Wastewater Management Report

Proposed Subdivision

Lot 3 DP 614789 29 Fords Road, Clarence Town

Prepared for Le Mottee Group

Prepared by RCA Australia

RCA ref 15771-201/0

November 2021

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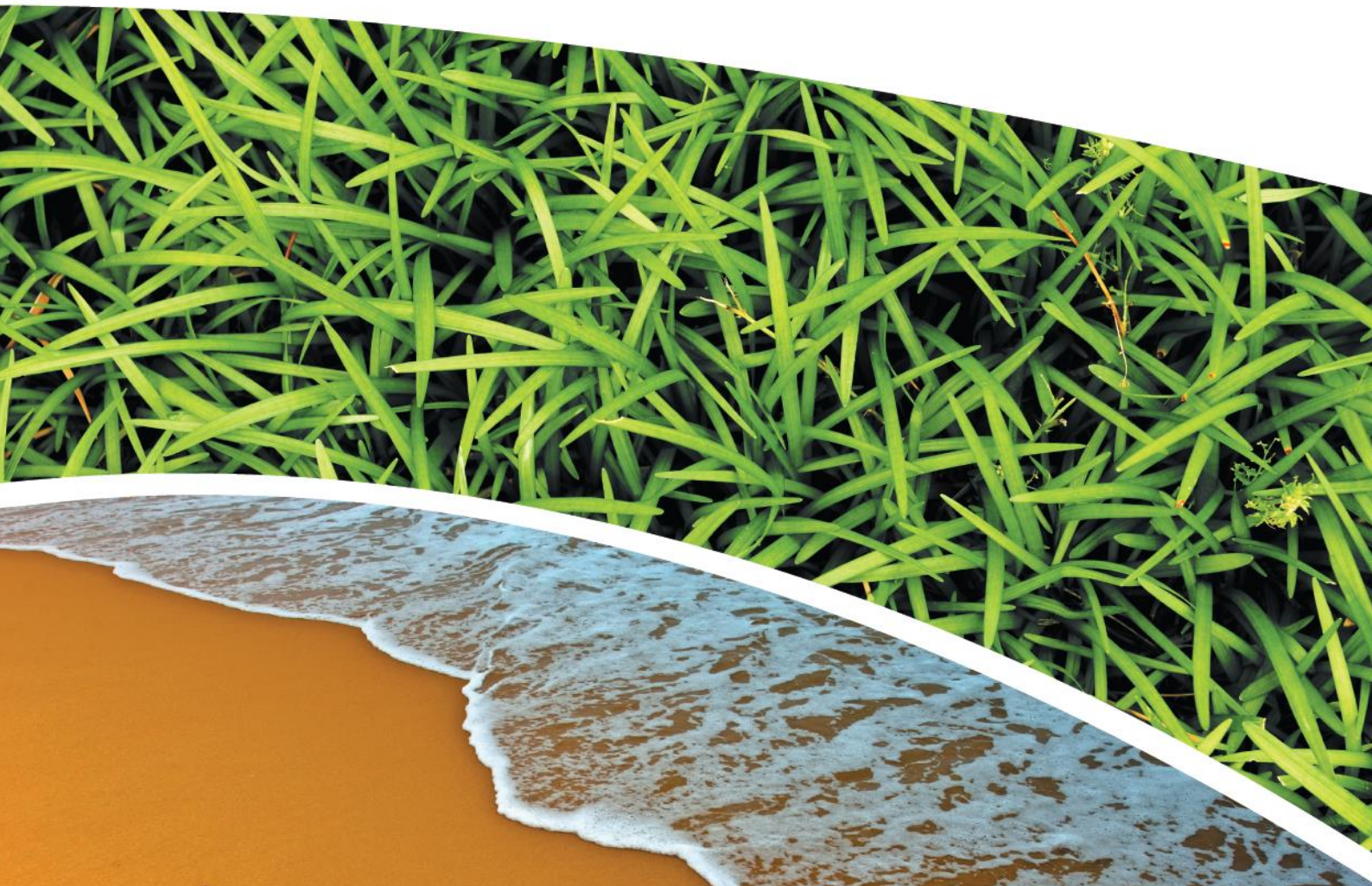

RCA Australia
ABN 53 063 515 711
92 Hill Street, Carrington NSW 2294

Telephone: 02 4902 9200
Email: administrator@rca.com.au
Internet: www.rca.com.au

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bsi. ISO 9001 Quality Management

bsi. AS/NZS 4801 Occupational Health and Safety Management

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RCA Ref.: 15771-201/0

16 November 2021

Kevin Greenhalgh
C/o Le Mottee Group
PO Box 363
RAYMOND TERRACE NSW 2324

Attention: Kate Wheeler

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Occupational Hygiene

WASTEWATER MANAGEMENT REPORT

PROPOSED SUBDIVISION

LOT 3 DP 614789 29 FORDS ROAD, CLARENCE TOWN

1 INTRODUCTION

This report presents the findings of a wastewater management study undertaken at Lot 3 DP 614789 29 Fords Road, Clarence Town. The investigation was undertaken at the request of Kate Wheeler of Le Mottee Group.

It is understood that the site is proposed to be subdivided into two (2) new lots, including:

- Proposed Lot 311: Approximately 2.2ha in size, includes existing dwelling and associated on-site sewerage management system (OSSM).
- Proposed Lot 312: Approximately 1.16 ha in size.

Proposed Lot 312 is the subject of the investigation and is herein referred to as the site.

The report provides the following:

- Description of the surface and subsurface conditions encountered at the site.
- Details of fieldwork and laboratory testing undertaken.
- Description of the site geology and subsurface conditions encountered at the site

- A detailed evaluation of the site and soil constraints to onsite sewerage management (OSSM).
- Comments on acceptable / suitable onsite wastewater treatment systems and sizing.

For the purpose of the investigation, RCA were provided with preliminary site plans produced by Le Mottee Group showing the location and configuration of the proposed subdivision (Reference 6701 PS-V6, sheet 1 and 2, dated 8/09/2021).

2 SITE DESCRIPTION

2.1 GENERAL

The site is a 1.16-hectare irregular shaped rural lot located approximately 250m east of the intersection of Glen William Road and Fords Road, Clarence Town. The site has a southern frontage onto Fords Road and is bordered on all other sides by predominately developed rural lots. The Williams River meanders to the east (approximately 800m south-east of the site the closest point). A site locality plan showing the approximate location of the site, the adjacent surrounding area and area of proposed development is presented on **Drawing 1**, which is attached as **Appendix A.**

Site details relevant to onsite wastewater management are summarised below in **Table 1**.

