



MEDLI Assessment Report

**SGP North Temporary Accommodation
Camp 500 EP (Option 2)**

Arrow Energy

12 July 2024

→ **The Power of Commitment**



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Executive Summary

MEDLI (the Model for Effluent Disposal Using Land Irrigation) is a computer-based model for designing and analysing effluent disposal systems for sewage treatment plants using land irrigation as a reuse option. It is the tool recommended by the Department of Environment and Science (DES), the primary environmental regulator in Queensland for assessing the viability of long term treated effluent irrigation.

Arrow Energy engaged GHD Pty Ltd to conduct MEDLI modelling across several mining camp facilities in the Western Downs region (Southwest Queensland) to assess the sites' suitability to receive irrigated treated effluent from onsite package sewage treatment plants. These plants are associated with one or more of the following: mobile drilling camps, accommodation camps, warehouses, and other facilities, being predominately temporary in nature.

This report presents the modelling of the Girrahween Temporary Camp 500 EP Second Option (the site) exclusively.

Girrahween Temporary Camp 500 EP Second Option

GHD sourced and developed MEDLI model inputs from data supplied by Arrow Energy, such as hydraulic loading and locality information, as well as from our desktop environmental review of the general site and probable treated effluent characteristics. Two scenarios were subsequently modelled (irrigation and non-irrigation case) at 500 equivalent persons (EP).

The following MEDLI model outputs were reviewed to assess the sustainability of the Girrahween Temporary Camp 500 EP Second Option irrigation scheme:

- The saturation point of the nominated land application area and potential for recycled water runoff
- The uptake of nutrients by selected site vegetation, and movement of nutrients to groundwater
- The incidence of overtopping.

Thereafter, the following irrigation scheme aspects were determined:

- Sustainable **application rates (mm/d)** of recycled water over the selected vegetation type
- Minimum required **land application area (ha)**
- **Storage volumes (kL)** required to mitigate incidents of overtopping / over-irrigation.

The irrigation rate, application areas, and storage volume outcomes for both modelled scenarios are compiled in the Guidance Tables of section 5.3 of this report and have been reproduced in Table A.

Table A Summary of Girrahween Temporary Camp 500 EP Second Option MEDLI outputs for modelled irrigation scenario

EP	Load scenario	
	250 EP	500 EP
Hydraulic loading (kL/day)	50	100
Maximum Irrigation Rate (mm/day) ~	3.7	3.7
Wet Weather Storage (kL) ^	150	300
Irrigation Area (m ²) – Minimum required ^*	16,100	39,350
Notes:		
^ To achieve zero incidents of storage overflow and acceptable soil performance outcomes (refer section 4.2), OR alternatively, at least 3 days minimum storage capacity, whichever is greater.		
* Rounded up to the nearest 50 m ²		
~ Based on Net Evaporation. Actual irrigation rate averaged over the year may differ from this value (lower)		

The key results from the modelling are:

For the maximum 500 EP loading scenario:

- A maximum effluent irrigation rate of **3.7 mm/d** via fixed sprinklers could be applied to the modelled soil profile (Sodosols), assuming Kikuyu crop cover (salt tolerant grass) is laid within the land application area (LAA).
- A minimum irrigation area of **3.935 ha**.
- The annual average irrigation depth over the 3.935 ha LAA is 3.0 mm/d noting:
 - Often the full irrigation depth was not applied on a given day during the model run period due to insufficient wastewater volumes being available. This would typically present operational alternatives regarding irrigation triggers (e.g., allowance for non-irrigation days and/or only triggering irrigation when full paddock demand is available)
 - For simplicity and in favour of low-maintenance scheme operation, daily application of “*up to 3.0 mm/d*” within the sized LAA has been modelled herein.
- A wet weather storage volume of **300 kL** is required (for the 500 EP scenario) to mitigate incidents of overtopping, which is compliant with the minimum three days’ storage volume as per the Queensland Technical Guideline for Disposal of Effluent using Irrigation (Tennakoon and Ramsay, 2020).
- The assumed effluent quality limits (averages) for nutrients and electrical conductivity for Class B effluent (with total nitrogen = 30 mg/L, total phosphorus = 20 mg/L, electrical conductivity = 1,600 µS/cm) are suitable to achieve longevity in the soil lifespan of up to 38 years. This soil lifespan extends beyond the anticipated lifespan of the facility (i.e., 3 to 10 years).
- The minimum irrigation area is 3.935 ha for the 500 EP scenario.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1 and the assumptions and qualifications contained throughout the report.

Abbreviations and acronyms

Abbreviation/acronym	Definition
Arrow Energy	Arrow Energy Pty Ltd
DRDMW	Department of Regional Development, Manufacturing and Water
GHD	GHD Pty Ltd
EP	Equivalent persons
EV	Environmental value
HWMP	Healthy Waters Management Plan
LAA	Land application area
mbgl	metres below ground level
MEDLI	Model for Effluent Disposal Using Land Irrigation
MSES	Matter of state environmental significance
SILO	Scientific Information for Land Owners
Sewage treatment plant	STP
WQO	Water quality objectives

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1. Introduction

1.1 Background

Arrow Energy Pty Ltd (Arrow Energy) engaged GHD Pty Ltd (GHD) to assist with the determination of the adequacy of the onsite treated wastewater storage and disposal infrastructure at their Girrahween Temporary Camp 500 EP Second Option, located on property defined as Lot 16 on AU38. This site has been assessed as an alternative to a location at the north of Lot 16 AU38 for which GHD have also provided MEDLI modelling assessment (GHD 9th October).

GHD understand that Arrow Energy require MEDLI modelling to identify how the proposed wastewater generated at the temporary camp may be treated at the facility and irrigated sustainably. Model results may be compared with the first site Girrahween Temporary Camp option (reported separately) (GHD October 2023).

MEDLI modelling will also be used to size the onsite wastewater treatment, storage, and disposal infrastructure, which is predominantly determined from the irrigation rate to dispose of the treated effluent. The land application area (LAA) and the wet weather storage required for the project's climate, paddock and irrigation regime conditions are also evaluated.

1.2 Purpose of this report

The purpose of this report is to outline the outcomes of the MEDLI assessment, which was undertaken using predicted values for onsite wastewater infrastructure and proposed practices for treated effluent management.

The objective of the MEDLI assessment was to establish a sustainable effluent irrigation rate and minimum wet weather storage and LAA to inform the design and construction of the Girrahween Temporary Camp 500 EP Second Option.

1.3 Scope of works

The scope of work addressed in this report is as follows:

- Desktop review of available climate, soil, topography, geology, groundwater, and environmental values for the proposed project areas
- Consolidate project area-specific MEDLI input data (climate, anticipated nutrient loading and daily hydraulic loadings etc.)
- Completion of a MEDLI assessment using the current MEDLI Version 2.1.0.0 for flows associated with 250 EP and 500 EP loadings for each soil type identified for the project area
- Conduct several modelling iterations for the project areas utilising area specific information to gain an appreciation of the minimum wastewater infrastructure required onsite and gain an understanding of adverse long-term impacts of treated effluent irrigation (if any)
- Preparation of a report (this document) outlining the scope of work, model inputs, model outcomes and general conclusions in accordance with the current Department of Environment and Science (DES) recommendations and guidelines for land based treated effluent irrigation schemes in Queensland (DES, 2019).

1.4 Document review

GHD was not provided with any site-specific reports to source data and develop inputs to the MEDLI modelling.

1.5 Limitations

This report has been prepared by GHD for Arrow Energy and may only be used and relied on by Arrow Energy for the purpose agreed between GHD and Arrow Energy as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Arrow Energy arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 1.6 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Arrow Energy and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has prepared the Girrahween Temporary Camp 500 EP Second Option model (“Model”) for, and for the benefit and sole use of, Arrow Energy to support design of the effluent irrigation scheme and must not be used for any other purpose or by any other person.

The Model is a representation only and does not reflect reality in every aspect. The Model contains simplified assumptions to derive a modelled outcome. The actual variables will inevitably be different to those used to prepare the Model. Accordingly, the outputs of the Model cannot be relied upon to represent actual conditions without due consideration of the inherent and expected inaccuracies. Such considerations are beyond GHD’s scope.

The information, data and assumptions (“Inputs”) used as inputs into the Model are from publicly available sources or provided by or on behalf of the Arrow Energy, (including possibly through stakeholder engagements). GHD has not independently verified or checked Inputs beyond its agreed scope of work. GHD’s scope of work does not include review or update of the Model as further Inputs becomes available.

The Model is limited by the mathematical rules and assumptions that are set out in the Report or included in the Model and by the software environment in which the Model is developed.

The Model is a customised model and not intended to be amended in any form or extracted to other software for amending. Any change made to the Model, other than by GHD, is undertaken on the express understanding that GHD is not responsible, and has no liability, for the changed Model including any outputs.

The modelling was completed using MEDLI V2.1.0.0. A more recent version of the software (Version 2.5) was released on 27 July 2023. However, the assessment for this commission had already commenced by this date. DES advice on the transition between versions indicates that the former V2.1.0.0 model and outputs will be supported for 12 months from the release date of V2.5

1.6 Assumptions

This report is based on the following assumptions:

- Environmental values as established through readily available desktop information are correct and reflect current site conditions. Note: MEDLI’s default soil profile library is normally only used for scoping or preliminary work before better estimates or site-specific soil data becomes available
- Final model input parameters described in Section 3.3 are representative of site conditions as advised by Arrow Energy
- Future treated effluent management onsite reflect the MEDLI assessment as presented in this report
- Arrow Energy provided GHD with JPEG images of land application area (LAA) footprints for the well pad site, however, no KMZ/KML files of the extents were provided. The footprint of associated facilities (e.g., greywater discharge points) is also assumed to be accommodated within the indicated extent.

2. Site characteristics

In planning for the disposal of treated effluent by land irrigation, the environmental regulator in Queensland (DES) recommends MEDLI modelling to make decisions and assess proposed/current practices on how to dispose of treated effluent by land irrigation. As part of MEDLI modelling, site specific information should be used to inform the model relevant to geoclimatic conditions specific to the project areas. The following section describes the relevant characteristics in the project area.

2.1 Locality

The Girrahween Temporary Camp 500 EP Second Option is proposed for construction ~17 km north of Miles (Figure 2), Western Downs Region, QLD. Key information pertaining to the camp's siting is given in Table 1

The camp is situated within Lot 16 Plan AU38. Figure 1 conveys the footprint of the Girrahween Temporary Camp 500 EP Second Option provided by Arrow Energy. GHD understands that the effluent irrigation area is to be accommodated within this footprint, consuming only a small fraction of the area. The total footprint shown in Figure 1 is at least 12.0 ha.

Table 1 Summary of Girrahween Temporary Camp 500 EP Second Option siting details

Site Name	Petroleum Lease	Lot Plan	Total irrigation area
Girrahween Temporary Camp 500 EP Second Option	PL305	Lot 16 AU38	Not specified.

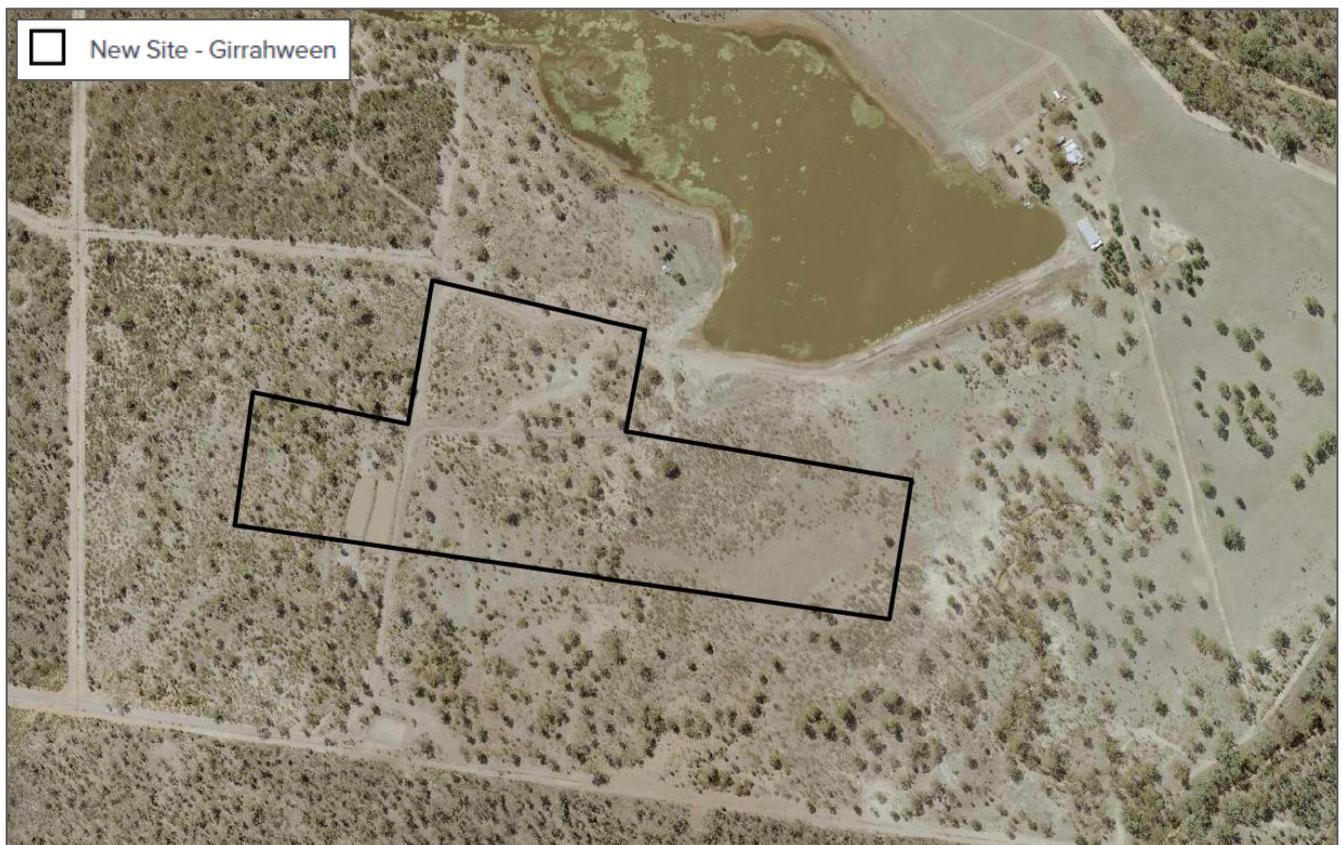
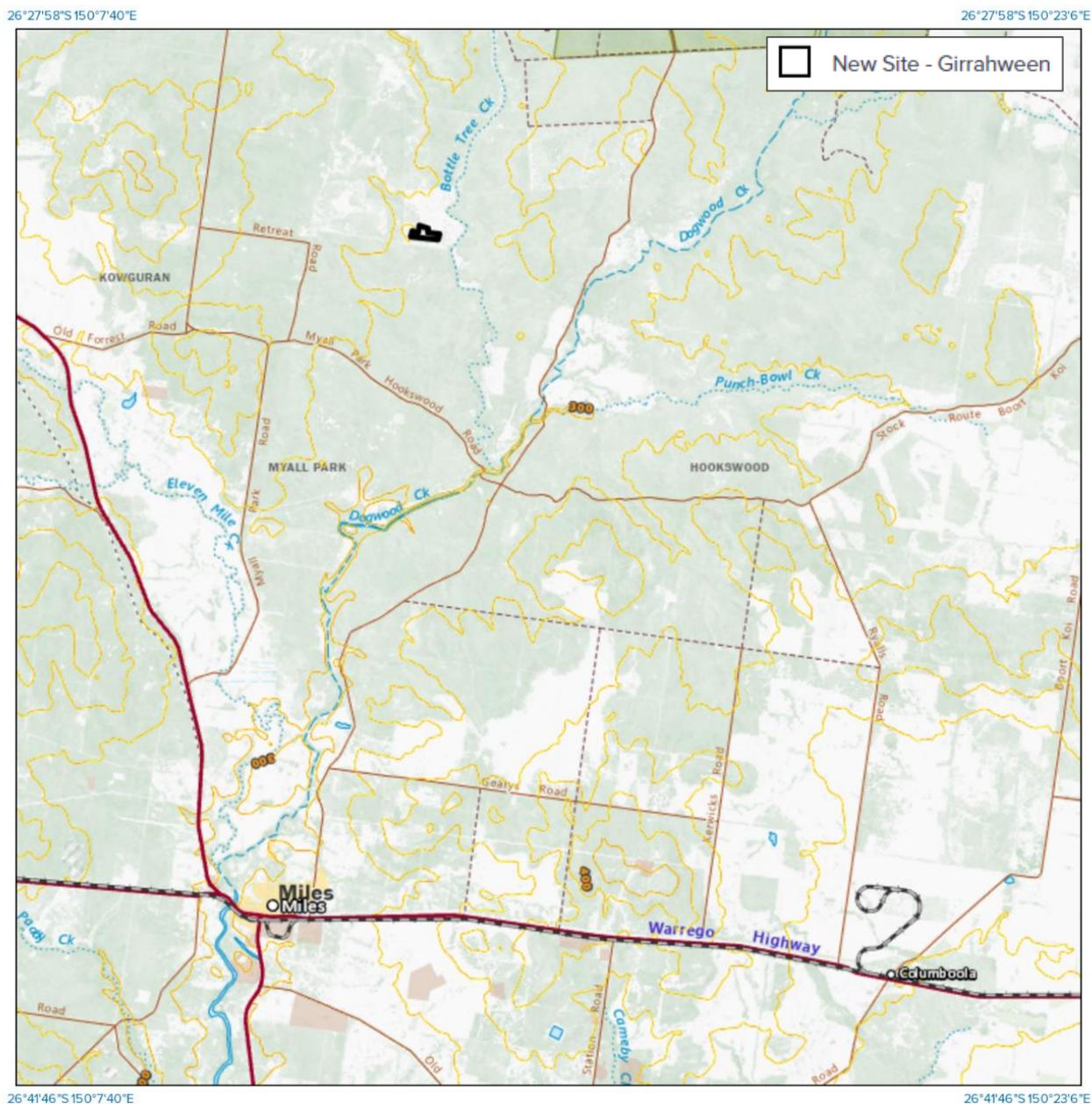


Figure 1 Nominated area for the Girrahween Temporary Camp 500 EP Second Option (enclosed in black) (GPS coordinates of footprint provided by Arrow Energy, 14 November 2023)

The Girrahween Temporary Camp 500 EP Second Option is situated approximately 16 km north of Miles and 21 km northwest of Columboola, as shown in Figure 2



26°41'46\"/>

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 Department of Resources

Figure 2 Locality, contour, and topographic plot of Girrahween Temporary Camp 500 EP Second Option (Source: Queensland Globe).

2.2 Facility longevity and hydraulic loading

GHD understands that the Girrahween Temporary Camp 500 EP Second Option is planned to be semi-permanent, with a lifespan of no more than 10 years. Hydraulic loading for domestic sewage comprising of greywater generation forecast by Arrow Energy is provided below in Table 2.

Table 2 Hydraulic loading and camp permanence

Site Name	Operational period	V=Volume/day [^] Maximum	Equivalent Persons (EP) EP=V/200
New Site – Girrahween Camp 2	Semi-Permanent (3-10 years)	100,000 L/day	500
Notes: [^] Volume in litres of the average dry weather flow of sewage that can be treated at the works in a day			

2.3 Climate

Climate data for the site was downloaded from the Scientific Information for Land Owners (SILO) LongPaddock database (Link; <https://www.longpaddock.qld.gov.au/silo/point-data/>).

SILO is hosted by the Science Division of the Queensland Government (DES). Using datasets constructed from Australian Bureau of Meteorology (BOM) observational data, SILO interpolates infills for missing data, which allows the user to focus on sites located between discrete weather stations. An example of this “Gridded Data” is given for Girrahween Temporary Camp 500 EP Second Option. Climate data for the Girrahween Temporary Camp 500 EP Second Option, was obtained from this coordinate (Latitude: -26.50, Longitude: 150.25).

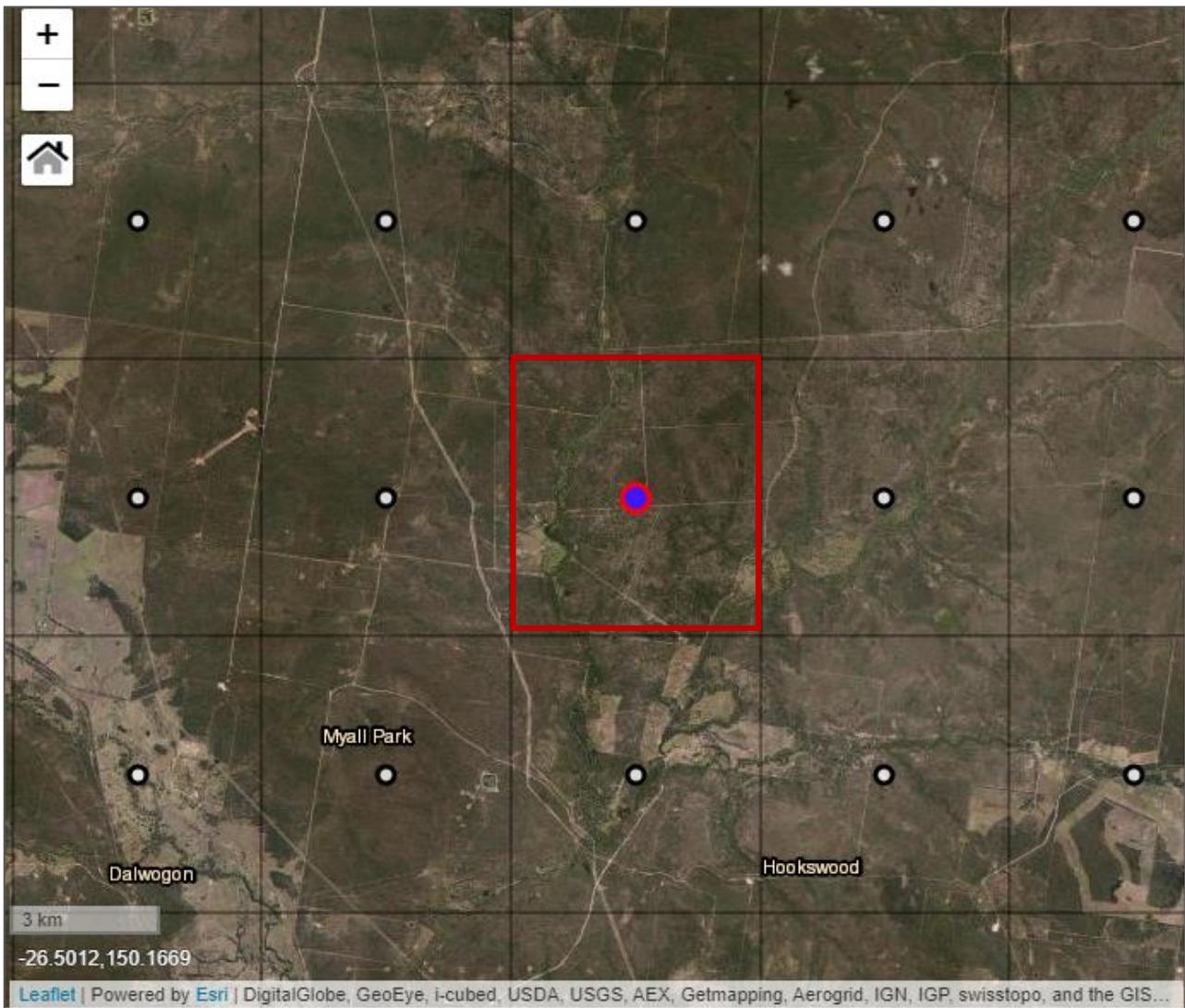


Figure 3 Gridded dataset (circled) specific to Girrahween Temporary Camp 500 EP Second Option, adopted for this MEDLI assessment (Lat: -26.50, Long: 150.25)

Monthly average climate data from the Girrahween Temporary Camp 500 EP Second Option grid point is summarised in Table 3. The annual rainfall in the area is relatively low (572 mm/year). Factoring the large pan evaporation (1973 mm/year), the site exhibits a net evaporation of 1391 mm/year (i.e., 3.8 mm per day).

Table 3 Climate data for Girrahween Temporary Camp 500 EP Second Option, for a 10-year period (January 2013 – December 2022)

Month	Average Rainfall (mm)	Average Pan Evaporation (mm)	Average Maximum Temperature (°C)	Average Minimum Temperature (°C)	Average Radiation (MJ/m ² /year)	Net Evaporation (mm) [^]
January	81.0	243.4	34.3	20.7	25.1	162.3
February	79.4	200.4	33.1	19.6	22.9	121.0
March	78.6	178.3	31.5	18.4	19.9	99.7
April	11.7	135.2	28.0	13.1	17.5	123.5
May	27.3	96.7	23.9	8.9	13.9	69.4
June	22.7	71.8	20.8	5.8	12.6	49.1
July	30.4	81.1	20.8	4.8	13.7	50.6
August	18.7	117.5	23.0	5.2	16.9	98.8

Month	Average Rainfall (mm)	Average Pan Evaporation (mm)	Average Maximum Temperature (°C)	Average Minimum Temperature (°C)	Average Radiation (MJ/m ² /year)	Net Evaporation (mm) [^]
September	37.3	160.7	26.8	9.6	19.9	123.4
October	55.3	202.8	29.8	14.1	22.8	147.5
November	65.0	237.2	32.2	16.5	25.4	172.2
December	64.3	247.9	33.6	18.8	25.9	183.7
Annual	571.7	1972.9	28.1	12.9	19.7	1401.2

Notes:

Data exported from MEDLI for the 10-year run period

Net evaporation equates to the difference between average rainfall and average pan evaporation on a monthly basis.

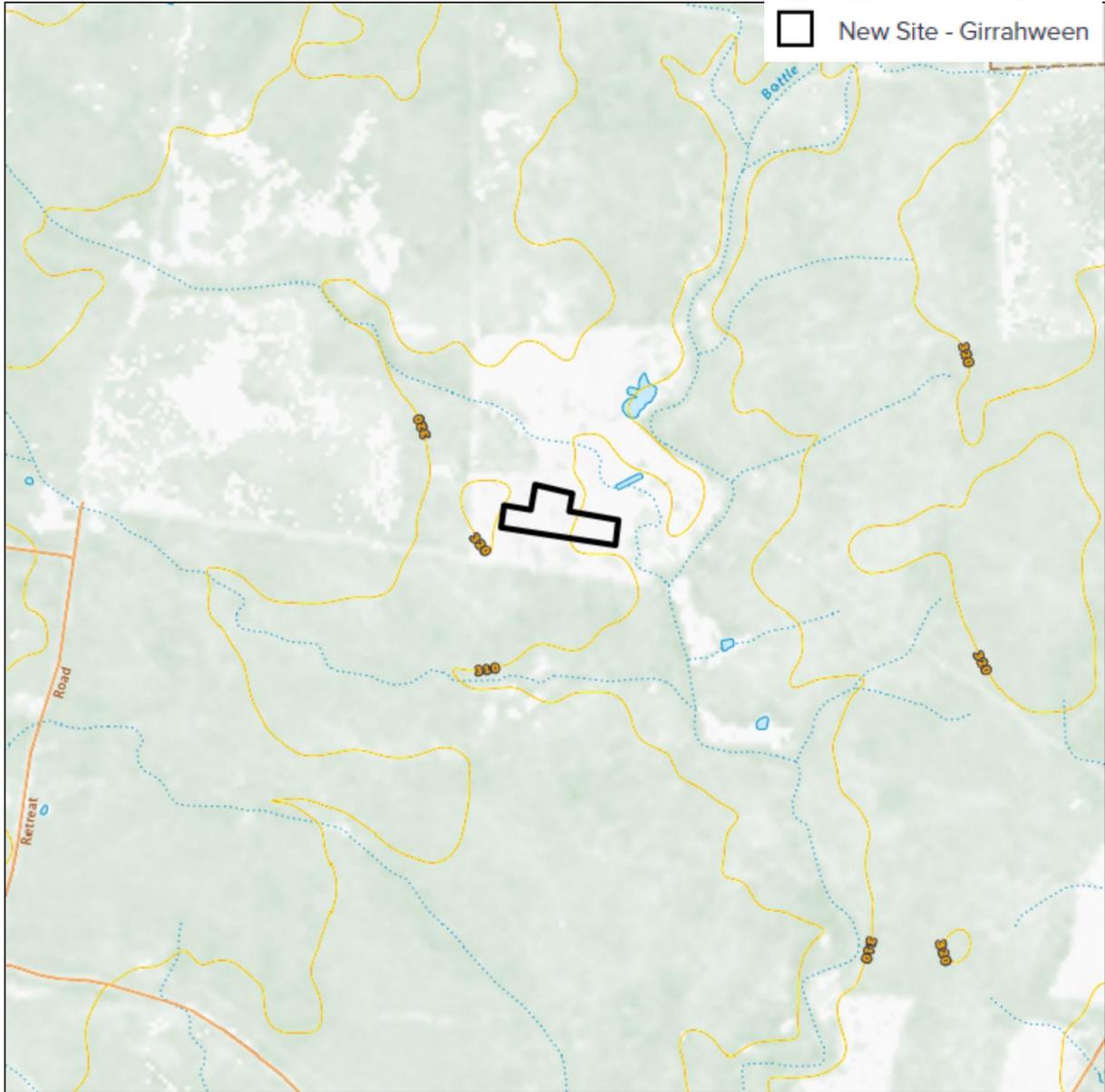
2.4 Topography

The topography and contour surrounding the Girrahween Temporary Camp 500 EP Second Option is seen in Figure 4 The selected site location is sat between 310 – 320 mAHD.

Survey data specific to the site has not been provided. It is assumed from Figure 4 that the site broadly presents a slight downward gradient to the east northeast (1 m fall over ~40 m).

26°29'2"S 150°11'41"E

26°29'2"S 150°15'29"E



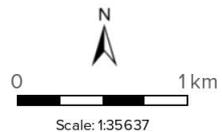
26°32'27"S 150°11'41"E

26°32'27"S 150°15'29"E



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Figure 4

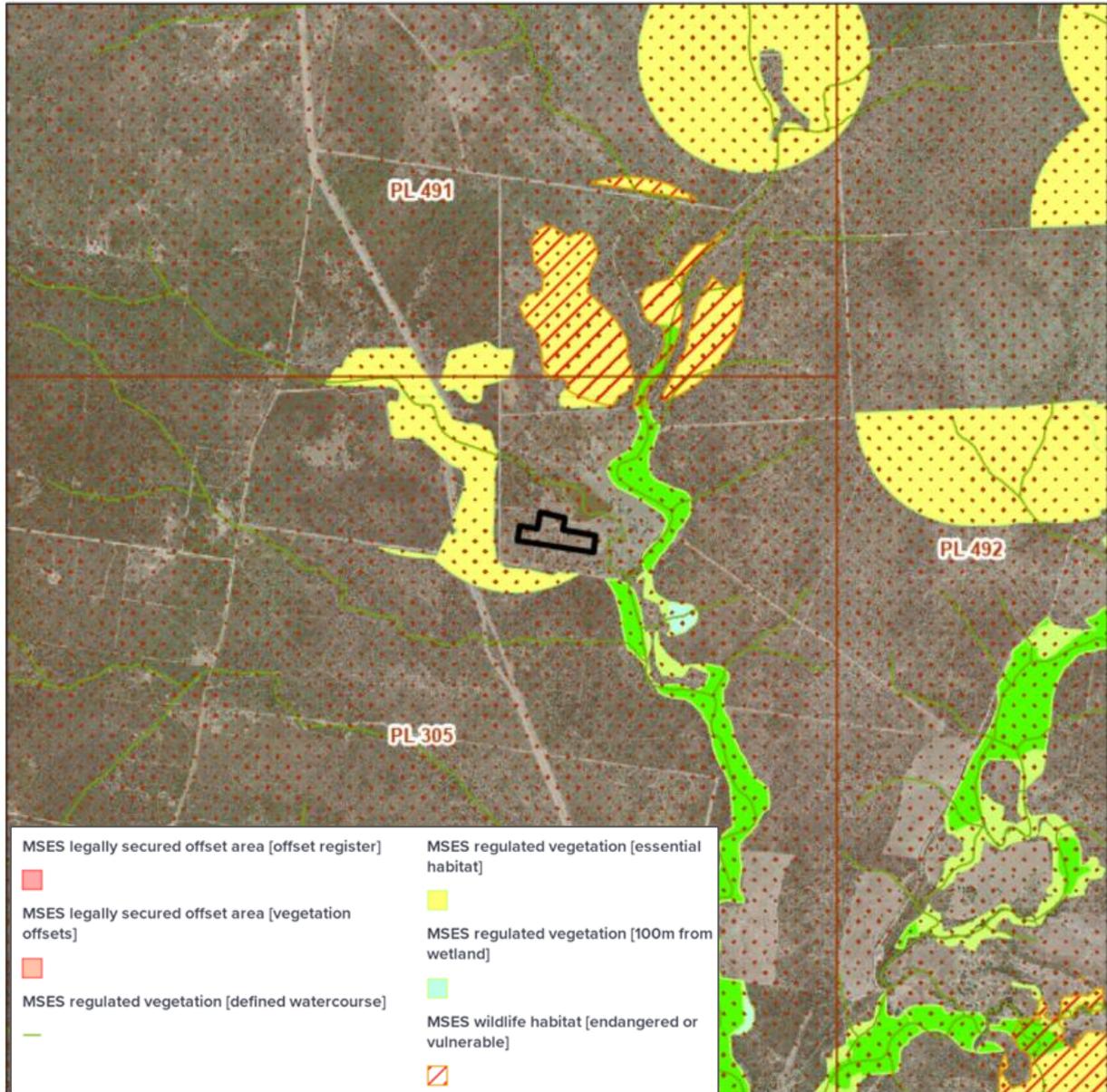
Contour and topography plot of Girrahween Temporary Camp 500 EP Second Option (markers as per Figure 1 coordinates) (Source: Queensland Globe)

2.5 Vegetation

Arrow Energy's 'Treated Sewage Effluent and Greywater Management Guide' specifies that vegetative cover must be present across a site where irrigation is proposed to occur. The presence of established vegetative groundcover across the site has not been confirmed by Arrow.

Desktop searches of the site and immediate vicinity reveal non-remnant vegetation occurring across the lot and plan identified for the Girrahween Temporary Camp 500 EP Second Option. MSES regulated vegetation [essential habitat, category A or B] does occur immediately south and west of the proposed site (at a similar topography), as shown below (Figure 5).

Within the proposed camp site, Queensland Globe's Regulated vegetation management mapping (RVM) indicates the vegetation as being Category X - areas not generally regulated by the vegetation management laws, whilst vegetation to the west, south and east of the site is Category B. Broad vegetation groups 12a/16c (Dry woodlands to open woodlands dominated by ironbarks such as *Eucalyptus decorticans* (gum-topped ironbark) and/or bloodwoods such as *Corymbia trachyphloia* (yellow bloodwood) / mostly on sub-coastal/inland hills with shallow soils / woodlands and open woodlands dominated by *Eucalyptus coolabah* (coolabah) on floodplains. Does not include alluvial areas dominated by herb and grasslands or alluvial plains that are not flooded.



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Figure 5 Proximal MSES vegetation to the site (Source: Queensland Globe)

2.6 Geology

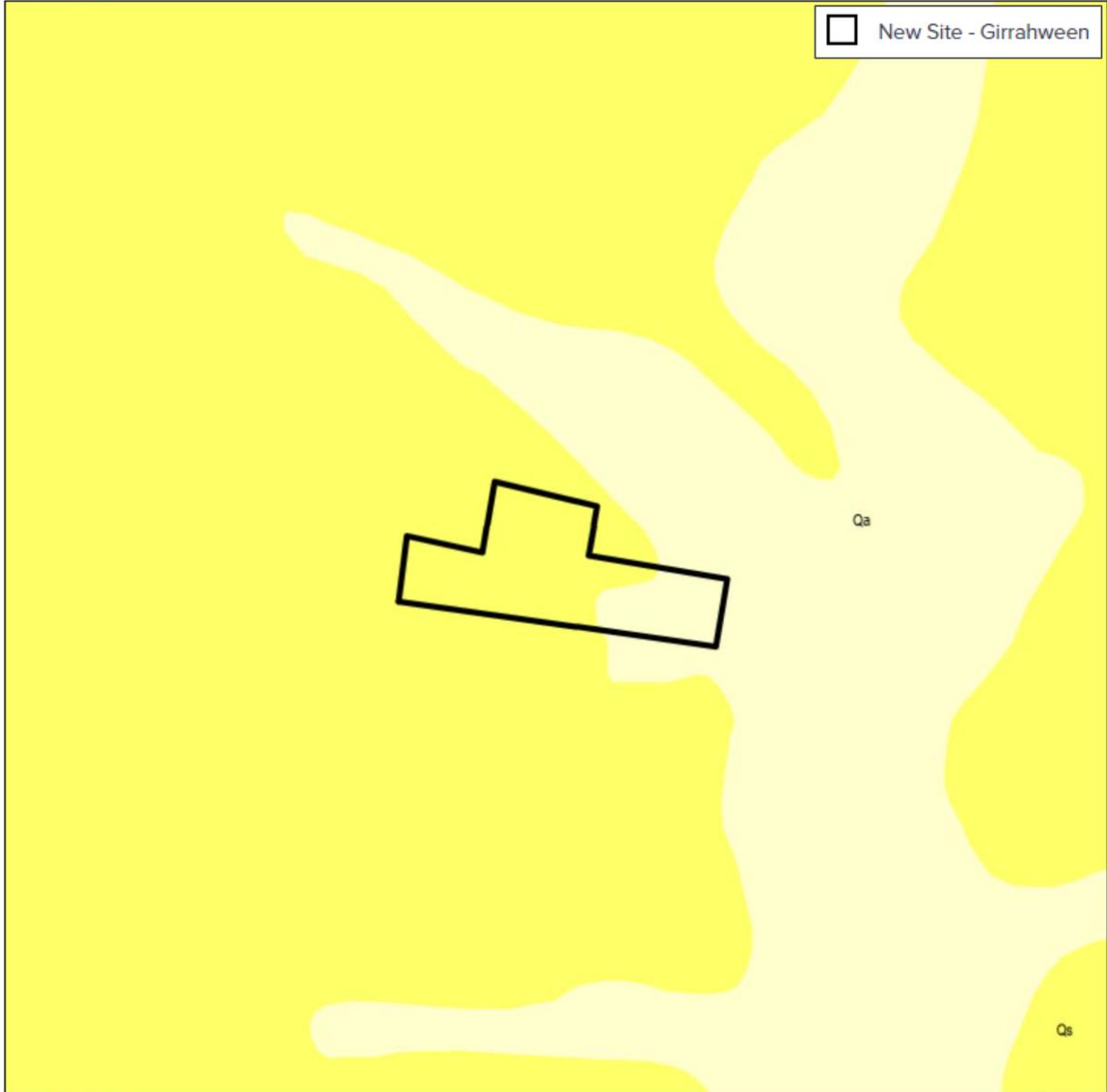
Figure 6 identifies the dominant lithology of the proposed Girrahween Temporary Camp 500 EP Second Option as mapped by the Department of Natural Resources and Mines digital geological mapping (DNRM, 2018) accessed via Queensland Globe. This lithology is summarised in Table 4.

Table 4 Dominant lithology

Aspect	Description	
	Dominant Lithology 1 (~80% of site footprint)	Dominant Lithology 2 (~20% of site footprint)
Rock unit name (symbol)	Qs-SQ	Qa-QLD
Lithological Summary	Sand, red sandy soil, silt and some gravel; floodout and sheet sand with some alluvium	Clay, silt, sand and gravel; flood-plain alluvium
Dominant Rock / Age	Miscellaneous unconsolidated sediments / Quaternary	Alluvium / Quaternary

26°30'0"S 150°12'55"E

26°30'0"S 150°14'17"E



New Site - Girrahween

Qa

Qs

26°31'14"S 150°12'55"E

26°31'14"S 150°14'17"E

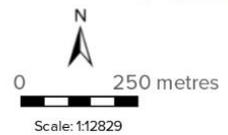
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Figure 6 Detailed surface geology 1:100k intersecting the proposed Girrahween Temporary Camp 500 EP Second Option site (Source: Queensland Globe)

2.7 Soil

To determine typical soil profiles to apply in the model, a desktop review was completed. Queensland Globe mapping produced by the Department of Environmental Science (DES) was used to identify the soil. Mapped as Sodosols, (map unit Va24) by Soil Atlas QLD.

Table 5 Description of soil type present within the project area

Aspect	Description
Soil types	Sodosols (map code Va24)
General description	Sodosols are texture-contrast soils with impermeable subsoils due to the concentration of sodium. These soils occupy a large area of inland Queensland. Generally, Sodosols have a low-nutrient status and are very vulnerable to erosion and dryland salinity when vegetation is removed.
Dominant soil description	Duplex yellow-grey, hard setting A horizon, A2 horizon conspic bleached, alk pedal mottled B horizon
Dominant soil PPF	Dy3.43

As is shown on Figure 7 the nearest soil mapping sites occur as a pair of Queensland Murray Darling Committee (QMDSC) sites, occurring within 8 km southeast of the Girrahween Temporary Camp 500 EP Second Option site. These sites confirm that soils may be considered Brown/Grey/Yellow Sodosols, with typically sandy loam observed to 0.2 mbgl and light to medium clays being observed through to 1.15 mbgl.

