MEDLI Assessment Report

SGP North Warehouse/Office Facility

Arrow Energy

12 July 2024

→ **The Power of Commitment**

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Executive Summary

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

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

This report presents the modelling of the Girrahween Warehouse and Office Facility (the site) exclusively.

Girrahween Warehouse/Office Facility

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 STP characteristics. Two scenarios were subsequently modelled (irrigation and non-irrigation case) at 28 equivalent persons (EP).

The following MEDLI model outputs were reviewed to assess the sustainability of the 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.

Irrigation scheme aspects were then determined, including:

– 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 Warehouse/Office Facility MEDLI outputs for modelled irrigation scenario

EP	**Load scenario**
	28 EP
Hydraulic loading (L/day)	5,600
Maximum Irrigation Rate (mm/day) ~	3.7
Wet Weather Storage (kL) ^	17.0
Irrigation Area (m^2) – Minimum required ^*	1,800

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:

– Under the 28 EP loading scenario, an irrigation area of at least **0.18 ha** is required for the minimum wet weather storage allowance (as described below).
– 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 0.18 ha land application area (LAA).
– The annual average irrigation depth over the 0.18 ha LAA is **3.2 mm/d** (ranging from 3.1 to 3.7 mm), noting:
    - Often the full irrigation depth of 3.7 mm 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 3.7 mm/d"* within the sized LAA has been modelled herein
– No runoff occurs as a result of irrigation, only due to rainfall
– An as-constructed wet weather storage volume of **17.0 kL** is required 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 C effluent (i.e., 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 to10 years).

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.4 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

Arrow Energy Pty Ltd (Arrow Energy) holds permits for petroleum and gas resource activities across several mining leases in the Western Downs region under Environmental Authority (EA) EPPG00972513. Ancillary to these petroleum activities are sewage treatment operations related to temporary accommodation camps, mobile drilling camps, semi-permanent camps, and warehouses and office facilities.

GHD Pty Ltd (GHD) understands that Arrow Energy has obtained approval to construct a warehouse/office facility (the site) at the terminus of Retreat Road, Kowguran QLD 4415 (within PL305) under EA0001399.

Arrow Energy has engaged GHD to conduct MEDLI (Model for Effluent Disposal Using Land Irrigation) modelling at the site, with the objective of identifying how the proposed wastewater generated and treated at the facility can be irrigated sustainably.

MEDLI modelling also assisted with sizing 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 site's climate, paddock and irrigation regime conditions are also evaluated.

1.1 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 Warehouse/Office Facility.

1.2 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 area
- Consolidate project area-specific MEDLI input data (climate, anticipated nutrient loading and daily hydraulic loadings etc.)
- Completion of a MEDLI assessment using the MEDLI Version 2.1.0.0 for flows associated with 28 EP loading for each soil type identified for the project area
- Conduct several modelling iterations for the project area using 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, Science and Innovation (DESI) recommendations and guidelines for land based treated effluent irrigation schemes in Queensland (DESI, 2019).

1.3 Document review

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

1.4 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 1.1 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 1.5 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 MEDLI 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 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.

1.5 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 should only be 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 LAA footprints for all of the warehouse/office facility; however, no KMZ/KML files of the extents were provided. The footprint of associated facilities (e.g., warehouse, greywater discharge points, etc.) is also assumed to be accommodated within the indicated extent.

2. Site summary

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

2.1 Locality

The Girrahween Warehouse/Office Facility is part of a wider mobile drilling camp proposed for construction in Kowguran in the Western Downs region of Queensland. The proposed facility is located approximately 17 km north of Miles (Figure 2-2) within Lot 16 Plan AU38, which comprises approximately 621 ha. Key information pertaining to the camp's siting is shown in Table 1.

Figure 2-1 shows the extent and boundary coordinates of the warehouse/office facility and temporary accommodation camp (described in a separate MEDLI report) provided by Arrow Energy. GHD understands that the effluent irrigation area is to be accommodated within this boundary and has inferred the total Girrahween Warehouse/Office Facility area within this area will comprise approximately 25 ha.

Table 1 Summary of Girrahween Warehouse/Office Facility siting details

Camp Name	Petroleum Lease	Lot Plan	Total irrigation area
Girrahween Warehouse/Office	PL305	Lot 16 AU38	Not specified. However, < 25 ha.

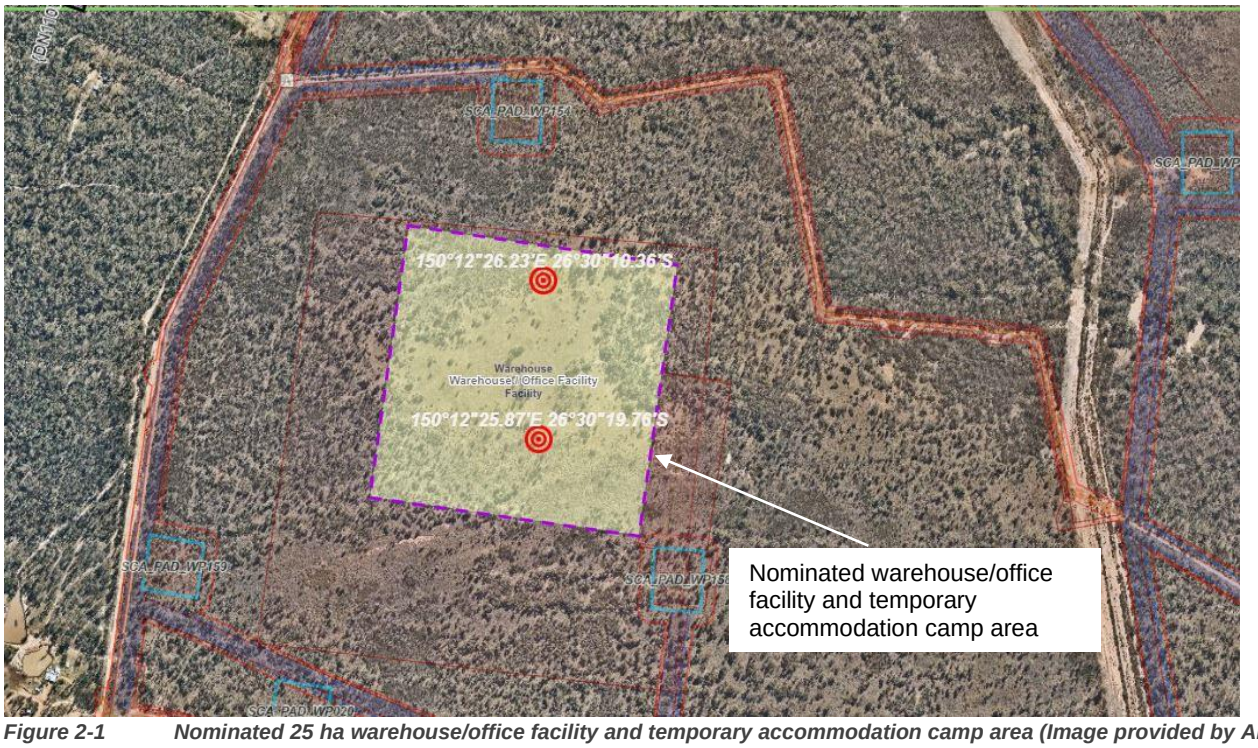

Figure 2-1 Nominated 25 ha warehouse/office facility and temporary accommodation camp area (Image provided by Arrow)

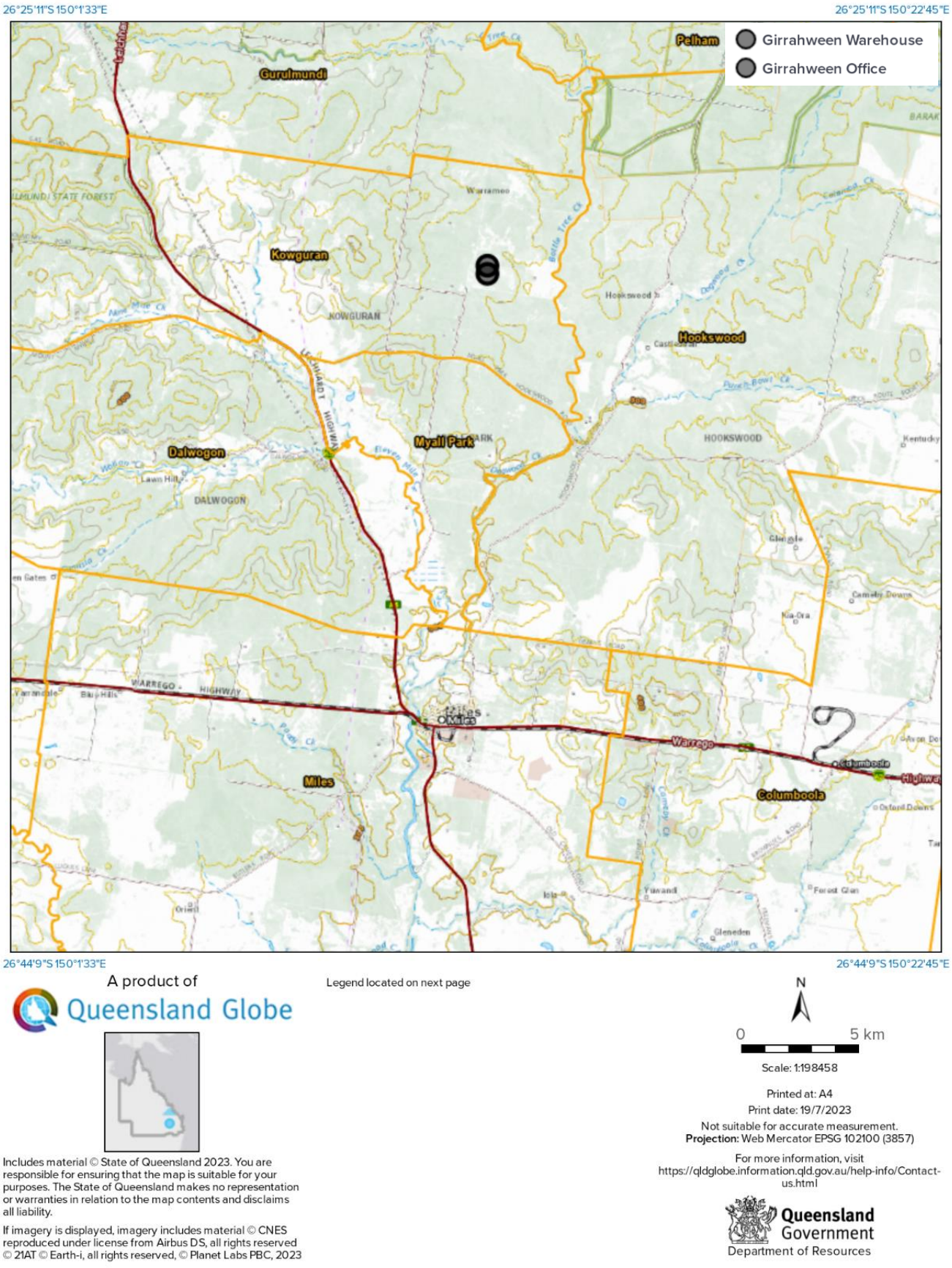

Figure 2-2 Locality, contour, and topography plot of Girrahween Warehouse/Office Facility (Source: Qld Globe, 2023)

2.2 Facility longevity and hydraulic loading

GHD understands that the warehouse/office is planned to be semi-permanent with a lifespan of no more than 10 years.

Hydraulic loading for domestic sewage comprising greywater generation forecast by Arrow Energy is provided in Table 2.

Table 2 Hydraulic loading and facility permanence

Site Name	Operational period	V=Volume/day^ Maximum	Equivalent Persons (EP) EP=V/200
Girrahween Warehouse/Office Facility	Permanent (3-10 years)	5,600 L/day	28
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 (Queensland Government, 2022a), which is hosted by the Science Division of the Queensland Government (DES). Using datasets constructed from Australian Bureau of Meteorology 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 in Figure 2-3 for Girrahween. Climate data for the Girrahween Warehouse/Office Facility was obtained from this coordinate (Latitude: -26.50, Longitude: 150.20).

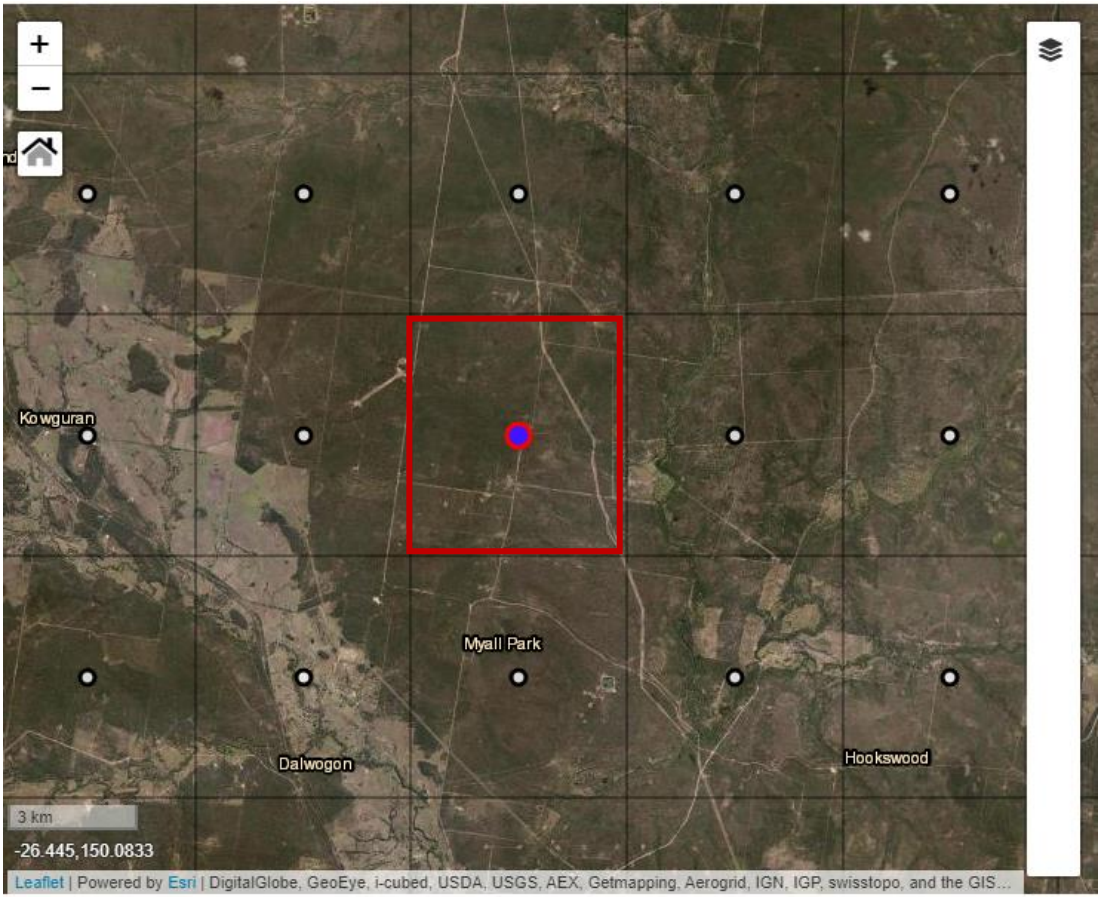

Figure 2-3 Gridded dataset (circled) specific to Girrahween, adopted for this MEDLI assessment (Lat: -26.50, Long: 150.20) (Source: SILO)

Monthly average climate data from the Girrahween Warehouse/Office Facility grid point is summarised in Table 3. The annual rainfall in the area is relatively low (577 mm/year). Factoring the large pan evaporation (1,968 mm/year), the site exhibits a net evaporation of 1,391 mm/year.

Table 3 Climate data for Girrahween Warehouse/Office Facility, 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/m²/year)	Net Evaporation (mm)^
January	83.1	243.3	34.3	20.6	22.9	160.2
February	82.0	200.1	33.0	19.6	21.6	118.1
March	76.9	178.0	31.4	18.4	18.5	101.1
April	11.3	134.7	27.9	13.1	16.7	123.4
May	28.8	96.3	23.8	8.9	13.2	67.5
June	23.7	71.2	20.7	5.7	11.5	47.5
July	31.2	80.5	20.7	4.7	13.1	49.3
August	19.1	117.0	22.9	5.2	16.8	97.9
September	38.2	160.2	26.6	9.5	19.6	121.9
October	54.9	202.3	29.7	14.0	22.0	147.4
November	66.2	236.6	32.1	16.5	24.1	170.3
December	61.5	247.8	33.5	18.8	23.9	186.3
Annual	**576.8**	**1967.7**	**28.0**	**12.9**	**18.6**	**1390.9**

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 of the nominated Girrahween Warehouse/Office Facility area is shown in Figure 2-4, indicating that the site resides above 320 m Australian Heigh Datum.

Survey data specific to the site has not been provided. It is assumed from Figure 2-4 that the site broadly presents a slight downward gradient to the east-south-east (less than 1 m fall over ~200 m).

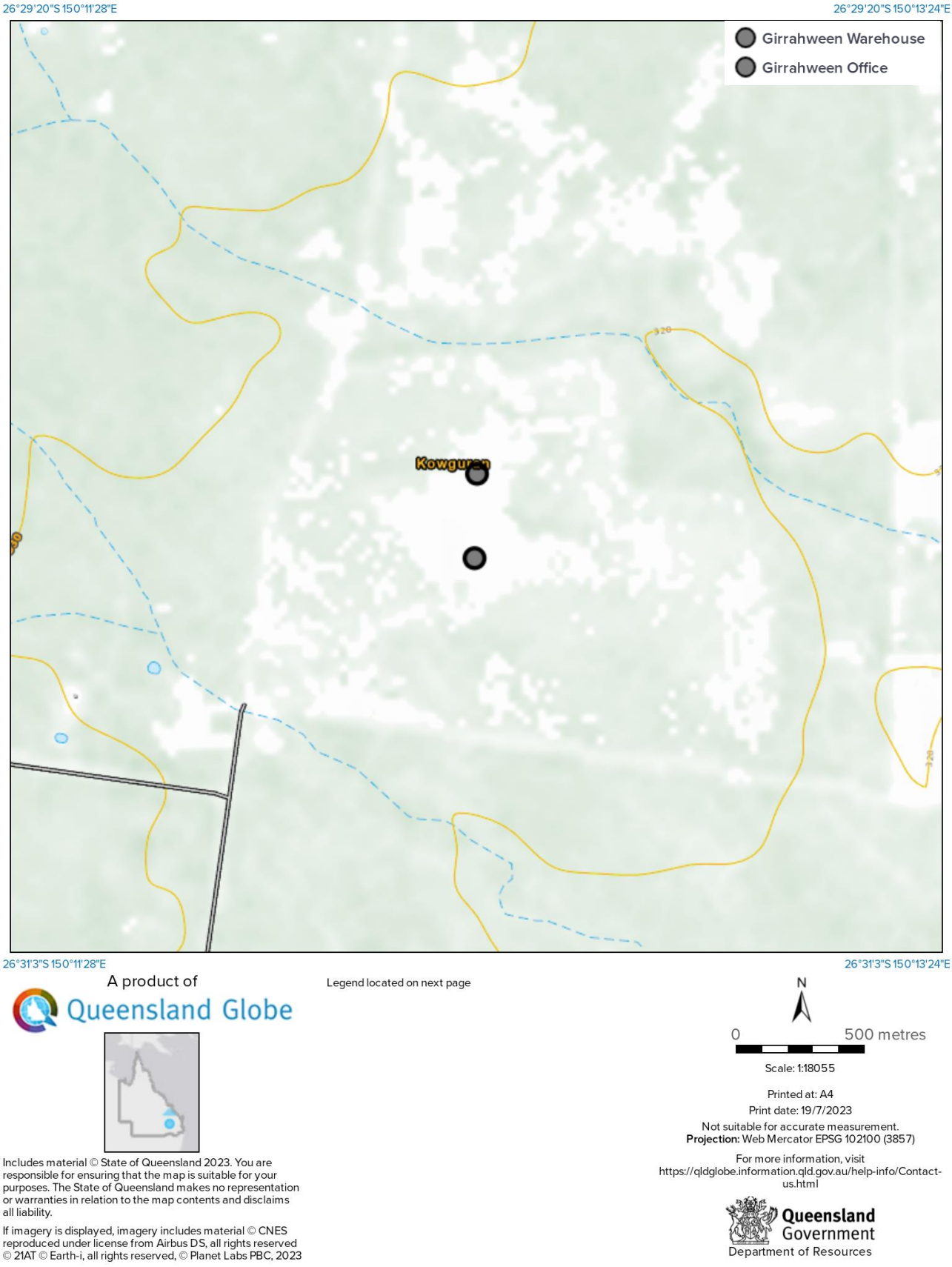

Figure 2-4 A contour plot of Girrahween Warehouse/Office Facility (Source: Queensland Globe)

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 Energy.

Desktop searches of the approximate project boundary (provided by Arrow) for the Girrahween Warehouse / Office & Temporary Accommodation Camp, as well as the immediate vicinity indicate there is category X (non-remnant vegetation) mapped across the area. Matters of state environmental significance (MSES) regulated vegetation (essential habitat; category A or B) are mapped within 250 to 400 m of the facility area to the north, east, and south-east (downgradient topographically), as shown in Figure 2-5.

Broad vegetation groups 12a/29b/24a (Eastern eucalypt woodlands to open forests/Open shrublands/Low woodlands to tall shrublands dominated by *Acacia spp*. on residuals) are listed for the area.

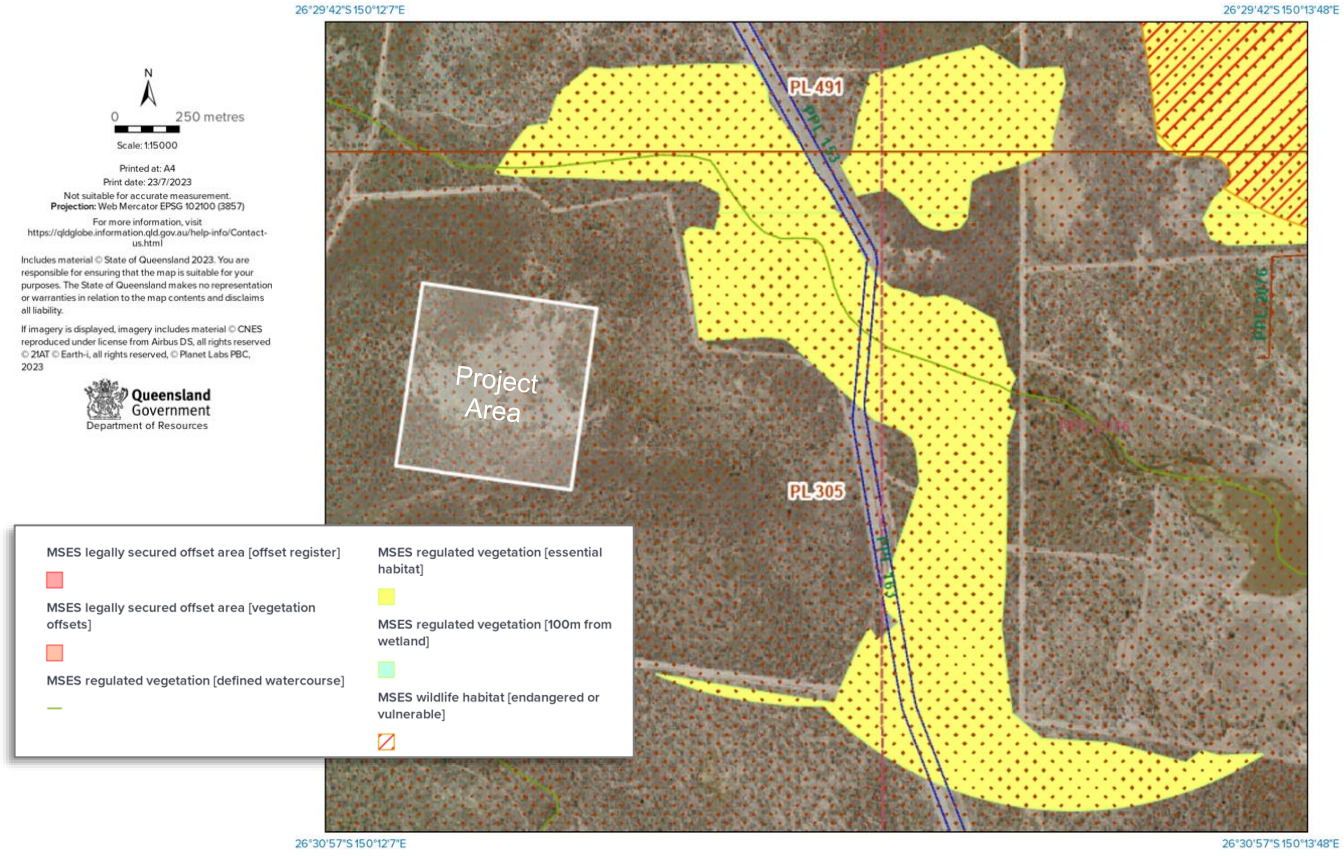

Figure 2-5 ***Proximal MSES vegetation and watercourse to the approximate project area boundary indicated by Arrow (Source: Queensland Globe)***

2.6 Geology

Figure 2-6 identifies two dominant lithologies within the project area as mapped by the Department of Natural Resources and Mines digital geological mapping (DNRM, 2018), accessed via Queensland Globe. Both lithologies are summarised in Table 4.

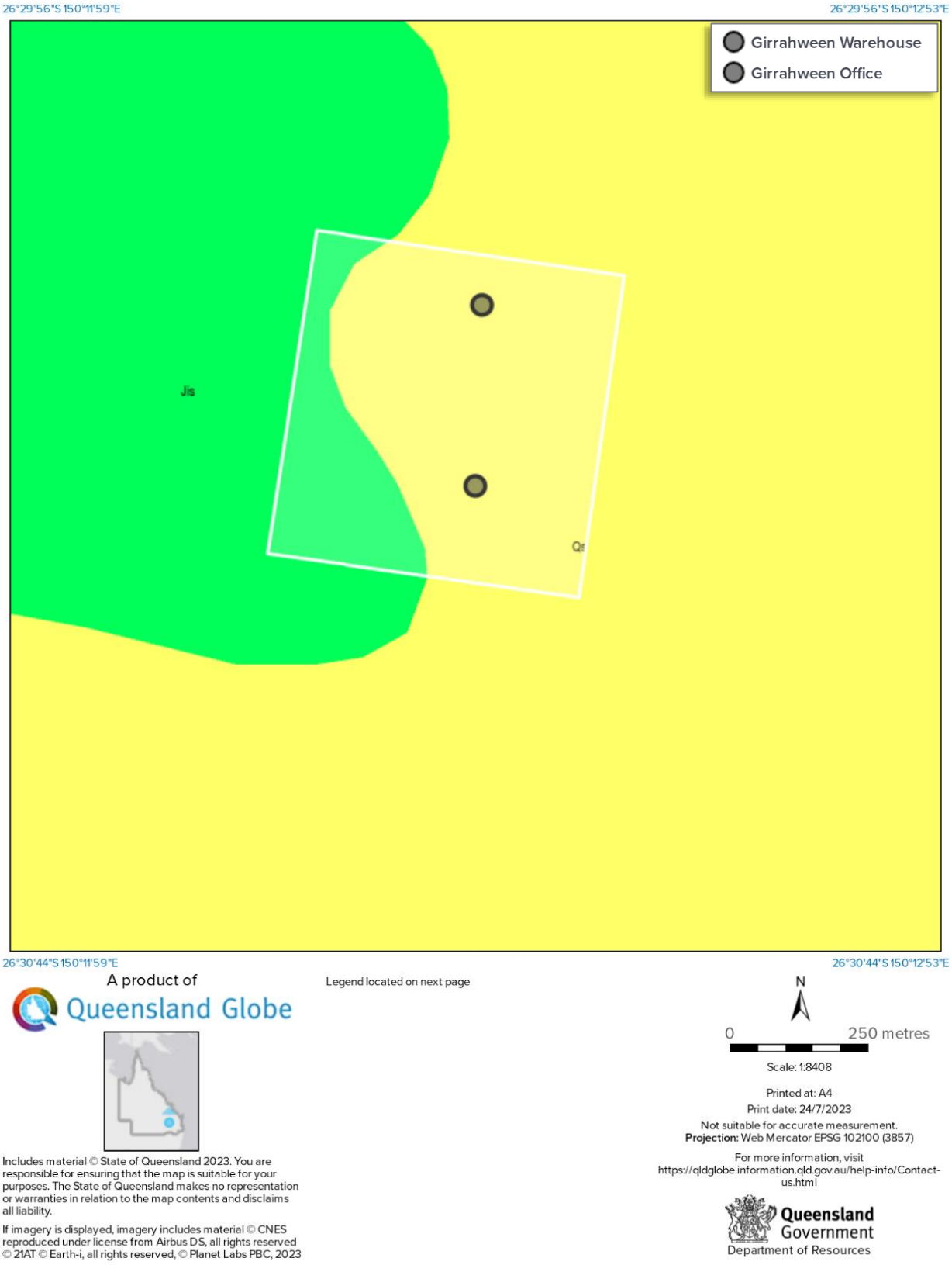

Figure 2-6 Detailed surface geology 1:100k intersecting the site (Source: Queensland Globe)

Table 4 Detailed surface geology (1:100k)

Aspect	Description	
	Dominant Lithology 1 (~25% of site footprint)	**Dominant Lithology 2 (~75% of site footprint)**
Rock unit name (symbol)	Qs-SQ (Qs)	Springbok Sandstone (Jis)
Lithological Summary	Sand, red sandy soil, silt and some gravel; floodout and sheet sand with some alluvium	Labile sandstone, siltstone, mudstone, some coal
Dominant Rock / Age	Miscellaneous Unconsolidated Sediments (Quaternary; Stratified unit including volcanic and metamorphic)	Arenite-Mudrock (Late Jurassic)

2.7 Soil

A desktop review of Queensland Globe mapping was used to identify soil types within the project area, to apply typical soil profiles in the model. The dominant mapped soil type is 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

The nearest government Western Downs Land Management Manual site (MWD) (ID#23) soil observation was recorded 8.0 km southwest of the Girrahween Warehouse/Office Facility, which confirms soils may be considered Grey Chromosols (bleached-sodic, eutrophic). Clay loams were recorded for the top 450 mm, thereafter medium clays were observed to 1.5 metres below ground level (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.

