ATTACHMENT 4

Amended Site Based Environmental Management Plan

Prepared by:

Integrity Ag

IntegrityAg

July 2026

Commercial in Confidence

Avondale Cage Free Layer Farm: Site Based Environmental Management Plan – July 2026

Ellerslie Free Range Farms Pty Ltd

Table of Contents

Table of Tables

Table of Figures

1. Introduction

This Site Based Environmental Management Plan (SBEMP) has been prepared by Integrity Ag on behalf of Ellerslie Free Range Farms for the development of an 840,000 bird cage-free/barn layer farm, and packing facility, developed over two stages. The proposed development will be situated on the 'Avondale' property at 240 Turallin Road, Turallin QLD 4357. The layer farm operation will help the Queensland egg industry to meet an identified shortfall in market capacity for cage free/barn eggs. This SBEMP relates to the potential impacts of the poultry laying sheds, packing facility and associated infrastructure, including manure and mortality management; greywater treatment and disposal; groundwater treatment via a reverse osmosis (RO) plant and evaporation basins; waste utilisation areas; and related management practices. It is intended to support the application for a development approval and environmental authority for this activity.

The SBEMP:

- provides a description of the site and identifies environmental values to be protected on the site (**Section 2**).
- details the nature of the farm operation and production practices (**Section 3**).
- conducts a risk assessment of likely impacts to these environmental values (**Section 4**).
- details the management plans and environmental procedures that will be undertaken on the site to ensure environmental outcomes are achieved and potential impacts are minimised **(Section 5**).

1.1 Ownership/Contact Information

Farm Owner: Ellerslie Free Range Farms

Farm Manager: Greg Quinn

Name of Farm: Avondale Farm

Postal Address: PO Box 49, Millmerran QLD 4357

Mobile Number: +61 7 4695 5777

Email Address: greg.quinn@ellersliefarms.com.au

1.2 Relevant ERAs

The proposed use involves the housing of birds for egg production, and packaging of eggs.

The relevant ERA for these activities is ERA 4 – Threshold 2 – farming more than 200,000 birds.

Composting of dead birds (or burial) and egg waste may be undertaken on the site as part of the by-product management plan for the operation. As these wastes are generated on-site as part of an agricultural activity, they are exempt from licencing under ERA 53.

Septic systems will be used for the treatment of blackwater from staff, however the waste stream generated from these systems falls below the requirements for licencing under ERA 63.

An RO plant and associated evaporation basins will be used to treat groundwater for drinking and cooling of birds, as well as for wash water in the packing facility. The waste stream (brine) generated from the RO plant falls below the requirements for licencing under ERA 64. Table 1 provides a summary of ERAs for the site and Section 3.4 provides more details.

Table 1. Site ERAs

ERA	Applicable
ERA 4 – Threshold 2	Y
ERA 53	N
ERA 63	N
ERA 64	N

2. Site Location and Description

2.1 Location and Existing Use

Figure 4 (Appendix A) shows location of the proposed layer farm, surrounding infrastructure (roads and rail), and the township of Millmerran. The Avondale site is located approximately 2.9km NW of Millmerran, approximately 4.5km via road. The surrounding locality is rural in nature, with primarily agricultural land use (see Figure 7). The site plan shown in Figure 5 outlines the proposed location of the key infrastructure to be developed on the property.

Site details	
Street address:	240 Turallin Road, Turallin QLD 4357
Real property description:	L2RP79686
Local government area:	Toowoomba Regional Council
Existing use:	Vacant land.
Land use mapping:	Land use mapping shown in Figure 7 shows that part of the site is currently mapped for grazing of native vegetation.
Land area (ha):	393.9 Ha
Tenure:	Freehold

2.2 Environmental Matters not Affecting the Site

An investigation of State mapping for environmental matters (available via QLD Globe) has shown that the site is not affected by the following mapping layers:

- Acid Sulphate Soils.
- Wetlands Referral.
- Heritage Places.
- State Development and Infrastructure

2.3 Site Environmental Values

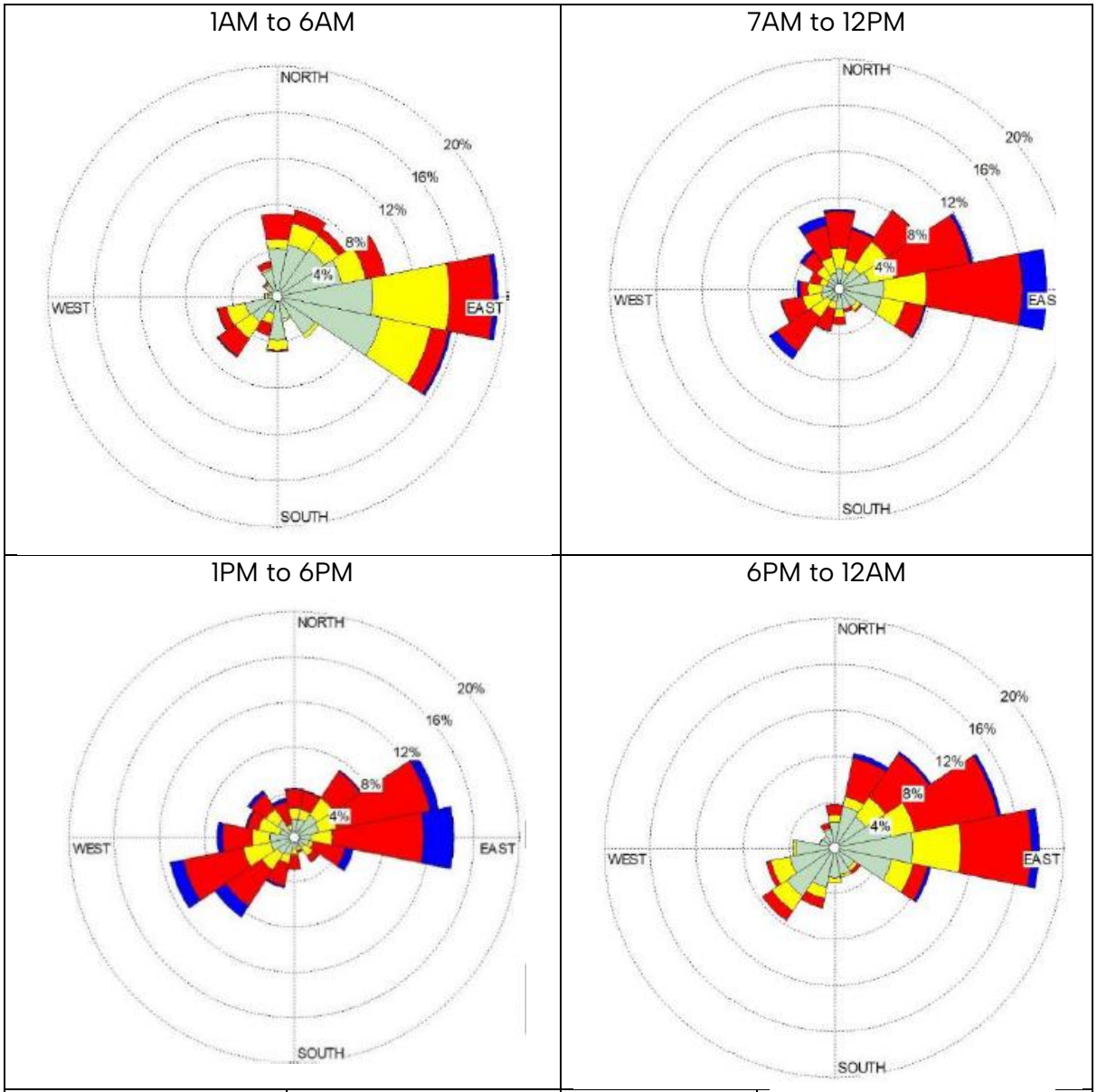
2.3.1 Climate

Table 2 shows climate data for the nearby (Pittsworth) Bureau of Meteorology weather station. It provides details of average/monthly rainfall, temperature (max and min), and solar radiation. The site has a dominant summer rainfall, with cold winter minimums and warm summer maximums.

The wind patterns for the site are displayed in the wind roses shown in Figure 1, as developed by Astute Environmental Consulting as part of their odour report for the site.

Table 2. Climate data from nearby Pittsworth Bureau of Meteorology site

	Mean rainfall	Mean max temp	Mean min temp	Solar exposure
January	90.9	29.9	17	25.2
February	75.4	29.1	16.9	22.4
March	65.7	27.8	15.4	20.1
April	37.2	24.7	12	17
May	40.5	20.5	8.4	13.6
June	40.4	17.3	6.1	11.7
July	39.2	16.7	5	12.9
August	30.2	18.6	5.9	16.2
September	36	22.1	8.7	19.7
October	63.8	25.6	11.9	22.5
November	75.5	28.4	14.4	24.8
December	97.6	29.8	16.1	25.4



Period	***Average wind speed (m/s)***	***Calm winds %***
1AM to 6 AM	2.40	0.14
7 AM to 12 PM	3.24	0.41
1 PM to 6 PM	3.61	0.18
7 PM to 12 AM	2.71	0.14

Location:	*Year:*	*Data Source:*	*Creator:*
Centre of domain	2019	CALMET extract	W. Shillito

Figure 1. Wind roses prepared by Astute Environmental Consulting (figure reproduced)

2.3.2 Land Use

An investigation of state government mapping available on the QLD Globe shows that the surrounding land use is primarily agricultural with grazing and cropping being the prominent land uses as shown in Figure 7. The site itself is mapped as grazing native vegetation.

2.3.3 Community Amenity

Figure 6 shows the location of nearby sensitive receptors from the site. An assessment of potential community amenity impacts is undertaken in Section 4.1, including details of odour, noise, and dust impact assessments undertaken by expert consultants, showing low risk of impacts from the proposed development.

2.3.4 Cultural Heritage

QLD Globe mapping indicates that the site is ***not affected*** by QLD heritage mapping as shown in Figure 8. Native title mapping and Indigenous land use mapping shows that the site is classed as 'future act notices current' and has indigenous land use agreements (Figure 9). The tribunal number related to the Future Act notice is QS2012/0032. The tribunal number for the ILUA is QI2012/116 (Arrow Energy Western Downs Unclaimed Area ILUA). The ILUA relates to the use of the area for resource activities by Arrow Energy.

2.3.5 Topography

The site is typically described as flat to gently sloping plains with occasional sandy ridges. The topographic map for the site (Figure 10) shows that the site slopes down from south to north, with the greatest elevation and slope in the southern corner of the property, and a decline in both elevation and slope towards the north of the property.

2.3.6 Soils

State mapping based on the Australian Soils Atlas (see Figure 11) shows that two soil mapping units are present on the site. The dominant soil in Wa13 mapping units is considered a Kurosol under the Australian Soils Classification, while dominant soil types in Va32 mapping units are considered Sodosols. Some features of this soils type are given in Table 3.

Table 3. Soil profile descriptions

Code	Wa13	Va32
Landform description	Flat to gently sloping plains with occasional sandy ridges	Low concave-convex hills with some mesas of laterized rock
Dominant soil type	Dy5.41	Dy3.43
Soil description	duplex yellow-grey, non hard setting A horizon, A2 horizon conspic bleached, acid mottled B horizon	duplex yellow-grey, hard setting A horizon, A2 horizon conspic bleached, alk pedal mottled B horizon
	Sandy pedal mottled-yellow duplex soils	Hard pedal mottled-yellow duplex soils
Co-dominant soils	Dy5.81/5.42	-

Adapted from QLD Globe dataset

ASRIS interpretation guidelines indicate that the saturated hydraulic conductivity of the dominant and codominant soils is 'slow' and 'moderate for Wa13. For Va32 soils, the interpretation guidelines indicate that the hydraulic conductivity is 'very slow'.

The Central Darling Downs Land Management Manual (Department of Natural Resources, 1999) lists three land types as being present on the site. The three land types are shown in Table 4. The primary land type on the site is Type 11a, which also contains the developed area for the site.

Table 4. Land type descriptions

Land type	Description
Type 11a Cyprus pine sands	Flat to gently undulating sandy alluvial plains. Deep sands and deep bleached sands over mottled, yellow or grey clays
Type 2d Older alluvial plains	Broad level plains of mixed basaltic and sandstone alluvium. Grey cracking clays
Type 9a Poplar Box Sodosols	Gently undulating plains on Sandstone. Bleached sands and loams over brown and grey clays

The predominant soils for type 11a land (Davy, Combidiban) associated with low soil fertility and low PAWC. Davy soils are highly permeable and well drained, while Combidiban soils are moderately permeable (highly permeable topsoils and impermeable subsoils) and imperfectly drained. As a result, the manual recommends these areas are used for grazing native and sown pastures (at low stocking rates), and a limited range of horticultural crops.

Site assessments indicate that Combidiban soils are likely dominant on the site, as indicated by the formation of an existing clay based earthen dam on site.

2.3.7 Strategic Cropping Land and Important Agricultural Areas

For the purposes of the regional planning interests act the site has been identified as strategic cropping land and falls within a priority agriculture area (shown in Figure 13). This site has been identified as containing important agricultural area (IAA) for purposes of the State Planning Policy as shown in Figure 14. The site is also mapped as Class A Agricultural Land. The activities undertaken on the site will not impact the productivity of IAAs or Agricultural Land and is in keeping with the requirements of the State Planning Policy.

2.3.8 Regulated Vegetation

No farm activities are to be undertaken in areas of Category B remnant vegetation. All development on the site will be suitably set-back from areas of regulated vegetation by a distance of at least 20m or 1.5 times the greatest tree height, whichever is greater.

2.3.9 Environmentally Sensitive Ecology

Mapping of environmentally sensitive ecology shows that the proposed development area does not contain areas of protected plants, or essential habitat for endangered, vulnerable or near threatened (EVNT) species (Figure 15).

With respect to mapping for matters of state environmental significance (Figure 16), the site does not contain MSES conservation areas, MSES wetland values, or, any areas of regulated vegetation, with the exception of the category B vegetation shown on the regulated vegetation mapping in Figure 15 and MSES regulated vegetation which corresponds to the minor waterway which runs through the property. The site also contains a small, fragmented area mapped as MSES wildlife habitat (threatened and special least concern animal) for Echidna. The small size of this area and its fragmentation from nearby areas mapped as Echidna habitat means that it is unlikely to support significant echidna population. Despite this, planned site roads shown in Figure 5 have been moved to the west of the vegetated area to avoid the mapped echidna habitat.

Biodiversity mapping (Figure 17) shows a small area of the property is considered to be an area of local biodiversity significance, correlating to the mapped category B vegetation area.

2.3.10 Surface Water

A minor waterway runs in a northly direction through the property (see Figure 18). This proposal does not require the taking of surface water from a defined watercourse, nor does it anticipate any significant impacts to surface water. The proposal does not involve any waterway barrier works which would require SARA referral.

The site is located in the Condamine-Balonne water plan area. Any activity which is likely to affect surface waters in these areas will need to be assessed under the relevant plan.

The water supply for the farm and associated licences and approvals are detailed in Section 3.6, and any activities relating to surface water will be undertaken in accordance with all water plan requirements. Furthermore, the activities to be carried out under this proposal are not expected to impact surface or groundwaters.

Greater detail on environmental risks associated with the proposed operation, as well as further details of the management practices and mitigation measures employed at the site, are detailed in Section 4.4 and Section 5.

2.3.11 Flooding

TRC flood risk mapping (Figure 19) shows that some areas of the site are mapped as "Balance – Mixed Flood Risk". Basin level flood mapping is shown in Figure 20. Site layout has been designed to ensure site operations are not to be conducted in areas within the TRC mapped flood risk area or basin level flood mapped areas as shown on the site plan in Figure 5. A Conceptual Stormwater Management Plan (RMA 2020a) was undertaken and showed that impacts to natural surface flows and flooding under the post-development scenario are expected to be minimal.

2.3.12 Groundwater

This site is part of the Condamine-Balonne water plan area, as well as the GABORA water plan area. For purposes of the former plan, artesian and spring water within the GABORA area is not considered part of the Condamine-Balonne water plan. Any activity which is likely to affect groundwater in these areas will need to be assessed under the relevant plan.

The water supply, including treatment of groundwater for the farm and associated licences and approvals are detailed in Section 3.6 and 3.7, and any activities relating to groundwater will be undertaken in accordance with all water plan requirements. Furthermore, the activities to be carried out under this proposal are not expected to impact surface or groundwaters.

There are several registered groundwater bores in the surrounding area as shown in Figure 21. Only some of these bores provide information on groundwater level, and most of these do not provide recent measurements. Table 5 shows water levels for nearby bores in order of the most recently available data. Bores selected were those closest to the site to provide the most relevant data.

Table 5. Bore report data for nearby bores

Bore no.	Date of record	SWL
RN137280	12/02/2007	57.0
RN26517	Not provided	Not provided
RN107627	27/11/1999	61.0
RN94366	23/06/1997	40.0
RN17405	Not provided	Not provided
RN147886	02/12/2014	24.0

3. Farm Layout, Design and Operation

The 393.9 hectare Avondale property is located northwest of Millmerran, between Millmerran and Turallin. Ellerslie Free Range Farms are planning to develop a barn/ cage free poultry farm, which will include 840,000 layer hens. The farm will also include a packhouse which will pack eggs from other nearby poultry farms (Ellerslie and Glenferrie) in addition to those produced at this operation.

3.1 Production Cycle

The layer farm will consist of 840,000 barn/ cage free birds which will be housed in 12 layer sheds.

The layer hens will arrive on site at 16 weeks of age and will remain on site until approximately 84 weeks of age (these birds will be supplied from existing rearing facilities within the group). Sheds will be 'dry cleaned' between batches by brushing / scraping accumulated manure.

3.2 Shed Design and Farm Layout

The birds will be housed in environmentally controlled layer sheds, with the development occurring over two stages. The areas that these developments will take place are indicated on the site map (Figure 5). Bird numbers and locations for each stage are:

- Stage 1:
  - 12 x bird layer sheds located on eastern side of the property, with shed at least 150 m from the eastern boundary
  - Egg packhouse adjacent to and south of the shed biosecure area
  - Manure and mortality processing area on the northern side of the property,
  - New groundwater bore
  - RO plant for treatment of groundwater located southwest of the production sheds
  - 3 x evaporation basins for brine generated from the RO plant located north of the manure pad (1 x basin per 4 sheds)
- Stage 2 facilities on the northeast side of the property, including:
  - Egg packing facility,
  - Wastewater treatment plant
  - Building store,
  - Solar array (150 m x 150 m)

The layer sheds will be constructed with an external cladding of cold room panel walls, with cavity insulation, and internal cladding, and a Colorbond® steel roof. Eight layer sheds will have dimensions of 132 m x 16.1 m and four sheds will have dimensions of 132m x 15.9m. Layer sheds will be constructed with concrete rat-walls and concrete floors, with a 2m concrete apron around the shed, and 2m eaves. Each shed will be housed on a compacted pad which extends 10m in each direction from the shed.

Due to the elevated salinity of groundwater proposed for use on the site, an RO treatment system will be used to improve water quality for operational purposes. Brine generated by the RO treatment process will be managed through three dedicated evaporation basins. The evaporation basins have been designed to align with the progressive expansion of the farm, with one evaporation basin servicing each group of four layer sheds. Further details of the RO plant and evaporation basin system are provided in Section 3.6.

The layer complex will include an ancillary building housing staff amenities and 2 x robotic egg handling systems. Eggs will be transported from the layer shed to the handling systems via mechanical conveyance. These handling systems will stack the eggs.

3.3 Lighting

In order to minimise the impact that light has on the neighbouring areas, all external lighting will be installed and operated in accordance with AS4282 1997 – Control of Unobtrusive Effects of Outdoor Lighting. Stationary lighting will be directed away from sensitive receptors, where this does not affect the safety of site operations. Lighting will be selected to ensure desirable characteristics of light, as 'harsh' light may be considered more obtrusive.

The layer sheds are barns with no external windows. Lighting will occur from 3.30 am but will not be visible from outside the barn. Staff will arrive from 6.00 am. Security lighting will be on the amenities buildings but will be shielded.

The packhouse will only operate from 6.00 am to 6.00 pm. All internal lights will not be visible from outside the building. Office and processing staff will arrive at 6.00 – 6.30 am. There will be security cameras with white light at the entries to monitor vehicle access outside of normal operating hours. The white light associated with these cameras will be shielded so as not cause impacts at sensitive receptors.

Any internal vehicle movements during outside of daylight hours will only be low beam.

3.4 Septic and Grey Water Systems

Septic systems will be used to handle blackwater generated from the amenities at the packing facility, and layer farm staff amenities. According to modified calculations to account for the new farm layout, the output of these systems would be less than that required to trigger assessment for ERA 63, as shown in Table 6. These updated calculations were based on the original RMA Engineering report (RMA 2020c) based on AS1547:2012, with an additional layer shed and no rearing sheds.

Table 6. Anticipated wastewater flows generated (adapted from RMA, 2020c)

Area	Maximum No. of staff onsite	Number of additional visitors	Total people onsite	Adopted wastewater design flow (L/person/day)	Total design flows	Total EP (based on 200 = EP)
Packing staff	25	15	40	50	2,000	10
Layer sheds	15	0	15	50	750	3.75
Existing farmhouse	-	-	-	-	250	1.25
Total	**39**	**15**	**54**	**-**	**3,000**	**15**

Greywater from the packing facility will be treated in a greywater treatment and disposal system designed by RMA Engineers. The expected throughput of this system is expected to be approximately 150 kL/d. Treated water from greywater systems will be used for irrigating the vegetation plantings on the site.

It should be noted that greywater and treated water from the greywater treatment and disposal system will be managed separately from the treatment of groundwater via the RO plant and evaporation basins.

3.5 Manure, Dead Bird and Egg Waste Management Areas

The majority of the manure produced in the layer sheds (approx. 75%) will be removed twice weekly via manure belts. This manure will be loaded directly into manure trucks for transport off-site. A large apron of impervious materials is provided around the sheds to facilitate loading of trucks and prevent leaching of nutrients from any spilt manure. Furthermore, the pad areas are constructed as controlled drainage areas to prevent direct stormwater away from any manure. Any spilt manure will be scraped up after each removal by conveyor and at end of batch. Runoff from the shed area is captured in an impervious retention basin, for evaporation and re-use on the site.

The manure remaining in layer sheds (floor manure, approx. 25%) will be removed at the end of each production cycle. All floor based manure will be transported to the manure pad for windrowing. A maximum of 800t of floor based manure will be stored on the manure pad at any one time. Estimates on manure production rates are provided in Appendix B.

Dead birds and egg waste will be moved to a dedicated area at the manure pad for burial. Dead birds will be disposed of via burial in designated burial pits located on the manure storage pad. The burial pits are expected to take approximately 20yrs to fill, and the location of future burial pits has been provided on the pad to account for a greater than 20yr planning horizon. There will also be emergency burial pits, as required by DPI Qld (refer to Appendix C). The location of primary and back-up pits have been identified to account for the possibility of several mass mortality events over the design life of the project. Each burial pit will be constructed with an impermeable base of compacted clay in accordance with DPI Qld Guidance (Appendix C). The size of the required burial pits is calculated in Appendix B.

The manure pad and ponds will be constructed as a controlled drainage area, with an impermeable base of compacted clay in accordance with DPI Qld Guidance (Appendix C). Stormwater will be diverted around the controlled drainage area using diversion banks, and runoff from compost and manure storage areas (Manure Pad) will be treated in a sedimentation basin to reduce suspended solids and captured in a retention basin attached to the pad.

The pad and ponds have been sized in accordance with the calculations outlined in in Appendix B, and the dimensions shown on the relevant site plan.

3.6 Water

Water supply for the site will be sourced via a new bore to be established in proximity to the egg packing facility while maintaining all required setback and separation distances to irrigation areas, infrastructure and other site constraints.

Application has been made for a 170 ML allocation for this supply. This allocation is expected to be sourced from existing entitlements held by Ellerslie Free Range Farms, with the purchase of additional water entitlements on the open market as they become available. Due to the use of existing entitlements, and close consultation with the department, the groundwater use for the site is not expected to result in additional stress to the groundwater system.

This water will primarily be used for drinking and cooling of the birds. It will also be used as wash water in the packing facility. Additional water will be used for cooling to ensure the thermal comfort and welfare of the birds, as well as amenities, and other minor on-site uses Total water usage (including waste brine water) at full production is anticipated to be approximately 131 ML/yr..

3.7 Reverse Osmosis Plant and Evaporation Basin System

Groundwater extracted from the site bore will provide the primary water source for the operation (i.e., for drinking and cooling of the birds, as well as cleaning water for the packing facility). Due to the saline nature of the groundwater, an RO treatment system will be used to improve water quality for operational use. The groundwater treatment system is separate from the greywater treatment and disposal system described in Section 3.4.

The RO treatment process produces both a treated water stream and a concentrated reject water stream (brine). Brine will be directed to dedicated evaporation basins. Three evaporation basins will operate in parallel, with one basin associated with each group of four layer sheds. This arrangement allows the evaporation basin and associated infrastructure to be expanded progressively in line with farm development while maintaining adequate storage capacity throughout operation.

The evaporation basins have been designed based on anticipated RO concentrate generation rates (approximately 22% of treated groundwater), site climatic conditions and long-term operational requirements. The evaporation basins will be constructed with an impermeable base of compacted clay in accordance with DPI Qld Guidance (Appendix C). The evaporation basins have been sized in accordance with the calculations outlined in Appendix B, and the dimensions shown on the relevant site plan.

A water balance assessment was undertaken using the Model for Effluent Disposal Using Land Irrigation (MEDLI) to assess the long-term performance of the basin system. The assessment demonstrated that the proposed evaporation basins provide sufficient storage capacity to manage the anticipated RO concentrate volumes and limit basin overtopping to less than one overtopping event in 20 years on average in accordance with Section B3.2.5 of the *National Environmental Guidelines for Indoor Piggeries* (Tucker et al., 2025). The MEDLI assessment predicted average basin salinity levels of approximately 50 dS/m. In reality, salinity levels will be much lower than this as the basin will be managed to allow periodic removal of settled salts.

As evaporation occurs, dissolved salts and other constituents contained within the RO reject stream will become progressively more concentrated within the evaporation basins. The evaporation basin management system will include monitoring of salt accumulation and available storage capacity to ensure ongoing operational performance. Where accumulated salts or residual solids require removal to maintain adequate storage capacity and reduce salinity levels, material will be removed and disposed of at an appropriately licenced waste facility in accordance with applicable waste classification and regulatory requirements.

3.8 Carbon Offset Plantings

Suitable tree species will be planted on additional land on the property to provide extra carbon offsets for the operations. These trees will also provide an added buffer between the operations and its neighbours in accordance with SPP AO4.1 – regarding provision of supplementary planting to ensure vegetated buffers are established and maintained between the poultry farm and sensitive land uses. Suitable bushfire management plans will also be implemented, with trees selected having a low fire risk. The species selected close to the sheds will be those that are less likely to attract wild birds (see Bielefeld et al., 2015 for details).

3.9 Power

It is intended that renewable energy will provide some of the power for the site. Each site will have its own solar / battery / diesel back up technologies, which will allow the sheds to be not reliant on the power network. Supplementary ground mounted solar will be provided for the packing facility as shown on the relevant plans. Newly designed positive pressure layer sheds will lower electricity usage by 40% over traditional sheds. Installation of the latest heat recovery HVAC systems at the packing facility will help to minimise LPG gas utilisation on the site. The RO plant will be powered by mains electricity and solar power with back up generators.

4. Environmental Risks

The following assessment of environmental risks was undertaken based on the site environmental values outlined in Section 2.3 and the farm layout, design and production practices described in Section 3. Management measures to minimise potential risks are outlined in Section 5.

4.1 Community Amenity

Risk of Odour Impacts: Low
Risk of Dust Impacts: Low
Risk of Noise Impacts: Low

4.1.1 Odour

The risk of odour impacts at sensitive receptors has been rated low in accordance with the expert report completed by Astute Environmental Consulting (Astute Environmental, 2025). The modelling presented by Astute Environmental has been performed in line with relevant requirements including those detailed in DESI (2024). The modelling shows that the operation of Avondale as assessed is unlikely to lead to offsite impacts. This modelling included emissions from the manure stockpile, for which specialist odour sampling was undertaken by The Odour Unit in order to determine appropriate odour emission rates for use in the modelling. The proposed RO plant and associated evaporation basins were not included in the Astute Environmental odour assessment. However, these systems will not generate offensive odour and therefore will not lead to offsite impacts or alter the conclusions of the assessment.

Figure 2 shows predicted odour contours (2.5 OU, 99.5th percentile, 1 hour) in relation to nearby receptors, for the Avondale farm in isolation as well as for cumulative impacts from other poultry farms. In accordance with DESI guidance, odour from different types of sources was not conserved to be purely additive. A qualitative assessment of the cumulative impacts from different types of odour was undertaken and was not considered to increase the risk of odour impacts.