Table 1 *Summary of site details.*

Site	Lot 3 DP 614789 29 Fords Road, Clarence Town
Lot Size	1.16Ha
Availability of Sewer	Nil
Proposed water Supply	Tank water
Council Area	Dungog Shire Council
Council OSSM Hazard Class	Medium*

*TBC by Council

2.2 TOPOGRAPHIC SETTING

The site is situated in the Clarence Town Hills region (Glen William Erosional Landscape - Ref [1]), comprising of undulating low hills to gently undulating rises of Carboniferous volcanics and sediments with localised areas of level plains to gently undulating low rises on alluvial terrace deposits.

The eastern portion of the site is situated on the lower northern foot slopes of a low hill located to the south. The slope is gently waxing divergent in form and inclined down to the north at an angle of approximately 5°. Slopes reduce to approximately 2° in the northern portion of the site, continuing to slope down towards a water course running adjacent to the site boundary. Reference to publicly available LiDAR data indicates that elevations vary across the site range from approximately 28m AHD at the southern site boundary down to approximately 19m AHD in the watercourse the in the north-eastern portion of the site

Hydrolines obtained from NSW Spatial Services indicate that the watercourse extending though the northern portion of the site is non-perennial. The extent of the watercourse can be clearly distinguished within hillshade models produced from LiDAR data.

Figure 1 provides and overview of the site and proposed development area on a contour / hillshade model of the existing ground surface terrain.

2.3 GEOLOGICAL SETTING

Reference to the NSW Seamless Geology Map (Ref [2]) indicates that the site is underlain by Carboniferous aged rocks belonging to the Wallringa Formation (New England Orogen / Gresford Block). The Wallringa Formation is documented to largely comprise of thick beds of brown to pink, lithic to conglomeratic sandstone with minor interbeds of fine-grained sediments. The nearest mapped structural measurement indicates that bedding of the Wallringa Formation is typically to the east at an angle of 15°.

Shallow to moderately deep alluvial terrace sediments are expected to overly bedrock in the northern portion of the site.

2.4 VEGETATION

The site is largely cleared of vegetation and is predominantly covered by a maintained grass cover. A number of scattered intermediate to mature trees were located on site boundaries and within the water course.

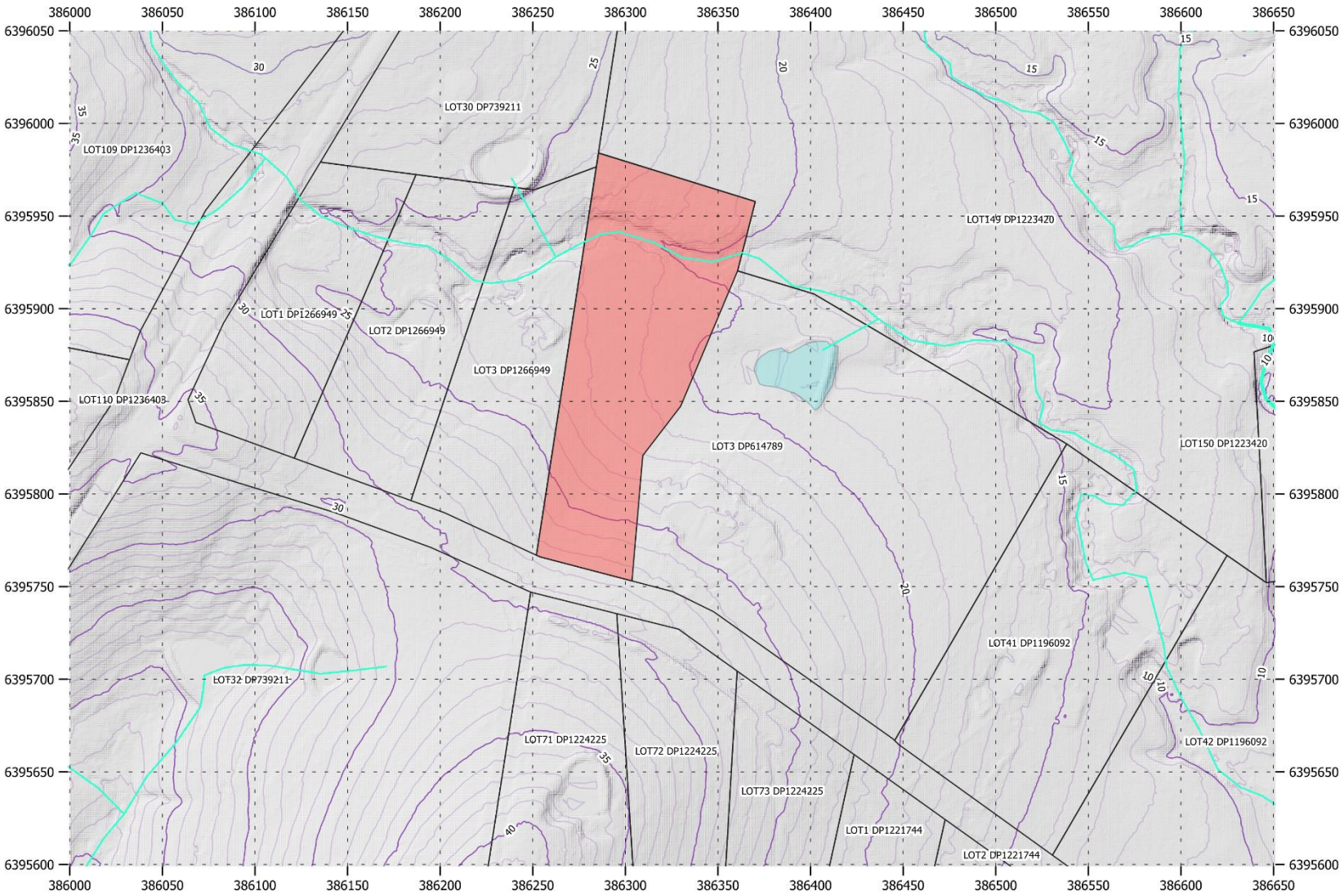

Figure 1 *Lot boundary and proposed 312 lot area (shaded red) overlayed on mapped hydrolines and surface contours. Proposed Lot 311 occupies the unshaded portion of Lot 3 DP614789. Model extracted from data obtained from NSW Spatial Services.*

3 FIELD AND LABORATORY INVESTIGATION

Field investigation was carried out on the 19th October 2021 and involved the following:

- A visual appraisal and mapping of site conditions and features.
- Drilling, sampling and logging of three (3) hand auger / shovel boreholes to depths ranging from 0.5m to 1.4m.

