Development Application and Environmental Impact Statement

Expansion of Beef Cattle Feedlot from 999 head to 3,200 head

Effluent pond sizing and effluent utilisation assessment

“High Claire”
58 Broughans Road
PINE LODGE NSW 2713

AJ & NA Varley
“Arkoona”
RMB 3095 Lower Finley Road
FINLEY NSW 2713

[November 2024]

RDC ENGINEERS
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1 Background

1.1 Introduction

AJ & NA Varley own and operate a mixed farming operation across several properties at Pine Lodge including “High Claire”, “Arkoona”, “Sunnyside”, “Killara Rise”, “Langunyah” and “Glen Cluan” some 16.5 km by road west of Finley and 49 km by road east-southeast of Deniliquin in Riverina region of NSW.

AJ & NA Varley primarily engage in dryland and irrigated cropping, beef, sheep and wool production. AJ & NA Varley produce wheat, barley in winter and sorghum and maize in summer under irrigation and dryland farming systems.

Central to the beef production enterprise is the breeding, growing and lot feeding of cattle for the domestic market. Currently the beef supply chain includes breeding and growing of beef cattle and lot feeding of cattle within a feedlot on the property “High Claire”.

“High Claire” comprises some 195.19 ha (~482.12 acres) and currently, a dryland and irrigated cropping business is undertaken on a large proportion of the property with lot feeding of beef cattle and sheep.

There has been a beef cattle feedlot on “High Claire” for over twenty years after approval was granted for a 999 head feedlot by the former Conargo Shire (now Edward River Council) in 2004 (DA 293). Under Schedule 3, Item 21 of the Environmental Planning and Assessment Regulation 2000, as the capacity of the existing beef cattle development does not exceed 1000 head it is not a designated development and an environmental licence from NSW EPA is not required.

Co-located with the beef cattle feedlot is a 4,000 head sheep feedlot which was granted approval in 2006 by the former Conargo Shire (now Edward River Council) in 2004 (DA 352). Under Schedule 3, Item 21 of the Environmental Planning and Assessment Regulation 2000, as the capacity of the existing sheep development does not exceed 4000 head it is not a designated development and an environmental licence from NSW EPA is not required.

AJ & NA Varley wish to expand the existing beef cattle feedlot from the current approved capacity of 999 head by gaining development approval for intensive livestock agriculture to operate as a 3,200 head beef cattle feedlot on the site. The proposal also involves the ceasation of the sheep feedlot with the existing infrastructure repurposed for the lot feeding of cattle. The proposed development is not proposed to be staged.

The proposed development shall utilise the existing approved and constructed development complex infrastructure on the subject land. The proposed development does not propose to reconfigure existing built infrastructure.

The increase in the number of head in the development shall be gained by reducing the cattle stocking density and utilising the pens currently used for the sheep feedlot as cattle pens.

The proposed development shall comprise one controlled drainage area with associated production pens and drainage system which includes catch drains, sedimentation basin and holding pond. Existing infrastructure such as the grain storage and processing and cattle handling facilities have sufficient capacity to cater for the demands of the proposed development.

The proposed development shall utilise the existing approved manure and effluent utilisation areas on the property. The proposed development does not propose to reconfigure the existing waste utilisation areas.

In NSW, Cattle feedlots which exceed 1,000 head capacity are defined as designated development under Schedule 3 (Part 1 Section 21a) of the *EP&A Regulation* and therefore require a full Environmental Impact Statement (EIS) to accompany the development application.

Assessment of the environmental impacts of the proposed development included an assessment of effluent management.

The Model for Effluent Disposal using Land Irrigation (MEDLI) was utilised for this purpose. MEDLI is a complex, daily-time-step, hydrological simulation model developed to estimate effluent generation and to simulate, over extended periods, the hydrological and nutrient balance of the holding pond storage and effluent utilisation system respectively.

This report has been prepared to provide supporting information for the EIS in regards to the use of effluent to irrigate an area of land that is capable of sustaining both the quantity and quality of effluent generated.

2 Site and locality

2.1 Subject land

The proposed development is to be located on a single land parcel which forms the property known as “High Claire”.

The property “High Claire” referred to as the subject land is located on Broughans Road, Pine Lodge approximately 14 km by road west southwest of Finley and some 49 km by road east-southeast of Deniliquin and 20 km north-northwest of Tocumwal in the Edward River Council area of New South Wales.

The subject land has primary frontage to Broughans Road (unsealed) of approximately 1.2 km in length and secondary frontage to James Road on the western boundary. Broughans Road intersects with the Newell Highway some 11 km east of the subject land. The subject land is 4.0 km south of the Riverina Highway via James Road.

The subject land has been historically used for irrigated agriculture (cereals, oats, lucerne), dryland agriculture (cereals (sorghum, oats), sheep and beef cattle grazing and intensive feeding of lambs and beef cattle and is located in a rural area which encourages agricultural uses.

Figure 1 is a locality plan highlighting the property in reference to Deniliquin, Finley and Tocumwal, and the main watercourses and drainage lines in the region.

2.1.1 Real property description

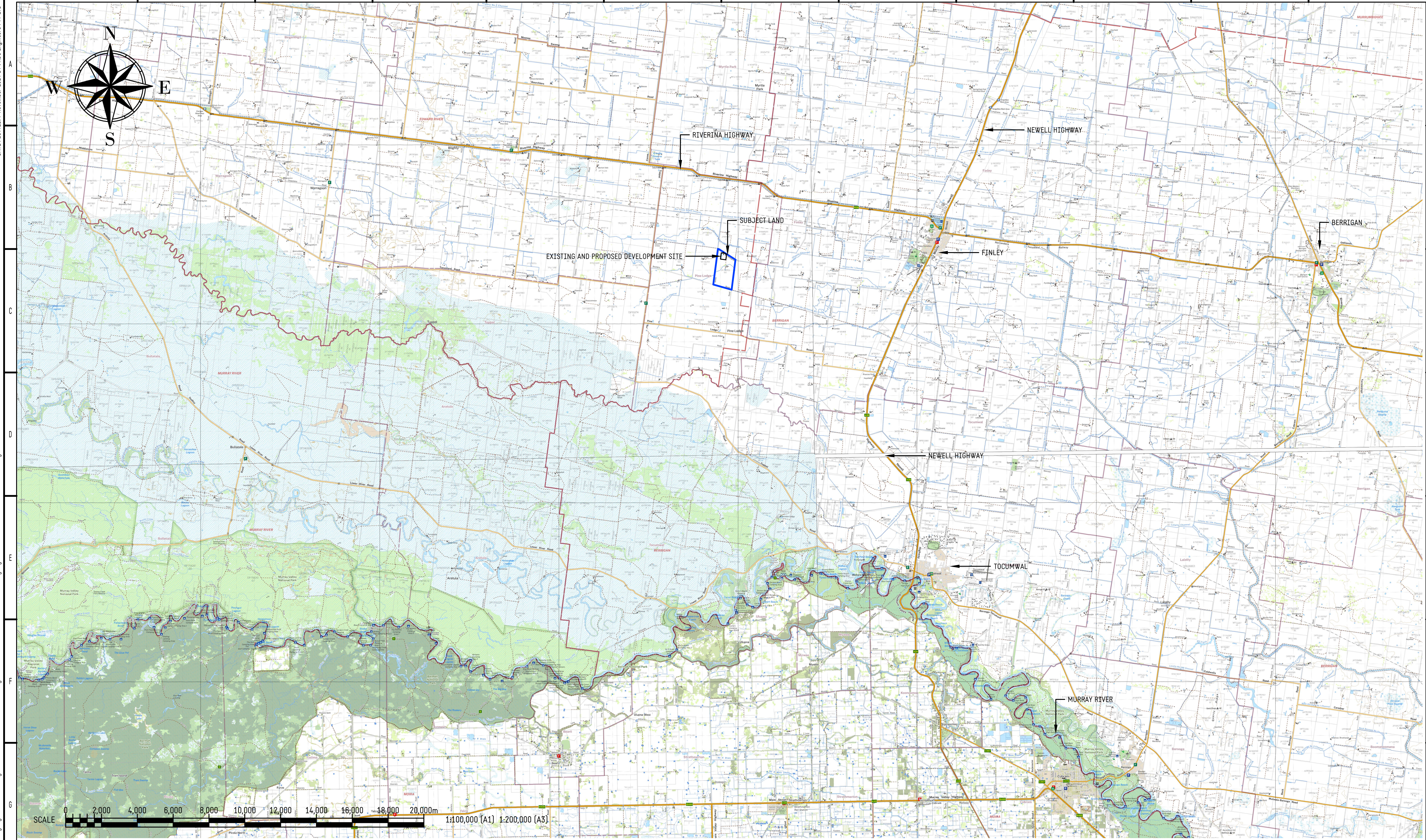
The subject land comprises one (1) cadastral portion. The description of the subject land is provided in Table 1. The total area of the subject land is about 195.2 ha (~482.23 acres).

Figure 2 is a cadastral plan highlighting the cadastral parcel that comprises the subject land.

Table 1 – Subject land – Description

Property name	Lot no.	Plan no.	Easements	Area Ha	Local government area
“High Claire”	130	DP756353	-	~195.19	Edward River Shire

All components of the proposed development including production pens, feed storage and processing, controlled drainage area, sedimentation basin/holding pond and associated infrastructure shall be located on the subject land. Effluent and solid waste utilisation areas shall be located on the subject land.



LEGEND

- SUBJECT LAND BOUNDARY
- LAND PARCEL BOUNDARY

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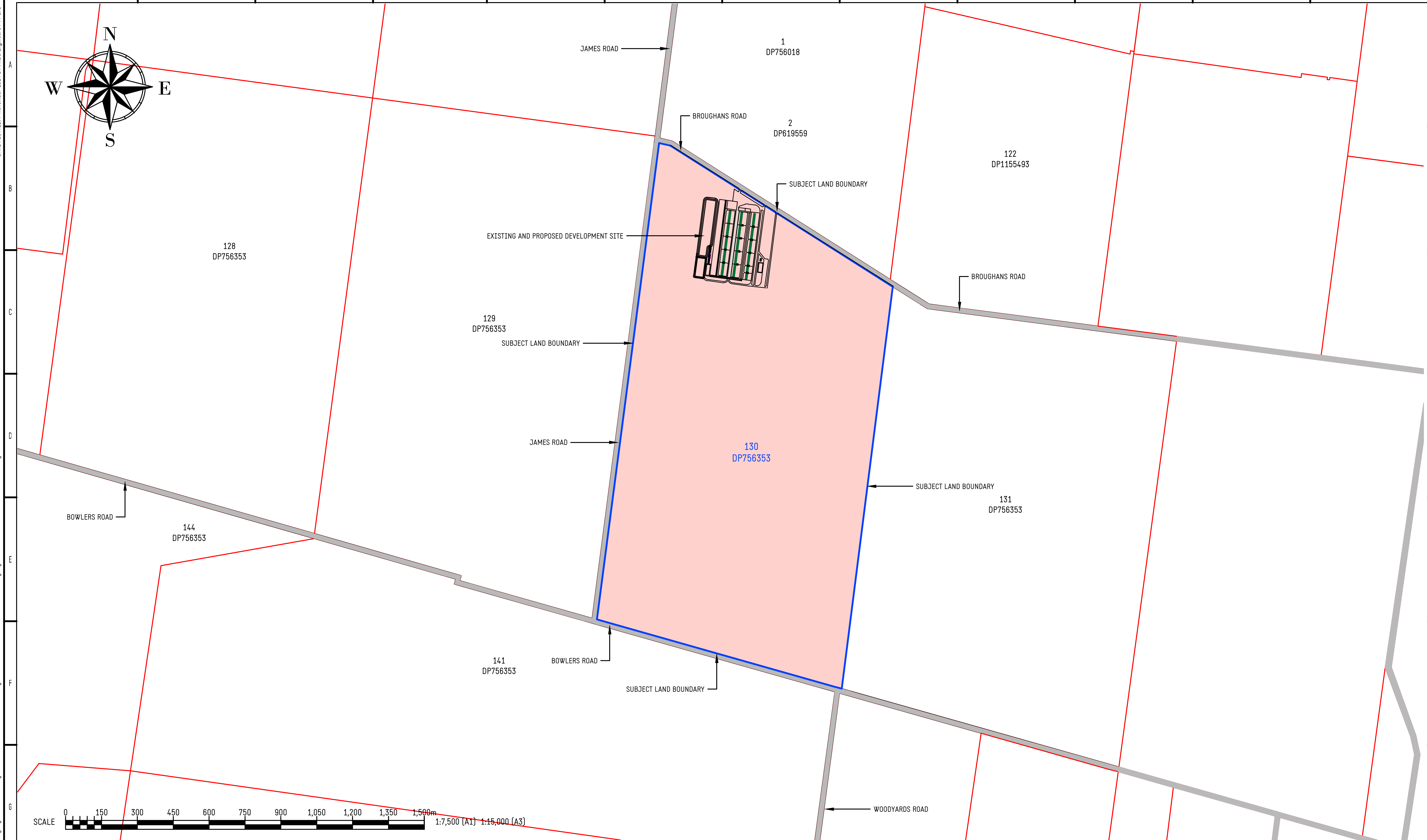
PROJECT: PROPOSED EXPANSION OF BEEF CATTLE FEEDLOT

TITLE: DEVELOPMENT APPLICATION FOR INTENSIVE LIVESTOCK AGRICULTURE
EIS APPENDIX M - EFFLUENT POND SIZING AND WASTE UTILISATION
SUBJECT LAND - LOCALITY PLAN

REPORT REFERENCE	SUPPLIED DRAWING NUMBER		DRAWING NUMBER	REV.
FIGURE 1		A3	F3-107-500-01	B



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- SUBJECT LAND BOUNDARY
- LAND PARCEL BOUNDARY
- SUBJECT LAND AREA
- ROAD RESERVE
- EASEMENT

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TITLE: DEVELOPMENT APPLICATION FOR INTENSIVE LIVESTOCK AGRICULTURE
EIS APPENDIX M - EFFLUENT POND SIZING AND WASTE UTILISATION
SUBJECT LAND - CADASTRAL PLAN

REPORT REFERENCE	SUPPLIED DRAWING NUMBER		DRAWING NUMBER	REV.
FIGURE 2		A3	F3-107-500-02	B

DATE PLOTTED: 7 November 2024 BY : RDC Engineers PTY LTD

FILE PATH: C:\RDC Engineers\RDCE - Projects\F3-107 A and N Varley High Claire FL Finley\05 - ACAD MasterPlan\05.1 Drawings - CURRENT FILE NAME: F3-107 ANVarley High Claire MASTERPLAN-00-20230407 v8.dwg

2.2 Climate

Daily climate data for the locality is required to undertake the hydraulic and nutrient modelling of the effluent utilisation system. Long-term daily interpolated daily climate data for the area (Latitude -35.65S, Longitude 145.45E) were derived from the Department of Science, Information Technology and Innovation (DSITIA) Silo Data Drill database (DSITIA, 2024). The Data Drill accesses data on a 5 km grid derived by interpolation from point observations by the Bureau of Meteorology station records. The data in the Data Drill are all synthetic; there are no original meteorological station data left in the calculated grid fields (Jeffrey et al. 2001). The data are supplied as an individual file of interpolated daily rainfall, maximum and minimum temperature, potential evapotranspiration and radiation at the nominated point location for the period 01/01/1924 to 31/12/2023 (DSITIA, 2024).

A summary of the data used is included in Table 2.

Table 2 – Climatic data derived for SILO (1924-2023) (DSITIA, 2024)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall													
Mean rainfall (mm)	33.1	28.7	32.8	30.6	37.5	37.2	38.6	38.1	35.9	42.8	34.9	33.8	423.9
Median rainfall (mm)	21.7	16.6	22.8	25.6	28.8	34.0	32.9	35.5	32.1	33.4	30.2	23.4	421.5
Lowest rainfall (mm)	0	0	0	0	0	0.2	1.7	1.1	3.9	0	0.4	0	180.4
90% years at least rainfall (mm)	1.0	0.4	1.1	3.0	7.7	11.2	13.1	9.5	7.5	8.4	6.5	2.4	249.5
10% years at least rainfall (mm)	66.4	74.6	75.6	66.5	78.3	69.1	71.6	64.5	63.5	84.9	71.2	80.9	584.2
Highest rainfall (mm)	247.2	144.3	189.4	112.2	127.3	106.8	97.7	108.1	130	202.5	138.2	180.1	836.8
Temperature, Humidity and Pan evaporation													
Mean pan evaporation (mm)	273.9	219.0	176.5	99.0	54.1	35.2	38.1	58.0	91.9	146.4	201.1	254.9	1650.2
Mean maximum temperature (deg C)	31.7	31.4	28.0	22.7	18.0	14.5	14.1	15.6	18.8	22.6	26.5	29.7	22.8
Mean minimum temperature (deg C)	15.9	16.0	13.4	9.4	6.5	4.1	3.3	4.2	5.9	8.6	11.4	14.0	9.4
Relative Humidity (%)	43.5	46.3	46.2	46.0	48.0	48.7	45.5	42.1	40.1	40.0	39.8	41.4	44.0

2.3 Soil resource information

The subject land is located on the alluvial riverine plains and the soil types comprise Red-brown Earths/transitional Red-brown Earths. The soils would be classified as Chromosols or Sodosols according to the Australian Soil Classification (Isbell, 2002).

Chromosols and Sodosols are texture contrast soils with a sandy or loamy surface horizon overlying a clay textured B horizon. The loamy or sandy surface soil is more than 0.1 m deep, changing abruptly to clay subsoil. The surface soil may have a weakly developed bleached zone in the lower part, while the subsoil is relatively dense to well structured and may be subplastic. For sodosols, the subsoil (B) horizon is not strongly acid (pH greater than 5.5) and is slightly to moderately sodic in the upper 20 cm. The structure of the subsoil may range from massive to strongly structured. Based on soil chemical analyses presented in Table 3, the soils are best described as Sodosols.

From an agronomic perspective, the soils on-farm are suited to crop or pasture production. The top soil properties indicate that the soils could benefit from the addition of effluent and manure. Nitrate-nitrogen levels are low to optimal in the top 0-10cm and ammonium nitrogen optimal. Available Phosphorus levels range from low to adequate. Available potassium levels are optimal to high in the surface. None of the elements are present at levels considered to be excessive. Organic matter levels are low to moderate for the soil type. The soils are non-saline and non-sodic 0-20 cm. They are moderately to slightly acidic, with available calcium levels sub-optimal as a percentage of total exchangeable cations.

Table 3 – Subject land – Soil analysis results

Parameter	Units	Depth (cm)		
		0-10	10-20	20-30
pH (1:5 Water)		5.76	6.4	7.44
Conductivity	dS/m	0.066	0.065	0.09
Organic matter	%	2.96	2.49	1.21
Total nitrogen	%	0.13	0.11	0.08
Nitrate nitrogen	mg/kg	7.3	4.7	3.2
Ammonium nitrogen	mg/kg	1.6	3.1	0.8
Total Phosphorus	mg/kg	496	368	213
Phosphorus – Bray 1	mg/kg	47	26	13
Potassium	mg/kg	2,619	2,492	140
Calcium	mg/kg	1,110	1,283	1,703
Magnesium	mg/kg	1,817	1,839	2,939
Sodium	mg/kg	133	155	383
Cation Exchange Capacity	cmol+/kg	8.99	10.30	14.73
Exchangeable Sodium	cmol+/kg	0.39	0.31	1.13
Exchangeable Potassium	cmol+/kg	1.00	0.95	0.98
Exchangeable Calcium	cmol+/kg	4.44	5.19	6.74
Exchangeable Magnesium	cmol+/kg	2.95	3.57	5.82
ESP (%)	%	4.3	4.9	7.7
Ca/Mg Ratio	-	1.5	1.5	1.2
Bulk density	t/m^3	1.05	1.19	1.19

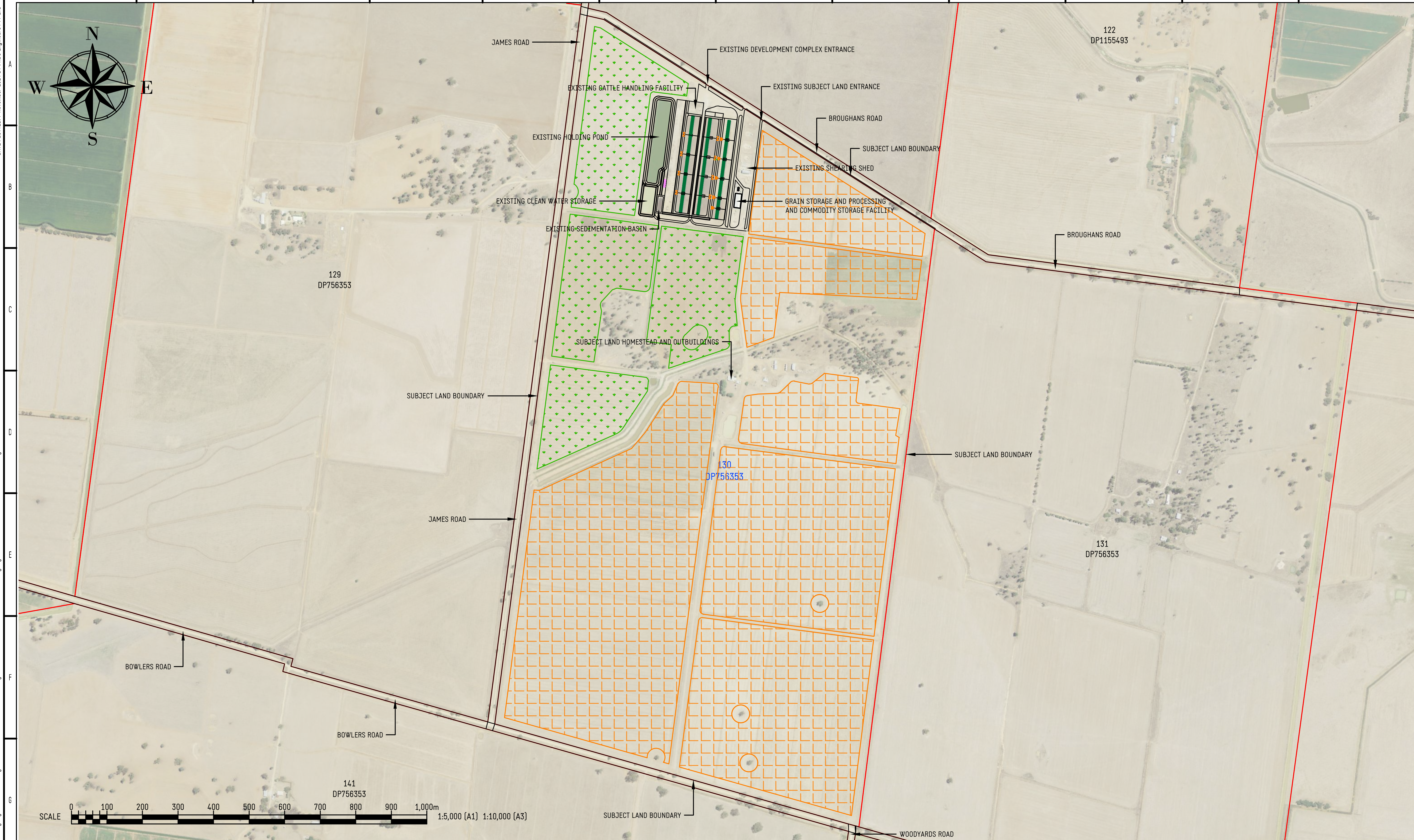
3 Proposed development

The proposed development is an expansion of an existing beef cattle feedlot on the subject land from 999 head to 3,200 head. The proposed development shall have a maximum capacity of 3,200 head. The proposed development shall be designed and constructed in a manner that will allow flexibility of use with the ability to increase or decrease the number of animals within the development in line with market and economic factors.

