

Greenacres Caravan Park

Environmental Evaluation of Treated Effluent Application to Land



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Document Control



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EXECUTIVE SUMMARY

This report outlines the investigation conducted by Simmonds & Bristow into the option for the release of treated wastewater from the Sewage Treatment Plant (STP) at the Greenacres Caravan Park as required by the 'Notice to conduct or commission an environmental evaluation' (reference CA50774, COMP01252) issued by the Department of Environment and Science (DES) in October 2018.

The Department of Environment and Science is of the opinion that current activities of the release of treated effluent to waters has potential to cause environmental harm to receiving waters due to high levels of nutrients. This disposal method and the investigation into other disposal methods were undertaken. Effluent release to land is the most suitable disposal method for this site; sewer connection is not feasible.

Initial assessment of the climate and soil data for the proposed irrigation area found that the application of all the treated effluent to land was not sustainable for this location due to the limited land availability, effluent quality and the soil profile in the proposed irrigation area.

Therefore, a combination of land disposal during dry weather periods and disposal via the existing permitted released point to the Coolnwynpin creek in times of rainfall greater than 40mm or that cause over flow of the nominated wet weather storage tank is proposed.

This would reduce the requirement for the site to invest in significant wet weather storage, and reduce the load to the irrigation area to closer to the irrigation demand, rather than well above the irrigation demand.

Various MEDLI models were performed; with the use of 90KL wet weather storage, the potential effluent overflow releases that were modelled were significantly less in number of overflows per year than that of a desktop based water balance study, but with greater effluent volume as KL/Year modelled.

The MEDLI models performed overestimate the potential overflow releases, potential deep drainage on site (well below that modelled) and the potential nitrogen and phosphorus leaching within the proposed irrigation area.

The release to waters during wet weather to the Coolnwynpin creek system is expected to reduce the potential deep drainage on site (well below that modelled) and the potential nitrogen and phosphorus leaching within the proposed irrigation area.

The water balance conducted indicates that in a minimum rainfall year the release to the creek would be 2% of the total treated effluent produced and that the irrigation rate will be below the maximum allowable rate for the soil type in the proposed irrigation area when using the proposed combination of effluent disposal methods.

With the use of both effluent disposal to land and use of emergency release to waters during weather events is most suitable and applicable to Greenacres Caravan Park site.

Additionally, the Department of Environment and Science has requested that an investigation of the sites sewage treatment plant be conducted to assess the likelihood of improved nutrient removal being achieved.

Greenacres Caravan Park has been implementing several changes to their process to improve disinfection and reduce the nutrient concentrations in the STP final effluent including the following:

1. Changing chlorine tablets to avoid additional nitrogen being added to the final effluent as cyanurate
2. Conversion from tablet chlorination to liquid sodium hypochlorite dosing
3. Installation of baffles into the chlorine contact tank to prevent flow short circuiting and increase the contact time
4. Installation of a final effluent filter to reduce suspended solids and lower the chlorine demand
5. Installation of a pre-anoxic tank prior to the trickling filter to achieve further nitrogen removal.

Further changes, including refitting the trickling filter are underway to further improve effluent quality and improvements in disinfection, suspended solids and nitrogen removal is already evidenced in recent months of monitoring as a consequence of the progressive improvements implemented to the plant.



**Greenacres Caravan Park
Environmental Evaluation of
Treated Effluent Application to Land**

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1. INTRODUCTION

This report has been prepared for Greenacres Caravan Park by Simmonds & Bristow.

The purpose of this document is to investigate the options for the release of treated wastewater from the Sewage Treatment Plant (STP) at the Greenacres Caravan Park.

This investigation is a requirement of the 'Notice to conduct or commission an environmental evaluation' (reference CA50774, COMP01252) issued by the Department of Environment and Science (DES) in October 2018.

The scope of this investigation was to model the sustainable irrigation of wastewater from the sewage treatment plant to Lot 5 on RP 123875.

To do this a site suitability assessment, desktop assessment, and a MEDLI (Model for Effluent Disposal via Land Irrigation) model was performed.

The MEDLI model and desktop assessment was produced in accordance with the requirements outlined in the 'Environmental Evaluation Notice', with inputs based on;

- Actual wastewater quality and quantity produced by the sewage treatment plant at the premises;
- Proposed wet weather storage to be provided;
- The irrigation strategy, management and methods to be used;
- The available land area, soil characteristics in the irrigation area and crop type (grass or trees).

A site visit was conducted by Simmonds & Bristow on the 18th March, 2019, during which soil samples were collected and submitted to a NATA accredited laboratory for analysis.

Site observations, analysis and data from the STP were utilised to derive the model.

This document also addresses the concerns surrounding the final effluent water quality, and the improvements that are achieved through multiple changes to Greenacres Caravan Park STP process, including the improvement of disinfection and the reduction the nutrient concentrations in the STP final effluent.

A glossary of terms used throughout this report can be found on page 56.

2. THE SITE

2.1 Site description

Greenacres Caravan Park is situated at 508/520 Mount Cotton Rd, Sheldon and is within the Redland City Council local government area. The caravan park is on Lot 3/RP123875 and the proposed irrigation area investigated is located on Lot 5/RP123875 adjacent. The site is elevated from local drainage and creek lines, and according to Redlands Planning Scheme it is not a flood prone area.



Figure 1: Greenacres Caravan Park Site layout plan

2.2 Climate

An overview of yearly rainfall totals for Greenacres Caravan Park is provided in Figure 2. The rainfall data is based on the closest weather station to Greenacres Caravan Park, the Mount Cotton West (Station ID 040141).

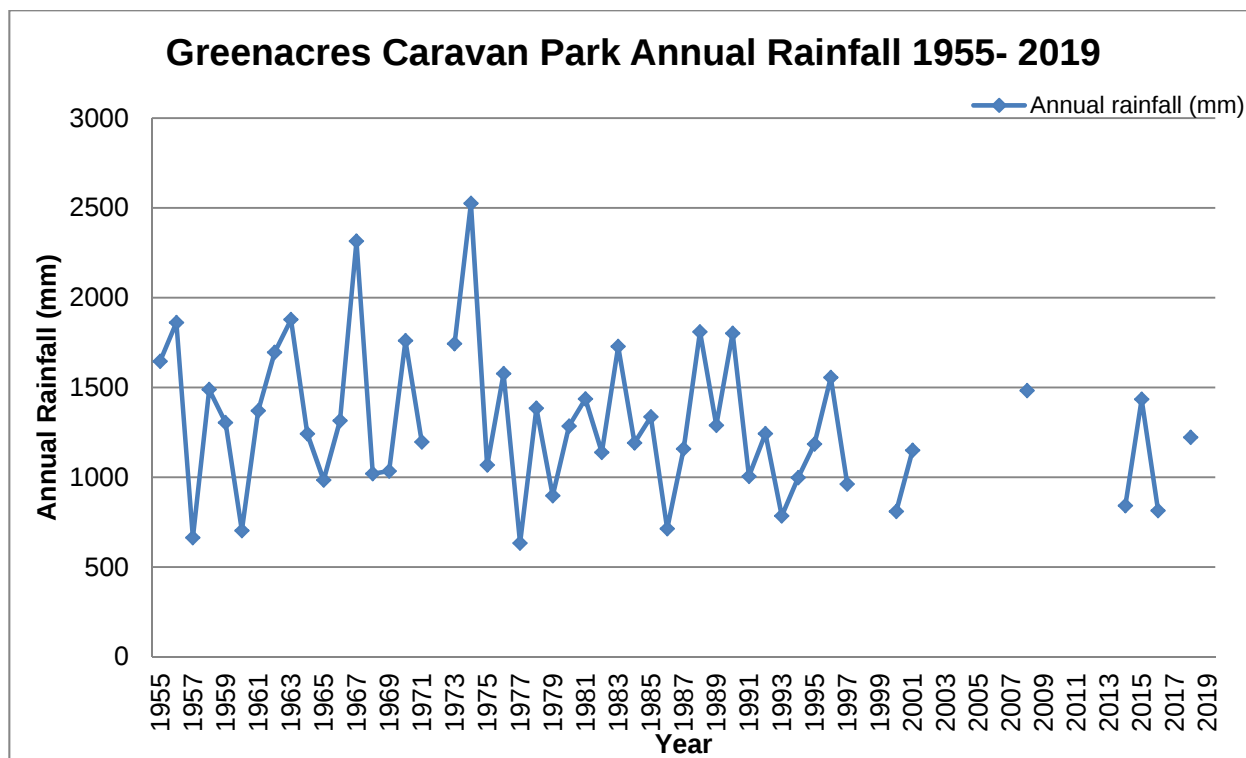


Figure 2: Greenacres Annual Rainfall

The rainfall data demonstrates the large variability in rainfall that occurs in the area, with the majority of rainfall falling during the wet season and beyond, between November and June, as shown in Figure 3.

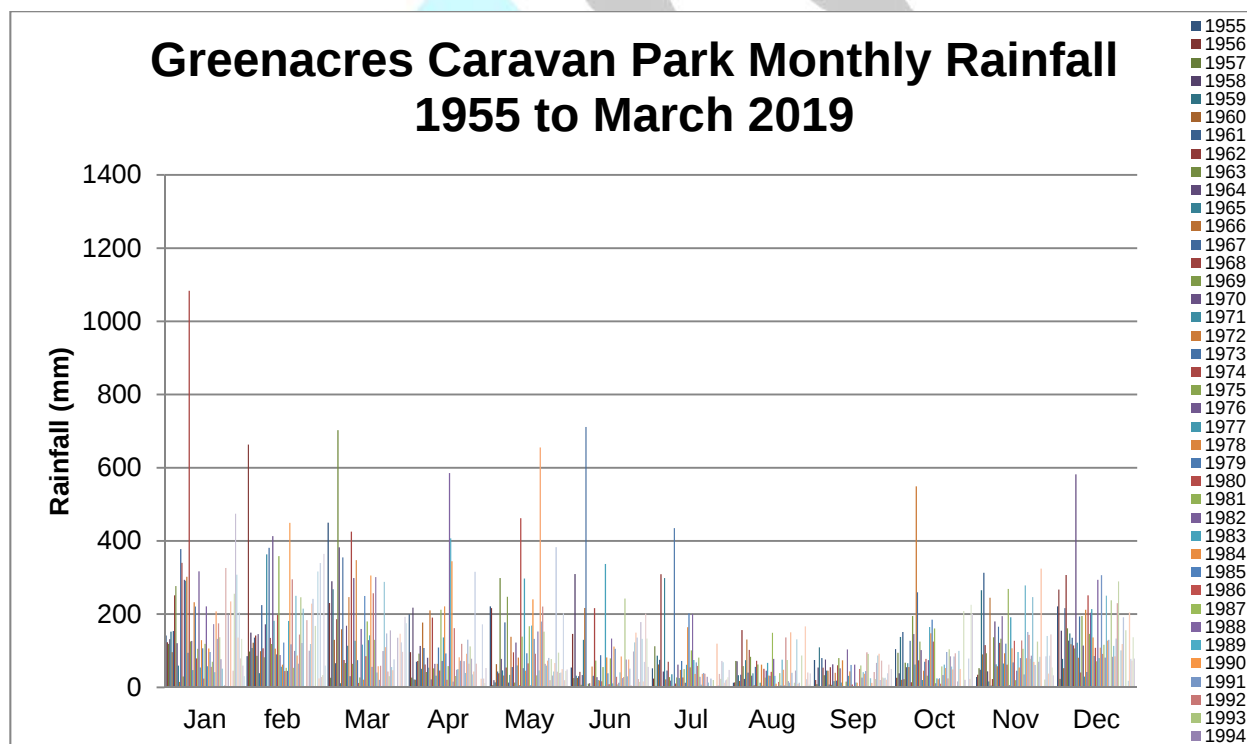


Figure 3: Greenacres Monthly rainfall

Annual rainfall totals for the region range from 633 mm (recorded in 1977) to 2525 mm (recorded in 1974) per year, with an annual median rainfall of 1242 mm per year (this is excluding 2019 data).

The current rainfall for this year to date is 265mm; rain collated from January to March 2019.

2.3 Australian Rainfall & Runoff (AR&R) Data Hub Information (Initial & Continuing Losses)

During periods of rainfall, prior to runoff (flow) occurring within the stream there is an initial loss of rainfall. This loss is mostly caused by;

- a) Interception by vegetation;
- b) Infiltration into the soil;
- c) Retention on the surface (depressions);
- d) Loss through the stream bed and banks.

Following the initial loss, the stream flow will begin to increase.

The initial loss for a storm can range from zero (when stream flow increases as soon as rain starts) to the total storm rainfall (when all the rain is lost and the storm does not result in any increase in stream flow).

According to Australian Rainfall and Runoff Data Hub, Greenacres Caravan Park experiences storms with Initial Losses of 26.0 mm and Storm Continuing Losses of 1.7 mm/hr.

This suggests that any rainfall in a storm event less than 26 mm would not provide any stormwater flow into the creek and therefore will not provide any dilution to the treated effluent that is being discharged and released to waters. This does not reset with each storm, rather for successive storms only results in the first 26 mm of rain in the weather event being absorbed into the surface soils causing a horizon saturation and thence runoff.

As it is unlikely that the soil characteristics will allow irrigation of all treated effluent to the available 1 ha of land, a discharge to creek needs to be maintained. Provided there is sufficient flow in the creek to provide dilution to assimilate residual pollutants, the impact on the creek water quality should be lessened.

2.4 Stormwater Catchment

The catchment associated with the tributary of the Coolnwynpin Creek where the treated effluent release point is located, is approximately 120 ha as shown in Figure 4.

The catchment is somewhat developed but could be expected to have a gross runoff coefficient of 0.6-0.7 in most significant storm events.

It would be expected that for say a 40-50mm storm event that 28,000 m³ – 36,000 m³ would be expected to flow out of the catchment into the creek line.



Figure 4: Approximate catchment area for the Coolnwynpin Creek tributary

2.5 Surroundings and Environmental Considerations

The site is located in a residential area with other large home estates surrounding the property. The Coolnwynpin Creek is located to the east and west location of the site, which flows into the Tingalpa Creek which is located to the North of the property.



Figure 5: Coolnwynpin Creek, East & West to the site



Figure 6: Tingalpa Creek North of property

2.6 Matters of state environmental significance

According to Queensland's State Planning Policy (SPP) mapping, the matters of state environmental significance (MSES) in the area of interest are:

- Wildlife Habitat – threatened and special least concern animal
- Regulated Vegetation – Endangered/of concern in Category B;
- Regulated Vegetation – Essential habitat;
- Regulated Vegetation – Defined watercourse.

The MSES are highlighted in Figure 7.

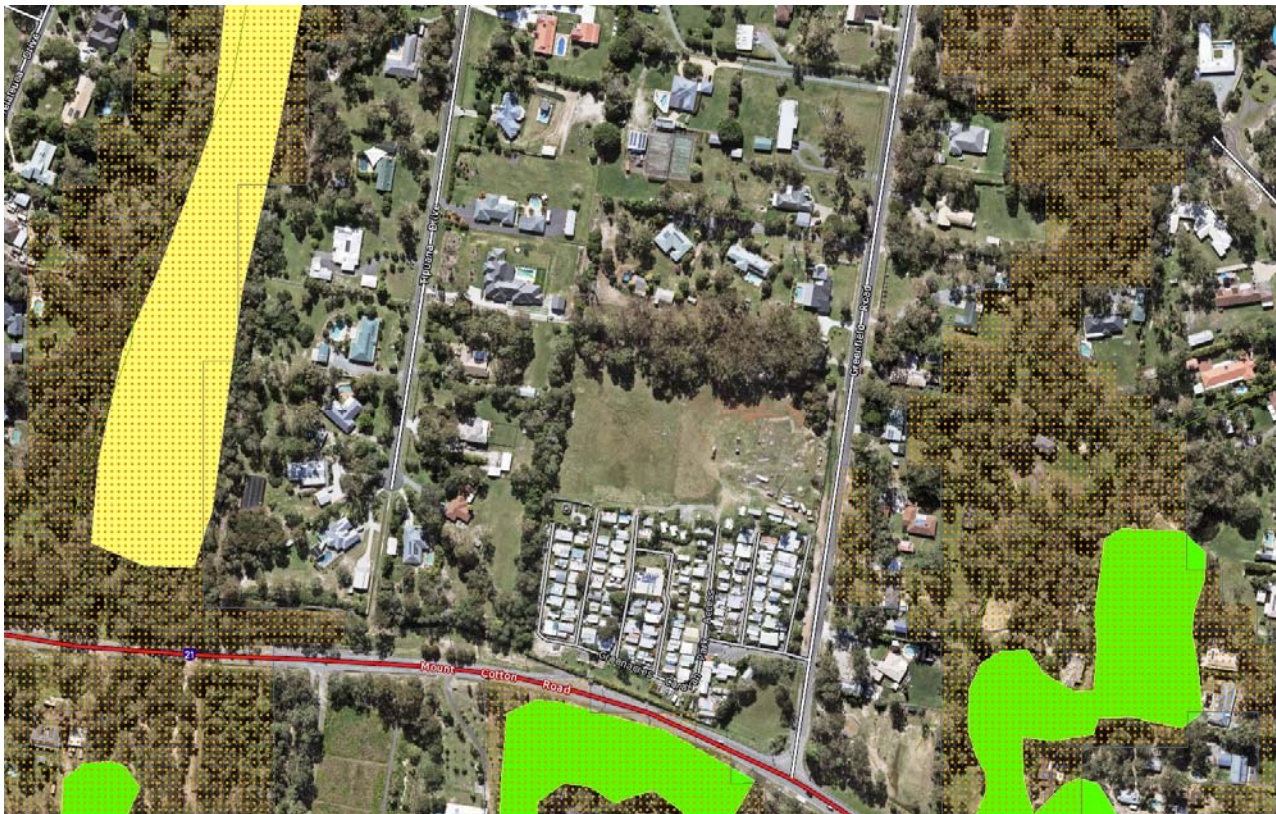


Figure 7 MSES within Greenacres Caravan Park

2.7 Site inspection and observations

The proposed irrigation area consists of cleared land that is currently used for equipment storage or for the agistment of cattle in the summer season. Two cattle were observed on site during the inspection however the cattle can be relocated if necessary.

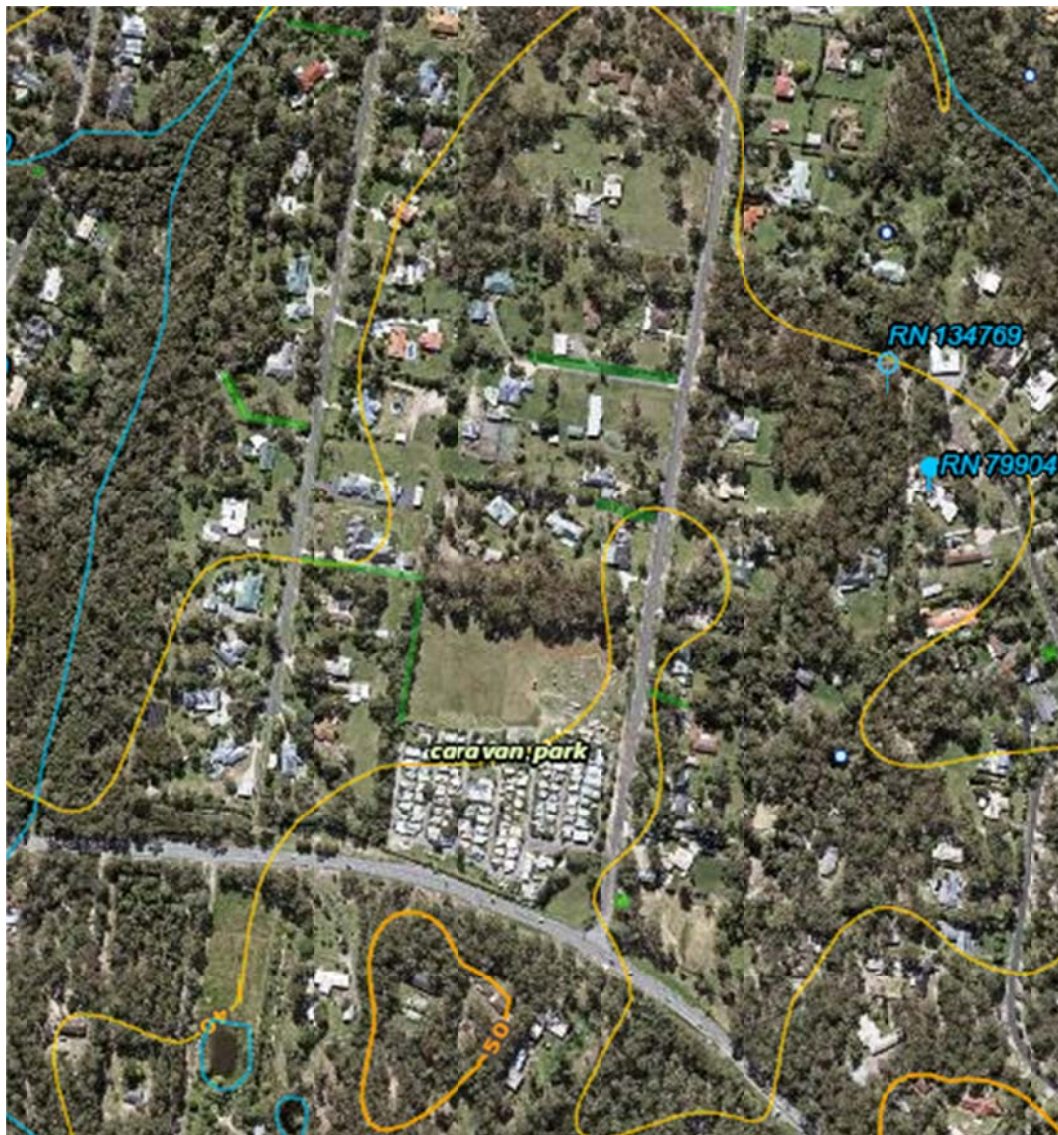


Figure 9: Landform and contours surrounding Caravan Park.

The site visit was conducted after a weekend of heavy rainfall. Whilst the eastern section of Lot 5/RP123875 was well drained, the contour of the land channelled stormwater to the north western corner and some ponding was observed.

It was also noted that overland flow of stormwater has created lush vegetation directly north of the Caravan Park and STP area; though visual observations, it was noted that this area had noticeably more organic matter present in the topsoil than the sampling site in the north eastern area.

2.8 STP Process Overview

The site is located outside of the municipal sewage network, and as such, is required to treat all wastewater generated in an on-site wastewater treatment plant.

The treatment plant installed on site is based upon trickling filter technology and consists of the following units of process:

- Inlet Screen & Macerator
- Septic Tank/Anaerobic Digester
- 1 Primary clarifier tank, split into 2 cells
- Rock media trickling filter with 2-arm rotary distributor

- Secondary clarifier
- Chlorine contact chamber with tablet chlorinator

The STP process schematic is displayed in Figure 10 below.

Greenacres Caravan Park has been implemented several changes to their process to reduce the nutrient concentrations in the STP final effluent, and to improve disinfection by:

1. Changing chlorine tablets to avoid additional nitrogen being added to the final effluent as cyanurate;
2. Conversion from tablet chlorination to liquid sodium hypochlorite dosing, interlinked with the filter pump start to improve disinfection;
3. Installation of baffles into the chlorine contact tank to prevent short circuiting and increase the contact time;
4. Installation of a glass media based final effluent filter to reduce suspended solids and lower the chlorine demand, thus improving disinfection;
5. Installation of a pre-anoxic tank prior to the trickling filter to achieve further nitrogen removal.

Greenacres Caravan Park is committed to continual improvement to the STP processes and to further improve effluent quality and improvement in disinfection, suspended solids and nitrogen removal.

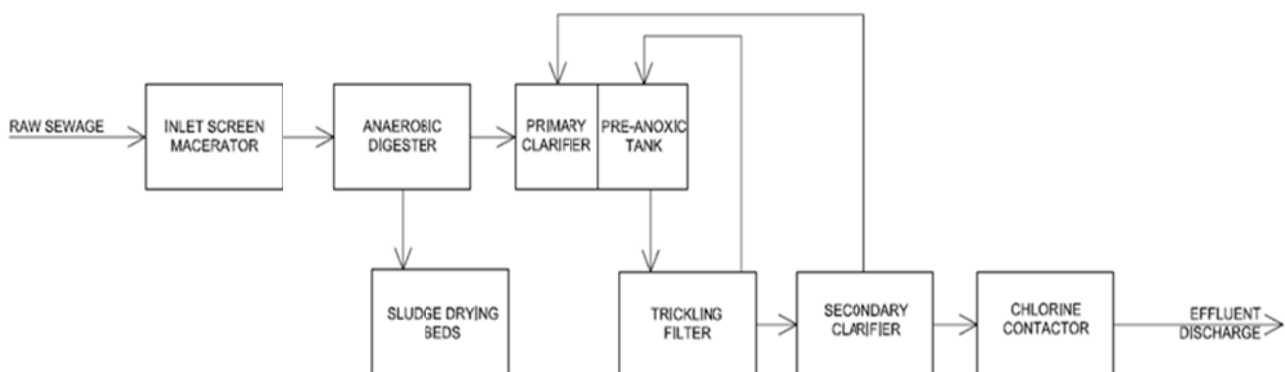


Figure 10: General STP Process Description

3. EFFLUENT WATER QUALITY

Treated effluent is sampled and analysed monthly as per the sites Environmental Authority EPPR00754013; water quality data recorded from Jan 2018 to current is presented below. Non-compliant results are shaded grey.

Table 1: Treated Effluent Analytical Results

Date	pH	DO	Cl ₂ Free	TN	TP	TSS	BOD	Faecal Coliforms Median	Faecal Coliforms Max
Min Limit	6.5	2	-	-	-	-	-		
Max Limit	8.5	-	0.7	-	-	60	40	1000 ¹	4000
Units	pH	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	cfu/100mL	cfu/100mL
17-Jan-18	6.9	3.6	0.1	20	6.3	19	11	190	290
7-Feb-18 ^{^^}	6.9	2.6	0.4	20	5.8	40	14	1000	3700
28-Mar-18 ^{^^}	7.2	2.5	0.3	19	4.8	23	12		
23-May-18 ^{^^}	7.2	4.0	<0.1	26	4.7	17	<10		
29-May-18	7.0	4.6	>0.1	25	4.3	26	11	1200	3600
20-Jun-18 ^{^^}	7.5	4.3	<0.1	36	6.2	52	25		
3-Jul-18	7.3	5.0	0.1	37	6.4	40	19	>6,000	>6,000
4-Sep-18	7.4	3.9	<0.1	43	7.2	38	15	1,400	>6,000
2-Oct-18	7.0	0.56	<0.1	58	9.0	92	79	>6,000	>6,000
7-Nov-18 ^{^^}	7.4	4.4	<0.1	33	7	41	<15		
7-Dec-18	7.4	2.2	<0.1	36	6.5	32	<5	>6000	>6000
9-Jan-19 ^{^^}	8.0	6.3	0.2	32	5.8	42	10		
12-Feb-19	7.5	5.9	0.2	26	7.0	27	<10	<10	20
15-Mar-19	6.2	6.1	0.1	19	5.4	21	6	80	2,600
3-Apr-19	7.0	8.5	<0.1	20	5.2	24	<5	<10	20
Average	7.2	4.0	0.2	31	6.2	37	17		

¹ Median value of minimum of 5 samples taken at not less than half hourly intervals, with 4 of the 5 samples containing less than 4000 org/100mL.

^{^^}Laboratory certificates have not been viewed by Simmonds & Bristow staff to confirm accurate data entry. Results were provided by Greenacres Caravan Park staff in the form of a spreadsheet.

The STP has undergone numerous upgrades and process changes as of 2018, which has had a positive impact on effluent quality as evident with continual improvement of water quality results; this is most notable as from February 2019 where improvement in both biological and chemical parameters are exhibited as a consequence in concert with the recorded reduced flows.

Further changes, including the refitting of the trickling filter are underway to further improve effluent quality and improvement in disinfection, suspended solids and nitrogen removal.

Improvement in disinfection, reduction in suspended solids and nitrogen is evidenced in recent months of monitoring with all parameters reporting compliant results as of January 2019 (with the exception of abnormal pH in March 2019).



4. EFFLUENT WATER QUANTITY

4.1 Treated effluent discharge

Treated effluent discharge data was provided by Greenacres Caravan Park Staff for the period of January 2017 to March 2019 and has been charted in **Error! Reference source not found. Error! Reference source not found..**

Flow meter readings are regularly taken by site personnel. The effluent discharge data has been calculated to an aggregated daily flow rate and plotted, as shown in **Error! Reference source not found..**

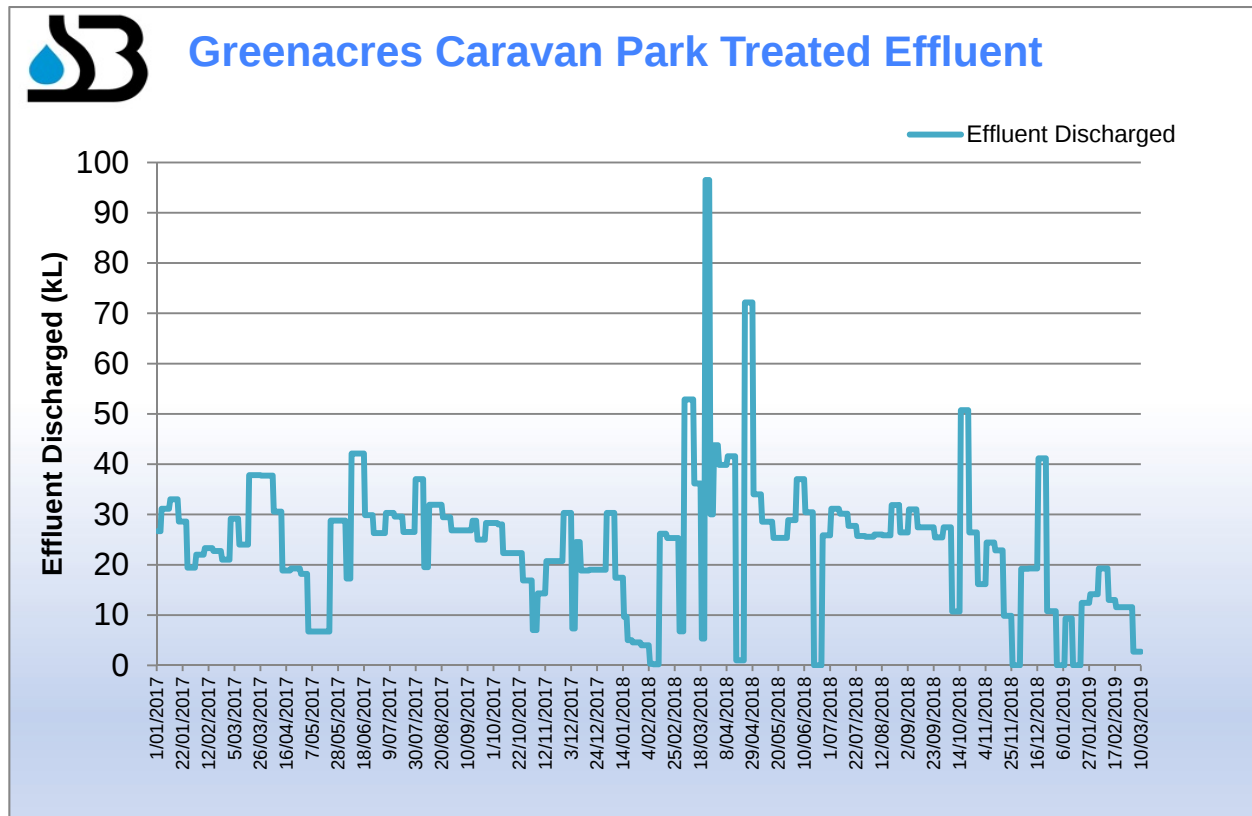


Figure 11: Daily flow of Treated Effluent (2017-2019)

The calculated daily effluent discharge rate average is **23.7 kL**; however the maximum daily discharge rate was recorded over three days at an average of 96.5kL/day in March 2018. A further effluent discharge peak was observed in April 2018 of 72kL. Since this time, such elevated effluent discharge quantities have not been experienced.

The daily average effluent discharge rate of 32.6kL was documented in the 'environmental evaluation notice' received by DES; the calculated daily flow, however, is far less at 23.7kL.

Both rounded effluent discharge rates of 25kL and 35kL have been used for all desktop and MEDLI modelling performed, based as 2 scenarios.

Effluent discharge data is presented in step form to present the average aggregate in a clear and representative format, namely when plotting against daily rainfall data as shown in Figure 12.

Table 2: Calculated Average Aggregate Daily Effluent Discharge Jan 2018 – March 2019

Date	Flow (kL)
Average Daily Flow 2017	24.9
Average Daily Flow 2018	25.8
Average Daily Flow 2019 (Jan to 10 th Mar)	9.5
Average Daily Flow 2017 -2019 (10 th Mar)	23.7
Daily flow utilised in MEDLI Model	25.0
Max Average Daily Flow 2017-2019 (10 th Mar)	96.5
90th Percentile Average Daily Flow 2017-2019	37.1
95th Percentile Average Daily Flow 2017-2019	41.9
Proposed Maximum Daily Flow Limit used in MEDLI model (DES value)	35.0

4.2 Rainfall and/or infiltration

An assessment of rainfall over the same period was conducted to determine if any correlation with effluent discharge quantities (rainfall infiltration into the STP), particularly for the effluent discharge peaks that occurred in March and April 2018.

Rainfall and aggregate effluent discharge flow meter readings are provided in Figure 12 for comparison.



Greenacres Caravan Park Treated Effluent

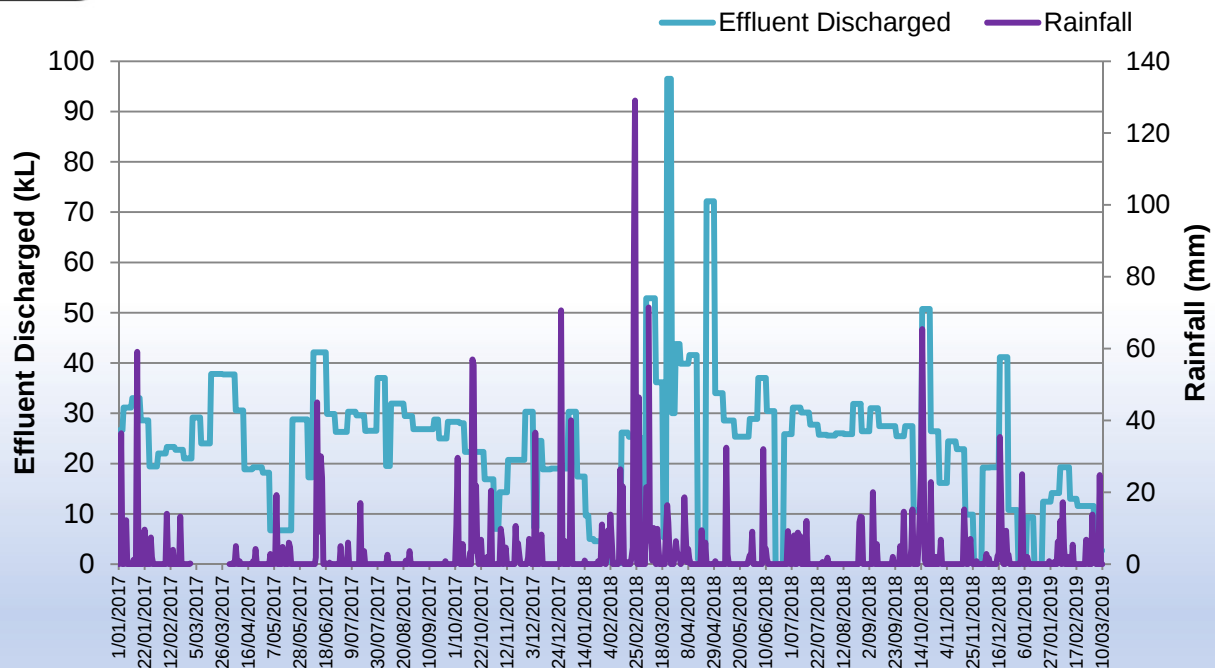


Figure 12: Comparison of Effluent discharge with rainfall

Of the data collated, it can be concluded that it is likely that a direct correlation between rainfall and daily effluent discharge peaks, but it is difficult to formally conclude due to the variability in effluent flow meter reading days.

5. CATCHMENT ASSESSMENT

5.1 Release to waters

The current release point for treated effluent from the site is a stormwater inlet designated as "Release Point Number W1" in the sites Environmental Authority.

Condition C4 states *"The total quantity of contaminants released from Release Point Number W1 during any dry weather day must not exceed 100 cubic metres and during a wet weather day must not exceed 250 cubic metres"*

The treated effluent is gravity fed through a PVC pipe, both above and underground at times, as shown in Figure 13.

The treated effluent is released to a tributary of the Coolnwynpin Creek. The tributary is described as ephemeral, in which it only flows after periods of rainfall. This suggests that there is likely to be little to no dilution of the treated effluent occurring in the receiving waterway during dry periods.



Figure 13: Final effluent discharge pipe near the North West border of lot

6. GROUNDWATER

A review of registered bores in the area with use of Queensland Globe mapping (Figure 14) was conducted. Likely groundwater directional flows are identified; without further studies it can be assumed that the groundwater flows direction is northward of the Greenacres Caravan Park site. The contour fall directing north and groundwater flowing from higher gradient to lower gradient responding to hydraulic head (from high to low hydraulic head) supports this observation.

Groundwater is assumed to direct away from the proposed irrigation area.

A summary of the bores in the area is presented in Table 3.

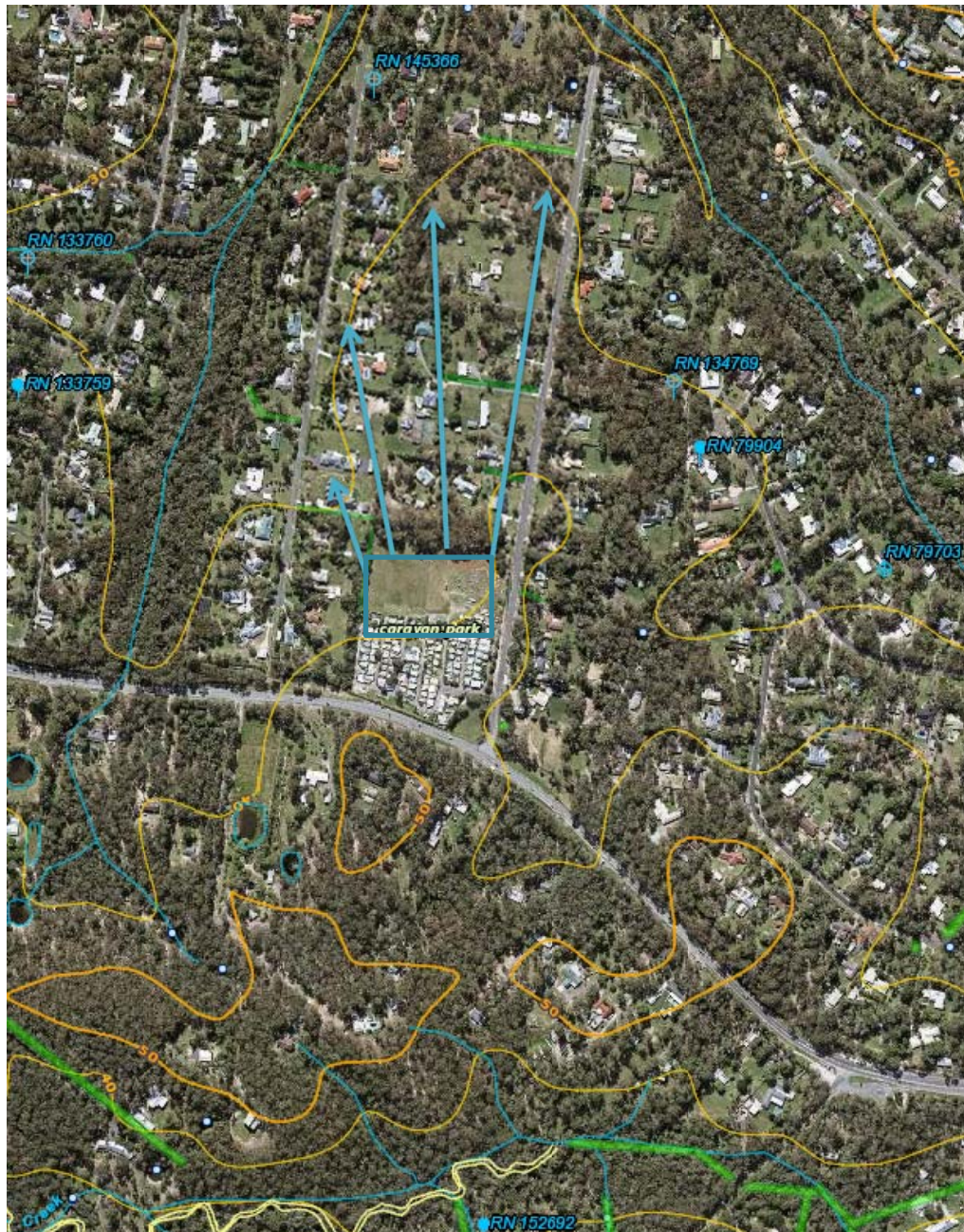


Figure 14: Caravan Park with contours and surrounding groundwater bores – Blue direction arrow show inferred groundwater flows, based on contours

Table 3: Groundwater Bore Assessment²

Registered Bore #	Approx. Distance to proposed Irrigation Area	Strata Information – Water bearing zone	Status
Units	m	m	-
79904	360	53-64m Water Bearing Shale	Existing
152692	820	36m - Decomposed Sandstone w/some water 48m - Decomposed Sandstone w/some water	Existing
133759	520	30m - Unknown 56m - Gravel	Existing
134769A	380	Nil @ 54m	Abandoned & Destroyed
133760	620	70m - Unknown	Abandoned & Destroyed

The location of the bores in relation to the contour lines, along with the depth of the bores (of the data available), indicates that there is significant vertical buffer distance from the application of treated effluent at the surface to the level of groundwater in the area.

Onsite Domestic Wastewater Management Standards AS1547:2012³ provides setback guidance risks for vertical setback buffer to groundwater between 0.6 – 1.5 m (low to high risk). The vertical buffer to groundwater is likely to be much higher than 1.5 m and is therefore deemed as low risk.

As shown in Figure 14, the closest registered bore (RN79904) is ~385m from the boundary of the proposed irrigation area. This complies with the guideline horizontal setback distance to bores/wells of 15 – 50 m.

Queensland Globe identifies the proposed irrigation area as having metamorphic rock aquifers, with likely groundwater directional flows entering an area of no identified aquifers although a groundwater monitoring bore (RN79904) is located in this band/area.

Data availability for standing water level measurements for all surrounding groundwater bores is limited; directional flows can only be assumed by land contour and natural groundwater flow and directional falls.

² Bore properties and status obtained from bore reports provided by Queensland Globe

³ AS1547 On-site Domestic Wastewater Management (2012) Table R1 and R2

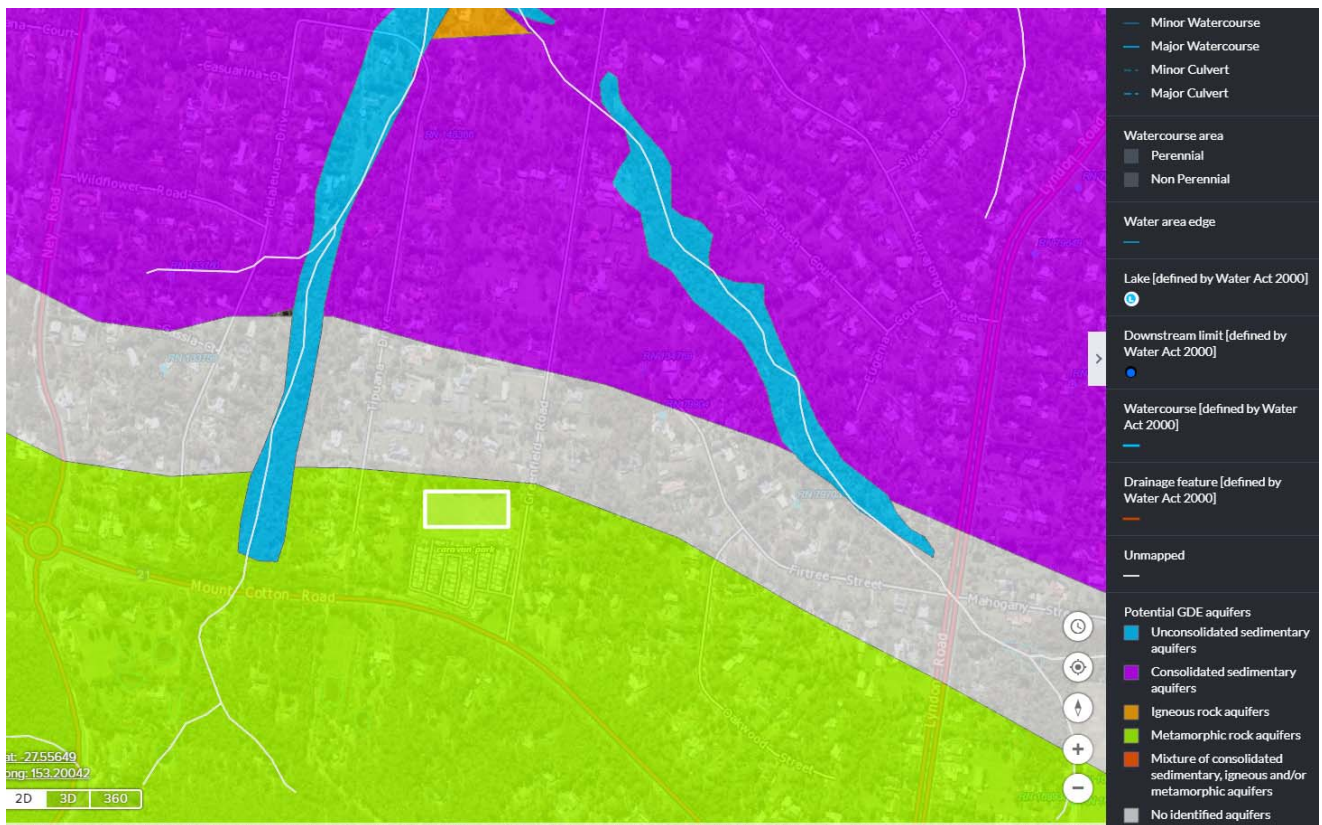


Figure 15: Aquifer zones from QLD Globe

Metamorphic rock can be highly permeable, but as this aquifer is regarded as a confined aquifer (not exposed at the ground surface) and is quite deep (minimum standing water levels reported for groundwater monitoring bores in the area is at 36 m), it is unlikely that irrigated effluent will easily penetrate through the soil and enter into the groundwater.

7. SOIL ASSESSMENT

To determine if the site is suitable for land application the soil was evaluated for a number of properties. The combination of the rate of water movement through the soil, as well as other physical and chemical properties was assessed.

Laboratory Certificates for the analysis conducted can be found attached in Appendix A and a summary of the analytical results for the soil profile is provided in Table 4.

Table 4: Soil Results

Parameter	Units	Top soil	Sub soil	Sub soil
Soil Texture		Clay loam	Fine sandy clay loam	Clay loam
pH (1:5 water)	pH Units	7.0		
Electrical Conductivity (1:5 water)	dS/m	0.201		
Moisture Content (40 O C)	%	20.2	12.8	13.4
Bulk density	t/m ³	1.36	1.63	1.60
Emerson Class Number		4	3	2
Phosphorus (Colwell)	mg/kg	23	6.9	4.9
Total Nitrogen	%	0.18		
Nitrate Nitrogen	mg/kg	12.0		
Ammonium Nitrogen	mg/kg	22.0		
Phosphate	mg/L	6.3		
Total Organic Carbon	%	3.55		
Estimated Organic Matter	%	6.2		
Exchangeable Calcium	mg/kg	2500	526	114
Exchangeable magnesium	mg/kg	216	141	150
Exchangeable Potassium	mg/kg	134	<50	<50
Exchangeable Sodium	mg/kg	88	69	132
Sodium - Exchangeable Sodium Percentage (ESP)	%	2.6	7.2	23.4
Calcium	%	83.3	62.5	23.1
Magnesium	%	11.9	27.6	50.4
Potassium	%	2.3	2.8	3.1

7.1 Soil Texture

The soils on site were classified as clay loam or fine sandy clay loam.

Texture will influence the movement of water through the soil, how much water can be stored in the soil, and how much of the stored water is available to plants.

Clay loams and fine sandy clay loams typically provide moderate to low drainage and moderate plant available water.

7.2 pH

The Australian Standard *Soils for Gardening and Landscape Use* (AS4419) provides recommended ranges for pH at 5.5 to 7.5. The topsoil sample tested returned a pH value within this range.

Another interpretation of soil pH is provided by Hazelton (2007), which defines a set of ratings outlined in Table 5.

Table 5: Rating for Soils pH (Hazelton, 2007)

pH	Ratings	Sample
>9.0	Very strongly alkaline	
9.0-8.5	Strongly alkaline	
8.4-7.9	Moderately alkaline*	
7.8-7.4	Mildly alkaline	
7.3-6.6	Neutral	Topsoil
6.5-6.1	Slightly acid	
6.0-5.6	Moderately acid	
5.5-5.1	Strongly acid	
5.0-4.5	Very strongly acid**	

* Test for calcium carbonate. Iron and zinc may be deficient.

** With increasing acidity exchangeable aluminium increases to toxic levels, cadmium and heavy metals become available and molybdenum becomes increasingly unavailable.

Nutrients are most accessible for plant growth in moderately acid to neutral soil pH. High pH can restrict availability of metal-based nutrients such as iron and zinc, whereas excessively low soil pH can cause metals in the soil matrix to become soluble. This in turn can affect water uptake and root growth.

The pH of the effluent discharge is between neutral and alkaline, averaging at near-neutral value of 7.2 pH. Due to the near-neutral pH value of the effluent, its expected alkalinity and relatively low oxidisable ammonia concentration, it is unlikely that effluent irrigation practices will negatively affect the soil pH.

7.3 Soil Sodicity (Exchangeable Sodium Percentage (ESP))

The ESP provides an indication of the sodicity of a given soil sample and therefore the soils susceptibility to dispersion when wetted, and its overall structure in terms of permeability. A soil with an ESP greater than six is generally regarded as being sodic soil in Australia.

For sodic soils, the level of sodium present in the water and soil is important as it influences the structural stability of clay minerals and the potential for dispersion, erosion and drainage problems.

The soils analysis revealed that subsoil 2 had an Exchangeable Sodium Percentage (ESP) of 23%, which is strongly sodic (greater than 15%). Soil sodicity occurs when available sodium ions cause the clay in soil to disperse, and even at low concentrations, sodium can cause clay dispersion which degrades the soil profile and interferes with root growth.

Dispersion occurs when the clay particles swell and separate from each other upon wetting, with electrostatic binding dominated by sodium ions over calcium ions. On drying, the soil becomes dense, cloddy and without structure due to a lack of flocculation. This dense layer is often impermeable to water and plant roots.

An Emerson dispersion test, which rates the soil on a scale of 1 to 8, provides an indication of the dispersive nature of the soil, as well as the tendency of the soil to slake when wet. This helps to determine whether the sodic properties of the soil are affecting the soil structure.

The top soil and subsoil 1 reported Emerson Class Numbers of 4 and 3 respectively which indicate slaking soils that may benefit from the addition of organic matter. The application of organic mulch (such as bark or straw) can provide organic content to the soil and improve soil quality.

Subsoil 2 reported an Emerson Class Number of 2 which indicates moderate dispersion likely due to high sodicity. Soil amelioration in the form of gypsum application is strongly recommended to overcome the potential for reduced permeability and compaction of Class 2 soils.

The soils also have an apparent organic carbon content of 3.5% and this coupled with the observed strong vegetative cover, indicates that much of the impact of sodicity of the soils has been negated.

7.4 Soil Salinity and Conductivity

In soils, salinity can be determined by measuring Electrical Conductivity. Saline soils can negatively affect plant growth. Sandy soils are classified as saline if the conductivity is greater than 0.4 dS/m (400 µS/cm) and clay soils are saline if the conductivity is above 0.7 dS/m (700 µS/cm).

The soils in the area are clay loam to fine sandy clay loam and the electrical conductivity (1:5 extract) result for the composite topsoil was reported at 0.2 dS/m.

According to the Salinity Management Handbook, this designates a very low to medium soil salinity rating and is unlikely to affect plant growth or present any soil quality issues.

$$EC_{se} = \frac{EC_i}{2.2 \times LF} \quad (4.1)$$

where:

EC_{se} = average root zone salinity in dS/m

EC_i = electrical conductivity of irrigation water in dS/m

LF = average leaching fraction.

Table 4.2.3 Soil type and average root zone leaching fraction^a

Soil type	Average root zone LF
Sand	0.6
Loam	0.33
Light clay	0.33
Heavy clay	0.2

Figure 16: Suitability of Irrigation Water Salinity (ANZECC 2000)

Using ANZECC Guideline equation 4.1 in Figure 16 above, using the effluent as irrigation water quality results, an EC_{se} value of 0.28 dS/m is calculated; as the soil is clay loam to fine sandy clay, the application of effluent should not influence root zone leaching.

7.5 Irrigation Effluent Salinity and Sodium Absorption Ratio (SAR)

The treated effluent is sampled monthly however neither Total Dissolved Solids nor Electrical Conductivity are included in the monthly analyses.

Therefore the treated effluent was sampled during the site visit on the 18th March 2019 for electrical conductivity and sodium absorption ratio (SAR).

The treated effluent reported an electrical conductivity of 490µS/cm (equivalent to 0.49 dS/m). This gives it a 'very low' water salinity rating⁴.

As noted in Section 7.3, for sodic soils, the level of sodium in the water is as important as the level of sodium in the soil.

The Sodium Absorption Ratio (SAR) of irrigation water is often used to determine the risk factor for irrigation on to dispersive soils. As the sub soil of the proposed irrigation area is considered highly sodic; this is an important consideration for the sustainability of the proposed irrigation area.

The treated effluent was sampled on the 18th March 2019 and reported a SAR value of 2.9. This is considered low and indicates that the treated effluent is suitable for irrigation on to the soil textures reported on site, provided soil amelioration and undergo regular soil management practices, such as gypsum applications, are carried out for the sodic subsoil.

7.6 Nitrogen and Phosphorus

Nutrients are essential for plant growth. However, the presence of nitrogen and phosphorus in high concentrations can be harmful to plants and waters. In the soil, nutrients available for plant uptake are in the forms of nitrate and phosphate. High concentrations of these nutrients can cause toxicity in some Australian natives as well as eutrophication of nearby surface and ground waters. The Australian and New Zealand Standard (AS/NZS 1547:2012 - *On-site domestic wastewater management* provides an informative section on the nutrients in effluent that is disposed of via land application.

⁴ Table 40 Salinity Management Handbook (DNR, QLD 1997)

AS/NZS 1547:2012 considers 500 mg/kg of nitrogen in soil to be very low. From an agricultural perspective, 5,000 mg/kg of nitrogen and above is considered to be very high.

The top soil sample is low in nitrogen, and mostly available in the form of ammonia nitrogen.

Nitrogen is only available to plants in the form of ammonia, nitrate, and nitrite. Nitrate was present in the topsoil sample. Nitrate availability in the soil is dependent upon irrigation practices and plant uptake; the presence of nitrate in the soil may suggest that the plant uptake rate may be lessened when effluent is applied, adding additional nitrogen loading to the soil.

AS4419 indicates that the optimum nitrate concentration (as nitrate is readily available to plants) is between 20 and 40 mg/kg. Nitrate concentrations were reported at 12 mg/kg for the topsoil sample therefore is lower in comparison, suggesting that crop growth may be limited.

The availability of phosphorus in the soil is dependent on the absorptive capability of the soil, where there is significant local variation. Phosphorus, in the form of phosphate, has a negative charge and is taken up by the soil via adsorption onto the soil particles, which causes it to become nearly insoluble.

There are no specific guidelines for typical Colwell (available) phosphorus concentrations, and this value is of more importance for the agriculture industry. Statistics from *Soil Quality (2011)* indicate that over 58% of agricultural soil samples tested in New South Wales ($n = 411$; no Queensland data available) have a Colwell P concentration of 10 – 50 mg/kg.

The Colwell phosphorus concentrations results of the soil at 23 mg/kg in the subsoil, 6.9 mg/kg and 4.9 mg/kg in the sub soils was received.

With the exception of the top soil (phosphorus being on the lower side of the scale for P-concentrations) and as like nitrogen, the phosphorus concentrations appear to be at levels where additional nutrient application (through effluent irrigation) would result in plant uptake by available vegetation, with limited nutrients leaching to deep drainage.

8. WATER BALANCE

8.1 Potential Design Irrigation Rate or Design Loading Rate

The soils on site are described between Fine Sandy Clay Loam and Clay Loam. To design a suitable irrigation rate, AS1547:2012 is adopted. The Design Irrigation Rate (DIR) for Fine Sandy Clay Loam and Clay Loam, the applicable rates is 3.0 to 3.5mm/day, as shown in Table 6.

A drip irrigation system has been recommended for use at Greenacres Caravan Park, as this is suitably fit for site. An application rate of 3.5 mm/day has been used for modelling purposes, on the proposed land parcel size of 10,000 m³.

AS1547:2012 recommends that drip irrigation systems are installed in an adequate depth of topsoil (150 – 250 mm of in situ or imported good quality topsoil) to slow the soakage and assist with nutrient reduction.

Table 6: Recommended Design Irrigation Rate (DIR) for irrigation systems⁵

Soil Category	Soil Texture	Structure	Design irrigation rate (DIR) (mm/day)		
			Drip Irrigation	Spray Irrigation	LPED Irrigation
4	Clay loams	High/moderate structured	3.5	3.5	3.0
		Weakly structured			
		Massive			

The daily average effluent discharge rate of 32.6 kL was documented in the 'environmental evaluation notice' received by DES; calculations obtained from this investigation are far less as 23.7 kL. Both rounded effluent discharge rates of 25 kL and 35 kL have been used for all desktop and MEDLI modelling performed.

Using the average aggregate daily effluent discharge is 25 kL/day at 3.5 mm/day application, a land parcel size of 0.7143ha (7,143 m³) or greater is adequate (3.5 mm x 0.7143ha = 25 kL).

Using an average daily effluent discharge rate of 35 kL/day at 3.5mm application, a land parcel size of 1 ha (10,000 m³) is adequate, to maximum usage (3.5 mm x 1ha = 35 kL)

⁵ AS1547:2012 On-site Domestic Wastewater Management Table M1

8.2 Water Balance Risk Assessment

A water balance was conducted using the decision process based on rainfall determined by Simmonds & Bristow and outlined in Figure 17.

The site currently does not have wet weather storage; when wet weather storage is required, the general approach is to store between 2-4 times the daily expected effluent volumes. Greenacres STP configuration requires 50-140 kL volume of wet weather storage. It is recommended that 2 x 46,400 L tanks be installed to provide a total of 90,000 L of wet weather buffer storage.

The wet weather storage was set to 90 kL, to provide approximately 3.6 days of wet weather storage if effluent quantities remain a 25 kL/day average, alternatively at 35 kL/day discharge average 2.6 days of storage is available.

To source and install 2 x 46,400 L tanks is a conventional approach.



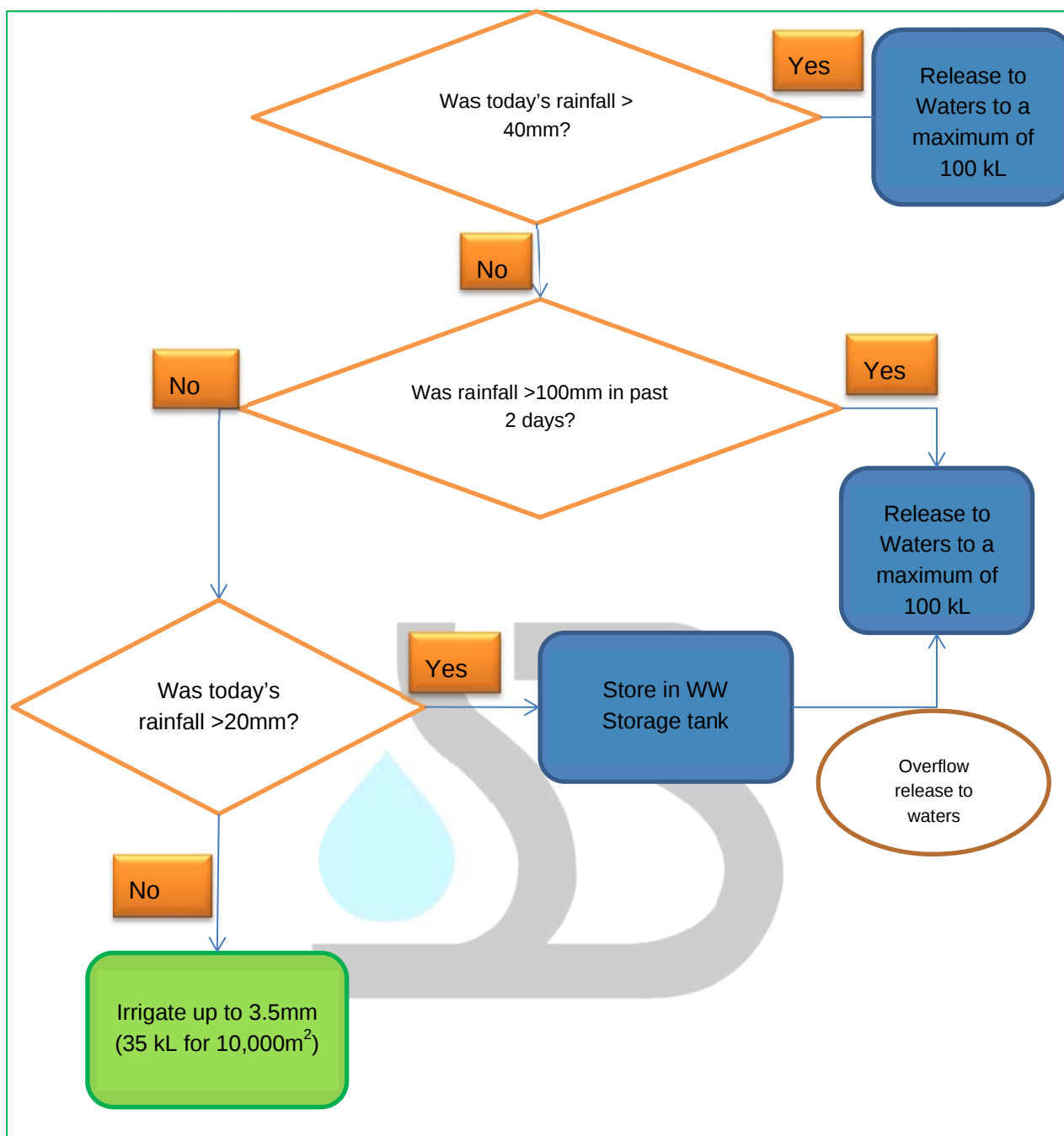


Figure 17: Release to Land & Water Decision Tree

The water balance was approached by using two effluent discharge rates, 25 kL/day and 35 kL/day as previously discussed, with the use of 10,000 m³ irrigation land, 3.5mm irrigation rate, and the use of wet weather storage. When the wet weather storage fills, the overflow will ultimately be released to waters.