The approximate locations of the boreholes together with site features are shown on the site plan which is attached as **Drawing 01**, in **Appendix A**. Engineering logs of the subsurface conditions encountered in the boreholes are presented in **Appendix B**, together with explanation sheets.

Fieldwork was undertaken during fine weather. The preceding monthly rainfall totals were generally in accordance with historical averages apart from March, in which over 600mm of rainfall was recorded. The weather conditions encountered prior, during and after the fieldwork are summarised in **Figure 2**.

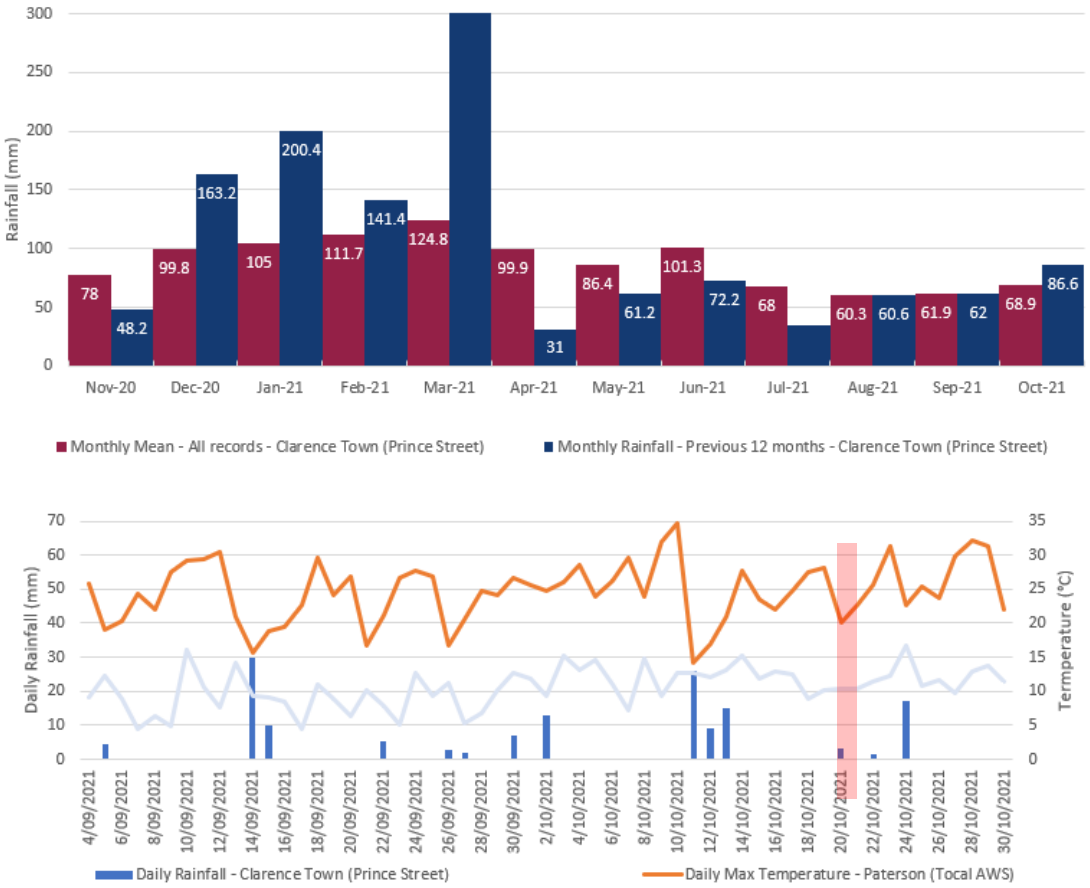

Figure 2 *Climate conditions prior, during and immediately after fieldwork (data source: BoM website). Duration of fieldwork shaded red.*

Site conditions encountered at the time of fieldwork are documented in **Figure 2** and **Figure 3** below.

Figure 3 *Panoramic photograph taken from the south-western corner of the site.*

Figure 4 *Conditions within the water course located in the northern portion of the site.*

4 SUBSURFACE CONDITIONS

The soil profile encountered in the southern portion of the site (hill foot slopes) typically comprised a relatively thin (up to 0.25m) sandy clay loam topsoil (A horizon) overlaying shallow depths of sandy clay / medium clay residual soils (B horizon). Hardpan / bedrock was encountered at depths of 0.6m or less.

The soil profile encountered in the northern portion of the site (lower alluvial terrace) comprised of shallow relatively thin (up to 0.25m) sandy clay loam topsoil (A horizon) overlaying sandy clay / heavy clay alluvium (B horizon) to depths of 0.95m. Hard residual sandy clay (C horizon)

While no groundwater or seepage was encountered in the hand auger / shovel boreholes at the time of fieldwork, soils were noted to be relatively moist in the lower northern portion of the site due to the presence of the water course and a small farm dam located in the northern portion of proposed lot 311. It should be noted that groundwater and ground surface conditions are likely to fluctuate with variations in climatic and site conditions.

5 SITE WASTEWATER DISPOSAL ASSESSMENT

5.1 INTRODUCTION

The suitability of the proposed site development area for on-site wastewater management has been assessed in accordance with the NSW Department of Local Government Guidelines of On-Site Sewage Management for Single Households 1998 (*EHPG 1998*) (Ref [3]) Australian Standard AS/NZS1547:2012 *On-site Domestic Wastewater Management (AS/NZS1547:2012)* (Ref [4]) and the BMT WBM Dungog Shire Council On-site Sewerage Development Assessment Framework (Ref [5]).

5.2 SITE AND SOIL ASSESSMENT

The site and soil assessment was in accordance with Section 5.2 and Appendix B of AS/NZS 1547:2012.

The assessment identified that suitable site effluent application areas were highly constrained due to limited soil depth, the presence of a water course and strongly to moderately acidic, marginally sodic soils with a low to moderate capacity to hold plant nutrients / pollutants. The following controls have been included within the advice to address the identified constraints:

- Conservatively sizing of the land application area (LAA) using monthly water balance and annual nutrient balance calculations.
- The location of the LAA is to be limited to slopes in southern portion of the site at a suitable distance away from the existing watercourse / farm dam.

- Application of approximately 0.5kg/m^2 of lime over the base of the LAA to ameliorate existing poor soil conditions. The lime should be mixed into the existing soil profile / fill material using ripping tynes prior to and during the placement of topsoil fill.