The proposed development would occupy a footprint of approximately 160.0 ha and includes the following components in a functional configuration:

- Water supply/Storage and reticulation – A reliable and uninterrupted supply of clean water of the required volume to sustain feedlot operations is required;
- Pens – Fenced areas are required for housing production cattle (production pens), cattle arriving to or being dispatched from the feedlot (induction/dispatch pens), and sick cattle (hospital pens);
- Livestock handling – Infrastructure and facilities are required for the arrival, processing and dispatch of cattle and stabling for horses;
- Feed processing and commodity storage – Feed rations are prepared on-site in a facility, with associated commodity storage, handling and ration delivery infrastructure;
- Access and internal roads – Access to the site and the layout of internal road systems are critical to the efficient and safe functioning of the feedlot;
- Administrative/Maintenance infrastructure – Facilities are required for conducting management, maintenance and administrative functions at the feedlot. This includes office, machinery workshop and associated facilities for example;
- Controlled drainage area – Stormwater runoff from areas such as pens, livestock handling, silage pits has a high organic matter and therefore a high pollution potential. This runoff is controlled within a system that collects and conveys this runoff to a sedimentation basin and holding pond prior to environmentally sustainable utilisation;
- Drainage system - The controlled drainage area contains a system including catch drains, sedimentation system and holding pond for conveying stormwater, allow entrained sediment to 'settle out' and capture and storage of the stormwater from the controlled drainage area until it can be sustainably utilised;
- Effluent and solid waste management areas – Solids wastes such as manure and mortalities are temporarily stockpiled and processed within the solid waste storage area prior to utilisation on-site or removed off-site. Effluent is stored in the holding pond pending application to the effluent utilisation area; and

Effluent and solid waste utilisation areas – Solid wastes generated are applied to an on-site utilisation area. There is approximately 148 ha of cropping land on-site suitable for effluent and solid waste utilisation. Any solid wastes not utilised on-site are removed off-site. When available effluent wastes are applied to land via irrigation within a dedicated effluent utilisation area.



LEGEND

- SUBJECT LAND BOUNDARY
- LAND PARCEL BOUNDARY
- EFFLUENT UTILISATION AREA
- SOLID WASTE UTILISATION AREA

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EIS APPENDIX M - EFFLUENT POND SIZING AND WASTE UTILISATION
PROPOSED DEVELOPMENT - DEVELOPMENT LAYOUT

REPORT REFERENCE	SUPPLIED DRAWING NUMBER		DRAWING NUMBER	REV.
FIGURE 3		A3	F3-107-500-03	B

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4 Effluent management

4.1 Introduction

Sustainable effluent management system will achieve a balance between the use of effluent for irrigation with the nutrient requirements of the crop while protecting the environment from potential pollution from irrigation and pond overtopping events. Additionally, the amenity of the surrounding environment and meeting the needs on a social and ecological level are important considerations in sustainability.

Application of effluent onto land areas designated for crop or pasture production is regarded as the most efficient and beneficial means of utilising the valuable water, nutrient and organic components of this feedlot by-product. This practice is consistent with the principles of the internationally accepted waste management hierarchy (i.e. avoidance, recycling, waste to energy, treatment and disposal) that lists recycling as the second most desirable management option.

The reuse of effluent through irrigation is aimed at:

- Using crops, pastures and soils to efficiently utilise or sustainably assimilate the nutrients, salts, organic matter and water contained in the effluent; and
- Maximise the utilisation of the fertiliser, water and soil amendment values of liquid waste while avoiding adverse environmental impacts.

Irrigation of effluent must be managed carefully to ensure that:

- Nutrients are not excessively leached below the active root zone.
- Dissolved and suspended contaminants are not exported from utilisation areas to watercourses.
- Excessive application of effluent does not adversely affect the chemical and physical properties of the soils in the utilisation areas.
- The productivity of pasture or cropping land is maintained or enhanced.
- Nearby neighbours do not experience odour or dust nuisance due to poorly timed and managed applications of effluent.

To maximise the benefits of the valuable water, nutrient and soil amendment values of the effluent, while minimising any adverse impacts upon the environment, land areas used for irrigation of effluent must be carefully selected and managed.

There are a number of commercially available tools to assist with water and nutrient balance calculations. The model adopted for the assessment was the Model for Effluent Disposal via Land Irrigation (MEDLI). A description of the MEDLI model is presented in the following sections.

4.2 MEDLI model

MEDLI is a Windows® based computer model for designing and analysing effluent Irrigation systems for intensive rural industries, agri-industrial processors (e.g. abattoirs), treatment plants and other effluent producers using land irrigation. It was developed jointly by the CRC for Waste Management and Pollution Control, the Queensland Department of Natural Resources and the Queensland Department of Primary Industries. MEDLI is the model recommended by Queensland regulators for predicting sustainable effluent Irrigation systems. MEDLI requires daily time series climate data for estimating crop water requirements, simulating crop growth and carrying out water balance computations. The data required are rainfall, temperature, Class A pan evaporation and solar radiation.

The waste estimation component of MEDLI generates, for a given industry, the daily composition and volume of effluent before pre-treatment, storage or irrigation. The simplest MEDLI waste estimation module uses measured waste stream details. Temporal variation in waste stream characteristics may be assigned monthly or seasonally, or for any other nominated periods, including single days. The user could enter different waste stream details for every day if the data is available. MEDLI assumes these details then apply for every year of the simulation.

Feedlots can be described in MEDLI using the Waste Estimation option. The feedlot model in MEDLI predicts the quantity and quality of the runoff entering the holding pond following rainfall. Design of a feedlot in MEDLI is very flexible with provision for selecting different herd compositions, diets, stocking density, pen configurations, and manure harvesting rates.

The pond module is a modified version of a design model for treating pig wastes (Casey 1995). The module consists of mass balances for the hydraulic, nitrogen, phosphorus, potassium and total dissolved salts components. It uses a number of empirically derived relationships. The model allows for up to four effluent ponds in series. Nutrients in the incoming mass are partitioned between the sludge and the supernatant, and a transfer coefficient is used to estimate the nitrogen volatilisation from the pond surface. The pond module's function is to predict water levels and nutrient and salt concentrations. A nominated pond can be used for recycling purposes and the last pond may be used for irrigation.

The soil water movement is simulated as a one-dimensional (vertical) water balance, averaged over a field sized area. The water balance component was taken from PERFECT (Littleboy et al. 1989, 1992) which was based on the Williams and LaSeur (1976) water balance models as used in CREAMS (Knisel 1980) and similar models. The calculation of plant available water holding capacity (PAWC) is determined as the difference between field capacity and the permanent wilting point. The method is an estimate only and is corrected by assessing restrictions such as potential rooting depth, sodicity, salinity and pH.

MEDLI simulates the movement of phosphorus through a soil profile by modelling adsorption of phosphorus to soil particles, desorption of phosphorus into soil water, and plant uptake of phosphorus.

Soil runoff is predicted using the United States Department of Agriculture's Curve Number technique (USDA-SCS 1972) and is calculated as a function of daily rainfall, soil water deficit and plant total cover. The higher the curve number the higher the runoff. Curves for soils generally range from 60 to 90. Loose sands on flat topography have the lowest runoff rates, while heavy clay soils with slopes greater than 10 degrees have the highest runoff rates. The plant growth module in MEDLI predicts the biomass accumulation and the quantities of N and P that are removed from the site through crop growth and the export of harvested material. Flexibility is gained through the provision of a dynamic pasture growth model and a dynamic crop growth model. The pasture module is selected if a plant species is grown continuously, allowing regrowth to occur following mowing (rather than resowing the crop as occurs for the dynamic crop module). In this model, plant cover increases with thermal time according to a fixed sine-curve algorithm defined by the total thermal time to reach full cover. Nitrogen stress and low biomass production modify cover development to improve the prediction of cover for stressed pastures. Prediction of daily plant growth allows estimation of the removal of N and P by nutrient uptake and storage in the shoot biomass. It is assumed that when a user-defined yield is reached, the pasture is mowed and the harvested material exported off site.

4.2.1 Inputs

4.2.1.1 Climate data

A 100-year (1924-2023) MEDLI climate file for the site was obtained from the SILO (Jeffrey 2001) database operated by the Bureau of Meteorology (BOM). These data includes minimum temperature, maximum temperature, rainfall, radiation and evaporation. Table 2 shows that the mean annual rainfall is 423.9 mm/year, whilst the annual pan evaporation is 1,650 mm/year.

4.2.1.2 Herd details

MEDLI requires details of the cattle within the proposed development. The details of the cattle to be fed within the proposed development shall be similar to the current development and are shown in Table 4.

Table 4 – Proposed development – Estimated market type composition

Parameter	Units	Market type Mid Fed
Days on feed	Days	150
Entry weight	kg	280
Exit weight	kg	550
SCU Scale Factor	-	0.75
Net gain (kg)	kg	270
Average daily gain	kg gain/head/day	1.8
Dry matter intake	kg DM/head/day	9.6
Mortality rate (No in/No Out)	%	0.5
Percent in lot	%	100.0

4.2.1.3 Manure excretion

Manure production data is required for accurate hydrological modelling of the feedlot as it affects the manure pad thickness (dry matter excretion) and the pad moisture content (excreted manure water). Where the MEDLI computer model (Gardner et al. 1996) is used for feedlot hydrology, the BEEFBAL spreadsheet (Queensland Primary Industries and Fisheries, 2019) is recommended for determining manure production data to input into MEDLI. The BEEFBAL methodology is outlined in Appendix B.

The key outputs from the BEEFBAL model that are used as inputs to the MEDLI model are:

- Total Solids (TS) in g/kg LWT.
- Volatile Solids (VS) in g/kg LWT.
- Excreted Manure Water in g/kg LWT.
- Salt (excluding salt from drinking water) in g/kg LWT.
- Nutrients (nitrogen, phosphorous, potassium) in g/kg LWT.

4.2.1.4 Manure management

The manure management regime for the proposed development shall be of the highest standard being Class 1. Pens shall be cleaned with a box scraper or similar equipment. Pens shall be cleaned after an under-fence pusher has removed all manure from under fence lines.

Pens are cleaned once every 70 days (minimum).

4.2.1.5 Controlled drainage area

Stormwater runoff from areas such as pens, livestock handling, solid waste storage and processing area and silage storage area has a high organic matter and therefore a high pollution potential. This runoff is controlled within a system that collects and conveys this runoff to a sedimentation basin and holding pond prior to environmentally acceptable utilisation.

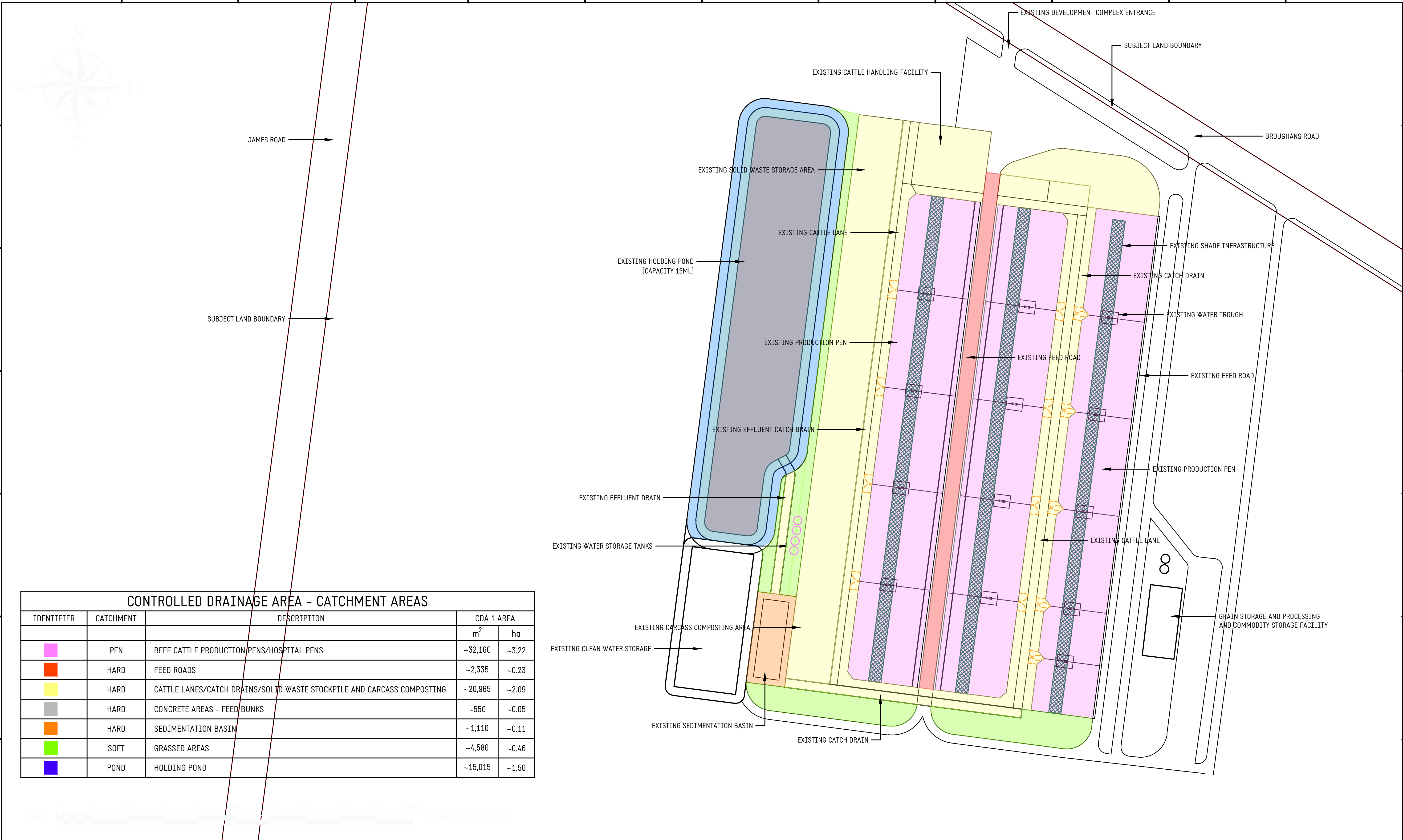
The proposed development comprises one controlled drainage area. The controlled drainage area is divided into three main sub-component areas, each of which has different runoff characteristics. These areas are:

- pen area – areas containing cattle and covered with manure e.g. production pens, holding pens, hospital pens etc.
- hard catchment – areas with a high runoff yield including access roads, feed roads, cattle lanes, catch/main drains, roofed areas, truck wash and solid waste storage/carcass composting area, sedimentation basin etc.
- soft catchment – areas with a low runoff yield such as grassed and other vegetated areas within the controlled drainage area.

The controlled drainage area along with pen, hard and soft areas for the proposed development are shown on Figure 4. Table 5 summaries the areas of the sub-catchments shown in Figure 4. Varying runoff coefficients are applied to the different sub-catchments depending on surface characteristics.

Table 5 – Proposed development - Controlled Drainage Area catchment details

	Runoff coefficient	Catchment area Area m^2
Pens – production pens, holding pens, hospital pens	0.8	~32,160
Hard – feed roads, cattle lanes, catch drains, solid waste stockpile and carcass composting area	0.8	~23,850
Hard – sedimentation basin	0.8	~1,110
Soft – grassed areas	0.4	~4,580
Holding pond – inside crest surface area	1.0	~15,015
Total		~76,715



CONTROLLED DRAINAGE AREA - CATCHMENT AREAS

IDENTIFIER	CATCHMENT	DESCRIPTION	CDA 1 AREA	
			m^2	ha
	PEN	BEEF CATTLE PRODUCTION PENS/HOSPITAL PENS	~32,160	~3.22
	HARD	FEED ROADS	~2,335	~0.23
	HARD	CATTLE LANES/CATCH DRAINS/SOLID WASTE STOCKPILE AND CARCASS COMPOSTING	~20,965	~2.09
	HARD	CONCRETE AREAS - FEED BUNKS	~550	~0.05
	HARD	SEDIMENTATION BASIN	~1,110	~0.11
	SOFT	GRASSED AREAS	~4,580	~0.46
	POND	HOLDING POND	~15,015	~1.50

LEGEND

- SUBJECT LAND BOUNDARY
- LAND PARCEL BOUNDARY
- EFFLUENT UTILISATION AREA
- SOLID WASTE UTILISATION AREA

NOTES:

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REV.	DATE	REVISION DESCRIPTION	DRAWN	CHECK	APPROVED
A	31/08/24	DRAFT ISSUE TO CLIENT	RJD	RJD	RJD
B	07/11/24	FINAL FOR LODGEMENT TO EDWARD RIVER COUNCIL	RJD	RJD	RJD

SCALE	1:2,000 (A3)
DRAWN	RJD
DATE	07/11/2024
CHECKED	RJD
DATE	07/11/2024
APPROVED	RJD
DATE	07/11/2024

CLIENT: AJ & NA VARLEY

PROJECT: PROPOSED EXPANSION OF BEEF CATTLE FEEDLOT

TITLE: DEVELOPMENT APPLICATION FOR INTENSIVE LIVESTOCK AGRICULTURE
EIS APPENDIX M - EFFLUENT POND SIZING AND WASTE UTILISATION
PROPOSED DEVELOPMENT - CONTROLLED DRAINAGE AREA PLAN

REPORT REFERENCE: FIGURE 4 | SUPPLIED DRAWING NUMBER: | A3 | DRAWING NUMBER: F3-107-500-04 | REV. B

DATE PLOTTED: 7 November 2024 BY: RDC Engineers PTY LTD
FILE NAME: F3-107 ANVarley High Claire MASTERPLAN-00-20230407 v8.dwg
FILE PATH: C:\RDC Engineers\RDCE - Projects\F3-107 A and N Varley High Claire FL Finley\05 - ACAD MasterPlan\05.1 Drawings - CURRENT

4.2.2 Effluent quality

The nitrogen and phosphorus concentrations of the effluent are required to model the nutrient and water balances of the system.

Effluent from beef cattle feedlots is a rather concentrated wastewater with high levels of nitrogen and phosphorus and considerable colour. The concentrations of both inorganic and organic nutrients are high. Salinity (EC) can also be quite high. However, holding pond nutrient concentrations are often variable because inflows only occur as a result of rainfall.

Table 6 shows the typical composition of beef cattle feedlot liquid waste based on data from MLA (2016b). These data were collected from holding ponds and evaporation ponds at various cattle feedlots.

Table 6 – Typical effluent characteristics (MLA, 2016b)

Parameter	Units	Avg.	Min.	Max.
pH	-	8	7	10
Total nitrogen	mg/L	220	25	1,025
Total Kjeldahl nitrogen	mg/L	218	23	1,025
Ammonia nitrogen	mg/L	89	0.1	670
Nitrate nitrogen	mg/L	2.3	0.1	68.8
Nitrite nitrogen	mg/L	0.5	0	5.1
Total phosphorus	mg/L	71	2	387
Phosphate-P	mg/L	17	1.5	133
Potassium	mg/L	665	1.2	9100
Total dissolved solids	mg/L	4,915	1,002	18,644
Calcium	mg/L	126	13	597
Chloride	mg/L	1,261	95	12,839
Magnesium	mg/L	118	2	805
Sodium	mg/L	494	12	6,700
Sulphate	mg/L	74	1	378
EC	dS/m	7.8	0.1	37.8

The MEDLI model predicts nutrient concentrations based on the mass balance calculations based on the concentrations of Nitrogen, Phosphorus and Potassium from the BEEFBAL model.

Effluent nutrient concentrations of 234 mg/L for nitrogen and 69 mg/L for phosphorus with an average electrical conductivity concentration of 7.5 dS/m were predicted by MEDLI. These concentrations are within the range of typically measured beef cattle holding pond effluent nutrient concentrations.

4.2.3 Soil type

The Red sodosol was selected as the primary representative soil to be used in the MEDLI model.

4.2.4 Modelled crops

The subject property currently produces irrigated winter cereals (wheat/barley) and irrigated summer cereals (corn silage). These crops are grown in rotation to facilitate sustainable soil management and long-term production. This rotation policy coupled with zero till and reduced tillage practices maximise the retention of crop residues as a compost addition.

Therefore, a rotation cropping program with Summer - 'Maize Silage and Winter - Barley' was adopted for the modelling. These crops shall be harvested and removed from the irrigation area to remove nutrient loading.

4.2.5 Irrigation area

The existing development has 33 ha of land approved on the subject land for effluent irrigation area. However, no effluent has been irrigated due to the of effluent generation over the last 20 years. Figure 3 shows the effluent utilisation area for the proposed development. The amount of land proposed to be irrigated is approximately 16 ha with a reserve area of 16 ha.

4.2.6 Irrigation schedule

The irrigation input data includes the system type, available area for irrigation and scheduling rules.

The irrigation system shall be surface irrigation. Therefore, the default 'Flood' irrigation method was used in the modelling.

The irrigation scheduling was based on a soil water deficit of 20 mm and when rainfall is less than or equal to 5 mm.

4.2.7 Outputs

The objective of the MEDLI modelling is to determine the quantity and quality of effluent generated from the proposed development and to determine an appropriate holding pond size and area required for effluent utilisation. The performance criteria for designing and evaluating such as system were:

- Holding pond overflows are less frequent than 1 in 10 years;
- Nitrogen loading rate (after losses) from effluent less than crop removal;

- Nitrate (NO_3) leaching below the root zone such that solution NO_3 concentration is < 15 mg/L
- Phosphorus loading rate is lower than crop removal and safe soil sorption
- Salinity levels in soil do not significantly reduce crop yield.

The sustainability of the effluent utilisation system is dependent on balanced hydraulic and nutrient loads. These parameters determine the plant growth and their impacts on the environment.

Table 7 and Table 8 shows a summary of the water and nutrient balances for the holding pond with the modelled scenario respectively.

The full output summary for the modelled scenario is attached in Appendix C.

Table 7 – Proposed development – Holding pond water balance

Water Movement	Units	Scenario 1 Clean water + Effluent
Runoff inflow	ML/year	6.01
Rain	ML/year	6.42
TOTAL IN	ML/year	12.43
Evaporation	ML/year	6.11
Seepage (estimated at 0.1 mm/d)	ML/year	0.16
Sludge accumulated	ML/year	0.07
Irrigation	ML/year	6.16
Overtopping	ML/year	0.00
TOTAL OUT	ML/year	12.50
Overtopping Events (no. per 10 yrs)		0
Percentage of reuse	%	97

Table 7 shows that the annual inflow to the pond from stormwater runoff was estimated by the MEDLI feedlot model to be 6.01 ML, which equates to about 99 mm of runoff from the 6.1 ha catchment area. This represents 23% of the annual rainfall for the site.

The MEDLI model predicts that the existing holding pond with a volume of 15 ML and a surface area of 1.5 ha will restrict any overtopping events to a frequency of less than once every 10 years. There are no overflow events.

Table 8 – Proposed development – Holding pond nutrient balance

Nutrient	Units	Scenario 1 Clean water + liquid waste
Nitrogen added by effluent runoff	tonnes/year	10.57
Nitrogen removed by irrigation	tonnes/year	2.09
Nitrogen removed by volatilisation	tonnes/year	6.08
Nitrogen accumulated in sludge	tonnes/year	2.43
Nitrogen lost in overtopping	tonnes/year	0.0
Phosphorus added by effluent runoff	tonnes/year	2.18
Phosphorus removed by irrigation	tonnes/year	0.20
Phosphorus accumulated in sludge	tonnes/year	1.96
Phosphorus lost in overtopping	tonnes/year	0.0
Salinity added by effluent runoff	tonnes/year	4.63
Salinity removed by irrigation	tonnes/year	4.11
Salinity lost in overtopping	tonnes/year	0.0

Table 9 – Proposed development – Effluent utilisation area water and nutrient mass balance

Parameter	Units	Scenario 1 Clean water + liquid waste
Water Balance		
Rainfall	mm/year	423.9
Irrigation	mm/year	574.6
Soil evaporation	mm/year	560.3
Transpiration	mm/year	395.9
Irrigation runoff	mm/year	0.0
Drainage	mm/year	41.4
Crop yield (2 crops)	kg DM/ha/year	15,400
Nutrient Application and Losses		
N applied in irrigation	kg/ha/year	150
N volatilised	kg/ha/year	10
N removed by crop	kg/ha/year	170
N Leached	kg/ha/year	0.721
P applied in effluent	kg/ha/year	10
P removed by crop	kg/ha/year	20
P leached	kg/ha/year	0.0058
Change in adsorbed P	kg/ha/year	3.5
Average phosphate-P concentration in rootzone	mg/L	0.02
Nutrient Concentration in Deep Drainage		
Nitrogen	mg/L	1.74
Phosphorus	mg/L	0.01
Salt		
Average salinity of infiltrated water	dS/m	0.10
Average salinity at base of root zone	dS/m	2.88
Reduction in crop yield due to salinity	-	0.0

NB: All data are means over 100-year simulation period.

