



Water Management Plan

Narrandera Poultry Production Farm

ProTen Pty Ltd

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Australia

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Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with ProTen Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.



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Appendices

- Appendix A Water Access Licence 11788**
- Appendix B Civil Design Drawings for PPU Surface Water Management**
- Appendix C Bore Logs for the Production Bores**
- Appendix D Shallow Aquifer Piezometer Bore Logs**



1.0 Introduction

1.1 Background

The Narrandera Poultry Production Farm (the “Development”) was granted Development Consent 6882 on 9 November 2015 by the Planning Assessment Commission of NSW (now the Independent Planning Commission [IPC]) to be established within a rural property approximately 26 kilometres (km) west of Narrandera in southwestern New South Wales (NSW). As shown on **Figure 1** and **Figure 2**, the Development comprises five poultry production units (PPUs) or farms where broiler birds are grown for human consumption. Each PPU comprises 16 tunnel-ventilated fully enclosed climate-controlled poultry sheds, with associated support infrastructure and staff amenities.

For the purposes of this document, the Development is described in:

- The *Environmental Impact Statement* (EIS) (SLR, 2015a) and the appendices contained within; and
- The *Response to Submissions* (RTS) (SLR, 2015b) and the appendices contained within.

1.2 Purpose and Scope

This *Water Management Plan* (WMP) has been prepared by SLR Consulting Australia Pty Ltd (SLR), on behalf of ProTen Holdings (ProTen), for the operational phase of the Development. It has been prepared to satisfy condition B45 of Development Consent SSD 6882, which is listed in **Table 1**.

This WMP has been prepared as an appendix to the *Operational Environmental Management Plan* (OEMP) and is to be read in conjunction with the latest version of the OEMP.

Table 1: Development Consent Condition B45

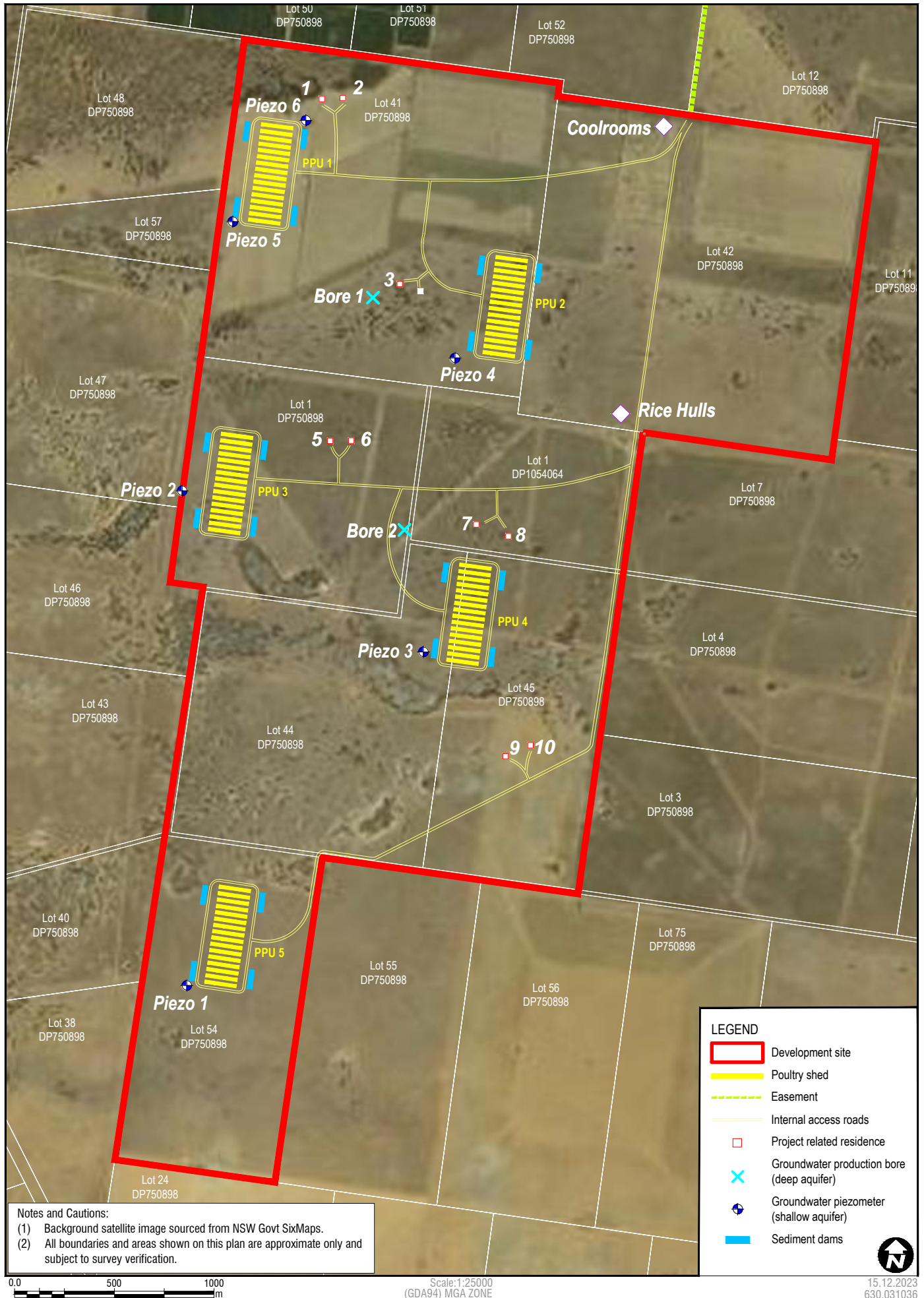
Condition No.	Condition	WMP Section
B45.	Prior to the commencement of operation, the Applicant shall prepare a Water Management Plan to the satisfaction of the Secretary. The Water Management Plan shall form part of the OEMP in Condition C4 and be prepared in accordance with Condition C6. The WMP shall:	
(a)	Be prepared in consultation with DPI;	Section 1.3
(b)	Detail water use, metering, disposal and management on-site;	Section 5.0
(c)	Detail the number and location of piezometers on-site;	Section 8.1
(d)	Detail the water licence requirements for the Development;	Section 2.4
(e)	Detail the management of wastewater streams on-site;	Section 5.0
(f)	Contain a Surface Water Management Plan, including; i. a program to monitor: • surface water flows and quantity; • surface water storage and use; and • sediment basin operation; ii. sediment and erosion controls plans; iii. surface water impact assessment criteria, including trigger levels for investigating any potentially adverse surface water impacts; iv. a protocol for the investigation and mitigation of identified exceedances of the surface water impact assessment criteria; and	Sections 6, 7 and 9
(g)	Contain a Groundwater Management Plan, including: i. baseline data on groundwater levels and quality;	Sections 8 and 9

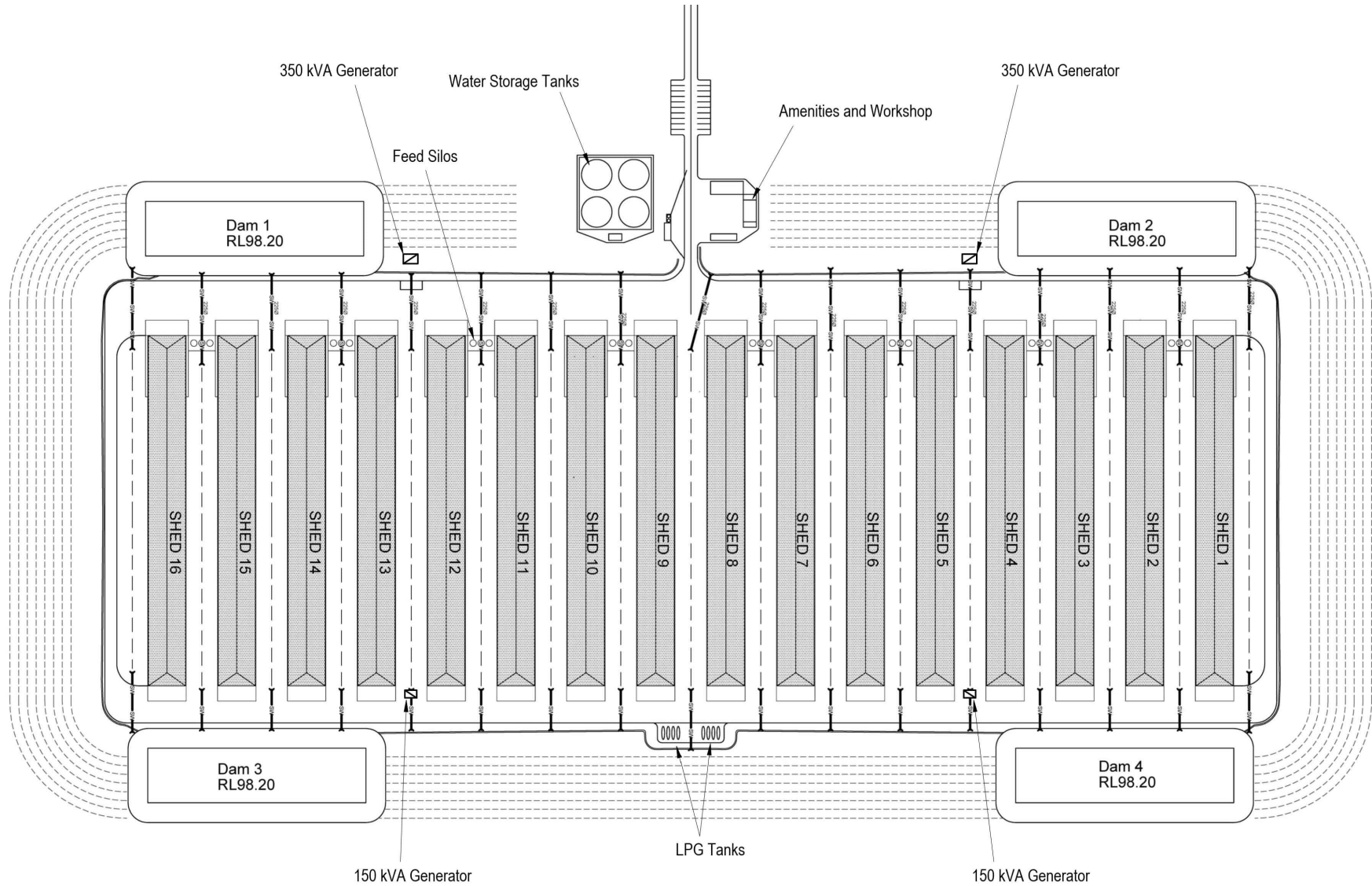


Condition No.	Condition	WMP Section
	ii. a program to monitor groundwater levels and quality; iii. groundwater impact assessment criteria, including trigger levels for investigating potentially adverse groundwater impacts; and iv. a protocol for the investigation and mitigation of identified exceedances of the groundwater quality impact assessment criteria.	
(h)	Contain a Contingency plan for the operation of the facility during extreme weather events such as heat wave or drought.	Section 5.6



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1.3 DPI Water Consultation

On 15 November 2015 a letter was emailed to the Department of Primary Industries – Water (DPI Water) (now the Department of Planning and Environment – Water [DPE Water] and the Natural Resources Access Regulator [NRAR]) presenting the proposed groundwater monitoring program for the Shallow and Deep aquifers and seeking their initial advice and comments. DPI Water responded via email on 6 January 2016 advising the hydrogeological staff had reviewed the proposed groundwater monitoring sites, water quality parameters and monitoring schedule and that these were supported by DPI Water.

DPI Water requested that one additional piezometer be installed at one of the proposed 10 residences, preferably in an area where there are lighter soils and shallower water tables. Responding to this, an additional piezometer was included near residences 1 and 2 (see **Figure 1**) where the soil is sandier than elsewhere in the Development Site. Further details are provided in **Section 8.1**.

The complete WMP was emailed to DPI Water for review and comment on 29 March 2016. Comments were received on 19 April 2016 and the WMP updated to address these comments prior to submission to the Department of Planning and Environment (now DPE) for approval. The first version of the WMP was submitted to DPI Water on 13 February 2017 for final approval and comment. This version included a recommendation of re-assessing the monitoring and trigger values after two years of operations.

Based on this recommendation, a review of the groundwater and surface water data was conducted by SLR in February 2020 (SLR, 2020) and a letter report detailing the findings of the data analysis was sent to NRAR recommending that the WMP be updated in order to:

- Reduce the groundwater monitoring frequency to six-monthly;
- Derive local triggers for groundwater ammonia and bicarbonate;
- Derive local triggers for groundwater levels; and
- Stop regular monitoring of sediment dams and only monitor the dams in the event of overflow/release event.

NRAR confirmed in a letter dated 13 February 2020 that the first three recommendations were supported. NRAR subsequently confirmed in a follow-up email on 25 February 2020 that an amended proposal to reduce monitoring of the sediment dams to six-monthly was also supported.

In September 2022, a routine 6-monthly water monitoring round (conducted 6 September 2022) led to the identification of surface water quality trigger exceedances of Total Nitrogen, Nitrate/Nitrite as N and Total Phosphorus at sediment dams PPU1, PPU2, PPU3, PPU4 and PPU5. These results were communicated to ProTen on 11 October 2022, and ProTen subsequently notified DPE, NRAR and the NSW Environment Protection Authority (EPA) of the exceedances on 31 October 2022. In response, the DPE issued the letter '*Euroley Poultry Production Complex (SSD 6882) Surface water trigger notification*' on 22 November 2022 which outlined requirements for an exceedance investigation. SLR were commissioned by ProTen to complete the investigation, which was delivered to ProTen on 9 January 2023 (SLR, 2023a). ProTen lodged the investigation with DPE, for which the DPE provided feedback on 20 January 2023, advising ProTen proceed with the development of site-specific surface water quality trigger values as recommended in SLR's investigation report. ProTen engaged SLR to determine the triggers, which SLR provided via report on 20 April 2023 (SLR, 2023b). ProTen submitted this report to the DPE, which the DPE responded to on 22 May 2023, requesting ProTen submit a revised WMP.

This WMP version was prepared to include these updates.



2.0 Planning Requirements

2.1 Legislation and Guidelines

This WMP was prepared in consideration of relevant NSW legislation, policies and guidelines, including (but not limited to) the following:

- *Protection of the Environment Operations Act 1997* (POEO Act);
- *Water Management Act 2000* (WM Act) and *Water Act 1912* where the WM Act is not yet in force;
- *NSW Aquifer Interference Policy* (NSW Office of Water [NOW], 2012);
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Australian and New Zealand Environment and Conservation Council [ANZECC] and Agriculture and Resource Management Council of Australia and New Zealand [ARMCANZ], 2000);
- Australian Drinking Water Guidelines (ADWG) (National Health and Medical Research Council [NHMRC] & National Resource Management Ministerial Council [NRMCC], 2011);
- *NSW State Groundwater Policy Framework Document* (Department of Land and Water Conservation [DLWC], 1997);
- *Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales* (NSW Environment Protection Authority [EPA], 2022);
- *Managing Urban Stormwater: Soils and Construction Volume 1, 4th edition* (Landcom, 2004); and
- *Managing Urban Stormwater: Soils and Construction Volume 2C: Unsealed Roads* (Department of Environment, Climate Change and Water [DECCW], 2008).

Note: The “Managing Urban Stormwater” publications are more commonly referred to as “the Blue Book”.

2.2 Development Consent

As outlined in **Section 1.2**, the WMP has been prepared to satisfy condition B45 of Development Consent SSD 6882. This condition and other relevant conditions relating to surface water and groundwater are listed in **Table 2**.

Table 2: Relevant Development Consent Conditions

Condition No.	Condition
Surface Water Discharge Limits	
B38	The Applicant shall ensure that all licensed surface water discharges from the site comply with the discharge limits (volume and quality) set for the Development in any EPL or relevant provisions of the POEO Act.
Stormwater	
B39	The Applicant must design, construct, operate and maintain all stormwater and water storage facilities on site with the internal surfaces equivalent to, or better than, a clay liner of a minimum permeability of 1×10^{-9} metres per second and a clay liner thickness of no less than 600mm, or an equivalent alternative.
Groundwater	



Condition No.	Condition
B40	The groundwater bores for the Development shall be constructed in accordance with the <i>Minimum Construction Requirements for Water Bores in Australia, Third Edition, February 2012</i> , (National Uniform Drillers Licensing Committee, 2012).
B41	Groundwater extracted from the bores shall be treated in accordance with the standards contained within the <i>National Water Biosecurity Manual – Poultry Production</i> (DAFF, 2009).
B42	Groundwater extraction for the purposes of the Development shall be limited to the provisions of the any water access licence(s) issued by the DPI.
Bunding	
B43	The Applicant shall store all chemicals, fuels and oils used on-site in appropriately banded areas in accordance with the requirements of all relevant Australian Standards, and/or EPA's <i>Storing and Handling Liquids: Environmental Protection – Participants Handbook</i> .
Domestic Effluent Disposal	
B44	The Applicant shall obtain the relevant license/approval from Council under section 68 of the <i>Local Government Act 1996</i> prior to the commencement of construction, for all domestic effluent disposal and management systems on-site.
Water Management Plan	
B45.	Prior to the commencement of operation, the Applicant shall prepare a Water Management Plan to the satisfaction of the Secretary. The Water Management Plan shall form part of the OEMP in Condition C4 and be prepared in accordance with Condition C6. The WMP shall: - Be prepared in consultation with DPI; - Detail water use, metering, disposal and management on-site; - Detail the number and location of piezometers on-site; - Detail the water licence requirements for the Development; - Detail the management of wastewater streams on-site - Contain a Surface Water Management Plan, including; - a program to monitor: - surface water flows and quantity; - surface water storage and use; and - sediment basin operation; - sediment and erosion controls plans; - surface water impact assessment criteria, including trigger levels for investigating any potentially adverse surface water impacts; - a protocol for the investigation and mitigation of identified exceedances of the surface water impact assessment criteria; and - Contain a Groundwater Management Plan, including: - baseline data on groundwater levels and quality; - a program to monitor groundwater levels and quality; - groundwater impact assessment criteria, including trigger levels for investigating potentially adverse groundwater impacts; and - a protocol for the investigation and mitigation of identified exceedances of the groundwater quality impact assessment criteria - Contain a Contingency plan for the operation of the facility during extreme weather events such as heat wave or drought.



2.3 Environment Protection Licence

The Development is considered a “scheduled activity” under Schedule 1 of the POEO Act requiring the occupier to hold an Environment Protection Licence (EPL) administered by the EPA.

The Development operates under the provisions of EPL 20748, as issued by the EPA. A copy of EPL 20748 is appended to the OEMP. Relevant conditions in EPL 20748 with respect to surface water and groundwater management are listed in **Table 3**.

Table 3: Relevant EPL Conditions

Condition No.	Condition			
P1 Location of Monitoring/Discharge Points and Areas				
P1.1	The following utilisation areas referred to in the table below are identified in this licence for the purposes of the monitoring and/or the setting of limits for any application of solids or liquids to the utilisation area.			
P1.2	The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.			
	EPA Identification No.	Type of Monitoring Point	Type of Discharge Point	Location Description
	2	Surface water quality monitoring		Sediment dam No 1 at PPU 1 identified in Figures 1 and 2 of the document titled “Narrandera Poultry Production Complex” – Water Management Plan dated March 2016, kept on EPA file EF16/1645 at DOC16/59520
	3	Surface water quality monitoring		Sediment dam No 3 at PPU 2 identified in Figures 1 and 2 of the document titled “Narrandera Poultry Production Complex” – Water Management Plan dated March 2016, kept on EPA file EF16/1645 at DOC16/59520
	4	Surface water quality monitoring		Sediment dam No 1 at PPU 3 identified in Figures 1 and 2 of the document titled “Narrandera Poultry Production Complex” – Water Management Plan dated March 2016, kept on EPA file EF16/1645 at DOC16/59520
	5	Surface water quality monitoring		Sediment dam No 3 at PPU 4 identified in Figures 1 and 2 of the document titled “Narrandera Poultry Production Complex” – Water Management Plan dated March 2016, kept on EPA file EF16/1645 at DOC16/59520



Condition No.	Condition			
	6	Surface water quality monitoring		Sediment dam No 1 at PPU 5 identified in Figures 1 and 2 of the document titled "Narrandera Poultry Production Complex" – Water Management Plan dated March 2016, kept on EPA file EF16/1645 at DOC16/59520
	7	Groundwater quality monitoring		Piezometer labelled 'Piezo 1' identified in Figures 1 of the document titled "Narrandera Poultry Production Complex" – Water Management Plan dated March 2016, kept on EPA file EF16/1645 at DOC16/59520
	8	Groundwater quality monitoring		Piezometer labelled 'Piezo 2' identified in Figures 1 of the document titled "Narrandera Poultry Production Complex" – Water Management Plan dated March 2016, kept on EPA file EF16/1645 at DOC16/59520
	9	Groundwater quality monitoring		Piezometer labelled 'Piezo 3' identified in Figures 1 of the document titled "Narrandera Poultry Production Complex" – Water Management Plan dated March 2016, kept on EPA file EF16/1645 at DOC16/59520
	10	Groundwater quality monitoring		Piezometer labelled 'Piezo 4' identified in Figures 1 of the document titled "Narrandera Poultry Production Complex" – Water Management Plan dated March 2016, kept on EPA file EF16/1645 at DOC16/59520
	11	Groundwater quality monitoring		Piezometer labelled 'Piezo 5' identified in Figures 1 of the document titled "Narrandera Poultry Production Complex" – Water Management Plan dated March 2016, kept on EPA file EF16/1645 at DOC16/59520



Condition No.	Condition			
	12	Groundwater quality monitoring		Piezometer labelled 'Piezo 6' identified in Figures 1 of the document titled "Narrandera Poultry Production Complex" – Water Management Plan dated March 2016, kept on EPA file EF16/1645 at DOC16/59520
L1 Pollution of Waters				
L1.1	Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.			
L4 Other Limit Conditions				
L4.2	All wastewater treatment, storage and terminal ponds must have a minimum pond base and wall permeability of 1 x 10 ⁻⁹ metres per second or be artificially lined with an impermeable high density polyethylene liner.			
L4.3	All wastewater collection ponds must be designed, constructed and maintained to accommodate the stormwater runoff volume generated in a 1 in 20 year, 24 hour rainfall event using a volumetric runoff coefficient of 0.8.			
O5 Waste Management				
O5.3	All wastewater and contaminated stormwater must be captured in a waste water collection system and be prevented from leaving the premises Note: This condition does not apply in rainfall events which create greater volumes of stormwater than an event with an average recurrence interval of a local 1 in 20 year, 24 hour rainfall event.			