- Installation of an upslope bund to divert all run-on stormwater to area downslope of the LAA.

- Filling of the LAA with a good quality site won / imported topsoil fill (clean sandy loam / clay loam) to raise the level of the LAA.

    - Some suitable fill material may be won onsite by selectively stockpiling topsoil (the upper ~0.2-0.3m of soil) stripped from the footprint of any proposed buildings (this material is typically considered unsuitable to be left in place below slabs).

    - An average imported thickness of 0.5m is recommended over the LAA to achieve a minimum overall soil depth of 0.7m (0.6m from the bottom of the irrigation line to the limiting layer). Fill material should be battered at 1V:3H at the edges for long term stability.

Summaries of the site and soil assessment are presented below on **Table 2** and **Table 3**. Full soil laboratory results are attached as **Appendix C**.

Table 2 *Summary of Site Assessment.*

Site Feature	Observation	Limitation	Comments
Slope	~ 6 – 7% across proposed LAA (southern portion of site). Slopes reduce in northern portion of site.	Minor to Moderate	Moderate limitation on surface irrigation. No influence on design of subsurface system.
Exposure	North facing slope with minimal tress. Expected high sun and wind exposure, minimal shading / overshadowing.	Minor	No influence on design.
Vegetation	Predominantly established grass. Scattered trees on site boundaries.	Minor	No influence on design.
Flood Potential	Council to confirm flood levels (not available at the time of writing this report)	Minor	LAA to be situated on southern slopes above RL 23m AHD (existing water course ~RL 20m AHD)
Surface water (run-on / upslope seepage)	Southern slopes appear well drained (gently waxing divergent slope). No indications of up-slope seepage. Minor run-on could be anticipated. Northern slopes likely to receive significant run-on (linear convergent slope).	Minor to Moderate	LAA to be situated on southern slopes. Stormwater / seepage from upslope areas to be diverted away from LAA by bund / catch drain.
Site Drainage	Southern slopes appear well drained. No indicators of surface saturation or waterlogging. Vigorous grass growth, increased soil moisture and soil mottling indicate water logging in northern slopes.	Minor to moderate	As above.

Depth to Limiting Horizon	Bedrock, hardpan or heavy residual clays typically encountered at depths less than 0.4m below existing ground surface.	Major	LAA will need to be raised above existing ground level to ensure adequate depth of soil to allow satisfactory hydraulic and treatment performance.
Depth to Groundwater	Groundwater not encountered. Groundwater in southern portion of site anticipated to be heavily influenced by water levels in adjacent water course and farm dam.	Minor to moderate	LAA to be situated on southern slopes.
Rocks and Outcrops	Surface outcrops of bedrock not observed.	Minor	No influence on design.
Filling	Minor disturbance / filling of topsoil noted in southern portion of site	Minor	No influence on design.
Buffers / Watercourse and Sensitive Receptors	Unnamed nonperennial water course located on northern site boundary. Farm dam located in the northern portion of the adjacent proposed Lot 311.	Moderate	Conservative buffer distances of >100m from the non-perennial watercourse and >70m from the existing farm dam can be achieved for a LAA constructed on the southern slopes. No influence on design.

Table 3 *Summary of Soil Assessment.*

Soil Feature	Observation / Laboratory Results		Limitation	Comments
Soil Depth	Approximately 0.2m to 0.4m on southern slopes. Hand auger refusal on bedrock / rock structure encountered at relatively shallow depths at all test locations on southern slopes.		Major	LAA will need to be raised above existing ground level to ensure adequate depth of soil to allow satisfactory hydraulic and treatment performance.
Soil Texture and Structure	BH01	0.00 – 0.20m A: Sandy Clay Loam, moderately structured (Cat 4) 0.20 – 0.45m B: Sandy Clay, weakly structured (Cat 4/5) 0.45 – 0.50m C: Sandstone	Moderate	Soils moderately to poorly suited to effluent irrigation.
	BH02	0.00 – 0.10m A1: Sandy Clay Loam, moderately structured (Cat 4) 0.20 – 0.25m A2: Sandy Clay, weakly structured (Cat 4/5) 0.45 – 0.60m B: Medium Clay, weakly structured to massive		
	BH03	0.00 – 0.20m A: Sandy Clay Loam, moderately structured (Cat 4) 0.15 – 0.60m B1: Sandy Clay, weakly structured (Cat 4/5) 0.60 – 0.95m B2: Heavy Clay, weakly structured to massive (Cat 6) 0.95 – 1.40m C: Sandy Clay, weakly structured		
Coarse fragments	Typically 2 to 10% gravel inclusions.		Minor	Larger cobbles (if encountered) to be removed during site preparation works.

Sample	BH01 0.10 – 0.25m	BH02 0.15 – 0.25m		
$pH_{(1:5\ water)}$	5.12	5.42	Moderate	Strongly to moderately acidic
EC (dS/m)	0.04	0.07	Minor	Non-saline
Emerson Aggregate Class	6	6	Minor	Low likelihood of dispersion
Cation Exchange Capacity (CEC)	7.26 cmol/kg	16.7 cmol/kg	Minor to moderate	Low to moderate capacity to hold plant nutrients / effluent pollutants
Exchangeable Sodium Percentage (ESP)	4.55 %	8.76 %	Minor to moderate	Non-sodic to marginally sodic
Phosphorus Sorption Capacity	810 mg/kg 11300kg/ha	740 mg/kg 10400hg/ha	Minor	High sorption capacity

5.3 WASTEWATER SYSTEM SELECTION

Due to the significant site and soil constraints, it is recommended that generated wastewater is treated to a minimum secondary quality standard with disinfection. Primary treatment systems such as septic tanks are not considered appropriate for the site.

Appropriate secondary treatment technologies considered suitable for the site include, but are not limited to, Aerated Wastewater Treatment Systems (AWTS), Aerobic Sand Filter Systems (appropriately designed to satisfy council) and other media / textile systems. The selection of the system is the responsibility of the property owner. The selected technology / system shall:

- Be accredited by the NSW Department of Health. Information on accreditation guidelines, systems and suppliers can be found on the NSW Government Health website (Ref [6]).
- Be capable of producing treated effluent of the following quality (90th Percentile):
    - Biochemical Oxygen Demand (BOD) ≤ 20mg/L
    - Total Suspended Solids (TSS) ≤ 30mg/L
    - Thermotolerant Coliforms ≤ 30cfu/100mL
    - Total Nitrogen ≤ 30mg/L
    - Total Phosphorus ≤ 10mg/L
- Be capable of effluent disinfection. Effluent disinfection methods typically comprise of ultraviolet radiation (UV) and /or chlorination.