4.1.2 Dust

The risk of dust impacts at sensitive receptors has been rated low in accordance with the expert report completed by Astute Environmental Consulting (Astute Environmental, 2020). The modelling presented in this report has been performed in line with relevant requirements including those detailed in Application requirements for activities with impacts to air (Ver 4.02 2019) (DES, 2018). Like the odour assessment, the proposed RO plant and associated evaporation basins were not included in the Astute Environmental dust assessment. However, these systems will not be a source of dust and will not alter the conclusions of the assessment.

Shed emission were based on published layer industry data and road emissions were based on standard industry methods. The results (including background concentrations) show compliance with the relevant criteria at all receptors for all species modelled. Therefore, the risk of dust impacts from the site is low. Figure 3 shows predicted levels of total

suspended particles in relation to nearby sensitive receptors. For more detail and modelling results refer to Astute Environmental (2020).

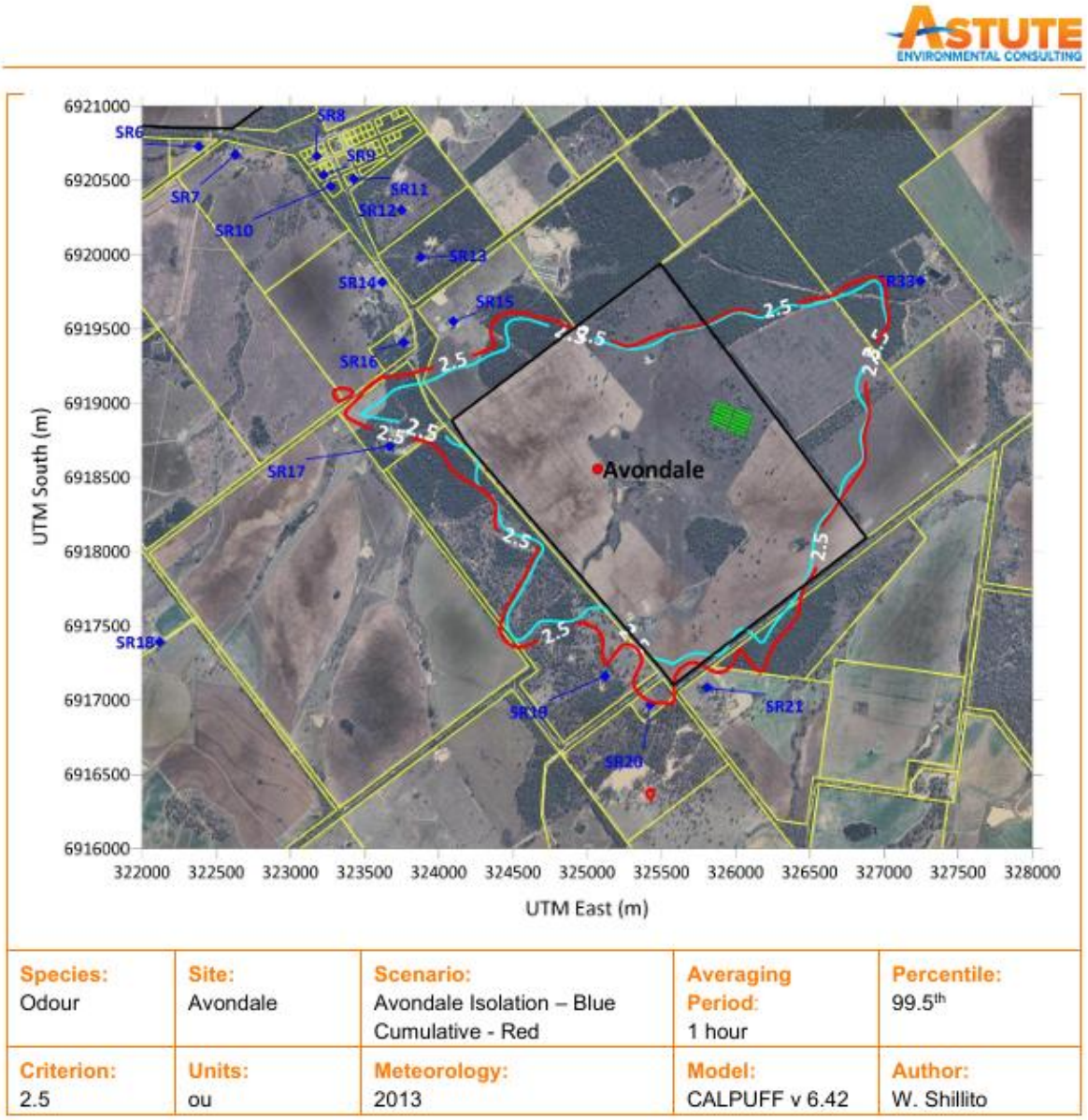
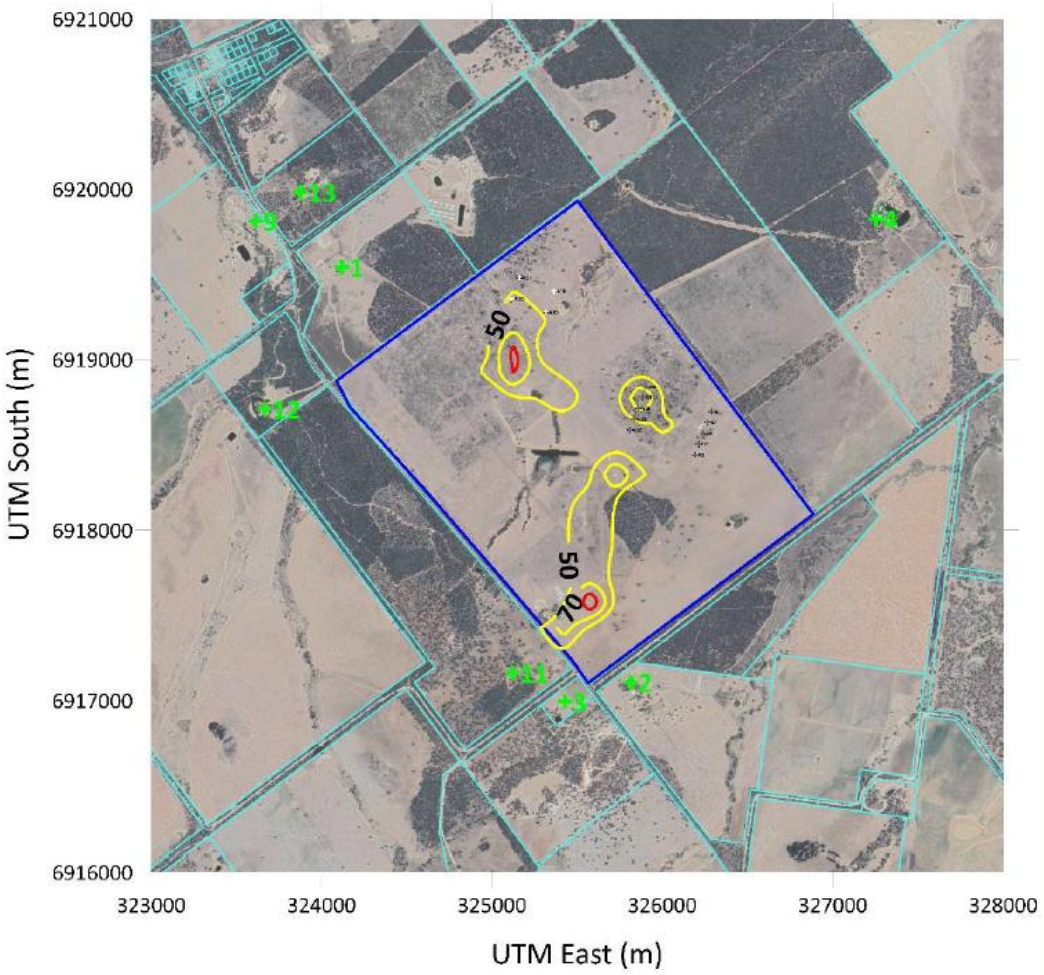


Figure 2. Predicted concentrations – comparison isolation and cumulative (Astute Environmental, 2025)



Species:	Site:	Scenario:	Averaging Period:	Percentile:
TSP	Avondale	Avondale with background	Annual	Maximum
Criterion:	**Units:**	**Meteorology:**	**Model:**	**Author:**
90	µg/m³	2013	CALPUFF v 6.42	W. Shillito

Figure 3. Total suspended particles -annual cumulative (Astute Environmental, 2020)

4.1.3 Noise

A noise impact assessment addressing the noise emissions from the proposed Avondale site has been undertaken by Matrix Acoustics (Matrix Acoustics, 2020). Background noise monitoring observed the existing acoustical environment prior to project commencement and was used to determine project criteria in accordance with the Toowoomba Regional Council *Environmental Standards Code*. A noise model was developed based on measured noise emissions from the existing proponent's site east of Millmerran and other source data. The results of the noise model and assessment indicates that the project is likely to be in compliance with all project criteria for both day and night-time periods, including

the shoulder period in the morning where the site commences work prior to the 'day' period commencing. It was recommended that the noise levels shown in Table 7 be set as project compliance criteria.

Table 7. Recommended project noise criteria (Matrix Acoustics, 2020)

Time period criteria	Noise criteria (15 min)
Day (7am – 10pm) – Façade	35 L_{Aeq}
Night (7am – 10pm) – Internal – variable	28 L_{Aeq}
Night (7am – 10pm) – External – continuous	25 L_{Aeq}
Sleep disturbance - Internal	45 LA_{Max}

It was also recommended that complaints monitoring be included in the SBEMP. See Section 6 for details of complaints handling and monitoring procedures.

The risk rating for potential noise impacts is 'low', as there are not anticipated to be any noise impacts from layer farm operation. This is in part due to the existing measures integrated into the design of the site (see below), large separation distances between potential sources of noise and sensitive receptors.

The main sources of noise on-site are expected to be point sources associated with farm infrastructure such as layer sheds, and the packing facility. As such, the RO plant was not included in the noise assessment for the site as it is expected to be a minor noise source relative to the rest of the site. The packing facility has been designed to maximise use of the north side of the building for goods docks, placing the largest distance between potential sources and receptors of noise. Furthermore, noise generated on the northern side of the building is likely to be partially screened by the building. The use of Vegetated Environmental Buffers on the site will potentially help to reduce noise, dust and odour emissions from the site in accordance with SPP AO4.1 - regarding provision of supplementary planting to ensure vegetated buffers are established and maintained between the poultry farm and sensitive land uses. Significant buffer areas will be planted around all major site infrastructure as shown on Figure 5. The traffic management measures outlined in Section 5.7 are expected to minimise potential impacts.

The traffic management plan for the site requires traffic movements for the sheds, as well as the packing facility are in the forward direction only, and the use of air-brakes in proximity to nearby receptors is prohibited.

4.1.4 Traffic

The vehicle movements associated with the final development stage of the layer farm is outlined in the report prepared by RMA engineering (RMA 2020b). The vertically integrated nature of the company means that it is possible to restrict traffic movements to the hours between 6pm and 6am (the night period) unless required for bird welfare.

The predicted traffic movements associated with farm operations are shown in Table 8, while traffic associated with staff movements are shown in

Table 9. Overall impacts to the local traffic network are expected to be lower than predicted by these calculations, as this development is likely to result in reductions in traffic to other nearby farms owned by Ellerslie Free Range Farms.

Table 8. Traffic movements from farm operations (adapted from RMA, 2020b)

Location	Trip type	Vehicle type	Origin / Destination	Timing	Estimated annual traffic generation (no. vehicle movements)
Avondale (subject site)	Hens in	19m Semi (AV)	Victoria	6am-6pm	8 loads x 2 = 16 vehicle movements
	Hens out	19m Semi (AV)	Toowoomba (east) / various locations (southwest)	6am-6pm	64 loads x 2 = 128 vehicle movements
	Feed delivery	19m Semi (AV)	Yandilla	6am-3pm	1,177 loads x 2 = 2,354 vehicle movements
	Unprocessed eggs	19m Semi (AV)	On site only	6am-4pm (weekdays only)	0.00
	Processed eggs	19m Semi (AV))	Various locations (70% east, 30% west at Gore Highway).	6am-4pm (weekdays only)	2,154 loads x 2 = 4,308 vehicle movements
	Manure	Trailer and dog	Various locations (80% east, 20% west at Gore Highway)	10am-4pm	504 loads x 2 = 1,008 vehicle movements
	Evaporation basin salts and solids	19m Semi (AV)	Toowoomba	6am-6pm	Average, 1 vehicle movement per annum

Table 9. Traffic movements from staff (RMA, 2020b)

Staff	No. of staff	No. vehicles per day	No. vehicle movements (i.e. in / out)	Esitmated daily traffic generation (no. vehicle movements)
Staff	41	20	2	40
Transfer crew	15	3	2	6

4.2 Land

Risk of Erosion Impacts: Low – Moderate
Risk of Impacts to Agricultural Land: Low

For the purpose of the regional planning interests act, the site has been identified as strategic cropping land and falls within a priority agriculture area (shown in Figure 13). No resource activities are proposed as part of this proposal. For the purpose of State Planning Policy, the site has been identified as Class A agricultural land which falls in an important agricultural area as shown in Figure 14. Class A land is considered as some of the most productive agricultural land in Queensland, with soil and land characteristics that allow successful crop and pasture production.

The area proposed for the establishment of the layer sheds, packing facility, manure pad, and evaporation basins, may limit future land use for cropping and grazing, however, measures aimed at reducing the impact of this development and its operations on future agricultural activities on this land are discussed in section 5.4. Class A land and Important Agricultural Areas adjoining the site will not be affected by site operations due to the minimal impact sources on site, low risk of impacts to agricultural productivity of nearby lands, and significant separation distances.

In accordance with the State Planning Policy, the proposed use is suitable for important agricultural areas. Any manure application carried out on-site or on other cropping areas owned by the client will improve the agricultural value and productive capacity of the land. As per the SPP, risk on the site is further minimised as the site will operate according to the measures outlined in this SBEMP. Due to the low potential productive value of the site, and ease of rehabilitation, the site is rated as a low risk for impacts to agricultural land.

The soil mapping detailed in Section 2.3.6 shows the various soil mapping and classifications applicable to the site. Due to the presence of sodic subsoils in Combidiban soils the site is rated as a moderate risk of erosion during the construction phase, although no soil disturbance is expected during the operational phase. Additional care will need to be taken to prevent exposure of dispersive soils and ensure sufficient groundcover to prevent wind erosion of sandy topsoil. Erosion and sediment control measures are discussed in Section 5.4.

4.3 Ecology

Risk of Impacts to Environmentally Sensitive Ecology: Low

Native vegetation mapping shows a small area of Category B remnant vegetation on the property (Figure 15), which also contains areas mapped as Echidna habitat. This area however will not be disturbed as part of this proposal. Other site mapping indicates no other areas of protected species, wetlands or essential habitat.

The site is not mapped as requiring referral for waterway barrier works. This is likely because the local site stream shown on Figure 18 terminates shortly after leaving the site and does not connect to downstream riverine systems.

4.4 Surface Water and Groundwater

Risk of Impacts to Surface Water: Low
Risk of Impacts to Groundwater: Low

The Egg Industry Environmental Guidelines – Edition III (McGahan et al., 2026) provide a risk assessment tool which can be used to evaluate the likelihood of impacts to surface and groundwater from range areas, however these principles can be extended to determine runoff and leaching risks from other aspects of egg production. The details and assumptions in Table 10 have been used to complete the risk assessment for the site. The completed risk assessment tables for the site are shown in Table 11 and Table 12, with the values used for the assessment highlighted in blue.

Sources of risk to surface water includes runoff from the manure pad, layer shed pads, and the packing facility pad, as well as the treated water application areas in the revegetation plantation areas, and overtopping of evaporation basins (see Appendix A). Runoff from shed pads is expected to present a low risk due to the lower nutrient levels compared to manure pad runoff, and runoff mitigation measures (see Section 5.3) used to meet TRC stormwater requirements. Runoff from manure pads is managed in accordance with DPI Qld requirements (see Section 5.3 and Appendix C). The Conceptual Stormwater Management Plan (CSMP) prepared by RMA Consulting (RMA 2020a), showed the flow paths and quantities of stormwater generated under the 1% AEP design storm. The evaporation basins have been designed in accordance with the MEDLI assessment provided in Appendix C which limits overtopping to one event in 20 years on average (Tucker et al., 2025), minimising any consequential impacts to surface water and groundwater.

Table 10. Factors used in risk assessment

Parameter	Rating	Rationale
Rainfall factor	1	Rainfall erosivity based on Lu et al (2001) is less than 5000.
Distance to waterways	1	A minor waterway runs in a northerly direction through the property. Based on the site plan shown in Figure 5, the manure pad, layer shed pads, are located >200m from the nearest waterway in the direction of flow. The packing facility pad, pullet shed pads, and evaporation basins are located at a distance of approximately 100–200 m from the waterway, however the significant mitigation measures in place justify selection of a lower risk score for this factor.
Farm size	8	This is a large farm with > 250,000 birds.
Soil profile	2/3	The likelihood of Davy and Combidiban soils identified in the regional NRM manual indicates soils of high–moderate permeability with some areas of impermeable subsoils where Combidiban soils are present. As such a score of 2 was chosen for runoff risk due to likelihood of well–draining soils, and a score of 3 was chosen for leaching risk as Combidiban soils (where present) will offer some degree of protection to groundwater resources.
Land shape	2	The shape is flat with some sloping land. The use of swales and contour banks as part of the stormwater management measures for the site will reduce this score.
Groundcover	1	Groundcover areas across the site are expected to be 80–100% due to the combination of the tree plantations and existing pastures.

Parameter	Rating	Rationale
Slope	1	The slope of the site ranges from 0.8% to 1.25%.
Soil P	2	Soil P on the site is expected to be in the range of agronomic requirements for the existing land use. In accordance with the NRM manual for the site, soils likely to be encountered on the site have low fertility, and the representative soil profiles have low-moderate amounts of P.
Topsoil PBI	2	The clay content of the soil and associated PBI can be determined from ASRIS information for the soil types on the site.

Table 11. Runoff risks to surface water

		FACTOR SCORE				
		LOW	MODERATE	HIGH	VERY HIGH	RISK FOR FACTOR
RUNOFF FACTORS	**FACTOR WEIGHT**	1	2	4	8	= WEIGHT X SCORE
RAINFALL FACTOR	20	<5000	5,000 – <10,000	10,000 – 20,000	>20,000	20
DISTANCE TO WATERWAYS	15	>200m	100 – 200m	30 – 100m	<30m	15
FARM SIZE	15	<10,000	10,000 – <60,000	60,000 – <250,000	>250,000	120
SOIL PROFILE	10	Well drained		Duplex		20
LAND SHAPE	10	Swales and contour banks	Uniform flat or sloping land	Slightly uneven, minor rills	Highly concentrated gully flow	20
GROUNDCOVER	10	80 – 100%	60 – <80%	45 – <60%	<45%	10
SLOPE	5	<1	1 – <3.75	3.75 – 15	>15	5
SOIL P	5		Refer to explanatory notes			5
TOPSOIL PBI	5	>280 (clay)	140 – 280 (clay loam)	35 – <140 (sandy loam)	<35 (sand)	10

Table 12. Leaching risks to groundwater

		FACTOR SCORE				
		LOW	MODERATE	HIGH	VERY HIGH	RISK FOR FACTOR
RUNOFF FACTORS	**FACTOR WEIGHT**	1	2	4	8	= WEIGHT X SCORE
SOIL PROFILE	25		Duplex		Well drained	100
GROUNDWATER	20	>10m to groundwater where protected by clay or impermeable strata (otherwise >20m)	>2m to groundwater where protected by clay or impermeable strata (otherwise >10m)	>2m to unprotected groundwater	<2m to groundwater	80
RAINFALL FACTOR	20	<5000	5,000 – <10,000	10,000 – 20,000	>20,000	20
PASTURE TYPE	15	>30% Lucerne	>30% deep rooted perennials	>30% shallow rooted perennials	<30% perennials	30
FARM SIZE	15	<10,000	10,000 – <60,000	60,000 – <250,000	>250,000	120

The total risk score for surface and groundwater risks is shown below in Table 13. This table also shows the corresponding risk rating derived from the Egg Industry Environmental Guidelines – Edition III (McGahan et al., 2026).

Table 13. Risk scores and risk ratings for impacts to surface and groundwater

Impact category	Score	Rating*
Surface water	215	Low
Groundwater	350	Low

**(McGahan et al., 2026)*

4.6 Flooding

Risk of Impacts from Flooding: Low

As described in Section 2.3.11 small and sometimes isolated areas of the farm are potentially affected by minor flooding and are mapped under TRC flood risk mapping. Layer sheds, manure pads, and evaporation basins are **not** located within the mapped flooding area or are constructed to ensure that the FFL is above the predicted flooding levels, and therefore the risk of impacts from flooding is low. The Conceptual Stormwater Management Plan (RMA 2020a) showed that impacts to natural surface flows and flooding under the post-development scenario are expected to be minimal.

5. Management Plans

The following management plans have been developed to mitigate potential environmental risks from the layer farm operation. Each management plan contains measures which may reduce the risk of impacts for each of the categories identified above, as well as additional management measures for the site which are not associated with likely environmental impacts.

5.1 Waste Management Plan

Manure Management
The manure pad (including areas used for dead bird management) and associated infrastructure will be constructed in accordance with Section 3.5.
Approximately 75% of the manure from the layer sheds will be removed via manure belts during the production cycle. This will be loaded directly into trucks via the manure belts for transport off site. No manure from the manure belts will be stockpiled outside of sheds prior to collection. The manure belts will be operated in each shed twice per week. Any spilt manure will be swept/collected and re-loaded into manure transport trucks.
At the end of the production cycle manure remaining in the layer sheds (floor manure, approx. 25% of total layer manure) will be collected via loader/skid-steer and loaded into tipper trucks for transport to the manure pad. Any spilt manure will be swept/collected and re-loaded into manure transport trucks.
All floor manure collected at the end of the layer and pullet production cycles will be windrowed on the manure pad. This manure will be aged in the windrows, before being removed for off-site use on annual cropping operations or applied on site to native pastures or revegetation plantings.
Windrows will be limited to 1.5m in height and 4m in width with side slopes of 1:1 as indicated in Appendix B. This appendix also includes details of estimated manure production rates.
The manure pad will be managed to ensure there is no more than 800 t of manure on the pad at any one time before being transported off-site or utilised on-farm.

Dead Bird Management
Manure Pads (including areas used for dead bird management, ponds, burial pits) and associated infrastructure will be constructed in accordance with Section 3.5.
Daily mortalities will be collected and buried on the manure pad, as discussed in Section 3.5. Spent hens will be sold and removed from the site, however, additional burial area has been allocated on the manure pad in the event that spent hens cannot be sold off farm.
Birds added to the burial pit will be covered with a layer of material 300mm thick to exclude pests and reduce odour. This material can be removed and replaced each time birds are added.
Once filled, the burial pit is to be capped with a domed layer of impervious material 300mm thick, to minimise rainwater infiltration and subsequent leaching, as well as odour generation and pest issues.

Evaporation Basin Management
The RO plant and associated evaporation basins for reject water (brine) will be constructed in accordance with Section 3.7 and Appendix B.
Evaporation basins are operated to maintain sufficient freeboard and storage capacity to accommodate rainfall events and prevent overtopping.
Evaporation basins are routinely inspected to identify erosion, seepage, cracking, or other signs of damage, with maintenance undertaken as required.
Embankments and associated pipework are maintained to ensure the integrity and effective operation of the evaporation basin system.
Water levels are routinely monitored to confirm adequate storage capacity is maintained under normal operating conditions.
Contingency measures are implemented where necessary to manage abnormal operating conditions, including prolonged rainfall or equipment failure, to minimise the risk of environmental impacts.
Accumulation of salts and other dissolved solids within the evaporation basins will be monitored as part of routine basin management to ensure storage capacity and operational performance are maintained.
Where accumulated salts or residual solids require removal, material will be managed and disposed of at an appropriately licenced waste facility in accordance with applicable waste classification and regulatory requirements.

Waste Management (General Waste) Measures
Avoid: Where possible avoid generating waste by purchasing unnecessary materials, products or equipment, and avoiding unnecessary printing.
Reduce: Reduce the amount of waste produced by buying bulk containers of regularly used items where possible. Ask suppliers if a low packaging option is available, especially where products have multiple layers/levels of packaging.
Reuse: Scrap metal, building materials, and landscaping waste can often be put to a productive use on farm. In some cases, packaging wastes such as cardboard can also find a useful role in farm operations. Whatever the intended use, ensure that re-used materials are suitable for the purpose and are not disposed to land or waterways following their reuse.

Waste Management (General Waste) Measures
Recycle: In locations with recycling programs/facilities wastes such as scrap metal, recyclable containers, electronics, cardboard and recyclable packaging, office waste, can be recycled. • Packaging waste and plastic from the packing facility operations will be recycled as on existing sites run by the client. • Organic waste such as landscaping trimmings will be added to mortalities composting as carbon bulking material. • Other organic wastes such as staff food scraps or spilt animal feed could be composted. On site composting should only be carried out in accordance with the procedures outlined in to *Optimising waste and by-product utilisation and conversion to value streams guidance manual* (Copley et al., 2025).
Energy Recovery: Some materials are suitable for use in energy recovery infrastructure such as biodigesters or boilers/furnaces.
Disposal: Where no suitable alternative has been identified, waste will be collected and stored in waste storage prior to removal. These storage areas are located within storage sheds at the layer farm, and packing facility. Waste will be disposed of to a licenced waste facility, in accordance with regulated waste requirements if applicable. Brine generated by the RO plant is managed separately from general waste and is directed to the dedicated evaporation basin system. Over time, dissolved salts and other constituents contained within the brine will accumulate within the evaporation basin as water is removed through evaporation. Basin condition and accumulated solids will be monitored as part of ongoing operational management. Where required to maintain available storage capacity and effective operation of the evaporation system, accumulated salt deposits and/or residual solids will be removed and disposed of at an appropriately licenced waste facility in accordance with applicable waste classification and disposal requirements.

5.2 Dust, Odour and Noise Management Plan

The site risk assessment indicates that the risk of impacts to amenity from dust, odour and noise are low.

Dust Management Measures
Limit on-site traffic speeds to 40 km/hr on unsealed roads in accordance with the traffic plan for the site.
Apply water to unsealed roads in times of high traffic and low rainfall.
Maintain vegetative screens to reduce potential impacts at closest sensitive receptors.
Manure and floor litter to be loaded into transport vehicles directly from sheds.
Loads to be covered in accordance with the traffic plan for the site.
Maintain complaints register.
Operate a telephone line during work hours to allow any complaints to be lodged.
Instruct all staff on the appropriate handling of odour complaints.

Odour Management Measures
Manure pad (including areas used for dead bird management) and associated infrastructure will be constructed and maintained in accordance with Section 3.5.
Ensure feeding equipment is in good working order with daily inspections.
Clean up any spilt feed daily.
Replace or repair faulty/broken augers.
Ensure manure belts are operated twice weekly to avoid manure build-up in sheds, with manure loaded directly into covered manure trucks for transport off-site.
At the end of the production cycle, remove all floor manure and transport to the on-site manure pad for windrowing.
Ensure carcasses removed from sheds daily and transported directly to the manure pad for burial.
Dead birds and egg waste will be disposed of via burial in designated burial pits located on the manure storage pad.
Birds added to the burial pit will be covered with a layer of material 300mm thick to prevent odour emissions. This material can be removed and replaced each time birds are added.
Ensure manure pad are not inundated with or pool water.
Ensure only groundwater is treated in the RO plant and only reject from groundwater is stored in evaporation basins.
Maintain complaints register.
Operate a telephone line during work hours to allow any complaints to be lodged.
Instruct all staff on the appropriate handling of odour complaints.

Noise Management Measures
Vehicles speeds will be <40 km/hr on-site and reduced further at night (if applicable).
Avoid truck exhaust and engine braking near sensitive receptors.
Night operations minimised to unnecessary generation of noise.
All feed deliveries should be conducted during daylight.
If required, vehicle and machinery reversing alarms are modified with proximity sensors (to limit activation) or automatically adjusted to surrounding noise levels.

Noise Management Measures
Maintain machinery and equipment so that it meets the legal noise requirements and manufacturers specifications.
Maintain complaints register.
Operate a telephone line during work hours to allow any complaints to be lodged.
Instruct all staff on the appropriate handling of odour complaints.

Complaints Management Measures

A Feedback and Incidents Register will be used to record all amenity complaints. The register in included in Section 6, along with noise, odour and dust monitoring forms. Details should be logged immediately and the following recorded:

- Time and date of detection and details of the incident.
- Method of communication (telephone, email, letter etc…).
- Name, contact address and contact telephone number of complainant (Note: if the complainant does not wish to be identified then, "not identified" is to be recorded).
- Wind strength, wind direction and other relevant climatic conditions (check records from nearby weather station).
- Details of complaint investigation undertaken and findings.
- Name of person responsible for investigating the complaint.
- Action taken as a result of the complaint investigation and signature of responsible person.
- Feedback provided to the complainant.
- Details of notification to the Administrating Authority (if applicable).