2.4 Water Licences

2.4.1 Surface Water Licences

The *Water Act 1912* and WM Act contain provisions for the licensing of surface water capture and use. The sediment dams at each PPU are specifically intended to act as pollution control dams and are therefore exempt from requiring licensing. As outlined below, all operational water is sourced via licensed groundwater bores and, as such, no surface water licences are required.

2.4.2 Groundwater Licences

The operational water requirements of the poultry farm are met via the extraction of groundwater from two licensed production bores within the Development Site (see **Figure 1**) under the provisions of water access licence (WAL) 11788, which has an annual extraction limit of 488 units (equivalent to 488 megalitres [ML]). These bores access the Deep Aquifer (Calivil Formation) in accordance with the WAL conditions. A copy of WAL 11788 is contained in **Appendix A** and further details regarding operational water requirements provided in **Section 5.4**.



3.0 Principles of Water Management

3.1 Water Management Classes

Under Section 120 of the POEO Act it is an offence to cause environmental harm or allow the pollution of waters unless specifically licensed to do so. For the purposes of clarifying allowable activities with respect to water management, different water classifications and objectives for water management have been identified.

Table 4 lists the classes of water within the Development Site, describes their source, the target design objectives/performance criteria, and the way each class is to be managed.

Table 4: Water Management Classifications

Water Resource Classification	Description and Source of Water	Target Design Objective	Treatment
Dirty Water	Sediment laden runoff produced from exposed soils and disturbed surfaces. Generally characterised by a high turbidity and sediment load. Generally associated with temporary construction activities and unsealed access roads.	Based on Blue Book criteria (depends on the size and duration of the disturbance).	Dirty water runoff is to be contained within sediment basins or passed through sediment control devices to detain sediment and reduce turbidity before discharge to the natural environment.
Wash Down Water	Water produced from the cleaning and wash down of the PPUs. Characterised by elevated nutrient levels.	An engineered surface water management system at each PPU has been designed with the total storage on site equivalent to 170 percent of the storage capacity required to contain runoff from a 100-year average recurrence interval (ARI), 72-hour flood event.	Wash down water will be directed to grassed swale drains between the poultry sheds designed to allow infiltration of the water into the topsoil for effective nutrient uptake by the grass. During heavy rainfall events, excess water from the swales will be conveyed via pipes under the PPU ring road and into a table drain installed around the PPU perimeter. The table drain will convey the water to one of four small sediment dams located at the corners of each PPU.
Clean Water	Surface water runoff produced from undisturbed clean water catchments such as forested areas or open pastures. Characterised by low turbidity and low nutrient content.	Clean water diversions designed, installed, and maintained to convey a 100-year ARI rainfall event.	Diverted around disturbance areas and released to the natural environment.
Groundwater	Groundwater contained within the aquifers.	N/A	Groundwater will be extracted to meet operational water requirements.
Sewage	Sewage produced from staff amenities and residences.	Designed, installed, and managed in accordance with relevant council guidelines.	Treated and disposed of via on-site aerated wastewater management systems.



3.2 General Water Management Principles

The following general water management principles apply for the management of surface water and groundwater resources throughout the operational phase of the Development:

- Clean water will be diverted around all disturbance and operational areas;
- Dirty water will be contained within sediment basins or directed through appropriate sediment control structures before being released to the environment in a suitable area;
- Wash down water will be contained within the engineered surface water management systems at each PPU;
- Where possible, wash down activities will be avoided during periods of high rainfall such as to minimise the potential for off-site discharge of nutrient rich water;
- An Erosion and Sediment Control Plan (ESCP) will be developed for any new disturbance areas and appropriate Erosion and Sediment Control (ESC) measures will be installed such as to contain and treat any dirty water runoff;
- All water management infrastructure will be subject to regular inspections to ensure their functionality and reduce the potential for uncontrolled overflow or release of potentially pollutant laden waters;
- Disturbed areas and rehabilitation areas will be managed to ensure the risk of erosion is minimised and rehabilitation is effective; and
- Groundwater will be used to meet the operational water requirements of the Development.



4.0 Water Management Environment

4.1 Meteorology

The Development Site is located within the Riverina region of southwestern NSW, which is generally dominated by a dry semi-arid climate and characterised by very warm to hot summers and cool to mild winters. Rainfall is, on average, relatively evenly distributed throughout the year. Summer rainfall tends to occur mainly from localised thunderstorms, with more consistent rainfall occurring in the winter months. The region is quite susceptible to periods of drought.

Evaporation exceeds mean monthly rainfall throughout the year. Evaporation is greatest during the warmer months of November to February (inclusive).

4.2 Soil Types

The majority of soils within the Development Site have been significantly modified by historic land clearing and long-term agricultural production activities. In the absence of detailed soil landscape mapping data, general information on soil types has been sourced from the Land and Soil Capability (LSC) Mapping of NSW managed by DPE – Biodiversity and Conservation Division (BCD).

The Development Site is broadly mapped as LSC Class 4 land (moderate capability land), which is defined as “land which has moderate to high limitations for high impact land use”. Based on this information it is anticipated that the soils across the Development Site may present an erosion hazard and are likely to be dispersive in nature (Type D/F Soils). Core samples extracted during drilling of the test groundwater bores for the EIS showed the top 10 metres (m) of soil comprised of silty clays.

In the absence of detailed site-specific soil testing, the soils within the Site are assumed to be of Type D/F for the purposes of ESC management. If detailed soil assessment and characterisation is undertaken and the soils are determined to be of a lower erosion risk, then a lower standard of ESC management may be adopted pending consultation with the relevant government agencies.

4.3 Surface Water Environment

The Development Site is located within the catchment of the Murrumbidgee River, which covers 84,000 square kilometres of southern NSW. The Murrumbidgee River flows to the north of the Development Site and is located approximately 9 km to the north of the Site at its nearest point. The nearest watercourse of significance is Yanco Creek, a regulated stream of the Murrumbidgee River system, flowing approximately 8 km to the east of the Development Site at its closest point.

The Development Site (and surrounding land) is very flat and slopes gently to the west. The majority of the Site is devoid of significant vegetation, primarily comprising paddocks that have been consistently cropped and grazed for a number of years. There are no natural surface water bodies or tributaries located within the bounds of the Development Site. Two minor topographical depressions that act as minor drainage features traverse the Development Site. These features do not have any formed banks and are only distinguishable as drainage features by their location topographically and vegetation present. There are also some constructed irrigation channels within the northern extent of the Site.

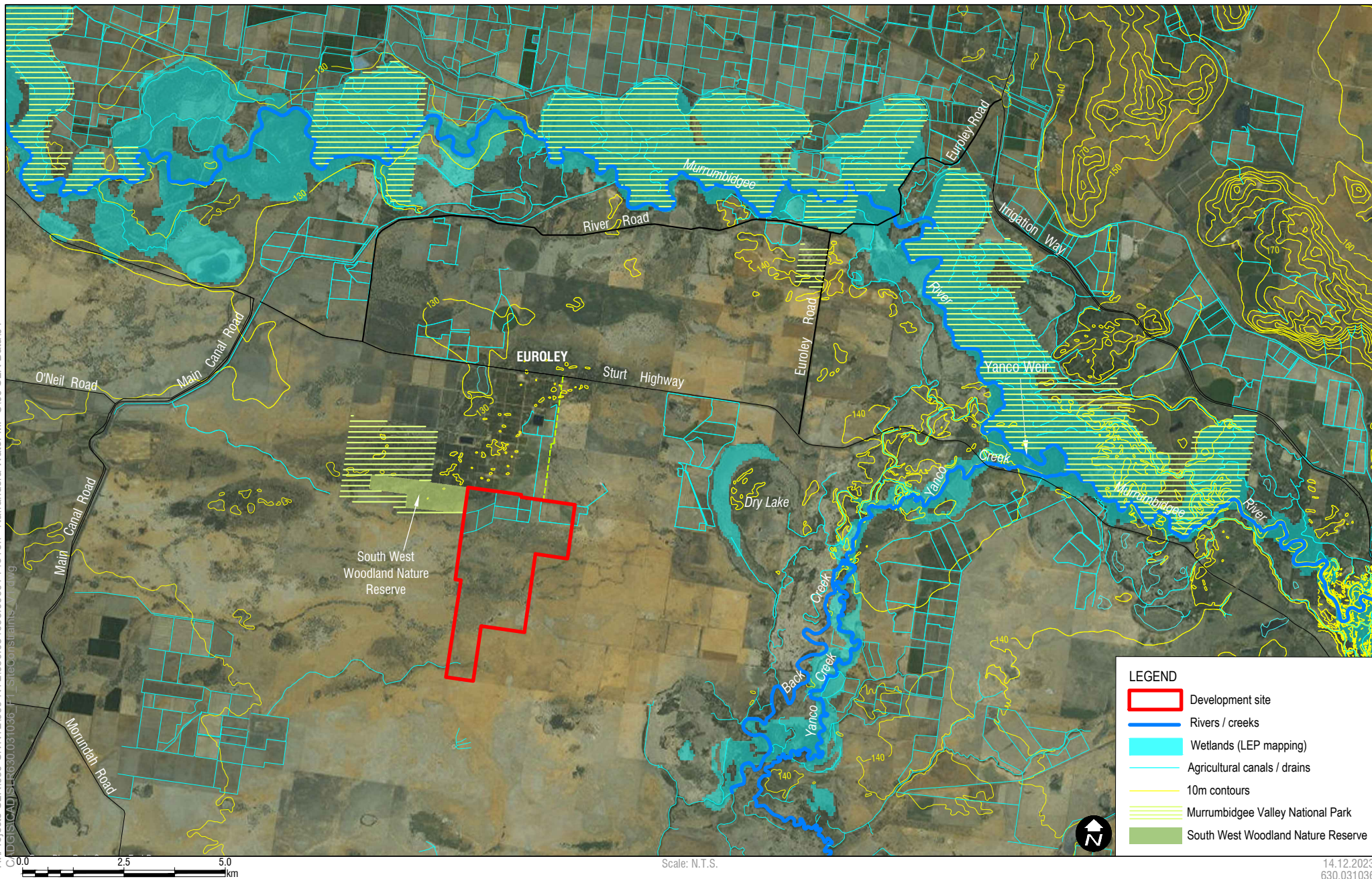
The nearest wetland to the Development Site is a small area identified as a wetland on the *NSW Wetlands Database* (DECCW, 2006) and in the *Narrandera Local Environmental Plan 2013* (Narrandera LEP), approximately 3.2 km north of the northernmost PPU.



A site constraints plan showing relevant external and internal features, including topographical features and waterways, is provided as **Figure 3**.



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4.4 Groundwater Environment

4.4.1 Principal Aquifers of Interest at the Development Site

The Development Site is located in the Lower Murrumbidgee Groundwater Management Area (GMA), which lies within the eastern Riverine Plains province of the Murray Geological Basin. The GMA is underlain by semi-consolidated to unconsolidated flat lying Cainozoic sediments of mainly continental origin. Deposition of these sediments began some 50 million years ago (middle Miocene to early Paleocene). The maximum thickness varies from 170 m in the east (at Narrandera) to about 400 m at Balranald (western end of the GMA). The sediments overlie Paleozoic and Mesozoic rocks that form the basement. Within the GMA the sedimentary deposits have been subdivided into three main units or layers. These are the Shepparton Formation, Calivil Formation and the Renmark Group. The Renmark Group lies at significant depth in relation to the Development Site and will not be discussed further.

Two aquifers have been identified as relevant to the Development Site; the Shepparton and Calivil Formation aquifers more commonly known as Shallow and Deep Aquifers, respectively. The Shallow Aquifer is defined as extending to a depth of 40 m or to the bottom of the Shepparton Formation, whichever is the greater. The Deep Aquifer is defined as extending from the bottom of Shepparton Formation down to bedrock.

4.4.2 Shallow Aquifer (Shepparton Formation)

The Shallow Aquifer, which is of Late Pliocene to Pleistocene age, directly overlies the Deep Aquifer. It is a complex assemblage of clays, silts and sands that were deposited in a fluvio-lacustrine environment. The proportion of sand is highly variable but mostly about 20 to 30 percent (%), with most occurring in the top 30%. The thickness of sediments is variable and averages around 65 m.

Drilling results at the Development Site indicate that the top of the Shepparton Formation lies very close to ground surface, extending to around 46 m depth. It is noted to consist of interbedded clay, silty clay, and sand, with some gravelly beds. The shallowest intersection of permeable material considered to form an aquifer generally lies between around 10 and 15 m depth across the Development Site, with these shallow permeable horizons generally being 3 to 4 m thick.

Four private bores have previously been identified within 2 km of the Development Site that are authorised to take water from the Shallow Aquifer for stock and domestic purposes (pers comm Tim Baker, April 2017). The general water quality of the aquifer has been identified as good enough to suggest that there is potential for this usage to include human consumption.

Groundwater levels in the Shallow Aquifer recorded at the time of drilling the shallow piezometers at the Development Site (refer **Figure 1**) were recorded to be between 25 and 29 metres below ground level (mBGL).

Groundwater sampling and analysis from the piezometers has been undertaken from April 2016 to September 2023. The results are presented in **Section 8.1.1**.

4.4.3 Deep Aquifer (Calivil Formation)

The Deep Aquifer (Calivil Formation) is a semi-confined to confined middle aquifer deposited 5 to 15 million years ago (Late to Middle Miocene). It is dominated by pale grey, coarse quartz sand with lenses of pale grey to white kaolinitic clay. The higher proportion of sand, typically 50 to 70%, makes it the most productive aquifer within the GMA. Its thickness ranges between 50 to 70 m in the eastern part of the management area (i.e. within the Narrandera / Euroley area) with a maximum of about 90 m. The Calivil Formation is described (Wooley 1991 as cited in CSIRO, 2002) as a poorly consolidated pale grey, poorly



sorted coarse to granular quartz sand conglomerate with white kaolinitic matrix. The formation includes thick intercalations of kaolin, with thin lenses of carbonaceous clay.

Drilling results at the Development Site indicate the top of the Calivil Formation lies at around 55 m depth/BGL and is noted to be around 46 m thick. The interpreted depths of the formation intersections at the Development Site are consistent with depths identified in relevant literature (e.g., CSIRO, 1997). In the two production bore locations at the Development Site, the Calivil Formation consisted of medium to coarse grained clean white quartzose sands, interbedded with thin clayey horizons.

Groundwater levels in the Deep Aquifer recorded at the time of drilling the two production bores at the Development Site were recorded to be around 24 mBGL, indicating that the Deep Aquifer is confined and sub-artesian at the Development Site.

The groundwater quality of the Deep Aquifer is generally of good quality, with electrical conductivity less than 1,000 microSiemens per centimetre ($\mu\text{S}/\text{cm}$), and water generally being suitable for domestic and stock irrigation purposes – the principal groundwater usages in the region. Monitoring from April 2016 to September 2023 shows groundwater quality has been predominantly below the *Australian Drinking Water Guidelines* ((NHMRC, NRMCC), 2011) for all parameters (**Section 8.1.2**).

4.4.4 Groundwater Use Surrounding the Development Site

The GMA plan identifies the following beneficial water uses for the two water sources:

- Ecosystem protection and agricultural water for shallow source; and
- Raw water for drinking, ecosystem protection and agricultural water for deep source.

A search of the *Bureau of Meteorology Australian Groundwater Explorer* indicates that there are 24 bores recorded within a 5 km radius of the Development Site. Groundwater bores within the area are primarily used for monitoring, irrigation, and stock and domestic uses.

The bore summaries for these 24 bores contain little information and are largely incomplete, however they indicate that 16 of the 24 bores are utilised for monitoring and the majority are located to the northwest, north and northeast of the Development Site. The minimum water bearing zone for these bores is not available in the groundwater summaries, however, bore depth ranges from 21.5 m to 138.6 m with an average of 62.7 m.



5.0 Site Water Management System

5.1 Surface Water Management

5.1.1 Surface Water Production

The poultry farm is a largely dry operation, with no effluent generated as a result of the poultry-rearing process itself. The main operational water sources are:

- Wash down water from within the poultry sheds at the end of each nine-week production cycle (approximately 5.7 times per year);
- Rainfall runoff from the shed roofs; and
- Rainfall runoff from the ground surfaces around the poultry sheds and additional improvements.

Approximately 12 kilolitres (kL) of water is used in the wash down process for each poultry shed at the end of each production cycle. This amounts to a total volume of around 192 kL per PPU per production cycle for wash down.

Analysis of wash down water from other similar facilities indicates the wash down water will have the following typical nutrient concentration:

- Total suspended solids - 2,500 milligrams per litre (mg/L);
- Total nitrogen - 65 mg/L;
- Total phosphorus - 45 mg/L.

When possible, wash down will not be undertaken during periods of high rainfall to limit the potential for overflow and off-site discharge of nutrient laden water from the surface water management system.

5.1.2 Engineering Surface Water Management System

The engineered surface water management system for the Development is detailed on the civil design drawings prepared by Lance Ryan Consulting Engineers (LRCE) in **Appendix B**. In summary, the surface water management system for each PPU comprises grassed swale drains between the poultry sheds to capture wash down water and rainfall runoff and table drains to convey the water to one of four small sediment dams. There are also stormwater pipes to convey water under roads.

Given the topography surrounding each PPU, there is minimal/negligible clean water catchment and, as such, no clean water diversions are warranted. Additionally, the pads for each of the PPUs have been constructed above the 100-year ARI flood event depth at a minimum of 300 mm above the existing adjacent ground levels to reduce the likelihood of runoff and floodwater ingress.

The typical “design event” for surface water management, in accordance with the Blue Book (Landcom, 2004), is a 20-year ARI, 24-hour rainfall event. However, the surface water management system has been designed with the total storage on site equivalent to 170% of the storage capacity required to contain runoff from a 100-year ARI, 72-hour event.

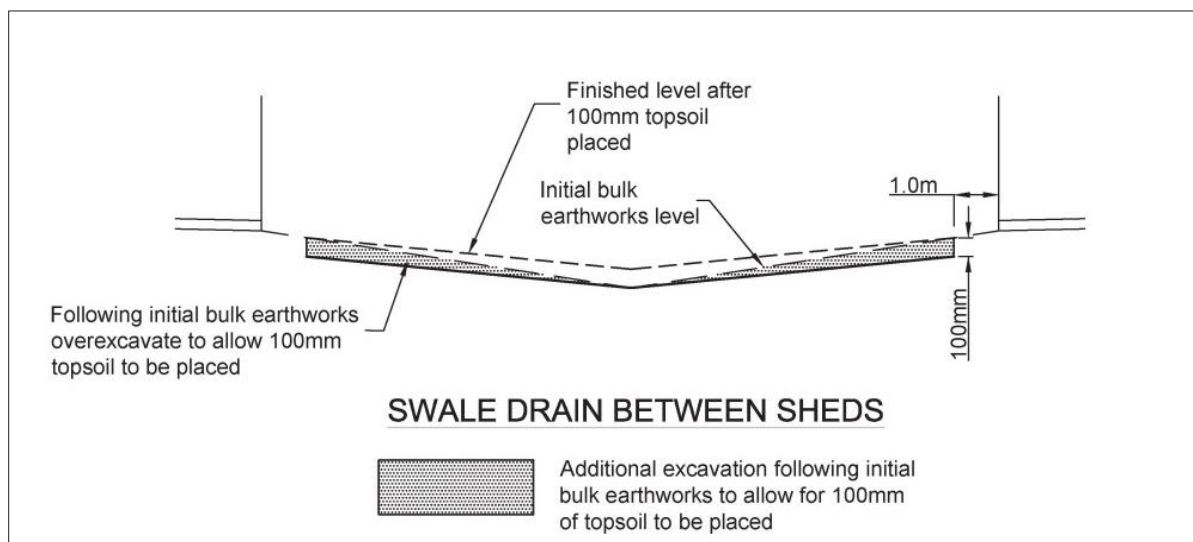
Based on the design of the surface water management system, along with the quality and low volume of water to be managed, there is negligible risk of nutrient high runoff flowing off site. The potential for impact to local water resources by runoff of nutrients, chemicals or pathogens is considered negligible.



Swale Drains

Each poultry shed has fully sealed concrete flooring and is surrounded by a 400 mm high dwarf concrete bund wall to prevent rainwater and runoff entering the sheds and to allow for the controlled discharge of wash down water from the sheds. The concrete bunds have strategically located seepage holes to convey excess wash down water from the sheds into grassed swales between each of the sheds. Rainfall runoff from the shed roofs and from some of the surrounding surfaces is also directed into the grassed swales.

The swale drains between the sheds have a triangular cross-section and have a low grade to maximise infiltration potential. The typical arrangement of the swale drains is shown on **Figure 4**.



Source: LRCE, 2015.

Figure 4: Typical Swale Drain Construction

The swale drains have been designed to allow infiltration of the water into the topsoil for effective nutrient uptake by the grass, which is regularly slashed to promote continued growth. The typical annual pollutant load removal efficiencies for vegetated swales according to *Australian Runoff Quality* (Engineers Australia, 2006) are:

- Total Suspended Solids: 60-80% removal
- Total Nitrogen: 25-40% removal
- Total Phosphorus: 30-50% removal

Considering typical wash down quality as presented in **Section 5.1.1**, analysis of surface water collected in the sediment dams within the Development Site (after nutrient removal by swale drains) shows the following observed removal rates (**Table 5**).

Table 5: Nutrient Removal Rate from Swale Drain

Parameter	Typical Wash Down Water ¹	Average Monitored in all Sediment Dams ²	% Removal
Total Suspended Solids (TSS)	2,500 mg/L	192 mg/L	92%
Total Nitrogen (TN)	65 mg/L	8.6 mg/L	87%
Total Phosphorus (TP)	45 mg/L	0.9 mg/L	98%

¹As presented in **Section 5.1.1**.

²Average from observed data provided in **Section 7.1.1**.