2.8 Environmental values (water)

The site is within the Maranoa and Balonne Rivers Basin. Under the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019*, locally relevant water quality objectives (WQOs) have been established in the region to protect or enhance environmental values (EVs) for water. 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 in Appendix A. An extract of this plan is shown in Figure 2-7. The Girrahween Warehouse/Office Facility site is located within Dogwood Creek catchment waters under the Plan, 17 km north of the Dogwood Creek Weir.

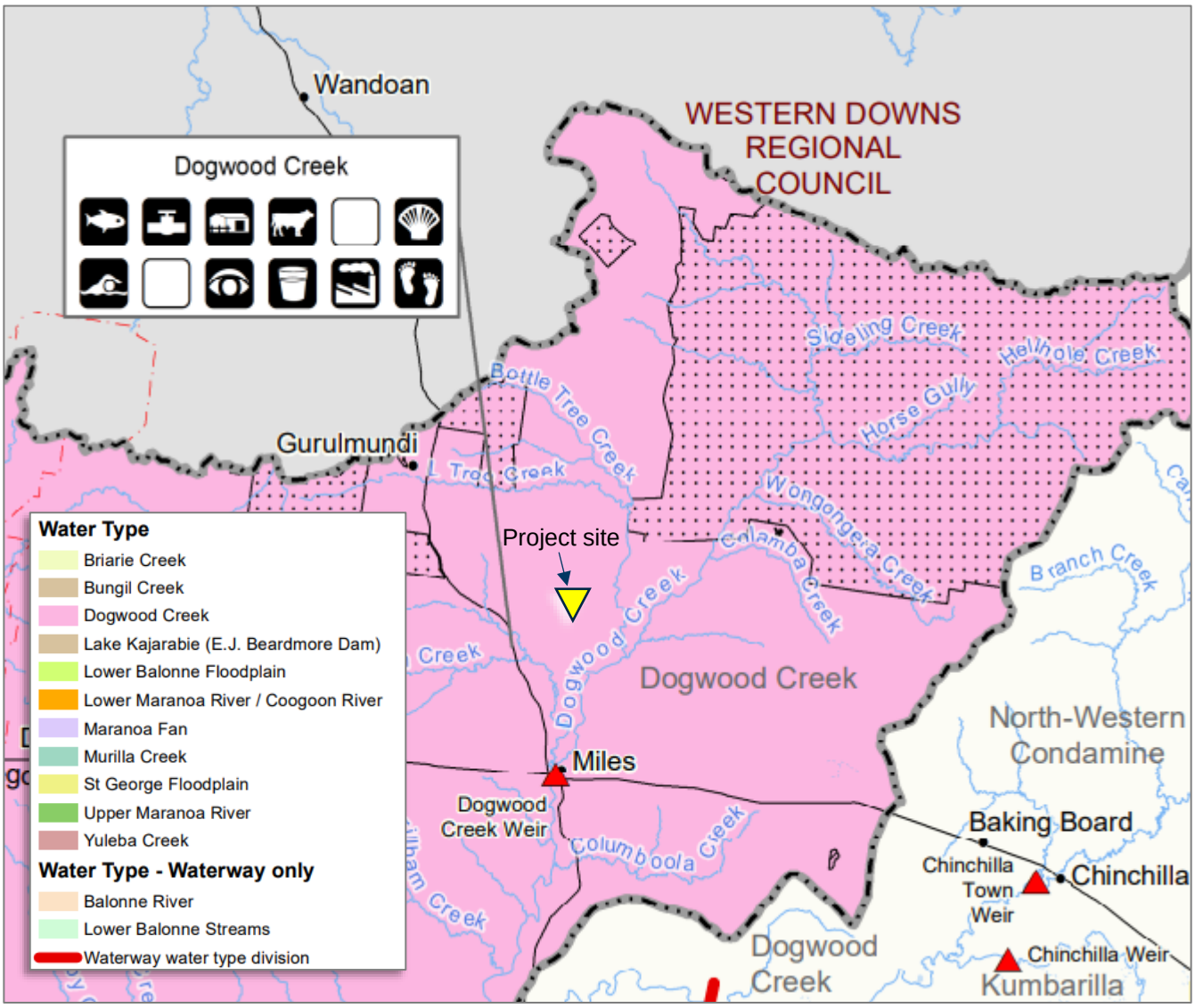

Figure 2-7 Basin Plan WQ4222 – Maranoa-Balonne Rivers Basin extract, (Source: State of Queensland ©)

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 Maranoa and Balonne Rivers Basin

Water type	Surface Water	Groundwater			
EVs	**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 1 km of the irrigation area (Figure 2-8). Details for these are summarised in Table 7. 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. The attributed aquifers of all bores shown below are given as Condamine Alluvium.

Table 7 Summary of existing registered groundwater bores within 1 km of irrigation area

ID	Proximity to irrigation area	Description	Depth (mbgl)	Screened interval (mbgl)	Relevant water quality or level data (if available)
RN 160575	<1 km	Sub-Artesian Facility, for mine monitoring	88.0	46.0 – 88.0	n/a
RN 16041	<1 km	Sub-Artesian Facility, for Coal Seam Gas (CSG) Monitoring	42.00	24.0 – 42.0	n/a
Notes: NS – indicates not specified					

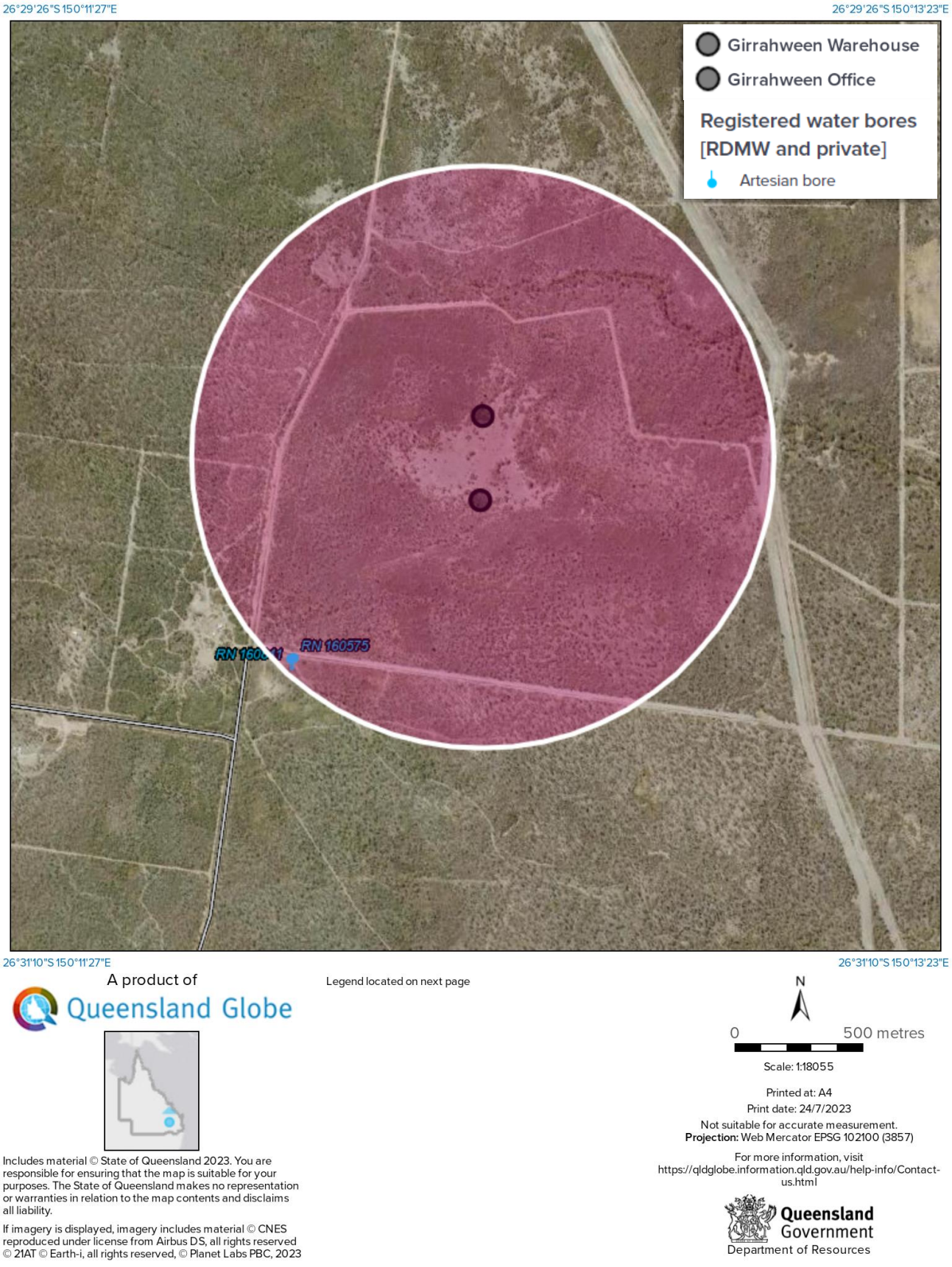

Figure 2-8 Registered groundwater bores within 1 km of the Girrahween Warehouse/Office Facility (Source: Queensland Globe)

2.9.2 Groundwater WQOs

It is important to consider the groundwater chemistry of the region in which the Girrahween Warehouse/Office Facility will reside 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 1.1, 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 Warehouse/Office Facility area.

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	20th	0.016	ID	528
	50th	0.054	ID	1528
	*80th**	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 Warehouse/Office Facility, 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 Warehouse/Office Facility, 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 planned Girrahween Warehouse/Office Facility is situated 2.5 km west of Bottle Tree Creek, which runs 6.5 km south before feeding into Dogwood Creek. Within 1 km of the Girrahween Warehouse/Office Facility, two non-perennial watercourses run eastward into Bottle Tree Creek. Supported by the topography of the area (refer to section 2.4), it is considered that site runoff would likely be directed to the south-east, following the watercourse lines into Bottle Tree Creek and eventually Dogwood Creek.

As described in section 1.1, all EVs except for aquaculture and secondary recreation apply to surface waters at the Girrahween Warehouse/Office Facility. 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 inputs

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) (now 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 the proposed 28 EP, flows generated by the warehouse and office facility 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 and land application area required for the STP to minimise environmental risks for each flow scenario.

3.3 Model inputs and assumptions

3.3.1 Climate data

The Girrahween Warehouse/Office Facility is understood to be utilised for a minimum of three consecutive years and up to a maximum of 10 consecutive years.

For MEDLI modelling, a 10-year run period is required to mitigate any influence of model stabilisation periods on the model outcomes. In this regard, the assessment period will be extended to a 10-year period of consecutive climate data which was obtained for the period from 1 January 2013 to 31 December 2022 (as described in section 2.3).

3.3.2 Soils

The soil type identified as likely to be encountered within the project area is described in section 2.7. A Sodosols soil profile was subsequently developed following the desktop review for input to the MEDLI, shown in Table 9. This assumes that the upper profile is sodic and non-acidic. Conservative hydraulic conductivities have been applied here in lieu of site-specific data.

Table 9 Soil profile adopted for MEDLI modelling (Sodosols)

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
Plant Available Water Capacity (mm)	9.5	47.5	271.5
Saturated Water Content (%v/v)	43.9	43.9	48.8

Parameter	Horizon 1	Horizon 2	Horizon 3
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

This assessment considers scenarios of 28 EP, where one EP is equivalent to 200 L/EP/day.

As per Arrow Energy's RFI response (17 July 2023), no seasonality has been adopted for hydraulic loading, 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 (5,600 L/day) 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 3.7 mm/day; refer climate section 2.3. As required, this rate was reduced to achieve the MEDLI assessment criteria listed in section 4.2.

3.3.5 Effluent quality

As per Waste Condition 11 of EA EPPG00972513:

"Treated sewage effluent or greywater can be released to land provided it:

a) meets or exceeds secondary treated class B standards for a treatment system with a daily peak design capacity of between 150 EP and 1500 EP; or

b) meets or exceeds secondary treated class C standards for a treatment system with a daily peak design capacity of less than 150 EP."

In reflection of the hydraulic loading forecast for the site (28 EP), Class C treated wastewater shall be assumed for the purposes of this model. For small onsite STPs, effluent nutrient concentrations can vary significantly, often 30 to 50 mg/L for TN and 15 to 20 mg/L for total phosphorus (TP), for average and maximum concentrations respectively.

Adopted effluent nutrient concentrations in the modelling are given below. A low-risk conductivity (1,600 µS/cm) has also been assumed based on GHD's experience.

Table 10 Adopted MEDLI average effluent quality conditions for Girrahween Warehouse/Office Facility

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 (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.

Sodic clay subsoils can resist root penetration, limiting plant root growth of annual crops and pastures. Perennial plants are more suited to these soils as root growth is not limited to one season.

3.3.7 Wet weather storage tanks

The minimum possible wet weather storage (presumed to be a closed tank) 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	5,600 L/day irrigated every day (i.e., 28 EP)	Refer to section 3.3.3.
Irrigation regime	Daily flow via fixed sprinklers; A fixed maximum 3.7 mm/d irrigation depth.	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	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 camp:

– **Scenario 1 (10-year):** Modelling was carried out assuming that effluent produced onsite will occur consistently on a daily basis over 10 years (indicatively 1 January 2013 to 31 December 2022). This scenario was adopted with a proposed load equivalent to that of 28 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 Girrahween Warehouse/Office Facility within the nominated facility area. 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 Summary of modelled scenarios

Model duration (i.e. effluent irrigation period)	Scenario	Daily Peak Design Capacity
		28 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 was:

– Annual rainfall plus annual irrigation does not exceed annual pan evaporation
– 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 occurs as a result of salinity
– No incidents of over topping from the wet weather storage facility occurs
– No significant increase in crop stress as a result of water logging associated with irrigation
– Nutrient leaching (below the root zone) 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 14. 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/year) for the model, climate data was reviewed.

As per section 2.3, the annual average pan evaporation rate equates to 1,938 mm and average annual rainfall rate to 579 mm. This results in a net water deficit of 1,361 mm/year for most soil types. This corresponds to an average daily irrigation rate of 3.7 mm/day. This value was initially adopted for commencement of MEDLI modelling as the maximum daily irrigation rate (Table 13).

5.3 Guidance table

The model indicates that the minimum wet weather storage allowance at the forecast 28 EP loading corresponds to 17.0 kL, having an irrigation area of at least 0.18 ha. This storage volume is compliant with the Queensland technical guideline for disposal of effluent using irrigation (Tennakoon and Ramsay, 2020) for fixed daily irrigation strategies, supplying at least the minimum storage capacity of three days of effluent volume (i.e., >16.8 kL) to deal with contingencies.

Table 13 Summary of Girrahween Warehouse/Office Facility MEDLI outputs for modelled irrigation scenario

EP	**Load scenario**
	28 EP
Hydraulic loading (L/day)	5,600
Maximum Irrigation Rate (mm/day) ~	3.7
Wet Weather Storage (kL) ^	17.0
Irrigation Area (m^2) – Minimum required ^*	1,800

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 constructed to irrigate no more than 3.7 mm/day, every day, irrespective of weather conditions.

The range of applied irrigation depths was therefore 3.1 to 3.7 mm. The lower bound corresponds to the daily effluent generation volume (5,600 L/day) evenly distributed over the 0.18 ha LAA.

Over the model run period, the annual average irrigation depth was reported at 1171 mm (or 3.2 mm/day).

Table 14 Key MEDLI outputs for modelled scenarios

Daily Peak Design Capacity		28 EP	
Output Parameter	**Unit**	**No Irrigation**	**Irrigation**
Required irrigation area (minimum)	m^2	1,800	1,800
Wet weather storage	kL	17.0	17.0
Wet weather storage overflow	kL/yr	n/a	0
Annual irrigation	mm/yr	0	1171
Rainfall	mm/yr	577	577
Soil evaporation	mm/yr	344	10.7
Transpiration	mm/yr	237	1352
Rain runoff	mm/yr	7.4	2.6
Irrigation portion of the runoff	mm/yr	n/a	0
Deep drainage	mm/yr	8.0	383
Average monthly plant cover	%	25	87
Nitrogen added by irrigation	$kg/m^2/yr$	0	0.03
Nitrogen removed by crop	$kg/m^2/yr$	0.01	0.03
Average nitrate concentration of deep drainage	mg/L	21.6	0.13*
Phosphorous added by irrigation	$kg/m^2/yr$	0	0.02
Phosphorous removed by crop	$kg/m^2/yr$	0.0005	0.01
Average phosphate concentration of deep drainage*	mg/L	0.06	0.15
Design soil profile storage life based on average infiltrated water phosphorous concentration of 13.02 mg/L	years	n/a	38.4

Notes:

* Due to an unavoidable model stabilisation period, the average nutrient concentrations for the 10-year run period are skewed by higher values reported in year 1 (refer Figure 5-1).

5.3.2 Soil parameters

5.3.2.1 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.

5.3.2.2 Deep drainage

The fixed irrigation scheme contributes an additional 375 mm/year to deep drainage in the irrigation area, compared to the dry land (no irrigation) baseline. This is largely attributable to irrigation occurring on wet weather days. There exists an operational opportunity to withhold irrigation on wet weather days to reduce deep drainage rates.

Due to the low nutrient concentrations reported in deep drainage (approaching zero after model stabilisation (Figure 5-1) in addition to the moderate (>20 m) depth to groundwater anticipated based on the construction of nearby groundwater bores logged on the DNRME database, this is considered to present a low risk to groundwater in the land application area. Particularly noting the short-term operation of the scheme (indicatively three to 10 years).

5.3.2.3 Nitrogen and phosphorus leaching

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 28 EP hydraulic loading scenario is presented in Figure 5-1. Following the model equilibration period, the annual nutrient leaching concentrations for the irrigation scenario approach zero (also refer MEDLI output files at Appendix B).

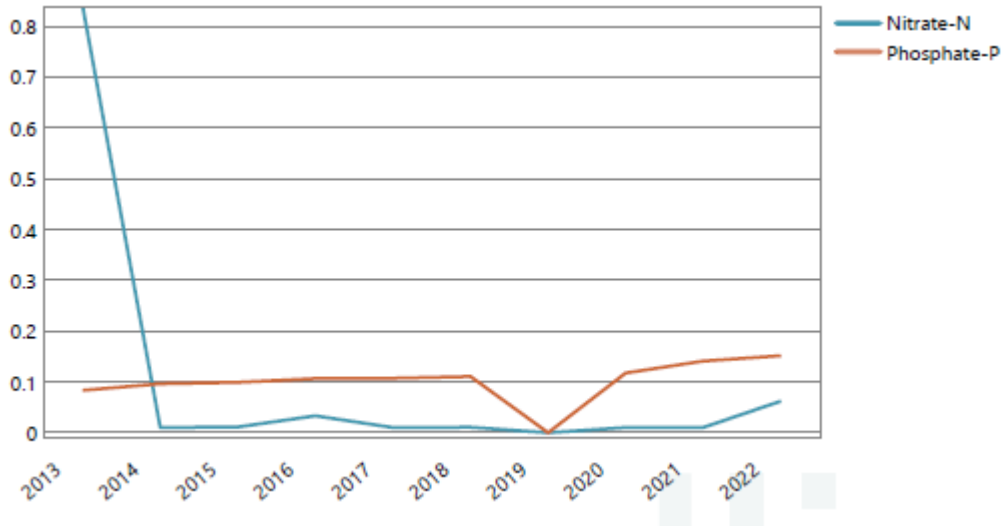

Figure 5-1 Annual nutrient leaching concentration for the 28EP loading scenario (0.26 ha irrigation area)

Phosphorus concentrations reported to occur below the root zone were equal to 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.

After only 1.5 modelled years (2013 – mid 2014), and despite the model equilibration period, the nutrient TN quality of leaching fraction is compliant with the 80th percentile WQO for the Lower Maranoa Alluvial Groundwater Zone (0.543 mg/L, refer section 2.9.2).

5.3.2.4 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 30 years. This far exceeds the lifespan of the Girrahween Warehouse/Office Facility (three to10 years).

5.3.3 Crop

5.3.3.1 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.

5.3.3.2 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 25 percent, while under irrigated conditions plant cover averaged 87 percent.

5.3.4 Wet weather storage

The 17 kL storage is sufficient to mitigate the incidence of overtopping, including on wet weather days (assuming low levels of infiltration to the system).

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
– The maximum allowable irrigation rate (3.7 mm/d) did not result in site run-off for the modelled soil profile and crop provided the LAA was at least 0.18 ha
– No runoff occurs as a result of irrigation, only due to rainfall.
– The level of nutrients in deep drainage and low deep drainage rates are considered sufficiently low to protect groundwater EVs, noting the moderate depth to groundwater and low nitrogen and phosphorus concentrations after the model stabilisation period (~1 year).

The protection of waters in the area is considered significant on account of the proximal MSES watercourse and vegetation (section 2.5).

6.2 Design and sizing implications

The following conclusions were made regarding infrastructure sizing:

– At the 28 EP loading scenario:
  - The minimum wet weather storage allowance corresponds to 17.0 kL (~3 days' storage), having an irrigation area of at least 0.18 ha. The LAA should not be undersized from this value to protect the surface and groundwaters in the area, noting the proximal MSES watercourse and vegetation (section 2.5).
  - Annually, a total of 1,170 mm of effluent was irrigated within the LAA. This corresponds to an average irrigation rate of only 3.2 mm/day.
– Regarding deep drainage rates:
  - Approximately 376 mm of deep drainage occurs within the LAA annually, attributable primarily to irrigation occurring on days of rainfall from the fixed daily irrigation regime modelled. Nutrient levels in this deep drainage however, as indicated in the model, should not significantly impact groundwater EVs.
  - Should reduced deep drainage rates be sought by the regulator, the largely inactive volume of the storage tank may be utilised to withhold irrigation from occurring on days of rainfall.
  - The LAA may be situated closer to the western boundary to increase the offset distance from the LAA to the MSES aspects described above.
– Regarding the soil's sodicity:
  - For effluent irrigation schemes, it is imperative that both the exchangeable sodium percentage of the soil and the sodium adsorption ratio 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 sodium adsorption ration).
– 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

– During detailed design of the Girrahween Warehouse/Office Facility, a comparison between the groundwater nutrient concentrations WQOs and proposed STP nutrient outputs will need to be considered in greater detail.

It should be noted that the soil profile adopted herein for the purposes of MEDLI modelling (and in lieu of site-specific data) should only be used for scoping or preliminary work before better estimates or site-specific soil data becomes available.

Two different surface geologies were identified via desktop assessment as being present within the Girrahween Warehouse/Office Facility boundary (Figure 2-6), which raises the possibility to situate the treated effluent LAA in the most favourable locality within the indicated extent. This assumes subsequent site-specific soils assessment confirms relevant variation in the profile.

7. References

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Windows® program 2015, MEDLI Version 2.1.1.0.

Facility boundary image as provided by Arrow Energy.

Appendices

Appendix A

Environmental Desktop Searches

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

Description			
Parish	332 - BARTSCH		
Original Name			
Driller Name	BOURNE, KEVIN JOHN		
Drill Company	DEPCO		
Const Method	ROTARY AIR		
Bore Line			
D/O File No		**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date		**Data Owner**	COC
Roles	Mine Monitoring		

Location

Latitude	26-30-37	**Basin**	4222
Longitude	150-12-03	**Sub-area**	
GIS Latitude	-26.51038104	**Lot**	15
GIS Longitude	150.2007102	**Plan**	AU38
Easting	221008		
Northing	7064749	**Map Scale**	
Zone	56	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

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

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**

Bore Report

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**

Bore Report

From Year:

User Licence and Conditions

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

Description			
Parish	6000 - NO LONGER USED		
Original Name			
Driller Name	BOURNE, KEVIN JOHN		
Drill Company	DEPCO		
Const Method	ROTARY AIR		
Bore Line			
D/O File No		**Polygon**	
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		

Location

Latitude	26-30-37	**Basin**	4222
Longitude	150-12-02	**Sub-area**	
GIS Latitude	-26.5103975	**Lot**	15
GIS Longitude	150.20062958	**Plan**	AU38
Easting	221000		
Northing	7064747	**Map Scale**	
Zone	56	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

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

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**

Bore Report

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**

Bore Report

From Year:

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Bore Report

From Year:

Registered Number	Facility Type	Facility Status	Drilled Date	Office	Shire
168216	Sub-Artesian Facility	Existing		Roma	7310 - WESTERN DOWNS REGIONAL

Details

Description			
Parish	1554 - DOGWOOD		
Original Name			
Driller Name			
Drill Company			
Const Method			
Bore Line			
D/O File No	PROJECT 508	**Polygon**	
R/O File No		**Equipment**	
H/O File No		**RN of Bore Replaced**	
Log Received Date		**Data Owner**	
Roles	Water Supply		

Location

Latitude	26-38-02	**Basin**	4222
Longitude	150-18-50	**Sub-area**	
GIS Latitude	-26.63388889	**Lot**	71
GIS Longitude	150.31388889	**Plan**	BWR159
Easting	232580		
Northing	7051302	**Map Scale**	
Zone	56	**Map Series**	
Accuracy		**Map No**	
GPS Accuracy		**Map Name**	
Checked	Yes	**Prog Section**	

Casing

0 ***records for RN*** **168216**

Strata Logs

0 ***records for RN*** **168216**

Stratigraphies

0 ***records for RN*** **168216**

Aquifers

0 ***records for RN*** **168216**

Pump Tests Part 1

0 ***records for RN*** **168216**

Pump Tests Part 2

0 ***records for RN*** **168216**

Bore Report

From Year:

Bore Conditions	**0**	*records for RN*	**168216**
Elevations	**0**	*records for RN*	**168216**
Water Analysis Part 1	**0**	*records for RN*	**168216**
Water Analysis Part 2	**0**	*records for RN*	**168216**
Water Levels	**0**	*records for RN*	**168216**
Wire Line Logs	**0**	*records for RN*	**168216**
Field Measurements	**0**	*records for RN*	**168216**
Special Water Analysis	**0**	*records for RN*	**168216**

Bore Report

From Year:

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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.