The Feedback and Incidents Register will be reviewed monthly. Recorded incidents will be reviewed, and the following information will be recorded:

- Management options available to reduce or solve the problem.
- Contingency measures taken to eliminate the source of each complaint.
- Effectiveness of contingency measures.
- Response of complainant/s about the level of impact after steps have been put into place to solve the problem.
- Details of further monitoring (through assessment by farm staff and consultation with the complainants.

5.3 Flood and Stormwater Management Plan

The site risk assessment indicates that the risk of impacts to surface waters from farm activities is low, and that the risk of impacts for flooding is low. The Conceptual Stormwater Management Plan (RMA 2020a) showed that impacts to natural surface flows and flooding under the post-development scenario are expected to be minimal. Runoff from the manure pad will be captured due to the potential for nutrient runoff, and runoff from shed pads will be captured as it may contain spilt feed, spilt manure, and deposition from shed ventilation. Evaporation basins have been designed to limit overtopping to once every 20 years on average (Tucker et al., 2025). The high levels of groundcover on the site are likely to reduce the impacts of any runoff from production areas.

Flood and Stormwater Management Measures
Flood Management
Layer sheds, packing facility, manure pad, and evaporation basins are not built in areas subject to the 1% AEP flood event.
Stormwater Management Measures
Manure pad (including areas used for dead bird management) and associated infrastructure and evaporation basins will be constructed in accordance with Section 3.5. and 3.7.
Runoff from the shed pads and manure management areas (Manure pad) will be captured in retention basins. • A sedimentation system and retention basin to treat and capture runoff from the manure pad area has been designed in accordance with the Feedlot Guidelines as recommended by DPI Qld (Appendix C). • A retention pond to capture runoff from around sheds has been sized to capture 20mm of runoff from impervious areas, in order to meet the requirements of the TRC planning scheme. • Brine from the RO plant will be diverted to evaporation basins and designed with consideration of site climatic conditions to limit overtopping to once every 20 years on average. Refer to Appendix B for more detail on design calculations for these environmental control measures.
Groundcover will be inspected regularly and managed to ensure a high level of groundcover is present on the site. Where groundcover levels cannot be managed, additional stormwater management measures will be employed.
Diversion banks, ponds/basins, bunding and other stormwater management measures will be inspected monthly for signs of erosion or deterioration, and maintained where necessary.
The sedimentation pond will be maintained to ensure sediment deposition does not limit the active capacity of the pond. This is to be undertaken when the pond is dry following rainfall events, where the active capacity of the pond is <90% of the design capacity.
The evaporation basins will be operated and maintained to preserve structural integrity, maintain adequate freeboard and storage capacity, accommodate rainfall events, and minimise the risk of overtopping.

5.4 Erosion and Sediment Control Plan

This Erosion and Sediment Control Plan (ESCP) seeks to mitigate the risks associated with the development and continual use of the layer farm. Due to the rural nature of the site, and low risk of impacts to surface waters, minimal erosion and sediment control measures are recommended as shown below.

This plan will be enacted both during development and during operation of the layer farm and will be updated regularly to ensure all practices are performing correctly. Additional or alternative erosion and sediment control measures may be required as part of the approval for this activity.

The site foreman is responsible for the correct implementation of this ESCP during the construction phase. The existing environment could potentially be impacted by loss of topsoil from erosion and the run-off entering surface waters. These impacts will have a higher potential to occur during the construction phase where areas will be cleared of groundcover. Areas that are left bare immediately following the construction will also pose as an erosion risk until vegetation can be re-established.

Erosion and Sediment Control Plan Measures
Construction Phase
Minimise the area of groundcover disturbance.
Stockpile removed groundcover or topsoil and reapply to the area after construction is completed.
Use diversion banks or bunding to direct upslope water away from construction areas.
Stormwater retention ponds designed for the operational phase will also act as sediment ponds for pad areas during the construction phase.
Use sediment fences or vegetated areas downslope of construction areas to reduce sediment runoff.
A rumble pad is to be located near layer farm as this location will minimise off-site noise impacts.
Inspect erosion and sediment control measures regularly to ensure they are operating correctly.
Roads leading in and out of the site will be formed of compacted road base.
Re-apply stockpiled groundcover & topsoil, or re-seed the area following construction.
Ensuring the control plan is kept in place until the ground cover is considered adequate.
Operational Phase
Stormwater management plan measures are enacted in accordance with Section 5.3.
Farm roads are inspected and maintained as required to prevent erosion.

5.5 Land Rehabilitation Plan

The risk of impacts to land is low (see Section 4.2) and the environmental values identified on the site (as detailed in Section 2.3) will be maintained. In addition, the disturbance footprint of activities associated with layer farm activities is small. The agricultural value of the land is limited by site constraints and areas of revegetation and carbon offset plantings are likely to improve the environmental values on the site. Subsequent land uses may wish to make use of layer farm infrastructure or assets and as such, these rehabilitation measures are dependent upon the subsequent use of the land.

Rehabilitation Measures
The layer sheds will be decommissioned and assessed for their structural integrity for future land uses. The Waste management hierarchy dictates that re-use provides the greatest environmental benefit.
All manure will be removed for use off-site.

5.6 Application and Storage of Chemicals Plan

The following procedures have been identified to guide chemical use on the site associated with fuel storage and ephemeral chemical use (such as approved chemicals for pest management).

Chemical Management Measures
General Requirements and Safety
All appropriate licencing and approvals for the storage has been obtained from state and local governments.
Site operations are conducted in accordance with the "Code of Practice: Managing risks of hazardous chemicals in the workplace" (Safe Work Australia, 2023), and all relevant WH&S regulations. See: https://www.safeworkaustralia.gov.au/sites/default/files/2023-06/model_code_of_practice_managing_the_risks_of_hazardous_chemicals_in_the_workplace.pdf
A register of all chemicals used on-site and their MSDS is maintained.
Chemicals are selected with low potential impacts to health, safety and the environment, as identified by the product MSDS.
All staff are provided with appropriate personal protective equipment (PPE) as identified in the product MSDS and trained in its use.
Staff are trained in the safe use of chemicals, and access to chemicals is restricted to trained staff and a register of training is kept.
Manufacturer's instructions are adhered to for use, including application rates and methods.
Storage and Chemical Handling Areas
Storage of flammable and combustible liquids is undertaken in accordance with the Australian Standard AS1940:2017 (Standards Australia, 2004).
Storage of corrosive substances is undertaken in accordance with the Australian Standard AS3780:2023 (Standards Australia, 2004).
Large containers (drums, tanks, etc) of dangerous, hazardous or flammable chemicals will be in chemical storage areas which capture any spills, leaks or storage tank/container failures. Bunding and bases of storage areas is constructed from an impermeable material such as concrete.
Incompatible chemicals are stored with adequate separation (e.g. in a small chemicals cabinet, incompatible chemicals are not stored above each other where leaking may cause an undesirable interaction).
Washing of chemical containers or mixing of chemicals is conducted in a sealed area, capable of capturing any spills. Adequate ventilation is provided to maintain health and safety requirements.
Spills
A spill kit suitable to the size and nature of potential spills is available. Staff are trained in the use of the spill kits, and all spills are cleaned up in an appropriate manner.
An emergency response plan for pollution incidents, including large chemical spills is prepared for the site.
Large spills may be required to be reported to regulators and relevant contact details should be included in the plan.

Chemical Management Measures
Release to the Environment
Chemical use near waterways is minimised.
Spray drift is minimised by using well maintained equipment, correct application rates, and applying chemicals during suitable weather conditions (winds are not directed to sensitive receptors).
Disposal
Unwanted or out of date chemicals, containers, and used spill containment materials are disposed of in accordance with manufacturer's instructions and regulated waste requirements.
If a chemical is considered a regulated waste, legislation may require disposal by an approved waste contractor and the keeping of certain records.
Where possible, application of chemicals in production sheds is undertaken when no birds are in the shed, and the shed is closed to prevent potential losses to the environment.

5.7 Traffic Management Plan

The following traffic management measures will be employed to minimise the risk of traffic incidents and potential amenity impacts from site traffic.

Traffic Management Plan Requirements
Access to the site will be restricted to staff and authorised transport contractors.
There will be two entries into the farm. All vehicle movements are to use one of these entries to access the farm.
Site traffic will be limited to a maximum of 40 km/h.
The use of 'high beam' headlights is to be avoided on the site unless safety concerns are identified.
The use of compression brakes and other secondary retarding systems is limited on the site unless justified for safety reasons.
Drivers must follow on-site directions and signage.
Delivery/pickup vehicles are to park close to sheds to minimise impacts to other site traffic.
Where possible transport vehicles are to park in the forward direction of travel to minimise noise and risks associated with reversing.
All transport vehicles are to cover loads while onsite and prior to leaving site.
All vehicles leaving the site are to come to a full stop prior to entering public roads and give way to existing traffic.
Traffic movements from off-site vehicles are to be restricted between the hours of 6:00 am and 6:00 pm.
The use of air-brakes in proximity to nearby receptors is prohibited.

General road rules will be maintained, except special areas requiring modified rules. Speed limits will be in place to reduce the potential for increased levels of dust entering the atmosphere from the road, as well as the load on the vehicle. Water sprays will be used to suppress dust during high traffic periods. Roads will be inspected regularly and repaired to reduce erosions and ensure safety.

5.8 Biosecurity Plan

The farm will be operated in accordance with the *National Farm Biosecurity Technical Manual for Egg Production* (AHA, 2023), and all other biosecurity requirements. For biosecurity purposes, the following measures are to be employed on the site.

Biosecurity Plan Measures
The farm adheres to the *National Farm Biosecurity Technical Manual for Egg Production* (AHA, 2023) Additional biosecurity measures will be employed at the site which are outlined in the manual.
In the event of a suspected disease outbreak, the procedures outlined in the industry biosecurity manual will be employed.
A biosecurity area is established around the layer farm production areas which is managed in accordance with farm biosecurity protocols.
Access to the biosecurity area is restricted, unless necessary. All persons entering the biosecurity area are required to follow biosecurity protocols.
Access to the production area is capable of being closed off to vehicle traffic and displays appropriate signage including "Biosecure Area No Entry Unless Authorised", or similar wording.
Clear signage will be erected at the entrance instructing transport drivers to contact the site farm manager on the contact details provided.
A visitors' log will be kept, detailing conditions of entry.
Drinking, cooling, cleaning and wash-down water used on farms will be drawn from bores. No dam or surface water will be used in the poultry operations.
Dedicated shed-only footwear will be provided for all persons entering sheds.
A pest management plan is enacted to control rodents (see Section 5.10 for more detail).
Manure removal and dead bird management is carried out in accordance with the requirements of the industry biosecurity manual and the practices outlined in this SBEMP.
Grazing animals, rodents, pigs, pets, feral animals and wild birds are excluded from the production and biosecurity areas to the greatest extent possible.
Feed silos and sheds are sealed against access by rodents and birds, and regular inspection and maintenance is undertaken to ensure they remain secure.
Spilt feed is cleaned up immediately to prevent attracting pests.
Evaporation basins are managed to minimise the attraction of wild birds, including maintaining high salinity within the brine and preventing the establishment of vegetation or other habitat features around the basins.
Evaporation basins are routinely monitored for bird activity, with additional deterrent measures implemented where excessive bird congregations are observed.
Evaporation basins are monitored routinely where any deceased birds identified within or adjacent to the evaporation basins are removed promptly and disposed of in accordance with farm biosecurity procedures.

5.9 Bushfire Management Plan

Preventative Measures
Asset protection: Establish cleared, well-maintained areas around buildings and key infrastructure.
Vegetation management: Regularly mow grass, prune trees, and remove leaf litter, especially near structures.
Firebreaks: Create and maintain firebreaks around paddocks, fence lines, and property boundaries.
Equipment storage: Store fuel, chemicals, and machinery away from buildings in well-ventilated, fire-resistant sheds.
Water supply: Ensure adequate water sources (tanks, dams, troughs) are available and accessible for firefighting.
Preparedness Measures
Develop and distribute a bushfire survival plan to all staff and family on-site members.
Conduct regular fire drills and training sessions on equipment use and evacuation procedures.
Install and maintain fire-fighting equipment, such as pumps, hoses, and extinguishers.
Prepare emergency kits with first aid supplies, protective clothing, torches, and important documents.
Register with local fire alert systems and monitor fire danger ratings.
Response Measures
Nominate a person responsible for coordinating the response.
Activate the bushfire survival plan and communicate with all farm occupants.
Relocate livestock to safer areas (bare paddocks, yards with water access).
Shut down sheds, block gutters, and remove flammable items.
Evacuate early if advised by emergency services, following pre-determined routes.
Contact neighbours and inform them of your situation.

5.10 Pest Management Plan

Subjective monitoring of pest and vermin population on the site will determine if any increases or unacceptable levels of pests/vermin are present on the site. Specific pests to be monitored are:

- Fly population.
- Rat/mice population.
- Wild bird population.

The farm will be operated in accordance with the industry biosecurity manual and all other biosecurity requirements. For biosecurity purposes, the following measures are to be employed on the site:

Pest Management Measures
Sheds materials and feed storages are regularly maintained and repaired to exclude pests.
Spilt feed is cleaned up promptly to avoid attracting pests.
Pest breeding sites are minimised.
Rodent breeding sites, such as burrows and rubbish piles, are removed.
Dead birds are removed to the dead bird management area daily and disposed of in accordance with the composting practices outlined in *Optimising waste and by-product utilisation and conversion to value streams guidance manual* (Copley et al., 2025).
Grass is slashed regularly to reduce seed production which may attract pests.
Baiting and/or traps are used to control rodents, and records are kept in accordance with the industry biosecurity manual.
Where baiting will be undertaken the following measures will be enacted.
• Bait stations will be numbered and a map kept of their location.
• Bait stations will be placed at regular intervals around the sheds. The number of bait stations should be increased in areas where there are signs of increased – rodent activity.
• The type and location will be of baits used will be selected to avoid impacts to poultry.
• Bait stations will minimise the opportunity for other mammals and birds to access the bait.
Use approved insecticides to control fly and insect pest populations and breeding sites.
Chemicals used for pest control and baiting do not adversely impact poultry.

5.11 Staff Training

Staff will be trained in standard procedures required for the efficient operation of the farm, including environmental monitoring and environmental management actions. Details of all relevant environmental training/information programs undertaken will be recorded in the relevant recording sheet in Section 6.

Specific tasks which require training will include:

Staff Environmental Training
Manure collection and handling.
Environmental monitoring procedures (e.g. monitoring odour, dust, and noise).
Inspection and repair of stormwater management measures.
Inspection and repair of evaporation basins.
Safe storage and use of chemicals.
Pest management procedures.

6. Monitoring and Recording

Due to the low risk of community amenity impacts associated with site activities, no fixed monitoring points or scheduled monitoring requirements have been identified. As such monitoring of community amenity measures will be undertaken in response to observed site performance and community feedback. As measurements are conducted on-site, the results are to be recorded in the corresponding record sheets provided. These monitoring activities include (but are not limited to):

- Feedback to the poultry farm by members of the surrounding community/general public in relation to impacts to community amenity (Table 14).
- Noise assessment measuring (Table 15).
- Odour assessment measuring Table 16).
- Dust assessment measuring (Table 17).

Where feedback investigations or monitoring show potential issues with environmental management for the site, the SBEMP is to be updated with the relevant solutions once identified.

In addition to community amenity monitoring, recording sheets are provided below for the following matters:

- Staff training (Table 18) – outlines which staff members have received specific training.
- Areas identified as requiring environmental improvement (Table 19).
- Revision of the SBEMP (Table 20).

Table 14. Feedback and incidents register

Date	Incident reported by (Name)	Nature of incident	Incident recorded by (Name)	Source of problem	Comment/Action taken	Does complainant believe impact has declined?	Further action taken?	Signature of responding officer

Table 15. Noise assessment record

Date and time	Location	Name	Level of noise nuisance

0	**Not audible**	**A**	**Sound pressure level**
1	Definitely not annoying	**B**	Its duration
2	Very little annoyance	**C**	The rate at which it happens
3	Some annoyance	**D**	Its audibility
4	Annoying	**E**	Whether it is continuous at a steady level; or whether it has fluctuating, intermittent, tonal; or impulsive nature
5	Quite annoying		
6	Very annoying		
7	Extremely annoying	**F**	Whether it has vibration components

NOTE: characteristics as described in Part 1 of the *Environmental Protection (Noise) Policy 1997*.

Table 16. Odour assessment record

If site performance or community feedback identifies an issue with increased odour emissions, the following will be undertaken:

1. Step 1: Using the German VDI 3882 (VDI-RICHTLINIEN 1993) odour intensity scale provided, record the odour intensity every 30 seconds over a 10-minute period.
2. Step 2: Enter the highest intensity level experienced during the 10-minute period into the record below.
3. Step 3: When an odour intensity of A-D is experienced, corrective action is required.

Odour intensity	Intensity level
Extremely strong	A
Very strong	B
Strong	C
Distinct	D
Weak	E
Very weak	F
Not perceptive	G

Date and time	Location	Name	Wind direction	Wind speed	Odour intensity

Table 17. Dust assessment record

Date & Time	Location	Name	Wind direction	Wind speed	Dust from poultry farm	
					Absent	Present

Table 18. Staff training register

Date	Name of participant	Training conducted

Table 19. Environmental improvement record

Date	What requires environmental improvement or monitoring

Table 20. SBEMP revision register

Date amended	Amendment made

7. References and Bibliography

AHA, 2023. National Farm Biosecurity Technical Manual for Egg Production.

Astute Environmental (2025) *"Avondale Farm" – Odour Assessment.* Prepared for Ellerslie Free Range Farms Pty Ltd.

Astute Environmental (2020) *"Avondale Farm" – Dust Assessment.* Prepared for DA Hall Pty Ltd.

Bielefeld, E., McGahan, E., Prentice, E., Consulting, F.S.A., Centre, T.L., Bielefeld, E., McGahan, E., Prentice, E., 2015. Vegetative Environmental Buffers for Australian Meat Chicken Farms: A Guide for Growers. Rural Industries Research and Development Corporation, Kingston, Australia.

Copley, M.-F., McGahan, E., Wiedemann, S., 2025b. Optimising waste and by-product utilisation and conversion to value streams guidance manual A report for Australian Eggs Limited. Australian Eggs.

Department of Natural Resources (1999) *Central Darling Downs Land Management Manual.* Edited by P. . Harris, A. J. W. Biggs, and A. J. Coutts. The State of Queensland, Department of Natural Resources.

DES (2019) *Healthy Waters Management Plan – Condamine River Basin*. State of Queensland. Department of Environment and Science (DES).

DESI, 2024. Guideline: Odour Impact Assessment from Developments , Brisbane, Queensland:

Department of Environment, Science and Innovation.

Lu, H. et al. (2001) *'Prediction of sheet and rill erosion over the Australian continent, incorporating monthly soil loss distribution'*, Land and Water Technical Report. CSIRO, Canberra, Australia.

Matrix Acoustics (2020) *Avondale Farm Noise Impact Assessment*. Prepared for Astute Environmental/DA Hall

McGahan, E., Wiedemann, S., Copley, M.-F., & Walker, L. (2026). Egg Industry Environmental Guidelines - Edition III. https://www.australianeggs.org.au/assets/research/documents/EGG_108381_EGG-INDUSTRY-GUIDELINES_03-WEB.pdf

QUU (2012) *Sewerage Standards – Supporting Documentation to WSA 02 Part 1.* Queensland Urban Utilities (QUU).

RMA (2020a) *Conceptual stormwater management plan.* Prepared for DA Hall and Co.

RMA (2020b) *Traffic Impact Assessment – Avondale Cage Free Farm.* Prepared for DA Hall and Co.

RMA (2020c) *13549 IR Response 7 - Onsite Wastewater Management Assessment.* Prepared for DHP Consolidated PTY LTD

Standards Australia. (2004). The storage and handling of flammable and combustible liquids. AS1940:2004. Standards Australia.

Standards Australia (2017) *'The storage and handling of flammable and combustible liquids. AS1940:2004'*. Australia: Standards Australia.

Standards Australia (2023) 'The storage and handling of corrosive substances. AS1780:2023'. Australia: Standards Australia.

Tucker, R., Price, J., & Tait, S. (2025). National Environmental Guidelines for Indoor Piggeries (NEGIP) - Siting and Design (Fourth Edition). APL.

VDI-RICHTLINIEN (1993) *Determination of Odourants in Ambient Air by Field Inspections.* Dusseldorf: Kommission Reinhaltung der Luft im VDI and DIN.

Wiedemann, S. et al. (2008) *Composting Every Day Mortality and Other Wastes from Layer Farms.* Australia. Available at: https://www.aecl.org/assets/RD-files/Outputs-

2/1EC081A-Final-Report.pdf.

Appendix A Environmental Values Mapping

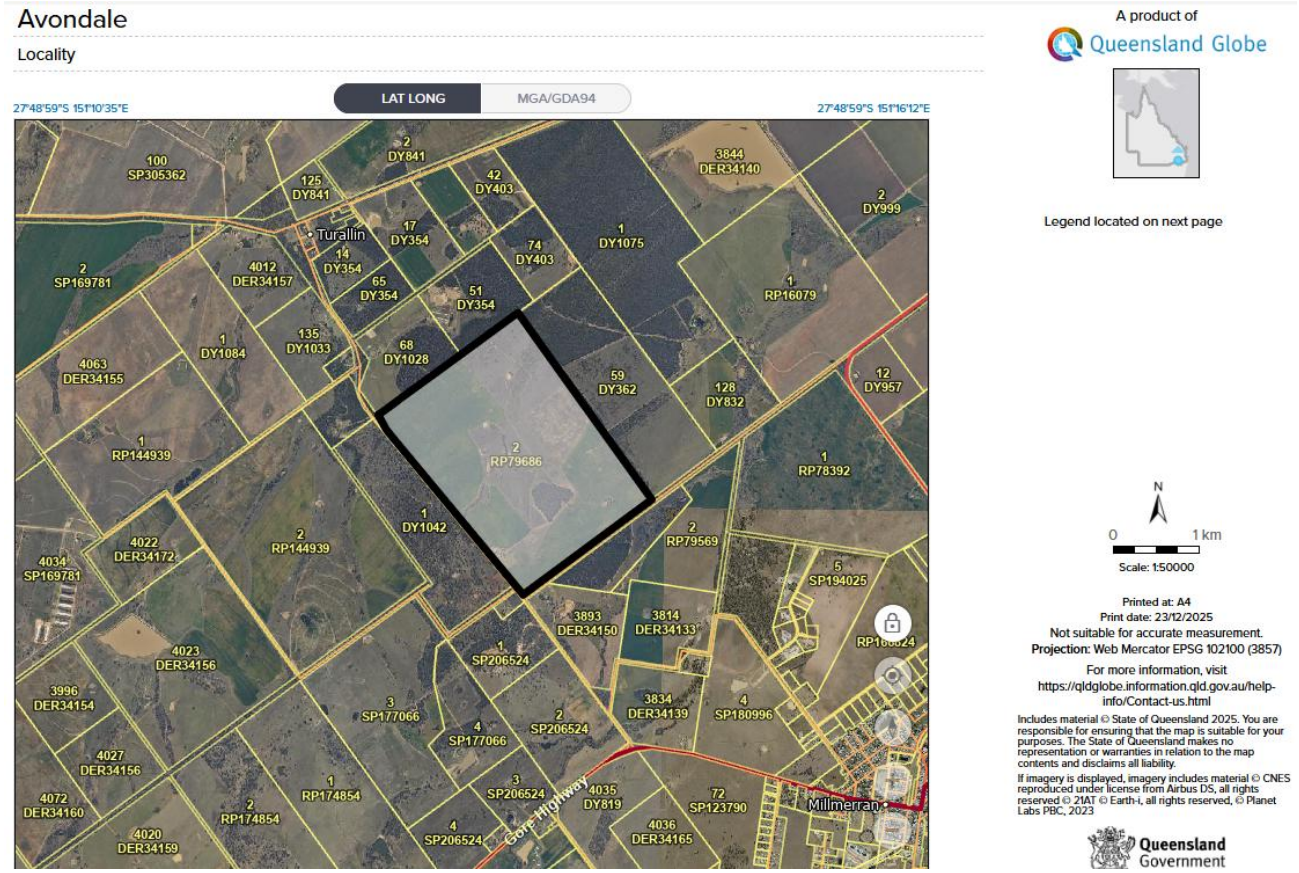


Figure 4. Locality Plan

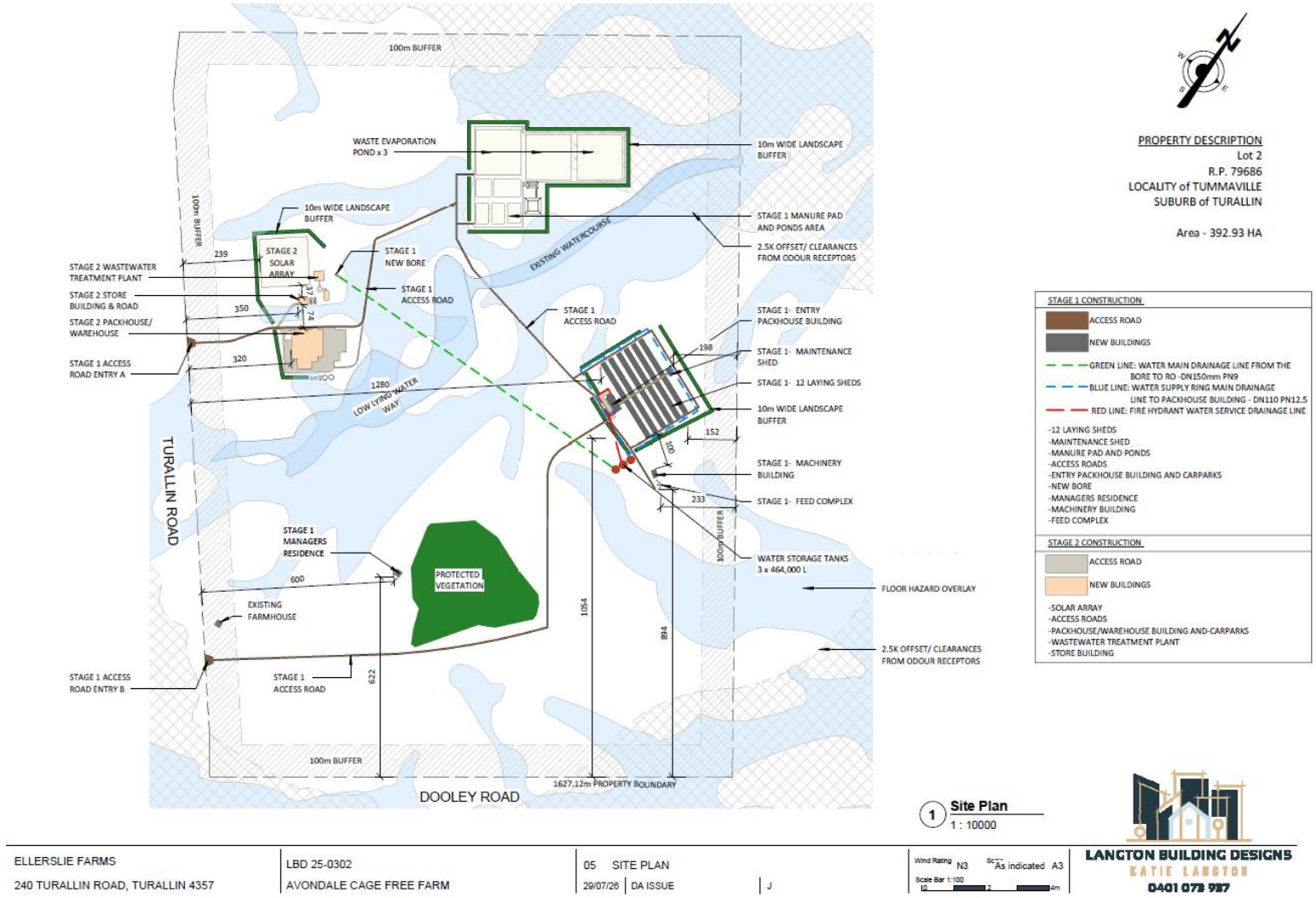


Figure 5. Site Plan (supplied)