Table Drains

During heavy rainfall events, excess water from the grassed swales is conveyed via underground pipes under the PPU ring road and into a table drain around the perimeter of the PPU. The perimeter table drain ensures that all rainfall runoff from the ground surfaces within the PPU environs is contained within the controlled surface water management system.

The table drains have a trapezoidal cross-section with varying dimensions (depending upon the predicted runoff volume). The batter side slopes are approximately 1 vertical to 5 horizontal (1:5).

Sediment Dams

The table drain around the perimeter of each PPU conveys the water to one of four small storage dams constructed at each corner of the PPU. Each dam has a capacity of approximately 7,000 cubic metres (m³), amounting to a combined capacity of 28,000 m³. The total water storage capacity at each PPU (including the swale drains and table drains) is equivalent to 170% of the capacity required to contain runoff from a 100-year ARI, 72-hour event. The internal side slope batters of the dams are approximately 1 vertical to 5 horizontal (1:5).

Laboratory data captured through the Surface Water Monitoring Program (**Section 7.0**) from April 2016 to September 2023 demonstrates that the grassed swale drains meet the pollutant load removal efficiencies for vegetated swales per *Australian Runoff Quality* (Engineers Australia, 2006) (**Table 5**). However, water that transfers from the swales to the sediment dams following nutrient reduction still surpasses the ANZECC (2000) trigger values for total nitrogen and phosphorus. As such, site-specific trigger values were defined to better capture any deviation from regular nutrient levels in the surface water management system. It is well understood that wash down water from the poultry sheds is nutrient rich, and the operation mitigates the risk of discharge by way of storage capacity for a large design storm.

Given the design of the surface water management system and the typically high evaporation rates within the region (see **Section 4.1**), the sediment dams typically only receive runoff during moderate to large rainfall events. Water in the dams is allowed to dissipate through evaporation. Overflow from the dams and off-site discharge are not anticipated, however, if any near miss events are observed, the site will review the need for further stormwater mitigation.

The internal surfaces of the sediment dams have been compacted to limit permeability to the subsurface.

5.1.3 PPU Roof Rainfall

Rainfall runoff from the poultry shed roofs is directed into the grassed swales drains (See **Section 5.1**).

5.2 Sewage Management

Sewage generated by the on-site residences and staff amenities at each PPU is treated and disposed of via on-site aerated wastewater treatment systems (one at each residence and one at each PPU) installed and operated in accordance with Council approvals and the relevant standards/guidelines.



5.3 Wheel Wash Units

The potential for mechanical transmission of disease pathogens is reduced through the operation of a wheel wash facility on the access road to each PPU. All vehicles entering a PPU site are required to pass through the wheel wash to remove dust particles from the wheels and chassis. On approach the driver is requested (via signage) to push a button, a small pump turns on and the driver is requested (via signage) to proceed slowly through the wheel wash spray.

An appropriate chemical sanitiser, such as Virukil, which is commonly used on poultry farms, is added to the wash water.

5.4 Operational Water Supply

The Development requires a long-term average water supply of around 460 ML/year (1.26 ML/day or 14.6 litres per second [L/s] averaged over a year) for shed ventilation, bird consumption, shed cleaning, landscaping and staff amenity requirements. This water is sourced from two groundwater bore located within the Development Site (labelled 'Bore 1' and 'Bore 2' on **Figure 1**), each location with two bores (a production bore and a backup bore).

As advised in **Section 2.4**, WAL 11788 permits the abstraction of 488 units annually from the two bores. These bores access the Deep Aquifer (Calivil Formation) in accordance with the WAL conditions (see **Appendix A**). Bore logs for the two production bores are presented in **Appendix C**, and summary information is presented in **Table 6**.

Table 6: Production Bore Information

Bore ID	Easting (GDA94)	Northing (GDA94)	Total Drilled Depth (mBGL)	Top of Calivil Formation (mBGL)	Base of Calivil Formation (mBGL)	Bore Screens (ss wire-wound)	
						Aperture	Setting (mBGL)
Bore 1	430623	6157517	78	54	Not drilled	0.050"	57-59
						0.060"	59-60
						0.040"	64-65
						0.050"	65-66
						0.060"	66-71
						0.070"	71-73
Bore 2	430780	6156352	107	54	100	0.060"	73-75
						0.070"	75-77
						0.040"	85-91
						0.050"	91-93

Water extracted from the bores is treated as per the recommendations by the *National Water Biosecurity Manual – Poultry Production* (Department of Agriculture, Fisheries and Forestry [DAFF], 2009). The water is pumped from the bore and filtered through sand media. The water pH is monitored and if it is found to be high, citric acid is added to maintain pH at approximately 7.0. The water is then chlorinated to deliver approximately 3 parts per million (ppm) in to four storage tanks located at each PPU (combined 1.4 ML storage capacity at each PPU). Water from the storage tanks is pumped to each poultry shed at the respective PPU, with chlorine dioxide dosed into the water delivery system supplying the sheds at 0.5 to 0.1 ppm.

The groundwater extraction from the two production bores is recorded from a single totaliser flow meter installed at each bore on a six-monthly basis.



5.5 Water Supply Contingency Plan

5.5.1 Operational Water Supply

The results of the groundwater pumping test undertaken for the RTS (SLR, 2015b) indicate that the Calivil Formation aquifer has sufficient capacity to support the Development's long-term water supply requirements of approximately 1.26 ML/day and can support significantly higher rates of extraction. The pumped bore recorded a maximum drawdown of only 4.18 m after 2 days of pumping at 45 L/s (3.89 ML/day), with the observation bore located almost 1.2 km away recording a maximum of 0.44 m drawdown. The achieved yields demonstrate appropriate water supply security for the Development.

In the unlikely event that the operational water requirements of the Development cannot be provided, for example during an extended extreme drought, this is a commercial risk for ProTen. If this occurs, several options will be available including the purchase of water from off-site and/or reducing the operating capacity of the Development until the required water supply can be obtained. Should additional groundwater be required in extended extreme drought periods, groundwater trades will be sourced from the local area. On this basis, there should not be any impact or disadvantage to other local water users.

Due to biosecurity requirements, ProTen does not capture and re-use stormwater run-off from the roofs of the poultry sheds. While the captured roof water can be chlorinated, there is still an element of risk associated with introducing disease pathogens to the livestock and the possibility of spreading disease.

5.6 Mitigation and Management

The Development is managed in compliance with ProTen's standard operating procedures. This includes a regular site inspection and maintenance program to minimise the potential for adverse environmental impacts, extend the life of farm equipment, reduce operating costs and maximise operational efficiency.

The following best management practices and mitigation measures will continue to be implemented to safeguard local water resources and/or minimise and manage potential adverse impacts include:

- The surface water management systems will be visually inspected on a monthly basis, as well as prior to any predicted significant rainfall event and following significant rainfall events. Where water management or ESC structures are identified to have reduced capacity due to excessive sediment build-up or scouring, rectification works (desilting, regrading and/or reshaping) will be undertaken to ensure the structures maintain their design capacity and can handle subsequent rainfall events.
- The grassed swale drains between the poultry sheds will be carefully managed to minimise soil disturbance and maximise infiltration of runoff, as well as regularly slashed to encourage continual grass growth and associated nutrient up-take.
- Dry-cleaning practices at the end of each production cycle will be maximised within the poultry sheds prior to washing with water to minimise the volume of wash down water, along with the amount of poultry litter (and associated sediments and nutrients) washed out of the sheds.
- The waste management systems described in the OEMP will be implemented to ensure that each waste stream generated by the Development is effectively managed and disposed of off site. There will not be any on-site stockpiling or disposal of waste materials.



- The best management practices and mitigation measures for chemical use and storage described in the OEMP will be implemented.
- Should an overflow or spill event occur, it will be dealt with according to the *Environmental Incident Management Procedure* in the OEMP. If the incident threatens to cause material harm to the environment, the relevant government agencies will be immediately notified, and any instructions provided strictly adhered to. Based on the nature of the incident, sampling/additional investigation may be considered necessary to characterise the possible impact of the incident.

5.7 Roles and Responsibilities

The key personnel responsible for environmental management, including surface water and groundwater management, throughout operation of the Development are listed in **Table 7**.

Table 7: Roles and Responsibilities

Role	Responsibilities
ProTen Site Management	• Overall responsibility for environmental management and compliance with the Development Consent and relevant legislation; • Coordinate environmental inspections, reporting and authority liaisons; • Record, notify, investigate and respond to any complaints and/or enquiries and, where necessary, develop and implement corrective actions; • Record, notify, investigate and respond to any environmental incidents and, where necessary, develop and implement corrective actions; • Oversee the implementation of this WMP and provide adequate resources to enable implementation of this WMP; • Provide adequate environmental inductions/training to employees and contractors regarding their requirements under this WMP; and • Report on the performance of the WMP to senior management for review and as a basis for improvement of the system.
All employees and contractors	• Ensure familiarity with this WMP and ensure appropriate and effective implementation and compliance; • Support ProTen's commitment to environmental management and compliance; • Work in a manner that will not harm the environment or impact on surrounding receptors; • Report all environmental incidents and complaints to ProTen Site Management without delay; and • Report any inappropriate operational and/or environmental management practices to ProTen Site Management without delay.

5.8 Inductions and Training

ProTen Site Management will ensure that all employees and contractors are suitably inducted and trained prior to commencing any work on site. Training in relation to the OEMP, including implementation of the management strategies and mitigation measures in this WMP, will take place initially through the site induction and then on an on-going basis through "toolbox talks" (or similar).



6.0 Erosion and Sediment Control

6.1 Erosion Potential

All operational surface water runoff from within the PPU environs is directed into the grassed swale drains (see **Section 5.1.2**). Possible areas of concern with respect to erosion and sedimentation during the operational phase include:

- Unsealed access roads;
- Soil stockpiles;
- Unsealed and/or hardstand laydown areas;
- Any additional construction areas; and
- Revegetation areas.

However, the potential for erosion and sedimentation is considered to be low during the operational phase due to limited disturbance activities and untreated disturbance areas.

6.2 Erosion and Sediment Control

Appropriate ESC structures and management measures will be maintained during the operational phase of the Development in accordance with the *Blue Book* (Landcom, 2004) and *Erosion and Sediment Control on Unsealed Roads* (Office of Environment and Heritage [OEH], 2012). Some of these measures will include:

- Appropriate shaping and grading of unsealed roads and laydown areas;
- Regular maintenance of unsealed roads, laydown areas and vehicle parking areas;
- Where necessary, use of spoon drains and swale drains to manage runoff from unsealed roads and other disturbed surfaces;
- Where necessary, clean extraneous surface water from upslope will be diverted around areas of disturbance;
- Vehicular access will be restricted (as much as possible) to the designated access roads;
- Soil and other material stockpiles will be located in areas away from roadways and surface water management features;
- Temporary ESC structures, such as silt fences, will be installed prior to the commencement of any disturbance activities;
- Disturbed areas will be promptly rehabilitated and revegetated to a stable landform following the completion of disturbance activities; and
- An on-going maintenance program to ensure the continued integrity of surface water management and ESC structures.

6.3 Revegetation

The most effective means of controlling erosion and sedimentation is through the establishment and maintenance of a healthy vegetation cover. Vegetation provides surface protection against raindrop impact, binds the underlying soil to resist detachment by surface flows and improves the soil's infiltration capacity.



6.3.1 General Disturbance Areas

General disturbance areas will be promptly rehabilitated to a stable landform and revegetated following completion of the construction/disturbance activities. Broadcast seeding will be utilised as the preferred revegetation method for all disturbance areas requiring revegetation. For critical areas requiring quick revegetation or for areas where poor revegetation is identified, more intensive revegetation methods (i.e., hydromulching) may be warranted. Broadcast seeding involves the spreading of a suitable pasture seed mix over the area to be revegetated and will be undertaken according to the following construction notes:

- Where possible, topsoil will be re-spread to a minimum depth of 100 millimetres in the reverse sequence to its removal so that the organic layer containing any seed or vegetation is returned to the surface. Re-spreading on the contour will aid runoff control and increase moisture retention for subsequent plant growth. The re-spread topsoil will be levelled to achieve an even surface (avoiding a compacted or an over-smooth finish) and tilled;
- After surface soil tillage is completed for any given area, revegetation will commence as soon as practicable; and
- An appropriate fertiliser such as Granulock 15 (or similar) will be applied during the seeding operation at a rate of approximately 250 kilograms per hectare.

The pasture grass and legume mix provided in **Table 8** will be applied.

Table 8: Pasture Grasses and Legumes for Revegetation

Species	Rate (kilograms per hectare)	
	Spring / Summer	Autumn / Winter
Japanese Millet	20	5
Ryecorn/Oats	5	20
Couch Grass	10	8
Wimmera Ryegrass	5	10
White Clover	8	-
Lucerne	5	-
Sub Clover	-	8
Serradella	-	10
Consol	-	2

All legumes (clovers and lucerne) should be inoculated with Rhizobia and lime pelleted to promote nodulation and facilitate subsequent nitrogen fixation.

6.3.2 Topsoil Stockpiles

In accordance with the *Blue Book*, any long-term soil stockpiles (i.e., greater than 10 days) will be sown with a cover crop immediately after stockpile formation. The cover crop specifications in **Table 9** are recommended for temporary erosion control protection.

Table 9: Topsoil Stockpile Cover Crop

Species	Rate (kilograms per hectare)	
	Spring / Summer	Autumn / Winter
Ryecorn/Oats	10	20
Japanese Millet	20	10



7.0 Surface Water Monitoring Program

7.1 Baseline Data

There are no notable surface water bodies within or adjacent to the Development Site and, as such, no historical baseline surface water quality data is available. As outlined in **Section 4.3**, the Development Site is well removed from any notable surface water features with only two minor drainage depressions traversing the Site.

7.1.1 Surface Water Monitoring

Surface water quality monitoring is undertaken to:

- Establish the quality of water collected in the sediment dams;
- Characterise the nature of wash down water;
- Establish baseline criteria for on-going improvements to water management;
- Provide data for long term comparison and assessment purposes; and
- Review and monitor the effectiveness of ESC structures and drainage control infrastructure.

The surface water monitoring data from June 2017 to September 2023 in the sediment dams is presented in **Table 10**.

Table 10: Surface Water Quality Data in Sediment Dams

Site	Date Sampled	General			Nutrients			
		pH	Electrical Conductivity (µS/cm)	Total Suspended Solids (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Total Nitrogen (mg/L)	Nitrate/ Nitrite as N (mg/L)	Total Phosphorus (mg/L)
ANZECC Criteria Limits		6.5 - 8.0	125 - 2,200	-	-	0.5	0.04	0.05
NSW Water Quality Objectives		6.5 - 8.5	125 - 2,200	-	-	0.5	-	0.05
PPU1	Jun-17	7.7	272	744	2	-	0.5	0.2
PPU2		7.5	67	732	2	-	0.5	0.3
PPU3		7.4	266	288	3	-	0.9	0.4
PPU4		7.5	246	13	2	-	3.5	0.3
PPU5		7.4	187	88	2	-	4.6	0.6
PPU1	Sep-17	7.8	360	116	<2	<2	0.6	<0.01
PPU2		7.3	361	345	15	16	1.4	2.7
PPU3		7.6	327	10	3	7	3.6	0.5
PPU4		8.2	303	9	2	8	5.9	0.2
PPU1	Jan-18	7.5	268	1000	2	4	1.8	0.1
PPU2		7.2	213	510	9	9	0.2	0.6
PPU3		9.2	374	221	3	3	0.1	0.1
PPU4		9.1	258	218	5	5	0.1	0.3
PPU5		8.2	222	115	2	6	4.5	0.4
PPU1	Mar-18	9.7	493	29	2	2	<0.5	0.3
PPU2		8.7	388	1280	10	14	3.8	2.1
PPU3		8.5	729	1660	14	14	<0.5	2.2
PPU4		8.1	514	454	10	10	<0.5	1.2
PPU5		8.2	301	87	<2	2	2.5	0.7
PPU1	Jun-18	9.4	677	28	19	19	0.2	0.2
PPU2		7.9	479	1100	21	21	0.3	2.8
PPU3		9	833	39	4	5	1.4	0.3
PPU4		8.5	456	13	2	3	0.9	0.8



PPU5		8.3	370	129	<2	3	3.1	0.9
PPU1	Sep-18	8	720	69	78	79	0.8	1.2
PPU2		7.9	389	27	79	80	1.2	1.7
PPU3		8.2	407	32	4	4	0.2	0.9
PPU4		9	573	390	25	25	0.4	2
PPU5		8.1	395	49	3	6	3	1.1
PPU1	Dec-18	7	708	12	4	4	<0.5	0.6
PPU2		7.2	388	117	5	5	<0.5	1.6
PPU3		7.2	701	106	7	8	0.5	1.2
PPU4		7.6	411	15	2	2	<0.5	1
PPU5		8.6	482	21	2	3	0.8	0.7
PPU1	Mar-19	8.3	862	129	6	6	<1	0.6
PPU2		7.4	447	1220	18	18	<1	3.7
PPU3		7.9	249	330	46	46	<1	0.5
PPU4		7.4	434	11	2	2	<1	0.7
PPU5		7.4	636	55	7	7	<1	1
PPU1	Jun-19	7.6	271	-	3	3	<0.5	0.4
PPU2		7.4	253	-	3	3	<0.5	0.4
PPU3		7.4	202	-	5	8	2.8	1.4
PPU4		7.7	318	-	<2	<2	<0.5	0.6
PPU5		8	400	-	4	5	0.6	0.7
PPU1	Sep-19	7.2	293	124	5	5	<1	0.2
PPU2		7	317	677	6	20	14	0.2
PPU3		7.5	268	301	4	6	2	0.6
PPU4		7.5	397	54	4	11	7	2.4
PPU5		7.4	410	45	4	8	4	1.8
PPU1	Dec-19	7.1	429	242	3	5	1.8	0.9
PPU2		7.4	409	946	9	9	<0.1	2.7
PPU3		7.4	413	309	6	7	1.1	2.1
PPU4		7.4	525	643	8	8	<0.1	2.4
PPU5		7.5	465	94	<2	<2	0.9	0.7
PPU1	Mar-20	6.6	368	135	3	4	0.6	0.5
PPU2		6.6	211	37	5	5	<0.1	1.2
PPU3		6.8	242	26	2	2	0.5	0.8
PPU4		7.2	215	19	3	3	<0.1	1.2
PPU5		7.3	415	59	2	2	0.3	0.8
PPU1	Jun-20	6.9	308	4	2	2	<1	0.6
PPU2		6.7	192	121	4	6	2	1
PPU3		6.7	243	74	4	5	1	1.2
PPU4		6.8	253	21	2	2	<1	0.6
PPU5		7.2	294	56	5	6	1	0.7
PPU1	Nov-20	7.5	327	444	3	3	<0.1	0.2
PPU2		7.5	265	144	6	6	<0.1	0.9
PPU3		8.4	266	49	5	5	<0.1	0.5
PPU4		8.1	356	64	4	4	0.4	1.5
PPU5		7.9	338	60	4	6	1.8	1
PPU1	Apr-21	7.2	214	9	<2	<2	<0.1	<0.01
PPU2		7.2	173	132	6	6	<0.1	0.59
PPU3		7.2	271	102	5	6	1.3	0.55
PPU4		7.2	205	80	4	4	<0.1	0.98
PPU5		7.5	215	37	3	3	0.4	<0.01
PPU1	Sep-21	7.3	222	35	2	2	0.2	0.39
PPU2		7.3	248	114	3	6	3	0.81
PPU3		7.3	268	91	4	6	2.5	0.94
PPU4		7.4	198	44	2	2	0.3	0.21
PPU5		7.4	254	30	5	6	0.7	0.88
PPU1	May-22	6.8	180	15	2	4	2	<0.01
PPU2		6.9	77	30	8	8	<0.01	0.55
PPU3		6.8	166	24	3	6	3.1	0.54
PPU4		6.8	152	33	3	7	4	1.11



PPU5		6.9	170	7	3	4	1	<0.1
PPU1	Sep-22	7	205	103	3	7	4.1	0.86
PPU2		7.1	129	68	2	3	0.9	0.57
PPU3		7.1	180	36	2	6	4.2	0.75
PPU4		7.2	189	29	5	8	2.9	1.06
PPU5		7.3	190	24	4	6	2.4	0.7
PPU1	Mar-23	6.7	220	88	2	2	0.4	0.15
PPU2		8.8	245	55	7	7	0.4	0.23
PPU3		8.4	255	20	4	6	2	0.42
PPU4		9.2	200	11	3	3	0.1	0.21
PPU5		8.5	204	10	2	3	1.4	0.32
PPU1	Sep-23	7.2	317	111	7	8	1.1	1.01
PPU2		7.2	288	72	12	12	0.5	1.1
PPU3		7.3	283	45	8	11	3.4	1.48
PPU4		7.3	236	32	7	8	0.6	1.13
PPU5		7.3	267	32	10	11	1	1.99
Minimum		6.6	67	4	2	2	0.1	0.1
Maximum		9.7	862	1660	79	80	14	3.7
Average		7.6	332	192	7	9	1.9	0.9

7.1.2 Visual Inspections

Visual inspections of the engineered surface water management systems and ESC structures shall be undertaken on the following basis:

- Monthly;
- Prior to any predicted significant rainfall events; and
- Following any significant rainfall events.

Inspections shall focus on the capacity and condition of the surface water management system structures and ESC structures, water retention within the sediment dams, condition of vegetation (grass) within swale drains and general water management practices across the Site. Where water management or ESC structures are identified to have reduced capacity or are in poor condition, remediation works will be undertaken without delay. If the structures have excessive sediment build-up or scouring, they will be desilted, regraded and/or reshaped to ensure the structures maintain their design capacity and can handle subsequent rainfall events.

The results of any visual inspections and any remediation works required/undertaken shall be recorded in an inspection checklist and retained for future reference.

7.1.3 Surface Water Quality Monitoring

The surface water quality monitoring parameters to be analysed are listed in **Table 11**. This analytical suite was devised to detect any potential environmental impact to downstream water resources as a result of the Development.

