moree	Quirindi	Charlton	Mt Barker
In-flows	Rainfall on pond (ML*)	13.2	8.3	6.9	9.5	2.9	6.6
	Inflow of runoff (ML)	33.0	34.4	31.5	30.7	15.9	23.8
Out-flows	Evaporation (ML)	24.0	16.3	12.9	13.8	4.3	6.1
	Seepage (ML)	0.6	0.4	0.4	0.5	0.3	0.2
	Overtopping (ML)	0.2	0.2	0.3	0.2	0.2	0.1
	Extracted (ML)	21.4	25.5	24.8	25.6	14.0	24.0
	(% of inflow)	46%	60%	65%	64%	75%	79%

*ML (megalitre) = 1,000,000 litres

Table 4.2 Feedlot pond water balance for a 10,000 SCU feedlot

Long-term annual average		Comet	Dalby	Moree	Quirindi	Charlton	Mt Barker
In-flows	Rainfall on pond (ML)	27.7	21.4	15.4	18.0	8.9	16.2
	Inflow of runoff (ML)	65.2	69.2	63.4	61.8	32.1	47.5
Out-flows	Evaporation (ML)	52.6	44.9	31.3	28.2	15.4	17.1
	Seepage (ML)	1.3	1.1	0.8	0.8	0.5	0.7
	Overtopping (ML)	0.2	0.2	0.2	0.2	0.1	0.1
	Extracted (ML)	38.7	44.4	46.6	50.5	25.0	46.0
	(% of inflow)	42%	49%	59%	63%	61%	72%

Table 4.3 Feedlot pond water balance for a 25,000 SCU feedlot

Long-term annual average		Comet	Dalby	Moree	Quirindi	Charlton	Mt Barker
In-flows	Rainfall on pond (ML)	61.2	38.5	31.2	42.9	11.2	44.1
	Inflow of runoff (ML)	163.6	172.6	157.9	153.7	80.0	119.7
Out-flows	Evaporation (ML)	122.4	83.1	66.9	72.2	20.8	50.7
	Seepage (ML)	3.1	1.9	1.7	2.1	0.7	2
	Overtopping (ML)	0.3	0.5	0.8	0.5	0.7	0.3
	Extracted (ML)	99.0	125.6	119.7	121.8	69.0	110.8
	(% of inflow)	44%	59%	63%	62%	76%	68%

A holding pond retains effluent until it evaporates or can be used for irrigation.

Sampling effluent ponds for analyses

Feedlot storm water runoff carries a significant bacterial load but this reduces rapidly.

Effluent composition

Chemical composition of effluent

The wide range of levels of nutrients and solids that can be expected in effluent from Australian feedlot holding ponds (Table 4.4) illustrates why effluent management must be based on site-specific effluent analyses.

Table 4.4. Effluent quality in feedlot holding ponds

	Mean level	Maximum level	Minimum level	No. of samples
Total nitrogen (mg/L)	220	1,095	25	175
Total Kjeldahl nitrogen (mg/L)	218	1,095	23	173
Ammonia nitrogen (mg/L)	89	670	0	99
Nitrate nitrogen (mg/L)	2.3	68.8	0	96
Nitrite nitrogen (mg/L)	0.5	5.1	0	20
Total phosphorus (mg/L)	71	387	2	171
Phosphate-P (mg/L)	17	133	0	102
Potassium (mg/L)	1,092	6,390	21	122
pH	8	10	7	135
Electrical Conductivity (dS/m)	7.8	37.8	1.0	187
Total dissolved solids (mg/L)	4,915	18,644	1,002	57
Calcium (mg/L)	126	597	13	114
Magnesium (mg/L)	118	805	2	114
Sodium (mg/L)	494	6,700	12	114
Sodium absorption ratio	7.1	65.8	0.5	119
Chloride (mg/L)	1,261	12,839	95	110
Sulphate (mg/L)	74	378	1	51
Total hardness (mg/L)	943	3,435	85	61
Total alkalinity (mg/L)	2,082	8,920	168	62
Aluminium (μg/L)	989	3,435	47	43
Boron (μg/L)	2,180	7,100	56	52
Copper (mg/L)	142	1,820	0	52
Total iron (mg/L)	24.1	110.0	0	50
Total manganese (mg/L)	2.9	46.0	0.2	42
Zinc (μg/L)	2,173	8,920	62	58

Microbial contaminants in liquid wastes

Runoff from beef cattle feedlots contains large populations of bacteria. Table 4.5 shows microbial analysis for *E. coli* and *E. enterococcus* for effluent sampled from holding ponds at three sites in southern Queensland immediately after runoff and seven days later. The heavy microbial load is significantly reduced by pond storage.

Table 4.5 Microbial analyses from Australian feedlot effluent samples showing rapid reduction in microbial load ('000 CFU) (Roser et al. 2011)

Sample ID and timing	*E. coli* ('000 CFU/100 mL)			*Enterococcus* ('000 CFU/100 mL)		
	Average	Minimum	Maximum	Average	Minimum	Maximum
Feedlot 1						
– After runoff	18,600	8,000	26,000	104,000*	56,000	>200,000
– 7 days later	83	30	170	2,340	840	4,200
Feedlot 2						
– After runoff	12,700	4,900	22,000	50,000	44,000	60,000
– 7 days later	980	420	2,000	13,200	8,400	16,400
Feedlot 3						
– After runoff	2,160	200	4,600	2,167	1,040	2,820
– 7 days later	88	10	30	442	318	528

* assuming 200,000,000 CFU/mL is the upper value

Advanced effluent treatment

In response to changes in water availability and the cost of supply, the feedlot industry has expressed interest in treating and reusing effluent as part of the water supply for feedlots. There has also been interest in collecting biogas from holding ponds (see *Appendix 5. Advances in treatment of manure*).

Further reading

FLIAC 2012a, National Beef Cattle Feedlot Environmental Code of Practice – 2nd Edition, FIA Committee (ed.), Meat & Livestock Australia, North Sydney, NSW.

FLIAC 2012b, National Guidelines for Beef Cattle Feedlots in Australia – 3rd Edition, FIA Committee (ed.), Meat & Livestock Australia, North Sydney, NSW.

Roser D, Tucker R, Khan S, Klein M, Coleman H, Brown L, et al. 2011, Microbiological and chemical human health risks arising from cattle feedlot wastes: Their characterisation and management, Report for MLA Project FLOT.333: Managing the Contaminants in Feedlot Wastes, Meat & Livestock Australia, North Sydney, NSW.

Tucker RW, Davis RJ, Scobie MJ, Watts PJ, Trigger RZ, Poad GD. 2010, Determination of effluent volumes and reliability, effluent characterisation and feedlot water requirements, Milestone 2 Report for MLA Project B.FLT.0348, Meat & Livestock Australia, North Sydney, NSW.

Tucker R, Roser R, Klein M and Khan S. 2011a, Guidelines for the safe management of feedlot wastes, Report for MLA Project FLOT.333: Managing the Contaminants in Feedlot Wastes, Meat & Livestock Australia, North Sydney, NSW.