Natural flow rates of the creek were not available and therefore mass loadings were unable to be calculated. An estimated dilution factor was calculated based on initial storm losses for the latitude and longitude of the site. A 40 mm rainfall event was used to provide a reasonable and practical rainfall threshold to allow release to the creek.

With a stormwater catchment area of 120 ha, the catchment area will yield a certain amount of stormwater flow which inevitably will be caught in the Coolnwynpin creek.

The catchment is somewhat developed but could be expected to have a gross runoff coefficient of 0.6-0.7 in most significant storm events.

With a runoff coefficient of 0.6, a total of 28,800 m³ of rain is likely to runoff from the creek catchment area, and pass into the creek. With a maximum effluent discharge volume of 100 kL released into the creek system during weather events, a 288:1 dilution of creek catchment flow to effluent is probable. This gross estimation is demonstrated below;

= 40mm Rain x 120 ha stormwater catchment area x 0.6 runoff coefficient

= 28,800 m³ rain passing in the creek

= 28,800 m³ rain / 100 kL (m³) of effluent = minimum dilution factor 288

Note that nutrient loading of the urban runoff is not included in this stormwater catchment calculation due to limited data available.

With the proposed irrigation cut off of 20 mm rainfall, the wet weather storage starts to fill if this volume of rainfall is exceeded and irrigation is stopped, or the inflow to the treatment plant is higher than average. 20 mm was selected as just below the Australian Rainfall and Runoff Initial Loss estimate of 26.0 mm and Storm Continuing Losses of 1.7 mm/hr. The soil will be regarded as saturated at this point.

The water balance was developed as single year approach.

The water balance was assessed over a variety of different rainfall years (Minimum, 10th, 50th 90th Percentile and Maximum rainfall) using climate data from the closest weather station at Mount Cotton West (Station ID 040141).

Table 7 and Table 8 summarise the findings.

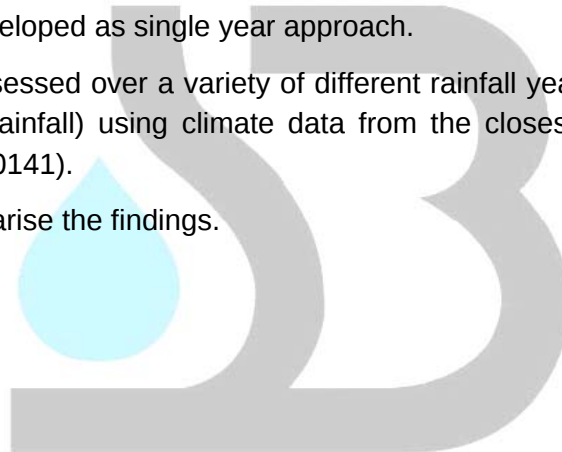


Table 7: Water Balance Statistics for Daily Effluent Volume 25 kL/day/year

	Minimum	10 th Percentile	50 th Percentile	90 th Percentile	Maximum
Year	1977	2016	1989	1921	1947
Yearly Rainfall (mm)	633	814	1289	1894	2703
Total Volume of Effluent (m ³)	9125	9125	9125	9125	9125
Effluent Releases to Water					
Number of releases to water per year	4	6	13	20	23
Volume of releases to water per year (m ³)	153	328	728	1128	1056
Percentage of total effluent produced	1.7%	3.6%	8.0%	12.4%	11.6%
Effluent Irrigated to Land					
Volume of effluent irrigated (m ³)	8972	8797	8397	7997	8069
Average irrigation rate (mm/day)	2.5	2.4	2.3	2.2	2.2

Table 8: Water Balance Statistics for Daily Effluent Volume 35 kL/day/year

	Minimum	10 th Percentile	50 th Percentile	90 th Percentile	Maximum
Year	1977	2016	1989	1921	1947
Yearly Rainfall (mm)	633	814	1289	1894	2703
Total Volume of Effluent (m ³)	12,775	12,775	12,775	12,775	12,775
Effluent Releases to Water					
Number of releases to water per year	4	6	13	20	23
Volume of releases to water per year (m ³)	243	488	1048	1608	1536
Percentage of total effluent produced	1.9%	3.8%	8.2%	12.6%	12.0%
Effluent Irrigated to Land					
Volume of effluent irrigated (m ³)	12532	12287	11727	11167	11239
Average irrigation rate (mm/day)	3.4	3.4	3.2	3.1	3.1

At an aggregate average discharge rate of 25 kL/day, overflow % (release to waters) of total effluent produced ranges from a minimum of 1.7% to maximum 11.6% on a yearly basis. These equivalents to 153 kL to 1056 kL of effluent discharged on a yearly basis.

On all occasions, irrigation is below the target irrigation rate of 3.5 mm/day, ranging at 2.2 mm/day to 2.5 mm/day. With this, less hydraulic load and therefore less nutrient load is being applied to the irrigation land, ensuring sustainable irrigation practice.

At an average discharge rate of 35 kL/day, overflow % (release to waters) of effluent produced ranges from a minimum of 1.9% to maximum of 12.0% on a yearly basis. These equivalents to 243 kL to 1536 kL of effluent discharged on a yearly basis.

On all occasions, irrigation is below the target irrigation rate of 3.5 mm/day, ranging at 3.1 mm/day to 3.4 mm/day. This provides minimally less hydraulic load to the irrigation land parcel.

For both effluent daily discharge rates, 25 kL and 35 kL, a significantly reduced quantity of effluent is discharged to the watercourse than that currently employed (single application of release to waters).

At times of low rainfall, both scenarios exhibit less than 2% of total effluent produced being released to waters. At times of large rainfall, 12% or less of the total effluent being produced is released to water, which ultimately will be diluted with stormwater.

9. MEDLI MODEL ASSESSMENT

The Model for Effluent Disposal Using Land Irrigation (MEDLI) is a program for designing effluent re-use schemes. MEDLI is the tool recommended by the environmental regulator in Queensland to make (or assess) decisions about how to dispose of effluent by land irrigation.

The model addresses all the facets of effluent re-use; the quality and quantity of effluent available, climate, storage and treatment, irrigation frequency and amount, the flow paths of water, nitrogen, phosphorus and salt components and plant growth.

The inputs utilised in each section of the model are described below.

9.1 Climate

Greenacres Caravan Park is located in Sheldon, QLD.

Climate data for MEDLI was sourced by the SILO database, via data drill for the latitude -27.55 and longitude 153.20.

SILO is an enhanced climate database hosted by the Science Delivery Division of the Department of Science, Information Technology and Innovation (DSITI).

The period of time chosen for the run was the most recent 50 years of data 1969 – 2018; 50 years provides a suitable timeframe for analysis

9.2 Waste Estimation

9.2.1 Quality

Greenacres Caravan Park STP treated effluent is sampled every month for water quality and analysed. The most recent data is provided in Table 1.

The average nutrient values were rounded up to provide the basis for the MEDLI scenarios adopted. This allows for a conservative estimate of the nutrient leaching using actual values from the treatment plant.

Table 9: Water Quality Data utilised in the MEDLI model

Parameter	Unit	Water Quality Average Data	Adopted average Data for MEDLI Scenarios
Total Nitrogen	mg/L	30.7	35
Total Phosphorus	mg/L	6.2	6.5
Electrical Conductivity	µS/cm	670	-
Total Dissolved Solids	mg/L	430 ⁶	430

⁶ Analytical results of Final Effluent sampled on 19th July 2018. TDS calculated (EC*0.64), routine monitoring of this parameter was not available.

9.2.2 Quantity

The average aggregate daily effluent discharged recorded between January 2017 and March 2019 was 23.7 kL/day. The average aggregate daily effluent discharge utilised for the model was 25 kL.

It was observed in the 'Environmental Evaluation Notice' that the average effluent discharge of 32.6 kL was calculated from the date range 1st January 2018 to the 8th July 2018, however on assessment of the effluent discharge data this figure could not be reproduced. For use of the model, 32.6kL was rounded to 35kL/day.

Of the data collected, a peak period was observed in March 2018. No cause for the peak period has been provided by Greenacres Caravan Park staff.

Table 10: Effluent Flow discharge used for MEDLI Modelling

Average Daily	Unit	Average Data	Adopted average Data for MEDLI Scenarios
Calculated average daily discharge 2017-2019	kL/day	23.7	25
Calculated average daily discharge 2018 (6 months) ⁷	kL/day	32.6	35

9.3 Wet Weather Storage/Pond Details

There is currently no wet weather storage facility on site, nor is it required as the current Environmental Authority is licenced to release treated effluent to waters.

When wet weather storage is required, it is often recommended that storage is between 2-4 times the daily expected effluent volumes experienced on site. For the Greenacres Caravan Park STP configuration, this calculates between 50 – 140 kL of tank volume.

To source and install 2 x 46,400 L tanks is also conventional approach.

After initial modelling, it became apparent that the soil profile with the available irrigation land parcel would not support full disposal via land application, unless a water reduction program could be instigated at the site to reduce overall water flow. The site however, has already undergone water efficiency programs, and it may not be possible to further reduce water usage onsite at this stage.

The wet weather storage tank volume has been modelled at 90 kL (~ 3 days of wet weather storage). This allows for reasonable wet weather storage. This volume was used when performing the water balance and desktop assessment.

Employing wet weather storage also comes with other benefits; it can provide some attenuation for unusual peak effluent volumes and provides a buffer to allow the irrigation to occur at the appropriate design rate over a number of days, if required.

⁷ Figure derived from notice, not able to be reproduced.

9.4 Irrigation Area Size

The proposed irrigation area is ~10,000 m², as shown in **Figure 8**, this value has been utilised in all MEDLI scenarios. This includes provisions for setbacks/buffers from boundary fences and an area for the proposed wet weather storage.

The proposed irrigation rate is 3.5 mm/day.

Table 11: Flow and Irrigation Rates used in MEDLI models

Options	Area	Avg Daily Discharge	Wet weather Tank Size	Irrigation Rate	Comment
Units	m ²	kL/day	kL	mm/day	
1	10,000	0	90	0	No irrigation
2	10,000	25	90	3.5	Average Flow Experienced
3	10,000	35	90	3.5	'Environmental Evaluation Notice' calculated average Flow

9.5 Irrigation and Rainfall Cut-off

Irrigation settings were set to simulate irrigation with a rainfall cut out By setting the irrigation trigger in the model to a 0 mm soil water deficit and applying the irrigation to a fixed depth as described in Table 11 above. That is, if rainfall exceeds 20 mm then irrigation will not proceed.

Rainfall cut off at 20mm was selected based on the estimated initial losses of 26.0 mm and storm continuing losses of 1.7 mm/hr, assuming at this point the ground is saturated and no further irrigation should be applied.

During periods of high rainfall, the availability to direct treated effluent (as overflow) from the wet weather storage tanks to the existing release to waters discharge point is beneficial as this:

- Reduces the hydraulic loading to the irrigation area during rainfall;
- Reduces the need for excessive wet weather storage and associated infrastructure;
- Effluent is diluted with subsequent rainfall within the catchment area.

The MEDLI model will not differentiate between effluent overflow release during high rainfall or general overflow based on the STP configuration and sizing. Therefore this was assessed separately in the water balance, and is discussed.

9.6 Proposed Irrigation Method

The proposed irrigation method is sub surface drip irrigation. This is modelled within MEDLI as the 'flood' method.

This will require pressure compensated drippers or pre-fabricated dripline to ensure even distribution across the entire irrigation field.

The soil type is most suited to this type of irrigation set-up, where AS1547:2012 recommends that drip irrigation systems are installed in 150 – 250 mm good quality topsoil will slow the soakage and assist with nutrient reduction.

Once installed, this type of irrigation is low maintenance, and is virtually unseen.

9.7 Soil Quality & Soil Profile

Soil samples from the soil profiles were taken from locations marked in Figure 18 and composites formed by a NATA accredited soil laboratory. The composites provided for Top Soil and two sub soils.

Laboratory Certificates for the analysis conducted can be found attached in Appendix A.

The summary of the analytical results and derived MEDLI inputs for the soil profile is provided in Table 12.

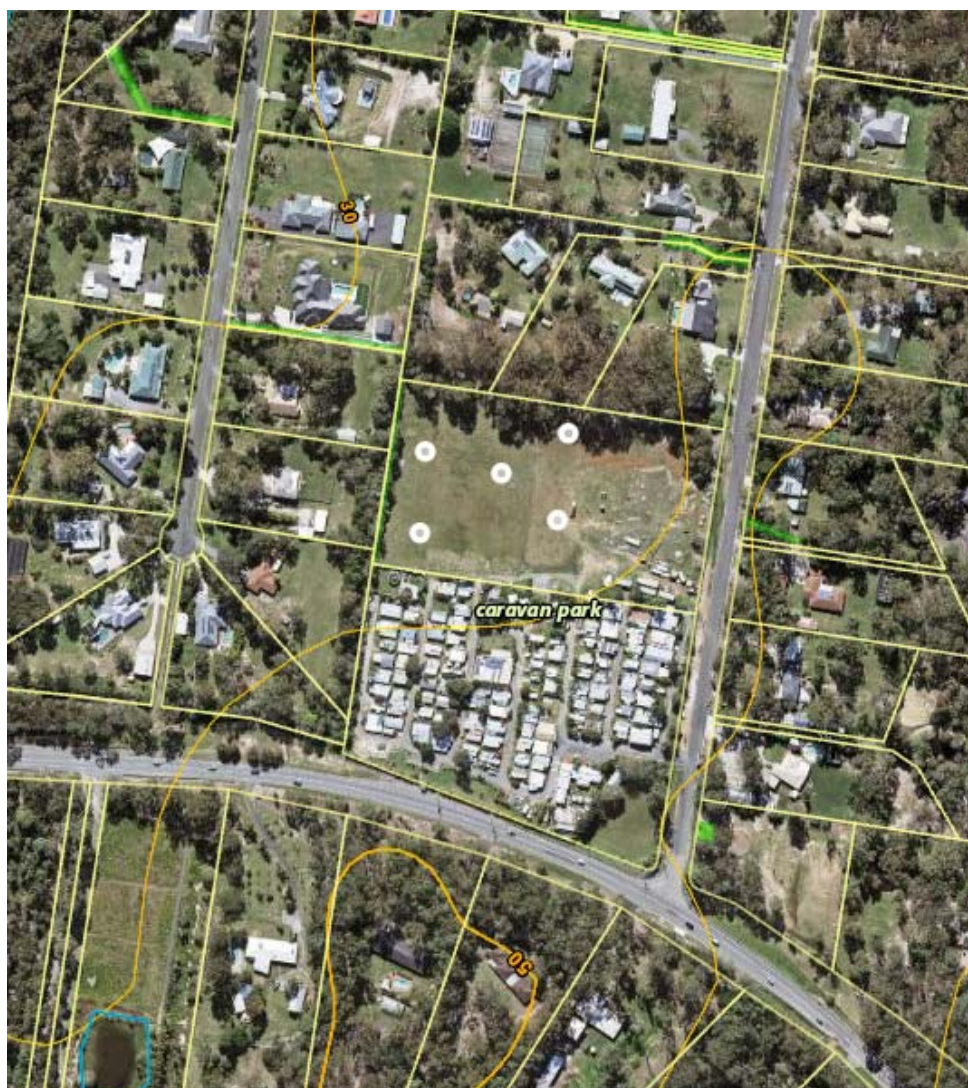


Figure 18: Soil sampling locations within proposed irrigation area

Table 12: Soil quality data and MEDLI soil profile inputs

Parameter	Units	Source of data	March 2019 Soil assessment		
			Proposed Irrigation Area		
Classification	-	Analytical results	Clay Loam	Fine Sandy Clay Loam	Clay Loam
Layer number	-	-	Layer 1	Layer 2	Layer 3
Soil layer thickness	mm	Identified in the field	100	300	300
Air dry	% v/v	Analytical results	20.3 ⁸	12.76	13.68
Lower storage limit	% v/v	Analytical results	10	8	8
Drained upper limit	% v/v	Analytical results	25	19	22
Available water capacity	mm	Calculated by model	-	-	-
Saturated water content	% v/v	Calculated by model	-	-	-
Bulk density	g/cm ³	Analytical results & MEDLI V2 manual table 3.11	1.36	1.32	1.30
Porosity	% v/v	MEDLI V2 manual table 3.11	47-51	47-51	47-51
Saturated hydraulic conductivity	cm/day	Analytical results	14.24	9.29	7.05
Saturated hydraulic conductivity	mm/hr	Analytical results	5.9	3.9	2.9
Initial soil phosphorus	mg/kg	Analytical results	23	6.9	4.9
P adsorption coefficient	-	Analytical results	615.43	403.33	481.92
P adsorption exponent	-	Analytical results	0.1702	0.2058	0.1661
P desorption exponent	-	Analytical results	0.1617	0.1955	0.1578
Runoff curve number	-	MEDLI V2 manual table 3.13	87-90	-	-
Evaporation Stage I drying max (U)	mm	MEDLI V2 manual table 3.14 (based on clay content)	9		
Slope of evaporation Stage II drying (CONA)	mm/sqrt day		4		
Initial nitrate nitrogen (avg in profile)	mg/kg	Analytical results	12	-	-
Initial organic nitrogen (avg in org layer)	mg/kg	Analytical results	1800	-	-
Thickness of organic layer	mm	Identified in the field	100		
Thickness of labile carbon layer	mm	Identified in the field	100		

⁸ Queried with laboratory. Lower storage limit % value utilised in MEDLI for air dry moisture.

9.8 Vegetation/Planting Parameters

The proposed irrigation area is currently vegetated with a mix of grasses. Some of these are identified as;

- Kikuyu;
- Green Panic; and
- Ryegrass.

It is proposed that the area remain vegetated with a similar mix of tropically suited C4 grasses (defined as warm weather grasses) that are readily available and suitable to the Queensland climate.

Often seed mixes such as kikuyu /ryegrass blend provide fast germination (ryegrass) and protect the existing kikuyu whilst it develops and also provide for year round green cover.

If the area requires seeding after the installation of drip irrigation, a kikuyu blend product such as this is recommended as this modelled for the best nutrient removal for effluent irrigation from the options provided.

A coastal couch is not recommended due to the lack of nutrient uptake which can lead to increased nutrient leaching below the root zone. This is discussed further in Section 10.4.

A comparison between Kikuyu and Ryegrass was used in the MEDLI scenarios.

9.9 Proposed Harvest Scheme

There is no harvest scheme currently in place due to the agistment of cattle.

Whilst 'Harvest' is an agricultural term, the purpose of this section is to outline the expectations of the irrigation system as a form of treated effluent disposal.

With irrigation of treated effluent there is an addition of nutrients to the irrigation area from the source water. These nutrients are taken up by the vegetation in its growth cycle. The clippings from the vegetation need to be removed from the irrigation area so that the nutrients in the decaying vegetation do not return to the soil and overload the irrigation area. This is known as a 'cut and cart' system and is modelled as such within MEDLI.

The 'harvest' scheme proposed is mowing with a catcher to remove clippings to elsewhere on the property. These can be used for compost or mulching of garden beds or removed to offsite green waste. It is recommended an estimate of removal of biomass (clippings) be kept to assess the sustainability of the system in future.

A reasonable expectation of an irrigated area harvest requirement is summer mowing every 6 weeks with winter mowing every 6-12 weeks.

9.10 Summary of MEDLI model scenarios conducted

A summary of the MEDLI scenarios modelled and the outputs produced is detailed in Table 13.

Table 13: Summary of MEDLI Scenario Outputs

Parameter	Units	No Irrigation Scenario		Average Daily Aggregate Effluent discharge (25kl/day)		Max Effluent Discharge (35kl/day)	
Daily Flow	kL	0		25		35	
Irrigation Rate	mm/day	0		3.5		3.5	
	MEDLI outputs						
Crop		Kikuyu	Ryegrass	Kikuyu	Ryegrass	Kikuyu	Ryegrass
Irrigation	mm/year	0	0	911	911	1,222	1,222
Irrigation Volume	kL/year	0	0	9,110	9,110	12,216	12,216
TN Leached	kg/ha/year	0.29	1.17	0.43	2.1	0.5	7.26
TP Leached	kg/ha/year	0.00003	0.00004	0.03	0.05	0.06	0.10
Deep Drainage	mm/year	275	373	965	1,189	1,268	1,502
Annual Shoot DM Yield	kg/ha/year	4,030	5,113	19,136	17,045	22,157	18,613
Avg Normal Harvests per year	-	0.3	0.9	3.4	4.4	4.0	4.8
Avg Crop Deaths per year	No./year	2.04	2.16	0.00	0.02	0.00	0.00
Avg Annual nitrogen deficiency index	coefficient ⁹	0.73	0.61	0.54	0.24	0.44	0.11
Avg January temperature stress index	coefficient	0.00	0.46	0.00	0.46	0.00	0.46
Avg July temperature stress index	coefficient	0.55	0.01	0.55	0.01	0.55	0.01
Avg monthly water stress index	coefficient	0.21	0.18	0.00	0.00	0.00	0.00
Avg monthly water logging index	coefficient	0.00	0.00	0.00	0.00	0.00	0.00
Relative Crop Yield due to salinity	fraction	-	-	1.00	1.00	1.00	1.00
Comments		No Irrigation baseline		Appropriate on site scenario		Excessive Overflows with a Tank Vol of 90kL. This over estimates the water quantity produced.	

⁹ 0 = no stress, 1 = full stress (crop death)

10. MODEL OUTPUTS

10.1 Climate Diagnostics

The run period indicates a distinct wet and dry season typical of Queensland climate with an average annual rainfall of ~1200 mm. Net evaporation (Evaporation – Rainfall) over a year is approximately 382 mm or ~1.0 mm/day.

Rainfall is lower than evaporation for 9 months of the year (July to January), then a small net evaporation in March & April, and rainfall is slightly higher than evaporation in February and May.

10.2 Pond (Tank) Diagnostics

With the proposed irrigation cut off of 20 mm rainfall, the wet weather storage starts to fill if this volume of rainfall is exceeded and irrigation is stopped, or the inflow to the treatment plant is higher than average.

The irrigation is set to 3.5 mm/day which is a slightly higher rate than required for the daily aggregate average of 25 kL/day, but only just enough to use as the daily rate when modelled at 35 kL/day, for the land parcel size available at 10,000 m³ (1 ha).

In peak periods where treated effluent is produced above the allowable irrigation volume, this is stored until the following days where irrigation can occur to 'catch up' on the treated effluent produced.

When modelled at the daily aggregate effluent discharge rate of 25 kL/day, the effluent overflow release to waters is at 1 event per year, with an average volume of 22 kL/year.

When modelled at the daily average effluent discharge of 35 kL/day, an effluent overflow release is to waters is an evident 12 times per year, with an average volume of 566 kL/year.

The overflows described in the MEDLI model are not accurate for the dual release system proposed. MEDLI is not able to model the controlled release to waters of up to 100 kL as proposed. MEDLI only models the overtopping of the tank (what is unable to be held when tank is at maximum capacity). The model assumes the tank is full, even after high rainfall days, whereas after controlled release to waters the tank can be empty.

The volume of releases to the creek are more accurately calculated in the water balance and discussed in that section.

The water balance provides more detailed calculations for effluent discharge to waters; it can be assumed that the data provided in the water balance is more realistic to that gained from MEDLI.

10.3 Irrigation Diagnostics

According to MEDLI, the irrigation effluent is available when required by the system and the proportion of irrigation days prevented is very low (0.04).

This is overestimated as described in Section 8 and Section 10.2.

10.4 Nutrient Leaching

The total phosphorus leaching is low in both the Kikuyu (0.03 kg/ha/year) and Ryegrass (0.05 kg/ha/year) scenarios using the overall average aggregated effluent discharge data of 25 kL/day. It is also low in maximum discharge scenario at 35 kL/day, at 0.06 kg/ha/year and 0.1 kg/ha/year respectively.

The total nitrogen leaching is low in both the Kikuyu ((0.43 kg/ha/year) and Ryegrass (2.1 kg/ha/year) scenarios using the overall average aggregated effluent discharge data of 25 kL/day.

When modelling the scenario at 'maximum effluent discharge' at 35 kL/day, kikuyu grass shows very little difference in nitrogen leaching when comparing to the 25 kL/day scenario (0.5 kg/ha/year compared to 0.43 kg/ha/year). Ryegrass pastures shows an increase in nitrogen leaching, to 7.26 kg/ha/year.

As the vegetation on site is a mixed sward, and is purchased and applied to the soil as a blend variety, the actual leaching values are likely to be an average between these two values.

Kikuyu and Ryegrass are blended together to provide full ground coverage and complement each other when the temperature profiles change through the seasons. Kikuyu thrives during summer and Ryegrass thrives during winter. This ensures the sward is in a viable and healthy state for nutrient uptake at all times.

It must also be noted that the groundwater on-site is quite deep. It appears that the risk of leaching to groundwater is very low. It should be noted that MEDLI modelling indicates deep drainage as anything below the soil profile modelled or approximately 2 metres deep. The groundwater in the area is greater than 36 m below the surface.

10.5 Deep drainage

The deep drainage for the irrigated scenarios is approximately 3 times that for the non-irrigated scenario.

The MEDLI model, however, does not take into account the proposed effluent release to waters during high rainfall periods, so the application of treated effluent in the model is higher than proposed.

The deep drainage will therefore be lower than that predicted in the models. This will vary dependent on the rainfall, as high rainfall years will result in higher releases to the tributary of the creek than lower rainfall years.

It must also be noted that the groundwater on-site is quite deep. It appears that the risk of leaching to groundwater is very low. It should be noted that MEDLI modelling indicates deep drainage as anything below the soil profile modelled or approximately 2 metres deep. The groundwater in the area is greater than 36 m below the surface.

10.6 Vegetation Health

A successful irrigation system relies on a healthy and robust crop cover to perform appropriately. In this section the model is assessed to determine plant health and sustainability.

For the non-irrigated scenario there are ~30 days with no Kikuyu crop cover due to plant stress, with the major factor being nitrogen deficiency (0.73) and other factors of temperature stress (0.55) and water stress (0.21).

For both the irrigated scenarios using 25 kL/day and 35 kL/day there was no period of loss of crop cover, and many reduced stress coefficients. Nitrogen deficiency was reduced (to 0.54 and 0.44, respectively) and no water stress was recorded.

Crop deaths per year were reduced from 2.04 and 2.16 for Kikuyu and Ryegrass with no irrigation to either 0.02 (once every 50 years) or 0.00 (no crop deaths) in the irrigated scenarios.

The average harvests predicted per year range between 3 and 5, this correlates with the predicted harvest scenario of 6-8 weekly in the summer growth periods and no harvest requirement in the dormant winter period, and is therefore a reasonable prediction.

The dry matter yield predicted for the irrigated scenarios is approximately 20 tonne/year, this is significant increase in comparison with ~5 tonne/year for the non-irrigated scenario. The site has not previously recorded the quantity of harvest that occurs on the proposed irrigation area, however this value correlates with expected herbage mass in non-irrigated areas and the increase is evident of healthy vegetation with no water stress

In some situations the application of salts from the irrigation water can result in reduced crop yield due to salinity. The MEDLI models indicated that no yield reduction is expected in any of the scenarios performed.

No scenario indicated water logging stress, indicating that the irrigation rates utilised are suitable for the soil and vegetation described.

These indicators demonstrate that the vegetation modelled is suitable for the location, soil and irrigation water applied.



11. IRRIGATION INSTALLATION & IMPLEMENTATION FACTORS

11.1 Irrigation System

For soil described as loams to light clays, the drip irrigation system needs to be installed in an adequate depth of topsoil (minimum 150mm) of ~200 mm of imported good quality topsoil to slow the soakage and assist with nutrient reduction.

Installation of the irrigation system should also include suitable practices such as;

- a) Installation to occur when soils are dry or slightly moist;
- b) Avoiding heavy equipment on application area when soils are moist or wet;
- c) Preparing the surface of soil and the addition of top soil over drip irrigation pipes.

11.2 Buffer distances/Setbacks

The Queensland Plumbing and Wastewater Code (2011) provides guidance on setback distances for subsurface land application areas for on-site sewage treatment plants in.

The irrigation area has been calculated taking into account ~5m **minimum** buffer distances to boundaries and buildings.

Table 14: Excerpt of Table T4 of the Qld Plumbing and Wastewater Code (2011)

Setback distances for Subsurface land application area for on-site STP's (metres)			
Feature	Upslope	Downslope	Level
Property boundaries, pedestrian paths, footings of buildings, walkways, recreation areas and retaining walls.	2	4	2

AS1547:2012 also provides guidance on the risk assessment of buffer distances. The guideline values and the buffers able to be provided are outlined in Table 15.

Table 15: Setback distance guidelines and provided values

Setback distances for Subsurface land application area for on-site STP's (metres)		
Feature	Guideline (Low - High Risk)	Provided
Property boundaries	1.5-50	5
Buildings	2-6	>5
Surface Water	15-100	>100
Bore, well	15-50	>300 ¹⁰
In ground water tank ¹¹	4-15	>5
Retaining walls, embankments, escarpments, cuttings	3	>5
Groundwater	0.6-1.5	>30 ¹²
Hardpan or bedrock	0.5-1.5	>0.5

11.3 Boundaries

Boundaries of the irrigation area must be clearly delineated by an appropriate vegetative border, fence or other delineation. In this case two edges of the proposed irrigation area have existing boundary fencing. Internal fencing on the southerly and easterly side of the proposed irrigation area will need to be relocated from its current position.

11.4 Slopes

The Design Irrigation Rate (DIR) used in this modelling was based on applicable areas of land from flat to 10% slope. Greater than 10% slope will result in a reduction of the allowable irrigation rate.

The proposed irrigation land has a gentle fall to the north-west at 3-5% slope from site contours

11.5 Run-on/run-off protection

Currently the proposed irrigation area receives stormwater run-off via overland flow from the caravan park surface areas and internal roads due to the natural contours of the land.

To ensure stormwater does not enter the proposed irrigation area and creating additional hydraulic load and possible erosion; drainage and stormwater re-direction is recommended. This can be as a suitable reverse camber and/or drainage along the upper side of the proposed irrigation area, along the southern side of the land parcel. This will reduce overland flow entering the irrigation land parcel, and provide greater control of stormwater onsite.

¹⁰ Registered bores (may or may not be in use)

¹¹ No groundwater bores were observed during site inspection, however as these are in-ground they may be present.

¹² Estimated based on local bore logs

Currently, the proposed irrigation area directs stormwater to the north-west corner of the property. The north-west corner has not been included in the proposed irrigation area as it is not suitable, and to avoid water logging in this area.

11.6 Overflow protection

It is proposed that the current licenced effluent release point to remain in the same location, and continue to be utilised as the water release point for the wet weather storage tank during peak rainfall periods. The water balance demonstrates minimal effluent release to waters, releasing predominately at times of significant rainfall where effluent is diluted.

11.7 Site works

A portion of the proposed irrigation area close to the STP has not been utilised in calculating the irrigation area, as it has been set aside to leave room for the install of the required wet weather storage. Detailed design and drawings of these works is not within the scope of this investigation.

11.8 Irrigation Control & Rainfall

The modelling and water balance in this investigation make decisions based on the rainfall experienced on site.

A suitable irrigation flow meter, rain gauge and manual monitoring procedure to record both the rainfall and the irrigation rates will be required to monitor the sustainability of the scheme.

11.9 Wet Weather Storage

It is recommended the wet weather storage is in the form of enclosed tank/s, to avoid rainwater infiltration, and this setting has been utilised in the MEDLI models.

Poly water tanks typically only come off the shelf in sizes up to ~45 - 50 kL therefore multiple tanks will need to be utilised. As 90 kL of wet weather storage has been recommended based on the STP configuration, 2 x ~46,400L tanks are required.

Steel water tanks are available in much larger sizes and thus may not require multiple tanks to achieve the wet weather storage required.

11.10 Soil Management

As addressed, suitable soil management practices need be employed to ensure the longevity of the irrigation land parcel.

This should entail ongoing soil monitoring and observations.

The application of organic mulch (such as bark or straw) can provide organic content to the soil and maintain and improve soil quality.

Soil amelioration and the application of gypsum should be carried out to prevent clay dispersion, nominally for the sodic subsoil.

12. CONCLUSIONS AND RECOMMENDATIONS

12.1 Treated Effluent Quantity

Initial assessment of the climate and soil data for the proposed irrigation area found that the application of all the treated effluent to land was not sustainable for this location. This was due to the combination of the available land for irrigation, quantity of final effluent and the soil profile in the proposed irrigation area.

The current method of treated effluent disposal in the Environmental Authority is via release to waters through an outlet pipe that gravity feeds the treated effluent under easements to a tributary of Coolnwynpin Creek at 6.5km AMTD.

The current Environmental Authority includes the condition “*The total quantity of treated effluent released from Release Point Number W1 during any dry weather day must not exceed 100 cubic metres and during any wet weather day must not exceed 250 cubic metres.*”

The site rarely reaches the treated effluent discharge limits outlined in the current Environmental Authority, with an average aggregate daily discharge recorded of 25 cubic metres per day ($\text{m}^3/\text{day}^{13}$).

The tributary has been described as ephemeral or intermittent, and as such the treated effluent released during dry weather does not experience dilution until it reaches further downstream in the tributary of Coolnwynpin creek.

12.2 Proposed release strategies

Irrigation to land as a singular effluent disposal method is not recommended as it is not sustainable for this location due to the limited land availability, effluent quality and the soil profile in the proposed irrigation area.

It is therefore recommended that a combination of disposal techniques be employed; effluent disposal through land irrigation during dry weather periods, and effluent discharge to the creek in times of rainfall greater than 40mm.

Natural flow rates of the creek were not available and therefore mass loadings were unable to be calculated. An estimated dilution factor was calculated based on initial storm losses for the latitude and longitude of the site. This was used to provide a reasonable and practical rainfall threshold to allow release to the creek.

The quantity of release suggested is a conservative value based on the current condition C4 in the Environmental Authority, historical flow data from the site and sizing of the proposed wet weather storage.

By adopting both techniques, this would:

1. Reduce the requirement for the site to invest in significant wet weather storage;
2. Reduce the hydraulic load to the irrigation area;
3. Reduce both the potential for deep drainage on-site (well below that was modelled); and,
4. Reduce the potential nitrogen and phosphorus leaching into the groundwater within the proposed irrigation area;
5. Reduce the irrigation rate to below the maximum allowable rate of 3.5mm.

¹³ m^3/day is equivalent to kL/day

Additionally, as the tributary of Coolnwynpin creek is described as ephemeral, reducing the amount of treated effluent released to system to only occur during high rainfall will provide stormwater dilution to the treated effluent.

A further reduction in water use on site via a water reduction program is recommended. This may include actions such as;

- a. Installation of water efficient taps and shower heads;
- b. Education program for caravan park tenants and users;
- c. Leak detection programs.

An irrigation management plan is also recommended. This will provide guidelines for effluent disposal in a safe, manageable and sustainable approach. This should also include soil management practices, such as the application of organic mulch (bark or straw) to provide organic content to the soil, soil amelioration and gypsum applications to prevent clay dispersion and reduce the soil sodicity.

12.3 Treated effluent quality

The tributary has been described as ephemeral or intermittent, and as such the treated effluent released has the potential to cause environmental harm due to high levels of nutrients.

From January to May 2018 the site experienced average total nitrogen levels of 22 mg/l. However from June 2018 to January 2019 average nitrogen levels increased to 39 mg/L.

Simmonds & Bristow conducted a site visit in late 2018 and provided a nitrogen investigation report detailing a review of the process units and modifications or rectifications required to repair damage and improve performance.

Following the investigation, Greenacres Caravan Park has been implementing several changes to their process to reduce the nutrient concentrations in the STP final effluent and improve disinfection including the following:

1. Changing chlorine tablets to avoid additional nitrogen being added to the final effluent as cyanurate
2. Conversion from tablet chlorination to liquid sodium hypochlorite dosing
3. Installation of baffles into the chlorine contact tank to prevent flow short circuiting and increase the contact time
4. Installation of a final effluent filter to reduce suspended solids and lower the chlorine demand
5. Installation of a pre-anoxic tank prior to the trickling filter to achieve further nitrogen removal.

Further changes, including refitting the trickling filter are underway to further improve effluent quality.

Recent results from March and April 2019 indicate these improvements have had some affect with improvements in disinfection, suspended solids and nitrogen removal evidenced.

It is recommended to further improve the nutrient concentrations in the treated effluent:

1. Education for phosphorus containing soaps and detergents for tenants and visitors;
2. Complete improvement works on the STP, particularly the trickling filter;

13. REFERENCES

- Department of Natural Resources. (1997). *Salinity Management Handbook*. Coorparoo: State of Queensland.
- Dept Environment & Science (DES). (2017). *Model operating conditions ERA 63 Sewage Treatment*. Qld Government.
- Dept Environment & Science. (2018). *Model Operating Conditions - ERA 63 - Sewage Treatment*. Qld Govt.
- Dept of Environment and Heritage Protection (DEHP). (2013). *Queensland Water Quality Guidelines 2009*. State of Queensland.
- Dept of Environment and Heritage Protection (DEHP). (2016). *Technical Guideline for Wastewater Release to Queensland Waters*. State of Queensland.
- Dept of Science, Information Technology and Innovation (DSITI). (2016). *MEDLI User Manual Version 2*. Department of Science, Information Technology and Innovation (DSITI).
- (2011). *Queensland Plumbing and Wastewater Code*. State of Queensland.
- Hazelton, P. and Murphy, B. (2007). *'Interpreting Soil Test Results'* CSIRO Publishing, Collingwood, VIC.
- McKenzie, N., Jacquier, D., Isbell, R., Brown, K. (2004). *Australian Soils and Landscapes – An Illustrated Compendium*. CSIRO Publishing, Collingwood, VIC.
- Soil Quality (2011). *New South Wales Colwell Phosphorus (0 – 10 cm)*. Soil Quality Pty Ltd 2016. <http://soilquality.org.au/au/nsw/examine/state/colwell-phosphorus-0-10>
- Standards Australia. (2012). *AS1547:2012 On-site domestic wastewater management*. Standards Australia.

GLOSSARY OF TERMS

Term	Definition
ADWF	Average dry weather flow
Alum	Aluminium sulphate ($\text{Al}_2\text{SO}_4 \cdot 14\text{H}_2\text{O}$)
BOD ₅	5-day biochemical oxygen demand
COD	Chemical oxygen demand – a measure of all oxidisable material within a sample of water.
Conductivity	A measure of the salt content of a water sample
DO	Dissolved oxygen
<i>E. coli</i>	<i>Escherichia coli</i> , a Gram-negative, facultatively anaerobic, rod-shaped bacterium of the genus <i>Escherichia</i> that is commonly found in the lower intestine of warm-blooded animals (e.g. Humans). Used as an indicator of faecal contamination
EIS	Environmental impact assessment
EMPs	Environmental management programs
EPPs	Environmental protection policies
ERA	Environmentally relevant activity (Specific to Queensland legislation, may also be used for Environmental Risk Assessment)
Thermotolerant Coliforms	A range of coliform bacteria generally used as an indicator of faecal contamination.
Nitrate	An oxide of nitrogen with the molecular formula NO_3^-
Nitrite	An oxide of nitrogen with the molecular formula NO_2^-
Nm ³ /hr	“Normal” cubic meters per hour – a measure of air flow normalised to 20°C and one atmosphere of pressure
Orthophosphate	A form of phosphorus with the formula PO_4 . It is biologically available for use by plants, algae and bacterium.
PDWF	Peak dry weather flow – the peak flow that is expected to enter the plant during dry weather. Is often assumed to be 3x the ADWF.
PWWF	Peak wet weather flow – the flow that is expected to enter the plant during a wet-weather event. Is often assumed to be 5x the ADWF
REF	Review of environmental factors

Term	Definition
SDS	Safety data sheet
STP	Sewage treatment plant (may also refer to Standard Temperature and Pressure)
TDS	Total dissolved solids. Generally a measure of salt concentration or salinity. May be converted to conductivity using a conversion factor
TKN	Total kjeldahl nitrogen – a measure of the Organic nitrogen plus Ammonia nitrogen
TN	Total nitrogen - the concentration of organic plus inorganic nitrogen
TOG/FOG	Total oil and grease/ Fats, oil and grease
TP	Total phosphorus - the concentration of organic plus inorganic phosphorous
TSS	Total suspended solids
UV	Ultra violet light – an invisible light at a wavelength ranging between 10nm to 400nm
WTP	Water treatment plant
WWTP/WwTP	Wastewater treatment plant

APPENDIX A:
Laboratory Analytical Soil Data

AGRICULTURAL SOIL ANALYSIS REPORT

3 samples supplied by Simmonds and Bristow on 21st March, 2019. Lab Job No.H9856

Analysis requested by Fiona Milnes. Your Job: PO C903004a

Unit 2A 40 Reginald St ROCKLEA QLD 4106

Samples supplied by Simmonds and Stow on 21st March, 2019. Lab 000 R06-19000
 Analysis requested by Fiona Milnes. Your Job: PO C903004a

Unit 2A 40 Reginald St ROCKLEA QLD 4106

		Sample ID:	Sample 1 Top soil Composite (Sites A-E)	Sample 2 Sub soil Composite X	Sample 3 Sub soil Composite Y
		Crop:	--	--	--
		Client:	F.Milnes	F.Milnes	F.Milnes
	Parameter	Method reference	H9856/C1	H9856/C2	H9856/C3
	Phosphorus (mg/kg P)	**Rayment & Lyons 2011 - 9B2 (Colwell)	23	6.9	4.9
	Nitrate Nitrogen (mg/kg N)	APHA 4500 NO ₃ ⁻ -F	12	--	--
	Ammonium Nitrogen (mg/kg N)	APHA 4500 NH ₃ -H	22	--	--
	Phosphate (mg/L P)	APHA 4500 P-G	6.3	--	--
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	7.02	--	--
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.201	--	--
	Chloride Estimate (equiv. mg/kg)	**Calculation: Electrical Conductivity x 640	129	--	--
	Exchangeable Calcium (cmol _e /kg) (kg/ha) (mg/kg)	**Rayment & Lyons 2011 - 15A1 (1M NH ₄ Cl)	12.47	2.63	0.57
			5600	1179	255
			2500	526	114
	Exchangeable Magnesium (cmol _e /kg) (kg/ha) (mg/kg)		1.77	1.16	1.24
			483	315	337
			216	141	150
	Exchangeable Potassium (cmol _e /kg) (kg/ha) (mg/kg)		0.34	<0.12	<0.12
			301	<112	<112
			134	<50	<50
	Exchangeable Sodium (cmol _e /kg) (kg/ha) (mg/kg)		0.38	0.30	0.58
			197	155	296
			88	69	132
Effective Cation Exchange Capacity (ECEC) (cmol _e /kg)	**Calculation: Sum of Ca,Mg,K,Na (cmol _e /kg)	14.97	4.20	2.46	
Calcium (%)	**Base Saturation Calculations - Cation cmol _e /kg / ECEC x 100	83.3	62.5	23.1	
Magnesium (%)		11.9	27.6	50.4	
Potassium (%)		2.3	2.8	3.1	
Sodium - ESP (%)		2.6	7.2	23.4	
Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol _e /kg)	7.0	2.3	0.5	
Total Nitrogen (%)	Inhouse S4a (LECO Trumac Analyser)	0.18	--	--	
Total Organic Carbon (%)	LECO Trumac Analyser - Inhouse S15b	3.55	--	--	
Estimated Organic Matter (% OM)	**Calculation: Total Organic Carbon x 1.75	6.2	--	--	
Soil Texture	**AS1547-2012 (Based on Northcote 1979)	Clay Loam	Fine Sandy Clay Loam	Clay Loam	
Moisture Content (%)	**Inhouse S2 (105°C)	23.78	14.86	14.07	
Moisture Content (%)	**Inhouse (40°C)	20.25	12.76	13.68	
Bulk Density (t/m ³)	**AS4419-2003	1.36	1.63	1.60	

AGRICULTURAL SOIL ANALYSIS REPORT

3 samples supplied by Simmonds and Bristow on 21st March, 2019. Lab Job No.H9856

Analysis requested by Fiona Milnes. Your Job: PO C903004a

Unit 2A 40 Reginald St ROCKLEA QLD 4106

Sample ID:	Sample 1 Top soil Composite (Sites A-E)	Sample 2 Sub soil Composite X	Sample 3 Sub soil Composite Y
Crop:	--	--	--
Client:	F.Milnes	F.Milnes	F.Milnes
	H9856/C1	H9856/C2	H9856/C3

Parameter	Method reference	H9856/C1	H9856/C2	H9856/C3
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Notes:

- All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
- Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia*. CSIRO Publishing: Collingwood.
- Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
- 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
- Guidelines for phosphorus have been reduced for Australian soils.
- Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
- Total Acid Extractable Nutrients indicate a store of nutrients.
- 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.
- Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
- Conversions for 1 cmol./kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
- Conversions to kg/ha = mg/kg x 2.24
- The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
- ** NATA accreditation does not cover the performance of this service.
- Analysis conducted between sample arrival date and reporting date.
- This report is not to be reproduced except in full. Results only relate to the item tested.
- All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions. These Terms and Conditions are available on the EAL website: scu.edu.au/eal, or on request.

Quality Checked: Kris Saville
 Agricultural Co-Ordinator

KS

AGRICULTURAL SOIL ANALYSIS REPORT

3 samples supplied by Simmonds and Bristow on 21st March, 2019. Lab Job No.H9856

Analysis requested by Fiona Milnes. Your Job: PO C903004a

Unit 2A 40 Reginald St ROCKLEA QLD 4106

Sample ID:

Crop:

Client:

Heavy Soil	Medium Soil	Light Soil	Sandy Soil
Clay	Clay Loam	Loam	Loamy Sand

	Parameter	Method reference	Indicative guidelines - refer to Notes 6 and 8			
	Phosphorus (mg/kg P)	**Rayment & Lyons 2011 - 9B2 (Colwell)	80	50	45	35
	Nitrate Nitrogen (mg/kg N)	APHA 4500 NO ₃ -F	15	13	10	10
	Ammonium Nitrogen (mg/kg N)	APHA 4500 NH ₃ -H	20	18	15	12
	Phosphate (mg/L P)	APHA 4500 P-G	10.0	8.0	8.0	7.0
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	6.5	6.5	6.3	6.3
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.200	0.150	0.120	0.100
	Chloride Estimate (equiv. mg/kg)	**Calculation: Electrical Conductivity x 640	..	..	..	..
	Exchangeable Calcium (cmol _e /kg) (kg/ha) (mg/kg)	**Rayment & Lyons 2011 - 15A1 (1M NH ₄ Cl)	15.6	10.8	5.0	1.9
			7000	4816	2240	840
			3125	2150	1000	375
	Exchangeable Magnesium (cmol _e /kg) (kg/ha) (mg/kg)		2.4	1.7	1.2	0.60
			650	448	325	168
			290	200	145	75
	Exchangeable Potassium (cmol _e /kg) (kg/ha) (mg/kg)		0.60	0.50	0.40	0.30
			526	426	336	224
			235	190	150	100
	Exchangeable Sodium (cmol _e /kg) (kg/ha) (mg/kg)		0.3	0.26	0.22	0.11
			155	134	113	57
			69	60	51	25
Effective Cation Exchange Capacity (ECEC) (cmol _e /kg)	**Calculation: Sum of Ca,Mg,K,Na (cmol _e /kg)	20.1	14.3	7.8	3.3	
Calcium (%)	**Base Saturation Calculations - Cation cmol _e /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	
Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol _e /kg)	6.5	6.4	4.2	3.2	
Total Nitrogen (%)	Inhouse S4a (LECO Trumac Analyser)	> 0.30	> 0.25	> 0.20	> 0.15	
Total Organic Carbon (%)	LECO Trumac Analyser - Inhouse S15b	< 0.5 (Very Low); 0.5–1.5 (Low); 1.5–2.5 (Medium); 2.5–5.0 (High); > 5.0 (Very High)				
Estimated Organic Matter (% OM)	**Calculation: Total Organic Carbon x 1.75	> 5.5	>4.5	> 3.5	> 2.5	
Soil Texture	**AS1547-2012 (Based on Northcote 1979)	..				
Moisture Content (%)	**Inhouse S2 (105°C)	..				
Moisture Content (%)	**Inhouse (40°C)					
Bulk Density (t/m³)	**AS4419-2003	> 0.7				

AGRICULTURAL SOIL ANALYSIS REPORT

3 samples supplied by Simmonds and Bristow on 21st March, 2019. Lab Job No.H9856

Analysis requested by Fiona Milnes. Your Job: PO C903004a

Unit 2A 40 Reginald St ROCKLEA QLD 4106

Sample ID:	Heavy Soil	Medium Soil	Light Soil	Sandy Soil
Crop:				
Client:	Clay	Clay Loam	Loam	Loamy Sand

Parameter	Method reference	Indicative guidelines - refer to Notes 6 and 8
-----------	------------------	--

Notes:

- All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
- Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia*. CSIRO Publishing: Collingwood.
- Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
- 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
- Guidelines for phosphorus have been reduced for Australian soils.
- Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
- Total Acid Extractable Nutrients indicate a store of nutrients.
- 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.
- Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
- Conversions for 1 cmol_e/kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
- Conversions to kg/ha = mg/kg x 2.24
- The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
- ** NATA accreditation does not cover the performance of this service.
- Analysis conducted between sample arrival date and reporting date.
- This report is not to be reproduced except in full. Results only relate to the item tested.
- All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions. These Terms and Conditions are available on the EAL website: scu.edu.au/eal, or on request.

Quality Checked: Kris Saville
 Agricultural Co-Ordinator

KS



SOIL HYDRAULIC PROPERTIES

3 samples supplied by Simmonds and Bristow on 21st March, 2019. Lab Job No.H9856

Analysis requested by Fiona Milnes. Your Job: PO C903004a

Unit 2A 40 Reginald St ROCKLEA QLD 4106

Client id	EAL lab code	Worksheet id to view soil moisture retention curve	Bulk Density (t DW/m³)	USDA			van Genuchten parameters								Available water capacity assuming FC is at 10 kPa	Available water capacity assuming FC is at 33 kPa
				%Sand	%Silt	%Clay	(for WAVES, HYDRUS etc)					Field capacity (10 kPa)	Field capacity (33 kPa)	Permanent wilting point (1500 kPa)		
				from hydrometer determinations			thetaR	thetaS	alpha	n	Ksat (cm/day)	from Rosetta pedotransfer functions in RETC				
Top soil Composite (Sites A-E)	H9856/C1	1	1.36	37.2	39.5	23.2	0.0693	0.4218	0.0091	1.5301	14.24	35%	25%	10%	26%	16%
Sub soil Composite X	H9856/C2	2	1.63	44.6	40.7	14.7	0.0442	0.3393	0.0161	1.3967	9.29	26%	19%	8%	18%	11%
Sub soil Composite Y	H9856/C3	3	1.60	32.3	49.9	17.8	0.0532	0.3511	0.009	1.4962	7.05	29%	22%	8%	22%	14%

Notes:

1: The Hydrometer Analysis method was used to determine the percentage sand, silt and clay under the USDA soil classification, based on SOP meth004 (California Dept of Pesticide Regulation), using hydrometer method of Gee & Bauder. Reference:

Gee GW & Bauder JW (1986) Particle-size Analysis. In *Methods of Soil Analysis, Part 1. Physical and Mineralogical Methods*

- Agronomy monograph no. 9 (Second Edition), American Society of Agronomy-Soil Science Society of America, WI

2. Predicted van Genuchten soil water retention curve (SWRC) parameters are derived from Rosetta pedotransfer routines within RETC. References:

Rosetta: Schaap MG (2001) 'ROSETTA', Version 1.2, US Salinity Laboratory ARS-USDA, Riverside CA.

Rosetta software is incorporated into RETC software: van Genuchten, M. T., Simunek, J., Leij, F. J. & Sejna, M. (2000). RETC ("RETention Curve")

- Code for Quantifying the Hydraulic Functions of Unsaturated Soils. Riverside, CA, US Salinity Laboratory, USDA, ARS.

Environmental Analysis Laboratory, Southern Cross University,
Tel. 02 6620 3678, website: scu.edu.au/eal

checked:
Graham Lancaster
Laboratory Manager

MEDLI P ADSORPTION ISOTHERM PARAMETER CALCULATOR

Algorithms from HSPF (Johnson et al., 1984) and described fully in the MEDLI Version 2.0 Manual

Excel version by Alison Vieritz, NRS, NR&M [09/2002]

1 Colwell P

Analyse the sample for sodium bicarbonate extractable P (Colwell-P) in a solution to soil mixture. Enter the Colwell P in mg/kg solution and the solution to soil ratio used.

2 Isotherm Data

P sorption curve is performed on dried (40°C) soil samples ground to <2mm. The soil is then equilibrated with a solution containing 0.01 M CaCl₂ and phosphorus (added as KH₂PO₄) ranging in concentration from 20 to 1600 mgP/kg (six data points on the curve). A soil to solution ratio of 1:10 is used and each sample is shaken end-over-end at 30 rpm for 18 hr at 25°C, before centrifuging at 2000 g for 30 minutes. The supernatant solution P concentration is then read by Auto Analyser using the procedure of Warrell and Moody (1984). This measure is then used to calculate the amount of extra phosphorus (mg/kg) that can be adsorbed by the soil at each equilibrium solution P concentration (P_{added ads}). For each equilibrium solution P concentration (mg/L):

$$\text{Total sorbed P (mg/kg)} = P_{\text{added ads}} + \text{Colwell-P}$$

3 Linear regression of Ln(X) and Ln(Y)

The X (P Equilibrium concentration in mg/L) and Y (P sorbed in mg/kg) data is then fitted to the equation:

$$Y = AX^B \text{ by linear regression of } \ln(Y) = a\ln(X) + b$$

where $b = \ln(A)$ and $a=B$.

A = MEDLI adsorption coefficient

B = MEDLI adsorption exponent

Check the fit shown by the graph.

4 MEDLI Parameters

The MEDLI adsorption coefficient, adsorption exponent, desorption exponent are then estimated. In the absence of a desorption isotherm the desorption exponent is assumed to be 95% of the adsorption exponent to allow conservatively a very minor hysteresis effect.

MEDLI P ADSORPTION ISOTHERM PARAMETER CALCULATOR

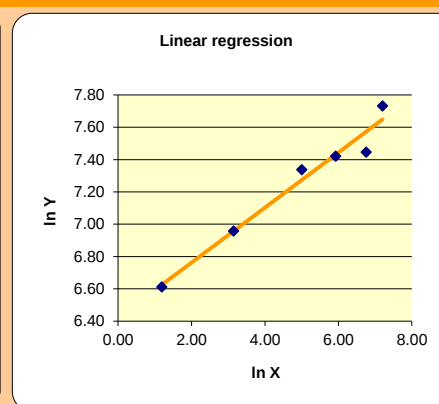
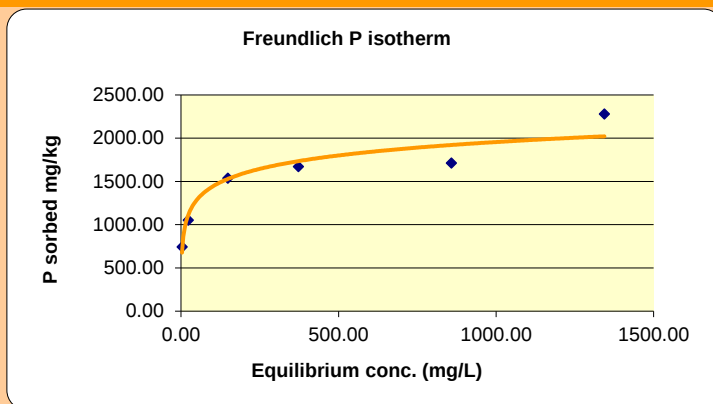
Input data in white cells only

1 Colwell P

Colwell P mg/kg solution	Solution:soil ratio
23	10

2 Isotherm Data

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
54.74	3.30	744.48
105.30	23.13	1051.64
279.44	148.76	1536.88
517.04	372.92	1671.15
1006.58	858.29	1712.88
1548.91	1343.91	2280.00



3 Linear regression of Ln(X) and Ln(Y)

The linear regression equation uses the form $y=ax+b$

a	b	Equation is	r^2
0.1702	6.4223	$y = 0.1702x + 6.4223$	0.9660

4 MEDLI Parameters

MEDLI's isotherm equation $Y=AX^B$ is shown on the graph above.

Adsorption Coefficient (A)	615.43
Adsorption Exponent (B)	0.1702
Desorption Exponent	0.1617

Example 1 Orig soln	Soln dilution	soln:soil ratio ?
50	54.74	0.913355449
100	105.30	0.949701889
250	279.44	0.89463459
500	517.04	0.9670456
1000	1006.58	0.993464296
1500	1548.91	0.968425331
	avg	0.947771193

MEDLI P ADSORPTION ISOTHERM PARAMETER CALCULATOR

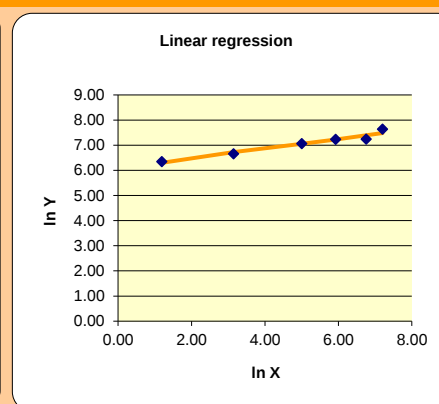
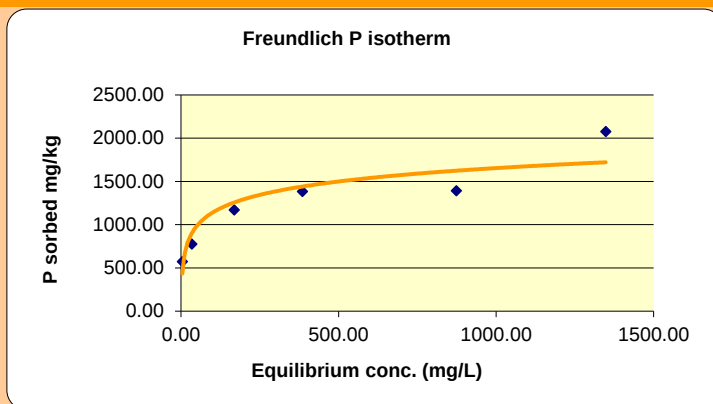
Input data in white cells only

1 Colwell P

Colwell P mg/kg solution	Solution:soil ratio
6.9	10

2 Isotherm Data

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
54.74	4.29	573.53
105.30	34.46	777.38
279.44	169.15	1171.90
517.04	385.43	1385.10
1006.58	874.16	1393.16
1548.91	1348.01	2078.00



3 Linear regression of Ln(X) and Ln(Y)

The linear regression equation uses the form $y=ax+b$

a	b	r^2
0.2058	5.9998	0.9467

Equation is $y = 0.2058x + 5.9998$

4 MEDLI Parameters

MEDLI's isotherm equation $Y=AX^B$ is shown on the graph above.

Adsorption Coefficient (A)	403.33
Adsorption Exponent (B)	0.2058
Desorption Exponent	0.1955

Example 1 Orig soln	Soln dilution	soln:soil ratio ?
50	54.74	0.913355449
100	105.30	0.949701889
250	279.44	0.89463459
500	517.04	0.9670456
1000	1006.58	0.993464296
1500	1548.91	0.968425331
	avg	0.947771193

MEDLI P ADSORPTION ISOTHERM PARAMETER CALCULATOR

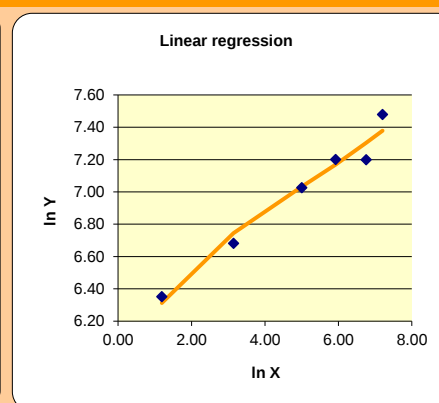
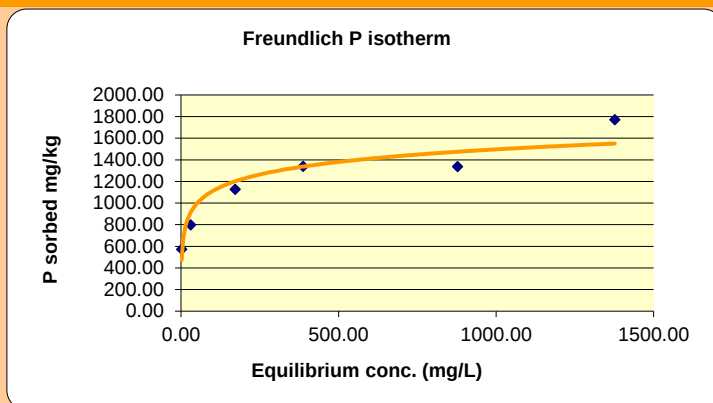
Input data in white cells only

1 Colwell P

Colwell P mg/kg solution	Solution:soil ratio
4.9	10

2 Isotherm Data

Std Conc mg/L	Equil Conc mg/L X	P Sorbed mg/kg Y
54.74	2.25	573.93
105.30	30.37	798.28
279.44	171.72	1126.28
517.04	387.89	1340.50
1006.58	877.67	1338.11
1548.91	1376.71	1771.00



3 Linear regression of Ln(X) and Ln(Y)

The linear regression equation uses the form $y=ax+b$

a	b	r^2
0.1661	6.1778	0.9666

Equation is $y = 0.1661x + 6.1778$

4 MEDLI Parameters

MEDLI's isotherm equation $Y=AX^B$ is shown on the graph above.