Field measurement of water quality parameters will be undertaken using appropriate field equipment maintained and calibrated in accordance with the manufacturer's recommendations. Analytical testing is to be undertaken by a National Association of Testing Authorities (NATA) accredited laboratory. Sampling will be undertaken by suitably qualified personnel.



Table 11: Surface Water Quality Monitoring Analytical Suite

Analytical Suite
- pH (field) - Electrical conductivity (EC) (field and laboratory) - Total suspended solids (TSS) - Nitrogen - Phosphorus

Surface water quality sampling will be undertaken according to the *Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales* (EPA, 2022).

The surface water quality monitoring regime for the Development Site is listed in **Table 12**. This includes requirements for periodic and reactive monitoring.

Table 12: Surface Water Quality Monitoring Schedule

Monitoring Site	Parameters	Frequency
Periodic Sampling		
One sediment dam at each PPU	- Water quality (see Table 11); - Water level; and - Photos	6-monthly grab sample when water is available
Reactive Sampling		
Overflow from sediment dam	- Water quality (see Table 11); and - Photos	Grab sample during overflow
Any surface water impacted by a spill, discharge or other incident	Targeted analytes selected based on the nature of the incident	Immediately and/or as instructed by consulted government agencies

7.1.4 Surface Water Flow Monitoring

As there are no flowing watercourses within or near the Development Site, no surface water flow monitoring shall be undertaken.

7.2 Surface Water Monitoring Trigger Values

Surface water quality impact assessment trigger values were initially based on ANZECC (2000) for water quality and NSW's Water Quality Objectives (WQOs). Following the identification of water quality exceedances at the Development during 2022, an investigation was conducted that recommended the establishment of site-specific water quality exceedance criteria (SLR, 2023a). In accordance with this recommendation, a trigger review was completed in 2023 which identifies site-specific surface water quality trigger values to be adopted for each of the monitored sediment dams (SLR, 2023b).

The following triggers will be used to determine if the impact investigation procedure should be initiated:

- Occurrence of an overflow or spill event which may impact surface waters;
- Breaching of relevant surface water quality or quantity triggers; and/or
- When a legitimate complaint is received from a local landholder.



7.2.1 Surface Water Quality Trigger Values

Statistical Site-Specific Trigger Criteria

To the end of 2023, the surface water quality trigger values for the Development Site were based upon the NSW WQOs which are almost identical to the ANZECC (2000) limits for the applicable analytes. The WQO limits were adopted in the absence of site-specific surface water quality data at the time the initial environmental management documents were prepared.

The trigger review performed in 2023 highlighted that a total of 18 sampling rounds had been conducted at the PPU dams between June 2017 and September 2022. Despite the total number of data points being less than the equivalent of two years of monthly data (24 data points) as endorsed in ANZECC (2000) for establishment of triggers, it was recognised that:

- The data were acquired over a time span of nearly six years, meaning the results are likely more representative of temporal and seasonal climatic fluctuations than what could be acquired over two years; and
- A distinct climatic shift was observed across the monitoring timeline – a drought period prevailed over NSW between 2017 and the end of 2019 (Bureau of Meteorology, 2023), then generally wetter than average conditions followed from 2020 to 2022.

Provided the extended monitoring timeline and the acquisition of baseline data through opposing climates, site-specific water quality trigger values were determined through statistical analysis. The trigger values were derived with consideration for the nature of the available data, the frequency of monitoring, and the level of risk associated with water quality management at the Development Site. To effectively capture deviation from standard water conditions at the Development Site, the trigger values for each analyte are based upon:

- A lower trigger value equivalent to the observed 10th percentile value (where applicable); and/or
- An upper trigger value equivalent to the observed 90th percentile value.

Table 13 shows the surface water quality trigger values determined for the Development Site. Each analyte only has an upper trigger value, except for pH which has both lower and upper trigger values (in the event pH trends towards more acidic ranges).

Consistent with **Section 9.1**, the Impact Investigation Procedure will be activated in the event two consecutive exceedances occur for the same analyte at a designated monitoring site (while biannual monitoring continues). If the monitoring regime changes, the trigger values and the exceedance criteria will be reviewed.



Table 13: Surface Water Quality Trigger Values

Site	General				Nutrients			
	pH (pH unit)		Electrical Conductivity (µS/cm)	Total Suspended Solids (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Total Nitrogen (mg/L)	Nitrate/ Nitrite as N (mg/L)	Total Phosphorus (mg/L)
	Lower	Upper						
PPU1	6.8	7.9	690	128	4.5	5.6	1.0	0.9
PPU2	6.8	7.7	420	1,160	12.5	19.0	1.7	2.8
PPU3	6.8	8.7	394	296	5.5	7.6	3.3	1.2
PPU4	7.0	8.7	517	62	5.0	9.0	3.2	1.4
PPU5	7.2	8.3	472	104	5.0	6.6	4.2	1.0

7.2.2 Surface Water Quantity Trigger Values

In the absence of prescriptive trigger values for surface water flow criteria, a risk-based approach will be adopted for the management of further investigation into surface water quantity issues based on the potential impact to the receiving environment.

Surface water runoff and wash down water will be managed as outlined in **Section 5.1**. There will not be any harvesting of surface water, and rainfall runoff from within the PPU environs or on the poultry shed roofs will be directed to the engineered surface water management system.

On this basis, the potential impact to surface water flows is considered negligible. Surface water quantity issues that will trigger additional investigation and mitigation include:

- Overflow of sediment dams;
- Off-site discharge; and
- Significant erosion of land surfaces and/or surface water management structure.



8.0 Groundwater Monitoring Program

8.1 Baseline Data

Baseline groundwater conditions for the Development Site were established in mid-2015 (Deep Aquifer groundwater levels) and early 2016 (Deep Aquifer groundwater quality, and Shallow Aquifer groundwater levels and quality).

8.1.1 Shallow Aquifer

Twelve piezometers have been installed into the Shallow Aquifer at the Development Site, as shown in **Figure 1** and detailed in **Table 14**. The twelve piezometers are installed in six individual locations in a nested configuration to monitor different depths within the Shallow Aquifer. The shallower of the two piezometers at any one location were installed into the shallowest permeable horizon encountered and for the most part are noted to be dry. The deeper of the two piezometers at any one location were installed into the shallowest water bearing permeable horizon encountered. The ten piezometers located near the PPUs are to monitor any impact on the Shallow Aquifer as a result of the engineered surface water drainage systems managing rainfall runoff within the bounds of the respective PPU and wash down water. The remaining two piezometers located near residences 1 and 2 are to monitor any impact on the Shallow Aquifer as a result of domestic effluent (sewage) irrigation. The site for these nested piezometers, which was requested by DPI Water (see **Section 1.3**), was selected given that the soil in this area is sandier than elsewhere within the Development Site.

Table 14: Shallow Aquifer Piezometer Installation Details

Piezometer ID	Easting (GDA94)	Northing (GDA94)	Top of Screen Interval (mBGL)	Base of Screen Interval (mBGL)
Piezo 1 shallow	429678	6154073	19	22
Piezo 1 deep	429652	6154073	42	45
Piezo 2 shallow	429659	6156568	19	22
Piezo 2 deep	429659	6156537	40	42
Piezo 3 shallow	430835	6155683	19	22
Piezo 3 deep	430810	6155622	36	39
Piezo 4 shallow	431027	6157225	13	16
Piezo 4 deep	431052	6157225	25	28
Piezo 5 shallow	429903	6157925	5	8
Piezo 5 deep	429877	6157925	32	38
Piezo 6 shallow	430280	6158421	10	13
Piezo 6 deep	430306	6158421	30	31

Bore logs for the twelve piezometers are presented in **Appendix D**.

Shallow Aquifer Groundwater Levels

Initial groundwater levels and quality from the six (deeper) piezometers that were found to contain water were collected in April 2016. The shallower of the two piezometers at each nested site were found to be dry. **Table 15** presents the groundwater levels recorded for the six deeper Shallow Aquifer piezometers between February 2016 and September 2023.



Table 15: Shallow Aquifer Water Levels

Date	Standing Water Level (mTOC ¹)											
	Piezo 1 shallow	Piezo 1 deep	Piezo 2 shallow	Piezo 2 deep	Piezo 3 shallow	Piezo 3 deep	Piezo 4 shallow	Piezo 4 deep	Piezo 5 shallow	Piezo 5 deep	Piezo 6 shallow	Piezo 6 deep
Feb-16	n/a ²	27.1	n/a ²	25.9	n/a ²	26	n/a ²	25.7	n/a ²	25.6	n/a ²	25.6
Apr-16	n/a ²	25.9	n/a ²	25.9	n/a ²	25.9	n/a ²	25.7	n/a ²	25.7	n/a ²	25.7
Oct-16	n/a ²	24.4	n/a ²	n/a ³	n/a ²	24.9	n/a ²	n/a ³	n/a ²	n/a ³	n/a ²	n/a ³
Mar-17	n/a ²	25.8	n/a ²	25.4	n/a ²	25.5	n/a ²	25.6	n/a ²	25.3	n/a ²	25.3
Jun-17	n/a	24.1	n/a	24.8	n/a	24.7	n/a	25.5	n/a	25	n/a	25
Sep-17	n/a	25	n/a	24.6	n/a	24.7	n/a	25.4	n/a	24.6	n/a	24.6
Dec-17	n/a	25.9	n/a	25.5	n/a	25.5	n/a	25.4	n/a	25.4	n/a	25.4
Mar-18	n/a	27.9	n/a	26.1	n/a	26.2	n/a	25.7	n/a	25.8	n/a	25.8
Jun-18	n/a	27.4	n/a	25.9	n/a	26.1	n/a	25.9	n/a	25.8	n/a	25.8
Sep-18	n/a	26.4	n/a	25.8	n/a	25.8	n/a	26	n/a	25.8	n/a	25.7
Dec-18	n/a	27.9	n/a	26.3	n/a	26.4	n/a	26.1	n/a	26	n/a	26
Mar-19	n/a	28.4	n/a	26.9	n/a	27.2	n/a	26.3	n/a	26.3	n/a	26.5
Jun-19	n/a	26.7	n/a	27.4	n/a	26.9	n/a	26.4	n/a	26.3	n/a	26.5
Sep-19	n/a	26.2	n/a	26.3	n/a	26.3	n/a	26.4	n/a	26.4	n/a	26.3
Dec-19	n/a	28.6	n/a	26.9	n/a	27.1	n/a	27	n/a	26.6	n/a	26.6
Mar-20	n/a	28	n/a	27.2	n/a	27.5	n/a	27.2	n/a	26.9	n/a	26.9
Jun-20	n/a	26.9	n/a	27	n/a	26.9	n/a	27	n/a	26.8	n/a	26.9
Nov-20	n/a	27.3	n/a	26.9	n/a	26.9	15.4	25.5	n/a	26.8	n/a	26.9
Apr-21	n/a	26.9	n/a	26.9	n/a	26.9	n/a	25.5	n/a	26.9	n/a	27.1
Sep-21	n/a	25.9	n/a	26.3	n/a	26.1	n/a	26.8	n/a	26.5	n/a	26.6
May-22	n/a	25.3	n/a	26	n/a	25.8	n/a	26.6	n/a	26.1	n/a	26.3
Sep-22	n/a	24.5	n/a	25.5	n/a	25.3	n/a	25.8	n/a	25.8	n/a	26
Mar-23	n/a	24.4	n/a	26	n/a	24.8	n/a	25.6	n/a	25.7	n/a	25.2
Sep-23	n/a	23.3	19.2	22.8	n/a	23.8	n/a	24.6	8.6	24	n/a	23.8
Minimum	n/a	23.3	19.2	22.8	n/a	23.8	15.4	24.6	8.6	24	n/a	23.8
Maximum	n/a	28.6	19.2	27.4	n/a	27.5	15.4	27.2	8.6	26.9	n/a	27.1
Average	n/a	26.3	19.2	26.0	n/a	26.0	15.4	26.0	8.6	25.9	n/a	25.9

¹ - metres below the top of casing (mTOC).

² - piezometer not monitored due to not being a component of the WMP at the time (Piezo 1 to 6 shallow added to WMP in 'Revision 5' dated 6 April 2017).

³ - not monitored due to lack of access (flooding).

Shallow Aquifer Groundwater Quality

Table 16 presents the groundwater quality parameter concentrations recorded for the deeper six Shallow Aquifer piezometers for the period April 2016 through September 2023. Note that sampling has not been undertaken at Piezo 1 to 6 shallow due to a lack of groundwater within the piezometers. A review of monitoring data obtained from 2016 to 2023 shows that most parameters have been wholly compliant with the *Australian Drinking Water Guidelines* ((NHMRC, NRMCC), 2011) except for:

- pH;
- Bicarbonate as CaCO₃; and
- Ammonia as N.



Table 16: Shallow Aquifer Water Quality Data

Site	Date	General Parameters			Major Ions								Nutrients			Misc
		pH	Electrical Conductivity	Total Dissolved Solids	Sodium	Calcium	Potassium	Magnesium	Chloride	Sulfate	Carbonate as CaCO ₃	Bicarbonate as CaCO ₃	Ammonia as N	Nitrate as N	Phosphorus	Total organic carbon
		-	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Australian Drinking Water Guidelines		6.5 - 8.5	-	1,200	180	-	-	-	250	250	200	200	0.5	50	-	-
Piezo 1 Deep	Apr-16	7.1	253	215	39	8.7	3	4.7	13	5	2	116	0.1	1	0.11	11
	Oct-16	7.2	190	148	33.3	4.4	2.3	3.2	13.3	5	2	167	0.1	1	0.04	0.7
	Mar-17	7.1	190	135	31.6	4.8	1.1	3.7	15.6	4.6	2	91	0.1	0.1	0.16	4.4
	Jun-17	7	181	152	24.8	5.3	0.8	2.7	11.6	2.5	2	76	0.1	0.5	0.01	0.6
	Sep-17	7.2	186	133	24.6	4.7	1.6	4	11.5	2.5	2	76	1.1	0.5	0.01	0.7
	Jan-18	7.5	196	79	26.6	4.2	1.4	4	18.3	8	2	75	0.1	0.5	0.01	0.5
	Mar-18	9.1	191	140	30.9	5.2	1.6	2.9	12	9.3	2	-	0.1	1	0.09	1
	Jun-18	7.4	191	141	27.7	2.7	0.6	2.2	20.8	3.8	-	77	0.1	0.1	0.09	0.5
	Sep-18	7.5	182	119	31	2.6	2	0.7	11.6	4.1	2	80	0.1	0.5	0.11	0.7
	Dec-18	8.2	244	137	38.8	4.7	1.2	3.9	14.9	4.8	2	76	0.1	0.5	0.09	0.9
	Mar-19	7.7	200	170	36.5	2.8	2.1	2.3	20	5.9	2	369	0.3	1	0.18	0.6
	Jun-19	8.1	175	149	39.6	5.1	1.7	2.8	11.2	3.2	-	77	22	0.5	0.19	0.7
	Sep-19	7.5	189	142	40.8	3.9	1.7	2.3	13	6	2	81	0.1	1	0.01	0.8
	Dec-19	7.7	186	149	30.1	5.5	1.7	2.6	11.2	4.5	2	-	0.1	0.1	0.01	0.5
	Mar-20	6.8	183	124	28.8	3.8	0.9	3	16.3	2.7	2	-	2.5	0.1	0.03	0.5
	Jun-20	7.4	190	191	29.4	2.8	0.9	3.2	7.8	1.9	2	83	0.2	1	0.06	0.5
	Nov-20	7.8	283	130	32	-	1.1	3	13	11.2	2	-	0.1	1	0.01	0.9



	Apr-21	7.3	193	178	39.7	3.44	2.2	2.89	9.6	2.8	<2	82	0.1	1	0.01	0.5
	Sep-21	7.5	183	141	28.1	4.48	<2.00	2.22	12	5	<2	-	0.1	0.3	<0.1	<0.5
	May-22	6.7	167	116	40	3.66	2	2.95	11.5	2.5	<2	-	<0.1	0.4	<0.01	<0.5
	Sep-22	7.6	186	170	30	4.8	1.3	3.1	41	<5	<2	-	<0.1	<1	0.24	0.6
	Mar-23	6.3	195	119	28.6	4.65	2.6	3.11	12.7	4.1	<2	-	0.3	0.3	0.16	0.5
	Sep-23	8.4	190	122	34	4.68	<2.0	3.2	41	10.4	<2	-	0.4	<1	0.36	0.5
	Average	7.5	197	143	32	4	2	3	16	5	2	109	1.3	0.6	0.09	1.3
Piezo 2 Deep	Apr-16	7.1	305	220	49	9.2	3.4	5.7	22	5	2	122	0.1	1	0.12	5
	Oct-16	6.9	179	141	17.2	-	1.1	3.5	69.1	-	2	71	0.1	0.5	0.08	0.5
	Mar-17	7.2	276	172	48.7	5.9	1.3	4.6	19.2	5.5	2	126	0.1	0.1	0.02	0.8
	Jun-17	7	266	190	36.8	7.9	1.6	4.3	16.4	4.1	2	110	0.1	0.5	0.05	1.4
	Sep-17	7.1	269	200	35.4	6.9	1.7	5.6	20.5	4.8	2	104	0.3	0.5	0.01	0.8
	Jan-18	7.3	293	205	35.6	6.9	1.9	5.3	24.9	6.9	2	104	0.1	0.5	0.01	0.8
	Mar-18	8.5	281	204	45.5	7.7	2.4	4.8	19	11.2	2	-	0.1	1	0.04	0.8
	Jun-18	7.2	271	193	38.7	4.4	1	3.7	12.5	2.4	-	105	0.1	0.1	0.12	0.5
	Sep-18	7.3	283	200	48.8	3.6	2.8	1.8	21.1	6.4	2	111	0.1	0.5	0.08	0.7
	Dec-18	8	301	191	48.7	6.4	1.6	4.8	17.6	5.8	2	104	0.1	0.5	0.06	0.8
	Mar-19	7.5	275	222	49.9	4.8	2.6	3.6	18	6.1	2	110	0.1	1	0.09	0.5
	Jun-19	7.4	271	204	52	6.9	2	4.7	19.3	4.1	-	108	34	0.5	0.09	0.6
	Sep-19	7.3	281	219	61.1	6.5	2.8	4.5	19	7	2	115	0.1	1	0.01	0.8
	Dec-19	7.3	272	196	43.2	5.8	2.3	4.8	18.2	6.1	2	-	0.1	0.2	0.01	0.5
	Mar-20	6.8	264	180	37.5	5.6	1.7	4.3	16.3	3.1	2	-	0.1	0.2	0.04	0.5
	Jun-20	7.2	277	205	46.2	5.2	1.2	4.7	14.8	2.3	2	112	0.1	1	0.01	0.5
	Nov-20	7.6	294	188	46	-	1.6	4.9	22.8	14.5	2	-	0.1	1	0.01	1
	Apr-21	7.2	280	198	60.3	6.44	3.4	4.99	15.4	4	2	116	0.1	2	0.01	0.6
	Sep-21	7.2	345	215	50.4	9.4	2	5.55	22	7	<2	-	<0.1	0.4	<0.01	<0.5



	May-22	6.8	350	243	55.5	6.5	3	5	46.2	6	<2	-	<0.1	0.4	<0.01	<0.5
	Sep-22	7.4	380	233	57	9.9	2	6.8	10	<5	<2	-	<0.1	<0.1	0.04	0.6
	Mar-23	6.3	426	233	54.5	9.57	3.2	6.84	72.9	5.7	<2	-	<0.1	0.5	<0.01	0.6
	Sep-23	7.6	459	294	69.9	13.4	2.4	8.69	11	12.8	<2	-	<0.1	<1.0	0.05	0.5
	Average	7.3	300	206	47	7	2	5	24	6	2	108	2.0	0.6	0.05	0.9
Piezo 3 Deep	Apr-16	7.2	278	194	41	11.4	4.9	6.7	17	5	2	131	0.1	1	0.35	5.9
	Oct-16	6.8	224	154	31.2	7.3	2.8	5.6	21.1	9	2	74	0.1	1	0.03	6.5
	Mar-17	7	182	132	27.2	5.7	1.2	4.6	14	3.4	2	72	0.1	0.1	0.09	0.7
	Jun-17	7.4	192	165	21.9	7.9	1.8	4.7	13.1	2.5	2	76	0.1	0.5	0.09	0.8
	Sep-17	7.2	182	157	19.2	6.7	1.6	5.4	13.2	2.5	2	70	1.3	0.5	0.01	0.6
	Jan-18	7.2	182	117	18.2	6.6	1.8	5.2	13.4	6.1	2	66	0.1	0.5	0.01	0.7
	Mar-18	8.3	182	122	22	6.7	1.8	4	14	7.5	2	-	0.1	1	0.06	0.5
	Jun-18	7.1	180	139	21.7	5.1	1.1	4.1	15.6	2.8	-	65	0.1	0.1	0.13	0.5
	Sep-18	7.2	181	124	20.8	3.2	2.3	1.5	13.6	3.6	2	70	0.1	0.5	0.1	0.6
	Dec-18	8	177	137	25	5.9	1.4	4.6	12.6	3.8	2	65	0.1	0.5	0.07	0.6
	Mar-19	7.4	189	161	27.2	4.6	2.6	3.4	13	4.1	2	71	0.1	1	0.01	0.6
	Jun-19	7.2	174	149	29.3	7.3	2.6	5.1	12.6	3	-	66	0.1	0.5	0.14	0.6
	Sep-19	7.2	173	137	30.2	5.8	2.3	3.9	13	5	2	70	0.1	1	0.01	0.5
	Dec-19	7.3	174	134	21.6	5.4	2.1	4.1	12.8	3.9	2	-	0.1	0.1	0.01	0.5
	Mar-20	6.8	168	114	18.6	5.1	1.3	4	7.6	1.9	2	-	0.1	0.2	0.01	0.5
	Jun-20	7	169	138	21.5	4.5	1.1	4.49	10.7	1.1	2	71	0.1	1	0.03	0.5
	Nov-20	7.4	534	128	23	-	1.4	4.2	11.9	10	2	-	0.1	1	0.01	0.7
	Apr-21	7.1	193	149	32.1	6.56	3.1	4.68	12.5	2.5	2	73	0.1	1	0.01	0.6
	Sep-21	7.2	178	105	21.8	6.35	<2.00	3.76	11	<5	<2	-	0.1	0.3	<0.01	<0.5
	May-22	6.8	182	154	30.5	6.51	3.1	4.55	13.6	3	<2	-	<0.1	0.6	<0.01	<0.5
	Sep-22	7.4	190	137	24	6.8	1.7	4.5	64	6	<2	-	<0.1	<1	0.1	0.6