Queensland Government

Prepared on: 28 August 2020

N

0 25 50 75 100 125
Kilometres

Scale: 1:1,550,000 @ A1

Projection: Geocentric Datum of Australia 1994 (GDA94)

Horizontal Datum: Geocentric Datum of Australia 1994 (GDA94)

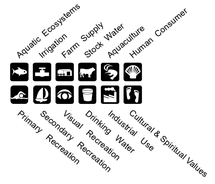
Legend

- 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
- Wooloowins

Key to Environmental Values



Notes:
1. The AWQG 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).
2. 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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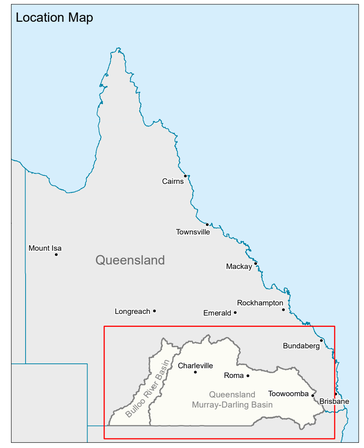
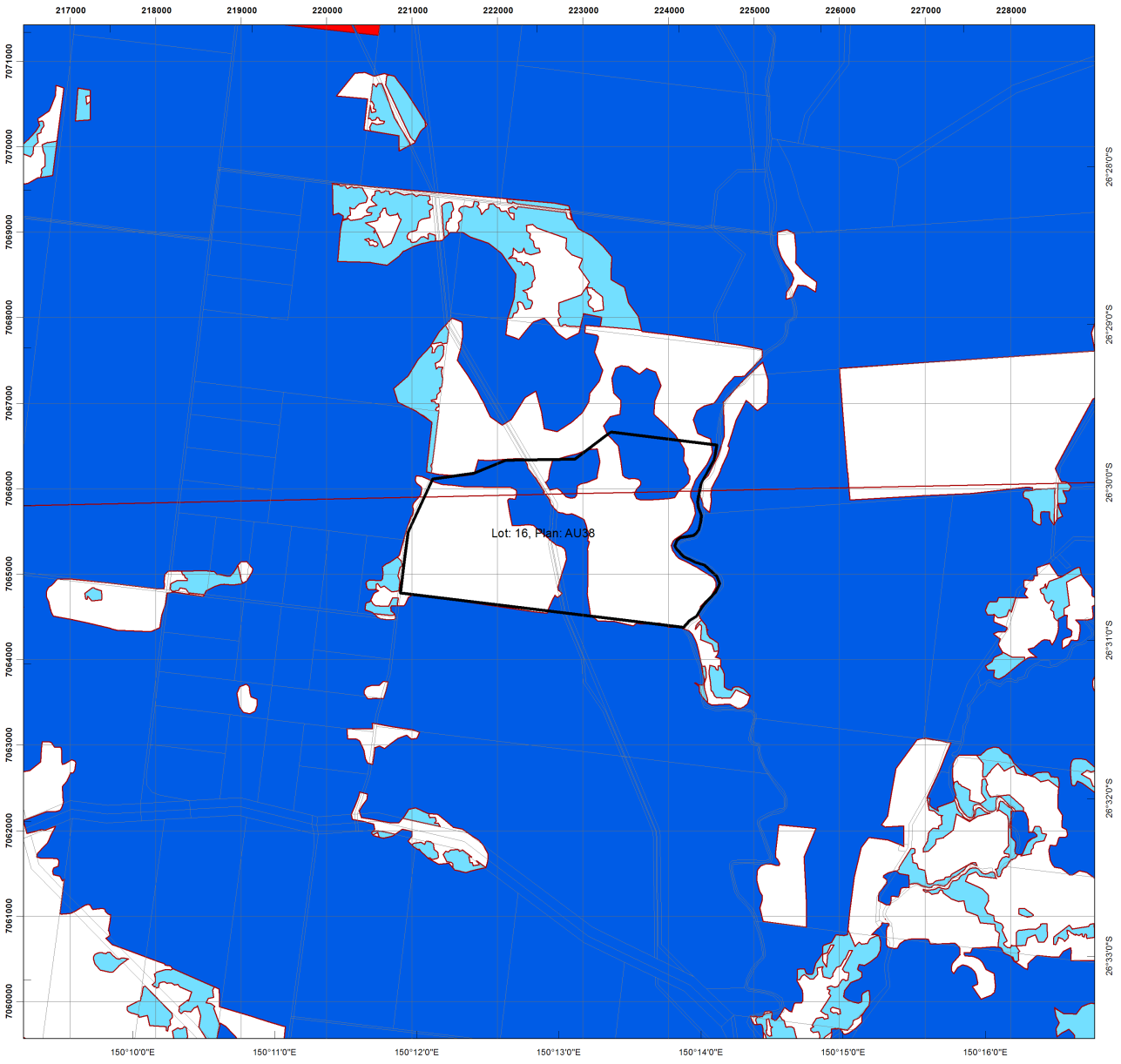
Includes data © Commonwealth of Australia (Geoscience Australia, MDBA) 2020.

Location Map

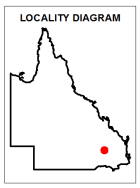


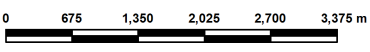


Regulated Vegetation Management Map

Legend

- Selected Lot and Plan
- Category A area (Vegetation offsets/compliance notices/VDecs)
- Category B area (Remnant vegetation)
- Category C area (High-value regrowth vegetation)
- Category R area (Reef regrowth watercourse vegetation)
- Category X area (Exempt clearing work on Freehold, Indigenous and Leasehold land)
- Water
- Other land parcel boundaries





This product is projected into:
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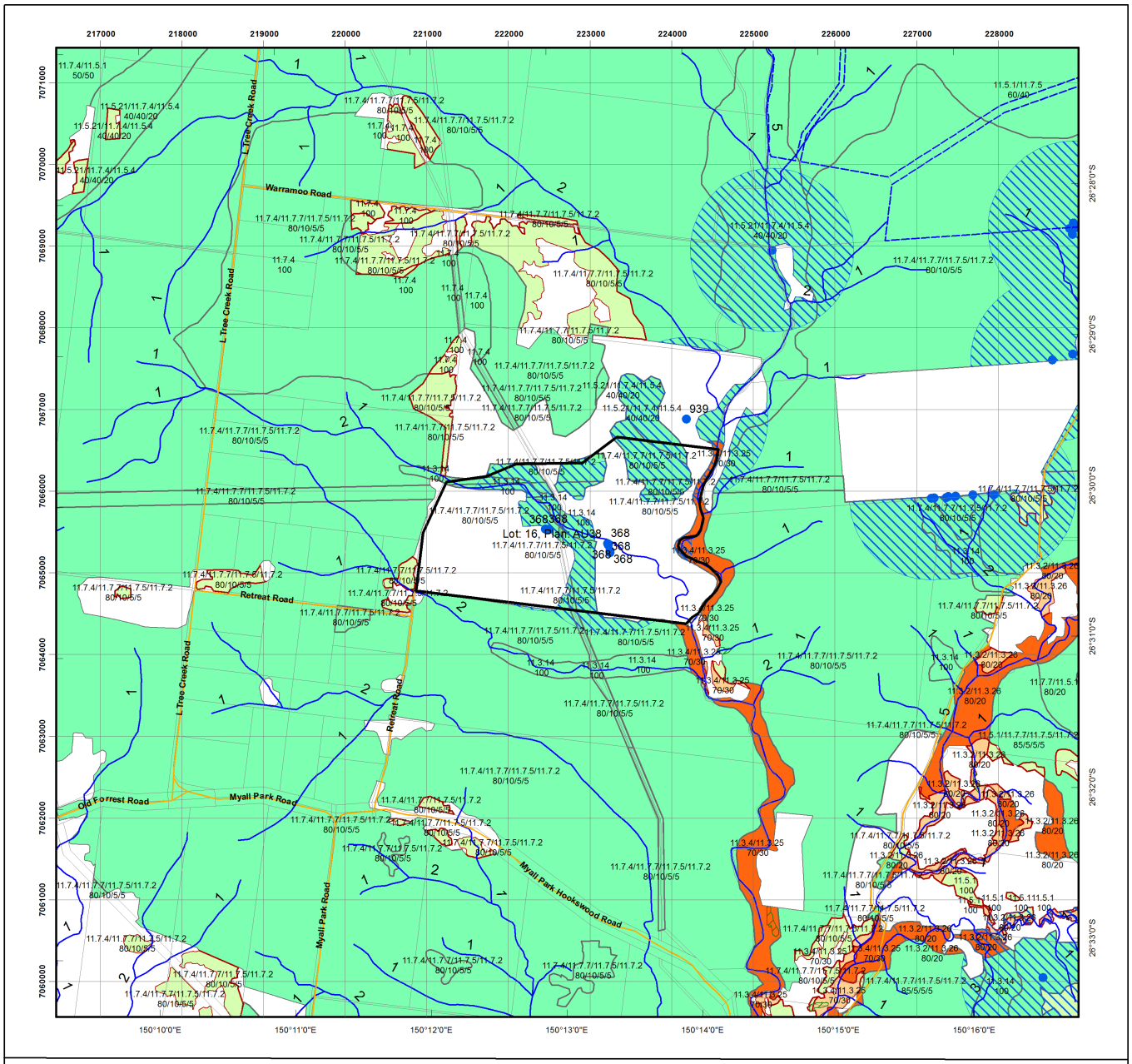
Additional information required for the assessment of vegetation values is provided in the accompanying "Vegetation Management Supporting map". For further information go to the web site: www.resources.qld.gov.au or contact the Department of Resources.

Digital data for the regulated vegetation management map is available from the Queensland Spatial Portal at http://www.information.qld.gov.au/

Land parcel boundaries are provided as locational aid only.

This map is updated on a monthly basis to ensure new PMAVs are included as they are approved.

Queensland Government



Vegetation Management Supporting Map

Legend

- Selected Lot and Plan
- Category A or B area containing endangered regional ecosystems
- Category A or B area containing of concern regional ecosystems
- Category A or B area that is a least concern regional ecosystem
- Category C or R area containing endangered regional ecosystems
- Category C or R area containing of concern regional ecosystems
- Category C or R area that is a least concern regional ecosystem
- Category X area
- Water
- Wetland on the vegetation management wetlands map
- Essential habitat on the essential habitat map
- Essential habitat species record
- Watercourses and drainage features on the vegetation management watercourse and drainage features maps (Stream order shown as black number against stream where available)
- Highway
- Connector
- Street/Local Road
- National Parks, State Forest and other reserves
- Other land parcel boundaries

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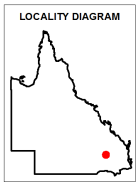
LOCALITY DIAGRAM



N

0 480 960 1,440 1,920 2,400 m

This product is projected into: GDA 1994 MGA Zone 56

Labels for Essential Habitat are centred on the area of enquiry.

Regional ecosystem linework has been compiled at a scale of 1:100 000, except in designated areas where a compilation scale of 1:50 000 is available. Linework should be used as a guide only. The positional accuracy of RE data mapped at a scale of 1:100 000 is +/- 100 metres.

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Additional information may be required for the purposes of land clearing or assessment of a regional ecosystem map or PMAV applications. For further information go to the web site: www.resources.qld.gov.au or contact the Department of Resources.

Digital data for the vegetation management watercourse and drainage feature map, vegetation management wetlands map, essential habitat map and the vegetation management remnant and regional ecosystem map are available from the Queensland Spatial Portal at http://www.information.qld.gov.au/

Land parcel boundaries are provided as locational aid only.

Vegetation Management Act 1999 - Extract from the essential habitat database

Essential habitat is required for assessment under the:

- State Development Assessment Provisions - State Code 16: Native vegetation clearing which sets out the matters of interest to the state for development assessment under the *Planning Act 2016*; and
- Accepted development vegetation clearing codes made under the *Vegetation Management Act 1999*

Essential habitat for one or more of the following species is found on and within 1.1 km of the identified subject lot/s on the accompanying essential habitat map.

This report identifies essential habitat in Category A, B and Category C areas.

The numeric labels on the essential habitat map can be cross referenced with the database below to determine which essential habitat factors might exist for a particular species.

Essential habitat is compiled from a combination of species habitat models and buffered species records.

The Department of Resources website (http://www.resources.qld.gov.au) has more information on how the layer is applied under the State Development Assessment Provisions - State Code 16: Native vegetation clearing and the *Vegetation Management Act 1999*.

Regional ecosystem is a mandatory essential habitat factor, unless otherwise stated.

Essential habitat, for protected wildlife, means a category A area, a category B area or category C area shown on the regulated vegetation management map-

1) that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database; or

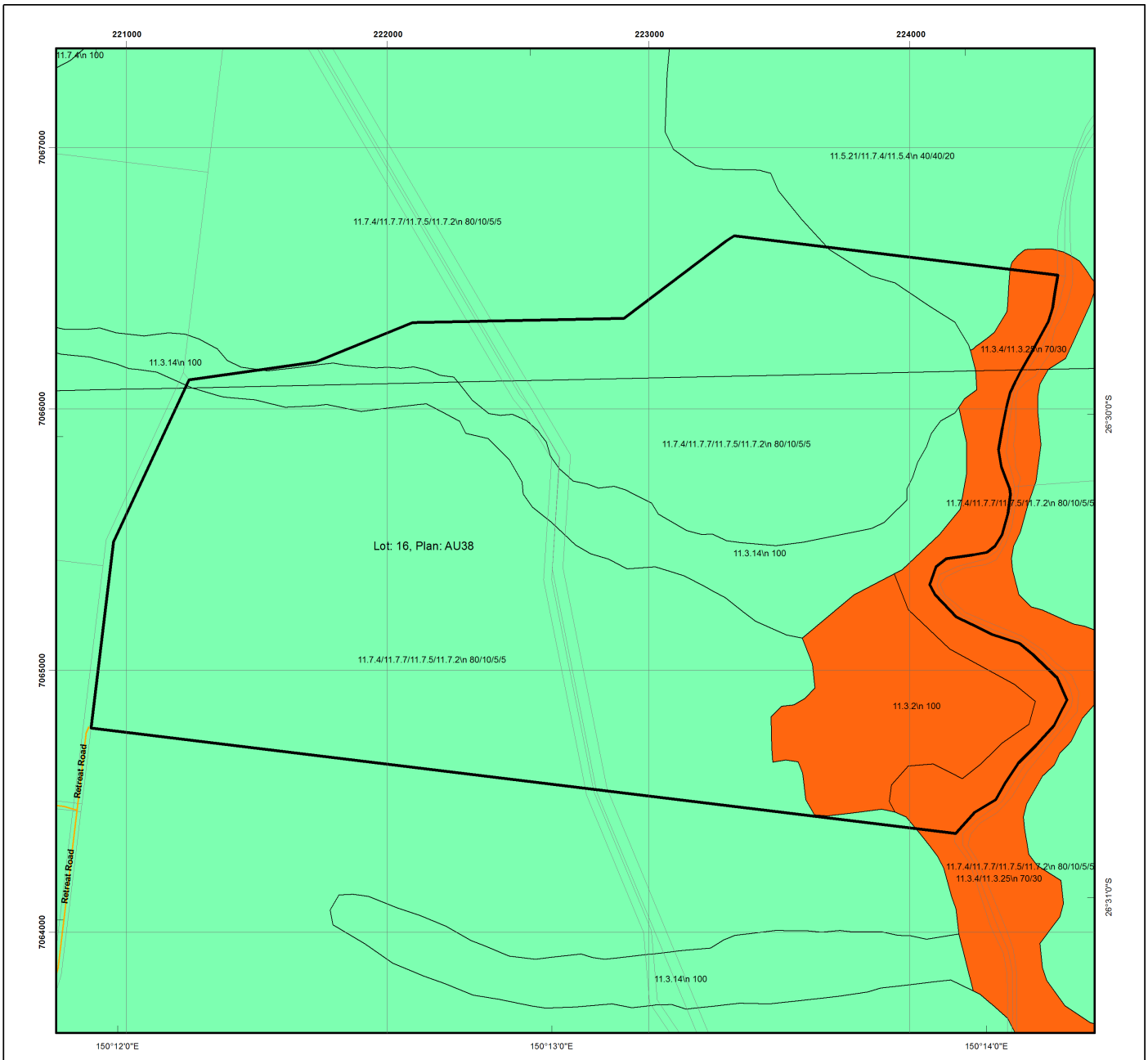
2) in which the protected wildlife, at any stage of its life cycle, is located.

Protected wildlife includes critically endangered, endangered, vulnerable or near-threatened native wildlife prescribed under the *Nature Conservation Act 1992*.

Essential habitat in Category A and/or Category B and/or Category C

Label	Scientific Name	Common Name	NCA Status	Vegetation Community	Altitude	Soils	Position in Landscape
368	Strophurus taenicauda	golden-tailed gecko	NT	Open Acacia scrubs, eucalypt and Callitris woodland, and dry sclerophyll forest.	150-600m.	None	None
939	Nyctophilus corbeni	eastern long-eared bat	V	Dry open woodland (box and/or ironbark, savannah) and mallee; particularly riparian vegetation (Eucalyptus camaldulensis, Allocasuarina luehmanni, A. cristata and Callitris), also vine thickets.	100-600m.	None	None

Label	Regional Ecosystem (mandatory unless otherwise specified)
368	11.1.4, 11.2.1, 11.2.2, 11.2.5, 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.5, 11.3.6, 11.3.7, 11.3.8, 11.3.9, 11.3.10, 11.3.12, 11.3.13, 11.3.14, 11.3.15, 11.3.16, 11.3.17, 11.3.18, 11.3.19, 11.3.20, 11.3.23, 11.3.25, 11.3.26, 11.3.27, 11.3.28, 11.3.29, 11.3.30, 11.3.32, 11.3.33, 11.3.34, 11.3.35, 11.3.36, 11.3.37, 11.3.38, 11.3.39, 11.4.2, 11.4.3, 11.4.5, 11.4.7, 11.4.8, 11.4.9, 11.4.10, 11.4.12, 11.4.13, 11.5.1, 11.5.2, 11.5.3, 11.5.4, 11.5.5, 11.5.7, 11.5.8, 11.5.9, 11.5.12, 11.5.13, 11.5.14, 11.5.16, 11.5.17, 11.5.20, 11.5.21, 11.7.1, 11.7.2, 11.7.3, 11.7.4, 11.7.6, 11.7.7, 11.8.1, 11.8.2, 11.8.4, 11.8.5, 11.8.8, 11.8.9, 11.8.11, 11.8.12, 11.8.14, 11.8.15, 11.9.1, 11.9.2, 11.9.3, 11.9.5, 11.9.6, 11.9.7, 11.9.9, 11.9.10, 11.9.13, 11.9.14, 11.10.1, 11.10.2, 11.10.3, 11.10.4, 11.10.5, 11.10.6, 11.10.7, 11.10.9, 11.10.11, 11.10.12, 11.10.13, 11.11.1, 11.11.2, 11.11.3, 11.11.4, 11.11.6, 11.11.7, 11.11.8, 11.11.9, 11.11.10, 11.11.11, 11.11.12, 11.11.13, 11.11.14, 11.11.15, 11.11.16, 11.11.17, 11.11.19, 11.11.20, 11.12.1, 11.12.2, 11.12.3, 11.12.5, 11.12.6, 11.12.7, 11.12.8, 11.12.9, 11.12.10, 11.12.11, 11.12.12, 11.12.13, 11.12.14, 11.12.15, 11.12.16, 11.12.17, 11.12.19, 11.12.20, 11.12.21
939	5.3.1, 5.3.2, 5.3.3, 5.3.4, 5.3.5, 5.3.6, 5.3.7, 5.3.8, 5.3.9, 5.3.10, 5.3.20, 5.5.6, 5.7.4, 5.7.8, 6.3.1, 6.3.2, 6.3.3, 6.3.4, 6.3.5, 6.3.7, 6.3.8, 6.3.9, 6.3.16, 6.3.17, 6.3.18, 6.3.24, 6.3.25, 6.4.3, 6.5.1, 6.5.2, 6.5.3, 6.5.5, 6.5.17, 6.5.18, 6.5.19, 6.7.5, 6.7.6, 6.7.7, 6.9.2, 11.2.1, 11.2.3, 11.2.5, 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.6, 11.3.8, 11.3.9, 11.3.10, 11.3.11, 11.3.12, 11.3.13, 11.3.14, 11.3.15, 11.3.16, 11.3.17, 11.3.18, 11.3.19, 11.3.20, 11.3.23, 11.3.25, 11.3.27, 11.3.28, 11.3.29, 11.3.30, 11.3.32, 11.3.33, 11.3.35, 11.3.36, 11.3.37, 11.3.39, 11.3.40, 11.4.1, 11.4.2, 11.4.3, 11.4.5, 11.4.6, 11.4.8, 11.4.10, 11.4.12, 11.4.13, 11.5.1, 11.5.2, 11.5.3, 11.5.4, 11.5.5, 11.5.8, 11.5.9, 11.5.12, 11.5.13, 11.5.14, 11.5.15, 11.5.17, 11.5.20, 11.5.21, 11.7.1, 11.7.2, 11.7.3, 11.7.4, 11.7.6, 11.8.2, 11.8.3, 11.8.4, 11.8.5, 11.8.6, 11.8.8, 11.8.9, 11.8.11, 11.8.12, 11.8.13, 11.8.14, 11.8.15, 11.9.2, 11.9.3, 11.9.4, 11.9.7, 11.9.8, 11.9.9, 11.9.14, 11.10.1, 11.10.4, 11.10.6, 11.10.7, 11.10.8, 11.10.11, 11.10.12, 11.10.13, 11.11.1, 11.11.2, 11.11.3, 11.11.4, 11.11.5, 11.11.6, 11.11.7, 11.11.8, 11.11.9, 11.11.10, 11.11.11, 11.11.12, 11.11.15, 11.11.16, 11.11.17, 11.11.18, 11.11.19, 11.11.20, 11.11.21, 11.12.1, 11.12.2, 11.12.3, 11.12.4, 11.12.5, 11.12.6, 11.12.7, 11.12.8, 11.12.9, 11.12.10, 11.12.11, 11.12.12, 11.12.13, 11.12.14, 11.12.17, 11.12.20, 13.3.1, 13.3.4, 13.11.1, 13.11.3, 13.11.4, 13.11.7, 13.11.8, 13.12.2, 13.12.3, 13.12.5, 13.12.8, 13.12.9, 13.12.10, 13.12.11



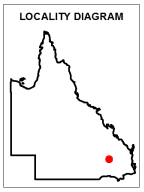
Vegetation Management Pre-clear Regional Ecosystem Map

Legend

- Selected Lot and Plan
- Pre-clearing area containing Endangered RE
- Pre-clearing area containing Of Concern RE
- Pre-clearing area that is a Least Concern RE
- Water
- Highway
- Connector
- Street/Local Road
- Other land parcel boundaries

Queensland Government

LOCALITY DIAGRAM



N

0 150 300 450 600 750 m

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GDA 1994 MGA Zone 56

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Pre-clearing regional ecosystem line-work reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only.

Digital data for the Pre-clearing regional ecosystem map is available from the Queensland Spatial Portal at http://www.information.qld.gov.au/

Land parcel boundaries shown are provided as a locational aid only.

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Vegetation management report

For Lot: 16 Plan: AU38

27/07/2023

Queensland Government

Recent changes

Updated mapping

Updated vegetation mapping was released on 8 September 2022 and includes the most recent Queensland Herbarium scientific updates to the Regulated Vegetation Management Map, regional ecosystems, wetland, high-value regrowth and essential habitat mapping.

The Department of Environment and Science have also updated their protected plant and koala protection mapping to align with the Queensland Herbarium scientific updates.

Overview

Based on the lot on plan details you have supplied, this report provides the following detailed information:

Property details - information about the specified Lot on Plan, lot size, local government area, bioregion(s), subregion(s) and catchment(s);

Vegetation management framework - an explanation of the application of the framework and contact details for the Department of Resources who administer the framework;

Vegetation management framework details for the specified Lot on Plan including:

- the vegetation management categories on the property;
- the vegetation management regional ecosystems on the property;
- vegetation management watercourses or drainage features on the property;
- vegetation management wetlands on the property;
- vegetation management essential habitat on the property;
- whether any area management plans are associated with the property;
- whether the property is coastal or non-coastal; and
- whether the property is mapped as Agricultural Land Class A or B;

Protected plant framework - an explanation of the application of the framework and contact details for the Department of Environment and Science who administer the framework, including:

- high risk areas on the protected plant flora survey trigger map for the property;

Koala protection framework - an explanation of the application of the framework and contact details for the Department of Environment and Science who administer the framework; and

Koala protection framework details for the specified Lot on Plan including:

- the koala district the property is located in;
- koala priority areas on the property;
- core and locally refined koala habitat areas on the property;
- whether the lot is located in an identified koala broad-hectare area; and
- koala habitat regional ecosystems on the property for core koala habitat areas.

This information will assist you to determine your options for managing vegetation under:

- the vegetation management framework, which may include:

- exempt clearing work;
- accepted development vegetation clearing code;
- an area management plan;
- a development approval;

- the protected plant framework, which may include:

- the need to undertake a flora survey;
- exempt clearing;
- a protected plant clearing permit;

- the koala protection framework, which may include:

- exempted development;
- a development approval;
- the need to undertake clearing sequentially and in the presence of a koala spotter.

Other laws

The clearing of native vegetation is regulated by both Queensland and Australian legislation, and some local governments also regulate native vegetation clearing. You may need to obtain an approval or permit under another Act, such as the Commonwealth Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Section 8 of this guide provides contact details of other agencies you should confirm requirements with, before commencing vegetation clearing.

Table of Contents

1. Property details

1.1 Tenure and title area

All of the lot, plan, tenure and title area information associated with property Lot: 16 Plan: AU38, are listed in Table 1.

Table 1: Lot, plan, tenure and title area information for the property

Lot	Plan	Tenure	Property title area (sq metres)
16	AU38	Freehold	6,209,900
CN	SP265432	Easement	75,700
CT	SP261960	Easement	56,780
CO	SP265433	Easement	75,310
CU	SP261960	Easement	53,230

The tenure of the land may affect whether clearing is considered exempt clearing work or may be carried out under an accepted development vegetation clearing code.

Does this property have a freehold tenure and is in the Wet Tropics of Queensland World Heritage Area?

No, this property is not located in the Wet Tropics of Queensland World Heritage Area.

1.2 Property location

Table 2 provides a summary of the locations for property Lot: 16 Plan: AU38, in relation to natural and administrative boundaries.

Table 2: Property location details

Local Government(s)
Western Downs Regional

Bioregion(s)	Subregion(s)
Brigalow Belt	Barakula

Catchment(s)
Balonne-Condamine

2. Vegetation management framework (administered by the Department of Resources)

The *Vegetation Management Act 1999* (VMA), the Vegetation Management Regulation 2012, the *Planning Act 2016* and the Planning Regulation 2017, in conjunction with associated policies and codes, form the Vegetation Management Framework.

The VMA does not apply to all land tenures or vegetation types. State forests, national parks, forest reserves and some tenures under the *Forestry Act 1959* and *Nature Conservation Act 1992* are not regulated by the VMA. Managing or clearing vegetation on these tenures may require approvals under these laws.

The following native vegetation is not regulated under the VMA but may require permit(s) under other laws:

- grass or non-woody herbage;
- a plant within a grassland regional ecosystem prescribed under Schedule 5 of the Vegetation Management Regulation 2012; and
- a mangrove.

2.1 Exempt clearing work

Exempt clearing work is an activity for which you do not need to notify the Department of Resources or obtain an approval under the vegetation management framework. Exempt clearing work was previously known as exemptions.

In areas that are mapped as Category X (white in colour) on the regulated vegetation management map (see section 4.1), and where the land tenure is freehold, indigenous land and leasehold land for agriculture and grazing purposes, the clearing of vegetation is considered exempt clearing work and does not require notification or development approval under the vegetation management framework. For all other land tenures, contact the Department of Resources before commencing clearing to ensure that the proposed activity is exempt clearing work.

A range of routine property management activities are considered exempt clearing work. A list of exempt clearing work is available at
https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/exemptions.

Exempt clearing work may be affected if the proposed clearing area is subject to development approval conditions, a covenant, an environmental offset, an exchange area, a restoration notice, or an area mapped as Category A. Exempt clearing work may require approval under other Commonwealth, State or Local Government laws, or local government planning schemes. Contact the Department of Resources prior to clearing in any of these areas.

2.2 Accepted development vegetation clearing codes

Some clearing activities can be undertaken under an accepted development vegetation clearing code. The codes can be downloaded at
https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/codes

If you intend to clear vegetation under an accepted development vegetation clearing code, you must notify the Department of Resources before commencing. The information in this report will assist you to complete the online notification form.

You can complete the online form at
https://apps.dnrm.qld.gov.au/vegetation/

2.3 Area management plans

Area Management Plans (AMP) provide an alternative approval system for vegetation clearing under the vegetation management framework. They list the purposes and clearing conditions that have been approved for the areas covered by the plan. It is not necessary to use an AMP, even when an AMP applies to your property.

On 8 March 2020, AMPs ended for fodder harvesting, managing thickened vegetation and managing encroachment. New notifications cannot be made for these AMPs. You will need to consider options for fodder harvesting, managing thickened vegetation or encroachment under a relevant accepted development vegetation clearing code or apply for a development approval.

New notifications can be made for all other AMPs. These will continue to apply until their nominated end date.

If an Area Management Plan applies to your property for which you can make a new notification, it will be listed in Section 3.6 of this report. Before clearing under one of these AMPs, you must first notify the Department of Resources and then follow the conditions and requirements listed in the AMP.
https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/area-management-plans

2.4 Development approvals

If under the vegetation management framework your proposed clearing is not exempt clearing work, or is not permitted under an accepted development vegetation clearing code, or an AMP, you may be able to apply for a development approval. Information on how to apply for a development approval is available at
https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/development

2.5. Contact information for the Department of Resources

For further information on the vegetation management framework:
Phone 135VEG (135 834)
Email vegetation@resources.qld.gov.au
Visit https://www.resources.qld.gov.au/?contact=vegetation to submit an online enquiry.

3. Vegetation management framework for Lot: 16 Plan: AU38

3.1 Vegetation categories

The vegetation categories on your property are shown on the regulated vegetation management map in section 4.1 of this report. A summary of vegetation categories on the subject lot are listed in Table 3. Descriptions for these categories are shown in Table 4.

Table 3: Vegetation categories for subject property. Total area: 619.61ha

Vegetation category	Area (ha)
Category B	172.3
Category X	447.3

Table 4: Description of vegetation categories

Category	Colour on Map	Description	Requirements / options under the vegetation management framework
A	red	Compliance areas, environmental offset areas and voluntary declaration areas	Special conditions apply to Category A areas. Before clearing, contact the Department of Resources to confirm any requirements in a Category A area.
B	dark blue	Remnant vegetation areas	Exempt clearing work, or notification and compliance with accepted development vegetation clearing codes, area management plans or development approval.
C	light blue	High-value regrowth areas	Exempt clearing work, or notification and compliance with managing Category C regrowth vegetation accepted development vegetation clearing code.
R	yellow	Regrowth within 50m of a watercourse or drainage feature in the Great Barrier Reef catchment areas	Exempt clearing work, or notification and compliance with managing Category R regrowth accepted development vegetation clearing code or area management plans.
X	white	Clearing on freehold land, indigenous land and leasehold land for agriculture and grazing purposes is considered exempt clearing work under the vegetation management framework. Contact the Department of Resources to clarify whether a development approval is required for other State land tenures.	No permit or notification required on freehold land, indigenous land and leasehold land for agriculture and grazing. A development approval may be required for some State land tenures.