Several land application systems were considered for the site. **Table 4** provides a summary of the options considered and justification of selected land application system.

Table 4 *Summary of land application option considered for the site.*

Land Application Option	Comments	Suitable?
Subsoil Trenches and Beds	Major site constraints such as limited soil depth make this option unsuitable for the site.	No
Wisconsin Mound	Economic cost likely to be substantially greater than subsurface irrigation.	No
Surface Irrigation	Considered unsuitable due limited soil depth and potential contact risks.	No
Subsurface Irrigation	Likely to provide highest level of performance however will require importation of a minimum of 0.5m of sandy loam / clay loam fill.	Yes

As indicated in **Table 4,** given the site and soil constraints we recommend that the treated effluent be dispersed via sub-surface irrigation (SSI). SSI evenly distributes treated effluent to the root zone of the irrigation area through a network of proprietary polyethylene pipes located just below the ground surface of the LAA. The system optimises hydraulic and nutrient uptake, minimises the risk of human contact, reduces surface runoff and is comparatively easy to construct.

5.4 LAND APPLICATION AREA SIZING

5.4.1 GENERAL

The sizing of a site suitable SSI LAA has been estimated on the basis of nutrient and hydraulic balance as discussed below.

5.4.2 HYDRAULIC LOADING

Hydraulic (wastewater) loading has been calculated in accordance with *AS1547:2012* assuming a daily allowance of 120L per equivalent person for residential tank / roof water supply. The adopted number of equivalent persons has been based on an occupancy of two (2) equivalent persons for the first two (2) bedrooms and one (1) equivalent person for each bedroom beyond that. Calculations are provided for dwellings ranging in size from two (2) to four (4) bedrooms.

Table 5 provides a summary of the design hydraulic loading.

Table 5 *Design Hydraulic Loading.*

Number of:		Daily Wastewater Allowance	Design Daily Hydraulic Load
Bedrooms	**Occupants**		
2	4	120 L / occupant	480 L
3	5		600 L
4	6		720 L

5.4.3 CALCULATION PARAMETERS

The sizing of the LAA was undertaken using the parameters summarised in **Table 6**.

Table 6 *Summary of parameters adopted in water and nutrient balance.*

Design Parameter	Value	Comment
Rainfall Data	Clarence Town (Prince Street) – 061010	
Evaporation Data	Paterson (Tocal) – 061250	
Retained Rainfall	0.7	Conservative value for rainfall infiltrating LAA.
Design Loading Rate	3mm / day	Cat 4 soils - AS/NSZ 1547:2012
Design Nitrogen Load	30 mg/L	Target effluent quality following secondary treatment
Design Phosphorus Load	12 mg/L	
Crop Nitrogen Uptake	250 kg / ha / year	Published nutrient uptake for grass (DECCW -2004) reduced by 75%
Crop Phosphorus Uptake	30 kg / ha / year	
P-Sorption Capacity	740mg/kg	Conservative value based on labs
P-Sorption effectiveness	50%	Typical conservative value
Depth of Soil	0.6m	Design existing / imported soil depth
Nitrogen loss to soil processes	20%	Geary and Garner (1996)

5.4.4 RESULTS

The results of the calculations are presented in **Appendix D** and summarised in **Table 7** below.

Table 7 *Summary of calculation results.*

Number of Bedrooms	Minimum Required Area (m^2)			Nominated LLA Size (m^2)
	Hydraulic Balance	Nitrogen Balance	Phosphorus Balance	
2	**255**	168	228	255
3	**317**	210	285	320
4	**380**	252	342	380

It is noted, considering suitable offset distances / buffers areas, that approximately 3,370m^2 of the proposed 11,600m^2 Lot 312 is considered suitable for use as LAA. The area considered suitable for LAA is shown shaded green on **Drawing 2 (Appendix A)**.

5.5 SPECIFICATION

A concept level specification for the on-site sewage management system is documented in the following sections.

5.5.1 PLUMBING

All wastewater (i.e. greywater and blackwater) generated from the residence is to be collected and directed to the proposed secondary wastewater treatment through a network of sanitary drainage pipes installed by a licensed plumber in accordance all with relevant standards including AS/NZS 2566.2:2002 Buried Flexible pipelines Part 2: Installation.

5.5.2 WASTEWATER TREATMENT SYSTEM

The accredited wastewater treatment system, selected by the owner in consultation with RCA and the supplier, should produce secondary quality disinfected effluent conforming to the quality requirements listed in Section 5.3. Final siting of the wastewater treatment system will depend on the localised site conditions / ground levels and should be determined in consultation with the system installer and council prior to installation. It is noted that:

- The system should be located within the area notated as “Area Suitable for LAA” in **Drawing 2** (**Appendix A**), and shall comply with the following buffer distances:
    - at least 3m downslope or 6m upslope from any building.
    - at least 15m downslope of any pool or potable water tanks.
- System access lids should be located above the 1% AEP flood level and approximately 100mm above surrounding finished ground level. The surrounding ground surface should be sloped away from the lid to avoid the accumulation and ingress of stormwater.
- All electrical components should be located above the 1% AEP flood level and tested by an appropriately qualified technician during system commissioning.

It is noted that excavations undertaken for the installation of a treatment system may encounter difficulties due to shallow rock that was encountered in all boreholes over the investigation area.

5.5.3 LAND APPLICATION SYSTEM

Treated effluent is to be disposed via a pressure compensated SSI incorporating:

- An adequately sized high head / low flow pump. Typically, an operating pressure of 100kPa to 400kPa is required at the emitters to ensure pressure compensation.
- An in-line 120-mesh filter installed on the irrigation supply main to prevent solids entering the pipelines and emitters. The filter should be installed to allow either manual cleaning or backflushing.

- Proprietary, pressure-compensating subsurface drip (PCSD) lines specifically designed for effluent irrigation such as Netafim Bioline. Lateral PSCD lines should be installed in approved site won / imported sandy loam / clayey loam at a depth of 0.1m to 0.15. PSCD lateral lines should be laid on spacings of approximately 0.6m and orientated roughly parallel to the slope contours. A minimum 0.6m of soil should be located between the base of the PSCD line and the limiting layer (bedrock). Drip line emitters are to contain root inhibitor and be rated for a flow rate of 1.6L to 2.1L per hour.