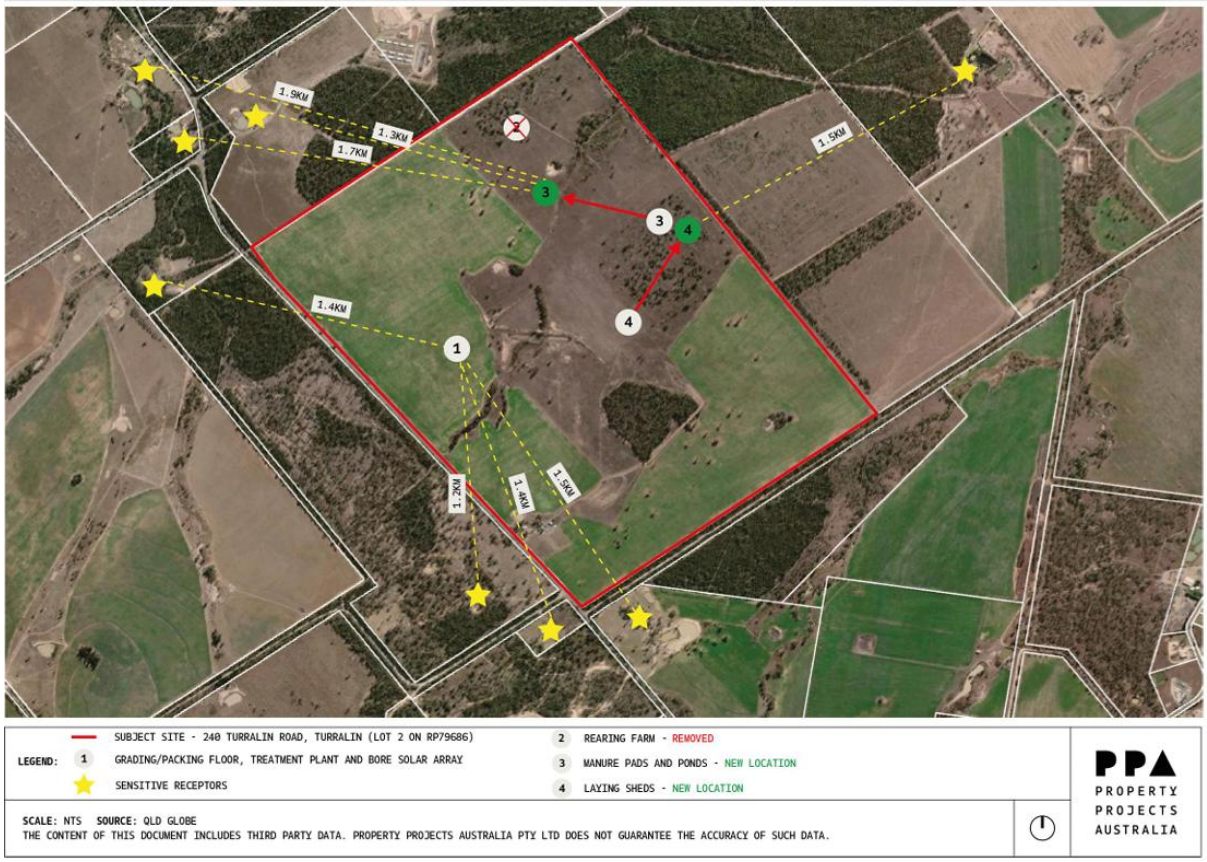


Figure 6. Nearby receptors (reproduced from Property Projects Australia)

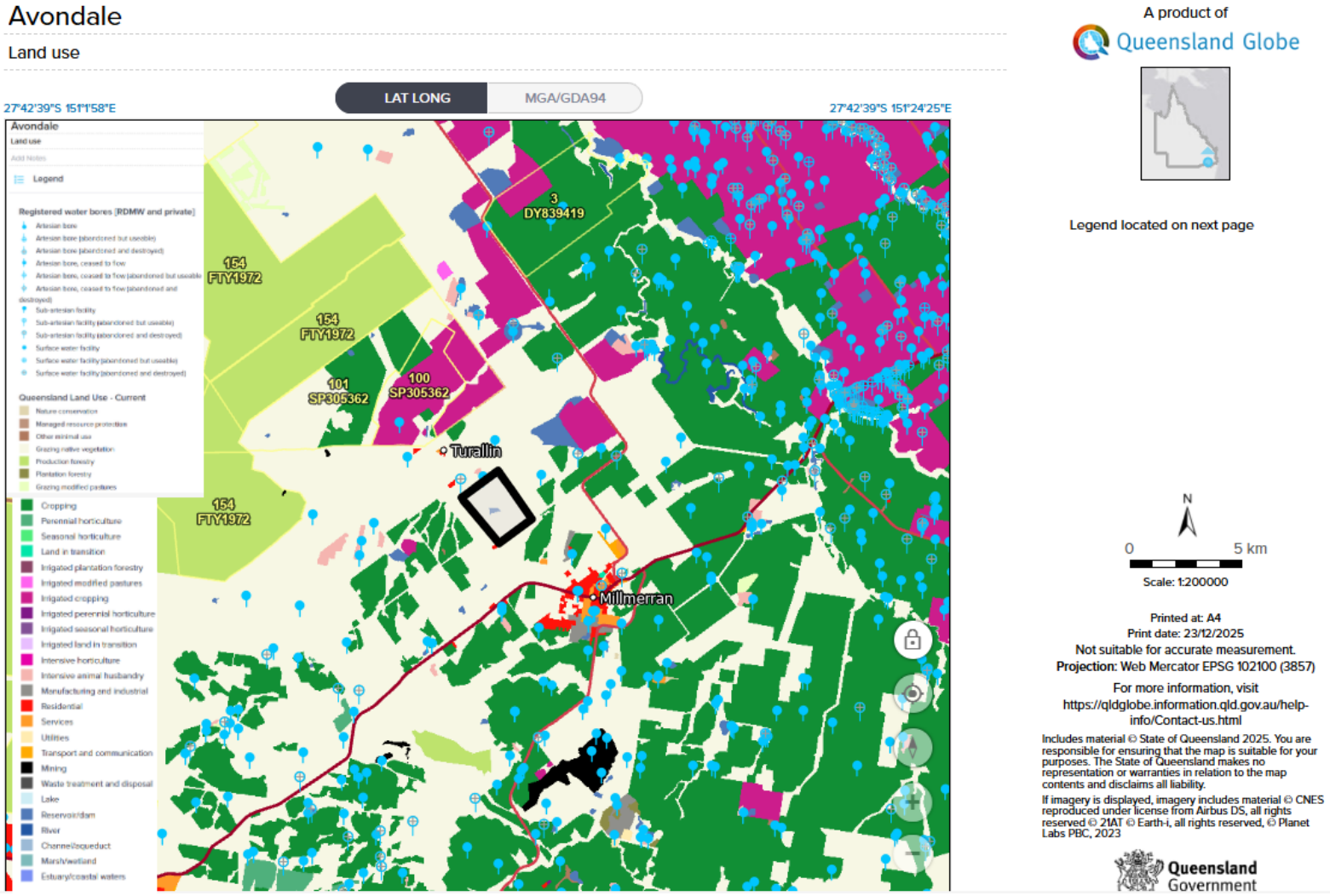


Figure 7. Land use

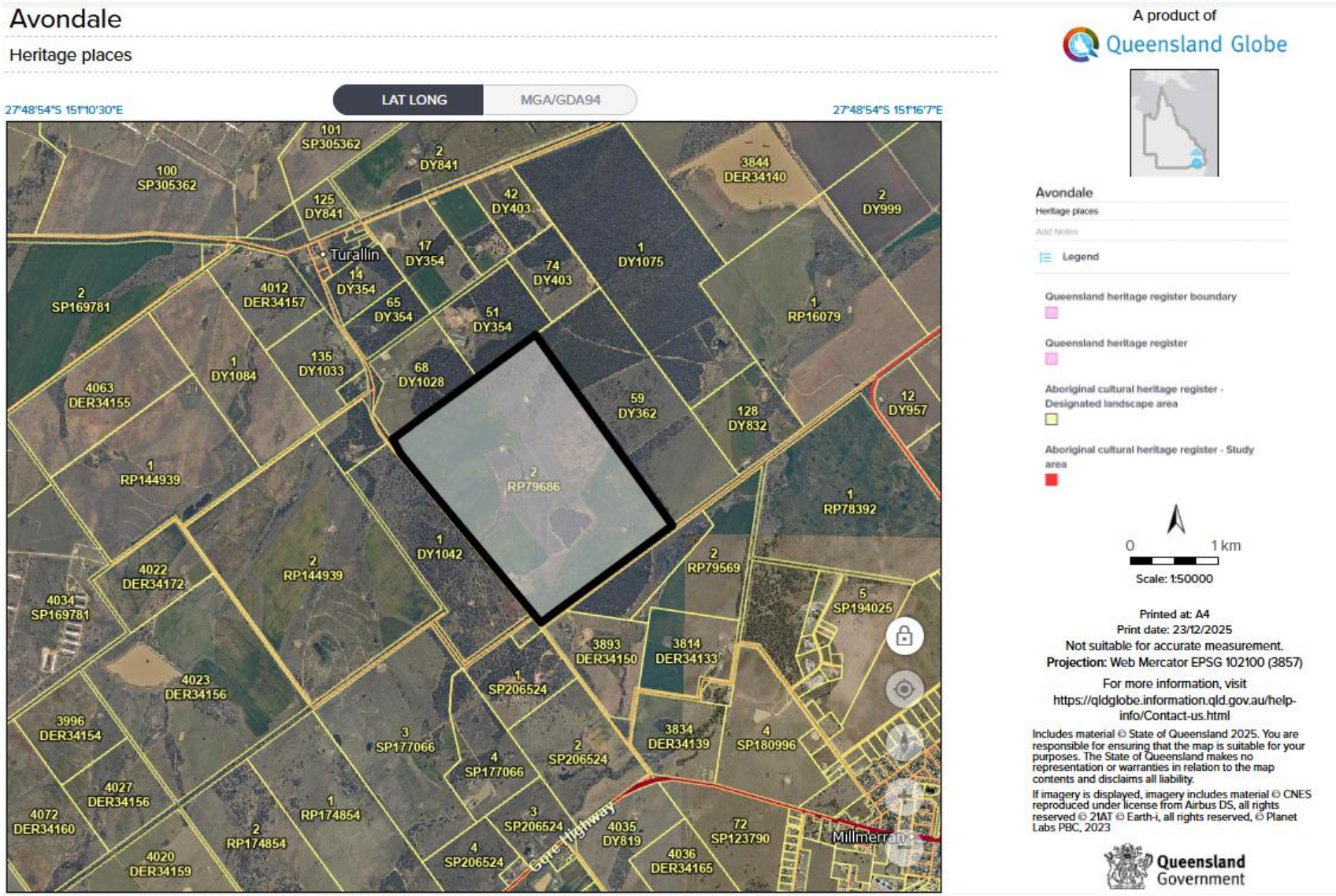


Figure 8. Heritage places

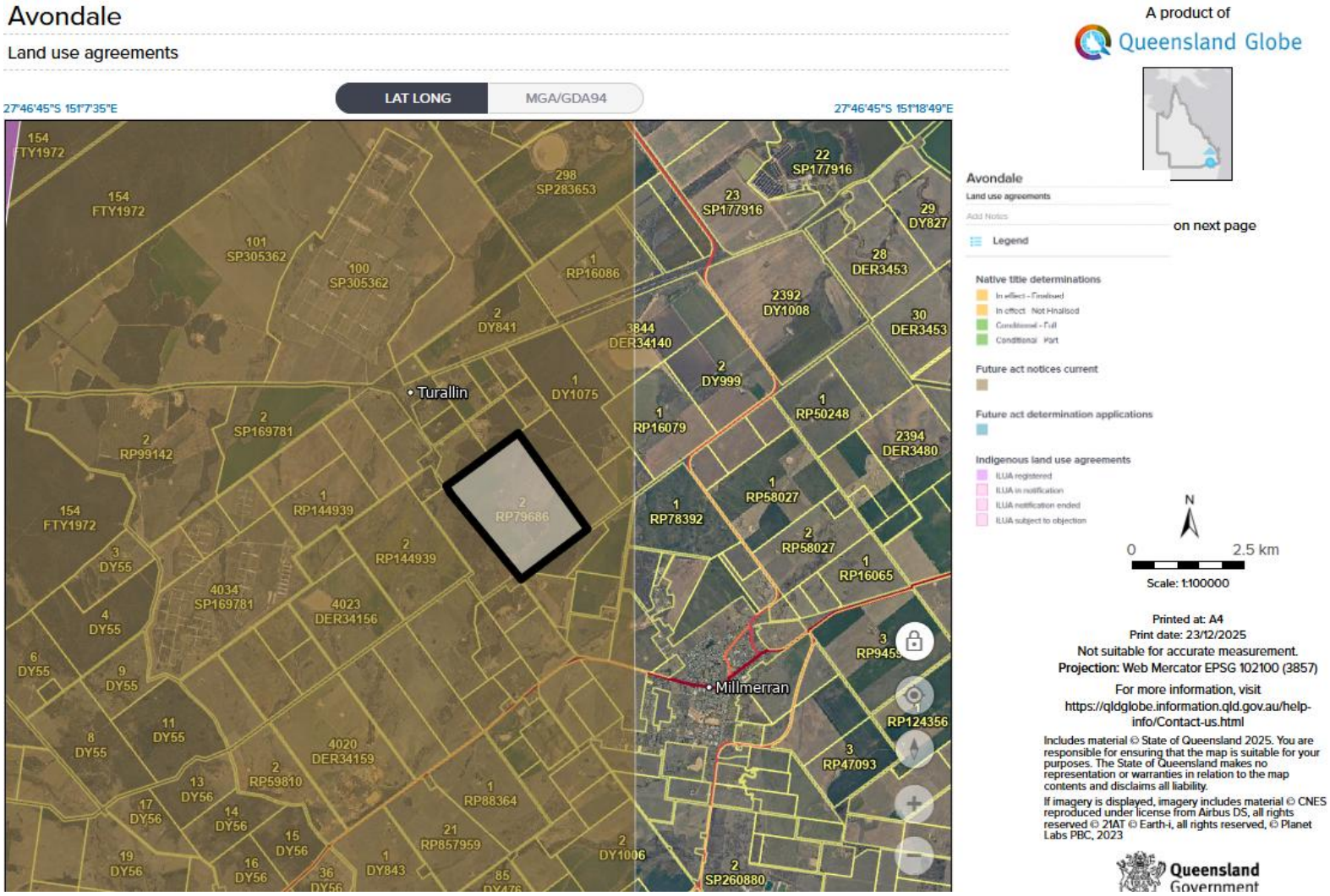


Figure 9. Land use agreements

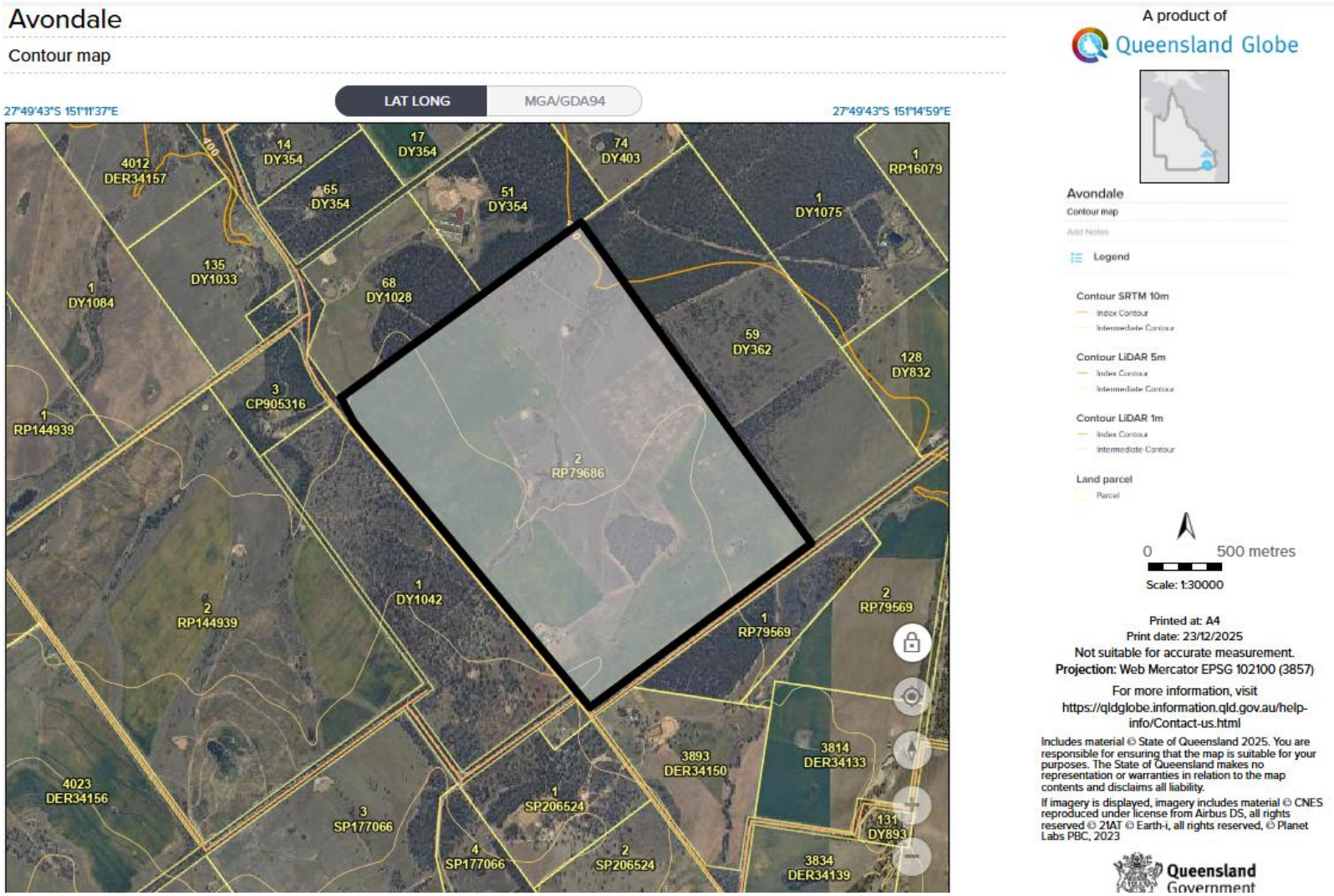


Figure 10. Topography

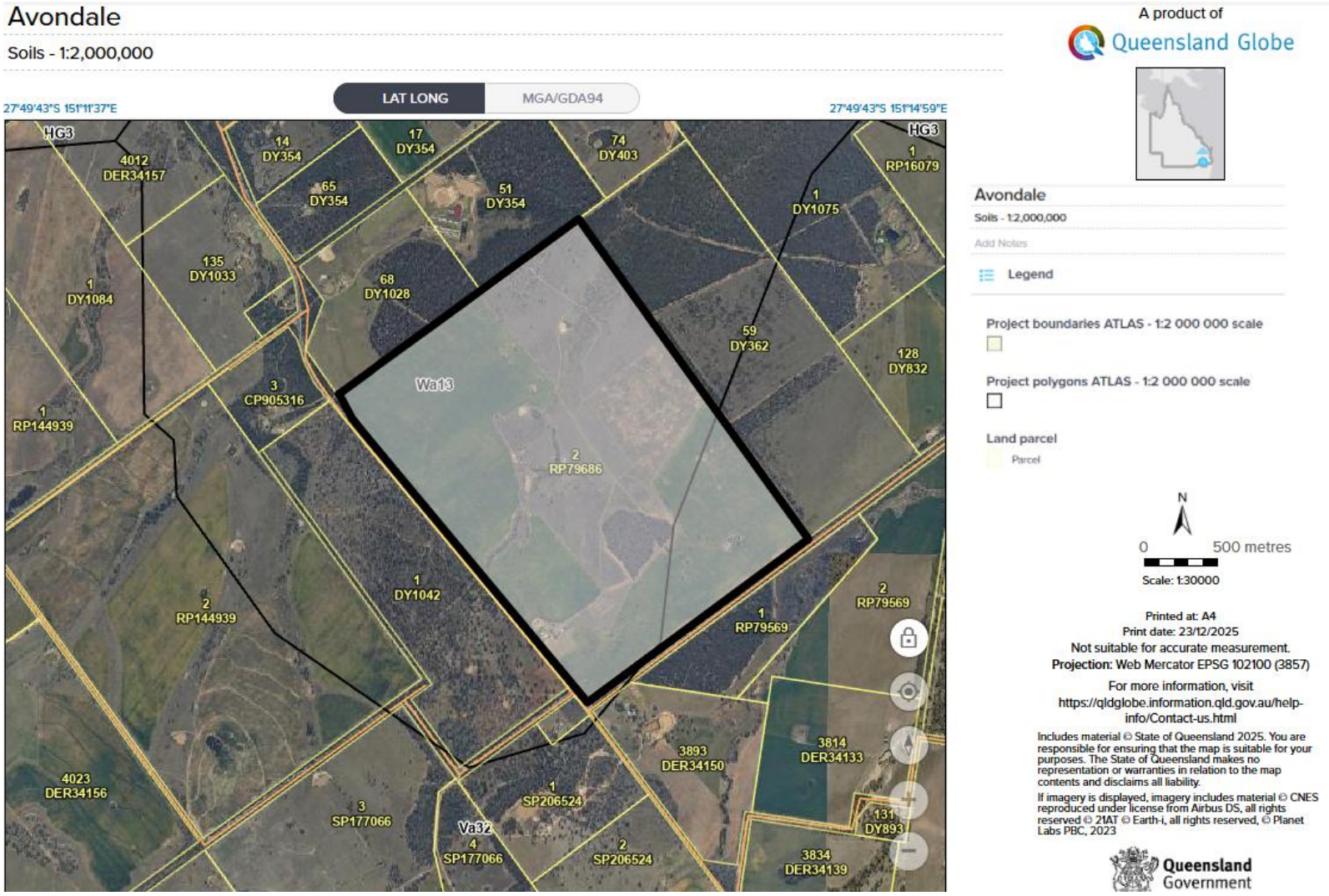


Figure 11. Soil types

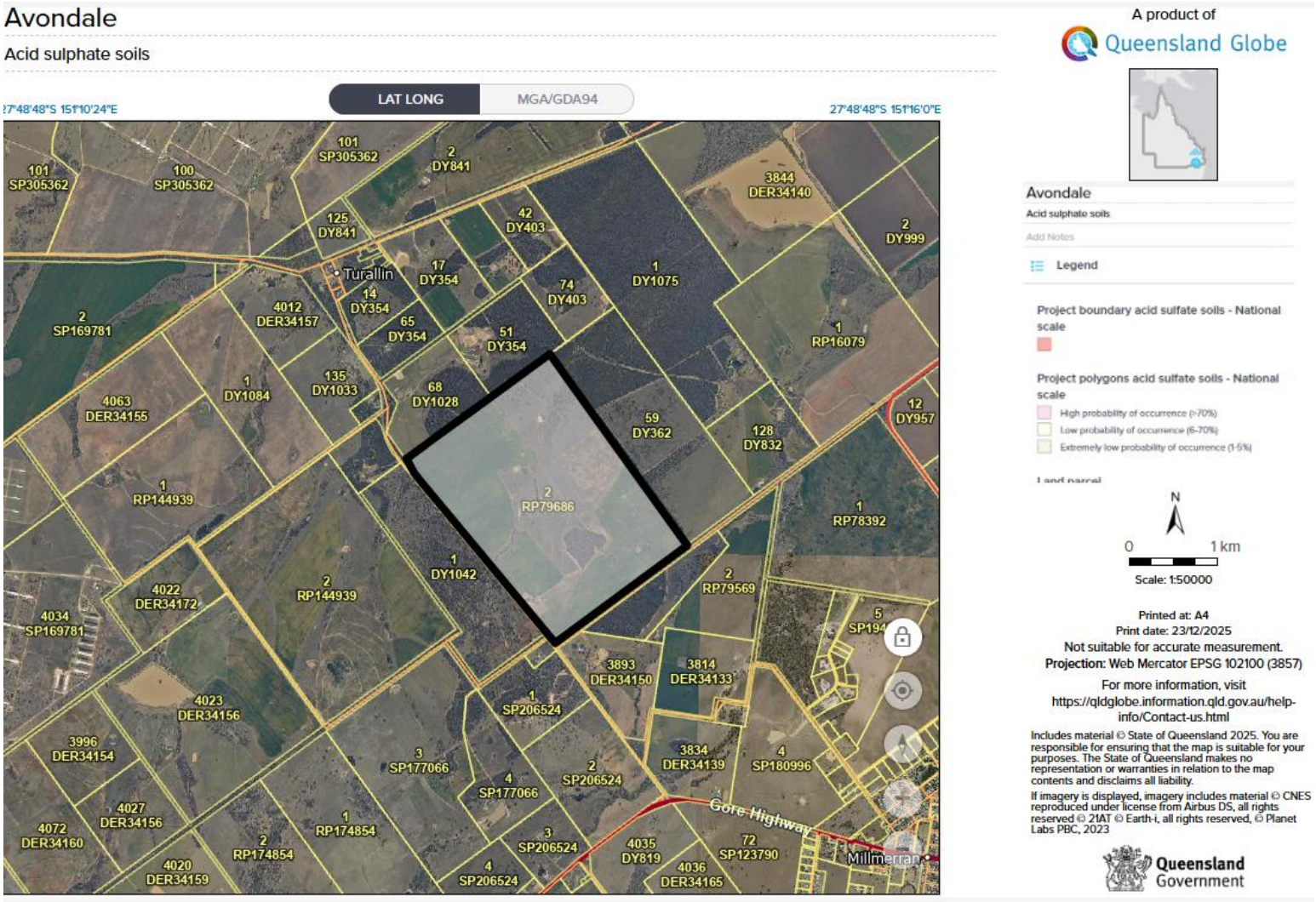


Figure 12. Acid sulphate soils

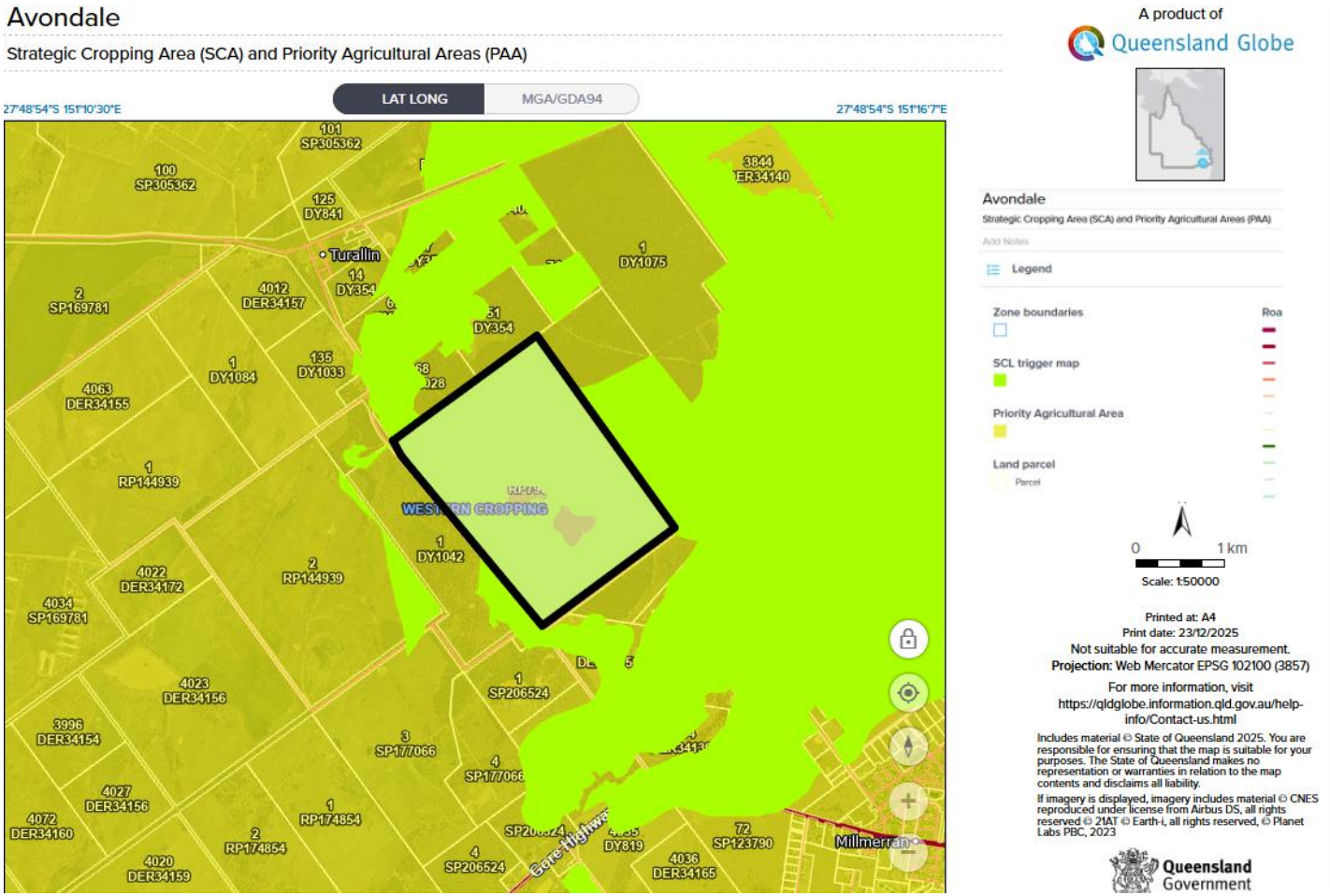


Figure 13. Strategic cropping areas (SCA) and Priority agricultural area (PAA)