4.2.7.1 Reuse

The proposed irrigation system is sustainable as the effluent utilisation percentage is maximised (>97%). The effluent utilisation obtained is estimated at some 97% and thus meets the criteria for a successful full utilisation scheme.

4.2.7.2 Nutrient utilisation

4.2.7.2.1 Nitrogen

Table 9 shows that about 150 kg/ha/year of nitrogen would be available for crop uptake after some losses on nitrogen as a result of volatilisation with Scenario 1. The crop would remove some 170 kg/ha/year of nitrogen per year with Scenario 1. Subsequently, the plant uptake of nitrogen is in excess of the nitrogen added in irrigation. The nitrogen deficit and this will need to be met by existing soil reserves and/or additional applications of nitrogen.

Therefore, the irrigation area is considered to be sustainable with respect to nitrogen as required by relevant guidelines.

4.2.7.2.2 Phosphorus

Table 9 shows that about 10 kg/ha/year of phosphorus would be applied through irrigation of effluent with Scenario 1. The crop would remove some 20 kg/ha/year with phosphorus adsorbed by the soil removed and no phosphorus leached. Subsequently, all of the phosphorus added in irrigation will be removed by crop uptake. The phosphorus concentration in the root zone is 0.2 mg/L which is considered acceptable for Scenario 1.

Therefore, the irrigation area is considered to be sustainable with respect to phosphorus as required by relevant guidelines.

4.2.7.3 Root zone nutrient concentrations

The irrigation of effluent onto the land is considered sustainable, with a low nitrate concentration (1.74 mg/L) and a low phosphorous concentration (0.01 mg/L) detected in the deep drainage respectively. There is no guideline limit for nutrient levels in these zones. However, it is desirable to maintain low concentrations.

4.2.7.4 Salinity

The salt balance is shown in Table 9. The irrigation scheme is considered sustainable in terms of salt loads and soil salinity as MEDLI predicted no reduction in plant yield due to salinity.

Deep drainage of water will assist with flushing salt through the soil profile. Based on deep drainage rates and salt concentrations predicted in MEDLI, all salt applied in the effluent is flushed through the soil profile with infiltrated water and is unlikely to accumulate over time and result in crop stress.

The average salinity of effluent is estimated to be 1.35 dS/m. After shandying with clean water, the average salinity of the irrigation water is estimated to be 0.1 dS/m.

The salinity change in the root zone remained stable over the 100 year modelling period.

Hence, this indicates, minimum to no leaching of salts into the root zone. The MEDLI model indicates no reduction in crop yield and no years that crop yield falls below 90% potential yield because of soil salinity.

4.2.8 Summary

The effluent utilisation area has been selected and sized to be ecologically sustainable to prevent environmental harm, especially to soils, groundwater and surface water.

The utilisation potential of the effluent for land irrigation was assessed to determine the environmentally sustainability of the proposed system. A sustainable system is one that applies treated effluent only when soil conditions permit, balances applied nutrients with removed nutrients, has no significant impact on runoff or deep drainage and minimises the losses of nutrients below the root zone.

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Appendix A – Soil test results

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AGRICULTURAL SOIL ANALYSIS REPORT

21 samples supplied by Hybrid Ag on 09/03/2023. Lab Job No.N8431
Analysis requested by Amos Rowe. Your Job: SMIP LM0407T2J1 - 7 sites
PO Box 633 WANGARATTA VIC 3676

			Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
		Sample ID:	LM0407T2J1 Site 1 - L1	LM0407T2J1 Site 1 - L1	LM0407T2J1 Site 1 - L1	LM0407T2J1 Site 2 - HC1	LM0407T2J1 Site 2 - HC1
		Depth:	0-10cm	10-20cm	20-30cm	0-10cm	10-20cm
		Client:	Varley	Varley	Varley	Varley	Varley
Parameter		**Method reference**	**N8431/1**	**N8431/2**	**N8431/3**	**N8431/4**	**N8431/5**
Soluble Calcium (mg/kg)		**Inhouse S10 - Morgan 1	592	800	737	529	547
Soluble Magnesium (mg/kg)		**Inhouse S10 - Morgan 1	404	669	681	302	295
Soluble Potassium (mg/kg)		**Inhouse S10 - Morgan 1	123	60	80	189	173
Soluble Phosphorus (mg/kg)		**Inhouse S10 - Morgan 1	2.0	1.5	1.2	2.4	1.8
Phosphorus (mg/kg P)		**Rayment & Lyons 2011 - 9E2 (Bray 1)	18	2.8	7.6	47	26
		**Rayment & Lyons 2011 - 9B2 (Colwell)	69	..	..	116	..
		**Inhouse S3A (Bray 2)	33	5	15	76	43
pH		Rayment & Lyons 2011 - 4A1 (1:5 Water)	6.03	7.83	7.47	5.76	6.40
Electrical Conductivity (dS/m)		Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.110	0.100	0.142	0.066	0.065
Estimated Organic Matter (% OM)		**Calculation: Total Carbon x 1.75	4.39	1.44	2.05	2.96	2.49
Exchangeable Calcium	(cmol$_+$/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	6.55	9.49	8.10	4.44	5.19
	(kg/ha)		2942	4259	3636	1992	2328
	(mg/kg)		1313	1901	1623	889	1039
Exchangeable Magnesium	(cmol$_+$/kg)		5.57	10.70	10.06	2.95	3.57
	(kg/ha)		1515	2912	2739	804	972
	(mg/kg)		676	1300	1223	359	434
Exchangeable Potassium	(cmol$_+$/kg)		0.81	0.62	0.78	1.00	0.95
	(kg/ha)		713	541	684	872	831
	(mg/kg)		318	241	305	389	371
Exchangeable Sodium	(cmol$_+$/kg)		0.93	2.23	2.41	0.39	0.51
	(kg/ha)		478	1147	1241	201	261
	(mg/kg)		213	512	554	90	116
Exchangeable Aluminium	(cmol$_+$/kg)	**Inhouse S37 (KCl)	0.10	0.07	0.08	0.15	0.08
	(kg/ha)		21	15	15	31	17
	(mg/kg)		9	7	7	14	8
Exchangeable Hydrogen	(cmol$_+$/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	<0.01	<0.01	0.06	<0.01
	(kg/ha)		<1	<1	<1	1	<1
	(mg/kg)		<1	<1	<1	<1	<1
Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg)		**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg)	13.97	23.10	21.43	8.99	10.30
Calcium (%)		**Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100	47	41	38	49	50
Magnesium (%)			40	46	47	33	35
Potassium (%)			5.8	2.7	3.6	11	9.2
Sodium - ESP (%)			6.6	9.6	11	4.3	4.9
Aluminium (%)			0.7	0.3	0.4	1.7	0.8
Hydrogen (%)			0.0	0.0	0.0	0.7	0.0
Calcium/Magnesium Ratio		**Calculation: Calcium / Magnesium (cmol$_+$/kg)	1.2	0.9	0.8	1.5	1.5
Zinc (mg/kg)		Rayment & Lyons 2011 - 12A1 (DTPA)	3.6	1.5	16.5	2.0	1.6
Manganese (mg/kg)			37	13	19	67	74
Iron (mg/kg)			192	35	63	133	89
Copper (mg/kg)			1.6	1.2	1.1	1.4	1.3
Boron (mg/kg)		**Rayment & Lyons 2011 - 12C2 (Hot $CaCl_2$)	1.36	1.52	2.01	1.09	0.95
Silicon (mg/kg Si)		**Inhouse S11 (Hot CaCl2)	82	41	56	61	69
Total Carbon (%)		Inhouse S4a (LECO Trumac Analyser)	2.51	0.83	1.17	1.69	1.42
Total Nitrogen (%)			0.20	0.09	0.13	0.13	0.11
Carbon/Nitrogen Ratio		**Calculation: Total Carbon/Total Nitrogen	12.9	9.0	9.0	13.5	12.8
Chloride Estimate (equiv. mg/kg)		**Calculation: Electrical Conductivity x 640	70	64	91	42	42

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AGRICULTURAL SOIL ANALYSIS REPORT

21 samples supplied by Hybrid Ag on 09/03/2023. Lab Job No.N8431
Analysis requested by Amos Rowe. Your Job: SMIP LM0407T2J1 - 7 sites
PO Box 633 WANGARATTA VIC 3676

		Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Sample ID:		LM0407T2J1 Site 1 - L1	LM0407T2J1 Site 1 - L1	LM0407T2J1 Site 1 - L1	LM0407T2J1 Site 2 - HC1	LM0407T2J1 Site 2 - HC1
Depth:		0-10cm	10-20cm	20-30cm	0-10cm	10-20cm
Client:		Varley	Varley	Varley	Varley	Varley
Parameter	**Method reference**	**N8431/1**	**N8431/2**	**N8431/3**	**N8431/4**	**N8431/5**
Total Calcium (mg/kg)	Rayment & Lyons 2011 - 17C1 Aqua Regia	1,746	2,257	2,005	1,110	1,283
Total Magnesium (mg/kg)		2,767	5,011	4,846	1,817	1,839
Total Potassium (mg/kg)		2,744	3,675	3,739	2,619	2,492
Total Sodium (mg/kg)		324	683	789	133	155
Total Sulfur (mg/kg)		203	91	116	100	83
Total Phosphorus (mg/kg)		390	165	234	496	368
Total Zinc (mg/kg)		35	41	63	29	29
Total Manganese (mg/kg)		318	371	402	843	878
Total Iron (mg/kg)		23,409	30,467	30,957	19,363	19,305
Total Copper (mg/kg)		15	18	18	13	13
Total Boron (mg/kg)		8	11	14	6	6
Total Silicon (mg/kg)		783	633	654	733	759
Total Aluminium (mg/kg)		20,405	28,630	28,997	15,858	15,376
Total Molybdenum (mg/kg)		0	0	0	0	0
Total Cobalt (mg/kg)		8	14	12	12	12
Total Selenium (mg/kg)		1	1	1	<0.5	1
Total Cadmium (mg/kg)		<0.5	<0.5	<0.5	<0.5	<0.5
Total Lead (mg/kg)		15	17	17	15	16
Total Arsenic (mg/kg)		6	7	8	5	6
Total Chromium (mg/kg)		28	35	37	25	25
Total Nickel (mg/kg)		14	20	26	12	13
Total Mercury (mg/kg)		<0.1	<0.1	<0.1	<0.1	<0.1
Total Silver (mg/kg)		<1	<1	<1	<1	<1
Total Organic Carbon (%)	LECO Trumac Analyser - Inhouse S15b	2.54	0.93	1.42	1.69	1.23
Nitrate Nitrogen (mg/kg N)	**Inhouse S37 (2M KCl)	24.1	3.6	11.1	7.3	4.7
Ammonium Nitrogen (mg/kg N)		3.2	1.1	1.3	1.6	3.1
Field Texture Grade	**Field Texture	Medium Clay	Medium Clay	Heavy Clay	Sandy Clay Loam	Medium Clay
Bulk Density (t/m3)	503.01	1.43	1.27	1.11	1.05	1.19

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. National Environmental Protection (Assessment of Site Contamination) Measure 2013,
   Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 $cmol_+/kg$ = 230 mg/kg Sodium, 390 mg/kg Potassium,
    122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
14. Analysis conducted between sample arrival date and reporting date.
15. This report is not to be reproduced except in full. Results only relate to the item tested.
16. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (refer SCU.edu.au/eal/t&cs).
17. This report was issued on 15/03/2023.

Quality Checked: Kris Saville
Agricultural Co-Ordinator
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NATA
WORLD RECOGNISED ACCREDITATION
Accreditation No. 14960
Accredited for compliance with ISO/IEC 17025 - Testing

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Environmental Analysis Laboratory

AGRICULTURAL SOIL ANALYSIS REPORT

21 samples supplied by Hybrid Ag on 09/03/2023. Lab Job No.N8431

Analysis requested by Amos Rowe. Your Job: SMIP LM0407T2J1 - 7 sites

PO Box 633 WANGARATTA VIC 3676

Parameter	Method reference	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10
Sample ID:		LM0407T2J1 Site 2 - HC1	LM0407T2J1 Site 3 - L8	LM0407T2J1 Site 3 - L8	LM0407T2J1 Site 3 - L8	LM0407T2J1 Site 4 - KR7
Depth:		20-30cm	0-10cm	10-20cm	20-30cm	0-10cm
Client:		Varley	Varley	Varley	Varley	Varley
		N8431/6	N8431/7	N8431/8	N8431/9	N8431/10
Soluble Calcium (mg/kg)	**Inhouse S10 - Morgan 1	726	682	704	736	654
Soluble Magnesium (mg/kg)		491	304	595	740	343
Soluble Potassium (mg/kg)		140	170	53	35	219
Soluble Phosphorus (mg/kg)		1.4	1.4	1.2	<1	2.0
Phosphorus (mg/kg P)	**Rayment & Lyons 2011 - 9E2 (Bray 1)	13	17	4.4	2.5	32
	**Rayment & Lyons 2011 - 9B2 (Colwell)	..	72	..	..	121
	**Inhouse S3A (Bray 2)	28	36	9	5	65
pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	7.44	6.16	7.70	8.09	5.89
Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.090	0.074	0.060	0.078	0.088
Estimated Organic Matter (% OM)	**Calculation: Total Carbon x 1.75	1.21	2.70	1.40	0.93	2.64
Exchangeable Calcium (cmol$_+$/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	6.74	6.19	7.01	7.27	6.63
Exchangeable Calcium (kg/ha)		3026	2778	3145	3263	2976
Exchangeable Calcium (mg/kg)		1351	1240	1404	1457	1329
Exchangeable Magnesium (cmol$_+$/kg)		5.82	3.60	7.81	9.46	4.44
Exchangeable Magnesium (kg/ha)		1583	979	2126	2576	1208
Exchangeable Magnesium (mg/kg)		707	437	949	1150	539
Exchangeable Potassium (cmol$_+$/kg)		0.98	0.58	0.49	0.47	1.58
Exchangeable Potassium (kg/ha)		856	510	426	409	1386
Exchangeable Potassium (mg/kg)		382	227	190	183	619
Exchangeable Sodium (cmol$_+$/kg)		1.13	0.41	1.25	1.74	0.33
Exchangeable Sodium (kg/ha)		582	210	645	897	171
Exchangeable Sodium (mg/kg)		260	94	288	400	76
Exchangeable Aluminium (cmol$_+$/kg)	**Inhouse S37 (KCl)	0.07	0.08	0.08	0.03	0.05
Exchangeable Aluminium (kg/ha)		14	16	17	6	11
Exchangeable Aluminium (mg/kg)		6	7	7	3	5
Exchangeable Hydrogen (cmol$_+$/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	<0.01	<0.01	<0.01	0.08
Exchangeable Hydrogen (kg/ha)		<1	<1	<1	<1	2
Exchangeable Hydrogen (mg/kg)		<1	<1	<1	<1	<1
Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg)	14.73	10.86	16.64	18.97	13.12
Calcium (%)	**Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100	46	57	42	38	51
Magnesium (%)		39	33	47	50	34
Potassium (%)		6.6	5.4	2.9	2.5	12
Sodium - ESP (%)		7.7	3.8	7.5	9.2	2.5
Aluminium (%)		0.5	0.7	0.5	0.2	0.4
Hydrogen (%)		0.0	0.1	0.0	0.0	0.6
Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol$_+$/kg)	1.2	1.7	0.9	0.8	1.5
Zinc (mg/kg)	Rayment & Lyons 2011 - 12A1 (DTPA)	1.5	4.4	1.4	0.7	1.7
Manganese (mg/kg)		34	24	32	10	47
Iron (mg/kg)		50	138	40	22	203
Copper (mg/kg)		1.0	1.8	1.2	1.0	1.7
Boron (mg/kg)	**Rayment & Lyons 2011 - 12C2 (Hot $CaCl_2$)	1.70	0.81	1.02	1.48	1.26
Silicon (mg/kg Si)	**Inhouse S11 (Hot CaCl2)	50	64	27	20	66
Total Carbon (%)	Inhouse S4a (LECO Trumac Analyser)	0.69	1.54	0.80	0.53	1.51
Total Nitrogen (%)		0.08	0.12	0.11	0.06	0.12
Carbon/Nitrogen Ratio	**Calculation: Total Carbon/Total Nitrogen	8.9	12.8	7.6	8.4	12.3
Chloride Estimate (equiv. mg/kg)	**Calculation: Electrical Conductivity x 640	58	47	38	50	56

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AGRICULTURAL SOIL ANALYSIS REPORT

21 samples supplied by Hybrid Ag on 09/03/2023. Lab Job No.N8431
Analysis requested by Amos Rowe. Your Job: SMIP LM0407T2J1 - 7 sites
PO Box 633 WANGARATTA VIC 3676

		Sample 6	Sample 7	Sample 8	Sample 9	Sample 10
	Sample ID:	LM0407T2J1 Site 2 - HC1	LM0407T2J1 Site 3 - L8	LM0407T2J1 Site 3 - L8	LM0407T2J1 Site 3 - L8	LM0407T2J1 Site 4 - KR7
	Depth:	20-30cm	0-10cm	10-20cm	20-30cm	0-10cm
	Client:	Varley	Varley	Varley	Varley	Varley
Parameter	**Method reference**	**N8431/6**	**N8431/7**	**N8431/8**	**N8431/9**	**N8431/10**
Total Calcium (mg/kg)	Rayment & Lyons 2011 - 17C1 Aqua Regia	1,703	1,466	1,662	1,674	1,607
Total Magnesium (mg/kg)		2,939	2,108	3,638	4,420	2,588
Total Potassium (mg/kg)		3,182	2,254	2,921	3,131	3,642
Total Sodium (mg/kg)		383	154	468	664	143
Total Sulfur (mg/kg)		64	91	73	67	113
Total Phosphorus (mg/kg)		213	310	163	164	449
Total Zinc (mg/kg)		34	37	36	38	37
Total Manganese (mg/kg)		530	209	575	366	454
Total Iron (mg/kg)		24,421	20,273	30,913	32,122	22,956
Total Copper (mg/kg)		15	13	17	18	16
Total Boron (mg/kg)		9	5	7	9	7
Total Silicon (mg/kg)		523	632	629	572	618
Total Aluminium (mg/kg)		22,239	17,633	27,653	29,036	22,446
Total Molybdenum (mg/kg)		0	0	0	0	0
Total Cobalt (mg/kg)		10	8	13	11	10
Total Selenium (mg/kg)		<0.5	<0.5	1	1	1
Total Cadmium (mg/kg)		<0.5	<0.5	<0.5	<0.5	<0.5
Total Lead (mg/kg)		15	14	16	17	16
Total Arsenic (mg/kg)		7	6	7	8	6
Total Chromium (mg/kg)		30	27	34	37	30
Total Nickel (mg/kg)		16	11	20	20	16
Total Mercury (mg/kg)		<0.1	<0.1	<0.1	<0.1	<0.1
Total Silver (mg/kg)		<1	<1	<1	<1	<1
Total Organic Carbon (%)	LECO Trumac Analyser - Inhouse S15b	0.95	1.42	0.85	0.63	1.57
Nitrate Nitrogen (mg/kg N)	**Inhouse S37 (2M KCl)	3.2	13.6	2.8	2.1	17.0
Ammonium Nitrogen (mg/kg N)		0.8	3.0	0.9	0.6	2.2
Field Texture Grade	**Field Texture	Medium Clay	Fine Sandy Clay Loam	Medium Clay	Medium Clay	Light Clay
Bulk Density (t/m3)	503.01	1.19	1.49	1.56	1.94	1.42

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. National Environmental Protection (Assessment of Site Contamination) Measure 2013,
   Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 $cmol_+/kg$ = 230 mg/kg Sodium, 390 mg/kg Potassium,
    122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
14. Analysis conducted between sample arrival date and reporting date.
15. This report is not to be reproduced except in full. Results only relate to the item tested.
16. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (
17. This report was issued on 15/03/2023.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

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CRICOS Provider: 01241G

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AGRICULTURAL SOIL ANALYSIS REPORT

21 samples supplied by Hybrid Ag on 09/03/2023. Lab Job No.N8431
Analysis requested by Amos Rowe. Your Job: SMIP LM0407T2J1 - 7 sites
PO Box 633 WANGARATTA VIC 3676

			Sample 11	Sample 12	Sample 13	Sample 14	Sample 15
Sample ID:			LM0407T2J1 Site 4 - KR7	LM0407T2J1 Site 4 - KR7	LM0407T2J1 Site 5 - ES & MT	LM0407T2J1 Site 5 - ES & MT	LM0407T2J1 Site 5 - ES & MT
Depth:			10-20cm	20-30cm	0-10cm	10-20cm	20-30cm
Client:			Varley	Varley	Varley	Varley	Varley
Parameter		Method reference	N8431/11	N8431/12	N8431/13	N8431/14	N8431/15
Soluble Calcium (mg/kg)		**Inhouse S10 - Morgan 1	1251	1376	392	265	283
Soluble Magnesium (mg/kg)			461	704	66	37	36
Soluble Potassium (mg/kg)			152	112	88	98	94
Soluble Phosphorus (mg/kg)			1.6	1.1	12.9	10.6	9.8
Phosphorus (mg/kg P)		**Rayment & Lyons 2011 - 9E2 (Bray 1)	7.0	1.5	60	82	68
		**Rayment & Lyons 2011 - 9B2 (Colwell)	..	..	72	..	..
		**Inhouse S3A (Bray 2)	15	5	84	100	96
pH		Rayment & Lyons 2011 - 4A1 (1:5 Water)	7.19	8.02	6.22	6.20	6.25
Electrical Conductivity (dS/m)		Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.103	0.088	0.069	0.040	0.046
Estimated Organic Matter (% OM)		**Calculation: Total Carbon x 1.75	1.42	0.72	1.30	0.70	0.69
Exchangeable Calcium	($cmol_+/kg$)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	11.66	13.73	3.15	2.10	2.08
	(kg/ha)		5232	6164	1412	942	932
	(mg/kg)		2336	2752	630	421	416
Exchangeable Magnesium	($cmol_+/kg$)		5.88	9.90	0.68	0.35	0.32
	(kg/ha)		1600	2695	186	94	87
	(mg/kg)		714	1203	83	42	39
Exchangeable Potassium	($cmol_+/kg$)		1.43	1.40	0.35	0.39	0.35
	(kg/ha)		1254	1227	310	338	310
	(mg/kg)		560	548	138	151	138
Exchangeable Sodium	($cmol_+/kg$)		0.33	0.83	<0.065	<0.065	<0.065
	(kg/ha)		168	430	<33	<33	<33
	(mg/kg)		75	192	<15	<15	<15
Exchangeable Aluminium	($cmol_+/kg$)	**Inhouse S37 (KCl)	0.02	0.02	<0.01	0.02	0.01
	(kg/ha)		4	4	2	3	2
	(mg/kg)		2	2	<1	1	<1
Exchangeable Hydrogen	($cmol_+/kg$)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	<0.01	0.01	0.02	<0.01
	(kg/ha)		<1	<1	<1	<1	<1
	(mg/kg)		<1	<1	<1	<1	<1
Effective Cation Exchange Capacity (ECEC) ($cmol_+/kg$)		**Calculation: Sum of Ca,Mg,K,Na,Al,H ($cmol_+/kg$)	19.31	25.88	4.24	2.89	2.78
Calcium (%)		**Base Saturation Calculations - Cation $cmol_+/kg$ / ECEC x 100	60	53	74	73	75
Magnesium (%)			30	38	16	12	12
Potassium (%)			7.4	5.4	8.3	13.4	13
Sodium - ESP (%)			1.7	3.2	0.8	0.7	0.6
Aluminium (%)			0.1	0.1	0.2	0.6	0.4
Hydrogen (%)			0.0	0.0	0.3	0.7	0.0
Calcium/Magnesium Ratio		**Calculation: Calcium / Magnesium ($cmol_+/kg$)	2.0	1.4	4.6	6.1	6.5
Zinc (mg/kg)		Rayment & Lyons 2011 - 12A1 (DTPA)	0.8	<0.5	1.4	1.6	1.9
Manganese (mg/kg)			37	6	17	15	16
Iron (mg/kg)			48	12	51	41	42
Copper (mg/kg)			1.1	1.0	0.2	0.2	0.2
Boron (mg/kg)		**Rayment & Lyons 2011 - 12C2 (Hot $CaCl_2$)	1.05	1.38	0.29	0.22	0.22
Silicon (mg/kg Si)		**Inhouse S11 (Hot CaCl2)	35	24	23	17	21
Total Carbon (%)		Inhouse S4a (LECO Trumac Analyser)	0.81	0.41	0.74	0.40	0.40
Total Nitrogen (%)			0.08	0.07	0.07	0.05	0.03
Carbon/Nitrogen Ratio		**Calculation: Total Carbon/Total Nitrogen	10.5	5.9	10.7	8.4	12.4
Chloride Estimate (equiv. mg/kg)		**Calculation: Electrical Conductivity x 640	66	56	44	26	29