- Air / vacuum release valves installed at the high points of each application zone.

A schematic representation of a typical SSI system is presented as **Drawing 3** (**Appendix A**).. Specialist advice is required for detailing and installation of the system.

LAA earthwork preparations are expected to comprise;

- Removal of all shrubs and boulders within the proposed LAA area.

- Construction of an upslope bund / catch drain to divert all run-on stormwater / seepage to area downslope of the LAA. A typical bund / catch drain arrangement is included on **Drawing 4** (**Appendix A**).

- Application of approximately 0.5kg/m^2 of lime over the base of the LAA to ameliorate existing poor soil conditions. The lime should be mixed into the existing soils via ripping / scarification of the natural soils across the entire basal area to minimum depth of 0.2m taking care to ensure that the basal area is not compacted during the process. Ripping / scarification should extend a minimum of 1m beyond the perimeter of the LAA.

- Importation of a good quality site won / imported topsoil fill (clean sandy loam / clay loam) to raise the level of the LAA. The material is to be inspected and approved by RCA prior to importation. An average imported thickness of 0.5m is recommended over the LAA to achieve a minimum overall soil depth of 0.7m (0.6m from the bottom of the irrigation line to the limiting layer). Compaction of existing soils and imported fill soils should be minimised during fill placement. Fill material should be battered at 1V:3H at the edges and vegetated with grass for long term stability.

- Establishment of grass over the LAA immediately after the completion of constructions.

5.5.4 OPERATION OF WASTEWATER SYSTEM

Operation and management of the onsite wastewater system must be in accordance with relevant legislature, council requirements and the requirements of the system installer. Operation and management requirements of the onsite wastewater systems would typically include:

- A reserve area off 100% the design LAA set aside to allow for site expansion, the resting of the land application system or for duplication of the land application system if other circumstances require this at some time in the future.
- The erection of adequate signage to indicate that the area is being irrigated with treated effluent. Signage should be located in at least two places around perimeter of the LAA, with wording such as, “Recycled Water – Avoid Contact – DO NOT DRINK”.
- The erection of fencing around the LAA to protect the LAA from damage caused vehicles, livestock and native animals and to exclude access of children or domestic animals.
- Regular mowing (at least monthly) of the LAA, with removal and disposal of the lawn clippings outside the LAA.
- Quarterly inspection by the service provider to ensure the wastewater system is operating correctly. During the inspection it is recommended that the service provider:
    - Services the secondary treatment system components in accordance with the owners/service manual.
    - Checks controls and alarms are functioning correctly.
    - Cleans in-line filters.
    - Flushes irrigation lines to remove any biofilm build up / blockages.

6 LIMITATIONS

This report has been prepared for Le Mottee Group accordance with the agreement with RCA Australia (RCA). The services performed by RCA have been conducted in a manner consistent with that generally exercised by members of its profession and consulting practice.

This report has been prepared for the sole use of Le Mottee Group for the specific purpose and the specific development described in the report. The report may not contain sufficient information for purposes or developments other than that described in the report or for parties other than Le Mottee Group. This report shall only be presented in full and may not be used to support objectives other than those stated in the report without permission.

The information in this report is considered accurate at the date of issue with regard to the current conditions of the site. The conclusions drawn in the report are based on interpolation

between boreholes or test pits. Conditions can vary between test locations that cannot be explicitly defined or inferred by investigation.

Yours faithfully
RCA AUSTRALIA

Byron Garner
Senior Geotechnical Engineer

Mark Allman
Principal Geotechnical Engineer

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[3] NSW Department of Local Government, "Environmental Health Protection Guidelines – On Site Sewage Management for Single Households", February 1998

[4] Standards Association of Australia. AS/NZS 1547-2012: On-Site domestic wastewater management. Standards Association of Australia, 2012

[5] BMT WBM. Dungog Shire Council On-site Sewerage Development Assessment Framework – Version 3. Dungog Shire Council, June 2015

[6] NSW Government Health Website. https://www.health.nsw.gov.au/environment/domesticwastewater/Pages/default.aspx

Appendix A

Drawing 1 – Site Plan

Drawing 2 – Suitable LAA Area

Drawing 3 – Typical SSI Layout 1

Drawing 4 – Typical SSI Layout 2

LEGEND

- Site (Proposed Lot 312)
- Bores

NOTE: Subject site (proposed Lot 312) shaded red

N

0 30 60 90 120 m

RCA AUSTRALIA
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SITE PLAN
LOT 3 DP 614789
29 FORDS ROAD
CLARENCE TOWN

CLIENT	LE MOTTEE GROUP			RCA Ref	15771
DRAWN BY	BG	SCALE	1:1,500 (A3)	DRAWING 1	REV 0
APPROVED BY	MA	DATE	16.11.2021	OFFICE	NEWCASTLE

PATH: H:\JOBFILES\Job15771- Clarencetown\500 CAD\15771-Clarence Town.qgz

LOT30 DP739211

LOT149 DP1223420

LOT2 DP1266949

20

LOT3 DP1266949

BH03

LOT3 DP614789

BH02

25

BH01

LOT32 DP739211

30

LOT71 DP1224225

LOT72 DP1224225

LEGEND

- Site (Proposed Lot 312)
- Area Suitable for LAA
- Water course / dam
- Bore/test locations

NOTE: Set back buffers of:
- 100m from water course in northern portion of site
- 40m from dam
- 3m from site boundaries