Adsorption Coefficient (A)	481.92
Adsorption Exponent (B)	0.1661
Desorption Exponent	0.1578

Example 1 Orig soln	Soln dilution	soln:soil ratio ?
50	54.74	0.913355449
100	105.30	0.949701889
250	279.44	0.89463459
500	517.04	0.9670456
1000	1006.58	0.993464296
1500	1548.91	0.968425331
	avg	0.947771193

REFERENCES

Johnson, R.C., J.C. Imhoff, J.L. Kittle and A.S. Donigan (1984). Hydrological Simulation Program - Fortran (HSPF): User

Warrell, LA, and Moody, PW (1984). Automated determination of micro amounts of phosphate in dilute calcium chloride extracts of soils. Commun. Soil Sci. Plant Anal. v 15, pp 779-85.

APPENDIX B:
Laboratory Analytical Effluent Data

REDLAND LABORATORY GREENACRES CARAVAN PARK EFFLUENT REPORT

Redland City Council

DATE SAMPLED: 17-Jan-2018
ANALYSED FROM: 17-Jan-2018

TO 22-Jan-2018

SAMPLED BY: Caravan Park staff.

REPORT NUMBER: 4237

COPIES TO: Greenacres Caravan Park, PO Box 97, Bulimba, QLD 4171

DOCUMENT NO.: ~

Redland Water-Redland Laboratory
233 Middle Street CLEVELAND 4163

PO Box 21 CLEVELAND 4163

Tel: (07) 3829 8386

Fax: (07) 3829 8765

SAMPLE NUMBER	S60084	S60085	~	~	~	~	~
SAMPLE IDENTIFICATION	Greenacres Caravan Park Unchlorinated effluent	Greenacres Caravan Park Chlorinated effluent	Greenacres Caravan Park Chlorinated effluent	Greenacres Caravan Park Chlorinated effluent	Greenacres Caravan Park Chlorinated effluent	Greenacres Caravan Park Chlorinated effluent	Greenacres Caravan Park Chlorinated effluent
SAMPLE TIME	7:00	9:15	7:00	7:30	8:00	8:30	9:00
SAMPLE TYPE	Grab	Grab	Grab	Grab	Grab	Grab	Grab
METHOD CODE	ANALYSIS	UNITS					
PR-RWSE-0052	pH	units	~	6.9	~	~	~
PR-RWSE-0051	D.O.	mg/L	~	3.6	~	~	~
PR-RWSE-0050	CL2 Free	mg/L	~	0.1	~	~	~
refer comments	T.N.	mg/L	20	~	~	~	~
refer comments	T.P.	mg/L	6.3	~	~	~	~
PR-RWSE-0053	T.S.S.	mg/L	35	19	~	~	~
PR-RWSE-0043	B.O.D.	mg/L	11	~	~	~	~
refer comments	Thermotolerant Coliforms	cfu/100mL	~	~	200	30	190
							< 10
							290

COMMENTS: Thermotolerant coliforms and nutrients by Scientific Analytical Services(Accreditation Number 11085) on batch 18/00594, report date 22/01/18.

SCIENTIFIC OFFICER:

C.Casey

RELEASE DATE : 22/01/18



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"as received" by the laboratory.

ACCREDITED FOR
TECHNICAL
COMPETENCE
No.12412

REDLAND LABORATORY GREENACRES CARAVAN PARK EFFLUENT REPORT

Redland City Council

Redland Water-Redland Laboratory
233 Middle Street CLEVELAND 4163

PO Box 21 CLEVELAND 4163

Tel: (07) 3829 8386

Fax: (07) 3829 8765

DATE SAMPLED: 28-Mar-2018
ANALYSED FROM: 28-Mar-2018 TO 09-Apr-2018
SAMPLED BY: Caravan Park & Laboratory Staff
REPORT NUMBER: 4286
COPIES TO: Greenacres Caravan Park, PO Box 97, Bulimba, QLD 4171
DOCUMENT NO.: A2955584

SAMPLE NUMBER		S60286	S60287	~	~	~	~	~
SAMPLE IDENTIFICATION		Greenacres Caravan Park Unchlorinated effluent	Greenacres Caravan Park Chlorinated effluent	Greenacres Caravan Park Chlorinated effluent	Greenacres Caravan Park Chlorinated effluent	Greenacres Caravan Park Chlorinated effluent	Greenacres Caravan Park Chlorinated effluent	Greenacres Caravan Park Chlorinated effluent
SAMPLE TIME		Grab	Grab	7:00	7:30	8:00	8:30	9:00
SAMPLE TYPE		Grab	Grab	Grab	Grab	Grab	Grab	Grab
METHOD CODE	ANALYSIS	UNITS						
1.002 [^]	pH	units	~	7.2	~	~	~	~
PR-RWSE-0051	D.O.	mg/L	~	2.5	~	~	~	~
PR-RWSE-0050	CL2 Free	mg/L	~	0.3	~	~	~	~
FIA.013 [^]	T.N.	mg/L	19	~	~	~	~	~
FIA011B [^]	T.P.	mg/L	4.8	~	~	~	~	~
1.601 [^]	T.S.S.	mg/L	~	23	~	~	~	~
1.604 [^]	B.O.D.	mg/L	12	~	~	~	~	~
4.404 [^]	Thermotolerant Coliforms	cfu/100mL	~	~	1900	3700	1000	900
								700

Notes

1. Thermotolerant coliforms, BOD, TSS and nutrients by Scientific Analytical Services(Accreditation Number 11085) on batch 18/02840 , report date 6/4/2018.
2. Methods marked with ^ indicate sub contracting laboratory method.
3. Sampling by Laboratory Staff is performed in accordance with in house method PR RWSE 0055.



ACCREDITED FOR
TECHNICAL
COMPETENCE

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RELEASE DATE : 9/4/2018

D.Simon

No.12412

RWSE-F18 JUL 14

LABORATORY REPORT

Client: Glen Cross
Greenacres Caravan Park
508 Mount Cotton Road
Capalaba QLD 4157

Job Name: Greenacres Caravan Park

Sampled By: Client
Sampling Date: 29/05/2018
Sampling Method: Grab
Sample Matrix: Aqueous
Batch Number: 18/04616
Registration Date: 29 May 2018
Date of Report: 6 June 2018



Authorised Signatories:

Bruce Weatherill Rebecca de Graaf Clive Bateman Sara Botero Montoya Samuel Hutchinson

PLEASE NOTE:

1. The results refer only to the samples tested.
2. All sampling performed by SAS Laboratory is in accordance with In-house Method F.001.
3. This document shall not be reproduced except in full, without written approval from SAS Laboratory.
4. Method with * indicates NATA accreditation does not cover the performance of this service.

Client: Greenacres Caravan Park
Job Name: Greenacres Caravan Park

Batch Number: 18/04616
Report Date: 6/06/2018

Method	Test	Units	18/04616/1 Sample 1 29/05/2018 07:00	18/04616/2 Sample 2 29/05/2018 07:30	18/04616/3 Sample 3 29/05/2018 08:00	18/04616/4 Sample 4 29/05/2018 08:30
4.404	Thermotolerant Coliforms (MF)	cfu/100mL	3,600	260	2,800	1,200
1.601	Suspended Solids	mg/L	26	[NR]	[NR]	[NR]
1.604	BOD 5 days @ 20°C	mg/L	11	[NR]	[NR]	[NR]
FIA.013	Total Nitrogen as N	mg/L	25	[NR]	[NR]	[NR]
FIA.011B	Total Phosphorus as P	mg/L	4.3	[NR]	[NR]	[NR]
Method	Test	Units	18/04616/5 Sample 5 29/05/2018 09:00	18/04616/6 Sample 6 29/05/2018 09:30		
4.404	Thermotolerant Coliforms (MF)	cfu/100mL	<10	[NR]		
1.003A	Free Chlorine	mg/L	[NR]	<0.1		
1.002	pH	pH Unit	[NR]	7.0		
1.004	Diss. Oxygen as O ₂	mg/L	[NR]	4.6 @ 18.4 o C		
1.601	Suspended Solids	mg/L	[NR]	32		

[ND] - Not Detected [NR] - Not Required [NT] - Not Tested

PLEASE NOTE:

1. The results refer only to the samples tested.
2. All sampling performed by SAS Laboratory is in accordance with In-house Method F.001.
3. This document shall not be reproduced except in full, without written approval from SAS Laboratory.
4. Method with * indicates NATA accreditation does not cover the performance of this service.

LABORATORY REPORT

Client: Glen Cross
Greenacres Caravan Park
508 Mount Cotton Road
Capalaba QLD 4157

Job Name: Greenacres Caravan Park

Sampled By: Client
Sampling Method: Grab
Sample Matrix: Aqueous
Batch Number: 18/05787
Registration Date: 3 July 2018
Date of Report: 11 July 2018
Sampled Date: 3/07/2018

Bruce Weatherill Sue Evans
Authorised Signatory Authorised Signatory

PLEASE NOTE:

1. The results refer only to the samples tested.
2. All sampling performed by SAS Laboratory is in accordance with In-house Method F.001.
3. This document shall not be reproduced except in full, without written approval from SAS Laboratory.
4. Method with * indicates NATA accreditation does not cover the performance of this service.

Client: Greenacres Caravan Park
Job Name: Greenacres Caravan Park

Batch Number: 18/05787
Report Date: 11/07/18

Method	Test	Units	18/05787/1 Sample 1 3/07/2018 07:00	18/05787/2 Sample 2 3/07/2018 07:30	18/05787/3 Sample 3 3/07/2018 08:00	18/05787/4 Sample 4 3/07/2018 08:30	18/05787/5 Sample 5 3/07/2018 09:00	18/05787/6 Sample 6 3/07/2018 09:30
4.404	Thermotolerant Coliforms (MF)	cfu/100mL	>6,000	4,000	>6,000	>6,000	>6,000	[NR]
1.003A	Free Chlorine	mg/L	[NR]	[NR]	[NR]	[NR]	[NR]	<0.1
1.002	pH	pH Unit	[NR]	[NR]	[NR]	[NR]	[NR]	7.3
1.004	Diss. Oxygen as O ₂	mg/L	[NR]	[NR]	[NR]	[NR]	[NR]	5.0 @19.5 oC
1.601	Suspended Solids	mg/L	40	[NR]	[NR]	[NR]	[NR]	44
1.604	BOD 5 days @ 20°C	mg/L	19	[NR]	[NR]	[NR]	[NR]	[NR]
FIA.013	Total Nitrogen as N	mg/L	37	[NR]	[NR]	[NR]	[NR]	[NR]
FIA.011B	Total Phosphorus as P	mg/L	6.4	[NR]	[NR]	[NR]	[NR]	[NR]

[ND] - Not Detected [NR] - Not Required [NT] - Not Tested

PLEASE NOTE:

1. The results refer only to the samples tested.
2. All sampling performed by SAS Laboratory is in accordance with In-house Method F.001.
3. This document shall not be reproduced except in full, without written approval from SAS Laboratory.
4. Method with * indicates NATA accreditation does not cover the performance of this service.

LABORATORY REPORT

Client: Glen Cross
Greenacres Caravan Park
508 Mount Cotton Road
Capalaba QLD 4157

Job Name: Greenacres Caravan Park

Sampled By: Client
Sampling Method: Grab
Sample Matrix: Aqueous
Batch Number: 18/07691
Registration Date: 4 September 2018
Date of Report: 10 September 2018
Sampled Date: 4/09/2018

Courtney Hamilton Sue Evans
Authorised Signatory Authorised Signatory

PLEASE NOTE:

1. The results refer only to the samples tested.
2. All sampling performed by SAS Laboratory is in accordance with In-house Method F.001.
3. This document shall not be reproduced except in full, without written approval from SAS Laboratory.
4. Method with * indicates NATA accreditation does not cover the performance of this service.

Client: Greenacres Caravan Park
Job Name: Greenacres Caravan Park

Batch Number: 18/07691
Report Date: 10/09/18

Method	Test	Units	18/07691/1 Sample 1 4/09/2018 07:00	18/07691/2 Sample 2 4/09/2018 07:30	18/07691/3 Sample 3 4/09/2018 08:00	18/07691/4 Sample 4 4/09/2018 08:30	18/07691/5 Sample 5 4/09/2018 09:00	18/07691/6 Sample 6 4/09/2018 09:30
4.404	Thermotolerant Coliforms (MF)	cfu/100mL	900	1,400	800	>6,000	3,000	[NR]
1.003A	Free Chlorine	mg/L	[NR]	[NR]	[NR]	[NR]	[NR]	<0.1
1.002	pH	pH Unit	[NR]	[NR]	[NR]	[NR]	[NR]	7.4
1.004	Diss. Oxygen as O ₂	mg/L	[NR]	[NR]	[NR]	[NR]	[NR]	3.9 @ 16.5 C
1.601	Suspended Solids	mg/L	38	[NR]	[NR]	[NR]	[NR]	32
1.604	BOD 5 days @ 20°C	mg/L	15	[NR]	[NR]	[NR]	[NR]	[NR]
FIA.013	Total Nitrogen as N	mg/L	43	[NR]	[NR]	[NR]	[NR]	[NR]
FIA.011B	Total Phosphorus as P	mg/L	7.2	[NR]	[NR]	[NR]	[NR]	[NR]

[ND] - Not Detected [NR] - Not Required [NT] - Not Tested

PLEASE NOTE:

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LABORATORY REPORT

Client: Glen Cross
Greenacres Caravan Park
508 Mount Cotton Road
Capalaba QLD 4157

Job Name: Greenacres Caravan Park

Sampled By: Client
Sampling Method: Grab
Sample Matrix: Aqueous
Batch Number: 18/08766
Registration Date: 2 October 2018
Date of Report: 15 October 2018
Sampled Date: 2/10/2018

Courtney Hamilton Sue Evans
Authorised Signatory Authorised Signatory

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Client: Greenacres Caravan Park
Job Name: Greenacres Caravan Park

Batch Number: 18/08766
Report Date: 15/10/2018

Method	Test	Units	18/08766/1 Sample 1 2/10/2018 07:00	18/08766/2 Sample 2 2/10/2018 07:30	18/08766/3 Sample 3 2/10/2018 08:00	18/08766/4 Sample 4 2/10/2018	18/08766/5 Sample 5 2/10/2018	18/08766/6 Sample 6 2/10/2018
4.404	Thermotolerant Coliforms (MF)	cfu/100mL	>6,000	>6,000	>6,000	>6,000	>6,000	[NR]
1.003A	Free Chlorine	mg/L	[NR]	[NR]	[NR]	[NR]	[NR]	<0.1
1.002	pH	pH Unit	[NR]	[NR]	[NR]	[NR]	[NR]	7.0
1.004	Diss. Oxygen as O ₂	mg/L	[NR]	[NR]	[NR]	[NR]	[NR]	0.56 @ 19 °C
1.601	Suspended Solids	mg/L	92	[NR]	[NR]	[NR]	[NR]	100
1.604	BOD 5 days @ 20°C	mg/L	79	[NR]	[NR]	[NR]	[NR]	[NR]
FIA.013	Total Nitrogen as N	mg/L	58	[NR]	[NR]	[NR]	[NR]	[NR]
FIA.011B	Total Phosphorus as P	mg/L	9.0	[NR]	[NR]	[NR]	[NR]	[NR]

[ND] - Not Detected [NR] - Not Required [NT] - Not Tested

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LABORATORY REPORT

Client: Glen Cross
Greenacres Caravan Park
508 Mount Cotton Road
Capalaba QLD 4157

Job Name: Greenacres Caravan Park

Sampled By: Client
Sampling Method: Grab
Sample Matrix: Aqueous
Batch Number: 18/11006
Registration Date: 7 December 2018
Date of Report: 13 December 2018
Sampled Date: 7/12/2018

Authorised Signatories:

Bruce Weatherill Rebecca de Graaf Clive Bateman Sara Botero Montoya Samuel Hutchinson

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Client: Greenacres Caravan Park
Job Name: Greenacres Caravan Park

Batch Number: 18/11006
Report Date: 13/12/2018

Method	Test	Units	18/11006/1 Sample 1 7/12/2018 07:00	18/11006/2 Sample 2 7/12/2018 07:30	18/11006/3 Sample 3 7/12/2018 08:00	18/11006/4 Sample 4 7/12/2018 08:30	18/11006/5 Sample 5 7/12/2018 09:00	18/11006/6 Sample 6 7/12/2018 09:30
4.404	Thermotolerant Coliforms (MF)	cfu/100mL	4,300	>6,000	>6,000	>6,000	>6,000	[NR]
1.003A	Free Chlorine	mg/L	[NR]	[NR]	[NR]	[NR]	[NR]	<0.1
1.002	pH	pH Unit	[NR]	[NR]	[NR]	[NR]	[NR]	7.4
1.004	Diss. Oxygen as O ₂	mg/L	[NR]	[NR]	[NR]	[NR]	[NR]	2.2 @19.6 oC
1.601	Suspended Solids	mg/L	63	[NR]	[NR]	[NR]	[NR]	32
1.604	BOD 5 days @ 20°C	mg/L	<5	[NR]	[NR]	[NR]	[NR]	[NR]
FIA.013	Total Nitrogen as N	mg/L	36	[NR]	[NR]	[NR]	[NR]	[NR]
FIA.011B	Total Phosphorus as P	mg/L	6.5	[NR]	[NR]	[NR]	[NR]	[NR]

[ND] - Not Detected [NR] - Not Required [NT] - Not Tested

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LABORATORY REPORT

Client: Glen Cross
Greenacres Caravan Park
508 Mount Cotton Road
Capalaba QLD 4157

Job Name: Greenacres Caravan Park

Sampled By: Client
Sampling Method: Grab
Sample Matrix: Aqueous
Batch Number: 19/01476
Registration Date: 12 February 2019
Date of Report: 18 February 2019
Sampled Date: 12/02/2019

Courtney Hamilton Sue Evans
Authorised Signatory Authorised Signatory

PLEASE NOTE:

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Client: Greenacres Caravan Park
Job Name: Greenacres Caravan Park

Batch Number: 19/01476
Report Date: 18/02/2019

Method	Test	Units	19/01476/1 Sample 1 12/02/2019 07:00	19/01476/2 Sample 2 12/02/2019 07:30	19/01476/3 Sample 3 12/02/2019 08:00	19/01476/4 Sample 4 12/02/2019 08:30	19/01476/5 Sample 5 12/02/2019 09:00	19/01476/6 Sample 6 12/02/2019 09:30
4.404	Thermotolerant Coliforms (MF)	cfu/100mL	<10	<10	20	<10	<10	[NR]
1.003A	Free Chlorine	mg/L	[NR]	[NR]	[NR]	[NR]	[NR]	0.2
1.002	pH	pH Unit	[NR]	[NR]	[NR]	[NR]	[NR]	7.5
1.004	Diss. Oxygen as O ₂	mg/L	[NR]	[NR]	[NR]	[NR]	[NR]	5.9 @ 22.9 oC
1.601	Suspended Solids	mg/L	27	[NR]	[NR]	[NR]	[NR]	15
1.604	BOD 5 days @ 20°C	mg/L	<10	[NR]	[NR]	[NR]	[NR]	[NR]
FIA.013	Total Nitrogen as N	mg/L	26	[NR]	[NR]	[NR]	[NR]	[NR]
FIA.011B	Total Phosphorus as P	mg/L	7.0	[NR]	[NR]	[NR]	[NR]	[NR]

[ND] - Not Detected [NR] - Not Required [NT] - Not Tested

PLEASE NOTE:

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LABORATORY REPORT

Client: Glen Cross
Greenacres Caravan Park
508 Mount Cotton Road
Capalaba QLD 4157

Job Name: Greenacres Caravan Park

Sampled By: Client
Sampling Method: Grab
Sample Matrix: Aqueous
Batch Number: 19/02234
Registration Date: 15 March 2019
Date of Report: 22 March 2019
Sampled Date: 15/03/2019

Courtney Hamilton Sue Evans
Authorised Signatory Authorised Signatory

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Client: Greenacres Caravan Park
Job Name: Greenacres Caravan Park

Batch Number: 19/02234
Report Date: 22/03/2019

Method	Test	Units	19/02234/1 Sample 1 15/03/2019 07:00	19/02234/2 Sample 2 15/03/2019 07:30	19/02234/3 Sample 3 15/03/2019 08:00	19/02234/4 Sample 4 15/03/2019 08:30	19/02234/5 Sample 5 15/03/2019 09:00	19/02234/6 Sample 6 15/03/2019 09:30
4.404	Thermotolerant Coliforms (MF)	cfu/100mL	2,600	80	1,200	<10	<10	[NR]
1.003A	Free Chlorine	mg/L	[NR]	[NR]	[NR]	[NR]	[NR]	0.1
1.002	pH	pH Unit	[NR]	[NR]	[NR]	[NR]	[NR]	6.2
1.004	Diss. Oxygen as O ₂	mg/L	[NR]	[NR]	[NR]	[NR]	[NR]	6.1 @ 19.8 oC
1.601	Suspended Solids	mg/L	25	[NR]	[NR]	[NR]	[NR]	21
1.604	BOD 5 days @ 20°C	mg/L	6	[NR]	[NR]	[NR]	[NR]	[NR]
FIA.013	Total Nitrogen as N	mg/L	19	[NR]	[NR]	[NR]	[NR]	[NR]
FIA.011B	Total Phosphorus as P	mg/L	5.4	[NR]	[NR]	[NR]	[NR]	[NR]

[ND] - Not Detected [NR] - Not Required [NT] - Not Tested

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LABORATORY REPORT

Client: Glen Cross
Greenacres Caravan Park
508 Mount Cotton Road
Capalaba QLD 4157

Job Name: Greenacres Caravan Park

Sampled By: Client
Sampling Method: Grab
Sample Matrix: Aqueous
Batch Number: 19/03030
Registration Date: 3 April 2019
Date of Report: 11 April 2019
Sampled Date: 3/04/2019

Courtney Hamilton Sue Evans
Authorised Signatory Authorised Signatory

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Client: Greenacres Caravan Park
Job Name: Greenacres Caravan Park

Batch Number: 19/03030
Report Date: 11/04/2019

Method	Test	Units	19/03030/1 Sample 1 3/04/2019 07:00	19/03030/2 Sample 2 3/04/2019 07:30	19/03030/3 Sample 3 3/04/2019 08:00	19/03030/4 Sample 4 3/04/2019 08:30	19/03030/5 Sample 5 3/04/2019 09:00	19/03030/6 Sample 6 3/04/2019 09:30
4.404	Thermotolerant Coliforms (MF)	cfu/100mL	20	<10	<10	10	<10	[NR]
1.003A	Free Chlorine	mg/L	[NR]	[NR]	[NR]	[NR]	[NR]	<0.1
1.002	pH	pH Unit	[NR]	[NR]	[NR]	[NR]	[NR]	7.0
1.004	Diss. Oxygen as O ₂	mg/L	[NR]	[NR]	[NR]	[NR]	[NR]	8.5 @ 15.5oC
1.601	Suspended Solids	mg/L	24	[NR]	[NR]	[NR]	[NR]	24
1.604	BOD 5 days @ 20°C	mg/L	<5	[NR]	[NR]	[NR]	[NR]	[NR]
FIA.013	Total Nitrogen as N	mg/L	20	[NR]	[NR]	[NR]	[NR]	[NR]
FIA.011B	Total Phosphorus as P	mg/L	5.2	[NR]	[NR]	[NR]	[NR]	[NR]

[ND] - Not Detected [NR] - Not Required [NT] - Not Tested

PLEASE NOTE:

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CERTIFICATE OF ANALYSIS

CERTIFICATE NO.: B767123 Page 1 of 3
ISSUE DATE: 26/03/19

REVISION NO: 00
 This certificate supersedes any previous revisions

CLIENT DETAILS: FIONA MILNES
 Simmonds & Bristow Pty Ltd
 2/40 Reginald Street
 Rocklea QLD 4106
DATE RECEIVED: 19/03/2019
CLIENT REF. NO: C1903-004-b
ORDER NO: C1903-004-b

JOB INFORMATION: Water - WATER ANALYSIS
RECEIVE CONDITION: 6.3 °C
STORAGE CONDITION: 4 °C
TEST DATE: Sample tested between date received
 and reported

RESULTS OF ANALYSIS:

Test	Method Code	LOR	Unit	B767123-1 Final Effluent 18/03/2019 13:45
General Tests				
Chlorine (Free)	EFF027	0.01	mg/L	0.18
Chlorine (Total)	EFF028	0.01	mg/L	8.95
Electrical Conductivity	EFF007	5	µS/cm	490
Total Nitrogen	EFF029.1	0.05	mg/L	21
Total Phosphorus	EFF029.1	0.01	mg/L	3.4
Major Anions				
Chloride	EFF011	2	mg/L	64
Sulphur (Dissolved)	EWI01	0.1	mg/L	9.1
Sulphur (as Sulphate)#	EWI01	0.3	mg/L	27.4
Sum of Anions	EFF076	0.1	meq/L	3.8
EFF063 Sodium Absorption Ratio				
Alkalinity Total (CaCO3)	EFF031	1	mg/L	99



The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
 Accredited for compliance with ISO/IEC 17025 – Testing.
 NATA Corporate Accreditation No.: 2455

Symbio Laboratories Pty Ltd
 ABN 82 079 645 015

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- Townsville: 17 Hamill Street, Garbutt QLD 4814
- Melbourne: Unit 36, 640-680 Geelong Rd, Brooklyn VIC 3025
- Sydney: 2 Sirius Rd, Lane Cove West NSW 2066
- Wagga Wagga: Unit 5, 10-12 Koorringal Rd, Wagga Wagga NSW 2650
- Perth: 2/20 Milford Street, East Victoria Park WA 6101

Test	Method Code	LOR	Unit	B767123-1 Final Effluent 18/03/2019 13:45
Alkalinity Bicarb (CaCO ₃)	EFF031	1	mg/L	99
Alkalinity Carbonate (CaCO ₃)	EFF031	1	mg/L	<1
Alkalinity Hydroxide (CaCO ₃)	EFF031	1	mg/L	<1
pH	EFF006		pH Unit	7.30
Calcium (Dissolved)	EWI01	0.1	mg/L	17
Magnesium (Dissolved)	EWI01	0.05	mg/L	4.6
Sodium (Dissolved)	EWI01	1	mg/L	52
Corrected SAR *#	EFF063	0.01	-	5.16
SAR (Sodium Adsorption Ratio)#	EFF063	0.8		2.9



The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
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- Wagga Wagga: Unit 5, 10-12 Koorringal Rd, Wagga Wagga NSW 2650
- Perth: 2/20 Milford Street, East Victoria Park WA 6101

DEFINITIONS: < : Less than, > : Greater than, [NT] : Not Tested, DWB : Dry Weight Basis, NA: not applicable, RP: Result Pending, - : Not received / requested / tested, ~ : Estimated, TBA: - to be advised, Δ: reference only holding time exceeded

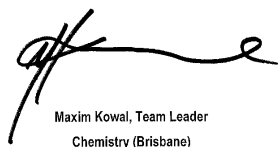
* Test not covered by NATA scope of accreditation

: The result is derived from a calculation and includes results equal to, or greater than the LOR. Where applicable, results are calculated as sum of reportable isomers.

Results were reported on an "as received" basis unless otherwise indicated.

Sampling was conducted by the customer and results reported pertain only to the samples submitted.

Responsibility for representative sampling rests with the customer.



Maxim Kowal, Team Leader
Chemistry (Brisbane)

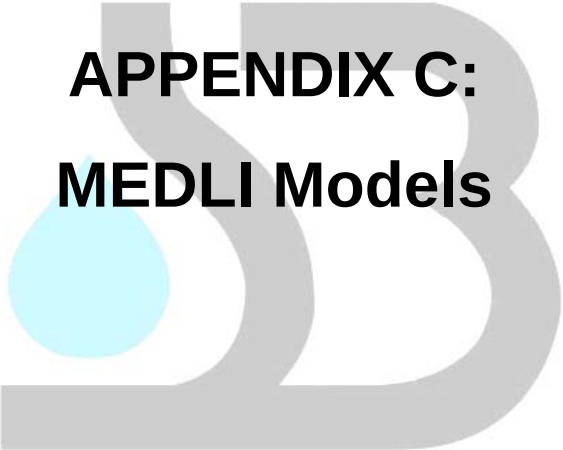


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APPENDIX C: MEDLI Models

Enterprise: Greenacres Caravan Park

Description:

Greenacres Caravan Park

Client: Greenacres Caravan Park

MEDLI User: F Milnes

Scenario Details:

Sustainability Investigation for land application of treated effluent as alternative to discharge to waters.

Flow 0 kL

TN 35

TP 6.5

TDS 430 based on EC 670 uS/cm

Tank 90kL

Irrigation 3 mm/day

Kikuyu 1 Pasture

MEDLI REPORT - FULL RUN



Climate Data: Greenacres -27.55_153.20, -27.55°, 153.2°

Run Period: 01/01/1969 to 31/12/2018 50 years, 0 days

Climate Statistics:

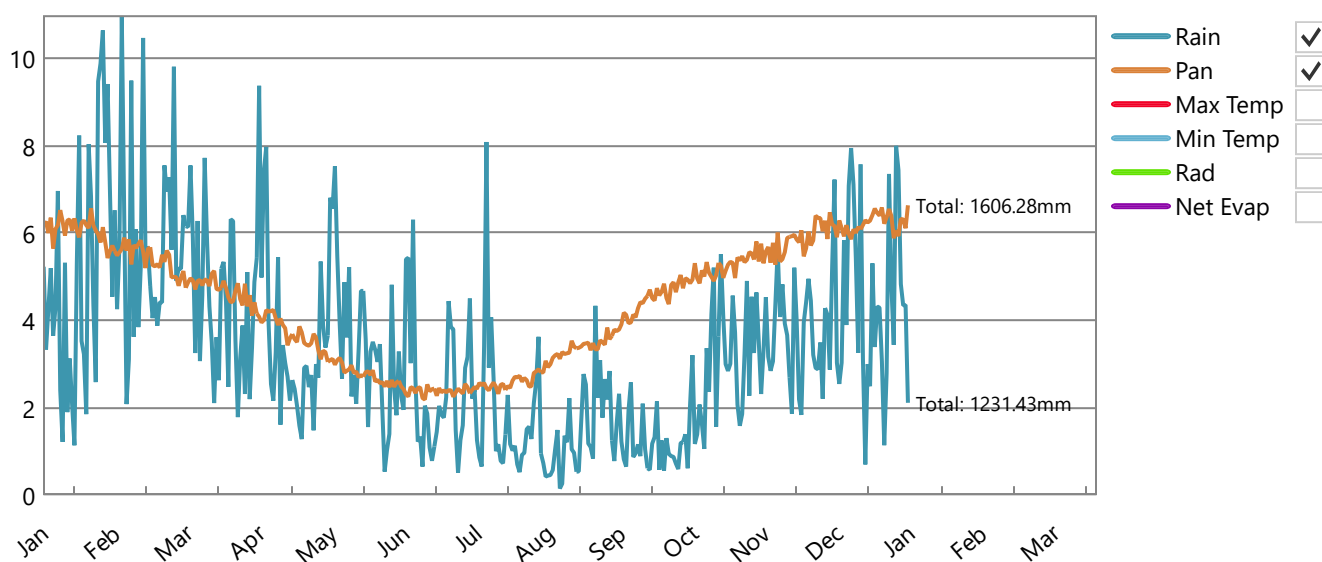
	5th ▾	Percentile	50th Percentile	95th ▾	Percentile
Rainfall (mm/year)		734	1199		1749
Pan Evaporation (mm/year)		1434	1607		1829

Climate Data:

☒ Chart ☐ Table

☐ Monthly ☒ Daily

Daily Average Across Run Period



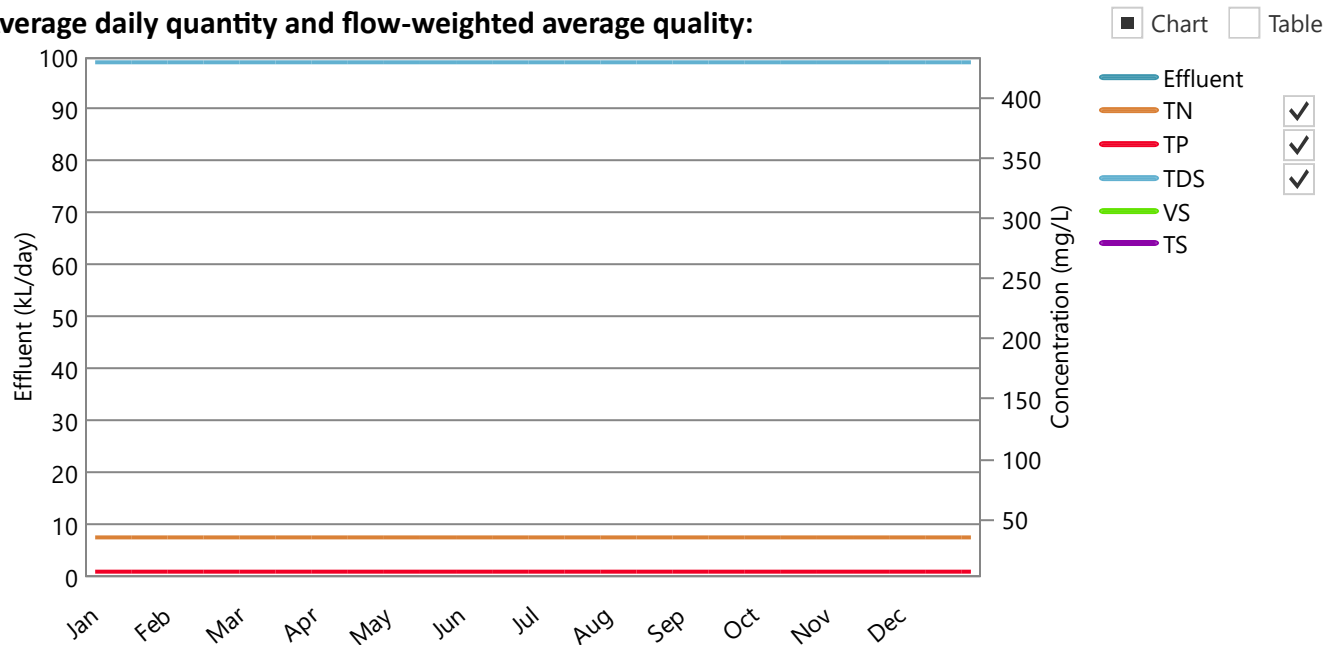
DESCRIPTION



Effluent type: New Generic System

Wastestream before any recycling or pretreatment

Average daily quantity and flow-weighted average quality:



Wastestream after any recycling and pretreatment if applicable

Effluent quantity: **0.00 kL/year** or 0.00 kL/day (Min-Max: 0.00 - 0.00)

Flow-weighted average (minimum - maximum) daily effluent quality entering pond system:

	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Phosphorus	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Dissolved Salts	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
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)

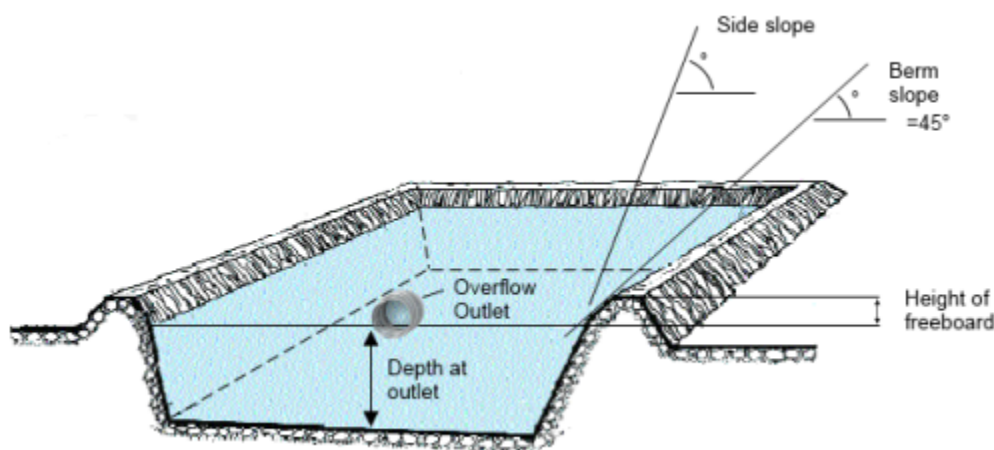
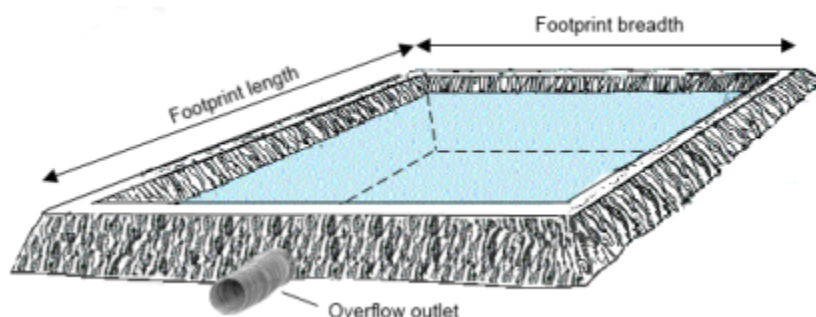
DESCRIPTION

medli

Pond system: 1 closed storage tank

Pond system details:

	Pond 1
Maximum pond volume (kL)	90.00
Minimum allowable pond volume (kL)	1.24
Pond depth at overflow outlet (m)	2.18
Maximum water surface area (m2)	41.31
Pond footprint length (m)	7.63
Pond footprint width (m)	7.63
Pond catchment area (m2)	58.17
Average active volume (kL)	0.00



Irrigation pump limits:

Minimum pump rate per area limit (ML/day/ha)	0.00
Maximum pump rate per area limit (ML/day/ha)	1.00

Shandying water:

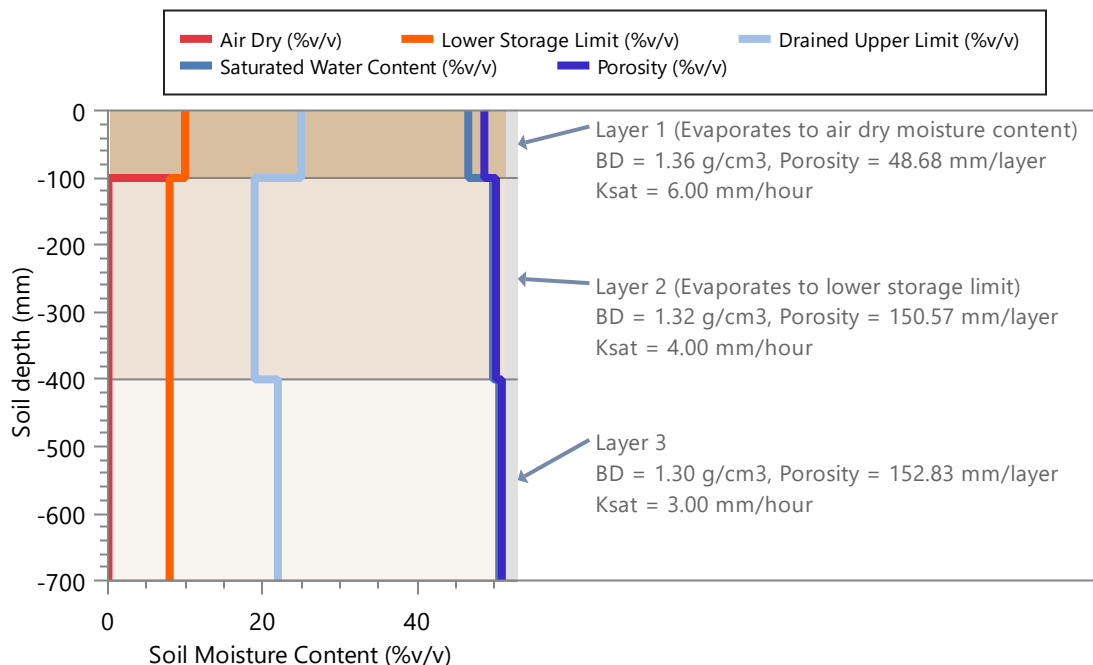
Annual allocation of fresh water available for shandying (kL/year)	0.00
Maximum rate of application of fresh water (ML/day)	0.00
Nitrogen concentration (mg/L)	0.00
Salinity (dS/m)	0.00
Minimum shandy water is used	False

Land: Default Paddock

Area (ha): 1.00

Soil Type: Greenacres Caravan Park, 700.00 mm defined profile depth

Profile Porosity (mm)	352.08
Profile saturation water content (mm)	347.80
Profile drained upper limit (or field capacity) (mm)	148.00
Profile lower storage limit (or permanent wilting point) (mm)	58.00
Profile available water capacity (mm)	90.00
Profile limiting saturated hydraulic conductivity (mm/hour)	3.00
Surface saturated hydraulic conductivity (mm/hour)	6.00
Runoff curve number II (coefficient)	88.00
Soil evaporation U (mm)	9.00
Soil evaporation Cona (mm/sqrt day)	4.00



Plant Data: Continuous Kikuyu 1 Pasture

Average monthly cover (fraction) (minimum - maximum)	0.59 (0.34 - 0.70)
Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 0.8 x Pan coefficient 1)	0.80
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Maximum potential root depth in defined soil profile (mm)	700.00
Salt tolerance	Moderately tolerant
Salinity threshold EC sat. ext. (dS/m)	3.00
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.03



Pond System Water Performance - Overflow: 1 closed storage tank

Capacity of wet weather storage pond: 90 kL

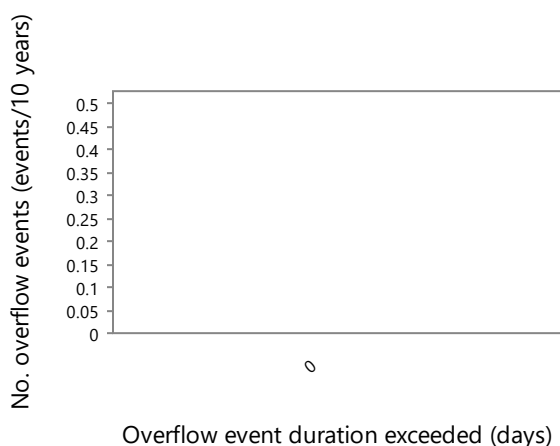
Pond System Water Balance (kL/year)

Name	Value
Rain	0.00
Inflow	0.00
Recycling	0.00
Evaporation	0.00
Overflow	0.00
Irrigation	0.00
Seepage	0.00
Delta Storage	0.00

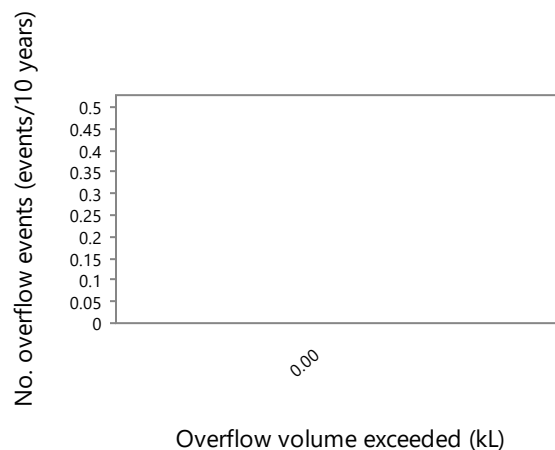
(no data available)

Overflow Diagnostics

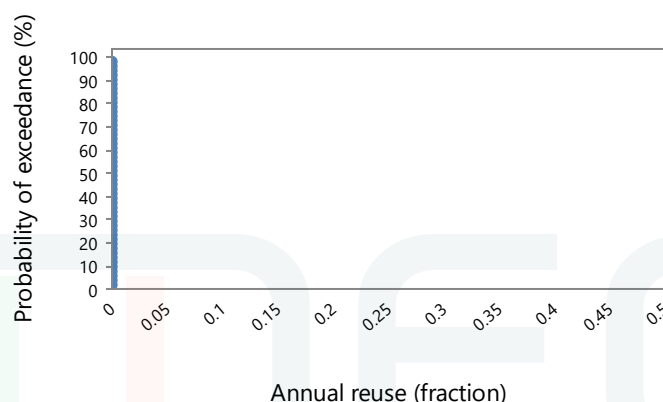
Volume of overflow (kL/year)	0.00
No. days pond overflows (days/year)	0.00
Average duration of overflow (days)	0.00
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	0.00
Probability of at least 90% reuse (fraction)	0.00



[Export plot](#)



[Export plot](#)



[Export plot](#)

Pond System Performance - Nutrient: 1 closed storage tank

Pond System Nutrients and Salt Balance:

Nitrogen Balance (kg/year)

(no data available)

Name	Value
Inflow	0.00
Recycling	0.00
Volatilisation	0.00
Sludge	0.00
Overflow	0.00
Irrigation	0.00
Seepage	0.00
Delta Storage	0.00

Phosphorus Balance (kg/year)

(no data available)

Name	Value
Inflow	0.00
Recycling	0.00
Sludge	0.00
Overflow	0.00
Irrigation	0.00
Seepage	0.00
Delta Storage	0.00

Salt Balance (kg/year)

(no data available)

Name	Value
Inflow	0.00
Recycling	0.00
Sludge*	0.00
Overflow	0.00
Irrigation	0.00
Seepage	0.00
Delta Storage	0.00

* 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 0.00 kg/year

Pond System Sludge Accumulation: 0.00 kg dwt/year

Pond System Performance - Nutrient: 1 closed storage tank

Pond Nutrient Concentrations and Salinity:

Average across simulation period	Pond 1
Average nitrogen concentration of pond liquid (mg/L)	0.00
Average phosphorus concentration of pond liquid (mg/L)	0.00
Average salinity of pond liquid (dS/m)	0.00

Value on final day of simulation period	Pond 1
Final nitrogen concentration of pond liquid (mg/L)	N.D.*
Final phosphorus concentration of pond liquid (mg/L)	N.D.*
Final salinity of pond liquid (dS/m)	N.D.*

* Not determined. Pond is empty.

Irrigation Performance:

Water Use: (assumes 100% Irrigation Efficiency)

Pond water irrigated (kL/year)	0.00
Average Shandy water irrigation (kL/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Total water irrigated (kL/year)	0.00
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Proportion of years shandying water allocation of 0 kL/year is exceeded (fraction of years)	0.00
Average exceedance as a proportion of annual shandy water allocation (fraction of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)

Irrigation Quality:

Average nitrogen concentration of irrigation water - before ammonia loss during irrigation (mg/L)	0.00
Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)	0.00
Average phosphorus concentration of irrigation water (mg/L)	0.00
Average salinity of irrigation water (dS/m)	0.00

Irrigation Diagnostics (No effluent irrigation occurred!):

Proportion of Days rain prevents irrigation (fraction)	0.04
Proportion of Days pond volume below min. vol. for irrigation (fraction)	0.96
Proportion of Days irrigation occurs (fraction)	0.00

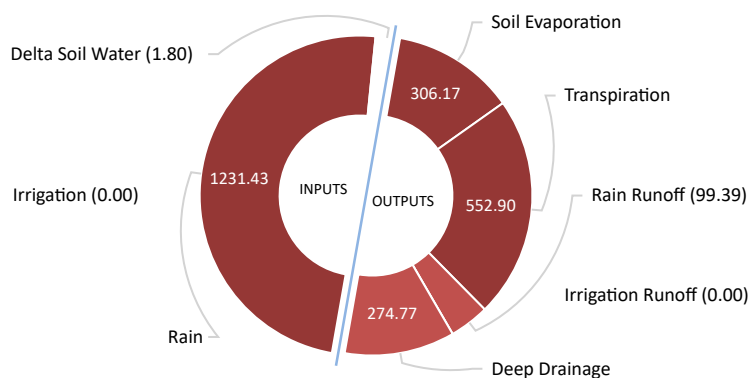
Land Performance - Soil Water

Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park, 90.00 mm PAWC at maximum root depth**

Land Water Balance (mm/year):

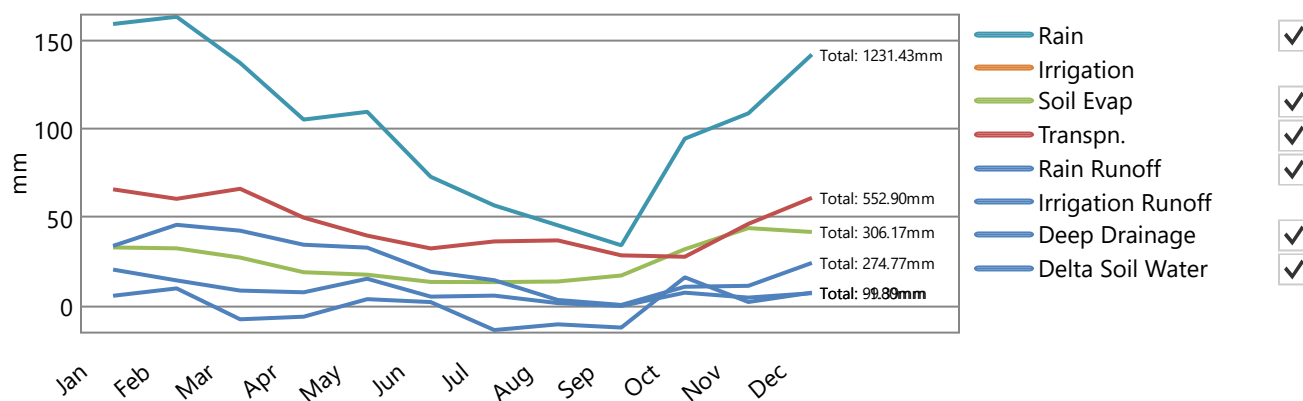
☒ mm/year ☐ % Total inputs



Name	Value
Rain	1231.43
Irrigation	0.00
Soil Evaporation	306.17
Transpiration	552.90
Rain Runoff	99.39
Irrigation Runoff	0.00
Deep Drainage	274.77
Delta Soil Water	-1.80

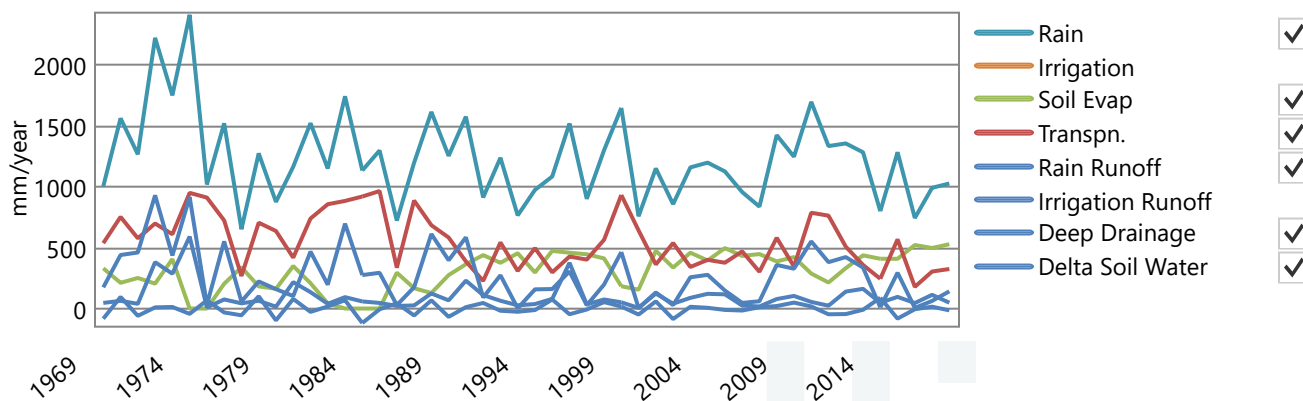
Average Monthly Totals (mm):

☒ Chart ☐ Table



Average Annual Totals (mm/year):

☒ Chart ☐ Table



Land Performance - Soil Nutrient

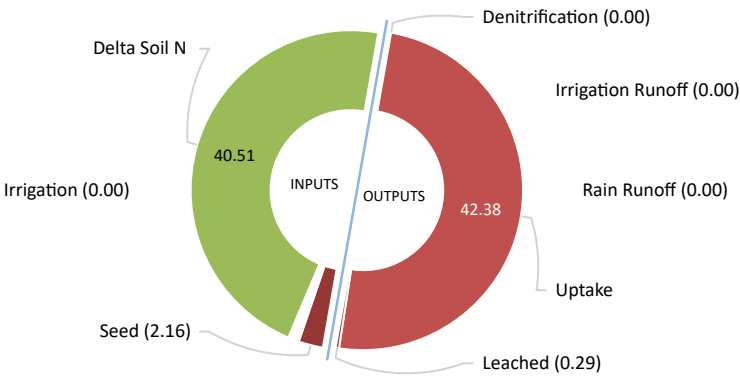
Paddock: Default Paddock, 1 ha

Soil Type: Greenacres Caravan Park

Irrigation ammonium volatilisation losses (kg/ha/year): 0.00

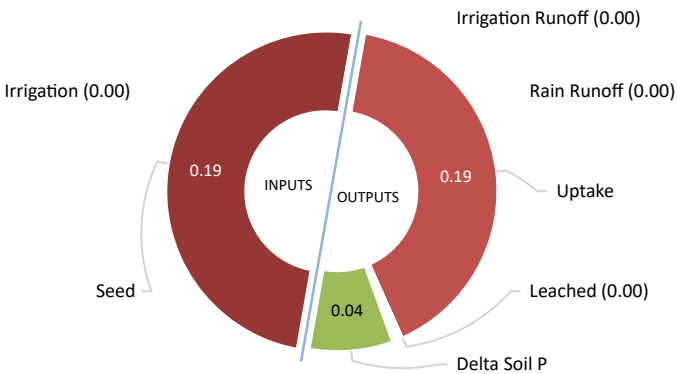
Proportion of total nitrogen in irrigated effluent as ammonium (fraction): 0.40

Land Nitrogen Balance (kg/ha/year)



Name	Value
Seed	2.16
Irrigation	0.00
Denitrification	2.94E-05
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	42.38
Leached	0.29
Delta Soil N	-40.51

Land Phosphorus Balance (kg/ha/year)



Name	Value
Seed	0.19
Irrigation	0.00
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	0.19
Leached	3.15E-05
Delta Soil P	0.04

PERFORMANCE

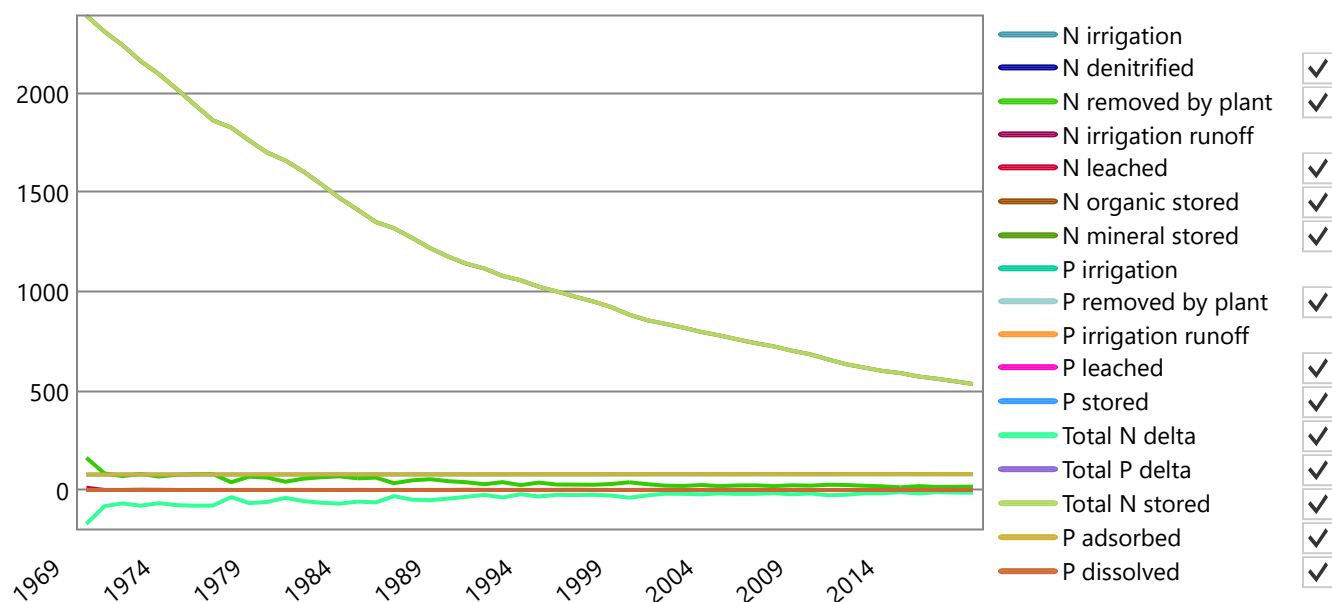


Land Performance - Soil Nutrient

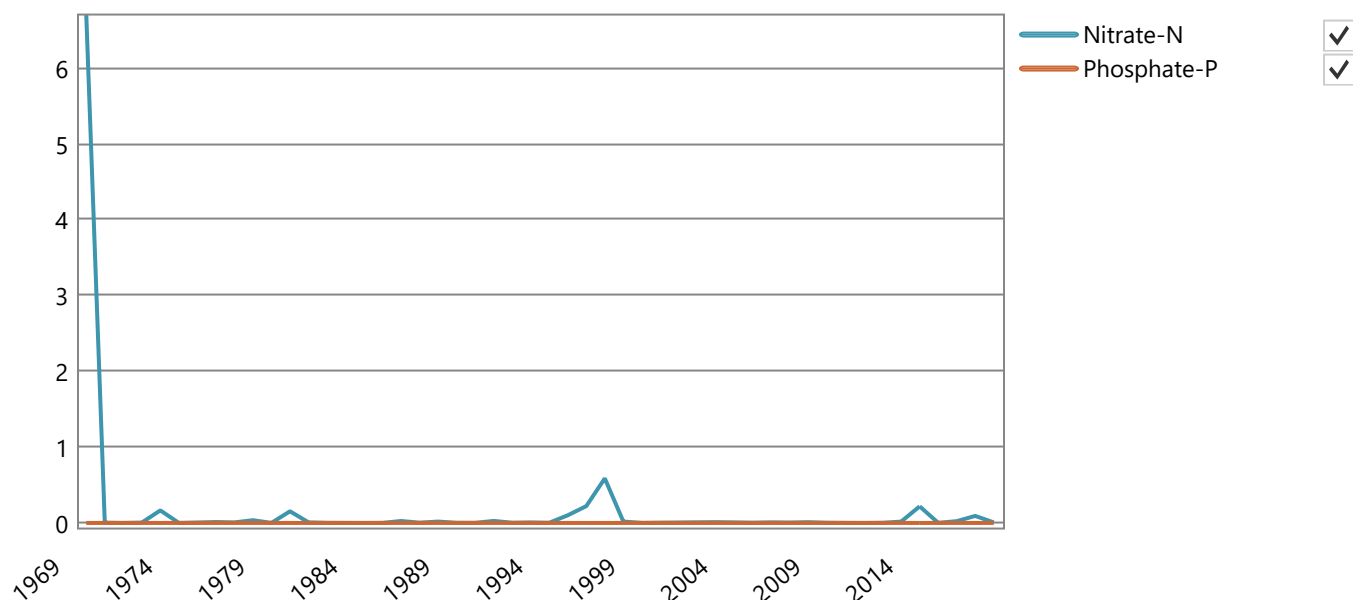
Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park**

Annual Nutrient Totals (kg/ha):



Annual Nutrient Leaching Concentration (mg/L):



PERFORMANCE

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Plant Performance and Nutrients

Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park**

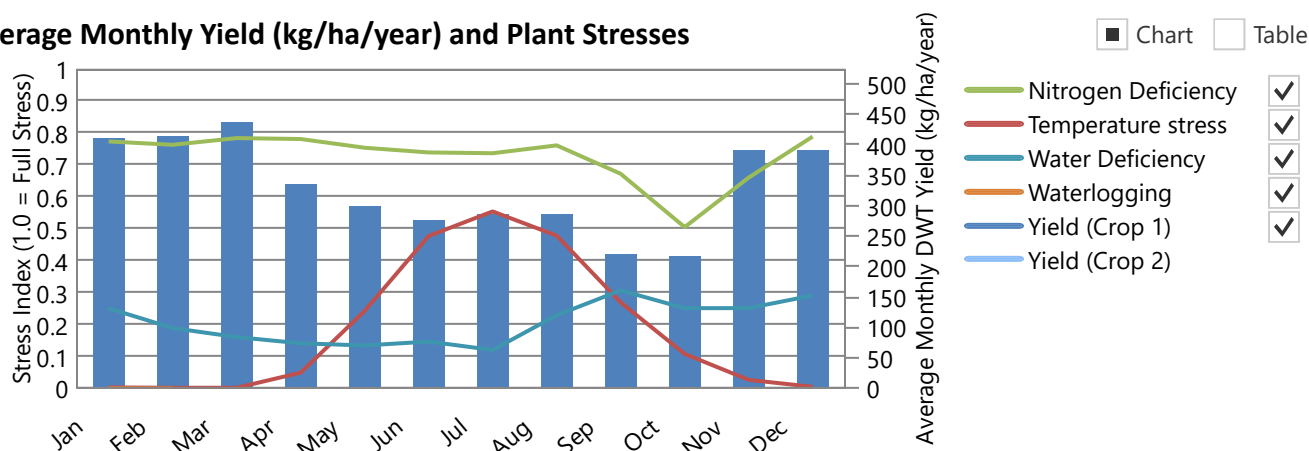
Plant: **Continuous Kikuyu 1 Pasture**

Average annual shoot dry matter yield (kg/ha/year)	4028.56 (1367.19 - 10366.03)
Average monthly plant (green) cover (fraction) (minimum - maximum)	0.59 (0.34 - 0.70)
Average monthly root depth (mm) (minimum - maximum)	557.64 (353.13 - 632.71)

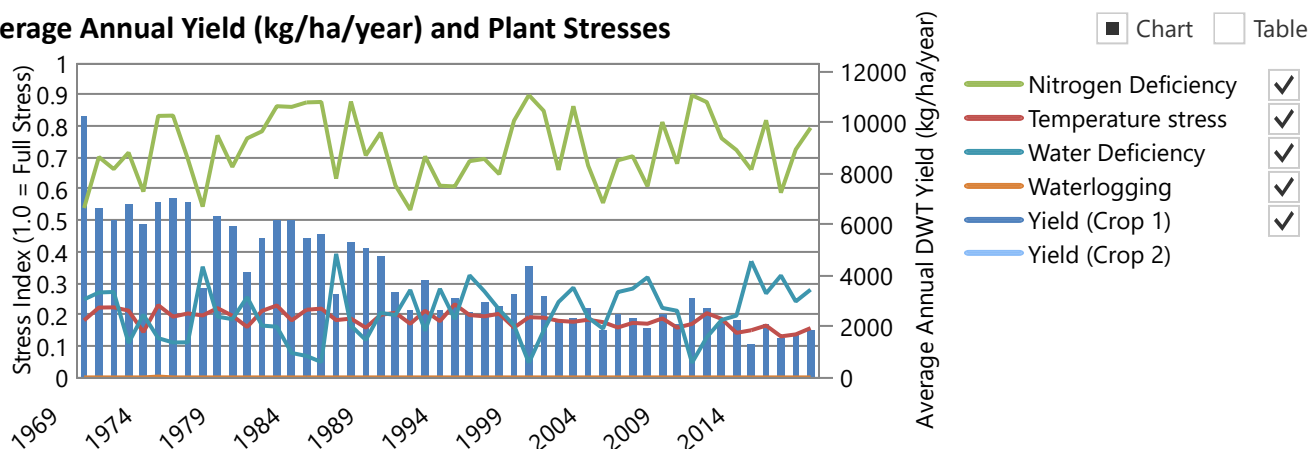
Nutrient Uptake (minimum - maximum):

Average annual net nitrogen removed by plant uptake (kg/ha/year)	42.38 (13.16 - 162.01)
Average annual net phosphorus removed by plant uptake (kg/ha/year)	0.19 (0.00 - 0.36)
Average annual shoot nitrogen concentration (fraction dwt)	0.01 (0.01 - 0.02)
Average annual shoot phosphorus concentration (fraction dwt)	0.000 (0.000 - 0.000)

Average Monthly Yield (kg/ha/year) and Plant Stresses

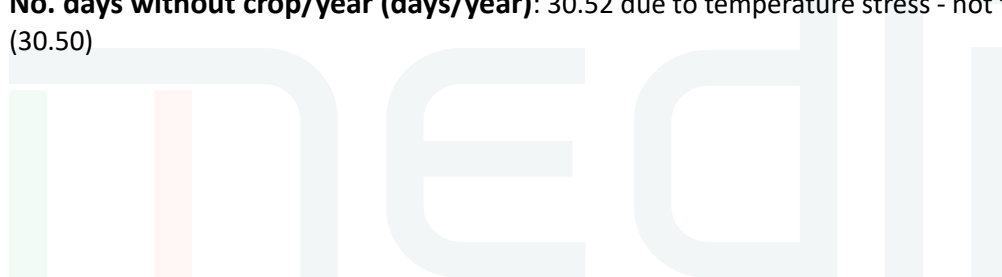


Average Annual Yield (kg/ha/year) and Plant Stresses



No. of harvests/year: 0.30 (normal), 2.04 (forced by crop death due to water stress (2.04))

No. days without crop/year (days/year): 30.52 due to temperature stress - not frost (0.02), water stress (30.50)



Land Performance

Paddock: Default Paddock, 1 ha Soil Type: Greenacres Caravan Park

Plant: Continuous Kikuyu 1 Pasture

Salt tolerance	Moderately tolerant
Salinity threshold EC sat. ext. (dS/m)	3.00
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.03
No. years assumed for leaching to reach steady-state (years)	10.00

Soil Salinity:

Average Infiltrate Salinity (dS/m)	0.03
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Insufficient deep drainage to run steady state salinity calculations.