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AGRICULTURAL SOIL ANALYSIS REPORT

21 samples supplied by Hybrid Ag on 09/03/2023. Lab Job No.N8431
Analysis requested by Amos Rowe. Your Job: SMIP LM0407T2J1 - 7 sites
PO Box 633 WANGARATTA VIC 3676

		Sample 11	Sample 12	Sample 13	Sample 14	Sample 15
	Sample ID:	LM0407T2J1 Site 4 - KR7	LM0407T2J1 Site 4 - KR7	LM0407T2J1 Site 5 - ES & MT	LM0407T2J1 Site 5 - ES & MT	LM0407T2J1 Site 5 - ES & MT
	Depth:	10-20cm	20-30cm	0-10cm	10-20cm	20-30cm
	Client:	Varley	Varley	Varley	Varley	Varley
Parameter	**Method reference**	**N8431/11**	**N8431/12**	**N8431/13**	**N8431/14**	**N8431/15**
Total Calcium (mg/kg)	Rayment & Lyons 2011 - 17C1 Aqua Regia	2,887	3,022	857	609	552
Total Magnesium (mg/kg)		3,793	5,036	1,138	1,420	1,467
Total Potassium (mg/kg)		4,379	5,119	1,330	1,705	1,632
Total Sodium (mg/kg)		194	315	<50	<50	<50
Total Sulfur (mg/kg)		79	<50	57	<50	<50
Total Phosphorus (mg/kg)		225	121	343	370	325
Total Zinc (mg/kg)		42	46	20	25	23
Total Manganese (mg/kg)		815	437	182	230	215
Total Iron (mg/kg)		30,846	34,177	9,822	12,274	12,246
Total Copper (mg/kg)		19	21	4	5	5
Total Boron (mg/kg)		9	12	2	3	<2
Total Silicon (mg/kg)		741	608	635	670	497
Total Aluminium (mg/kg)		29,064	33,863	5,165	6,670	6,233
Total Molybdenum (mg/kg)		0	0	<0.2	<0.2	<0.2
Total Cobalt (mg/kg)		13	15	3	5	5
Total Selenium (mg/kg)		1	<0.5	<0.5	<0.5	<0.5
Total Cadmium (mg/kg)		<0.5	<0.5	<0.5	<0.5	<0.5
Total Lead (mg/kg)		19	18	5	6	6
Total Arsenic (mg/kg)		7	7	3	4	4
Total Chromium (mg/kg)		38	40	10	12	12
Total Nickel (mg/kg)		23	22	5	6	7
Total Mercury (mg/kg)		<0.1	<0.1	<0.1	<0.1	<0.1
Total Silver (mg/kg)		<1	<1	<1	<1	<1
Total Organic Carbon (%)	LECO Trumac Analyser - Inhouse S15b	0.77	0.50	1.00	0.59	0.54
Nitrate Nitrogen (mg/kg N)	**Inhouse S37 (2M KCl)	8.6	4.5	14.2	1.4	5.0
Ammonium Nitrogen (mg/kg N)		0.7	1.2	1.9	0.6	0.6
Field Texture Grade	**Field Texture	Medium Clay	Medium Clay	Loamy Sand	Sandy Loam	Loamy Sand
Bulk Density (t/m3)	503.01	1.65	1.44	1.83	1.97	1.81

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. National Environmental Protection (Assessment of Site Contamination) Measure 2013,
   Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 $cmol_+/kg$ = 230 mg/kg Sodium, 390 mg/kg Potassium,
    122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
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Quality Checked: Kris Saville
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AGRICULTURAL SOIL ANALYSIS REPORT

21 samples supplied by Hybrid Ag on 09/03/2023. Lab Job No.N8431
Analysis requested by Amos Rowe. Your Job: SMIP LM0407T2J1 - 7 sites
PO Box 633 WANGARATTA VIC 3676

			Sample 16	Sample 17	Sample 18	Sample 19	Sample 20
		Sample ID:	LM0407T2J1 Site 6 SS-SW 1/2	LM0407T2J1 Site 6 SS-SW 1/2	LM0407T2J1 Site 6 SS-SW 1/2	LM0407T2J1 Site 7 - KR9	LM0407T2J1 Site 7 - KR9
		Depth:	0-10cm	10-20cm	20-30cm	0-10cm	10-20cm
		Client:	Varley	Varley	Varley	Varley	Varley
Parameter		**Method reference**	**N8431/16**	**N8431/17**	**N8431/18**	**N8431/19**	**N8431/20**
Soluble Calcium (mg/kg)		**Inhouse S10 - Morgan 1	..	..	..	..	..
Soluble Magnesium (mg/kg)			..	..	..	..	..
Soluble Potassium (mg/kg)			..	..	..	..	..
Soluble Phosphorus (mg/kg)			..	..	..	..	..
Phosphorus (mg/kg P)		**Rayment & Lyons 2011 - 9E2 (Bray 1)	..	..	..	..	..
		**Rayment & Lyons 2011 - 9B2 (Colwell)	79	..	..	85	..
		**Inhouse S3A (Bray 2)	..	..	..	..	..
pH		Rayment & Lyons 2011 - 4A1 (1:5 Water)	5.28	6.71	7.73	5.17	5.71
Electrical Conductivity (dS/m)		Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.117	0.072	0.075	0.088	0.068
Estimated Organic Matter (% OM)		**Calculation: Total Carbon x 1.75	..	..	..	..	..
Exchangeable Calcium	(cmol$_+$/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	..	..	..	..	..
	(kg/ha)		..	..	..	..	..
	(mg/kg)		..	..	..	..	..
Exchangeable Magnesium	(cmol$_+$/kg)		..	..	..	..	..
	(kg/ha)		..	..	..	..	..
	(mg/kg)		..	..	..	..	..
Exchangeable Potassium	(cmol$_+$/kg)		..	..	..	..	..
	(kg/ha)		..	..	..	..	..
	(mg/kg)		..	..	..	..	..
Exchangeable Sodium	(cmol$_+$/kg)		..	..	..	..	..
	(kg/ha)		..	..	..	..	..
	(mg/kg)		..	..	..	..	..
Exchangeable Aluminium	(cmol$_+$/kg)	**Inhouse S37 (KCl)	..	..	..	..	..
	(kg/ha)		..	..	..	..	..
	(mg/kg)		..	..	..	..	..
Exchangeable Hydrogen	(cmol$_+$/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	..	..	..	..	..
	(kg/ha)		..	..	..	..	..
	(mg/kg)		..	..	..	..	..
Effective Cation Exchange Capacity (ECEC) (cmol$_+$/kg)		**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol$_+$/kg)	..	..	..	..	..
Calcium (%)		**Base Saturation Calculations - Cation cmol$_+$/kg / ECEC x 100	..	..	..	..	..
Magnesium (%)			..	..	..	..	..
Potassium (%)			..	..	..	..	..
Sodium - ESP (%)			..	..	..	..	..
Aluminium (%)			..	..	..	..	..
Hydrogen (%)			..	..	..	..	..
Calcium/Magnesium Ratio		**Calculation: Calcium / Magnesium (cmol$_+$/kg)	..	..	..	..	..
Zinc (mg/kg)		Rayment & Lyons 2011 - 12A1 (DTPA)	..	..	..	..	..
Manganese (mg/kg)			..	..	..	..	..
Iron (mg/kg)			..	..	..	..	..
Copper (mg/kg)			..	..	..	..	..
Boron (mg/kg)		**Rayment & Lyons 2011 - 12C2 (Hot $CaCl_2$)	..	..	..	..	..
Silicon (mg/kg Si)		**Inhouse S11 (Hot CaCl2)	..	..	..	..	..
Total Carbon (%)		Inhouse S4a (LECO Trumac Analyser)	..	..	..	..	..
Total Nitrogen (%)			..	..	..	..	..
Carbon/Nitrogen Ratio		**Calculation: Total Carbon/Total Nitrogen	..	..	..	..	..
Chloride Estimate (equiv. mg/kg)		**Calculation: Electrical Conductivity x 640	..	..	..	..	..

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PO Box 633 WANGARATTA VIC 3676

		Sample 16	Sample 17	Sample 18	Sample 19	Sample 20
	Sample ID:	LM0407T2J1 Site 6 SS-SW 1/2	LM0407T2J1 Site 6 SS-SW 1/2	LM0407T2J1 Site 6 SS-SW 1/2	LM0407T2J1 Site 7 - KR9	LM0407T2J1 Site 7 - KR9
	Depth:	0-10cm	10-20cm	20-30cm	0-10cm	10-20cm
	Client:	Varley	Varley	Varley	Varley	Varley
Parameter	**Method reference**	**N8431/16**	**N8431/17**	**N8431/18**	**N8431/19**	**N8431/20**
Total Calcium (mg/kg)	Rayment & Lyons 2011 - 17C1 Aqua Regia	..	..	..	..	..
Total Magnesium (mg/kg)		..	..	..	..	..
Total Potassium (mg/kg)		..	..	..	..	..
Total Sodium (mg/kg)		..	..	..	..	..
Total Sulfur (mg/kg)		..	..	..	..	..
Total Phosphorus (mg/kg)		..	..	..	..	..
Total Zinc (mg/kg)		..	..	..	..	..
Total Manganese (mg/kg)		..	..	..	..	..
Total Iron (mg/kg)		..	..	..	..	..
Total Copper (mg/kg)		..	..	..	..	..
Total Boron (mg/kg)		..	..	..	..	..
Total Silicon (mg/kg)		..	..	..	..	..
Total Aluminium (mg/kg)		..	..	..	..	..
Total Molybdenum (mg/kg)		..	..	..	..	..
Total Cobalt (mg/kg)		..	..	..	..	..
Total Selenium (mg/kg)		..	..	..	..	..
Total Cadmium (mg/kg)		..	..	..	..	..
Total Lead (mg/kg)		..	..	..	..	..
Total Arsenic (mg/kg)		..	..	..	..	..
Total Chromium (mg/kg)		..	..	..	..	..
Total Nickel (mg/kg)		..	..	..	..	..
Total Mercury (mg/kg)		..	..	..	..	..
Total Silver (mg/kg)		..	..	..	..	..
Total Organic Carbon (%)	LECO Trumac Analyser - Inhouse S15b	2.05	1.15	0.77	2.02	1.22
Nitrate Nitrogen (mg/kg N)	**Inhouse S37 (2M KCl)	31.2	12.8	6.5	13.1	9.2
Ammonium Nitrogen (mg/kg N)		3.5	1.1	0.7	3.4	2.4
Field Texture Grade	**Field Texture	Medium Clay	Medium Clay	Medium Clay	Light Clay	Medium Clay
Bulk Density (t/m3)	503.01	1.32	1.08	1.10	1.40	1.42

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. National Environmental Protection (Assessment of Site Contamination) Measure 2013,
   Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 $cmol_+/kg$ = 230 mg/kg Sodium, 390 mg/kg Potassium,
    122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
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AGRICULTURAL SOIL ANALYSIS REPORT

21 samples supplied by Hybrid Ag on 09/03/2023. Lab Job No.N8431
Analysis requested by Amos Rowe. Your Job: SMIP LM0407T2J1 - 7 sites
PO Box 633 WANGARATTA VIC 3676

Parameter		Method reference	Sample 21	Heavy Soil	Medium Soil	Light Soil	Sandy Soil
		Sample ID:	LM0407T2J1 Site 7 - KR9				
		Depth:	20-30cm				
		Client:	Varley	Clay	Clay Loam	Loam	Loamy Sand
			N8431/21	Indicative guidelines - refer to Notes 6 and 8			
Soluble Calcium (mg/kg)		**Inhouse S10 - Morgan 1	..	1150	750	375	175
Soluble Magnesium (mg/kg)			..	160	105	60	25
Soluble Potassium (mg/kg)			..	113	75	60	50
Soluble Phosphorus (mg/kg)			..	15	12	10	5.0
Phosphorus (mg/kg P)		**Rayment & Lyons 2011 - 9E2 (Bray 1)	..	45 note 5	30 note 5	24 note 5	20 note 5
		**Rayment & Lyons 2011 - 9B2 (Colwell)	..	80	50	45	35
		**Inhouse S3A (Bray 2)	..	90 note 5	60 note 5	48 note 5	40 note 5
pH		Rayment & Lyons 2011 - 4A1 (1:5 Water)	6.60	6.5	6.5	6.3	6.3
Electrical Conductivity (dS/m)		Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.050	0.200	0.150	0.120	0.100
Estimated Organic Matter (% OM)		**Calculation: Total Carbon x 1.75	..	> 5.5	>4 .5	> 3.5	> 2.5
Exchangeable Calcium	(cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	..	15.6	10.8	5.0	1.9
	(kg/ha)		..	7000	4816	2240	840
	(mg/kg)		..	3125	2150	1000	375
Exchangeable Magnesium	(cmol+/kg)		..	2.4	1.7	1.2	0.60
	(kg/ha)		..	650	448	325	168
	(mg/kg)		..	290	200	145	75
Exchangeable Potassium	(cmol+/kg)		..	0.60	0.50	0.40	0.30
	(kg/ha)		..	526	426	336	224
	(mg/kg)		..	235	190	150	100
Exchangeable Sodium	(cmol+/kg)		..	0.3	0.26	0.22	0.11
	(kg/ha)		..	155	134	113	57
	(mg/kg)		..	69	60	51	25
Exchangeable Aluminium	(cmol+/kg)	**Inhouse S37 (KCl)	..	0.6	0.5	0.4	0.2
	(kg/ha)		..	121	101	73	30
	(mg/kg)		..	54	45	32	14
Exchangeable Hydrogen	(cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	..	0.6	0.5	0.4	0.2
	(kg/ha)		..	13	11	8	3
	(mg/kg)		..	6	5	4	2
Effective Cation Exchange Capacity (ECEC) (cmol+/kg)		**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	..	20.1	14.3	7.8	3.3
Calcium (%)		**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	..	77.6	75.7	65.6	57.4
Magnesium (%)			..	11.9	11.9	15.7	18.1
Potassium (%)			..	3.0	3.5	5.2	9.1
Sodium - ESP (%)			..	1.5	1.8	2.9	3.3
Aluminium (%)			..	6.0	7.1	10.5	12.1
Hydrogen (%)			..				
Calcium/Magnesium Ratio		**Calculation: Calcium / Magnesium (cmol+/kg)	..	6.5	6.4	4.2	3.2
Zinc (mg/kg)		Rayment & Lyons 2011 - 12A1 (DTPA)	..	6.0	5.0	4.0	3.0
Manganese (mg/kg)			..	25	22	18	15
Iron (mg/kg)			..	25	22	18	15
Copper (mg/kg)			..	2.4	2.0	1.6	1.2
Boron (mg/kg)		**Rayment & Lyons 2011 - 12C2 (Hot $CaCl_2$)	..	2.0	1.7	1.4	1.0
Silicon (mg/kg Si)		**Inhouse S11 (Hot CaCl2)	..	50	45	40	35
Total Carbon (%)		Inhouse S4a (LECO Trumac Analyser)	..	> 3.1	> 2.6	> 2.0	> 1.4
Total Nitrogen (%)			..	> 0.30	> 0.25	> 0.20	> 0.15
Carbon/Nitrogen Ratio		**Calculation: Total Carbon/Total Nitrogen	..	10–12	10–12	10–12	10–12
Chloride Estimate (equiv. mg/kg)		**Calculation: Electrical Conductivity x 640	..	..	..	..	..

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PO Box 633 WANGARATTA VIC 3676

		Sample 21	Heavy Soil	Medium Soil	Light Soil	Sandy Soil
	Sample ID:	LM0407T2J1 Site 7 - KR9				
	Depth:	20-30cm				
	Client:	Varley	Clay	Clay Loam	Loam	Loamy Sand
Parameter	**Method reference**	**N8431/21**	**Indicative guidelines - refer to Notes 6 and 8**			
Total Calcium (mg/kg)	Rayment & Lyons 2011 - 17C1 Aqua Regia	..	1000–10 000 Ca			
Total Magnesium (mg/kg)		..	500–5000 Mg			
Total Potassium (mg/kg)		..	200–2000 K			
Total Sodium (mg/kg)		..	100–500 Na			
Total Sulfur (mg/kg)		..	100–1000 S			
Total Phosphorus (mg/kg)		..	400–1500 P			
Total Zinc (mg/kg)		..	20–50 Zn			
Total Manganese (mg/kg)		..	200–2000 Mn			
Total Iron (mg/kg)		..	1000–50 000 Fe			
Total Copper (mg/kg)		..	20–50 Cu			
Total Boron (mg/kg)		..	2–50 B			
Total Silicon (mg/kg)		..	1000–3000 Si			
Total Aluminium (mg/kg)		..	2000–50 000 Al			
Total Molybdenum (mg/kg)		..	0.5–3.0 Mo			
Total Cobalt (mg/kg)		..	5–50 Co			
Total Selenium (mg/kg)		..	0.1–2.0 Se			
Total Cadmium (mg/kg)		..	<1 Cd			
Total Lead (mg/kg)		..	2–200 Pb			
Total Arsenic (mg/kg)		..	1–50 As			
Total Chromium (mg/kg)		..	5–1000 Cr			
Total Nickel (mg/kg)		..	5–500 Ni			
Total Mercury (mg/kg)		..	< 0.2 Hg			
Total Silver (mg/kg)		..	.. Ag			
Total Organic Carbon (%)	LECO Trumac Analyser - Inhouse S15b	1.00	< 0.5 (Very Low); 0.5–1.5 (Low); 1.5–2.5 (Medium); 2.5–5.0 (High); > 5.0 (Very High)			
Nitrate Nitrogen (mg/kg N)	**Inhouse S37 (2M KCl)	4.0	15	13	10	10
Ammonium Nitrogen (mg/kg N)		0.8	20	18	15	12
Field Texture Grade	**Field Texture	Medium Clay	10.0	8.0	8.0	7.0
Bulk Density (t/m3)	503.01	1.34	10.0	8.0	8.0	7.0

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. National Environmental Protection (Assessment of Site Contamination) Measure 2013,
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9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 $cmol_c/kg$ = 230 mg/kg Sodium, 390 mg/kg Potassium,
    122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
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Appendix B – Waste estimation

BEEFBAL is a spreadsheet model which is used to estimate the mass of waste produced by cattle feedlots. BEEFBAL performs a mass balance on the nitrogen, phosphorus, potassium and salt entering the feedlot system (in the forms of incoming cattle, feed and drinking water) to determine the masses of nutrients and salt in the manure and liquid waste produced by the feedlot. BEEFBAL uses the DAMP (digestibility approximation of manure production) dry matter digestibility method to determine the "as excreted" manure constituents, based on a wide range of possible ration ingredients and up to four cattle classes (e.g. Domestic, Mid-Fed, Long-Fed) based on dry matter digestibility theory (van Sliedregt et al. 2000).

A schematic diagram showing the various components of a feedlot system is shown in Figure 5. The BEEFBAL component is shown as Part A with Part B representing the MEDLI model. The following inputs are required for the BEEFBAL model:

- The market types fed. The market type (e.g. domestic, long-fed) influences entry and exit weights, daily feed intakes, daily gain, rations fed and SCU weighting.
- The cattle numbers for each market type. The proportion of total feedlot capacity assigned to each market type influences total manure production.
- Occupancy rate. Typical feedlot occupancy rates are entered to enable long-term average manure production to be calculated.
- Mortality rate. Mortality rates are typically very low in feedlots (<1.0%).
- Ration specifications. Diets are specified in terms of the ingredients used by the feedlot that are used to estimate key characteristics of the diet.
- Entry and exit weights. Cattle size influences digestive performance, and this is integrated into manure production data using entry and exit weights.
- Daily feed intake. The daily feed intake of the cattle is usually specified in kilograms of dry matter per head per day (kg DM/head/day) or kilograms of as fed per head per day.
- Water consumption of the cattle. Water quality of the drinking water at the feedlot. The salinity of drinking water influences the salt content of manure excreted by the cattle.

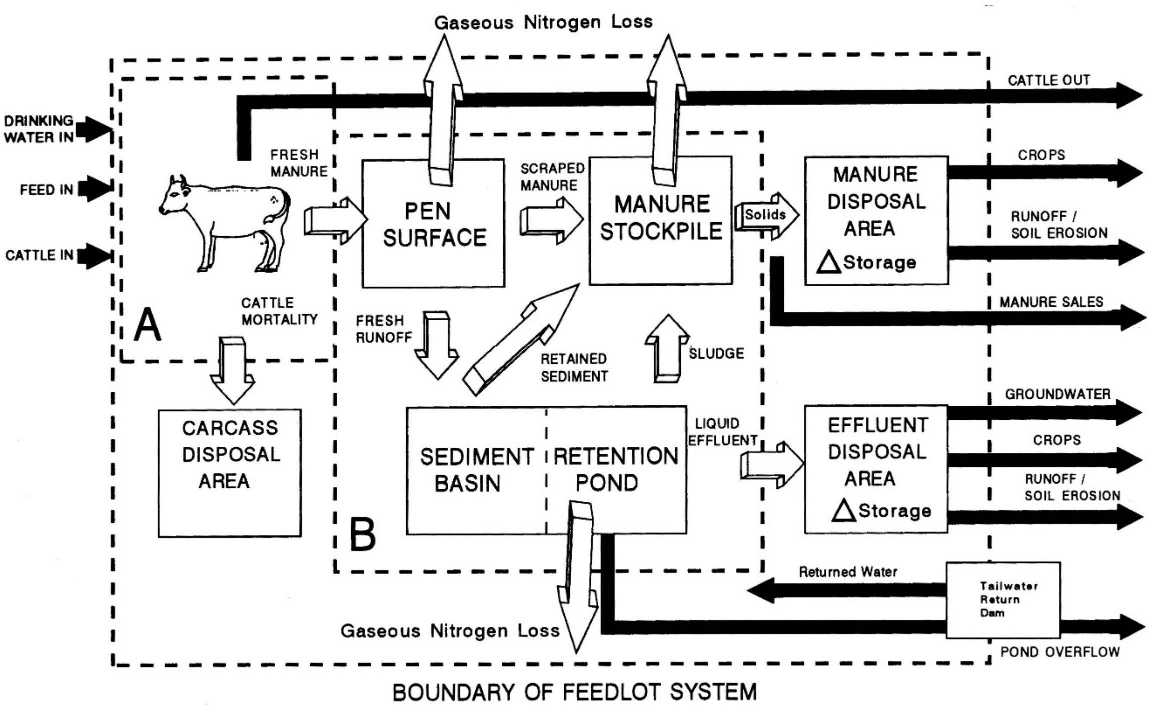


Figure 5 – Feedlot Whole-of-System Diagram (Watts et al., 1994)

B.2 Input data

The estimated market type composition of the proposed development is shown in Table 10. The market composition is based on existing markets, market growth and opportunities. However, the composition may change seasonally and from year to year depending on the previously mentioned factors.

Typical long-term occupancy rates for the existing development is in the order of 95% with mortalities being 0.81% expressed as a percentage of cattle in, to cattle out.

Table 10 – Proposed development – Estimated cattle throughput

Parameter	Units	Market type Mid Fed
Development capacity	Head	3,200
Entry weight	kg	280
Exit weight	kg	550
Nett gain	kg	270
Days on fed	Days	150
Occupancy	%	95
Mortality rate (No in/No out)	%	0.81
Market type percent in lot	%	100
Head-on-feed	No head per year	3040
Average daily gain	kg gain/head/day	1.8
Dry matter intake	kg DM/head/day	9.6

The diet composition and digestibility plays a major role in the mass of manure and nutrients contained in the liquid and solid wastes. For example a dry-rolled diet, which is high in protein, phosphorus and salt with low digestibility will produce more mass and nutrients in the manure when compared to a highly digestible diet containing steam flaked grain.

Rations are prepared on-site in a dedicated facility, with associated commodity storage, handling and ration delivery infrastructure. The grain shall be processed using dry rolling.