	Mar-23	6.2	185	122	22.3	5.77	2.6	4.15	15.3	4.6	<2	-	<0.1	0.2	0.05	0.5
	Sep-23	7.5	185	118	26.7	6.08	<2.0	4.15	62	9.1	<2	-	<0.1	<1	0.06	0.5
	Average	7.2	202	139	25	6	2	4	18	5	2	74	0.2	0.6	0.07	1.1
Piezo 4 Deep	Apr-16	7.3	590	716	100	17.4	7.2	12.9	50	7	2	248	0.1	1	2.35	11
	Oct-16	6.7	250	188	24.6	-	2	5.9	13	-	2	192	0.1	0.5	0.07	0.9
	Mar-17	7	566	372	96	17.6	8.5	15.5	57.6	10.2	2	210	0.5	0.1	1.85	2
	Jun-17	7	618	405	87.5	21	3.4	12.1	53	8.2	2	242	0.1	0.5	1.13	1.6
	Sep-17	6.9	600	341	79.4	17.1	3.9	14.6	60.2	10.2	2	212	0.1	0.5	0.94	1
	Jan-18	7	554	355	71.8	14.9	3.1	11.7	58.9	8.7	2	183	0.1	0.5	0.17	1
	Mar-18	7.9	538	307	80.6	23.1	3.9	14.1	58	27.7	2	-	0.1	1	0.69	0.6
	Jun-18	7	469	353	67.5	9.4	2.2	7.5	55.4	8.4	-	146	2	0.3	1.11	0.5
	Sep-18	7.2	481	245	80	7.5	5.8	6.9	56.3	9.8	2	155	1.8	0.5	0.93	0.7
	Dec-18	7.7	460	317	78.7	11.3	2.6	8.4	52.8	9.9	2	141	0.1	0.5	1.71	0.7
	Mar-19	7.6	427	288	84.3	9.5	7.8	7.2	56	10.7	2	133	0.7	1	1.27	0.5
	Jun-19	7	489	303	93.3	15.4	6.3	11.8	54.3	12.7	-	165	0.6	0.5	2.39	0.8
	Sep-19	7.2	526	378	114	15.6	5.8	11.3	62	10	2	178	0.1	1	0.01	0.9
	Dec-19	7.1	526	324	80.8	14.3	5.3	101	52.9	10.8	2	-	1	0.1	3.15	1.3
	Mar-20	6.7	505	343	72.1	14.8	8	90.6	60.6	6	2	-	4.6	0.3	0.45	2.4
	Jun-20	6.9	501	337	85.4	12.6	3.4	29.3	52.2	5.7	2	173	0.4	1	0.16	0.9
	Nov-20	7	585	387	79	-	2.1	35	92.3	12.5	2	-	0.1	1	0.27	1.6
	Apr-21	6.9	586	363	118	18.9	-	10.8	85.5	-	2	142	<0.1	<1	<0.01	0.6
	Sep-21	7	606	329	92.3	17.6	3.9	10.5	65	9	<2	-	0.4	0.1	0.57	<0.5
	May-22	6.7	600	364	100	15.9	9.9	10.1	105	9.5	<2	-	<0.1	0.8	<0.01	<0.5
	Sep-22	7.2	507	298	36	13	2.1	9	28	8	<2	-	<0.1	<1	0.5	0.5
	Mar-23	6.5	474	276	63.8	12.3	6.7	10.3	77.4	11.7	<2	-	0.2	0.2	0.04	0.5
	Sep-23	7.5	545	349	96.8	13.8	2.7	10.6	33	20.7	<2	-	<0.1	<1	0.31	0.5



	Average	7.1	522	345	82	15	5	20	58	11	2	180	0.7	0.6	0.96	1.5
Piezo 5 Deep	Apr-16	6.9	273	214	37	11.7	3.3	7.9	12	5	2	122	0.1	1	0.07	2.2
	Oct-16	6.7	178	139	17.7	-	1.2	3.7	13.7	-	2	68	0.1	0.5	0.08	0.5
	Mar-17	6.9	246	174	38.7	9.3	1.8	7.1	15.2	5.4	2	108	0.1	0.1	0.07	1.2
	Jun-17	6.9	236	184	26.3	10.5	1.2	5.9	11.9	2.5	2	105	0.1	0.5	0.03	1
	Sep-17	6.6	239	190	25.1	9.3	1.7	7.5	12.9	3	2	103	0.1	0.5	0.01	0.6
	Jan-18	7	241	191	23.5	9.2	1.8	6.9	12.5	6.3	2	100	0.1	0.5	0.01	0.7
	Mar-18	7.8	234	79	30.1	9.8	2	6	13	17.9	2	-	0.1	1	0.03	0.5
	Jun-18	6.9	234	162	28.6	7.5	1.2	5.8	15.2	3.2	-	98	0.1	0.1	0.13	0.5
	Sep-18	7	266	190	35.8	5	3.1	3.5	17.8	7.2	2	108	0.8	0.5	0.12	0.9
	Dec-18	7.6	232	168	32.8	9.2	1.5	6.7	11.2	4.1	2	100	0.1	0.5	0.05	0.6
	Mar-19	7.5	272	220	43.1	7.7	2.6	5.4	21	8.4	2	104	0.1	1	0.08	0.5
	Jun-19	6.7	236	171	35.7	9.6	2.2	6.3	13.3	4.4	-	100	0.1	0.5	0.16	1
	Sep-19	7.1	238	173	42.2	9.2	2.7	5.9	14	5	2	102	0.1	1	0.01	0.9
	Dec-19	7	232	171	28.8	8.2	2.3	6.2	12.1	4.9	2	-	0.1	0.1	0.05	0.7
	Mar-20	6.7	253	172	28.1	8.1	1.4	7.1	11.5	4.9	2	-	0.1	0.2	0.04	0.6
	Jun-20	6.8	241	203	30.3	7.8	1.3	6.8	9.6	2.4	2	107	0.1	1	0.04	0.5
	Nov-20	7	242	156	30	-	1.5	6.5	10	2.5	2	-	0.1	1	0.01	0.9
	Apr-21	6.9	236	195	40	9.26	2.9	6.49	10.8	2.6	2	107	0.1	1	0.01	0.5
	Sep-21	7	238	168	31.1	8.95	<2.00	6.01	14	<5	<2	-	0.2	0.2	0.06	<0.5
	May-22	6.7	265	198	44.4	9.66	3	6.55	20.5	4	<2	-	<0.1	0.5	<0.01	<0.5
	Sep-22	7	324	267	36	13	2	9.3	50	13	<2	-	<0.1	1	0.05	<0.5
	Mar-23	6.4	337	224	36.1	12.5	34	8.62	38.9	17.5	<2	-	<0.1	1.2	0.03	<0.5
	Sep-23	7.3	310	198	42	12.7	2.2	8.08	52	16	<2	-	<0.1	1	0.08	<0.5
	Average	7.0	252	183	33	9	3	7	18	7	2	102	0.1	0.6	0.06	0.8
Piezo 6	Apr-16	7	409	276	56	18.5	4.8	11.5	35	5	2	210	0.1	1	0.15	5.2



Deep	Oct-16	6.6	252	179	24.8	-	2	6.1	12.6	-	2	140	0.2	0.5	0.09	1.1
	Mar-17	6.8	347	271	50.6	13	2.3	9.2	36.1	6	2	119	0.1	0.2	0.08	1.1
	Jun-17	6.8	326	206	35.8	12	1.4	7.2	32.1	3.8	2	112	0.1	0.5	0.01	0.5
	Sep-17	6.7	391	253	43.7	13.4	3.2	11.2	43.6	8.2	2	122	1	0.5	0.01	1.1
	Jan-18	6.8	360	269	37.3	12.6	2.4	9.8	41	7.2	2	109	0.1	0.5	0.01	0.6
	Mar-18	7.5	347	213	43	12.9	2.5	8.1	38	15	2	-	0.1	1	0.02	0.5
	Jun-18	6.8	332	188	36.6	10.2	1.4	7.2	28.9	3.1	-	109	0.1	0.1	0.13	0.5
	Sep-18	7	339	174	45.6	7.5	3.1	5.9	37.8	6.6	2	114	0.1	0.5	0.1	0.8
	Dec-18	6.8	338	218	45.9	13	1.9	8.9	35	6.7	2	109	0.1	0.5	0.07	0.8
	Mar-19	7	344	240	48.3	10.4	3	6.3	36	7.1	2	107	0.1	1	0.13	0.5
	Jun-19	6.8	339	237	60.7	14.7	2.9	10.9	35.5	5.8	-	100	0.9	0.5	0.12	0.7
	Sep-19	7	338	220	56.9	12.6	2.9	8.3	43	5	2	111	0.1	1	0.01	0.7
	Dec-19	6.9	329	212	41.5	11.3	2.7	7.9	38.8	6.4	2	-	0.4	0.2	0.03	0.5
	Mar-20	6.6	319	217	34.3	10.4	1.9	7.5	29	3.6	2	-	0.1	0.3	0.24	0.6
	Jun-20	6.8	318	226	41.5	10.3	1.6	8.1	30	2.6	2	121	0.2	1	0.04	0.5
	Nov-20	6.8	325	197	39	-	1.7	8	27	2.5	2	-	0.1	1	0.01	1
	Apr-21	6.7	334	200	53.2	12.9	3.8	8.29	29.8	3.5	<2	116	<0.1	2	<0.01	0.8
	Sep-21	6.9	360	236	44.7	16.2	2.3	8.55	45	<5	<2	-	<0.1	0.4	<0.01	<0.5
	May-22	6.8	360	242	-	11.1	3.5	8.55	37.1	5	<2	-	<0.1	0.6	<0.01	<0.5
	Sep-22	6.9	332	256	40	14	2.2	8.7	44	6	<2	-	0.1	3	0.08	<0.5
	Mar-23	6.4	348	306	38.2	12.1	3.2	8.02	41.2	6.3	<2	-	<0.1	0.2	0.03	<0.5
	Sep-23	7.2	363	232	51.5	14.3	2.4	8.69	44	11.5	<2	-	<0.1	2	0.09	<0.5
	Average	6.9	341	229	44	13	3	8	36	6	2	121	0.2	0.8	0.07	1.0

Note: value – observation exceeding ADWG guidelines.



8.1.2 Deep Aquifer

Two production bores have been installed into the Deep Aquifer at the Development Site, as shown on **Figure 1** and detailed in **Table 17**.

Table 17: Deep Aquifer Production Bore Information

Bore ID	Easting (GDA94)	Northing (GDA94)	Top of Screen Interval (mBGL)	Base of Screen Interval (mBGL)
Bore 1	430623	6157517	57	73
Bore 2	430780	6156352	73	93

Initial groundwater levels from the two production bores were collected in August 2015 and initial groundwater quality was collected in April 2016. The results are presented below.

Deep Aquifer Groundwater Levels

Table 18 presents the initial groundwater levels established for the two production bores in August 2015. The August 2015 groundwater levels were established after drilling and construction of the two production bores, and immediately prior to pumping tests undertaken on the bores. These results were presented in the Response to Submissions (SLR, 2015).

Table 18: Deep Aquifer Initial Water Levels (August 2015)

Bore ID	Standing Water Level (mBGL)
	August 2015
Bore 1	24.5
Bore 2	24.2

Deep Aquifer Groundwater Quality

Table 19 presents the groundwater quality parameter concentrations recorded for the two Deep Aquifer production bores for the period April 2016 through September 2023.

A review of the monitoring data from 2016 to 2023 shows that all parameters have been wholly compliant with the *Australian Drinking Water Guidelines* ((NHMRC, NRMCC), 2011) except for:

- Ammonia at Bore 2 in June 2018.



Table 19: Deep Aquifer Water Quality Data

Site	Date	General Parameters			Major Ions								Nutrients			Misc
		pH	Electrical Conductivity	Total Dissolved Solids	Sodium	Calcium	Potassium	Magnesium	Chloride	Sulfate	Carbonate as CaCO ₃	Bicarbonate as CaCO ₃	Ammonia as N	Nitrate as N	Phosphorus	Total organic carbon
		-	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Australian Drinking Water Guidelines		6.5 - 8.5	-	1,200	180	-	-	-	250	250	200	200	0.5	50	-	-
Bore 1	Aug-15	6.6	685	-	84.3	29.7	1.9	22	144	19	-	-	0.1	0.5	0.04	0.5
	Apr-16	6.8	149	104	14	6.7	1.9	5.1	9	5	2	70	0.1	1	0.11	0.5
	Oct-16	7.3	145	122	16	5.9	2	5	9.7	3.4	2	67	0.1	0.1	0.01	0.5
	Jun-17	6.8	149	120	12.6	7.2	0.7	4.7	8.8	2.1	2	63	0.1	0.5	0.01	0.5
	Sep-17	Not sampled due to maintenance at the time of sampling.														
	Jan-18	7	152	129	11.4	6.1	1.2	5.5	8.6	2.4	2	61	0.1	0.5	0.01	0.5
	Jun-18	6.9	154	109	22.1	4.7	1.4	5.1	14.4	1	2	64	0.1	0.1	0.05	0.7
	Dec-18	6.9	153	107	18.8	6.5	1.1	5.4	8.5	3.3	2	61	0.1	0.5	0.02	0.5
	Jun-19	7	135	125	21.3	6.8	1.2	5.5	10.7	2.5	-	55	0.1	0.5	0.12	0.5
	Dec-19	7	141	108	13.2	5.4	1.6	4.4	9.4	3.1	2	-	0.1	0.1	0.08	0.5
	Jun-20	6.9	151	135	16	5.1	0.8	5.5	16.7	1.4	2	65	0.3	1	0.01	0.7
	Nov-20	6.9	154	106	16	-	1.1	5.1	7	2.5	2	-	0.1	1	0.01	0.6
	Apr-21	7.2	151	111	20.7	5.88	2.1	4.98	7.4	2.5	2	69	0.1	1	0.01	0.5
	Sep-21	7	149	119	16	6.29	<2.00	5.74	7.1	<5	<2	-	<0.1	<0.1	<0.01	<0.5
	May-22	7	155	123	15.9	5.6	2	4.85	9.6	1.5	<2	-	<0.1	<0.1	<0.01	<0.5
	Sep-22	7	153	142	18	6.9	1.3	5.3	10	<5	<2	-	<0.1	4	<0.01	<0.5
	Mar-23	6.5	152	95	15.9	5.93	2.2	4.71	9.6	3.1	<2	-	<0.1	<0.1	<0.01	<0.5



	Sep-23	7.3	153	98	18.9	6.35	<2.0	4.75	10	7.2	<2	-	<0.1	3	0.06	<0.5
	Average	6.9	181	116	21	8	2	6	18	4	2	64	0.1	1.0	0.0	0.5
Bore 2	Apr-16	6.8	138	124	13.7	5.5	1.9	4.4	9.9	5	2	55	0.1	1	0.1	0.5
	Oct-16	7	132	117	15.7	5.4	2	4.6	9.5	2.3	2	56	0.1	0.3	0.01	0.5
	Jun-17	7	139	107	11.3	6.3	0.6	4.2	9.3	1.8	2	56	0.1	0.5	0.01	0.5
	Sep-17	6.7	139	128	11	5.9	1.1	5.4	9.2	2.5	2	55	0.3	0.5	0.01	0.5
	Jan-18	7	140	114	9.9	5.9	1.1	5	8.7	2.2	2	53	0.1	0.5	0.01	0.5
	Jun-18	6.9	139	94	19	4.8	1.3	4.8	19.4	6.6	2	57	1.2	0.3	0.07	1
	Dec-18	6.9	140	94	15.3	5.7	1	4.7	8.7	2.9	2	53	0.1	0.5	0.02	0.5
	Jun-19	6.8	138	117	22	6.8	1.2	5.4	9.3	2.5	-	55	0.1	0.5	0.08	0.5
	Dec-19	7	141	100	13.4	5.5	1.6	4.5	9.5	5	2	-	0.1	0.1	0.01	0.5
	Jun-20	6.9	139	114	14.4	5.1	0.8	5.1	32.8	1.3	2	59	0.1	1	0.04	0.7
	Nov-20	6.9	143	95	13	-	1	4.6	8	2.5	2	-	0.1	1	0.01	0.5
	Apr-21	6.6	139	83	17.7	5.63	2.1	4.94	7.5	2.5	2	59	0.1	1	0.01	0.5
	Sep-21	7	133	103	14.1	5.97	<2.00	5.35	7.03	<5	<2	-	0.1	<0.1	<0.01	<0.5
	May-22	6.7	141	117	15.8	5.55	2	4.9	9.4	2	<2	-	<0.1	<0.1	<0.01	<0.5
	Sep-22	6.9	142	115	15	6.5	1.2	4.9	16	<5	<2	-	0.2	2	0.02	<0.5
	Mar-23	6.5	139	77	14.1	5.59	2.1	4.37	9.6	2.8	<2	-	<0.1	<0.1	<0.01	<0.5
	Sep-23	7.2	208	133	17.6	20.8	<2.0	4.68	10	7.1	<2	-	<0.1	2	<0.01	<0.5
	Average	6.9	143	108	15	7	1	5	11	3	2	56	0.2	0.8	0.0	0.6

Note: value – observation exceeding ADWG guidelines.



8.2 Groundwater Monitoring

8.2.1 Groundwater Use Monitoring

Groundwater extraction from the two production bores is to be recorded from a single totaliser flow meter installed at each bore on a six-monthly basis.

8.2.2 Groundwater Level Monitoring

Groundwater levels are to be measured manually via an e-tape “dipper” in the two production bores accessing the Deep Aquifer and the twelve piezometers accessing the Shallow Aquifer according to the schedule outlined in **Table 20**.

Table 20: Groundwater Level Monitoring Schedule

Aquifer	Monitoring Point	Frequency
Shallow Aquifer	Piezo 1 to 6 Shallow Piezo 1 to 6 Deep	Six-monthly
Deep aquifer	Bores 1 and 2	Six-monthly

8.2.3 Groundwater Quality Monitoring

The water quality monitoring parameters to be monitored are listed in **Table 21**. The analytical suite has been devised to detect any environmental impact to groundwater resulting from operation of the Development.

Table 21: Groundwater Quality Monitoring Analytical Suite

Aquifer	Analytical Suite	
Shallow Aquifer and Deep aquifer	- pH (field) - Electrical conductivity (EC) (field and laboratory) - Total dissolved solids (TDS) - Sodium (dissolved) - Calcium (dissolved) - Potassium (dissolved) - Magnesium (acid extractable)	- Sulphate - Chloride - Carbonate as HCO_3 - Bicarbonate as HCO_3 - Total organic carbon (TOC) - Ammonia as N - Nitrate as N - Phosphorus

Field measurement of water quality parameters will be undertaken using appropriate field equipment maintained and calibrated in accordance with the manufacturer's recommendations. Analytical testing will be undertaken by an NATA accredited laboratory. Sampling will be undertaken by suitably qualified personnel.

Groundwater quality sampling will be undertaken according to the following relevant guidelines:

- *Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales* (DEC, 2022);
- *Groundwater Sampling and Analysis - A Field Guide* (Geoscience Australia, 2009); and
- *AS/NZS 5667.11:1998 Water Quality - Sampling - Guidance on Sampling of Groundwaters*.



Groundwater quality is to be sampled from the two production bores accessing the Deep Aquifer and the twelve piezometers accessing the Shallow Aquifer according to the schedule outlined in **Table 22**.

Table 22: Groundwater Quality Monitoring Schedule

Aquifer	Monitoring Point	Frequency
Shallow Aquifer	Piezo 1 to 6 Shallow Piezo 1 to 6 Deep	Six-monthly
Deep aquifer	Bores 1 and 2	Six-monthly

8.3 Groundwater Monitoring Trigger Values

Impact assessment criteria for groundwater levels and quality have been developed using statistical analysis of the baseline data and the predicted impacts presented in the EIS (SLR, 2015a) and RTS (SLR, 2015b). The following triggers will be used to determine if the impact investigation procedure should be initiated:

- Breaching of relevant groundwater water quality or level triggers; and/or
- When a legitimate complaint is received from a local landholder

8.3.1 Groundwater Level Trigger Values

Groundwater level trigger values for the six actively water-bearing Shallow Aquifer piezometers have been defined based on the data collected to date (**Table 15**). The trigger values are presented in **Table 23**.

Table 23: Groundwater Level Trigger Values

	Piezometer ID	Average water level (mTOC)	Trigger Level
Aquifer	Piezo 1 Deep	26.3	<2 m from observed average
	Piezo 2 Deep	26.0	
	Piezo 3 Deep	26.0	
	Piezo 4 Deep	26.0	
	Piezo 5 Deep	25.9	
	Piezo 6 Deep	25.9	

Note that, in accordance with DPI Water advice, no trigger levels are established for the Deep Aquifer bores.

8.3.2 Groundwater Quality Trigger Values

Groundwater quality triggers have been established for each analyte at each monitoring point based on the *Australian Drinking Water Guidelines* ((NHMRC, NRMCC), 2011) in accordance with DPI Water (now DPE Water/NRAR) advice regarding the existing water quality and uses of the Shallow Aquifer (refer **Section 4.4.2**). To assess whether any changes to the criteria should be implemented, a groundwater quality trigger review was completed in 2024 based upon monitoring data observed to date (SLR, 2024). As ammonia and bicarbonate exceed *Australian Drinking Water Guidelines* ((NHMRC, NRMCC), 2011) periodically for Piezo 4 Deep, site-specific triggers have been developed for this bore based on the 90th percentile of historical data. It is noted that the Guidelines do not provide a health trigger value for bicarbonate (hardness) or ammonia. Instead, the trigger values are based on aesthetic considerations.



Table 24 presents the groundwater quality trigger values derived for the Development Site. Each analyte only has an upper trigger value, except for pH which has both lower and upper trigger values (in the event pH trends towards more acidic ranges).