PERFORMANCE

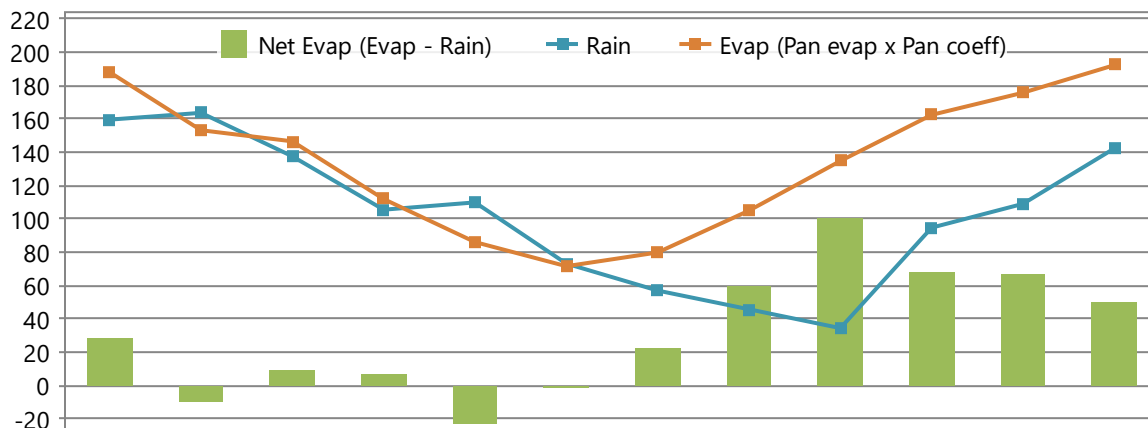


Sustainability Diagnostics: Greenacres Caravan Park

Averaged Historical Climate Data Used in Simulation (mm)

Location: Greenacres -27.55_153.20, -27.55°, 153.2°

Run Period: 01/01/1969 to 31/12/2018 50 years, 0 days



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	159.5	163.6	137.5	105.4	109.8	73.1	56.9	45.6	34.3	94.6	108.9	142.2	1231.4
Evap	188.0	153.1	146.5	111.8	86.0	71.5	79.8	104.9	134.7	162.3	175.6	192.2	1606.3
Net Evap	28.5	-10.4	9.0	6.4	-23.8	-1.6	22.9	59.2	100.3	67.7	66.7	50.0	374.9
Net Evap/day	0.9	-0.4	0.3	0.2	-0.8	-0.1	0.7	1.9	3.3	2.2	2.2	1.6	1.0

DIAGNOSTICS

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Sustainability Diagnostics: Greenacres Caravan Park

Pond System: 1 closed storage tank

New Generic System - 0.00 kL/year or 0.00 kL/day generated on average

Effluent entering pond system after any pretreatment and recycling

Average (Minimum-Maximum) influent quality calculated for 0.00 non-zero flow days, after any pretreatment and recycling.

Constituent	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Phosphorus	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Dissolved Salts	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
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)

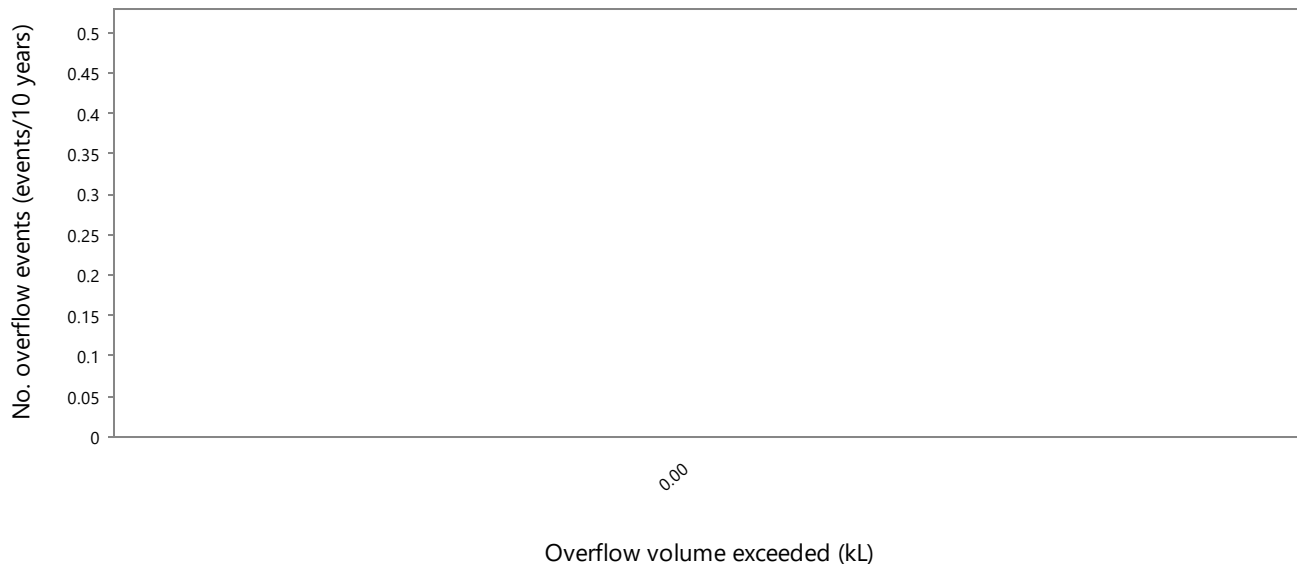
Last pond (Wet weather store): 90.00 kL

Theoretical hydraulic retention time (days)	0.00
Average volume of overflow (kL/year)	0.00
No. overflow events per year exceeding threshold* of 0.04 kL (no./year)	0.00
Average duration of overflow (days)	0.00
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	0.00
Probability of at least 90% effluent reuse (fraction)	0.00
Average salinity of last pond (dS/m)	0.00
Salinity of last pond on final day of simulation (dS/m)	0.00
Ammonia loss from pond system water area (kg/m2/year)	0.00

* The threshold is the volume equivalent to the top 1 mm depth of water of a full pond

Overflow exceedance:

☒ Chart ☐ Table



[Export plot](#)



Sustainability Diagnostics: Greenacres Caravan Park

Irrigation Information

Irrigation: 1 ha total area (assumed 100% irrigation efficiency)

	Quantity/year	Quantity/ha/year
Total irrigation applied (kL)	0.00	0.00
Total nitrogen applied (kg)	0.00	0.00
Total phosphorus applied (kg)	0.00	0.00
Total salts applied (kg)	0.00	0.00

Shandying

Annual allocation of fresh water for shandying (kL/year)	0.00
Average Shandy water irrigation (kL/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Average exceedance as a proportion of annual shandy water allocation (% of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Minimum shandy water is used	False

Irrigation Issues

Proportion of Days irrigation is prevented when triggered (fraction)	1.00
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Sustainability Diagnostics: Greenacres Caravan Park

Paddock Land: Default Paddock: 1 ha

Irrigation: Flood with 0.1% ammonium loss during irrigation

Irrigation triggered when soil water deficit reaches 0.00 mm and rainfall is less than or equal to 20.00 mm
Irrigate a fixed amount of 3.00 mm each day
Irrigation window from 1/1 to 31/12 including the days specified
A minimum of 0 days must be skipped between irrigation events

Soil Water Balance (mm): Greenacres Caravan Park, 90.00 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	159.5	163.6	137.5	105.4	109.8	73.1	56.9	45.6	34.3	94.6	108.9	142.2	1231.4
Irrigation	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
Soil Evap	33.1	32.6	27.4	19.1	17.7	13.6	13.5	13.9	17.2	32.1	44.1	41.9	306.2
Transpn.	66.0	60.6	66.3	50.0	39.8	32.6	36.5	37.1	28.6	27.9	46.4	61.2	552.9
Runoff	20.6	14.5	8.7	7.8	15.4	5.3	5.9	1.6	0.0	7.6	4.8	7.3	99.4
Drainage	34.0	45.9	42.6	34.6	33.0	19.4	14.6	3.4	0.6	10.9	11.4	24.4	274.8
Delta	5.8	10.0	-7.5	-6.0	3.9	2.2	-13.6	-10.4	-12.2	16.2	2.3	7.6	-1.8

Soil Nitrogen Balance

Average annual effluent nitrogen added (kg/ha/year)	0.00
Average annual soil nitrogen removed by plant uptake (kg/ha/year)	42.38
Average annual soil nitrogen removed by denitrification (kg/ha/year)	2.94E-05
Average annual soil nitrogen leached (kg/ha/year)	0.29
Average annual nitrate-N loading to groundwater (kg/ha/year)	0.29
Soil organic-N kg/ha (Initial - Final)	2448.00 - 533.27
	110.64 - 0.10
Average nitrate-N concentration of deep drainage (mg/L)	0.10
Max. annual nitrate-N concentration of deep drainage (mg/L)	6.70

Soil Phosphorus Balance

Average annual effluent phosphorus added (kg/ha/year)	0.00
Average annual soil phosphorus removed by plant uptake (kg/ha/year)	0.19
Average annual soil phosphorus leached (kg/ha/year)	3.15E-05
Dissolved phosphorus (kg/ha) (Initial - Final)	0.00 - 3.00E-05
Adsorbed phosphorus (kg/ha) (Initial - Final)	77.71 - 79.62
Average phosphate-P concentration in rootzone (mg/L)	2.93E-05
Average phosphate-P concentration of deep drainage (mg/L)	1.15E-05
Max. annual phosphate-P concentration of deep drainage (mg/L)	1.47E-05
Design soil profile storage life based on average infiltrated water phosphorus concn. of 0.00 mg/L (years)	0.00

DIAGNOSTICS

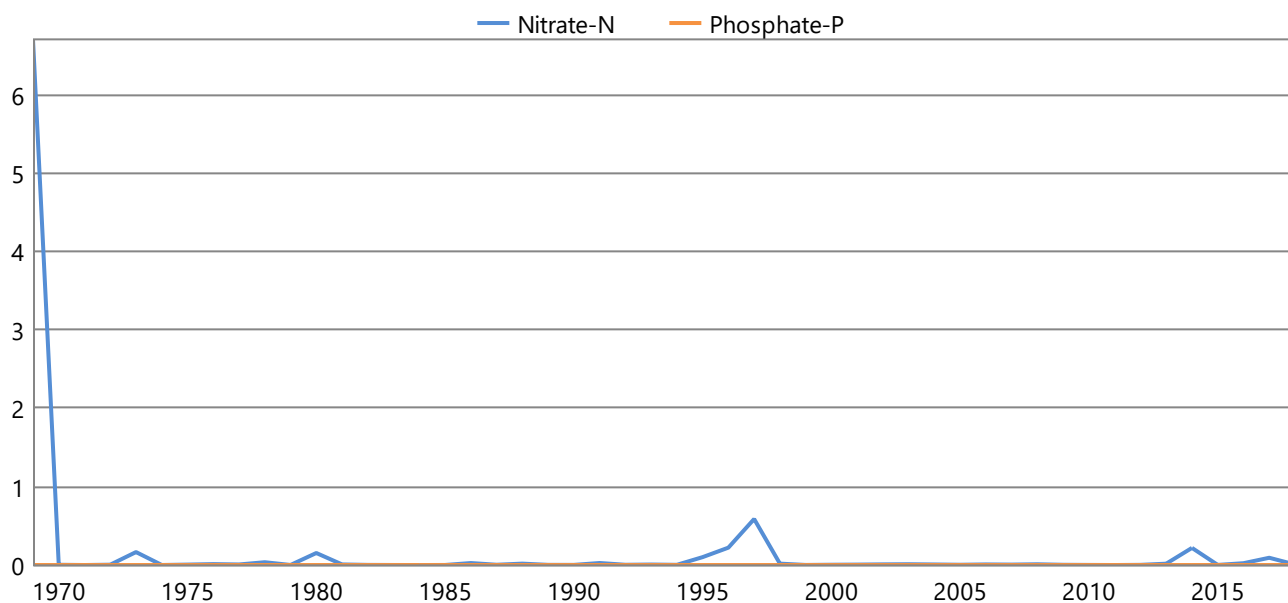
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Sustainability Diagnostics: Greenacres Caravan Park

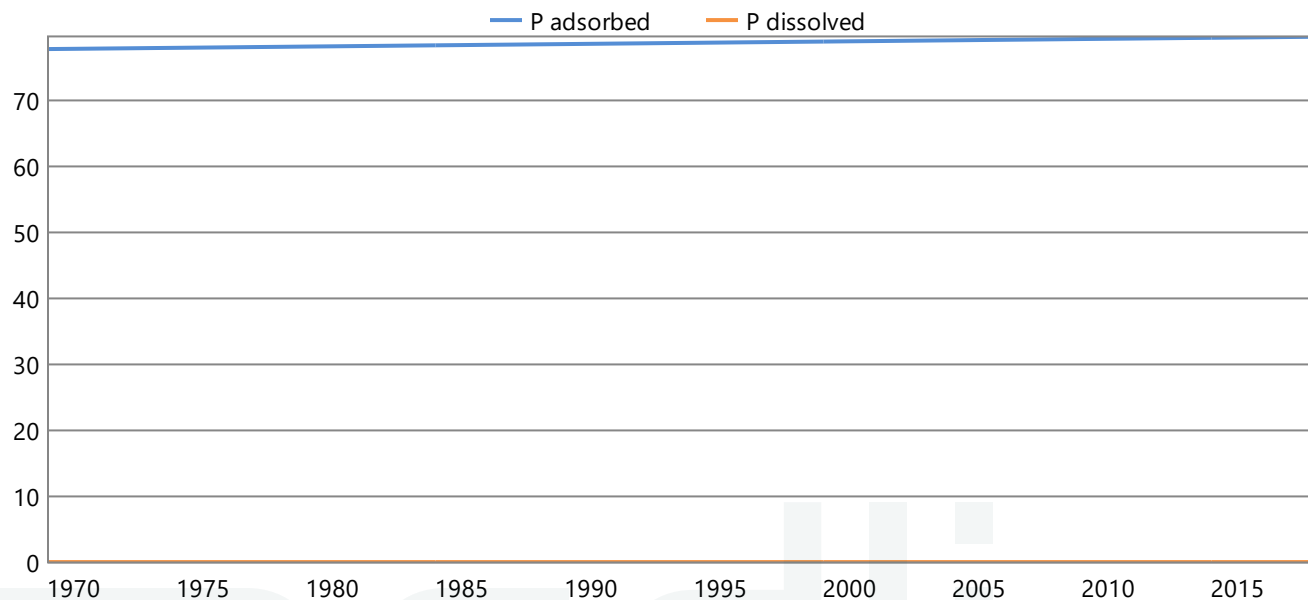
Paddock Land: Default Paddock: 1 ha

Irrigation: Flood with 0.1% ammonium loss during irrigation

Annual nutrient leachate concentration (mg/L)



Annual Phosphate-P in soil (kg/ha)



Sustainability Diagnostics: Greenacres Caravan Park

Paddock Plant Performance: Default Paddock: 1 ha

Average Plant Performance (Minimum - Maximum): Continuous Kikuyu 1 Pasture

Average annual shoot dry matter yield (kg/ha/year)	4028.56 (1367.19 - 10366.03)
Average monthly plant (green) cover (fraction)	0.59 (0.34 - 0.70)
Average monthly crop factor (fraction)	0.47 (0.27 - 0.56)
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Average monthly root depth (mm)	557.64 (353.13 - 632.71)
Average number of normal harvests per year (no./year)	0.30 (0.00 - 2.00)
Average number of normal harvests for last five years only (no./year)	0.00
Average number of crop deaths per year (no./year)	2.04 (0.00 - 4.00)
Average number of crop deaths for last five years only (no./year)	2.80
Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient)	0.73 (0.53 - 0.90)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.02)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.55 (0.34 - 0.69)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.21 (0.12 - 0.31)
Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.00)
No. days without crop/year (days)	30.52

Soil Salinity - Plant salinity tolerance: Moderately tolerant

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

All values based on 10 year running averages

Insufficient deep drainage to run steady state salinity calculations.

Run Messages

Messages generated when the scenario was run:

This is a Dryland scenario
No effluent irrigation has occurred!
Full run chosen

Enterprise: Greenacres Caravan Park

Description:

Greenacres Caravan Park

Client: Greenacres Caravan Park

MEDLI User: F Milnes

Scenario Details:

Sustainability Investigation for land application of treated effluent as alternative to discharge to waters.

Flow 0 kL

TN 35

TP 6.5

TDS 430 based on EC 670 uS/cm

Tank 90kL

Irrigation 3 mm/day

Ryegrass 1 Pasture

MEDLI REPORT - FULL RUN



Climate Data: Greenacres -27.55_153.20, -27.55°, 153.2°

Run Period: 01/01/1969 to 31/12/2018 50 years, 0 days

Climate Statistics:

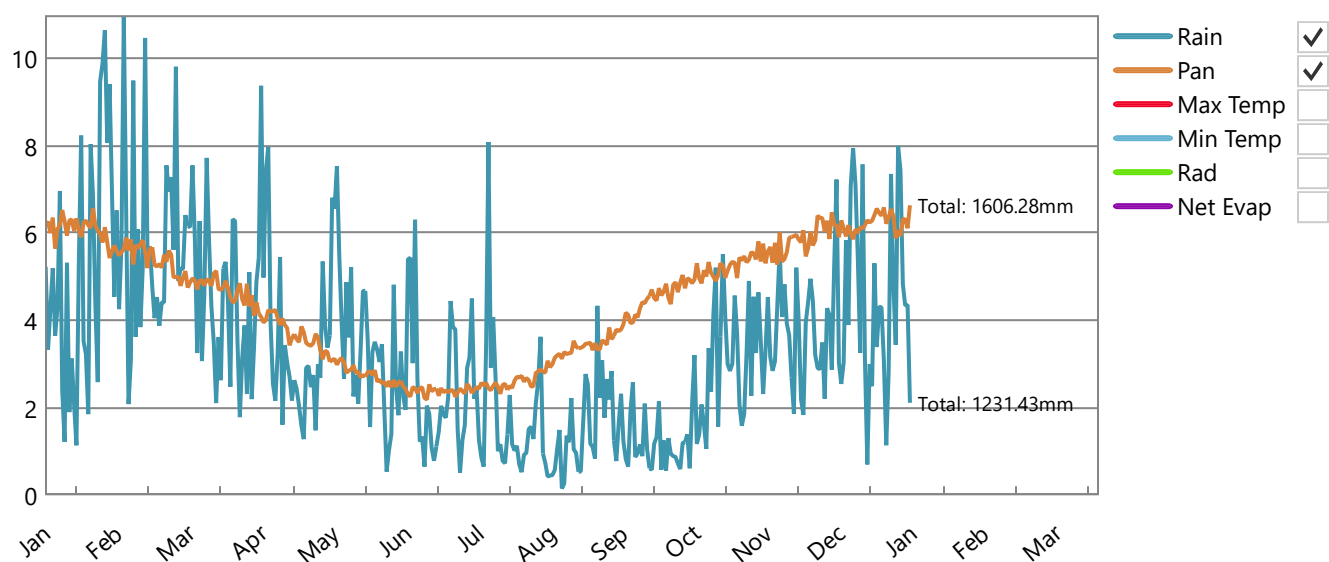
	5th ▾	Percentile	50th Percentile	95th ▾	Percentile
Rainfall (mm/year)		734	1199		1749
Pan Evaporation (mm/year)		1434	1607		1829

Climate Data:

☒ Chart ☐ Table

☐ Monthly ☒ Daily

Daily Average Across Run Period



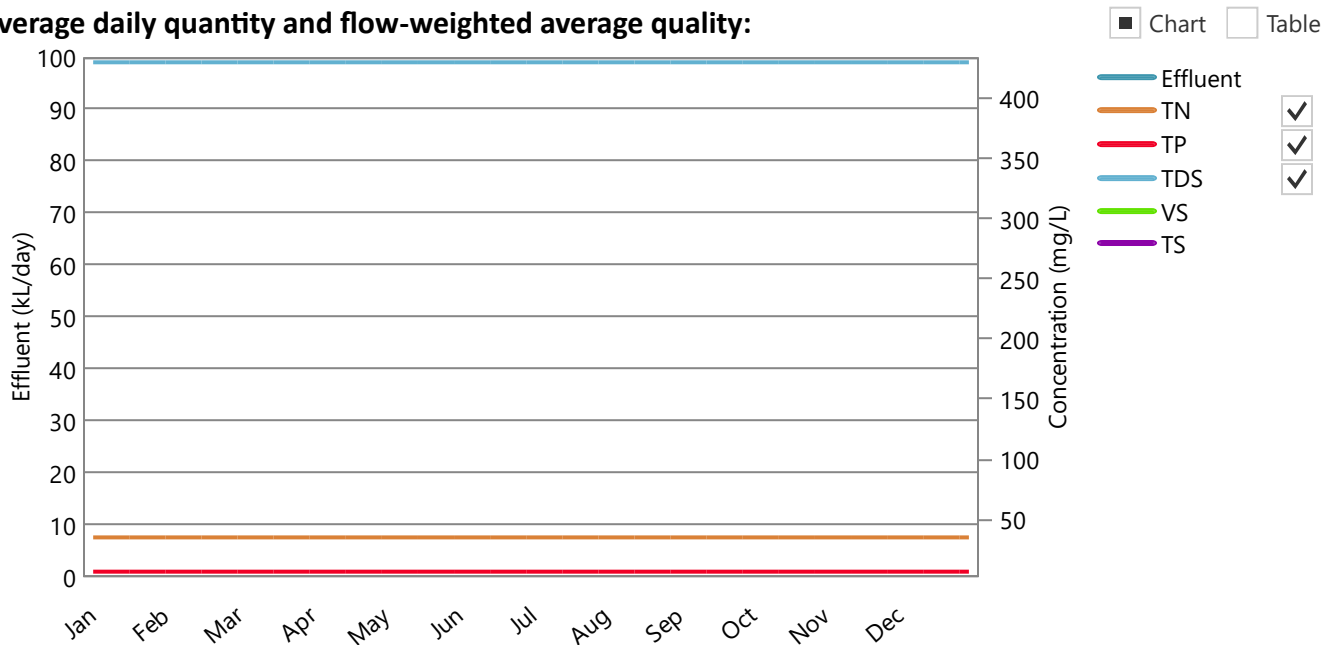
DESCRIPTION



Effluent type: New Generic System

Wastestream before any recycling or pretreatment

Average daily quantity and flow-weighted average quality:



Wastestream after any recycling and pretreatment if applicable

Effluent quantity: **0.00 kL/year** or 0.00 kL/day (Min-Max: 0.00 - 0.00)

Flow-weighted average (minimum - maximum) daily effluent quality entering pond system:

	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Phosphorus	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Dissolved Salts	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
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)

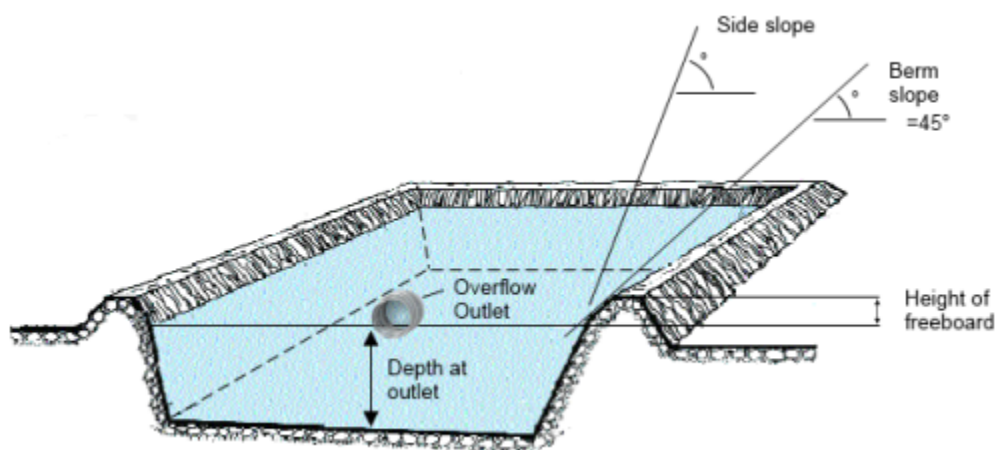
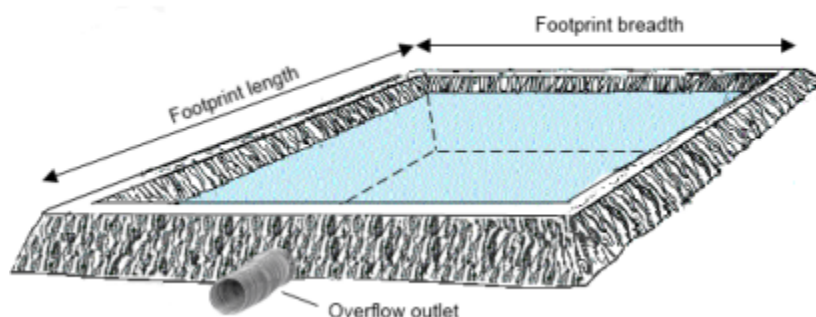
DESCRIPTION

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Pond system: 1 closed storage tank

Pond system details:

	Pond 1
Maximum pond volume (kL)	90.00
Minimum allowable pond volume (kL)	1.24
Pond depth at overflow outlet (m)	2.18
Maximum water surface area (m2)	41.31
Pond footprint length (m)	7.63
Pond footprint width (m)	7.63
Pond catchment area (m2)	58.17
Average active volume (kL)	0.00



Irrigation pump limits:

Minimum pump rate per area limit (ML/day/ha)	0.00
Maximum pump rate per area limit (ML/day/ha)	1.00

Shandying water:

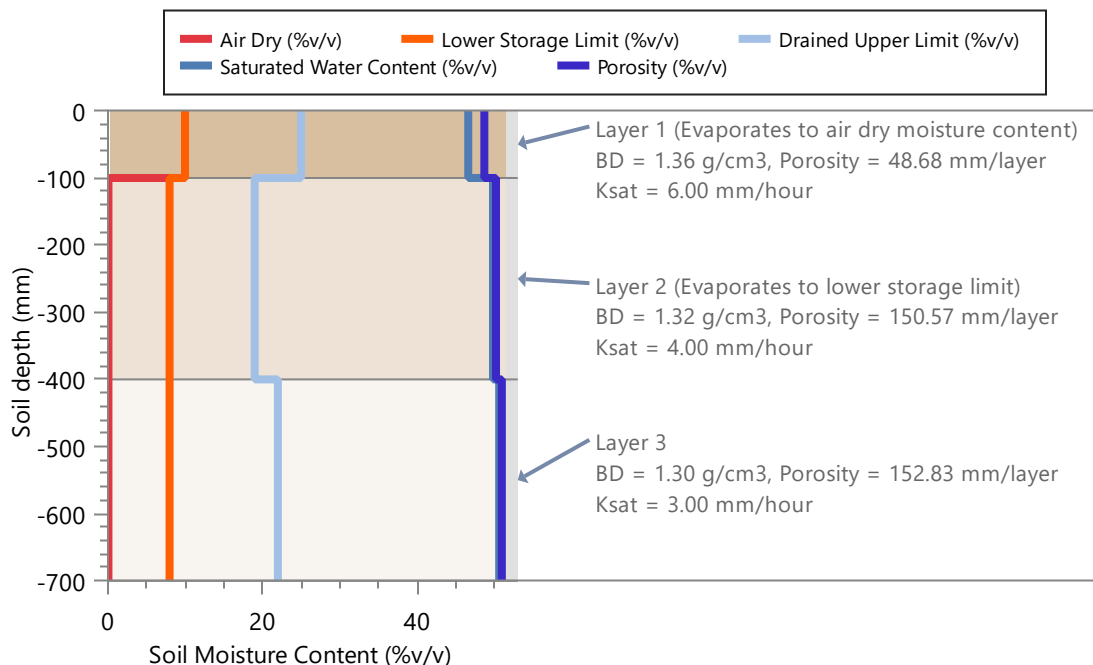
Annual allocation of fresh water available for shandying (kL/year)	0.00
Maximum rate of application of fresh water (ML/day)	0.00
Nitrogen concentration (mg/L)	0.00
Salinity (dS/m)	0.00
Minimum shandy water is used	False

Land: Default Paddock

Area (ha): 1.00

Soil Type: Greenacres Caravan Park, 700.00 mm defined profile depth

Profile Porosity (mm)	352.08
Profile saturation water content (mm)	347.80
Profile drained upper limit (or field capacity) (mm)	148.00
Profile lower storage limit (or permanent wilting point) (mm)	58.00
Profile available water capacity (mm)	90.00
Profile limiting saturated hydraulic conductivity (mm/hour)	3.00
Surface saturated hydraulic conductivity (mm/hour)	6.00
Runoff curve number II (coefficient)	88.00
Soil evaporation U (mm)	9.00
Soil evaporation Cona (mm/sqrt day)	4.00



Plant Data: Continuous Ryegrass 1 Pasture

Average monthly cover (fraction) (minimum - maximum)	0.50 (0.38 - 0.55)
Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 0.8 x Pan coefficient 1)	0.80
Total plant cover (both green and dead) left after harvest (fraction)	0.97
Maximum potential root depth in defined soil profile (mm)	600.00
Salt tolerance	Moderately tolerant
Salinity threshold EC sat. ext. (dS/m)	5.60
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.08



Pond System Water Performance - Overflow: 1 closed storage tank

Capacity of wet weather storage pond: 90 kL

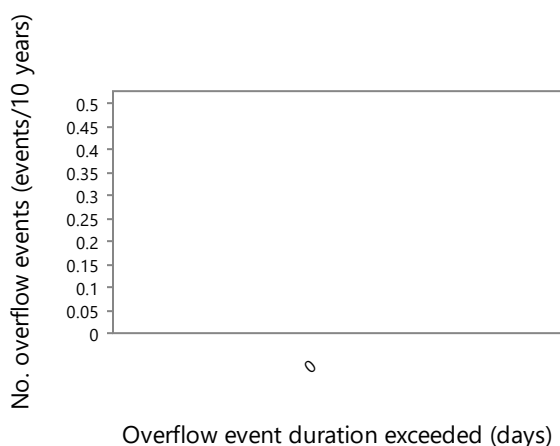
Pond System Water Balance (kL/year)

Name	Value
Rain	0.00
Inflow	0.00
Recycling	0.00
Evaporation	0.00
Overflow	0.00
Irrigation	0.00
Seepage	0.00
Delta Storage	0.00

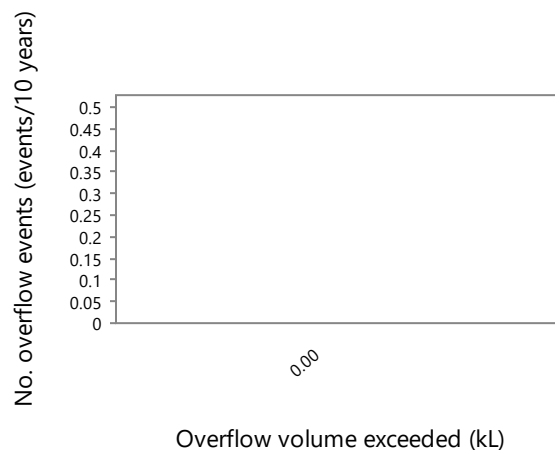
(no data available)

Overflow Diagnostics

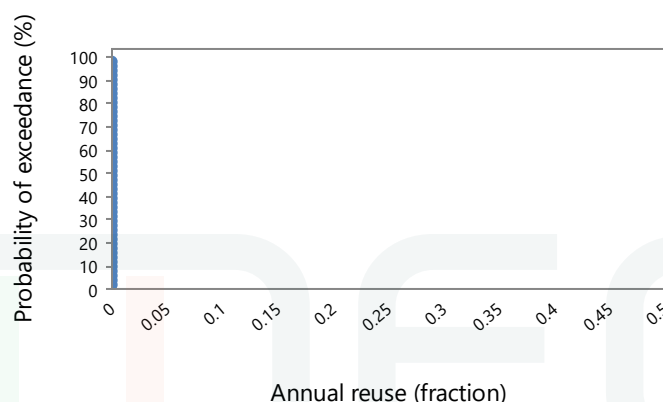
Volume of overflow (kL/year)	0.00
No. days pond overflows (days/year)	0.00
Average duration of overflow (days)	0.00
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	0.00
Probability of at least 90% reuse (fraction)	0.00



[Export plot](#)



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Pond System Performance - Nutrient: 1 closed storage tank

Pond System Nutrients and Salt Balance:

Nitrogen Balance (kg/year)

(no data available)

Name	Value
Inflow	0.00
Recycling	0.00
Volatilisation	0.00
Sludge	0.00
Overflow	0.00
Irrigation	0.00
Seepage	0.00
Delta Storage	0.00

Phosphorus Balance (kg/year)

(no data available)

Name	Value
Inflow	0.00
Recycling	0.00
Sludge	0.00
Overflow	0.00
Irrigation	0.00
Seepage	0.00
Delta Storage	0.00

Salt Balance (kg/year)

(no data available)

Name	Value
Inflow	0.00
Recycling	0.00
Sludge*	0.00
Overflow	0.00
Irrigation	0.00
Seepage	0.00
Delta Storage	0.00

* 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 0.00 kg/year

Pond System Sludge Accumulation: 0.00 kg dwt/year

Pond System Performance - Nutrient: 1 closed storage tank

Pond Nutrient Concentrations and Salinity:

Average across simulation period	Pond 1
Average nitrogen concentration of pond liquid (mg/L)	0.00
Average phosphorus concentration of pond liquid (mg/L)	0.00
Average salinity of pond liquid (dS/m)	0.00

Value on final day of simulation period	Pond 1
Final nitrogen concentration of pond liquid (mg/L)	N.D.*
Final phosphorus concentration of pond liquid (mg/L)	N.D.*
Final salinity of pond liquid (dS/m)	N.D.*

* Not determined. Pond is empty.

Irrigation Performance:

Water Use: (assumes 100% Irrigation Efficiency)

Pond water irrigated (kL/year)	0.00
Average Shandy water irrigation (kL/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Total water irrigated (kL/year)	0.00
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Proportion of years shandying water allocation of 0 kL/year is exceeded (fraction of years)	0.00
Average exceedance as a proportion of annual shandy water allocation (fraction of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)

Irrigation Quality:

Average nitrogen concentration of irrigation water - before ammonia loss during irrigation (mg/L)	0.00
Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)	0.00
Average phosphorus concentration of irrigation water (mg/L)	0.00
Average salinity of irrigation water (dS/m)	0.00

Irrigation Diagnostics (No effluent irrigation occurred!):

Proportion of Days rain prevents irrigation (fraction)	0.04
Proportion of Days pond volume below min. vol. for irrigation (fraction)	0.96
Proportion of Days irrigation occurs (fraction)	0.00

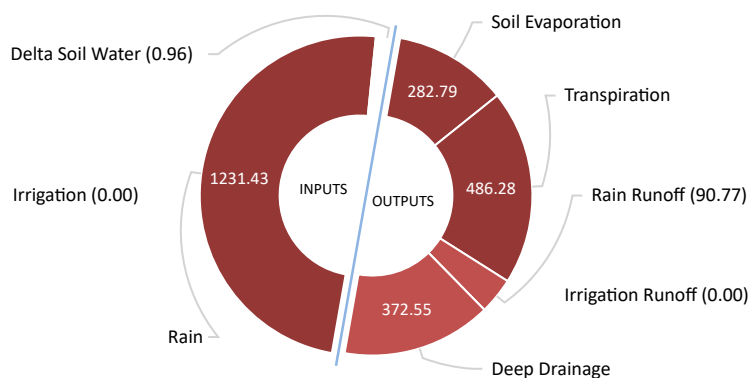
Land Performance - Soil Water

Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park, 76.00 mm PAWC at maximum root depth**

Land Water Balance (mm/year):

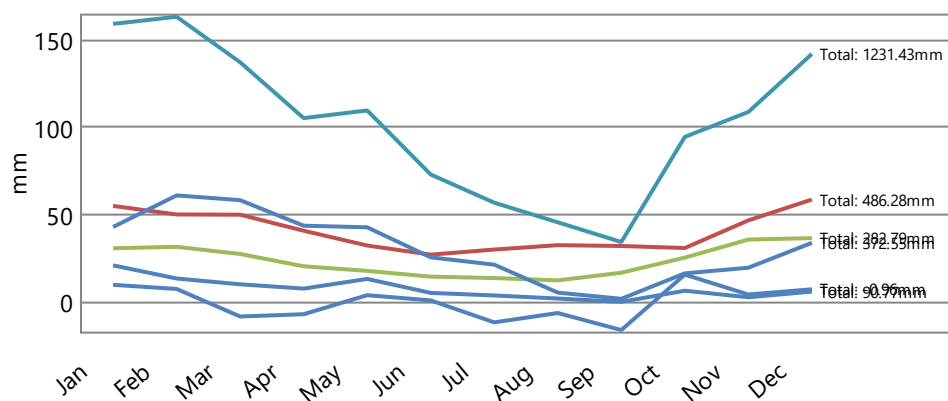
☒ mm/year ☐ % Total inputs



Name	Value
Rain	1231.43
Irrigation	0.00
Soil Evaporation	282.79
Transpiration	486.28
Rain Runoff	90.77
Irrigation Runoff	0.00
Deep Drainage	372.55
Delta Soil Water	-0.96

Average Monthly Totals (mm):

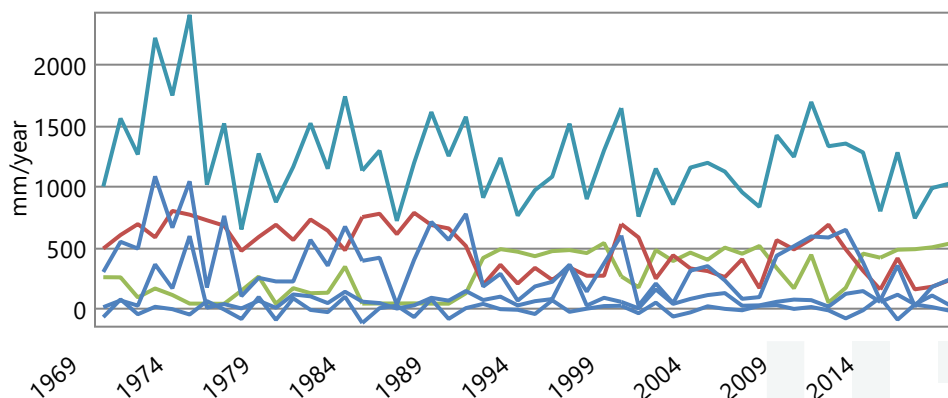
☒ Chart ☐ Table



- ☒ Rain
- ☒ Irrigation
- ☒ Soil Evap
- ☒ Transpn.
- ☒ Rain Runoff
- ☒ Irrigation Runoff
- ☒ Deep Drainage
- ☒ Delta Soil Water

Average Annual Totals (mm/year):

☒ Chart ☐ Table



- ☒ Rain
- ☒ Irrigation
- ☒ Soil Evap
- ☒ Transpn.
- ☒ Rain Runoff
- ☒ Irrigation Runoff
- ☒ Deep Drainage
- ☒ Delta Soil Water

PERFORMANCE



Land Performance - Soil Nutrient

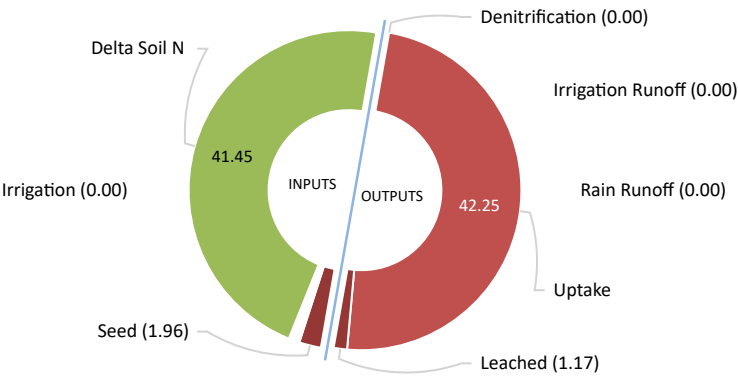
Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park**

Irrigation ammonium volatilisation losses (kg/ha/year): 0.00

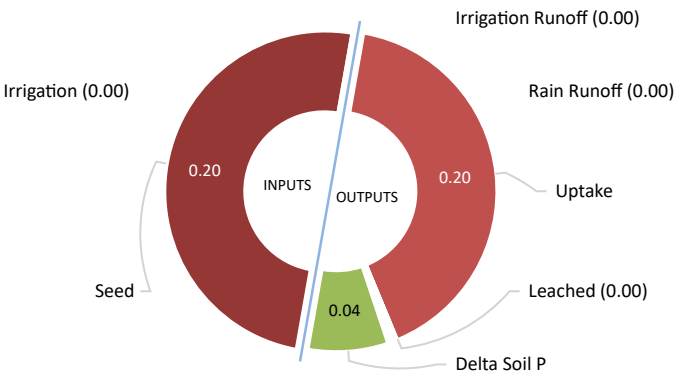
Proportion of total nitrogen in irrigated effluent as ammonium (fraction): 0.40

Land Nitrogen Balance (kg/ha/year)



Name	Value
Seed	1.96
Irrigation	0.00
Denitrification	3.63E-05
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	42.25
Leached	1.17
Delta Soil N	-41.45

Land Phosphorus Balance (kg/ha/year)



Name	Value
Seed	0.20
Irrigation	0.00
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	0.20
Leached	4.31E-05
Delta Soil P	0.04

PERFORMANCE

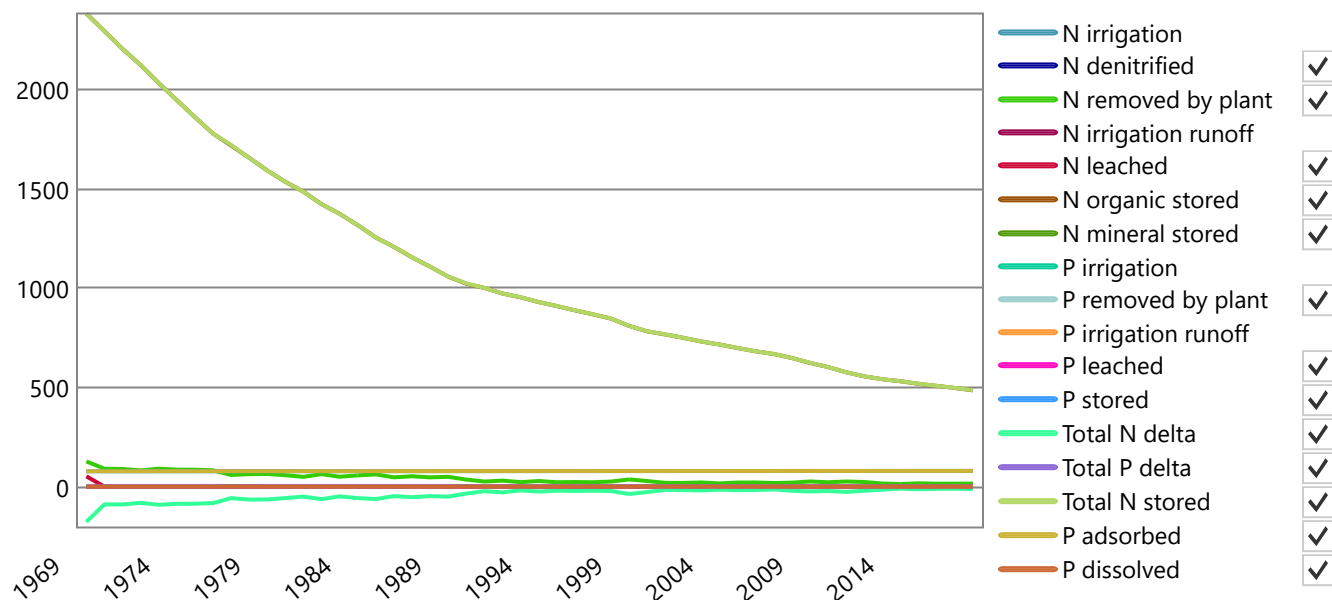


Land Performance - Soil Nutrient

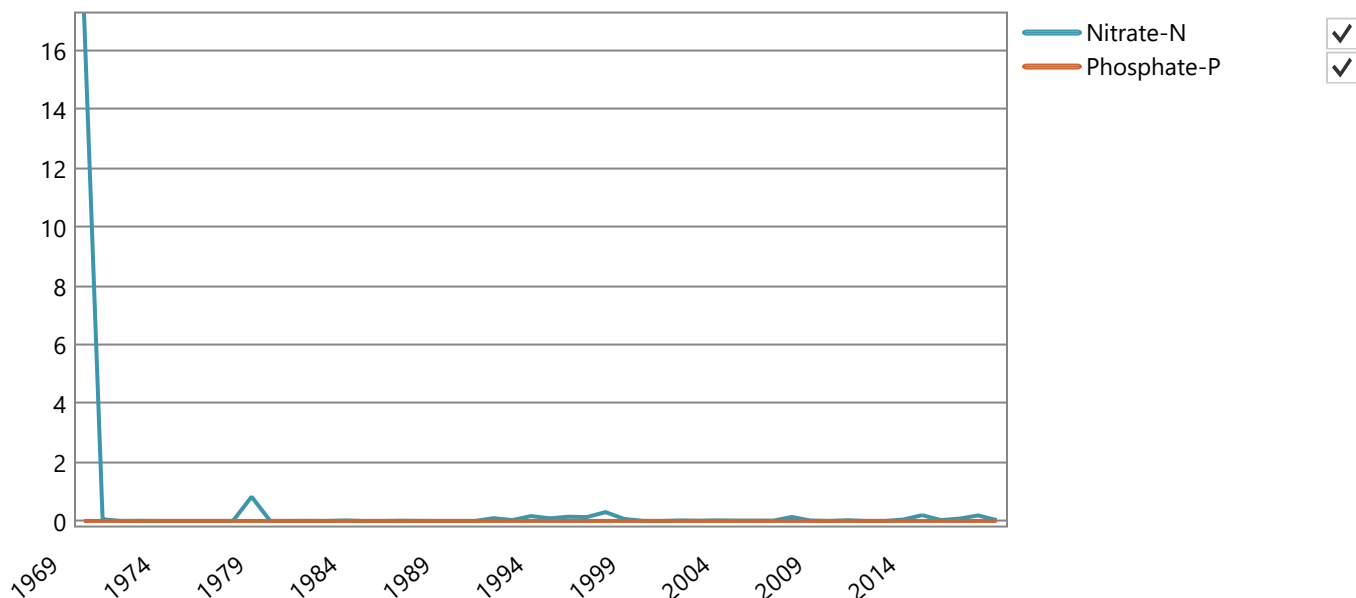
Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park**

Annual Nutrient Totals (kg/ha):



Annual Nutrient Leaching Concentration (mg/L):



PERFORMANCE

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Plant Performance and Nutrients

Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park**

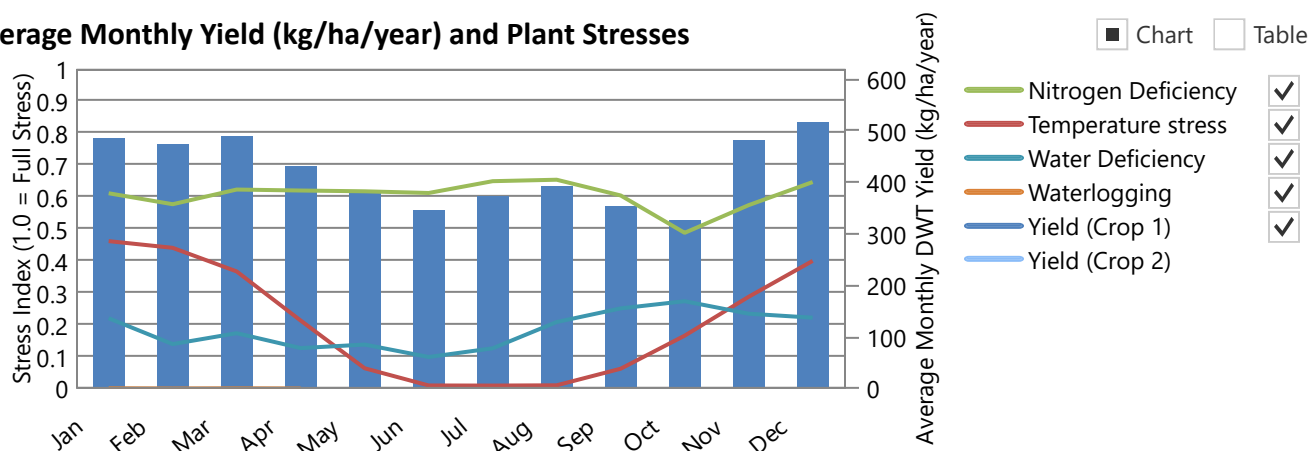
Plant: **Continuous Ryegrass 1 Pasture**

Average annual shoot dry matter yield (kg/ha/year)	5113.00 (1924.18 - 8896.78)
Average monthly plant (green) cover (fraction) (minimum - maximum)	0.50 (0.38 - 0.55)
Average monthly root depth (mm) (minimum - maximum)	410.77 (329.31 - 447.76)

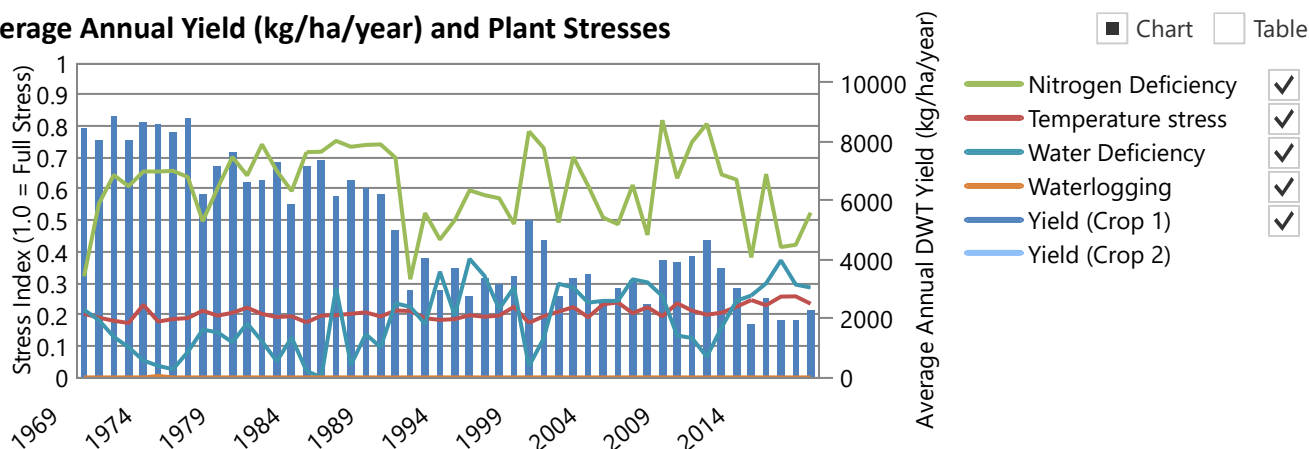
Nutrient Uptake (minimum - maximum):

Average annual net nitrogen removed by plant uptake (kg/ha/year)	42.25 (13.45 - 127.21)
Average annual net phosphorus removed by plant uptake (kg/ha/year)	0.20 (0.00 - 0.54)
Average annual shoot nitrogen concentration (fraction dwt)	0.01 (0.01 - 0.02)
Average annual shoot phosphorus concentration (fraction dwt)	0.000 (0.000 - 0.000)

Average Monthly Yield (kg/ha/year) and Plant Stresses



Average Annual Yield (kg/ha/year) and Plant Stresses



No. of harvests/year: 0.86 (normal), 2.16 (forced by crop death due to water stress (2.16))

No. days without crop/year (days/year): 33.28 due to water stress (33.28)



Land Performance

Paddock: Default Paddock, 1 ha

Soil Type: Greenacres Caravan Park

Plant: Continuous Ryegrass 1 Pasture

Salt tolerance	Moderately tolerant
Salinity threshold EC sat. ext. (dS/m)	5.60
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.08
No. years assumed for leaching to reach steady-state (years)	10.00

Soil Salinity:

Average Infiltrate Salinity (dS/m)	0.03
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Insufficient deep drainage to run steady state salinity calculations.

PERFORMANCE

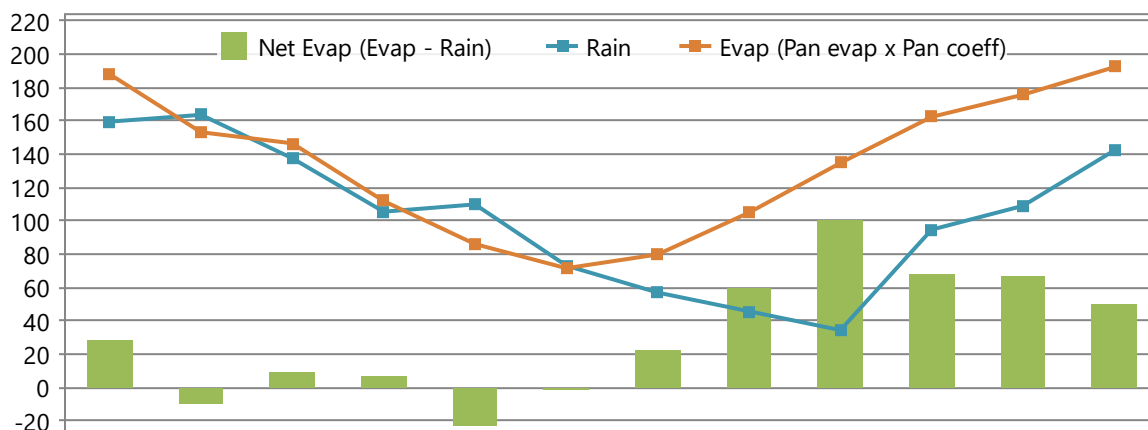


Sustainability Diagnostics: Greenacres Caravan Park

Averaged Historical Climate Data Used in Simulation (mm)

Location: Greenacres -27.55_153.20, -27.55°, 153.2°

Run Period: 01/01/1969 to 31/12/2018 50 years, 0 days



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	159.5	163.6	137.5	105.4	109.8	73.1	56.9	45.6	34.3	94.6	108.9	142.2	1231.4
Evap	188.0	153.1	146.5	111.8	86.0	71.5	79.8	104.9	134.7	162.3	175.6	192.2	1606.3
Net Evap	28.5	-10.4	9.0	6.4	-23.8	-1.6	22.9	59.2	100.3	67.7	66.7	50.0	374.9
Net Evap/day	0.9	-0.4	0.3	0.2	-0.8	-0.1	0.7	1.9	3.3	2.2	2.2	1.6	1.0

DIAGNOSTICS

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Sustainability Diagnostics: Greenacres Caravan Park

Pond System: 1 closed storage tank

New Generic System - 0.00 kL/year or 0.00 kL/day generated on average

Effluent entering pond system after any pretreatment and recycling

Average (Minimum-Maximum) influent quality calculated for 0.00 non-zero flow days, after any pretreatment and recycling.