2.7.1 Sodosols properties and treated effluent adsorption

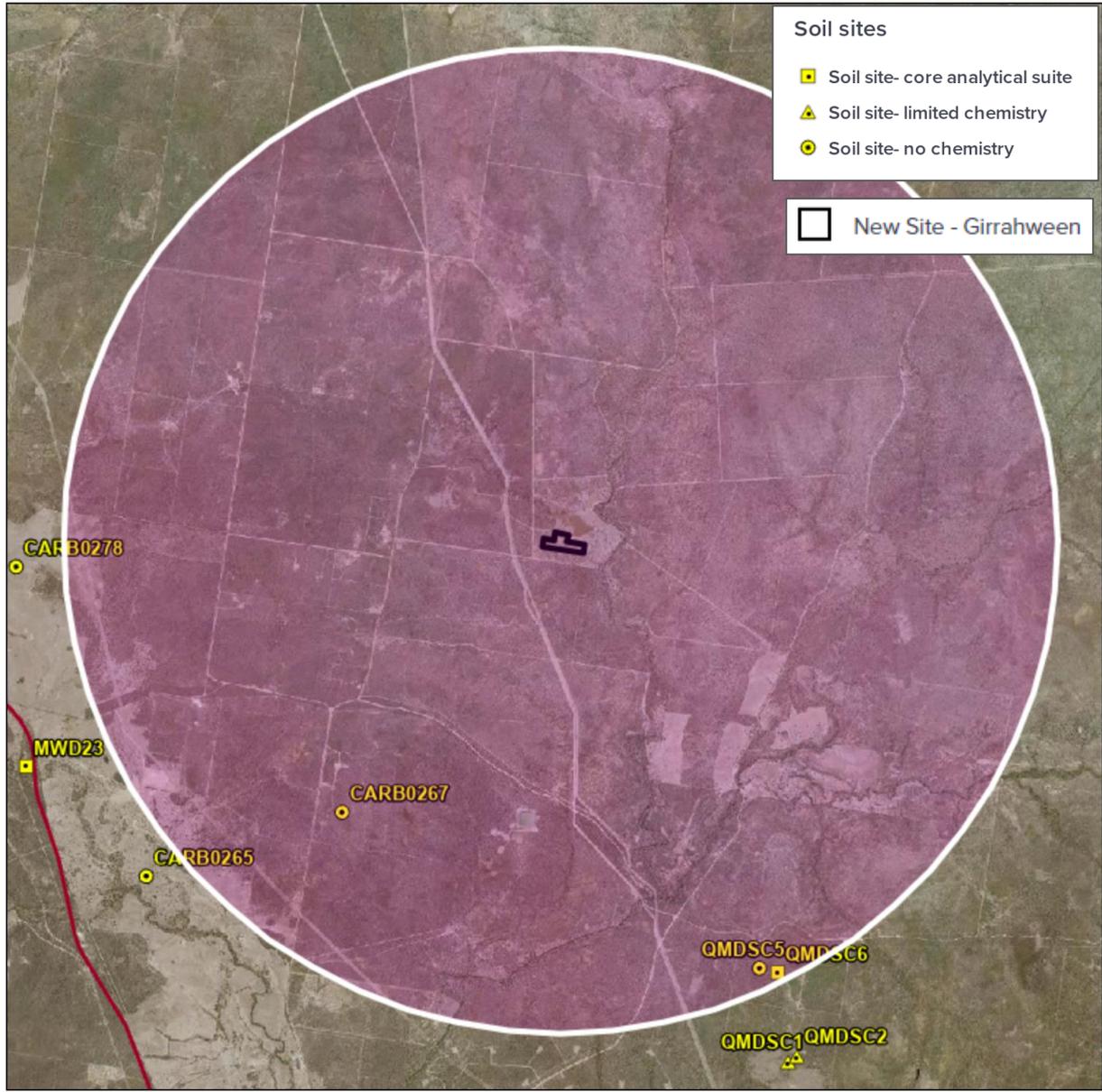
Sodosols show strong texture contrast with highly sodic B horizon but they are not highly acidic (pH > 5.5). Parent materials of Sodosols range from highly siliceous, siliceous to intermediate in composition. Sodosols are only found in poorly drained sites with rainfall between 50 mm and 1,100 mm. Generally, Sodosols have very low agricultural potential with high sodicity leading to high erodibility, poor structure, and low permeability and water infiltration properties. These soils have low to moderate chemical fertility and can be associated with soil salinity. Sodicity is one of the major risks in land disposal schemes and the adverse impact of sodicity on soils structural stability needs to be assessed outside of MEDLI.

Long-term irrigation with treated effluent can exacerbate these effects if the effluent has a relatively high sodium adsorption ratio (SAR), which has the potential to further deteriorating soil structure.

In terms of nutrients absorptivity, Sodosols can absorb and retain nitrogen, but the extent depends on the soil's organic matter content and microbial activity. Over time, the nitrogen in the effluent can contribute to nitrogen leaching, especially if the soil's permeability is compromised. Additionally, Phosphorus mobility in Sodosols is generally low due to strong adsorption to soil particles and fixation by calcium, aluminium, and iron compounds. However, the high pH typical of sodic soils can reduce phosphorus availability to plants.

However, while Sodosols have limited absorptivity properties due to their inherent sodicity, careful management of treated effluent irrigation, including monitoring nutrient levels and employing soil amendments, can help mitigate adverse effects and improve soil structure and nutrient retention over the long term.

No other soil testing reports were provided by Arrow for the desktop assessment.



Soil sites

- Soil site- core analytical suite
- ▲ Soil site- limited chemistry
- Soil site- no chemistry

□ New Site - Girrahween

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Queensland Government
 Department of Resources

Figure 7 Soil mapping sites occurring within 8 km of the Girrahween Temporary Camp 500 EP Second Option (Source: Queensland Globe)

2.8 Environmental values (waters)

The site is situated within the **Maranoa and Balonne Rivers Basin**. Under the *Environmental Protection (Water) Policy 2009* (EPP Water), locally relevant water quality objectives (WQOs) have been established in the region to protect or enhance Environmental Values (EVs) for waters. Both EVs and WQOs are used to help set development conditions, influence local government planning schemes, and underpin report card grades for ecosystem health monitoring programs.

The Basin Plan (WQ4222), indicating the EVs relevant to this region, is included at Appendix A (Environmental Desktop Searches). An extract of this plan is shown in Figure 8. The Girrahween Temporary Camp 500 EP Second Option may be seen to reside within Dogwood Creek waters, being ~17 km north of Dogwood Creek Weir.

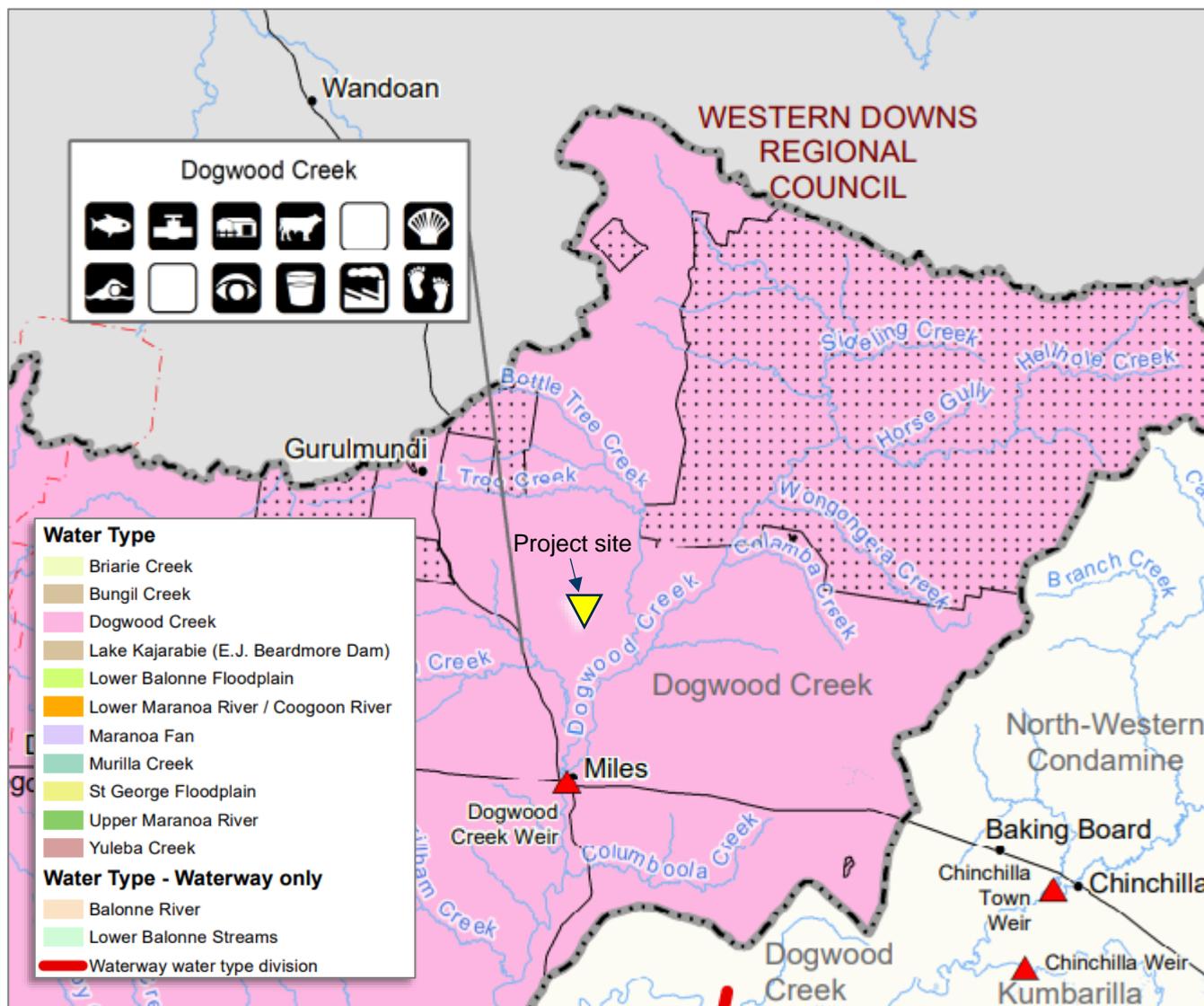


Figure 8 Basin Plan WQ4222 – Maranoa-Balonne Rivers Basin extract, (Source: State of Queensland ©)

Under the Environmental Protection (Water and Wetland Biodiversity) Policy 2019, a Healthy Waters Management Plan (HWMP) for the Maranoa and Balonne River basin was prepared, presenting ways to improve the quality of water for this region. Maps contained within the HWMP that demonstrate the boundaries for both surface water and groundwater zones in the region are included in Appendix A. These maps indicate that Dogwood Creek is the most appropriate zone for applicable surface WQOs, whilst the Lower Condamine sub-catchments/sub-aquifers are most appropriate for finding which groundwater EVs apply to the Girrahween Warehouse/Office Facility site. EVs stipulated in the HWMP for relevant zones across both surface and groundwater are presented in Table 6. Specific WQOs (i.e., threshold limits) for surface and groundwaters are described in more detail in sections 2.9 and 2.10, respectively.

Table 6 EVs for relevant zones and waters of Condamine River Basin

Water type	Surface Water	Groundwater			
	Dogwood Creek	Alluvial zone: Lower Condamine	Mid GAB Aquifer: Eastern Cretaceous Outcrop	Lower GAB Aquifer: Eastern Springbok Outcrop	Basal GAB Zone: Northeastern Evergreen Outcrop
Aquatic ecosystems	✓	✓	✓	✓	✓
Irrigation	✓	✓			✓
Farm supply / use	✓	✓	✓	✓	✓
Stock water	✓	✓	✓	✓	
Aquaculture		✓			
Human consumer	✓				
Primary recreation	✓				
Secondary recreation					
Visual recreation	✓				
Drinking water	✓	✓	✓	✓	✓
Industrial use	✓		✓	✓	
Cultural and spiritual values	✓	✓	✓	✓	✓

2.9 Groundwater

2.9.1 Registered bores

A review of the Department of Regional Development, Manufacturing and Water (DRDMW) bore log database was conducted using Queensland Globe. Two registered bores were identified within 2.5 km of the Girrahween Temporary Camp 500 EP Second Option (Figure 9). Details for these are summarised in Table 1. Available data suggests no bores in proximity are used for drinking water consumption (only mine monitoring), and that the groundwater table resides more than 20.0 m below the ground surface. Of the bores with attributed aquifers listed, all are listed as Condamine River Alluvium.

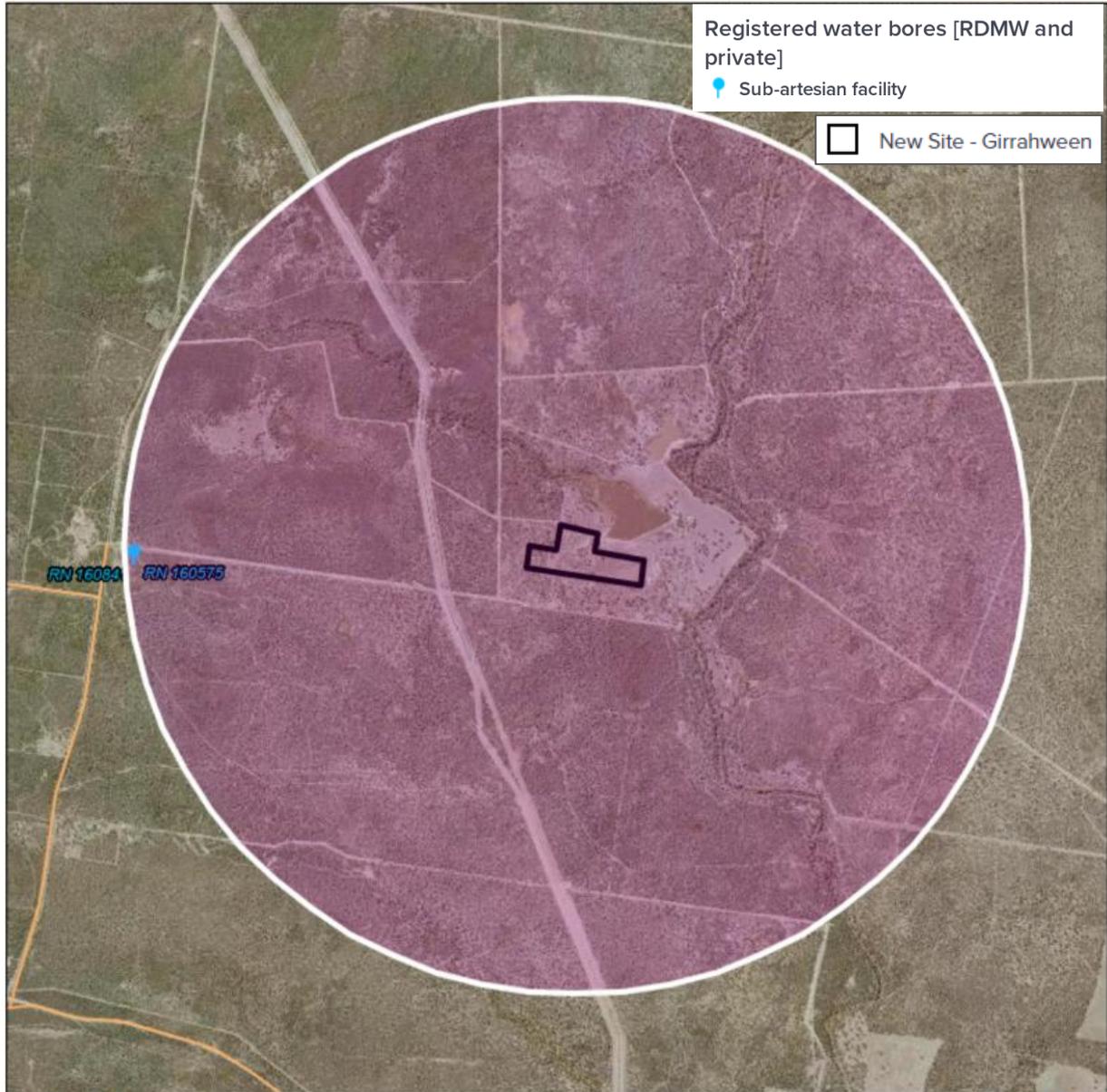
Table 7 Summary of existing registered groundwater bores within 2.5 km of Girrahween Temporary Camp 500 EP Second Option

ID	Proximity to irrigation area	Description	Depth (mbgl)	Screened interval (mbgl)	Relevant water quality or level data (if available)
RN 160575	2.5 km	Sub-Artesian Facility, for mine monitoring	88.0	46.0 – 88.0	NS
RN 16041	2.5 km	Sub-Artesian Facility, for Coal Seam Gas (CSG) Monitoring	42.00	24.0 – 42.0	NS

Notes: NS – indicates not specified

26°28'55"S 150°11'36"E

26°28'55"S 150°15'25"E



26°32'19"S 150°11'36"E

26°32'19"S 150°15'25"E

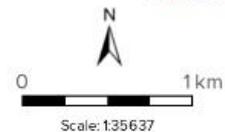
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Figure 9 Registered groundwater bores within 2.5 km of the Girrahween Temporary Camp 500 EP Second Option (Source: Queensland Globe)

2.9.2 Groundwater WQOs

It is important to consider the groundwater chemistry of the region in which the Girrahween Temporary Camp 500 EP Second Option resides to understand the sensitivity of the groundwater, and subsequently ascertain a

suitable irrigation area and flow rate that will not impede groundwater resources. As described in section 2.8, the EVs for aquatic ecosystem, irrigation, farm supply, stock water, aquaculture, drinking water, industrial uses, and cultural and spiritual values may apply to the groundwaters of the Girrahween Temporary Camp 500 EP Second Option.

Groundwater nutrient WQOs for Aquatic Ecosystems are the most conservative assessment criteria for the acceptability of deep drainage nutrient concentrations in the MEDLI assessment. Of the WQOs for aquatic ecosystem protection described in the HWMP, the most conservative total nitrogen (TN) and electrical conductivity (EC) values belonged to the Lower Maranoa Zone. The nutrient WQO objectives for this zone are described in Table 8 below.

Table 8 Nutrient and EC WQOs (aquatic ecosystem) for the Lower Maranoa Alluvial Groundwater Zone (Maranoa and Balonne River Basin)

Waters	Percentile	TN (mg/L)	TP (mg/L)	EC (mg/L)
Alluvial groundwaters	20 th	0.016	ID	528
	50 th	0.054	ID	1528
	80 th *	0.543	ID	4403
Notes: ID = Insufficient Data * Reference value for MEDLI average nitrate concentration of deep drainage				

It is noted that although groundwater WQOs within the project area have been outlined above, for the purposes of this assessment deep drainage nutrient concentrations are not the focus. This assessment is to provide Arrow Energy with a guide for estimating the size of the LAA required for the Girrahween Temporary Camp 500 EP Second Option, depending on the anticipated hydraulic flow, associated sewage treatment plant (STP) capacity, and the soil type present within the disposal area. During detailed design of the Girrahween Temporary Camp 500 EP Second Option, a comparison between the groundwater nutrient concentrations WQOs and proposed STP nutrient outputs will need to be considered in greater detail.

2.10 Surface waters

The Girrahween Temporary Camp 500 EP Second Option is situated within 1 km west of Bottle Tree Creek, which runs 6.5 km south before feeding into Dogwood Creek. Within 50 m of the northernmost boundary of the New Site Option 2 is an unnamed reservoir, situated along a non-perennial watercourse runs southeast into Bottle Tree Creek. Aerial imagery suggests that the reservoir is boarded by limited structures on its eastern edge (sheds, a dwelling) near a pontoon. Algal blooms are a common reservoir feature over the last decade (Google Earth). Supported by the topography of the area (refer to section 2.4), it is considered that site runoff would likely be directed to the east northeast, before following the watercourse lines into Bottle Tree Creek and eventually Dogwood Creek. The reservoir's use is not known.

As described in section 2.8, all EVs except for aquaculture and secondary recreation apply to surface waters at the Girrahween Temporary Camp 500 EP Second Option. Generally, EV WQOs default to targets as per the ANZECC guidelines (ANZECC/ARMCANZ, 2000), or Australia New Zealand Food Standards Code, Food Standards Australia New Zealand (FSANZ, 2007 & updates) for the protection of human use EVs.

As per the MEDLI model Assessment Criteria (section 5), it is considered that no irrigated effluent should translate to runoff. That is, any runoff would comprise solely of rainfall. WQOs were therefore not considered further for this assessment.

MSES defined watercourses occur between 400 m to 500 m north of the site and 800 m to 1,000 m south of the site. It can be assumed from the topography outlined in section 2.4 that both watercourses are draining in an eastern direction.

3. MEDLI Modelling

3.1 General

The assessment was undertaken using the computer-based MEDLI (Version 2.1.0.0) program developed by the former Department of Science Information Technology, Innovation and the Arts (DSITIA) (currently referred to as DES). The MEDLI program is used for designing and analysing effluent disposal systems for intensive and rural industries, agri-industrial processors and STPs via land irrigation. It models the discharge of the effluent stream from the STP as irrigation and predicts changes in the soil water balance and associated nutrients, nitrogen and phosphorus concentrations as well as soluble salts over a daily time step.

3.2 Modelling objectives

The objectives of the modelling were as follows:

- To assist in determining the size of the land application area required to accommodate each of the proposed flows/loads (250 EP and 500 EP) generated over a ten-year period without resulting in adverse environmental impacts.
- To assist in understanding potential impacts of wastewater discharge and associated concentration of total dissolved salts, nitrogen and phosphorus in the final effluent to groundwater, the soil profile and plant yield.
- To assess the minimum size of the wet weather storage facility required for the STPs to minimise environmental risks for each flow scenario.

3.3 Model inputs and assumptions

3.3.1 Climate data

The New Site – Girraheen camp is understood to be utilised for up to 10 years. In this regard, the assessment period incorporates a minimum of 10 years of climate data as a conservative assessment. Ten years of consecutive climate data was considered in the assessment, extending from 1 January 2013 to 31 December 2022.

Ten years is required to mitigate any influence of model stabilisation periods on the model outcomes. This will permit assessment of the short to medium-term sustainability of effluent irrigation schemes proposed. This period was selected for the assessment to include average and also above average rainfall conditions as a means of considering the outputs of the model under periods of higher rainfall.

3.3.2 Soils

The soil type identified as likely to be encountered throughout the project areas are described in Section 2.7.

A soil profile was developed using the outcomes of the desktop review and by adapting default soil categories available within MEDLI. The profiles used in the model are shown in Table 9.

Table 9 Soil profile adopted for MEDLI modelling (Sodosols)

Soil profile – 2 nd Site Option			
Parameter	Horizon 1	Horizon 2	Horizon 3
Soil Layer Thickness (mm)	100	500	1500
Air Dry (% v/v)	2.9		
Lower Storage Limit (%v/v)	7.5	7.5	14.3
Drained Upper Limit (%v/v)	17.0	17.0	32.4

Soil profile – 2 nd Site Option			
Parameter	Horizon 1	Horizon 2	Horizon 3
Plant Available Water Capacity (mm)	9.5	47.5	271.5
Saturated Water Content (%v/v)	43.9	43.9	48.8
Bulk Density (g/cc)	1.48	1.48	1.34
Porosity (% v/v)	44.15	44.15	49.43
Saturated Hydraulic Conductivity (mm/hr)	7.5	7.5	0.5
Initial Soil Phosphorous (mg/kg)	54.6	84.4	191.1
Adsorption Coefficient	114	150	310
Adsorption Exponent	0.32	0.25	0.21
Desorption Exponent	0.13	0.1	0.06
Nitrate Nitrogen (Topsoil Only) (mg/kg) – Initial	2.5		

3.3.3 Volume of effluent

A flow rate basis of 200 L/EP was adopted for this assessment. This assessment considers scenarios of 250 EP and 500 EP with one EP equivalent to 200 L/EP/day for the camp. For the purpose of the assessment, the camp is assumed to be operational for a ten-year period at peak capacity. No seasonality has been adopted, as the facility is anticipated to be occupied at a similar frequency throughout the year. A conservative allowance of *LOW* infiltration in the MEDLI model has been selected, which results in some additional wastewater volume requiring irrigation following wet weather events.

3.3.4 Irrigation regime

The adopted method of irrigation in the model is fixed sprinklers. These are triggered to irrigate daily up to a fixed depth, irrespective of the needs of the plants or the weather condition. This simplistic operational philosophy best reflects the probable irrigation scheme design.

Irrigation of at least the daily effluent volume (i.e., 100,000 L/day for 500 EP) occurs each day, with the addition of low levels of system infiltration on wet weather days.

The maximum allowable irrigation depth was initially fixed to be 3.8 mm/day; refer climate section 2.3. As required, this rate was reduced to achieve the MEDLI assessment criteria listed in section 4.2. The final maximum fixed irrigation amount was 3.0 mm/day.

3.3.5 Effluent quality

Following previous assessments completed by GHD for mobile drilling camps using onsite sewage treatment plants, effluent nutrient concentrations typically vary between 30-50 mg/L for total nitrogen (TN) and 15-20 mg/L for total phosphorus (TP), for average and maximum concentrations respectively. A low-risk conductivity (1,600 µS/cm) as adopted in reflection of the soils probable sodicity described in section 2.7.

Average effluent nutrient concentrations adopted in the modelling are given below (Table 10).

Table 10 Adopted MEDLI average effluent quality conditions for all scenarios.

TN (mg/L)	TP (mg/L)	EC (µS/cm)
30.0	20.0	1,600

3.3.6 Vegetation type

As per comms with Arrow Energy on 19 July 2023, existing native grasses should be able to facilitate nutrient uptake across the site where available. Aerial imagery for the site suggests groundcover is minimal, aligning with the vegetation desktop assessment of open scrubland (section 2.5).

In the absence of site-level species identification survey data and noting that groundcover must be established to facilitate the modelling and appropriate nutrient uptake for effluent disposal, Kikuyu 1 grass (salt tolerant) has been adopted for the purposes of MEDLI modelling. This species has a moderate waterlogging tolerance and high tolerance of acid soils.

3.3.7 Wet weather storage tanks

The minimum possible wet weather storage required for each flow scenario has been adopted for this assessment. This is variable depending on daily flow. For MEDLI assessment, the wet weather storage tank is assumed to be closed and hence the volume of treated effluent inside is immune to rainfall and evaporation.

As per the Queensland technical guideline for disposal of effluent using irrigation (Tennakoon and Ramsay, 2020), the regulatory authority in Queensland prefers to see 100 percent reuse efficiency (i.e., the ratio of inflow to the storage versus the amount used for irrigation), with no overflows from the storage. However, if MEDLI is being used to design the scheme, 95 percent reuse efficiency is normally accepted considering uncertainties in the MEDLI model parameters and practicality of operation.

Schemes using fixed daily irrigation strategies require a minimum storage capacity of three to four days of effluent volume to deal with contingencies.

3.3.8 Summary of input parameters

A summary of the parameters used in the MEDLI assessment is provided in Table 11.

Table 11 Summary of Parameters Used in the MEDLI Assessment

Parameters	Value	Comments
Climate data	The assessment used climate data over a ten-year period from 1 January 2013 to 31 December 2022.	Refer to section 2.3 and 3.3.1.
Soil type	Sodosol	Refer to section 2.7 and 3.3.2.
Effluent volume	Two scenarios: (1) 50 kL/day and (2) 100 kL/day irrigated every day	Refer to section 3.3.3.
Irrigation regime	Daily flow via fixed sprinklers; A fixed maximum 3.8 mm/d irrigation depth initially. Adjusted to 3.0 mm/d to reduce deep drainage rates.	Refer to section 3.3.4 and Section 3.3.3.
System Infiltration	LOW	Refer to section 3.3.3.
Effluent quality	Nutrient concentrations: 30 mg/L TN, 20 mg/L TP Electrical conductivity: 1,600 µS/cm	Refer to section 3.3.5
Plant type	Kikuyu 1 (From MEDLI Crop library)	Refer to section 3.3.6.
Wet weather storage	Minimum volume allowable by MEDLI to achieve assessment criteria, OR 3 times the daily wastewater inflow, whichever is greater.	Refer to section 3.3.7 & section 4.2 for assessment criteria

4. MEDLI Methodology

4.1 Modelled scenarios

The following scenarios were modelled for the well pad camp:

- **Scenario 1 (10-year camps):** Modelling was carried out assuming that effluent produced onsite will occur consistently on a daily basis over 10 years (1 January 2013 to 31 December 2022). This scenario was adopted for camps with proposed loads equivalent to that of 250 EP and 500 EP based on 200 L/EP/day.
- **Scenario 2 (No irrigation scenario):** A no irrigation scenario (i.e., baseline case) was also included to enable comparison of critical factors from Scenario 1.

The two scenarios outlined above were modelled using the MEDLI program to gain an understanding of the environmental impacts associated with irrigating treated effluent from the Tipton Camp. Scenario 2 (no irrigation) was modelled to serve as a control, allowing for an indication of likely drainage, runoff and leaching likely to occur because of natural rainfall where no treated effluent is applied. Table 12 below provides a summary of the modelled scenarios.

Table 12 Summary of modelled scenarios

Model duration (i.e. effluent irrigation period)	Scenario	Daily Peak Design Capacity	
		250 EP	500 EP
Ten years	No irrigation	✓	✓
	Fixed irrigation	✓	✓

4.2 Assessment criteria

Criteria for assessing the outcomes of the MEDLI scenarios were developed to assist in determining the maximum allowable irrigation rate (and thus required irrigation area) and the minimum wet weather storage volume and smallest irrigation area required for anticipated flows. The criteria were as follows:

- Annual rainfall plus annual irrigation does not exceed annual pan evaporation
- Surface runoff occurring as a result of irrigation does not contain effluent
- Phosphorus leaching is limited to levels that would avoid soil structure failure (this is indicated by persistently high and increasing values of leached phosphorus per year reported in the MEDLI summary output)
- The soil’s design life must exceed the life of the camp, although preferably greater than 30 years as contingency
- No reduction in crop yield as a result of salinity
- No over topping of the wet weather storage facility throughout the model run duration
- No significant increase in crop stress as a result of water logging associated with irrigation
- Nutrient leaching (below the rootzone) should be minimised as far as practicable, in consideration of the WQOs for the region (refer section 2.9.2).

5. Results and assessment

5.1 General

Effluent discharge was modelled to rationalise wet weather and disposal area requirements for each soil type whilst meeting the criteria nominated in Section 4.2 of this report. A summary of the results of the MEDLI assessment for each scenario modelled is provided in Table 11. A discussion of how each scenario modelled complied with the assessment criteria identified in Section 4.2 has been provided below.

5.2 Water balance

Before determining the fixed effluent daily application rate (mm/yr) for the model, climate data was reviewed.

As per section 2.3, the annual average pan evaporation rate equates to 1937 mm/year and average annual rainfall rate to 572 mm. This results in a net water deficit of 1391 mm/year for most soil types. This corresponds to an average daily irrigation rate of 3.8 mm/day. This value was adopted for commencement of MEDLI modelling as the fixed daily irrigation rate for all irrigation scenarios, before being reduced (refer section 5.3.1).

5.3 Guidance table

Several modelling iterations were conducted to gain an appreciation of the minimum wastewater infrastructure required onsite. The results of these are shown in Table 13.

The model indicates that the minimum wet weather storage allowance at the forecast 500 EP loading corresponds to 300 kL, having an irrigation area of at least 3.935 ha. This storage volume allowance is compliant with the Queensland Technical Guideline for Disposal of Effluent using Irrigation (2020) for fixed daily irrigation strategies, supplying above the minimum storage capacity of 3 days of effluent volume (>150 kL) to deal with contingencies.

At the 500 EP loading scenario, approximately one third of the nominated irrigation area (3.935 ha of estimated 12 ha total; refer section 2.1) will be required to function as the effluent irrigation area.

Table 13 Summary of Girrahween Temporary Camp 500 EP Second Option MEDLI outputs for modelled scenarios

EP	Load scenario	
	250 EP	500 EP
Hydraulic loading (kL/day)	50	100
Maximum Irrigation Rate (mm/day) ~	3.0	3.0
Wet Weather Storage (kL) ^	150	300
Irrigation Area (m ²) – Minimum required ^*	19,750	39,350
Notes:		
^ To achieve zero incidents of storage overflow and acceptable soil performance outcomes (refer Section 4.2), OR alternatively, at least 3 days minimum storage capacity, whichever is greater.		
* Rounded up to the nearest 50 m ²		
~ Based on Net Evaporation. Actual irrigation rate averaged over the year may differ from this value (lower).		

5.3.1 Annual irrigation depth

The MEDLI model scenario was initially constructed to irrigate no more than 3.8 mm per day, every day, irrespective of weather conditions. However, in reflection of the site characteristics described in section 2, this was subsequently reduced to 3.0 mm.

The range of applied irrigation depths was therefore 2.5 to 3.0 mm. The lower bound corresponds to the daily effluent generation volume (e.g., 50 kL/day at 250 EP) evenly distributed over the LAA. Over the model run period, the annual average irrigation depth was reported at 954 mm (or 2.6 mm/d).

Table 14 Key MEDLI outputs for all modelled scenarios

Daily Peak Design Capacity		250 EP		500 EP	
Output Parameter	Unit	No Irrigation	Irrigation	No Irrigation	Irrigation
Required irrigation area (minimum)	m ²	19,750	19,750	39,350	39,350
Wet weather storage	kL	150	150	300	300
Wet weather storage overflow	kL/yr	0	0	0	0
Annual irrigation	mm/yr	0	954	0	956
Rainfall	mm/yr	572	572	572	572
Soil evaporation	mm/yr	338	9.3	338	9.4
Transpiration	mm/yr	249	1315	249	1314
Rain runoff	mm/yr	7.5	2.6	7.5	2.6
Irrigation portion of the runoff	mm/yr	0	0	0	0
Deep drainage	mm/yr	7.9	199	7.9	203
Average monthly plant cover	%	29	87	29	86
Nitrogen added by irrigation	kg/m ² /yr	0	0.02	0	0.02
Nitrogen removed by crop	kg/m ² /yr	0.002	0.03	0.002	0.03
Average nitrate concentration of deep drainage	mg/L	1.57	0.15	1.57	0.15
Phosphorous added by irrigation	kg/m ² /yr	0	0.02	0	0.02
Phosphorous removed by crop	kg/m ² /yr	0.0005	0.01	0.0005	0.01
Average phosphate concentration of deep drainage*	mg/L	0.04	0.11	0.04	0.11
Design soil profile storage life based on average infiltrated water phosphorous concentration of 12.17 mg/L	years	NA	45.7	NA	45.7
Notes:					
* Due to an unavoidable model stabilisation period, the average nutrient concentrations for the 10-year run period are skewed by high values reported in year 1 (refer Figure 7).					

5.3.1.1 Runoff

Results show that no runoff off irrigation effluent occurs from the irrigation area. That is, the irrigation rate does not exceed the capacity of the soil to accommodate the discharged effluent, as well as confirming that the effluent volume is able to be assimilated by the endemic soil during wet days without mixing with runoff associated with precipitation.

5.3.1.2 Deep Drainage

The fixed irrigation scheme, at the lower 3.0 mm per day rate, contributes an additional 199-203 mm/year to deep drainage in the irrigation area, compared to the dryland (no irrigation) baseline. This represents a considerable reduction in the deep drainage compared to the initial maximum 3.8 mm/day fixed rate scheme (~380 mm/year). In other words, over the course of one year approximately 7,000 m³ irrigated wastewater is no longer reaching the rootzone, but instead being removed from the system via transpiration.

Coupled with the above, the low nutrient concentrations reported in deep drainage (approaching zero after model stabilisation, refer Figure 10) and the moderate (estimated >17 m) depth to groundwater anticipated based on the construction of nearby groundwater bores logged on the DNRME database, suggests the irrigation scheme will present a low risk to groundwater in the land application area. Particularly noting the timeframe for operation of the scheme (indicatively 10 years). The residual risk can be further mitigated by offsetting the LAA as far as practicable from the reservoir.

5.3.1.3 Nitrogen and phosphorous leaching

Even at moderate hydraulic application rates, nutrients which exceed the soil's storage capacity can eventually move offsite and potentially contaminate surface water or groundwater.

Nitrate concentrations in deep drainage are higher for all dryland scenarios when compared to irrigation.

Nitrate concentrations in deep drainage are usually higher for dryland (no irrigation) scenarios because of decreased crop cover. Increased crop cover correlates with larger root mass which will provide a greater surface area to facilitate the uptake of nutrients. In dryland scenarios the low plant cover results in nitrate being transported below the root zone, returning higher results in the model.

The annual nutrient leaching concentrations modelled over the 10-year run period for the 250 EP hydraulic loading scenario is presented below. It is evident that following the model equilibration period that the annual nutrient leaching concentrations for the irrigation scenario approach zero, as per the 500 EP scenario also.

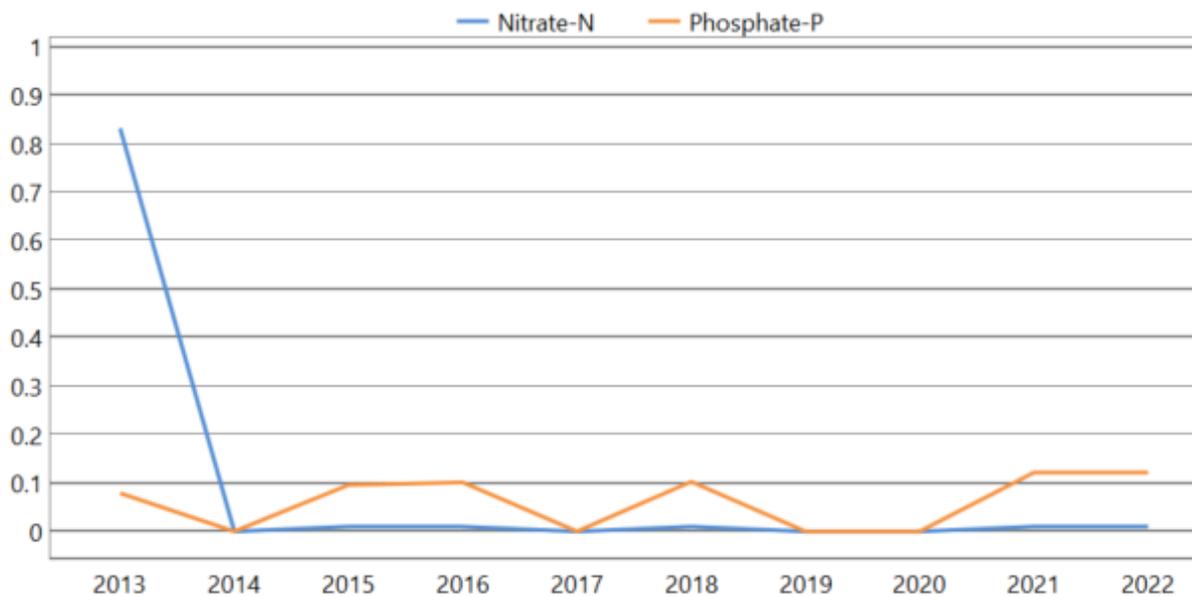


Figure 10 Annual nutrient leaching concentration for the 250 EP loading scenario (1.97 ha irrigation area)

Phosphorus concentrations reported to occur below the root zone were equal 0.1 mg/L for all scenarios. In general terms, the low results returned indicate that phosphorus is not a significant limiting factor for disposal for all scenarios modelled at the nominated effluent nutrient quality.

5.3.1.4 Soil Design Life

The soil design life which is an indication of the soil's nutrient absorption capacity measure was sufficiently high for all scenarios when irrigation was triggered, being more than 40 years. This far exceeds the lifespan of the camp (10 years).

5.3.2 Crop

5.3.2.1 Salinity Impacts

Results that suggest that salinity will not adversely impact on crop yield for the Sodosol soil type modelled at the nominated irrigation rate and effluent quality (being of low-risk conductivity, noting the site's sodic soil type). Results show a zero reduction in crop yield due to salinity.

5.3.2.2 Crop Cover

Comparisons of all "no irrigation" loading scenarios to their corresponding irrigation scenarios demonstrates that improved crop cover occurs in each instance.

Under natural (dryland) conditions, plant cover was as low as 38%, while under irrigated conditions plant cover averaged 87%, respectively.

5.3.3 Wet weather storage

All flow volumes for all soil types confirmed the size of the wet weather storages outlined in Table 14 as sufficient, with no overtopping reported.

6. Conclusions

6.1 General

The MEDLI model scenarios described in this report suggest the following:

- Salinity had no adverse impacts on crop yield for any of the soil types, noting that a salt-tolerant grass species (Kikuyu) was assumed to be planted within the irrigation area.
- Despite the low hydraulic conductivity of the Sodosol soil horizons (1 mm/hr or less) which generally restricts internal drainage and increases the propensity for runoff to occur, irrigation did not contribute to runoff for any modelled irrigation scenario. The adjusted maximum allowable irrigation rate (3.0 mm/d) was not exceeded on any day during the modelled period. Over the model run period, the annual average irrigation depth was reported at 2.6 mm/d.
- The near proximity of a reservoir being as little as 50 m offset at the northern site boundary presents a surface water contamination risk. The reservoir already presents persistent algal bloom issues observed from aerial imagery, which may be worsened by additional nutrient loading. Surplus irrigation, represented by deep drainage, can migrate via shallow groundwater, and potentially contaminate. Conservatively, it is considered that deep drainage should be minimised as far as practical at this location.
- The level of nutrients in deep drainage are considered sufficiently low to protect groundwater environmental values, noting the moderate depth to groundwater and low nitrogen and phosphorus concentrations after the model stabilisation period (~1 year).

6.2 Design and sizing implications

The following conclusions were made regarding infrastructure sizing:

- At the **500 EP loading scenario**:
 - The minimum wet weather storage allowance corresponds to 300 kL (more than 3 day's storage), having an irrigation area of at least 3.935 ha.
 - Approximately one third of the nominated land application area (of estimated 12 ha total) will be required to function as the effluent irrigation area.
 - Having not exceeded the maximum allowable footprint, there is an opportunity to achieve additional offsets between the LAA and:
 - Spaces accessed by camp occupants and greywater release areas, as well as for contingency regarding effluent spray drift.
 - The adjacent reservoir, to reduce the residual risk of shallow deep drainage migrating to the water body and contributing to its eutrophication.
- Regarding the soil's probable sodicity:
 - For effluent irrigation schemes, it is imperative that both the exchangeable sodium percentage (ESP of the soil) and the sodium adsorption ratio (SAR of the wastewater) are clearly indicated.
 - Soil amelioration may be required to compensate for poor effluent quality should it eventuate (i.e., in the event of a high SAR).
- Generally, crop selection and management are imperative to facilitating the high degree of nutrient uptake modelled. For example, a grass type having similar nutrient uptake and salt tolerance to Kikuyu should be implemented. Regular inspections of the irrigation area should be conducted to identify any waterlogging, or crop stress. Also, certain management practices pertaining to long term irrigation schemes have demonstrated to be useful in managing the permeability of the soil, improve soil structure and nutrient retention over the long term. Soil management practices include:
- **Soil Amendments:** To improve the absorptivity and reduce the negative impacts of sodicity, soil additives such as gypsum (Calcium sulphate) can be applied. Gypsum helps to replace sodium ions with calcium ions, improving soil structure and permeability.

- **Effluent Quality:** Monitoring and managing the quality of the treated effluent, particularly its SAR and total dissolved solids (TDS), can mitigate adverse effects on Sodosols.
- **Irrigation Practices:** Implementing irrigation practices that avoid waterlogging and minimise salt accumulation, such as using efficient irrigation systems and scheduling irrigation based on soil moisture levels, can help maintain soil health

7. References

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Windows® program 2015, MEDLI Version 2.1.1.0.