Consistent with **Section 9.1**, the Impact Investigation Procedure will be activated in the event two consecutive exceedances occur for the same analyte at a designated monitoring site (while biannual monitoring continues). If the monitoring regime changes, the trigger values and the exceedance criteria will be reviewed.

Table 24: Groundwater Quality Trigger Values

Parameter	Units	Trigger Type	Trigger value
pH	-	Lower Limit	6.5 ¹
		Upper Limit	8.5 ¹
Electrical Conductivity	µS/cm	Upper Limit	-
Total Dissolved Solids	mg/L	Upper Limit	1,200 ¹
Sodium	mg/L	Upper Limit	180 ¹
Calcium	mg/L	Upper Limit	-
Potassium	mg/L	Upper Limit	-
Magnesium	mg/L	Upper Limit	-
Sulfate	mg/L	Upper Limit	250 ¹
Chloride	mg/L	Upper Limit	250 ¹
Carbonate as CaCO ₃	mg/L	Upper Limit	200 ¹
Bicarbonate as CaCO ₃	mg/L	Upper Limit	200 ¹
Bicarbonate as CaCO ₃ (Piezo 4 Deep)	mg/L	Upper Limit	233 ²
Total Organic Carbon	mg/L	Upper Limit	-
Ammonia as N	mg/L	Upper Limit	0.5 ¹
Ammonia as N (Piezo 4 Deep)	mg/L	Upper Limit	0.8 ²
Nitrate as N	mg/L	Upper Limit	50 ¹
Phosphorus	mg/L	Upper Limit	-

¹ Australian Drinking Water Guidelines ((NHMRC, NRMCC), 2011).

² Site-specific trigger equivalent to the 90th percentile of observed monitoring data to end 2023.



9.0 Surface Water and Groundwater Response Plan

9.1 Impact Investigation Procedure

If any of the surface water or groundwater quality or quantity/level triggers identified in **Sections 7.2** and **8.3** are exceeded, the following impact investigation procedure will be activated:

- If a trigger or trend is identified in a data set the Environmental Incident Management System in the latest version of the OEMP will be followed. If it has caused or threatens to cause material harm to the environment, the relevant regulatory agencies (including DPE, EPA and DPI Water) will be immediately notified, and any instructions will be strictly adhered to.
- If a complaint is received, the Environmental Complaint Management System in the latest version of the OEMP will be followed.
- Where a sediment dam overflows or an off-site surface water discharge is identified, sampling will be initiated to characterise the quality and quantity of waters discharged.
- If a trigger or trend is identified in a data set:
 - a) The first step will be to verify the data if it appears anomalous. The relevant data set will be reviewed by an appropriately qualified person who will determine if further investigation is necessary and/or additional sampling is necessary.
 - b) Where monitoring results indicate that a trigger value has been breached, the regulatory agency will be notified within 14 days of ProTen being notified an exceedance has occurred (allowing time for laboratory analysis and review of laboratory results by an appropriately qualified person).
 - c) If a surface water or groundwater contaminant trigger level is exceeded, then an investigation into the potential for environmental harm will be completed and sent to the regulatory authority within 3 months of receiving the analysis results.
 - d) Once the validity of the breach is established or a landholder complaint has been verified, a preliminary investigation will be undertaken by an appropriately qualified specialist involving the evaluation of the monitoring results/complaint in conjunction with Development activities being undertaken at the time, baseline water data, local water use, the prevailing and preceding meteorological conditions and other any relevant factors.
 - e) The preliminary investigation may deem that further additional investigation and monitoring is required to determine the cause of the breach and whether or not it is directly related to Development activities.
 - f) If the investigations deem that triggers have been breached as a result of the Development, contingency measures may need to be implemented, and additional monitoring may be deemed necessary to measure the effectiveness of any contingency measure implemented.
- In the event that trigger levels or impact assessment criteria continue to be exceeded, further investigations may be undertaken (i.e., a process of continual improvement or adjustment of the relevant triggers if warranted).
- If regular exceedances occur, an action plan (corrective actions) will be developed in consultation with the relevant regulatory agencies. Note two consecutive



exceedances of the same surface water or groundwater quality trigger value at the same monitoring location will prompt an investigation.

- The results of any breaches of trigger levels and investigations will be documented for reporting and audit purposes.

9.2 Impact Mitigation

In the event that the preliminary and any follow-up investigations conclusively identify that the Development has adversely impacted a neighbouring water user (affected groundwater user or surface water resource), ProTen will work with the impacted user and the relevant regulatory agencies and attempt in “good faith” to negotiate suitable mitigation measures in a timely manner to rectify the identified problem.

ProTen may involve an appropriately qualified environmental specialist to assist with development of the mitigation measures. The development of suitable mitigation measures will be based on the outcomes of an appropriate scientific investigation.



10.0 Reporting and Data Management

10.1 Data Management

The data gathered from the surface water and groundwater monitoring programs will be collated into a database which will include:

- A site plan showing sample locations;
- Periodic inspection reports and photos;
- Tabulated results of the monitoring compared with applicable background/trigger levels;
- All data collected during each monitoring round;
- A record of chain of custody of the samples from sampling through to analysis;
- Laboratory analysis certificates; and
- A description of the procedures, methods and calculations used.

10.2 Reporting

10.2.1 Impact Investigation

As outlined in **Section 9.1**, where monitoring results indicate that a trigger value has been breached, the relevant regulatory agencies will be notified within 14 days of ProTen being notified an exceedance has occurred. Note two consecutive exceedances of the same surface water or groundwater quality trigger value at the same monitoring location will prompt an investigation.

If a surface water or groundwater level or quality trigger is exceeded, then an investigation into the potential for environmental harm will be completed as detailed in **Section 9.1** and sent to the regulatory authority within 3 months of receiving the analysis results.

10.2.2 Annual Review

Condition C8 of Development Consent SSD 6882 requires an Annual Review to be submitted to DPE each year of operation. The review must include (among other things) any monitoring results, complaints records and non-compliances. This Annual Review will include reporting on surface water and groundwater monitoring, trigger breaches and any additional investigations and/or mitigation measures implemented.

10.2.3 Annual Return

EPL 20748 requires an Annual Return, comprising a statement of compliance, a summary of any monitoring activities and a summary of any complaints received, to be submitted to the EPA within 60 days of the end of each annual reporting period. This Annual Return will include reporting on surface water and groundwater monitoring, trigger breaches and any additional investigations and/or mitigation measures implemented.



10.3 Review and Update

This WMP will be reviewed and, if necessary, revised in response to the following:

- Development modification, including notable operational and/or management changes;
- Where it is identified (via on-going inspections/monitoring) that the water management system is not meeting the objectives of this WMP and/or adverse environmental impacts are identified within the Development Site and/or downstream;
- Changes to the conditions imposed by the Development Consent and/or the Development Site's EPL; and/or
- At the request of a relevant regulatory agency.



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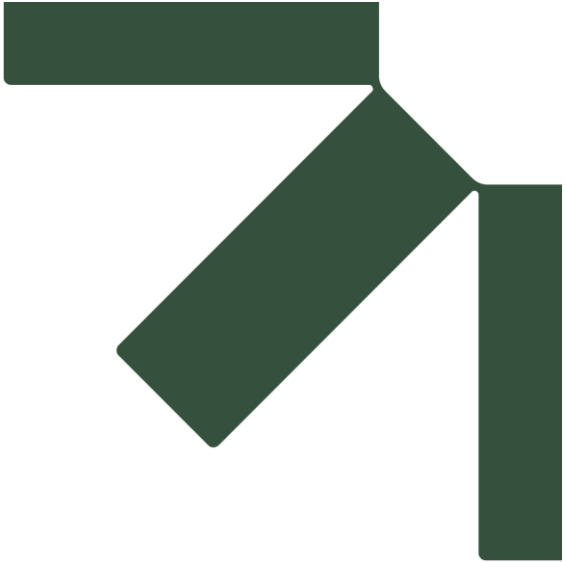
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Appendix A Water Access Licence 11788

Water Management Plan

Narrandera Poultry Production Farm

ProTen Pty Ltd

SLR Project No.: 630.031036.00001

26 February 2024



Statement of Conditions

as at Wednesday, 8 April 2015
Issued under Water Management Act 2000

WAL number 11788

Reference number 40AL403630

Contact for service of documents

Name PROTEN HOLDINGS PTY LTD

Address PO Box 1746
NORTH SYDNEY NSW 2060

All holders

Name(s) PROTEN HOLDINGS PTY LTD

Licence details

Water source LOWER MURRUMBIDGEE DEEP GROUNDWATER SOURCE

Water sharing plan LOWER MURRUMBIDGEE GROUNDWATER SOURCES

Management zone

Category AQUIFER

Share component 488 units

Tenure type Continuing

Conditions

The water access licence with DWE Reference No 40AL403630 is subject to the following conditions:

Plan conditions

Water sharing plan

Lower Murrumbidgee Groundwater Sources

Take of water

MW0812-00001

This licence entitles its holder to the specified shares in the available water from the specified water source as described in this licence.

MW0697-00001

Where the licence holder is a member of a registered group formed under the plan, the licence holder must not cause or allow the combined restricted extraction calculated to apply to the group in any one year, to be exceeded.

MW0814-00001

The licence holder must only take water under this licence using the water supply work nominated by this licence, unless otherwise allowed by the Act or the plan.

MW0815-00001

The licence holder must comply with the terms of the extraction component specified on this licence, including the times, rates or circumstances in which, and the areas or locations from which, water may be taken under this licence, subject to any extraction restrictions in local impact areas.

MW0822-00001

The licence holder must not take water under this licence if the resulting debit from the water allocation account for this licence will exceed the volume of water in the account.

MW0820-00001

The licence holder must comply with all restrictions and reductions of extraction rates declared or ordered by the Minister to apply in a local impact area.

MW0818-00001

The licence holder must comply with all applicable available water determination(s).

MW0821-00001

The licence holder must comply with the water allocation account management rules established by the plan.

MW0824-00001

The licence holder must not take water through a water supply work located in areas where the extraction is likely to cause an adverse local impact on water levels, water quality, aquifer integrity or on groundwater dependent ecosystems.

MW0819-00001

The licence holder must not take more water than is allowed pursuant to an applicable AWD unless the taking is pursuant to a lawful transfer or assignment under Chapter 3 Part 2 of the Act.

Use of water

MW0686-00001

The licence holder must not take water for any purpose other than domestic consumption and stock watering purposes or other than in exercising native title rights, through a water supply work nominated on this licence, if the water supply work is within 1,000 m of any high priority groundwater dependent ecosystem listed in Schedule 4 of the plan, or within 1,000 m of any creek or river, unless the water supply work :

- (A) only draws water from an aquifer at depths approved by the Minister, and complies with all specifications of the Minister under clause 38 of the plan, or
- (B) was authorised by licence under the Water Act 1912.

Water management works

MW0813-00001

The water supply work nominated by this licence is the water supply work authorised by a works approval nominated by this licence.

Monitoring and recording

MW0636-00001

The licence holder must produce the logbook to the Minister for inspection, when requested.

Additional conditions

MW0698-00001

The licence holder must comply with the access licence dealing principles as gazetted under section 71Z of the Act and all other access licence dealing rules established by the plan.

MW0823-00001

The licence holder must pay any charge imposed by the Minister under section 114 of the Act or regulations, for the cost of activities or works under the plan.

Other conditions

No other conditions applicable

Glossary

available water determination - An Available water determination (AWD) is a water allocation which specifies the amount of water that can be taken during the water year. AWDs are made for each access licence category in each water source. AWDs are defined under the Water Management Act 2000, s. 59.

cease to take - Cease to take conditions means any condition on this approval, or on the access licence under which water is proposed to be taken, that prohibits the taking of water in a particular circumstance.

domestic consumption - Domestic consumption is the use of water for normal household purposes in domestic premises situated on the land.

high priority groundwater dependent ecosystem - High priority groundwater dependent ecosystems have their species composition and natural ecological processes wholly or partially determined by groundwater and are considered high priority for protection or restoration.

logbook - A logbook is a document, electronic or hard copy, that records specific required information.

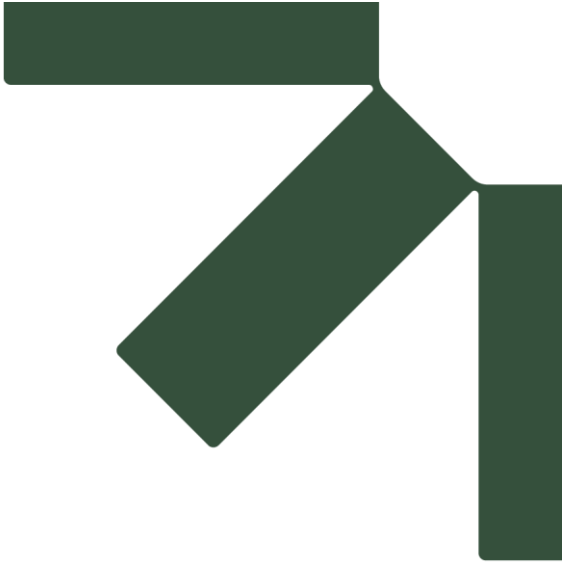
share component - The share component is the specified shares in the available water within a particular water management area.

stock watering - Stock watering is the use of water for stock animals being raised on the land. It does not include the use of water for the raising of stock animals on an intensive commercial basis (kept in feedlots or buildings for all, or a substantial part, of the period during which the stock animals are being raised).

General Notes

All conditions on a water access licence require compliance. An appeal to the Land and Environment Court against a decision to impose certain conditions on an approval can be made within 28 days after the date the decision is made. Conditions identified with the first letter "D" are those that can be appealed during the appeal period.

Certain dealings and other matters relating to this water access licence or a holding in this water access licence must be registered in the Access Register in accordance with section 71A of the *Water Management Act 2000*. For information about the Access Register, contact Land and Property Information (<http://www.lpi.nsw.gov.au>).



Appendix B Civil Design Drawings for PPU Surface Water Management

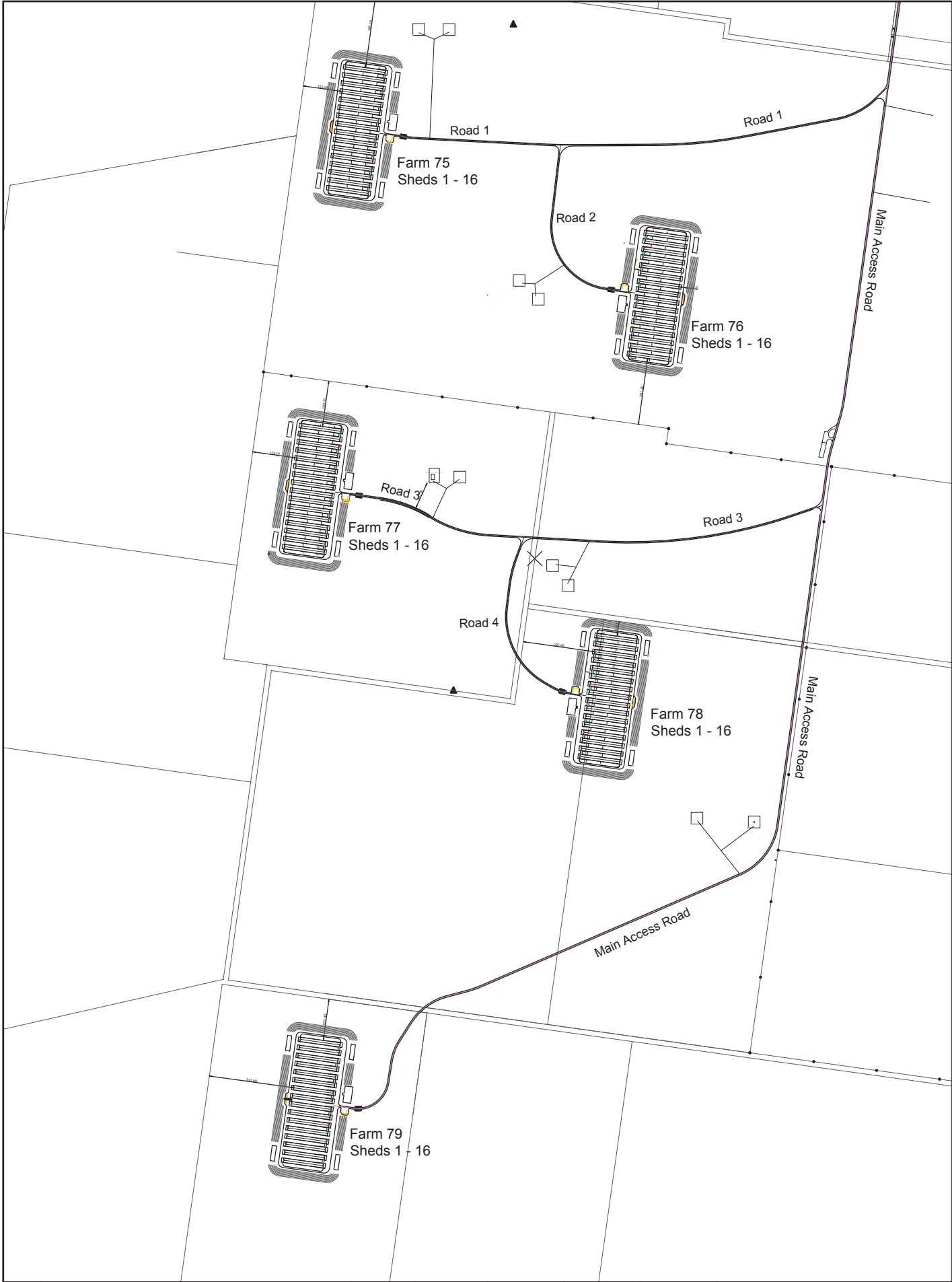
Water Management Plan

Narrandera Poultry Production Farm

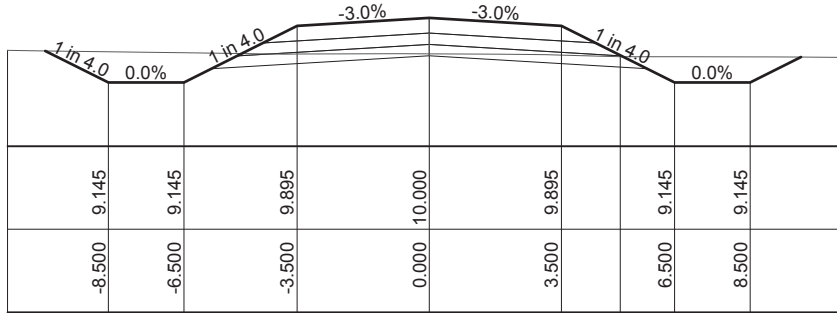
ProTen Pty Ltd

SLR Project No.: 630.031036.00001

26 February 2024

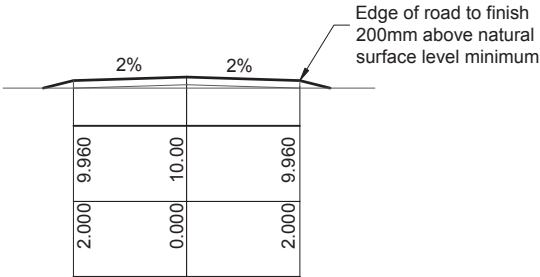


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										Client ProTen		Scales 1:10000		Client Project No.			
1	Issued for Information	28.04.2015	L.V.R.	L.V.R.	L.V.R.					* Drawing Status Warning: Unless there is an authorised Lance Ryan Consulting Engineers Pty. Ltd. signature at * , this drawing is not authorised for issue.	Architect / Project Manager		Project Number 15W013		Dwg. No. C01	Sheet 01 of 76	Revision 1
Revision	Amendment or reason for issue	Issue date	Drawing completed by	Designed & dwg. checked by	Verified by X = Not verified	Issue authorised (*)											



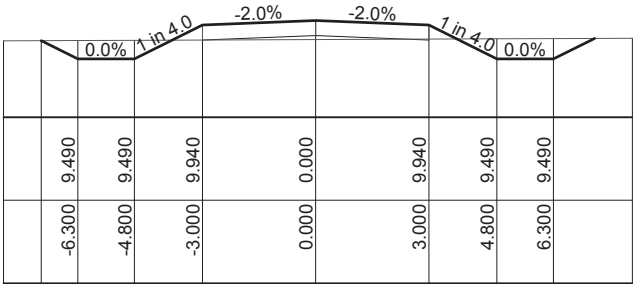
Typical Road Cross from Sturt Highway to first Intersection Ch 0 to Ch 3900

Pavement to consist of 300mm fill compacted in two layers fom material won from table drains and 200mm of Road base Gravel. Through the sand hills (Ch 200 to 800) the top 200mm layer of fill to stabilised with slag lime as per Geotechnical recommendations.



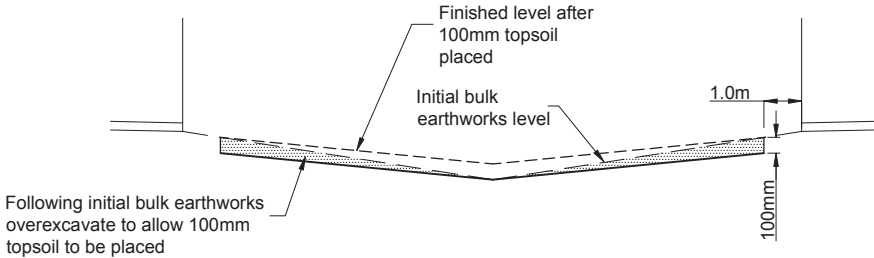
Scale Horizontal 1:100 Vertical 1:100

Typical Road Cross Section to Houses



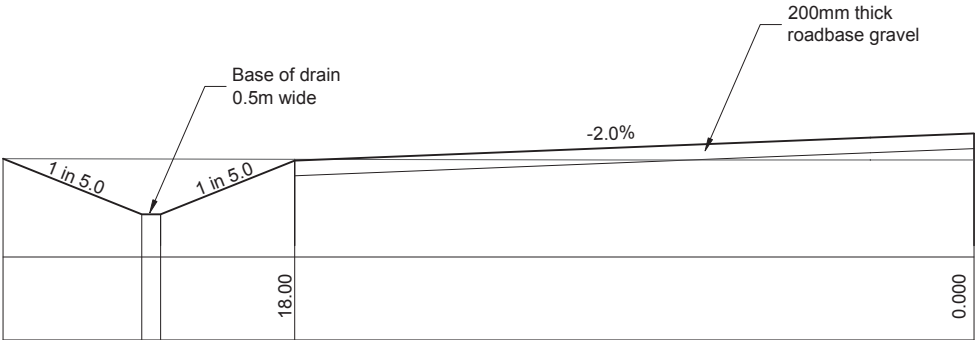
Typical Road Cross for all Internal Roads including main access road from CH 3900 to End

Pavement to consist of 200mm of Road base Gravel.