Property Map of Assessable Vegetation (PMAV)

The following Property Map of Assessable Vegetation (PMAVs) may be present on this property:

Reference number

2006/011741

3.2 Regional ecosystems

The endangered, of concern and least concern regional ecosystems on your property are shown on the vegetation management supporting map in section 4.2 and are listed in Table 5.

A description of regional ecosystems can be accessed online at
https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/descriptions/

Table 5: Regional ecosystems present on subject property

Regional Ecosystem	VMA Status	Category	Area (Ha)	Short Description	Structure Category
11.3.14	Least concern	B	30.72	Eucalyptus spp., Angophora spp., Callitris spp. woodland on alluvial plains	Sparse
11.3.25	Least concern	B	3.82	Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines	Sparse
11.3.4	Of concern	B	8.92	Eucalyptus tereticornis and/or Eucalyptus spp. woodland on alluvial plains	Sparse
11.5.21	Least concern	B	2.18	Corymbia bloxsomei +/- Callitris glaucophylla +/- Eucalyptus crebra +/- Angophora leiocarpa woodland on Cainozoic sand plains and/or remnant surfaces	Sparse
11.5.4	Least concern	B	1.09	Eucalyptus chloroclada, Callitris glaucophylla, C. endlicheri, Angophora leiocarpa woodland on Cainozoic sand plains and/or remnant surfaces	Sparse
11.7.2	Least concern	B	6.17	Acacia spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone	Sparse
11.7.4	Least concern	B	100.91	Eucalyptus decorticans and/or Eucalyptus spp., Corymbia spp., Acacia spp., Lysicarpus angustifolius woodland on Cainozoic lateritic duricrust	Sparse
11.7.5	Least concern	B	6.17	Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks	Sparse
11.7.7	Least concern	B	12.34	Eucalyptus fibrosa subsp. nubilis +/- Corymbia spp. +/- Eucalyptus spp. woodland on Cainozoic lateritic duricrust	Sparse
non-rem	None	X	447.29	None	None

Please note:

1. All area and area derived figures included in this table have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

2. If Table 5 contains a Category 'plant', please be aware that this refers to 'plantations' such as forestry, and these areas are considered non-remnant under the VMA.

The VMA status of the regional ecosystem (whether it is endangered, of concern or least concern) also determines if any of the following are applicable:

- exempt clearing work;
- accepted development vegetation clearing codes;
- performance outcomes in State Code 16 of the State Development Assessment Provisions (SDAP).

3.3 Watercourses

Vegetation management watercourses and drainage features for this property are shown on the vegetation management supporting map in section 4.2.

3.4 Wetlands

There are no vegetation management wetlands present on this property.

3.5 Essential habitat

Under the VMA, essential habitat for protected wildlife is native wildlife prescribed under the *Nature Conservation Act 1992* (NCA) as critically endangered, endangered, vulnerable or near-threatened wildlife.

Essential habitat for protected wildlife includes suitable habitat on the lot, or where a species has been known to occur up to 1.1 kilometres from a lot on which there is assessable vegetation. These important habitat areas are protected under the VMA.

Any essential habitat on this property will be shown as blue hatching on the vegetation supporting map in section 4.2.

If essential habitat is identified on the lot, information about the protected wildlife species is provided in Table 6 below. The numeric labels on the vegetation management supporting map can be cross referenced with Table 6 to outline the essential habitat factors for that particular species. There may be essential habitat for more than one species on each lot, and areas of Category A, Category B and Category C can be mapped as Essential Habitat.

Essential habitat is compiled from a combination of species habitat models and buffered species records. Regional ecosystem is a mandatory essential habitat factor, unless otherwise stated. Essential habitat, for protected wildlife, means an area of vegetation shown on the Regulated Vegetation Management Map -

1) that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database. Essential habitat factors are comprised of - regional ecosystem (mandatory for most species), vegetation community, altitude, soils, position in landscape; or
2) in which the protected wildlife, at any stage of its life cycle, is located.

If there is no essential habitat mapping shown on the vegetation management supporting map for this lot, and there is no table in the sections below, it confirms that there is no essential habitat on the lot.

Category A and/or Category B and/or Category C

Table 6: Essential habitat in Category A and/or Category B and/or Category C

Label	Scientific Name	Common Name	NCA Status	Vegetation Community	Altitude	Soils	Position in Landscape
368	Strophurus taenicauda	golden-tailed gecko	NT	Open Acacia scrubs, eucalypt and Callitris woodland, and dry sclerophyll forest.	150-600m.	None	None
939	Nyctophilus corbeni	eastern long-eared bat	V	Dry open woodland (box and/or ironbark, savannah) and mallee; particularly riparian vegetation (Eucalyptus camaldulensis, Allocasuarina luehmanni, A. cristata and Callitris), also vine thickets.	100-600m.	None	None

Label	Regional Ecosystem (mandatory unless otherwise specified)
368	11.1.4, 11.2.1, 11.2.2, 11.2.5, 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.5, 11.3.6, 11.3.7, 11.3.8, 11.3.9, 11.3.10, 11.3.12, 11.3.13, 11.3.14, 11.3.15, 11.3.16, 11.3.17, 11.3.18, 11.3.19, 11.3.20, 11.3.23, 11.3.25, 11.3.26, 11.3.27, 11.3.28, 11.3.29, 11.3.30, 11.3.32, 11.3.33, 11.3.34, 11.3.35, 11.3.36, 11.3.37, 11.3.38, 11.3.39, 11.4.2, 11.4.3, 11.4.5, 11.4.7, 11.4.8, 11.4.9, 11.4.10, 11.4.12, 11.4.13, 11.5.1, 11.5.2, 11.5.3, 11.5.4, 11.5.5, 11.5.7, 11.5.8, 11.5.9, 11.5.12, 11.5.13, 11.5.14, 11.5.16, 11.5.17, 11.5.20, 11.5.21, 11.7.1, 11.7.2, 11.7.3, 11.7.4, 11.7.6, 11.7.7, 11.8.1, 11.8.2, 11.8.4, 11.8.5, 11.8.8, 11.8.9, 11.8.11, 11.8.12, 11.8.14, 11.8.15, 11.9.1, 11.9.2, 11.9.3, 11.9.5, 11.9.6, 11.9.7, 11.9.9, 11.9.10, 11.9.13, 11.9.14, 11.10.1, 11.10.2, 11.10.3, 11.10.4, 11.10.5, 11.10.6, 11.10.7, 11.10.9, 11.10.11, 11.10.12, 11.10.13, 11.11.1, 11.11.2, 11.11.3, 11.11.4, 11.11.6, 11.11.7, 11.11.8, 11.11.9, 11.11.10, 11.11.11, 11.11.12, 11.11.13, 11.11.14, 11.11.15, 11.11.16, 11.11.17, 11.11.19, 11.11.20, 11.12.1, 11.12.2, 11.12.3, 11.12.5, 11.12.6, 11.12.7, 11.12.8, 11.12.9, 11.12.10, 11.12.11, 11.12.12, 11.12.13, 11.12.14, 11.12.15, 11.12.16, 11.12.17, 11.12.19, 11.12.20, 11.12.21

Label	Regional Ecosystem (mandatory unless otherwise specified)
939	5.3.1, 5.3.2, 5.3.3, 5.3.4, 5.3.5, 5.3.6, 5.3.7, 5.3.8, 5.3.9, 5.3.10, 5.3.20, 5.5.6, 5.7.4, 5.7.8, 6.3.1, 6.3.2, 6.3.3, 6.3.4, 6.3.5, 6.3.7, 6.3.8, 6.3.9, 6.3.16, 6.3.17, 6.3.18, 6.3.24, 6.3.25, 6.4.3, 6.5.1, 6.5.2, 6.5.3, 6.5.5, 6.5.17, 6.5.18, 6.5.19, 6.7.5, 6.7.6, 6.7.7, 6.9.2, 11.2.1, 11.2.3, 11.2.5, 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.6, 11.3.8, 11.3.9, 11.3.10, 11.3.11, 11.3.12, 11.3.13, 11.3.14, 11.3.15, 11.3.16, 11.3.17, 11.3.18, 11.3.19, 11.3.20, 11.3.23, 11.3.25, 11.3.27, 11.3.28, 11.3.29, 11.3.30, 11.3.32, 11.3.33, 11.3.35, 11.3.36, 11.3.37, 11.3.39, 11.3.40, 11.4.1, 11.4.2, 11.4.3, 11.4.5, 11.4.6, 11.4.8, 11.4.10, 11.4.12, 11.4.13, 11.5.1, 11.5.2, 11.5.3, 11.5.4, 11.5.5, 11.5.8, 11.5.9, 11.5.12, 11.5.13, 11.5.14, 11.5.15, 11.5.17, 11.5.20, 11.5.21, 11.7.1, 11.7.2, 11.7.3, 11.7.4, 11.7.6, 11.8.2, 11.8.3, 11.8.4, 11.8.5, 11.8.6, 11.8.8, 11.8.9, 11.8.11, 11.8.12, 11.8.13, 11.8.14, 11.8.15, 11.9.2, 11.9.3, 11.9.4, 11.9.7, 11.9.8, 11.9.9, 11.9.14, 11.10.1, 11.10.4, 11.10.6, 11.10.7, 11.10.8, 11.10.11, 11.10.12, 11.10.13, 11.11.1, 11.11.2, 11.11.3, 11.11.4, 11.11.5, 11.11.6, 11.11.7, 11.11.8, 11.11.9, 11.11.10, 11.11.11, 11.11.12, 11.11.15, 11.11.16, 11.11.17, 11.11.18, 11.11.19, 11.11.20, 11.11.21, 11.12.1, 11.12.2, 11.12.3, 11.12.4, 11.12.5, 11.12.6, 11.12.7, 11.12.8, 11.12.9, 11.12.10, 11.12.11, 11.12.12, 11.12.13, 11.12.14, 11.12.17, 11.12.20, 13.3.1, 13.3.4, 13.11.1, 13.11.3, 13.11.4, 13.11.7, 13.11.8, 13.12.2, 13.12.3, 13.12.5, 13.12.8, 13.12.9, 13.12.10, 13.12.11

3.6 Area Management Plan(s)

Mulga Lands Fodder Area Management Plan

3.7 Coastal or non-coastal

For the purposes of the accepted development vegetation clearing codes and State Code 16 of the State Development Assessment Provisions (SDAP), this property is regarded as*

Non Coastal

*See also Map 4.3

3.8 Agricultural Land Class A or B

The following can be used to identify Agricultural Land Class A or B areas under the "Managing regulated regrowth vegetation" accepted development vegetation clearing code:

Does this lot contain land that is mapped as Agricultural Land Class A or B in the State Planning Interactive Mapping System?

No Class A

No Class B

Note - This confirms Agricultural Land Classes as per the State Planning Interactive Mapping System only. This response does not include Agricultural Land Classes identified under local government planning schemes. For further information, check the Planning Scheme for your local government area.

See Map 4.4 to identify the location and extent of Class A and/or Class B Agricultural land on Lot: 16 Plan: AU38.

4. Vegetation management framework maps

Vegetation management maps included in this report may also be requested individually at:
https://www.resources.qld.gov.au/qld/environment/land/vegetation/vegetation-map-request-form

Regulated vegetation management map

The regulated vegetation management map shows vegetation categories needed to determine clearing requirements. These maps are updated monthly to show new property maps of assessable vegetation (PMAV).

Vegetation management supporting map

The vegetation management supporting map provides information on regional ecosystems, wetlands, watercourses and essential habitat.

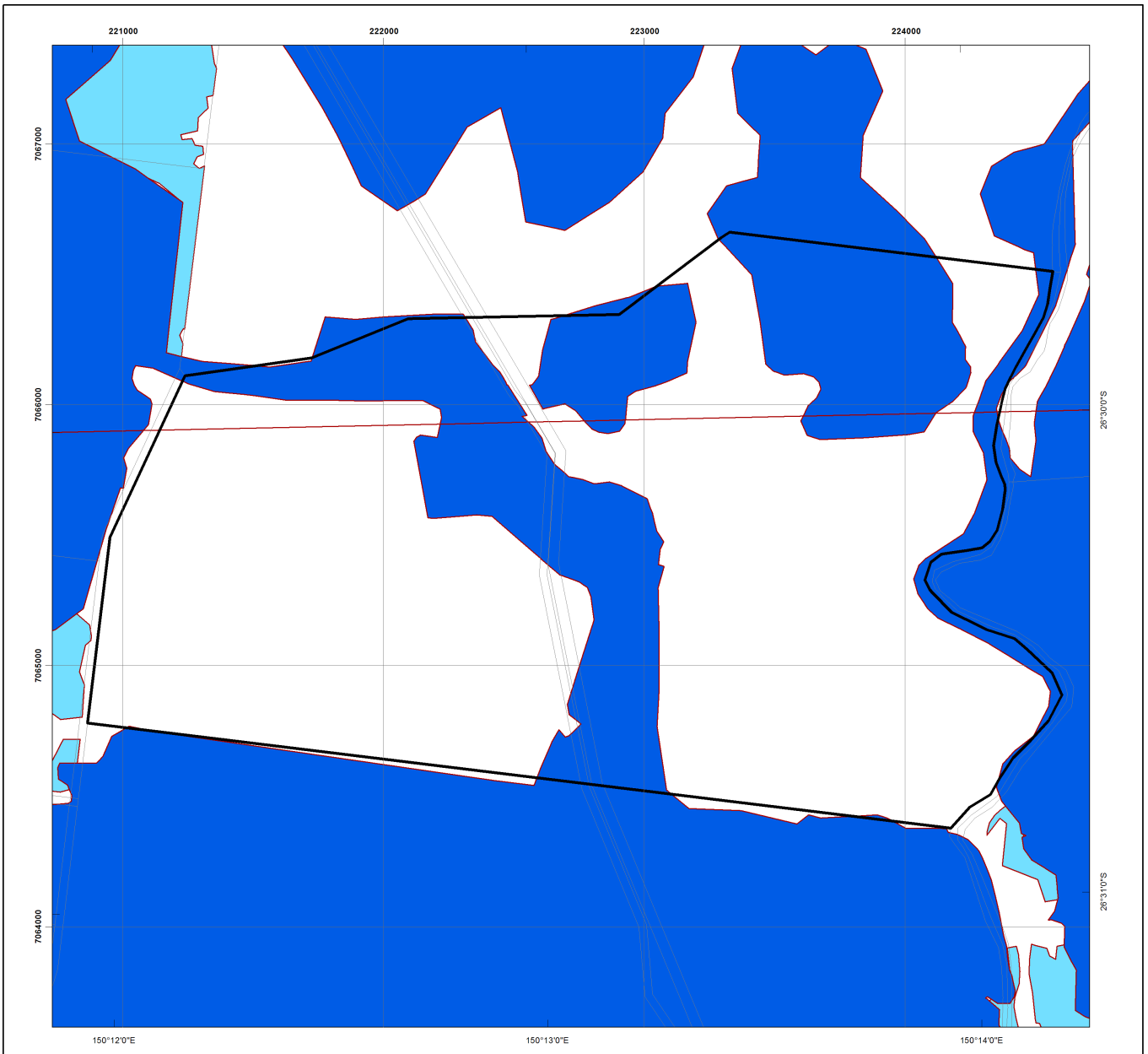
Coastal/non-coastal map

The coastal/non-coastal map confirms whether the lot, or which parts of the lot, are considered coastal or non-coastal for the purposes of the accepted development vegetation clearing codes and State Code 16 of the State Development Assessment Provisions (SDAP).

Agricultural Land Class A or B as per State Planning Policy: State Interest for Agriculture

The Agricultural Land Class map confirms the location and extent of land mapped as Agricultural Land Classes A or B as identified on the State Planning Interactive Mapping System. Please note that this map does not include areas identified as Agricultural Land Class A or B in local government planning schemes. This map can be used to identify Agricultural Land Class A or B areas under the "Managing regulated regrowth vegetation" accepted development vegetation clearing code.

4.1 Regulated vegetation management map

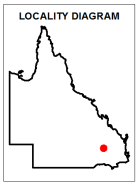


Regulated Vegetation Management Map

Legend

- Selected Lot and Plan
- Category A area (Vegetation offsets/compliance notices/VDecs)
- Category B area (Remnant vegetation)
- Category C area (High-value regrowth vegetation)
- Category R area (Reef regrowth watercourse vegetation)
- Category X area (Exempt clearing work on Freehold, Indigenous and Leasehold land)
- Water
- Other land parcel boundaries

LOCALITY DIAGRAM



N

0 210 420 630 840 1,050 m

This product is projected into:
GDA 1994 MGA Zone 56

Disclaimer:
While every care is taken to ensure the accuracy of this product, the Department of Resources makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which you might incur as a result of the product being inaccurate or incomplete in any way and for any reason.

Additional information required for the assessment of vegetation values is provided in the accompanying "Vegetation Management Supporting map". For further information go to the web site: www.resources.qld.gov.au or contact the Department of Resources.

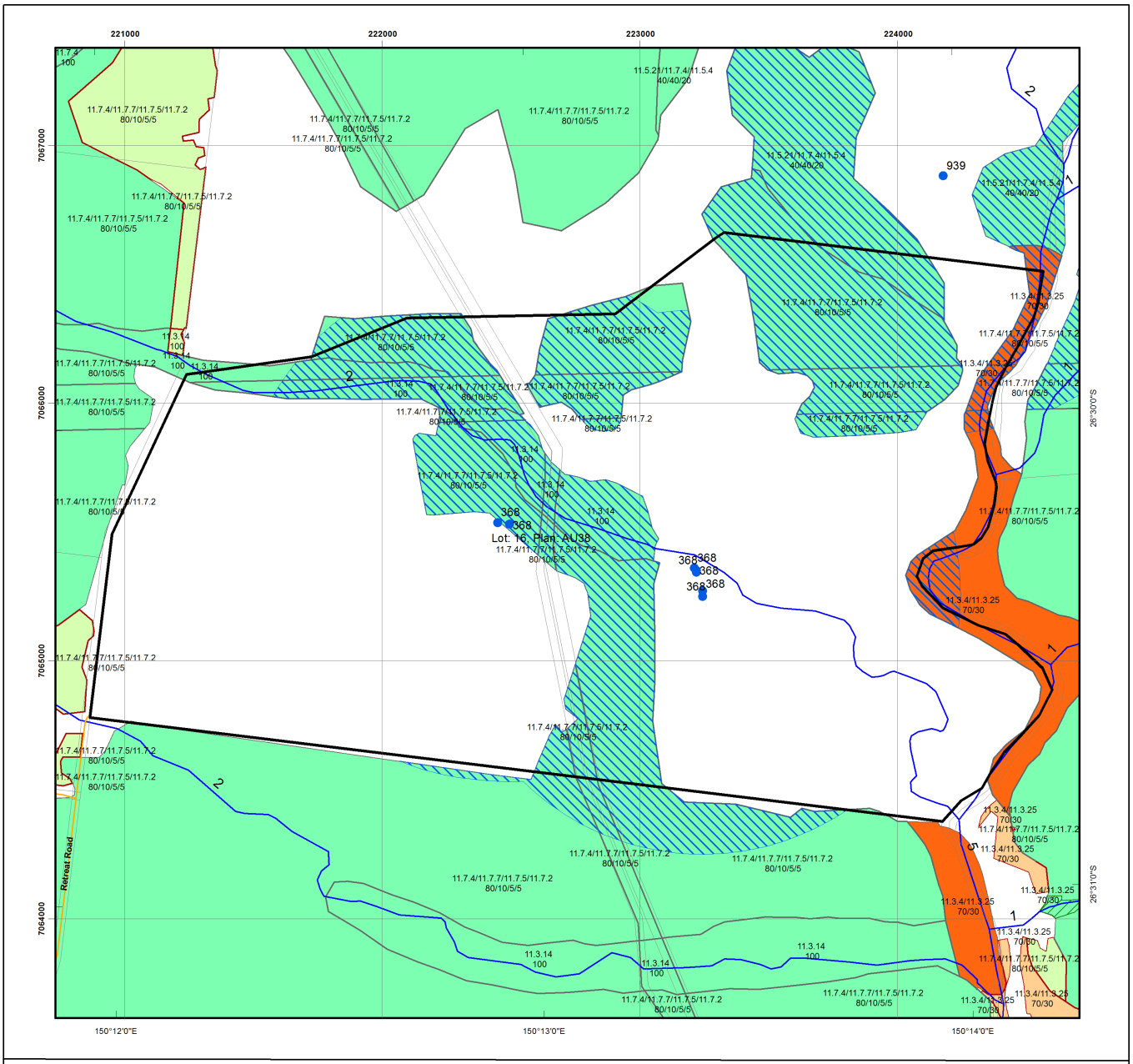
Digital data for the regulated vegetation management map is available from the Queensland Spatial Portal at http://www.information.qld.gov.au/

Land parcel boundaries are provided as locational aid only.

This map is updated on a monthly basis to ensure new PMAVs are included as they are approved.

Queensland Government

4.2 Vegetation management supporting map



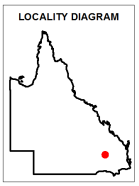
Vegetation Management Supporting Map

Legend

- Selected Lot and Plan
- Category A or B area containing endangered regional ecosystems
- Category A or B area containing of concern regional ecosystems
- Category A or B area that is a least concern regional ecosystem
- Category C or R area containing endangered regional ecosystems
- Category C or R area containing of concern regional ecosystems
- Category C or R area that is a least concern regional ecosystem
- Category X area
- Water
- Wetland on the vegetation management wetlands map
- Essential habitat on the essential habitat map
- Essential habitat species record
- Watercourses and drainage features on the vegetation management watercourse and drainage features map (Stream order shown as black number against stream where available)
- Highway
- Connector
- Street/Local Road
- National Parks, State Forest and other reserves
- Other land parcel boundaries

Queensland Government

LOCALITY DIAGRAM



N

0 150 300 450 600 750 m

This product is projected into: GDA 1994 MGA Zone 56

Labels for Essential Habitat are centred on the area of enquiry.

Regional ecosystem linework has been compiled at a scale of 1:100 000, except in designated areas where a compilation scale of 1:50 000 is available. Linework should be used as a guide only. The positional accuracy of RE data mapped at a scale of 1:100 000 is +/- 100 metres.

Disclaimer:
While every care is taken to ensure the accuracy of this product, the Department of Resources makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which you might incur as a result of the product being inaccurate or incomplete in any way and for any reason.

Additional information may be required for the purposes of land clearing or assessment of a regional ecosystem map or PMAV applications. For further information go to the web site: www.resources.qld.gov.au or contact the Department of Resources.

Digital data for the vegetation management watercourse and drainage feature map, vegetation management wetlands map, essential habitat map and the vegetation management remnant and regional ecosystem map are available from the Queensland Spatial Portal at http://www.information.qld.gov.au/

Land parcel boundaries are provided as locational aid only.

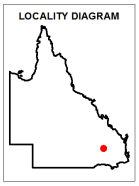
4.3 Coastal/non-coastal map

Coastal/Non Coastal Map

Legend

- Selected Lot and Plan
- Coastal
- Non Coastal
- Other land parcel boundaries

LOCALITY DIAGRAM



N

0 210 420 630 840 1,050 m

This product is projected into:
GDA 1994 MGA Zone 56

Disclaimer:
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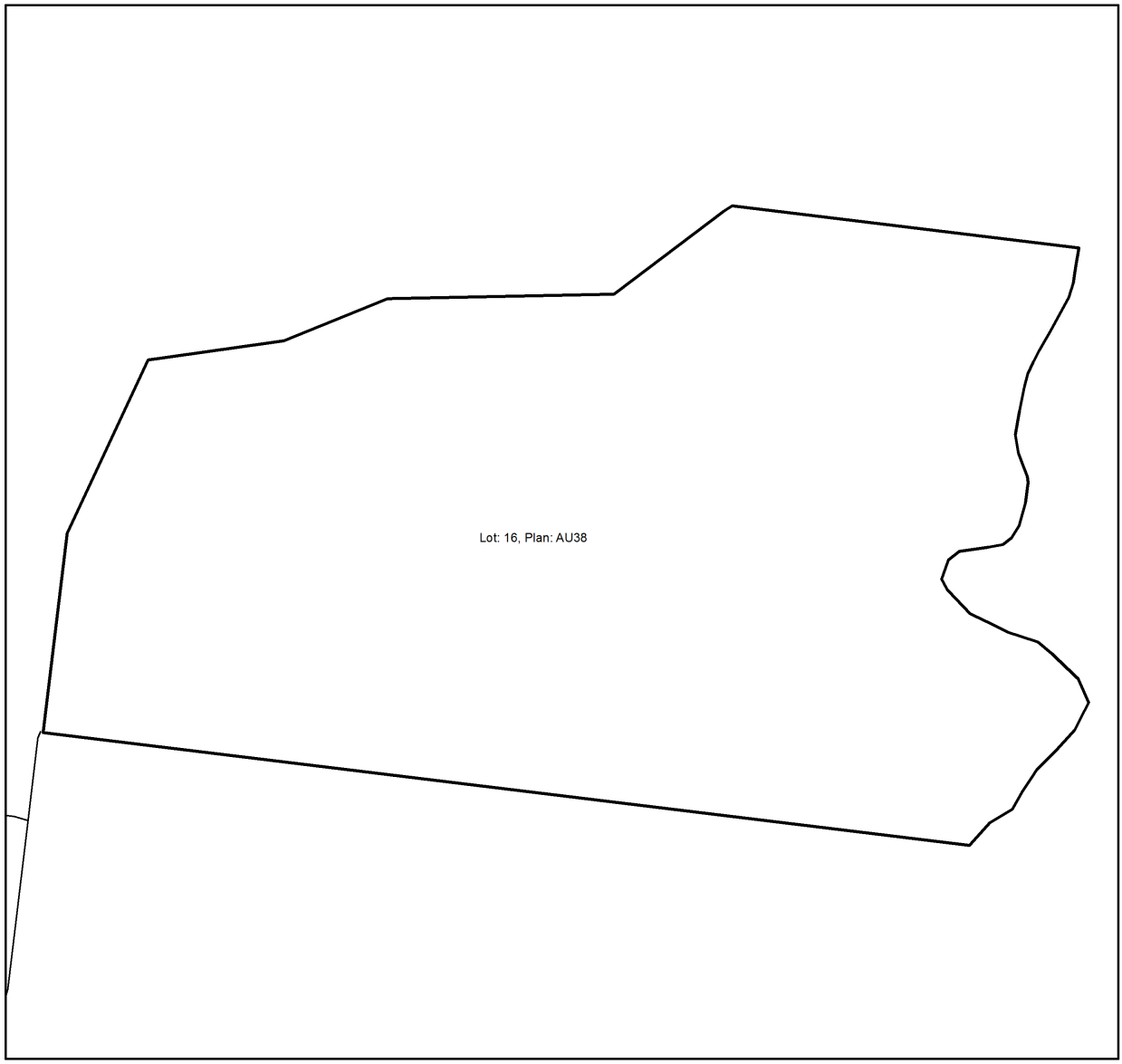
Queensland Government

4.4 Agricultural Land Class A or B as per State Planning Policy: State Interest for Agriculture



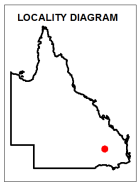
Agricultural Land Class A or B
as per State Planning Policy: State Interest for Agriculture

Legend

- Selected Lot and Plan
- Towns
- Rivers and creeks
- Freeways / motorways; Highways
- Secondary roads; Streets

Agricultural land class A or B

- A
- B
- Not class A or B



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0 210 420 630 840 1050 m

This product is projected into GDA 1994 MGA Zone 56

5. Protected plants framework (administered by the Department of Environment and Science (DES))

In Queensland, all plants that are native to Australia are protected plants under the *Nature Conservation Act 1992* (NCA). The NCA regulates the clearing of protected plants 'in the wild' (see Operational policy: When a protected plant in Queensland is considered to be 'in the wild') that are listed as critically endangered, endangered, vulnerable or near threatened under the Act.

Please note that the protected plant clearing framework applies irrespective of the classification of the vegetation under the *Vegetation Management Act 1999* and any approval or exemptions given under another Act, for example, the *Vegetation Management Act 1999* or *Planning Regulation 2017*.

5.1 Clearing in high risk areas on the flora survey trigger map

The flora survey trigger map identifies high-risk areas for threatened and near threatened plants. These are areas where threatened or near threatened plants are known to exist or are likely to exist based on the habitat present. The flora survey trigger map for this property is provided in section 5.5.

If you are proposing to clear an area shown as high risk on the flora survey trigger map, a flora survey of the clearing impact area must be undertaken by a suitably qualified person in accordance with the Flora survey guidelines. The main objective of a flora survey is to locate any threatened or near threatened plants that may be present in the clearing impact area.

If the flora survey identifies that threatened or near threatened plants are not present within the clearing impact area or clearing within 100m of a threatened or near threatened plant can be avoided, the clearing activity is exempt from a permit. An exempt clearing notification form must be submitted to the Department of Environment and Science, with a copy of the flora survey report, at least one week prior to clearing.

If the flora survey identifies that threatened or near threatened plants are present in, or within 100m of, the area to be cleared, a clearing permit is required before any clearing is undertaken. The flora survey report, as well as an impact management report, must be submitted with the clearing permit application form.