Appendices

Appendix A

Environmental Desktop Searches

Report Date: 13/11/2023 15:10

Groundwater Information

GWDB8250

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire	
160575	Sub-Artesian Facility	Existing	05/12/2011	Roma	7310 - WESTERN DOWNS REGIONAL	
Details			Location			
Description			Latitude	26-30-37	Basin	4222
Parish	332 - BARTSCH		Longitude	150-12-03	Sub-area	
Original Name			GIS Latitude	-26.51038104	Lot	15
			GIS Longitude	150.2007102	Plan	AU38
			Easting	221008		
Driller Name	BOURNE, KEVIN JOHN		Northing	7064749	Map Scale	
Drill Company	DEPCO		Zone	56	Map Series	
Const Method	ROTARY AIR		Accuracy		Map No	
Bore Line			GPS Accuracy		Map Name	
D/O File No	Polygon		Checked	Yes	Prog Section	
R/O File No	Equipment					
H/O File No	RN of Bore Replaced					
Log Received Date	Data Owner	COC				
Roles	Mine Monitoring					

Casing

7 records for RN 160575

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	05/12/2011	1	0.00	6.00	Polyvinyl Chloride	6.000	WT - Wall Thickness	132
A	05/12/2011	2	0.00	88.00	Polyvinyl Chloride	5.000	WT - Wall Thickness	60
A	05/12/2011	3	46.00	88.00	Perforated or Slotted Casing	0.500	AP - Aperture Size	60
X	05/12/2011	4	0.00	6.00	Grout			165
X	05/12/2011	5	6.00	43.00	Grout			120

Report Date: 13/11/2023 15:10

Groundwater Information

GWDB8250

Bore Report

From Year:

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	05/12/2011	6	43.00	45.00	Bentonite Seal			120
X	05/12/2011	7	45.00	88.00	Gravel Pack			120

Strata Logs

15 records for RN 160575

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.00	SAND
2	1.00	8.00	SANDSTONE WITH IRONSTONE BANDS
3	8.00	17.00	FINE SANDSTONE WITH SILTSTONE BANDS
4	17.00	26.00	CLAYEY SANDSTONE
5	26.00	30.00	MUDSTONE WITH COAL BANDS
6	30.00	40.00	GREY SANDSTONE
7	40.00	44.00	COAL
8	44.00	49.00	GREY SANDSTONE WITH SILTSTONE BANDS
9	49.00	52.00	COAL, SILTSTONE BANDS
10	52.00	57.00	SILTSTONE, GREY
11	57.00	60.00	MUDSTONE, CARBONACEOUS
12	60.00	64.00	SANDSTONE GREY
13	64.00	73.00	MUDSTONE, COAL BANDS
14	73.00	80.00	GREY SANDSTONE, CARBONACEOUS
15	80.00	88.00	GREY SANDSTONE

Stratigraphies

0 records for RN 160575

Aquifers

0 records for RN 160575

Pump Tests Part 1

0 records for RN 160575

From Year:

Pump Tests Part 2	0 records for RN 160575
Bore Conditions	0 records for RN 160575
Elevations	0 records for RN 160575
Water Analysis Part 1	0 records for RN 160575
Water Analysis Part 2	0 records for RN 160575
Water Levels	0 records for RN 160575
Wire Line Logs	0 records for RN 160575
Field Measurements	0 records for RN 160575
Special Water Analysis	0 records for RN 160575

From Year:

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Groundwater Information

GWDB8250

Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire	
160841	Sub-Artesian Facility	Existing	05/12/2011	Roma	7310 - WESTERN DOWNS REGIONAL	
Details			Location			
Description			Latitude	26-30-37	Basin	4222
Parish	6000 - NO LONGER USED		Longitude	150-12-02	Sub-area	
Original Name			GIS Latitude	-26.5103975	Lot	15
			GIS Longitude	150.20062958	Plan	AU38
			Easting	221000		
Driller Name	BOURNE, KEVIN JOHN		Northing	7064747	Map Scale	
Drill Company	DEPCO		Zone	56	Map Series	
Const Method	ROTARY AIR		Accuracy		Map No	
Bore Line			GPS Accuracy		Map Name	
D/O File No		Polygon	Checked	Yes	Prog Section	
R/O File No		Equipment				
H/O File No		RN of Bore Replaced				
Log Received Date		Data Owner	COC			
Roles	Coal Seam Gas (CSG) Monitoring					

Casing

7 records for RN 160841

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
A	05/12/2011	1	0.00	6.00	Polyvinyl Chloride			132
A	05/12/2011	2	0.00	42.00	Polyvinyl Chloride			60
A	05/12/2011	3	24.00	42.00	Perforated or Slotted Casing			60
X	05/12/2011	4	0.00	6.00	Grout			165
X	05/12/2011	5	6.00	21.00	Grout			120

Report Date: 13/11/2023 15:12

Groundwater Information

GWDB8250

Bore Report

From Year:

Pipe	Date	Rec	Top (m)	Bottom (m)	Material Description	Mat Size (mm)	Size Desc	Outside Diameter (mm)
X	05/12/2011	6	21.00	23.00	Bentonite Seal			120
X	05/12/2011	7	23.00	42.00	Gravel Pack			120

Strata Logs

7 records for RN 160841

Rec	Top (m)	Bottom (m)	Strata Description
1	0.00	1.00	SAND
2	1.00	8.00	FINE SANDSTONE; IRONSTONE BANDS
3	8.00	17.00	FINE SANDSTONE; SILTSTONE BANDS
4	17.00	26.00	CLAYEY SANDSTONE
5	26.00	30.00	MUDSTONE; COAL BANDS
6	30.00	40.00	FINE SANDSTONE GREY
7	40.00	42.00	COAL

Stratigraphies

2 records for RN 160841

Source	Rec	Top (m)	Bottom (m)	Strata Description
DNR	1	0.00	3.26	UNDIFFERENTIATED
DNR	2	3.26	42.00	WALLOON COAL MEASURES

Aquifers

1 records for RN 160841

Rec	Top (m)	Bottom (m)	Lithology	Date	SWL (m)	Flow	Quality	Yield (L/s)	Contr	Cond	Formation Name
1	24.00	42.00	COAL - Coal						Y	PS	WALLOON COAL MEASURES

Pump Tests Part 1

0 records for RN 160841

From Year:

Pump Tests Part 2 0 records for RN 160841

Bore Conditions 0 records for RN 160841

Elevations 1 records for RN 160841

Pipe	Date	Elevation (m)	Precision		Datum	Meas	Point	Survey Source
X	05/12/2011	312.94	EST	Estimate Using Contours	AHD - Aust. Height Datum	N	Natural Surface	AUS_SRTM_1SEC_DEM_S_V1

Water Analysis Part 1 0 records for RN 160841

Water Analysis Part 2 0 records for RN 160841

Water Levels 0 records for RN 160841

Wire Line Logs 0 records for RN 160841

Field Measurements 0 records for RN 160841

Special Water Analysis 0 records for RN 160841

From Year:

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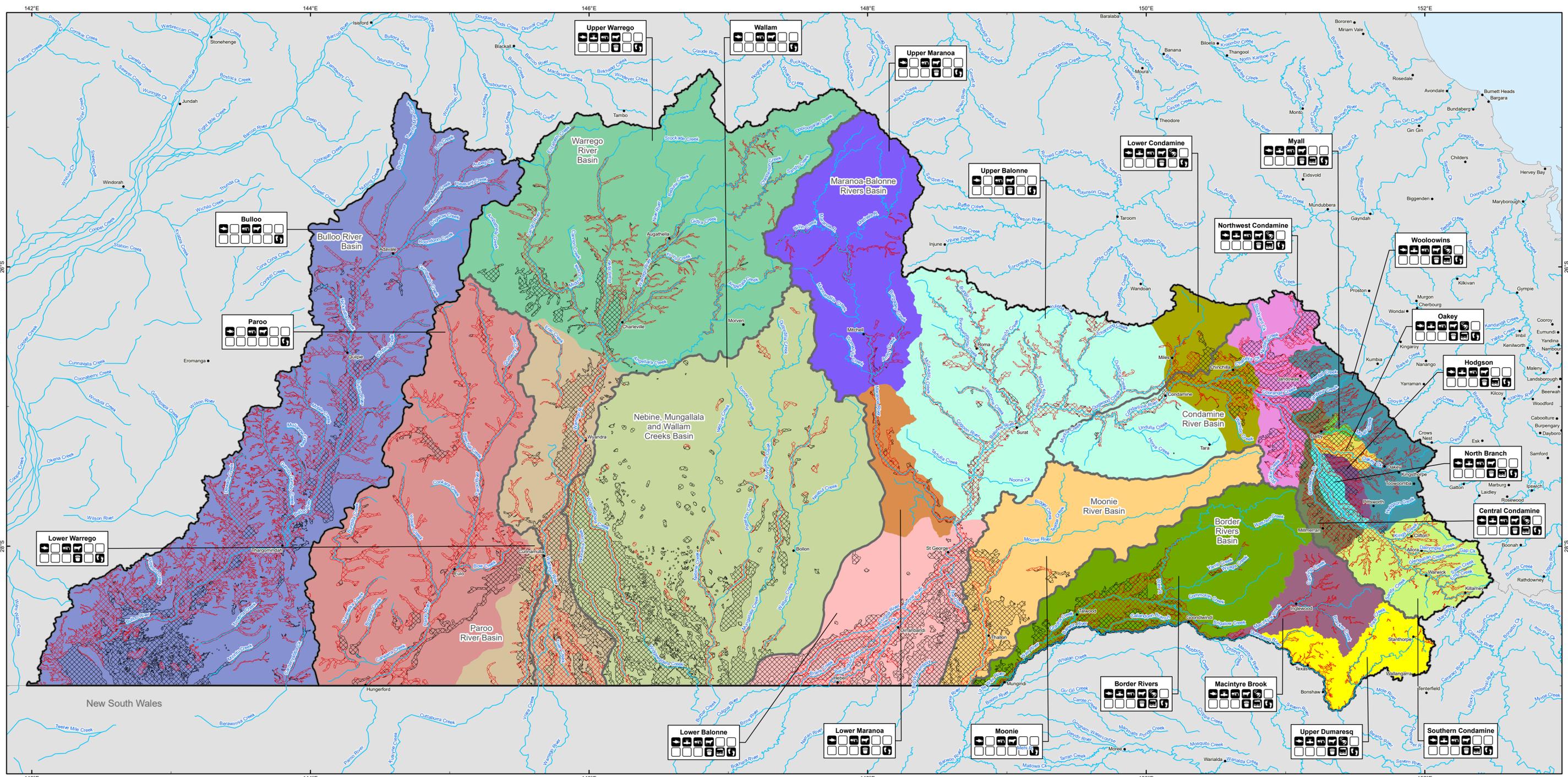
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Legend

- Town
- Watercourse
- Drainage basin boundary
- Boundary of waters covered by the scheduling document

Alluvial Zones

- Alluvium
- Alluvium 'near stream'
- Border Rivers
- Bulloo
- Central Condamine
- Hodgson
- Lower Balonne
- Lower Condamine
- Lower Maranoa
- Lower Warrego
- Macintyre Brook
- Moonie
- Myall
- North Branch
- North West Condamine
- Oakey
- Paroo
- Southern Condamine
- Upper Balonne
- Upper Dumaresq
- Upper Maranoa
- Upper Warrego
- Wallam
- Woolloowins

Key to Environmental Values

- Aquatic Ecosystems
- Imposition
- Farm Supply
- Stock
- Water
- Manufacture
- Human Consumer
- Primary Recreation
- Secondary Recreation
- Drinking Water
- Industrial Use
- Cultural & Spiritual Values

Notes:

- The AWQGS recommends the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value. Where groundwaters are in good condition the intent is to maintain existing water quality (20th, 50th and 80th percentiles).
- Alluvium zone shown in cross hatching. For some Alluvium zones, water quality information is provided for 'near stream' areas (1.5km buffered area) and the overall alluvium zone - refer accompanying report.

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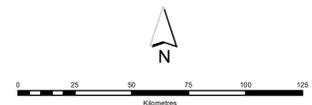
GWQ4161 - Queensland Murray-Darling and Bulloo Basins Groundwater Alluvial Zones

Environmental Protection (Water and Wetland Biodiversity) Policy 2019 Queensland Murray-Darling and Bulloo Basins Map Series

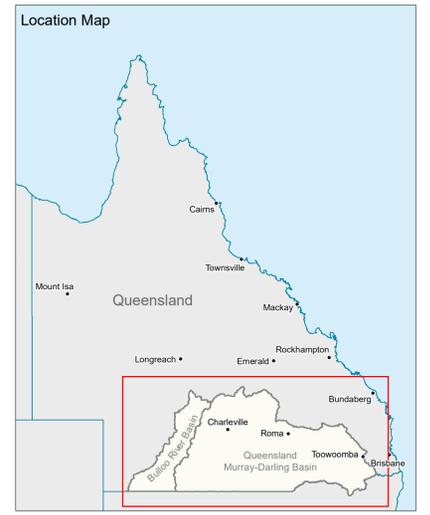
This plan forms part of the Queensland Murray-Darling and Bulloo Basins Groundwater Environmental Values and Water Quality Objectives scheduling document, prepared pursuant to the Environmental Protection (Water and Wetland Biodiversity) Policy 2019.



Prepared on: 28 August 2020



Scale: 1:1,550,000 @ A1
Projection: Geocentric Datum of Australia 1994 (GDA94)
Horizontal Datum: Geocentric Datum of Australia 1994 (GDA94)



Project QMDSC Site 5 Observation 1

SALI4320

Project description	
Project name:	Soil characterisation project for the Queensland Murray Darling Committee
Project status:	Data is from an active project and may be subject to change through additions/updates or further quality assessment processes
Location:	Queensland Murray Darling Committee regional boundaries

Site characteristics			
Date described:	4/12/2007	Observation type:	Relatively undisturbed soil core
Site Type:	DO NOT USE	Observation class:	Class I (detailed soil profile description)
Slope (%):	0.5	Morphological type:	
Slope type	Abney level or clinometer and tape	Landform element:	Plain
Geology:	Not recorded	Landform pattern:	Plain
Soil Name:	Not recorded	Substrate lithology:	Not recorded
Runoff:	Not recorded	Depth to free water:	Not recorded
Permeability:	Not recorded	Erosion:	Not recorded
Drainage:	Not recorded	Microrelief type:	Not recorded
Disturbance:	Limited clearing	Proportion gilgai:	N/A
Rock outcrop:	Not recorded	Vertical interval (m):	N/A
Surface condition:	Hard setting	Horizontal interval (m):	N/A
Surface coarse fragments:	No coarse fragments	Microrelief component sampled:	N/A

Site location							
Datum	Latitude (dd)	Longitude (dd)	Zone	Easting (m)	Northing (m)	Location accuracy (m)	Location measurement method
GDA 94	-26.573220	150.258610	56	226930.0	7057909.0	Not recorded	Differential GPS
GDA 2020	-26.573207	150.258616	56	226930.9	7057910.8		

Soil classification					
Australian Soil Classification (ASC)	Confidence	ASC Technical Reference	Buried	GSG	PPF
Grey Sodosol		Isbell (2002) The Australian Soil Classification Revised Edition	N/A		Dy3.43

Vegetation		
Community name	Cypress pine open forest	
Stratum	Species	Common name
Tallest	<i>Callitris glaucophylla</i>	white cypress pine
	<i>Eucalyptus melanophloia</i>	silver-leaved ironbark, silver ironbark

Profile morphology											
No	Name	Upper depth (m)	Lower depth (m)	Colour	Mottles	Textures	Structures	Coarse fragments	Segregations	Strengths	Bounds
1	A1	0	0.15	Brown (10YR 5/3) moist 		Sandy loam	Massive structure;			Dry, Weak strength;	clear
2	A2e	0.15	0.25	Pale brown (10YR 6/3) moist White (10YR 8/2) dry 	few (2-10%) medium (5-15 mm) faint orange mottles;	Sandy loam	Massive structure;	very few (<2%) subangular ferricrete medium pebbles (6-20 mm);	Very few (<2%) Medium (2-6 mm) Ferruginous Concretions;	Dry, Weak strength;	sharp
3	B21	0.25	0.6	Pale brown (10YR 6/3) moist 	common (10-20%) medium (5-15 mm) distinct orange mottles;	Medium clay	Weak 20-50 mm Angular blocky structure;			Moderately moist, Very firm strength;	
4	R	0.6	0.65								

Field test	
pH by Raupach and Tucker method	
Depth (m)	Value
0.05	5.5
0.3	6
0.5	6

Notes			
Note level	Horizon name	Horizon no	Note
Observation			Property name: Kelvyndale. Shallow site, moved on to site 6 approx 200m away.
Observation			Few Cyperus tussocks
Horizon	B21	3	Sodic feel to B horizon
Horizon	R	4	Quartzose sandstone

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Project name:	Soil characterisation project for the Queensland Murray Darling Committee
Project status:	Data is from an active project and may be subject to change through additions/updates or further quality assessment processes
Location:	Queensland Murray Darling Committee regional boundaries

Site characteristics			
Date described:	4/12/2007	Observation type:	Relatively undisturbed soil core
Site Type:	DO NOT USE	Observation class:	Class IIIb (core analytical suite)
Slope (%):	1.5	Morphological type:	Flat
Slope type	Abney level or clinometer and tape	Landform element:	Plain
Geology:	Not recorded	Landform pattern:	Plain
Soil Name:	Not recorded	Substrate lithology:	Not recorded
Runoff:	Very slow	Depth to free water:	Not recorded
Permeability:	Moderately permeable (50-500 mm/day)	Erosion:	Minor or present, partly stabilised, sheet erosion
Drainage:	Imperfectly drained	Microrelief type:	Not recorded
Disturbance:	Limited clearing	Proportion gilgai:	N/A
Rock outcrop:	Not recorded	Vertical interval (m):	N/A
Surface condition:	Hard setting	Horizontal interval (m):	N/A
Surface coarse fragments:	Not recorded	Microrelief component sampled:	N/A

Site location							
Datum	Latitude (dd)	Longitude (dd)	Zone	Easting (m)	Northing (m)	Location accuracy (m)	Location measurement method
GDA 94	-26.573830	150.261580	56	227227.0	7057848.0	Not recorded	Differential GPS
GDA 2020	-26.573817	150.261586	56	227228.3	7057849.5		

Soil classification					
Australian Soil Classification (ASC)	Confidence	ASC Technical Reference	Buried	GSG	PPF
Magnesian, Mesonatric, Grey Sodosol; medium, non-gravelly, loamy, clayey, deep.		Isbell (2002) The Australian Soil Classification Revised Edition	N/A	Solodized solonetz	Dy3.43

Vegetation		
Community name	cypress pine open forest	
Stratum	Species	Common name
Emergent 12.01-20 m	<i>Eucalyptus crebra</i>	narrow-leaved ironbark
Tallest 6.01-12 m	<i>Eucalyptus crebra</i>	narrow-leaved ironbark
	<i>Callitris glaucophylla</i>	white cypress pine
	<i>Allocasuarina luehmannii</i>	bull oak
Mid 3.01-6.0 m	<i>Dodonaea species</i>	
Lowest	<i>Aristida species</i>	wiregrass
	<i>Cyperus gracilis</i>	

Profile morphology											
No	Name	Upper depth (m)	Lower depth (m)	Colour	Mottles	Textures	Structures	Coarse fragments	Segregations	Strengths	Bounds
1	A1	0	0.1	Dark greyish brown (10YR 4/2) moist		Fine sandy loam	Weak structure;			Dry, Weak strength;	clear
2	A2e	0.1	0.18	Greyish brown (10YR 5/2) moist Light grey (10YR 7/2) dry		Fine sandy loam	Massive structure;	very few (<2%) subangular ironstone small pebbles (2-6 mm);		Dry, Weak strength;	sharp
3	B21t	0.18	0.35	Pale brown (10YR 6/3) moist	few (2-10%) fine (<5 mm) faint grey mottles;	Light clay; sandy	Moderate 10-20 mm Polyhedral structure;	very few (<2%) subangular ironstone small pebbles (2-6 mm);	Very few (<2%) Fine (<2mm) Ferruginous Concretions;	Dry, Strong strength;	clear
4	B22t	0.35	0.55	Light brownish grey (10YR 6/2) moist	few (2-10%) fine (<5 mm) faint yellow mottles;	Light clay; sandy	Weak 10-20 mm Polyhedral structure;	very few (<2%) subangular ironstone small pebbles (2-6 mm);	Very few (<2%) Fine (<2mm) Ferruginous Concretions;	Dry, Strong strength;	clear
5	B23t	0.55	0.9	Light olive brown (2.5Y 5/4) moist	common (10-20%) medium (5-15 mm) faint grey mottles;	Medium clay	Massive structure;			Dry, Strong strength;	gradual

Project QMDSC Site 6 Observation 1

SALI4320

6	B3	0.9	1.15	Olive yellow (2.5Y 6/6) moist 	many (20-50%) medium (5-15 mm) distinct grey mottles; common (10-20%) medium (5-15 mm) distinct orange mottles;	Light medium clay	Weak structure;			Dry, Strong strength;	
---	----	-----	------	--	---	-------------------	-----------------	--	--	-----------------------	--

Field test	
pH by Raupach and Tucker method	
Depth (m)	Value
0.05	5.5
0.2	5.5
0.3	7
0.4	7.5
0.6	8
0.7	8.5
0.8	8.5
0.9	8
1	8
1.1	8

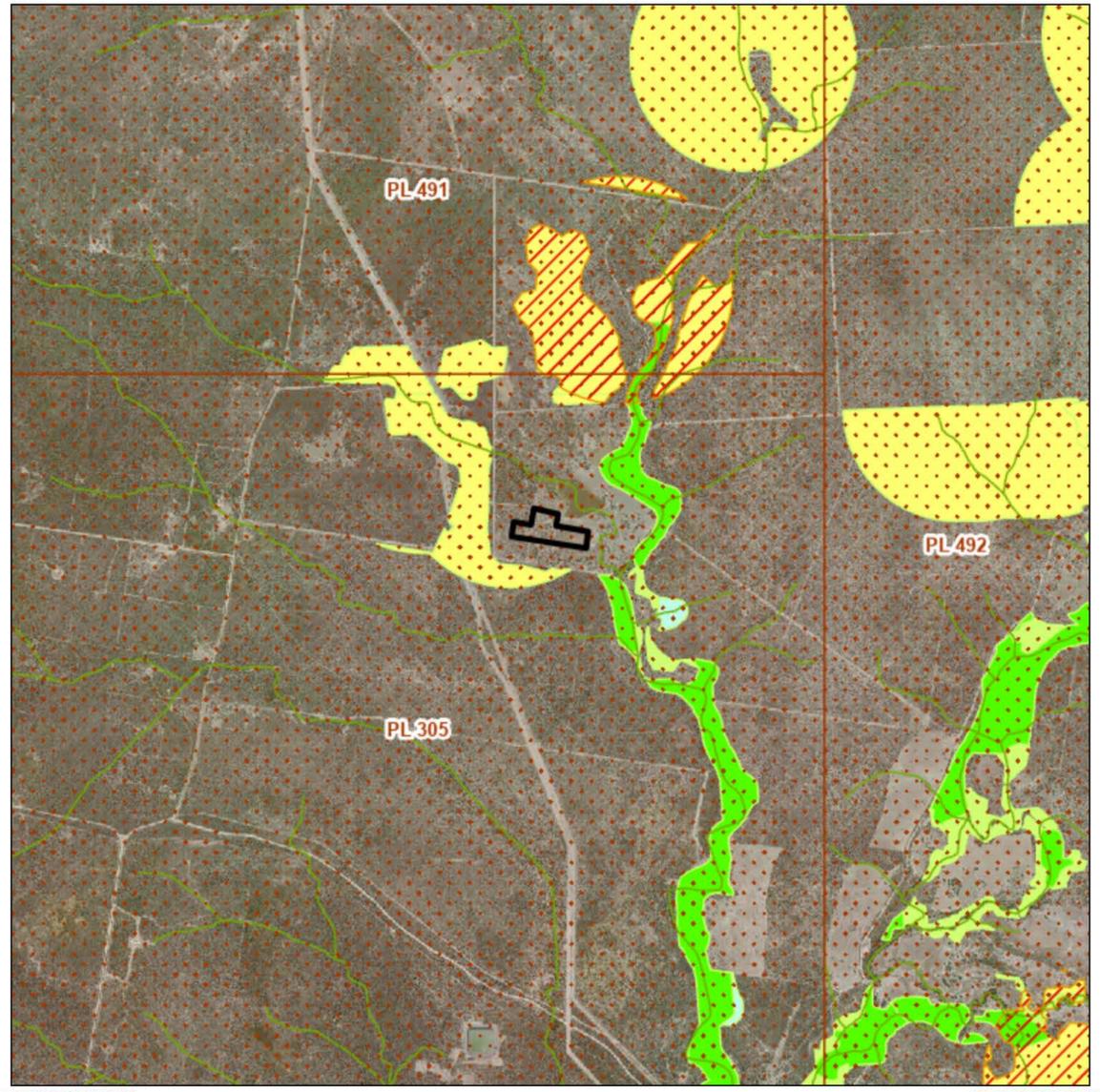
Notes			
Note level	Horizon name	Horizon no	Note
Observation			Property name: Kelvyndale
Horizon	B21t	3	B21: Possible coarse columnar structure
Horizon	B3	6	B3: Grey mottle maybe fragments of weathered substrate

Laboratory test results										
				Sample	1	2	3	4	6	7
				Upper depth (m)	0	0	0.2	0.5	0.8	1
				Lower depth (m)	0.1	0.1	0.3	0.6	0.9	1.1
Group	Method	Code	Units	Bulked Sample	Y	N	N	N	N	N
Profile General	pH - 1:5 water	4A1			5.0	5.6	6.4	8.5	8.5	8.5
	EC - 1:5 water	3A1	dS/m		0.02	0.01	0.14	0.3	0.47	0.46
	Cl - 1:5 water - automated	5A2	mg/kg		<20	<20	124	346	623	607
	Water sol NO3 - automated	7B1	mg/kg		<1	<1	<1	1	<1	<1
	OC - Walkley/Black	6A1	%		0.6					
	Total N - Kjeldahl, automated	7A2a			0.04					
	Coarse sand	2Z2_CS	%			32	18	24	19	15
	Fine sand	2Z2_FS	%			50	28	38	33	38
	Silt	2Z2_Silt	%			10	11	9	8	8
	Clay	2Z2_Clay	%			13	48	34	43	42
	PSA sum	2Z2_sum	%			105	105	105	103	103
	Moisture content - air-dry	2A1	%			<1.5	2.4	1.6	1.7	2.9
	Moisture content - 15 bar	2E1	%			2.5	15.5	12.0	13.0	13.0
	Silt+Clay/Total Silt+Clay (R1)	2Z1_R1				0.87	0.93	0.87	0.76	0.71
	Total S XRF	10A1	%			0.01	0.01	0.01	0.01	0.02
	Total P XRF	9A1	%			<0.015	<0.015	<0.015	<0.015	<0.015
	Total K XRF	17A1	%			0.100	0.130	0.120	0.110	0.100
Alcoholic Cations	Exch Ca - Alch NH4Cl, pH8.5, prewash	15C1_Ca	cmol_c/kg		0.44	0.24	0.46	0.29	<0.18	<0.18
	Exch Mg - Alch NH4Cl, pH8.5, prewash	15C1_Mg	cmol_c/kg		0.58	0.48	9.71	7.03	6.45	6.42
	Exch Na - Alch NH4Cl, pH8.5, prewash	15C1_Na	cmol_c/kg		<0.091	<0.091	3.16	4.19	3.88	4.15
	Exch K - Alch NH4Cl, pH8.5, prewash	15C1_K	cmol_c/kg		0.06	0.07	0.09	0.11	0.07	0.08
	CEC - Alch NH4Cl pH8.5 pre wash	15C1_CEC	cmol_c/kg		6	<3	13	9	9	10
Acid Cations	Exch Ca - NH4Cl, pH7, no prewash	15A1_Ca	cmol_c/kg		0.78					
	Exch Mg - NH4Cl, pH7, no prewash	15A1_Mg	cmol_c/kg		0.85					
	Exch Na - NH4Cl, pH7, no prewash	15A1_Na	cmol_c/kg		0.37					
	Exch Na - NH4Cl, pH7, adj. for soluble Na	15A3_Na	cmol_c/kg		0.369					
	Exch K - NH4Cl, pH7, no prewash	15A1_K	cmol_c/kg		0.08					
	Exchangeable Al (by KCl)	15G1_Al	cmol_c/kg		0.74					
	Exchange acidity (H + Al) by KCl	15G1_H	cmol_c/kg		0.81					
	Exch Al sat % (calc)	15G2	%		25.7					
	ECEC (Effective CEC)	15J1	cmol_c/kg		2.88					
Other Cations	ESP (Exch. Na %)	15N1	%		12.8	3.0	24.3	44.3	42.3	43.2
Other Bulk	DTPA Extr Cu	12A1_Cu	mg/kg		0.1					
	DTPA Extr Fe	12A1_Fe	mg/kg		156.0					
	DTPA Extr Mn	12A1_Mn	mg/kg		10.9					
	DTPA Extr Zn	12A1_Zn	mg/kg		0.3					
	Extr K - HCl	18B1	mg/kg		<0.1					
	P (Acid) - automated	9G2	mg/kg		3					
	P (BiCarb Extr)- automated	9B2	mg/kg		1					
	CaPhos Extr S - ICPAES	10B3	mg/kg		4					

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Legend

Attribution

<p>PL application</p>	<p>MSES declared high ecological value waters [wetland]</p>
<p>PL granted</p>	<p>MSES high ecological significance wetlands</p>
<p>MSES protected area [estates]</p>	<p>MSES strategic environmental area [designated precinct]</p>
<p>MSES protected area [nature refuges]</p>	<p>MSES regulated vegetation [category B - endangered or of concern]</p>
<p>MSES marine park [highly protected]</p>	<p>MSES regulated vegetation [category C - endangered or of concern]</p>
<p>MSES declared fish habitat area [A and B areas]</p>	<p>MSES regulated vegetation [category R - GBR riverine]</p>
<p>MSES legally secured offset area [offset register]</p>	<p>MSES regulated vegetation [essential habitat]</p>
<p>MSES legally secured offset area [vegetation offsets]</p>	<p>MSES regulated vegetation [100m from wetland]</p>
<p>MSES regulated vegetation [defined watercourse]</p>	
<p>MSES declared high</p>	

Earthstar Geographics

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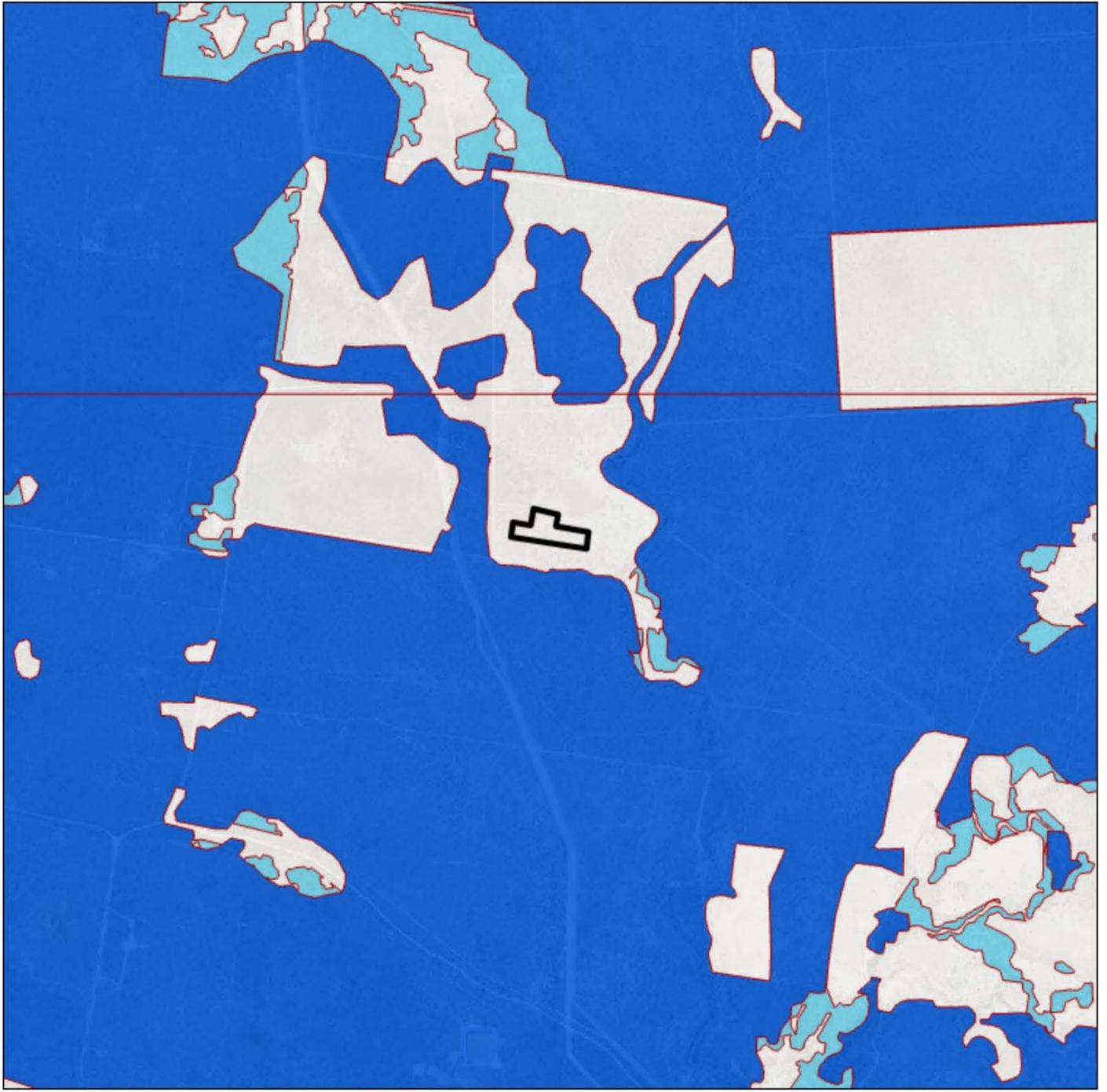
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Legend

<p>MSES wildlife habitat [SEQ koala habitat - core]</p>	<p>Roads and tracks</p> <ul style="list-style-type: none"> Motorway Highway Secondary Connector Local Restricted Access Road Mall Busway Bikeway Restricted Access Bikeway Walkway Restricted Access Walkway Non-vehicular Track Track Restricted Access Track Ferry Proposed Thoroughfare
<p>MSES wildlife habitat [SEQ koala habitat - locally refined]</p>	<p>Railway station</p>
<p>MSES protected area [special wildlife reserves]</p>	
<p>MSES wildlife habitat [sea turtle nesting areas]</p>	
<p>Places: My Places</p> <ul style="list-style-type: none"> Girrahween Camp 2 	
<p>Green bridges</p>	
<p>Bridges</p>	
<p>Tunnels</p>	
<p>Cities and Towns</p>	
<p>Railway</p>	



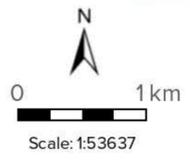
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Legend

Attribution

RVM - all

- Category A
- Category B
- Category C
- Category R
- Category X
- Water
- Not Categorised

Places: My Places

- Girrahween Camp 2

Cities and Towns

-

Green bridges

- ≡≡

Bridges

- ≡

Tunnels

-

Railway

-

Railway station

- 

Roads and tracks

- Motorway
- Highway
- Secondary
- Connector
- Local
- Restricted Access Road
- Mall
- Busway
- Bikeway
- Restricted Access Bikeway
- Walkway
- Restricted Access Walkway
- Non-vehicular Track
- Track
- Restricted Access Track
- Ferry
- - Proposed Thoroughfare

Earthstar Geographics

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Appendix B

MEDLI Results Summary

Enterprise: Girrahween Temporary Accommodation Camp (SITE 2) Assessment**Description:**

Scenarios to assess the effluent irrigation scheme sizing

Client: Arrow Energy

MEDLI User: GHDNET\lekuskopf

Scenario Details:

IRRIGATION LOAD SCENARIO: 250EP

10-year run period

TN=30, TP=20, EC=1600



Climate Data: Girrahween Camp 2_-26.50_150.25, -26.5°, 150.25°

Run Period: 01/01/2013 to 31/12/2022 10 years, 0 days

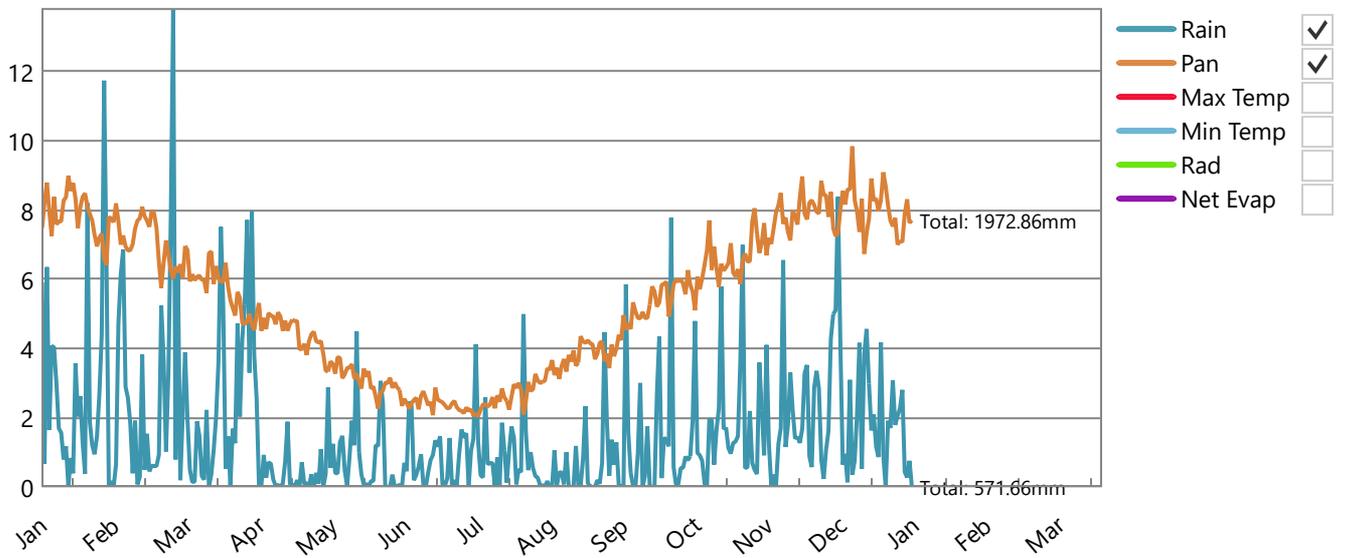
Climate Statistics:

	10th <input type="checkbox"/> Percentile	50th Percentile	90th <input type="checkbox"/> Percentile
Rainfall (mm/year)	346	544	889
Pan Evaporation (mm/year)	1643	2005	2250

Climate Data:

- Chart Table
 Monthly Daily

Daily Average Across Run Period



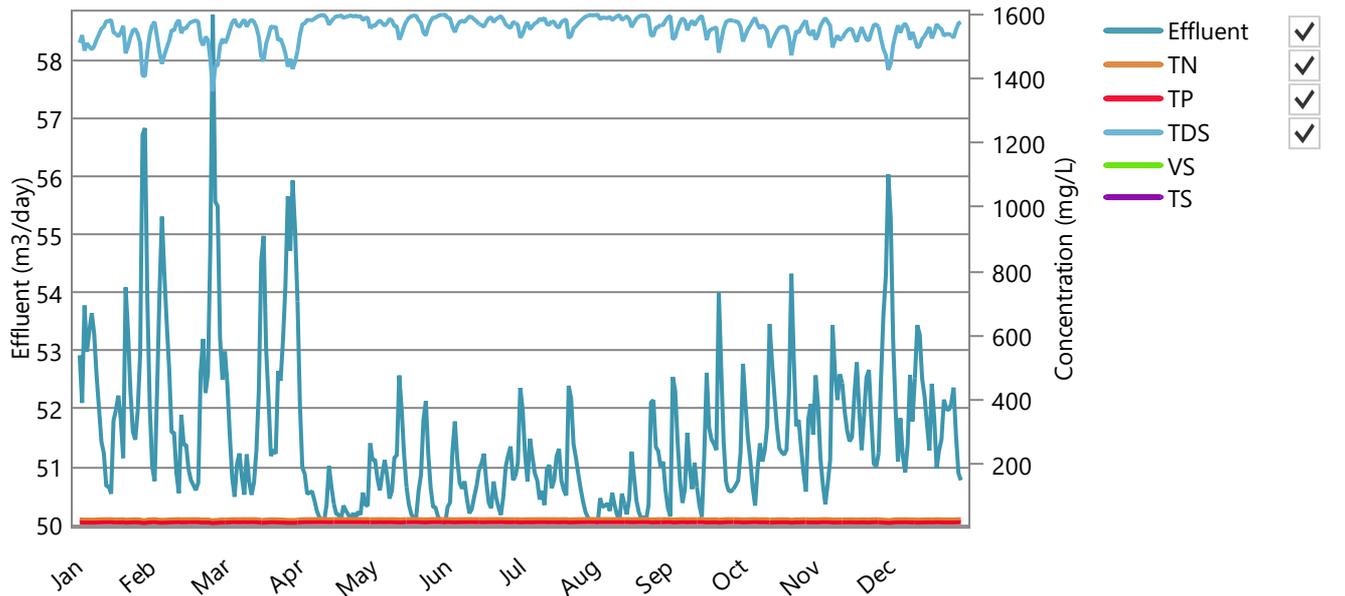
DESCRIPTION



Effluent type: Girrahween Temp Accom STP - Indicative

Wastestream before any recycling or pretreatment

Average daily quantity and flow-weighted average quality:



DESCRIPTION

Wastestream after any recycling and pretreatment if applicable

Effluent quantity: 18811.65 m3/year or 51.51 m3/day (Min-Max: 50.00 - 94.56)

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

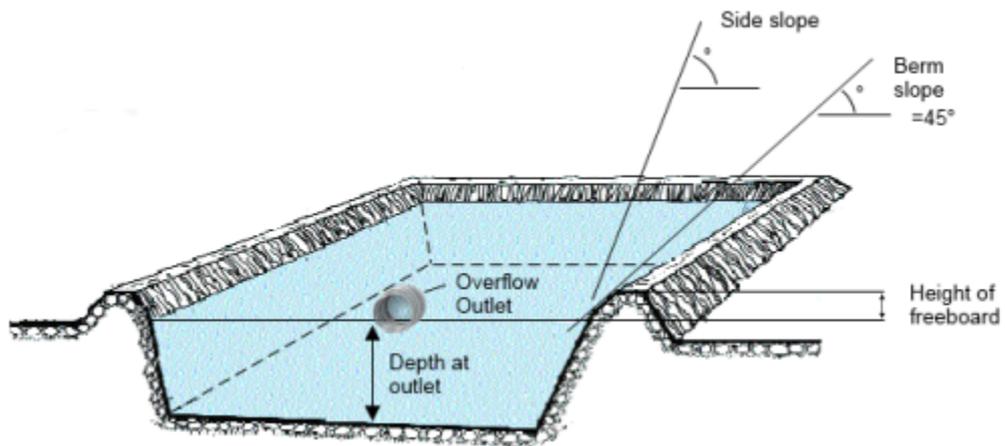
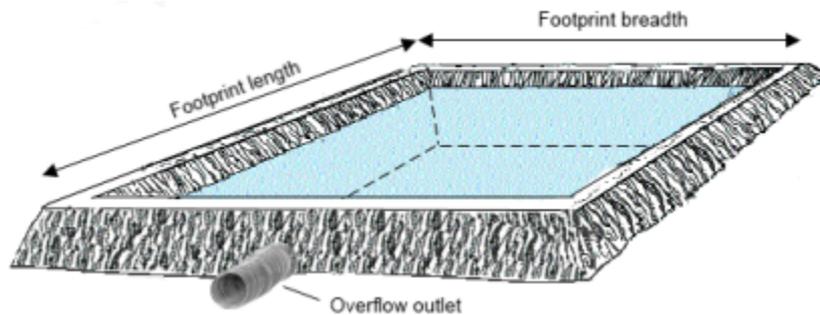
	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	29.12 (15.86 - 30.00)	547.80 (547.50 - 549.00)
Total Phosphorus	19.41 (10.58 - 20.00)	365.20 (365.00 - 366.00)
Total Dissolved Salts	1553.08 (846.03 - 1600.00)	29216.00 (29200.00 - 29280.00)
Volatile Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)



Pond system: 1 closed storage tank

Pond system details:

	Pond 1
Maximum pond volume (m3)	150.00
Minimum allowable pond volume (m3)	0.00
Pond depth at overflow outlet (m)	1.00
Maximum water surface area (m2)	166.00
Pond footprint length (m)	12.88
Pond footprint width (m)	12.88
Pond catchment area (m2)	166.00
Average active volume (m3)	1.58



Irrigation pump limits:

Minimum pump rate limit (ML/day)	0.00
Maximum pump rate limit (ML/day)	10000.00

Shandyng water:

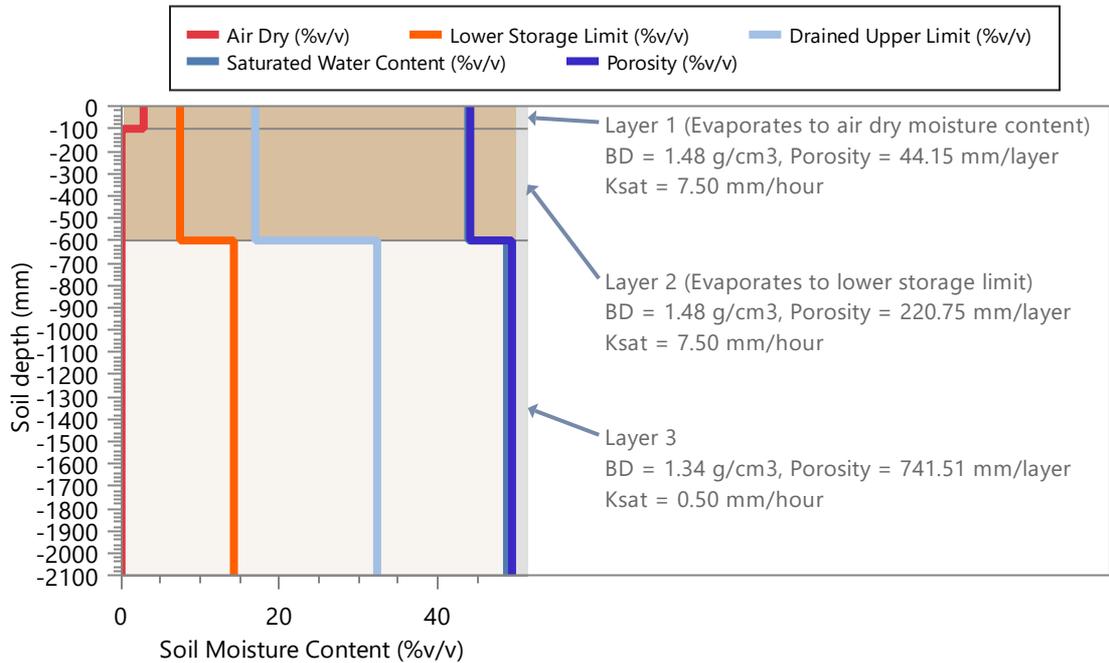
Annual allocation of fresh water available for shandyng (m3/year)	0.00
Maximum rate of application of fresh water (ML/day)	0.00
Nitrogen concentration (mg/L)	0.00
Salinity (dS/m)	0.00
Minimum shandy water is used	False

Land: Girrahween Temp Accom Applicatio

Area (m2): 19725.00

Soil Type: Sodosols representation_conserva, 2100.00 mm defined profile depth

Profile Porosity (mm)	1006.42
Profile saturation water content (mm)	995.40
Profile drained upper limit (or field capacity) (mm)	588.00
Profile lower storage limit (or permanent wilting point) (mm)	259.50
Profile available water capacity (mm)	328.50
Profile limiting saturated hydraulic conductivity (mm/hour)	0.50
Surface saturated hydraulic conductivity (mm/hour)	7.50
Runoff curve number II (coefficient)	83.00
Soil evaporation U (mm)	10.00
Soil evaporation Cona (mm/sqrt day)	4.00



Plant Data: Continuous Kikuyu 1 Pasture

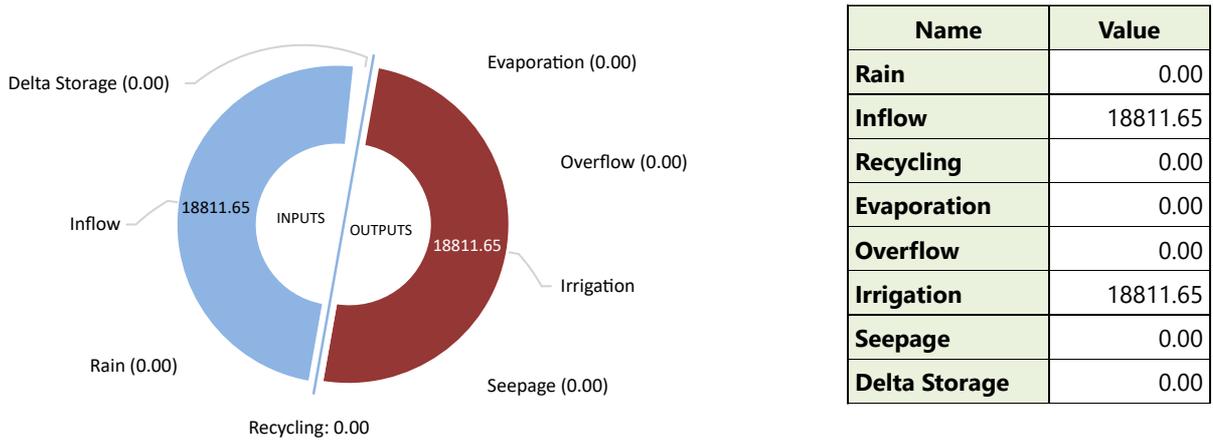
Average monthly cover (fraction) (minimum - maximum)	0.87 (0.83 - 0.90)
Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 0.8 x Pan coefficient 1)	0.80
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Maximum potential root depth in defined soil profile (mm)	1200.00
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

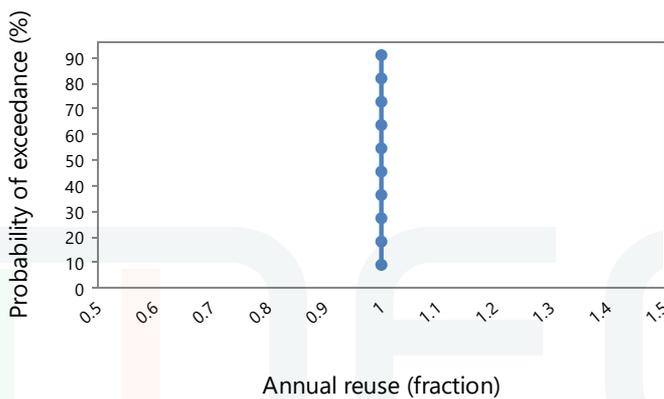
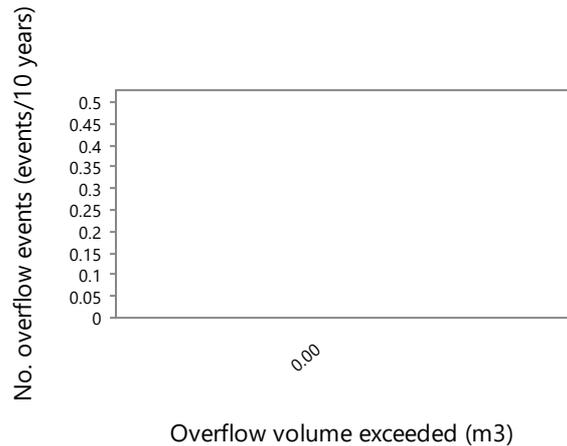
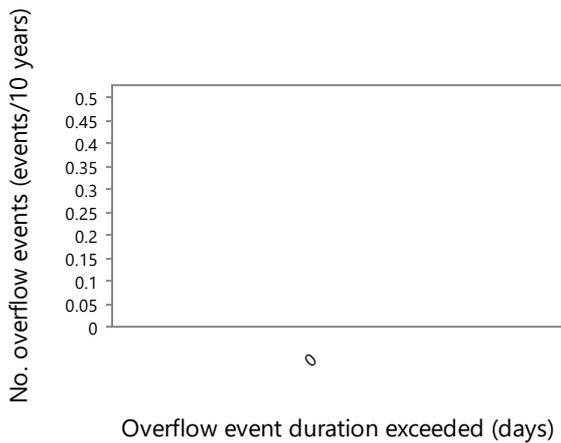
Capacity of wet weather storage pond: **150 m3**

Pond System Water Balance (m3/year)



Overflow Diagnostics

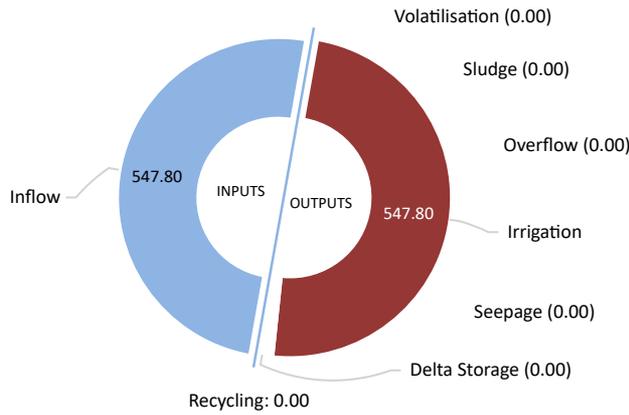
Volume of overflow (m3/year)	0.00
No. days pond overflows (days/year)	0.00
Average duration of overflow (days)	0.00
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	1.00
Probability of at least 90% reuse (fraction)	1.00



Pond System Performance - Nutrient: 1 closed storage tank

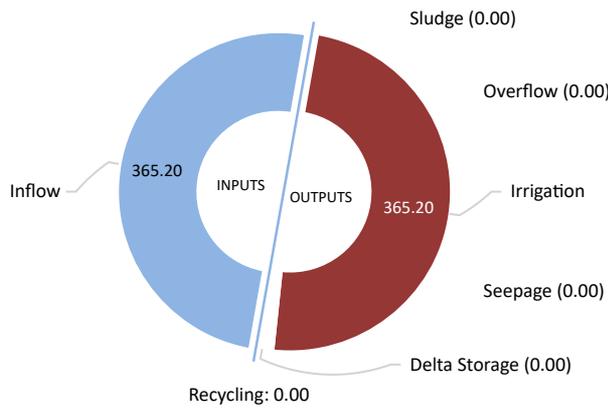
Pond System Nutrients and Salt Balance:

Nitrogen Balance (kg/year)



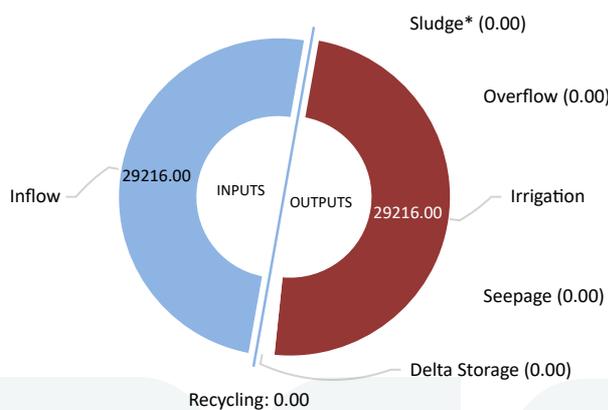
Name	Value
Inflow	547.80
Recycling	0.00
Volatilisation	0.00
Sludge	0.00
Overflow	0.00
Irrigation	547.80
Seepage	0.00
Delta Storage	0.00

Phosphorus Balance (kg/year)



Name	Value
Inflow	365.20
Recycling	0.00
Sludge	0.00
Overflow	0.00
Irrigation	365.20
Seepage	0.00
Delta Storage	0.00

Salt Balance (kg/year)



Name	Value
Inflow	29216.00
Recycling	0.00
Sludge*	0.00
Overflow	0.00
Irrigation	29216.00
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)	24.41
Average phosphorus concentration of pond liquid (mg/L)	16.27
Average salinity of pond liquid (dS/m)	2.03

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 (m3/year)	18811.65
Average Shandy water irrigation (m3/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Total water irrigated (m3/year)	18811.65
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Proportion of years shandying water allocation of 0 m3/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)	29.12
Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)	24.46
Average phosphorus concentration of irrigation water (mg/L)	19.41
Average salinity of irrigation water (dS/m)	2.43

Irrigation Diagnostics:

Proportion of Days irrigation occurs (fraction)	1.00
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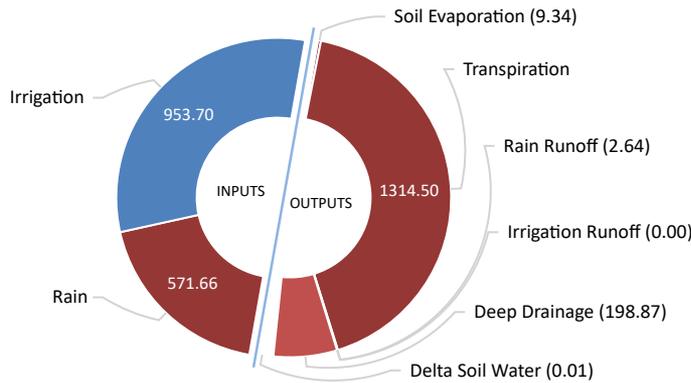
Land Performance - Soil Water

Paddock: **Girrahween Temp Accom Applicatio, 19725 m2**

Soil Type: **Sodosols representation_conserva, 165.60 mm PAWC at maximum root depth**

Land Water Balance (mm/year):

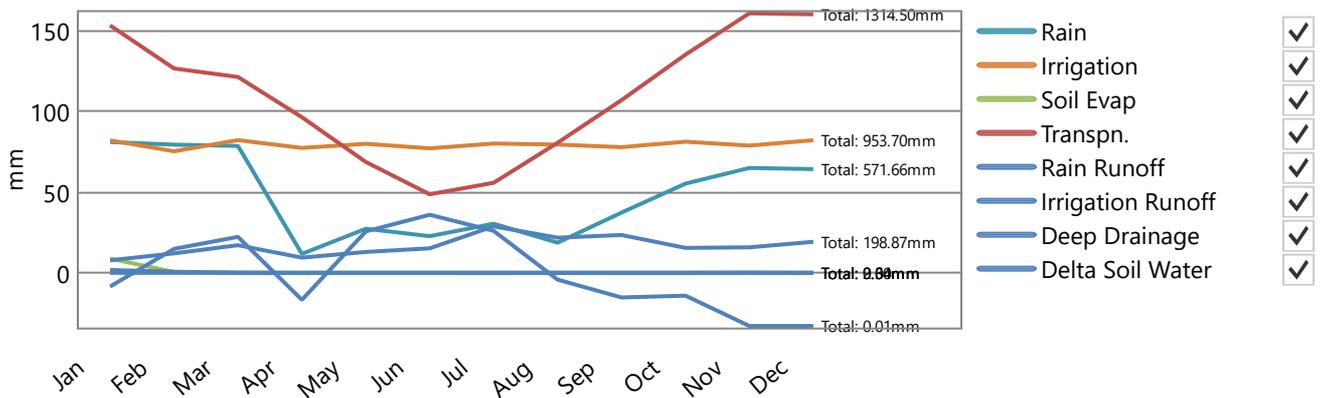
mm/year % Total inputs



Name	Value
Rain	571.66
Irrigation	953.70
Soil Evaporation	9.34
Transpiration	1314.50
Rain Runoff	2.64
Irrigation Runoff	0.00
Deep Drainage	198.87
Delta Soil Water	0.01

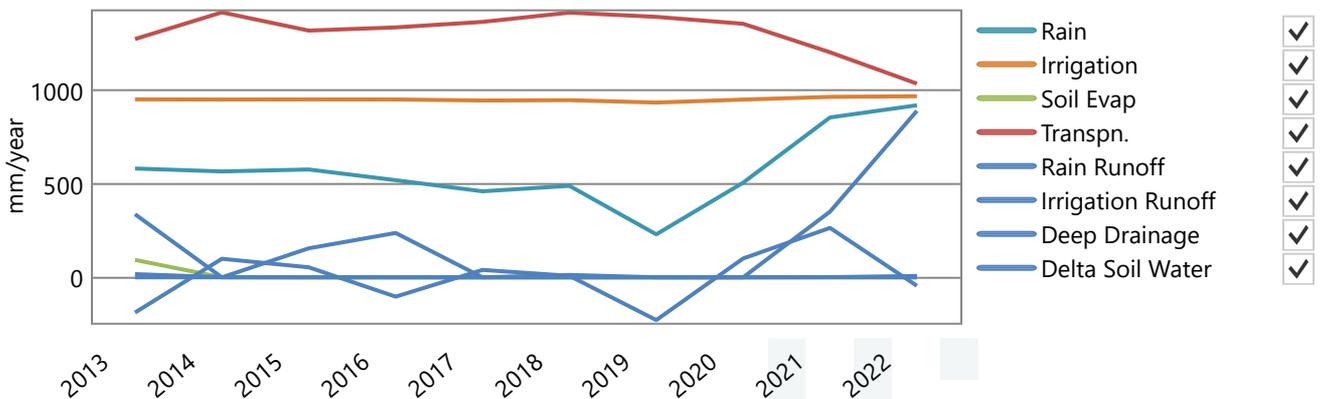
Average Monthly Totals (mm):

Chart Table



Average Annual Totals (mm/year):

Chart Table



PERFORMANCE



Land Performance - Soil Nutrient

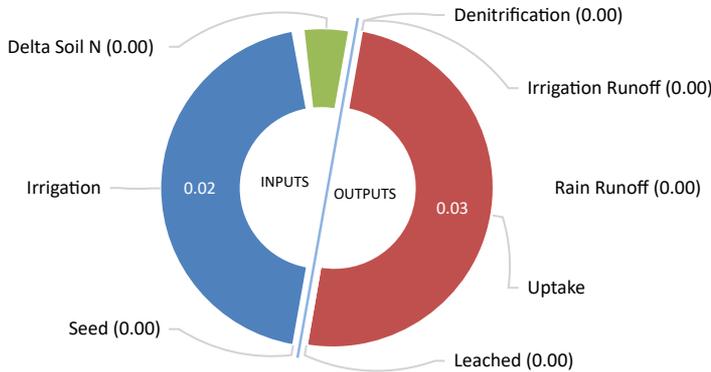
Paddock: **Girrahween Temp Accom Applicatio, 19725 m2 representation_conserva**

Soil Type: **Sodosols**

Irrigation ammonium volatilisation losses (kg/m2/year): 0.00

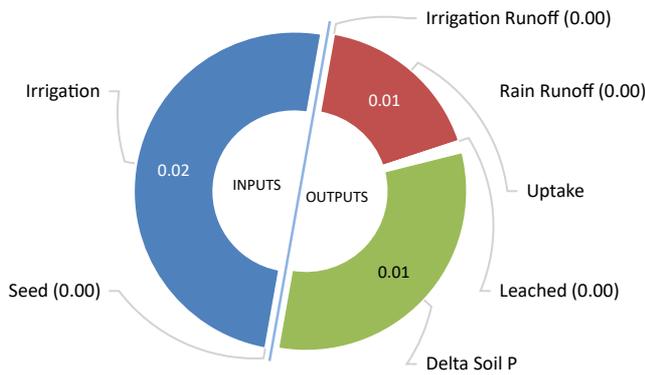
Proportion of total nitrogen in irrigated effluent as ammonium (fraction): 0.80

Land Nitrogen Balance (kg/m2/year)



Name	Value
Seed	1.05E-05
Irrigation	0.02
Denitrification	2.06E-07
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	0.03
Leached	2.98E-05
Delta Soil N	-2.39E-03

Land Phosphorus Balance (kg/m2/year)



Name	Value
Seed	9.00E-07
Irrigation	0.02
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	0.01
Leached	2.18E-05
Delta Soil P	0.01

PERFORMANCE

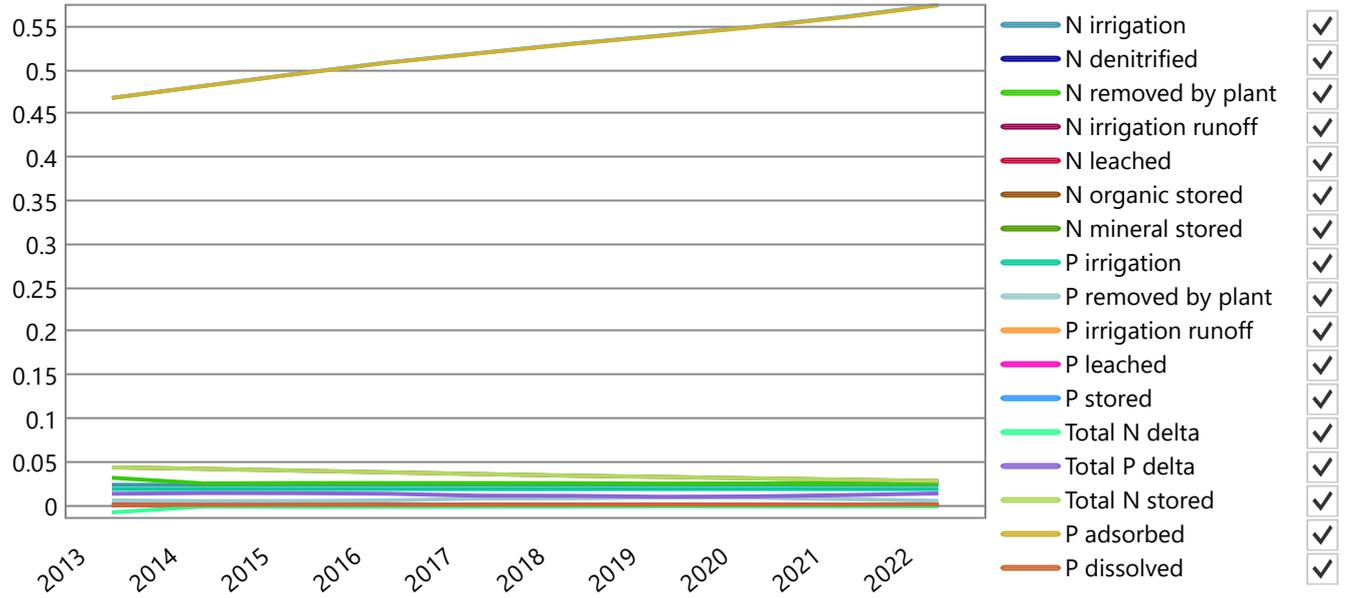


Land Performance - Soil Nutrient

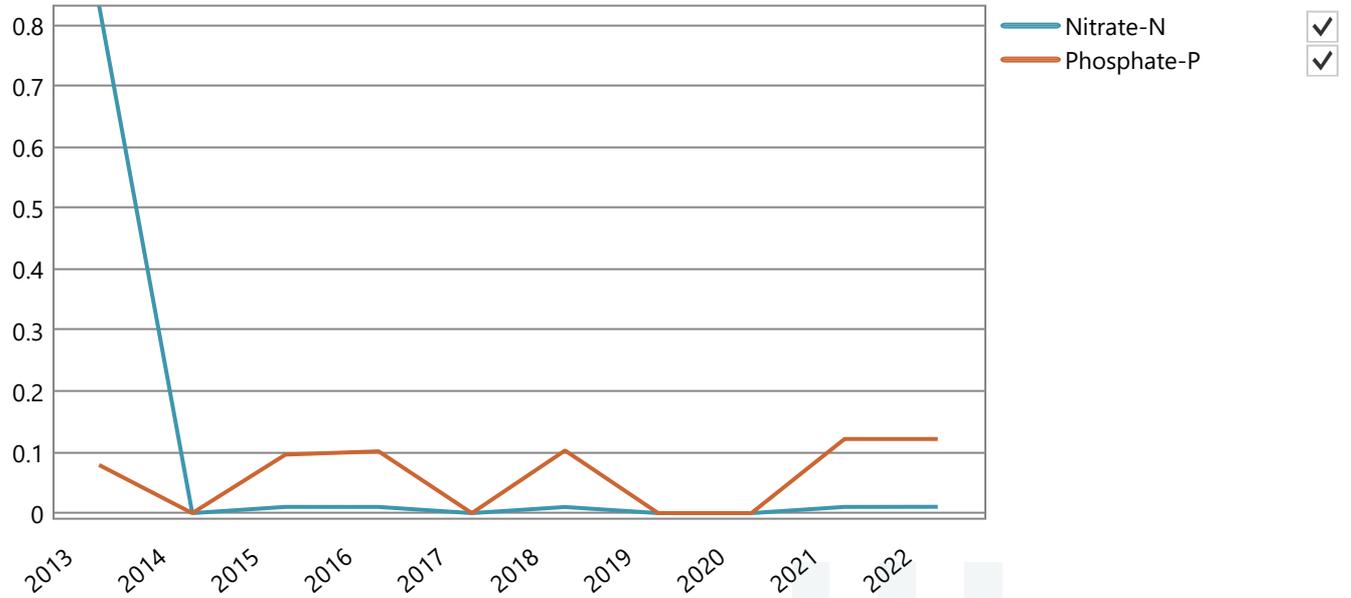
Paddock: Girrahween Temp Accom Applicatio, 19725 m2
representation_conserva

Soil Type: Sodosols

Annual Nutrient Totals (kg/m2):



Annual Nutrient Leaching Concentration (mg/L):



PERFORMANCE



Plant Performance and Nutrients

Paddock: Girrahween Temp Accom Applicatio, 19725 m2 representation_conserva

Soil Type: Sodosols

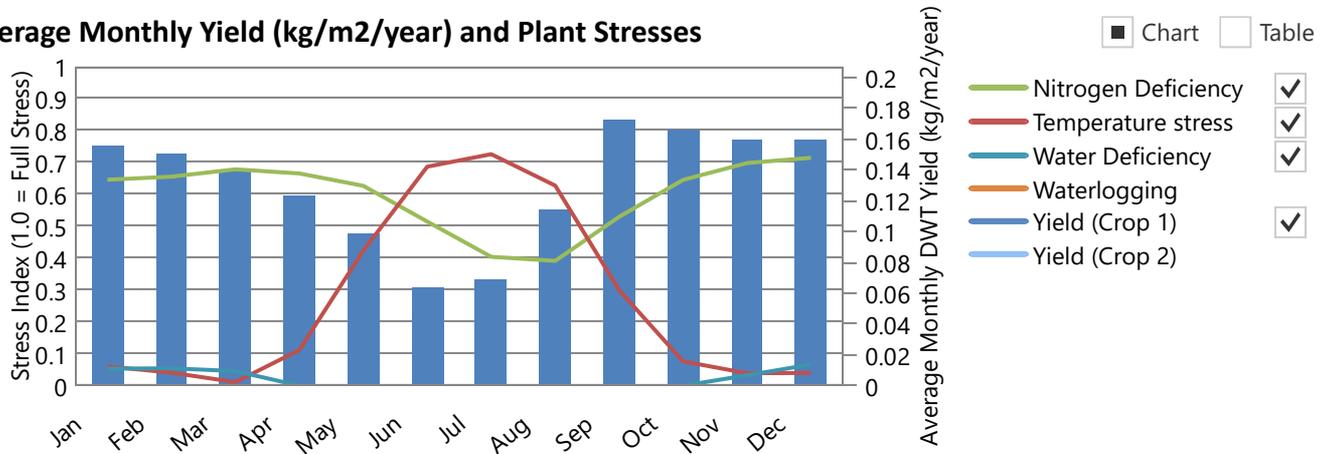
Plant: Continuous Kikuyu 1 Pasture

Average annual shoot dry matter yield (kg/m2/year)	1.58 (1.45 - 1.80)
Average monthly plant (green) cover (fraction) (minimum - maximum)	0.87 (0.83 - 0.90)
Average monthly root depth (mm) (minimum - maximum)	1194.08 (1131.62 - 1200.00)

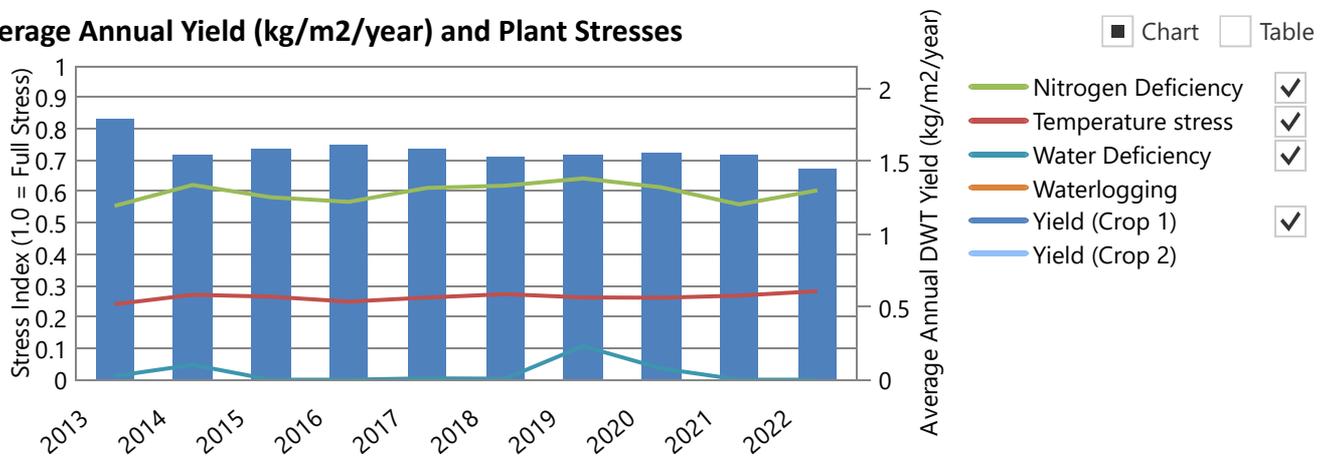
Nutrient Uptake (minimum - maximum):

Average annual net nitrogen removed by plant uptake (kg/m2/year)	0.03 (0.02 - 0.03)
Average annual net phosphorus removed by plant uptake (kg/m2/year)	0.01 (0.00 - 0.01)
Average annual shoot nitrogen concentration (fraction dwt)	0.02 (0.02 - 0.02)
Average annual shoot phosphorus concentration (fraction dwt)	0.004 (0.003 - 0.006)

Average Monthly Yield (kg/m2/year) and Plant Stresses



Average Annual Yield (kg/m2/year) and Plant Stresses



No. of harvests/year: 2.80 (normal)

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



Land Performance

Paddock: Girrahween Temp Accom Applicatio, 19725 m2 representation_conserva

Soil Type: Sodosols

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

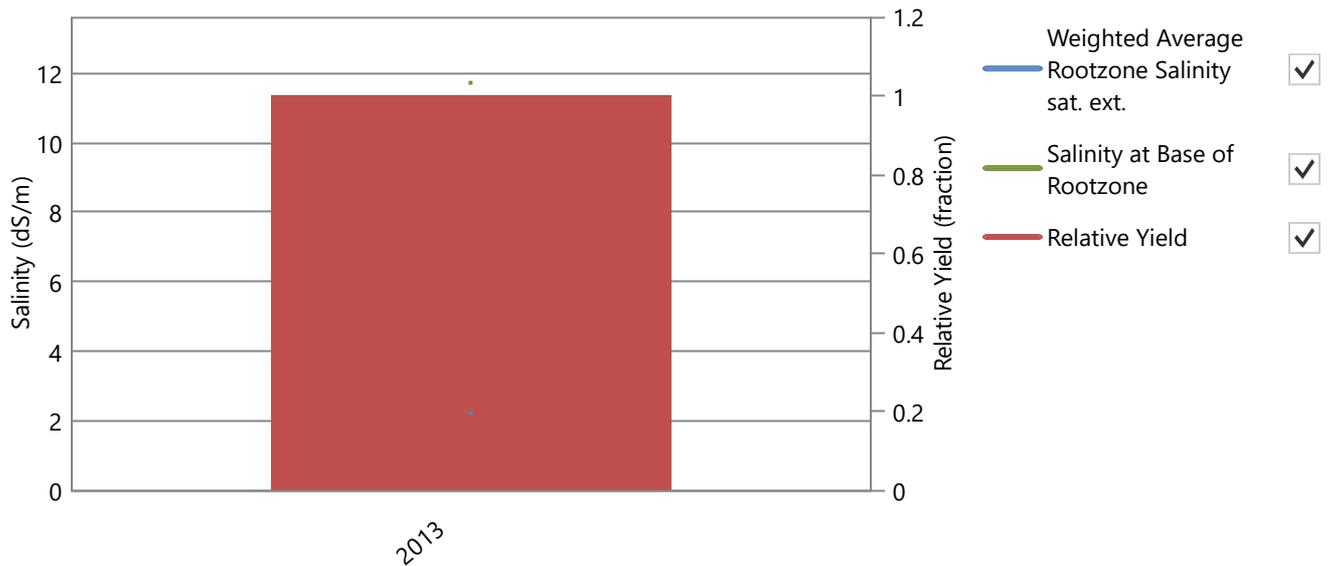
Soil Salinity:

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	1.53
Salt added by rainfall (kg/m2/year)	0.01
Average annual effluent salt added & leached at steady state (kg/m2/year)	1.49
Average leaching fraction based on 10 year running averages (fraction)	0.31
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	2.22
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	11.72
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



PERFORMANCE

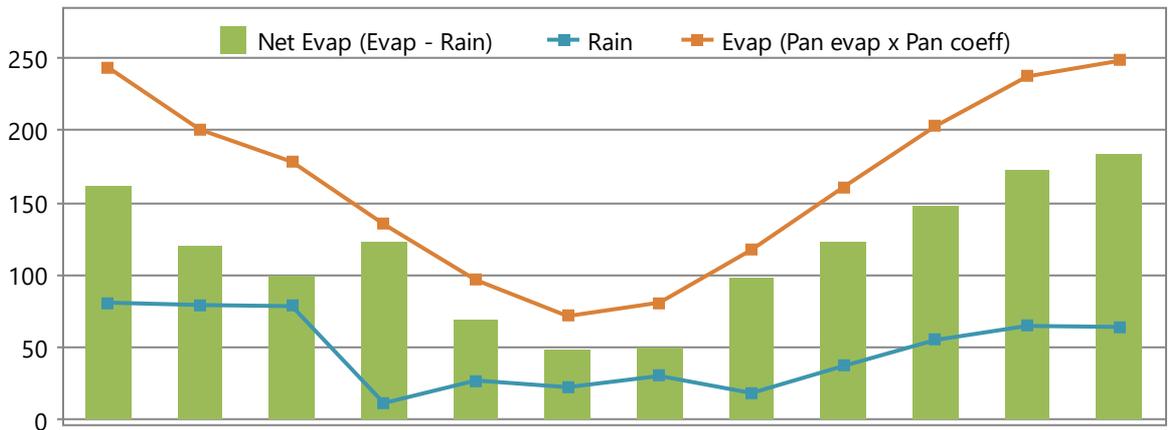


Sustainability Diagnostics: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Averaged Historical Climate Data Used in Simulation (mm)

Location: Girrahween Camp 2_-26.50_150.25, -26.5°, 150.25°

Run Period: 01/01/2013 to 31/12/2022 10 years, 0 days



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	81.0	79.4	78.6	11.7	27.3	22.7	30.4	18.7	37.3	55.3	65.0	64.3	571.7
Evap	243.4	200.4	178.3	135.2	96.7	71.8	81.1	117.5	160.7	202.8	237.2	247.9	1972.9
Net Evap	162.3	121.0	99.7	123.5	69.4	49.1	50.6	98.8	123.4	147.5	172.2	183.7	1401.2
Net Evap/day	5.2	4.3	3.2	4.1	2.2	1.6	1.6	3.2	4.1	4.8	5.7	5.9	3.8



Sustainability Diagnostics: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Pond System: 1 closed storage tank

Girrahween Temp Accom STP - Indicative - 18811.65 m3/year or 51.51 m3/day generated on average

Effluent entering pond system after any pretreatment and recycling

Average (Minimum-Maximum) influent quality calculated for 365.20 non-zero flow days, after any pretreatment and recycling.

Constituent	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	29.12 (15.86 - 30.00)	547.80 (547.50 - 549.00)
Total Phosphorus	19.41 (10.58 - 20.00)	365.20 (365.00 - 366.00)
Total Dissolved Salts	1553.08 (846.03 - 1600.00)	29216.00 (29200.00 - 29280.00)
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)

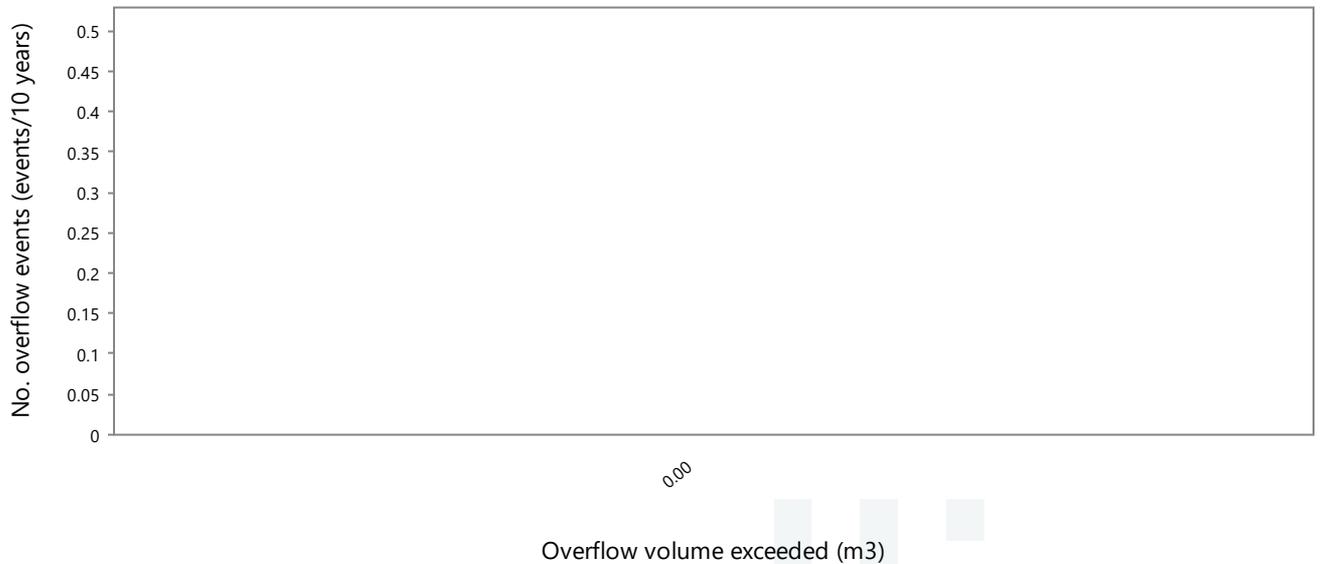
Last pond (Wet weather store): 150.00 m3

Theoretical hydraulic retention time (days)	2.91
Average volume of overflow (m3/year)	0.00
No. overflow events per year exceeding threshold* of 0.17 m3 (no./year)	0.00
Average duration of overflow (days)	0.00
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)	2.03
Salinity of last pond on final day of simulation (dS/m)	2.50
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: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Irrigation Information

Irrigation: 19725 m2 total area (assumed 100% irrigation efficiency)

	Quantity/year	Quantity/m2/year
Total irrigation applied (m3)	18811.65	0.95
Total nitrogen applied (kg)	460.15	0.02
Total phosphorus applied (kg)	365.20	0.02
Total salts applied (kg)	29216.00	1.48

Shandyng

Annual allocation of fresh water for shandyng (m3/year)	0.00
Average Shandy water irrigation (m3/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 shandyng (fraction of events)	0.00
Minimum shandy water is used	False

Irrigation Issues

Proportion of Days irrigation occurs (fraction)	1.00
---	------

Sustainability Diagnostics: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Paddock Land: Girrahween Temp Accom Applicatio: 19725 m2

Irrigation: Fixed Sprinkler with 0.2% ammonium loss during irrigation

Irrigation triggered every 1 days
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): Sodosols representation_conserva, 165.60 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	81.0	79.4	78.6	11.7	27.3	22.7	30.4	18.7	37.3	55.3	65.0	64.3	571.7
Irrigation	82.1	75.3	82.2	77.4	79.9	77.1	80.1	79.5	77.9	81.3	78.8	82.2	953.7
Soil Evap	8.8	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.3
Transpn.	153.3	126.6	121.3	96.4	68.7	48.7	55.8	80.6	107.0	135.2	160.8	160.2	1314.5
Rain Runoff	1.7	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	2.6
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	7.8	12.1	17.1	9.4	12.9	15.2	28.8	21.8	23.4	15.4	15.8	19.2	198.9
Delta	-8.5	14.9	22.3	-16.7	25.6	36.0	26.0	-4.2	-15.3	-14.1	-32.9	-32.9	0.0

Soil Nitrogen Balance

Average annual effluent nitrogen added (kg/m2/year)	0.02
Average annual soil nitrogen removed by plant uptake (kg/m2/year)	0.03
Average annual soil nitrogen removed by denitrification (kg/m2/year)	2.06E-07
Average annual soil nitrogen leached (kg/m2/year)	2.98E-05
Average annual nitrate-N loading to groundwater (kg/m2/year)	2.98E-05
Soil organic-N kg/m2 (Initial - Final)	0.04 - 0.03
	0.01 - 5.88E-06
Average nitrate-N concentration of deep drainage (mg/L)	0.15
Max. annual nitrate-N concentration of deep drainage (mg/L)	0.83

Soil Phosphorus Balance

Average annual effluent phosphorus added (kg/m2/year)	0.02
Average annual soil phosphorus removed by plant uptake (kg/m2/year)	0.01
Average annual soil phosphorus leached (kg/m2/year)	2.18E-05
Dissolved phosphorus (kg/m2) (Initial - Final)	5.88E-05 - 5.04E-04
Adsorbed phosphorus (kg/m2) (Initial - Final)	0.45 - 0.57
Average phosphate-P concentration in rootzone (mg/L)	1.01
Average phosphate-P concentration of deep drainage (mg/L)	0.11
Max. annual phosphate-P concentration of deep drainage (mg/L)	0.12
Design soil profile storage life based on average infiltrated water phosphorus concn. of 12.16 mg/L (years)	45.71