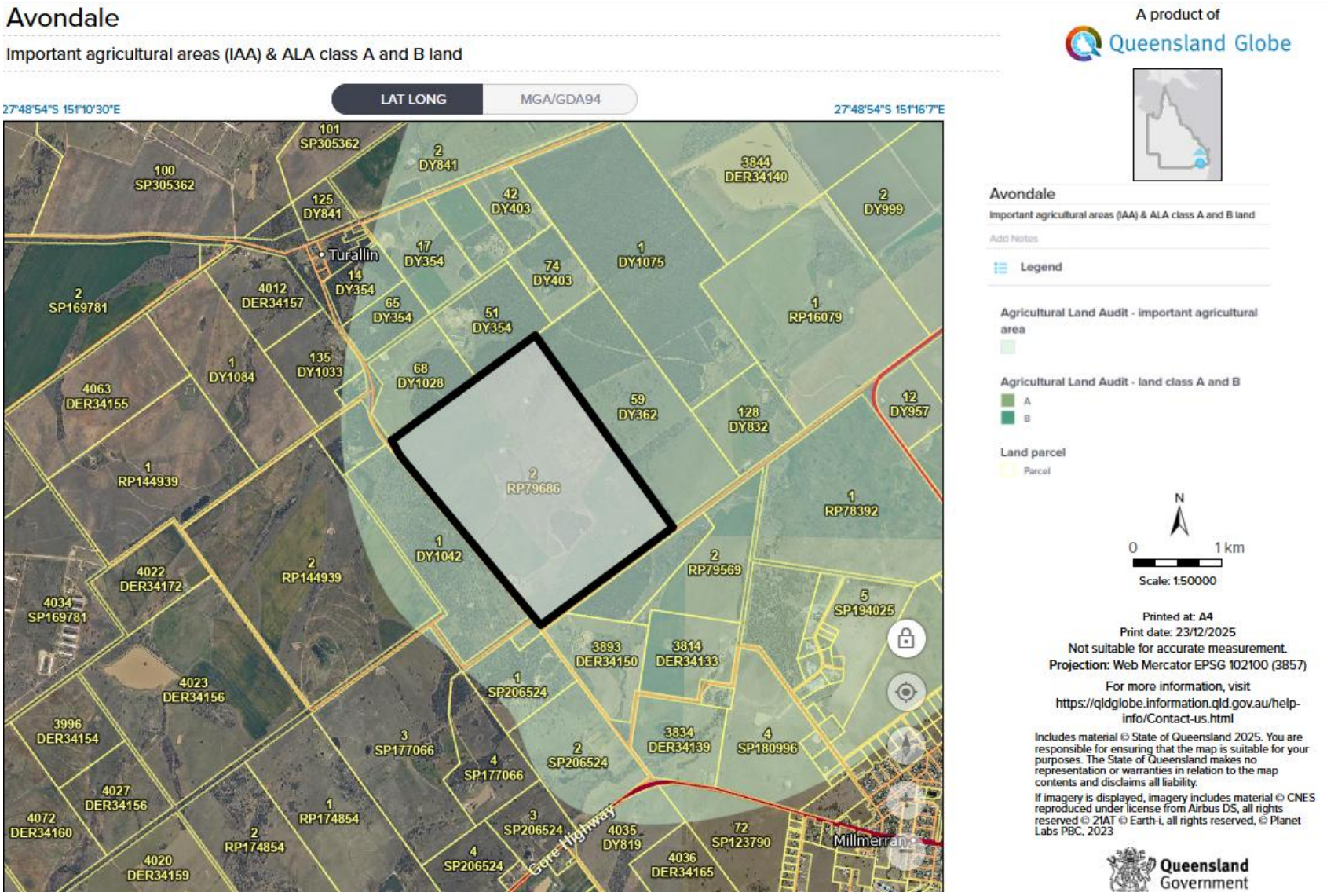


Figure 14. Important agricultural areas (IAA) & ALA Class A and B land

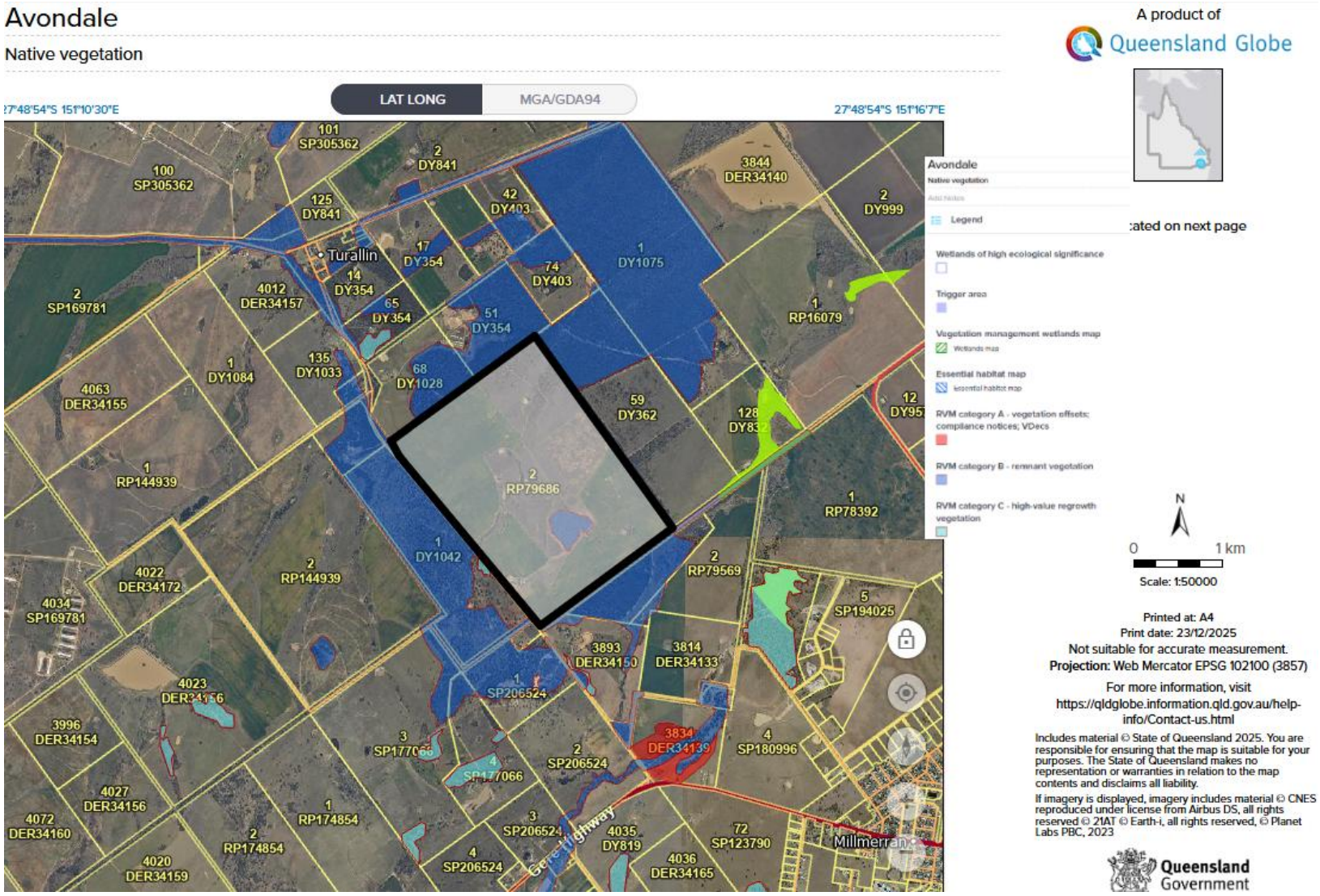


Figure 15. Native vegetation

Figure 16. Environmentally sensitive ecology

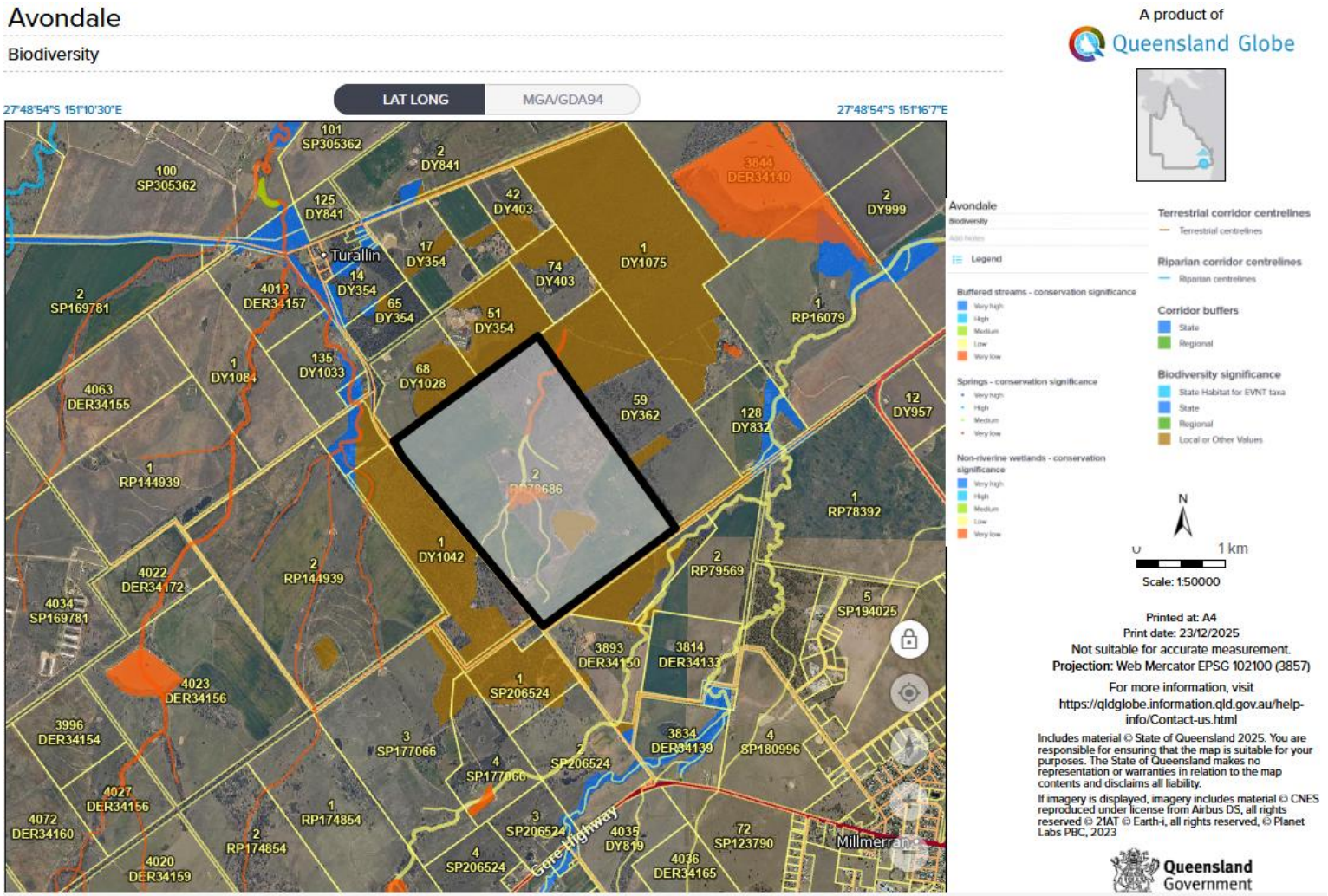


Figure 17. Biodiversity

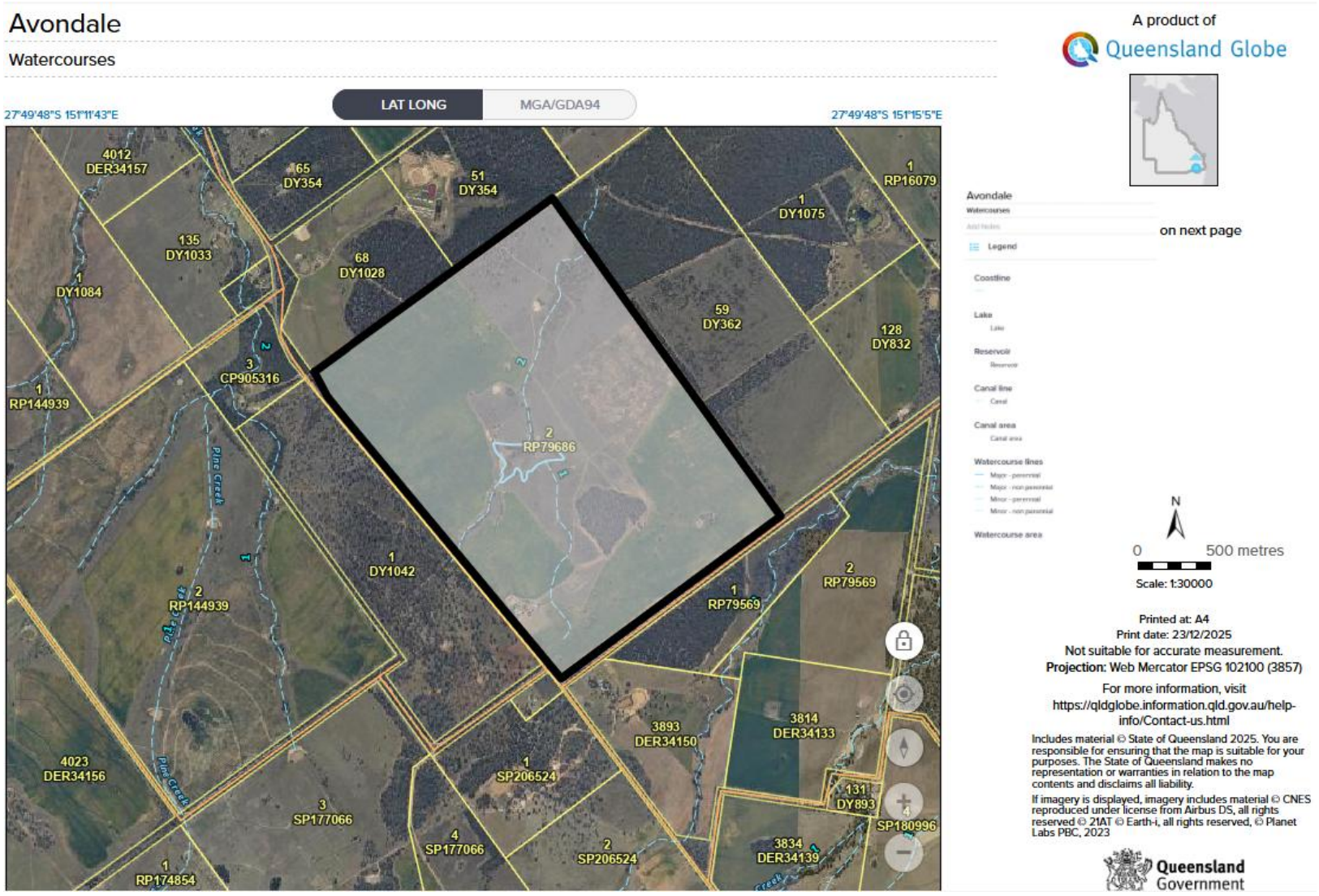


Figure 18. Watercourses

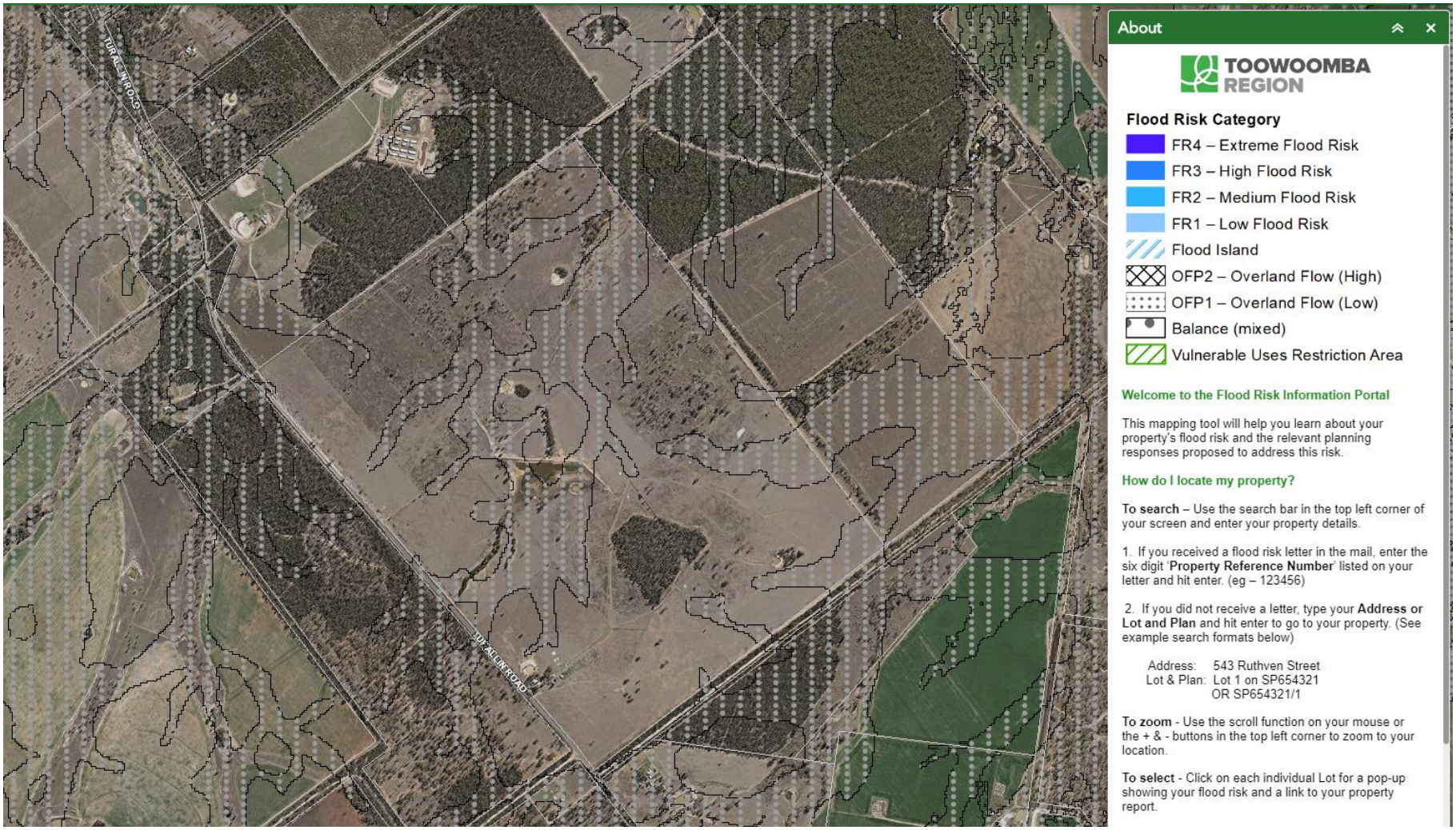


Figure 19. TRC Flood risk mapping

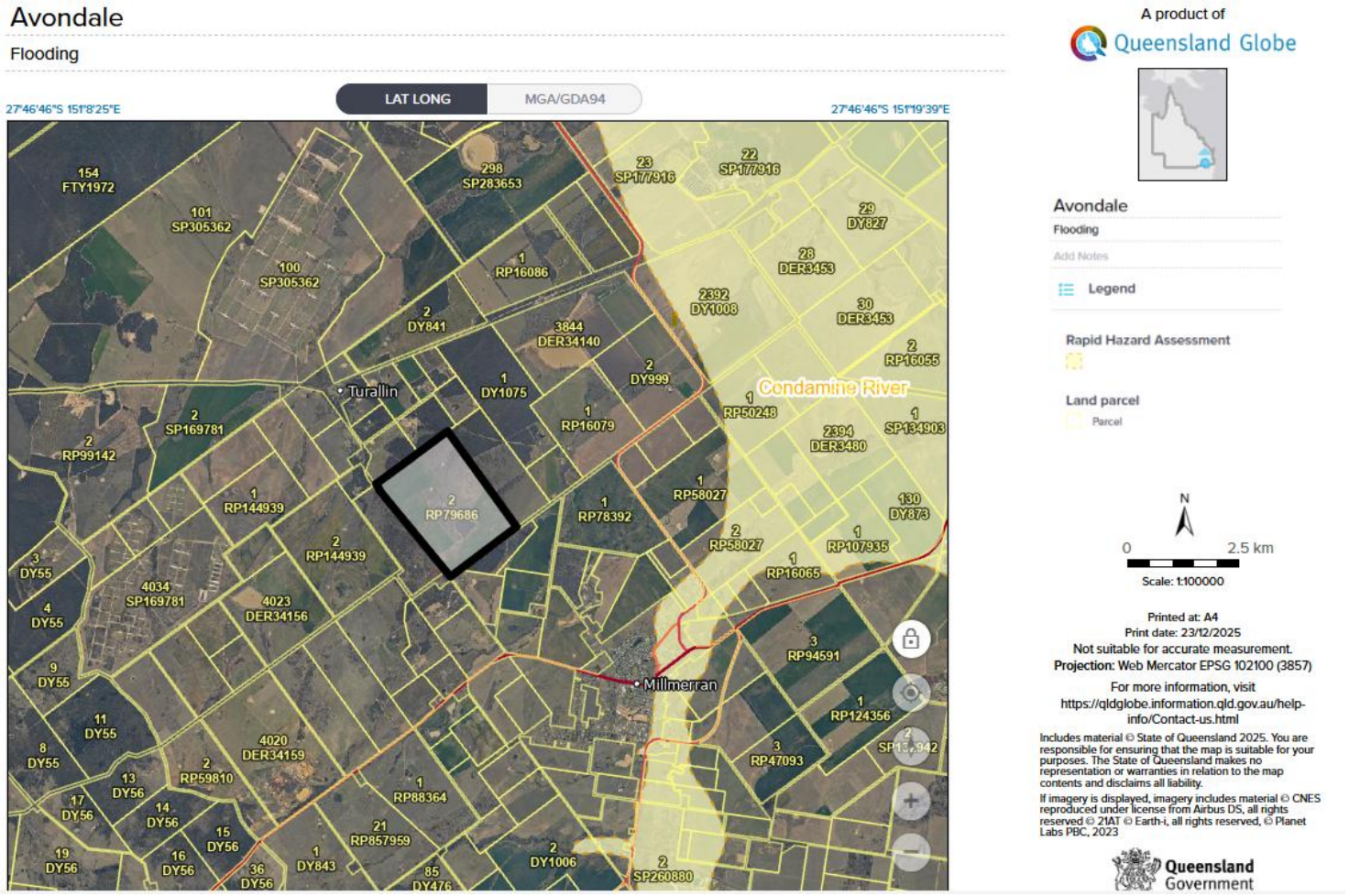


Figure 20. Modelled flood levels (Rapid hazard assessment)

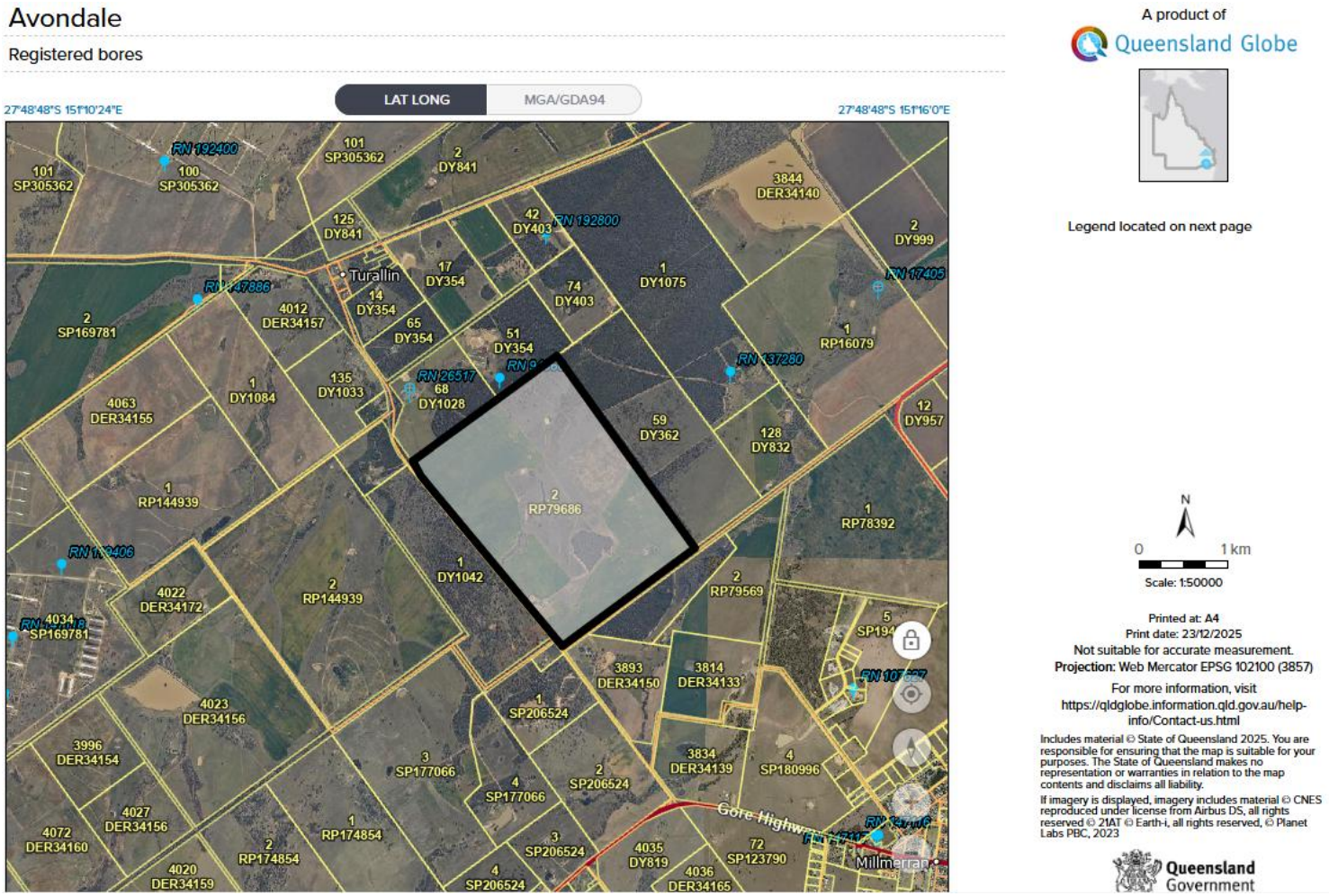


Figure 21. Registered groundwater bore locations

Appendix B Pad and Pond Calculations

Shed Pads and Runoff

The size of the controlled drainage area around the shed pad, including layer sheds, and the packing facility are calculated below, using representative runoff coefficients in accordance with runoff calculation guidance.

Layer Farm complex	Number	Unit
Length	310	m
B	285	m
Area	60,480	m^2
Sheds	12.0	#
L	132	m
B	16.1	m
Shed area	25,502	m^2
Pad shoulders	10	m
Additional Pad area	40,344	m^2
Runoff Coefficient – Sheds	1.0	C10
Runoff Coefficient – Pads / Carparks	0.8	C10
Runoff Coefficient – Natural areas	0.4	C10
Average C	0.8	C10
Runoff Capture	20.0	mm
Retention Dam	1.3	ML

Layer Farm complex	Number	Unit
L	250	m
B	150	m
Area	37,500	m^2
Sheds	1.0	#
L	100	m
B	100	m
Shed area	10,000	m^2
Pad shoulders	20.0	m
Additional Pad area	9,600	m^2
Runoff Coefficient – Sheds	1.0	C10
Runoff Coefficient – Pads / Carparks	0.8	C10
Runoff Coefficient – Natural areas	0.4	C10
Runoff Capture	20.0	mm
Shed runoff (to tanks)	0.2	ML
Average C (excl. sheds)	0.5	C10
Retention Dam	0.3	ML

Manure Pad Design

The manure pad and component areas have been sized in accordance with the calculations detailed on the following pages, based on production data from existing sites and the stated assumptions.

The general design consists of:

- The 150x145m (**2.18ha**) compacted pad for conducting manure and dead bird management.
- A 5m buffer and transport road runs the full perimeter of the pad.
- The 85x55m manure storage area, designed for windrowed manure in accordance with the calculations outlined below.
- Two 65x40m Emergency animal disease disposal (burial) areas.
- A 50x55m primary burial area for disposal of mortalities throughout the production cycle.
- A 65x40m future burial area once the primary burial area reaches capacity (approx. 20y at current production).
- Separation of 10m between each EAD area and future burial area, separation of 15m between EAD areas and manure storage area.