The ration contains grain, roughage (fibre), and minerals. Roughage is essential in the diet to enable normal rumen activity, and shall be provided by silage, hay or straw commodities. Commercial mineral/vitamin premixes shall be added to the ration. These may contain calcium, urea, sulphur, salt and various trace minerals and vitamins (or just the trace minerals and vitamins) required for achieving satisfactory growth rates.

Each market type is fed a different ration. A typical ration composition for each market type is outlined in Table 11. The percentage of each commodity within a ration is dependent on commodity availability and the buying price and therefore the composition often changes seasonally and from year to year.

Table 11 – Proposed development – Typical ration composition (As-fed)

			Starter	Grower	Finisher
Parameter	**Type**	**Units**	**Value**	**Value**	**Value**
Grain	Winter (barley/wheat)	%	43.0	51.0	62.5
Protein	Whole cottonseed	%	8.0	8.0	10.0
Roughage	Straw (barley/wheat)	%	6.0	6.0	0.0
	Almond hulls	%	14.0	14.0	11.0
	Hay (ryegrass)	%	14.0	6.0	0
Supplements	Minerals (dry)	%	3.0	4.0	5.5
Water	-	%	12.0	11.0	11.0

Appendix C – MEDLI Results

General Information

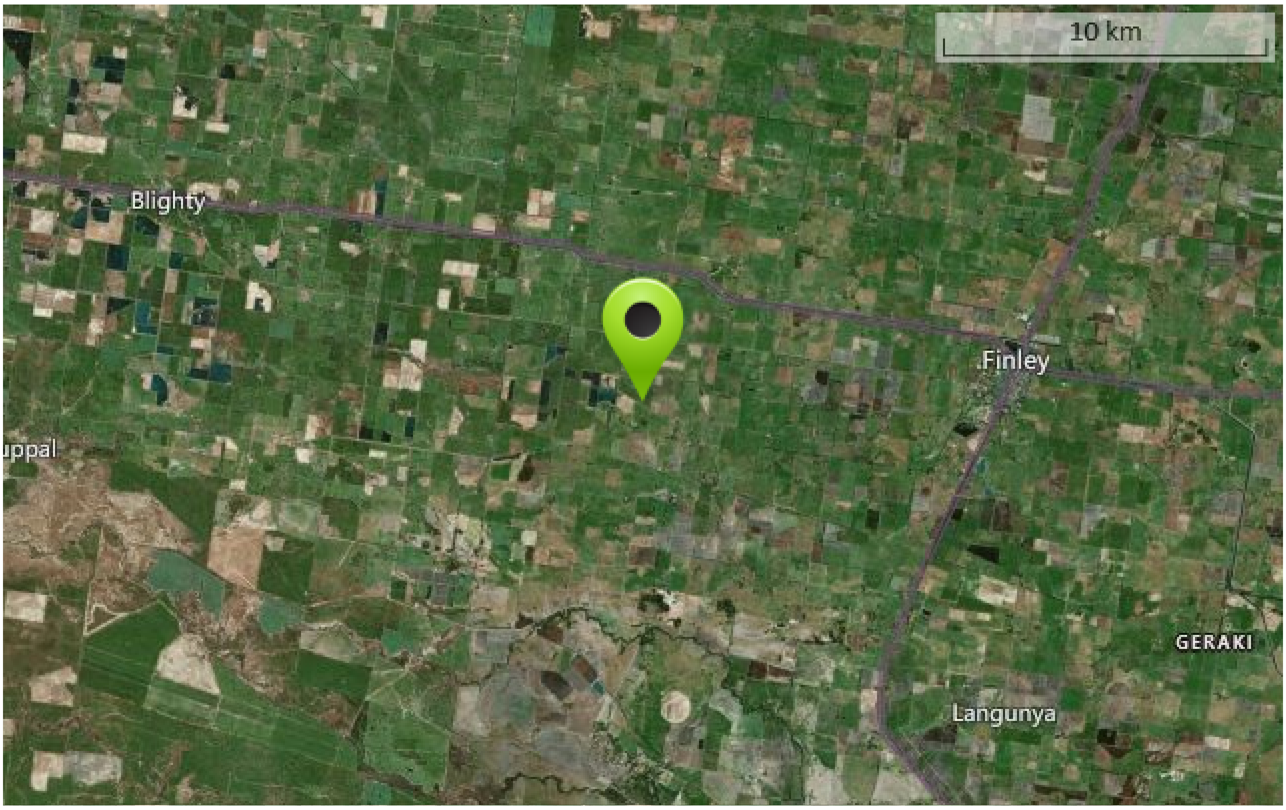
SCENARIO REPORT: Full run

General information
Enterprise: High Claire
Client: AJ and NA Varley
MEDLI user: RDC Engineers Pty Ltd

Description:
3200 head

Scenario details:
This feedlot has a number of areas that contribute runoff to a sedimentation basin which then flows into a holding pond. The runoff from each area is represented by particular wastestream type. The holding pond will need desludging and this takes place when the pond sludge exceeds 10% of the pond capacity. Since the flow is rainfall dependent, any vegetation will benefit from supplementary fresh water irrigation during the dry periods.

Map of location:
Note: If the map above appears as a dark box, check that the network is accessible and that the coordinates are not for a location in the ocean.



Description

Climate information

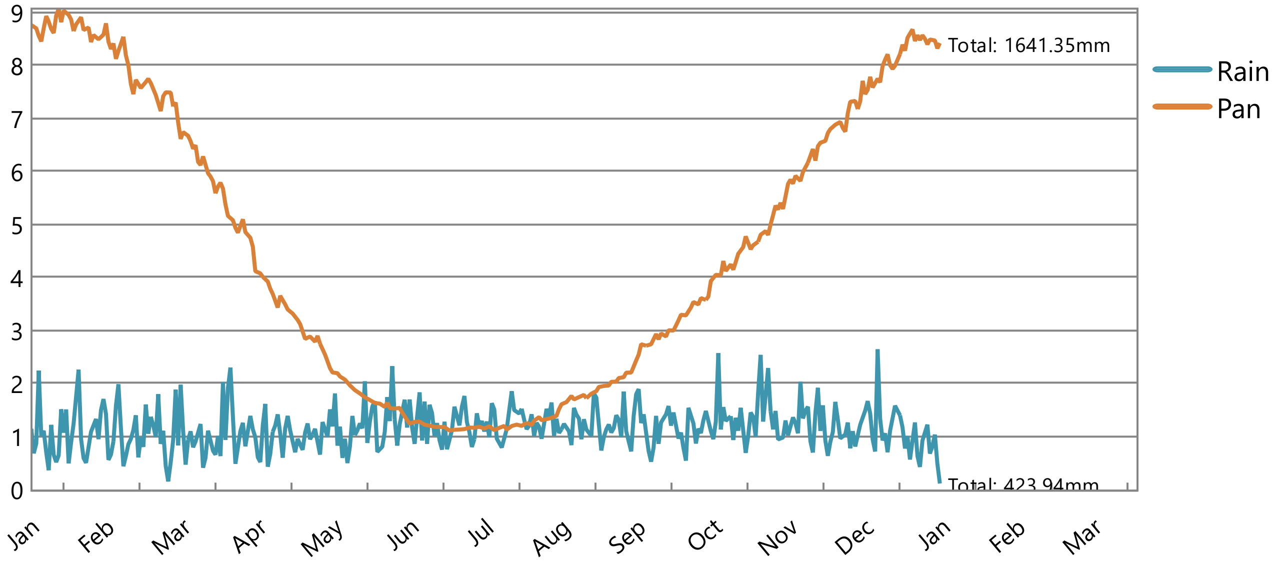
Climate Data Location: F3-107 AN Varley High Claire FL High Claire_-35.65_145.45, -35.65°, 145.45°
Run Period: 01/01/1924 to 31/12/2023 (100 years)

Climate statistics

	5th Percentile		50th Percentile		95th Percentile	
Rainfall (mm/year)	(Year 2019)	207.5	(Year 2021)	421.5	(Year 2010)	680.6
Pan evaporation (mm/year)	(Year 2023)	1438.0	(Year 1996)	1638.5	(Year 1982)	1819.5

Climate data

Daily average across run period:



Description

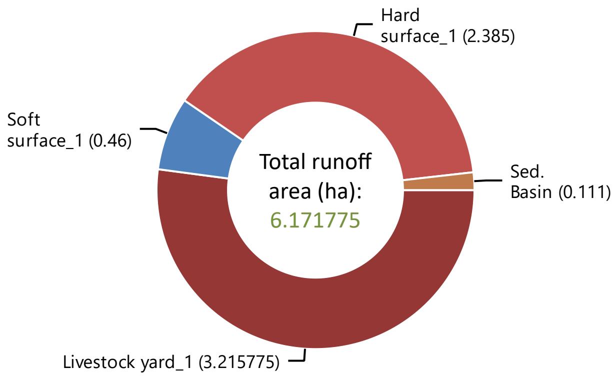
Livestock yard information

Enterprise Name: High Claire

Design of cattle feedlot

Name	Value
Maximum capacity (SCU)*	2427
Number of pens (pens)	17
Pen area (m2/pen)	1891.63
Stocking density (m2/SCU)	13.25
Working head (head)	3074
Calculated mortality rate (%)	1.00

*SCU - Standard Cattle Unit (kg/head) is 600



Herd details for each market type (before any mortalities)

	Mid Fed 150
Proportion of total SCUs (fraction)	1
SCU factor (factor)	0.75
Proportion of pens occupied (fraction)	0.95
Av. no. per occupied pen (head)	192.13
No. occupied pens (pens)	16
Working head (head)	3074
Entry weight (kg/head)	280
Exit weight (kg/head)	450
Daily weight gain (kg/head)	1.8

Raw manure production (tonnes/head/year)

	Mid Fed 150
Excreted nitrogen	0.0576
Excreted phosphorus	0.0074
Excreted salt	0.0031
Excreted volatile solids	0.614
Excreted total solids	0.911
Excreted water	5.161

Drinking Water Salinity (dS/m): 0.5

Drinking Water Used: 41525.33 m3/year or 18.01 m3/SCU/year

Manure management

Name	Value
Minimum number of days between cleaning events for a pen (days)	90
Pad depth above base after cleaning (mm)	25
Pad moisture content range suitable for pen cleaning (%g/g dry basis) (min - max)	20.00 - 120.00
Pad moisture content range suitable for pen cleaning (%g/g wet basis) (min - max)	16.67 - 54.55
Maximum number of pens cleaned in one day (pens)	10

Pad details (applies to both surface and subsurface layer)

Name	Value
Moisture content range (air dry to maximum) (%g/g dry basis)	7.00 - 190.00
Moisture content range (air dry to maximum) (%g/g wet basis)	6.54 - 65.52
Maximum percolation rate (mm/hour)	0.417

Description

Wastestream information

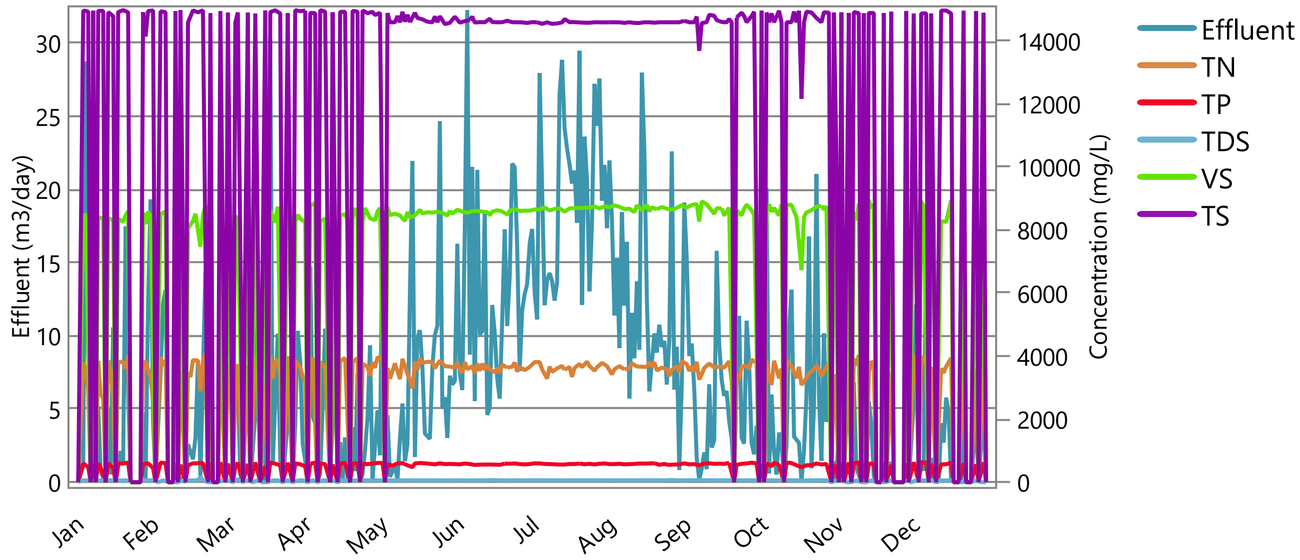
Wastestream Name: Waste estimation system - Livestock yard_1

Wastestream production description

Runoff from Livestock yard_1, a manure pad (impermeable) surface, with area 3.2158 ha with maximum capacity of 2427 SCU, 1.0000 % mortality, drinking water at 0.5000 dS/m salinity, and with 0.4000 (fraction) of total nitrogen in urine, and 0.6000 (fraction) of urine total nitrogen volatilised. Runoff quality assumes a nutrient enrichment ratio of 6.75 for total nitrogen, 5.40 for total phosphorus and 0.50 for salt. This wastestream is not separately pretreated. The sedimentation basin was used to treat the runoff.

Wastestream

Average Daily Quantity and Flow-Weighted Average Quality:



Wastestream (before sedimentation basin)

Effluent Quantity: 2490.19 m3/year or 6.82 m3/day (Min-Max 0.00 - 2971.66)

Flow-Weighted Average (Min - Max) Daily Effluent Quality:

	Concentration (mg/L)	Load (tonnes/year)
Total nitrogen	3655.10 (0.00 - 4154.65)	9.10 (0.00 - 34.30)
Total phosphorus	577.39 (0.00 - 648.60)	1.44 (0.00 - 5.47)
Total dissolved salts	59.54 (0.00 - 174.67)	0.15 (0.00 - 0.65)
Volatile solids	8625.21 (0.00 - 9010.30)	21.48 (0.00 - 93.11)
Total solids	14690.95 (0.00 - 14971.54)	36.58 (0.00 - 159.01)

Description

Wastestream information

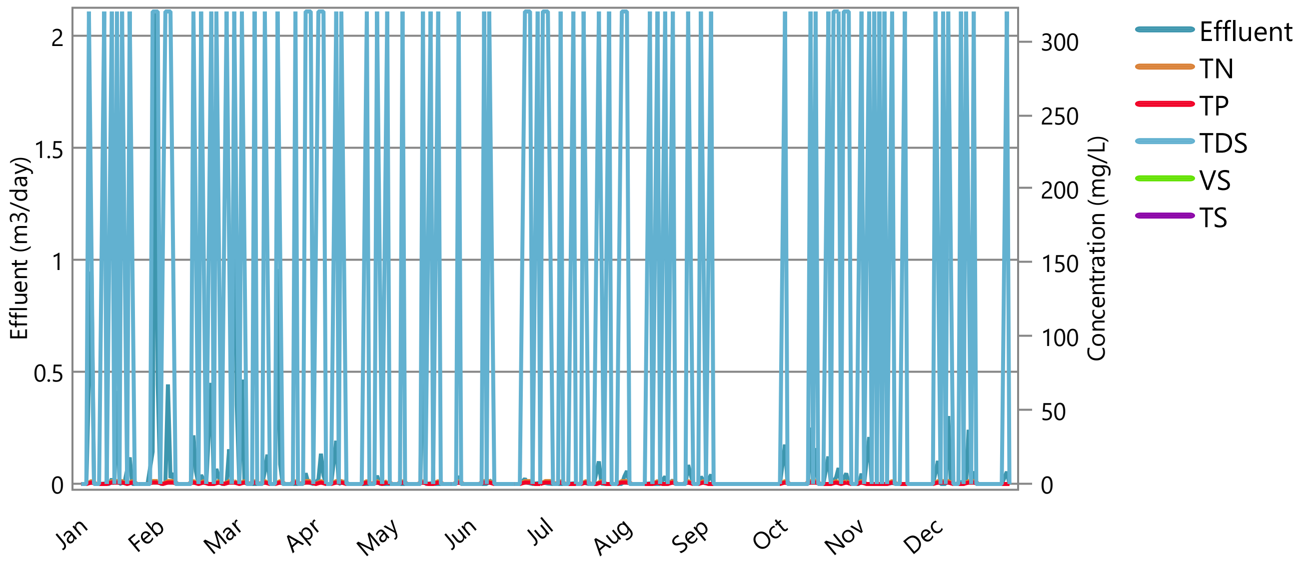
Wastestream Name: Waste estimation system - Soft surface_1

Wastestream production description

Runoff from Soft surface_1, a soft surface, with area 0.46 ha and assuming concentrations of 2.00 mg/L for total nitrogen, 1.00 mg/L for total phosphorus and 320.00 mg/L for total dissolved salt. This wastestream is not separately pretreated. The sedimentation basin was used to treat the runoff.

Wastestream

Average Daily Quantity and Flow-Weighted Average Quality:



Wastestream (before sedimentation basin)

Effluent Quantity: 14.24 m3/year or 0.04 m3/day (Min-Max 0.00 - 211.21)

Flow-Weighted Average (Min - Max) Daily Effluent Quality:

	Concentration (mg/L)	Load (tonnes/year)
Total nitrogen	2.00 (2.00 - 2.00)	0.00 (0.00 - 0.00)
Total phosphorus	1.00 (1.00 - 1.00)	0.00 (0.00 - 0.00)
Total dissolved salts	320.00 (320.00 - 320.00)	0.00 (0.00 - 0.09)
Volatile solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)

Description

Wastestream information

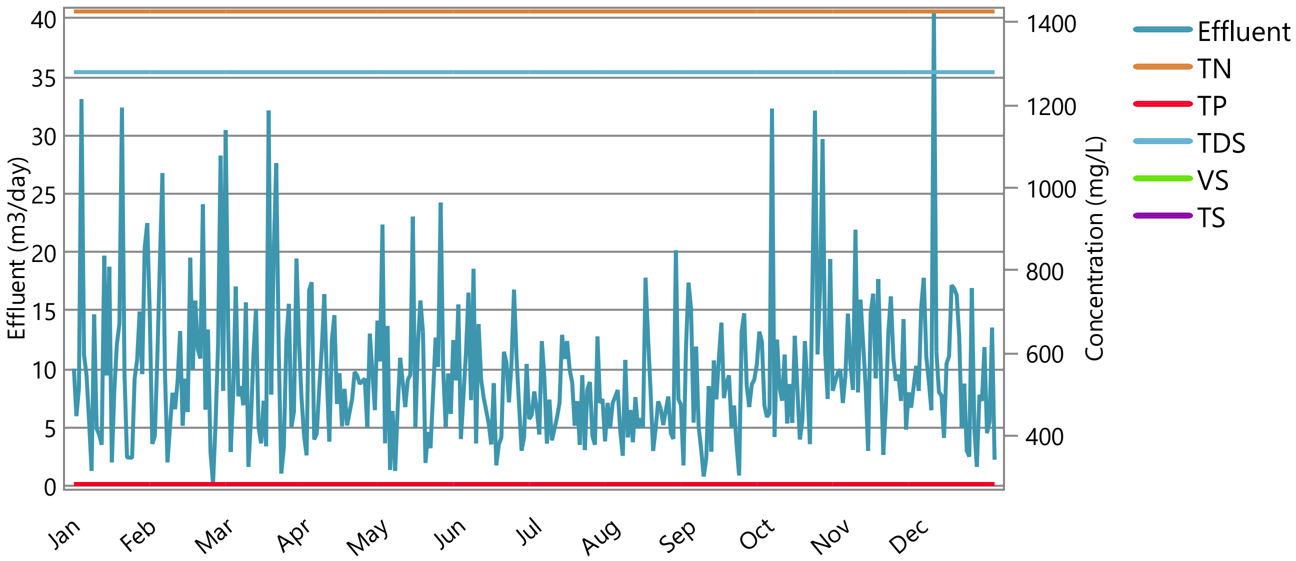
Wastestream Name: Waste estimation system - Hard surface_1

Wastestream production description

Runoff from Hard surface_1, a hard surface, with area 2.39 ha and assuming concentrations of 1427.00 mg/L for total nitrogen, 282.00 mg/L for total phosphorus and 1280.00 mg/L for total dissolved salt. This wastestream is not separately pretreated. The sedimentation basin was used to treat the runoff.

Wastestream

Average Daily Quantity and Flow-Weighted Average Quality:



Wastestream (before sedimentation basin)

Effluent Quantity: 3499.19 m3/year or 9.58 m3/day (Min-Max 0.00 - 2411.78)

Flow-Weighted Average (Min - Max) Daily Effluent Quality:

	Concentration (mg/L)	Load (tonnes/year)
Total nitrogen	1427.00 (1427.00 - 1427.00)	4.99 (1.24 - 13.95)
Total phosphorus	282.00 (282.00 - 282.00)	0.99 (0.24 - 2.76)
Total dissolved salts	1280.00 (1280.00 - 1280.00)	4.48 (1.11 - 12.52)
Volatile solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)

Description

Wastestream information

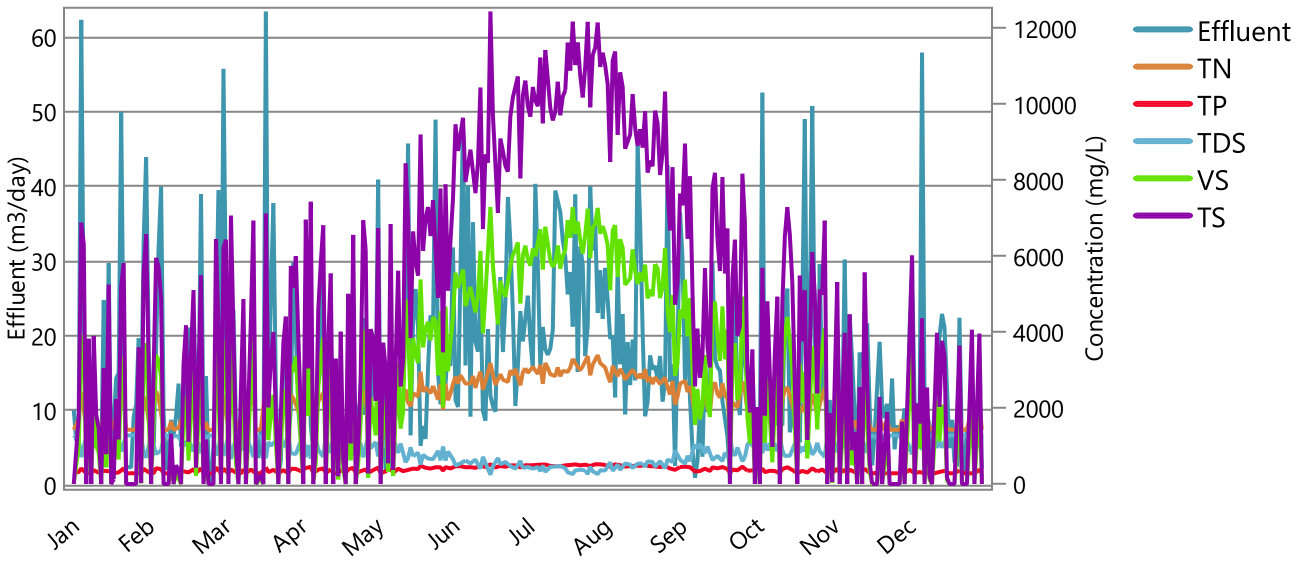
Combined Wastestream Name: High Claire - Waste estimation system

Wastestream production description

The enterprise Waste estimation system has a combined wastestream primarily consisting of flows from Livestock yard_1 and with additional flows from Soft surface_1, and Hard surface_1. This includes runoff from a total of 6.17 ha of land when including the sedimentation basin area.

Wastestream before sedimentation basin

Average Daily Quantity and Flow-Weighted Average Quality:



Sedimentation basin

The sedimentation basin was assumed to remove 0.25 (fraction) of total nitrogen, 0.10 (fraction) of total phosphorus, 0.60 (fraction) of volatile solids, and 0.60 (fraction) of total solids from the effluent. Rainfall runoff from the 0.11 ha basin also contributed on average an additional 10.19 m3 to the annual flow into the pond system.