Constituent	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Phosphorus	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Dissolved Salts	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
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)

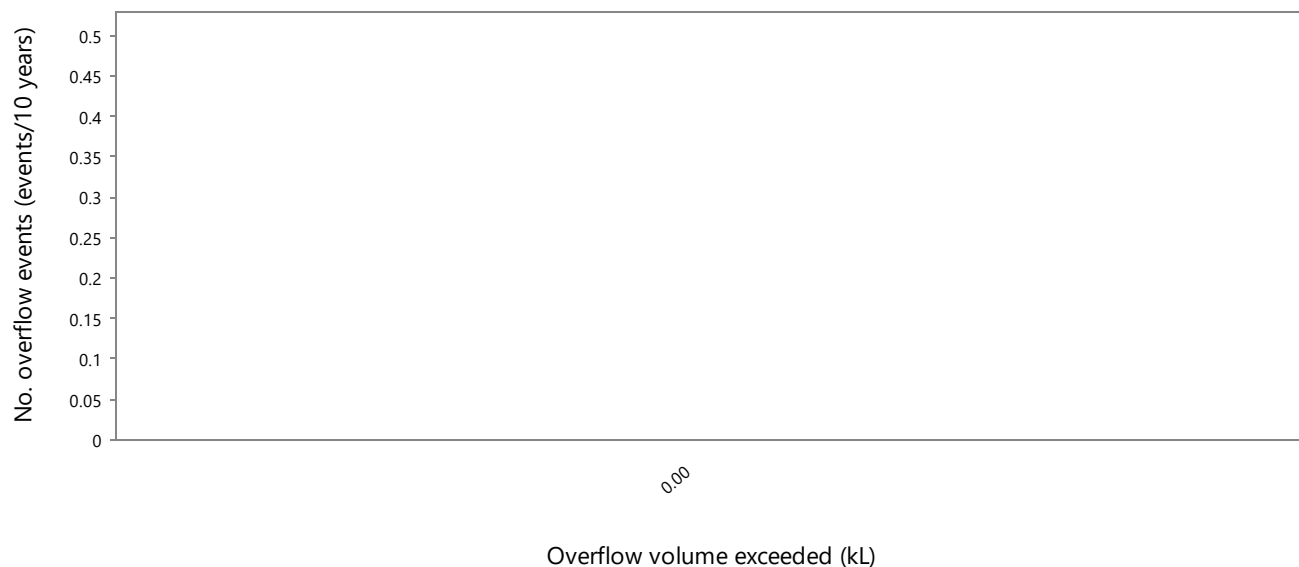
Last pond (Wet weather store): 90.00 kL

Theoretical hydraulic retention time (days)	0.00
Average volume of overflow (kL/year)	0.00
No. overflow events per year exceeding threshold* of 0.04 kL (no./year)	0.00
Average duration of overflow (days)	0.00
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	0.00
Probability of at least 90% effluent reuse (fraction)	0.00
Average salinity of last pond (dS/m)	0.00
Salinity of last pond on final day of simulation (dS/m)	0.00
Ammonia loss from pond system water area (kg/m2/year)	0.00

* The threshold is the volume equivalent to the top 1 mm depth of water of a full pond

Overflow exceedance:

☒ Chart ☐ Table



[Export plot](#)



Sustainability Diagnostics: Greenacres Caravan Park

Irrigation Information

Irrigation: 1 ha total area (assumed 100% irrigation efficiency)

	Quantity/year	Quantity/ha/year
Total irrigation applied (kL)	0.00	0.00
Total nitrogen applied (kg)	0.00	0.00
Total phosphorus applied (kg)	0.00	0.00
Total salts applied (kg)	0.00	0.00

Shandying

Annual allocation of fresh water for shandying (kL/year)	0.00
Average Shandy water irrigation (kL/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Average exceedance as a proportion of annual shandy water allocation (% of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Minimum shandy water is used	False

Irrigation Issues

Proportion of Days irrigation is prevented when triggered (fraction)	1.00
--	------

Sustainability Diagnostics: Greenacres Caravan Park

Paddock Land: Default Paddock: 1 ha

Irrigation: Flood with 0.1% ammonium loss during irrigation

Irrigation triggered when soil water deficit reaches 0.00 mm and rainfall is less than or equal to 20.00 mm
Irrigate a fixed amount of 3.00 mm each day
Irrigation window from 1/1 to 31/12 including the days specified
A minimum of 0 days must be skipped between irrigation events

Soil Water Balance (mm): Greenacres Caravan Park, 76.00 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	159.5	163.6	137.5	105.4	109.8	73.1	56.9	45.6	34.3	94.6	108.9	142.2	1231.4
Irrigation	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
Soil Evap	30.7	31.6	27.5	20.4	17.8	14.5	13.6	12.3	16.7	25.4	35.8	36.6	282.8
Transpn.	55.0	50.1	50.0	40.8	32.3	27.1	30.0	32.5	32.0	30.9	46.7	58.7	486.3
Runoff	20.9	13.4	10.1	7.6	13.1	5.1	3.7	1.9	0.0	6.4	2.6	5.9	90.8
Drainage	43.0	61.1	58.3	43.7	42.8	25.5	21.3	5.3	1.8	16.3	19.6	33.9	372.6
Delta	9.8	7.4	-8.4	-7.1	3.8	0.8	-11.8	-6.4	-16.2	15.6	4.2	7.2	-1.0

Soil Nitrogen Balance

Average annual effluent nitrogen added (kg/ha/year)	0.00
Average annual soil nitrogen removed by plant uptake (kg/ha/year)	42.25
Average annual soil nitrogen removed by denitrification (kg/ha/year)	3.63E-05
Average annual soil nitrogen leached (kg/ha/year)	1.17
Average annual nitrate-N loading to groundwater (kg/ha/year)	1.17
Soil organic-N kg/ha (Initial - Final)	2448.00 - 485.06
	110.64 - 0.90
Average nitrate-N concentration of deep drainage (mg/L)	0.31
Max. annual nitrate-N concentration of deep drainage (mg/L)	17.29

Soil Phosphorus Balance

Average annual effluent phosphorus added (kg/ha/year)	0.00
Average annual soil phosphorus removed by plant uptake (kg/ha/year)	0.20
Average annual soil phosphorus leached (kg/ha/year)	4.31E-05
Dissolved phosphorus (kg/ha) (Initial - Final)	0.00 - 3.00E-05
Adsorbed phosphorus (kg/ha) (Initial - Final)	77.71 - 79.61
Average phosphate-P concentration in rootzone (mg/L)	2.99E-05
Average phosphate-P concentration of deep drainage (mg/L)	1.16E-05
Max. annual phosphate-P concentration of deep drainage (mg/L)	1.37E-05
Design soil profile storage life based on average infiltrated water phosphorus concn. of 0.00 mg/L (years)	0.00

DIAGNOSTICS

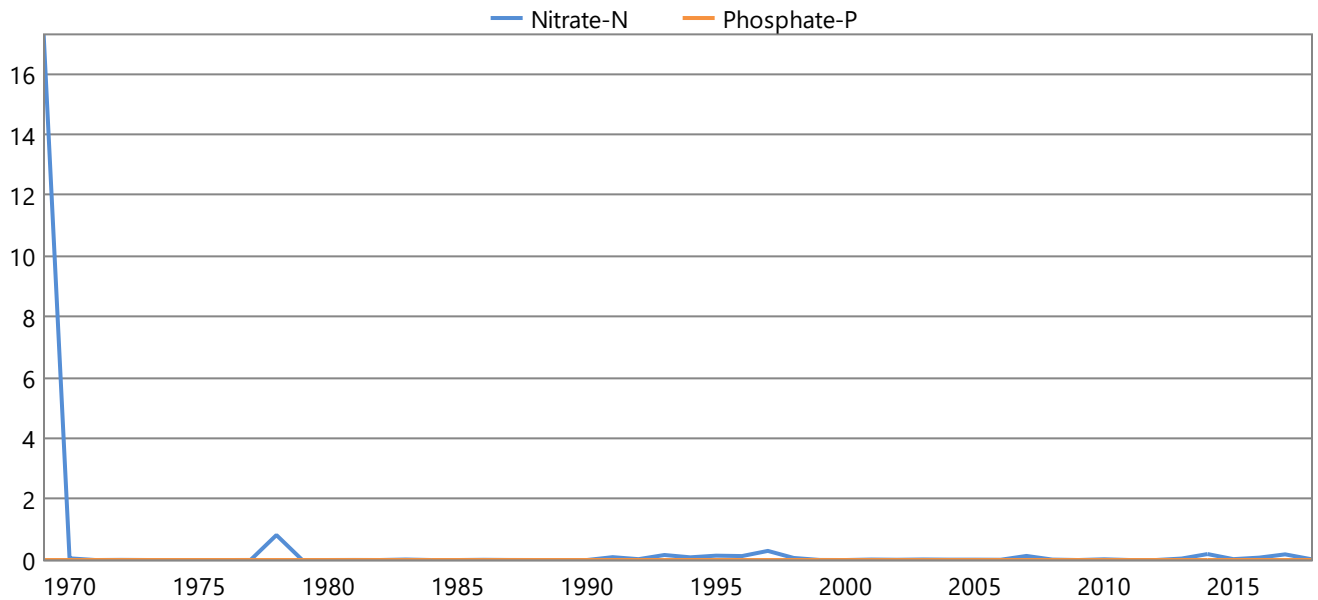
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Sustainability Diagnostics: Greenacres Caravan Park

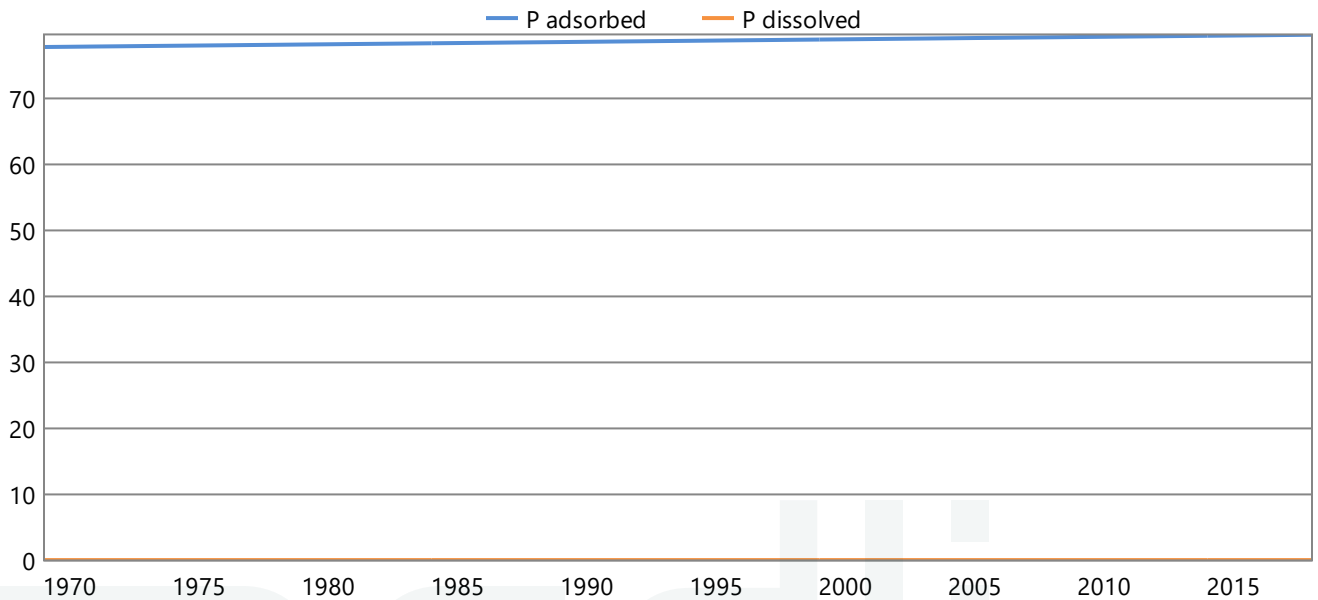
Paddock Land: Default Paddock: 1 ha

Irrigation: Flood with 0.1% ammonium loss during irrigation

Annual nutrient leachate concentration (mg/L)



Annual Phosphate-P in soil (kg/ha)



Sustainability Diagnostics: Greenacres Caravan Park

Paddock Plant Performance: Default Paddock: 1 ha

Average Plant Performance (Minimum - Maximum): Continuous Ryegrass 1 Pasture

Average annual shoot dry matter yield (kg/ha/year)	5113.00 (1924.18 - 8896.78)
Average monthly plant (green) cover (fraction)	0.50 (0.38 - 0.55)
Average monthly crop factor (fraction)	0.40 (0.30 - 0.44)
Total plant cover (both green and dead) left after harvest (fraction)	0.97
Average monthly root depth (mm)	410.77 (329.31 - 447.76)
Average number of normal harvests per year (no./year)	0.86 (0.00 - 3.00)
Average number of normal harvests for last five years only (no./year)	0.00
Average number of crop deaths per year (no./year)	2.16 (0.00 - 6.00)
Average number of crop deaths for last five years only (no./year)	4.80
Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient)	0.61 (0.31 - 0.82)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.46 (0.33 - 0.57)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.01 (0.00 - 0.04)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.18 (0.10 - 0.27)
Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.00)
No. days without crop/year (days)	33.28

Soil Salinity - Plant salinity tolerance: Moderately tolerant

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

All values based on 10 year running averages

Insufficient deep drainage to run steady state salinity calculations.

Run Messages

Messages generated when the scenario was run:

This is a Dryland scenario
No effluent irrigation has occurred!
Full run chosen

Enterprise: Greenacres Caravan Park

Description:

Greenacres Caravan Park

Client: Greenacres Caravan Park

MEDLI User: F Milnes

Scenario Details:

Sustainability Investigation for land application of treated effluent as alternative to discharge to waters.

Flow 25 kL

TN 35

TP 6.5

TDS 430 based on EC 670 uS/cm

Tank 90kL

Irrigation 3.5 mm/day

Kikuyu 1 Pasture

MEDLI REPORT - FULL RUN



Climate Data: Greenacres -27.55_153.20, -27.55°, 153.2°

Run Period: 01/01/1969 to 31/12/2018 50 years, 0 days

Climate Statistics:

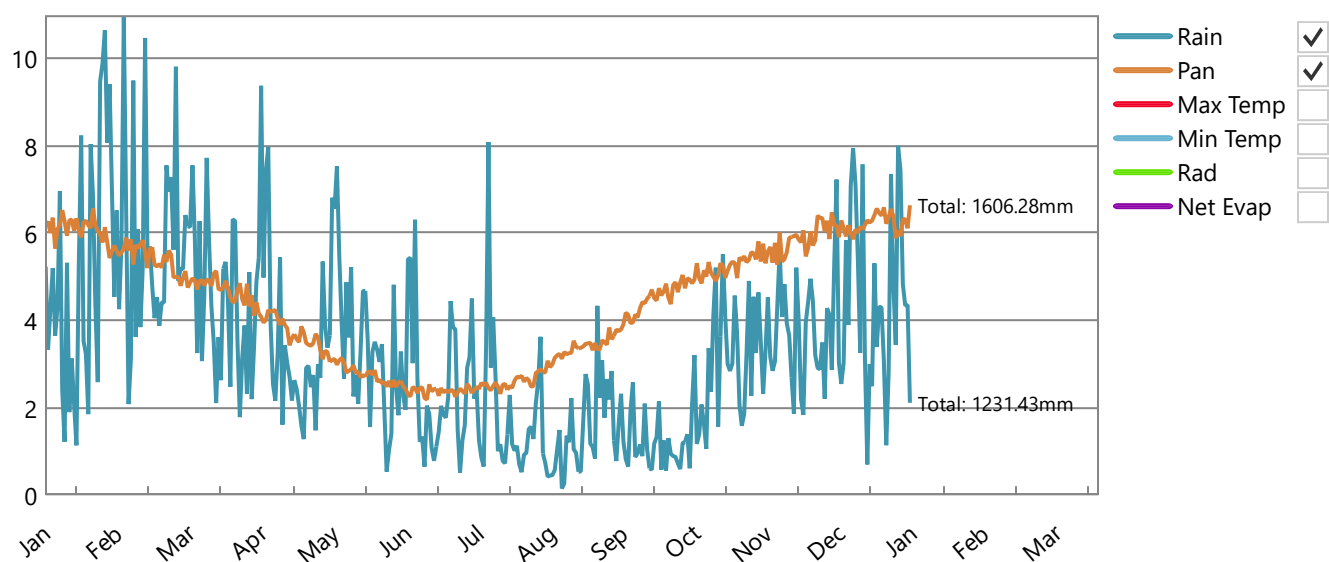
	5th ▾	Percentile	50th Percentile	95th ▾	Percentile
Rainfall (mm/year)		734	1199		1749
Pan Evaporation (mm/year)		1434	1607		1829

Climate Data:

☒ Chart ☐ Table

☐ Monthly ☒ Daily

Daily Average Across Run Period



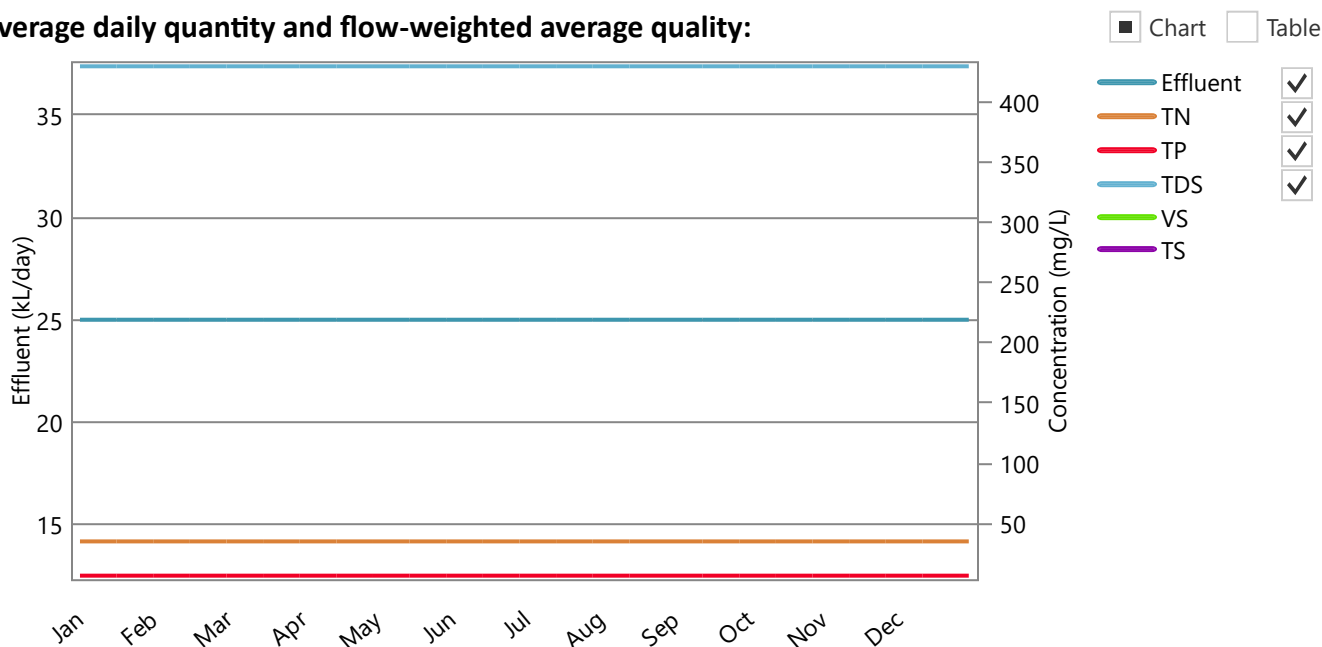
DESCRIPTION



Effluent type: New Generic System

Wastestream before any recycling or pretreatment

Average daily quantity and flow-weighted average quality:



Wastestream after any recycling and pretreatment if applicable

Effluent quantity: **9131.00 kL/year** or 25.00 kL/day (Min-Max: 25.00 - 25.00)

Flow-weighted average (minimum - maximum) daily effluent quality entering pond system:

	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	35.00 (35.00 - 35.00)	319.59 (319.38 - 320.25)
Total Phosphorus	6.50 (6.50 - 6.50)	59.35 (59.31 - 59.48)
Total Dissolved Salts	430.00 (430.00 - 430.00)	3926.33 (3923.75 - 3934.50)
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)

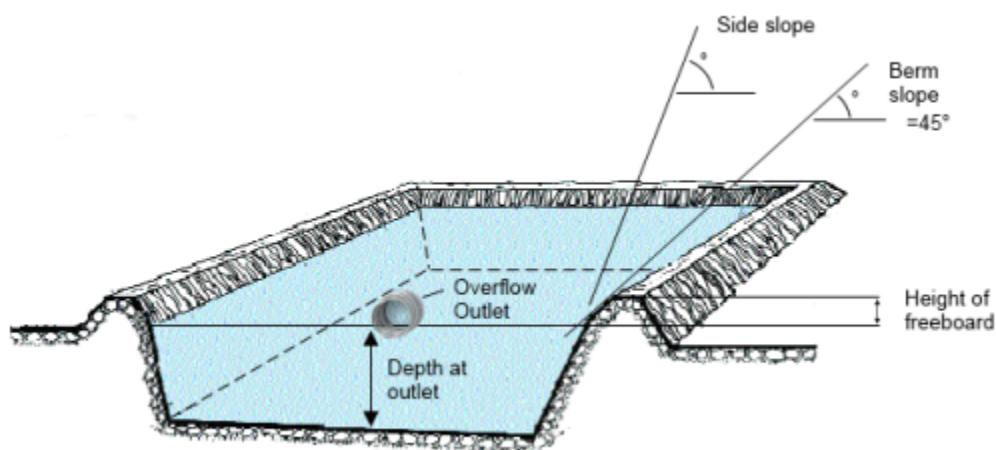
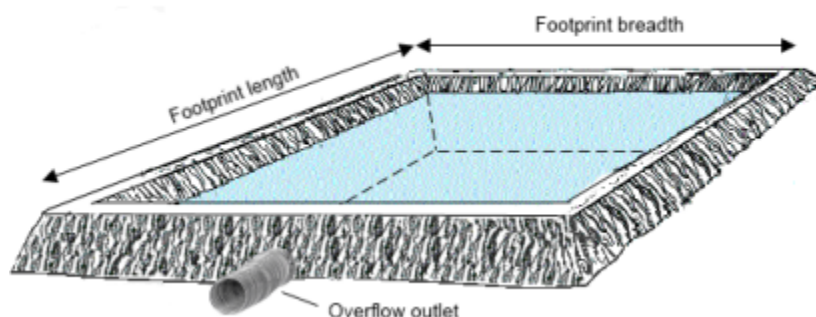
DESCRIPTION

medli

Pond system: 1 closed storage tank

Pond system details:

	Pond 1
Maximum pond volume (kL)	90.00
Minimum allowable pond volume (kL)	1.24
Pond depth at overflow outlet (m)	2.18
Maximum water surface area (m2)	41.31
Pond footprint length (m)	7.63
Pond footprint width (m)	7.63
Pond catchment area (m2)	58.17
Average active volume (kL)	4.41



Irrigation pump limits:

Minimum pump rate per area limit (ML/day/ha)	0.00
Maximum pump rate per area limit (ML/day/ha)	1.00

Shandying water:

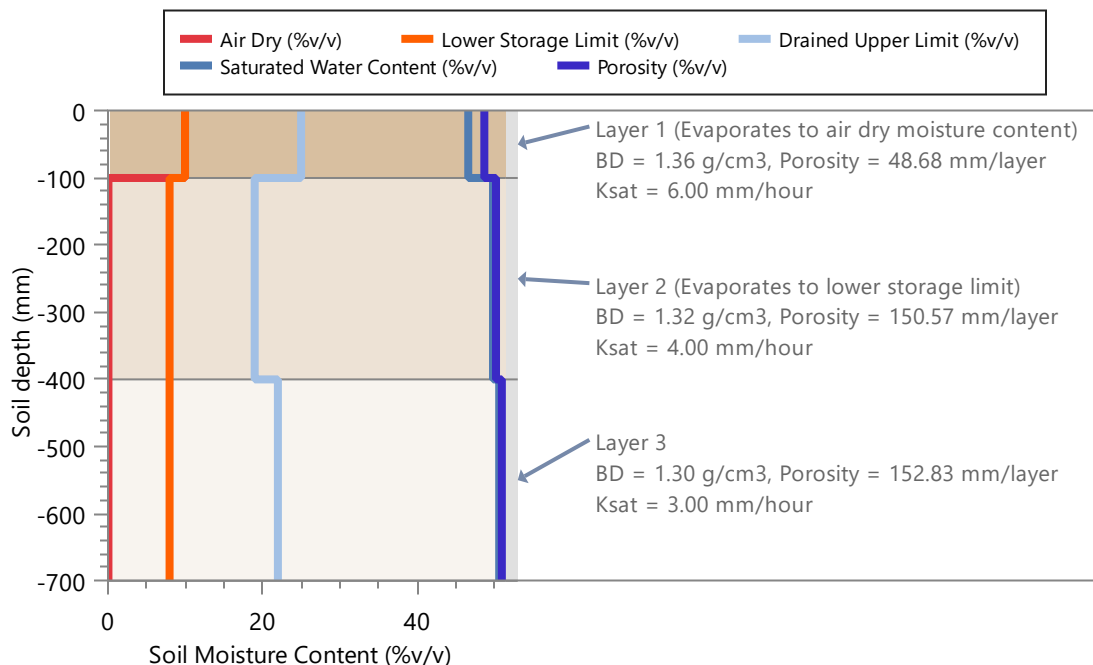
Annual allocation of fresh water available for shandying (kL/year)	0.00
Maximum rate of application of fresh water (ML/day)	0.00
Nitrogen concentration (mg/L)	0.00
Salinity (dS/m)	0.00
Minimum shandy water is used	False

Land: Default Paddock

Area (ha): 1.00

Soil Type: Greenacres Caravan Park, 700.00 mm defined profile depth

Profile Porosity (mm)	352.08
Profile saturation water content (mm)	347.80
Profile drained upper limit (or field capacity) (mm)	148.00
Profile lower storage limit (or permanent wilting point) (mm)	58.00
Profile available water capacity (mm)	90.00
Profile limiting saturated hydraulic conductivity (mm/hour)	3.00
Surface saturated hydraulic conductivity (mm/hour)	6.00
Runoff curve number II (coefficient)	88.00
Soil evaporation U (mm)	9.00
Soil evaporation Cona (mm/sqrt day)	4.00



Plant Data: Continuous Kikuyu 1 Pasture

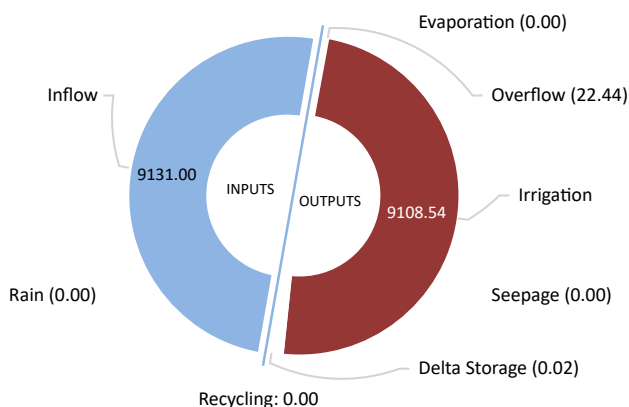
Average monthly cover (fraction) (minimum - maximum)	0.87 (0.83 - 0.89)
Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 0.8 x Pan coefficient 1)	0.80
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Maximum potential root depth in defined soil profile (mm)	700.00
Salt tolerance	Moderately tolerant
Salinity threshold EC sat. ext. (dS/m)	3.00
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.03



Pond System Water Performance - Overflow: 1 closed storage tank

Capacity of wet weather storage pond: **90 kL**

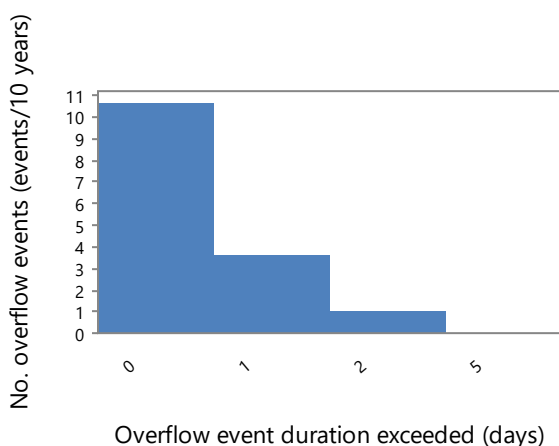
Pond System Water Balance (kL/year)



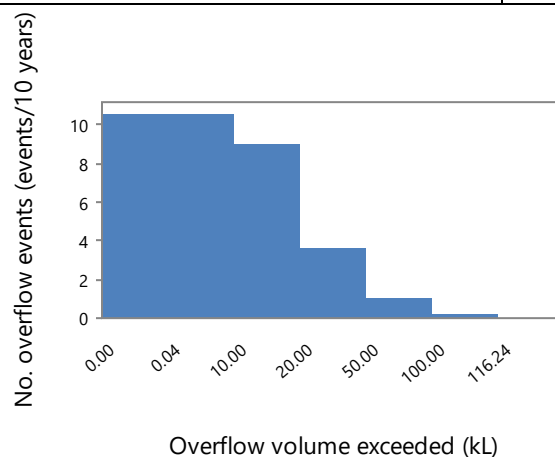
Name	Value
Rain	0.00
Inflow	9131.00
Recycling	0.00
Evaporation	0.00
Overflow	22.44
Irrigation	9108.54
Seepage	0.00
Delta Storage	0.02

Overflow Diagnostics

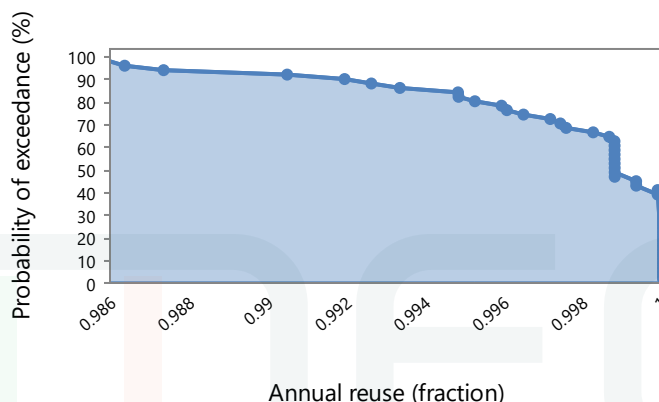
Volume of overflow (kL/year)	22.44
No. days pond overflows (days/year)	1.56
Average duration of overflow (days)	1.47
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	1.00
Probability of at least 90% reuse (fraction)	1.00



[Export plot](#)



[Export plot](#)

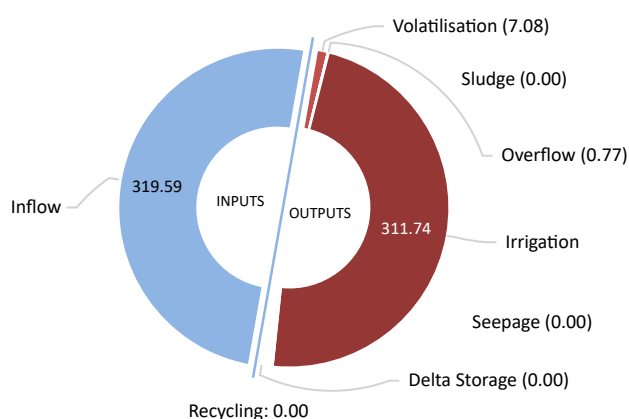


[Export plot](#)

Pond System Performance - Nutrient: 1 closed storage tank

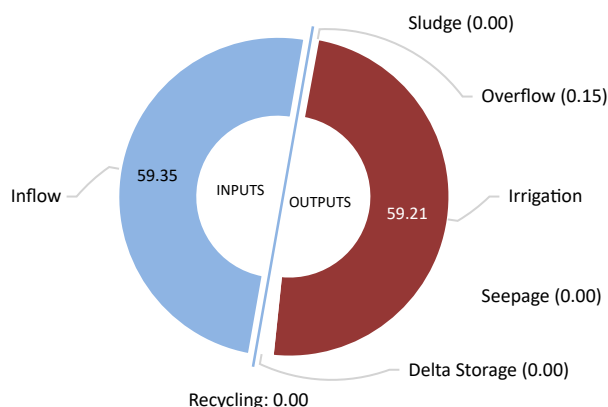
Pond System Nutrients and Salt Balance:

Nitrogen Balance (kg/year)



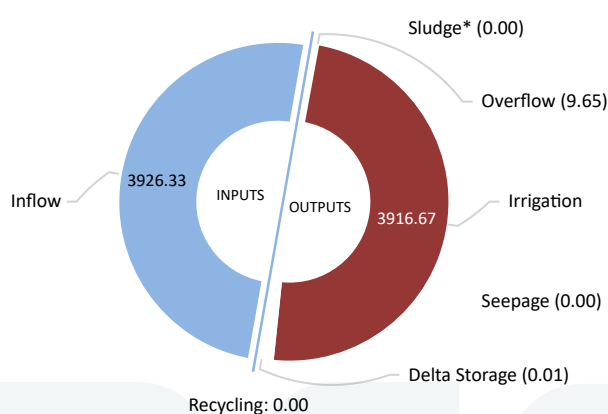
Name	Value
Inflow	319.59
Recycling	0.00
Volatilisation	7.08
Sludge	0.00
Overflow	0.77
Irrigation	311.74
Seepage	0.00
Delta Storage	0.00

Phosphorus Balance (kg/year)



Name	Value
Inflow	59.35
Recycling	0.00
Sludge	0.00
Overflow	0.15
Irrigation	59.21
Seepage	0.00
Delta Storage	0.00

Salt Balance (kg/year)



Name	Value
Inflow	3926.33
Recycling	0.00
Sludge*	0.00
Overflow	9.65
Irrigation	3916.67
Seepage	0.00
Delta Storage	0.01

* 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 0.00 kg/year

Pond System Sludge Accumulation: 0.00 kg dwt/year

Pond System Performance - Nutrient: 1 closed storage tank

Pond Nutrient Concentrations and Salinity:

Average across simulation period	Pond 1
Average nitrogen concentration of pond liquid (mg/L)	29.83
Average phosphorus concentration of pond liquid (mg/L)	6.50
Average salinity of pond liquid (dS/m)	0.67

Value on final day of simulation period	Pond 1
Final nitrogen concentration of pond liquid (mg/L)	18.57
Final phosphorus concentration of pond liquid (mg/L)	6.50
Final salinity of pond liquid (dS/m)	0.67

Irrigation Performance:

Water Use: (assumes 100% Irrigation Efficiency)

Pond water irrigated (kL/year)	9108.54
Average Shandy water irrigation (kL/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Total water irrigated (kL/year)	9108.54
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Proportion of years shandying water allocation of 0 kL/year is exceeded (fraction of years)	0.00
Average exceedance as a proportion of annual shandy water allocation (fraction of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)

Irrigation Quality:

Average nitrogen concentration of irrigation water - before ammonia loss during irrigation (mg/L)	34.23
Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)	32.86
Average phosphorus concentration of irrigation water (mg/L)	6.50
Average salinity of irrigation water (dS/m)	0.67

Irrigation Diagnostics:

Proportion of Days rain prevents irrigation (fraction)	0.04
Proportion of Days irrigation occurs (fraction)	0.96

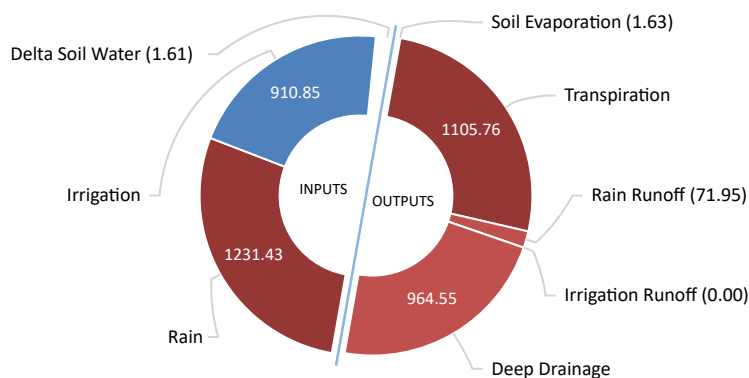
Land Performance - Soil Water

Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park, 90.00 mm PAWC at maximum root depth**

Land Water Balance (mm/year):

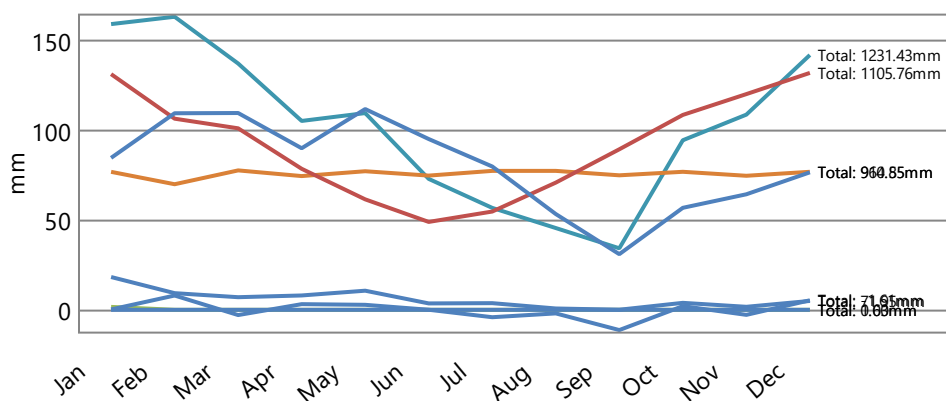
■ mm/year □ % Total inputs



Name	Value
Rain	1231.43
Irrigation	910.85
Soil Evaporation	1.63
Transpiration	1105.76
Rain Runoff	71.95
Irrigation Runoff	0.00
Deep Drainage	964.55
Delta Soil Water	-1.61

Average Monthly Totals (mm):

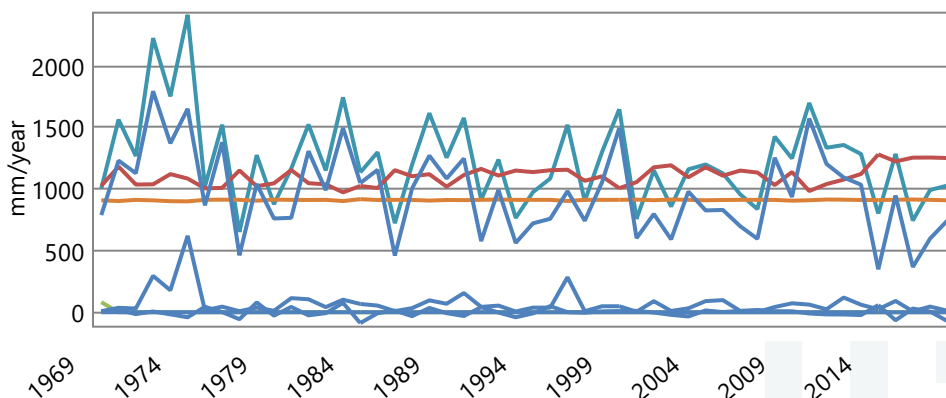
■ Chart □ Table



☒ Rain
☒ Irrigation
☒ Soil Evap
☒ Transpn.
☒ Rain Runoff
☒ Irrigation Runoff
☒ Deep Drainage
☒ Delta Soil Water

Average Annual Totals (mm/year):

■ Chart □ Table



☒ Rain
☒ Irrigation
☒ Soil Evap
☒ Transpn.
☒ Rain Runoff
☒ Irrigation Runoff
☒ Deep Drainage
☒ Delta Soil Water

Land Performance - Soil Nutrient

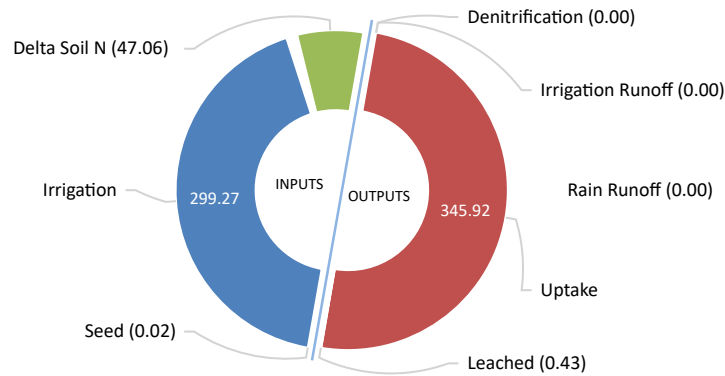
Paddock: Default Paddock, 1 ha

Soil Type: Greenacres Caravan Park

Irrigation ammonium volatilisation losses (kg/ha/year): 12.47

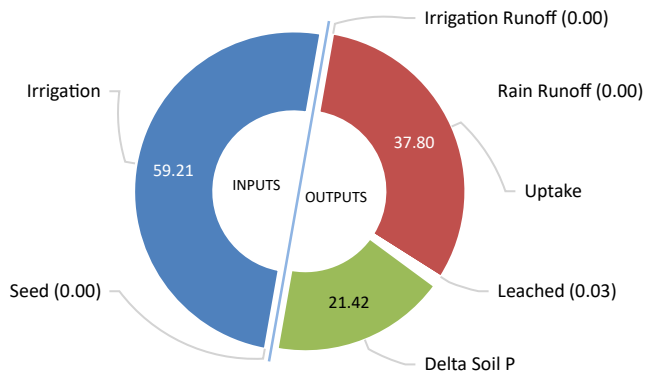
Proportion of total nitrogen in irrigated effluent as ammonium (fraction): 0.40

Land Nitrogen Balance (kg/ha/year)



Name	Value
Seed	0.02
Irrigation	299.27
Denitrification	4.75E-04
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	345.92
Leached	0.43
Delta Soil N	-47.06

Land Phosphorus Balance (kg/ha/year)



Name	Value
Seed	1.80E-03
Irrigation	59.21
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	37.80
Leached	0.03
Delta Soil P	21.42

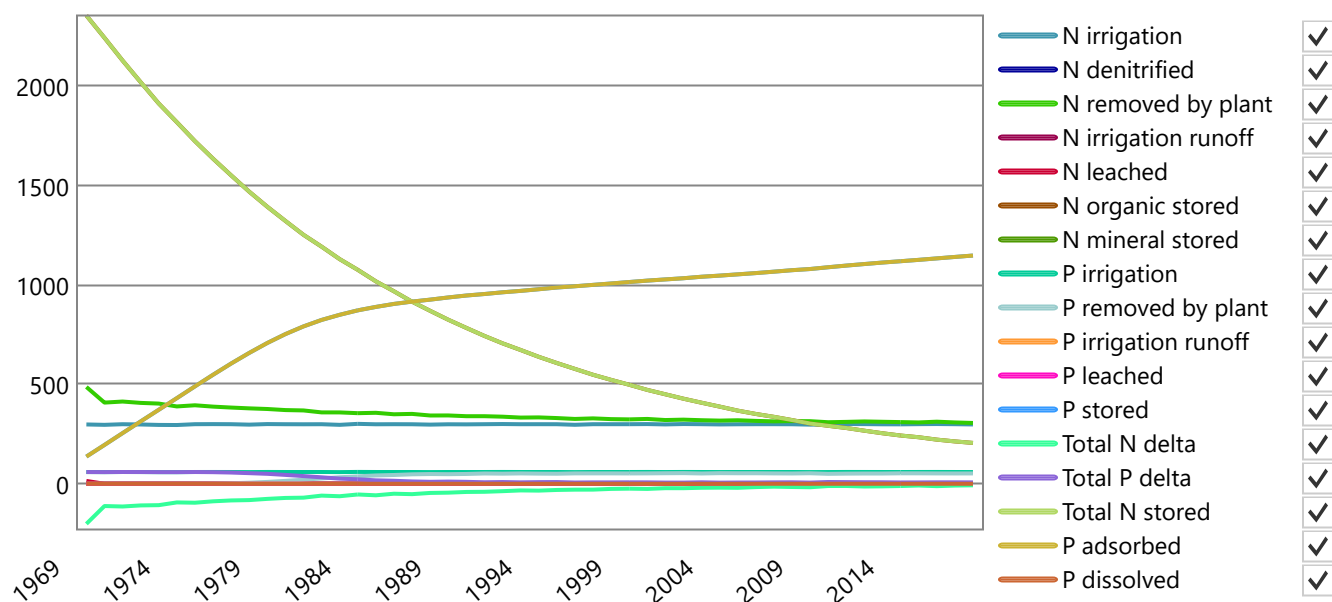


Land Performance - Soil Nutrient

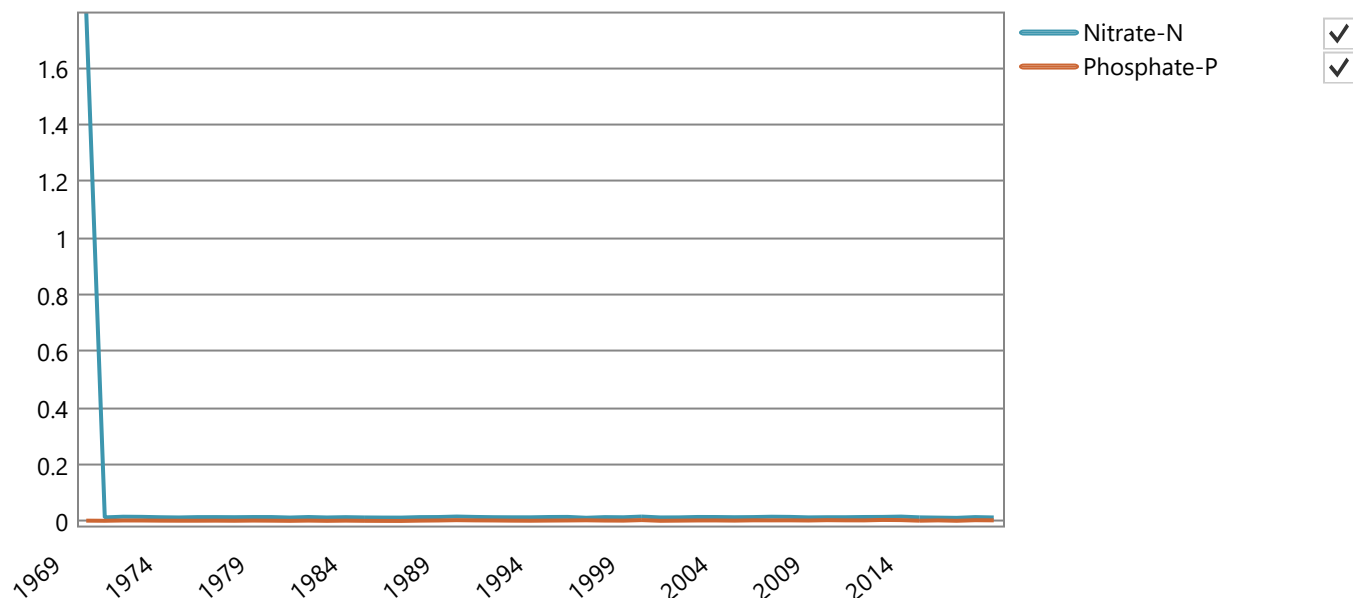
Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park**

Annual Nutrient Totals (kg/ha):



Annual Nutrient Leaching Concentration (mg/L):



PERFORMANCE

medii

Plant Performance and Nutrients

Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park**

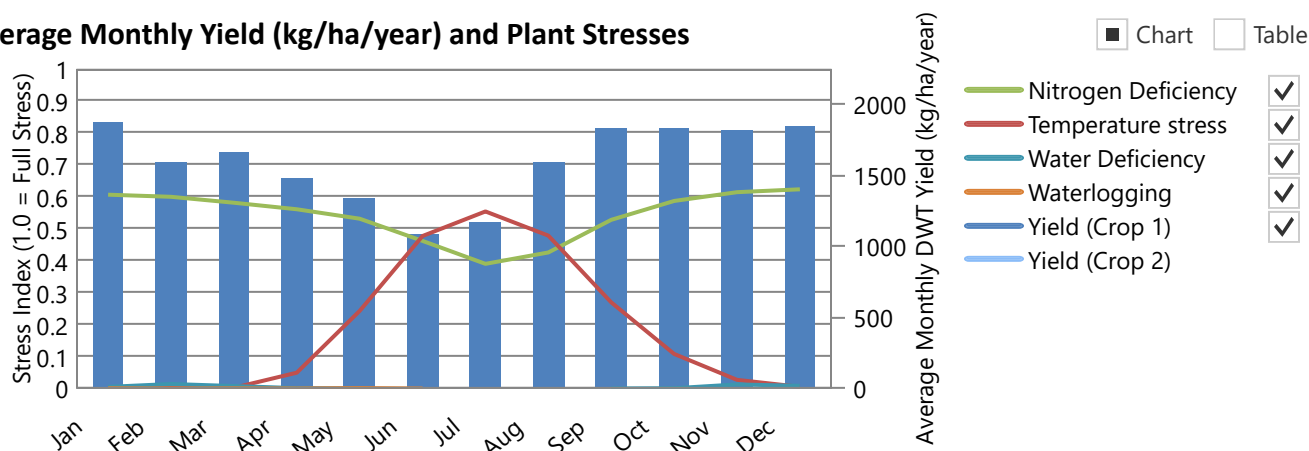
Plant: **Continuous Kikuyu 1 Pasture**

Average annual shoot dry matter yield (kg/ha/year)	19135.65 (17183.88 - 23575.49)
Average monthly plant (green) cover (fraction) (minimum - maximum)	0.87 (0.83 - 0.89)
Average monthly root depth (mm) (minimum - maximum)	699.64 (695.70 - 700.00)

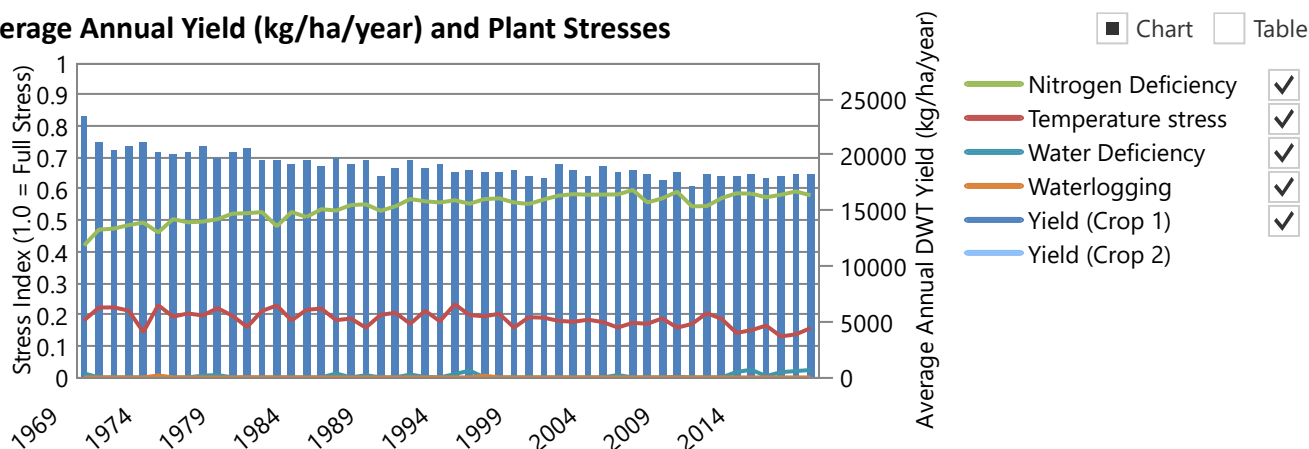
Nutrient Uptake (minimum - maximum):

Average annual net nitrogen removed by plant uptake (kg/ha/year)	345.92 (306.10 - 487.33)
Average annual net phosphorus removed by plant uptake (kg/ha/year)	37.80 (0.00 - 53.53)
Average annual shoot nitrogen concentration (fraction dwt)	0.02 (0.02 - 0.02)
Average annual shoot phosphorus concentration (fraction dwt)	0.002 (0.000 - 0.003)

Average Monthly Yield (kg/ha/year) and Plant Stresses

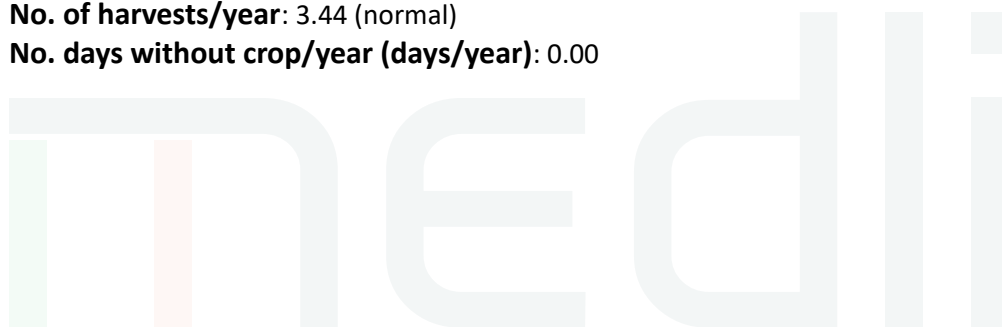


Average Annual Yield (kg/ha/year) and Plant Stresses



No. of harvests/year: 3.44 (normal)

No. days without crop/year (days/year): 0.00



Land Performance

Paddock: Default Paddock, 1 ha

Soil Type: Greenacres Caravan Park

Plant: Continuous Kikuyu 1 Pasture

Salt tolerance	Moderately tolerant
Salinity threshold EC sat. ext. (dS/m)	3.00
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.03
No. years assumed for leaching to reach steady-state (years)	10.00

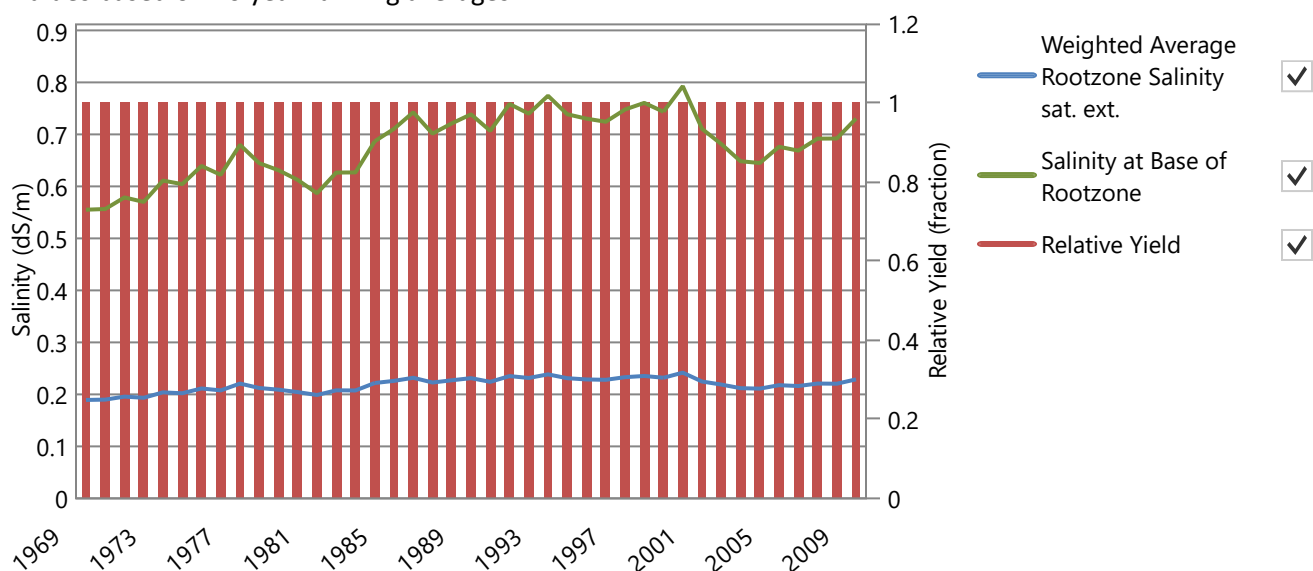
Soil Salinity:

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.31
Salt added by rainfall (kg/ha/year)	222.62
Average annual effluent salt added & leached at steady state (kg/ha/year)	4139.29
Average leaching fraction based on 10 year running averages (fraction)	0.66
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.22
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	0.68
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:

☒ Chart ☐ Table

All values based on 10 year running averages

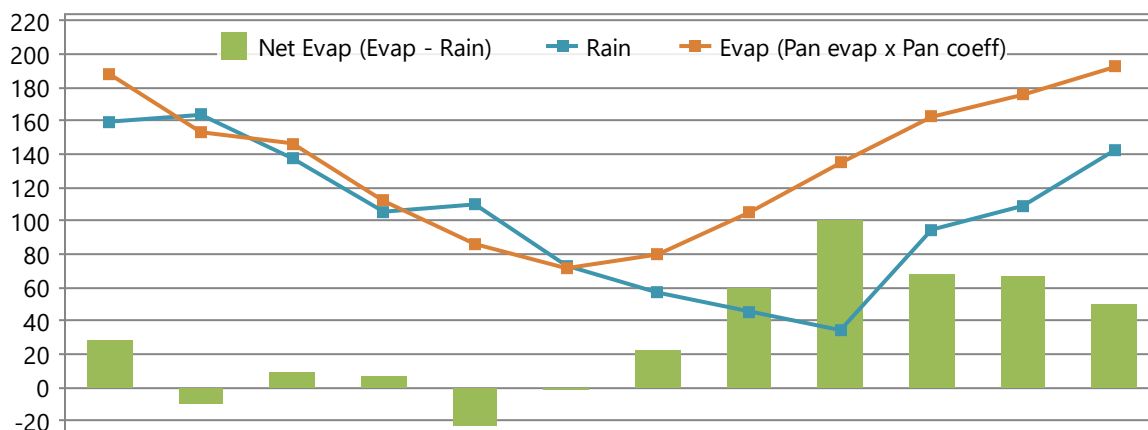


Sustainability Diagnostics: Greenacres Caravan Park

Averaged Historical Climate Data Used in Simulation (mm)

Location: Greenacres -27.55_153.20, -27.55°, 153.2°

Run Period: 01/01/1969 to 31/12/2018 50 years, 0 days



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	159.5	163.6	137.5	105.4	109.8	73.1	56.9	45.6	34.3	94.6	108.9	142.2	1231.4
Evap	188.0	153.1	146.5	111.8	86.0	71.5	79.8	104.9	134.7	162.3	175.6	192.2	1606.3
Net Evap	28.5	-10.4	9.0	6.4	-23.8	-1.6	22.9	59.2	100.3	67.7	66.7	50.0	374.9
Net Evap/day	0.9	-0.4	0.3	0.2	-0.8	-0.1	0.7	1.9	3.3	2.2	2.2	1.6	1.0

DIAGNOSTICS

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Sustainability Diagnostics: Greenacres Caravan Park

Pond System: 1 closed storage tank

New Generic System - 9131.00 kL/year or 25.00 kL/day generated on average

Effluent entering pond system after any pretreatment and recycling

Average (Minimum-Maximum) influent quality calculated for 365.24 non-zero flow days, after any pretreatment and recycling.