5.2 Clearing outside high risk areas on the flora survey trigger map

In an area other than a high risk area, a clearing permit is only required where a person is, or becomes aware that threatened or near threatened plants are present in, or within 100m of, the area to be cleared. You must keep a copy of the flora survey trigger map for the area subject to clearing for five years from the day the clearing starts. If you do not clear within the 12 month period that the flora survey trigger map was printed, you need to print and check a new flora survey trigger map.

5.3 Exemptions

Many activities are 'exempt' under the protected plant clearing framework, which means that clearing of native plants that are in the wild can be undertaken for these activities with no need for a flora survey or a protected plant clearing permit. The Information sheet - General exemptions for the take of protected plants provides some of these exemptions.

Some exemptions under the NCA are the same as exempt clearing work (formerly known as exemptions) under the *Vegetation Management Act 1999* (i.e. listed in Schedule 21 of the Planning Regulations 2017) while some are different.

5.4 Contact information for DES

For further information on the protected plants framework:
Phone 1300 130 372 (and select option four)
Email palm@des.qld.gov.au
Visit https://www.qld.gov.au/environment/plants-animals/plants/protected-plants

5.5 Protected plants flora survey trigger map

This map included may also be requested individually at: https://apps.des.qld.gov.au/map-request/flora-survey-trigger/.

Updates to the data informing the flora survey trigger map

The flora survey trigger map will be reviewed, and updated if necessary, at least every 12 months to ensure the map reflects the most up-to-date and accurate data available.

Species information

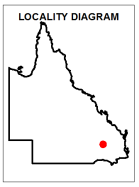
Please note that flora survey trigger maps do not identify species associated with 'high risk areas'. While some species information may be publicly available, for example via the Queensland Spatial Catalogue, the Department of Environment and Science does not provide species information on request. Regardless of whether species information is available for a particular high risk area, clearing plants in a high risk area may require a flora survey and/or clearing permit. Please see the Department of Environment and Science webpage on the clearing of protected plants for more information.

Protected Plants Flora Survey Trigger Map

Legend

- Selected Lot and Plan
- High risk area
- Other land parcel boundaries
- Freeways / motorways / highways
- Secondary roads / streets

LOCALITY DIAGRAM



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0 150 300 450 600 750 m

This product is projected into:
GDA 1994 MGA Zone 56

This map shows areas where particular provisions of the Nature Conservation Act 1992 apply to the clearing of protected plants.

Land parcel boundaries are provided as locational aid only.

This map is produced at a scale relevant to the size of the area selected and should be printed as A4 size in portrait orientation.

For further information or assistance with interpretation of this product, please contact the Department of Environment and Science at palm@des.qld.gov.au

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6. Koala protection framework (administered by the Department of Environment and Science (DES))

The koala (*Phascolarctos cinereus*) is listed in Queensland as endangered by the Queensland Government under *Nature Conservation Act 1992* and by the Australian Government under the *Environment Protection and Biodiversity Conservation Act 1999*.

The Queensland Government's koala protection framework is comprised of the *Nature Conservation Act 1992*, the Nature Conservation (Animals) Regulation 2020, the Nature Conservation (Koala) Conservation Plan 2017, the *Planning Act 2016* and the Planning Regulation 2017.

6.1 Koala mapping

6.1.1 Koala districts

The parts of Queensland where koalas are known to occur has been divided into three koala districts - koala district A, koala district B and koala district C. Each koala district is made up of areas with comparable koala populations (e.g. density, extent and significance of threatening processes affecting the population) which require similar management regimes.

Section 7.1 identifies which koala district your property is located in.

6.1.2 Koala habitat areas

Koala habitat areas are areas of vegetation that have been determined to contain koala habitat that is essential for the conservation of a viable koala population in the wild based on the combination of habitat suitability and biophysical variables with known relationships to koala habitat (e.g. landcover, soil, terrain, climate and ground water). In order to protect this important koala habitat, clearing controls have been introduced into the Planning Regulation 2017 for development in koala habitat areas.

Please note that koala habitat areas only exist in koala district A which is the South East Queensland "Shaping SEQ" Regional Plan area. These areas include the local government areas of Brisbane, Gold Coast, Logan, Lockyer Valley, Ipswich, Moreton Bay, Noosa, Redland, Scenic Rim, Somerset, Sunshine Coast and Toowoomba (urban extent).

There are two different categories of koala habitat area (core koala habitat area and locally refined koala habitat), which have been determined using two different methodologies. These methodologies are described in the document Spatial modelling in South East Queensland.

Section 7.2 shows any koala habitat area that exists on your property.

Under the Nature Conservation (Koala) Conservation Plan 2017, an owner of land (or a person acting on the owner's behalf with written consent) can request to make, amend or revoke a koala habitat area determination if they believe, on reasonable grounds, that the existing determination for all or part of their property is incorrect.

More information on requests to make, amend or revoke a koala habitat area determination can be found in the document Guideline - Requests to make, amend or revoke a koala habitat area determination.

The koala habitat area map will be updated at least annually to include any koala habitat areas that have been made, amended or revoked.

Changes to the koala habitat area map which occur between annual updates because of a request to make, amend or revoke a koala habitat area determination can be viewed on the register of approved requests to make, amend or revoke a koala habitat area available at: https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/koalamaps. The register includes the lot on plan for the change, the date the decision was made and the map issued to the landholder that shows areas determined to be koala habitat areas.

6.1.3 Koala priority areas

Koala priority areas are large, connected areas that have been determined to have the highest likelihood of achieving conservation outcomes for koalas based on the combination of habitat suitability, biophysical variables with known relationships to koala habitat (e.g. landcover, soil, terrain, climate and ground water) and a koala conservation cost benefit analysis.

Conservation efforts will be prioritised in these areas to ensure the conservation of viable koala populations in the wild including a focus on management (e.g. habitat protection, habitat restoration and threat mitigation) and monitoring. This includes a prohibition on clearing in koala habitat areas that are in koala priority areas under the Planning Regulation 2017 (subject to some exemptions).

Please note that koala priority areas only exist in koala district A which is the South East Queensland "Shaping SEQ" Regional Plan area. These areas include the local government areas of Brisbane, Gold Coast, Logan, Lockyer Valley,

Ipswich, Moreton Bay, Noosa, Redland, Scenic Rim, Somerset, Sunshine Coast and Toowoomba (urban extent).

Section 7.2 identifies if your property is in a koala priority area.

6.1.4 Identified koala broad-hectare areas

There are seven identified koala broad-hectare areas in SEQ. These are areas of koala habitat that are located in areas committed to meet development targets in the SEQ Regional Plan to accommodate SEQ's growing population including bring-forward Greenfield sites under the Queensland Housing Affordability Strategy and declared master planned areas under the repealed *Sustainable Planning Act 2009* and the repealed *Integrated Planning Act 1997*.

Specific assessment benchmarks apply to development applications for development proposed in identified koala broad-hectare areas to ensure koala conservation measures are incorporated into the proposed development.

Section 7.2 identifies if your property is in an identified koala broad-hectare area.

6.2 Koala habitat planning controls

On 7 February 2020, the Queensland Government introduced new planning controls to the Planning Regulation 2017 to strengthen the protection of koala habitat in South East Queensland (i.e. koala district A).

More information on these planning controls can be found here:
https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/legislation-policy.

As a high-level summary, the koala habitat planning controls make:

- development that involves interfering with koala habitat (defined below) in an area that is both a koala priority area and a koala habitat area, prohibited development (i.e. development for which a development application cannot be made);
- development that involves interfering with koala habitat (defined below) in an area that is a koala habitat area but is not a koala priority area, assessable development (i.e. development for which development approval is required); and
- development that is for extractive industries where the development involves interfering with koala habitat (defined below) in an area that is both a koala habitat area and a key resource area, assessable development (i.e. development for which development approval is required).

Interfering with koala habitat means:

1) Removing, cutting down, ringbarking, pushing over, poisoning or destroying in anyway, including by burning, flooding or draining native vegetation in a koala habitat area; but
2) Does not include destroying standing vegetation by stock or lopping a tree.

However, these planning controls do not apply if the development is exempted development as defined in Schedule 24 of the Planning Regulation 2017. More information on exempted development can be found here:
https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/legislation-policy.

There are also assessment benchmarks that apply to development applications for:

- building works, operational works, material change of use or reconfiguration of a lot where:
  - the local government planning scheme makes the development assessable;
  - the premises includes an area that is both a koala priority area and a koala habitat area; and
  - the development does not involve interfering with koala habitat (defined above); and

- development in identified koala broad-hectare areas.

The Guideline - Assessment Benchmarks in relation to Koala Habitat in South East Queensland assessment benchmarks outlines these assessment benchmarks, the intent of these assessment benchmarks and advice on how proposed development may meet these assessment benchmarks.

6.3 Koala Conservation Plan clearing requirements

Section 10 and 11 of the Nature Conservation (Koala) Conservation Plan 2017 prescribes requirements that must be met when clearing koala habitat in koala district A and koala district B.

These clearing requirements are independent to the koala habitat planning controls introduced into the Planning Regulation 2017, which means they must be complied with irrespective of any approvals or exemptions offered under other legislation.

Unlike the clearing controls prescribed in the Planning Regulation 2017 that are to protect koala habitat, the clearing requirements prescribed in the Nature Conservation (Koala) Conservation Plan 2017 are in place to prevent the injury or death of koalas when koala habitat is being cleared.

6.4 Contact information for DES

For further information on the koala protection framework:
Phone 13 QGOV (13 74 68)
Email koala.assessment@des.qld.gov.au
Visit https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping

7. Koala protection framework details for Lot: 16 Plan: AU38

7.1 Koala districts

Koala District C

7.2 Koala priority area, koala habitat area and identified koala broad-hectare area map

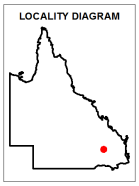
Koala priority area, koala habitat area and identified koala broad-hectare area map

Legend

- Selected Lot and Plan
- Koala habitat area (core)
- Koala habitat area (locally refined)
- Koala priority area
- Identified koala broad-hectare area
- Cadastral Boundaries
- Towns
- Highway
- Connector
- Street/Local Road
- Major rivers/creeks
- Queensland

The koala habitat mapping within South East Queensland uses regional ecosystem linework compiled at a scale varying from 1:25,000 to 1:100,000. Linework should be used as a guide only. The positional accuracy of regional ecosystem data mapped at a scale of 1:100,000 is +/- 100 metres.

LOCALITY DIAGRAM



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The koala conservation plan maps will be updated at least annually to include any koala habitat areas that have been made, amended or revoked.

In order to ensure that the most recent map for an area of interest can be accessed, prior to the annual update, a register of changes made to koala habitat areas as a result of the map amendment process will be available at: https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/. The register will include lot on plan for the change, the date the decision was made and the map issued to the landholder which shows areas determined to be koala habitat areas.

This product is projected into GDA 1994 MGA Zone 56

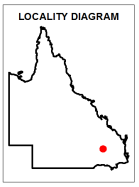
7.3 Koala habitat regional ecosystems for core koala habitat areas

Koala habitat regional ecosystems for core koala habitat areas

Legend

- Selected Lot and Plan
- Koala habitat area (core)
- Towns
- Highway
- Connector
- Street/Local Road
- Major rivers/creeks
- Queensland

LOCALITY DIAGRAM



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This product is projected into GDA 1994 MGA Zone 56

8. Other relevant legislation contacts list

Activity	Legislation	Agency	Contact details
• Interference with overland flow • Earthworks, significant disturbance	*Water Act 2000* *Soil Conservation Act 1986*	Department of Regional Development, Manufacturing and Water (Queensland Government) Department of Resources (Queensland Government)	Ph: 13 QGOV (13 74 68) www.rdmw.qld.gov.au www.resources.qld.gov.au
• Indigenous Cultural Heritage	*Aboriginal Cultural Heritage Act 2003* *Torres Strait Islander Cultural Heritage Act 2003*	Department of Seniors, Disability Services and Aboriginal and Torres Strait Islander Partnerships	Ph: 13 QGOV (13 74 68) www.datsip.qld.gov.au
• Mining and environmentally relevant activities • Infrastructure development (coastal) • Heritage issues	*Environmental Protection Act 1994* *Coastal Protection and Management Act 1995* *Queensland Heritage Act 1992*	Department of Environment and Science (Queensland Government)	Ph: 13 QGOV (13 74 68) www.des.qld.gov.au
• Protected plants and protected areas	*Nature Conservation Act 1992*	Department of Environment and Science (Queensland Government)	Ph: 1300 130 372 (option 4) palm@des.qld.gov.au www.des.qld.gov.au
• Koala mapping and regulations	*Nature Conservation Act 1992*	Department of Environment and Science (Queensland Government)	Ph: 13 QGOV (13 74 68) Koala.assessment@des.qld.gov.au
• Interference with fish passage in a watercourse, mangroves • Forestry activities on State land tenures	*Fisheries Act 1994* *Forestry Act 1959*	Department of Agriculture and Fisheries (Queensland Government)	Ph: 13 QGOV (13 74 68) www.daf.qld.gov.au
• Matters of National Environmental Significance including listed threatened species and ecological communities	*Environment Protection and Biodiversity Conservation Act 1999*	Department of Agriculture, Water and the Environment (Australian Government)	Ph: 1800 803 772 www.environment.gov.au
• Development and planning processes	*Planning Act 2016* *State Development and Public Works Organisation Act 1971*	Department of State Development, Infrastructure, Local Government and Planning (Queensland Government)	Ph: 13 QGOV (13 74 68) www.dsdmip.qld.gov.au
• Local government requirements	*Local Government Act 2009* *Planning Act 2016*	Department of State Development, Infrastructure, Local Government and Planning (Queensland Government)	Ph: 13 QGOV (13 74 68) Your relevant local government office
• Harvesting timber in the Wet Tropics of Qld World Heritage area	*Wet Tropics World Heritage Protection and Management Act 1993*	Wet Tropics Management Authority	Ph: (07) 4241 0500 www.wettropics.gov.au

Appendix B

MEDLI Output Reports

MEDLI REPORT - FULL RUN

Enterprise: **Girrahween Warehouse & Office Assessment**

Description:
Scenarios to assess the effluent irrigation scheme sizing

Client: **Arrow Energy**

MEDLI User: GHDNET\lekuskopf

Scenario Details:
IRRIGATION LOAD SCENARIO: 28EP
10-year run period
TN=30, TP=20, EC=1600

DESCRIPTION

Climate Data: Girrahween_Climate_-26.50_150.21_-26.50_150.20, -26.5°, 150.2°

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

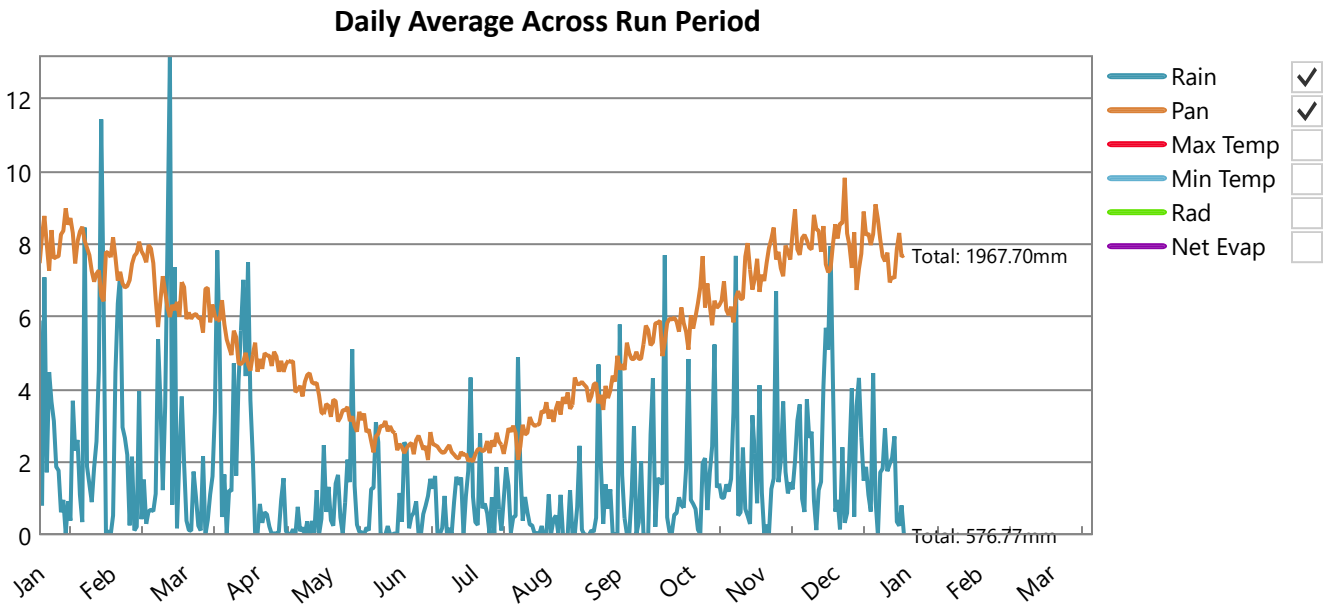
Climate Statistics:

	10th Percentile	50th Percentile	90th Percentile
Rainfall (mm/year)	353	545	899
Pan Evaporation (mm/year)	1639	2000	2245

Climate Data:

Chart Table

Monthly Daily

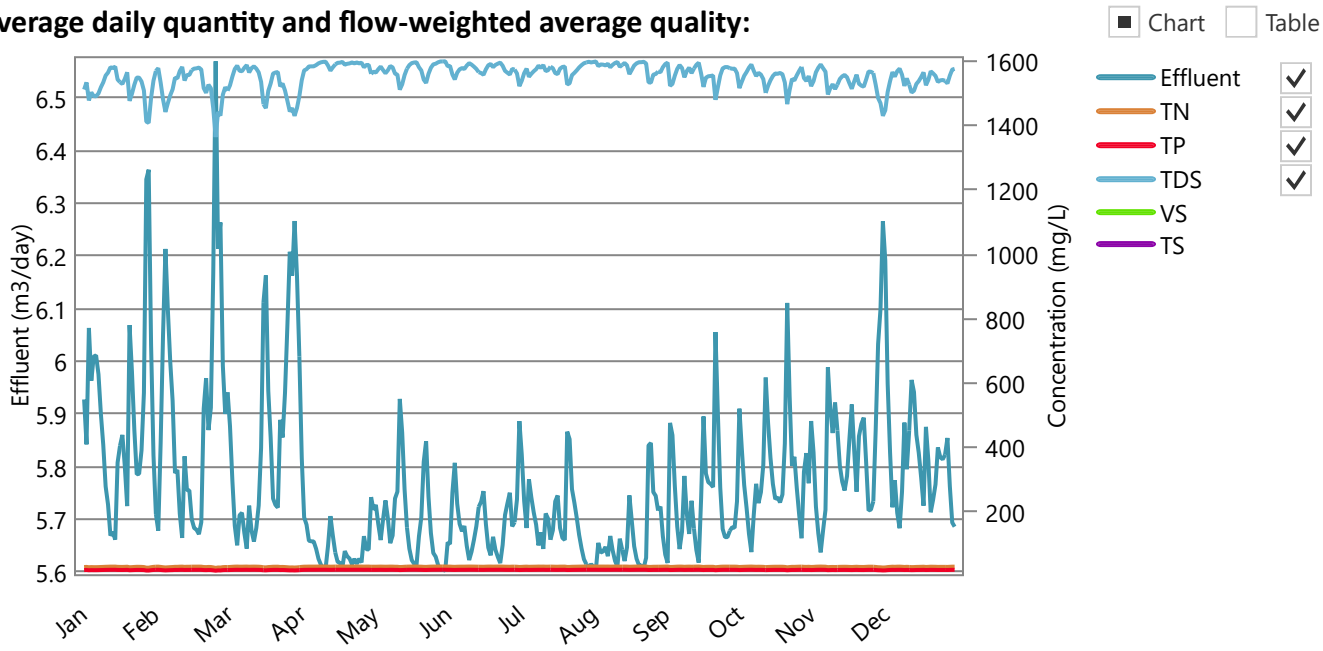


DESCRIPTION

Effluent type: Girrahween Warehouse/Office STP - Indicative

Wastestream before any recycling or pretreatment

Average daily quantity and flow-weighted average quality:



Wastestream after any recycling and pretreatment if applicable

Effluent quantity: **2107.46 m3/year** or 5.77 m3/day (Min-Max: 5.60 - 10.57)

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

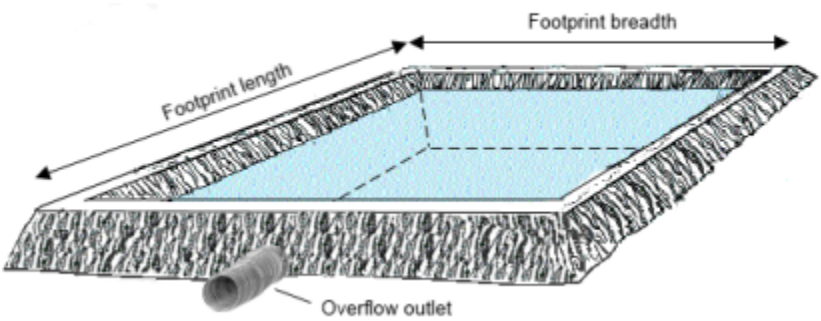
	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	29.11 (15.89 - 30.00)	61.35 (61.32 - 61.49)
Total Phosphorus	19.41 (10.59 - 20.00)	40.90 (40.88 - 40.99)
Total Dissolved Salts	1552.67 (847.58 - 1600.00)	3272.19 (3270.40 - 3279.36)
Volatile Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)

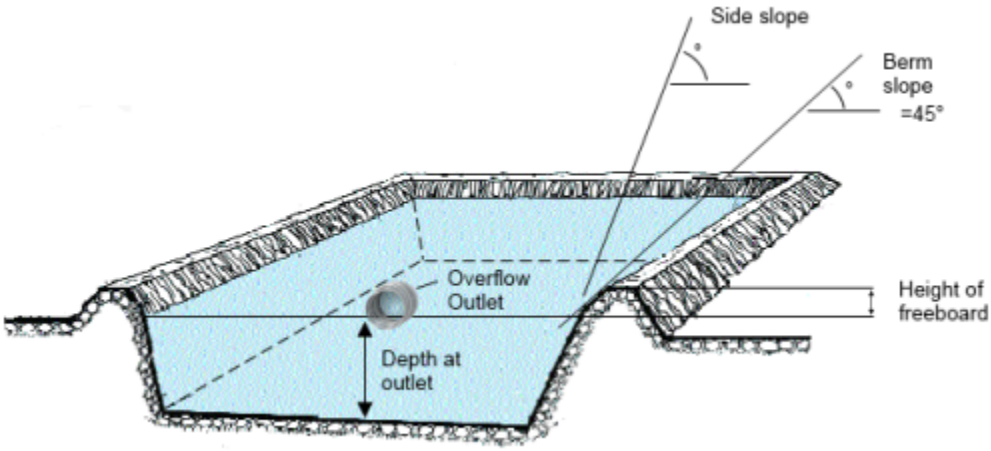
DESCRIPTION

Pond system: 1 closed storage tank

Pond system details:

	Pond 1
Maximum pond volume (m3)	17.00
Minimum allowable pond volume (m3)	0.00
Pond depth at overflow outlet (m)	1.00
Maximum water surface area (m2)	22.55
Pond footprint length (m)	4.75
Pond footprint width (m)	4.75
Pond catchment area (m2)	22.55
Average active volume (m3)	0.18





Irrigation pump limits:

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

Shandying water:

Annual allocation of fresh water available for shandying (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

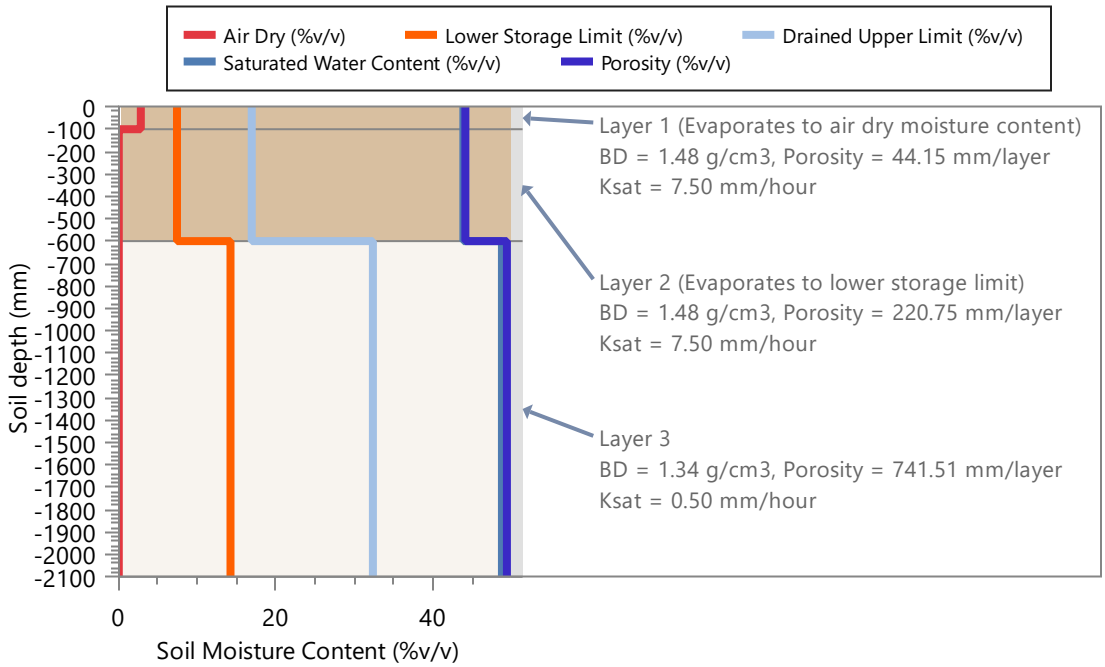
DESCRIPTION

Land: Girrahween Office Application Ar

Area (m2): 1800.00

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

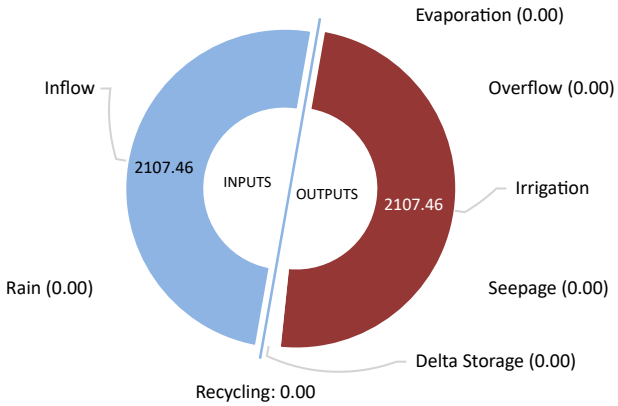
Average monthly cover (fraction) (minimum - maximum)	0.87 (0.79 - 0.93)
Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 0.8 x Pan coefficient 1)	0.80
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Maximum potential root depth in defined soil profile (mm)	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

PERFORMANCE

Pond System Water Performance - Overflow: 1 closed storage tank

Capacity of wet weather storage pond: **17 m3**

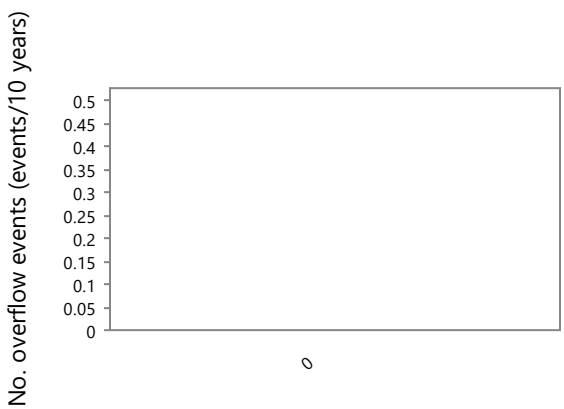
Pond System Water Balance (m3/year)



Name	Value
Rain	0.00
Inflow	2107.46
Recycling	0.00
Evaporation	0.00
Overflow	0.00
Irrigation	2107.46
Seepage	0.00
Delta Storage	0.00

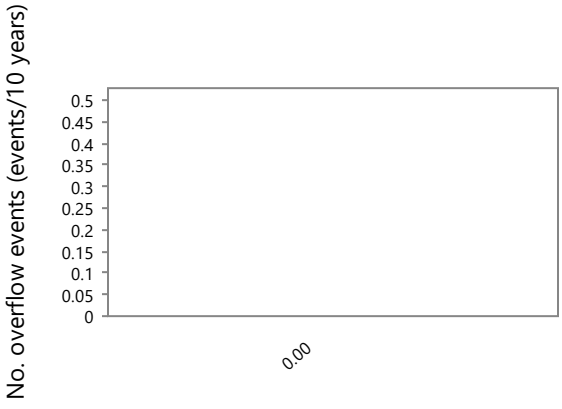
Overflow Diagnostics

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



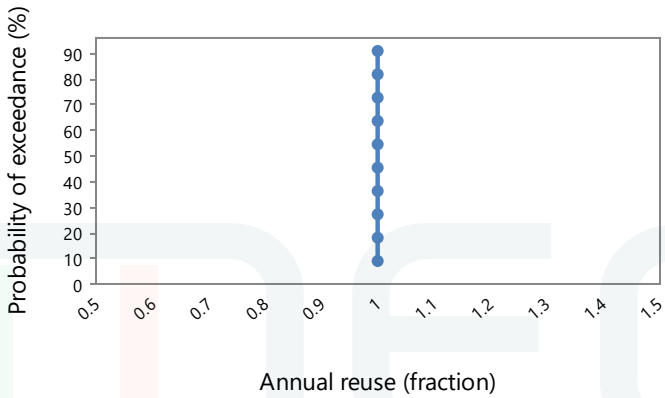
Overflow event duration exceeded (days)