N

0 10 20 30 40 m

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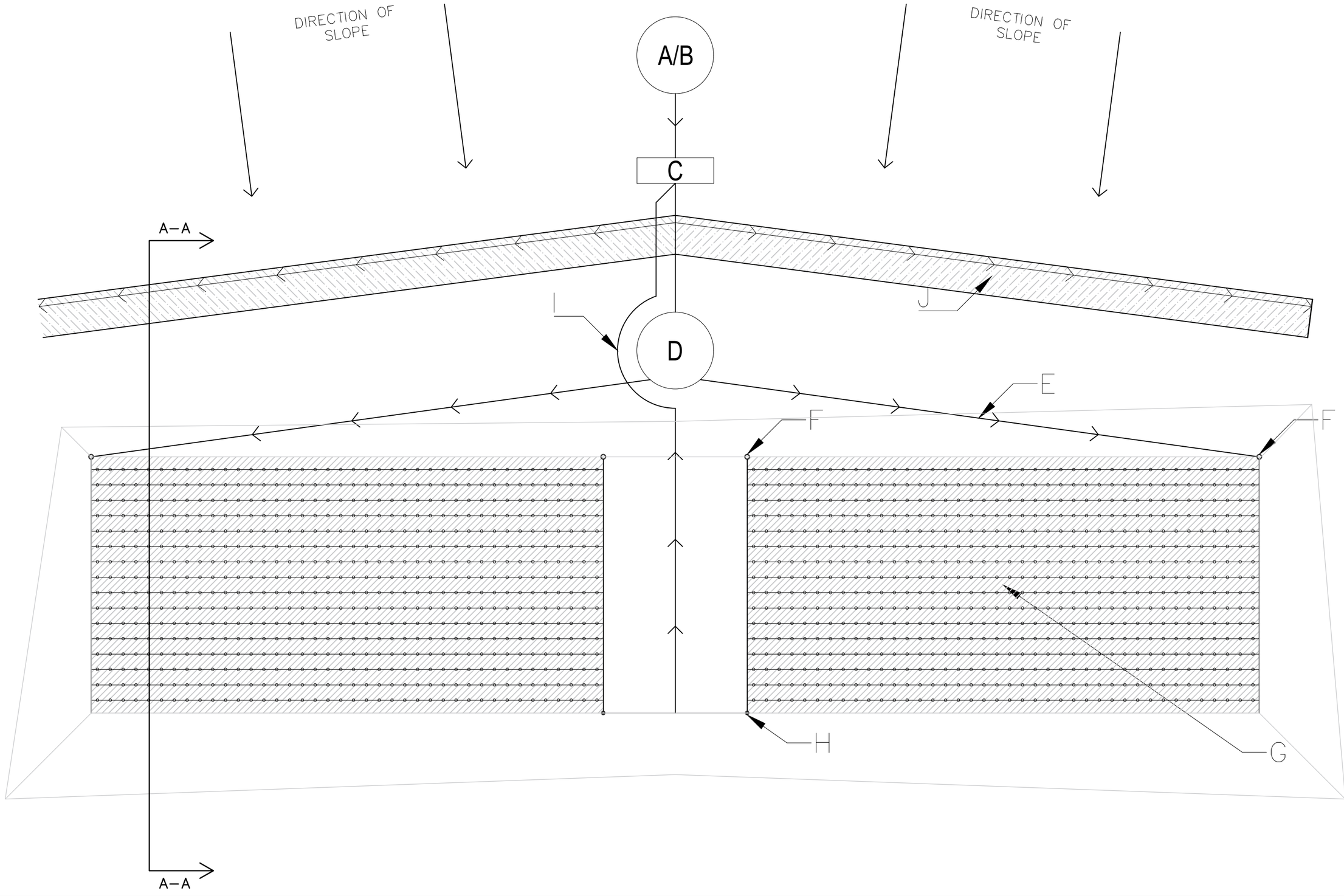
SUITABLE LAA
PORPOSED LOT 312
29 FORDS ROAD
CLARENCE TOWN

CLIENT	LE MOTTEE GROUP				RCA Ref	15771	
DRAWN BY	BG	SCALE	1:700	(A3)	DRAWING	1	REV 0
APPROVED BY	MA	DATE	15.11.2021		OFFICE	NEWCASTLE	

PATH: H:\JOBFILES\Job 15771- Clarencetown\500 CAD\15771-Clarence Town.agz



LEGEND
A - AWTS/secondary treatment system
B - PUMP
C - FILTER/FILTER FLUSHING MECHANISM
D - SEQUENCING VALVE
E - DISTRIBUTION LINES
F - AIR RELIEF VALVES
G - SUBSURFACE LATERAL DRIP LINES
H - FLUSH VALVES
I - FLUSH RETURN LINES
J - DIVERSION DRAIN (DETAIL 01)

NOT FOR CONSTRUCTION
INDICATIVE ONLY

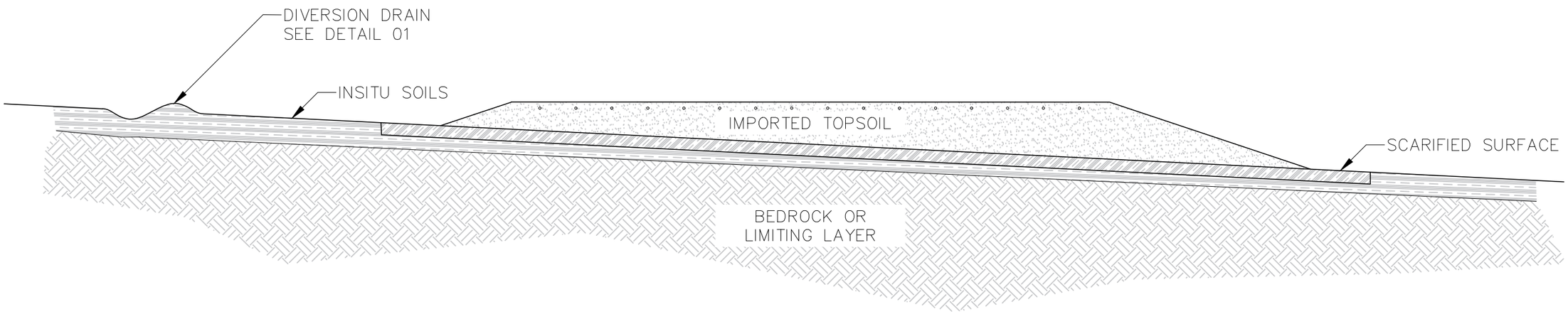
NOTE: Drawing adapted from Designing and Installing Onsite Wastewater Systems, A Sydney Catchment Authority Current Recommended Practice (dated May 2012).