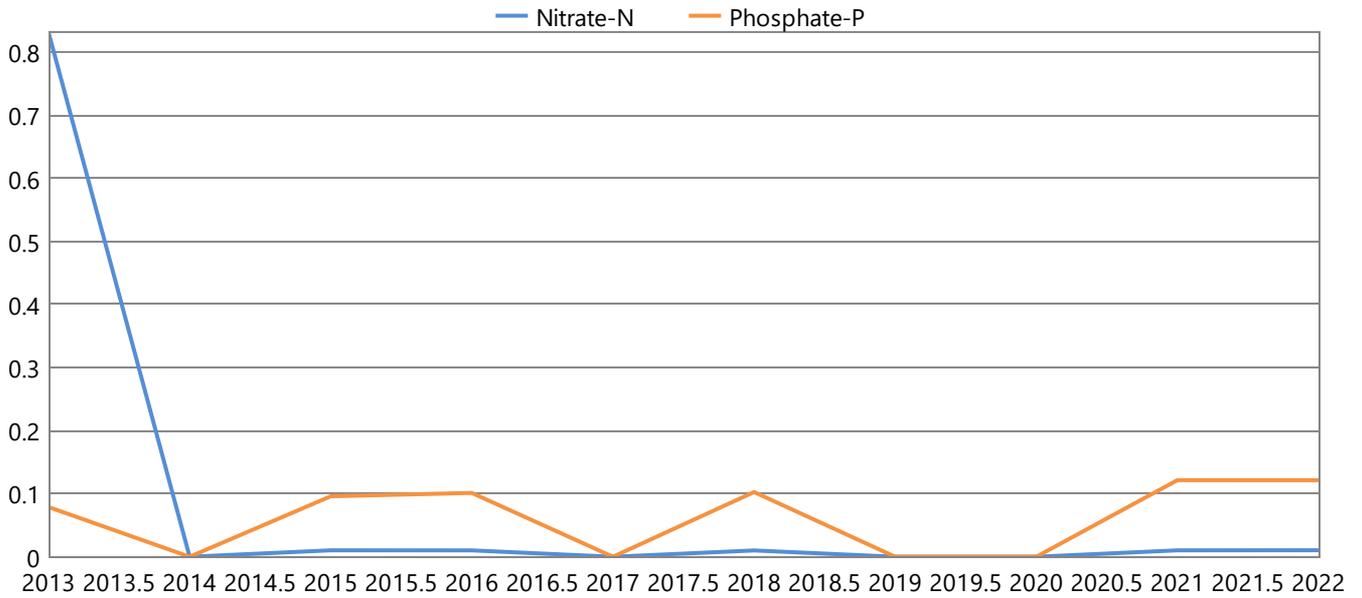
DIAGNOSTICS

Sustainability Diagnostics: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

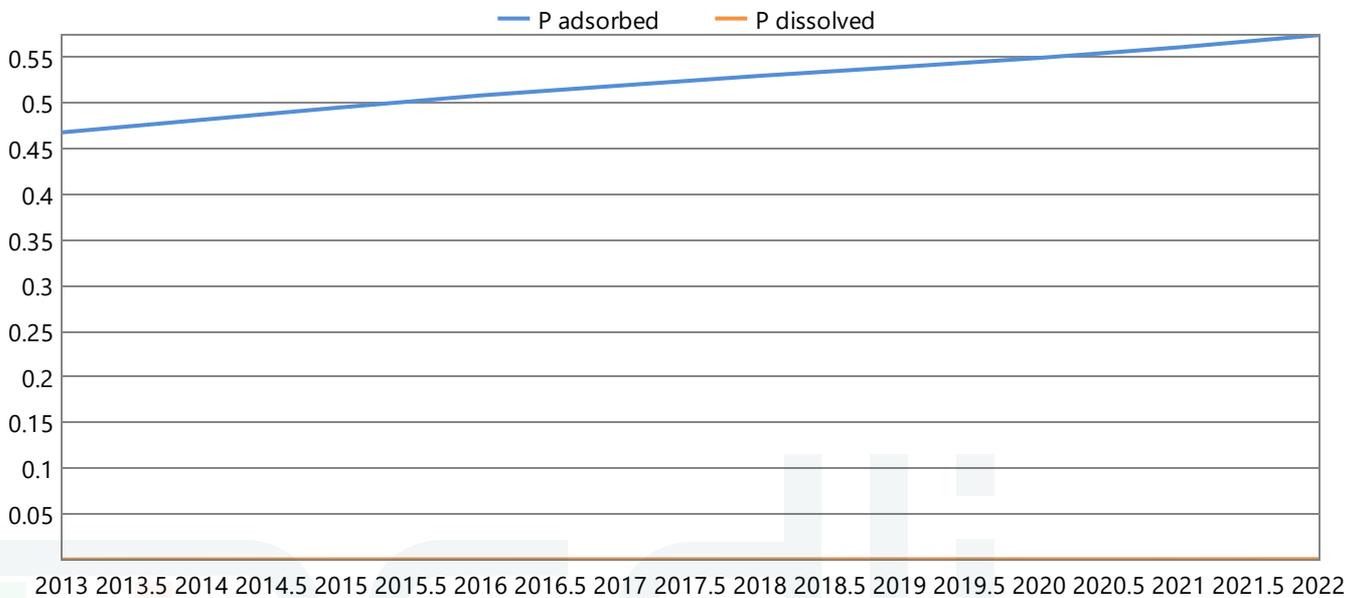
Paddock Land: Girrahween Temp Accom Applicatio: 19725 m2

Irrigation: Fixed Sprinkler with 0.2% ammonium loss during irrigation

Annual nutrient leachate concentration (mg/L)



Annual Phosphate-P in soil (kg/m2)



Sustainability Diagnostics: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Paddock Plant Performance: Girrahween Temp Accom Applicatio: 19725 m2

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

Average annual shoot dry matter yield (kg/m ² /year)	1.58 (1.45 - 1.80)
Average monthly plant (green) cover (fraction)	0.87 (0.83 - 0.90)
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)	1194.08 (1131.62 - 1200.00)
Average number of normal harvests per year (no./year)	2.80 (2.00 - 3.00)
Average number of normal harvests for last five years only (no./year)	2.80
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)	0.60 (0.55 - 0.64)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.06 (0.01 - 0.12)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.73 (0.60 - 0.85)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.02 (0.00 - 0.07)
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)	1.53
Salt added by rainfall (kg/m ² /year)	0.01
Average annual effluent salt added & leached at steady state (kg/m ² /year)	1.49
Average leaching fraction based on 10 year running averages (fraction)	0.31
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	2.22
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	11.72
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



Run Messages

Messages generated when the scenario was run:

Full run chosen

DIAGNOSTICS



Enterprise: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Description:

Scenarios to assess the effluent irrigation scheme sizing

Client: Arrow Energy

MEDLI User: GHDNET\lekuskopf

Scenario Details:

NO IRRIGATION CASE: 250EP

MEDLI REPORT - FULL RUN



Climate Data: Girrahween Camp 2_-26.50_150.25, -26.5°, 150.25°

Run Period: 01/01/2013 to 31/12/2022 10 years, 0 days

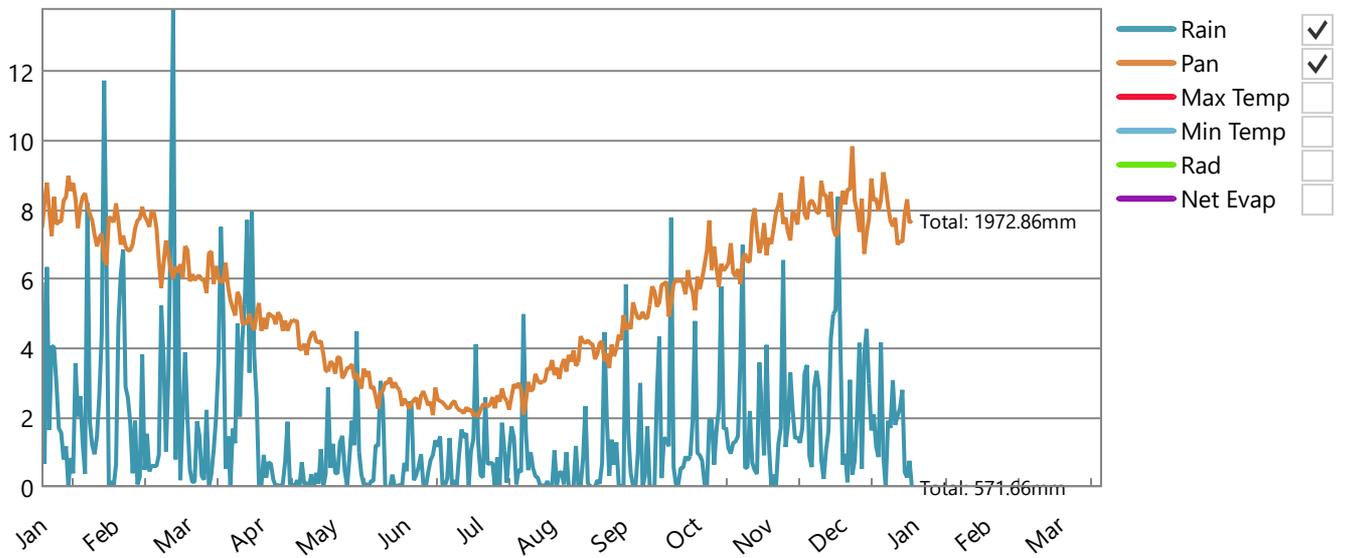
Climate Statistics:

	10th <input type="checkbox"/> Percentile	50th Percentile	90th <input type="checkbox"/> Percentile
Rainfall (mm/year)	346	544	889
Pan Evaporation (mm/year)	1643	2005	2250

Climate Data:

- Chart Table
 Monthly Daily

Daily Average Across Run Period



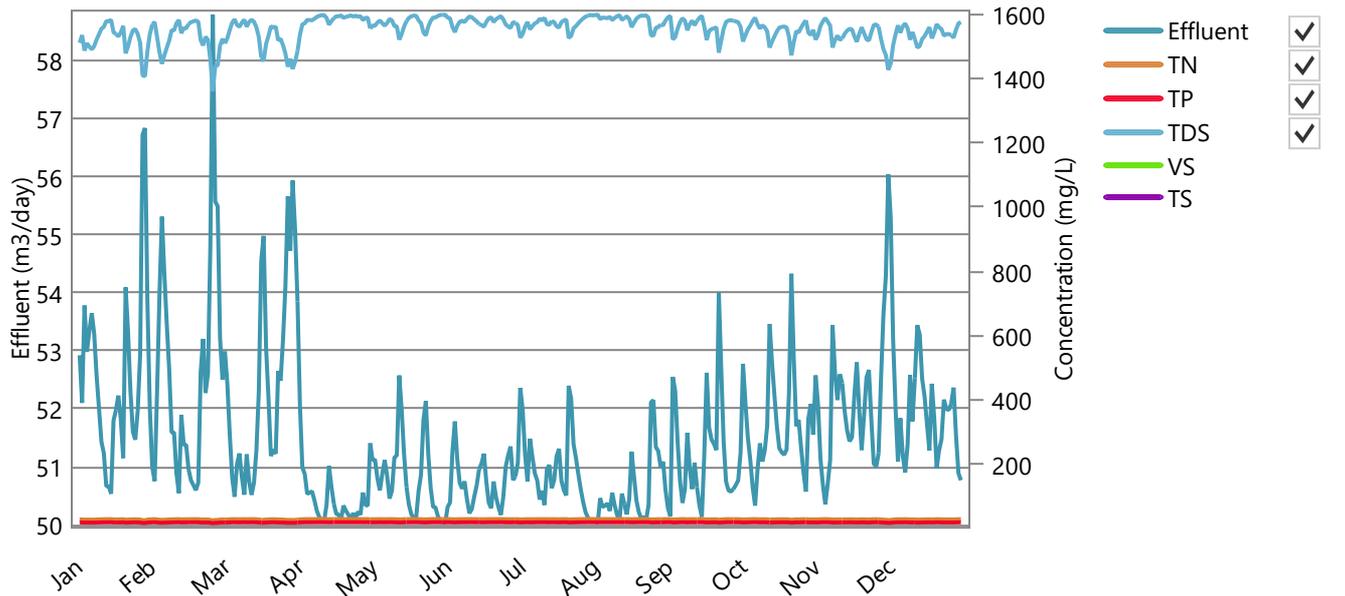
DESCRIPTION



Effluent type: Girrahween Temp Accom STP - Indicative

Wastestream before any recycling or pretreatment

Average daily quantity and flow-weighted average quality:



DESCRIPTION

Wastestream after any recycling and pretreatment if applicable

Effluent quantity: 18811.65 m3/year or 51.51 m3/day (Min-Max: 50.00 - 94.56)

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

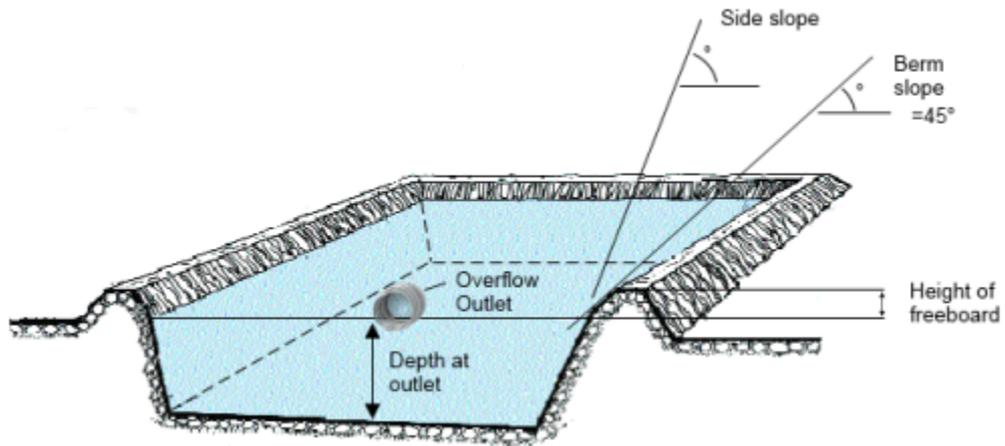
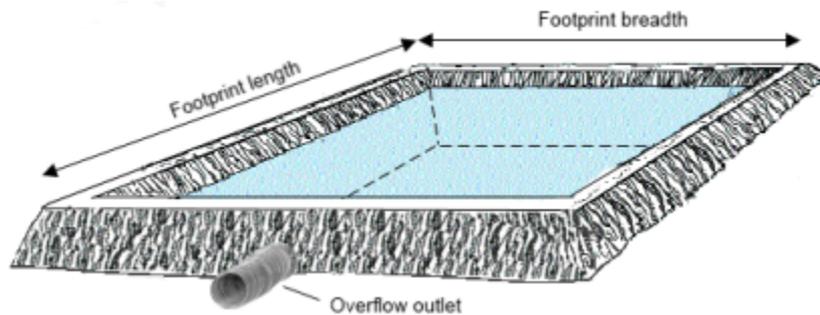
	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	29.12 (15.86 - 30.00)	547.80 (547.50 - 549.00)
Total Phosphorus	19.41 (10.58 - 20.00)	365.20 (365.00 - 366.00)
Total Dissolved Salts	1553.08 (846.03 - 1600.00)	29216.00 (29200.00 - 29280.00)
Volatile Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)



Pond system: 1 closed storage tank

Pond system details:

	Pond 1
Maximum pond volume (m3)	150.00
Minimum allowable pond volume (m3)	0.00
Pond depth at overflow outlet (m)	1.00
Maximum water surface area (m2)	166.00
Pond footprint length (m)	12.88
Pond footprint width (m)	12.88
Pond catchment area (m2)	166.00
Average active volume (m3)	149.96



Irrigation pump limits:

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

Shandyng water:

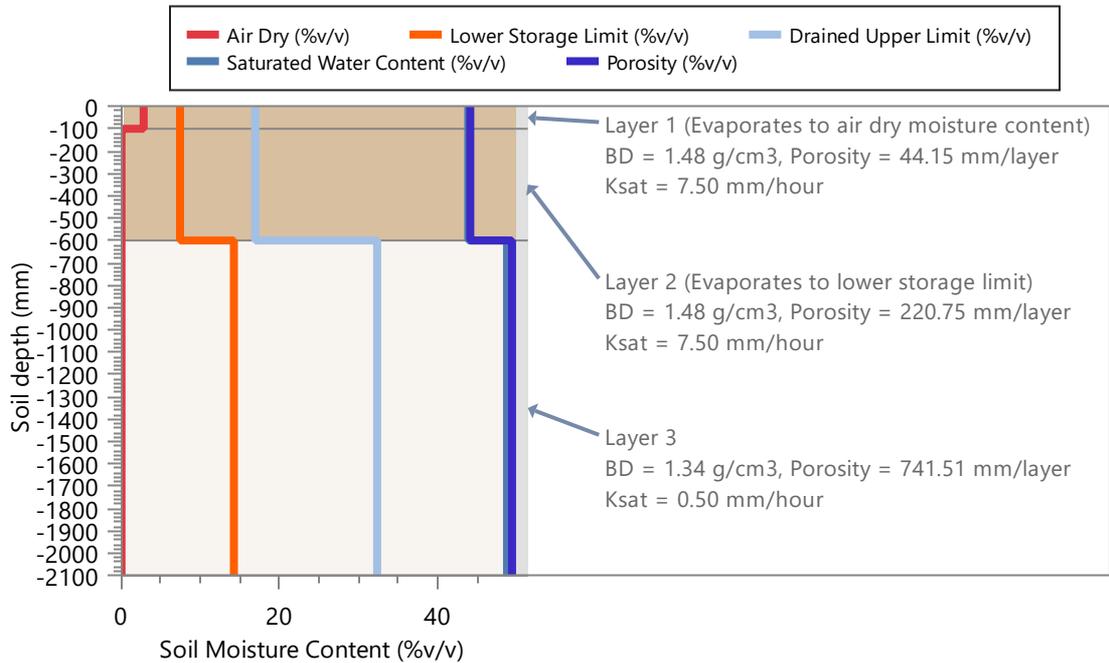
Annual allocation of fresh water available for shandyng (m3/year)	0.00
Maximum rate of application of fresh water (ML/day)	0.00
Nitrogen concentration (mg/L)	0.00
Salinity (dS/m)	0.00
Minimum shandy water is used	False

Land: Girrahween Temp Accom Applicatio

Area (m2): 19725.00

Soil Type: Sodosols representation_conserva, 2100.00 mm defined profile depth

Profile Porosity (mm)	1006.42
Profile saturation water content (mm)	995.40
Profile drained upper limit (or field capacity) (mm)	588.00
Profile lower storage limit (or permanent wilting point) (mm)	259.50
Profile available water capacity (mm)	328.50
Profile limiting saturated hydraulic conductivity (mm/hour)	0.50
Surface saturated hydraulic conductivity (mm/hour)	7.50
Runoff curve number II (coefficient)	83.00
Soil evaporation U (mm)	10.00
Soil evaporation Cona (mm/sqrt day)	4.00



Plant Data: Continuous Kikuyu 1 Pasture

Average monthly cover (fraction) (minimum - maximum)	0.29 (0.19 - 0.38)
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)	1200.00
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

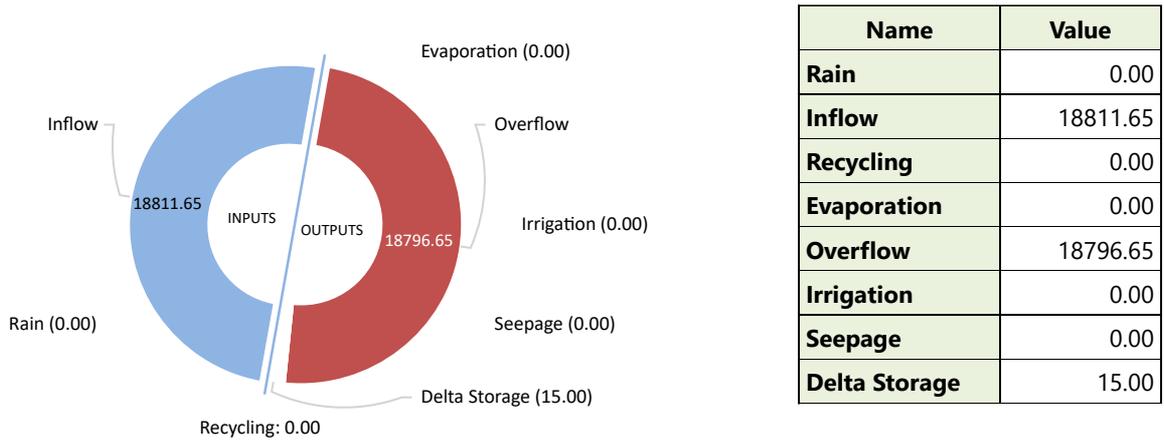


DESCRIPTION

Pond System Water Performance - Overflow: 1 closed storage tank

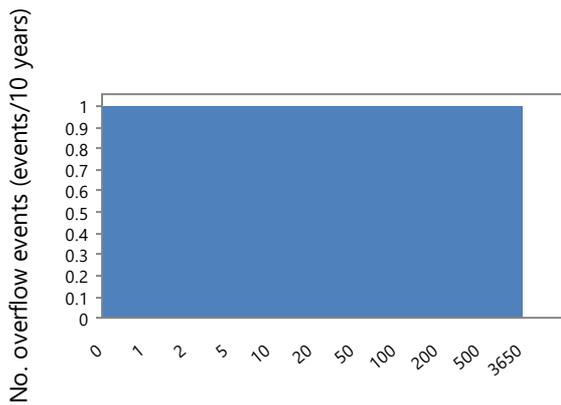
Capacity of wet weather storage pond: 150 m3

Pond System Water Balance (m3/year)

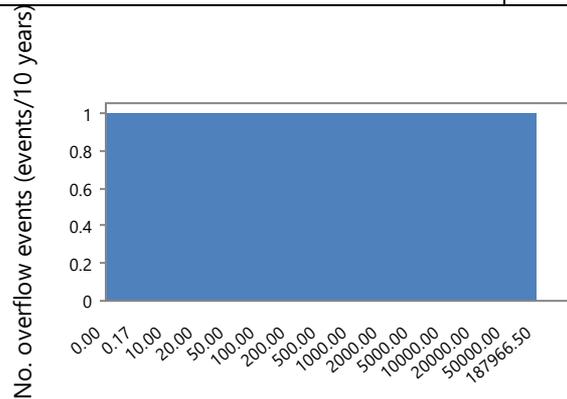


Overflow Diagnostics

Volume of overflow (m3/year)	18796.65
No. days pond overflows (days/year)	365.00
Average duration of overflow (days)	3650.00
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	0.00
Probability of at least 90% reuse (fraction)	0.00



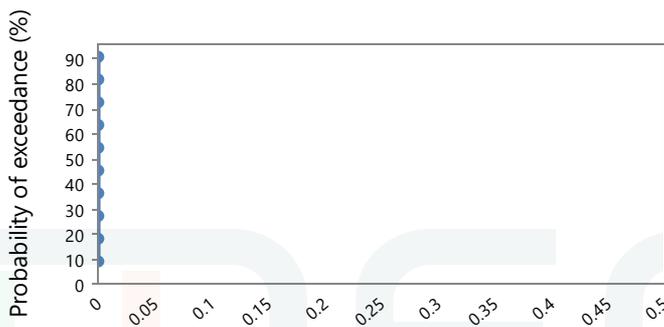
Overflow event duration exceeded (days)



Overflow volume exceeded (m3)

[Export plot](#)

[Export plot](#)



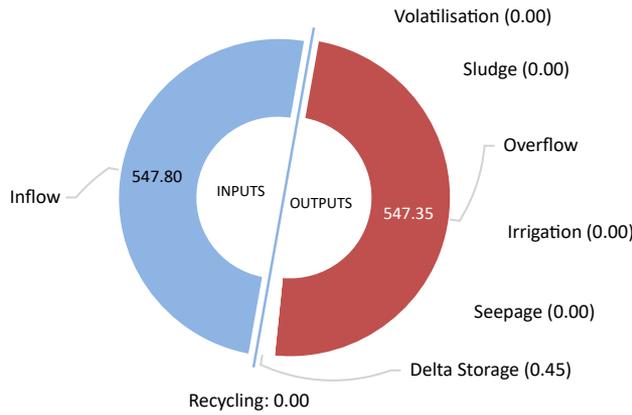
Annual reuse (fraction)

[Export plot](#)

Pond System Performance - Nutrient: 1 closed storage tank

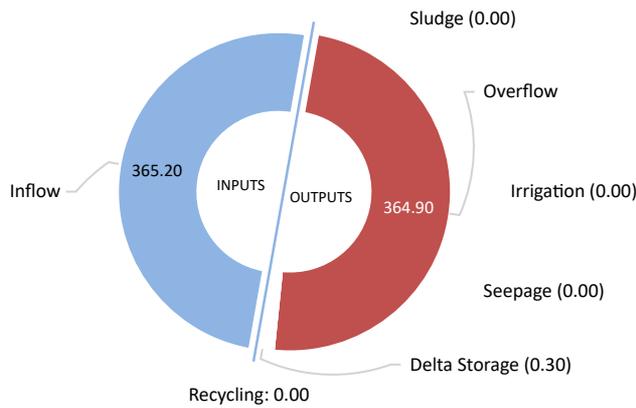
Pond System Nutrients and Salt Balance:

Nitrogen Balance (kg/year)



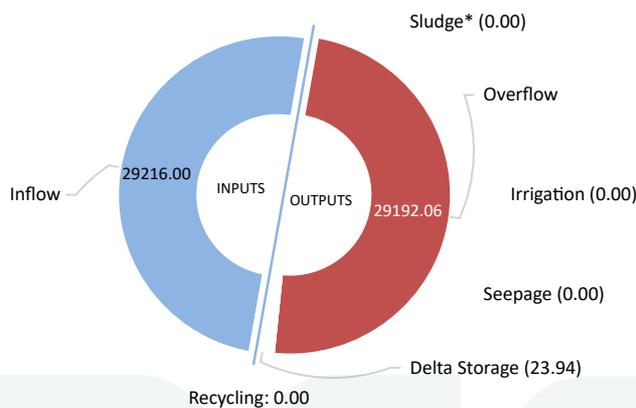
Name	Value
Inflow	547.80
Recycling	0.00
Volatilisation	0.00
Sludge	0.00
Overflow	547.35
Irrigation	0.00
Seepage	0.00
Delta Storage	0.45

Phosphorus Balance (kg/year)



Name	Value
Inflow	365.20
Recycling	0.00
Sludge	0.00
Overflow	364.90
Irrigation	0.00
Seepage	0.00
Delta Storage	0.30

Salt Balance (kg/year)



Name	Value
Inflow	29216.00
Recycling	0.00
Sludge*	0.00
Overflow	29192.06
Irrigation	0.00
Seepage	0.00
Delta Storage	23.94

* 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)	29.19
Average phosphorus concentration of pond liquid (mg/L)	19.46
Average salinity of pond liquid (dS/m)	2.43

Value on final day of simulation period	Pond 1
Final nitrogen concentration of pond liquid (mg/L)	29.92
Final phosphorus concentration of pond liquid (mg/L)	19.95
Final salinity of pond liquid (dS/m)	2.49

Irrigation Performance:**Water Use: (assumes 100% Irrigation Efficiency)**

Pond water irrigated (m3/year)	0.00
Average Shandy water irrigation (m3/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Total water irrigated (m3/year)	0.00
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Proportion of years shandying water allocation of 0 m3/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 Days Irrigation Turned Off (fraction)	1.00 (Hence no irrigation!)
Proportion of days maximum irrigation rate set to zero (fraction)	1.00 (Hence no irrigation!)
Proportion of Days irrigation occurs (fraction)	0.00



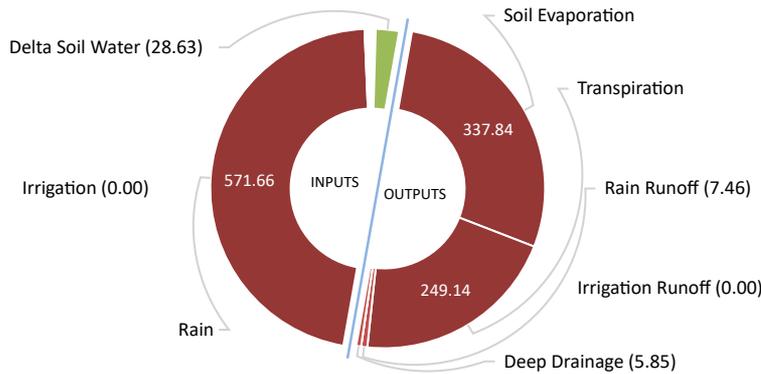
Land Performance - Soil Water

Paddock: Girrahween Temp Accom Applicatio, 19725 m2

Soil Type: Sodosols representation_conserva, 165.60 mm PAWC at maximum root depth

Land Water Balance (mm/year):

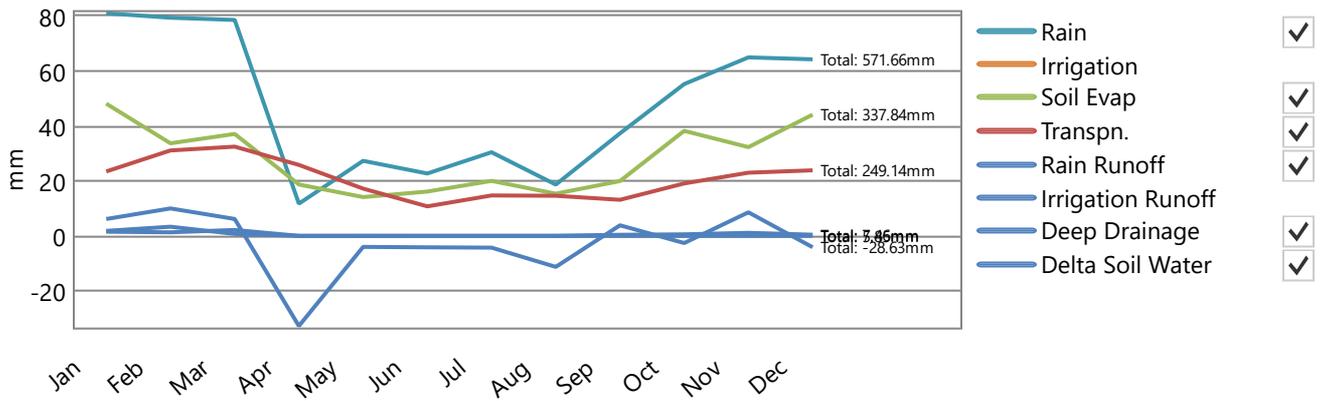
mm/year % Total inputs



Name	Value
Rain	571.66
Irrigation	0.00
Soil Evaporation	337.84
Transpiration	249.14
Rain Runoff	7.46
Irrigation Runoff	0.00
Deep Drainage	5.85
Delta Soil Water	-28.63

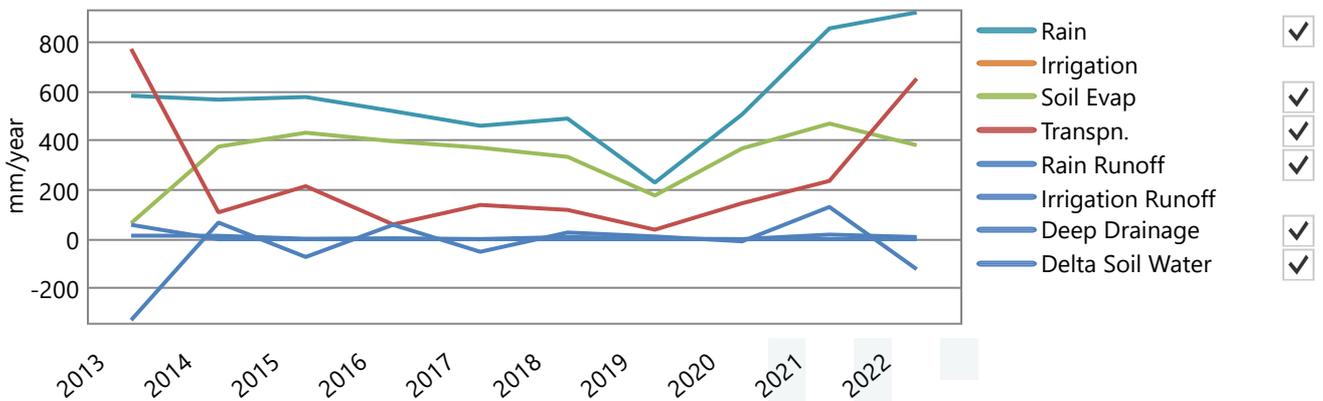
Average Monthly Totals (mm):

Chart Table



Average Annual Totals (mm/year):

Chart Table



PERFORMANCE



Land Performance - Soil Nutrient

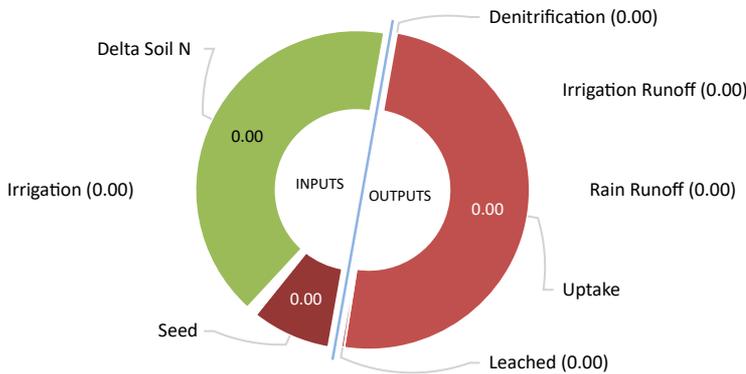
Paddock: **Girrahween Temp Accom Applicatio, 19725 m2 representation_conserva**

Soil Type: **Sodosols**

Irrigation ammonium volatilisation losses (kg/m2/year): 0.00

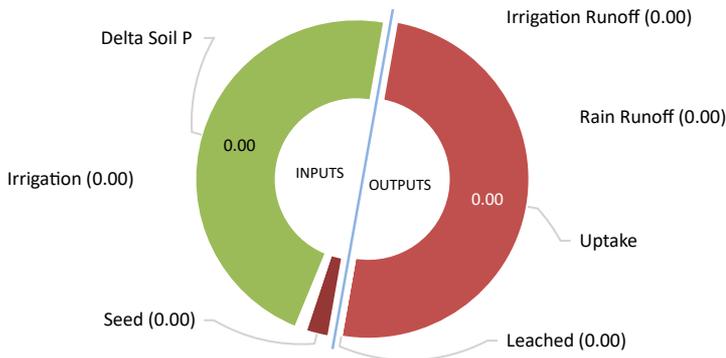
Proportion of total nitrogen in irrigated effluent as ammonium (fraction): 0.80

Land Nitrogen Balance (kg/m2/year)



Name	Value
Seed	2.63E-04
Irrigation	0.00
Denitrification	0.00
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	1.61E-03
Leached	9.20E-06
Delta Soil N	-1.35E-03

Land Phosphorus Balance (kg/m2/year)



Name	Value
Seed	2.25E-05
Irrigation	0.00
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	4.80E-04
Leached	2.58E-07
Delta Soil P	-4.58E-04

PERFORMANCE

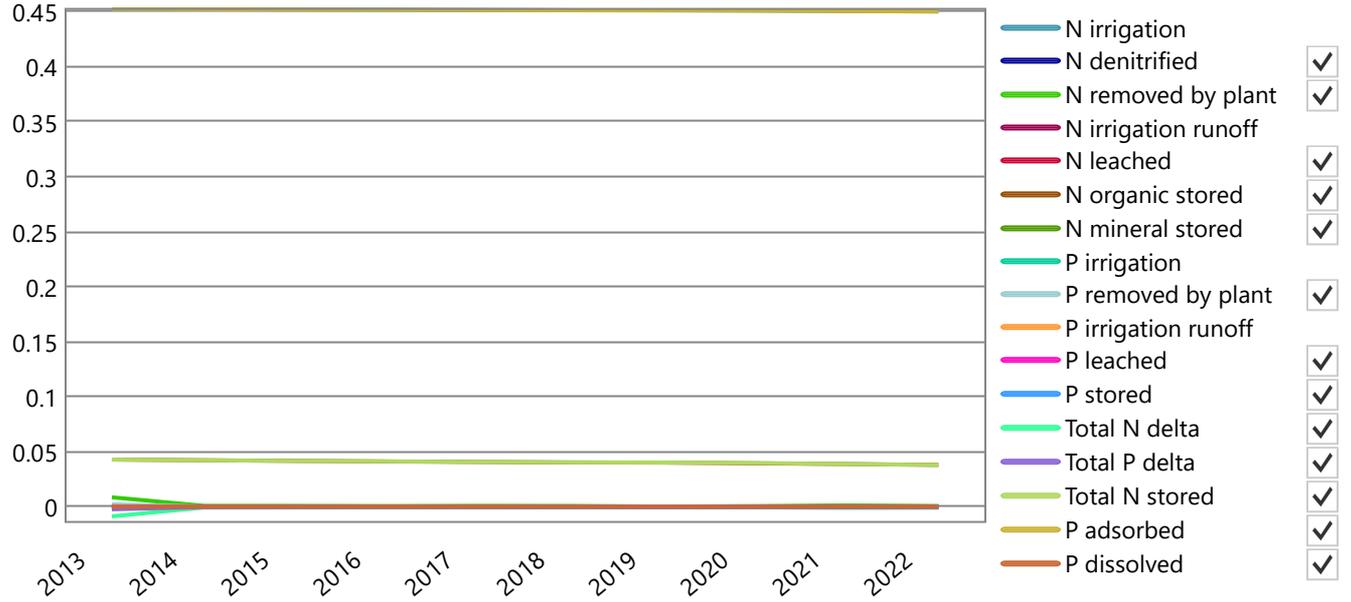


Land Performance - Soil Nutrient

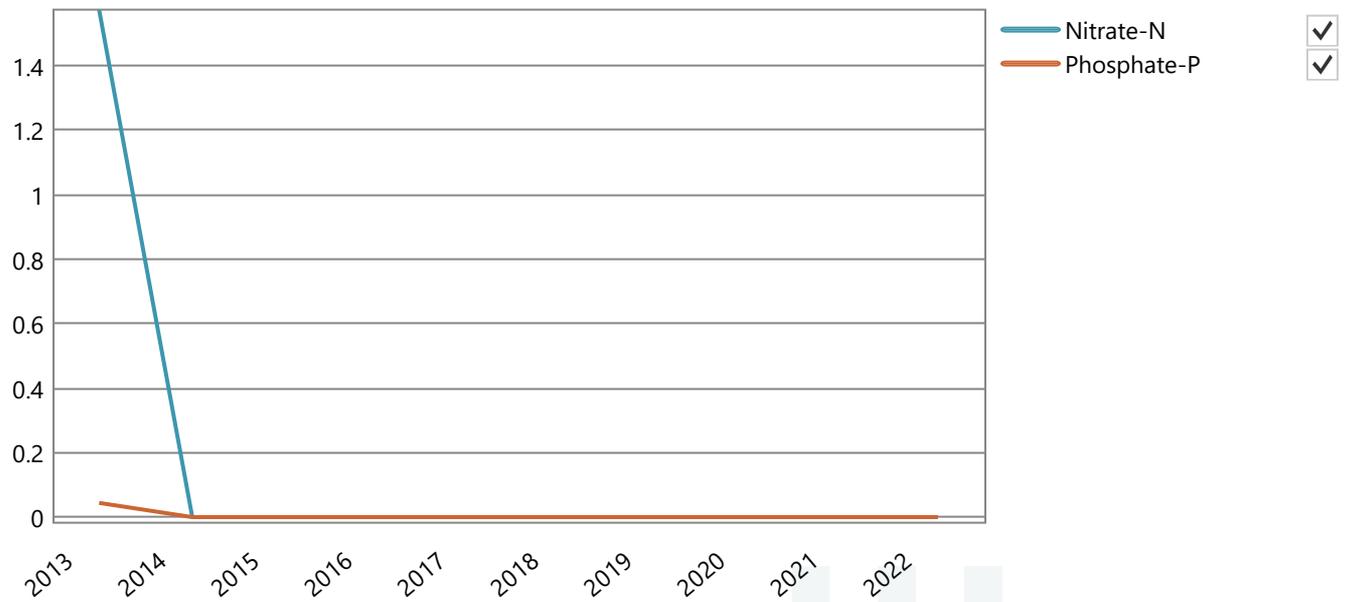
Paddock: Girrahween Temp Accom Applicatio, 19725 m2
representation_conserva

Soil Type: Sodosols

Annual Nutrient Totals (kg/m2):



Annual Nutrient Leaching Concentration (mg/L):



PERFORMANCE



Plant Performance and Nutrients

Paddock: Girrahween Temp Accom Applicatio, 19725 m2 representation_conserva

Soil Type: Sodosols

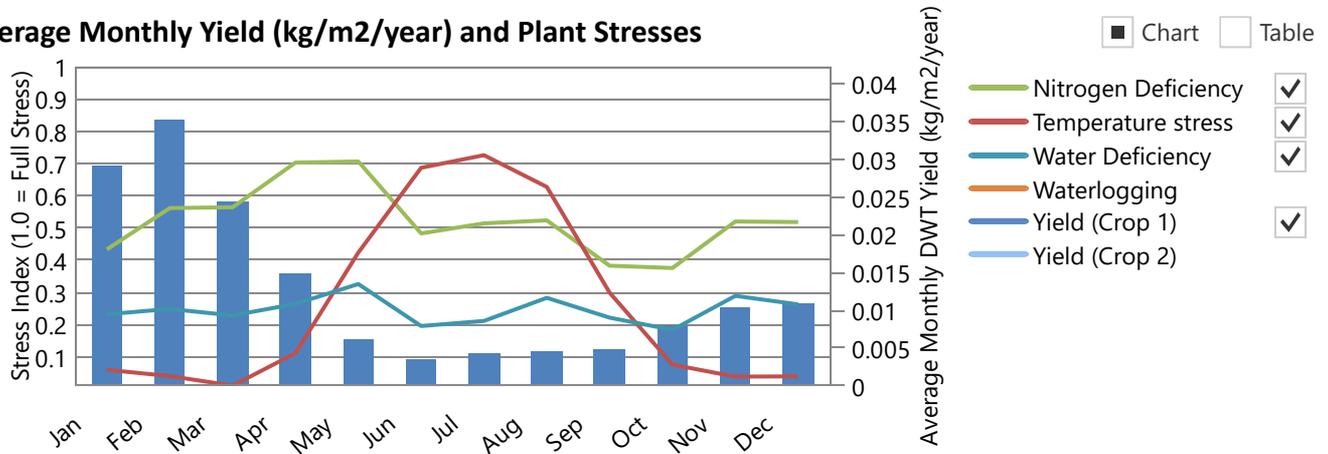
Plant: Continuous Kikuyu 1 Pasture

Average annual shoot dry matter yield (kg/m2/year)	0.16 (0.04 - 0.75)
Average monthly plant (green) cover (fraction) (minimum - maximum)	0.29 (0.19 - 0.38)
Average monthly root depth (mm) (minimum - maximum)	406.09 (280.30 - 535.81)

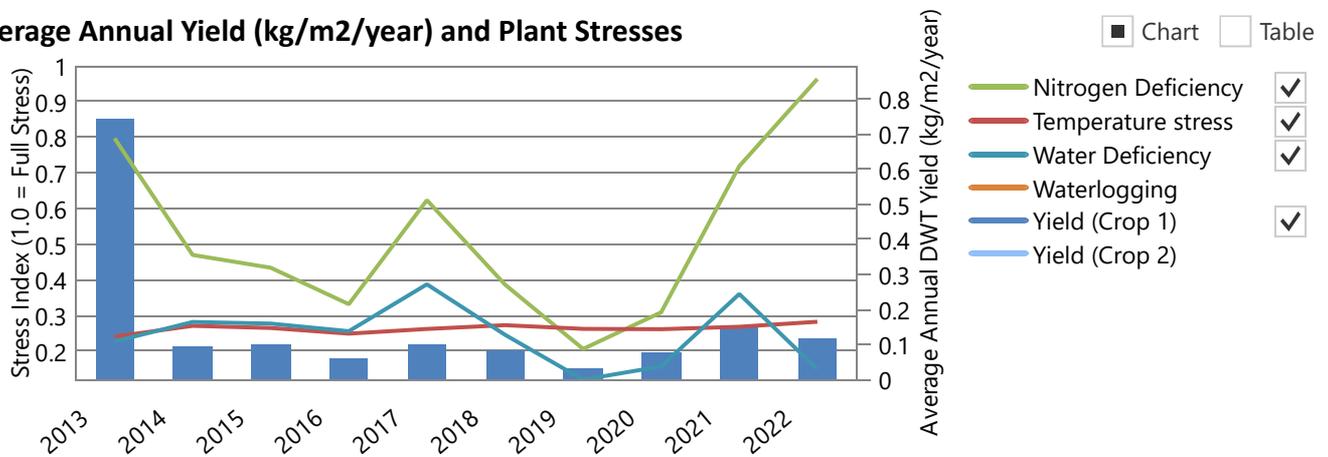
Nutrient Uptake (minimum - maximum):

Average annual net nitrogen removed by plant uptake (kg/m2/year)	0.00 (0.00 - 0.01)
Average annual net phosphorus removed by plant uptake (kg/m2/year)	0.00 (0.00 - 0.00)
Average annual shoot nitrogen concentration (fraction dwt)	0.01 (0.01 - 0.01)
Average annual shoot phosphorus concentration (fraction dwt)	0.003 (0.003 - 0.003)

Average Monthly Yield (kg/m2/year) and Plant Stresses



Average Annual Yield (kg/m2/year) and Plant Stresses



No. of harvests/year: 0.10 (normal), 2.40 (forced by crop death due to nitrogen stress (0.20), water stress (2.20))

No. days without crop/year (days/year): 122.60 due to frosting (5.00), temperature stress - not frost (2.20), water stress (115.40)

PERFORMANCE

Land Performance

Paddock: Girrahween Temp Accom Applicatio, 19725 m2
representation_conserva

Soil Type: Sodosols

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
------------------------------------	------

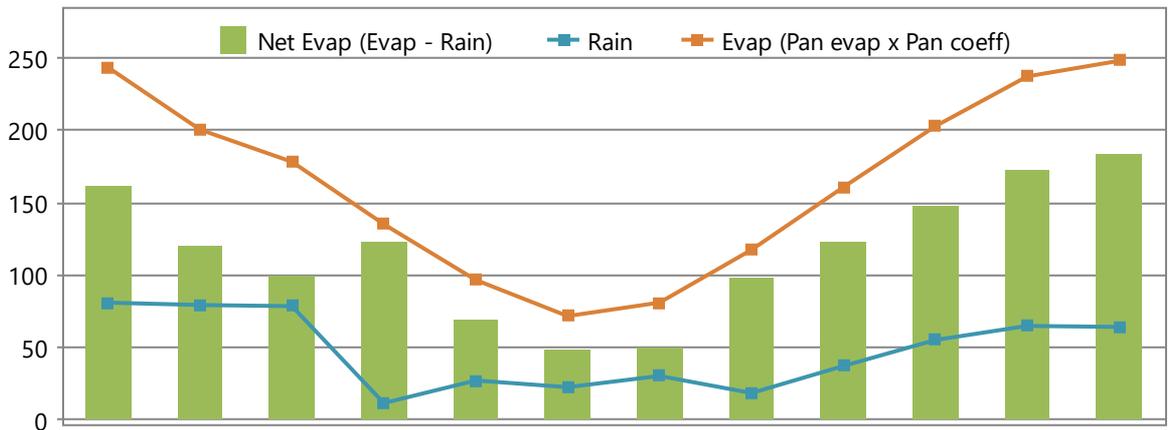
Insufficient years to run salinity calculations.