Export plot



Overflow volume exceeded (m3)

Export plot



Annual reuse (fraction)

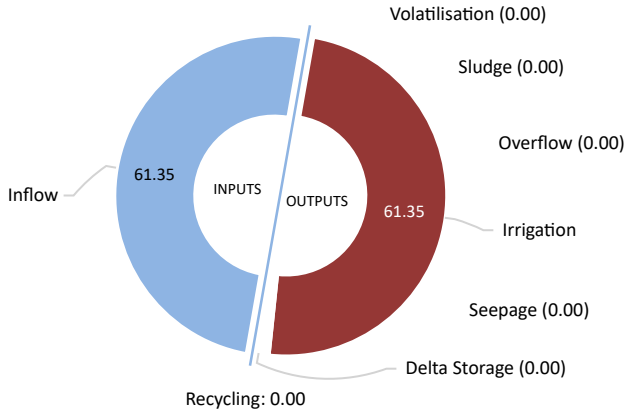
Export plot

PERFORMANCE

Pond System Performance - Nutrient: 1 closed storage tank

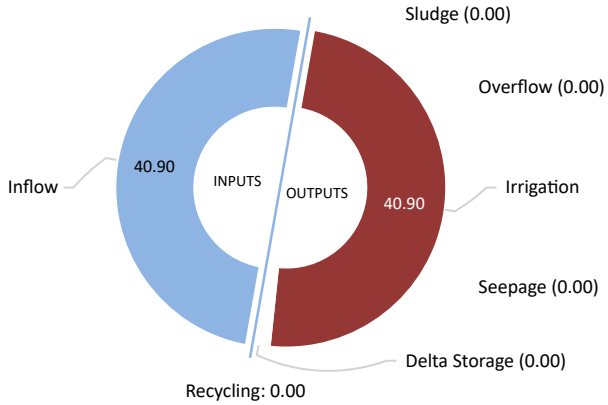
Pond System Nutrients and Salt Balance:

Nitrogen Balance (kg/year)



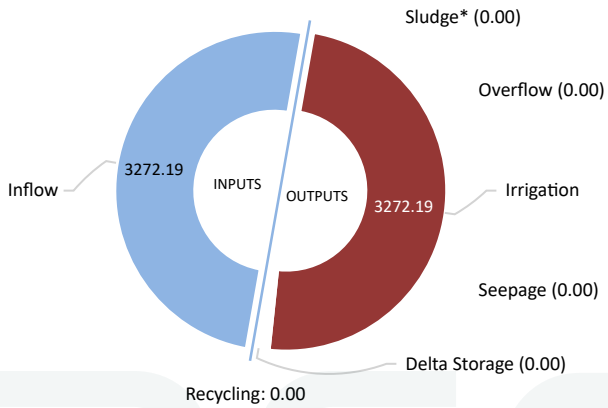
Name	Value
Inflow	61.35
Recycling	0.00
Volatilisation	0.00
Sludge	0.00
Overflow	0.00
Irrigation	61.35
Seepage	0.00
Delta Storage	0.00

Phosphorus Balance (kg/year)



Name	Value
Inflow	40.90
Recycling	0.00
Sludge	0.00
Overflow	0.00
Irrigation	40.90
Seepage	0.00
Delta Storage	0.00

Salt Balance (kg/year)



Name	Value
Inflow	3272.19
Recycling	0.00
Sludge*	0.00
Overflow	0.00
Irrigation	3272.19
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

PERFORMANCE

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)	24.31
Average phosphorus concentration of pond liquid (mg/L)	16.20
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)	29.98
Final phosphorus concentration of pond liquid (mg/L)	19.99
Final salinity of pond liquid (dS/m)	2.50

PERFORMANCE

Irrigation Performance:

Water Use: (assumes 100% Irrigation Efficiency)

Pond water irrigated (m3/year)	2107.46
Average Shandy water irrigation (m3/year) (minimum - maximum)	0.00 (0.00 - 0.00)
Total water irrigated (m3/year)	2107.46
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)	29.11
Average nitrogen concentration of irrigation water - after ammonia loss during irrigation (mg/L)	24.45
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

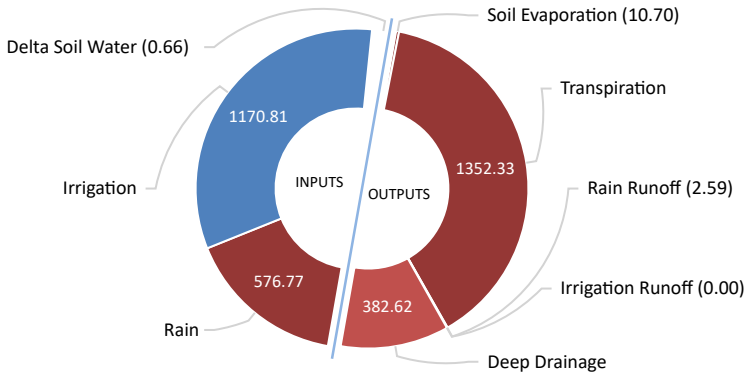
PERFORMANCE

Land Performance - Soil Water

Paddock: Girrahween Office Application Ar, 1800 m2
Soil Type: Sodosols representation_conserva, 165.60 mm PAWC at maximum root depth

Land Water Balance (mm/year):

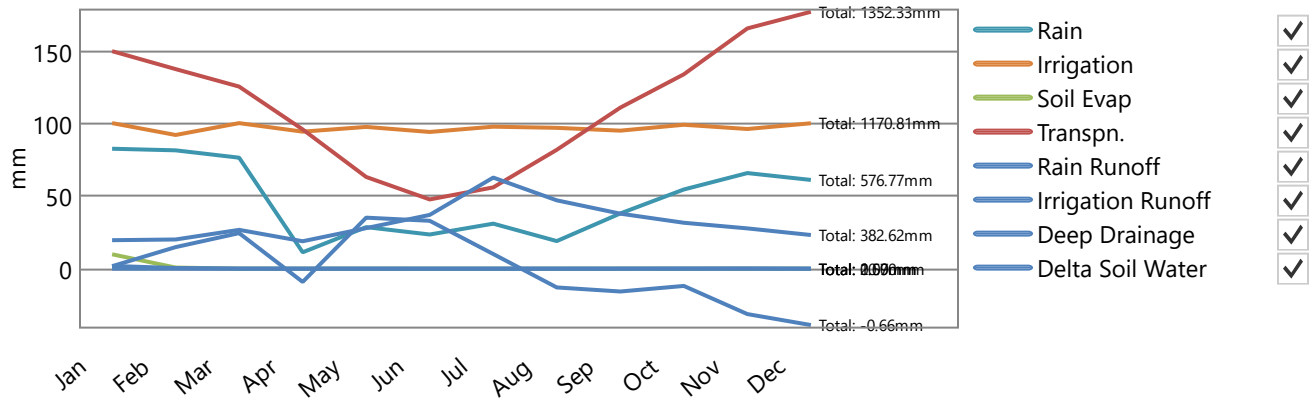
mm/year % Total inputs



Name	Value
Rain	576.77
Irrigation	1170.81
Soil Evaporation	10.70
Transpiration	1352.33
Rain Runoff	2.59
Irrigation Runoff	0.00
Deep Drainage	382.62
Delta Soil Water	-0.66

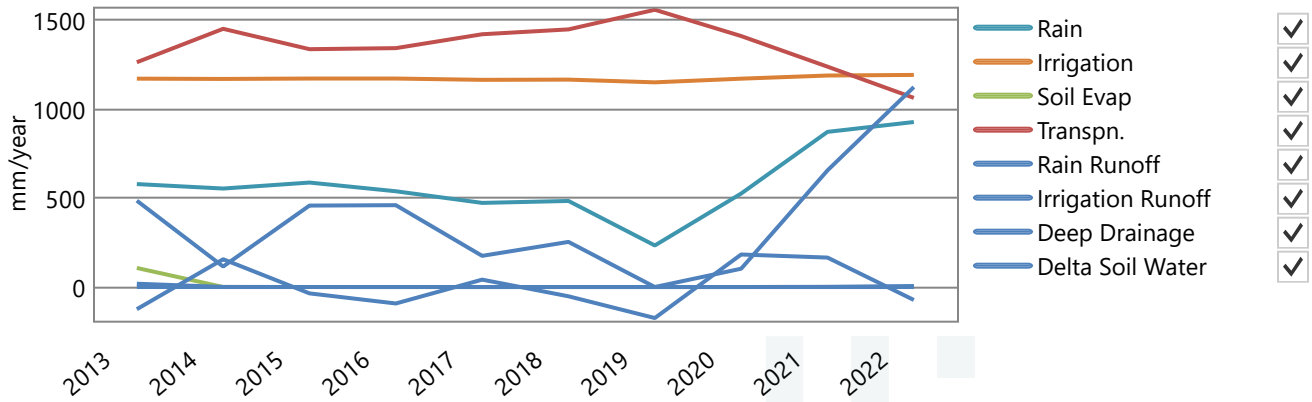
Average Monthly Totals (mm):

Chart Table



Average Annual Totals (mm/year):

Chart Table



PERFORMANCE

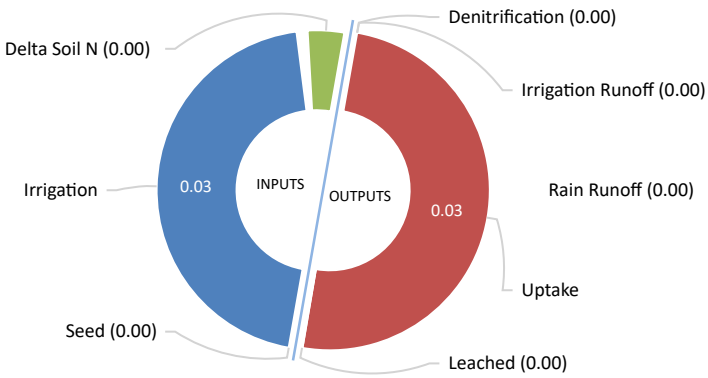
Land Performance - Soil Nutrient

Paddock: Girrahween Office Application Ar, 1800 m2 representation_conserva

Soil Type: Sodosols

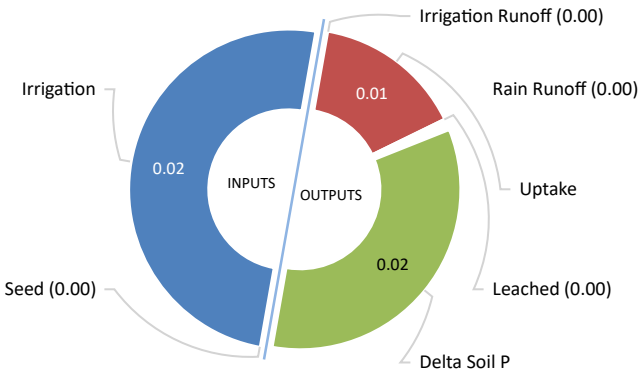
Irrigation ammonium volatilisation losses (kg/m2/year): 0.01
Proportion of total nitrogen in irrigated effluent as ammonium (fraction): 0.80

Land Nitrogen Balance (kg/m2/year)



Name	Value
Seed	1.05E-05
Irrigation	0.03
Denitrification	3.98E-07
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	0.03
Leached	5.10E-05
Delta Soil N	-2.33E-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	4.67E-05
Delta Soil P	0.02

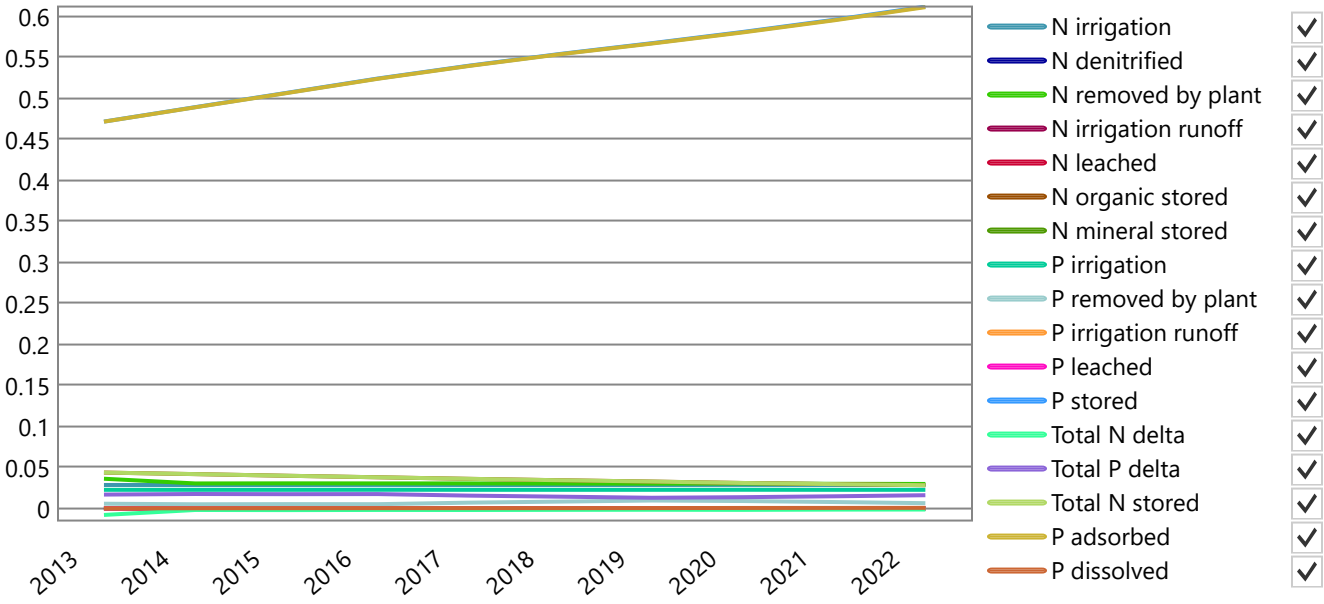
PERFORMANCE

Land Performance - Soil Nutrient

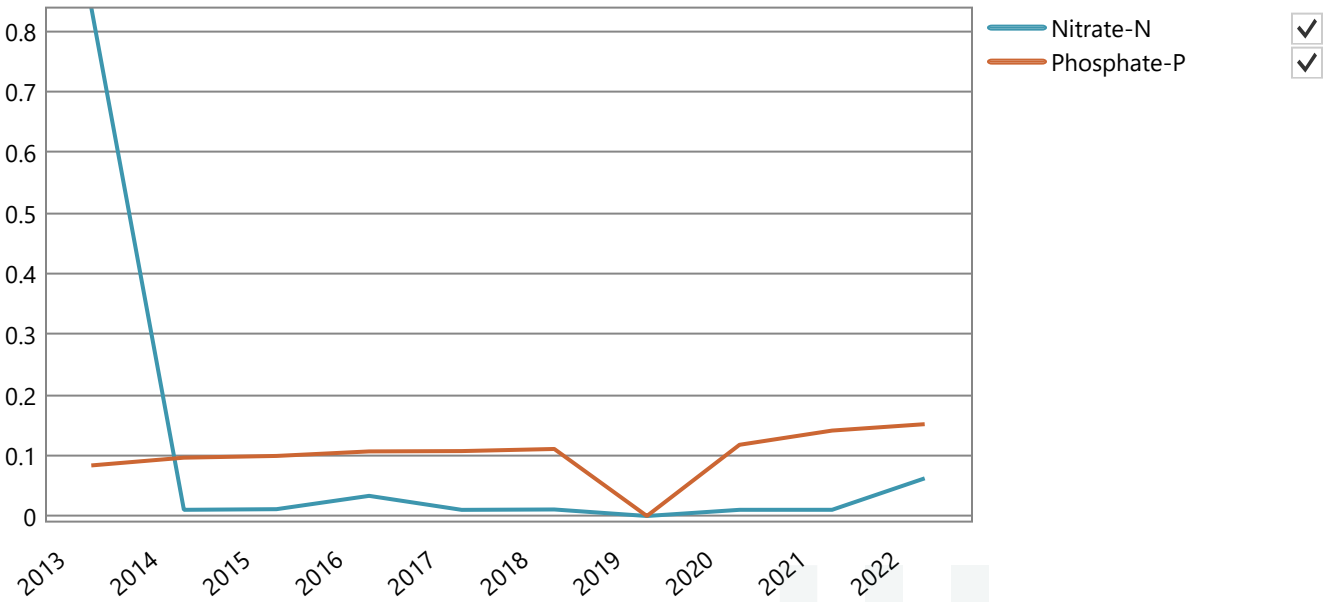
Paddock: Girrahween Office Application Ar, 1800 m2 representation_conserva

Soil Type: Sodosols

Annual Nutrient Totals (kg/m2):



Annual Nutrient Leaching Concentration (mg/L):



PERFORMANCE

Plant Performance and Nutrients

Paddock: Girrahween Office Application Ar, 1800 m2 representation_conserva

Soil Type: Sodosols

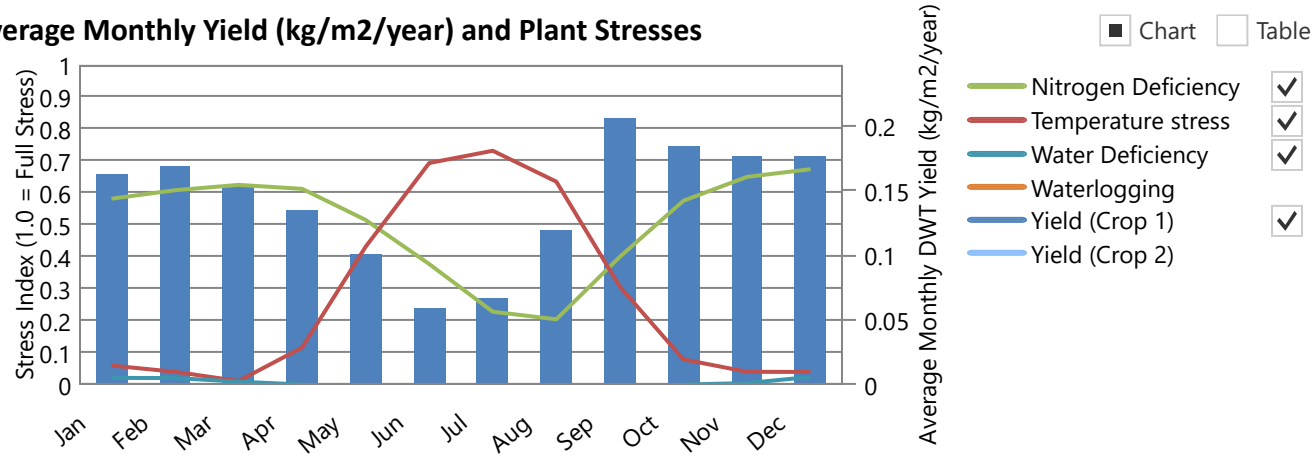
Plant: Continuous Kikuyu 1 Pasture

Average annual shoot dry matter yield (kg/m2/year)	1.71 (1.57 - 1.94)
Average monthly plant (green) cover (fraction) (minimum - maximum)	0.87 (0.79 - 0.93)
Average monthly root depth (mm) (minimum - maximum)	1193.78 (1129.27 - 1200.00)

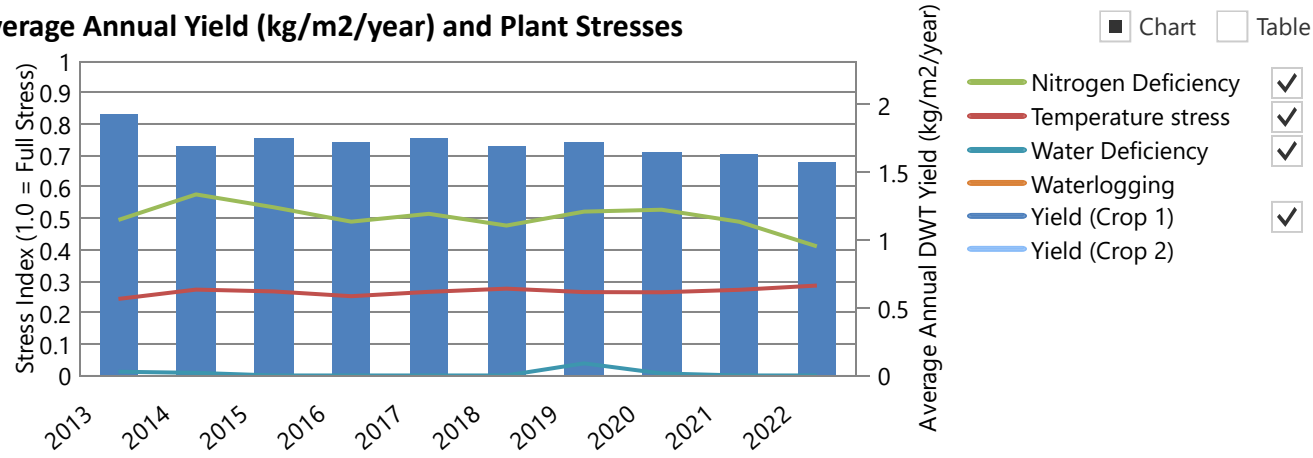
Nutrient Uptake (minimum - maximum):

Average annual net nitrogen removed by plant uptake (kg/m2/year)	0.03 (0.03 - 0.04)
Average annual net phosphorus removed by plant uptake (kg/m2/year)	0.01 (0.01 - 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: 3.00 (normal)

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

PERFORMANCE

Land Performance

Paddock: Girrahween Office Application Ar, 1800 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

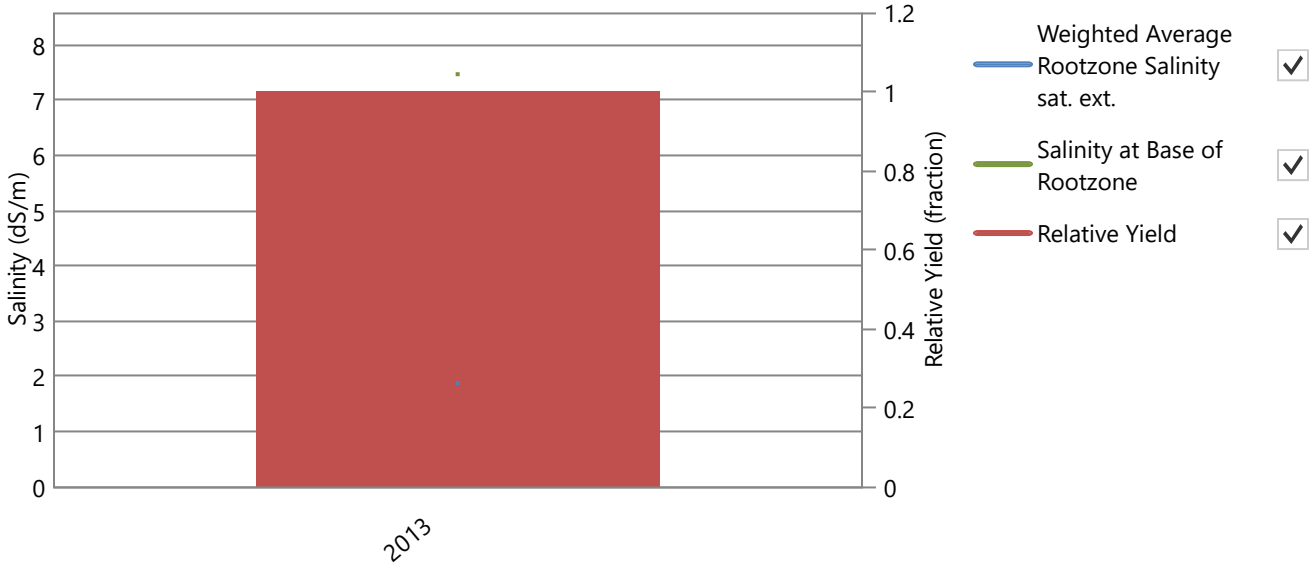
Soil Salinity:

Salinity of infiltrated water (Average salinity of rainwater = 0.03 dS/m) (dS/m)	1.64
Salt added by rainfall (kg/m2/year)	0.01
Average annual effluent salt added & leached at steady state (kg/m2/year)	1.83
Average leaching fraction based on 10 year running averages (fraction)	0.40
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	1.88
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	7.47
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



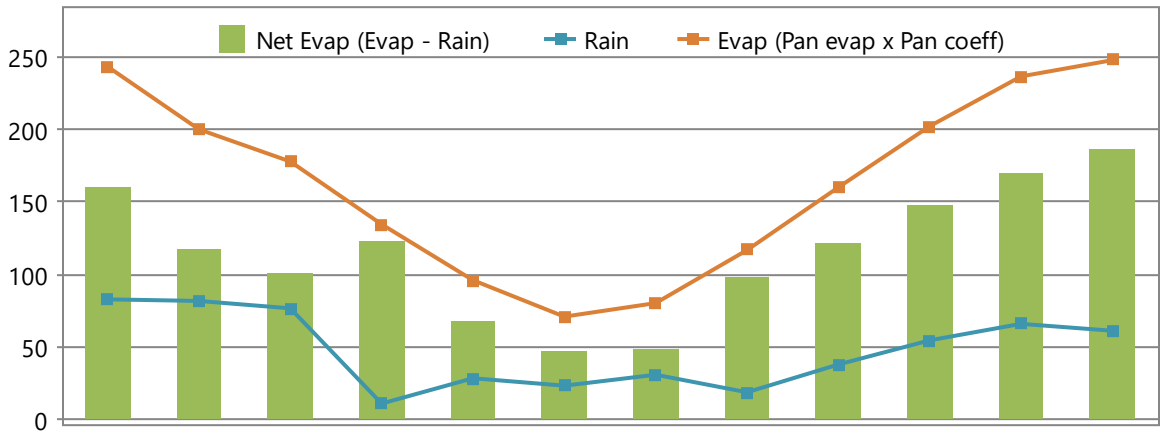
DIAGNOSTICS

Sustainability Diagnostics: Girrahween Warehouse & Office Assessment

Averaged Historical Climate Data Used in Simulation (mm)

Location: Girrahween_Climate_-26.50_150.21_-26.50_150.20, -26.5°, 150.2°

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	83.1	82.0	76.9	11.3	28.8	23.7	31.2	19.1	38.2	54.9	66.2	61.5	576.8
Evap	243.3	200.1	178.0	134.7	96.3	71.2	80.5	117.0	160.2	202.3	236.6	247.8	1967.7
Net Evap	160.2	118.1	101.1	123.4	67.5	47.5	49.3	97.9	121.9	147.4	170.3	186.3	1390.9
Net Evap/day	5.2	4.2	3.3	4.1	2.2	1.6	1.6	3.2	4.1	4.8	5.7	6.0	3.8

DIAGNOSTICS

Sustainability Diagnostics: Girrahween Warehouse & Office Assessment

Pond System: 1 closed storage tank

Girrahween Warehouse/Office STP - Indicative - 2107.46 m3/year or 5.77 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	29.11 (15.89 - 30.00)	61.35 (61.32 - 61.49)
Total Phosphorus	19.41 (10.59 - 20.00)	40.90 (40.88 - 40.99)
Total Dissolved Salts	1552.67 (847.58 - 1600.00)	3272.19 (3270.40 - 3279.36)
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)

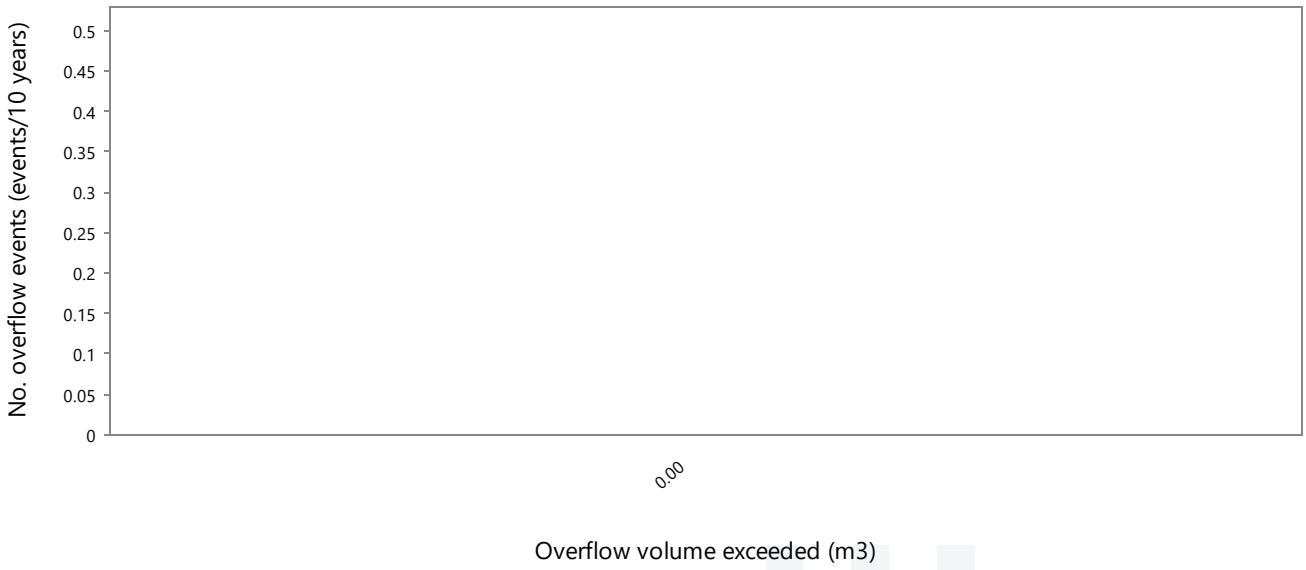
Last pond (Wet weather store): 17.00 m3

Theoretical hydraulic retention time (days)	2.95
Average volume of overflow (m3/year)	0.00
No. overflow events per year exceeding threshold* of 0.02 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