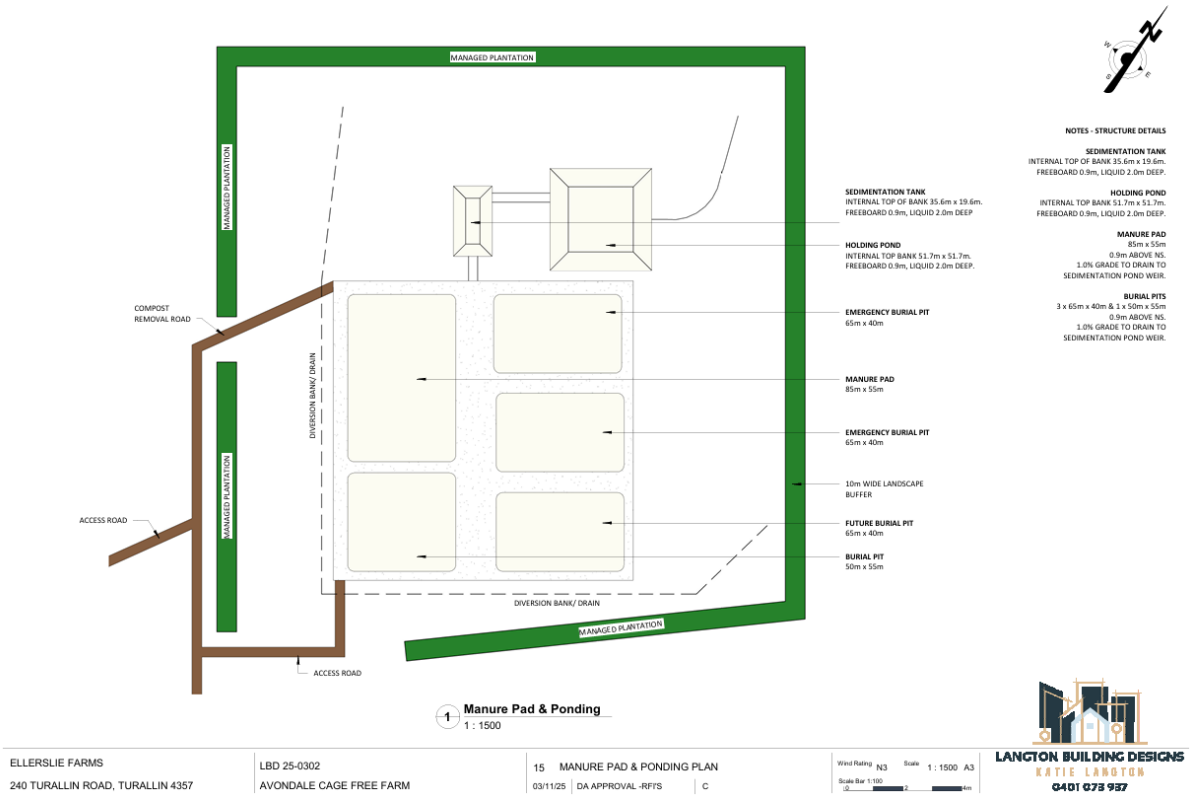


Figure 22. Manure pad indicative design (subject to change)

Manure Production (dry matter)			
Parameter	**Value**	**Units**	**Refs / Assumptions**
Layer hen manure	10.6	t DM/1000 birds / yr	From National Egg Guidelines
Layer hen number	840,000	bird places	
Total Layer manure	8,940	t DM/yr	
Layer manure – to belts (offsite removal)	6,678	t DM/yr	75% to manure belts
Layer manure – to pad (temporary storage)	2,226	t DM/yr	25% to floor section of sheds
Total manure to pad	2,226	t DM/yr	
Total manure DM (removed every 12wks)	514	t DM /12wks	
Moisture content floor manure	28.9	%	Jenkins 2015 (as reported in Egg Guidelines)
Manure weight (inc. moisture)	662	t manure /12wks	
Bulk Density	550	kg/m^3 @ 25% MC	WA COP 2004– Moisture similar to spent litter, assume same bulk density.
Volume manure produced	1,204	m^3 manure /12wks	

Pad Sizing		
Windrow dimensions		
Height	1.0	m
Base	3.4	m
Length	85.0	m
CSA	2.4	m^2
Number of Windrows (@1376m3/12wks)	6.0	#
Space between rows	5.0	m
Length of manure area (incl handling)	55	m
Width of manure area	85	m

EAD Burial Pit		
Layer hen number	840,000	#
Volume of dead layer	0.005	m^3
Pit Volume (REQ)	3,780	m^3
Pit Volume (CALC)	3,839	m3
Length @ GL	65	
Width @ GL	40	m^3
Side Batters	2	:1 x:y
Depth	1.7	m
Bottom length	58.2	m
Bottom width	33.2	m

Primary Burial Pit		
Layer hen number	840,000	#
Volume of dead layer	0.005	m^3
Mortality /yr (max)	5%	
Design life	20	yrs
Pit Volume (REQ)	3,780	m^3
Pit Volume (CALC)	3,884	m^3
Length @ GL	50	
Width @ GL	55	m^3
Side Batters	2	:1 x:y
Depth	1.6	m
Bottom length	43.6	m
Bottom width	48.6	m

Manure Pad Ponds

The manure pad ponds are designed with a sedimentation basin and holding pond in accordance with the Feedlot Guidelines, in order to meet DPI Qld requirements (Appendix C).

CATCHMENT AREAS AND SLOPE		
Hard catchment area	2.18	ha
Soft catchment area	0.00	ha
Sedimentation system area	0.08	ha
Holding pond area	0.27	ha
Pad down-slope	1.0%	
Pad cross-slope	1.0%	
Catch drain slope	1.0%	

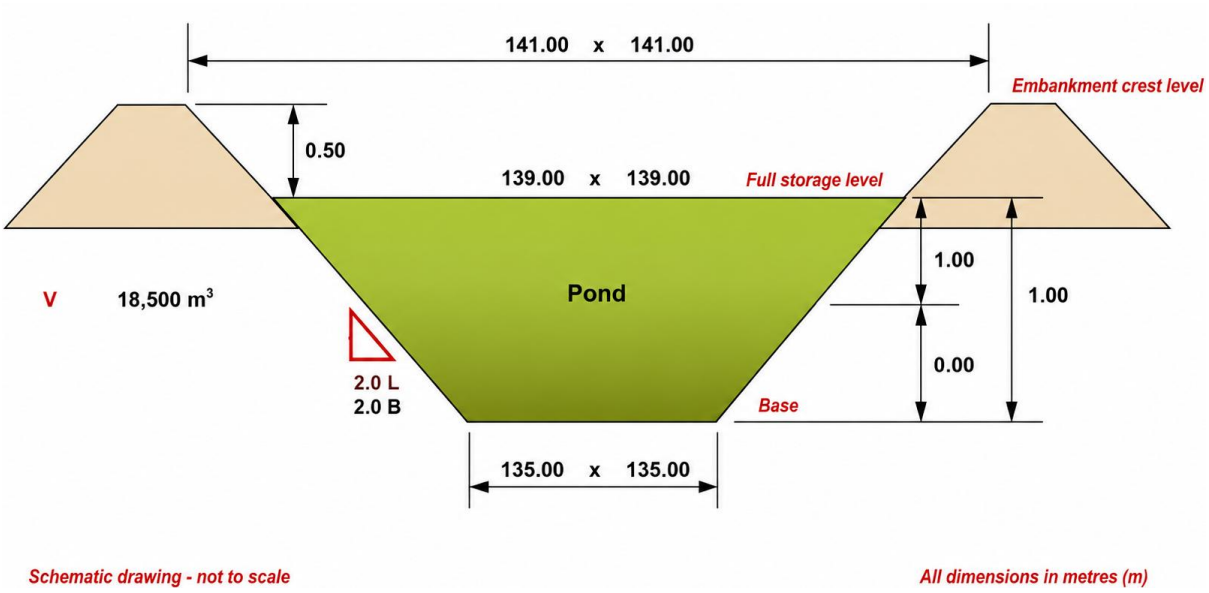
SEDIMENTATION SYSTEM		
Sedimentation system type	Basin	
Length to width ratio (L/W)	2.0	
Scaling factor (□)	2.5	
Design flow velocity (v)	0.005	m/s
Overland flow length	209	m
Overland flow time	15.59	minutes
Drain length	0	m
Drain flow time	0.00	minutes
Time of concentration (tc)	15.59	minutes
Tabulated rainfall intensity (Qld localities) for 5% Annual Exceedance Probability (AEP)	134.8	mm/hr
Peak inflow rate (Qp) for 5% AEP design storm	0.7	m^3/s
Required sedimentation system volume (V)	675	m^3
Proposed sedimentation system volume	675	m^3
Minimum surface area	0.07	ha
Tabulated rainfall intensity (Qld localities) for 2% Annual Exceedance Probability (AEP)	160.8	mm/hr
Peak inflow rate (Qp) for 2% AEP design storm	0.8	m^3/s
Suggested minimum control weir width (based on 0.6 m deep by-wash flow)	1.0	m

RUNOFF HOLDING POND		
Pen pond volume co-efficient (Cp)	1.481	ML/ha
Pen area (Ap)	0.00	ha
Hard catchment pond volume co-efficient (Ch)	1.541	ML/ha
Hard catchment area (Ah)	2.52	ha
Soft catchment pond volume co-efficient (Cs)	0.754	ML/ha
Soft catchment area (As)	0.00	ha
Effluent holding pond storage capacity (V)	3.89	ML
Proposed effluent holding pond storage capacity (V)	3.90	ML
Depth – base to by-wash level, (D)	2.00	m
Batter – lengthwise, Zl (1 vertical : z horizontal)	2.00	
Batter – breadthwise, Zb (1 vertical : z horizontal)	2.00	
Freeboard – by-wash to crest, (F)	0.90	m
Length – at embankment crest, (Lc)	51.70	m
Breadth – at embankment crest, (Bc)	51.70	m
Length – At by-wash level, (Lfsl)	48.10	m
Breadth – at by-wash level, (Bfsl)	48.10	m
Length – at base, (Lb)	40.10	m
Breadth – at base, (Bb)	40.10	m
Length : Breadth Ratio	1.00	
Surface Area at Embankment Crest	0.267	ha
Peak outflow rate (Qp) for 2% AEP design storm	0.90	
Suggested minimum by-wash inlet width (based on 0.5 m deep by-wash flow)	0.85	

Evaporation Basins

The three evaporation basins are designed in parallel to each other and in accordance with findings from the MEDLI assessment to limit overtopping to once in every 20 years on average (Tucker et al., 2025). The dimensions and cross section of each basin are provided in the table and figure in this section.

EVAPORATION BASIN		
Length – at embankment crest	141.0	m
Breadth – at embankment crest	141.0	m
Length – at full storage level	139.0	m
Breadth – at full storage level	139.0	m
Length – at base	135	m
Breadth – at base	135	m
Height of berm	0.5	m
Length: Breadth Ratio	1.0	
Maximum basin volume	18,500	m^3
Maximum water surface area	19,322	m^2
Pond depth at outlet	1	m
Leakage rate	0.1	mm/day
Evaporation coefficient	0.7	mm/mm
Surface area at embankment crest	1.99	ha



Appendix C Standard Specification – Clay Lining Guide

APPENDIX E
STANDARD SPECIFICATION

CATTLE FEEDLOTS

QUEENSLAND GOVERNMENT

DPI QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

CLAY LINING OF DRAINS, SEDIMENTATION SYSTEMS, HOLDING PONDS AND MANURE STOCKPILE AREAS

Alan Skerman, Senior Environmental Engineer, Intensive Livestock Environmental Management Services

INTRODUCTION

This standard specification is intended to provide guidance and technical direction to licensees, contractors, consultants and project managers involved in the construction of cattle feedlots at sites where groundwater impact assessments have indicated a high potential for contamination of underground and/or surface water resources, because of leaching of nutrients through permeable, underlying soil or rock strata. It outlines this Department's recommended practices for the clay lining of drains, sedimentation systems, holding ponds and manure stockpile areas and provides a set of enforceable, quantitative standards to ensure that consistency is achieved throughout the industry.

This specification is based on established engineering principles and operational experience gained by the industry over several years. However, it may be revised from time to time as new methods are developed and/or as experience dictates. Proposals involving alternative materials and/or construction methods may be submitted to the administering authority for consideration.

1. PERMEABILITY STANDARD

If a groundwater impact assessment indicates a high potential for contamination of underground and/or surface water resources, because of the leaching of nutrients through permeable, underlying soil/rock strata, clay lining of the feedlot complex should be undertaken in accordance with this specification. For the purpose of this specification, it is considered that there is a significant risk of nutrient leaching if the permeability of underlying soil/rock strata exceeds 0.1 mm/day (37 mm/year).

Because in-situ and laboratory measurement of permeability is difficult and relatively inaccurate, rather than relying on permeability standards, this document provides proven standards for materials and methods used for clay lining. By applying these standards, the required permeability should be achieved consistently.

2. AREAS TO BE CLAY LINED

Unless the underlying soil type and geology changes significantly across the feedlot site, each of the following areas of the feedlot complex should be clay lined:

- internal catch drain(s),
- sedimentation system(s),
- holding pond(s) and
- manure stockpile area(s)

Because of the formation of a low permeability soil–manure interface layer, clay lining is not generally required on the pen and yard areas, unless directed by the administering authority.

3. CLAY LINING SURFACE PREPARATION

All surfaces to be clay lined shall be cleared and grubbed, stripped of topsoil and prepared to the required levels and gradients by cutting and filling, as required. This will involve over-excavation (excavation below the design level indicated on the plans) to accommodate the required thickness of clay lining while ensuring that the final design gradients, levels and dimensions are achieved, in accordance with the plans approved by the administering authority.

To produce a satisfactory bonding surface for the placement of subsequent layers, the following operations should be carried out on all areas to be clay lined:

(i) scarifying or ripping with a tined implement, to a minimum depth of 150 mm,
(ii) watering to produce the correct moisture content, as specified in Clause 6,
(iii) compaction in accordance with Clause 7.

4. CLAY LINING MATERIAL

Soils shall be considered suitable for use as clay lining materials, subject to compliance with the following requirements:

The material shall be classified as either CL, CI, CH, SC or GC in accordance with the soil classification system described in Appendix A of AS 1726. Furthermore, it shall conform with the following particle size distribution and plasticity limits:

(i) Particle Size Distribution:

AS Metric Sieve Size (mm)	**Percentage Passing** (by dry weight)
75	100
19	70 – 100
2.36	40 – 100
0.075	25 – 90

(ii) Plasticity Limits on fines fraction, passing 0.425 mm sieve:

Liquid Limit W_L	30 – 60 %
Plasticity Index I_p	> 10 %

Note for explanatory purposes: *The material classification symbols CL, CI, CH, SC* and *GC represent clays having low, intermediate and high plasticity, clayey sands and clayey gravels respectively.*

If materials complying with the above plasticity limits are not readily available, clays having liquid limits between 60% and 80% may be used as lining material, provided that the clay lining layer is covered with a layer of compacted gravel (or other approved material), having a minimum thickness of 100 mm, to prevent the clay lining from drying out and cracking.

Topsoil, soils incorporating tree roots or organic matter and any other material which does not compact properly, must not be placed in any of the areas to be clay lined. Wherever non-dispersive materials are available, they are to be used in preference to materials shown to be dispersive using the Emerson test, as described in Method 8.1 of AS 1289.

5. MATERIAL SUITABILITY AND IDENTIFICATION

The visual identification methods described in AS 1726 may be used by suitably qualified and experienced persons, for classifying soils in the field. However, if there is doubt about the suitability of the material, the administering authority may direct the licensee to arrange for laboratory testing, in accordance with the appropriate sections of AS 1289. All such laboratory testing must be carried out by a soils laboratory, accredited by the National Association of Testing Authorities (NATA).

6. CLAY LINING THICKNESS

The minimum required thickness of clay lining depends on the maximum head of effluent in contact with the clay lining and the duration of that contact. The following table outlines minimum lining thicknesses (after compaction), for the different areas of the feedlot, for two maximum head conditions.

Area of Feedlot	**Maximum Head Over Clay Lining** (m)	**Minimum Clay Lining Thickness** (mm)
Internal Catch Drains Sedimentation Systems Holding Ponds Manure Stockpile Areas	< 2 m	300
Sedimentation Systems Holding Ponds	> 2 m	450

7. PLACEMENT OF MATERIAL

Clay lining material complying with Clause 4, shall be placed at the correct moisture content as defined in Clause 8, on surfaces prepared in accordance with Clause 3, in progressive, uniform, horizontal layers, not exceeding 200 mm in thickness, prior to compaction.

8. CORRECT MOISTURE CONTENT

Prior to compaction, all material used for lining purposes shall be conditioned to have a moisture content within the range of two (2) percent wet to two (2) percent dry of the optimum moisture content required to produce the maximum dry density when compacted in accordance with Method 5.1.1 of AS 1289.

Note for explanatory purposes: *This moisture content is consistent with the requirements for compaction using a sheepsfoot roller to produce maximum impermeability. As a guide, the required moisture content is as wet as can be rolled without clogging a sheepsfoot roller. A preliminary assessment of the required moisture content can be made by rolling a sample of the material between the hands. If it can be rolled to pencil thickness without breaking, it should be satisfactory.*

9. COMPACTION

Each layer of material placed in accordance with Clause 7, shall be compacted to produce **either** a field dry density of at least 95% of the standard maximum laboratory dry density determined in accordance with Method 5.4.1 of AS 1289, **or alternatively**, a Hilf density ratio of at least 95% when tested in accordance with Method 5.7.1 of AS 1289.

Note for explanatory purposes: *This degree of compaction may generally be achieved by rolling each layer of material, placed at the correct moisture content, with at least eight (8) passes of a sheepsfoot roller of the configuration described in Clause 10 below. As a guide, compaction will generally be sufficient when there is a clearance of 100 mm between the drum of the roller and the compacted material.*

10. SHEEPSFOOT ROLLER

The following specifications describe a sheepsfoot roller which is suitable for fulfilling the compaction requirements described in Clause 9:

(i) The diameter of the drum(s) shall be not less than 1m.
(ii) The length of each drum(s) shall be approximately 1.2 times the drum diameter.
(iii) The feet shall extend approximately 175mm radially from the drum and be of the taper-foot type, with a cross-sectional area close to the outer end of not less than 3200mm^2 and not more than 4500mm^2.
(iv) The number of feet shall be such that their total area close to the outer ends shall be between 5% and approximately 8% of the area of the cylinder which would enclose all the feet, *i.e.* a cylinder having a diameter equal to the diameter of the drum plus twice the length of each foot.
(v) The weight of the roller ballasted, shall be such that the bearing pressure thus obtained shall be not less than 1750 kilopascals, in accordance with the following formula:

$$\text{Bearing Pressure (kPa)} = \frac{\text{Mass (kg)} \times 9.81 \times 1000}{\text{Area of contact of one row of feet (mm}^2\text{)}}$$

Rollers of other types and configurations may be used provided that the required compaction is achieved in accordance with Clause 9.

11. TEST FOR ADEQUATE COMPACTION

The administering authority may direct the licensee to arrange for compaction testing, in accordance with the methods referred to in Clause 9 of this specification, to be carried out on appropriate sections of the works area. Compaction testing is to be performed by suitably qualified and experienced personnel, employed by a soils laboratory accredited by the National Association of Testing Authorities (NATA) for the specified testing method.

Failure of the test results to comply with the compaction requirements described in Clause 9 will result in the licensee being prohibited from stocking the feedlot until appropriate remedial measures are implemented, as directed by the administering authority.

12. EXEMPTION FROM CLAY LINING REQUIREMENTS

The administering authority may exempt a licensee from the requirement to clay line cattle feedlot facilities if the licensee can submit certified test results confirming that the permeability of soils underlying nominated areas of the feedlot does not exceed 0.1 mm/day.

Permeability testing is to be carried in accordance with the methods specified in either Part 6 of BS 1377 (Triaxial Permeability) or Section F7.1 of AS 1289. The test results shall be submitted to the administering authority, following certification by a National Association of Testing Authorities (NATA) accredited soils laboratory.

13. FINAL TRIMMING

Following the completion of compaction, final trimming of all clay lined areas shall be carried out to produce a smooth, uniform surface, in accordance with the design gradients, levels and dimensions shown on the plans, as previously approved by the administering authority.

14. SYNTHETIC LINERS

A licensee may submit to the administering authority, alternate material and installation specifications relating to the use of synthetic lining materials, in lieu of clay lining. Approval of synthetic lining proposals will be subject to assessment by the administering authority.

15. INDEMNITY

The Department of Primary Industries and Officers of that Department shall not be responsible for any costs incurred by either the licensee or his/her contractor, in carrying out any works, as directed by the administering authority, for the purpose of rectifying design and/or construction faults or omissions.

Appendix D Evaporation Basin MEDLI Outputs

General Information

SCENARIO REPORT: Full run

General information

Enterprise: 2145 - Avondale RO Evaopration Ponds
Client: DA Hall
MEDLI user: LW

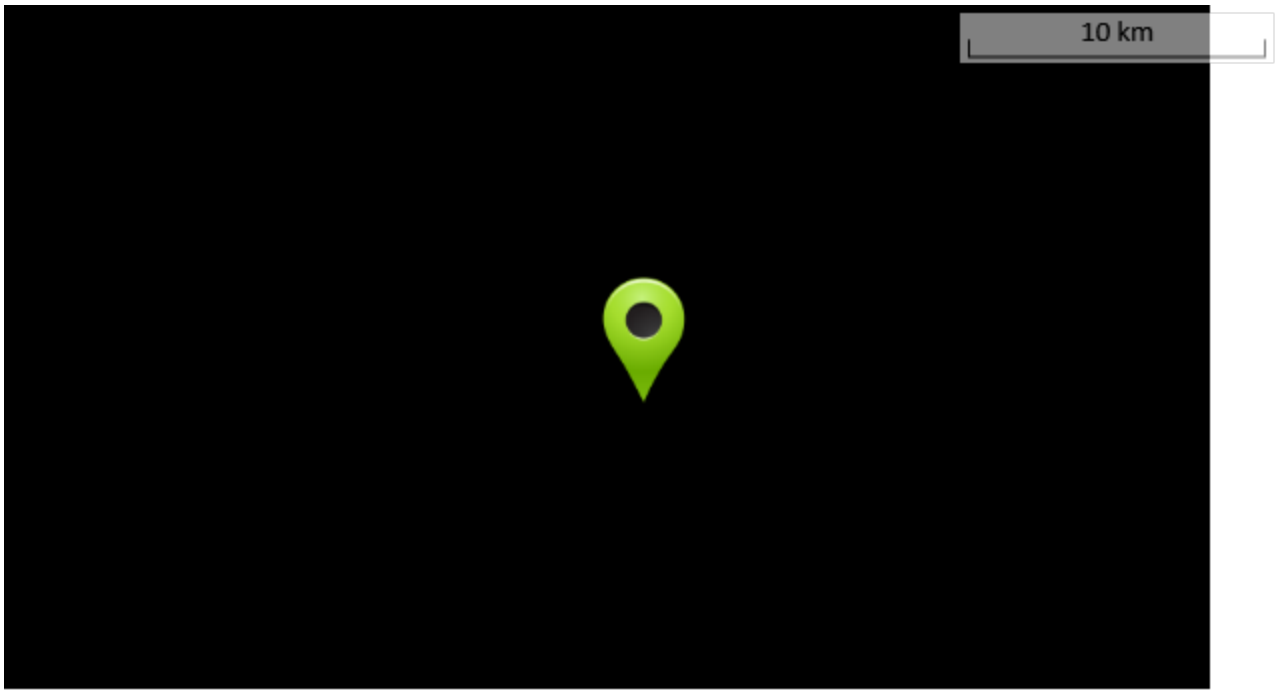
Description:

RO wastewater drains to 2 evaporation ponds (incl. one overflow pond). No irrigation. Only losses th

Scenario details:

Map of location:

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



Description

Climate information

Climate Data Location: Avondale, -27.84°, 151.24°

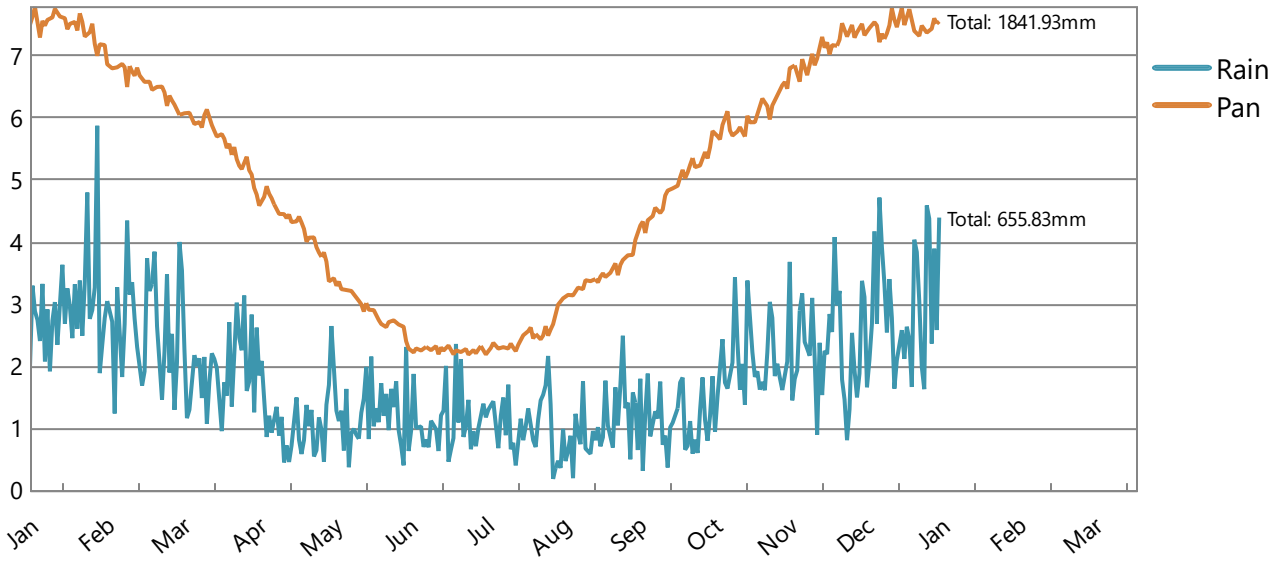
Run Period: 01/01/1925 to 31/12/2025 (101 years)

Climate statistics

	5th Percentile		50th Percentile		95th Percentile	
Rainfall (mm/year)	(Year 2018)	408.0	(Year 1977)	640.2	(Year 1999)	922.8
Pan evaporation (mm/year)	(Year 2011)	1593.4	(Year 2017)	1853.5	(Year 1993)	2073.5

Climate data

Daily average across run period:



Description

Wastestream information

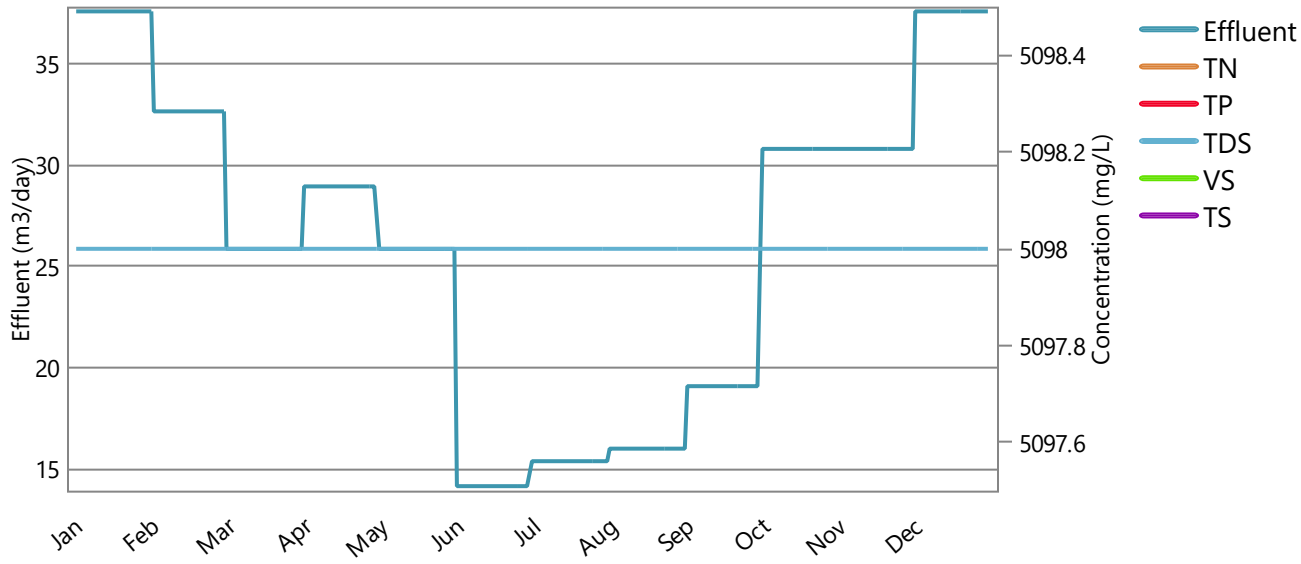
Wastestream Name: Waste estimation system - New generic system

Wastestream production description

Daily New generic system data supplied for a representative year. This wastestream is not separately pretreated.