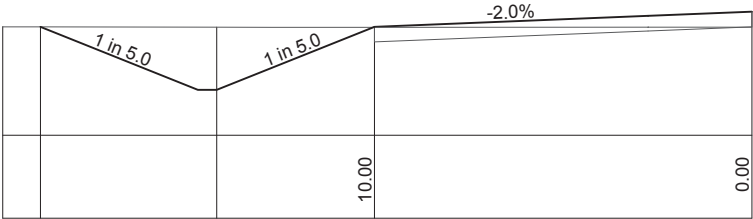


SWALE DRAIN BETWEEN SHEDS

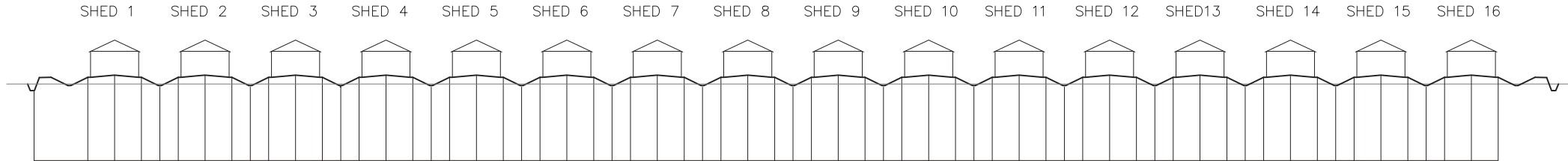
Additional excavation following initial bulk earthworks to allow for 100mm of topsoil to be placed



TYPICAL CROSS SECTION RING ROAD AT FRONT

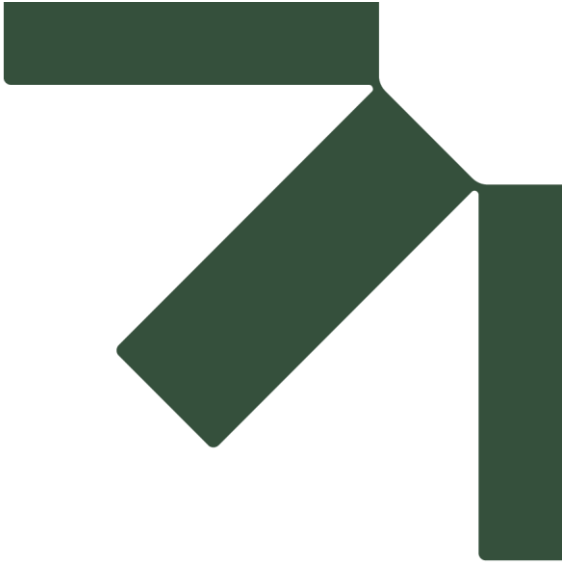


TYPICAL CROSS SECTION RING ROAD AT BACK



TYPICAL SECTION THROUGH SHEDS

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Revision	Amendment or reason for issue	Issue date	Drawing completed by	Designed & dwg. checked by	Verified by X = Not verified				Project Number 15W013		Dwg. No. C02	Sheet 02 of 76	Revision 1



Appendix C Bore Logs for the Production Bores

Water Management Plan

Narrandera Poultry Production Farm

ProTen Pty Ltd

SLR Project No.: 630.031036.00001

26 February 2024

Water Bore Drilling Summary Report

Bore 1

Spudded: 07-04-2015	Report Date: 21-07-2015
TD Reached: 07-04-2015	Job: ProTen - Euroley
Rig Release	Job No: 610.14072
Well Name.: Bore 1	Co-ordinates (GDA94): 430623 e
Tenure: n/a	6157517 n
Target Formation: Calivil Formation	Elevation:
Predicted TD (m GL): 90	Logging hydrogeologist: Derwin Lyons
Drilling Co./Rig: Watson Drilling	TD Reached (m GL): 78

Stratigraphy

Depth (m GL)			Unit
From	To	Thickness	
0	1	1	Topsoil
1	54	53	Shepparton Formation
54	78	24	Calivil Formation

Cuttings Description

Depth (m GL)			Description
From	To	Thickness	
0.0	1.0	1.0	CLAY, brown; some fine-medium grained sand
1.0	3.0	2.0	CLAY, medium grey/brown and orange mottled, firm
3.0	4.0	1.0	SILTY CLAY, brown, some sand
4.0	7.0	3.0	CLAYEY SAND, red-brown, fine to medium grained
7.0	8.0	1.0	SILTY SAND, fine grained, orange-brown
8.0	9.0	1.0	CLAY, light grey and orange, firm
9.0	11.0	2.0	SAND, medium to coarse grained, moderately well sorted, moderately well rounded, lithic, orange-brown
11.0	12.0	1.0	SAND, medium grained, clean, well sorted, orange-brown
12.0	13.0	1.0	CLAYEY SAND, fine grained, orange
13.0	15.0	2.0	SILTY CLAY, orange and grey mottled, firmer with less silt towards base
15.0	16.0	1.0	SAND, fine to coarse grained, poorly sorted, lithic, orange
16.0	17.0	1.0	CLAYEY SAND, medium to coarse grained, orange-brown
17.0	31.0	14.0	CLAY, firm, orange-brown, some light grey clay. Occasional stiff red clay and siltier clay horizons
31.0	35.0	4.0	SILTY CLAY, orange-brown
35.0	36.0	1.0	CLAYEY SAND, medium grained, orange
36.0	37.0	1.0	GRAVELLY SAND, loose, angular lithic grains
37.0	39.0	2.0	SAND, fine to coarse grained, poorly sorted, moderately angular, light brown
39.0	41.0	2.0	GRAVELLY CLAY, dark orange-brown with up to 1cm diameter moderately rounded lithics. Gravel decreases with depth
41.0	43.0	2.0	SANDY CLAY, coarse grained sand in stiff dark orange-brown clay matrix
43.0	44.0	1.0	CLAYEY SAND, firm, orange-brown
44.0	46.0	2.0	CLAY, stiff, brown
46.0	49.0	3.0	CLAY, stiff, brown, mottled with red & grey clay
49.0	51.0	2.0	CLAY, stiff, brown
51.0	54.0	3.0	CLAY, stiff, brown, mottled with grey clay, minor sand 52-53m
54.0	57.0	3.0	SAND, medium grained, clean, well sorted, angular grains, orange. Coarsening with depth
57.0	58.0	1.0	SAND, coarse grained, clean, sub-rounded, moderate sorting, orange and white
58.0	60.0	2.0	GRAVELLY SAND, coarse grained, clean, sub-rounded, orange and white
60.0	62.0	2.0	GRAVELLY SAND, clayey, sub-angular gravels up to 5mm diameter, orange. Lithic. Gravel decreasing with depth
62.0	63.0	1.0	CLAY, gravelly, orange
63.0	64.0	1.0	SAND, fine to medium grained, clean, orange
64.0	65.0	1.0	SAND, medium to coarse grained, moderately sorted, clean, orange-white
65.0	67.0	2.0	SAND, coarse to gravelly, quartz rich, clean, sub-angular, orange
67.0	68.0	1.0	SAND and GRAVEL, poorly sorted, clean, sub-rounded gravels, white-orange
68.0	69.0	1.0	SAND, medium to coarse grained, quartz rich, moderate sorting, clean, orange-white
69.0	70.0	1.0	SAND, coarse to gravelly, clean, sub-angular, white
70.0	71.0	1.0	SAND, fine to coarse grained, poorly sorted, some sub-rounded gravels to 5mm diameter, clean, orange
71.0	72.0	1.0	SAND, medium to coarse grained, white-orange
72.0	73.0	1.0	SANDY GRAVEL, quartz rich, angular, clean, white-orange
73.0	75.0	2.0	SAND, medium to coarse grained, some fine quartz gravels, white-orange
75.0	76.0	1.0	CLAYEY SAND, medium to coarse grained, orange
76.0	78.0	2.0	CLAY, with some rounded gravels, white

Bit log		Mud Log		Well Construction log			
Depth (m GL)	Type	Depth (m GL)	Description	Depth (m GL)	Material/grade	Diameter/size/type	Purpose
0-78	6" blade	0-78	Bentonite mud (Aus-gel)	0-57	uPVC CI 18	225 mm DN	Bore Casing
0-73	12" blade			57-59	SS wedge-wire	225mm DN, 0.05" slot	Well Screen
				59-60	SS wedge-wire	225mm DN, 0.06" slot	Well Screen
				60-64	uPVC CI 18	225 mm DN	Bore Casing
				64-65	SS wedge-wire	225mm DN, 0.04" slot	Well Screen
				65-66	SS wedge-wire	225mm DN, 0.05" slot	Well Screen
				66-71	SS wedge-wire	225mm DN, 0.06" slot	Well Screen
				71-73	SS wedge-wire	225mm DN, 0.07" slot	Well Screen
				52	Cement basket	12"	Cement plug
				73-78	Cuttings backfill (natural)		Rathole backfill
				0-52	Cement	5% bentonite	Annular seal
				52-73	Natural development		Filter pack

Testing

Observations

Water Strike (m GL)	Airlift yield (L/s)	Salinity	SWL (mTOC)	Other observations

Water Bore Drilling Summary Report

Bore 2

Spudded: 22-07-2015	Report Date: 22-07-2015
TD Reached: 29-07-2015	Job: ProTen - Euroley
Rig Release	Job No: 610.14072
Well Name.: Bore 2	Co-ordinates (GDA94): 430780 e
Tenure: n/a	6156352 n
Target Formation: Calivil Formation	Elevation:
Predicted TD (m GL): 90	Logging hydrogeologist: Derwin Lyons
Drilling Co./Rig: Watson Drilling	TD Reached (m GL): 107

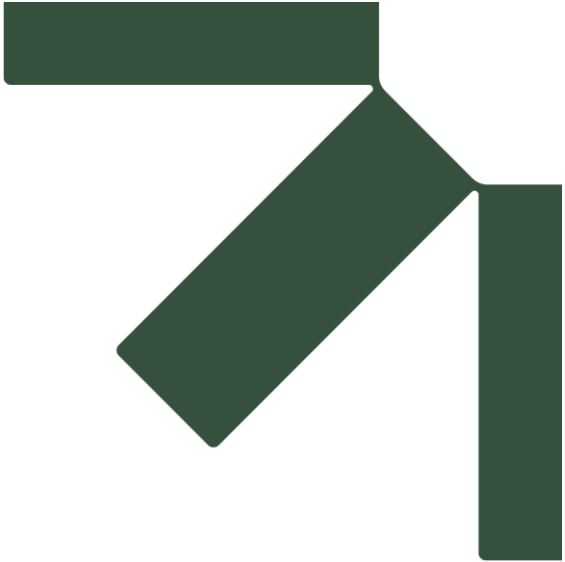
Stratigraphy			
Depth (m GL)			Unit
From	To	Thickness	
0	5	5	Topsoil & weathering
5	54	49	Shepparton Formation
54	100	46	Calivil Formation
100	107	>7	Renmark Group

Cuttings Description			
Depth (m GL)			Description
From	To	Thickness	
0.0	1.0	1.0	SILTY CLAY, dark brown and light grey mottled
1.0	2.0	1.0	CLAY, firm, light brown to dark grey
2.0	4.0	2.0	SILTY CLAY, light brown to grey
4.0	5.0	1.0	SANDY CLAY, fine grained sand in light brown to grey mottled clay matrix
5.0	6.0	1.0	SILTY CLAY, light brown to grey
6.0	16.0	10.0	CLAY, firm to stiff, grey. Some light brown-orange fine sand and silt with depth
16.0	17.0	1.0	SILTY SAND, fine grained, light brown to orange
17.0	18.0	1.0	GRAVEL, very coarse. Up to 2cm diameter pebbly lithics, moderately well rounded, poorly sorted.
18.0	19.0	1.0	GRAVEL, fine to coarse, lithics up to 1cm diameter, Poorly sorted, well rounded.
19.0	20.0	1.0	GRAVEL, medium to coarse lithics, clean, well rounded.
20.0	21.0	1.0	CLAY, firm, orange. 50% gravel inclusions likely hole fall-in from above
21.0	23.0	2.0	CLAY, firm, orange, with 50% very stiff red clay
23.0	24.0	1.0	CLAYEY SAND, coarse grained, well sorted, orange
24.0	25.0	1.0	SILTY SAND, coarse grained, well sorted, orange
25.0	27.0	2.0	SAND, coarse, clean, orange. Some rounded fine gravel
27.0	29.0	2.0	SANDY CLAY, firm, orange-brown and grey
29.0	30.0	1.0	SILTY SAND, coarse grained, with some fine to medium gravels. Orange
30.0	33.0	3.0	GRAVEL, fine to medium grading to coarse with depth, moderately rounded lithics, poorly sorted. Orange
33.0	37.0	4.0	CLAY, firm to stiff, light grey
37.0	38.0	1.0	SANDY CLAY, orange-brown
38.0	39.0	1.0	CLAYEY SAND, medium to coarse grained, orange-brown
39.0	40.0	1.0	SILTY SAND, medium to coarse grained, lithic. Orange-brown
40.0	41.0	1.0	GRAVELLY SAND, coarse grained, clean, orange.
41.0	43.0	2.0	SILTY SAND, medium to coarse grained, becoming clayey towards base. Light brown
43.0	44.0	1.0	SANDY CLAY, coarse grained sand grains, orange-brown
44.0	47.0	3.0	CLAY, stiff, red-brown to light brown. Thin hard dark grey to black laminations up to 3mm thick
47.0	49.0	2.0	CLAY, stiff, red-brown to light brown.
49.0	52.0	3.0	CLAY, firm, light brown & grey
52.0	53.0	1.0	CLAYEY SAND, coarse grained, quartzose, well sorted, light brown-orange
53.0	54.0	1.0	SAND, very coarse grained, moderately well sorted, quartzose and lithic, clean, orange-grey
54.0	58.0	4.0	SAND, coarse to very coarse grained, moderately well sorted, quartzose and lithic, clean, light grey to white
58.0	59.0	1.0	SANDY CLAY, firm, orange-brown. Coarse well sorted quartzose sand grains.
59.0	63.0	4.0	CLAY, firm to stiff, orange to light orange
63.0	64.0	1.0	CLAY, soft, orange to light orange
64.0	65.0	1.0	CLAY, firm, orange to light orange
65.0	66.0	1.0	SILTY SAND, medium grained, dark orange
66.0	67.0	1.0	CLAYEY SILTY SAND, medium grained, dark orange
67.0	68.0	1.0	CLAYEY SILTY SAND, coarse grained, dark orange
68.0	69.0	1.0	SAND, coarse to gravelly, quartzose, poorly sorted, moderately rounded, clean, orange
69.0	70.0	1.0	GRAVELLY SAND, quartzose with minor lithics, moderately well sorted, clean, white
70.0	71.0	1.0	SAND, medium to coarse grained with minor gravels, quartzose with minor lithics, moderately well sorted, clean, white-orange
71.0	73.0	2.0	GRAVELLY SAND, coarse grained, well sorted, moderately well rounded, clean, orange
73.0	75.0	2.0	GRAVELLY SAND, coarse grained, well sorted, moderately well rounded, clean, white-orange to white
75.0	76.0	1.0	GRAVELLY SAND, very coarse grained, well sorted, moderately well rounded, clean, white
76.0	77.0	1.0	GRAVELLY SAND, very coarse grained, well sorted, moderately well rounded, clean, orange
77.0	79.0	2.0	CLAYEY GRAVEL, well sorted, well rounded, white-orange
79.0	80.0	1.0	SANDY GRAVEL, coarse grained, clean, white-orange
80.0	83.0	3.0	CLAYEY SAND, coarse grained, quartzose and lithic, orange-brown
83.0	84.0	1.0	SAND, fine to gravelly, poorly sorted, angular, quartzose, clean, white
84.0	86.0	2.0	SAND, medium grained, poorly sorted, angular, quartzose, clean, white
86.0	89.0	3.0	SAND, medium to coarse grained, poorly sorted, angular, quartzose, clean, white
89.0	90.0	1.0	SAND, medium grained, poorly sorted, angular, quartzose with some lithics, clean, orange-white
90.0	91.0	1.0	SAND, medium to coarse grained, poorly sorted, angular, quartzose, clean, white
91.0	92.0	1.0	SAND, coarse grained, poorly sorted, angular, quartzose, clean, white
92.0	93.0	1.0	SAND, coarse grained, poorly sorted, angular, quartzose with some lithics, clean, orange-white
93.0	96.0	3.0	CLAYEY SAND, coarse grained, well sorted, well rounded, orange-white
96.0	98.0	2.0	CLAYEY SAND, silty, coarse grained, well sorted, well rounded, orange-white
98.0	100.0	2.0	CLAYEY SAND, coarse grained, well sorted, well rounded, dark orange-white
100.0	101.0	1.0	CLAYEY SAND, fine to medium grained, carbonaceous with some coal flecks, quartzose, well sorted, dark grey
101.0	102.0	1.0	SILTY SAND, medium grained, quartzose, well sorted, dark grey
102.0	103.0	1.0	SAND, medium grained, well sorted, quartzose, grey
103.0	104.0	1.0	SAND, fine to coarse grained, poorly sorted, quartzose, carbonaceous with some coal flecks, dark grey
104.0	106.0	2.0	SAND, medium to coarse grained, poorly sorted, quartzose, some carbonaceous flecks, dark grey
106.0	107.0	1.0	SAND, coarse grained, quartzose, moderately sorted, grey

Bit log		Mud Log		Well Construction log			
Depth (m GL)	Type	Depth (m GL)	Description	Depth (m GL)	Material/grade	Diameter/size/type	Purpose
0-107	6" blade	0-107	Bentonite mud (Aus-gel)	0-73	uPVC CI 18	225 mm DN	Bore Casing
0-93	12" blade			73-75	SS wedge-wire	225mm DN, 0.06"	Well Screen
				75-77	SS wedge-wire	225mm DN, 0.07"	Well Screen
				77-85	uPVC CI 18	225 mm DN	Bore Casing
				85-91	SS wedge-wire	225mm DN, 0.04"	Well Screen
				91-93	SS wedge-wire	225mm DN, 0.05"	Well Screen
				68	Cement basket	12"	Cement plug
				93-107	Cuttings backfill (natural)		Rathole backfill
				0-68	Cement	5% bentonite	Annular seal
				68-93	Natural development		Filter pack

Testing

Observations				
Water Strike (m GL)	Airlift yield (L/s)	Salinity	SWL (mTOC)	Other observations



Appendix D Shallow Aquifer Piezometer Bore Logs

Water Management Plan

Narrandera Poultry Production Farm

ProTen Pty Ltd

SLR Project No.: 630.031036.00001

26 February 2024

Water Bore Drilling Summary Report

Piezometer 1 Deep

Spudded: 28-02-2016	Report Date:	
TD Reached: 28-02-2016	Job: ProTen - Euroley	
Rig Release	Job No:	
Well Name.: Piezometer 1 Deep	Co-ordinates (GDA94): 34 45 11 S	
Tenure:	146 13 53 E	
Target Formation: Shepparton Formation	Elevation:	
Predicted TD (m GL):	Logging: Watson Drilling	
Drilling Co./Rig: Watson Drilling	TD Reached (m GL): 46	

Stratigraphy			
Depth (m GL)			Unit
From	To	Thickness	
0	1	1	Topsoil
1	46	45	Shepparton Formation

Cuttings Description			
Depth (m GL)			Decription
From	To	Thickness	
0.0	1.0	1.0	TOPSOIL, brown
1.0	16.0	15.0	CLAY, cream and brown
16.0	22.0	6.0	SAND & GRAVEL
22.0	42.0	20.0	CLAY, brown and red
42.0	45.0	3.0	SAND, orange
45.0	46.0	1.0	CLAY, red

Bit log		Mud Log		Well Construction log			
Depth (m GL)	Type	Depth (m GL)	Description	Depth (m GL)	Material/grade	Diameter/size/type	Purpose
0-46	4" blade	0-46	Bentonite mud (Aus-gel)	0-42	uPVC CI 12	50 mm DN	Bore Casing
				42-45	uPVC CI 12 slotted	50 mm DN	Bore Screens
				45-46	uPVC CI 12	50 mm DN	Casing Sump
				36-38	Cement grout		Annular seal
				38-40	Bentonite pellets		Annular seal
				40-46	Gravel		Filter pack

Testing				
Observations				
Water Strike (m GL)	Airlift yield (L/s)	Salinity	SWL (mTOC)	Other observations
	0.5	100 ppm	27.1	

Water Bore Drilling Summary Report

Piezometer 1 Shallow

Spudded: 05-02-2016	Report Date:
TD Reached: 05-02-2016	Job: ProTen - Euroley
Rig Release	Job No:
Well Name.: Piezometer 1 Shallow	Co-ordinates (GDA94): 34 45 11 S
Tenure:	146 13 54 E
Target Formation: Shepparton Formation	Elevation:
Predicted TD (m GL):	Logging: Watson Drilling
Drilling Co./Rig: Watson Drilling	TD Reached (m GL): 23

Stratigraphy			
Depth (m GL)			Unit
From	To	Thickness	
0	1	1	Topsoil
1	23	22	Shepparton Formation

Cuttings Description			
Depth (m GL)			Decription
From	To	Thickness	
0.0	1.0	1.0	TOPSOIL, red
1.0	4.0	3.0	CLAY, dark brown
4.0	8.0	4.0	CLAY, red
8.0	17.0	9.0	CLAY, light brown
17.0	22.0	5.0	SAND & GRAVEL
22.0	23.0	1.0	CLAY, cream