DIAGNOSTICS

Sustainability Diagnostics: Girrahween Warehouse & Office Assessment

Irrigation Information

Irrigation: 1800 m2 total area (assumed 100% irrigation efficiency)

	Quantity/year	Quantity/m2/year
Total irrigation applied (m3)	2107.46	1.17
Total nitrogen applied (kg)	51.54	0.03
Total phosphorus applied (kg)	40.90	0.02
Total salts applied (kg)	3272.19	1.82

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 occurs (fraction)	1.00

DIAGNOSTICS

Sustainability Diagnostics: Girrahween Warehouse & Office Assessment

Paddock Land: Girrahween Office Application Ar: 1800 m2

Irrigation: Fixed Sprinkler with 0.2% ammonium loss during irrigation

Irrigation triggered every 1 days
Irrigate a fixed amount of 3.70 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	83.1	82.0	76.9	11.3	28.8	23.7	31.2	19.1	38.2	54.9	66.2	61.5	576.8
Irrigation	100.8	92.6	100.8	94.9	98.2	94.7	98.4	97.6	95.6	99.7	96.8	100.7	1170.8
Soil Evap	9.9	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7
Transpn.	150.7	138.3	126.1	96.5	63.5	48.0	56.3	82.4	111.6	134.7	166.4	178.0	1352.3
Rain Runoff	1.9	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	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	19.7	20.2	26.9	19.0	28.1	37.2	63.1	47.3	38.1	31.8	27.9	23.3	382.6
Delta	1.7	14.9	24.6	-9.2	35.3	33.2	10.1	-13.0	-15.8	-12.0	-31.5	-39.1	-0.7

Soil Nitrogen Balance

Average annual effluent nitrogen added (kg/m2/year)	0.03
Average annual soil nitrogen removed by plant uptake (kg/m2/year)	0.03
Average annual soil nitrogen removed by denitrification (kg/m2/year)	3.98E-07
Average annual soil nitrogen leached (kg/m2/year)	5.10E-05
Average annual nitrate-N loading to groundwater (kg/m2/year)	5.10E-05
Soil organic-N kg/m2 (Initial - Final)	0.04 - 0.03
	0.01 - 5.81E-06
Average nitrate-N concentration of deep drainage (mg/L)	0.13
Max. annual nitrate-N concentration of deep drainage (mg/L)	0.84

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)	4.67E-05
Dissolved phosphorus (kg/m2) (Initial - Final)	5.88E-05 - 7.19E-04
Adsorbed phosphorus (kg/m2) (Initial - Final)	0.45 - 0.61
Average phosphate-P concentration in rootzone (mg/L)	1.26
Average phosphate-P concentration of deep drainage (mg/L)	0.12
Max. annual phosphate-P concentration of deep drainage (mg/L)	0.15
Design soil profile storage life based on average infiltrated water phosphorus concn. of 13.02 mg/L (years)	38.36

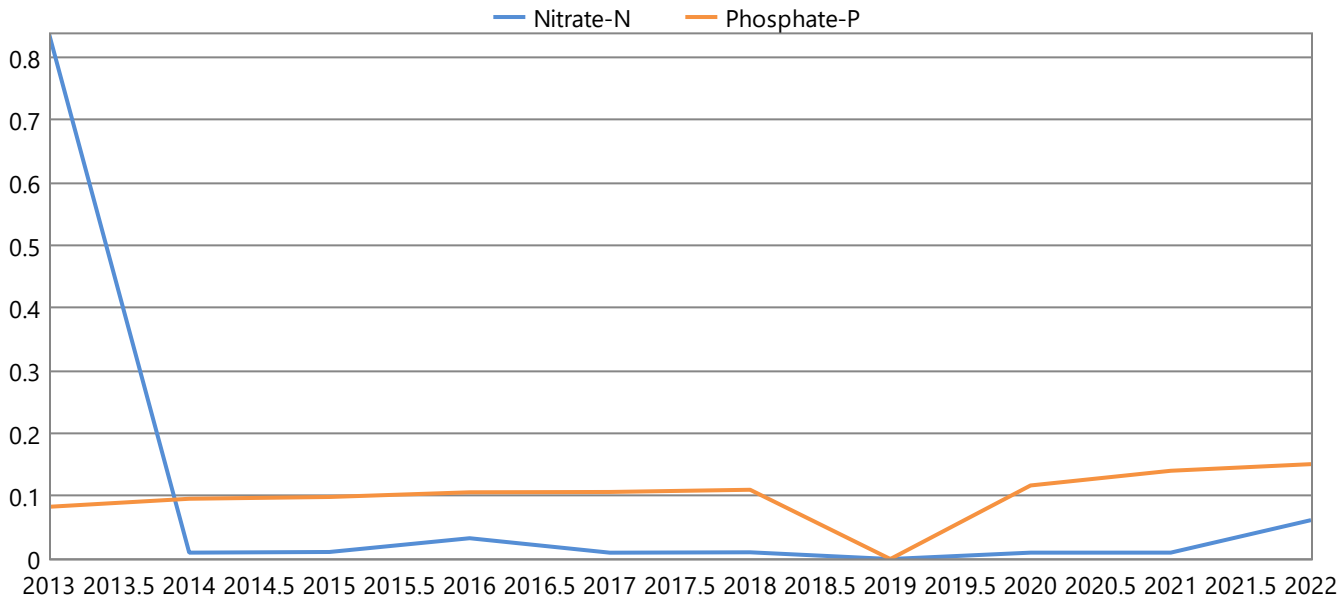
DIAGNOSTICS

Sustainability Diagnostics: Girrahween Warehouse & Office Assessment

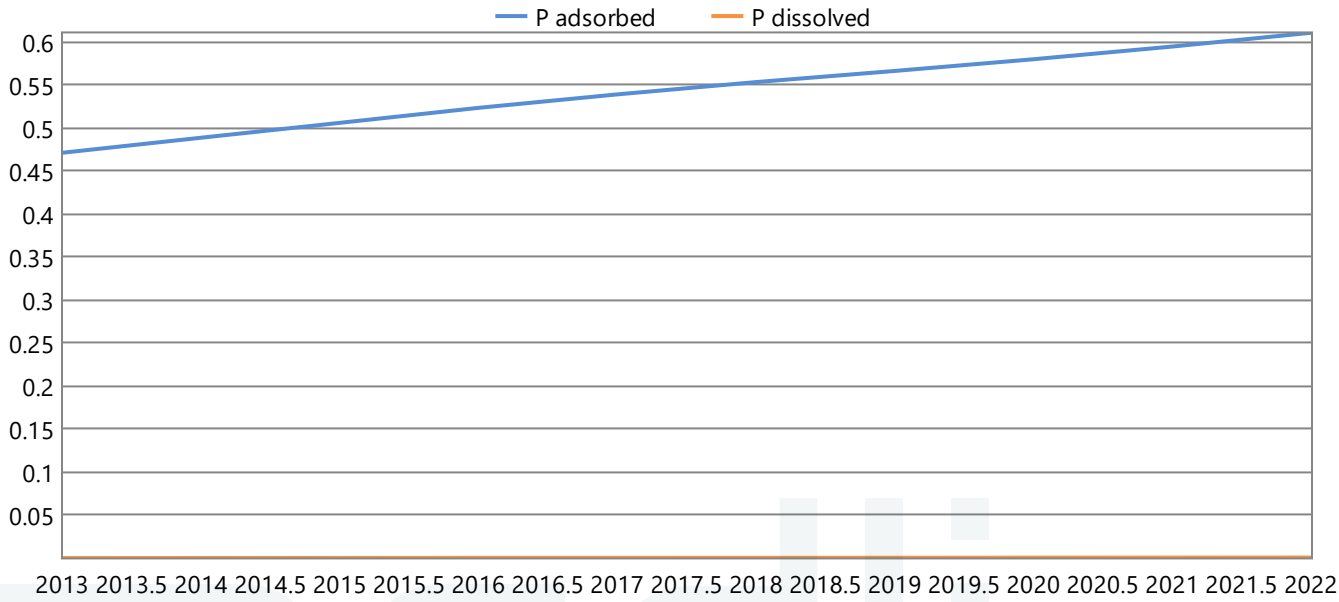
Paddock Land: Girrahween Office Application Ar: 1800 m2

Irrigation: Fixed Sprinkler with 0.2% ammonium loss during irrigation

Annual nutrient leachate concentration (mg/L)



Annual Phosphate-P in soil (kg/m2)



DIAGNOSTICS

Sustainability Diagnostics: Girrahween Warehouse & Office Assessment

Paddock Plant Performance: Girrahween Office Application Ar: 1800 m2

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

Average annual shoot dry matter yield (kg/m2/year)	1.71 (1.57 - 1.94)
Average monthly plant (green) cover (fraction)	0.87 (0.79 - 0.93)
Average monthly crop factor (fraction)	0.69 (0.63 - 0.74)
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Average monthly root depth (mm)	1193.78 (1129.27 - 1200.00)
Average number of normal harvests per year (no./year)	3.00 (2.00 - 4.00)
Average number of normal harvests for last five years only (no./year)	3.00
Average number of crop deaths per year (no./year)	0.00 (0.00 - 0.00)
Average number of crop deaths for last five years only (no./year)	0.00
Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient)	0.50 (0.41 - 0.58)
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)	0.01 (0.00 - 0.02)
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)	1.64
Salt added by rainfall (kg/m2/year)	0.01
Average annual effluent salt added & leached at steady state (kg/m2/year)	1.83
Average leaching fraction based on 10 year running averages (fraction)	0.40
Average water-uptake-weighted rootzone salinity sat. ext. (dS/m)	1.88
Salinity of the soil solution (at drained upper limit) at base of rootzone (dS/m)	7.47
Relative crop yield expected due to salinity (fraction)	1.00
Proportion of years that crop yields would be expected to fall below 90% of potential due to salinity (fraction)	0.00

DIAGNOSTICS

Run Messages

Messages generated when the scenario was run:

Full run chosen

MEDLI REPORT - FULL RUN

Enterprise: **Girrahween Warehouse & Office Assessment**

Description:
Scenarios to assess the effluent irrigation scheme sizing

Client: **Arrow Energy**

MEDLI User: GHDNET\lekuskopf

Scenario Details:
NO IRRIGATION SCENARIO

DESCRIPTION

Climate Data: Girrahween_Climate_-26.50_150.21_-26.50_150.20, -26.5°, 150.2°

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

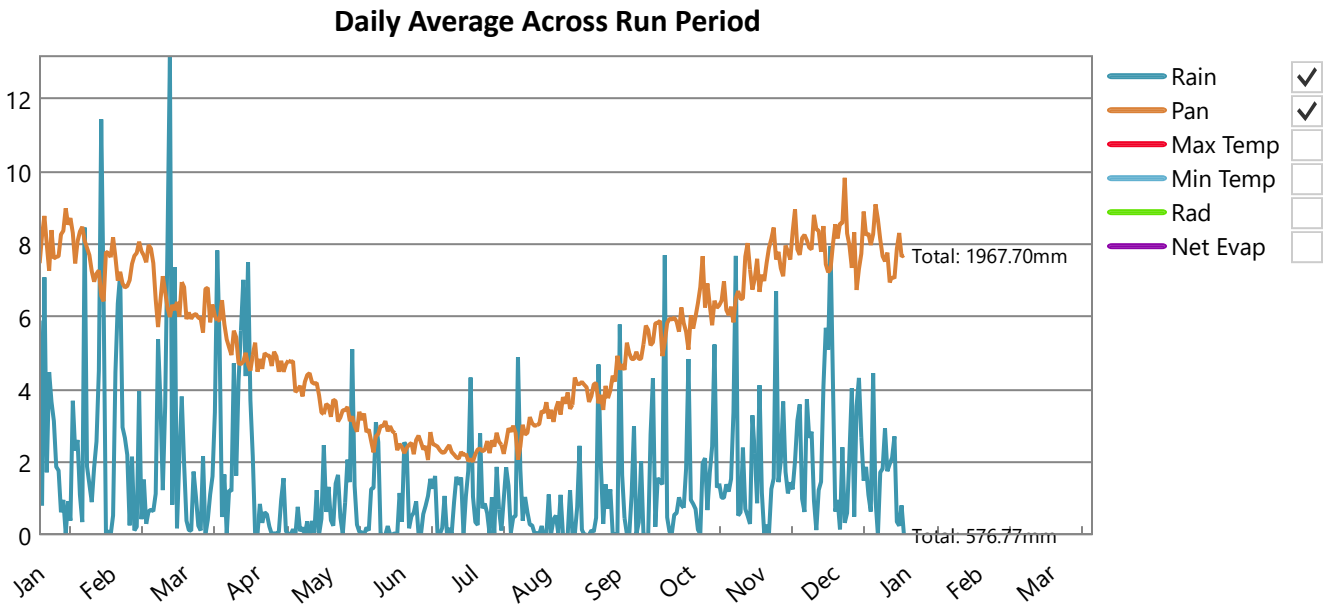
Climate Statistics:

	10th Percentile	50th Percentile	90th Percentile
Rainfall (mm/year)	353	545	899
Pan Evaporation (mm/year)	1639	2000	2245

Climate Data:

Chart Table

Monthly Daily

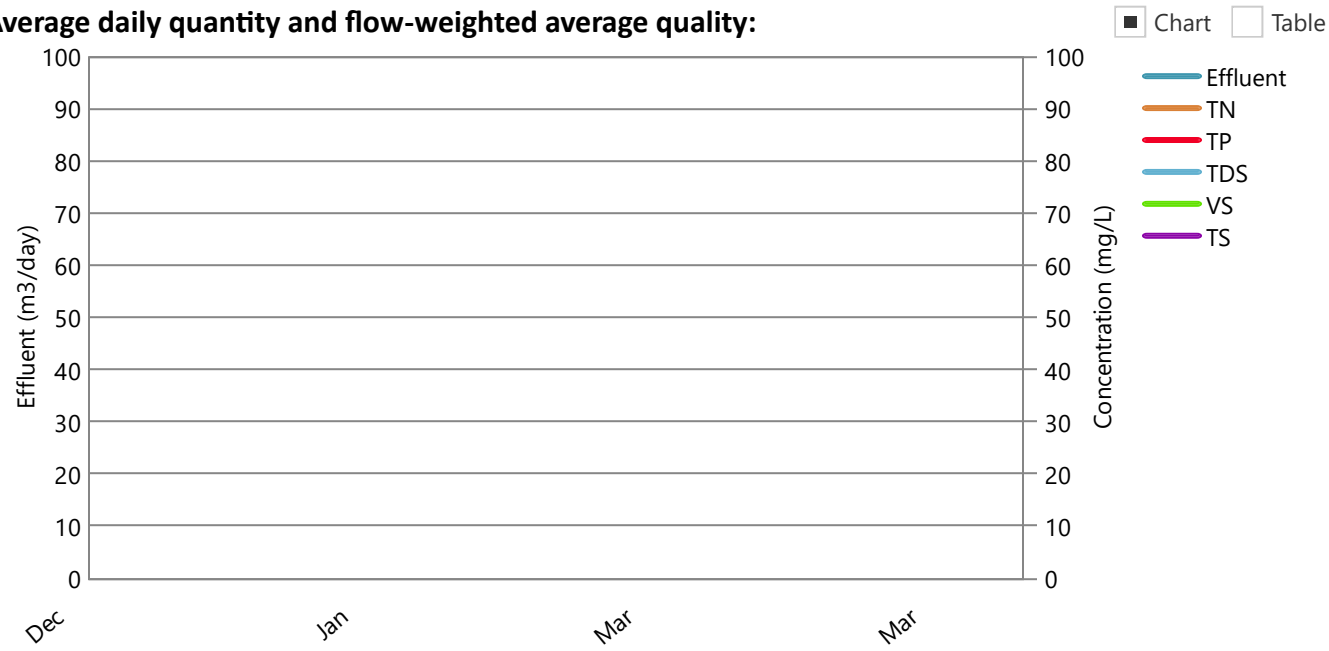


DESCRIPTION

Effluent type: Girrahween Warehouse/Office STP - Indicative

Wastestream before any recycling or pretreatment

Average daily quantity and flow-weighted average quality:



Wastestream after any recycling and pretreatment if applicable

Effluent quantity: **0.00 m3/year** or 0.00 m3/day (Min-Max: 0.00 - 0.00)

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

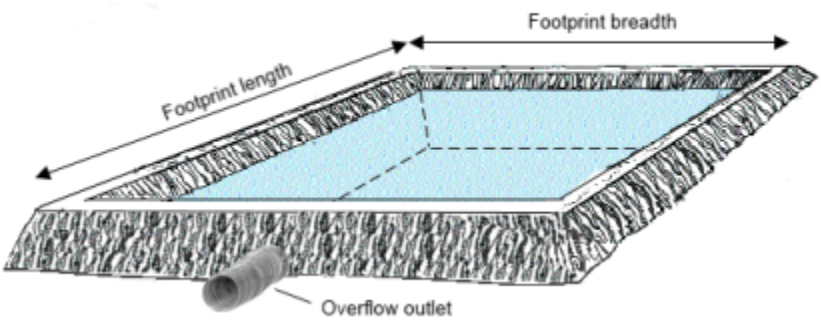
	Concentration (mg/L)	Load (kg/year)
Total Nitrogen	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Phosphorus	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Dissolved Salts	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Volatile Solids	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
Total Solids	0.00 (0.00 - 0.00)	0.00 (0.00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

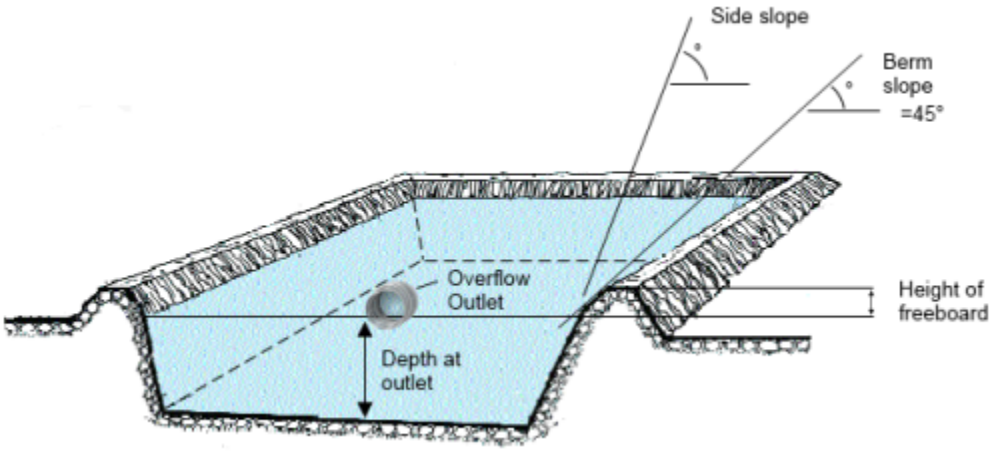
DESCRIPTION

Pond system: 1 closed storage tank

Pond system details:

	Pond 1
Maximum pond volume (m3)	17.00
Minimum allowable pond volume (m3)	0.00
Pond depth at overflow outlet (m)	1.00
Maximum water surface area (m2)	22.55
Pond footprint length (m)	4.75
Pond footprint width (m)	4.75
Pond catchment area (m2)	22.55
Average active volume (m3)	0.00





Irrigation pump limits:

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

Shandying water:

Annual allocation of fresh water available for shandying (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

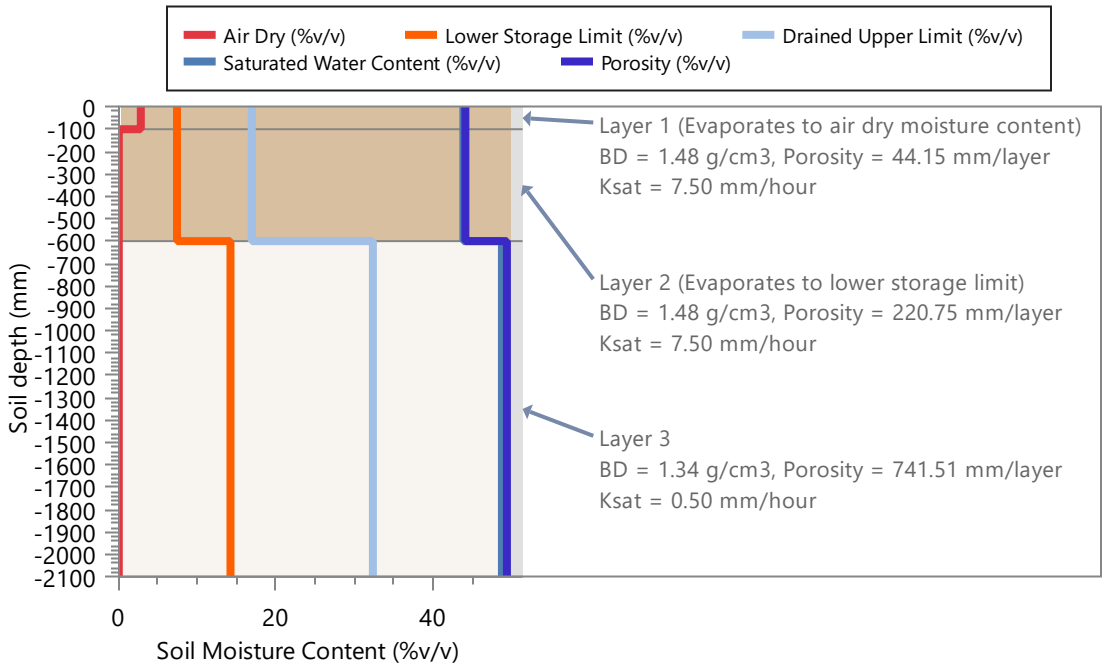
DESCRIPTION

Land: Girrahween Office Application Ar

Area (m2): 1800.00

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)	0.25 (0.17 - 0.34)
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

PERFORMANCE

Pond System Water Performance - Overflow: 1 closed storage tank

Capacity of wet weather storage pond: **17 m3**

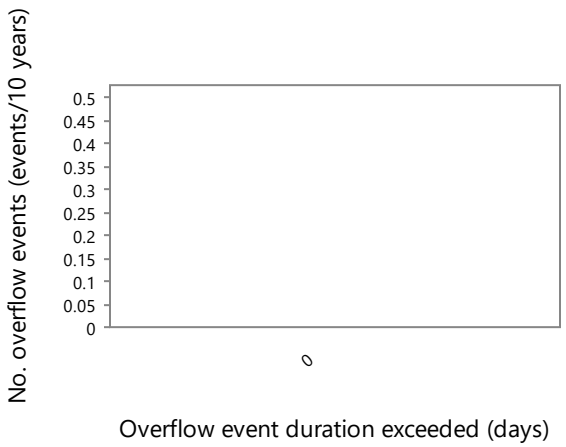
Pond System Water Balance (m3/year)

(no data available)

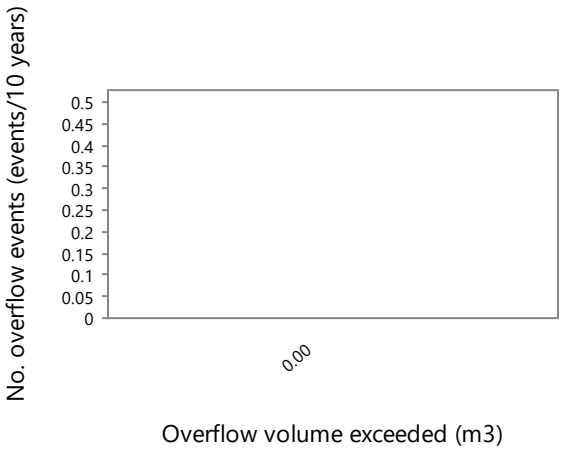
Name	Value
Rain	0.00
Inflow	0.00
Recycling	0.00
Evaporation	0.00
Overflow	0.00
Irrigation	0.00
Seepage	0.00
Delta Storage	0.00

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)	0.00
Probability of at least 90% reuse (fraction)	0.00



Export plot



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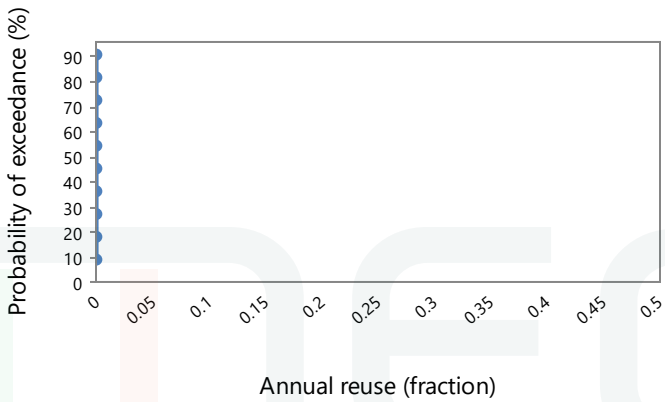


Export plot

PERFORMANCE

Pond System Performance - Nutrient: 1 closed storage tank

Pond System Nutrients and Salt Balance:

Nitrogen Balance (kg/year)

(no data available)

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

Phosphorus Balance (kg/year)

(no data available)

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

Salt Balance (kg/year)

(no data available)

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

* Salt removal in sludge is not calculated from the pond salt balance. However if salt could be assumed to be present in the sludge at the same concentration as in the pond supernatant (up to a maximum of salt added in inflow) - then salt accumulation in the sludge could be 0.00 kg/year

Pond System Sludge Accumulation: 0.00 kg dwt/year

PERFORMANCE

Pond System Performance - Nutrient: 1 closed storage tank

Pond Nutrient Concentrations and Salinity:

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

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

* Not determined. Pond is empty.