Sustainability Diagnostics: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Averaged Historical Climate Data Used in Simulation (mm)

Location: Girrahween Camp 2_-26.50_150.25, -26.5°, 150.25°

Run Period: 01/01/2013 to 31/12/2022 10 years, 0 days



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	81.0	79.4	78.6	11.7	27.3	22.7	30.4	18.7	37.3	55.3	65.0	64.3	571.7
Evap	243.4	200.4	178.3	135.2	96.7	71.8	81.1	117.5	160.7	202.8	237.2	247.9	1972.9
Net Evap	162.3	121.0	99.7	123.5	69.4	49.1	50.6	98.8	123.4	147.5	172.2	183.7	1401.2
Net Evap/day	5.2	4.3	3.2	4.1	2.2	1.6	1.6	3.2	4.1	4.8	5.7	5.9	3.8

DIAGNOSTICS



Sustainability Diagnostics: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Pond System: 1 closed storage tank

Girrahween Temp Accom STP - Indicative - 18811.65 m3/year or 51.51 m3/day generated on average

Effluent entering pond system after any pretreatment and recycling

Average (Minimum-Maximum) influent quality calculated for 365.20 non-zero flow days, after any pretreatment and recycling.

Constituent	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	29.12 (15.86 - 30.00)	547.80 (547.50 - 549.00)
Total Phosphorus	19.41 (10.58 - 20.00)	365.20 (365.00 - 366.00)
Total Dissolved Salts	1553.08 (846.03 - 1600.00)	29216.00 (29200.00 - 29280.00)
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)

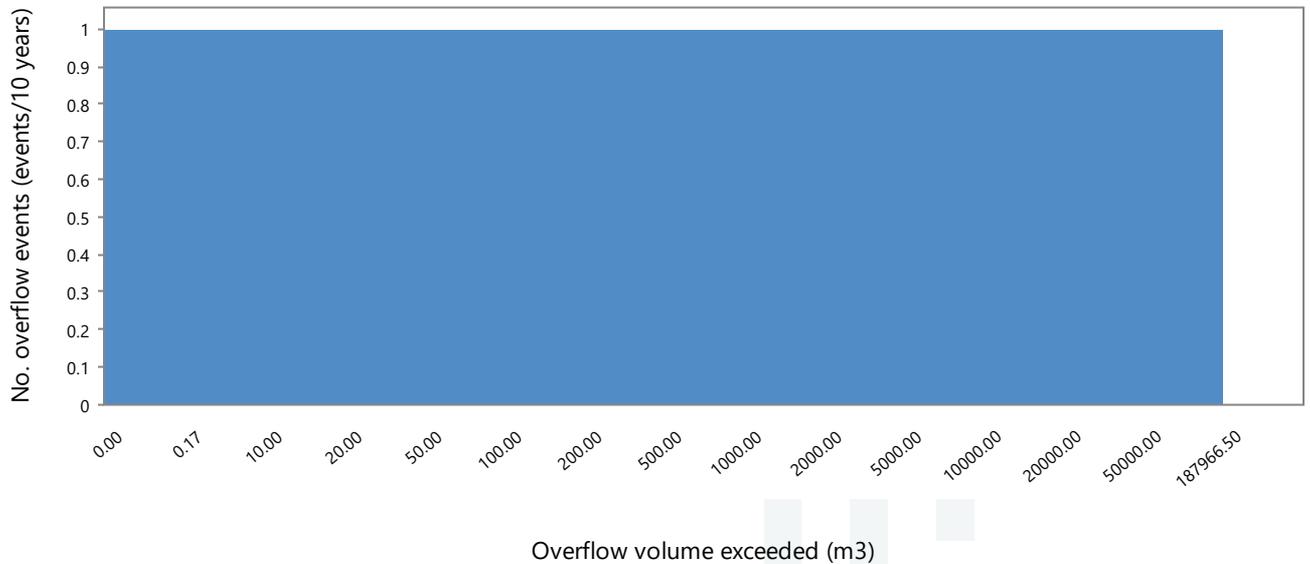
Last pond (Wet weather store): 150.00 m3

Theoretical hydraulic retention time (days)	2.91
Average volume of overflow (m3/year)	18796.65
No. overflow events per year exceeding threshold* of 0.17 m3 (no./year)	0.10
Average duration of overflow (days)	3650.00
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)	2.43
Salinity of last pond on final day of simulation (dS/m)	2.49
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: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Irrigation Information

Irrigation: 19725 m2 total area (assumed 100% irrigation efficiency)

	Quantity/year	Quantity/m2/year
Total irrigation applied (m3)	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 (m3/year)	0.00
Average Shandy water irrigation (m3/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 turned off (fraction)	1.00
--	------

Sustainability Diagnostics: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Paddock Land: Girrahween Temp Accom Applicatio: 19725 m2

Irrigation: Fixed Sprinkler with 0.2% ammonium loss during irrigation

Irrigation triggered every 1 days
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): Sodosols representation_conserva, 165.60 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	81.0	79.4	78.6	11.7	27.3	22.7	30.4	18.7	37.3	55.3	65.0	64.3	571.7
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	48.1	33.7	37.1	18.7	14.1	16.1	20.0	15.4	20.0	38.2	32.3	44.1	337.8
Transpn.	23.4	31.1	32.5	25.8	17.2	10.7	14.7	14.6	13.1	19.1	23.0	23.9	249.1
Runoff	1.5	1.3	2.2	0.0	0.0	0.0	0.0	0.0	0.4	0.6	1.1	0.4	7.5
Drainage	1.8	3.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9
Delta	6.1	10.0	6.2	-32.8	-4.0	-4.2	-4.3	-11.3	3.8	-2.6	8.6	-4.1	-28.6

Soil Nitrogen Balance

Average annual effluent nitrogen added (kg/m2/year)	0.00
Average annual soil nitrogen removed by plant uptake (kg/m2/year)	1.61E-03
Average annual soil nitrogen removed by denitrification (kg/m2/year)	0.00
Average annual soil nitrogen leached (kg/m2/year)	9.20E-06
Average annual nitrate-N loading to groundwater (kg/m2/year)	9.20E-06
Soil organic-N kg/m2 (Initial - Final)	0.04 - 0.04
	0.01 - 2.12E-05
Average nitrate-N concentration of deep drainage (mg/L)	1.57
Max. annual nitrate-N concentration of deep drainage (mg/L)	1.57

Soil Phosphorus Balance

Average annual effluent phosphorus added (kg/m2/year)	0.00
Average annual soil phosphorus removed by plant uptake (kg/m2/year)	4.80E-04
Average annual soil phosphorus leached (kg/m2/year)	2.58E-07
Dissolved phosphorus (kg/m2) (Initial - Final)	5.88E-05 - 2.70E-05
Adsorbed phosphorus (kg/m2) (Initial - Final)	0.45 - 0.45
Average phosphate-P concentration in rootzone (mg/L)	0.07
Average phosphate-P concentration of deep drainage (mg/L)	0.04
Max. annual phosphate-P concentration of deep drainage (mg/L)	0.04
Design soil profile storage life based on average infiltrated water phosphorus concn. of 0.00 mg/L (years)	999.00



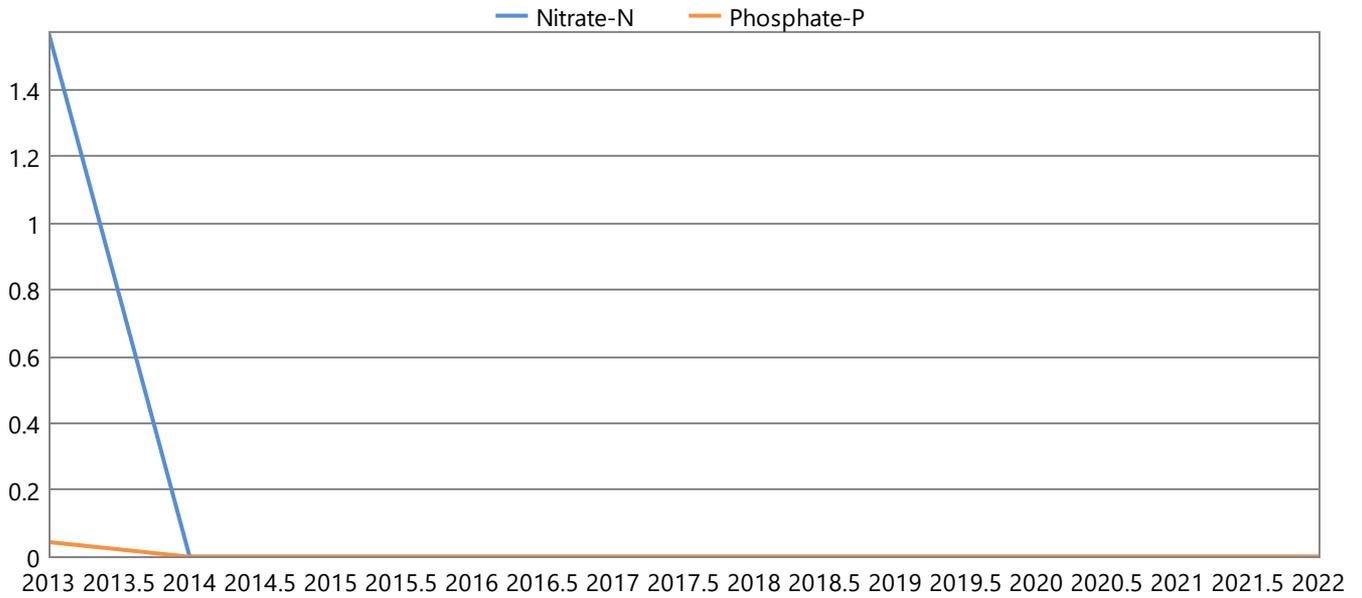
Sustainability Diagnostics: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Paddock Land: Girrahween Temp Accom Applicatio: 19725 m2

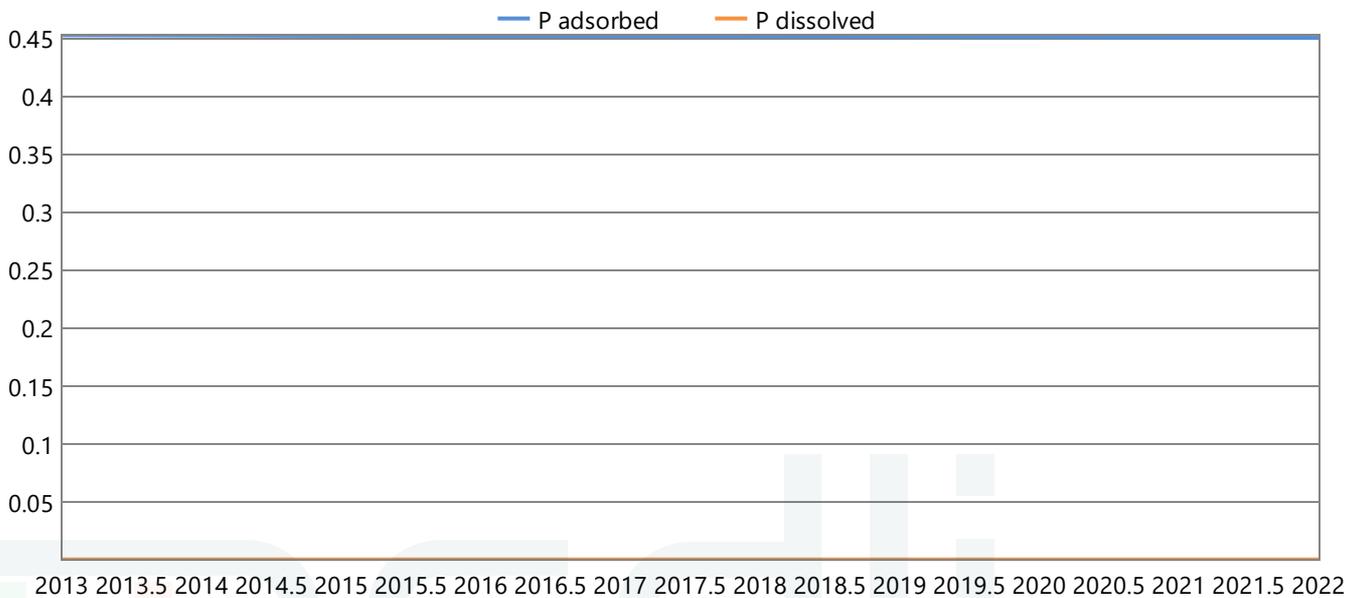
Irrigation: Fixed Sprinkler with 0.2% ammonium loss during irrigation

DIAGNOSTICS

Annual nutrient leachate concentration (mg/L)



Annual Phosphate-P in soil (kg/m2)



Sustainability Diagnostics: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Paddock Plant Performance: Girrahween Temp Accom Applicatio: 19725 m2

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

Average annual shoot dry matter yield (kg/m2/year)	0.16 (0.04 - 0.75)
Average monthly plant (green) cover (fraction)	0.29 (0.19 - 0.38)
Average monthly crop factor (fraction)	0.23 (0.15 - 0.30)
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Average monthly root depth (mm)	406.09 (280.30 - 535.81)
Average number of normal harvests per year (no./year)	0.10 (0.00 - 1.00)
Average number of normal harvests for last five years only (no./year)	0.00
Average number of crop deaths per year (no./year)	2.40 (0.00 - 4.00)
Average number of crop deaths for last five years only (no./year)	2.00
Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient)	0.52 (0.21 - 0.96)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.06 (0.01 - 0.12)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.73 (0.60 - 0.85)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.25 (0.18 - 0.33)
Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.00)
No. days without crop/year (days)	122.60

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 years to run salinity calculations.

DIAGNOSTICS

medli

Run Messages

Messages generated when the scenario was run:

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



Enterprise: Girrahween Temporary Accommodation Camp (SITE 2) Assessment**Description:**

Scenarios to assess the effluent irrigation scheme sizing

Client: Arrow Energy

MEDLI User: GHDNET\lekuskopf

Scenario Details:

IRRIGATION LOAD SCENARIO: 500EP

10-year run period

TN=30, TP=20, EC=1600



Climate Data: Girrahween Camp 2_-26.50_150.25, -26.5°, 150.25°

Run Period: 01/01/2013 to 31/12/2022 10 years, 0 days

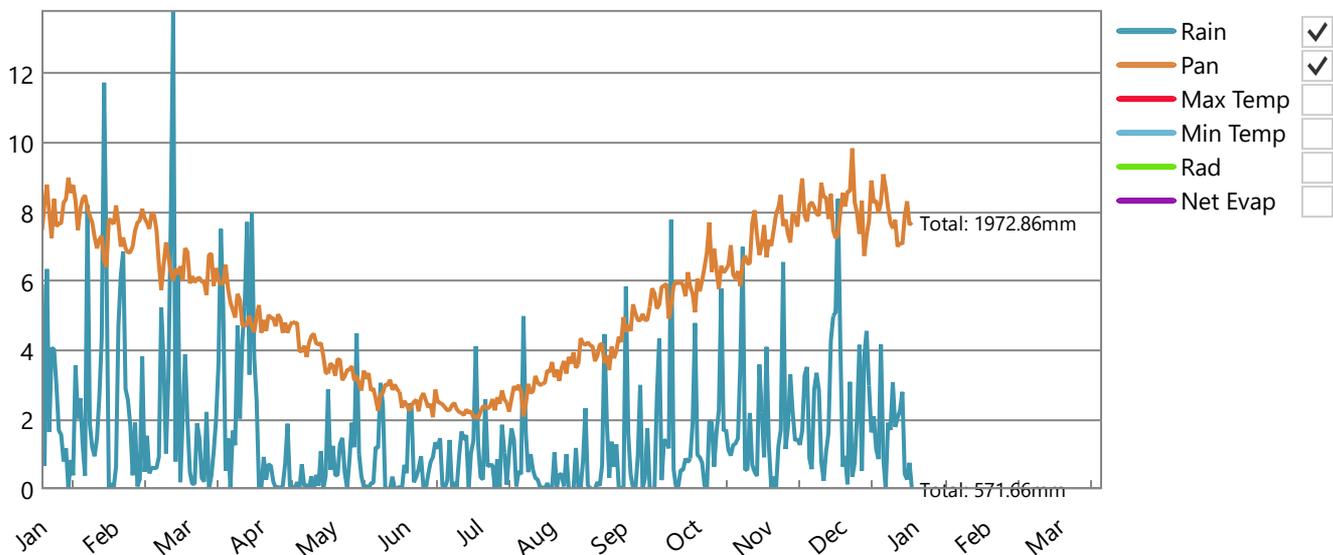
Climate Statistics:

	10th <input type="checkbox"/> Percentile	50th Percentile	90th <input type="checkbox"/> Percentile
Rainfall (mm/year)	346	544	889
Pan Evaporation (mm/year)	1643	2005	2250

Climate Data:

- Chart Table
- Monthly Daily

Daily Average Across Run Period



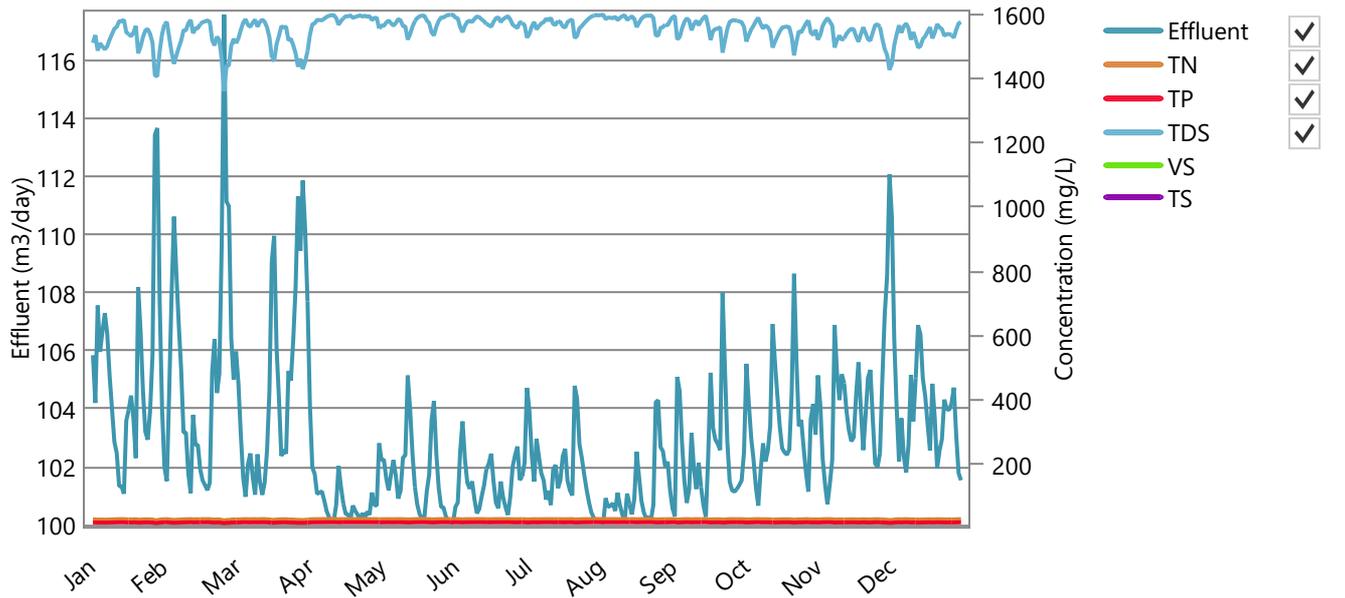
DESCRIPTION



Effluent type: Girrahween Temp Accom STP - Indicative

Wastestream before any recycling or pretreatment

Average daily quantity and flow-weighted average quality:



DESCRIPTION

Wastestream after any recycling and pretreatment if applicable

Effluent quantity: 37623.30 m3/year or 103.02 m3/day (Min-Max: 100.00 - 189.12)

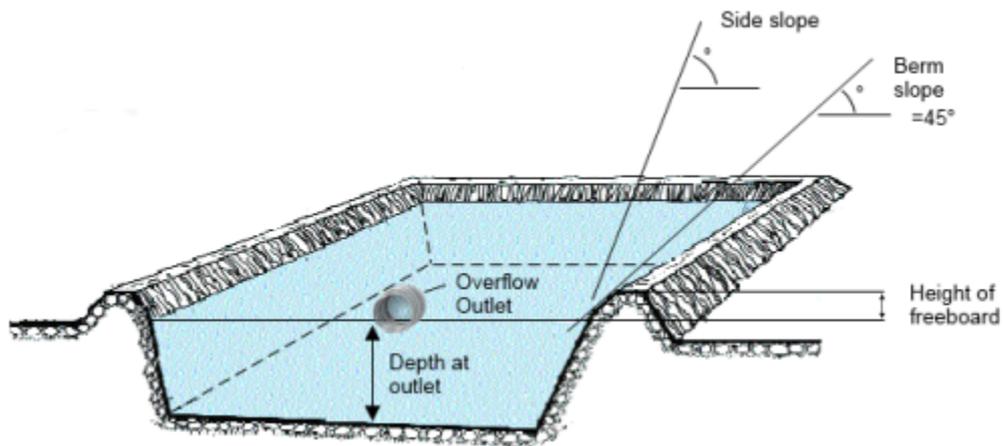
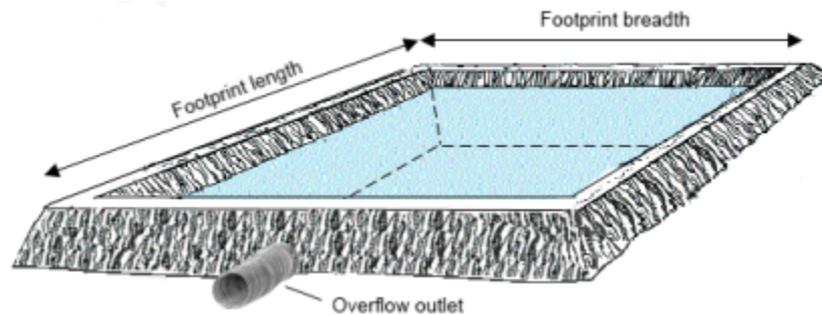
Flow-weighted average (minimum - maximum) daily effluent quality entering pond system:

	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	29.12 (15.86 - 30.00)	1095.60 (1095.00 - 1098.00)
Total Phosphorus	19.41 (10.58 - 20.00)	730.40 (730.00 - 732.00)
Total Dissolved Salts	1553.08 (846.03 - 1600.00)	58432.00 (58400.00 - 58560.00)
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)



Pond system: 1 closed storage tank**Pond system details:**

	Pond 1
Maximum pond volume (m3)	300.00
Minimum allowable pond volume (m3)	0.00
Pond depth at overflow outlet (m)	1.00
Maximum water surface area (m2)	322.51
Pond footprint length (m)	17.96
Pond footprint width (m)	17.96
Pond catchment area (m2)	322.51
Average active volume (m3)	3.32



DESCRIPTION

Irrigation pump limits:

Minimum pump rate limit (ML/day)	0.00
Maximum pump rate limit (ML/day)	10000.00

Shandyng water:

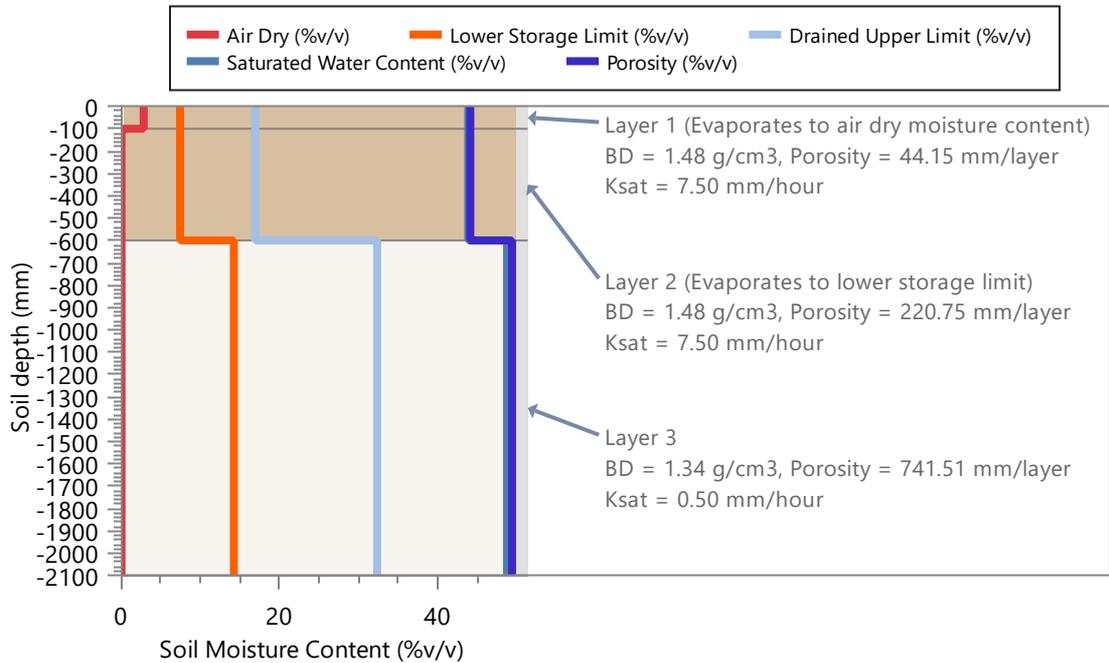
Annual allocation of fresh water available for shandyng (m3/year)	0.00
Maximum rate of application of fresh water (ML/day)	0.00
Nitrogen concentration (mg/L)	0.00
Salinity (dS/m)	0.00
Minimum shandy water is used	False

Land: Girrahween Temp Accom Applicatio

Area (m2): 39350.00

Soil Type: Sodosols representation_conserva, 2100.00 mm defined profile depth

Profile Porosity (mm)	1006.42
Profile saturation water content (mm)	995.40
Profile drained upper limit (or field capacity) (mm)	588.00
Profile lower storage limit (or permanent wilting point) (mm)	259.50
Profile available water capacity (mm)	328.50
Profile limiting saturated hydraulic conductivity (mm/hour)	0.50
Surface saturated hydraulic conductivity (mm/hour)	7.50
Runoff curve number II (coefficient)	83.00
Soil evaporation U (mm)	10.00
Soil evaporation Cona (mm/sqrt day)	4.00



Plant Data: Continuous Kikuyu 1 Pasture

Average monthly cover (fraction) (minimum - maximum)	0.86 (0.82 - 0.91)
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)	1200.00
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

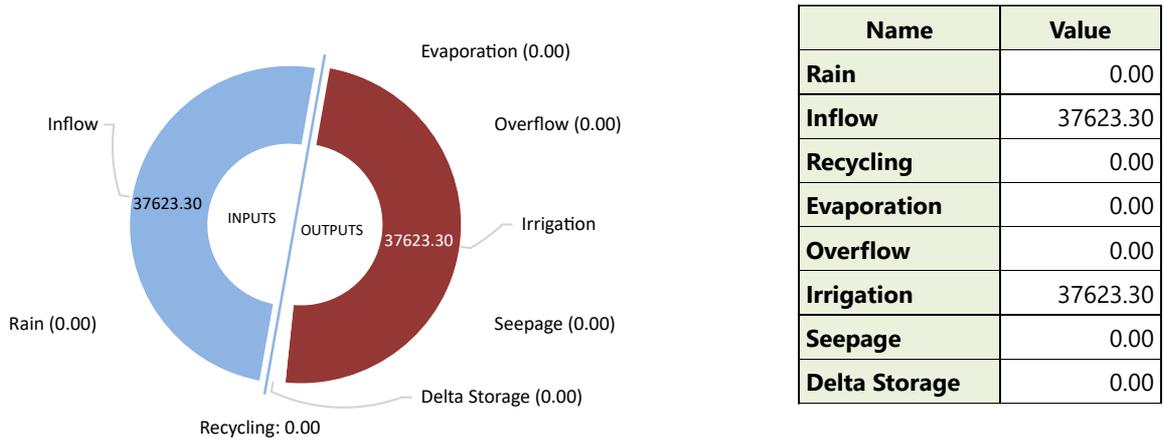


DESCRIPTION

Pond System Water Performance - Overflow: 1 closed storage tank

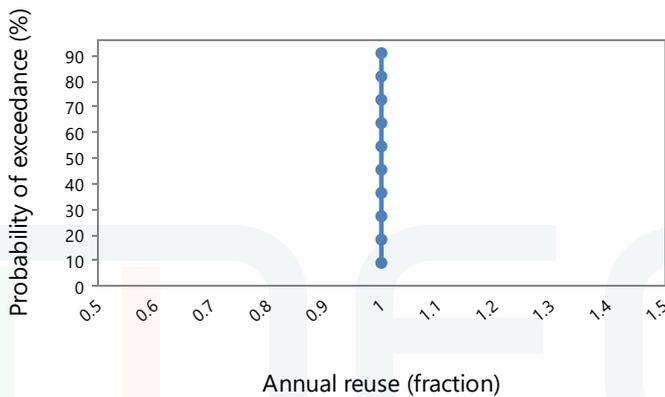
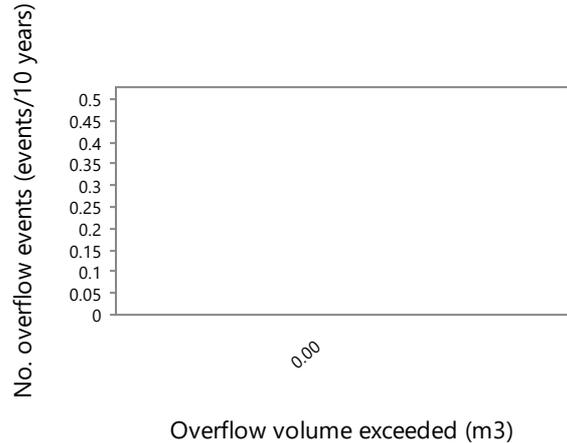
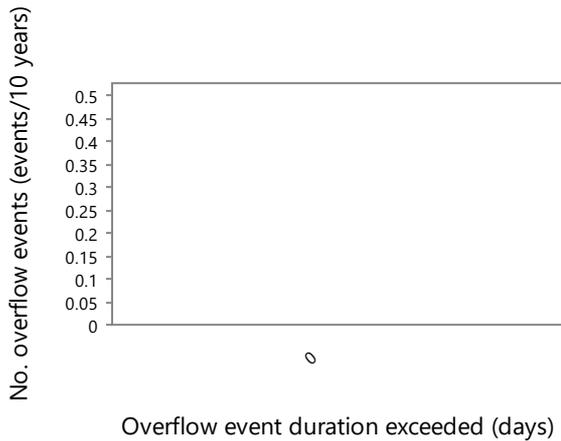
Capacity of wet weather storage pond: 300 m3

Pond System Water Balance (m3/year)



Overflow Diagnostics

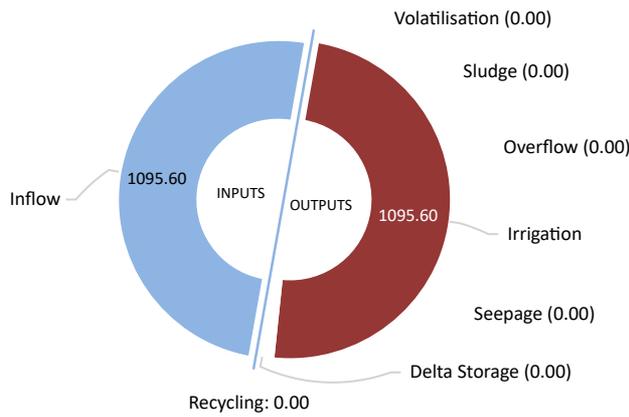
Volume of overflow (m3/year)	0.00
No. days pond overflows (days/year)	0.00
Average duration of overflow (days)	0.00
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	1.00
Probability of at least 90% reuse (fraction)	1.00



Pond System Performance - Nutrient: 1 closed storage tank

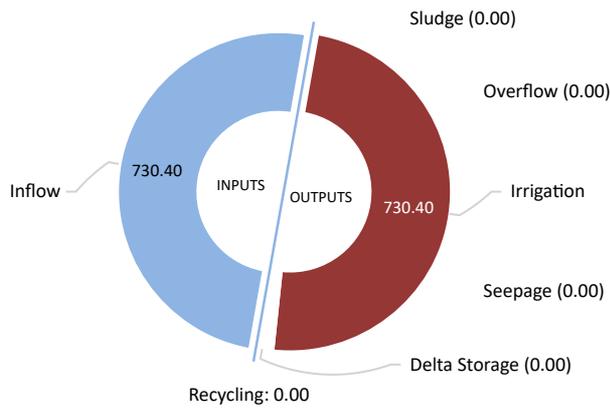
Pond System Nutrients and Salt Balance:

Nitrogen Balance (kg/year)



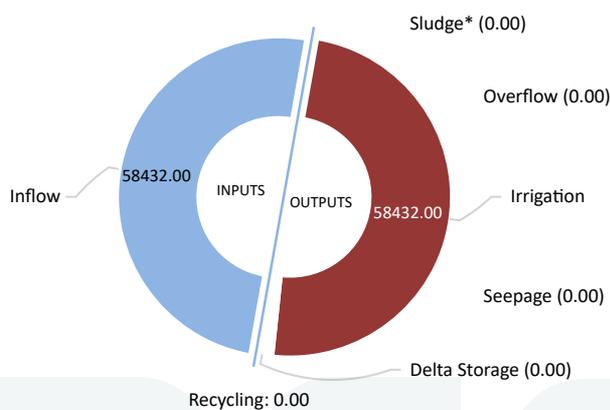
Name	Value
Inflow	1095.60
Recycling	0.00
Volatilisation	0.00
Sludge	0.00
Overflow	0.00
Irrigation	1095.60
Seepage	0.00
Delta Storage	0.00

Phosphorus Balance (kg/year)



Name	Value
Inflow	730.40
Recycling	0.00
Sludge	0.00
Overflow	0.00
Irrigation	730.40
Seepage	0.00
Delta Storage	0.00

Salt Balance (kg/year)



Name	Value
Inflow	58432.00
Recycling	0.00
Sludge*	0.00
Overflow	0.00
Irrigation	58432.00
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)	24.49
Average phosphorus concentration of pond liquid (mg/L)	16.32
Average salinity of pond liquid (dS/m)	2.04

Value on final day of simulation period	Pond 1
Final nitrogen concentration of pond liquid (mg/L)	29.98
Final phosphorus concentration of pond liquid (mg/L)	19.99
Final salinity of pond liquid (dS/m)	2.50

Irrigation Performance:**Water Use: (assumes 100% Irrigation Efficiency)**

Pond water irrigated (m3/year)	37623.30
Average Shandy water irrigation (m3/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Total water irrigated (m3/year)	37623.30
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Proportion of years shandying water allocation of 0 m3/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)	29.12
Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)	24.46
Average phosphorus concentration of irrigation water (mg/L)	19.41
Average salinity of irrigation water (dS/m)	2.43

Irrigation Diagnostics:

Proportion of Days irrigation occurs (fraction)	1.00
---	------



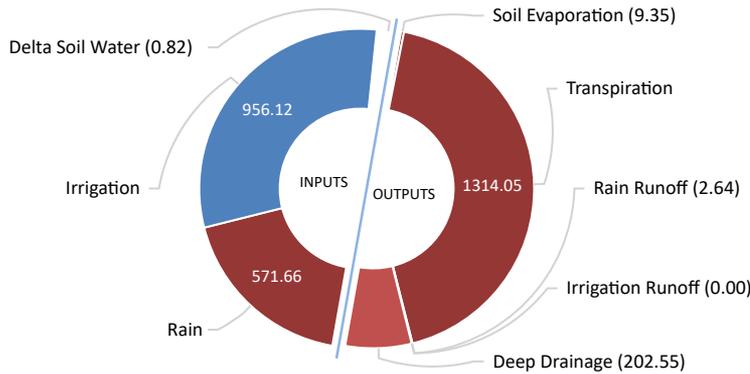
Land Performance - Soil Water

Paddock: **Girrahween Temp Accom Applicatio, 39350 m2**

Soil Type: **Sodosols representation_conserva, 165.60 mm PAWC at maximum root depth**

Land Water Balance (mm/year):

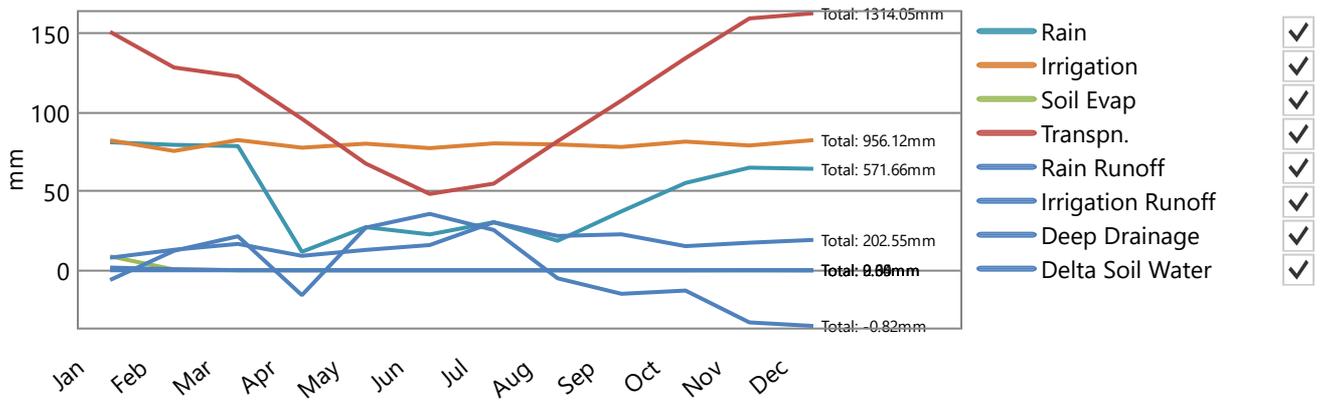
mm/year % Total inputs



Name	Value
Rain	571.66
Irrigation	956.12
Soil Evaporation	9.35
Transpiration	1314.05
Rain Runoff	2.64
Irrigation Runoff	0.00
Deep Drainage	202.55
Delta Soil Water	-0.82

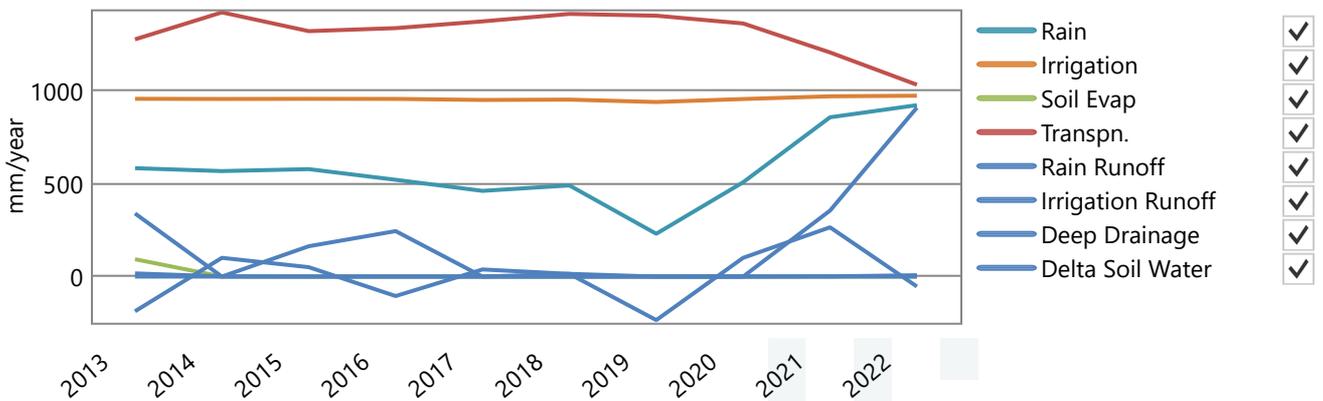
Average Monthly Totals (mm):

Chart Table



Average Annual Totals (mm/year):