Combined wastestream (after sedimentation basin)

Effluent Quantity: 6013.81 m3/year or 16.46 m3/day (Min-Max 0.00 - 5536.15)

Flow-Weighted Average (Min - Max) Daily Effluent Quality Entering the Pond System:

	Concentration (mg/L)	Load (tonnes/year)
Total nitrogen	1757.86 (0.00 - 3103.39)	10.57 (1.06 - 35.04)
Total phosphorus	362.85 (0.00 - 582.60)	2.18 (0.25 - 7.14)
Total dissolved salts	770.19 (0.00 - 1280.00)	4.63 (1.15 - 13.19)
Volatile solids	1428.60 (0.00 - 3567.21)	8.59 (0.00 - 37.24)
Total solids	2433.28 (0.00 - 5833.74)	14.63 (0.00 - 63.60)

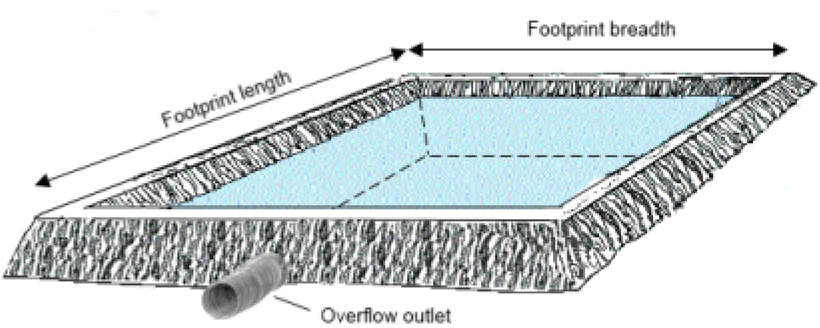
Description

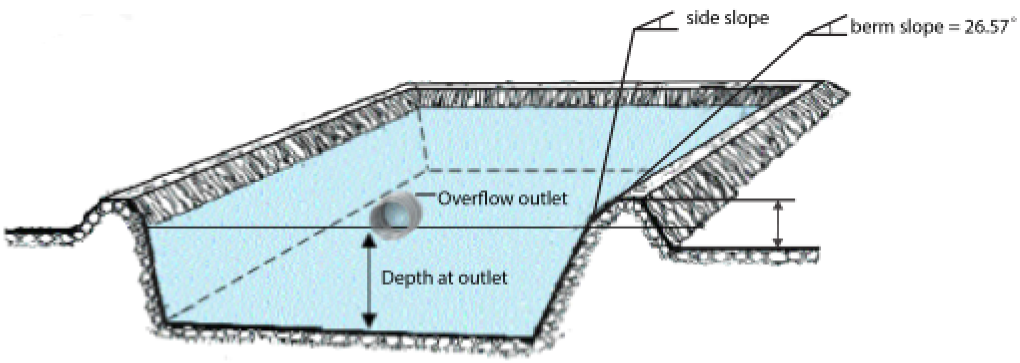
Pond system information

Pond System Configuration: 1 anaerobic pond

Pond system details

	Pond 1
Maximum pond volume (m3)	15000.00
Minimum allowable pond volume (m3)	390.66
Pond depth at overflow outlet (m)	1.15
Maximum water surface area (m2)	14052.05
Pond footprint length (m)	240.68
Pond footprint width (m)	62.87
Pond catchment area (m2)	15131.88
Average active volume (m3)	777.99





Irrigation pump limits

Minimum pump rate limit (ML/day)	0.00
Maximum pump rate limit (ML/day)	20.00

Shandying water

Annual allocation of fresh water available for shandying (m3/year)	100000.00
Maximum rate of application of fresh water (ML/day)	2.00
Nitrogen concentration (mg/L)	5.00
Salinity (dS/m)	0.10
Minimum shandy water is used	No

Description

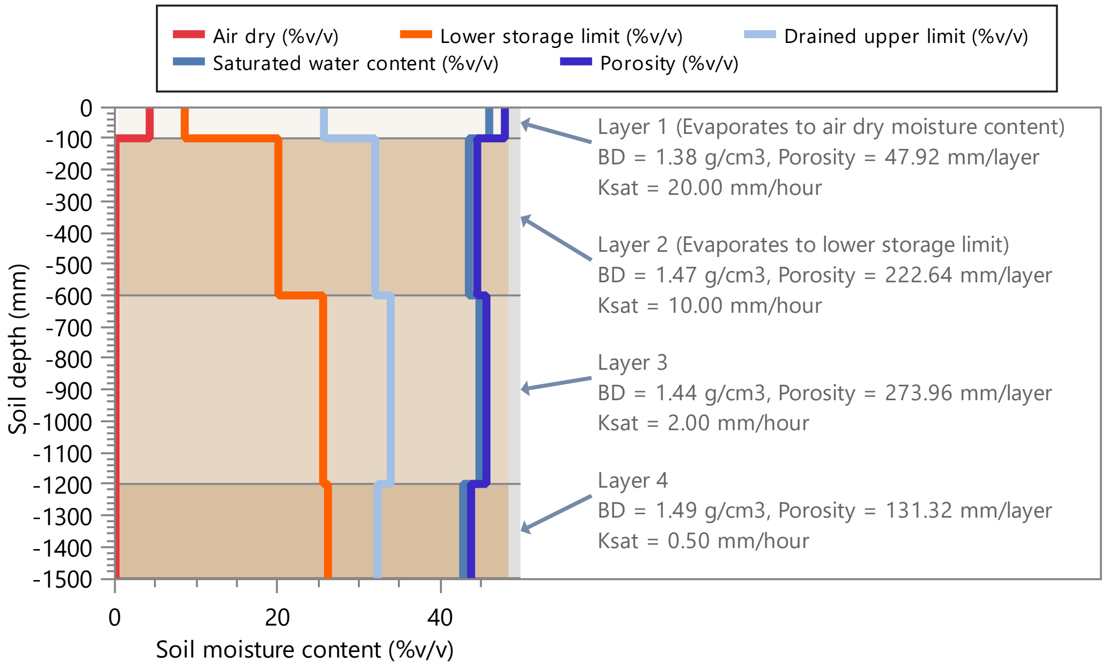
Paddock information

Paddock: Flood 1, 16 ha

Soil type: Red sodosol 1, 1500.00 mm defined profile depth

Profile porosity (mm)	675.85
Profile saturation water content (mm)	660.70
Profile drained upper limit (or field capacity) (mm)	486.00
Profile lower storage limit (or permanent wilting point) (mm)	341.30
Profile available water capacity (mm)	144.70
Profile limiting saturated hydraulic conductivity (mm/hour)	0.50
Surface saturated hydraulic conductivity (mm/hour)	20.00
Runoff curve number II (coefficient)	75.00
Soil evaporation U (mm)	10.00
Soil evaporation Cona (mm/sqrt day)	4.00

Profile



Planting regime: Rotated Forage maize crop | Barley crop

Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 0.8 | 0.9 x Pan coefficient 1 | 1)	0.80 | 0.90
Dead cover (if Mthly Covers) or Tot. cover left after harvest (fraction)	0.00 | 0.00
Potential rooting depth in defined soil profile (mm)	1500.00 | 1500.00
Salt tolerance	Moderately sensitive | Moderately tolerant
Salinity threshold (dS/m soil saturation extract)	1.80 | 6.00
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.07 | 0.07

Irrigation rules: Flood

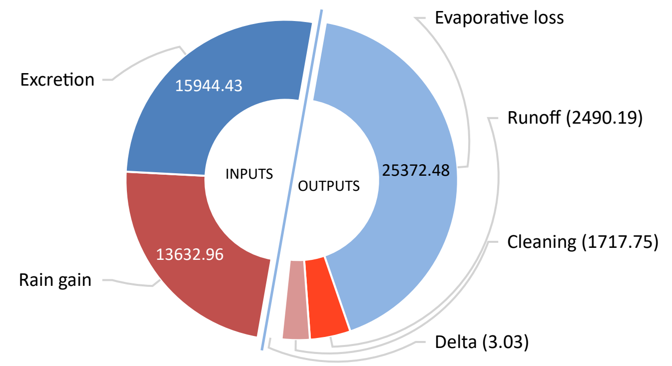
Rule 1. Irrigation triggered when soil water deficit reaches 20.00 mm and rainfall is less than or equal to 5.00 mm
Rule 2. Irrigate up to a soil water content of drained upper limit plus 0.00 mm
Rule 3. Irrigation window from 1/1 to 31/12 including the days specified
Rule 4. A minimum of 5 days must be skipped between irrigation events

Performance

Livestock yard information

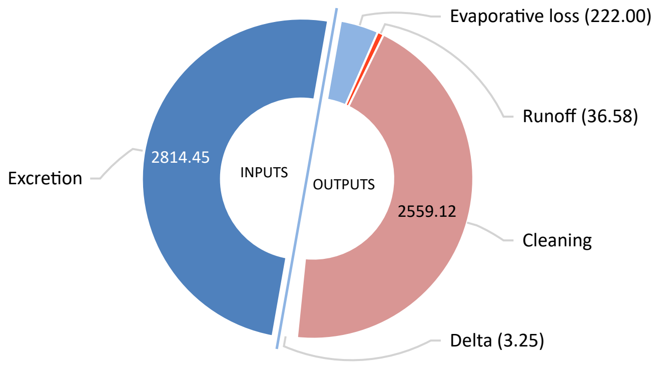
Enterprise Name: High Claire - Livestock yard_1

Yard water balance (tonnes/year)



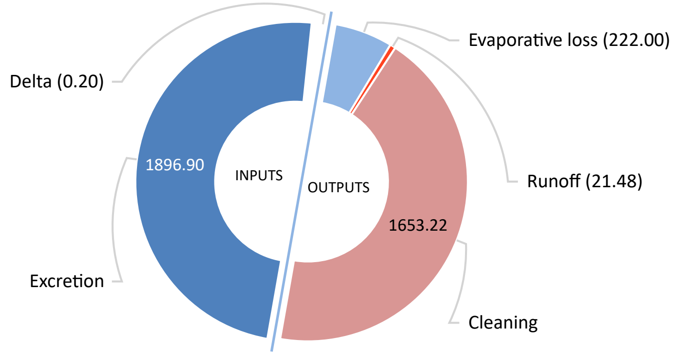
Name	Value
Rain gain	13632.96
Excretion	15944.43
Evaporative loss	25372.48
Runoff	2490.19
Cleaning	1717.75
Delta	3.03

Yard total solids balance (tonnes/year)



Name	Value
Excretion	2814.45
Evaporative loss	222.00
Runoff	36.58
Cleaning	2559.12
Delta	3.25

Yard volatile solids balance (tonnes/year)



Name	Value
Excretion	1896.90
Evaporative loss	222.00
Runoff	21.48
Cleaning	1653.22
Delta	-0.20

Pen cleaning: across the 17 -pen yard

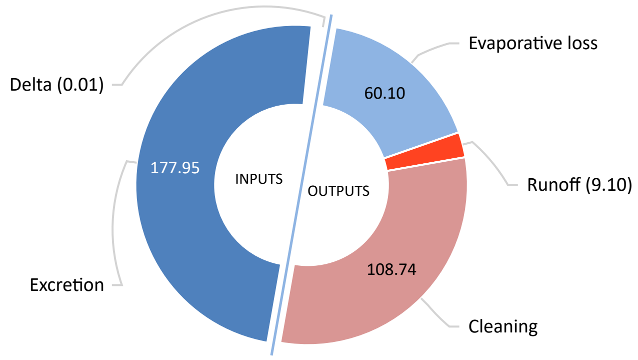
No. Days When At Least One Pen Was Cleaned: Over the simulation, at least one pen was cleaned on 1062 days over 100 years or 10.62 days/year.

Performance

Livestock yard information

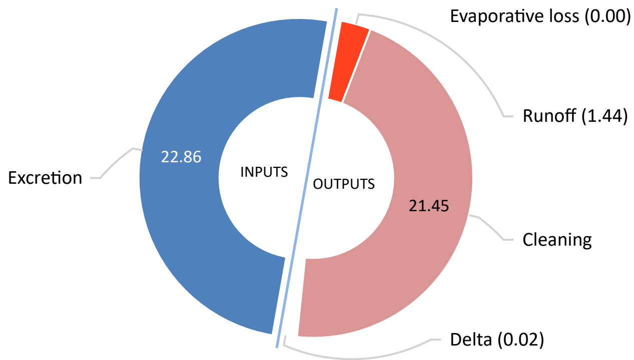
Enterprise Name: High Claire - Livestock yard_1

Yard total nitrogen balance (tonnes/year)



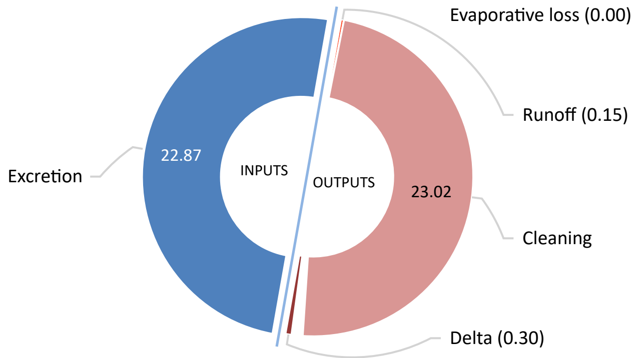
Name	Value
Excretion	177.95
Evaporative loss	60.10
Runoff	9.10
Cleaning	108.74
Delta	-0.01

Yard total phosphorus balance (tonnes/year)



Name	Value
Excretion	22.86
Evaporative loss	0.00
Runoff	1.44
Cleaning	21.45
Delta	0.02

Yard salts balance (tonnes/year)



Name	Value
Excretion	22.87
Evaporative loss	0.00
Runoff	0.15
Cleaning	23.02
Delta	0.30

Enrichment ratios used

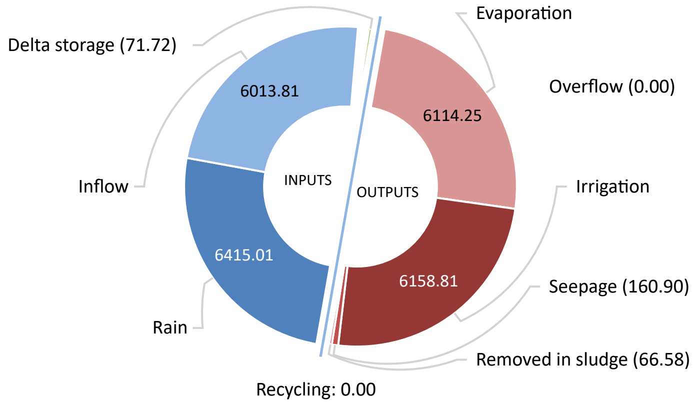
	Enrichment ratio
Total nitrogen	6.75
Total phosphorus	5.40
Salt	0.50

Performance

Pond system information

Pond System Configuration: 1 anaerobic pond (wet weather storage pond: 15000 m3)

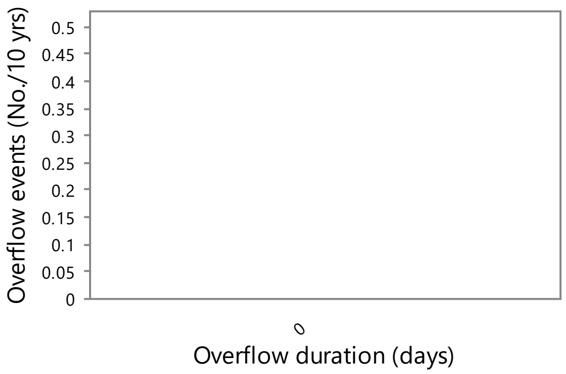
Pond system water balance (m3/year)

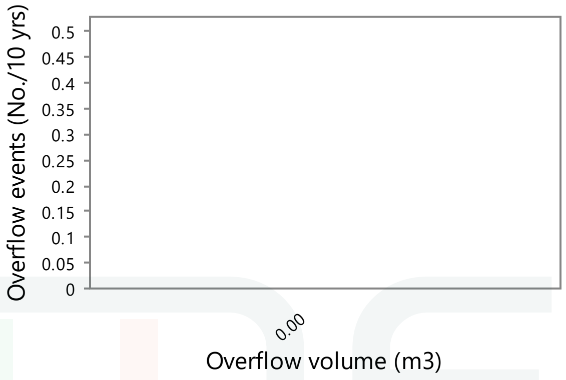


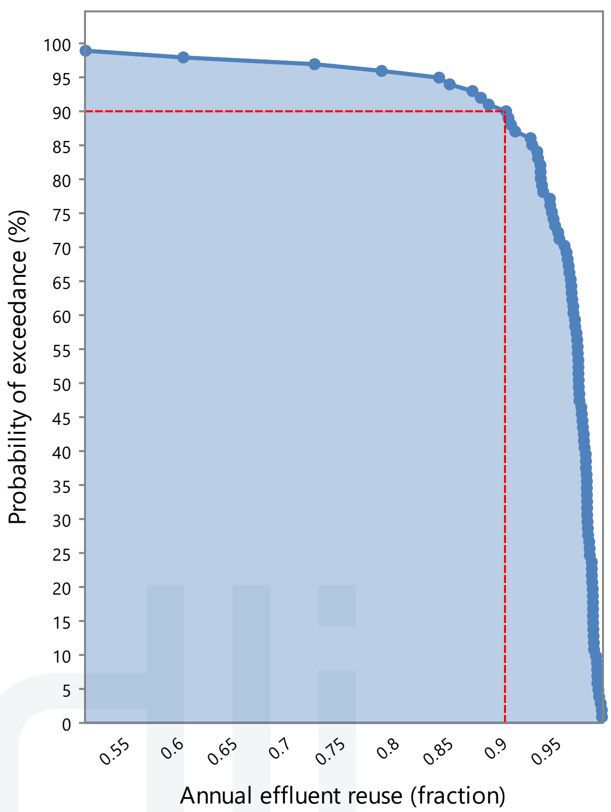
Name	Value
Rain	6415.01
Inflow	6013.81
Recycling	0.00
Evaporation	6114.25
Overflow	0.00
Irrigation	6158.81
Seepage	160.90
Removed in sludge	66.58
Delta storage	-71.72

Overflow and reuse diagnostics

Metric	Value
Total volume of overflow (m3/10 years)	0.00
Total number of overflow events (events/10 years)	0.00
Total number of pond overflow days (days/10 years)	0.00
Probability of at least 90% effluent reuse (%)	90.21
Effluent reuse (Proportion of inflow + net gain in rain that is irrigated) (fraction)	0.97





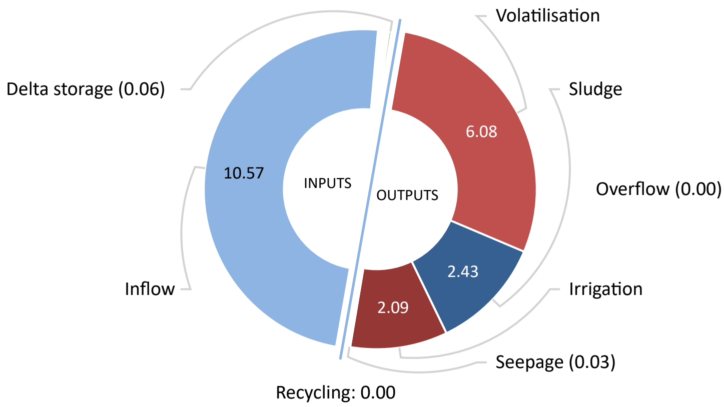


Performance

Pond system information

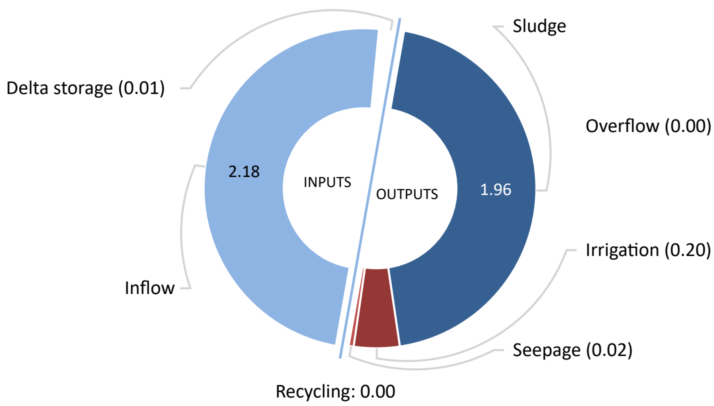
Pond System Configuration: 1 anaerobic pond

Pond system nitrogen balance (tonnes/year)



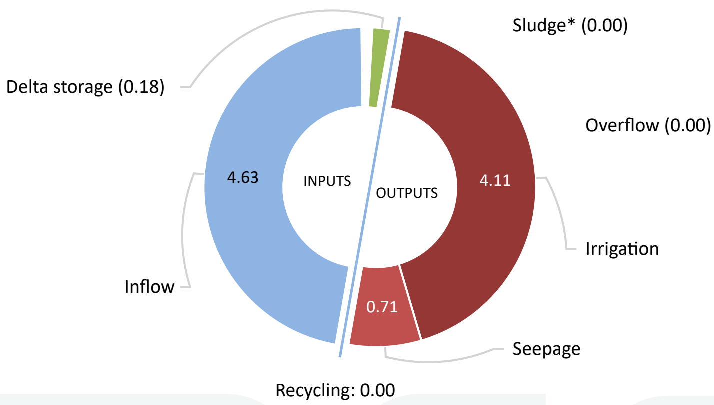
Name	Value
Inflow	10.57
Recycling	0.00
Volatilisation	6.08
Sludge	2.43
Overflow	0.00
Irrigation	2.09
Seepage	0.03
Delta storage	-0.06

Pond system phosphorus balance (tonnes/year)



Name	Value
Inflow	2.18
Recycling	0.00
Sludge	1.96
Overflow	0.00
Irrigation	0.20
Seepage	0.02
Delta storage	-0.01

Pond system salt balance (tonnes/year)



Name	Value
Inflow	4.63
Recycling	0.00
Sludge*	0.00
Overflow	0.00
Irrigation	4.11
Seepage	0.71
Delta storage	-0.18

* Salt removal in sludge is not calculated from the pond salt balance. However if salt could be assumed to be present in the sludge at the same concentration as in the pond supernatant (up to a maximum of salt added in inflow) - then salt accumulation in the sludge could be 0.03 tonnes/year

Pond system sludge accumulation: 40.61 tonnes dwt/year

Performance

Pond system information

Pond System Configuration: 1 anaerobic pond

Pond nutrient concentrations and salinity

Average across simulation period	Pond 1
Average nitrogen concentration of pond liquid (mg/L)	340.25
Average phosphorus concentration of pond liquid (mg/L)	40.47
Average salinity of pond liquid (dS/m)	1.35

Value on final day of simulation period	Pond 1
Final nitrogen concentration of pond liquid (mg/L)	195.71
Final phosphorus concentration of pond liquid (mg/L)	42.00
Final salinity of pond liquid (dS/m)	1.70

Performance

Water use (assumes 100% irrigation efficiency)

Metric	Value
Pond water irrigated (m3/year)	6158.81
Average shandy water irrigation (m3/year) (minimum - maximum)	85771.23 (38170.29 - 118000.00)
Total water irrigated (m3/year)	91930.04
Proportion of irrigation events requiring shandying (fraction of events)	0.99
Proportion of years shandying water allocation of 100000 m3/year is exceeded (fraction of years)	0.17
Average exceedance as a proportion of annual shandy water allocation (fraction of allocation) (minimum - maximum)	0.09 (0.00 - 0.18)

Irrigation quality

Metric	Value
Average nitrogen concentration of irrigation water - before ammonia loss during irrigation (mg/L)	27.38
Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)	25.79
Average phosphorus concentration of irrigation water (mg/L)	2.20
Average salinity of irrigation water (dS/m)	0.16

Irrigation diagnostics

Metric	Value
No. periods/year without any irrigable effluent in the wet weather storage pond (periods/year)	6.97
Average length of such periods (days)	36.77

Irrigation triggering and application

No. Days without Irrigation Applied per Year: 321.43 (with day below minimum time set between irrigations [219.11], water demand too small to trigger irrigation [90.70] and rain exceeding specified rainfall threshold [11.62])
No. Days without Irrigation Applied per Year: 321.43 (with not triggered)
No. Days with Irrigation Applied per Year: 43.82 (with supply limited - partial application [42.39] and full application [1.43])
No. Days with Irrigation Triggered per Year: 43.82