Constituent	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	35.00 (35.00 - 35.00)	319.59 (319.38 - 320.25)
Total Phosphorus	6.50 (6.50 - 6.50)	59.35 (59.31 - 59.48)
Total Dissolved Salts	430.00 (430.00 - 430.00)	3926.33 (3923.75 - 3934.50)
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)

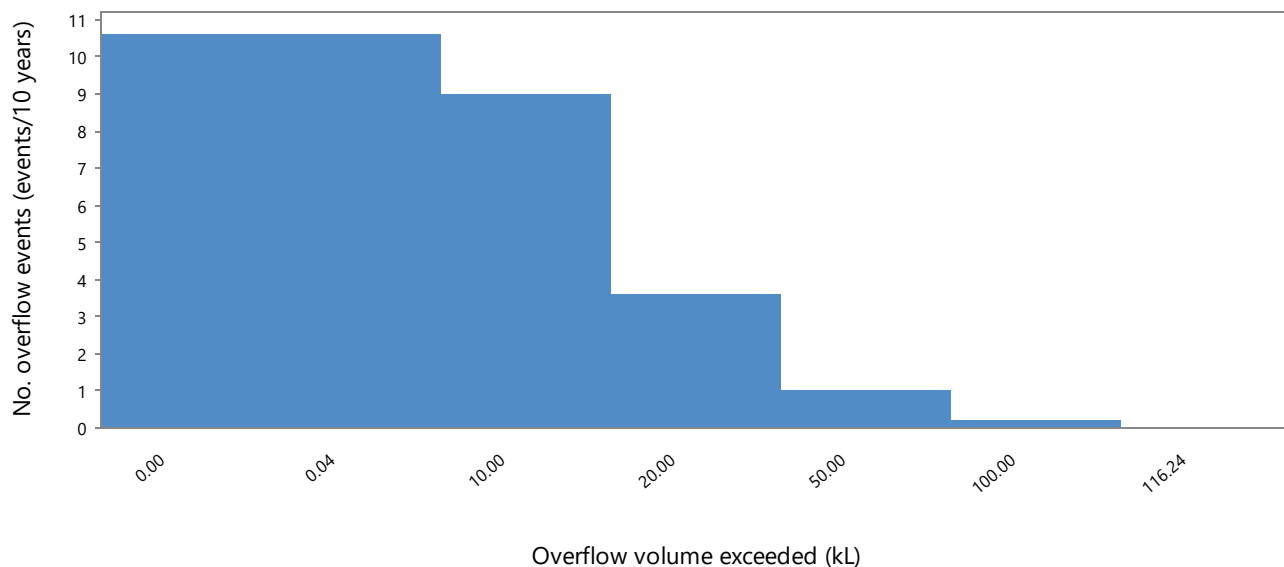
Last pond (Wet weather store): 90.00 kL

Theoretical hydraulic retention time (days)	3.60
Average volume of overflow (kL/year)	22.44
No. overflow events per year exceeding threshold* of 0.04 kL (no./year)	1.06
Average duration of overflow (days)	1.47
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	1.00
Probability of at least 90% effluent reuse (fraction)	1.00
Average salinity of last pond (dS/m)	0.67
Salinity of last pond on final day of simulation (dS/m)	0.67
Ammonia loss from pond system water area (kg/m2/year)	8.57

* The threshold is the volume equivalent to the top 1 mm depth of water of a full pond

Overflow exceedance:

☒ Chart ☐ Table



[Export plot](#)



Sustainability Diagnostics: Greenacres Caravan Park

Irrigation Information

Irrigation: 1 ha total area (assumed 100% irrigation efficiency)

	Quantity/year	Quantity/ha/year
Total irrigation applied (kL)	9108.54	9108.54
Total nitrogen applied (kg)	299.27	299.27
Total phosphorus applied (kg)	59.21	59.21
Total salts applied (kg)	3916.67	3916.67

Shandying

Annual allocation of fresh water for shandying (kL/year)	0.00
Average Shandy water irrigation (kL/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Average exceedance as a proportion of annual shandy water allocation (% of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Minimum shandy water is used	False

Irrigation Issues

Proportion of Days irrigation is prevented when triggered (fraction)	0.04
Proportion of Days irrigation occurs (fraction)	0.96

Sustainability Diagnostics: Greenacres Caravan Park

Paddock Land: Default Paddock: 1 ha

Irrigation: Flood with 0.1% ammonium loss during irrigation

Irrigation triggered when soil water deficit reaches 0.00 mm and rainfall is less than or equal to 20.00 mm
Irrigate a fixed amount of 3.50 mm each day
Irrigation window from 1/1 to 31/12 including the days specified
A minimum of 0 days must be skipped between irrigation events

Soil Water Balance (mm): Greenacres Caravan Park, 90.00 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	159.5	163.6	137.5	105.4	109.8	73.1	56.9	45.6	34.3	94.6	108.9	142.2	1231.4
Irrigation	77.0	70.1	77.8	74.6	77.3	74.9	77.5	77.6	75.1	77.0	74.8	77.0	910.9
Soil Evap	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6
Transpn.	131.5	106.7	101.3	78.7	61.6	49.1	54.9	71.0	89.6	108.8	120.4	132.2	1105.8
Rain Runoff	18.3	9.3	7.0	8.0	10.7	3.6	3.7	0.7	0.1	3.9	1.7	5.0	72.0
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	84.8	109.7	109.8	90.2	112.0	95.3	80.0	53.5	31.1	56.9	64.5	76.7	964.5
Delta	0.2	8.0	-2.9	3.2	2.8	0.0	-4.1	-2.0	-11.3	2.1	-2.8	5.3	-1.6

Soil Nitrogen Balance

Average annual effluent nitrogen added (kg/ha/year)	299.27
Average annual soil nitrogen removed by plant uptake (kg/ha/year)	345.92
Average annual soil nitrogen removed by denitrification (kg/ha/year)	4.75E-04
Average annual soil nitrogen leached (kg/ha/year)	0.43
Average annual nitrate-N loading to groundwater (kg/ha/year)	0.43
Soil organic-N kg/ha (Initial - Final)	2448.00 - 205.61
	110.64 - 0.01
Average nitrate-N concentration of deep drainage (mg/L)	0.04
Max. annual nitrate-N concentration of deep drainage (mg/L)	1.79

Soil Phosphorus Balance

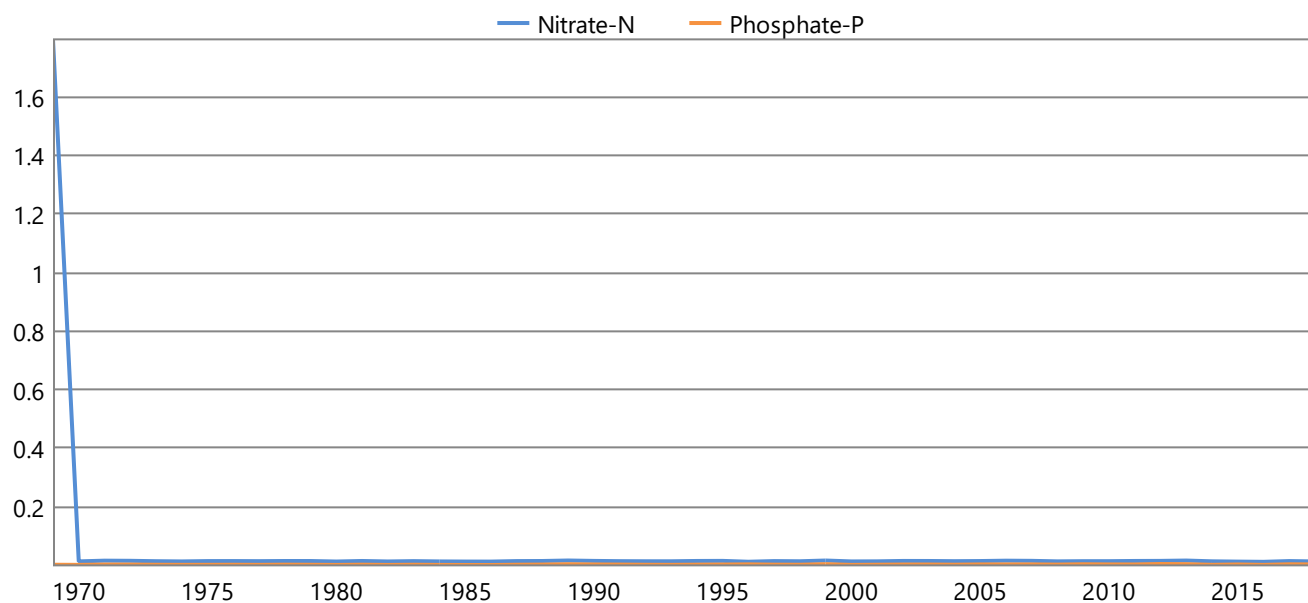
Average annual effluent phosphorus added (kg/ha/year)	59.21
Average annual soil phosphorus removed by plant uptake (kg/ha/year)	37.80
Average annual soil phosphorus leached (kg/ha/year)	0.03
Dissolved phosphorus (kg/ha) (Initial - Final)	0.00 - 1.74E-03
Adsorbed phosphorus (kg/ha) (Initial - Final)	77.71 - 1148.77
Average phosphate-P concentration in rootzone (mg/L)	0.01
Average phosphate-P concentration of deep drainage (mg/L)	3.33E-03
Max. annual phosphate-P concentration of deep drainage (mg/L)	0.01
Design soil profile storage life based on average infiltrated water phosphorus concn. of 2.86 mg/L (years)	87.32

Sustainability Diagnostics: Greenacres Caravan Park

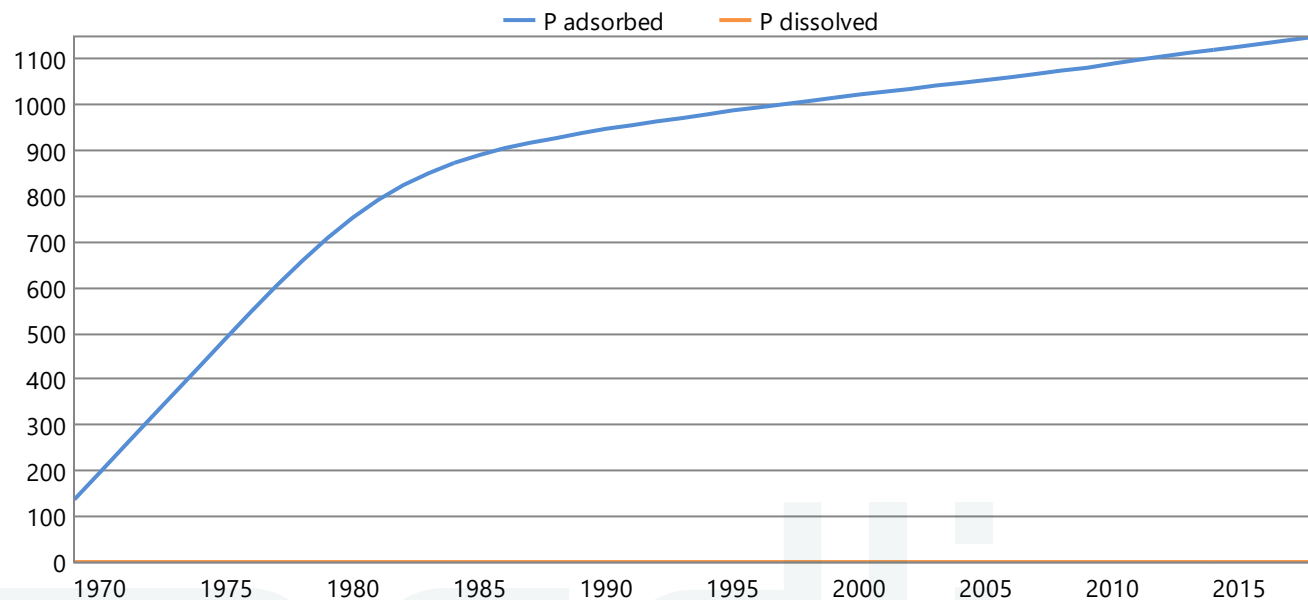
Paddock Land: Default Paddock: 1 ha

Irrigation: Flood with 0.1% ammonium loss during irrigation

Annual nutrient leachate concentration (mg/L)



Annual Phosphate-P in soil (kg/ha)



Sustainability Diagnostics: Greenacres Caravan Park

Paddock Plant Performance: Default Paddock: 1 ha

Average Plant Performance (Minimum - Maximum): Continuous Kikuyu 1 Pasture

Average annual shoot dry matter yield (kg/ha/year)	19135.65 (17183.88 - 23575.49)
Average monthly plant (green) cover (fraction)	0.87 (0.83 - 0.89)
Average monthly crop factor (fraction)	0.69 (0.67 - 0.72)
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Average monthly root depth (mm)	699.64 (695.70 - 700.00)
Average number of normal harvests per year (no./year)	3.44 (3.00 - 4.00)
Average number of normal harvests for last five years only (no./year)	3.20
Average number of crop deaths per year (no./year)	0.00 (0.00 - 0.00)
Average number of crop deaths for last five years only (no./year)	0.00
Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient)	0.54 (0.42 - 0.60)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.02)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.55 (0.34 - 0.69)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.01)
Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.00)
No. days without crop/year (days)	0.00

Soil Salinity - Plant salinity tolerance: Moderately tolerant

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

All values based on 10 year running averages

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.31
Salt added by rainfall (kg/ha/year)	222.62
Average annual effluent salt added & leached at steady state (kg/ha/year)	4139.29
Average leaching fraction based on 10 year running averages (fraction)	0.66
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.22
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	0.68
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

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Run Messages

Messages generated when the scenario was run:

Full run chosen

DIAGNOSTICS

medli

Enterprise: Greenacres Caravan Park

Description:

Greenacres Caravan Park

Client: Greenacres Caravan Park

MEDLI User: F Milnes

Scenario Details:

Sustainability Investigation for land application of treated effluent as alternative to discharge to waters.

Flow 25 kL

TN 35

TP 6.5

TDS 430 based on EC 670 uS/cm

Tank 90kL

Irrigation 3.5 mm/day

Ryegrass Pasture



Climate Data: Greenacres -27.55_153.20, -27.55°, 153.2°

Run Period: 01/01/1969 to 31/12/2018 50 years, 0 days

Climate Statistics:

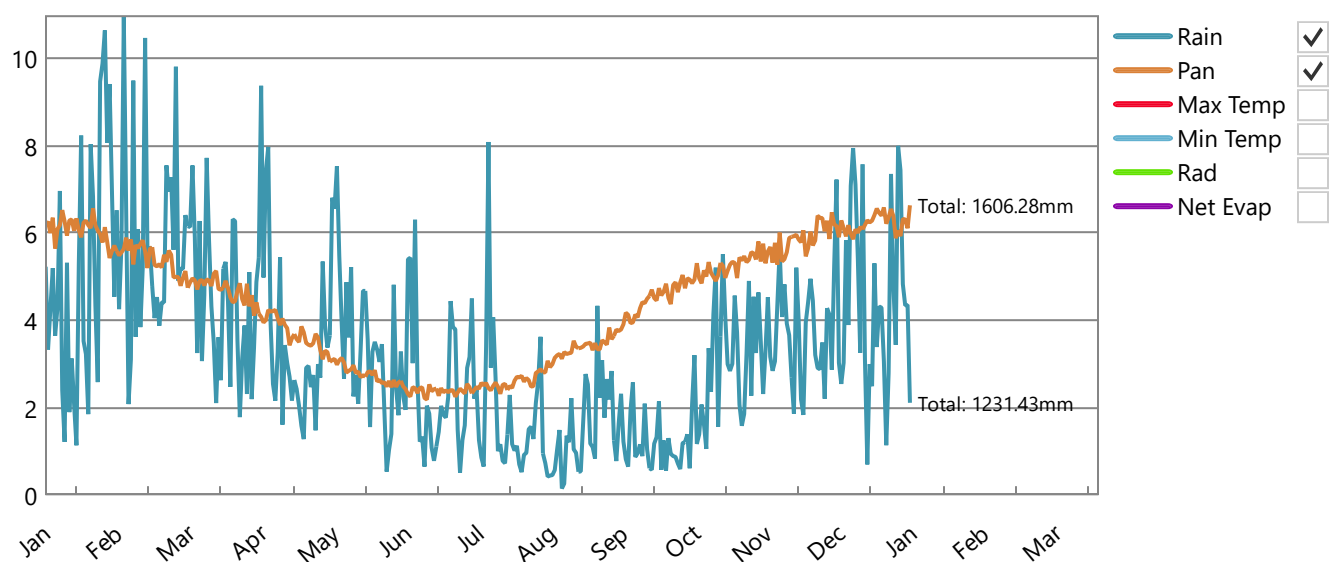
	5th ▾	Percentile	50th Percentile	95th ▾	Percentile
Rainfall (mm/year)		734	1199		1749
Pan Evaporation (mm/year)		1434	1607		1829

Climate Data:

☒ Chart ☐ Table

☐ Monthly ☒ Daily

Daily Average Across Run Period



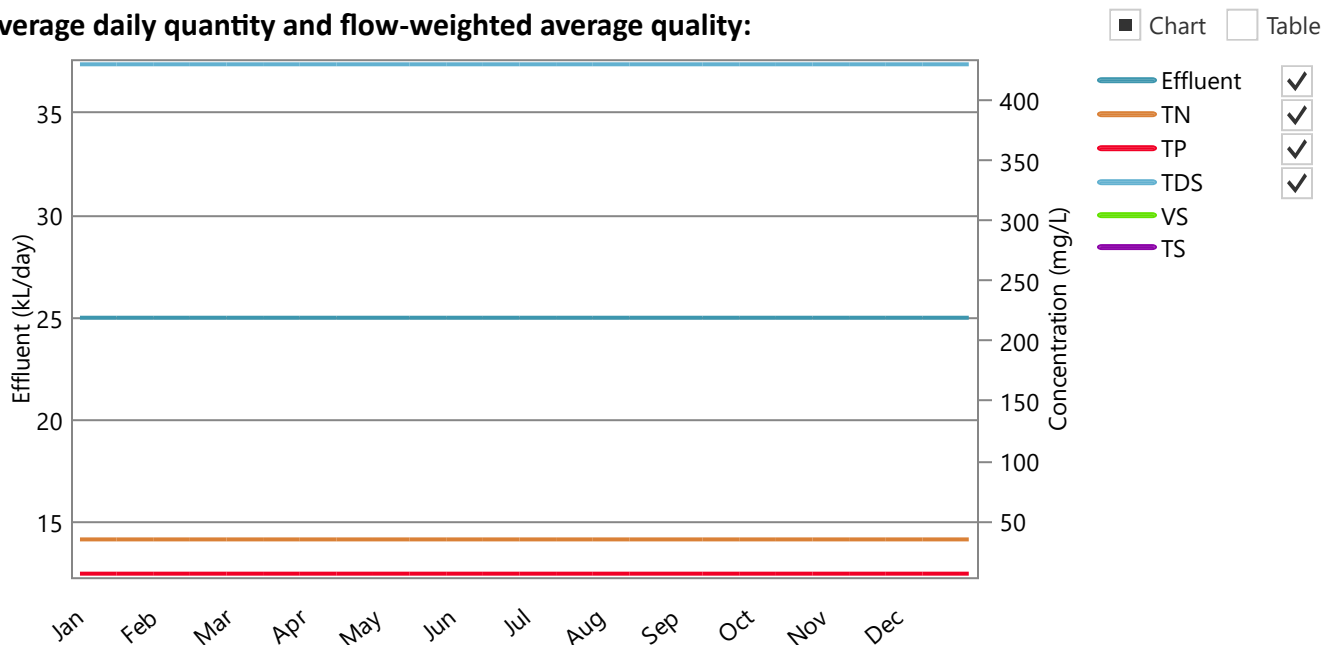
DESCRIPTION



Effluent type: New Generic System

Wastestream before any recycling or pretreatment

Average daily quantity and flow-weighted average quality:



Wastestream after any recycling and pretreatment if applicable

Effluent quantity: **9131.00 kL/year** or 25.00 kL/day (Min-Max: 25.00 - 25.00)

Flow-weighted average (minimum - maximum) daily effluent quality entering pond system:

	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	35.00 (35.00 - 35.00)	319.59 (319.38 - 320.25)
Total Phosphorus	6.50 (6.50 - 6.50)	59.35 (59.31 - 59.48)
Total Dissolved Salts	430.00 (430.00 - 430.00)	3926.33 (3923.75 - 3934.50)
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)

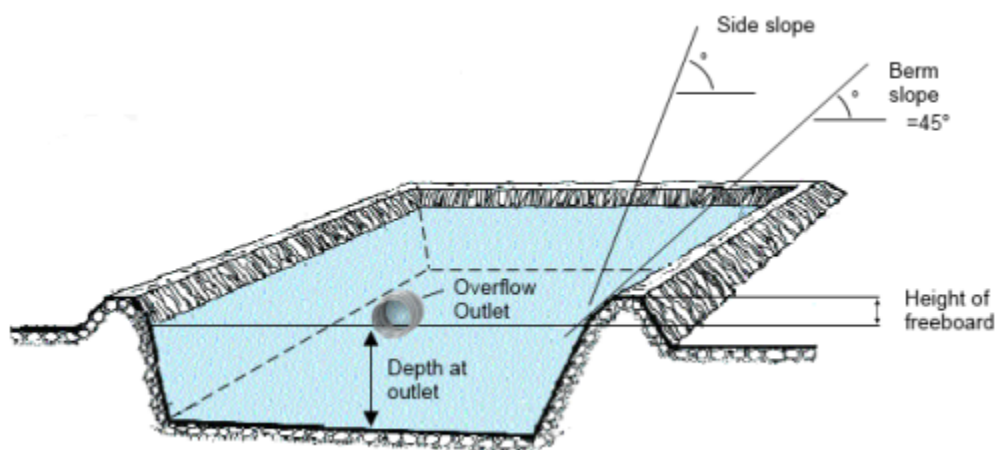
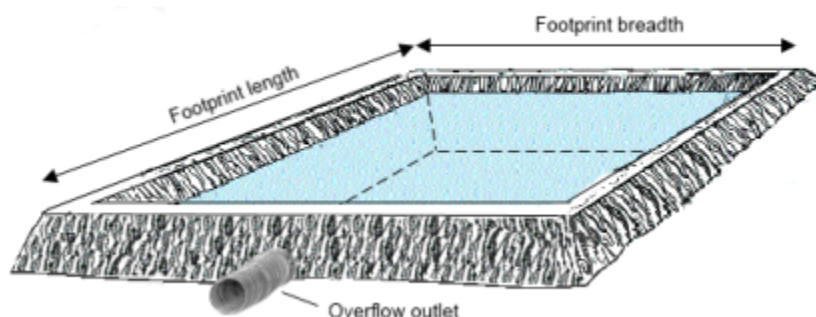
DESCRIPTION

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Pond system: 1 closed storage tank

Pond system details:

	Pond 1
Maximum pond volume (kL)	90.00
Minimum allowable pond volume (kL)	1.24
Pond depth at overflow outlet (m)	2.18
Maximum water surface area (m2)	41.31
Pond footprint length (m)	7.63
Pond footprint width (m)	7.63
Pond catchment area (m2)	58.17
Average active volume (kL)	4.41



Irrigation pump limits:

Minimum pump rate per area limit (ML/day/ha)	0.00
Maximum pump rate per area limit (ML/day/ha)	1.00

Shandying water:

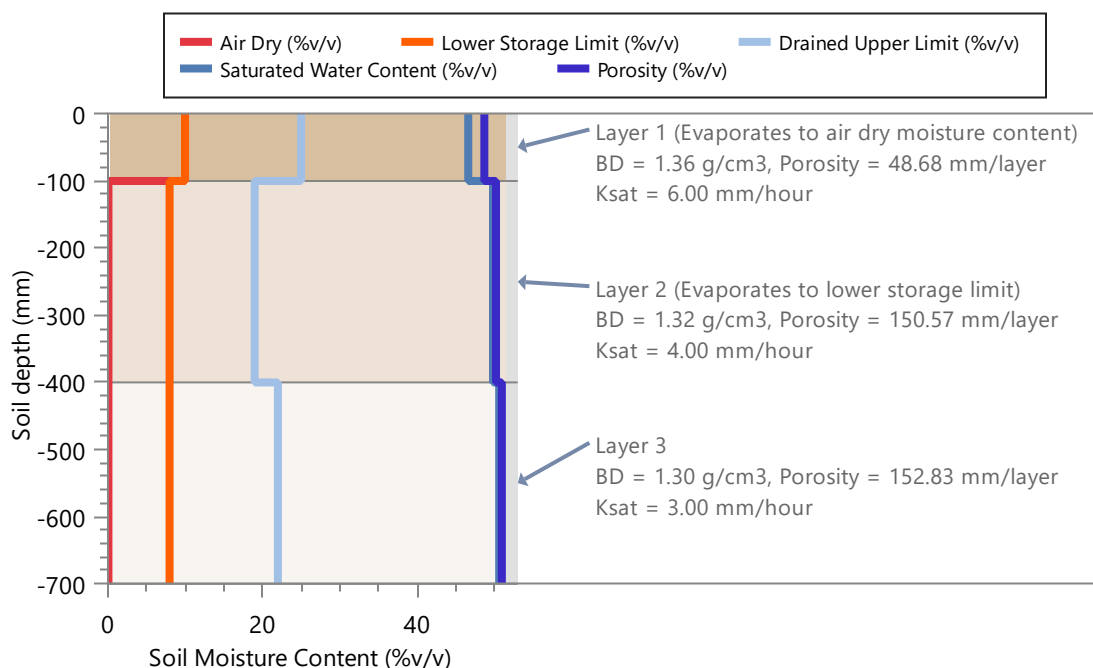
Annual allocation of fresh water available for shandying (kL/year)	0.00
Maximum rate of application of fresh water (ML/day)	0.00
Nitrogen concentration (mg/L)	0.00
Salinity (dS/m)	0.00
Minimum shandy water is used	False

Land: Default Paddock

Area (ha): 1.00

Soil Type: Greenacres Caravan Park, 700.00 mm defined profile depth

Profile Porosity (mm)	352.08
Profile saturation water content (mm)	347.80
Profile drained upper limit (or field capacity) (mm)	148.00
Profile lower storage limit (or permanent wilting point) (mm)	58.00
Profile available water capacity (mm)	90.00
Profile limiting saturated hydraulic conductivity (mm/hour)	3.00
Surface saturated hydraulic conductivity (mm/hour)	6.00
Runoff curve number II (coefficient)	88.00
Soil evaporation U (mm)	9.00
Soil evaporation Cona (mm/sqrt day)	4.00



Plant Data: Continuous Ryegrass 1 Pasture

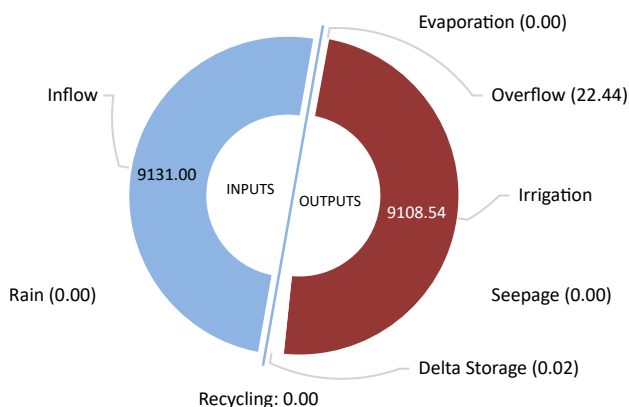
Average monthly cover (fraction) (minimum - maximum)	0.65 (0.62 - 0.66)
Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 0.8 x Pan coefficient 1)	0.80
Total plant cover (both green and dead) left after harvest (fraction)	0.97
Maximum potential root depth in defined soil profile (mm)	600.00
Salt tolerance	Moderately tolerant
Salinity threshold EC sat. ext. (dS/m)	5.60
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.08

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Pond System Water Performance - Overflow: 1 closed storage tank

Capacity of wet weather storage pond: 90 kL

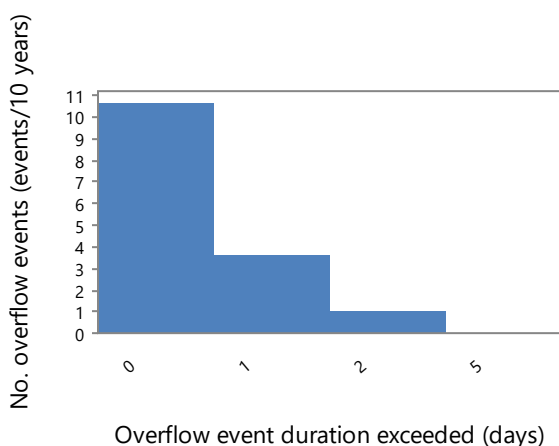
Pond System Water Balance (kL/year)



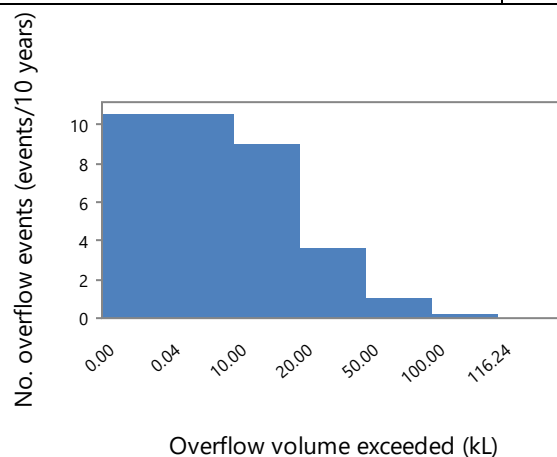
Name	Value
Rain	0.00
Inflow	9131.00
Recycling	0.00
Evaporation	0.00
Overflow	22.44
Irrigation	9108.54
Seepage	0.00
Delta Storage	0.02

Overflow Diagnostics

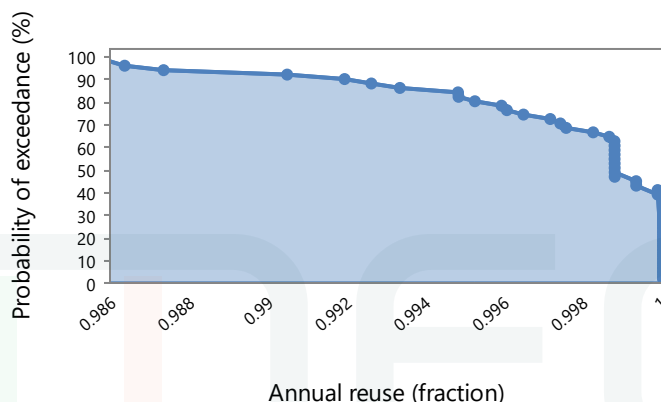
Volume of overflow (kL/year)	22.44
No. days pond overflows (days/year)	1.56
Average duration of overflow (days)	1.47
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	1.00
Probability of at least 90% reuse (fraction)	1.00



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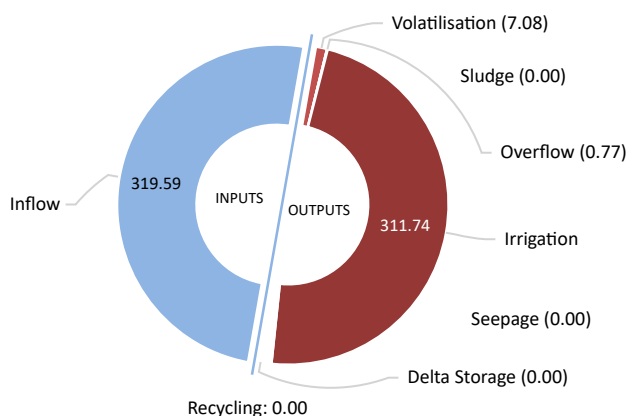


[Export plot](#)

Pond System Performance - Nutrient: 1 closed storage tank

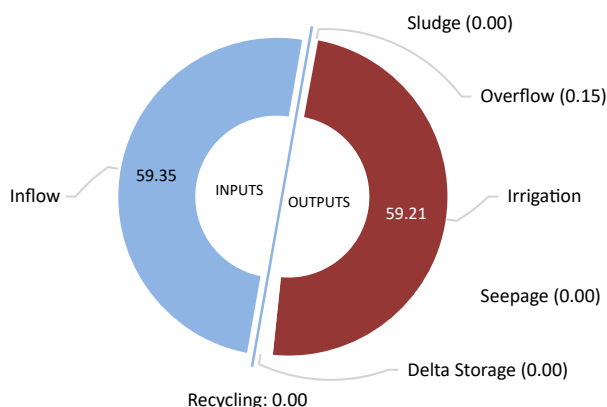
Pond System Nutrients and Salt Balance:

Nitrogen Balance (kg/year)



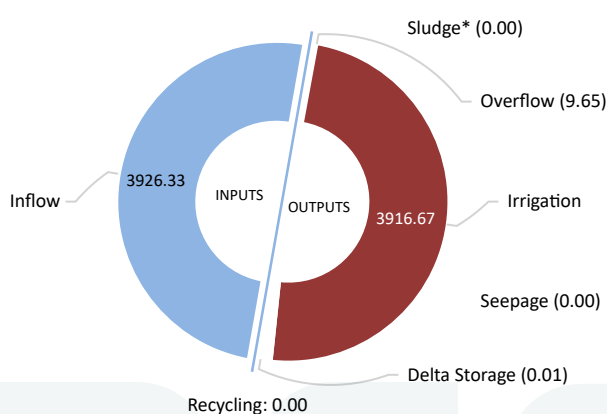
Name	Value
Inflow	319.59
Recycling	0.00
Volatilisation	7.08
Sludge	0.00
Overflow	0.77
Irrigation	311.74
Seepage	0.00
Delta Storage	0.00

Phosphorus Balance (kg/year)



Name	Value
Inflow	59.35
Recycling	0.00
Sludge	0.00
Overflow	0.15
Irrigation	59.21
Seepage	0.00
Delta Storage	0.00

Salt Balance (kg/year)



Name	Value
Inflow	3926.33
Recycling	0.00
Sludge*	0.00
Overflow	9.65
Irrigation	3916.67
Seepage	0.00
Delta Storage	0.01

* 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 0.00 kg/year

Pond System Sludge Accumulation: 0.00 kg dwt/year

Pond System Performance - Nutrient: 1 closed storage tank

Pond Nutrient Concentrations and Salinity:

Average across simulation period	Pond 1
Average nitrogen concentration of pond liquid (mg/L)	29.83
Average phosphorus concentration of pond liquid (mg/L)	6.50
Average salinity of pond liquid (dS/m)	0.67

Value on final day of simulation period	Pond 1
Final nitrogen concentration of pond liquid (mg/L)	18.57
Final phosphorus concentration of pond liquid (mg/L)	6.50
Final salinity of pond liquid (dS/m)	0.67

Irrigation Performance:

Water Use: (assumes 100% Irrigation Efficiency)

Pond water irrigated (kL/year)	9108.54
Average Shandy water irrigation (kL/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Total water irrigated (kL/year)	9108.54
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Proportion of years shandying water allocation of 0 kL/year is exceeded (fraction of years)	0.00
Average exceedance as a proportion of annual shandy water allocation (fraction of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)

Irrigation Quality:

Average nitrogen concentration of irrigation water - before ammonia loss during irrigation (mg/L)	34.23
Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)	32.86
Average phosphorus concentration of irrigation water (mg/L)	6.50
Average salinity of irrigation water (dS/m)	0.67

Irrigation Diagnostics:

Proportion of Days rain prevents irrigation (fraction)	0.04
Proportion of Days irrigation occurs (fraction)	0.96

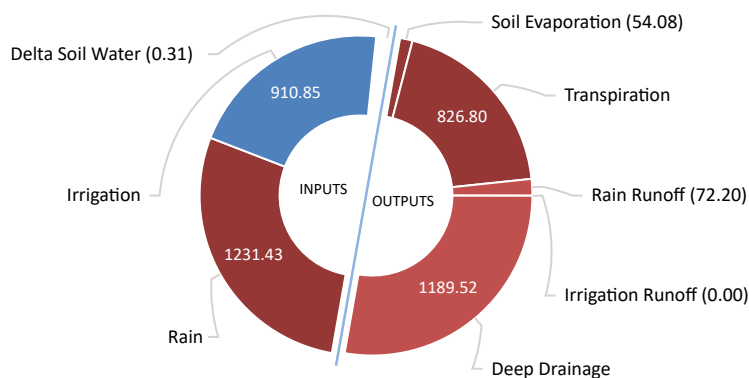
Land Performance - Soil Water

Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park, 76.00 mm PAWC at maximum root depth**

Land Water Balance (mm/year):

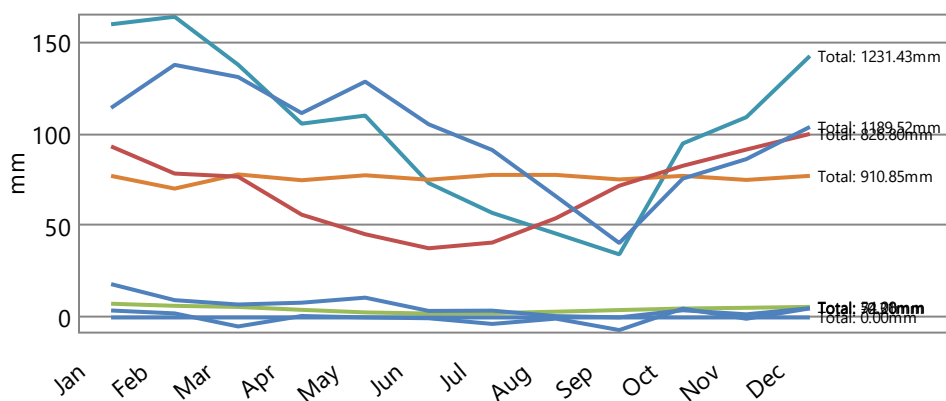
☒ mm/year ☐ % Total inputs



Name	Value
Rain	1231.43
Irrigation	910.85
Soil Evaporation	54.08
Transpiration	826.80
Rain Runoff	72.20
Irrigation Runoff	0.00
Deep Drainage	1189.52
Delta Soil Water	-0.31

Average Monthly Totals (mm):

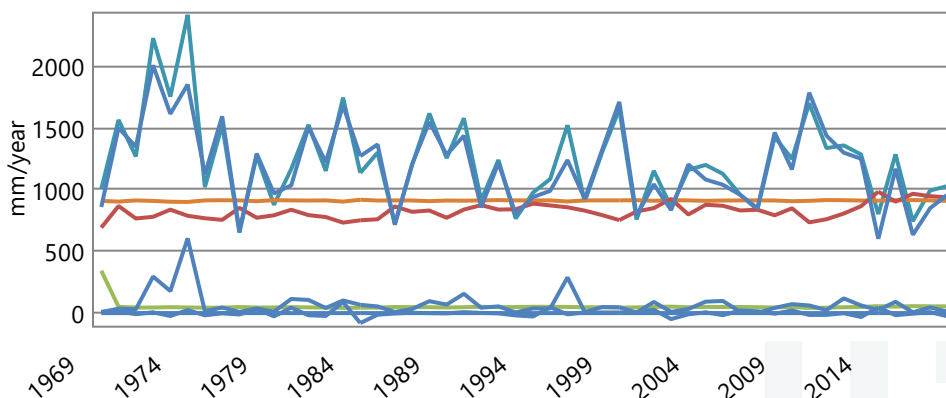
☒ Chart ☐ Table



- ☒ Rain
- ☒ Irrigation
- ☒ Soil Evap
- ☒ Transpn.
- ☒ Rain Runoff
- ☒ Irrigation Runoff
- ☒ Deep Drainage
- ☒ Delta Soil Water

Average Annual Totals (mm/year):

☒ Chart ☐ Table



- ☒ Rain
- ☒ Irrigation
- ☒ Soil Evap
- ☒ Transpn.
- ☒ Rain Runoff
- ☒ Irrigation Runoff
- ☒ Deep Drainage
- ☒ Delta Soil Water

PERFORMANCE

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Land Performance - Soil Nutrient

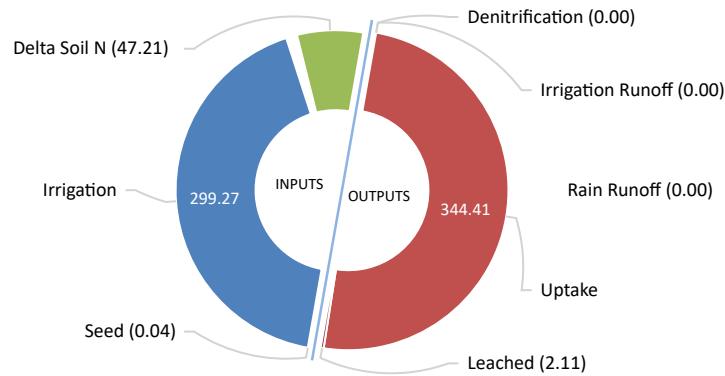
Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park**

Irrigation ammonium volatilisation losses (kg/ha/year): 12.47

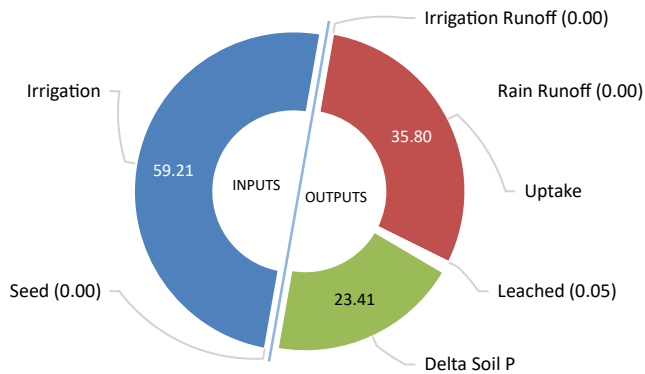
Proportion of total nitrogen in irrigated effluent as ammonium (fraction): 0.40

Land Nitrogen Balance (kg/ha/year)



Name	Value
Seed	0.04
Irrigation	299.27
Denitrification	6.34E-04
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	344.41
Leached	2.11
Delta Soil N	-47.21

Land Phosphorus Balance (kg/ha/year)



Name	Value
Seed	3.60E-03
Irrigation	59.21
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	35.80
Leached	0.05
Delta Soil P	23.41

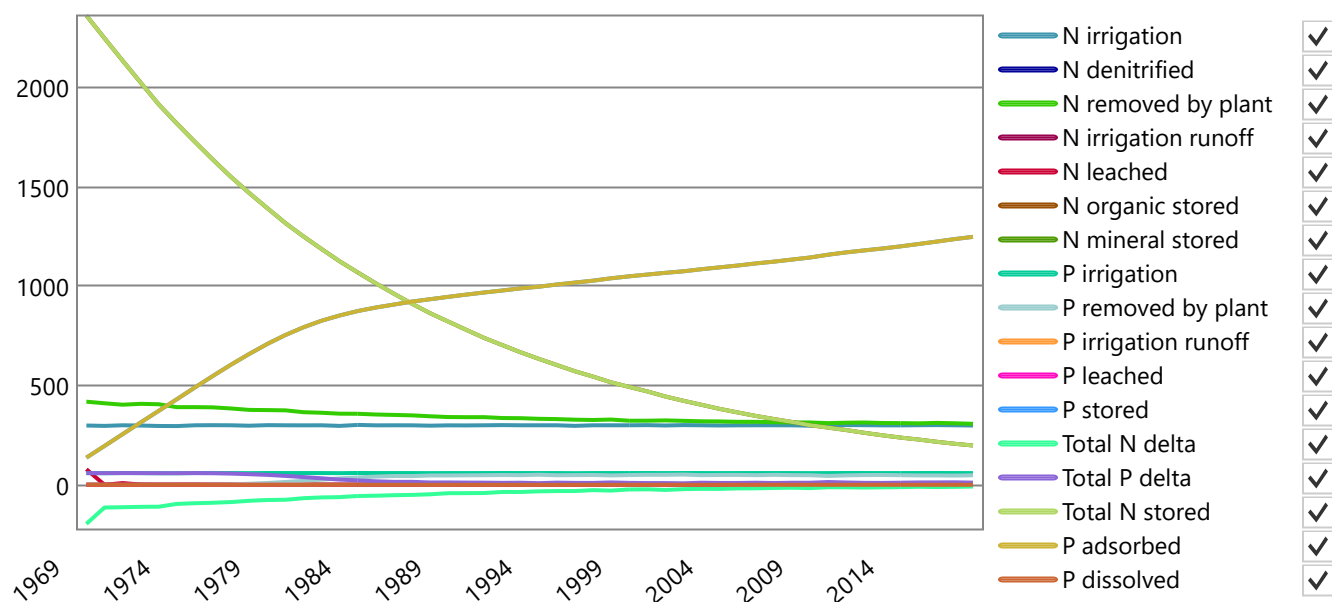


Land Performance - Soil Nutrient

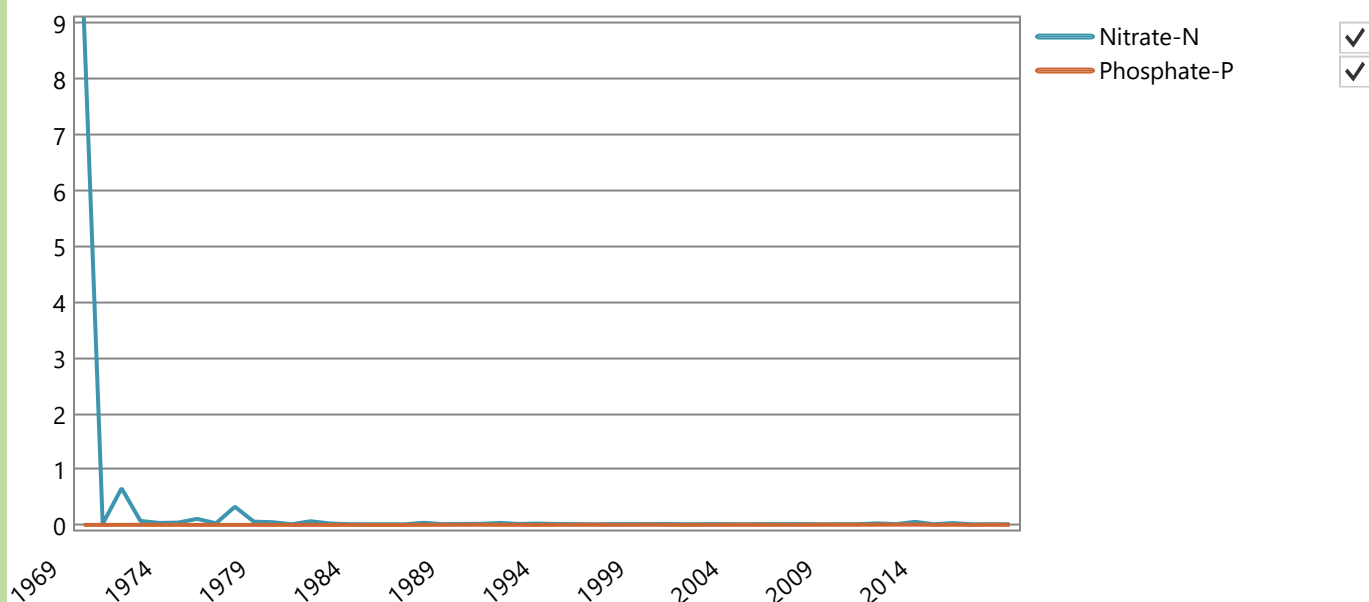
Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park**

Annual Nutrient Totals (kg/ha):



Annual Nutrient Leaching Concentration (mg/L):



PERFORMANCE



Plant Performance and Nutrients

Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park**

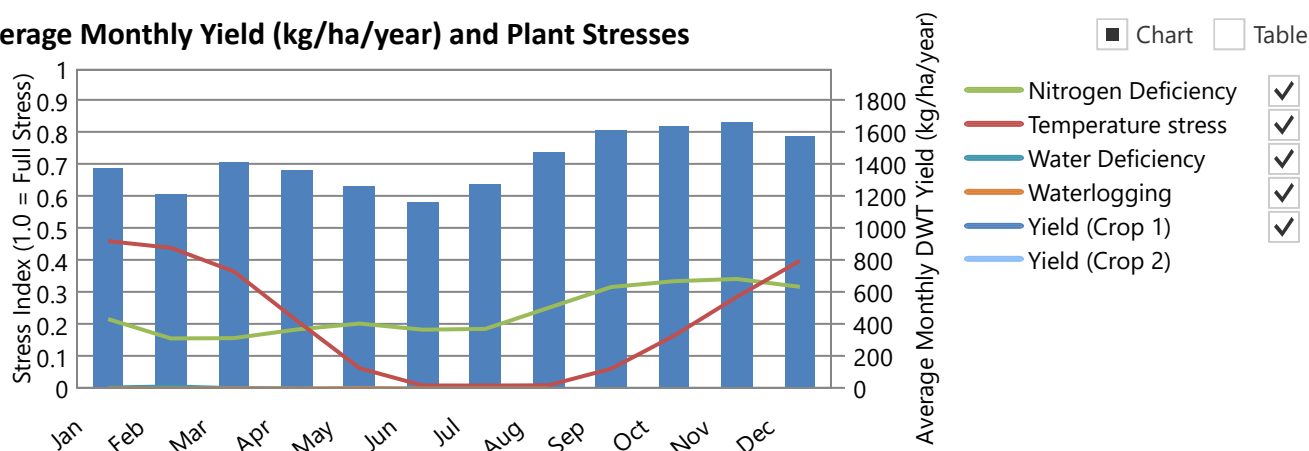
Plant: **Continuous Ryegrass 1 Pasture**

Average annual shoot dry matter yield (kg/ha/year)	17044.92 (15044.92 - 18726.00)
Average monthly plant (green) cover (fraction) (minimum - maximum)	0.65 (0.62 - 0.66)
Average monthly root depth (mm) (minimum - maximum)	597.77 (592.12 - 599.98)

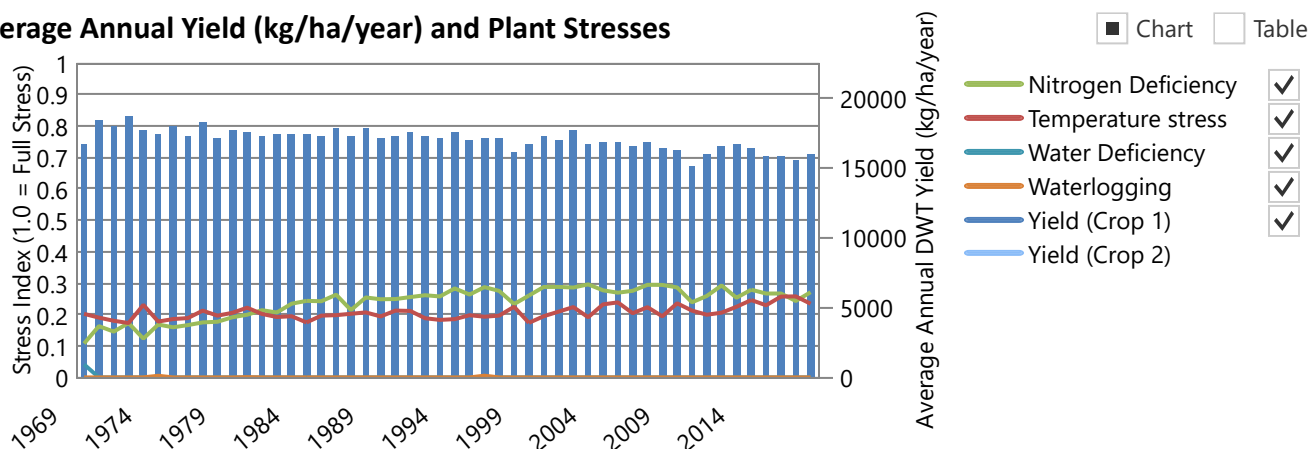
Nutrient Uptake (minimum - maximum):

Average annual net nitrogen removed by plant uptake (kg/ha/year)	344.41 (307.08 - 418.54)
Average annual net phosphorus removed by plant uptake (kg/ha/year)	35.80 (0.00 - 51.80)
Average annual shoot nitrogen concentration (fraction dwt)	0.02 (0.02 - 0.03)
Average annual shoot phosphorus concentration (fraction dwt)	0.002 (0.000 - 0.003)

Average Monthly Yield (kg/ha/year) and Plant Stresses



Average Annual Yield (kg/ha/year) and Plant Stresses



No. of harvests/year: 4.40 (normal), 0.02 (forced by crop death due to water stress (0.02))

No. days without crop/year (days/year): 0.08 due to water stress (0.08)



Land Performance

Paddock: Default Paddock, 1 ha

Soil Type: Greenacres Caravan Park

Plant: Continuous Ryegrass 1 Pasture

Salt tolerance	Moderately tolerant
Salinity threshold EC sat. ext. (dS/m)	5.60
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.08
No. years assumed for leaching to reach steady-state (years)	10.00

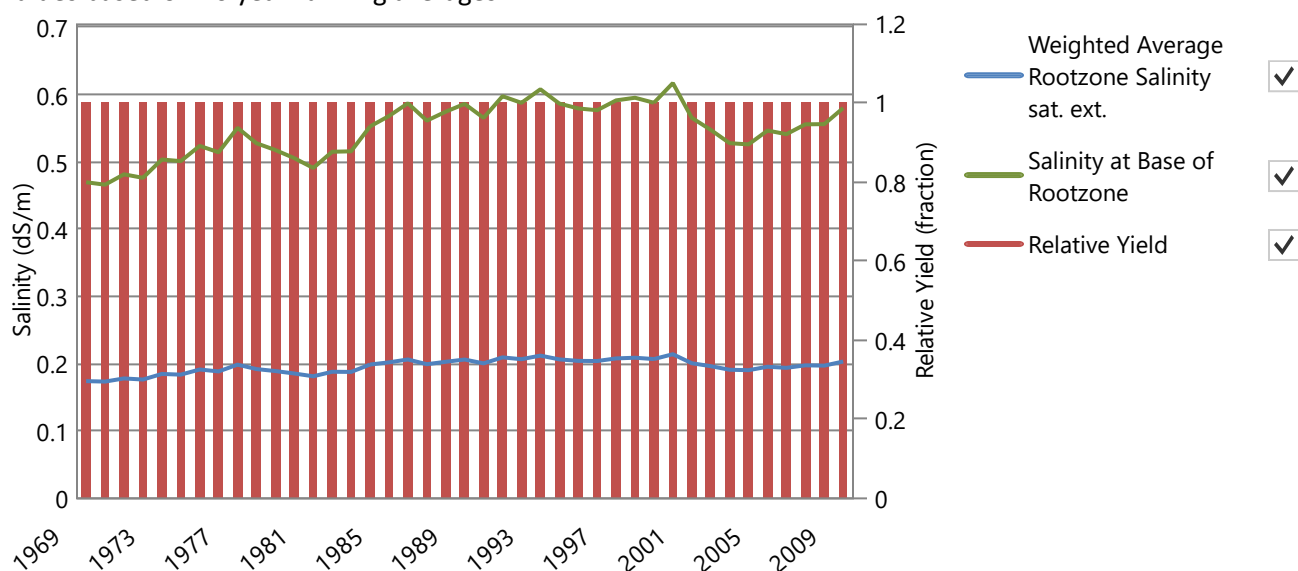
Soil Salinity:

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.31
Salt added by rainfall (kg/ha/year)	222.57
Average annual effluent salt added & leached at steady state (kg/ha/year)	4139.24
Average leaching fraction based on 10 year running averages (fraction)	0.73
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.20
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	0.55
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

☒ Chart ☐ Table



PERFORMANCE

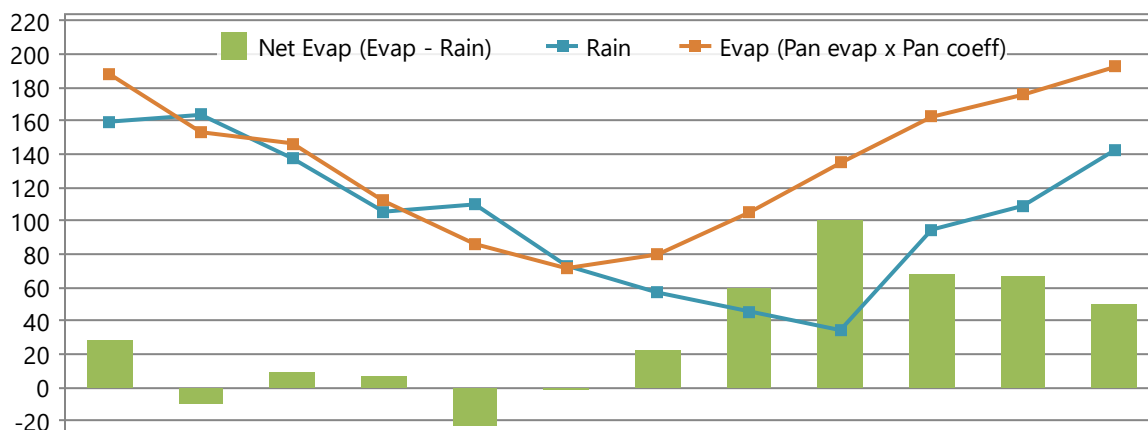


Sustainability Diagnostics: Greenacres Caravan Park

Averaged Historical Climate Data Used in Simulation (mm)

Location: Greenacres -27.55_153.20, -27.55°, 153.2°

Run Period: 01/01/1969 to 31/12/2018 50 years, 0 days



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	159.5	163.6	137.5	105.4	109.8	73.1	56.9	45.6	34.3	94.6	108.9	142.2	1231.4
Evap	188.0	153.1	146.5	111.8	86.0	71.5	79.8	104.9	134.7	162.3	175.6	192.2	1606.3
Net Evap	28.5	-10.4	9.0	6.4	-23.8	-1.6	22.9	59.2	100.3	67.7	66.7	50.0	374.9
Net Evap/day	0.9	-0.4	0.3	0.2	-0.8	-0.1	0.7	1.9	3.3	2.2	2.2	1.6	1.0

DIAGNOSTICS

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Sustainability Diagnostics: Greenacres Caravan Park

Pond System: 1 closed storage tank

New Generic System - 9131.00 kL/year or 25.00 kL/day generated on average

Effluent entering pond system after any pretreatment and recycling

Average (Minimum-Maximum) influent quality calculated for 365.24 non-zero flow days, after any pretreatment and recycling.

Constituent	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	35.00 (35.00 - 35.00)	319.59 (319.38 - 320.25)
Total Phosphorus	6.50 (6.50 - 6.50)	59.35 (59.31 - 59.48)
Total Dissolved Salts	430.00 (430.00 - 430.00)	3926.33 (3923.75 - 3934.50)
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)

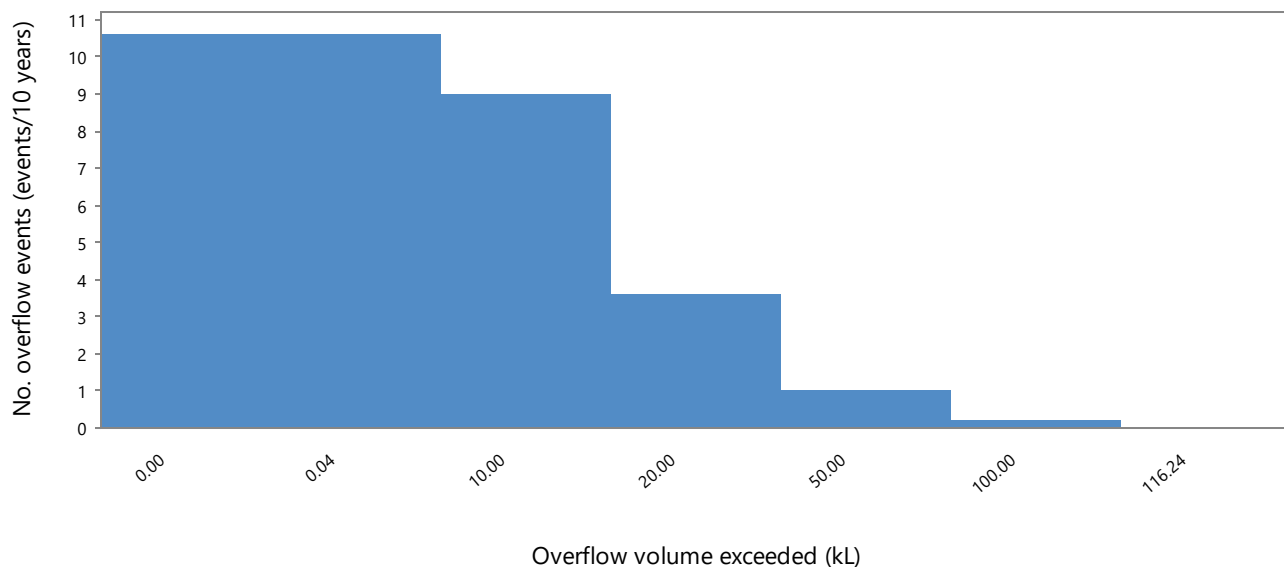
Last pond (Wet weather store): 90.00 kL

Theoretical hydraulic retention time (days)	3.60
Average volume of overflow (kL/year)	22.44
No. overflow events per year exceeding threshold* of 0.04 kL (no./year)	1.06
Average duration of overflow (days)	1.47
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	1.00
Probability of at least 90% effluent reuse (fraction)	1.00
Average salinity of last pond (dS/m)	0.67
Salinity of last pond on final day of simulation (dS/m)	0.67
Ammonia loss from pond system water area (kg/m2/year)	8.57

* The threshold is the volume equivalent to the top 1 mm depth of water of a full pond

Overflow exceedance:

☒ Chart ☐ Table



[Export plot](#)



Sustainability Diagnostics: Greenacres Caravan Park

Irrigation Information

Irrigation: 1 ha total area (assumed 100% irrigation efficiency)

	Quantity/year	Quantity/ha/year
Total irrigation applied (kL)	9108.54	9108.54
Total nitrogen applied (kg)	299.27	299.27
Total phosphorus applied (kg)	59.21	59.21
Total salts applied (kg)	3916.67	3916.67

Shandying

Annual allocation of fresh water for shandying (kL/year)	0.00
Average Shandy water irrigation (kL/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Average exceedance as a proportion of annual shandy water allocation (% of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Minimum shandy water is used	False

Irrigation Issues

Proportion of Days irrigation is prevented when triggered (fraction)	0.04
Proportion of Days irrigation occurs (fraction)	0.96

Sustainability Diagnostics: Greenacres Caravan Park

Paddock Land: Default Paddock: 1 ha

Irrigation: Flood with 0.1% ammonium loss during irrigation

Irrigation triggered when soil water deficit reaches 0.00 mm and rainfall is less than or equal to 20.00 mm
Irrigate a fixed amount of 3.50 mm each day
Irrigation window from 1/1 to 31/12 including the days specified
A minimum of 0 days must be skipped between irrigation events

Soil Water Balance (mm): Greenacres Caravan Park, 76.00 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	159.5	163.6	137.5	105.4	109.8	73.1	56.9	45.6	34.3	94.6	108.9	142.2	1231.4
Irrigation	77.0	70.1	77.8	74.6	77.3	74.9	77.5	77.6	75.1	77.0	74.8	77.0	910.9
Soil Evap	7.5	6.3	5.7	4.2	2.8	2.1	2.4	3.1	4.0	4.9	5.3	5.8	54.1
Transpn.	93.1	78.3	76.6	55.9	45.3	37.6	40.7	54.0	71.7	82.5	91.3	99.8	826.8
Rain Runoff	18.1	9.4	7.1	8.0	10.8	3.6	3.7	0.7	0.1	3.9	1.7	5.0	72.2
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	114.0	137.4	130.8	111.2	128.3	105.1	91.1	66.0	40.5	75.5	86.1	103.6	1189.5
Delta	3.8	2.2	-4.9	0.8	0.0	-0.4	-3.5	-0.6	-6.8	4.8	-0.7	5.0	-0.3

Soil Nitrogen Balance

Average annual effluent nitrogen added (kg/ha/year)	299.27
Average annual soil nitrogen removed by plant uptake (kg/ha/year)	344.41
Average annual soil nitrogen removed by denitrification (kg/ha/year)	6.34E-04
Average annual soil nitrogen leached (kg/ha/year)	2.11
Average annual nitrate-N loading to groundwater (kg/ha/year)	2.11
Soil organic-N kg/ha (Initial - Final)	2448.00 - 198.00
	110.64 - 0.01
Average nitrate-N concentration of deep drainage (mg/L)	0.18
Max. annual nitrate-N concentration of deep drainage (mg/L)	9.12

Soil Phosphorus Balance

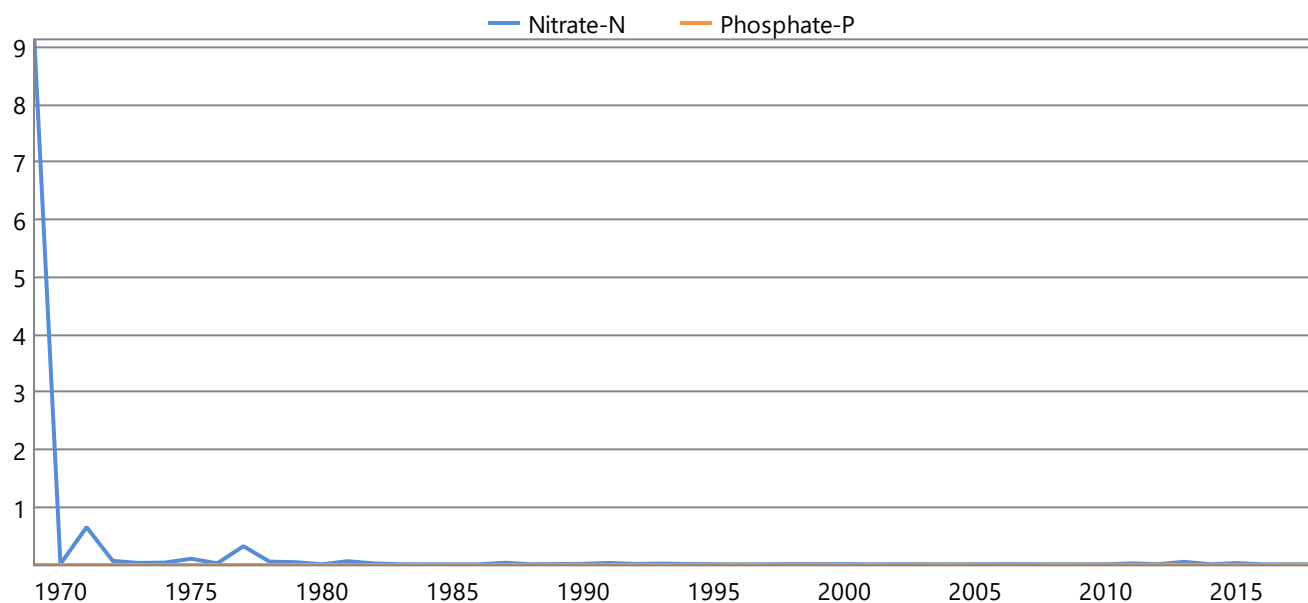
Average annual effluent phosphorus added (kg/ha/year)	59.21
Average annual soil phosphorus removed by plant uptake (kg/ha/year)	35.80
Average annual soil phosphorus leached (kg/ha/year)	0.05
Dissolved phosphorus (kg/ha) (Initial - Final)	0.00 - 0.07
Adsorbed phosphorus (kg/ha) (Initial - Final)	77.71 - 1248.04
Average phosphate-P concentration in rootzone (mg/L)	0.02
Average phosphate-P concentration of deep drainage (mg/L)	3.91E-03
Max. annual phosphate-P concentration of deep drainage (mg/L)	0.01
Design soil profile storage life based on average infiltrated water phosphorus concn. of 2.86 mg/L (years)	87.00

Sustainability Diagnostics: Greenacres Caravan Park

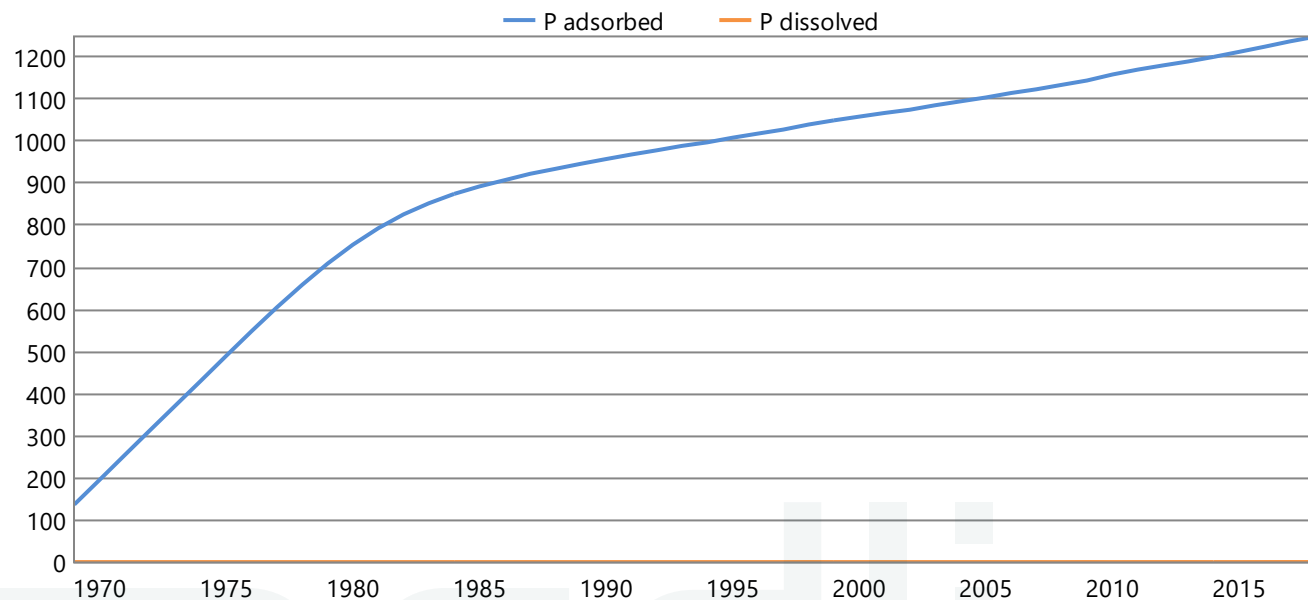
Paddock Land: Default Paddock: 1 ha

Irrigation: Flood with 0.1% ammonium loss during irrigation

Annual nutrient leachate concentration (mg/L)



Annual Phosphate-P in soil (kg/ha)



Sustainability Diagnostics: Greenacres Caravan Park

Paddock Plant Performance: Default Paddock: 1 ha

Average Plant Performance (Minimum - Maximum): Continuous Ryegrass 1 Pasture

Average annual shoot dry matter yield (kg/ha/year)	17044.92 (15044.92 - 18726.00)
Average monthly plant (green) cover (fraction)	0.65 (0.62 - 0.66)
Average monthly crop factor (fraction)	0.52 (0.50 - 0.53)
Total plant cover (both green and dead) left after harvest (fraction)	0.97
Average monthly root depth (mm)	597.77 (592.12 - 599.98)
Average number of normal harvests per year (no./year)	4.40 (3.00 - 5.00)
Average number of normal harvests for last five years only (no./year)	4.20
Average number of crop deaths per year (no./year)	0.02 (0.00 - 1.00)
Average number of crop deaths for last five years only (no./year)	0.00
Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient)	0.24 (0.11 - 0.30)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.46 (0.33 - 0.57)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.01 (0.00 - 0.04)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.01)
Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.00)
No. days without crop/year (days)	0.08

Soil Salinity - Plant salinity tolerance: Moderately tolerant

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

All values based on 10 year running averages

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.31
Salt added by rainfall (kg/ha/year)	222.57
Average annual effluent salt added & leached at steady state (kg/ha/year)	4139.24
Average leaching fraction based on 10 year running averages (fraction)	0.73
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.20
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	0.55
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

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Run Messages

Messages generated when the scenario was run:

Full run chosen

Enterprise: Greenacres Caravan Park

Description:

Greenacres Caravan Park

Client: Greenacres Caravan Park

MEDLI User: F Milnes

Scenario Details:

Sustainability Investigation for land application of treated effluent as alternative to discharge to waters.