Chart Table



PERFORMANCE



Land Performance - Soil Nutrient

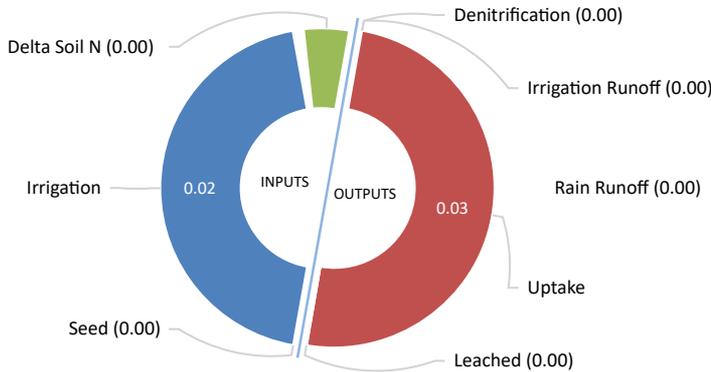
Paddock: **Girrahween Temp Accom Applicatio, 39350 m2 representation_conserva**

Soil Type: **Sodosols**

Irrigation ammonium volatilisation losses (kg/m2/year): 0.00

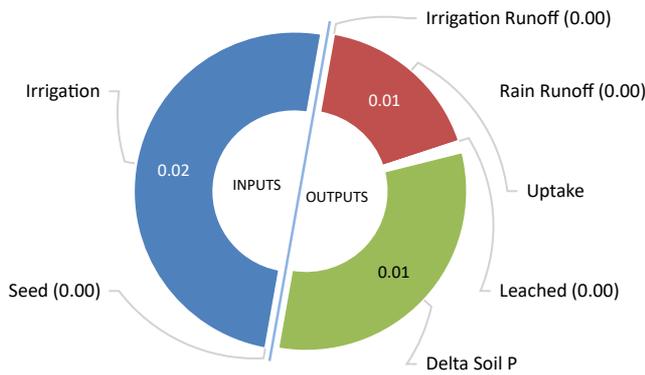
Proportion of total nitrogen in irrigated effluent as ammonium (fraction): 0.80

Land Nitrogen Balance (kg/m2/year)



Name	Value
Seed	1.05E-05
Irrigation	0.02
Denitrification	2.18E-07
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	0.03
Leached	3.11E-05
Delta Soil N	-2.38E-03

Land Phosphorus Balance (kg/m2/year)



Name	Value
Seed	9.00E-07
Irrigation	0.02
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	0.01
Leached	2.23E-05
Delta Soil P	0.01

PERFORMANCE

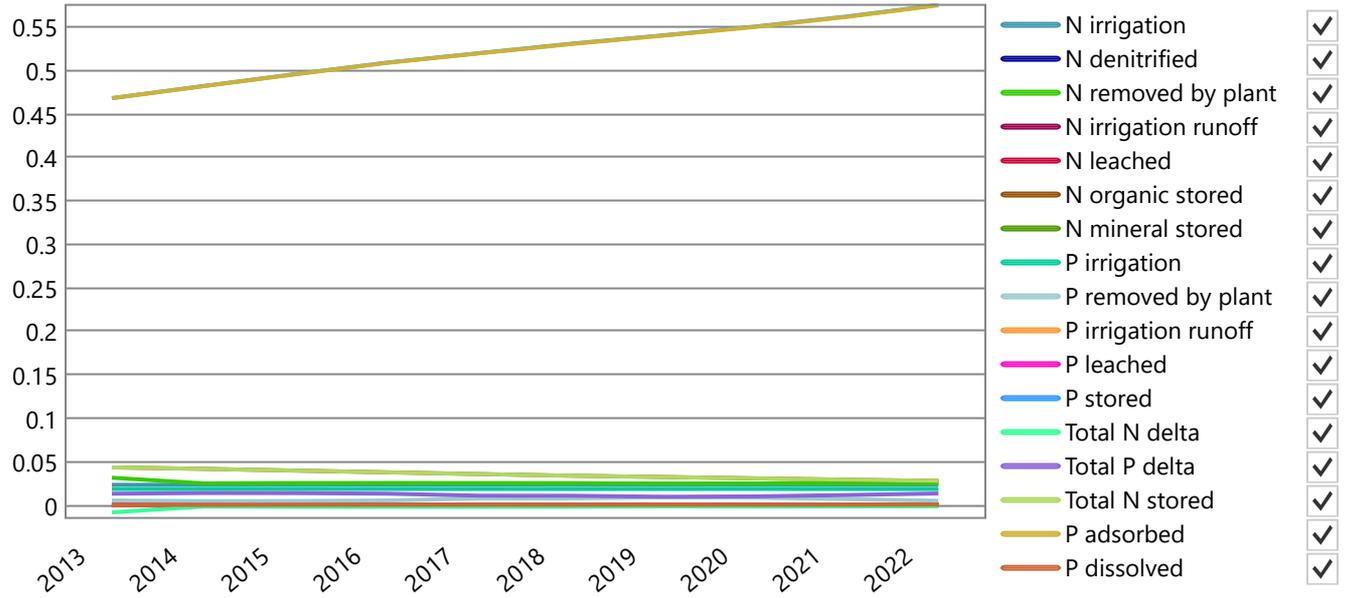


Land Performance - Soil Nutrient

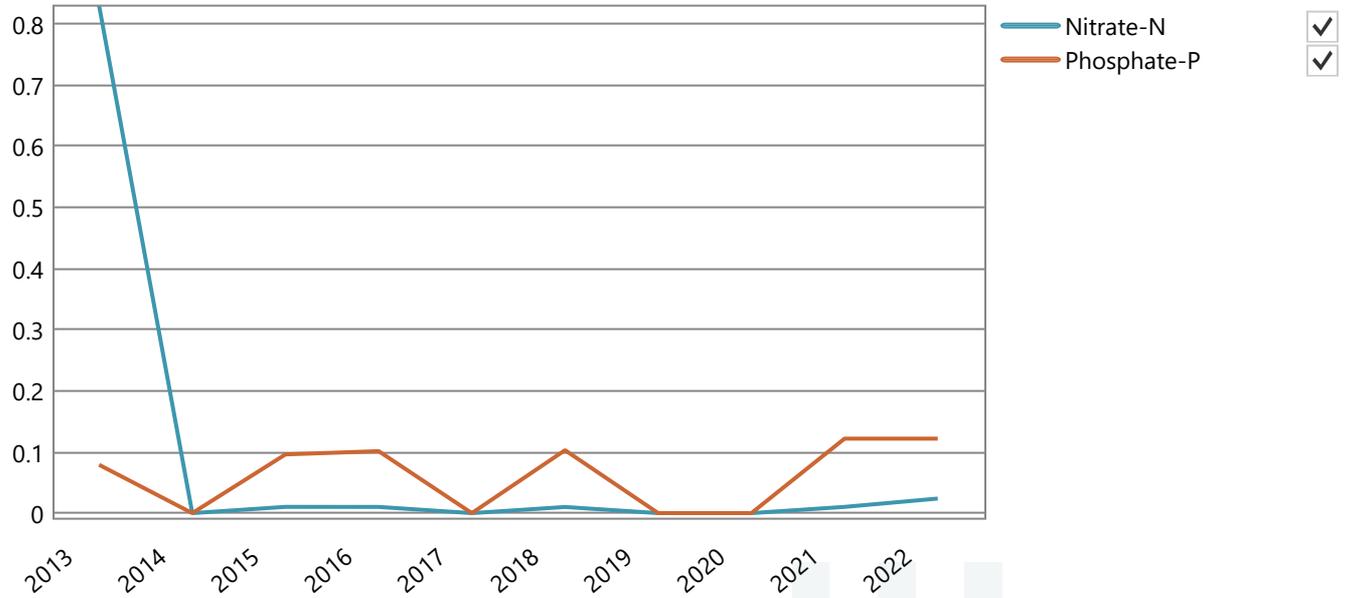
Paddock: Girrahween Temp Accom Applicatio, 39350 m2
representation_conserva

Soil Type: Sodosols

Annual Nutrient Totals (kg/m2):



Annual Nutrient Leaching Concentration (mg/L):



PERFORMANCE



Plant Performance and Nutrients

Paddock: Girrahween Temp Accom Applicatio, 39350 m2 representation_conserva

Soil Type: Sodosols

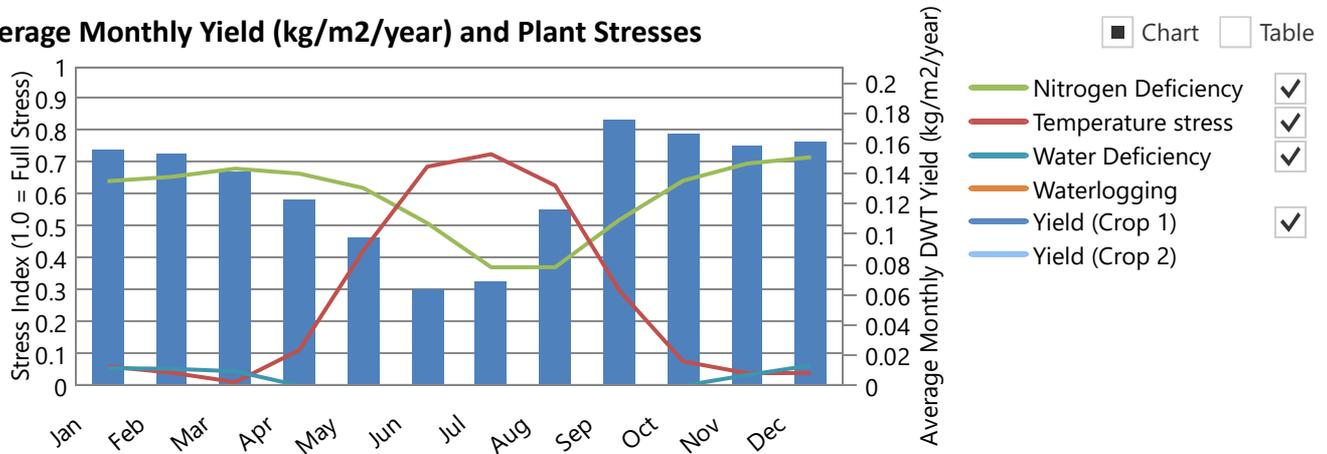
Plant: Continuous Kikuyu 1 Pasture

Average annual shoot dry matter yield (kg/m2/year)	1.58 (1.50 - 1.80)
Average monthly plant (green) cover (fraction) (minimum - maximum)	0.86 (0.82 - 0.91)
Average monthly root depth (mm) (minimum - maximum)	1194.08 (1131.62 - 1200.00)

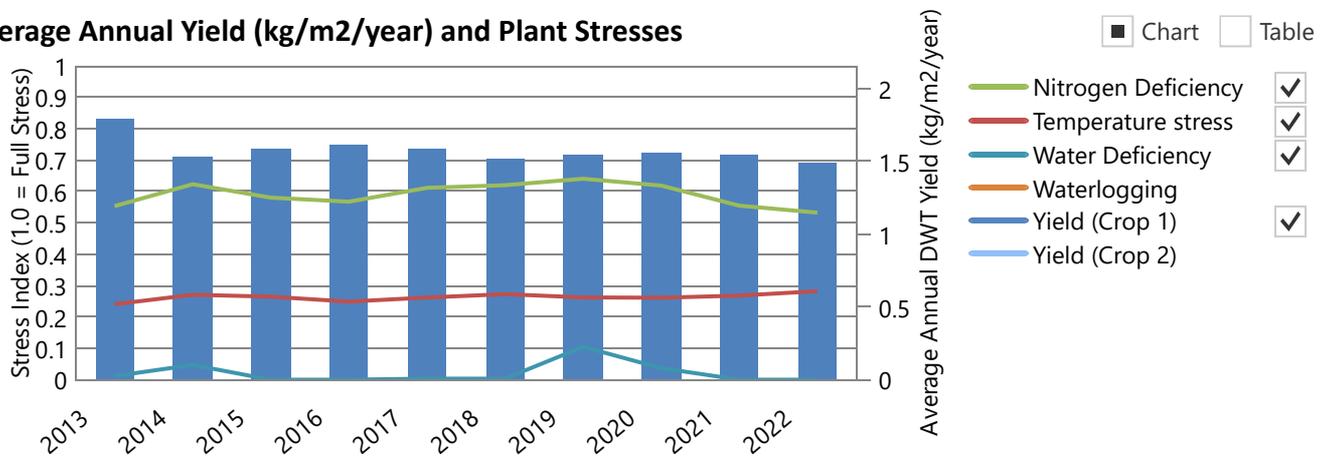
Nutrient Uptake (minimum - maximum):

Average annual net nitrogen removed by plant uptake (kg/m2/year)	0.03 (0.02 - 0.03)
Average annual net phosphorus removed by plant uptake (kg/m2/year)	0.01 (0.00 - 0.01)
Average annual shoot nitrogen concentration (fraction dwt)	0.02 (0.02 - 0.02)
Average annual shoot phosphorus concentration (fraction dwt)	0.004 (0.003 - 0.006)

Average Monthly Yield (kg/m2/year) and Plant Stresses



Average Annual Yield (kg/m2/year) and Plant Stresses



No. of harvests/year: 2.80 (normal)

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



Land Performance

Paddock: Girrahween Temp Accom Applicatio, 39350 m2
representation_conserva

Soil Type: Sodosols

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

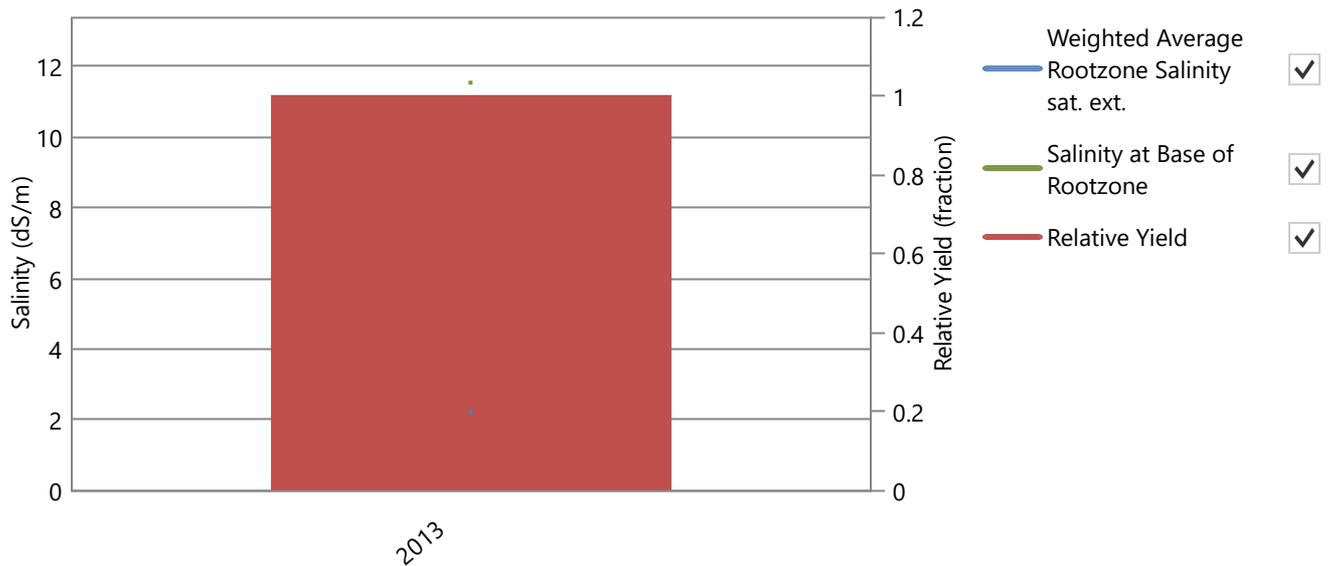
Soil Salinity:

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	1.53
Salt added by rainfall (kg/m2/year)	0.01
Average annual effluent salt added & leached at steady state (kg/m2/year)	1.50
Average leaching fraction based on 10 year running averages (fraction)	0.32
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	2.21
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	11.54
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



PERFORMANCE

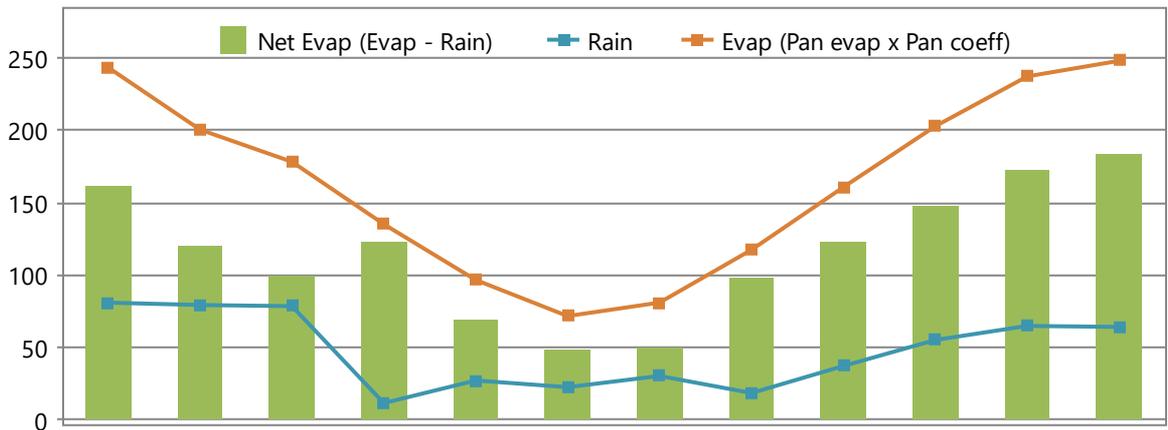


Sustainability Diagnostics: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Averaged Historical Climate Data Used in Simulation (mm)

Location: Girrahween Camp 2_-26.50_150.25, -26.5°, 150.25°

Run Period: 01/01/2013 to 31/12/2022 10 years, 0 days



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	81.0	79.4	78.6	11.7	27.3	22.7	30.4	18.7	37.3	55.3	65.0	64.3	571.7
Evap	243.4	200.4	178.3	135.2	96.7	71.8	81.1	117.5	160.7	202.8	237.2	247.9	1972.9
Net Evap	162.3	121.0	99.7	123.5	69.4	49.1	50.6	98.8	123.4	147.5	172.2	183.7	1401.2
Net Evap/day	5.2	4.3	3.2	4.1	2.2	1.6	1.6	3.2	4.1	4.8	5.7	5.9	3.8



Sustainability Diagnostics: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Pond System: 1 closed storage tank

Girrahween Temp Accom STP - Indicative - 37623.30 m3/year or 103.02 m3/day generated on average

Effluent entering pond system after any pretreatment and recycling

Average (Minimum-Maximum) influent quality calculated for 365.20 non-zero flow days, after any pretreatment and recycling.

Constituent	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	29.12 (15.86 - 30.00)	1095.60 (1095.00 - 1098.00)
Total Phosphorus	19.41 (10.58 - 20.00)	730.40 (730.00 - 732.00)
Total Dissolved Salts	1553.08 (846.03 - 1600.00)	58432.00 (58400.00 - 58560.00)
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)

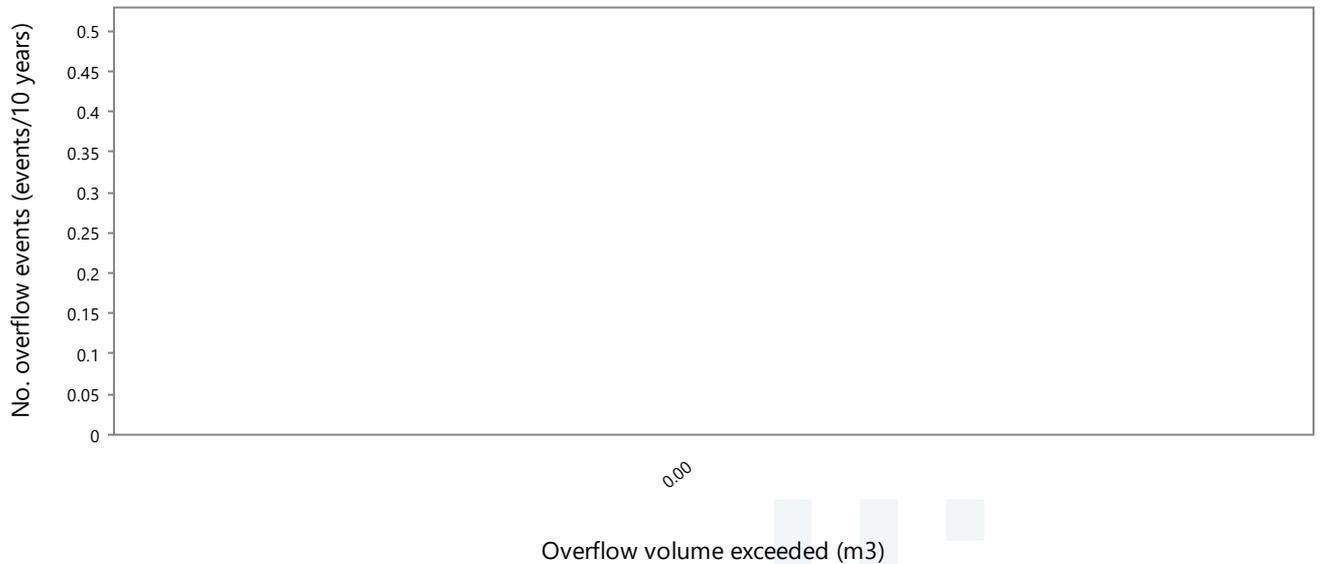
Last pond (Wet weather store): 300.00 m3

Theoretical hydraulic retention time (days)	2.91
Average volume of overflow (m3/year)	0.00
No. overflow events per year exceeding threshold* of 0.32 m3 (no./year)	0.00
Average duration of overflow (days)	0.00
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)	2.04
Salinity of last pond on final day of simulation (dS/m)	2.50
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: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Irrigation Information

Irrigation: 39350 m² total area (assumed 100% irrigation efficiency)

	Quantity/year	Quantity/m ² /year
Total irrigation applied (m ³)	37623.30	0.96
Total nitrogen applied (kg)	920.30	0.02
Total phosphorus applied (kg)	730.40	0.02
Total salts applied (kg)	58432.00	1.48

Shandyng

Annual allocation of fresh water for shandyng (m ³ /year)	0.00
Average Shandy water irrigation (m ³ /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 shandyng (fraction of events)	0.00
Minimum shandy water is used	False

Irrigation Issues

Proportion of Days irrigation occurs (fraction)	1.00
---	------

Sustainability Diagnostics: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Paddock Land: Girrahween Temp Accom Applicatio: 39350 m2

Irrigation: Fixed Sprinkler with 0.2% ammonium loss during irrigation

Irrigation triggered every 1 days
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): Sodosols representation_conserva, 165.60 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	81.0	79.4	78.6	11.7	27.3	22.7	30.4	18.7	37.3	55.3	65.0	64.3	571.7
Irrigation	82.3	75.5	82.4	77.6	80.1	77.3	80.3	79.7	78.1	81.5	79.0	82.4	956.1
Soil Evap	8.8	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.3
Transpn.	150.9	128.4	122.7	95.9	67.5	48.3	54.8	81.7	107.5	134.2	159.4	162.7	1314.1
Rain Runoff	1.7	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	2.6
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	8.0	13.0	16.7	9.2	12.9	16.0	30.4	21.7	22.8	15.3	17.4	19.2	202.6
Delta	-6.1	12.4	21.5	-15.7	27.0	35.7	25.5	-5.1	-14.9	-12.8	-33.0	-35.3	-0.8

Soil Nitrogen Balance

Average annual effluent nitrogen added (kg/m2/year)	0.02
Average annual soil nitrogen removed by plant uptake (kg/m2/year)	0.03
Average annual soil nitrogen removed by denitrification (kg/m2/year)	2.18E-07
Average annual soil nitrogen leached (kg/m2/year)	3.11E-05
Average annual nitrate-N loading to groundwater (kg/m2/year)	3.11E-05
Soil organic-N kg/m2 (Initial - Final)	0.04 - 0.03
	0.01 - 5.80E-06
Average nitrate-N concentration of deep drainage (mg/L)	0.15
Max. annual nitrate-N concentration of deep drainage (mg/L)	0.83

Soil Phosphorus Balance

Average annual effluent phosphorus added (kg/m2/year)	0.02
Average annual soil phosphorus removed by plant uptake (kg/m2/year)	0.01
Average annual soil phosphorus leached (kg/m2/year)	2.23E-05
Dissolved phosphorus (kg/m2) (Initial - Final)	5.88E-05 - 4.91E-04
Adsorbed phosphorus (kg/m2) (Initial - Final)	0.45 - 0.57
Average phosphate-P concentration in rootzone (mg/L)	1.01
Average phosphate-P concentration of deep drainage (mg/L)	0.11
Max. annual phosphate-P concentration of deep drainage (mg/L)	0.12
Design soil profile storage life based on average infiltrated water phosphorus concn. of 12.17 mg/L (years)	45.67



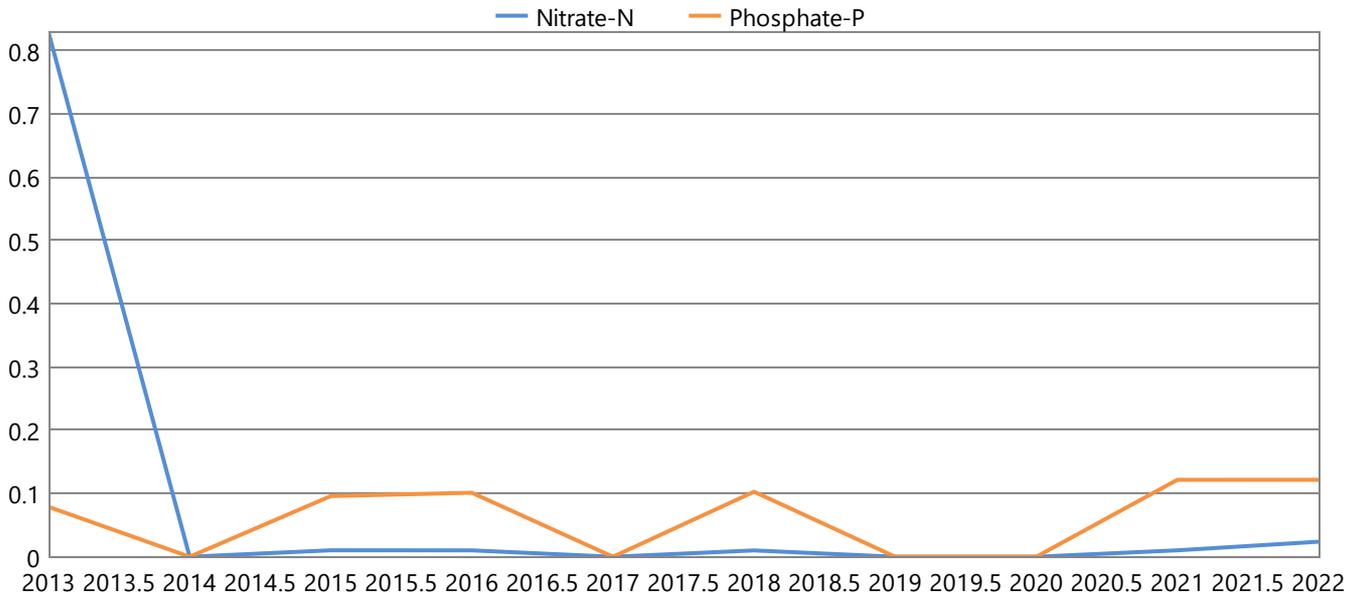
DIAGNOSTICS

Sustainability Diagnostics: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

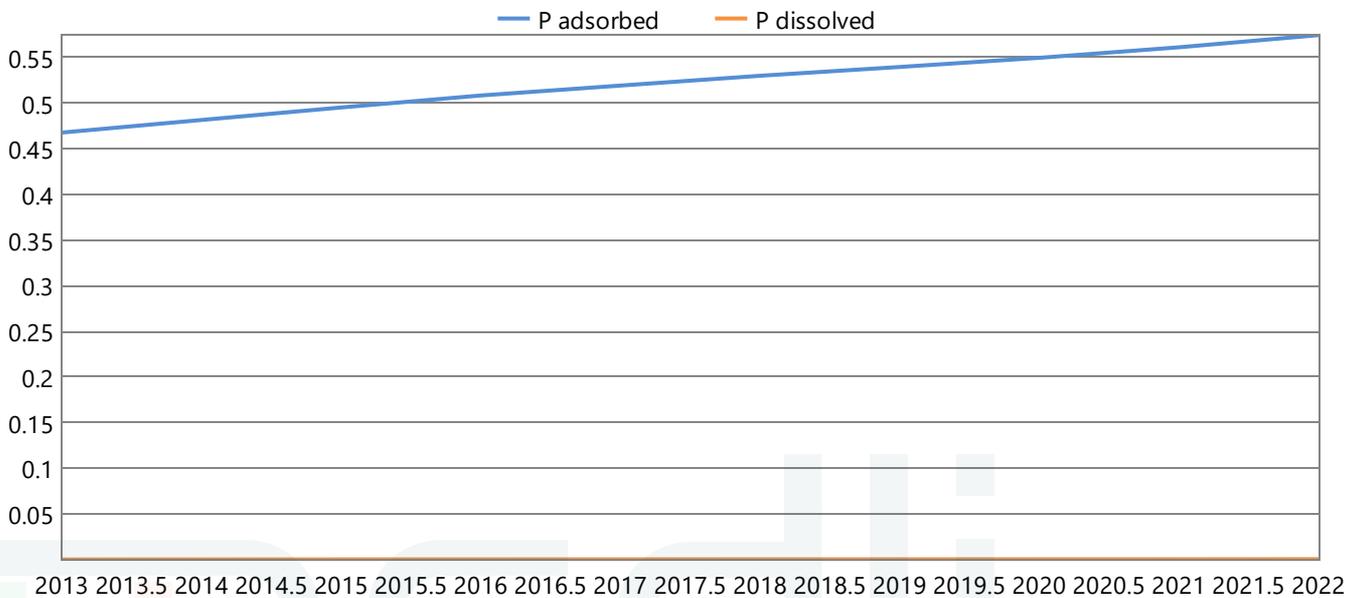
Paddock Land: Girrahween Temp Accom Applicatio: 39350 m2

Irrigation: Fixed Sprinkler with 0.2% ammonium loss during irrigation

Annual nutrient leachate concentration (mg/L)



Annual Phosphate-P in soil (kg/m2)



Sustainability Diagnostics: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Paddock Plant Performance: Girrahween Temp Accom Applicatio: 39350 m2

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

Average annual shoot dry matter yield (kg/m ² /year)	1.58 (1.50 - 1.80)
Average monthly plant (green) cover (fraction)	0.86 (0.82 - 0.91)
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)	1194.08 (1131.62 - 1200.00)
Average number of normal harvests per year (no./year)	2.80 (2.00 - 3.00)
Average number of normal harvests for last five years only (no./year)	2.80
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)	0.59 (0.53 - 0.64)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.06 (0.01 - 0.12)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.73 (0.60 - 0.85)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.02 (0.00 - 0.06)
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)	1.53
Salt added by rainfall (kg/m ² /year)	0.01
Average annual effluent salt added & leached at steady state (kg/m ² /year)	1.50
Average leaching fraction based on 10 year running averages (fraction)	0.32
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	2.21
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	11.54
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



Run Messages

Messages generated when the scenario was run:

Full run chosen

DIAGNOSTICS



Enterprise: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Description:

Scenarios to assess the effluent irrigation scheme sizing

Client: Arrow Energy

MEDLI User: GHDNET\lekuskopf

Scenario Details:

NO IRRIGATION CASE: 500EP

MEDLI REPORT - FULL RUN



Climate Data: Girrahween Camp 2_-26.50_150.25, -26.5°, 150.25°

Run Period: 01/01/2013 to 31/12/2022 10 years, 0 days

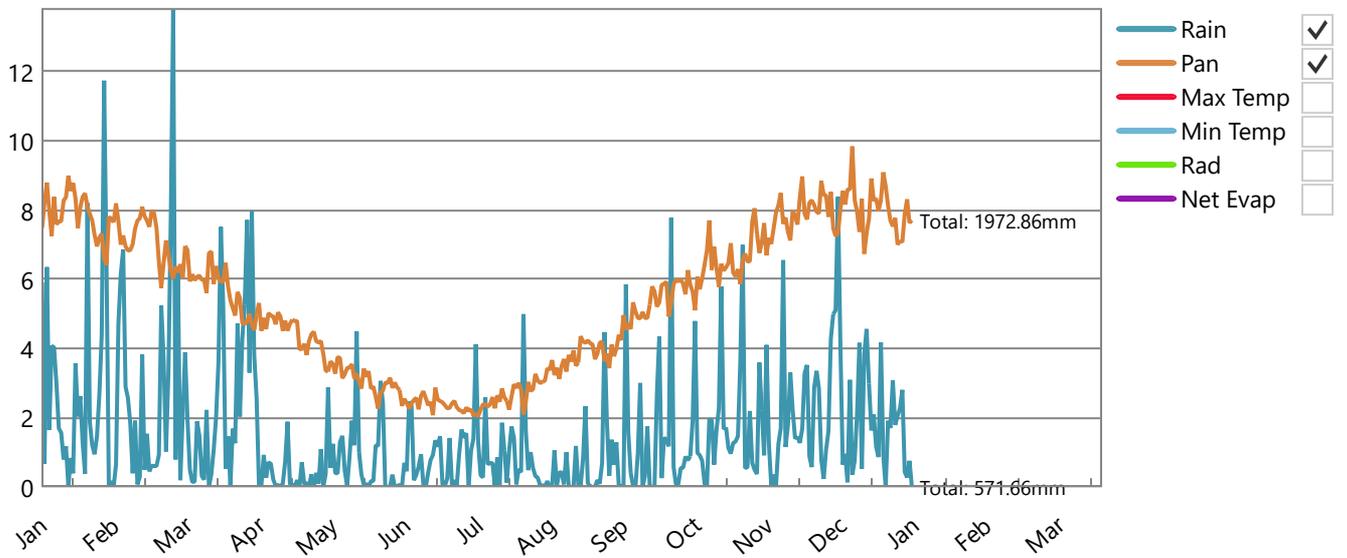
Climate Statistics:

	10th <input type="checkbox"/> Percentile	50th Percentile	90th <input type="checkbox"/> Percentile
Rainfall (mm/year)	346	544	889
Pan Evaporation (mm/year)	1643	2005	2250

Climate Data:

- Chart Table
 Monthly Daily

Daily Average Across Run Period



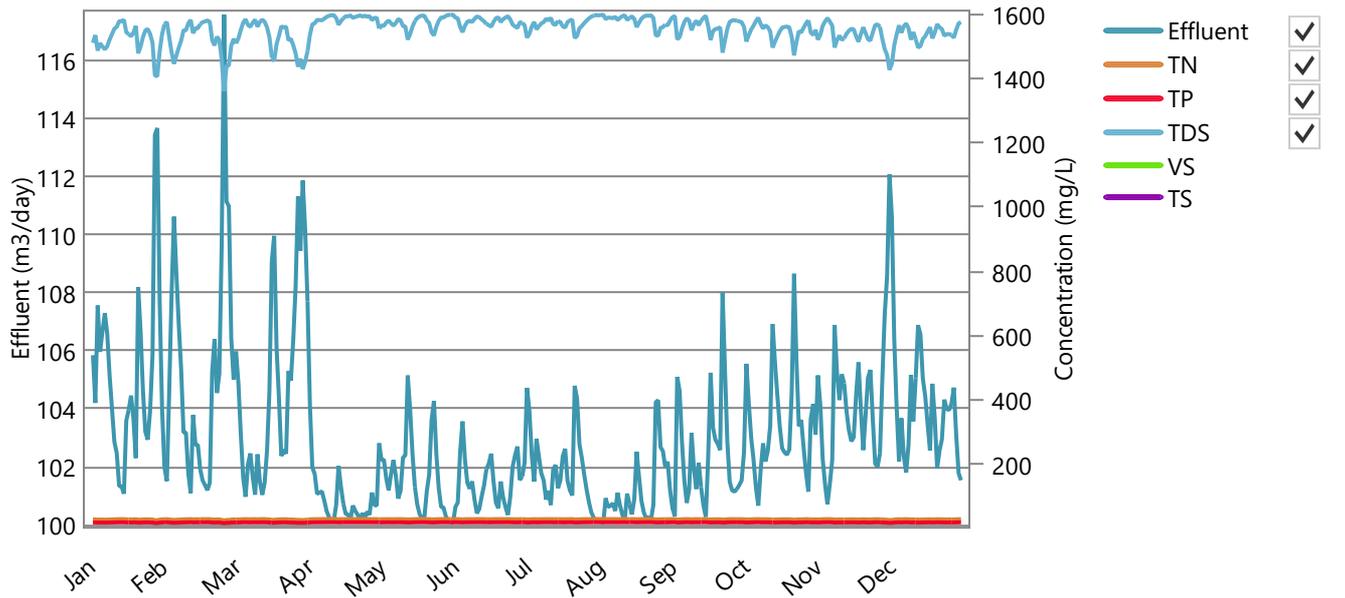
DESCRIPTION



Effluent type: Girrahween Temp Accom STP - Indicative

Wastestream before any recycling or pretreatment

Average daily quantity and flow-weighted average quality:



DESCRIPTION

Wastestream after any recycling and pretreatment if applicable

Effluent quantity: 37623.30 m3/year or 103.02 m3/day (Min-Max: 100.00 - 189.12)

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

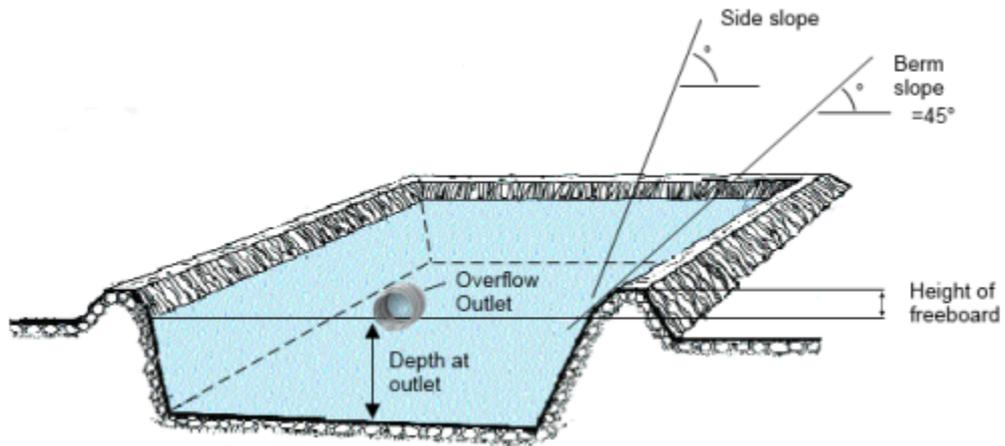
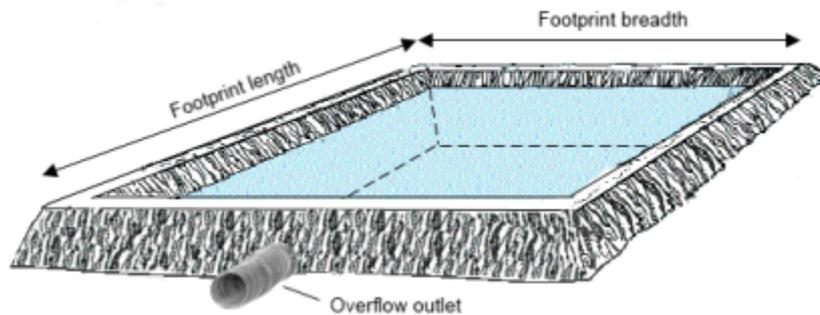
	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	29.12 (15.86 - 30.00)	1095.60 (1095.00 - 1098.00)
Total Phosphorus	19.41 (10.58 - 20.00)	730.40 (730.00 - 732.00)
Total Dissolved Salts	1553.08 (846.03 - 1600.00)	58432.00 (58400.00 - 58560.00)
Volatile Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)



Pond system: 1 closed storage tank

Pond system details:

	Pond 1
Maximum pond volume (m3)	300.00
Minimum allowable pond volume (m3)	0.00
Pond depth at overflow outlet (m)	1.00
Maximum water surface area (m2)	322.51
Pond footprint length (m)	17.96
Pond footprint width (m)	17.96
Pond catchment area (m2)	322.51
Average active volume (m3)	299.92



Irrigation pump limits:

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

Shandyng water:

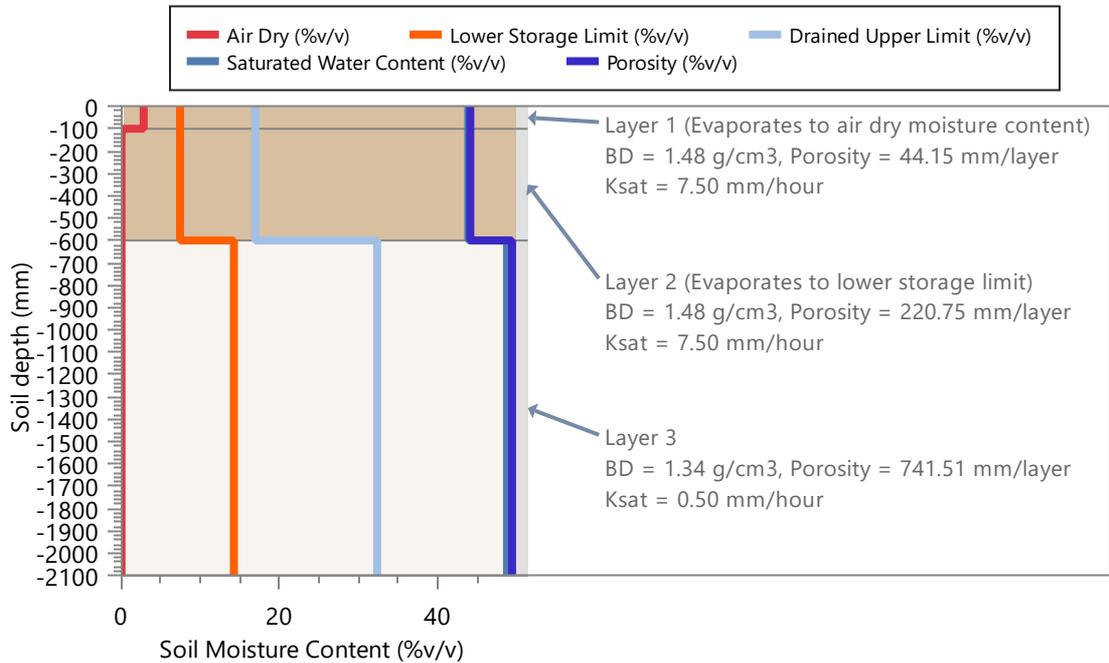
Annual allocation of fresh water available for shandyng (m3/year)	0.00
Maximum rate of application of fresh water (ML/day)	0.00
Nitrogen concentration (mg/L)	0.00
Salinity (dS/m)	0.00
Minimum shandy water is used	False