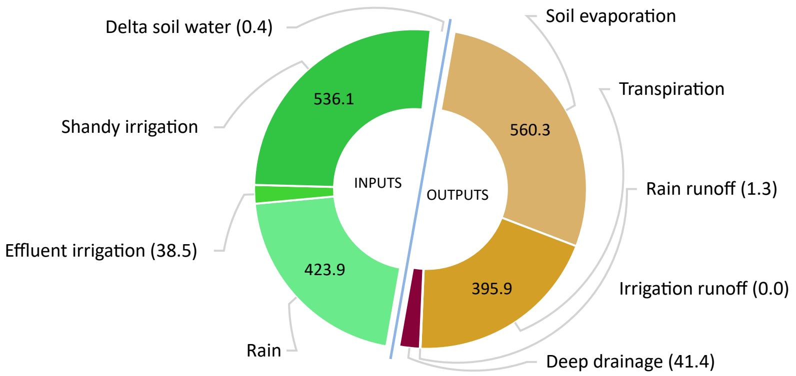
Performance

Paddock information

Paddock: Flood 1, 16 ha

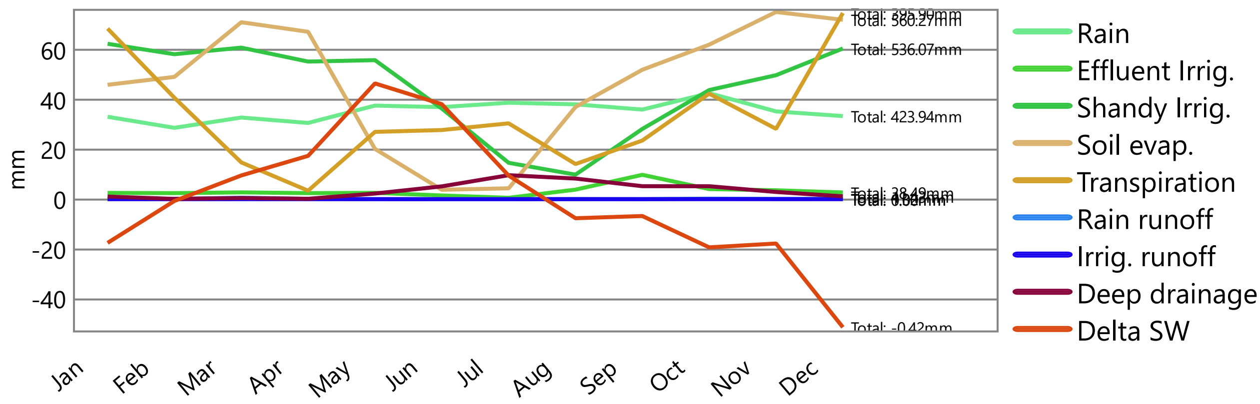
Soil Type: Red sodosol 1, 144.70 mm PAWC at maximum root depth

Soil water balance (mm/year)

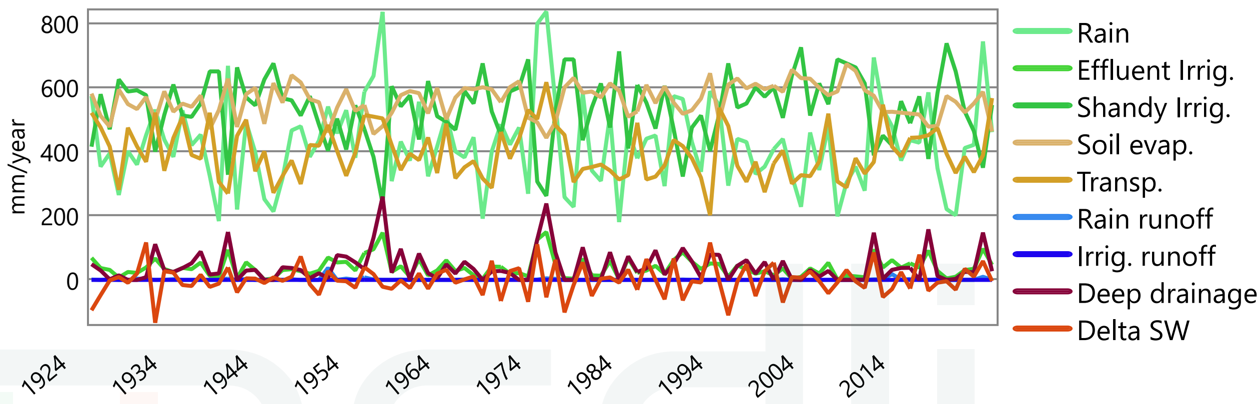


Name	Value
Rain	423.9
Effluent irrigation	38.5
Shandy irrigation	536.1
Soil evaporation	560.3
Transpiration	395.9
Rain runoff	1.3
Irrigation runoff	0.0
Deep drainage	41.4
Delta soil water	-0.4

Average monthly totals (mm)



Average annual totals (mm/year)



Performance

Paddock information

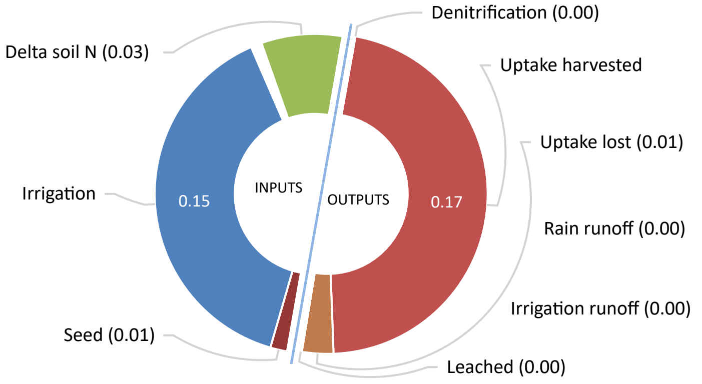
Paddock: Flood 1, 16 ha

Soil Type: Red sodosol 1

Irrigation Ammonia-N Volatilisation Losses (tonnes/ha/year): 0.01

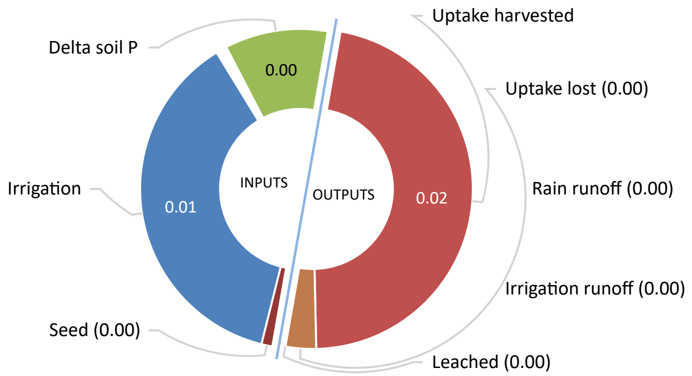
Proportion of Total Nitrogen in Irrigated Effluent as Ammonium (fraction): 0.58

Soil nitrogen balance (tonnes/ha/year)



Name	Value
Seed	0.01
Irrigation	0.15
Denitrification	4.15E-05
Uptake harvested	0.17
Uptake lost	0.01
Rain runoff	0.00
Irrigation runoff	0.00
Leached	7.21E-04
Delta soil N	-0.03

Soil phosphorus balance (tonnes/ha/year)



Name	Value
Seed	3.76E-04
Irrigation	0.01
Uptake harvested	0.02
Uptake lost	1.02E-03
Rain runoff	0.00
Irrigation runoff	0.00
Leached	5.79E-06
Delta soil P	-3.52E-03

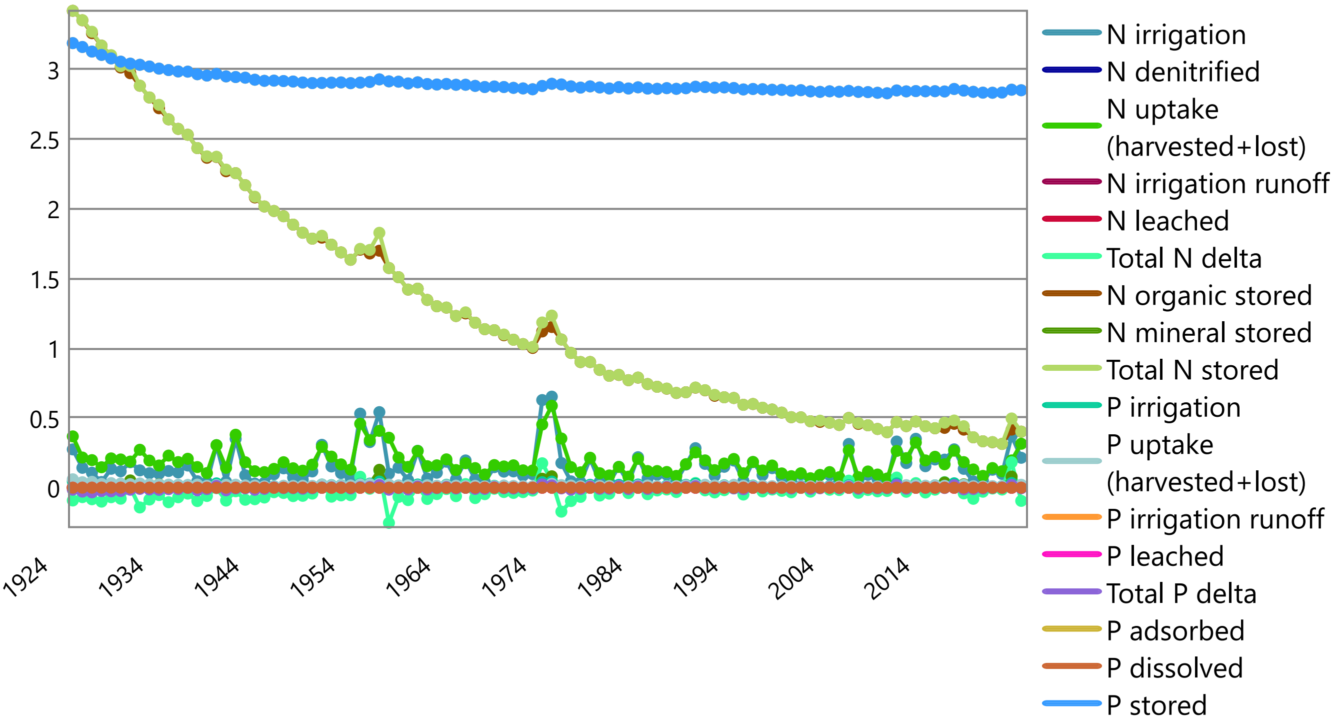
Performance

Paddock information

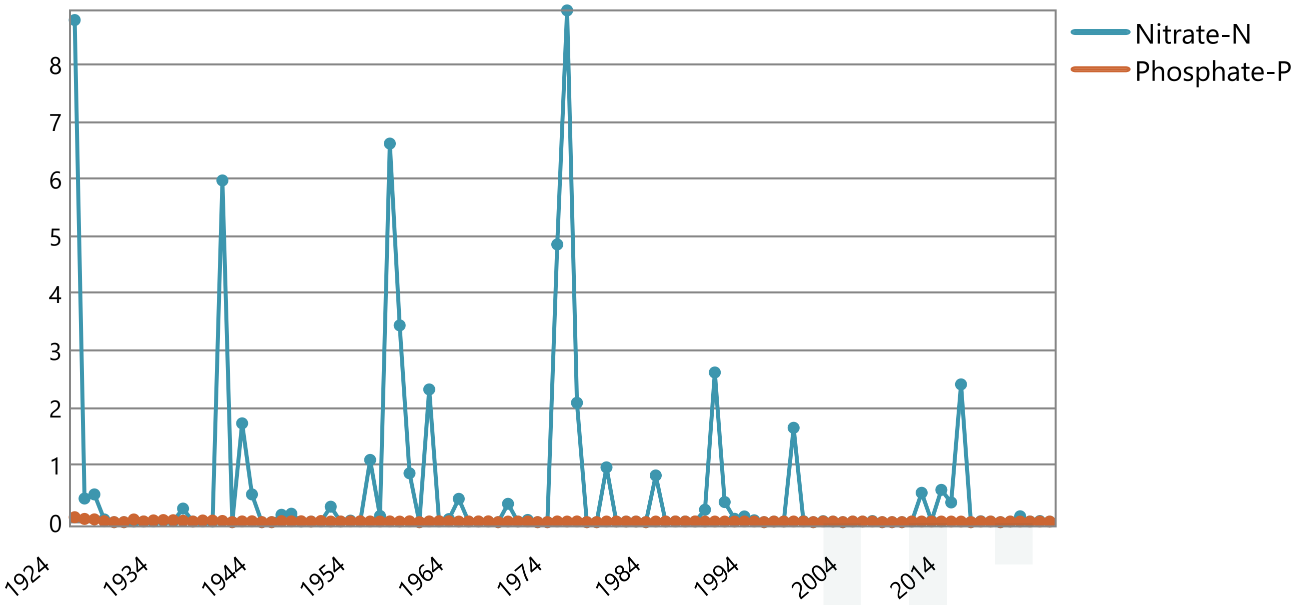
Paddock: Flood 1, 16 ha

Soil Type: Red sodosol 1

Annual nutrient totals (tonnes/ha)



Annual nutrient leaching concentration (mg/L)



Performance

Paddock information

Paddock: Flood 1, 16 ha
Soil Type: Red sodosol 1
Planting Regime: Rotated Forage maize crop & Barley crop

Plant growth (minimum - maximum)

Season one plant metrics	Value
Average annual shoot dry matter harvestable yield* (tonnes/ha/year)	7.29 (0.63 - 23.21)
Average annual shoot dry matter lost (tonnes/ha/year)	0.56 (0.07 - 1.38)
Average monthly plant (green) cover (fraction)	0.26 (0.00 - 0.74)
Average monthly root depth (mm)	591.09 (103.46 - 1372.29)

Season two plant metrics	Value
Average annual shoot dry matter harvestable yield* (tonnes/ha/year)	8.14 (3.69 - 18.30)
Average annual shoot dry matter lost (tonnes/ha/year)	0.38 (0.23 - 1.01)
Average monthly plant (green) cover (fraction)	0.61 (0.05 - 0.90)
Average monthly root depth (mm)	1119.97 (226.53 - 1500.00)

Plant nutrient uptake (minimum - maximum)

Season one plant metrics	Value
Average annual shoot nitrogen in harvestable yield* (tonnes/ha/year)	0.07 (0.00 - 0.32)
Average annual shoot nitrogen lost (tonnes/ha/year)	0.01 (0.00 - 0.02)
Average annual shoot phosphorus in harvestable yield* (tonnes/ha/year)	0.00 (0.00 - 0.03)
Average annual shoot phosphorus lost (tonnes/ha/year)	0.00 (0.00 - 0.00)
Average annual shoot nitrogen concentration (fraction dwt)	0.01 (0.01 - 0.03)
Average annual shoot phosphorus concentration (fraction dwt)	0.001 (0.000 - 0.002)

Season two plant metrics	Value
Average annual shoot nitrogen in harvestable yield* (tonnes/ha/year)	0.10 (0.03 - 0.26)
Average annual shoot nitrogen lost (tonnes/ha/year)	0.01 (0.00 - 0.02)
Average annual shoot phosphorus in harvestable yield* (tonnes/ha/year)	0.01 (0.00 - 0.04)
Average annual shoot phosphorus lost (tonnes/ha/year)	0.00 (0.00 - 0.00)
Average annual shoot nitrogen concentration (fraction dwt)	0.02 (0.01 - 0.03)
Average annual shoot phosphorus concentration (fraction dwt)	0.002 (0.001 - 0.003)

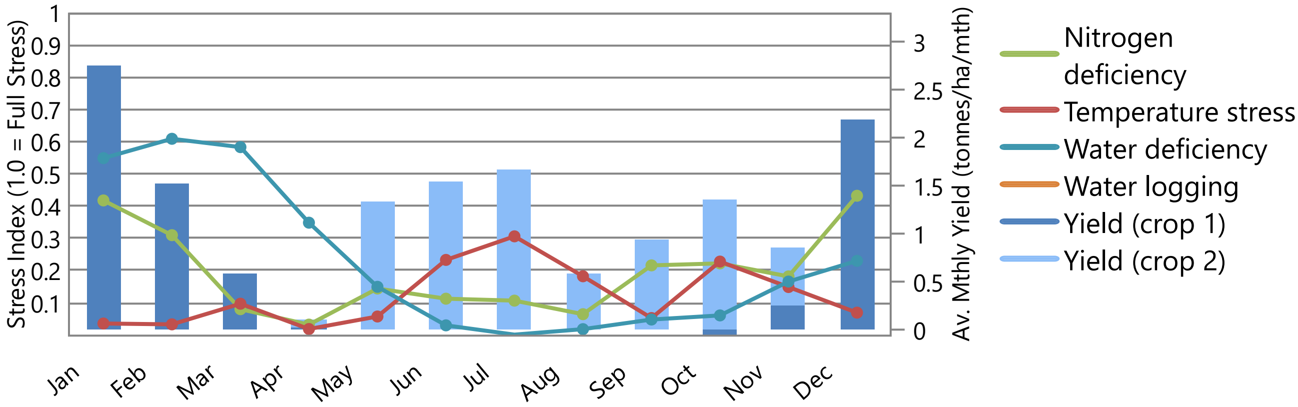
*Harvestable yield is a measure of *net* gain over a nominated period - say monthly. It is the total shoot-dry-matter gain minus any shot-dry-matter loss within a given period. Hence, just like financial investments, negative harvestable yields may occur when the (episodic) losses exceed the gains made within a particular accounting period.

Performance

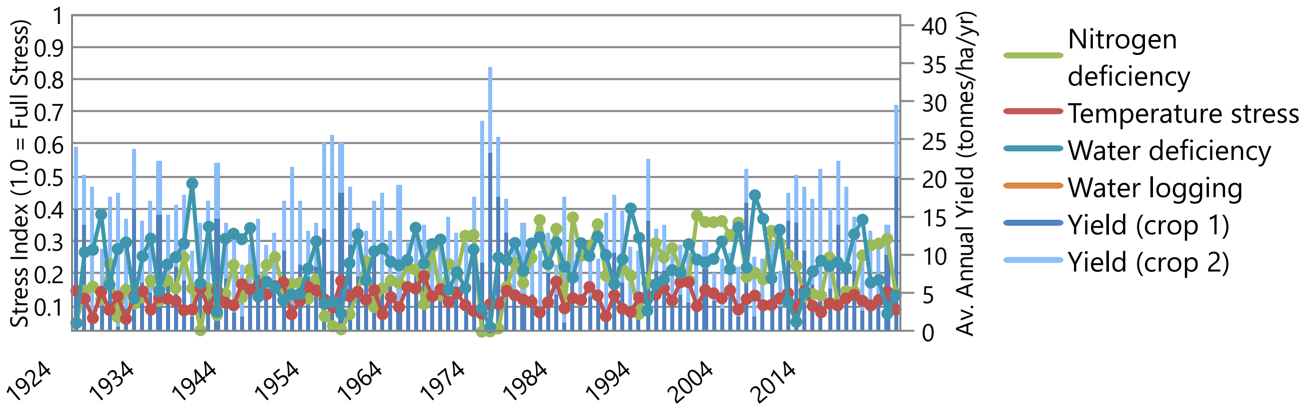
Paddock information

Paddock: Flood 1, 16 ha
Soil Type: Red sodosol 1
Planting Regime: Rotated Forage maize crop & Barley crop

Av. monthly stresses & harvestable yield* (tonnes/ha/month)



Av. annual stresses & harvestable yield* (tonnes/ha/year)



*Harvestable yield is a measure of *net* gain over a nominated period - say monthly. It is the total shoot-dry-matter gain minus any shot-dry-matter loss within a given period. Hence, just like financial investments, negative harvestable yields may occur when the (episodic) losses exceed the gains made within a particular accounting period.

Normal and forced harvest information

No. of Harvests per Year: 3.78 (normal), 0.39 (forced by crop death due to water stress [0.37] and nitrogen stress [0.02]).
No. Days without Crop per Year (no./year): 11.65 (due to water stress)

Performance

Paddock information

Paddock: Flood 1, 16 ha
Soil Type: Red sodosol 1
Planting Regime: Rotated Forage maize crop & Barley crop

Plant salinity tolerance

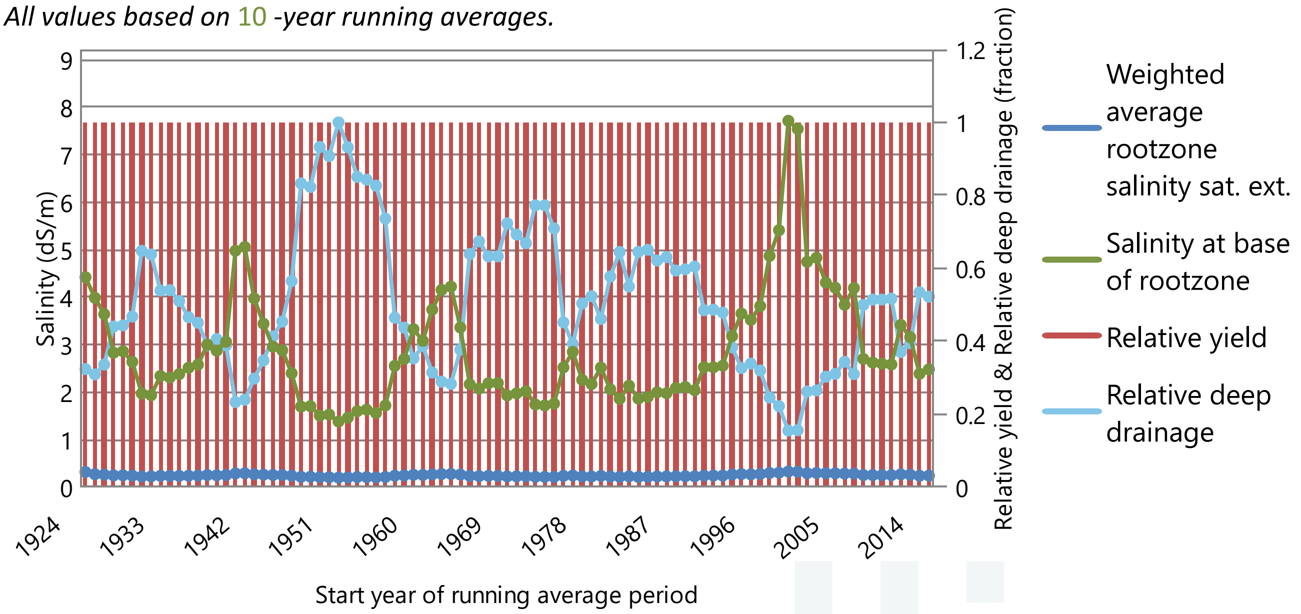
Metric	Value
Salt tolerance	Moderately sensitive | Moderately tolerant
Salinity threshold (dS/m soil saturation extract)	1.80 | 6.00
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.07 | 0.07
No. years assumed for leaching to reach steady-state (years)	10.00

Soil salinity

Metric	Value
Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.10
Salt added by rainfall (tonnes/ha/year)	0.08
Average annual salt added & leached at steady state (tonnes/ha/year)	0.68
Average leaching fraction based on 10 -year running averages (fraction)	0.19
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.25
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	2.88
Relative crop yield expected due to salinity (fraction)	1.00
Proportion of years that crop yields would be expected to fall below 90% of potential due to salinity (fraction)	0.00

Average annual rootzone salinity and relative yield

All values based on 10 -year running averages.