Flow 35 kL

TN 35

TP 6.5

TDS 430 based on EC 670 uS/cm

Tank 90kL

Irrigation 3.5 mm/day

Kikuyu 1 Pasture

MEDLI REPORT - FULL RUN



Climate Data: Greenacres -27.55_153.20, -27.55°, 153.2°

Run Period: 01/01/1969 to 31/12/2018 50 years, 0 days

Climate Statistics:

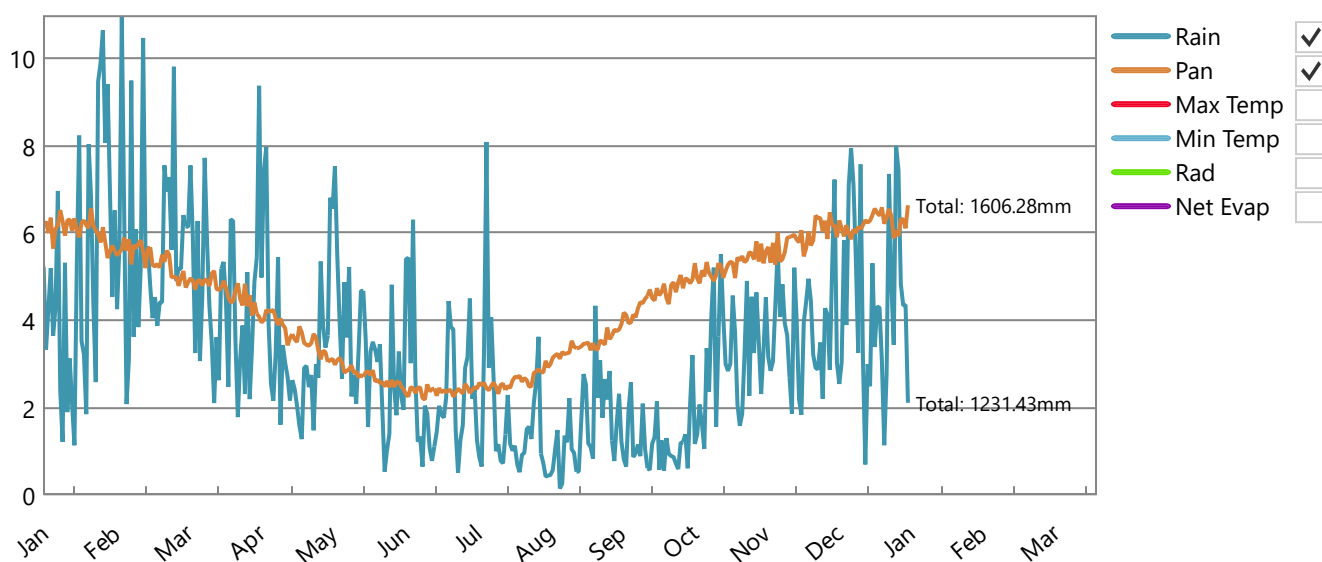
	5th ▾	Percentile	50th Percentile	95th ▾	Percentile
Rainfall (mm/year)		734	1199		1749
Pan Evaporation (mm/year)		1434	1607		1829

Climate Data:

☒ Chart ☐ Table

☐ Monthly ☒ Daily

Daily Average Across Run Period



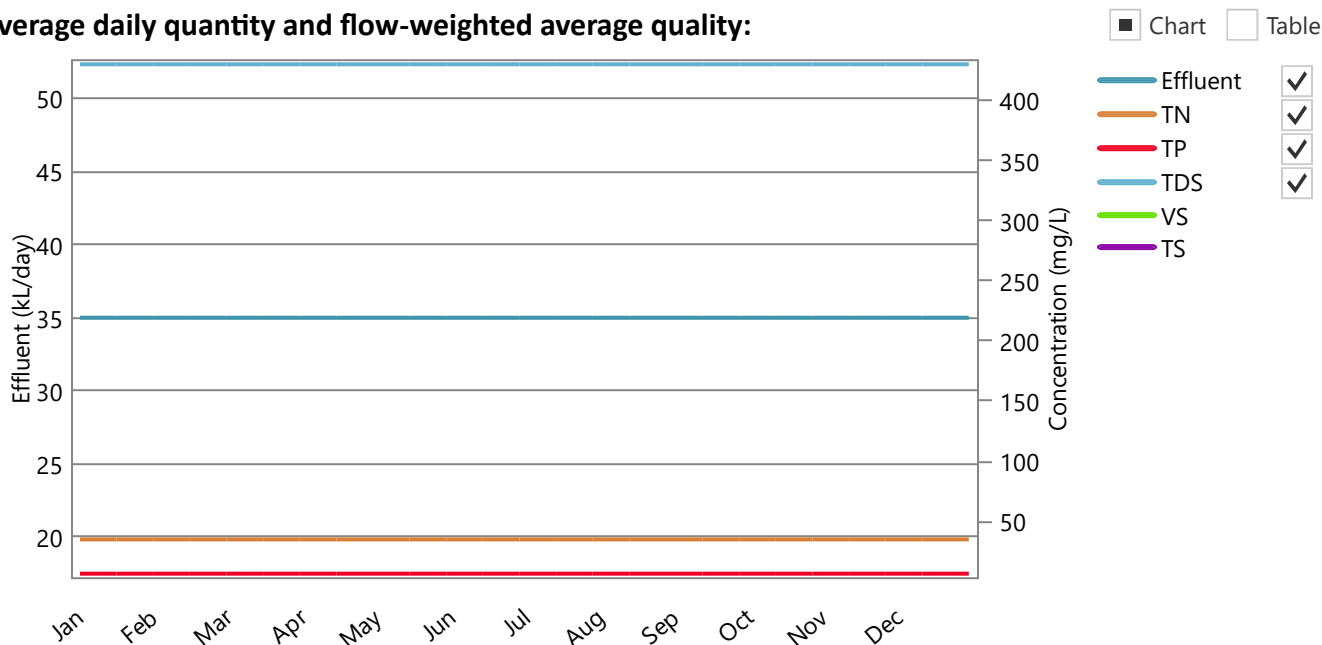
DESCRIPTION



Effluent type: New Generic System

Wastestream before any recycling or pretreatment

Average daily quantity and flow-weighted average quality:



Wastestream after any recycling and pretreatment if applicable

Effluent quantity: **12783.40 kL/year** or 35.00 kL/day (Min-Max: 35.00 - 35.00)

Flow-weighted average (minimum - maximum) daily effluent quality entering pond system:

	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	35.00 (35.00 - 35.00)	447.42 (447.13 - 448.35)
Total Phosphorus	6.50 (6.50 - 6.50)	83.09 (83.04 - 83.27)
Total Dissolved Salts	430.00 (430.00 - 430.00)	5496.86 (5493.25 - 5508.30)
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)

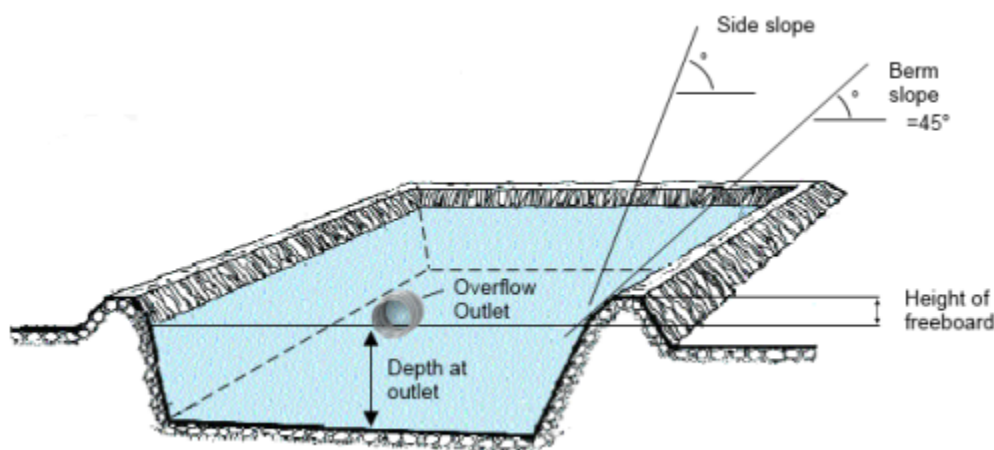
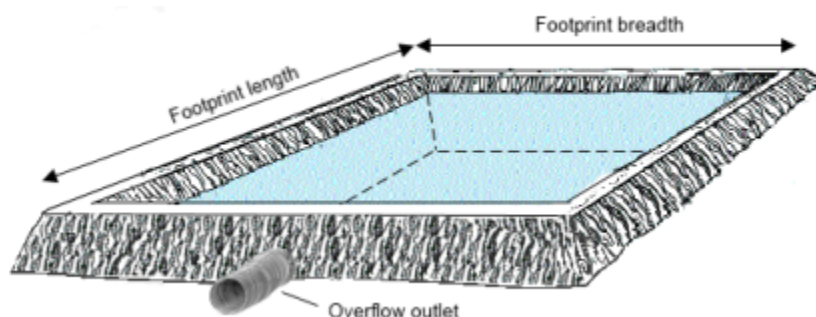
DESCRIPTION

medli

Pond system: 1 closed storage tank

Pond system details:

	Pond 1
Maximum pond volume (kL)	90.00
Minimum allowable pond volume (kL)	1.24
Pond depth at overflow outlet (m)	2.18
Maximum water surface area (m2)	41.31
Pond footprint length (m)	7.63
Pond footprint width (m)	7.63
Pond catchment area (m2)	58.17
Average active volume (kL)	56.50



Irrigation pump limits:

Minimum pump rate per area limit (ML/day/ha)	0.00
Maximum pump rate per area limit (ML/day/ha)	1.00

Shandying water:

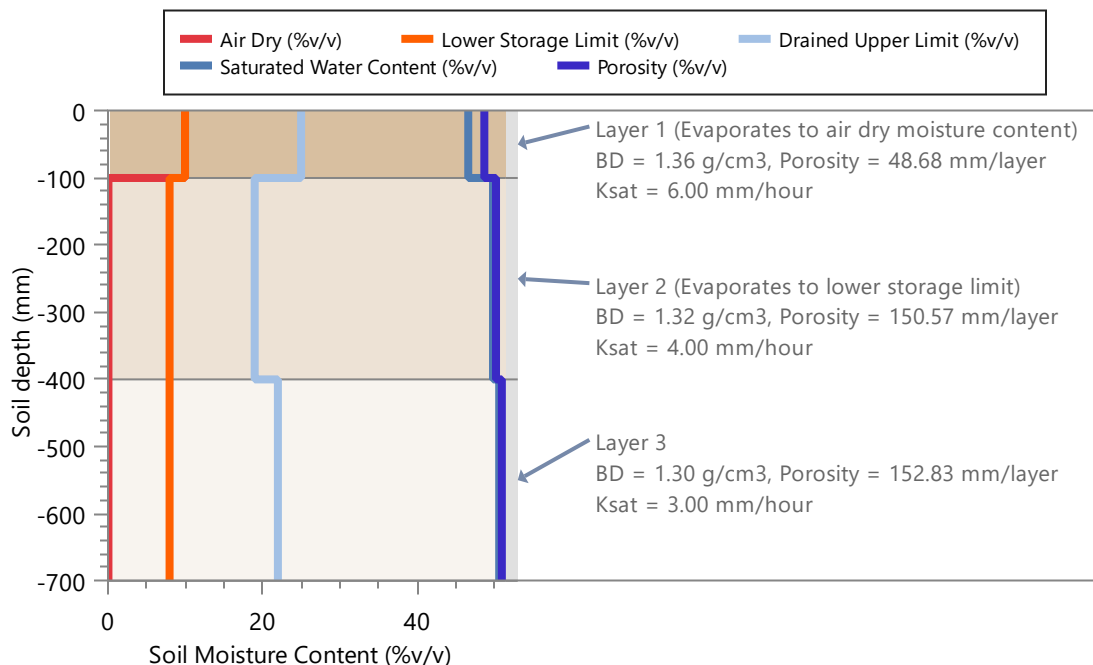
Annual allocation of fresh water available for shandying (kL/year)	0.00
Maximum rate of application of fresh water (ML/day)	0.00
Nitrogen concentration (mg/L)	0.00
Salinity (dS/m)	0.00
Minimum shandy water is used	False

Land: Default Paddock

Area (ha): 1.00

Soil Type: Greenacres Caravan Park, 700.00 mm defined profile depth

Profile Porosity (mm)	352.08
Profile saturation water content (mm)	347.80
Profile drained upper limit (or field capacity) (mm)	148.00
Profile lower storage limit (or permanent wilting point) (mm)	58.00
Profile available water capacity (mm)	90.00
Profile limiting saturated hydraulic conductivity (mm/hour)	3.00
Surface saturated hydraulic conductivity (mm/hour)	6.00
Runoff curve number II (coefficient)	88.00
Soil evaporation U (mm)	9.00
Soil evaporation Cona (mm/sqrt day)	4.00



Plant Data: Continuous Kikuyu 1 Pasture

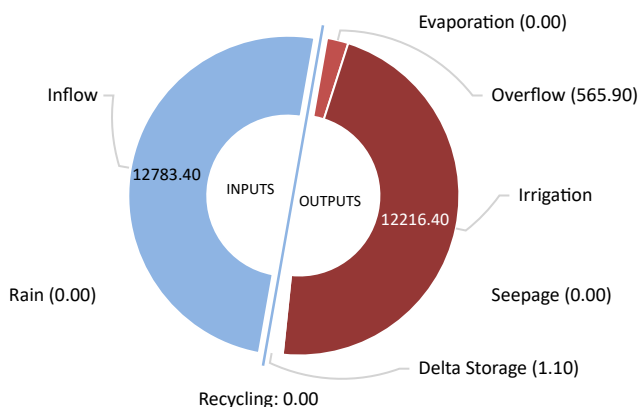
Average monthly cover (fraction) (minimum - maximum)	0.87 (0.81 - 0.92)
Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 0.8 x Pan coefficient 1)	0.80
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Maximum potential root depth in defined soil profile (mm)	700.00
Salt tolerance	Moderately tolerant
Salinity threshold EC sat. ext. (dS/m)	3.00
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.03



Pond System Water Performance - Overflow: 1 closed storage tank

Capacity of wet weather storage pond: 90 kL

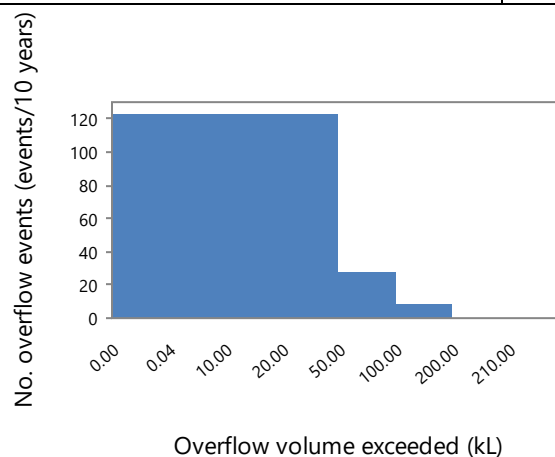
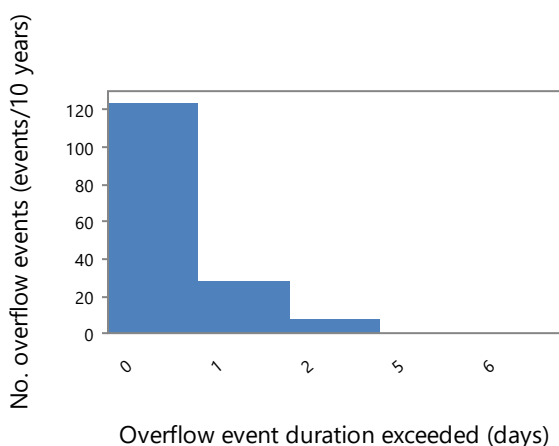
Pond System Water Balance (kL/year)



Name	Value
Rain	0.00
Inflow	12783.40
Recycling	0.00
Evaporation	0.00
Overflow	565.90
Irrigation	12216.40
Seepage	0.00
Delta Storage	1.10

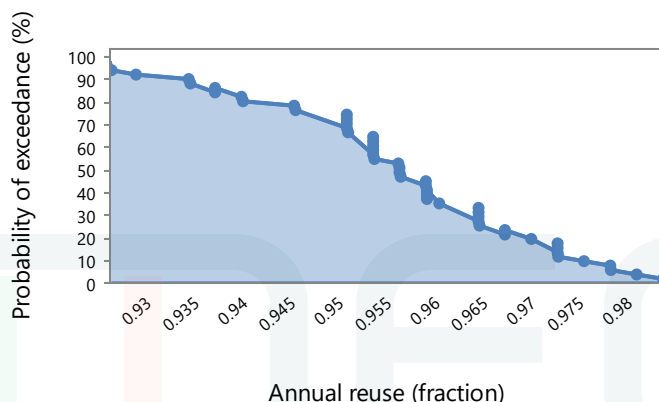
Overflow Diagnostics

Volume of overflow (kL/year)	565.90
No. days pond overflows (days/year)	16.18
Average duration of overflow (days)	1.31
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	0.96
Probability of at least 90% reuse (fraction)	1.00



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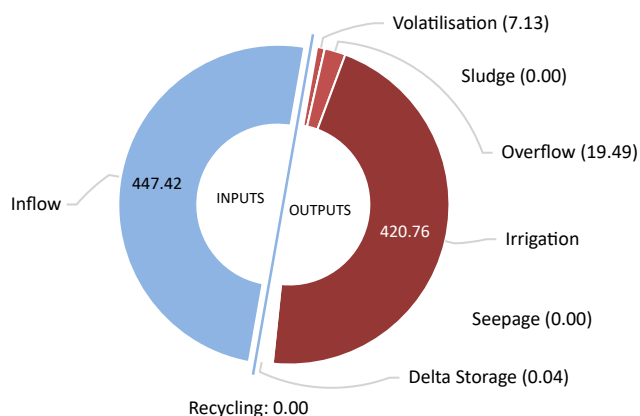


[Export plot](#)

Pond System Performance - Nutrient: 1 closed storage tank

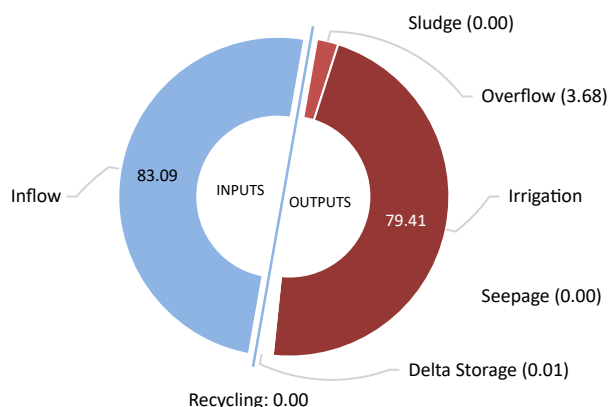
Pond System Nutrients and Salt Balance:

Nitrogen Balance (kg/year)



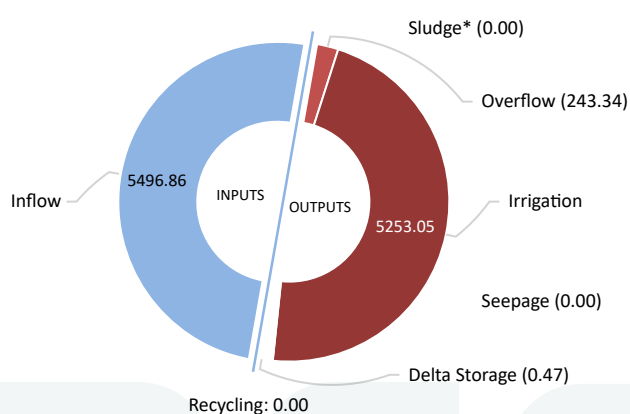
Name	Value
Inflow	447.42
Recycling	0.00
Volatilisation	7.13
Sludge	0.00
Overflow	19.49
Irrigation	420.76
Seepage	0.00
Delta Storage	0.04

Phosphorus Balance (kg/year)



Name	Value
Inflow	83.09
Recycling	0.00
Sludge	0.00
Overflow	3.68
Irrigation	79.41
Seepage	0.00
Delta Storage	0.01

Salt Balance (kg/year)



Name	Value
Inflow	5496.86
Recycling	0.00
Sludge*	0.00
Overflow	243.34
Irrigation	5253.05
Seepage	0.00
Delta Storage	0.47

* 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 0.00 kg/year

Pond System Sludge Accumulation: 0.00 kg dwt/year

Pond System Performance - Nutrient: 1 closed storage tank

Pond Nutrient Concentrations and Salinity:

Average across simulation period	Pond 1
Average nitrogen concentration of pond liquid (mg/L)	34.10
Average phosphorus concentration of pond liquid (mg/L)	6.50
Average salinity of pond liquid (dS/m)	0.67

Value on final day of simulation period	Pond 1
Final nitrogen concentration of pond liquid (mg/L)	34.09
Final phosphorus concentration of pond liquid (mg/L)	6.50
Final salinity of pond liquid (dS/m)	0.67

Irrigation Performance:

Water Use: (assumes 100% Irrigation Efficiency)

Pond water irrigated (kL/year)	12216.40
Average Shandy water irrigation (kL/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Total water irrigated (kL/year)	12216.40
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Proportion of years shandying water allocation of 0 kL/year is exceeded (fraction of years)	0.00
Average exceedance as a proportion of annual shandy water allocation (fraction of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)

Irrigation Quality:

Average nitrogen concentration of irrigation water - before ammonia loss during irrigation (mg/L)	34.44
Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)	33.06
Average phosphorus concentration of irrigation water (mg/L)	6.50
Average salinity of irrigation water (dS/m)	0.67

Irrigation Diagnostics:

Proportion of Days rain prevents irrigation (fraction)	0.04
Proportion of Days irrigation occurs (fraction)	0.96

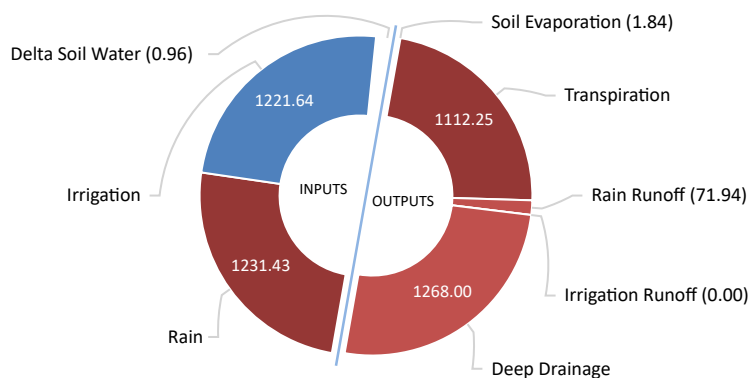
Land Performance - Soil Water

Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park, 90.00 mm PAWC at maximum root depth**

Land Water Balance (mm/year):

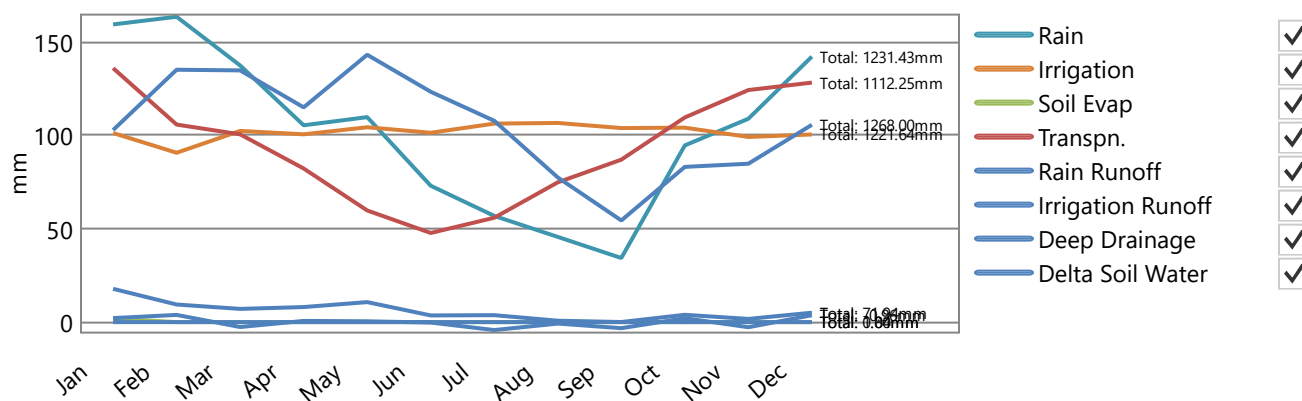
☒ mm/year ☐ % Total inputs



Name	Value
Rain	1231.43
Irrigation	1221.64
Soil Evaporation	1.84
Transpiration	1112.25
Rain Runoff	71.94
Irrigation Runoff	0.00
Deep Drainage	1268.00
Delta Soil Water	-0.96

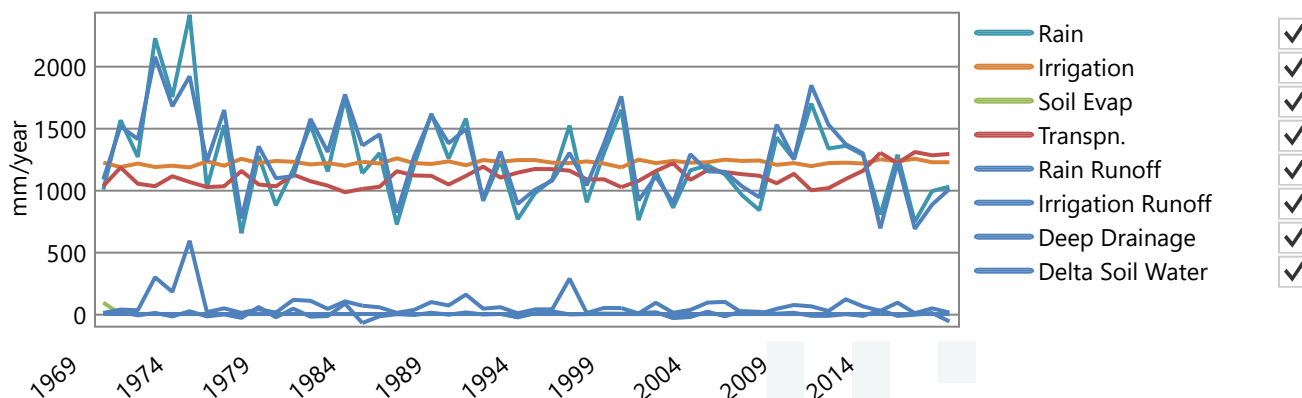
Average Monthly Totals (mm):

☒ Chart ☐ Table



Average Annual Totals (mm/year):

☒ Chart ☐ Table



PERFORMANCE



Land Performance - Soil Nutrient

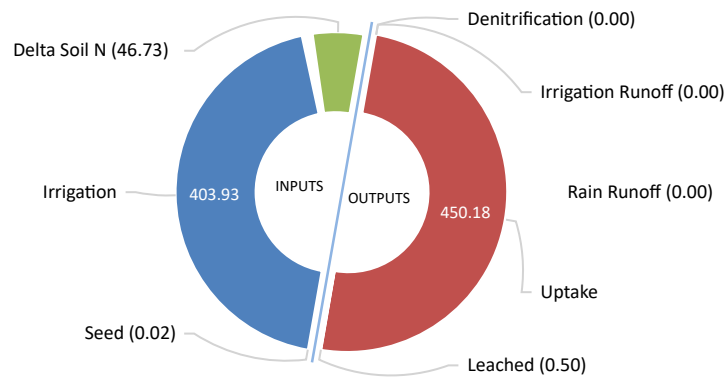
Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park**

Irrigation ammonium volatilisation losses (kg/ha/year): 16.83

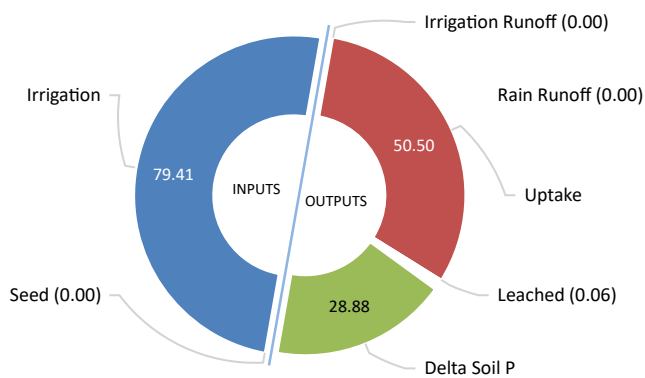
Proportion of total nitrogen in irrigated effluent as ammonium (fraction): 0.40

Land Nitrogen Balance (kg/ha/year)



Name	Value
Seed	0.02
Irrigation	403.93
Denitrification	8.19E-04
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	450.18
Leached	0.50
Delta Soil N	-46.73

Land Phosphorus Balance (kg/ha/year)



Name	Value
Seed	1.80E-03
Irrigation	79.41
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	50.50
Leached	0.06
Delta Soil P	28.88

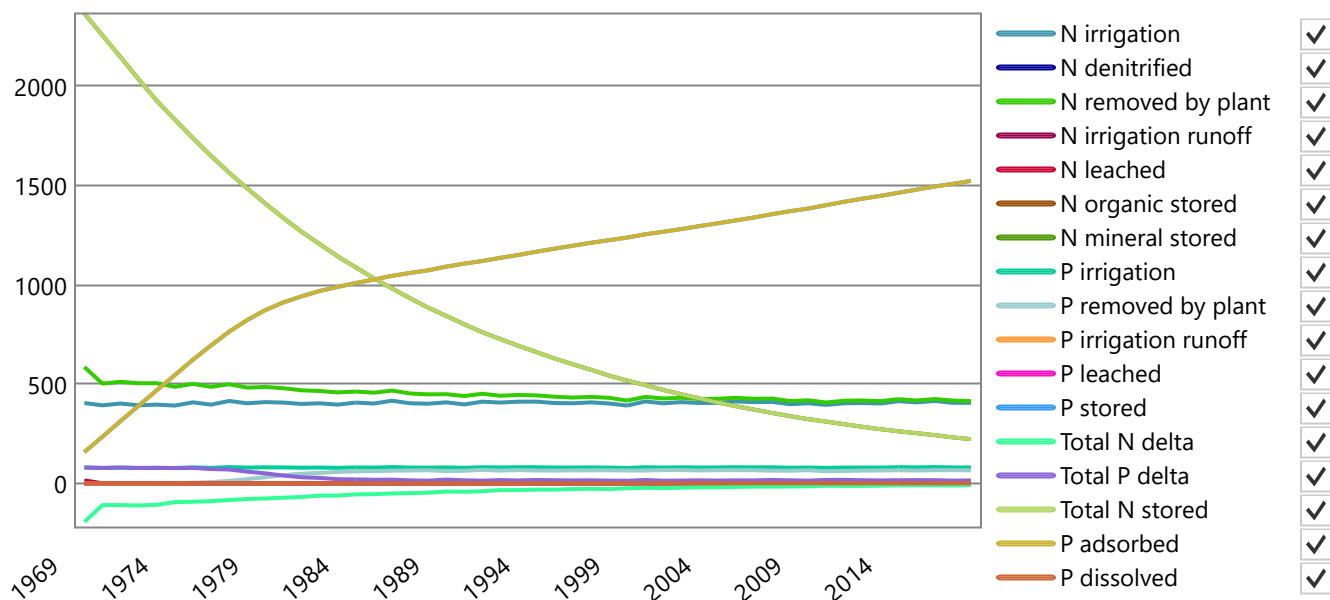


Land Performance - Soil Nutrient

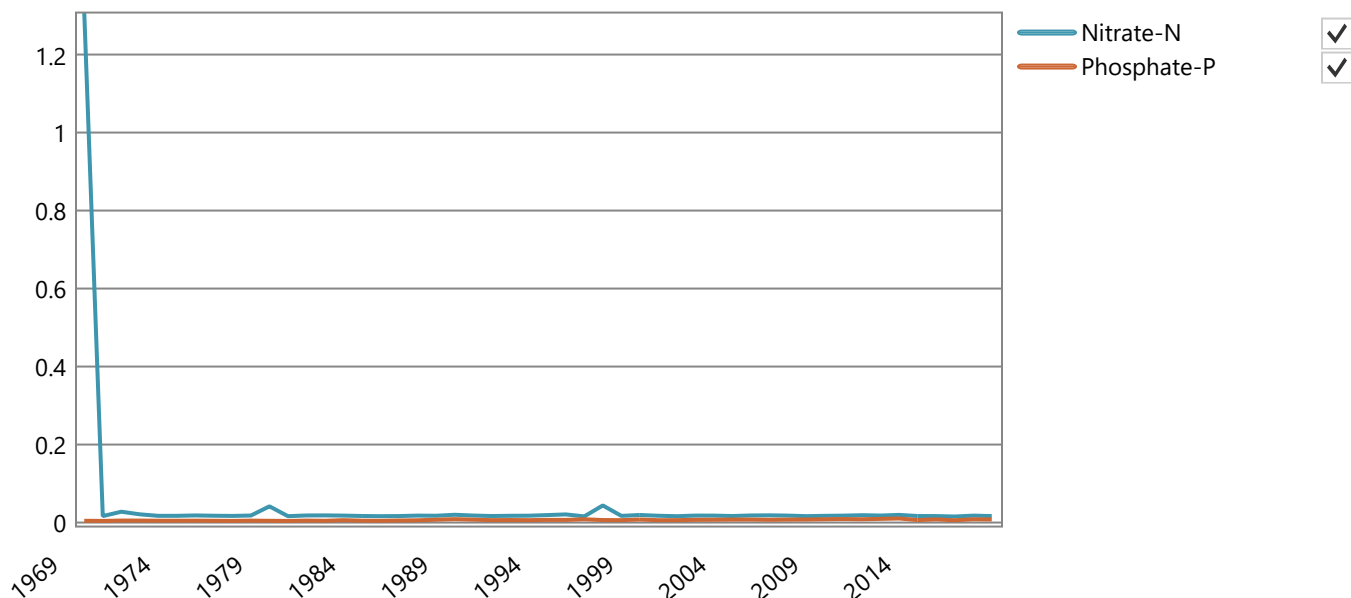
Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park**

Annual Nutrient Totals (kg/ha):



Annual Nutrient Leaching Concentration (mg/L):



PERFORMANCE



Plant Performance and Nutrients

Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park**

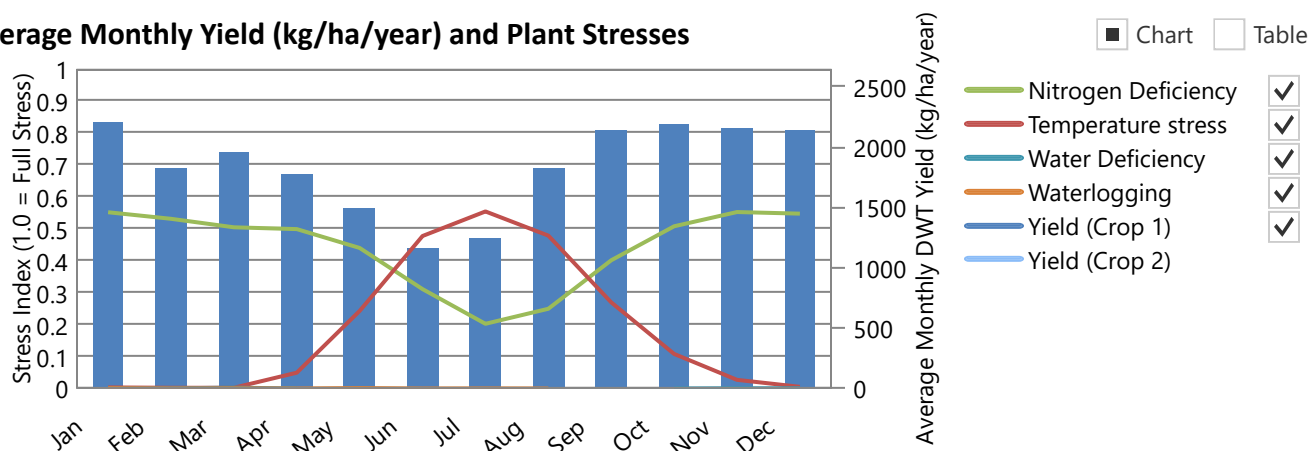
Plant: **Continuous Kikuyu 1 Pasture**

Average annual shoot dry matter yield (kg/ha/year)	22156.78 (20166.58 - 25814.20)
Average monthly plant (green) cover (fraction) (minimum - maximum)	0.87 (0.81 - 0.92)
Average monthly root depth (mm) (minimum - maximum)	699.64 (695.70 - 700.00)

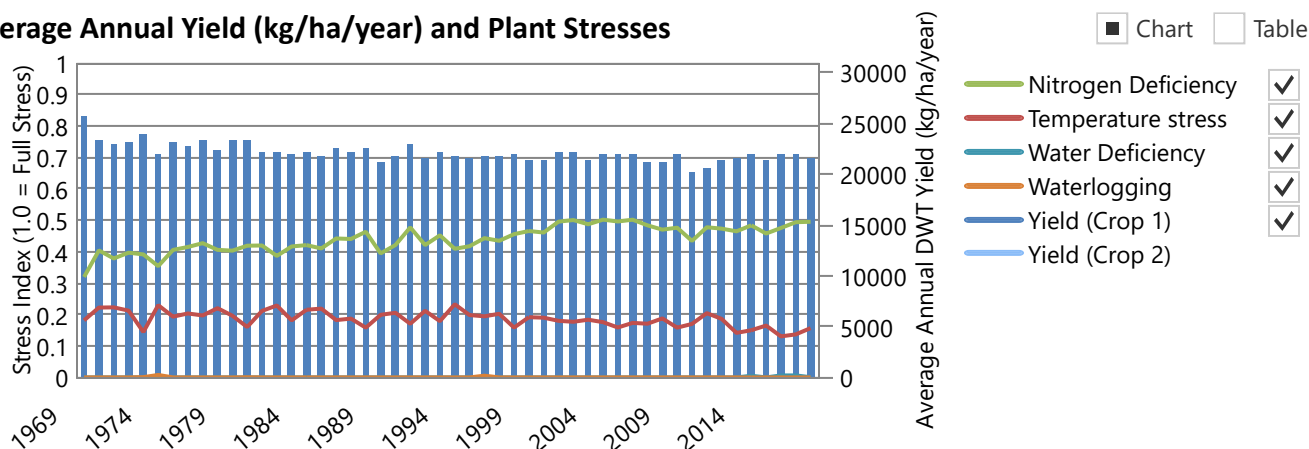
Nutrient Uptake (minimum - maximum):

Average annual net nitrogen removed by plant uptake (kg/ha/year)	450.18 (406.61 - 584.99)
Average annual net phosphorus removed by plant uptake (kg/ha/year)	50.50 (0.00 - 67.50)
Average annual shoot nitrogen concentration (fraction dwt)	0.02 (0.02 - 0.02)
Average annual shoot phosphorus concentration (fraction dwt)	0.002 (0.000 - 0.003)

Average Monthly Yield (kg/ha/year) and Plant Stresses



Average Annual Yield (kg/ha/year) and Plant Stresses



No. of harvests/year: 4.00 (normal)

No. days without crop/year (days/year): 0.00



Land Performance

Paddock: Default Paddock, 1 ha

Soil Type: Greenacres Caravan Park

Plant: Continuous Kikuyu 1 Pasture

Salt tolerance	Moderately tolerant
Salinity threshold EC sat. ext. (dS/m)	3.00
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.03
No. years assumed for leaching to reach steady-state (years)	10.00

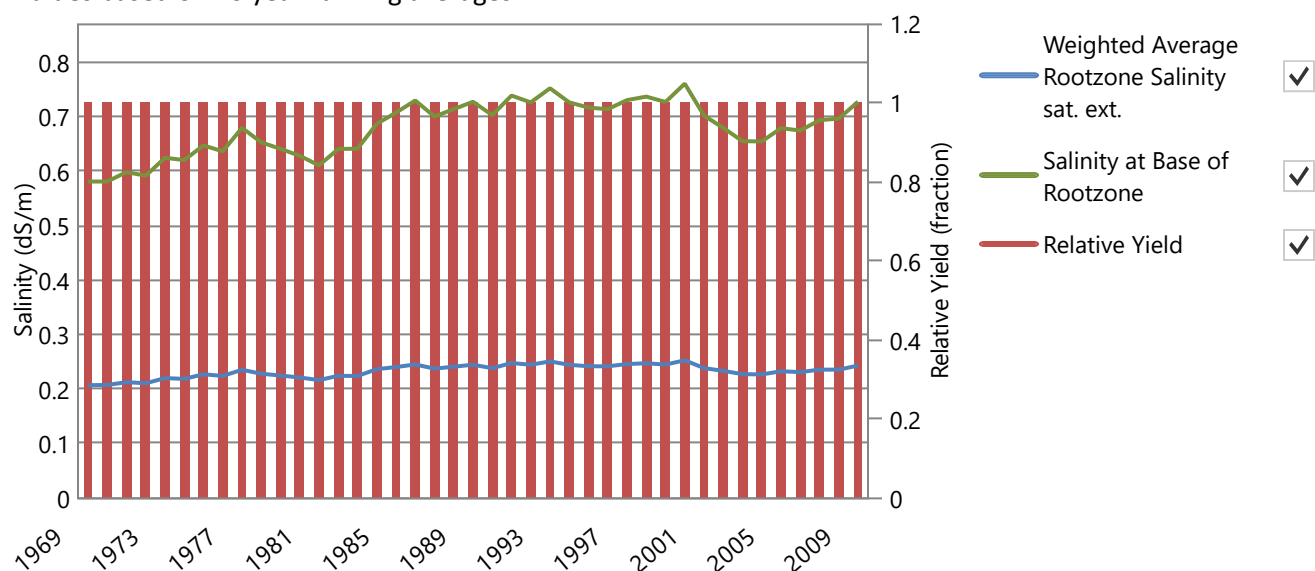
Soil Salinity:

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.36
Salt added by rainfall (kg/ha/year)	222.62
Average annual effluent salt added & leached at steady state (kg/ha/year)	5475.67
Average leaching fraction based on 10 year running averages (fraction)	0.71
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.23
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	0.68
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

☒ Chart ☐ Table

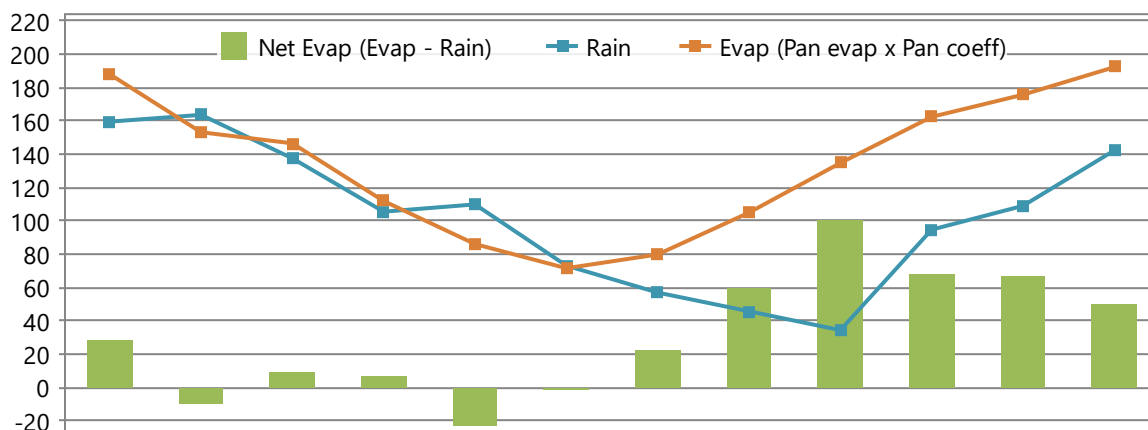


Sustainability Diagnostics: Greenacres Caravan Park

Averaged Historical Climate Data Used in Simulation (mm)

Location: Greenacres -27.55_153.20, -27.55°, 153.2°

Run Period: 01/01/1969 to 31/12/2018 50 years, 0 days



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	159.5	163.6	137.5	105.4	109.8	73.1	56.9	45.6	34.3	94.6	108.9	142.2	1231.4
Evap	188.0	153.1	146.5	111.8	86.0	71.5	79.8	104.9	134.7	162.3	175.6	192.2	1606.3
Net Evap	28.5	-10.4	9.0	6.4	-23.8	-1.6	22.9	59.2	100.3	67.7	66.7	50.0	374.9
Net Evap/day	0.9	-0.4	0.3	0.2	-0.8	-0.1	0.7	1.9	3.3	2.2	2.2	1.6	1.0

DIAGNOSTICS

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Sustainability Diagnostics: Greenacres Caravan Park

Pond System: 1 closed storage tank

New Generic System - 12783.40 kL/year or 35.00 kL/day generated on average

Effluent entering pond system after any pretreatment and recycling

Average (Minimum-Maximum) influent quality calculated for 365.24 non-zero flow days, after any pretreatment and recycling.

Constituent	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	35.00 (35.00 - 35.00)	447.42 (447.13 - 448.35)
Total Phosphorus	6.50 (6.50 - 6.50)	83.09 (83.04 - 83.27)
Total Dissolved Salts	430.00 (430.00 - 430.00)	5496.86 (5493.25 - 5508.30)
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)

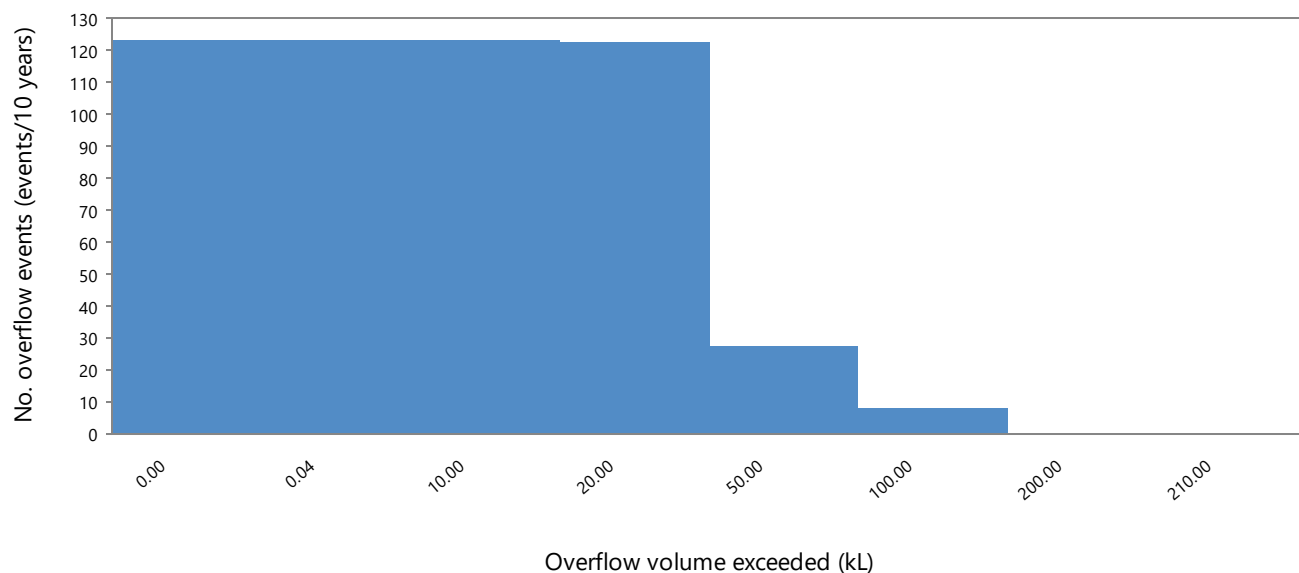
Last pond (Wet weather store): 90.00 kL

Theoretical hydraulic retention time (days)	2.57
Average volume of overflow (kL/year)	565.90
No. overflow events per year exceeding threshold* of 0.04 kL (no./year)	12.32
Average duration of overflow (days)	1.31
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	0.96
Probability of at least 90% effluent reuse (fraction)	1.00
Average salinity of last pond (dS/m)	0.67
Salinity of last pond on final day of simulation (dS/m)	0.67
Ammonia loss from pond system water area (kg/m2/year)	8.63

* The threshold is the volume equivalent to the top 1 mm depth of water of a full pond

Overflow exceedance:

☒ Chart ☐ Table



[Export plot](#)



Sustainability Diagnostics: Greenacres Caravan Park

Irrigation Information

Irrigation: 1 ha total area (assumed 100% irrigation efficiency)

	Quantity/year	Quantity/ha/year
Total irrigation applied (kL)	12216.40	12216.40
Total nitrogen applied (kg)	403.93	403.93
Total phosphorus applied (kg)	79.41	79.41
Total salts applied (kg)	5253.05	5253.05

Shandying

Annual allocation of fresh water for shandying (kL/year)	0.00
Average Shandy water irrigation (kL/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Average exceedance as a proportion of annual shandy water allocation (% of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Minimum shandy water is used	False

Irrigation Issues

Proportion of Days irrigation is prevented when triggered (fraction)	0.04
Proportion of Days irrigation occurs (fraction)	0.96

Sustainability Diagnostics: Greenacres Caravan Park

Paddock Land: Default Paddock: 1 ha

Irrigation: Flood with 0.1% ammonium loss during irrigation

Irrigation triggered when soil water deficit reaches 0.00 mm and rainfall is less than or equal to 20.00 mm
Irrigate a fixed amount of 3.50 mm each day
Irrigation window from 1/1 to 31/12 including the days specified
A minimum of 0 days must be skipped between irrigation events

Soil Water Balance (mm): Greenacres Caravan Park, 90.00 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	159.5	163.6	137.5	105.4	109.8	73.1	56.9	45.6	34.3	94.6	108.9	142.2	1231.4
Irrigation	101.3	90.7	102.4	100.6	104.4	101.4	106.3	106.7	104.0	104.2	99.2	100.5	1221.6
Soil Evap	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8
Transpn.	136.0	105.8	100.6	82.3	59.8	47.7	55.9	74.9	87.0	109.6	124.3	128.3	1112.3
Rain Runoff	17.8	9.4	7.1	8.1	10.7	3.6	3.7	0.8	0.1	3.9	1.7	5.0	71.9
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	102.9	135.2	134.8	115.0	143.2	123.4	107.8	77.5	54.5	83.2	84.8	105.7	1268.0
Delta	2.2	3.9	-2.6	0.6	0.4	-0.2	-4.3	-0.8	-3.2	2.1	-2.7	3.7	-1.0

Soil Nitrogen Balance

Average annual effluent nitrogen added (kg/ha/year)	403.93
Average annual soil nitrogen removed by plant uptake (kg/ha/year)	450.18
Average annual soil nitrogen removed by denitrification (kg/ha/year)	8.19E-04
Average annual soil nitrogen leached (kg/ha/year)	0.50
Average annual nitrate-N loading to groundwater (kg/ha/year)	0.50
Soil organic-N kg/ha (Initial - Final)	2448.00 - 222.28
	110.64 - 0.01
Average nitrate-N concentration of deep drainage (mg/L)	0.04
Max. annual nitrate-N concentration of deep drainage (mg/L)	1.31

Soil Phosphorus Balance

Average annual effluent phosphorus added (kg/ha/year)	79.41
Average annual soil phosphorus removed by plant uptake (kg/ha/year)	50.50
Average annual soil phosphorus leached (kg/ha/year)	0.06
Dissolved phosphorus (kg/ha) (Initial - Final)	0.00 - 0.11
Adsorbed phosphorus (kg/ha) (Initial - Final)	77.71 - 1521.71
Average phosphate-P concentration in rootzone (mg/L)	0.03
Average phosphate-P concentration of deep drainage (mg/L)	4.94E-03
Max. annual phosphate-P concentration of deep drainage (mg/L)	0.01
Design soil profile storage life based on average infiltrated water phosphorus concn. of 3.33 mg/L (years)	66.68



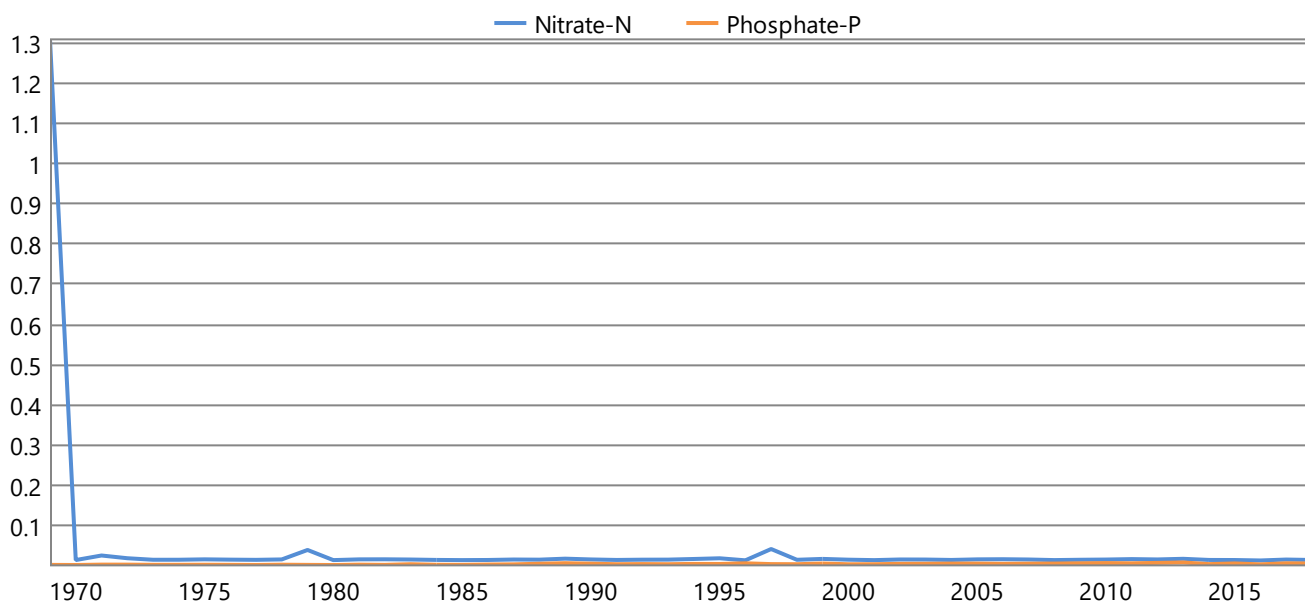
Sustainability Diagnostics: Greenacres Caravan Park

Paddock Land: Default Paddock: 1 ha

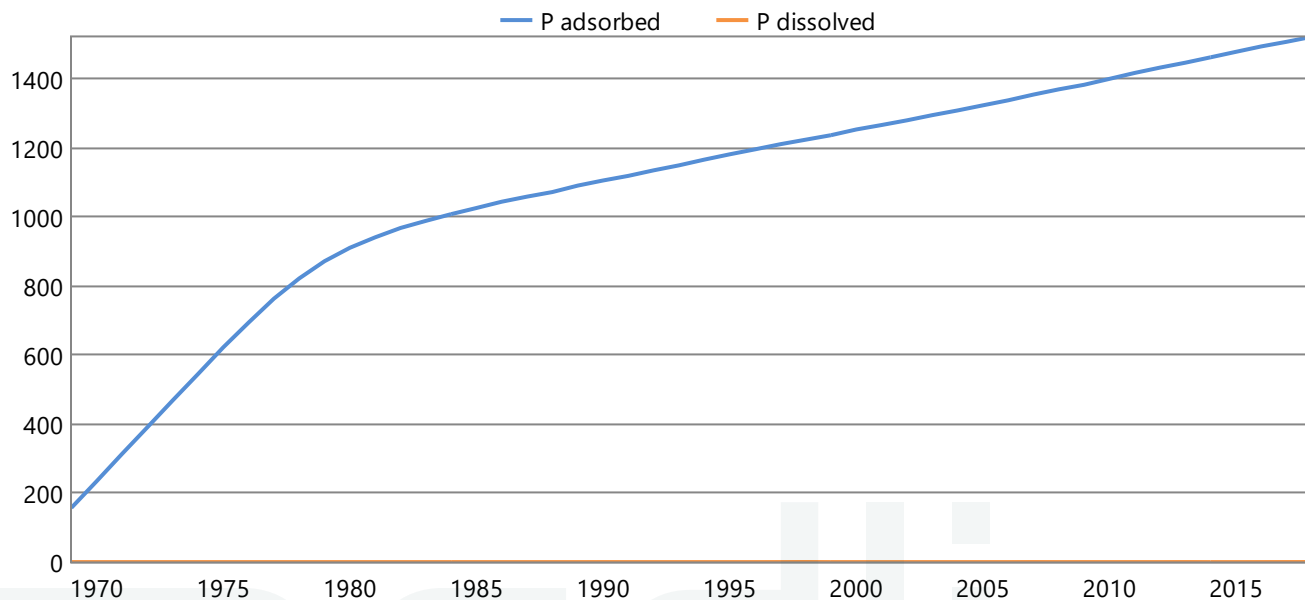
Irrigation: Flood with 0.1% ammonium loss during irrigation

DIAGNOSTICS

Annual nutrient leachate concentration (mg/L)



Annual Phosphate-P in soil (kg/ha)



Sustainability Diagnostics: Greenacres Caravan Park

Paddock Plant Performance: Default Paddock: 1 ha

Average Plant Performance (Minimum - Maximum): Continuous Kikuyu 1 Pasture

Average annual shoot dry matter yield (kg/ha/year)	22156.78 (20166.58 - 25814.20)
Average monthly plant (green) cover (fraction)	0.87 (0.81 - 0.92)
Average monthly crop factor (fraction)	0.69 (0.65 - 0.73)
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Average monthly root depth (mm)	699.64 (695.70 - 700.00)
Average number of normal harvests per year (no./year)	4.00 (3.00 - 5.00)
Average number of normal harvests for last five years only (no./year)	4.00
Average number of crop deaths per year (no./year)	0.00 (0.00 - 0.00)
Average number of crop deaths for last five years only (no./year)	0.00
Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient)	0.44 (0.32 - 0.50)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.02)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.55 (0.34 - 0.69)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.00)
Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.00)
No. days without crop/year (days)	0.00

Soil Salinity - Plant salinity tolerance: Moderately tolerant

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

All values based on 10 year running averages

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.36
Salt added by rainfall (kg/ha/year)	222.62
Average annual effluent salt added & leached at steady state (kg/ha/year)	5475.67
Average leaching fraction based on 10 year running averages (fraction)	0.71
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.23
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	0.68
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

medli

Run Messages

Messages generated when the scenario was run:

Full run chosen

DIAGNOSTICS

medli

Enterprise: Greenacres Caravan Park

Description:

Greenacres Caravan Park

Client: Greenacres Caravan Park

MEDLI User: F Milnes

Scenario Details:

Sustainability Investigation for land application of treated effluent as alternative to discharge to waters.