Land: Girrahween Temp Accom Applicatio

Area (m2): 39350.00

Soil Type: Sodosols representation_conserva, 2100.00 mm defined profile depth

Profile Porosity (mm)	1006.42
Profile saturation water content (mm)	995.40
Profile drained upper limit (or field capacity) (mm)	588.00
Profile lower storage limit (or permanent wilting point) (mm)	259.50
Profile available water capacity (mm)	328.50
Profile limiting saturated hydraulic conductivity (mm/hour)	0.50
Surface saturated hydraulic conductivity (mm/hour)	7.50
Runoff curve number II (coefficient)	83.00
Soil evaporation U (mm)	10.00
Soil evaporation Cona (mm/sqrt day)	4.00



DESCRIPTION

Plant Data: Continuous Kikuyu 1 Pasture

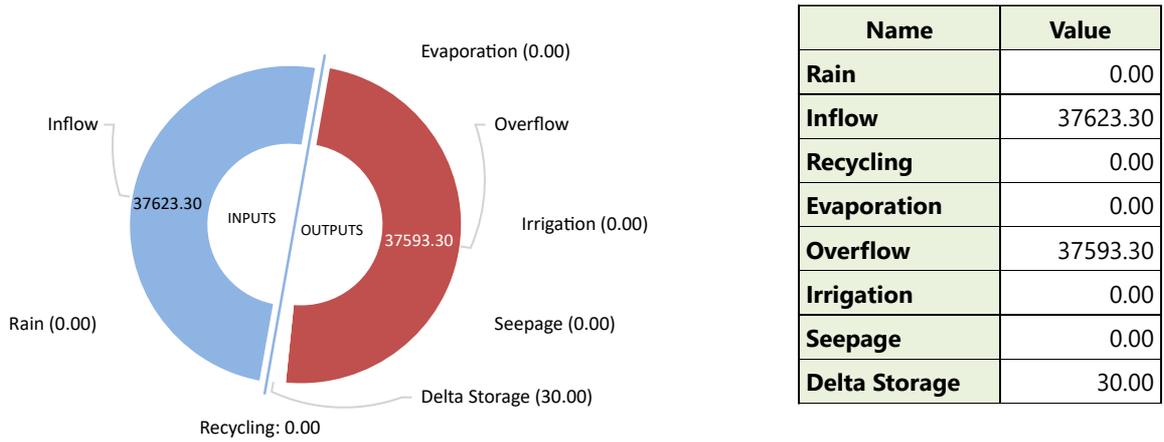
Average monthly cover (fraction) (minimum - maximum)	0.29 (0.19 - 0.38)
Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 0.8 x Pan coefficient 1)	0.80
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Maximum potential root depth in defined soil profile (mm)	1200.00
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

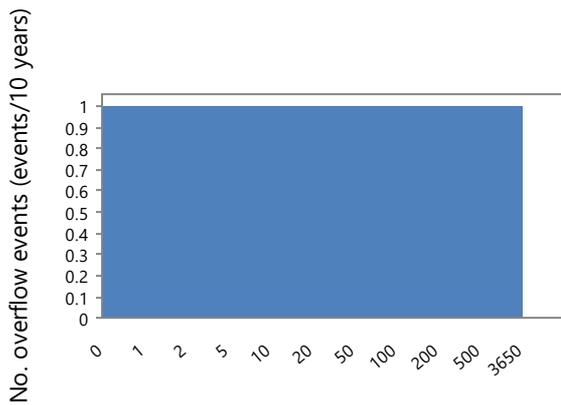
Capacity of wet weather storage pond: **300 m3**

Pond System Water Balance (m3/year)

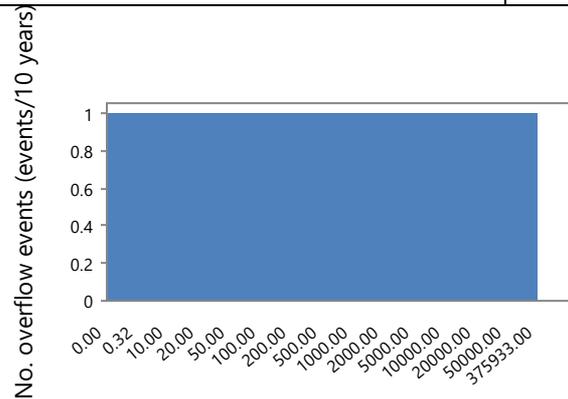


Overflow Diagnostics

Volume of overflow (m3/year)	37593.30
No. days pond overflows (days/year)	365.00
Average duration of overflow (days)	3650.00
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	0.00
Probability of at least 90% reuse (fraction)	0.00



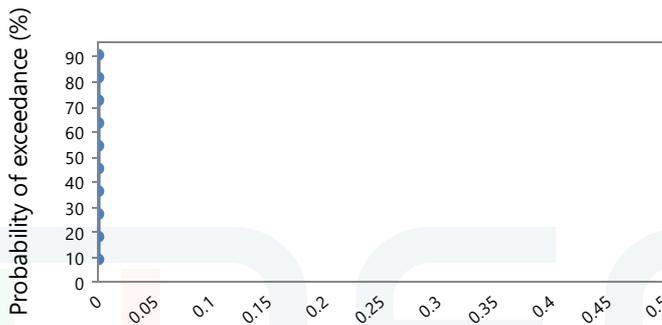
Overflow event duration exceeded (days)



Overflow volume exceeded (m3)

[Export plot](#)

[Export plot](#)



Annual reuse (fraction)

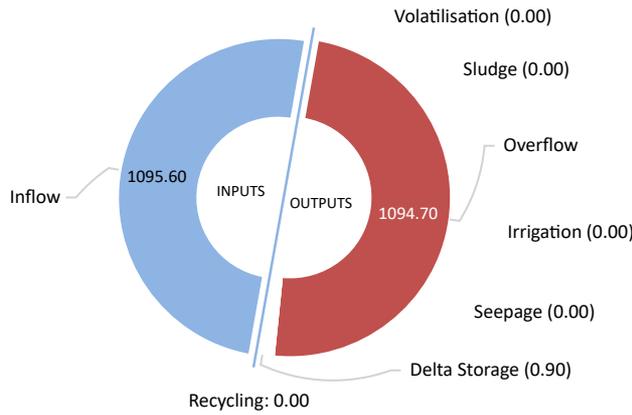
[Export plot](#)

PERFORMANCE

Pond System Performance - Nutrient: 1 closed storage tank

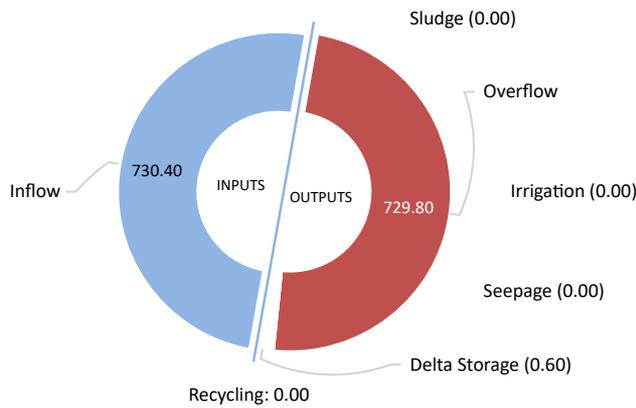
Pond System Nutrients and Salt Balance:

Nitrogen Balance (kg/year)



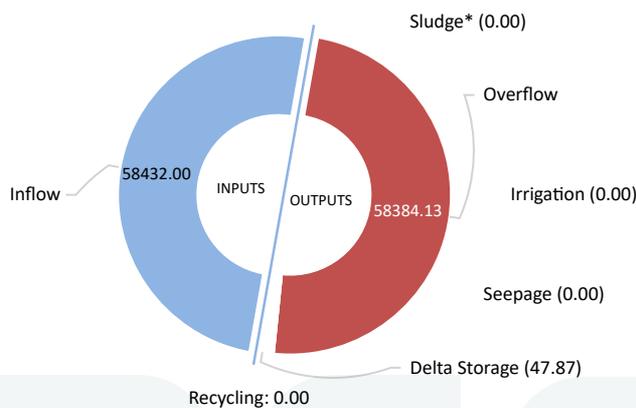
Name	Value
Inflow	1095.60
Recycling	0.00
Volatilisation	0.00
Sludge	0.00
Overflow	1094.70
Irrigation	0.00
Seepage	0.00
Delta Storage	0.90

Phosphorus Balance (kg/year)



Name	Value
Inflow	730.40
Recycling	0.00
Sludge	0.00
Overflow	729.80
Irrigation	0.00
Seepage	0.00
Delta Storage	0.60

Salt Balance (kg/year)



Name	Value
Inflow	58432.00
Recycling	0.00
Sludge*	0.00
Overflow	58384.13
Irrigation	0.00
Seepage	0.00
Delta Storage	47.87

* 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)	29.19
Average phosphorus concentration of pond liquid (mg/L)	19.46
Average salinity of pond liquid (dS/m)	2.43

Value on final day of simulation period	Pond 1
Final nitrogen concentration of pond liquid (mg/L)	29.92
Final phosphorus concentration of pond liquid (mg/L)	19.95
Final salinity of pond liquid (dS/m)	2.49

Irrigation Performance:**Water Use: (assumes 100% Irrigation Efficiency)**

Pond water irrigated (m3/year)	0.00
Average Shandy water irrigation (m3/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Total water irrigated (m3/year)	0.00
Proportion of irrigation events requiring shandying (fraction of events)	0.00
Proportion of years shandying water allocation of 0 m3/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 Days Irrigation Turned Off (fraction)	1.00 (Hence no irrigation!)
Proportion of days maximum irrigation rate set to zero (fraction)	1.00 (Hence no irrigation!)
Proportion of Days irrigation occurs (fraction)	0.00



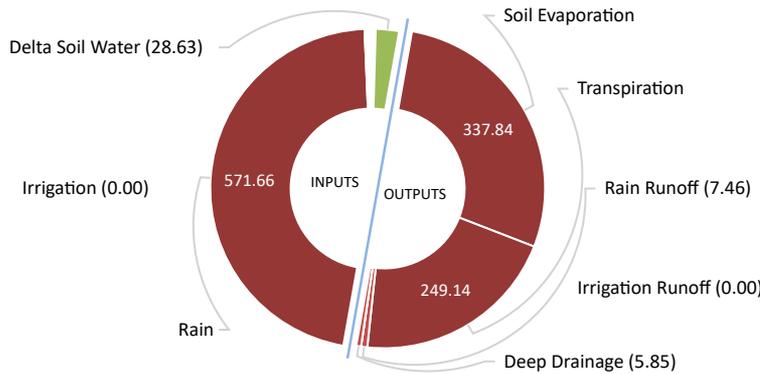
Land Performance - Soil Water

Paddock: Girrahween Temp Accom Applicatio, 39350 m2

Soil Type: Sodosols representation_conserva, 165.60 mm PAWC at maximum root depth

Land Water Balance (mm/year):

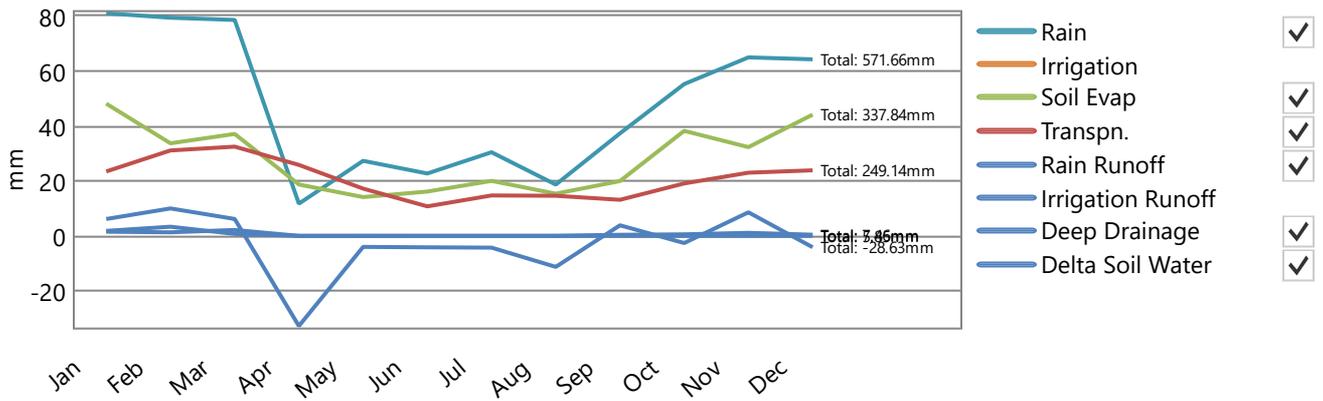
mm/year % Total inputs



Name	Value
Rain	571.66
Irrigation	0.00
Soil Evaporation	337.84
Transpiration	249.14
Rain Runoff	7.46
Irrigation Runoff	0.00
Deep Drainage	5.85
Delta Soil Water	-28.63

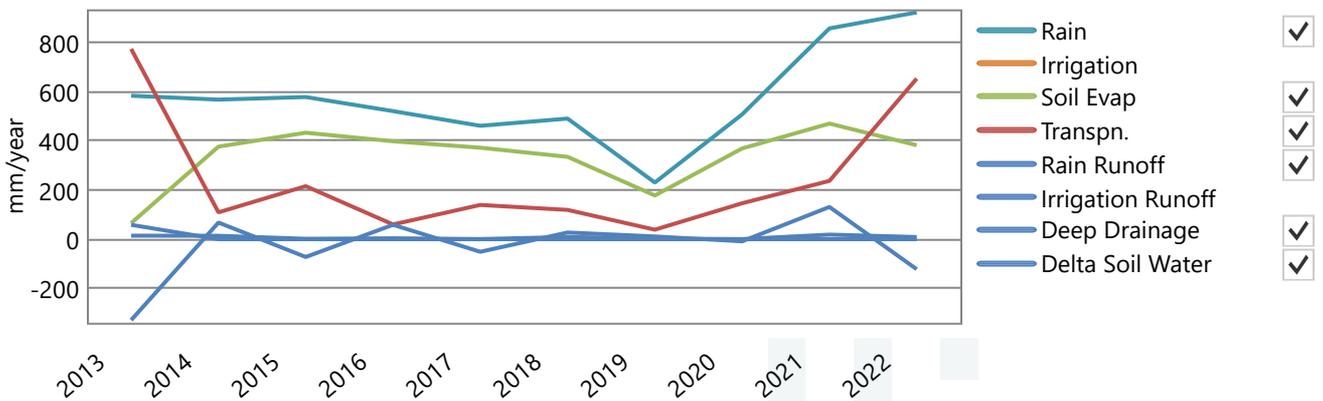
Average Monthly Totals (mm):

Chart Table



Average Annual Totals (mm/year):

Chart Table



PERFORMANCE



Land Performance - Soil Nutrient

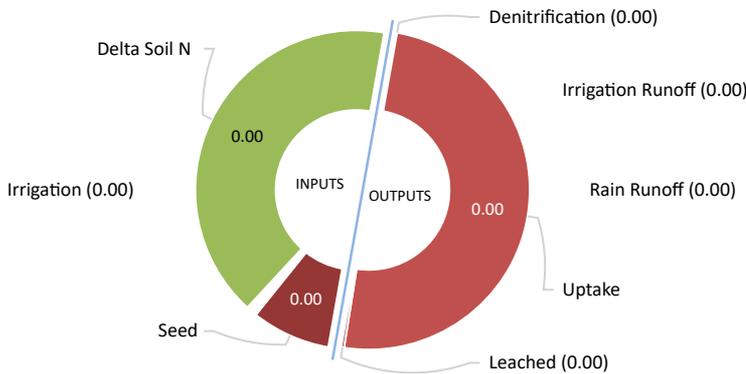
Paddock: **Girrahween Temp Accom Applicatio, 39350 m2 representation_conserva**

Soil Type: **Sodosols**

Irrigation ammonium volatilisation losses (kg/m2/year): 0.00

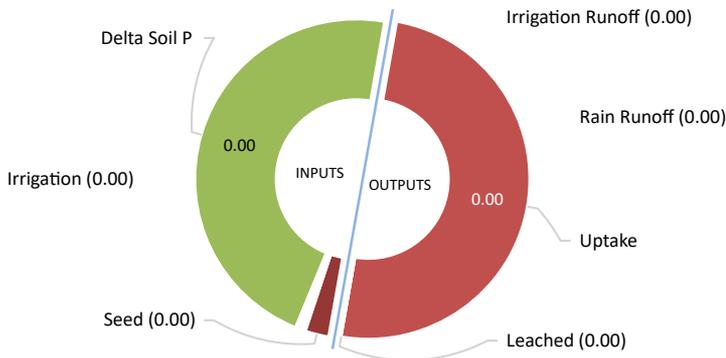
Proportion of total nitrogen in irrigated effluent as ammonium (fraction): 0.80

Land Nitrogen Balance (kg/m2/year)



Name	Value
Seed	2.63E-04
Irrigation	0.00
Denitrification	0.00
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	1.61E-03
Leached	9.20E-06
Delta Soil N	-1.35E-03

Land Phosphorus Balance (kg/m2/year)



Name	Value
Seed	2.25E-05
Irrigation	0.00
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	4.80E-04
Leached	2.58E-07
Delta Soil P	-4.58E-04

PERFORMANCE

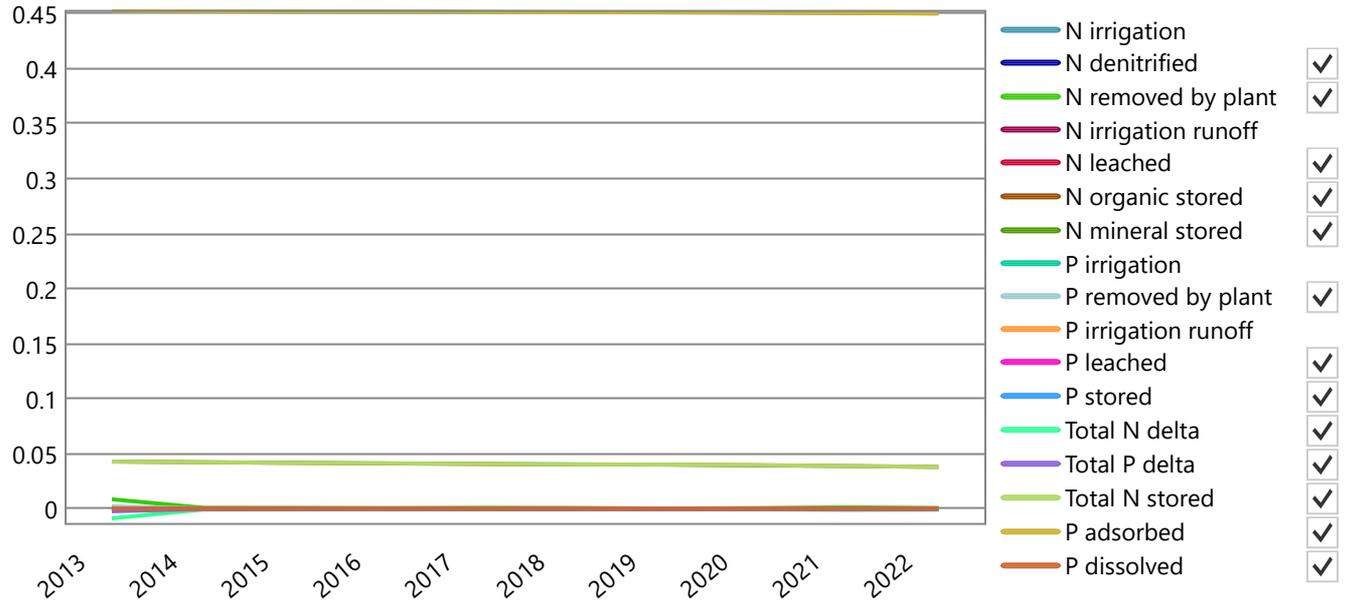


Land Performance - Soil Nutrient

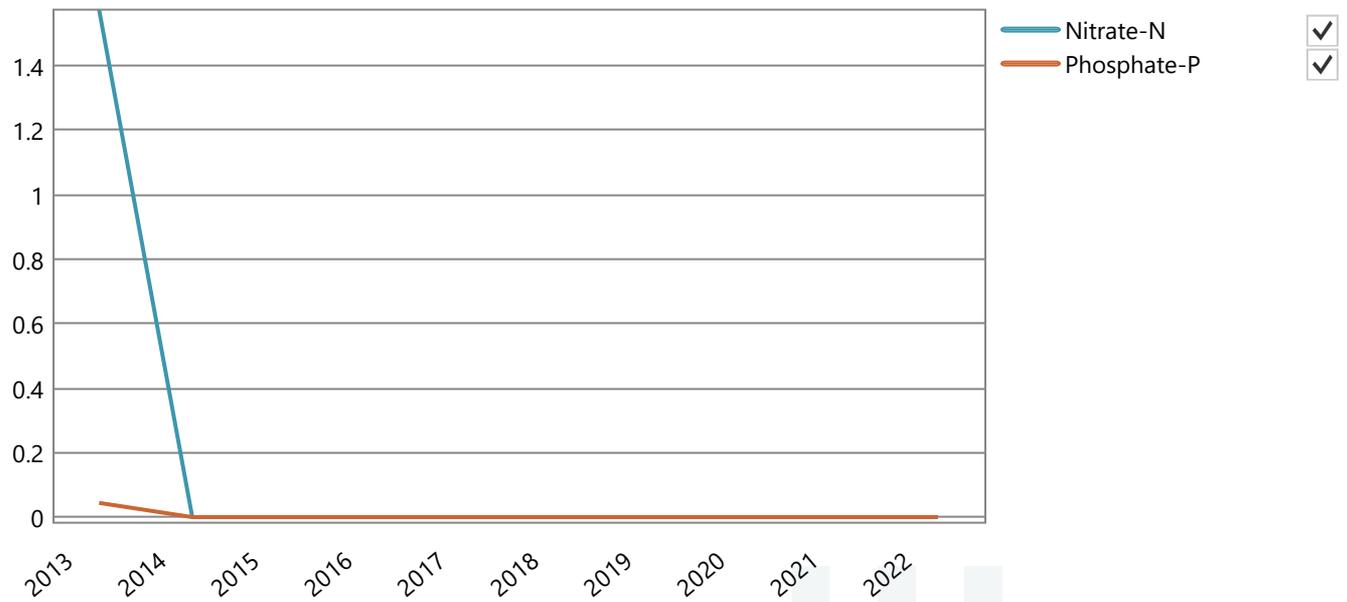
Paddock: **Girrahween Temp Accom Applicatio, 39350 m2 representation_conserva**

Soil Type: **Sodosols**

Annual Nutrient Totals (kg/m2):



Annual Nutrient Leaching Concentration (mg/L):



PERFORMANCE



Plant Performance and Nutrients

Paddock: Girrahween Temp Accom Applicatio, 39350 m2 representation_conserva

Soil Type: Sodosols

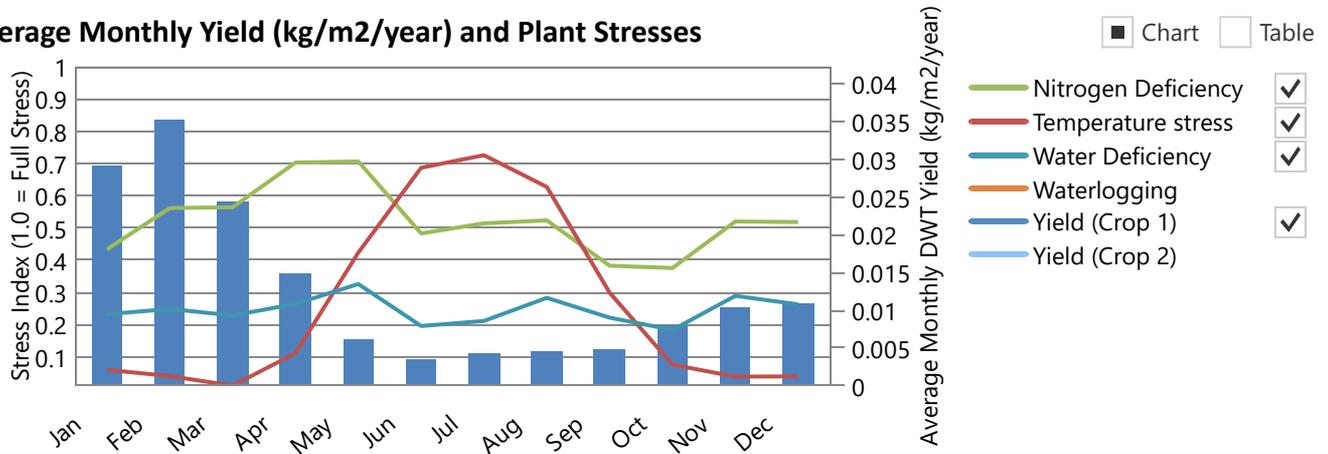
Plant: Continuous Kikuyu 1 Pasture

Average annual shoot dry matter yield (kg/m2/year)	0.16 (0.04 - 0.75)
Average monthly plant (green) cover (fraction) (minimum - maximum)	0.29 (0.19 - 0.38)
Average monthly root depth (mm) (minimum - maximum)	406.09 (280.30 - 535.81)

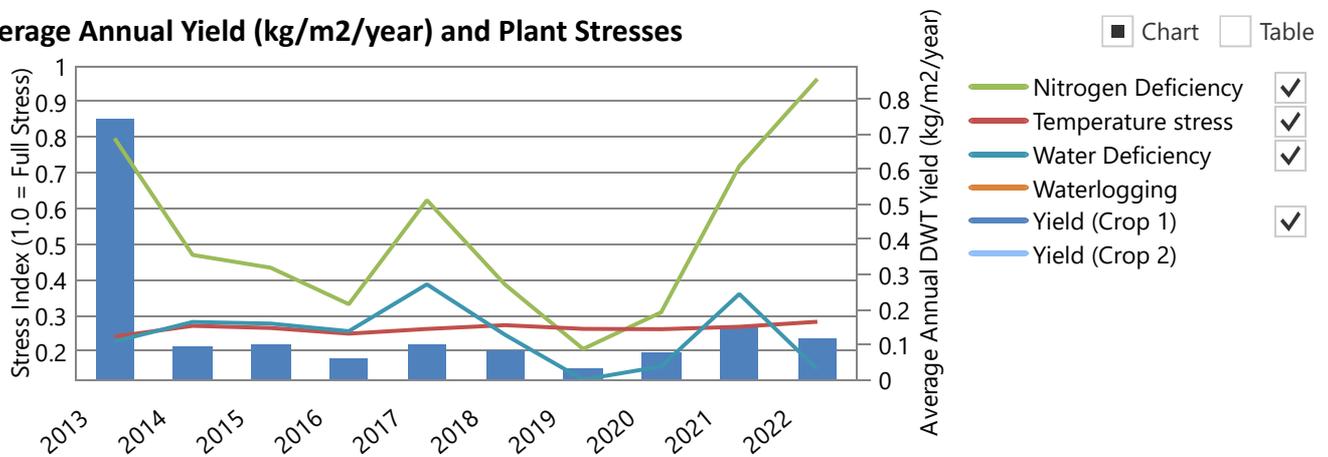
Nutrient Uptake (minimum - maximum):

Average annual net nitrogen removed by plant uptake (kg/m2/year)	0.00 (0.00 - 0.01)
Average annual net phosphorus removed by plant uptake (kg/m2/year)	0.00 (0.00 - 0.00)
Average annual shoot nitrogen concentration (fraction dwt)	0.01 (0.01 - 0.01)
Average annual shoot phosphorus concentration (fraction dwt)	0.003 (0.003 - 0.003)

Average Monthly Yield (kg/m2/year) and Plant Stresses



Average Annual Yield (kg/m2/year) and Plant Stresses



No. of harvests/year: 0.10 (normal), 2.40 (forced by crop death due to nitrogen stress (0.20), water stress (2.20))

No. days without crop/year (days/year): 122.60 due to frosting (5.00), temperature stress - not frost (2.20), water stress (115.40)

PERFORMANCE

Land Performance

Paddock: Girrahween Temp Accom Applicatio, 39350 m2
representation_conserva

Soil Type: Sodosols

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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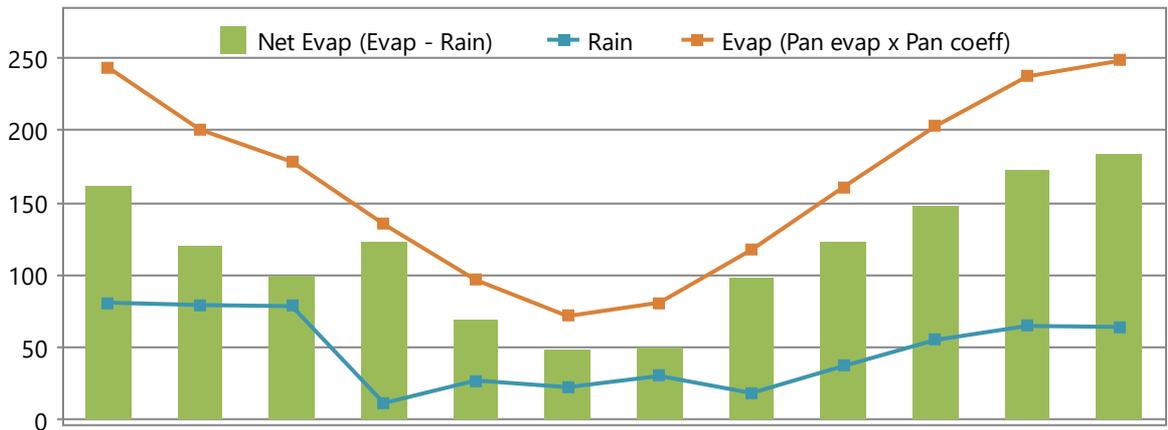
Insufficient years to run salinity calculations.

Sustainability Diagnostics: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Averaged Historical Climate Data Used in Simulation (mm)

Location: Girrahween Camp 2_-26.50_150.25, -26.5°, 150.25°

Run Period: 01/01/2013 to 31/12/2022 10 years, 0 days



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	81.0	79.4	78.6	11.7	27.3	22.7	30.4	18.7	37.3	55.3	65.0	64.3	571.7
Evap	243.4	200.4	178.3	135.2	96.7	71.8	81.1	117.5	160.7	202.8	237.2	247.9	1972.9
Net Evap	162.3	121.0	99.7	123.5	69.4	49.1	50.6	98.8	123.4	147.5	172.2	183.7	1401.2
Net Evap/day	5.2	4.3	3.2	4.1	2.2	1.6	1.6	3.2	4.1	4.8	5.7	5.9	3.8

DIAGNOSTICS



Sustainability Diagnostics: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Pond System: 1 closed storage tank

Girrahween Temp Accom STP - Indicative - 37623.30 m3/year or 103.02 m3/day generated on average

Effluent entering pond system after any pretreatment and recycling

Average (Minimum-Maximum) influent quality calculated for 365.20 non-zero flow days, after any pretreatment and recycling.

Constituent	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	29.12 (15.86 - 30.00)	1095.60 (1095.00 - 1098.00)
Total Phosphorus	19.41 (10.58 - 20.00)	730.40 (730.00 - 732.00)
Total Dissolved Salts	1553.08 (846.03 - 1600.00)	58432.00 (58400.00 - 58560.00)
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)

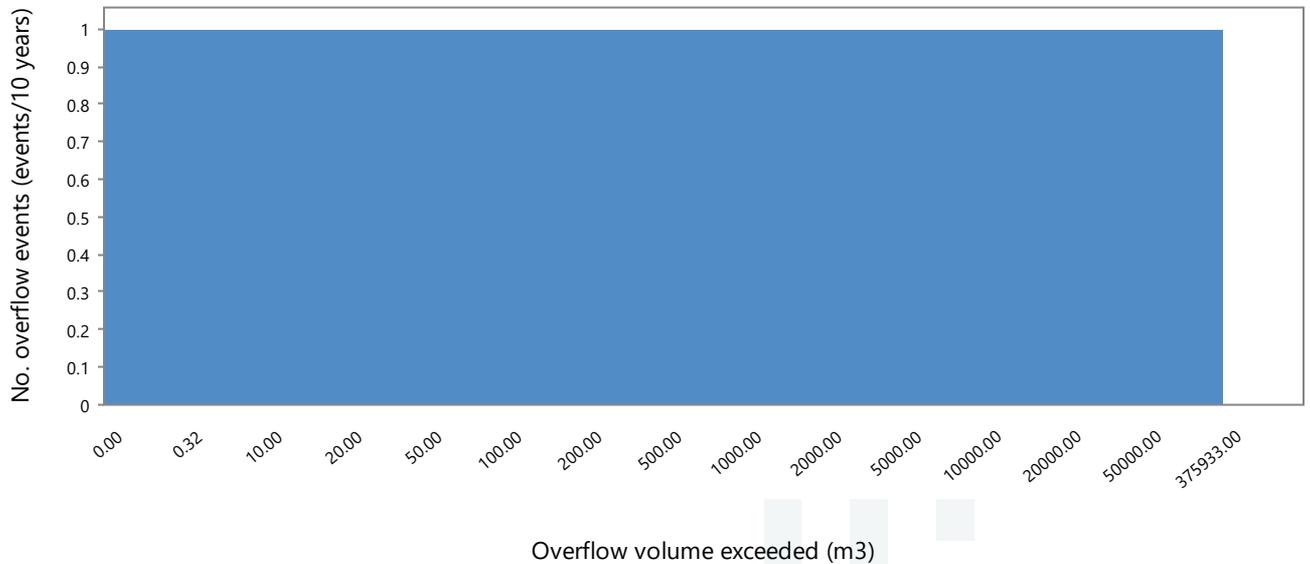
Last pond (Wet weather store): 300.00 m3

Theoretical hydraulic retention time (days)	2.91
Average volume of overflow (m3/year)	37593.30
No. overflow events per year exceeding threshold* of 0.32 m3 (no./year)	0.10
Average duration of overflow (days)	3650.00
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)	2.43
Salinity of last pond on final day of simulation (dS/m)	2.49
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: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Irrigation Information

Irrigation: 39350 m² total area (assumed 100% irrigation efficiency)

	Quantity/year	Quantity/m ² /year
Total irrigation applied (m ³)	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

Shandyng

Annual allocation of fresh water for shandyng (m ³ /year)	0.00
Average Shandy water irrigation (m ³ /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 shandyng (fraction of events)	0.00
Minimum shandy water is used	False

Irrigation Issues

Proportion of Days irrigation is turned off (fraction)	1.00
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Sustainability Diagnostics: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Paddock Land: Girrahween Temp Accom Applicatio: 39350 m2

Irrigation: Fixed Sprinkler with 0.2% ammonium loss during irrigation

Irrigation triggered every 1 days
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): Sodosols representation_conserva, 165.60 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	81.0	79.4	78.6	11.7	27.3	22.7	30.4	18.7	37.3	55.3	65.0	64.3	571.7
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	48.1	33.7	37.1	18.7	14.1	16.1	20.0	15.4	20.0	38.2	32.3	44.1	337.8
Transpn.	23.4	31.1	32.5	25.8	17.2	10.7	14.7	14.6	13.1	19.1	23.0	23.9	249.1
Runoff	1.5	1.3	2.2	0.0	0.0	0.0	0.0	0.0	0.4	0.6	1.1	0.4	7.5
Drainage	1.8	3.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9
Delta	6.1	10.0	6.2	-32.8	-4.0	-4.2	-4.3	-11.3	3.8	-2.6	8.6	-4.1	-28.6

Soil Nitrogen Balance

Average annual effluent nitrogen added (kg/m2/year)	0.00
Average annual soil nitrogen removed by plant uptake (kg/m2/year)	1.61E-03
Average annual soil nitrogen removed by denitrification (kg/m2/year)	0.00
Average annual soil nitrogen leached (kg/m2/year)	9.20E-06
Average annual nitrate-N loading to groundwater (kg/m2/year)	9.20E-06
Soil organic-N kg/m2 (Initial - Final)	0.04 - 0.04
	0.01 - 2.12E-05
Average nitrate-N concentration of deep drainage (mg/L)	1.57
Max. annual nitrate-N concentration of deep drainage (mg/L)	1.57

Soil Phosphorus Balance

Average annual effluent phosphorus added (kg/m2/year)	0.00
Average annual soil phosphorus removed by plant uptake (kg/m2/year)	4.80E-04
Average annual soil phosphorus leached (kg/m2/year)	2.58E-07
Dissolved phosphorus (kg/m2) (Initial - Final)	5.88E-05 - 2.70E-05
Adsorbed phosphorus (kg/m2) (Initial - Final)	0.45 - 0.45
Average phosphate-P concentration in rootzone (mg/L)	0.07
Average phosphate-P concentration of deep drainage (mg/L)	0.04
Max. annual phosphate-P concentration of deep drainage (mg/L)	0.04
Design soil profile storage life based on average infiltrated water phosphorus concn. of 0.00 mg/L (years)	999.00



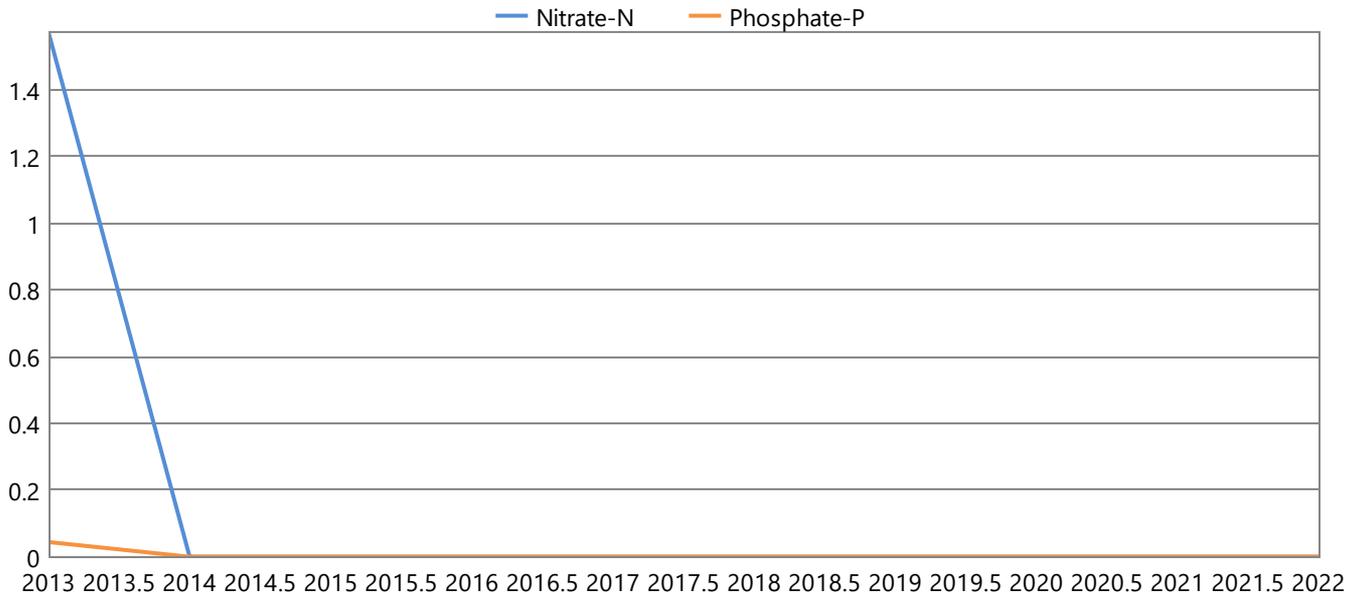
DIAGNOSTICS

Sustainability Diagnostics: Girraheen Temporary Accommodation Camp (SITE 2) Assessment

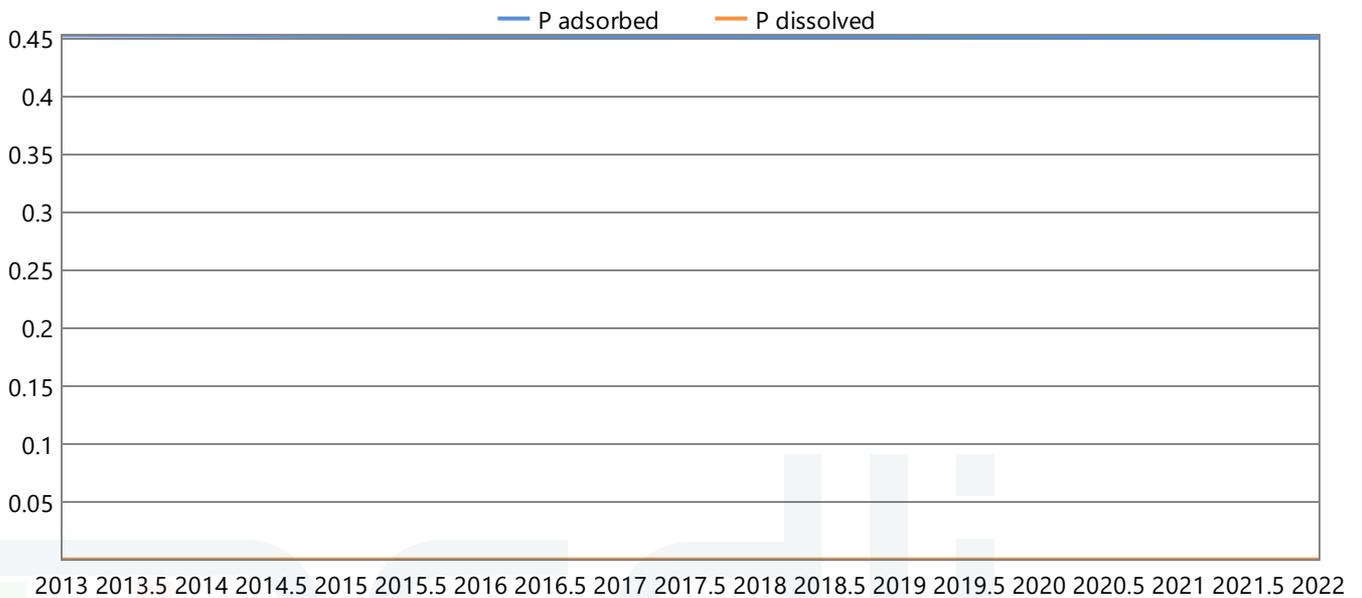
Paddock Land: Girraheen Temp Accom Applicatio: 39350 m2

Irrigation: Fixed Sprinkler with 0.2% ammonium loss during irrigation

Annual nutrient leachate concentration (mg/L)



Annual Phosphate-P in soil (kg/m2)



Sustainability Diagnostics: Girrahween Temporary Accommodation Camp (SITE 2) Assessment

Paddock Plant Performance: Girrahween Temp Accom Applicatio: 39350 m2

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

Average annual shoot dry matter yield (kg/m2/year)	0.16 (0.04 - 0.75)
Average monthly plant (green) cover (fraction)	0.29 (0.19 - 0.38)
Average monthly crop factor (fraction)	0.23 (0.15 - 0.30)
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Average monthly root depth (mm)	406.09 (280.30 - 535.81)
Average number of normal harvests per year (no./year)	0.10 (0.00 - 1.00)
Average number of normal harvests for last five years only (no./year)	0.00
Average number of crop deaths per year (no./year)	2.40 (0.00 - 4.00)
Average number of crop deaths for last five years only (no./year)	2.00
Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient)	0.52 (0.21 - 0.96)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.06 (0.01 - 0.12)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.73 (0.60 - 0.85)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.25 (0.18 - 0.33)
Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.00)
No. days without crop/year (days)	122.60

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 years to run salinity calculations.

DIAGNOSTICS

medli

Run Messages

Messages generated when the scenario was run:

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





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