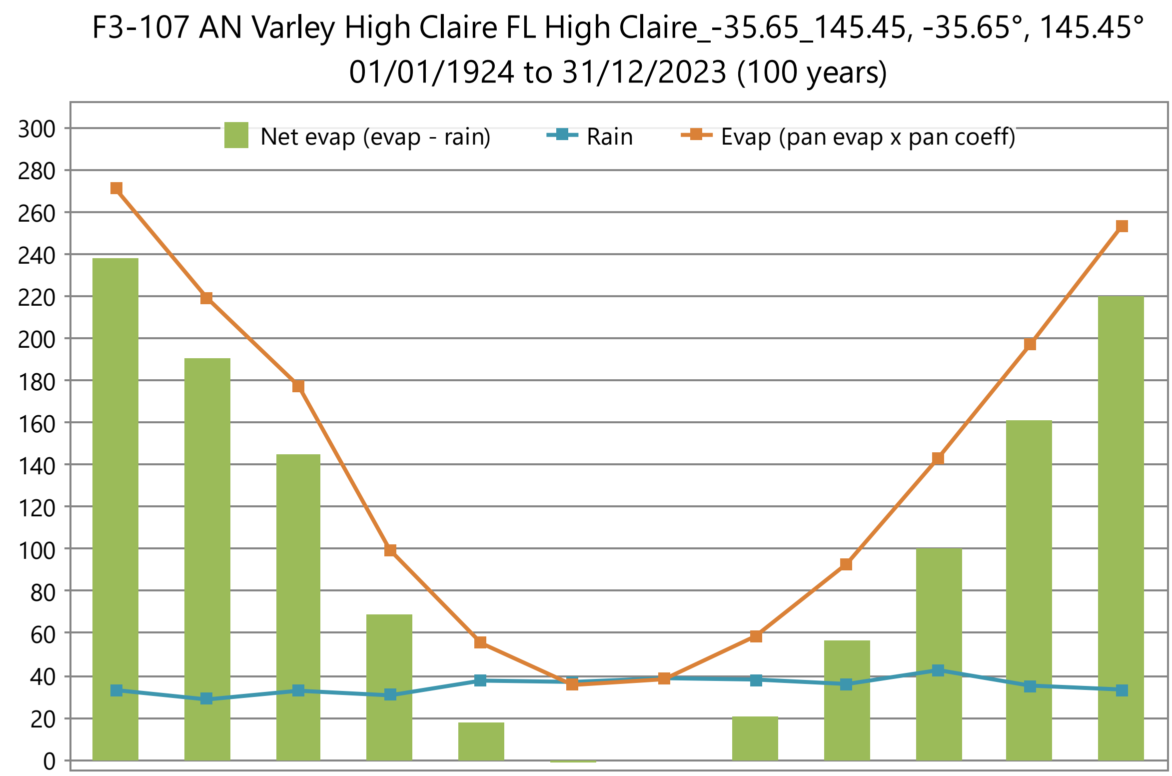


Diagnostics

Scenario information

Enterprise: High Claire

Climate long-term monthly averages (mm)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	33.1	28.7	32.8	30.6	37.6	37.0	38.8	38.1	36.0	42.6	35.3	33.4	423.9
Evap	270.9	219.1	177.5	99.6	55.3	35.6	38.3	58.7	93.1	143.3	196.8	252.9	1641.3
Net evap	237.8	190.5	144.7	69.0	17.7	-1.4	-0.5	20.6	57.1	100.8	161.5	219.5	1217.4
Net evap/day	7.7	6.7	4.7	2.3	0.6	0.0	0.0	0.7	1.9	3.3	5.4	7.1	3.3

Diagnostics

Enterprise name:

Enterprise Name: High Claire - Livestock yard_1 - 2306 SCU stocked - 1.001 % mortality

Key pad details

Name	Value
Pen pan factor for evaporation (at air dry MC - at max pugging MC)	0 - 1.2
Pad moisture content (at air dry MC - at max pad MC) (%g/g wet basis)	6.54 - 65.52
Bulk density (surface layer - subsurface layer) (g/cm3)	750 - 1000
Maximum percolation rate (mm/hour)	0.42
Baseline pad volatile solids decay rate (%pad VS/day)	0.15

Average pad manure composition

Component	Value	Powell (1994)	Sinclair (1994)
Dry matter content using wet basis (%g/g)	65.71	66	60
Water content using wet basis (%g/g)	34.29	34	40
Water content using dry basis (%g/g)	52.17	52	67
Total nitrogen content using dry basis (%g/g)	3.85	2.37	2.78
Total phosphorus content using dry basis (%g/g)	0.75	0.75	0.67
Salt content using dry basis (%g/g)	0.81	> 2.3	4.3

Note: The cattle used 41525.33 m3/year of drinking water, at a salinity of 0.50 dS/m. The output assumes 0.40 (fraction) of total nitrogen excreted is in the urine, of which 0.60 (fraction) volatilises.

Pen cleaning (tonnes/head/year)

Name	Value	Expected
Excreted manure (dry matter basis)	0.91	0.6 - 1.6
Manure removed in cleaning (dry matter basis)	0.83	0.41 - 1.05
Water removed in cleaning	0.56	0.02 - 0.3
Wet manure removed in cleaning	1.38	0.7 - 1.07

Pen cleaning operation - Average cleaning interval (min. - max.): 117.0 (91.0 - 271.0) days

Reasons for not cleaning pens	Fraction of non-cleaning days for Pen 1	Fraction of non-cleaning days for Yard
Insufficient buildup / too soon to clean	0.00 / 0.77	0.00 / 0.77
Pad too dry / too wet	0.08 / 0.15	0.08 / 0.14
Skipped as too many pens to clean	0.00	0.00

Average runoff quantity (m3/year) and quality (mg/L) from each surface defined.

Livestock Yard Enrichment Ratios Used: Total nitrogen 6.75 , Total phosphorus 5.4 , Salt 0.5

Area Names	Runoff	TS	VS	TN	TP	Salt
Livestock yard_1	2490.2	14690.9	8625.2	3655.1	577.4	59.5
Soft surface_1	14.2	0.0	0.0	2.0	1.0	320.0
Hard surface_1	3499.2	0.0	0.0	1427.0	282.0	1280.0

Mass lost in runoff as fraction of mass excreted

Runoff Expressed as a fraction of Rainfall, Yard: 0.18 , All Areas: 0.23

Area Names	TS	VS	TN	TP	Salt
Livestock yard	0.0	0.0	0.1	0.1	0.0
All defined areas	0.0	0.0	0.1	0.1	0.2

Diagnostics

Pond system information

Pond System Configuration: 1 anaerobic pond, desludging 4 times during the run according to the rule: "Maintain required active volume and desludge when sludge reaches 10% of pond volume"
Effluent Type: Waste estimation system - 6013.81 m3/year or 16.46 m3/day generated on average

Effluent entering pond system after any pretreatment and recycling

Average (Minimum-Maximum) influent quality calculated for 50.21 *non-zero flow days/year.*

Constituent	Concentration (mg/L)	Load (tonnes/year)
Total nitrogen	1757.86 (0.00 - 3103.39)	10.57 (1.06 - 35.04)
Total phosphorus	362.85 (0.00 - 582.60)	2.18 (0.25 - 7.14)
Total dissolved salts	770.19 (0.00 - 1280.00)	4.63 (1.15 - 13.19)
Volatile solids	1428.60 (0.00 - 3567.21)	8.59 (0.00 - 37.24)
Total solids	2433.28 (0.00 - 5833.74)	14.63 (0.00 - 63.60)

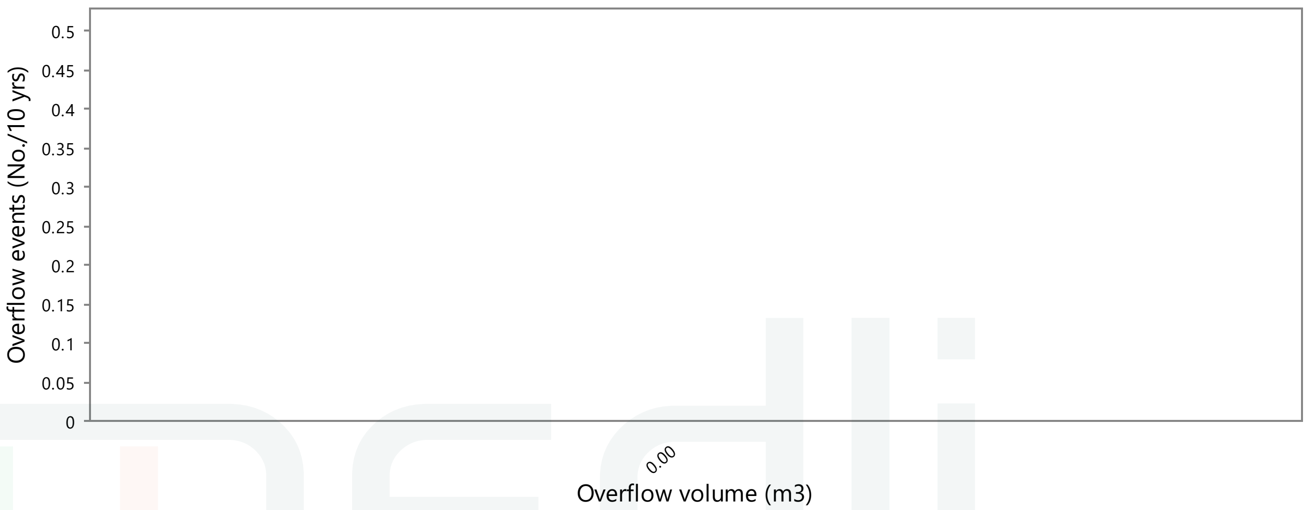
Ammonia-N loss from pond system water surface area: 0.05 tonnes/m2/year

Last pond (wet weather store): 15000.00 m3

Metric	Value
Theoretical hydraulic retention time (days)	911.03
Volume of overflow (m3/year) Average (minimum-maximum)	0.00 (0.00 - 0.00)
Volume of overflow per day (m3/day) Average (minimum-maximum)	0.00 (0.00 - 0.00)
No overflow days - Average per year (Total in run period)	0.00 (0)
No. overflow events per 10 years exceeding threshold of 10.000 m3* (events/10 years)	0.00
Average overflow event recurrence interval (years)	0.00
Average duration of overflow (days)	0.00
Probability of at least 90% effluent reuse (%)	90.21
Effluent reuse (proportion of inflow + net rain gain that is irrigated) (fraction)	0.97
Average salinity (dS/m)	1.35
Salinity on final day of simulation (dS/m)	1.70

* The overflow event is calculated as defined in WATBAL and based on the National Guidelines for Beef Cattle Feedlots in Australia

Volume distribution of the overflow events



Diagnostics

Scenario information

Area irrigated: 16 ha total area

Loading to whole irrigation area: (assuming 100% irrigation efficiency)

	Quantity/year	Quantity/ha/year
Total irrigation applied (m3)	91930.04	5745.63
Total nitrogen applied (tonnes)	2.37	0.15
Total phosphorus applied (tonnes)	0.20	0.01
Total salts applied (tonnes)	9.60	0.60

Shandying

Metric	Value
Annual allocation of fresh water for shandying (m3/year)	100000.00
Average shandy water irrigation (m3/year) (minimum - maximum)	85771.23 (38170.29 - 118000.00)
Average exceedance as a proportion of annual shandy water allocation (% of allocation) (minimum - maximum)	8.59 (0.00 - 18.00)
Minimum shandy water is used	No

Irrigation issues

Metric	Value
Number of days without irrigation (days/year)	321.43
Number of periods without irrigatable water (periods/year)	6.97
Average length of such periods (days)	36.77

Diagnostics

Paddock information

Paddock: - Flood 1, 16 ha

Irrigation: Flood with 0.1% ammonium loss during irrigation

Irrigation Rules
Irrigation triggered when soil water deficit reaches 20.00 mm and rainfall is less than or equal to 5.00 mm
Irrigate up to a soil water content of drained upper limit plus 0.00 mm
Irrigation window from 1/1 to 31/12 including the days specified
A minimum of 5 days must be skipped between irrigation events

Soil water balance (mm): Red sodosol 1, 144.70 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	33.1	28.7	32.8	30.6	37.6	37.0	38.8	38.1	36.0	42.6	35.3	33.4	423.9
Efflt. irrg.	2.5	2.4	2.7	2.4	2.5	1.5	0.5	3.8	9.8	4.0	3.6	2.7	38.5
Shdy. irrg.	62.4	58.3	60.9	55.3	55.9	36.4	14.6	9.8	28.2	43.9	49.8	60.6	536.1
Soil evap	46.0	49.1	71.1	67.3	20.2	3.8	4.4	37.0	52.0	62.1	75.2	72.1	560.3
Transpn.	68.6	40.7	14.8	3.4	27.0	27.8	30.5	14.1	23.6	42.4	28.3	74.8	395.9
Rain runoff	0.1	0.1	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	1.3
Irr. runoff	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Drainage	1.0	0.1	0.5	0.1	2.3	5.1	9.6	8.3	5.2	5.2	2.9	1.1	41.4
Delta SW	-17.6	-0.7	9.5	17.4	46.5	38.2	9.5	-7.7	-6.8	-19.4	-17.8	-51.5	-0.4

Soil nitrogen balance: (Concentrations are flow-weighted)

Metric	Value
Average annual nitrogen added in seed (tonnes/ha/year)	0.01
Average annual nitrogen added from irrigation (tonnes/ha/year)	0.15
Av. annual soil N removed by uptake (harvest + lost) (tonnes/ha/year)	0.18 (0.17, 0.01)
Av. annual soil nitrogen removed by denitrification (tonnes/ha/year)	4.15E-05
Average annual soil nitrogen leached (tonnes/ha/year)	7.21E-04
Average annual nitrate-N loading to groundwater (tonnes/ha/year)	7.21E-04
Soil organic-N tonnes/ha (Initial - Final)	3.46 - 0.40
Soil inorganic-N tonnes/ha (Initial - Final)	0.05 - 4.44E-05
Average nitrate-N concentration of deep drainage (Max annual concentration)	
Across all years (mg/L)	1.74 (8.94)
Excluding first year of data (mg/L)	1.66 (8.94)

Soil phosphorus balance: (Concentrations are flow-weighted)

Metric	Value
Average annual phosphorus added in seed (tonnes/ha/year)	3.76E-04
Average annual phosphorus added from irrigation (tonnes/ha/year)	0.01
Av. annual soil P removed by uptake (harvest + lost) (tonnes/ha/yr)	0.02 (0.02, 1.02E-03)
Average annual soil phosphorus leached (tonnes/ha/year)	5.79E-06
Dissolved phosphorus (tonnes/ha) (Initial - Final)	4.86E-04 - 4.44E-05
Adsorbed phosphorus (tonnes/ha) (Initial - Final)	3.20 - 2.85
Average phosphate-P concentration in rootzone (mg/L)	0.02
Average phosphate-P concentration of deep drainage (Max annual concentration)	
Across all years (mg/L)	0.01 (0.09)
Last year only (mg/L)	0.01 (N.D.*)
Design soil profile storage life based on average infiltrated water phosphorus concn. of 1.27 mg/L (years)	999.00

* Not determined

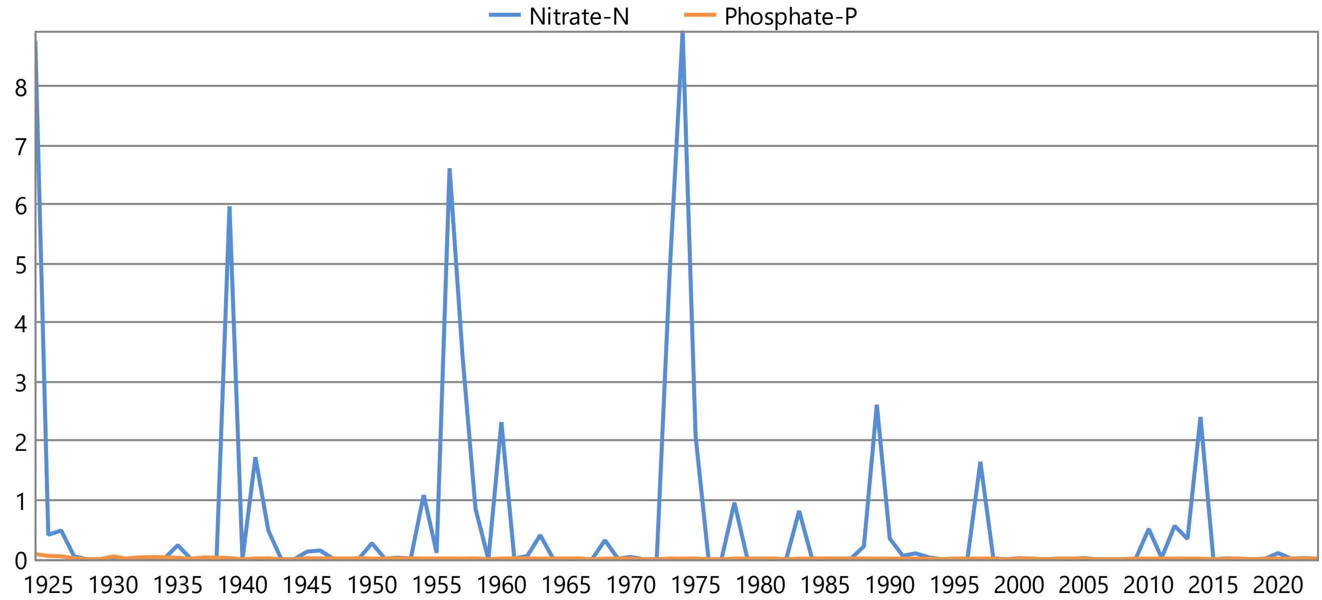
Diagnostics

Paddock information

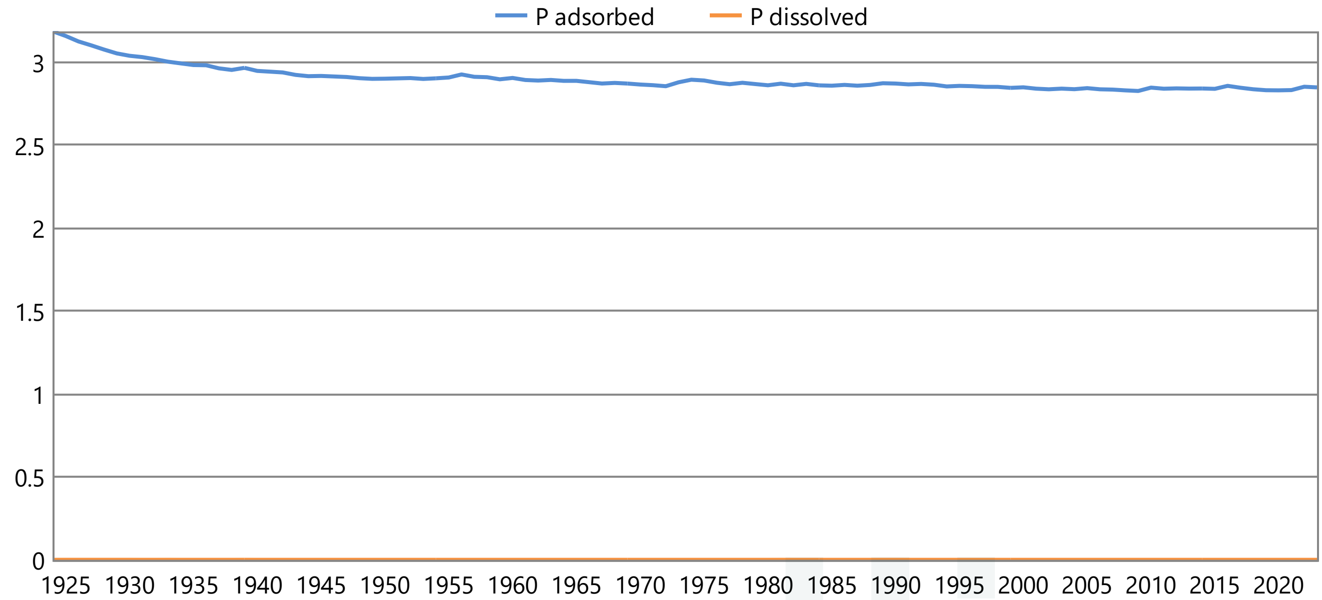
Paddock: Flood 1, 16 ha

Irrigation: Flood with 0.1% ammonium loss during irrigation

Annual nutrient leachate concentration (mg/L)



Annual phosphate-P in soil (tonnes/ha)



Diagnostics

Paddock information

Paddock: Flood 1, 16 ha

Planting Regime: Rotated Forage maize crop & Barley crop

Average plant performance (minimum - maximum)

Metric	Value
Average annual shoot dry matter harvestable yield (tonnes/ha/year)	15.43 (7.73 - 34.51)
Average annual shoot dry matter lost (tonnes/ha/year)	0.94 (0.42 - 1.77)
Average monthly plant (green) cover (fraction)	0.46 (0.06 - 0.90)
Average monthly crop factor (fraction)	0.40 (0.05 - 0.81)
Dead cover (if Mthly Covers) or Tot. cover left after harvest (fraction)	0.00 | 0.00
Average monthly root depth (mm)	896.21 (232.99 - 1481.80)
Average number of normal harvests per year (no./year)	3.78 (3.00 - 4.00)
Average number of normal harvests for last five years only (no./year)	3.80
Average number of forced harvests per year (no./year)	0.39 (0.00 - 2.00)
Average number of forced harvests for last five years only (no./year)	0.20
Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient)	0.19 (0.02 - 0.38)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.04 (0.00 - 0.11)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.31 (0.10 - 0.71)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.23 (0.00 - 0.61)
Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.00)
No. days without crop per year. Excludes bare fallow days (days)	11.65

Soil salinity - plant salinity tolerance: Moderately sensitive | Moderately tolerant

Assumes 1.0 dS/m Electrical Conductivity = 640 mg/L Total Dissolved Salts

All values based on 10 -year running averages.

Metric	Value
Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.10
Salt added by rainfall (tonnes/ha/year)	0.08
Average annual salt added & leached at steady state (tonnes/ha/year)	0.68
Average leaching fraction based on 10 -year running averages (fraction)	0.19
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.25
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	2.88
Relative crop yield expected due to salinity (fraction)	1.00
Proportion of years that crop yields would be expected to fall below 90% of potential due to salinity (fraction)	0.00

Diagnostics

Run information

Messages generated when the scenario was run
************************************** WASTESTREAM RESULTS **************************************
TABLE OF QUANTITY AND QUALITY OF EACH RUNOFF-BASED WASTESTREAM (AFTER PRETREATMENT AND BEFORE ENTERING ANY SEDIMENTATION BASIN)
____
Surface defined Runoff_m3/yr N conc_mg/L P conc_mg/L TDS conc_mg/L Area_ha Runoff_mm/yr Runoff as_%rainfall
Livestock yard_1* 2490.2 3655.1 577.4 59.5 3.2 77.4 18.3
Soft surface_1* 14.2 2.0 1.0 320.0 0.5 3.1 0.7
Hard surface_1* 3499.2 1427.0 282.0 1280.0 2.4 146.7 34.6
Combined runoff 6003.6 2347.8 403.9 771.5 6.1 99.1 23.4
____
* Wastestreams flowing into sedimentation basin
TABLE OF QUANTITY AND QUALITY OF MANURE AND ALSO EACH RAINFALL-INDEPENDENT WASTESTREAM (AFTER PRETREATMENT AND BEFORE ENTERING ANY SEDIMENTATION BASIN)
____
Source Volume_m3/yr N conc_mg/L P conc_mg/L TDS conc_mg/L N load_tonnes/yr P load_tonnes/yr TDS load_tonnes/yr
Manure removed from Livestock yard_1 4276.9 25425.9 5014.9 5381.4 108.7 21.4 23.0
____
(Dead carcasses removed from yard: 43.6 tonnes/yr) (Average moisture content of manure removed: 40.2 %g/g wet basis) * Wastestreams flowing into sedimentation basin
TABLE OF WASTESTREAM FLOWS TREATED BY 0.1 HA SEDIMENTATION BASIN:
____
Value defined Volume_m3/yr N load_tonnes/yr P load_tonnes/yr TDS load_tonnes/yr
Additions and Removals +10.2 -3.5 -0.2 -0.0
Post-Sedimentation Basin flow 6003.6 14.1 2.4 4.6
____
TABLE OF FINAL COMBINED WASTESTREAM COMPOSITION (EXCLUDING IMPACT OF RECYCLING)
____
Total flow Volume_m3/yr N conc_mg/L P conc_mg/L TDS conc_mg/L N load_tonnes/yr P load_tonnes/yr TDS load_tonnes/yr
Inflow to pond system 6013.8 1757.9 362.9 770.2 10.6 2.2 4.6
____
*************************************** END WASTESTREAM RESULTS ************************************
No. Days without Irrigation Applied per Year: 321.43 (with day below minimum time set between irrigations [219.11], water demand too small to trigger irrigation [90.70] and rain exceeding specified rainfall threshold [11.62])
UNCONDITIONAL FINISH