Flow 35 kL

TN 35

TP 6.5

TDS 430 based on EC 670 uS/cm

Tank 90kL

Irrigation 3.5 mm/day

Ryegrass Pasture

MEDLI REPORT - FULL RUN



Climate Data: Greenacres -27.55_153.20, -27.55°, 153.2°

Run Period: 01/01/1969 to 31/12/2018 50 years, 0 days

Climate Statistics:

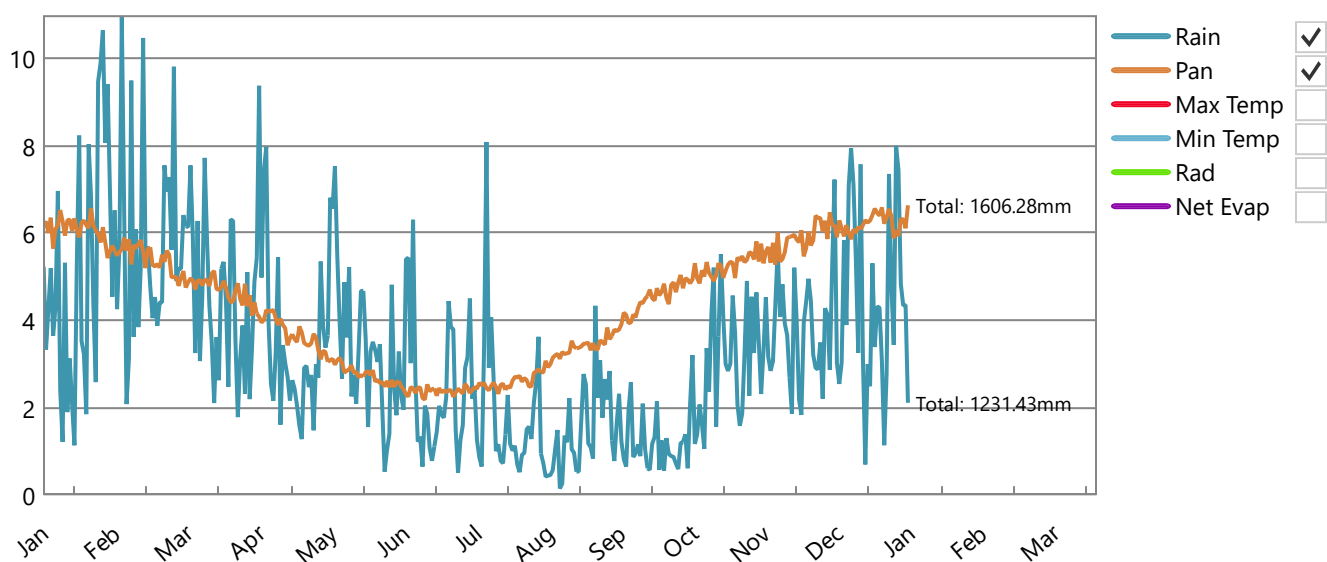
	5th ▾	Percentile	50th Percentile	95th ▾	Percentile
Rainfall (mm/year)		734	1199		1749
Pan Evaporation (mm/year)		1434	1607		1829

Climate Data:

☒ Chart ☐ Table

☐ Monthly ☒ Daily

Daily Average Across Run Period



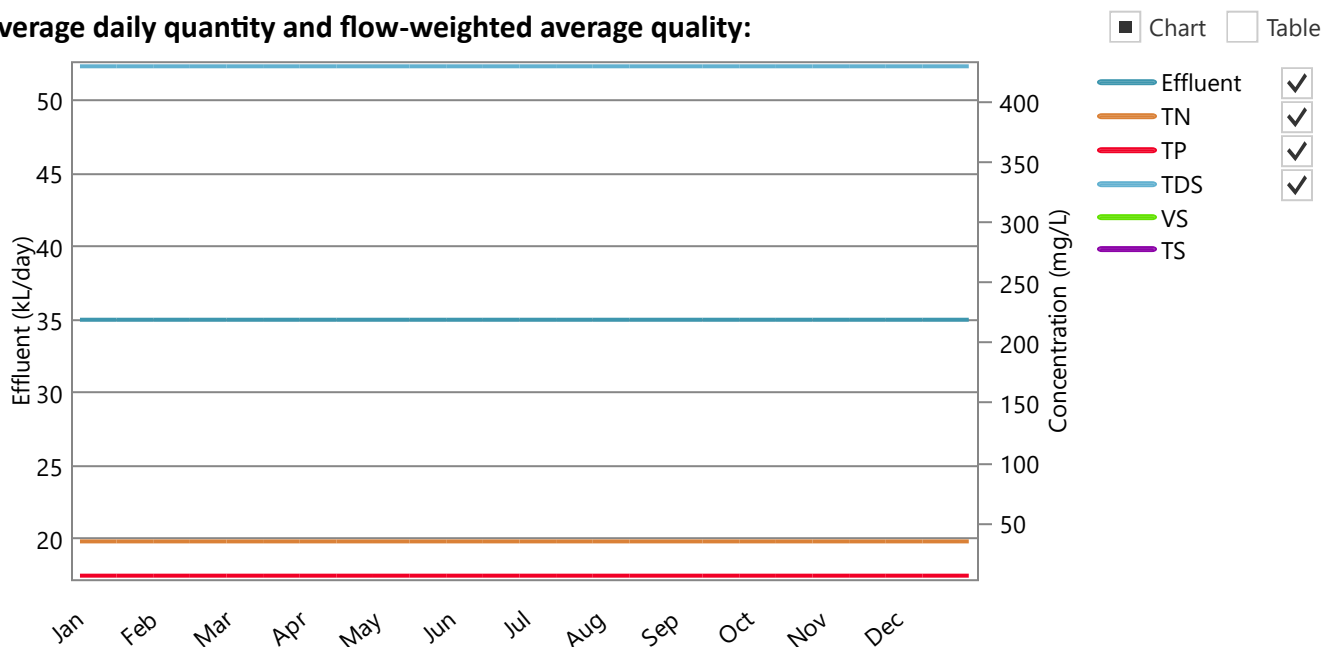
DESCRIPTION



Effluent type: New Generic System

Wastestream before any recycling or pretreatment

Average daily quantity and flow-weighted average quality:



Wastestream after any recycling and pretreatment if applicable

Effluent quantity: **12783.40 kL/year** or 35.00 kL/day (Min-Max: 35.00 - 35.00)

Flow-weighted average (minimum - maximum) daily effluent quality entering pond system:

	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	35.00 (35.00 - 35.00)	447.42 (447.13 - 448.35)
Total Phosphorus	6.50 (6.50 - 6.50)	83.09 (83.04 - 83.27)
Total Dissolved Salts	430.00 (430.00 - 430.00)	5496.86 (5493.25 - 5508.30)
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)

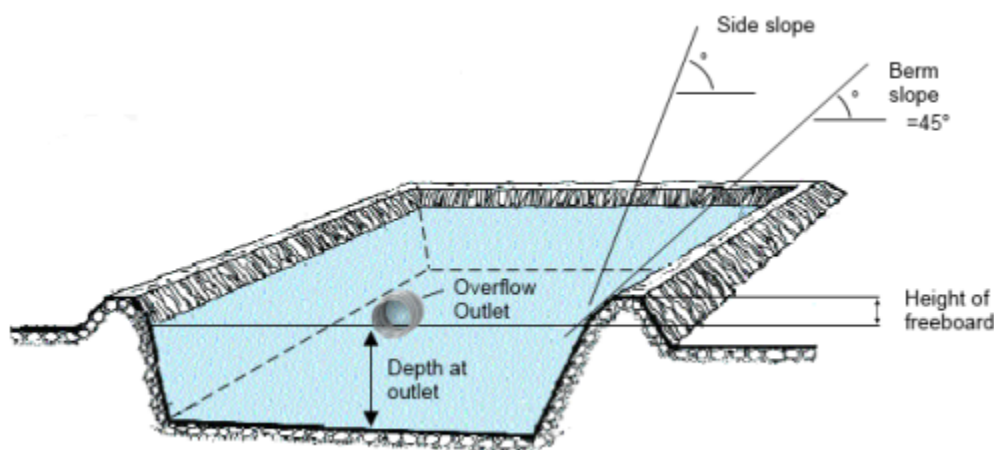
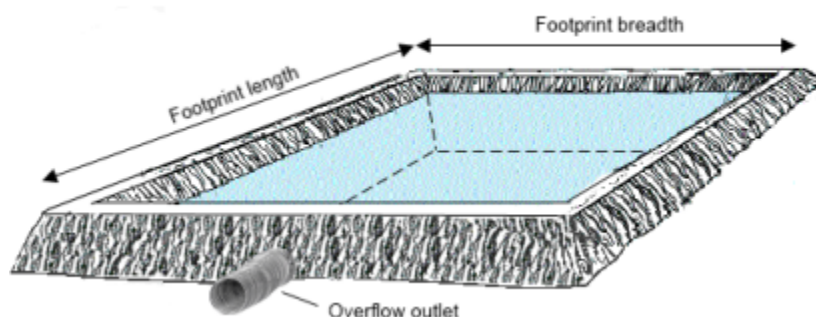
DESCRIPTION

medli

Pond system: 1 closed storage tank

Pond system details:

	Pond 1
Maximum pond volume (kL)	90.00
Minimum allowable pond volume (kL)	1.24
Pond depth at overflow outlet (m)	2.18
Maximum water surface area (m2)	41.31
Pond footprint length (m)	7.63
Pond footprint width (m)	7.63
Pond catchment area (m2)	58.17
Average active volume (kL)	56.50



Irrigation pump limits:

Minimum pump rate per area limit (ML/day/ha)	0.00
Maximum pump rate per area limit (ML/day/ha)	1.00

Shandying water:

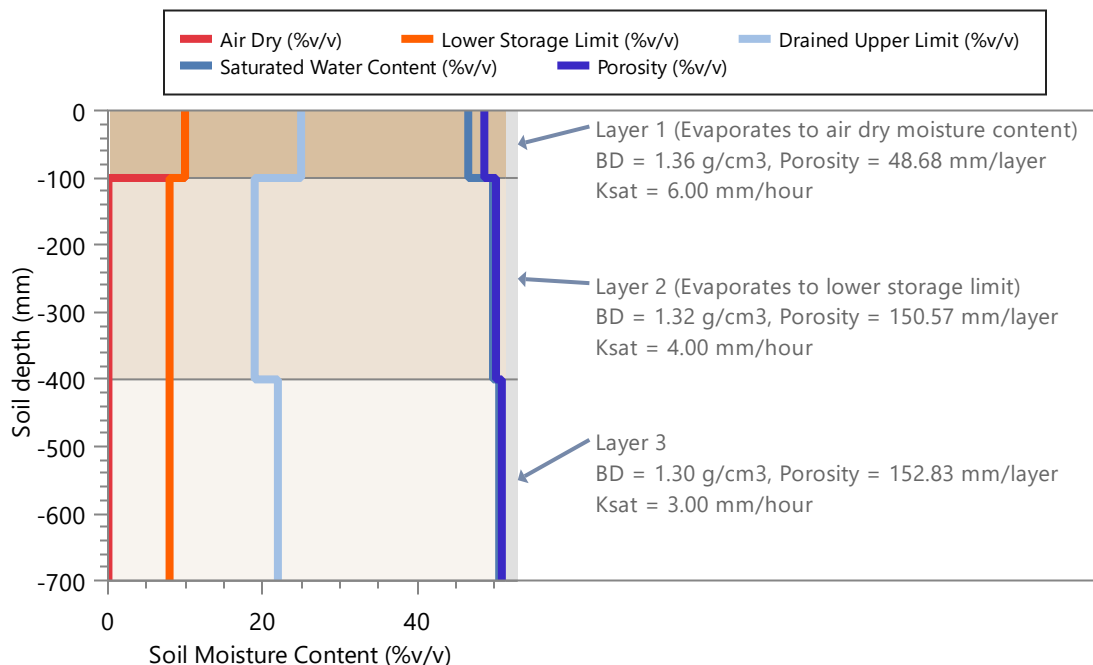
Annual allocation of fresh water available for shandying (kL/year)	0.00
Maximum rate of application of fresh water (ML/day)	0.00
Nitrogen concentration (mg/L)	0.00
Salinity (dS/m)	0.00
Minimum shandy water is used	False

Land: Default Paddock

Area (ha): 1.00

Soil Type: Greenacres Caravan Park, 700.00 mm defined profile depth

Profile Porosity (mm)	352.08
Profile saturation water content (mm)	347.80
Profile drained upper limit (or field capacity) (mm)	148.00
Profile lower storage limit (or permanent wilting point) (mm)	58.00
Profile available water capacity (mm)	90.00
Profile limiting saturated hydraulic conductivity (mm/hour)	3.00
Surface saturated hydraulic conductivity (mm/hour)	6.00
Runoff curve number II (coefficient)	88.00
Soil evaporation U (mm)	9.00
Soil evaporation Cona (mm/sqrt day)	4.00



Plant Data: Continuous Ryegrass 1 Pasture

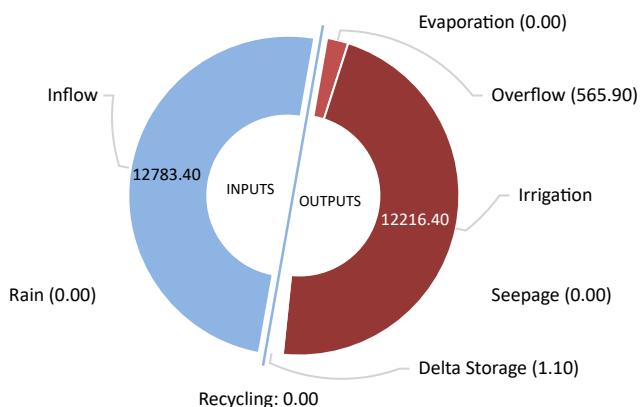
Average monthly cover (fraction) (minimum - maximum)	0.64 (0.62 - 0.67)
Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 0.8 x Pan coefficient 1)	0.80
Total plant cover (both green and dead) left after harvest (fraction)	0.97
Maximum potential root depth in defined soil profile (mm)	600.00
Salt tolerance	Moderately tolerant
Salinity threshold EC sat. ext. (dS/m)	5.60
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.08

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Pond System Water Performance - Overflow: 1 closed storage tank

Capacity of wet weather storage pond: 90 kL

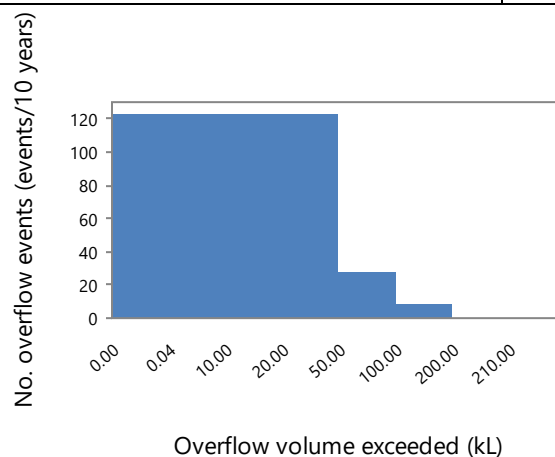
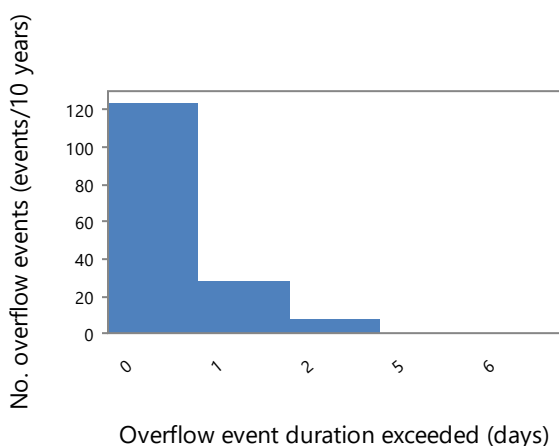
Pond System Water Balance (kL/year)



Name	Value
Rain	0.00
Inflow	12783.40
Recycling	0.00
Evaporation	0.00
Overflow	565.90
Irrigation	12216.40
Seepage	0.00
Delta Storage	1.10

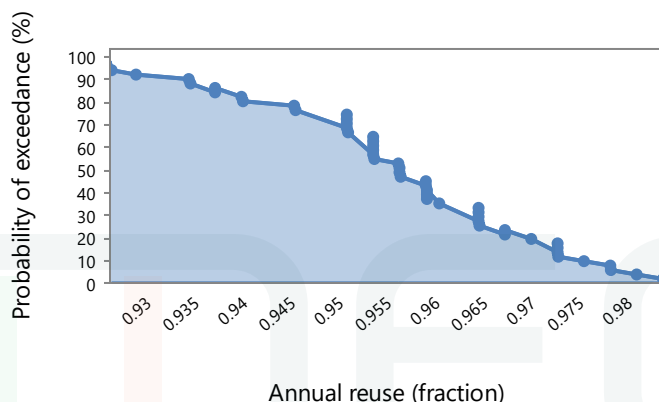
Overflow Diagnostics

Volume of overflow (kL/year)	565.90
No. days pond overflows (days/year)	16.18
Average duration of overflow (days)	1.31
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	0.96
Probability of at least 90% reuse (fraction)	1.00



[Export plot](#)

[Export plot](#)

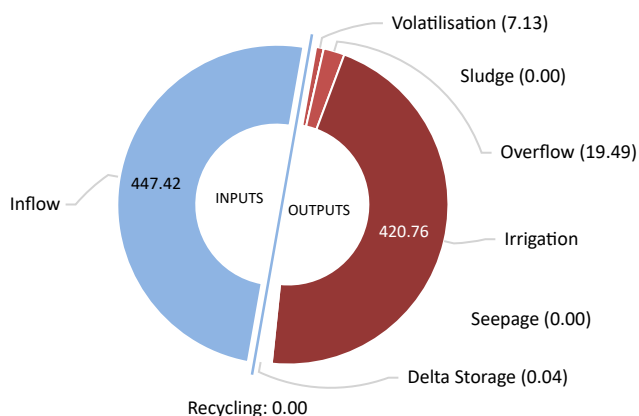


[Export plot](#)

Pond System Performance - Nutrient: 1 closed storage tank

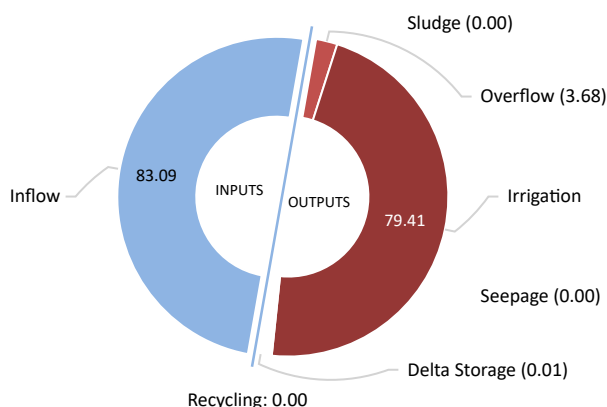
Pond System Nutrients and Salt Balance:

Nitrogen Balance (kg/year)



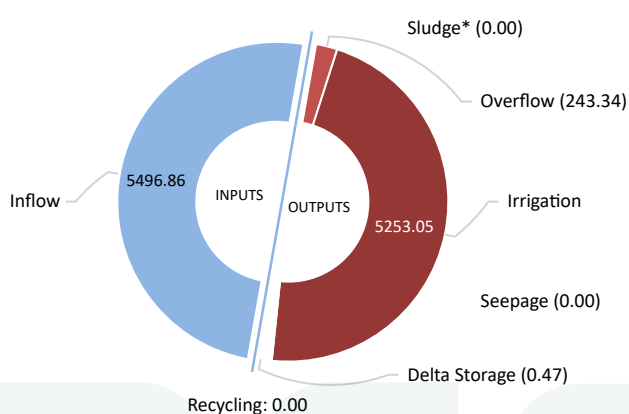
Name	Value
Inflow	447.42
Recycling	0.00
Volatilisation	7.13
Sludge	0.00
Overflow	19.49
Irrigation	420.76
Seepage	0.00
Delta Storage	0.04

Phosphorus Balance (kg/year)



Name	Value
Inflow	83.09
Recycling	0.00
Sludge	0.00
Overflow	3.68
Irrigation	79.41
Seepage	0.00
Delta Storage	0.01

Salt Balance (kg/year)



Name	Value
Inflow	5496.86
Recycling	0.00
Sludge*	0.00
Overflow	243.34
Irrigation	5253.05
Seepage	0.00
Delta Storage	0.47

* 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 0.00 kg/year

Pond System Sludge Accumulation: 0.00 kg dwt/year

Pond System Performance - Nutrient: 1 closed storage tank

Pond Nutrient Concentrations and Salinity:

Average across simulation period	Pond 1
Average nitrogen concentration of pond liquid (mg/L)	34.10
Average phosphorus concentration of pond liquid (mg/L)	6.50
Average salinity of pond liquid (dS/m)	0.67

Value on final day of simulation period	Pond 1
Final nitrogen concentration of pond liquid (mg/L)	34.09
Final phosphorus concentration of pond liquid (mg/L)	6.50
Final salinity of pond liquid (dS/m)	0.67

PERFORMANCE

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Irrigation Performance:

Water Use: (assumes 100% Irrigation Efficiency)

Pond water irrigated (kL/year)	12216.40
Average Shandy water irrigation (kL/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Total water irrigated (kL/year)	12216.40
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Proportion of years shandying water allocation of 0 kL/year is exceeded (fraction of years)	0.00
Average exceedance as a proportion of annual shandy water allocation (fraction of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)

Irrigation Quality:

Average nitrogen concentration of irrigation water - before ammonia loss during irrigation (mg/L)	34.44
Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)	33.06
Average phosphorus concentration of irrigation water (mg/L)	6.50
Average salinity of irrigation water (dS/m)	0.67

Irrigation Diagnostics:

Proportion of Days rain prevents irrigation (fraction)	0.04
Proportion of Days irrigation occurs (fraction)	0.96

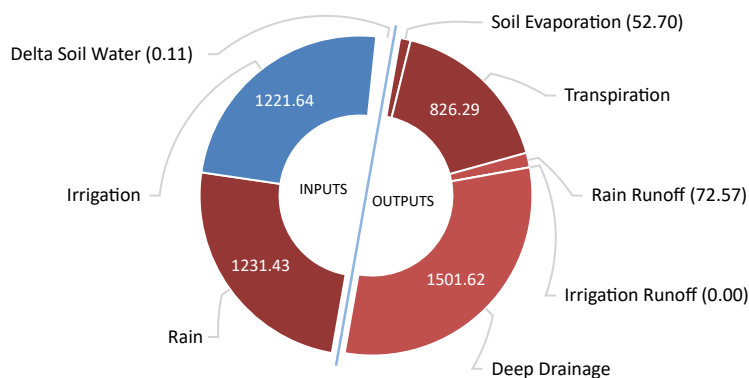
Land Performance - Soil Water

Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park, 76.00 mm PAWC at maximum root depth**

Land Water Balance (mm/year):

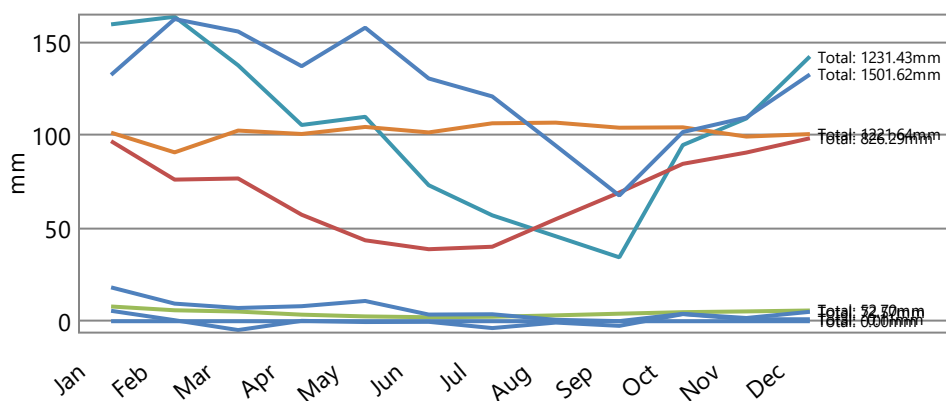
☒ mm/year ☐ % Total inputs



Name	Value
Rain	1231.43
Irrigation	1221.64
Soil Evaporation	52.70
Transpiration	826.29
Rain Runoff	72.57
Irrigation Runoff	0.00
Deep Drainage	1501.62
Delta Soil Water	-0.11

Average Monthly Totals (mm):

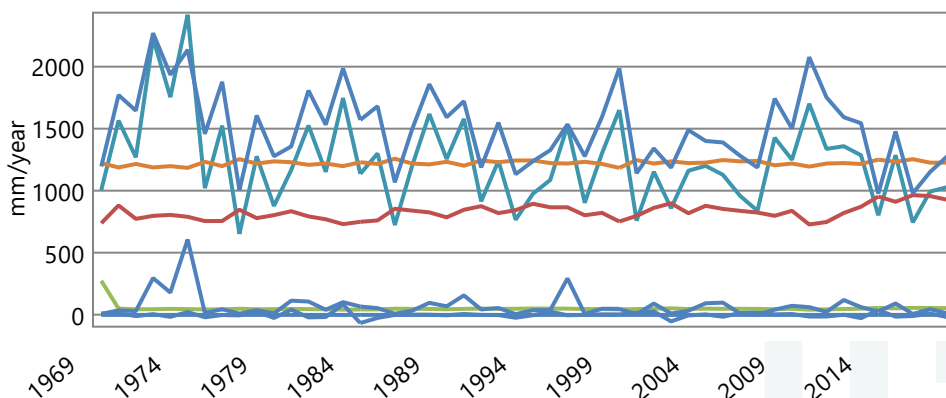
☒ Chart ☐ Table



- ☒ Rain
- ☒ Irrigation
- ☒ Soil Evap
- ☒ Transpn.
- ☒ Rain Runoff
- ☒ Irrigation Runoff
- ☒ Deep Drainage
- ☒ Delta Soil Water

Average Annual Totals (mm/year):

☒ Chart ☐ Table



- ☒ Rain
- ☒ Irrigation
- ☒ Soil Evap
- ☒ Transpn.
- ☒ Rain Runoff
- ☒ Irrigation Runoff
- ☒ Deep Drainage
- ☒ Delta Soil Water

PERFORMANCE

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Land Performance - Soil Nutrient

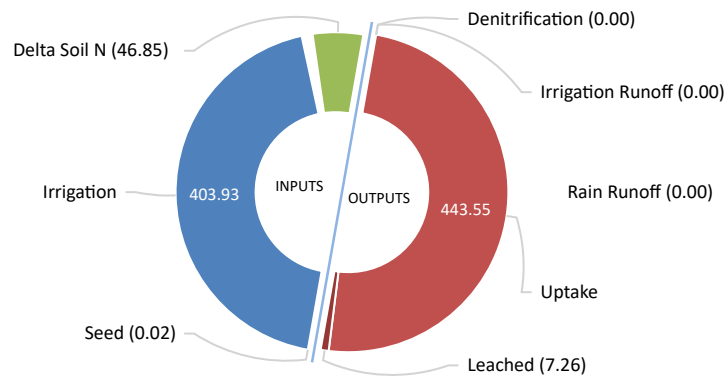
Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park**

Irrigation ammonium volatilisation losses (kg/ha/year): 16.83

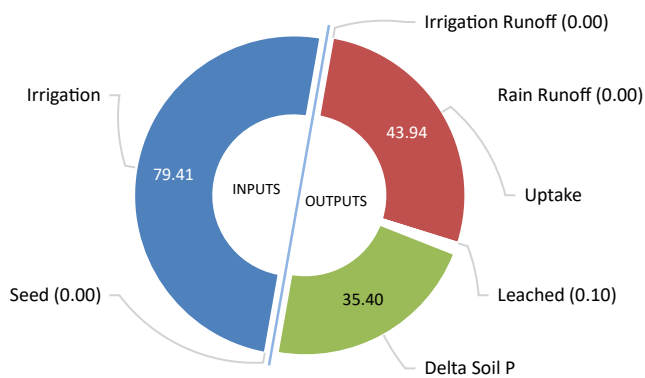
Proportion of total nitrogen in irrigated effluent as ammonium (fraction): 0.40

Land Nitrogen Balance (kg/ha/year)



Name	Value
Seed	0.02
Irrigation	403.93
Denitrification	1.71E-03
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	443.55
Leached	7.26
Delta Soil N	-46.85

Land Phosphorus Balance (kg/ha/year)



Name	Value
Seed	1.80E-03
Irrigation	79.41
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	43.94
Leached	0.10
Delta Soil P	35.40

PERFORMANCE

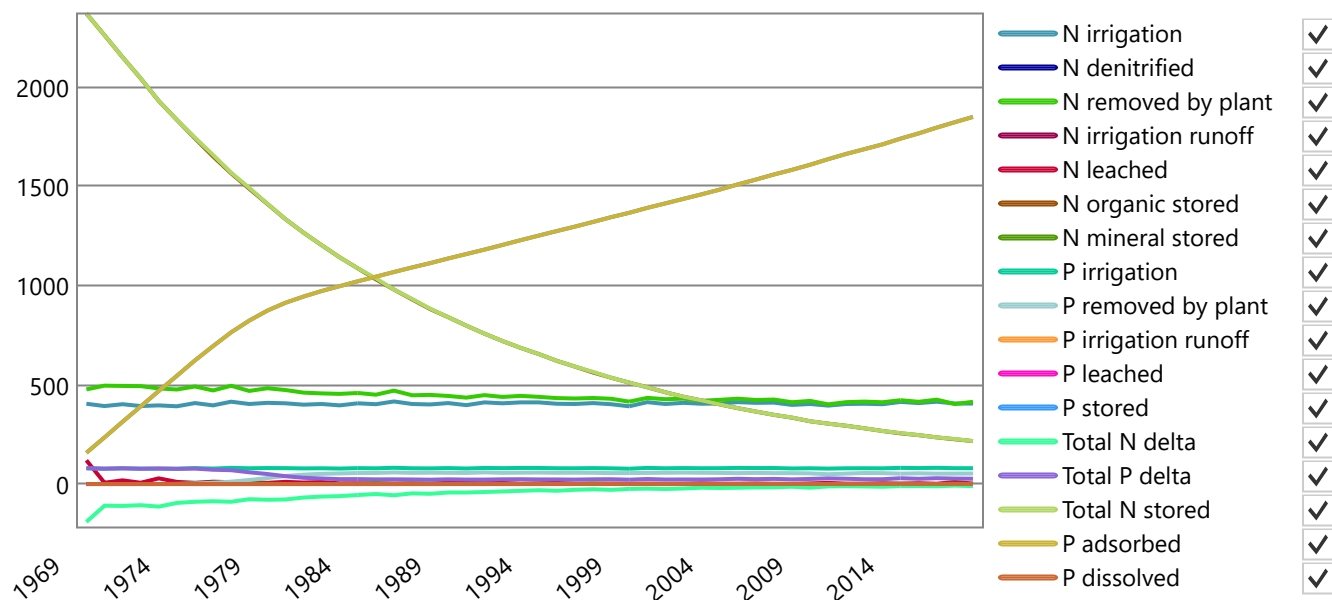


Land Performance - Soil Nutrient

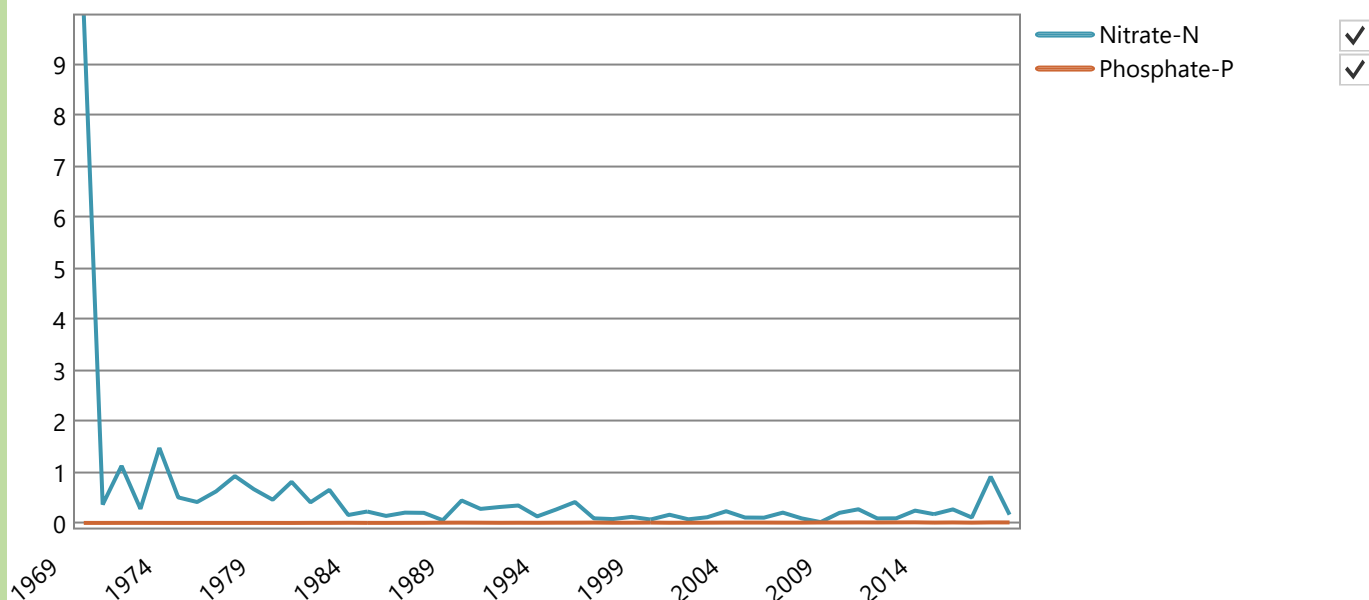
Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park**

Annual Nutrient Totals (kg/ha):



Annual Nutrient Leaching Concentration (mg/L):



PERFORMANCE

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Plant Performance and Nutrients

Paddock: **Default Paddock, 1 ha**

Soil Type: **Greenacres Caravan Park**

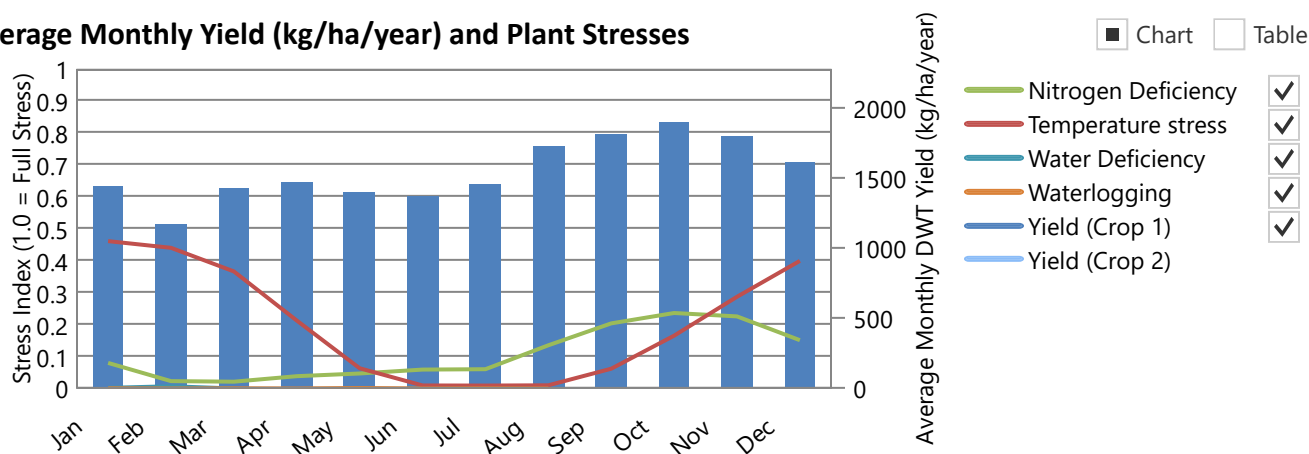
Plant: **Continuous Ryegrass 1 Pasture**

Average annual shoot dry matter yield (kg/ha/year)	18612.84 (16371.91 - 20093.74)
Average monthly plant (green) cover (fraction) (minimum - maximum)	0.64 (0.62 - 0.67)
Average monthly root depth (mm) (minimum - maximum)	598.54 (593.24 - 599.99)

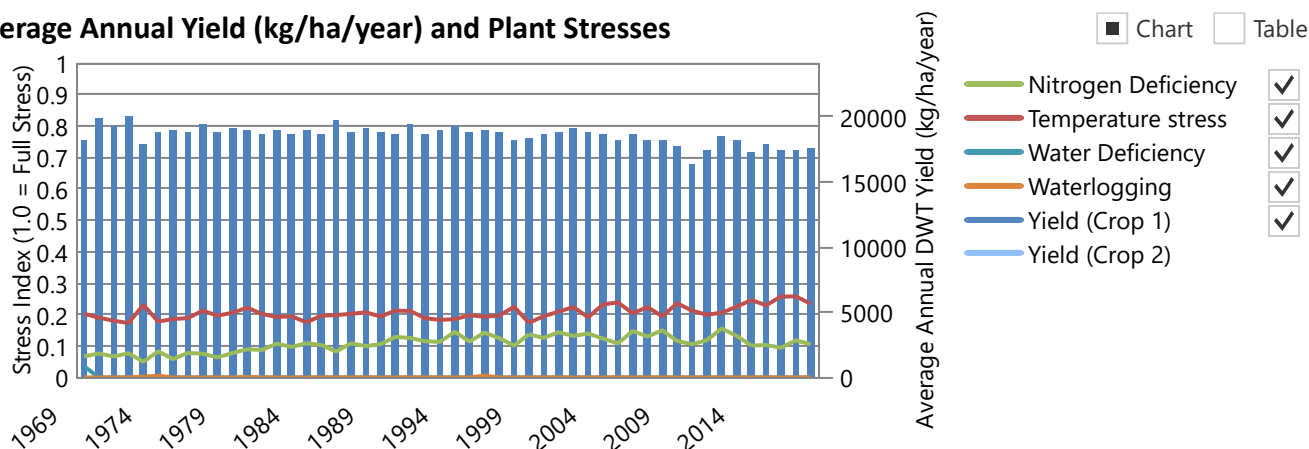
Nutrient Uptake (minimum - maximum):

Average annual net nitrogen removed by plant uptake (kg/ha/year)	443.55 (401.02 - 495.01)
Average annual net phosphorus removed by plant uptake (kg/ha/year)	43.94 (0.00 - 58.50)
Average annual shoot nitrogen concentration (fraction dwt)	0.03 (0.02 - 0.03)
Average annual shoot phosphorus concentration (fraction dwt)	0.002 (0.000 - 0.003)

Average Monthly Yield (kg/ha/year) and Plant Stresses

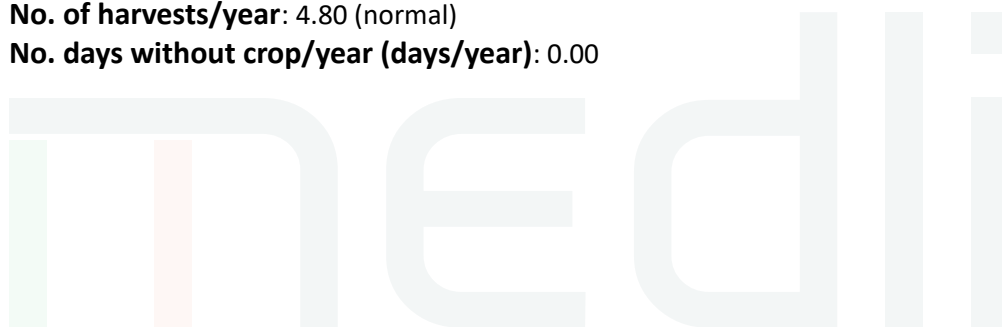


Average Annual Yield (kg/ha/year) and Plant Stresses



No. of harvests/year: 4.80 (normal)

No. days without crop/year (days/year): 0.00



Land Performance

Paddock: Default Paddock, 1 ha

Soil Type: Greenacres Caravan Park

Plant: Continuous Ryegrass 1 Pasture

Salt tolerance	Moderately tolerant
Salinity threshold EC sat. ext. (dS/m)	5.60
Proportion of yield decrease per dS/m increase (fraction/dS/m)	0.08
No. years assumed for leaching to reach steady-state (years)	10.00

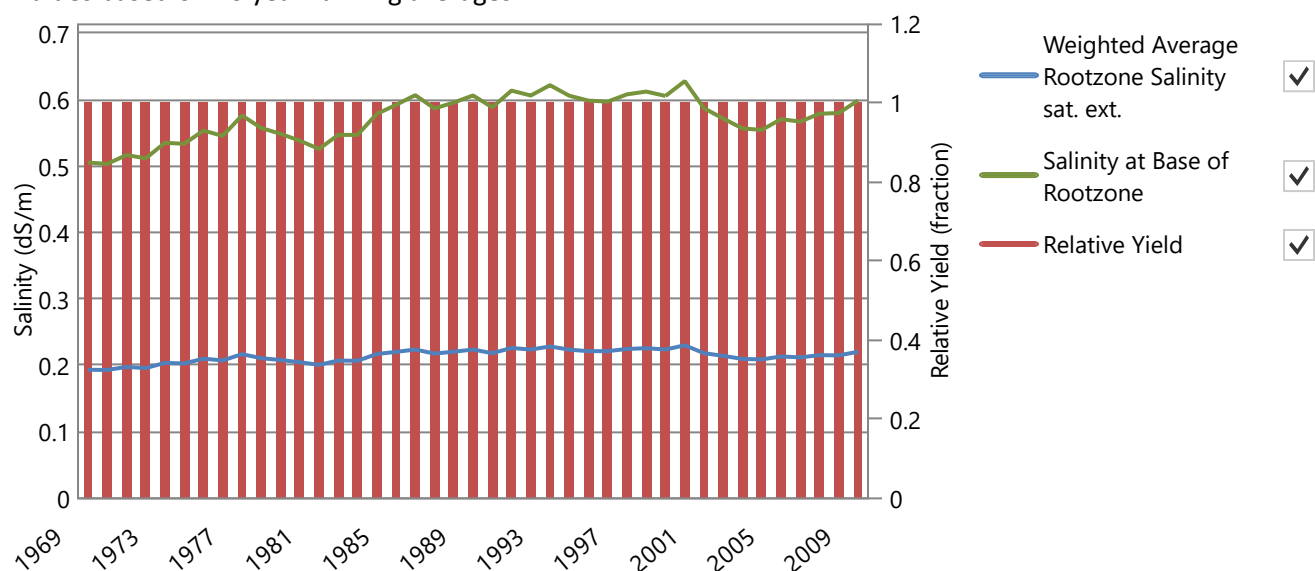
Soil Salinity:

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.36
Salt added by rainfall (kg/ha/year)	222.50
Average annual effluent salt added & leached at steady state (kg/ha/year)	5475.55
Average leaching fraction based on 10 year running averages (fraction)	0.77
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.21
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	0.57
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:

☒ Chart ☐ Table

All values based on 10 year running averages

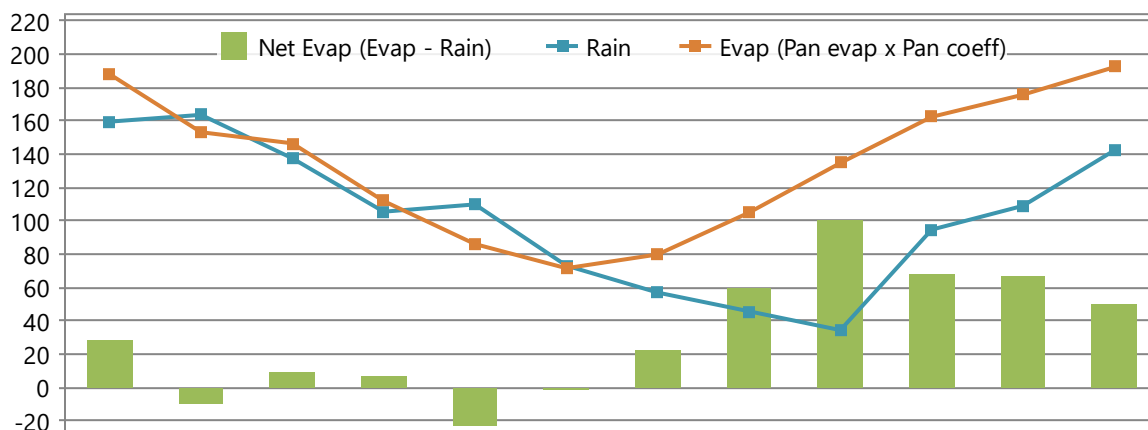


Sustainability Diagnostics: Greenacres Caravan Park

Averaged Historical Climate Data Used in Simulation (mm)

Location: Greenacres -27.55_153.20, -27.55°, 153.2°

Run Period: 01/01/1969 to 31/12/2018 50 years, 0 days



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	159.5	163.6	137.5	105.4	109.8	73.1	56.9	45.6	34.3	94.6	108.9	142.2	1231.4
Evap	188.0	153.1	146.5	111.8	86.0	71.5	79.8	104.9	134.7	162.3	175.6	192.2	1606.3
Net Evap	28.5	-10.4	9.0	6.4	-23.8	-1.6	22.9	59.2	100.3	67.7	66.7	50.0	374.9
Net Evap/day	0.9	-0.4	0.3	0.2	-0.8	-0.1	0.7	1.9	3.3	2.2	2.2	1.6	1.0

DIAGNOSTICS

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Sustainability Diagnostics: Greenacres Caravan Park

Pond System: 1 closed storage tank

New Generic System - 12783.40 kL/year or 35.00 kL/day generated on average

Effluent entering pond system after any pretreatment and recycling

Average (Minimum-Maximum) influent quality calculated for 365.24 non-zero flow days, after any pretreatment and recycling.

Constituent	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	35.00 (35.00 - 35.00)	447.42 (447.13 - 448.35)
Total Phosphorus	6.50 (6.50 - 6.50)	83.09 (83.04 - 83.27)
Total Dissolved Salts	430.00 (430.00 - 430.00)	5496.86 (5493.25 - 5508.30)
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)

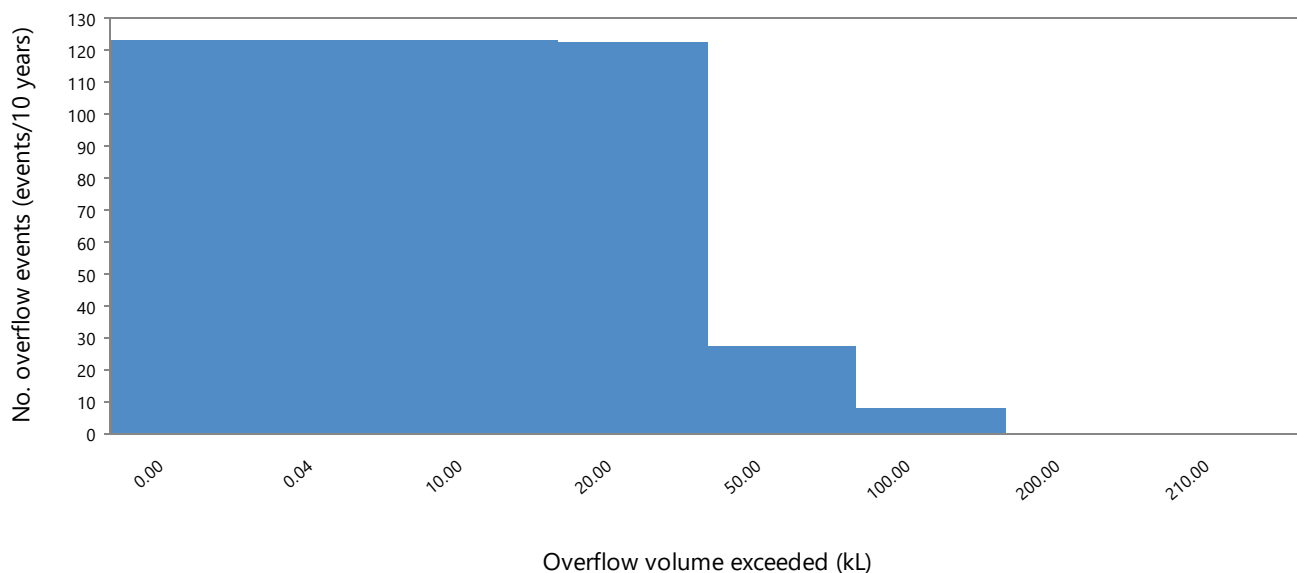
Last pond (Wet weather store): 90.00 kL

Theoretical hydraulic retention time (days)	2.57
Average volume of overflow (kL/year)	565.90
No. overflow events per year exceeding threshold* of 0.04 kL (no./year)	12.32
Average duration of overflow (days)	1.31
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	0.96
Probability of at least 90% effluent reuse (fraction)	1.00
Average salinity of last pond (dS/m)	0.67
Salinity of last pond on final day of simulation (dS/m)	0.67
Ammonia loss from pond system water area (kg/m2/year)	8.63

* The threshold is the volume equivalent to the top 1 mm depth of water of a full pond

Overflow exceedance:

☒ Chart ☐ Table



[Export plot](#)



Sustainability Diagnostics: Greenacres Caravan Park

Irrigation Information

Irrigation: 1 ha total area (assumed 100% irrigation efficiency)

	Quantity/year	Quantity/ha/year
Total irrigation applied (kL)	12216.40	12216.40
Total nitrogen applied (kg)	403.93	403.93
Total phosphorus applied (kg)	79.41	79.41
Total salts applied (kg)	5253.05	5253.05

Shandying

Annual allocation of fresh water for shandying (kL/year)	0.00
Average Shandy water irrigation (kL/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Average exceedance as a proportion of annual shandy water allocation (% of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Minimum shandy water is used	False

Irrigation Issues

Proportion of Days irrigation is prevented when triggered (fraction)	0.04
Proportion of Days irrigation occurs (fraction)	0.96

Sustainability Diagnostics: Greenacres Caravan Park

Paddock Land: Default Paddock: 1 ha

Irrigation: Flood with 0.1% ammonium loss during irrigation

Irrigation triggered when soil water deficit reaches 0.00 mm and rainfall is less than or equal to 20.00 mm
Irrigate a fixed amount of 3.50 mm each day
Irrigation window from 1/1 to 31/12 including the days specified
A minimum of 0 days must be skipped between irrigation events

Soil Water Balance (mm): Greenacres Caravan Park, 76.00 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	159.5	163.6	137.5	105.4	109.8	73.1	56.9	45.6	34.3	94.6	108.9	142.2	1231.4
Irrigation	101.3	90.7	102.4	100.6	104.4	101.4	106.3	106.7	104.0	104.2	99.2	100.5	1221.6
Soil Evap	7.9	5.9	5.2	3.5	2.6	2.1	2.4	3.1	4.0	4.9	5.3	5.8	52.7
Transpn.	96.7	76.1	76.7	57.2	43.5	38.7	40.0	54.8	69.2	84.6	90.6	98.3	826.3
Rain Runoff	18.2	9.5	7.1	8.1	10.9	3.6	3.7	0.8	0.1	3.9	1.7	5.1	72.6
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	132.3	162.3	155.6	137.0	157.7	130.4	120.8	94.3	67.5	101.6	109.5	132.6	1501.6
Delta	5.6	0.5	-4.8	0.2	-0.4	-0.3	-3.7	-0.7	-2.5	3.8	1.1	1.1	-0.1

Soil Nitrogen Balance

Average annual effluent nitrogen added (kg/ha/year)	403.93
Average annual soil nitrogen removed by plant uptake (kg/ha/year)	443.55
Average annual soil nitrogen removed by denitrification (kg/ha/year)	1.71E-03
Average annual soil nitrogen leached (kg/ha/year)	7.26
Average annual nitrate-N loading to groundwater (kg/ha/year)	7.26
Soil organic-N kg/ha (Initial - Final)	2448.00 - 215.94
	110.64 - 0.01
Average nitrate-N concentration of deep drainage (mg/L)	0.48
Max. annual nitrate-N concentration of deep drainage (mg/L)	9.98

Soil Phosphorus Balance

Average annual effluent phosphorus added (kg/ha/year)	79.41
Average annual soil phosphorus removed by plant uptake (kg/ha/year)	43.94
Average annual soil phosphorus leached (kg/ha/year)	0.10
Dissolved phosphorus (kg/ha) (Initial - Final)	0.00 - 0.30
Adsorbed phosphorus (kg/ha) (Initial - Final)	77.71 - 1847.50
Average phosphate-P concentration in rootzone (mg/L)	0.10
Average phosphate-P concentration of deep drainage (mg/L)	0.01
Max. annual phosphate-P concentration of deep drainage (mg/L)	0.01
Design soil profile storage life based on average infiltrated water phosphorus concn. of 3.34 mg/L (years)	66.78

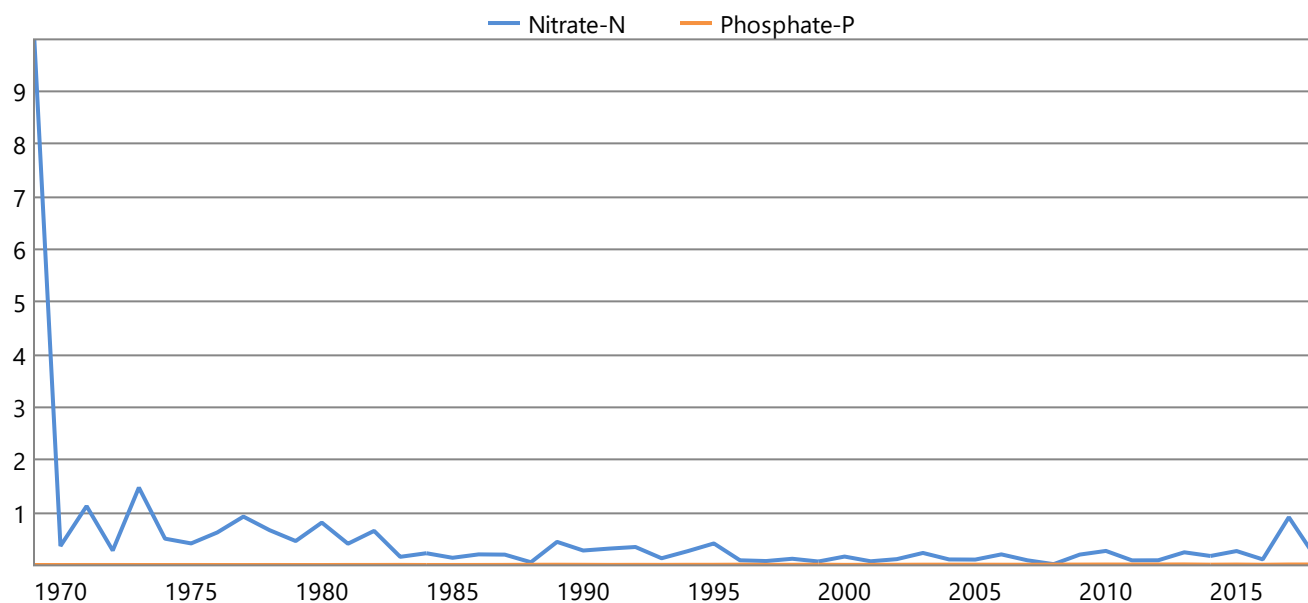


Sustainability Diagnostics: Greenacres Caravan Park

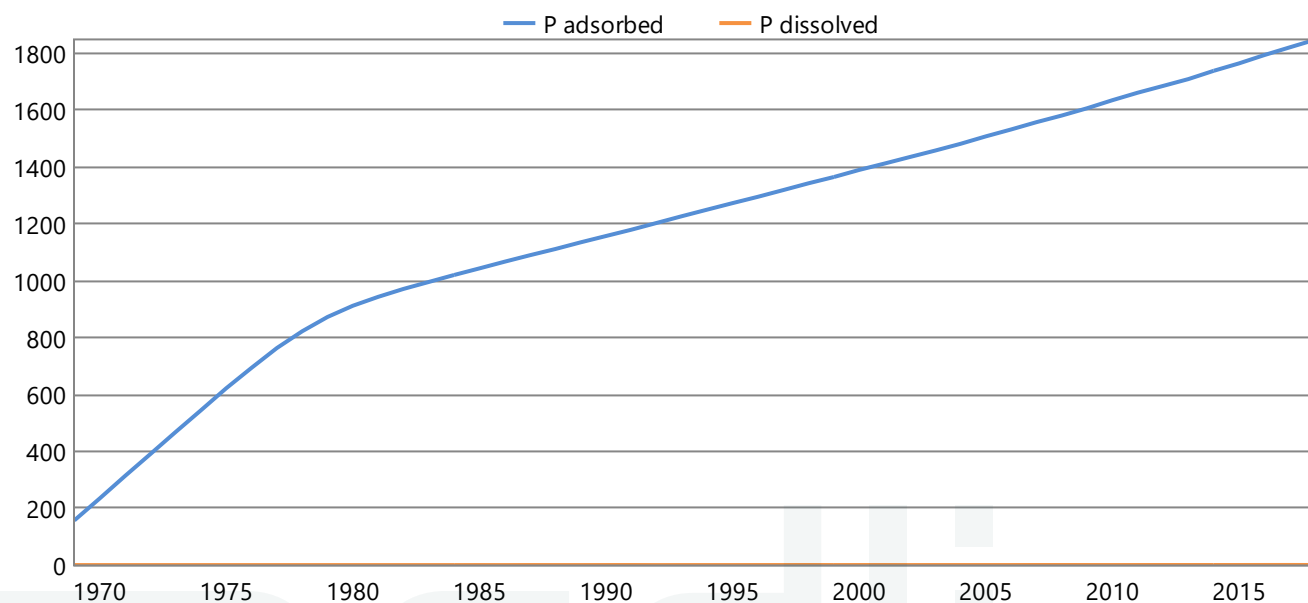
Paddock Land: Default Paddock: 1 ha

Irrigation: Flood with 0.1% ammonium loss during irrigation

Annual nutrient leachate concentration (mg/L)



Annual Phosphate-P in soil (kg/ha)



Sustainability Diagnostics: Greenacres Caravan Park

Paddock Plant Performance: Default Paddock: 1 ha

Average Plant Performance (Minimum - Maximum): Continuous Ryegrass 1 Pasture

Average annual shoot dry matter yield (kg/ha/year)	18612.84 (16371.91 - 20093.74)
Average monthly plant (green) cover (fraction)	0.64 (0.62 - 0.67)
Average monthly crop factor (fraction)	0.51 (0.50 - 0.54)
Total plant cover (both green and dead) left after harvest (fraction)	0.97
Average monthly root depth (mm)	598.54 (593.24 - 599.99)
Average number of normal harvests per year (no./year)	4.80 (4.00 - 6.00)
Average number of normal harvests for last five years only (no./year)	4.60
Average number of crop deaths per year (no./year)	0.00 (0.00 - 0.00)
Average number of crop deaths for last five years only (no./year)	0.00
Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient)	0.11 (0.05 - 0.16)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.46 (0.33 - 0.57)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.01 (0.00 - 0.04)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.01)
Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.00)
No. days without crop/year (days)	0.00

Soil Salinity - Plant salinity tolerance: Moderately tolerant

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

All values based on 10 year running averages

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	0.36
Salt added by rainfall (kg/ha/year)	222.50
Average annual effluent salt added & leached at steady state (kg/ha/year)	5475.55
Average leaching fraction based on 10 year running averages (fraction)	0.77
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	0.21
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	0.57
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

medli

Run Messages

Messages generated when the scenario was run:

Full run chosen

DIAGNOSTICS

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