PERFORMANCE

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

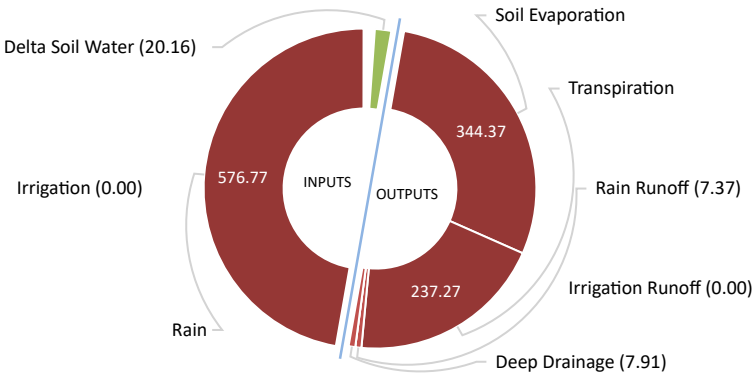
PERFORMANCE

Land Performance - Soil Water

Paddock: Girrahween Office Application Ar, 1800 m2
Soil Type: Sodosols representation_conserva, 165.60 mm PAWC at maximum root depth

Land Water Balance (mm/year):

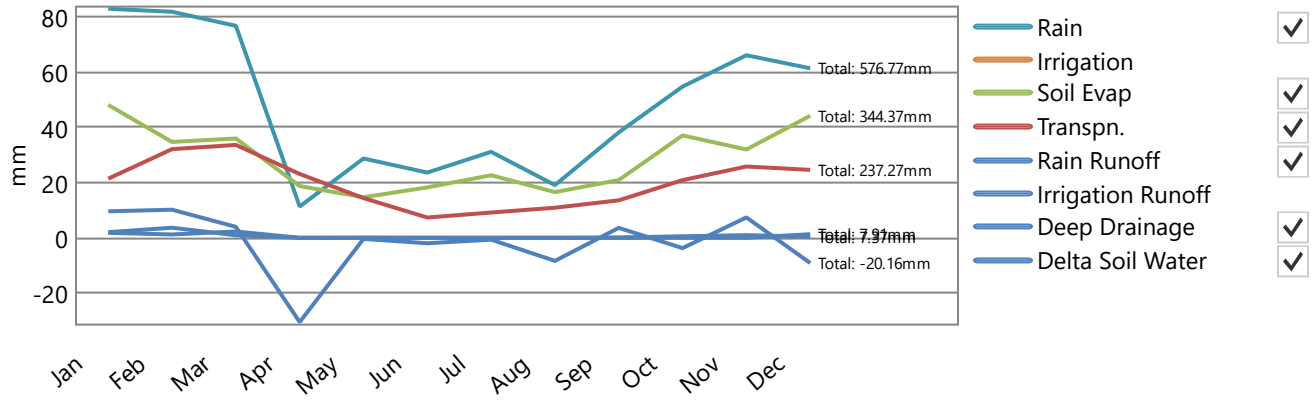
mm/year % Total inputs



Name	Value
Rain	576.77
Irrigation	0.00
Soil Evaporation	344.37
Transpiration	237.27
Rain Runoff	7.37
Irrigation Runoff	0.00
Deep Drainage	7.91
Delta Soil Water	-20.16

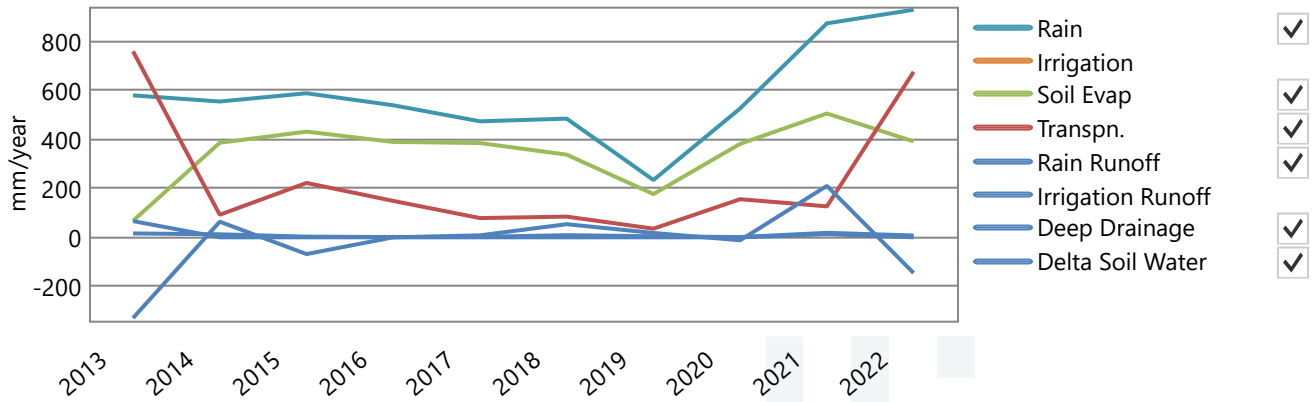
Average Monthly Totals (mm):

Chart Table



Average Annual Totals (mm/year):

Chart Table



PERFORMANCE

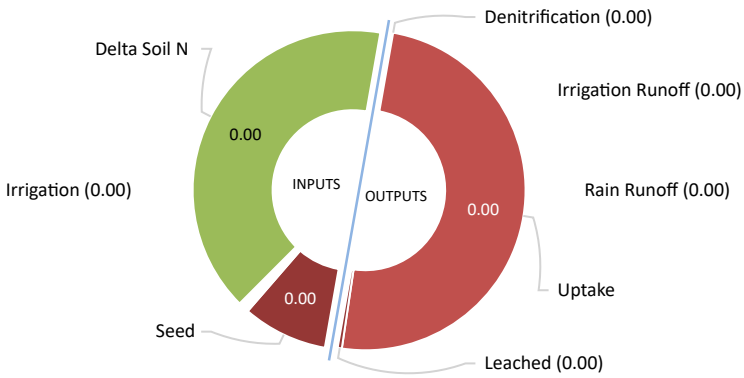
Land Performance - Soil Nutrient

Paddock: Girrahween Office Application Ar, 1800 m2 representation_conserva

Soil Type: Sodosols

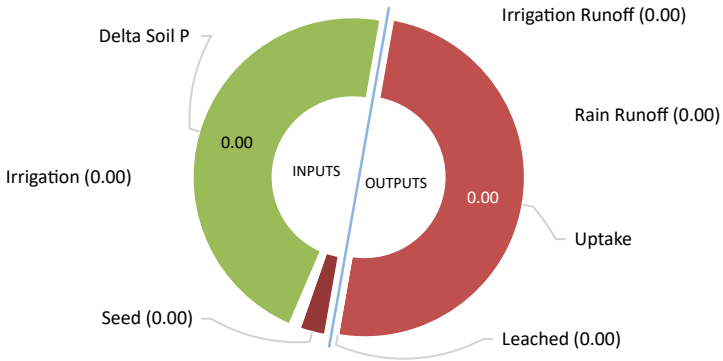
Irrigation ammonium volatilisation losses (kg/m2/year): 0.00
Proportion of total nitrogen in irrigated effluent as ammonium (fraction): 0.80

Land Nitrogen Balance (kg/m2/year)



Name	Value
Seed	2.84E-04
Irrigation	0.00
Denitrification	0.00
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	1.60E-03
Leached	1.36E-05
Delta Soil N	-1.33E-03

Land Phosphorus Balance (kg/m2/year)



Name	Value
Seed	2.43E-05
Irrigation	0.00
Irrigation Runoff	0.00
Rain Runoff	0.00
Uptake	4.60E-04
Leached	4.57E-07
Delta Soil P	-4.36E-04

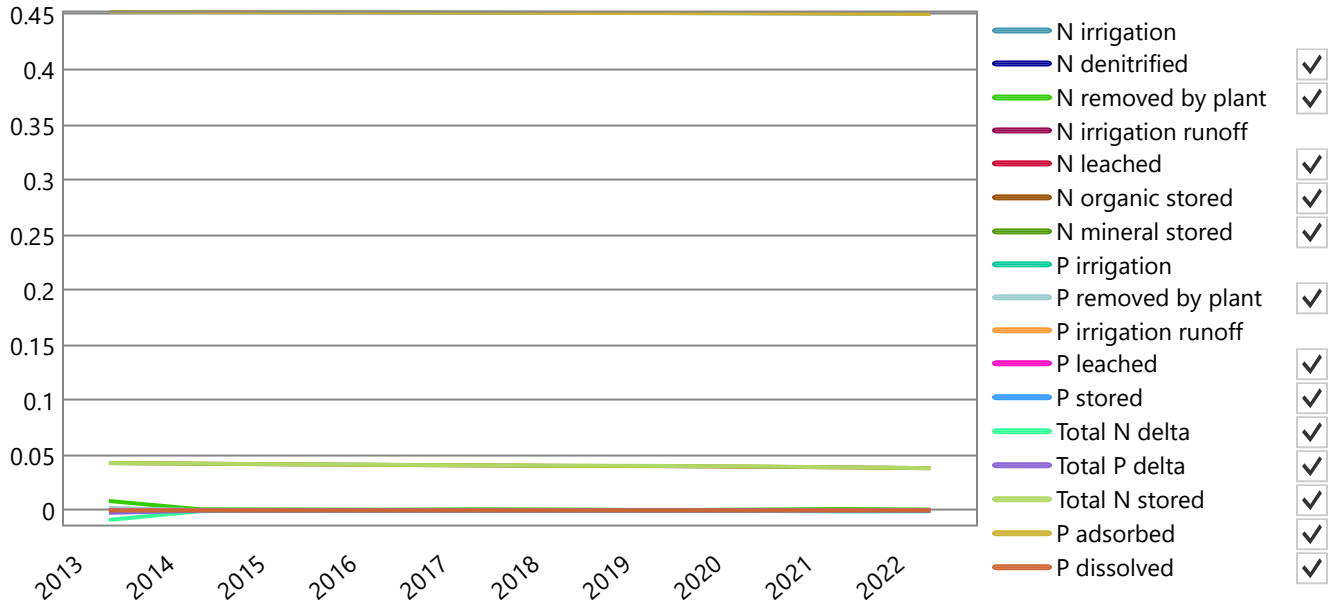
PERFORMANCE

Land Performance - Soil Nutrient

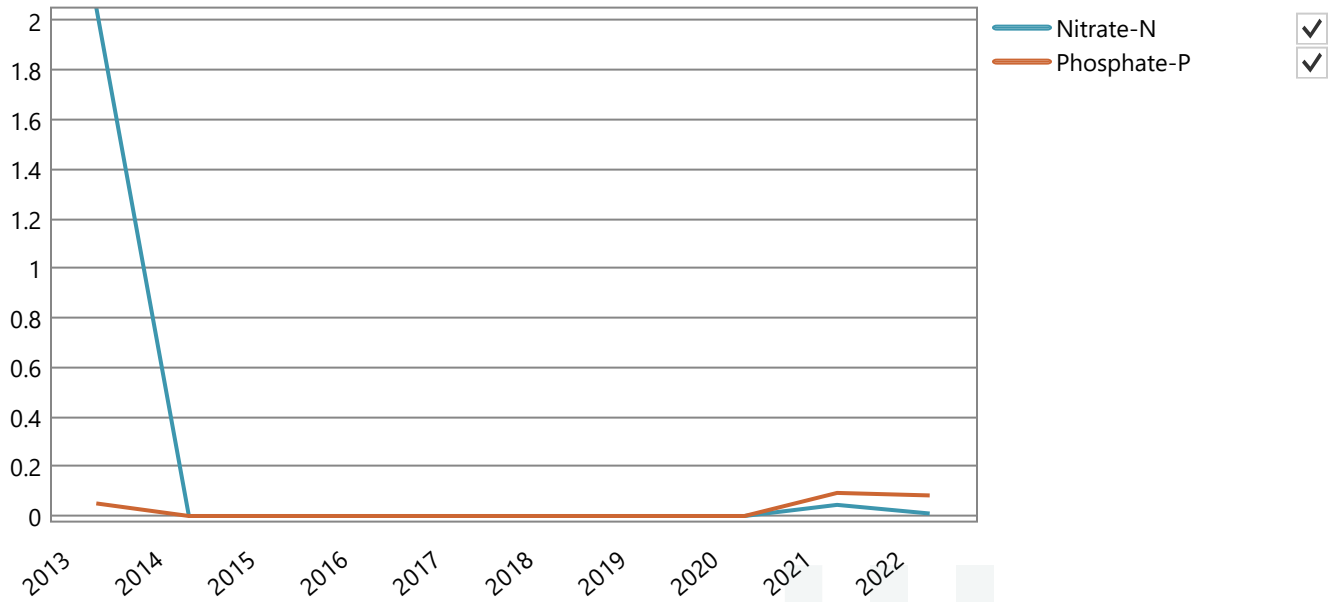
Paddock: Girrahween Office Application Ar, 1800 m2 representation_conserva

Soil Type: Sodosols

Annual Nutrient Totals (kg/m2):



Annual Nutrient Leaching Concentration (mg/L):



PERFORMANCE

Plant Performance and Nutrients

Paddock: Girrahween Office Application Ar, 1800 m2 representation_conserva

Soil Type: Sodosols

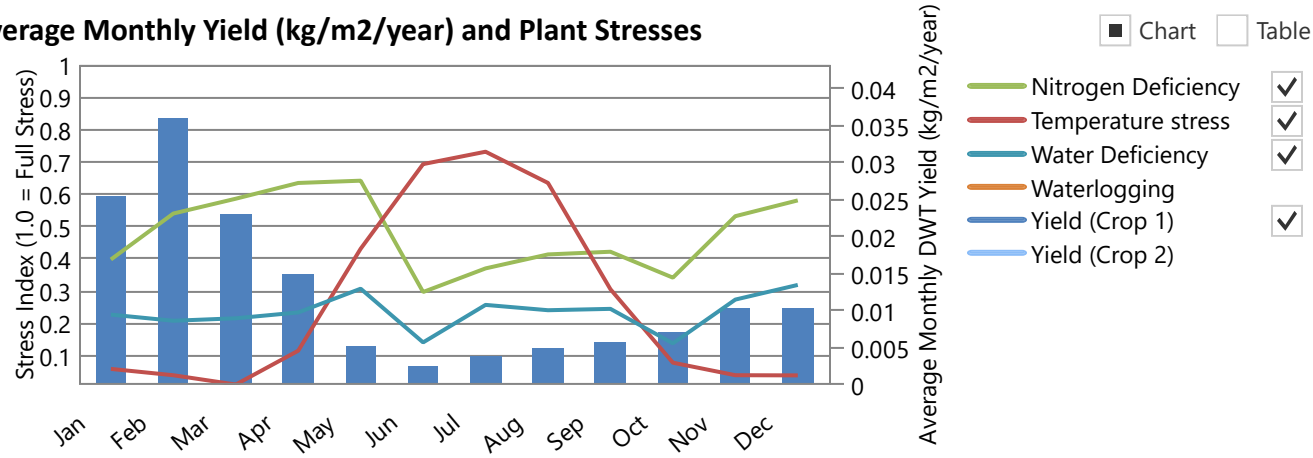
Plant: Continuous Kikuyu 1 Pasture

Average annual shoot dry matter yield (kg/m2/year)	0.16 (0.04 - 0.74)
Average monthly plant (green) cover (fraction) (minimum - maximum)	0.25 (0.17 - 0.34)
Average monthly root depth (mm) (minimum - maximum)	366.17 (259.16 - 471.21)

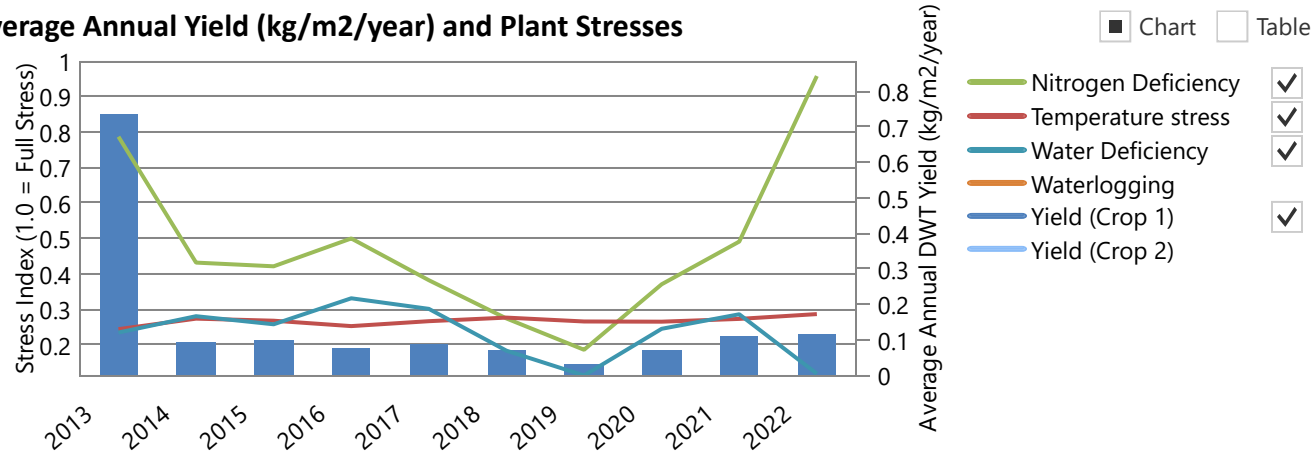
Nutrient Uptake (minimum - maximum):

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), 2.60 (forced by crop death due to nitrogen stress (0.10), water stress (2.50))

No. days without crop/year (days/year): 126.10 due to frosting (4.90), temperature stress - not frost (2.00), water stress (119.20)

PERFORMANCE

Land Performance

Paddock: **Girrahween Office Application Ar, 1800 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.

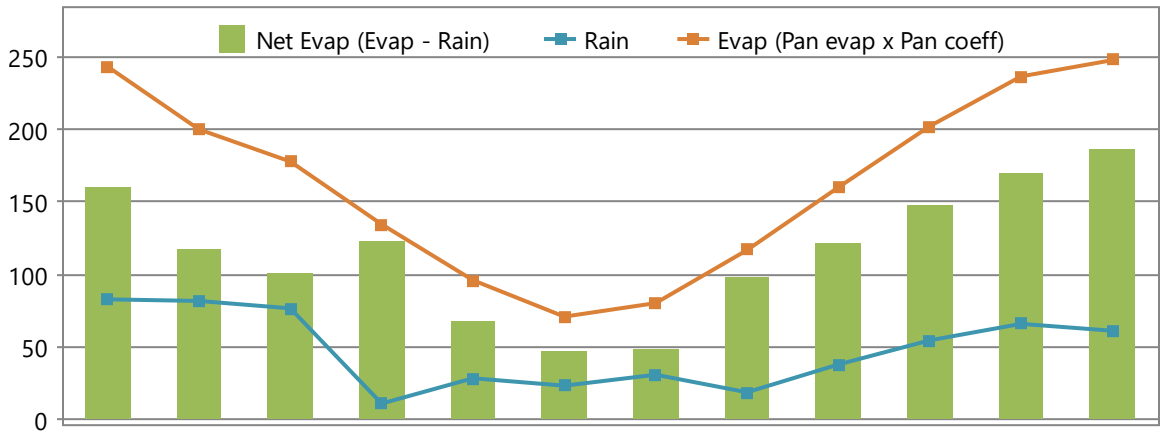
DIAGNOSTICS

Sustainability Diagnostics: Girrahween Warehouse & Office Assessment

Averaged Historical Climate Data Used in Simulation (mm)

Location: Girrahween_Climate_-26.50_150.21_-26.50_150.20, -26.5°, 150.2°

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	83.1	82.0	76.9	11.3	28.8	23.7	31.2	19.1	38.2	54.9	66.2	61.5	576.8
Evap	243.3	200.1	178.0	134.7	96.3	71.2	80.5	117.0	160.2	202.3	236.6	247.8	1967.7
Net Evap	160.2	118.1	101.1	123.4	67.5	47.5	49.3	97.9	121.9	147.4	170.3	186.3	1390.9
Net Evap/day	5.2	4.2	3.3	4.1	2.2	1.6	1.6	3.2	4.1	4.8	5.7	6.0	3.8

DIAGNOSTICS

Sustainability Diagnostics: Girrahween Warehouse & Office Assessment

Pond System: 1 closed storage tank

Girrahween Warehouse/Office STP - Indicative - 0.00 m3/year or 0.00 m3/day generated on average

Effluent entering pond system after any pretreatment and recycling

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

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

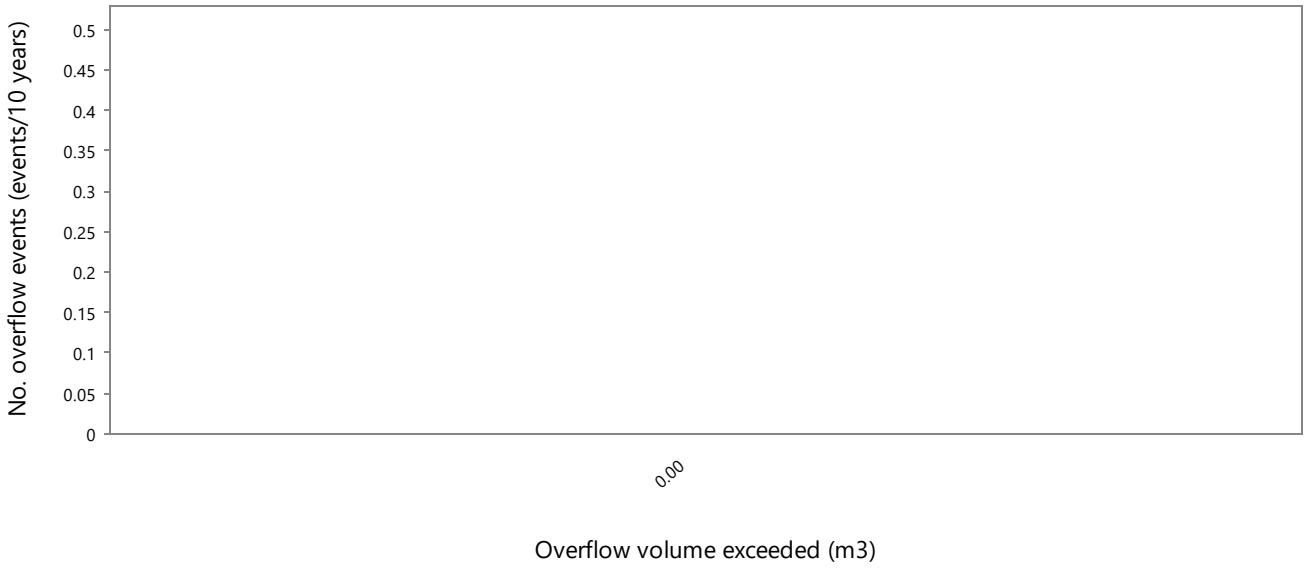
Last pond (Wet weather store): 17.00 m3

Theoretical hydraulic retention time (days)	0.00
Average volume of overflow (m3/year)	0.00
No. overflow events per year exceeding threshold* of 0.02 m3 (no./year)	0.00
Average duration of overflow (days)	0.00
Effluent Reuse (Proportion of Inflow + Net Rain Gain that is Irrigated) (fraction)	0.00
Probability of at least 90% effluent reuse (fraction)	0.00
Average salinity of last pond (dS/m)	0.00
Salinity of last pond on final day of simulation (dS/m)	0.00
Ammonia loss from pond system water area (kg/m2/year)	0.00

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

Overflow exceedance:

Chart Table



Export plot

DIAGNOSTICS

Sustainability Diagnostics: Girrahween Warehouse & Office Assessment

Irrigation Information

Irrigation: 1800 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

DIAGNOSTICS

Sustainability Diagnostics: Girrahween Warehouse & Office Assessment

Paddock Land: Girrahween Office Application Ar: 1800 m2

Irrigation: Fixed Sprinkler with 0.2% ammonium loss during irrigation

Irrigation triggered every 1 days
Irrigate a fixed amount of 3.70 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	83.1	82.0	76.9	11.3	28.8	23.7	31.2	19.1	38.2	54.9	66.2	61.5	576.8
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	48.2	34.8	36.0	18.8	14.7	18.3	22.7	16.6	20.9	37.1	32.0	44.3	344.4
Transpn.	21.4	32.2	33.7	23.2	14.4	7.4	9.2	10.9	13.6	20.9	25.9	24.6	237.3
Runoff	1.8	1.2	2.3	0.0	0.1	0.0	0.0	0.0	0.1	0.5	0.9	0.4	7.4
Drainage	2.0	3.7	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	7.9
Delta	9.6	10.2	4.0	-30.6	-0.4	-2.0	-0.7	-8.4	3.6	-3.7	7.4	-9.1	-20.2

Soil Nitrogen Balance

Average annual effluent nitrogen added (kg/m2/year)	0.00
Average annual soil nitrogen removed by plant uptake (kg/m2/year)	1.60E-03
Average annual soil nitrogen removed by denitrification (kg/m2/year)	0.00
Average annual soil nitrogen leached (kg/m2/year)	1.36E-05
Average annual nitrate-N loading to groundwater (kg/m2/year)	1.36E-05
Soil organic-N kg/m2 (Initial - Final)	0.04 - 0.04
	0.01 - 2.25E-05
Average nitrate-N concentration of deep drainage (mg/L)	1.72
Max. annual nitrate-N concentration of deep drainage (mg/L)	2.05

Soil Phosphorus Balance

Average annual effluent phosphorus added (kg/m2/year)	0.00
Average annual soil phosphorus removed by plant uptake (kg/m2/year)	4.60E-04
Average annual soil phosphorus leached (kg/m2/year)	4.57E-07
Dissolved phosphorus (kg/m2) (Initial - Final)	5.88E-05 - 3.50E-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)	0.06
Max. annual phosphate-P concentration of deep drainage (mg/L)	0.09
Design soil profile storage life based on average infiltrated water phosphorus concn. of 0.00 mg/L (years)	999.00

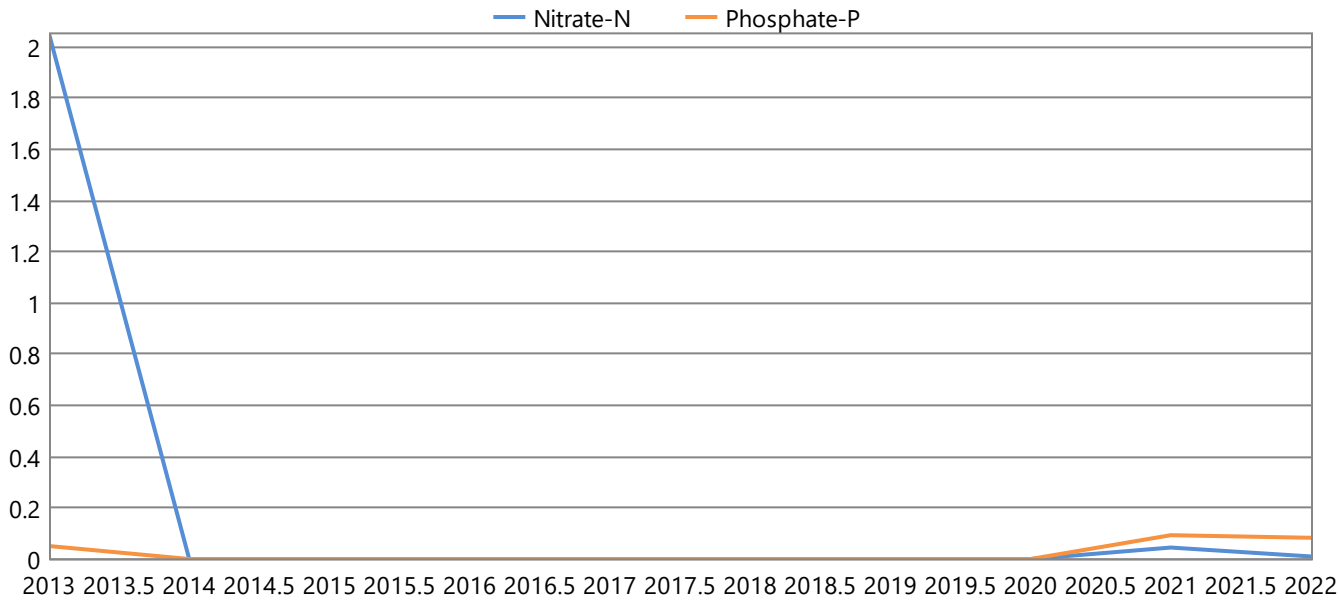
DIAGNOSTICS

Sustainability Diagnostics: Girrahween Warehouse & Office Assessment

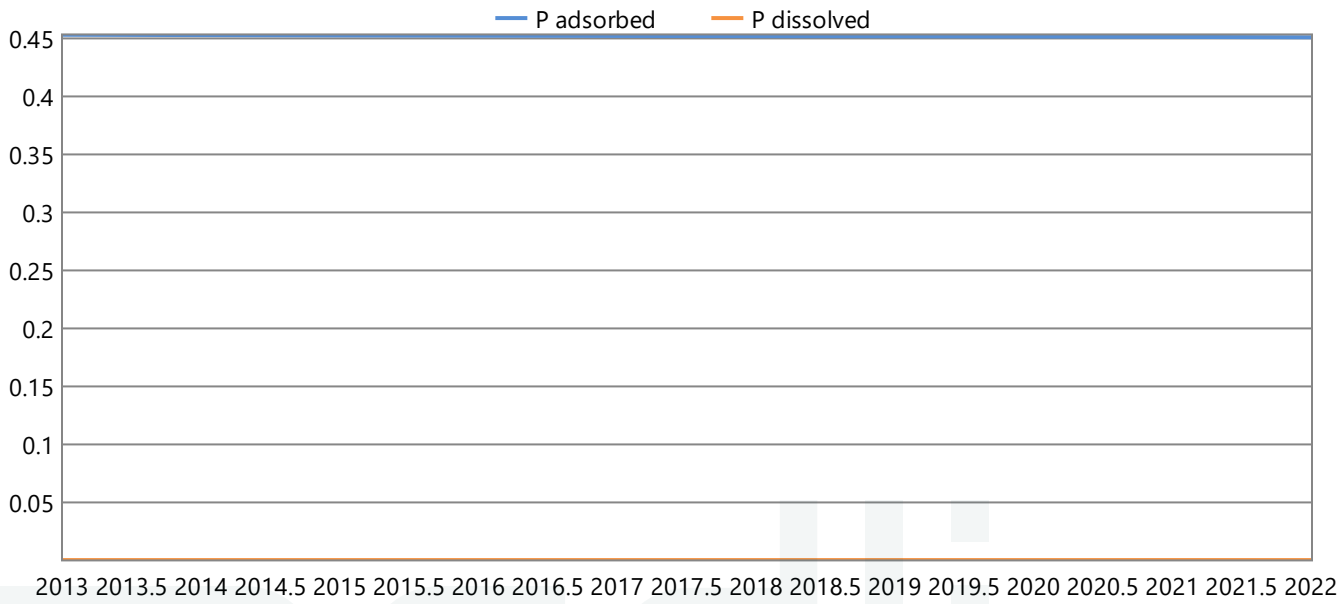
Paddock Land: Girrahween Office Application Ar: 1800 m2

Irrigation: Fixed Sprinkler with 0.2% ammonium loss during irrigation

Annual nutrient leachate concentration (mg/L)



Annual Phosphate-P in soil (kg/m2)



DIAGNOSTICS

Sustainability Diagnostics: Girrahween Warehouse & Office Assessment

Paddock Plant Performance: Girrahween Office Application Ar: 1800 m2

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

Average annual shoot dry matter yield (kg/m2/year)	0.16 (0.04 - 0.74)
Average monthly plant (green) cover (fraction)	0.25 (0.17 - 0.34)
Average monthly crop factor (fraction)	0.20 (0.14 - 0.27)
Total plant cover (both green and dead) left after harvest (fraction)	1.00
Average monthly root depth (mm)	366.17 (259.16 - 471.21)
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)	2.60 (0.00 - 5.00)
Average number of crop deaths for last five years only (no./year)	2.20
Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient)	0.48 (0.19 - 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)	0.23 (0.14 - 0.32)
Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.00)
No. days without crop/year (days)	126.10

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

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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