Wastestream

Average Daily Quantity and Flow-Weighted Average Quality:



Wastestream

Effluent Quantity: 9571.89 m3/year or 26.21 m3/day (Min-Max 14.17 - 37.58)

Flow-Weighted Average (Min - Max) Daily Effluent Quality Entering the 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	5098.00 (5098.00 - 5098.00)	48797.51 (48750.08 - 48941.67)
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)

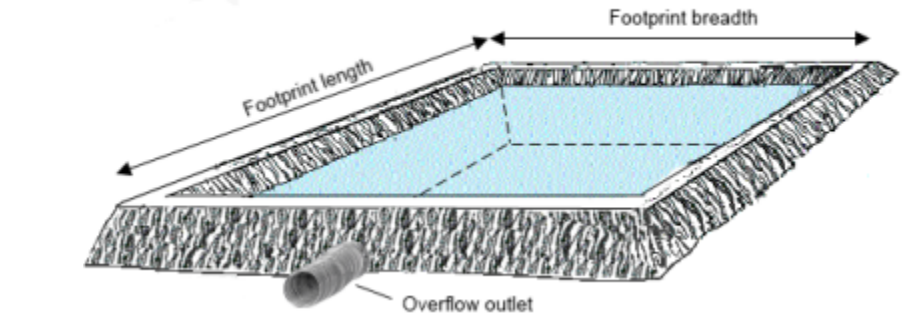
Description

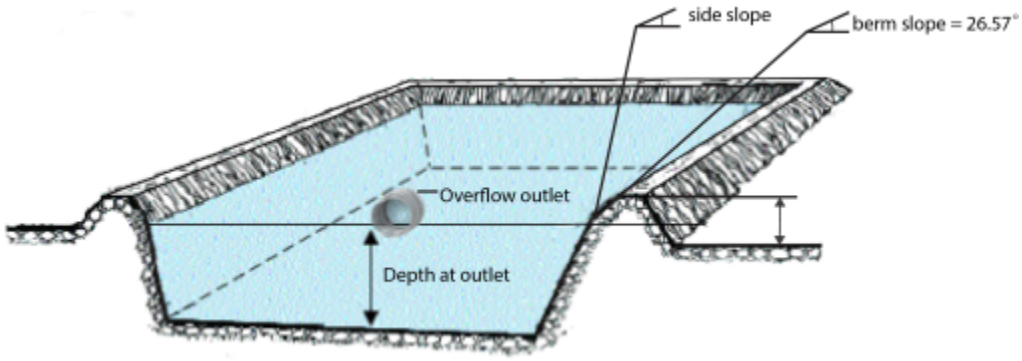
Pond system information

Pond System Configuration: 1 sludge-free pond

Pond system details

	Pond 1
Maximum pond volume (m3)	18500.00
Minimum allowable pond volume (m3)	18500.00
Pond depth at overflow outlet (m)	1.00
Maximum water surface area (m2)	19322.26
Pond footprint length (m)	141.00
Pond footprint width (m)	141.00
Pond catchment area (m2)	19882.28
Average active volume (m3)	5074.17





Irrigation pump limits

Minimum pump limit	As scheduled
Maximum pump limit	As scheduled

Shandying water

Annual allocation of fresh water available for shandying (m3/year)	0.00
Maximum rate of application of fresh water (L/day)	0.00
Nitrogen concentration (mg/L)	0.00
Salinity (dS/m)	0.00
Minimum shandy water is used	No

Description

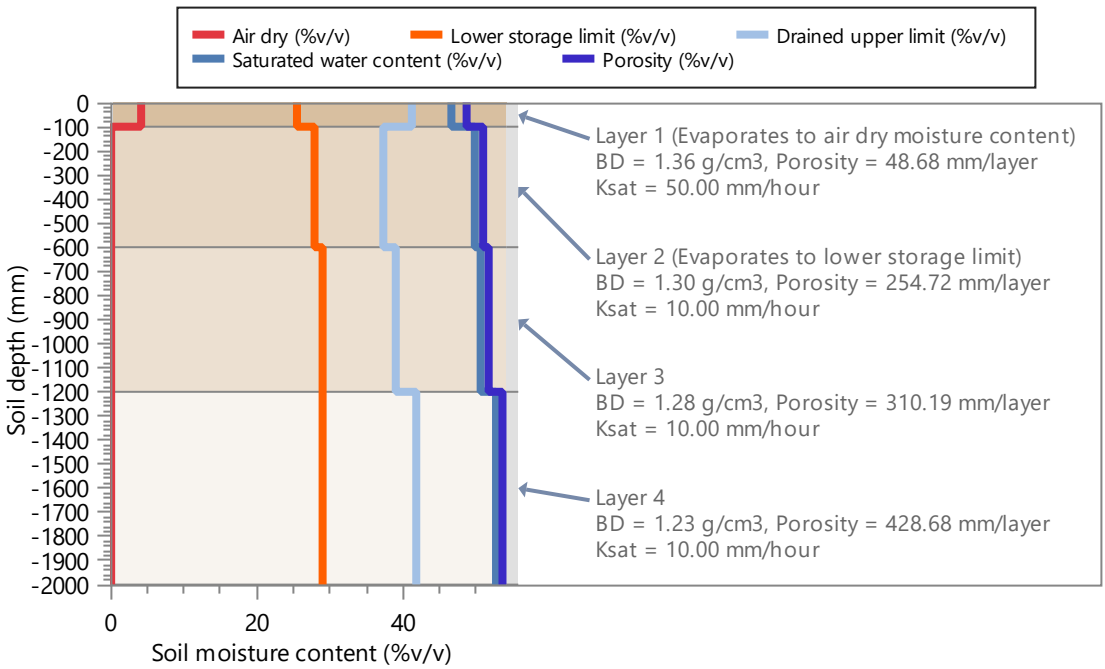
Paddock information

Paddock: New Paddock, 170 m2

Soil type: Red ferrosol, 2000.00 mm defined profile depth

Profile porosity (mm)	1042.26
Profile saturation water content (mm)	1020.80
Profile drained upper limit (or field capacity) (mm)	796.10
Profile lower storage limit (or permanent wilting point) (mm)	571.00
Profile available water capacity (mm)	225.10
Profile limiting saturated hydraulic conductivity (mm/hour)	10.00
Surface saturated hydraulic conductivity (mm/hour)	50.00
Runoff curve number II (coefficient)	78.00
Soil evaporation U (mm)	6.00
Soil evaporation Cona (mm/sqrt day)	3.50

Profile



Planting regime: Continuous Kikuyu 1 pasture

Average monthly cover (%) (minimum - maximum)	30.95 (18.20 - 43.80)
Maximum crop factor at 100% cover (mm/mm) (Maximum crop coefficient 0.8 x Pan coefficient 1)	0.80
Dead cover (if Mthly Covers) or Tot. cover left after harvest (%)	100.00
Potential rooting depth in defined soil profile (mm)	1200.00
Salt tolerance	Moderately tolerant
Salinity threshold (dS/m soil saturation extract)	3.00
Proportion of yield decrease per dS/m increase (%/dS/m)	3.00

Irrigation rules: Fixed sprinkler

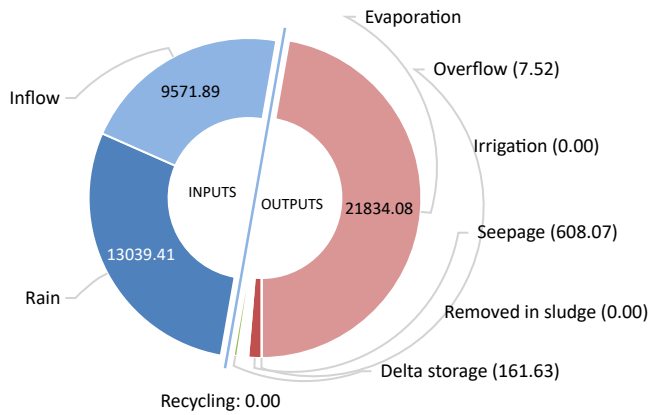
Rule 1. Irrigation triggered when soil water deficit reaches 100.00 mm and rainfall is less than or equal to 10000.00 mm
Rule 2. Irrigate up to a soil water content of 0.00 % of profile drained upper limit
Rule 3. Irrigation window from 1/1 to 31/12 including the days specified
Rule 4. A minimum of 0 days must be skipped between irrigation events

Performance

Pond system information

Pond System Configuration: 1 sludge-free pond (wet weather storage pond: 18500 m3)

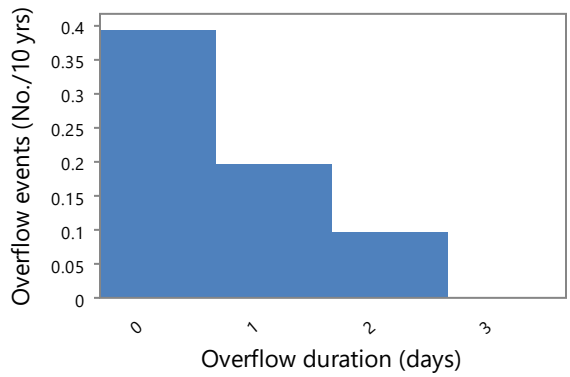
Pond system water balance (m3/year)

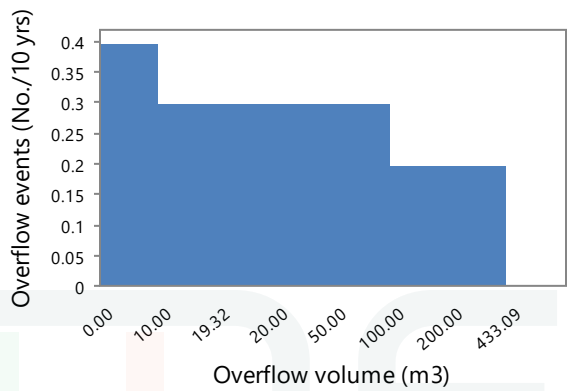


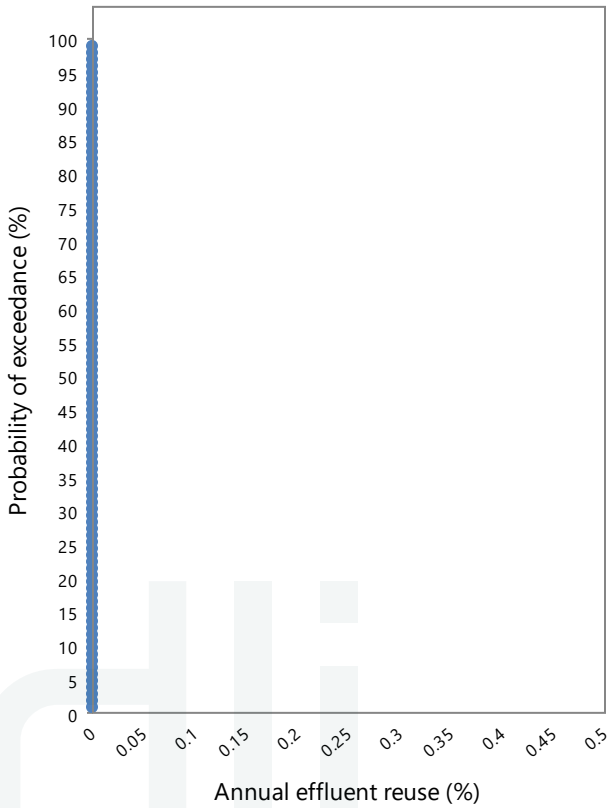
Name	Value
Rain	13039.41
Inflow	9571.89
Recycling	0.00
Evaporation	21834.08
Overflow	7.52
Irrigation	0.00
Seepage	608.07
Removed in sludge	0.00
Delta storage	161.63

Overflow and reuse diagnostics

Metric	Value
Total volume of overflow (m3/10 years)	75.25
Total number of overflow events (events/10 years)	0.40
Total number of pond overflow days (days/10 years)	0.69
Probability of at least 90% effluent reuse (%)	0.00
Effluent reuse (Proportion of inflow + net gain in rain that is irrigated) (%)	0.00







Performance

Pond system information

Pond System Configuration: 1 sludge-free pond

Pond system nitrogen balance (kg/year)

(no data available)

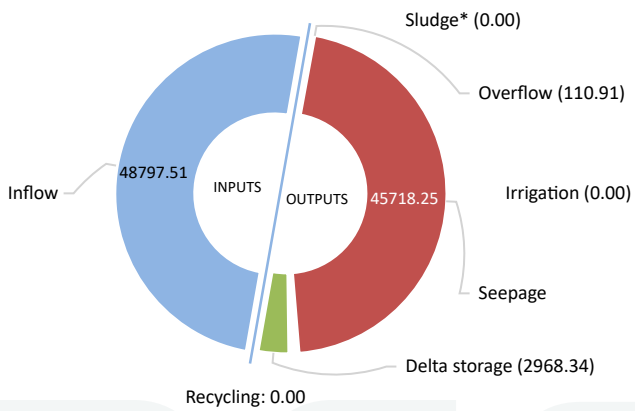
Name	Value
Inflow	0.00
Recycling	0.00
Volatilisation	0.00
Sludge	0.00
Overflow	0.00
Irrigation	0.00
Seepage	0.00
Delta storage	0.00

Pond system 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

Pond system salt balance (kg/year)



Name	Value
Inflow	48797.51
Recycling	0.00
Sludge*	0.00
Overflow	110.91
Irrigation	0.00
Seepage	45718.25
Delta storage	2968.34

* 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 information

Pond System Configuration: 1 sludge-free pond

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)	55.45

Value on final day of simulation period	Pond 1
Final nitrogen concentration of pond liquid (mg/L)	0.00
Final phosphorus concentration of pond liquid (mg/L)	0.00
Final salinity of pond liquid (dS/m)	28.70

Performance

Water use (assumes 100% irrigation efficiency)

Metric	Value
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 (% of events)	0.00
Proportion of years shandying water allocation of 0 m3/year is exceeded (% of years)	0.00
Average exceedance as a proportion of annual shandy water allocation (% of allocation) (minimum - maximum)	0.00 (0.00 - 0.00)

Irrigation quality

Metric	Value
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!)

Metric	Value
No. periods/year without any irrigable effluent in the wet weather storage pond (periods/year)	0.01
Average length of such periods (days)	36890.00

Irrigation triggering and application

No. Days without Irrigation Applied per Year: 365.25 (with maximum irrigation pump rate set to zero)
No. Days without Irrigation Applied per Year: 365.25 (with not triggered)
No. Days with Irrigation Applied per Year: 0.00
No. Days with Irrigation Triggered per Year: 0.00

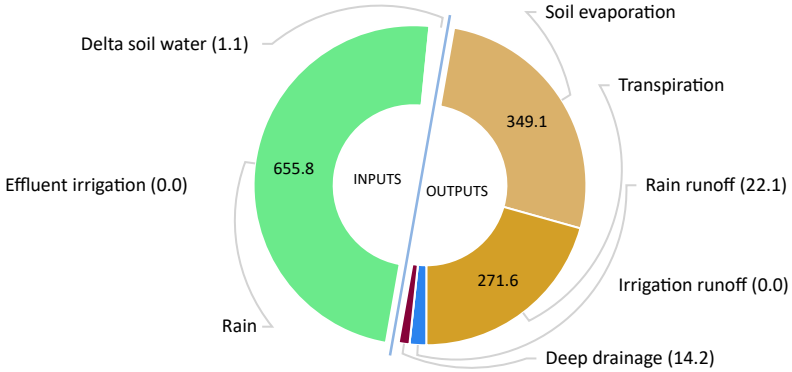
Performance

Paddock information

Paddock: New Paddock, 170 m2

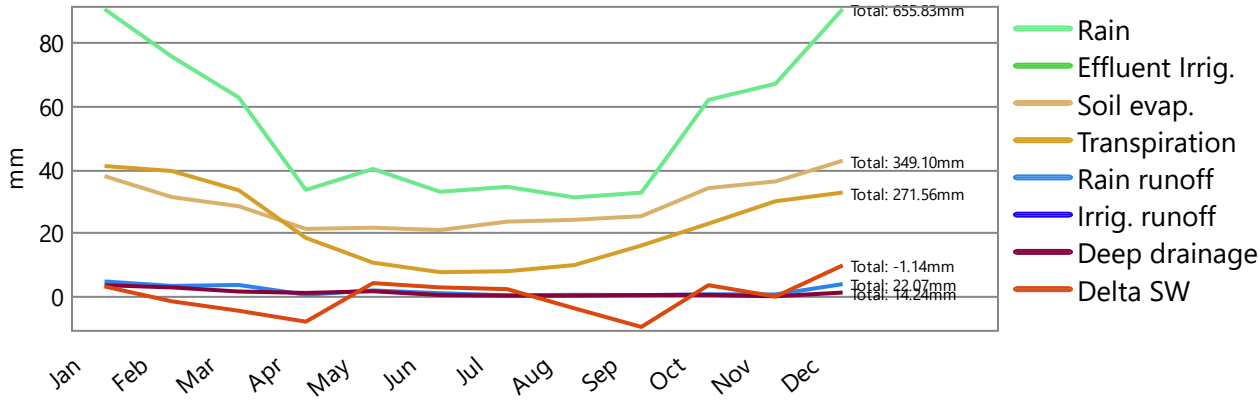
Soil Type: Red ferrosol, 122.70 mm PAWC at maximum root depth

Soil water balance (mm/year)

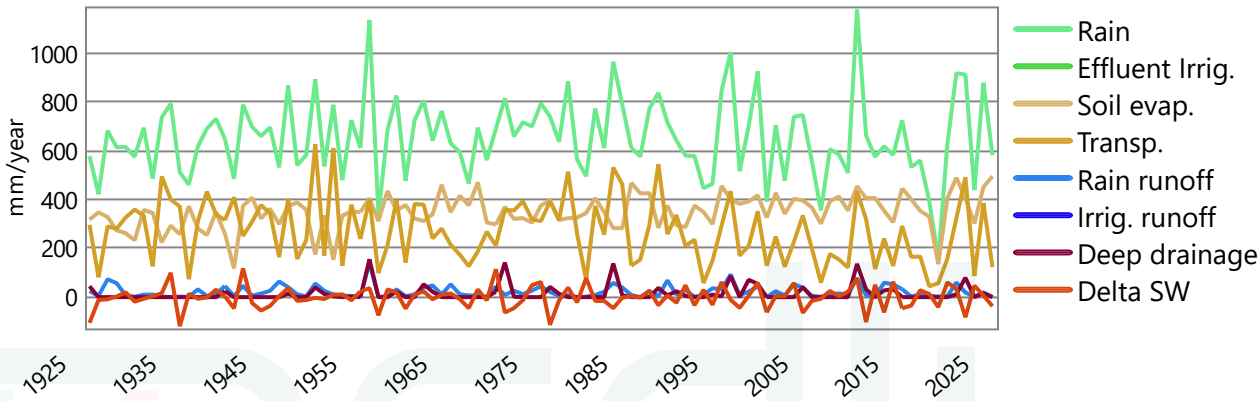


Name	Value
Rain	655.8
Effluent irrigation	0.0
Soil evaporation	349.1
Transpiration	271.6
Rain runoff	22.1
Irrigation runoff	0.0
Deep drainage	14.2
Delta soil water	-1.1

Average monthly totals (mm)



Average annual totals (mm/year)

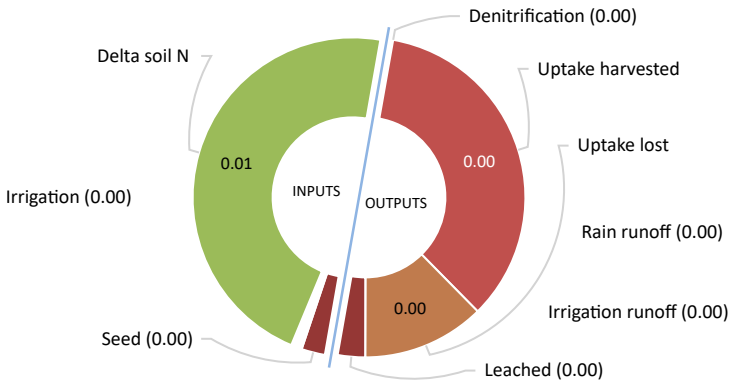


Performance

Paddock information

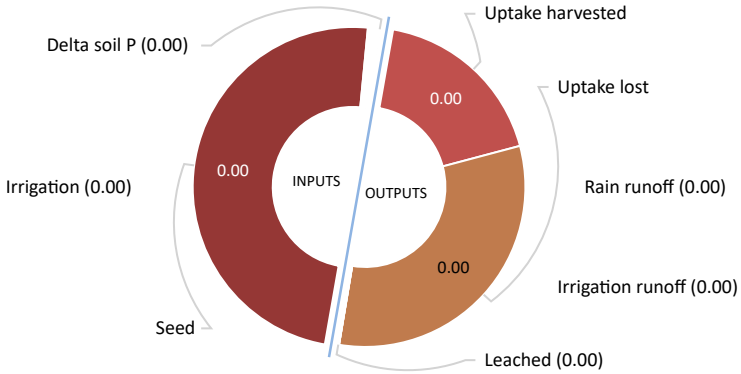
Paddock: New Paddock, 170 m2
Soil Type: Red ferrosol
Irrigation Ammonia-N Volatilisation Losses (kg/m2/year): 0.00
Proportion of Total Nitrogen in Irrigated Effluent as Ammonium (%): 30.00

Soil nitrogen balance (kg/m2/year)



Name	Value
Seed	3.07E-04
Irrigation	0.00
Denitrification	3.45E-07
Uptake harvested	4.40E-03
Uptake lost	1.57E-03
Rain runoff	0.00
Irrigation runoff	0.00
Leached	3.47E-04
Delta soil N	-0.01

Soil phosphorus balance (kg/m2/year)



Name	Value
Seed	2.63E-05
Irrigation	0.00
Uptake harvested	9.54E-06
Uptake lost	1.68E-05
Rain runoff	0.00
Irrigation runoff	0.00
Leached	7.13E-08
Delta soil P	-7.30E-08

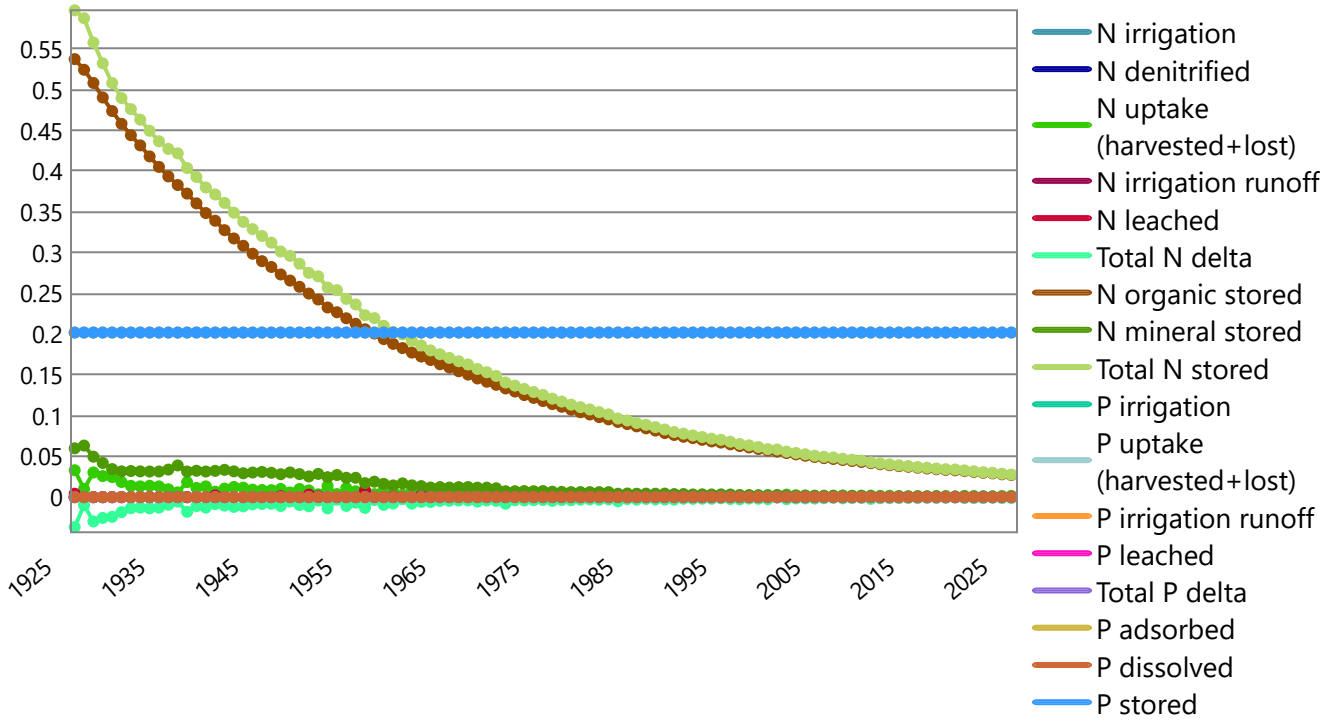
Performance

Paddock information

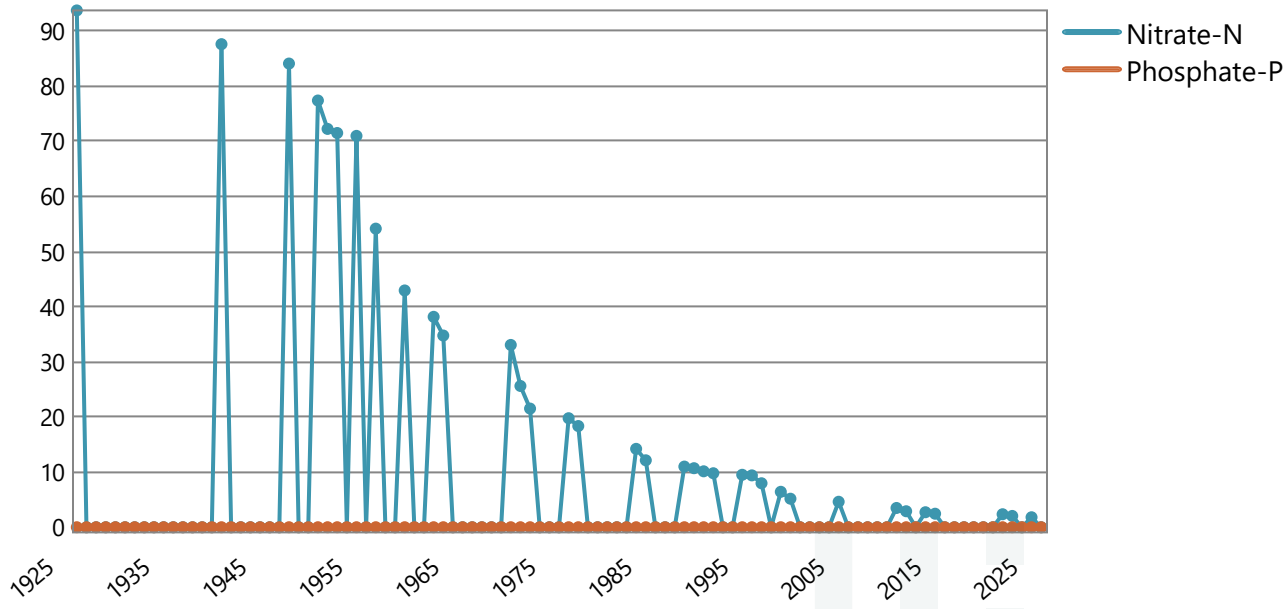
Paddock: New Paddock, 170 m2

Soil Type: Red ferrosol

Annual nutrient totals (kg/m2)



Annual nutrient leaching concentration (mg/L)



Performance

Paddock information

Paddock: New Paddock, 170 m2
Soil Type: Red ferrosol
Planting Regime: Continuous Kikuyu 1 pasture

Plant growth (minimum - maximum)

Metric	Value
Average annual shoot dry matter harvestable yield* (kg/m2/year)	0.28 (-0.05 - 1.03)
Average annual shoot dry matter lost (kg/m2/year)	0.11 (0.02 - 0.20)
Average monthly plant (green) cover (%)	30.95 (18.20 - 43.80)
Average monthly root depth (mm)	418.97 (285.72 - 565.36)

Plant nutrient uptake (minimum - maximum)