Bit log		Mud Log		Well Construction log			
Depth (m GL)	Type	Depth (m GL)	Description	Depth (m GL)	Material/grade	Diameter/size/type	Purpose
0-23	4" blade	0-23	Bentonite mud (Aus-gel)	0-19	uPVC CI 12	50 mm DN	Bore Casing
				19-22	uPVC CI 12 slotted	50 mm DN	Bore Screens
				22-23	uPVC CI 12	50 mm DN	Casing Sump
				0-14.5	Cement grout		Annular seal
				14.5-16	Bentonite pellets		Annular seal
				16-23	Gravel		Filter pack

Testing				
Observations				
Water Strike (m GL)	Airlift yield (L/s)	Salinity	SWL (mTOC)	Other observations

Water Bore Drilling Summary Report

Piezometer 2 Deep

Spudded: 27-02-2016	Report Date:
TD Reached: 27-02-2016	Job: ProTen - Euroley
Rig Release	Job No:
Well Name.: Piezometer 2 Deep	Co-ordinates (GDA94): 34 43 51 S
Tenure:	146 13 54 E
Target Formation: Shepparton Formation	Elevation:
Predicted TD (m GL):	Logging: Watson Drilling
Drilling Co./Rig: Watson Drilling	TD Reached (m GL): 43

Stratigraphy			
Depth (m GL)			Unit
From	To	Thickness	
0	1	1	Topsoil
1	43	42	Shepparton Formation

Cuttings Description			
Depth (m GL)			Decription
From	To	Thickness	
0.0	1.0	1.0	TOPSOIL, brown
1.0	17.0	16.0	CLAY, light brown
17.0	21.0	4.0	SAND & GRAVEL
21.0	40.0	19.0	CLAY, brown and red
40.0	42.0	2.0	SAND, yellow
42.0	43.0	1.0	CLAY, brown and red

Bit log		Mud Log		Well Construction log			
Depth (m GL)	Type	Depth (m GL)	Description	Depth (m GL)	Material/grade	Diameter/size/type	Purpose
0-43	4" blade	0-43	Bentonite mud (Aus-gel)	0-40	uPVC CI 12	50 mm DN	Bore Casing
				40-42	uPVC CI 12 slotted	50 mm DN	Bore Screens
				42-43	uPVC CI 12	50 mm DN	Casing Sump
				34-36	Cement grout		Annular seal
				36-38	Bentonite pellets		Annular seal
				38-43	Gravel		Filter pack

Testing

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Observations				
Water Strike (m GL)	Airlift yield (L/s)	Salinity	SWL (mTOC)	Other observations
	0.5	100 ppm	25.9	

Water Bore Drilling Summary Report

Piezometer 2 Shallow

Spudded: 06-02-2016	Report Date:
TD Reached: 06-02-2016	Job: ProTen - Euroley
Rig Release	Job No:
Well Name.: Piezometer 2 Shallow	Co-ordinates (GDA94): 34 44 50 S
Tenure:	146 33 10 E
Target Formation: Shepparton Formation	Elevation:
Predicted TD (m GL):	Logging: Watson Drilling
Drilling Co./Rig: Watson Drilling	TD Reached (m GL): 23

Stratigraphy

Depth (m GL)			Unit
From	To	Thickness	
0	1	1	Topsoil
1	23	22	Shepparton Formation

Cuttings Description

Depth (m GL)			Description
From	To	Thickness	
0.0	1.0	1.0	TOPSOIL, red
1.0	4.0	3.0	CLAY, red and brown
4.0	17.0	13.0	CLAY, light brown
17.0	22.0	5.0	SAND & GRAVEL
22.0	23.0	1.0	CLAY, brown

Bit log		Mud Log		Well Construction log			
Depth (m GL)	Type	Depth (m GL)	Description	Depth (m GL)	Material/grade	Diameter/size/type	Purpose
0-23	4" blade	0-23	Bentonite mud (Aus-gel)	0-19	uPVC CI 12	50 mm DN	Bore Casing
				19-22	uPVC CI 12 slotted	50 mm DN	Bore Screens
				22-23	uPVC CI 12	50 mm DN	Casing Sump
				0-14.5	Cement grout		Annular seal
				14.5-16	Bentonite pellets		Annular seal
				16-23	Gravel		Filter pack

Testing

Observations

Water Strike (m GL)	Airlift yield (L/s)	Salinity	SWL (mTOC)	Other observations

Water Bore Drilling Summary Report

Piezometer 3 Deep

Spudded: 26-02-2016	Report Date:	
TD Reached: 26-02-2016	Job: ProTen - Euroley	
Rig Release	Job No:	
Well Name.: Piezometer 3 Deep	Co-ordinates (GDA94): 34 44 21 S	
Tenure:	146 14 39 E	
Target Formation: Shepparton Formation	Elevation:	
Predicted TD (m GL):	Logging: Watson Drilling	
Drilling Co./Rig: Watson Drilling	TD Reached (m GL): 41	

Stratigraphy

Depth (m GL)			Unit
From	To	Thickness	
0	1	1	Topsoil
1	41	40	Shepparton Formation

Cuttings Description

Depth (m GL)			Description
From	To	Thickness	
0.0	1.0	1.0	TOPSOIL, brown
1.0	11.0	10.0	CLAY, light brown
11.0	12.0	1.0	SAND, light brown
12.0	16.0	4.0	CLAY, light brown
16.0	21.0	5.0	SAND & GRAVEL
21.0	34.0	13.0	CLAY, red and brown
34.0	39.0	5.0	SAND, orange
39.0	41.0	2.0	CLAY, brown

Bit log		Mud Log		Well Construction log			
Depth (m GL)	Type	Depth (m GL)	Description	Depth (m GL)	Material/grade	Diameter/size/type	Purpose
0-41	4" blade	0-41	Bentonite mud (Aus-gel)	0-36	uPVC CI 12	50 mm DN	Bore Casing
				36-39	uPVC CI 12 slotted	50 mm DN	Bore Screens
				39-41	uPVC CI 12	50 mm DN	Casing Sump
				30-32	Cement grout		Annular seal
				32-34	Bentonite pellets		Annular seal
				34-41	Gravel		Filter pack

Testing

Observations

Water Strike (m GL)	Airlift yield (L/s)	Salinity	SWL (mTOC)	Other observations
	0.25	100 ppm	26	

Water Bore Drilling Summary Report

Piezometer 3 Shallow

Spudded: 06-02-2016	Report Date:
TD Reached: 06-02-2016	Job: ProTen - Euroley
Rig Release	Job No:
Well Name.: Piezometer 3 Shallow	Co-ordinates (GDA94): 34 44 19 S
Tenure:	146 14 40 E
Target Formation: Shepparton Formation	Elevation:
Predicted TD (m GL):	Logging: Watson Drilling
Drilling Co./Rig: Watson Drilling	TD Reached (m GL): 23

Stratigraphy			
Depth (m GL)			Unit
From	To	Thickness	
0	1	1	Topsoil
1	23	22	Shepparton Formation

Cuttings Description			
Depth (m GL)			Decription
From	To	Thickness	
0.0	1.0	1.0	TOPSOIL, red
1.0	15.0	14.0	CLAY, light brown and orange
15.0	22.0	7.0	SAND & GRAVEL
22.0	23.0	1.0	CLAY, red

Bit log		Mud Log		Well Construction log			
Depth (m GL)	Type	Depth (m GL)	Description	Depth (m GL)	Material/grade	Diameter/size/type	Purpose
0-23	4" blade	0-23	Bentonite mud (Aus-gel)	0-19	uPVC CI 12	50 mm DN	Bore Casing
				19-22	uPVC CI 12 slotted	50 mm DN	Bore Screens
				22-23	uPVC CI 12	50 mm DN	Casing Sump
				0-14.5	Cement grout		Annular seal
				14.5-16.0	Bentonite pellets		Annular seal
				16-23	Gravel		Filter pack

Testing				
Observations				
Water Strike (m GL)	Airlift yield (L/s)	Salinity	SWL (mTOC)	Other observations

Water Bore Drilling Summary Report

Piezometer 4 Deep

Spudded: 24-02-2016	Report Date:
TD Reached: 24-02-2016	Job: ProTen - Euroley
Rig Release	Job No:
Well Name.: Piezometer 4 Deep	Co-ordinates (GDA94): 34 43 29 S
Tenure:	146 14 49 E
Target Formation: Shepparton Formation	Elevation:
Predicted TD (m GL):	Logging: Watson Drilling
Drilling Co./Rig: Watson Drilling	TD Reached (m GL): 41

Stratigraphy			
Depth (m GL)			Unit
From	To	Thickness	
0	1	1	Topsoil
1	41	40	Shepparton Formation

Cuttings Description			
Depth (m GL)			Decription
From	To	Thickness	
0.0	1.0	1.0	TOPSOIL, red
1.0	13.0	12.0	CLAY, light brown
13.0	15.0	2.0	GRAVEL, brown
15.0	24.0	9.0	CLAY, brown
24.0	28.0	4.0	SAND, red
28.0	41.0	13.0	CLAY, brown

Bit log		Mud Log		Well Construction log			
Depth (m GL)	Type	Depth (m GL)	Description	Depth (m GL)	Material/grade	Diameter/size/type	Purpose
0-41	4" blade	0-41	Bentonite mud (Aus-gel)	0-25	uPVC CI 12	50 mm DN	Bore Casing
				25-28	uPVC CI 12 slotted	50 mm DN	Bore Screens
				28-29	uPVC CI 12	50 mm DN	Casing Sump
				19-21	Cement grout		Annular seal
				21-23	Bentonite pellets		Annular seal
				23-29	Gravel		Filter pack
				29-41	Gravel		Backfill

Testing				
Observations				
Water Strike (m GL)	Airlift yield (L/s)	Salinity	SWL (mTOC)	Other observations
	nil		25.7	

Water Bore Drilling Summary Report

Piezometer 4 Shallow

Spudded: 06-02-2016	Report Date:
TD Reached: 06-02-2016	Job: ProTen - Euroley
Rig Release	Job No:
Well Name.: Piezometer 4 Shallow	Co-ordinates (GDA94): 34 43 29 S
Tenure:	146 14 48 E
Target Formation: Shepparton Formation	Elevation:
Predicted TD (m GL):	Logging: Watson Drilling
Drilling Co./Rig: Watson Drilling	TD Reached (m GL): 17

Stratigraphy			
Depth (m GL)			Unit
From	To	Thickness	
0	1	1	Topsoil
1	17	16	Shepparton Formation

Cuttings Description			
Depth (m GL)			Decription
From	To	Thickness	
0.0	1.0	1.0	TOPSOIL, red
1.0	13.0	12.0	CLAY, brown and cream
13.0	16.0	3.0	SAND & GRAVEL
16.0	17.0	1.0	CLAY, cream

Bit log		Mud Log		Well Construction log			
Depth (m GL)	Type	Depth (m GL)	Description	Depth (m GL)	Material/grade	Diameter/size/type	Purpose
0-17	4" blade	0-17	Bentonite mud (Aus-gel)	0-13	uPVC CI 12	50 mm DN	Bore Casing
				13-16	uPVC CI 12 slotted	50 mm DN	Bore Screens
				16-17	uPVC CI 12	50 mm DN	Casing Sump
				0-8.5	Cement grout		Annular seal
				8.5-10	Bentonite pellets		Annular seal
				10-17	Gravel		Filter pack

Testing				
Observations				
Water Strike (m GL)	Airlift yield (L/s)	Salinity	SWL (mTOC)	Other observations

Water Bore Drilling Summary Report

Piezometer 5 Deep

Spudded: 25-02-2016	Report Date:	
TD Reached: 25-02-2016	Job: ProTen - Euroley	
Rig Release	Job No:	
Well Name.: Piezometer 5 Deep	Co-ordinates (GDA94): 34 43 06 S	
Tenure:	146 14 03 E	
Target Formation: Shepparton Formation	Elevation:	
Predicted TD (m GL):	Logging: Watson Drilling	
Drilling Co./Rig: Watson Drilling	TD Reached (m GL): 40	

Stratigraphy			
Depth (m GL)			Unit
From	To	Thickness	
0	1	1	Topsoil
1	40	39	Shepparton Formation

Cuttings Description			
Depth (m GL)			Description
From	To	Thickness	
0.0	1.0	1.0	TOPSOIL, red
1.0	4.0	3.0	CLAY, brown
4.0	8.0	4.0	SAND, brown
8.0	11.0	3.0	CLAY, light brown
11.0	21.0	10.0	SAND & GRAVEL
21.0	32.0	11.0	CLAY, brown
32.0	38.0	6.0	SAND, orange
38.0	40.0	2.0	CLAY, brown

Bit log		Mud Log		Well Construction log			
Depth (m GL)	Type	Depth (m GL)	Description	Depth (m GL)	Material/grade	Diameter/size/type	Purpose
0-40	4" blade	0-40	Bentonite mud (Aus-gel)	0-32	uPVC CI 12	50 mm DN	Bore Casing
				32-38	uPVC CI 12 slotted	50 mm DN	Bore Screens
				38-39	uPVC CI 12	50 mm DN	Casing Sump
				26-28	Cement grout		Annular seal
				28-30	Bentonite pellets		Annular seal
				30-39	Gravel		Filter pack
				39-40	Gravel		Backfill

Testing				
Observations				
Water Strike (m GL)	Airlift yield (L/s)	Salinity	SWL (mTOC)	Other observations
	0.05	300 PPM	25.6	

Water Bore Drilling Summary Report

Piezometer 5 Shallow

Spudded: 09-02-2016	Report Date:
TD Reached: 09-02-2016	Job: ProTen - Euroley
Rig Release	Job No:
Well Name.: Piezometer 5 Shallow	Co-ordinates (GDA94): 34 43 6 S
Tenure:	146 14 4 E
Target Formation: Shepparton Formation	Elevation:
Predicted TD (m GL):	Logging: Watson Drilling
Drilling Co./Rig: Watson Drilling	TD Reached (m GL): 9

Stratigraphy

Depth (m GL)			Unit
From	To	Thickness	
0	9	9	Shepparton Formation

Cuttings Description

Depth (m GL)			Description
From	To	Thickness	
0.0	5.0	5.0	CLAY, brown
5.0	8.0	3.0	SAND, red
8.0	9.0	1.0	CLAY, brown

Bit log		Mud Log		Well Construction log			
Depth (m GL)	Type	Depth (m GL)	Description	Depth (m GL)	Material/grade	Diameter/size/type	Purpose
0-9	4" blade	0-9	Bentonite mud (Aus-gel)	0-5	uPVC CI 12	50 mm DN	Bore Casing
				5-8	uPVC CI 12 slotted	50 mm DN	Bore Screens
				8-9	uPVC CI 12	50 mm DN	Casing Sump
				0-1.5	Cement grout		Annular seal
				1.5-3	Bentonite pellets		Annular seal
				3-9	Gravel		Filter pack

Testing

Observations

Water Strike (m GL)	Airlift yield (L/s)	Salinity	SWL (mTOC)	Other observations

Water Bore Drilling Summary Report

Piezometer 6 Deep

Spudded: 26-02-2016	Report Date:	
TD Reached: 26-02-2016	Job: ProTen - Euroley	
Rig Release	Job No:	
Well Name.: Piezometer 6 Deep	Co-ordinates (GDA94): 34 42 50 S	
Tenure:	146 14 20 E	
Target Formation: Shepparton Formation	Elevation:	
Predicted TD (m GL):	Logging: Watson Drilling	
Drilling Co./Rig: Watson Drilling	TD Reached (m GL): 47	

Stratigraphy			
Depth (m GL)			Unit
From	To	Thickness	
0	1	1	Topsoil
1	47	46	Shepparton Formation

Cuttings Description			
Depth (m GL)			Decription
From	To	Thickness	
0.0	1.0	1.0	TOPSOIL, brown
1.0	9.0	8.0	CLAY, light brown
9.0	15.0	6.0	CLAY & SAND, light brown
15.0	18.0	3.0	GRAVEL
18.0	30.0	12.0	CLAY, brown
30.0	31.0	1.0	SAND, orange
31.0	47.0	16.0	CLAY, red and orange

Bit log		Mud Log		Well Construction log			
Depth (m GL)	Type	Depth (m GL)	Description	Depth (m GL)	Material/grade	Diameter/size/type	Purpose
0-47	4" blade	0-47	Bentonite mud (Aus-gel)	0-30	uPVC CI 12	50 mm DN	Bore Casing
				30-31	uPVC CI 12 slotted	50 mm DN	Bore Screens
				31-32	uPVC CI 12	50 mm DN	Casing Sump
				24-26	Cement grout		Annular seal
				26-28	Bentonite pellets		Annular seal
				28-32	Gravel		Filter pack
				32-47	Blue Metal gravel		Backfill

Testing				
Observations				
Water Strike (m GL)	Airlift yield (L/s)	Salinity	SWL (mTOC)	Other observations
	0.05	200 ppm	25.6	

Water Bore Drilling Summary Report

Piezometer 6 Shallow

Spudded: 09-02-2016	Report Date:
TD Reached: 09-02-2016	Job: ProTen - Euroley
Rig Release	Job No:
Well Name.: Piezometer 6 Shallow	Co-ordinates (GDA94): 34 42 50 S
Tenure:	146 14 19 E
Target Formation: Shepparton Formation	Elevation:
Predicted TD (m GL):	Logging: Watson Drilling
Drilling Co./Rig: Watson Drilling	TD Reached (m GL): 14

Stratigraphy

Depth (m GL)			Unit
From	To	Thickness	
0	14	14	Shepparton Formation

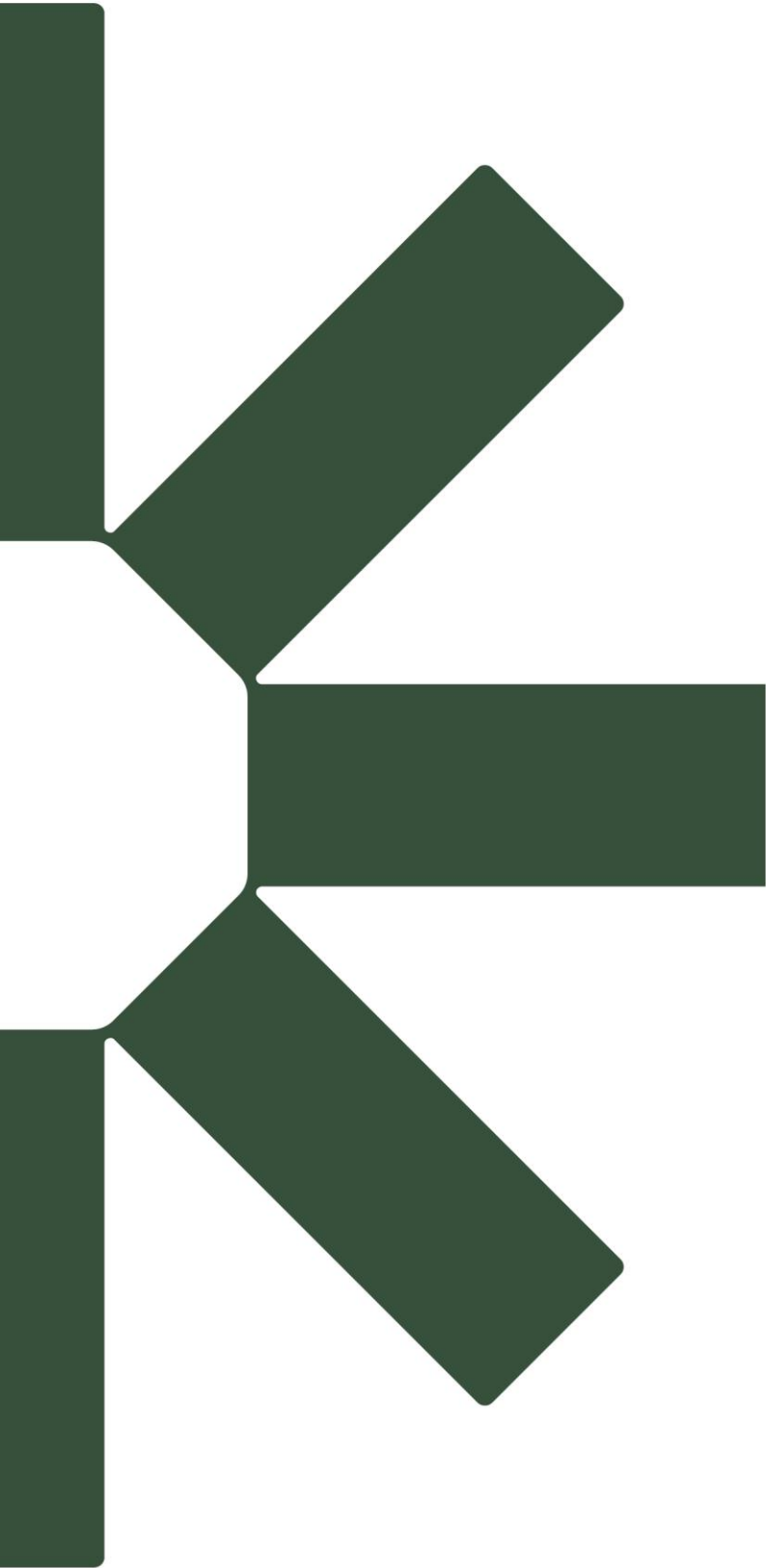
Cuttings Description

Depth (m GL)			Description
From	To	Thickness	
0.0	10.0	10.0	CLAY, dark and light brown
10.0	13.0	3.0	SAND & GRAVELS
13.0	14.0	1.0	CLAY, light brown

Bit log		Mud Log		Well Construction log			
Depth (m GL)	Type	Depth (m GL)	Description	Depth (m GL)	Material/grade	Diameter/size/type	Purpose
0-14	4" blade	0-14	Bentonite mud (Aus-gel)	0-10	uPVC CI 12	50 mm DN	Bore Casing
				10-13	uPVC CI 12 slotted	50 mm DN	Bore Screens
				13-14	uPVC CI 12	50 mm DN	Casing Sump
				0-6.5	Cement grout		Annular seal
				6.5-8	Bentonite pellets		Annular seal
				8-14	Gravel		Filter pack

Testing

Observations				
Water Strike (m GL)	Airlift yield (L/s)	Salinity	SWL (mTOC)	Other observations



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