Metric	Value
Average annual shoot nitrogen in harvestable yield* (kg/m2/year)	0.00 (0.00 - 0.03)
Average annual shoot nitrogen lost (kg/m2/year)	0.00 (0.00 - 0.01)
Average annual shoot phosphorus in harvestable yield* (kg/m2/year)	0.00 (0.00 - 0.00)
Average annual shoot phosphorus lost (kg/m2/year)	0.00 (0.00 - 0.00)
Average annual shoot nitrogen concentration (fraction dwt)	0.02 (0.01 - 0.04)
Average annual shoot phosphorus concentration (fraction dwt)	0.000 (0.000 - 0.001)

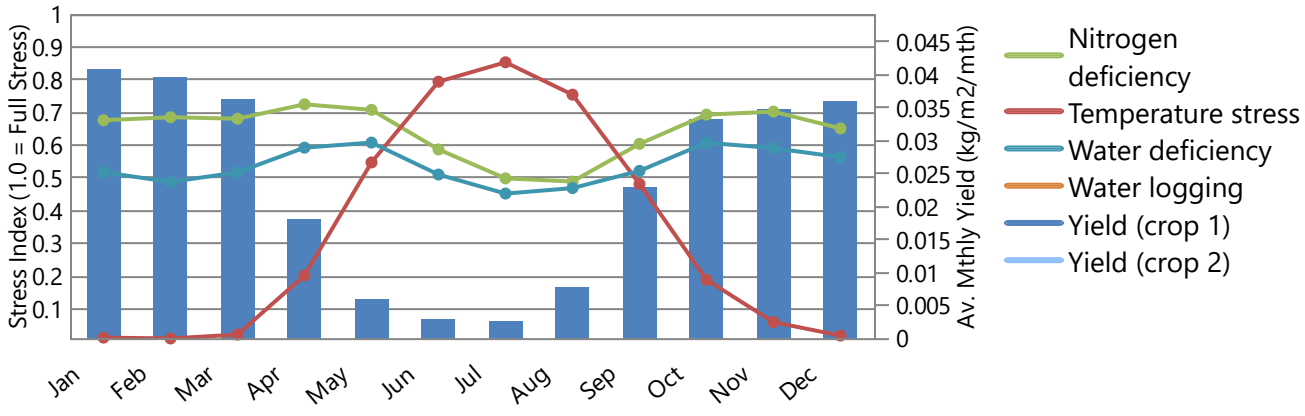
*Harvestable yield is a measure of *net* gain over a nominated period - say monthly. It is the total shoot-dry-matter gain minus any shot-dry-matter loss within a given period. Hence, just like financial investments, negative harvestable yields may occur when the (episodic) losses exceed the gains made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

Performance

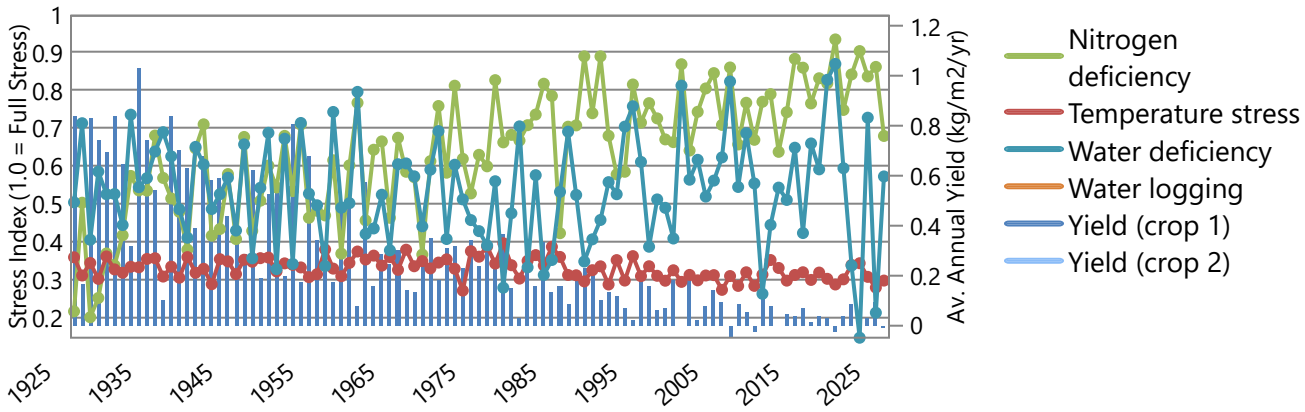
Paddock information

Paddock: New Paddock, 170 m2
Soil Type: Red ferrosol
Planting Regime: Continuous Kikuyu 1 pasture

Av. monthly stresses & harvestable yield* (kg/m2/month)



Av. annual stresses & harvestable yield* (kg/m2/year)



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

Normal and forced harvest information

No. of Harvests per Year: 0.12 (normal), 2.91 (forced by crop death due to water stress).
No. Days without Crop per Year (no./year): 109.60 (due to water stress [100.53], frosting [5.26] and temperature stress - not frost [3.81])

Performance

Paddock information

Paddock: New Paddock, 170 m2
Soil Type: Red ferrosol
Planting Regime: Continuous Kikuyu 1 pasture

Plant salinity tolerance

Metric	Value
Salt tolerance	Moderately tolerant
Salinity threshold (dS/m soil saturation extract)	3.00
Proportion of yield decrease per dS/m increase (%/dS/m)	3.00
No. years assumed for leaching to reach steady-state (years)	10.00

Soil salinity

Metric	Value
Average Infiltrate Salinity (dS/m)	0.03

No salinity calculations as no irrigation occurred.

Performance

Recharge

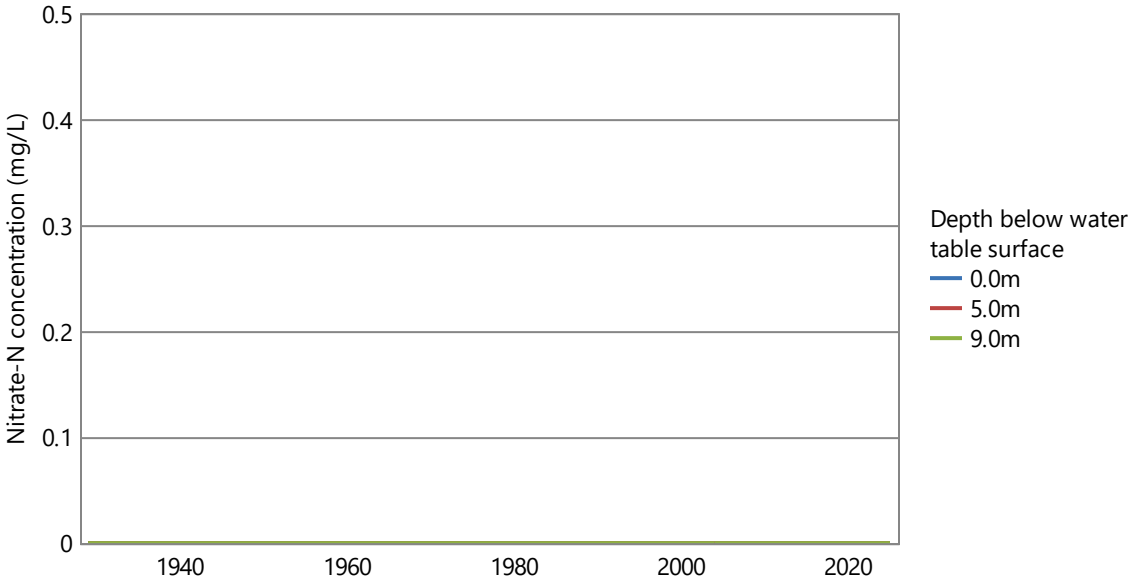
Average Groundwater Recharge (m3/day): 0.01
Average nitrate-N Concentration of Recharge (mg/L): 24.40

Aquifer characteristics

Metric	Value
Thickness (m)	10.0
Porosity (%)	10.0
Specific flux (mm/hour)	0.4
Vertical dispersion coefficient (m2/day)	0.1
Longitudinal dispersion coefficient (m2/day)	100.0
Retardation factor due to adsorption (multiplier)	1.0

Groundwater Nitrate-N concentration (mg/L)

Concentration at property boundary, 1000 m *from effluent irrigation area.*

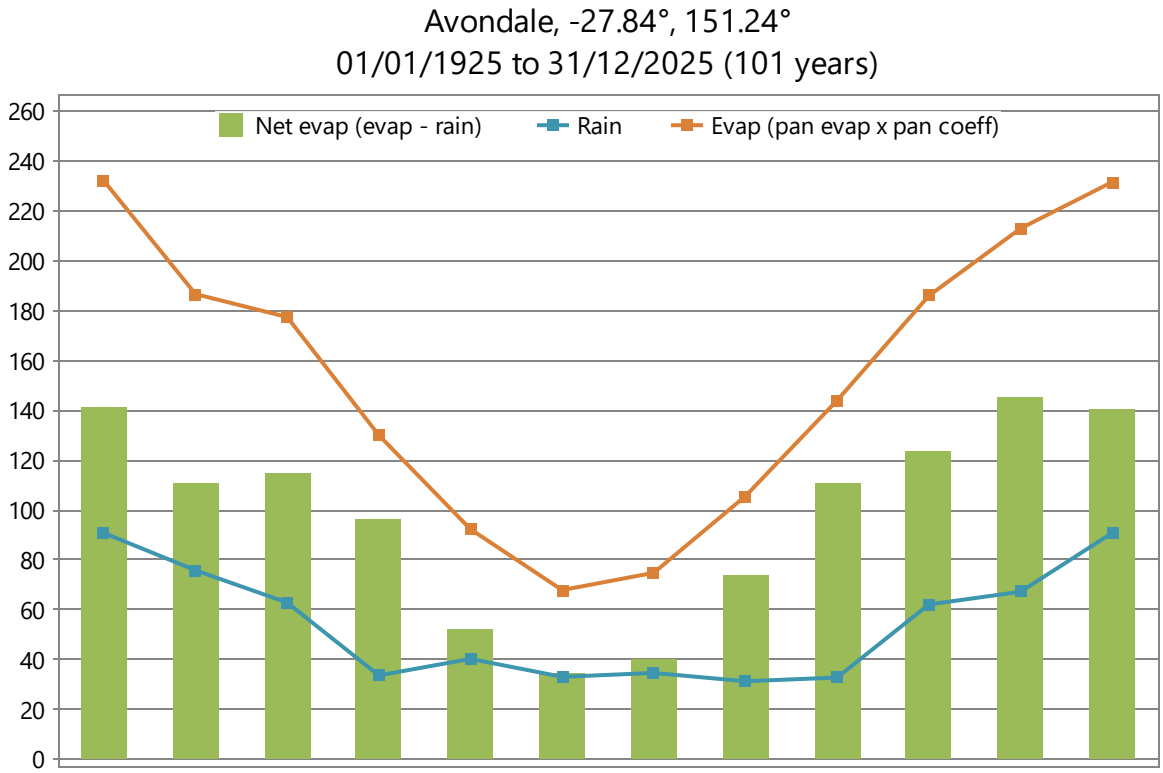


Diagnostics

Scenario information

Enterprise: 2145 - Avondale RO Evaopration Ponds

Climate long-term monthly averages (mm)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	90.8	75.9	62.9	33.7	40.3	33.1	34.7	31.3	32.8	62.1	67.3	90.9	655.8
Evap	232.2	186.7	177.5	130.1	92.4	67.9	74.9	105.7	144.0	186.0	213.0	231.6	1841.9
Net evap	141.3	110.8	114.6	96.4	52.0	34.8	40.2	74.3	111.2	123.8	145.8	140.8	1186.1
Net evap/day	4.6	3.9	3.7	3.2	1.7	1.2	1.3	2.4	3.7	4.0	4.9	4.5	3.2

Diagnostics

Pond system information

Pond System Configuration: 1 sludge-free pond

Effluent Type: Waste estimation system - 9571.89 m3/year or 26.21 m3/day generated on average

Effluent entering pond system after any pretreatment and recycling

Average (Minimum-Maximum) influent quality calculated for 365.25 non-zero flow days/year.

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	5098.00 (5098.00 - 5098.00)	48797.51 (48750.08 - 48941.67)
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)

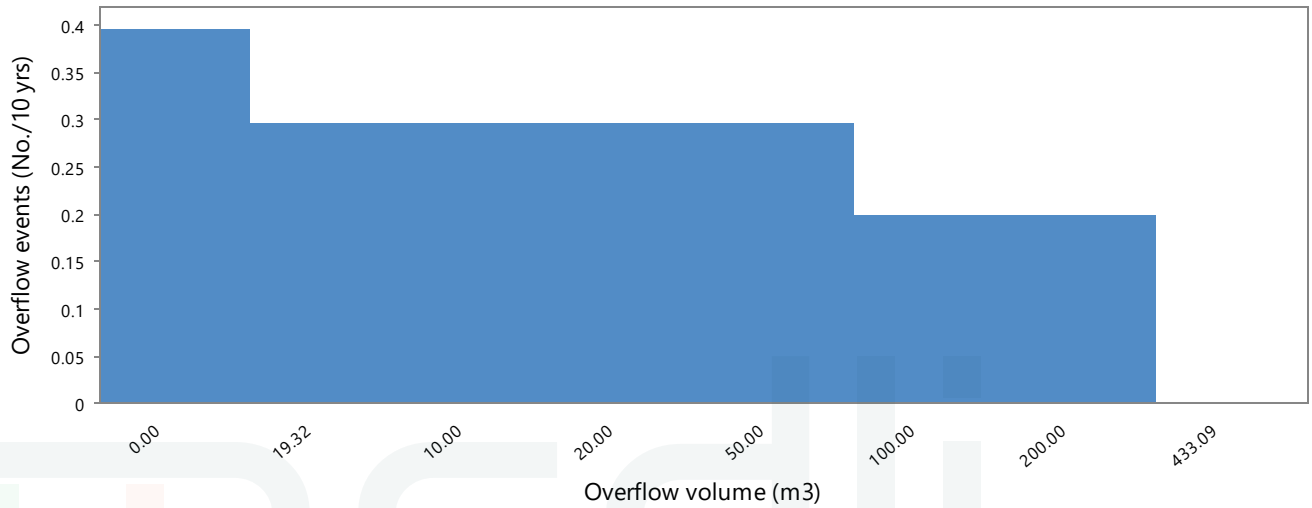
Ammonia-N loss from pond system water surface area: 0.00 kg/m2/year

Last pond (wet weather store): 18500.00 m3

Metric	Value
Theoretical hydraulic retention time (days)	705.93
Volume of overflow (m3/year) Average (minimum-maximum)	7.52 (0.00 - 531.59)
Volume of overflow per day (m3/day) Average (minimum-maximum)	0.02 (0.00 - 405.68)
No overflow days - Average per year (Total in run period)	0.07 (7)
No. overflow events per 10 years exceeding threshold of 19.322 m3* (events/10 years)	0.30
Average overflow event recurrence interval (years)	25.25
Average duration of overflow (days)	1.75
Probability of at least 90% effluent reuse (%)	0.00
Effluent reuse (proportion of inflow + net rain gain that is irrigated) (%)	0.00
Average salinity (dS/m)	55.45
Salinity on final day of simulation (dS/m)	28.70

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

Volume distribution of the overflow events



Diagnostics

Scenario information

Area irrigated: 170 m2 total area

Loading to whole irrigation area: (assuming 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

Metric	Value
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)
Minimum shandy water is used	No

Irrigation issues

Metric	Value
Number of days without irrigation (days/year)	365.25
Number of periods without irrigatable water (periods/year)	0.01
Average length of such periods (days)	36890.00

Diagnostics

Paddock information

Paddock: - New Paddock, 170 m2

Irrigation: Fixed sprinkler with 20% ammonium loss during irrigation

Irrigation Rules
Irrigation triggered when soil water deficit reaches 100.00 mm and rainfall is less than or equal to 10000.00 mm
Irrigate up to a soil water content of 0.00 % of profile drained upper limit
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): Red ferrosol, 122.70 mm PAWC at maximum root depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rain	90.8	75.9	62.9	33.7	40.3	33.1	34.7	31.3	32.8	62.1	67.3	90.9	655.8
Efflt. irrg.	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	38.1	31.4	28.5	21.4	21.8	21.0	23.7	24.3	25.4	34.3	36.4	42.9	349.1
Transpn.	41.2	39.7	33.6	18.5	10.7	7.7	8.0	9.9	16.1	23.0	30.1	32.9	271.6
Rain runoff	4.8	3.4	3.7	0.6	1.9	1.1	0.4	0.6	0.5	0.7	0.7	3.9	22.1
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	3.6	2.9	1.6	1.1	1.7	0.5	0.3	0.3	0.5	0.5	0.1	1.3	14.2
Delta SW	3.2	-1.5	-4.5	-8.0	4.2	2.9	2.3	-3.7	-9.6	3.6	0.0	9.9	-1.1

Soil nitrogen balance: (Concentrations are flow-weighted)

Metric	Value
Average annual nitrogen added in seed (kg/m2/year)	3.07E-04
Average annual nitrogen added from irrigation (kg/m2/year)	0.00
Av. annual soil N removed by uptake (harvest + lost) (kg/m2/year)	0.01 (4.40E-03, 1.57E-03)
Av. annual soil nitrogen removed by denitrification (kg/m2/year)	3.45E-07
Average annual soil nitrogen leached (kg/m2/year)	3.47E-04
Average annual nitrate-N loading to groundwater (kg/m2/year)	3.47E-04
Soil organic-N kg/m2 (Initial - Final)	0.55 - 0.03
Soil inorganic-N kg/m2 (Initial - Final)	0.08 - 6.07E-04
Average nitrate-N concentration of deep drainage (Max annual concentration)	
Across all years (mg/L)	24.40 (93.72)
Excluding first year of data (mg/L)	22.17 (87.60)

Soil phosphorus balance: (Concentrations are flow-weighted)

Metric	Value
Average annual phosphorus added in seed (kg/m2/year)	2.63E-05
Average annual phosphorus added from irrigation (kg/m2/year)	0.00
Av. annual soil P removed by uptake (harvest + lost) (kg/m2/yr)	2.63E-05 (9.54E-06, 1.68E-05)
Average annual soil phosphorus leached (kg/m2/year)	7.13E-08
Dissolved phosphorus (kg/m2) (Initial - Final)	4.19E-06 - 3.52E-06
Adsorbed phosphorus (kg/m2) (Initial - Final)	0.20 - 0.20
Average phosphate-P concentration in rootzone (mg/L)	0.01
Average phosphate-P concentration of deep drainage (Max annual concentration)	
Across all years (mg/L)	0.00 (0.01)
Last year only (mg/L)	0.00 (N.D.*)
Design soil profile storage life based on average infiltrated water phosphorus concn. of 0.00 mg/L (years)	999.00

* Not determined

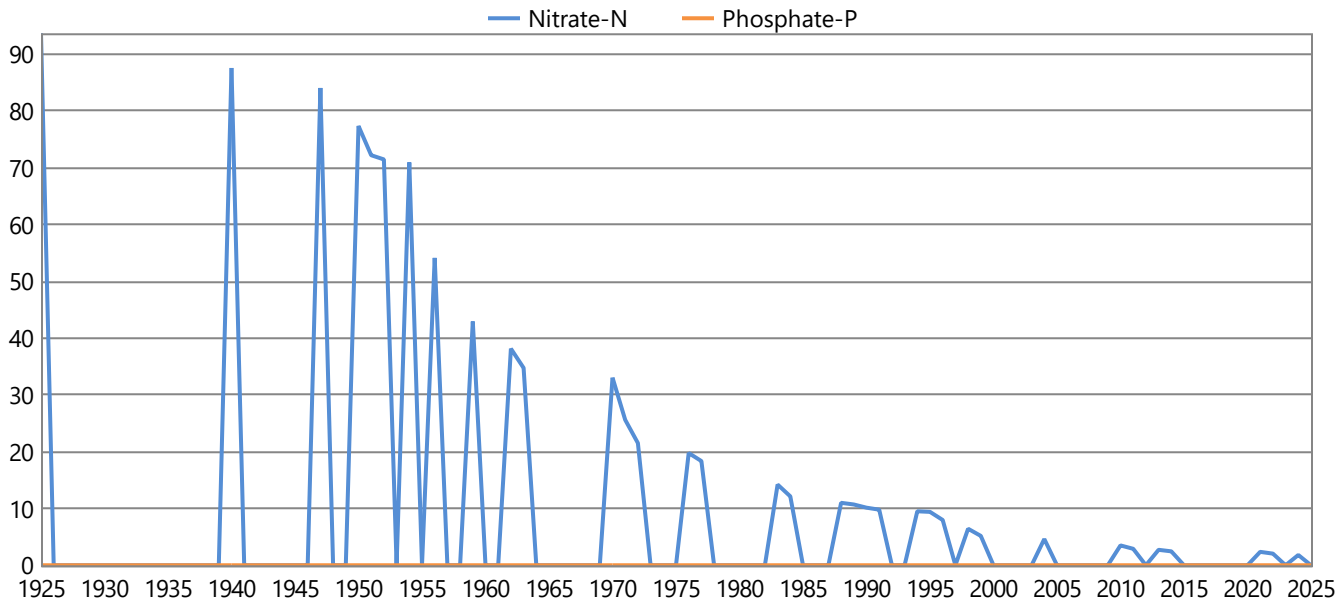
Diagnostics

Paddock information

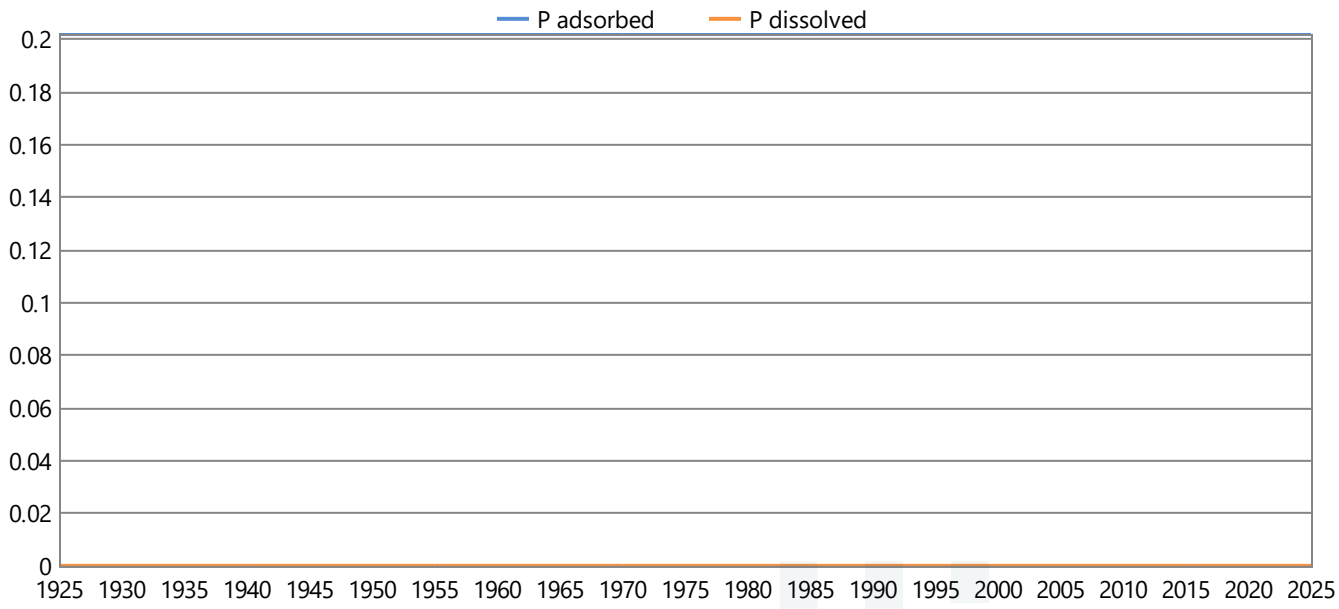
Paddock: New Paddock, 170 m2

Irrigation: Fixed sprinkler with 20% ammonium loss during irrigation

Annual nutrient leachate concentration (mg/L)



Annual phosphate-P in soil (kg/m2)



Diagnostics

Paddock information

Paddock: New Paddock, 170 m2

Planting Regime: Continuous Kikuyu 1 pasture

Average plant performance (minimum - maximum)

Metric	Value
Average annual shoot dry matter harvestable yield (kg/m2/year)	0.28 (-0.05 - 1.03)
Average annual shoot dry matter lost (kg/m2/year)	0.11 (0.02 - 0.20)
Average monthly plant (green) cover (%)	30.95 (18.20 - 43.80)
Average monthly crop factor (fraction)	0.25 (0.15 - 0.35)
Dead cover (if Mthly Covers) or Tot. cover left after harvest (%)	100.00
Average monthly root depth (mm)	418.97 (285.72 - 565.36)
Average number of normal harvests per year (no./year)	0.12 (0.00 - 2.00)
Average number of normal harvests for last five years only (no./year)	0.00
Average number of forced harvests per year (no./year)	2.91 (1.00 - 6.00)
Average number of forced harvests for last five years only (no./year)	2.60
Average annual nitrogen deficiency index (0 = no stress, 1 = full stress) (coefficient)	0.64 (0.20 - 0.93)
Average January temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.01 (0.00 - 0.07)
Average July temperature stress index (0 = no stress, 1 = full stress) (coefficient)	0.85 (0.61 - 0.96)
Average monthly water stress index (0 = no stress, 1 = full stress) (coefficient)	0.54 (0.45 - 0.61)
Average monthly waterlogging index (0 = no stress, 1 = full stress) (coefficient)	0.00 (0.00 - 0.00)
No. days without crop per year. Excludes bare fallow days (days)	109.60

Soil salinity - plant salinity tolerance: Moderately tolerant

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

All values based on 10 -year running averages.

No salinity calculations as no irrigation occurred.

Diagnostics

Run information

Messages generated when the scenario was run
********** WASTESTREAM RESULTS **********
TABLE OF QUANTITY AND QUALITY OF EACH RAINFALL-INDEPENDENT WASTESTREAM (AFTER PRETREATMENT AND BEFORE ENTERING ANY SEDIMENTATION BASIN)
_____
Source Volume_m3/yr N conc_mg/L P conc_mg/L TDS conc_mg/L N load_kg/yr P load_kg/yr TDS load_kg/yr
New generic system 9571.9 0.0 0.0 5098.0 0.0 0.0 48797.5
_____
********** END WASTESTREAM RESULTS **********
No. Days without Irrigation Applied per Year: 365.25 (with maximum irrigation pump rate set to zero)
This is a Dryland scenario
No effluent irrigation has occurred!
WARNING: Soil phosphorus adsorption capacity was already exhausted at start of run
NOTE: The allowable drawdown on the irrigation pond has been set to zero. No irrigation is possible
WARNING: Plant phosphorus deficiency. No soil phosphorus has been available for plant uptake for 54.35% of days of simulation.
WARNING: Plant phosphorus deficiency. At shoot P concentrations below 0.1% dry weight, many plant species will show reduced yields due to phosphorus deficiency. Please check if this is true for the simulated species, as if so, the predicted plant yield and soil nutrient balances will be INVALID!
WARNING: CONDITIONAL FINISH!

Document Information

Disclaimer

This publication was produced by Integrity Ag Pty Ltd, ABN 31 650 353 781 (Integrity Ag). This disclaimer governs the use of this publication. While professional care has been taken to ensure the accuracy of all the information provided, you must not rely on the information in the publication as an alternative to professional advice from an appropriately qualified professional. If you have specific questions about any data or suggestions contained in the report, you should consult an appropriately qualified professional. Results from specific parameter analyses, such as soil testing, must be understood to vary with seasonal and natural conditions, sometimes resulting in large variations over short distances.

Claims will not be considered relating to the application of specific soil interpretations to areas beyond the sampling point. Integrity Ag does not represent, warrant, undertake or guarantee that the use of guidance in the publication will lead to any particular outcome or result. We will not be liable to you in respect to any business or personal losses, including without limitation: loss of or damage to profits, income, revenue, use, production, anticipated savings, business, contracts, commercial opportunities or goodwill. This report is presented solely for informational purposes.

Contact details

Name	Eugene McGahan
Title	Agricultural Engineer
Email	eugene.mcgahan@integrityag.net.au
Mobile	0408 482 525

Version history

Client	Ellerslie Free Range Farms Pty Ltd
Abbreviation	Ellerslie Free Range Farms
Project Title	Avondale SBEMP Update
Project Code	2145

Version	Date	Author	Checked
1	10/07/2020	Nic Gould /Eugene McGahan	Eugene McGahan
2	06/01/2026	Eugene McGahan	Eugene McGahan
3	21/01/2026	Eugene McGahan/Lauren Walker	Eugene McGahan
4	31/07/2026	Eugene McGahan/Lauren Walker	Eugene McGahan

Version notes

Version 1: SBEMP prepared for original approval.
Version 2: Updated draft SBEMP for client with changed design.
Version 3: Updated SBEMP with changed design.
Version 4: Updated SBEMP with RO plant and evaporation basins.

IntegrityAg

Integrity Ag Pty Ltd
ABN: 31 650 353 781

10 Neil Street
Toowoomba City
Queensland 4350

+61 7 4615 4690
admin@integrityag.net.au
www.integrityag.net.au