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

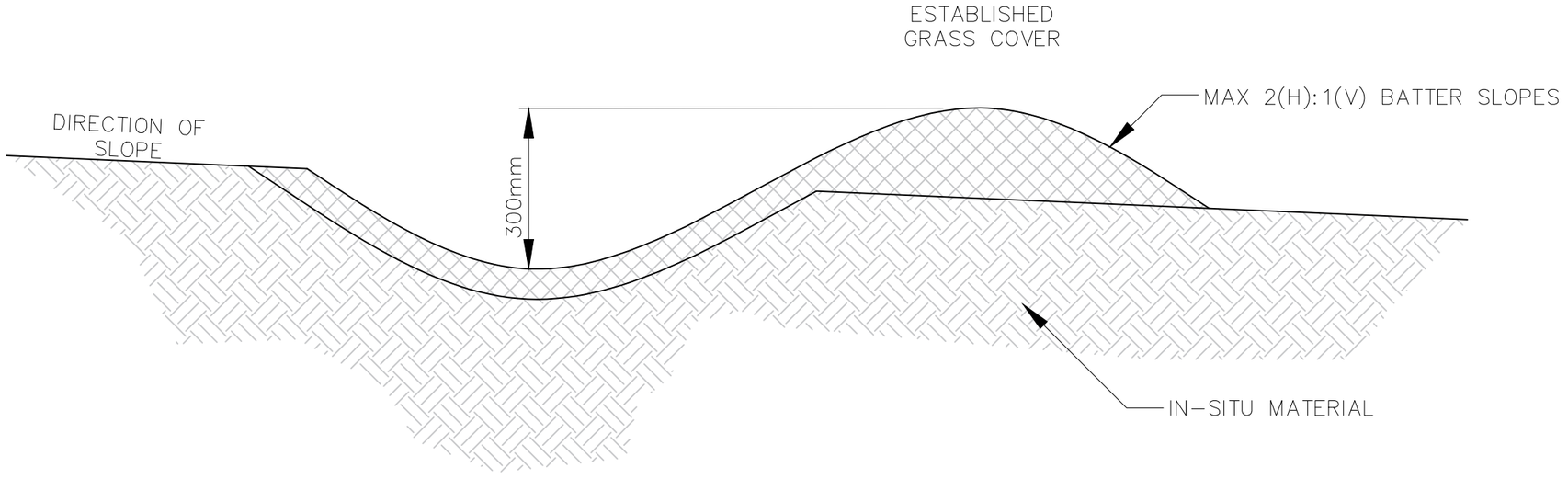
TYPICAL SSI LAYOUT 1
PLAN VIEW

CLIENT	LE MOTTEE GROUP			RCA Ref	15771
DRAWN BY	BG	SCALE	NTS (A3)	DRAWING No 3	REV 0
APPROVED BY	MA	DATE	15.11.21	OFFICE	NEWCASTLE

CDT–DWG–A3H–001/1



SECTION A-A
N.T.S.



DETAIL 01
N.T.S.

LEGEND
A - AWTS/secondary treatment system
B - PUMP
C - FILTER/FILTER FLUSHING MECHANISM
D - SEQUENCING VALVE
E - DISTRIBUTION LINES
F - AIR RELIEF VALVES
G - SUBSURFACE LATERAL DRIP LINES
H - FLUSH VALVES
I - FLUSH RETURN LINES
J - DIVERSION DRAIN (DETAIL 01)

NOT FOR CONSTRUCTION
INDICATIVE ONLY

NOTE: Drawing adapted from Designing and Installing Onsite Wastewater Systems, A Sydney Catchment Authority Current Recommended Practice (dated May 2012).

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

TYPICAL SSI LAYOUT 2
SECTION & DETAILS

CLIENT	LE MOTTEE GROUP			RCA Ref	15771
DRAWN BY	BG	SCALE	NTS (A3)	DRAWING No	4 REV 0
APPROVED BY	MA	DATE	15.11.21	OFFICE	NEWCASTLE

CDT-DWG-A3H-001/1

Appendix B

Engineering Logs

Explanatory Notes

GEOTECHNICAL BOREHOLE LOG

BH01

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15771
CLIENT: Le Mottee Group
PROJECT: Proposed Subdivision
LOCATION: 29 Fords Road, Clarence Town

DATE COMMENCED: 19/10/2021
DATE COMPLETED: 19/10/2021
SURFACE RL:
COORDS:
DRILL MODEL: Hand Auger & Shovel

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
SHOVEL	Not Encountered		0.10m D 0.25m			CL	TOPSOIL/FILL, Sandy Clay LOAM, brown, moderate structure, few coarse fragments	D - M		TOPSOIL / FILL A Horizon
HA			0.30m D 0.40m	0.25		CI	Sandy CLAY, grey mottled orange, common medium sized angular gravel (relict sandstone), weakly structured	w<PL	VSt	RESIDUAL B Horizon
				0.45			SANDSTONE, fine grained, grey and orange, excavated as Sandy CLAY, low plasticity, fine grained sand, dry and friable		H	BEDROCK C Horizon
				0.5			BOREHOLE BH01 TERMINATED AT 0.50 m Practical refusal of hand auger Note: Soils logged to AS/NZS 1517:2012 & Australian Soil & Land Survey - Field Handbook			
				1.0						

LOGGED: BG | CHECKED: MA | DATE: 15/11/2021

RCA_LIB_08.1_RCA_STANDARD.GLB Log RCA NON CORED LOG 15771-LOGS.GPJ <<DrawingFile>> 16/11/2021 16:14 Produced by gINT Professional, Developed by Datgel

Client: Le Mottee Group **RCA Australia**

Project: Proposed Subdivision

Location: 29 Fords Road, Clarence Town **RCA Report No:** 15771-301

GEOTECHNICAL BOREHOLE LOG

BH02

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15771
CLIENT: Le Mottee Group
PROJECT: Proposed Subdivision
LOCATION: 29 Fords Road, Clarence Town

DATE COMMENCED: 19/10/2021
DATE COMPLETED: 19/10/2021
SURFACE RL:
COORDS:
DRILL MODEL: Hand Auger & Shovel

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
SHOVEL	Not Encountered		D 0.10m	0.10		CL	TOPSOIL/FILL, Sandy Clay LOAM, brown, moderate structure, few to common fine fragments, with rootlets	D - M		TOPSOIL / FILL A1 Horizon
			0.15m			CL	FILL, Sandy CLAY, grey-brown mottled orange, common medium to coarse angular gravel (weathered sandstone fragments), weakly structured, with roots/rootlets	w<PL		FILL A2 Horizon
			D 0.25m	0.25						
HA			0.30m			CH	Medium CLAY, brown, very few fine gravels, weak to massive structure, trace of roots to ~0.4m (up to 10mmø)		H	RESIDUAL B Horizon
			D	0.5						
			0.60m	0.60			becoming with few coarse angular weathered sandstone gravels at ~0.55m			
							BOREHOLE BH02 TERMINATED AT 0.60 m Practical hand auger refusal Note: Soils logged to AS/NZS 1517:2012 & Australian Soil & Land Survey - Field Handbook			
				1.0						

LOGGED: BG | CHECKED: MA | DATE: 15/11/2021

RCA_LIB_08.1_RCA_STANDARD.GLB Log RCA NON CORED LOG 15771-LOGS.GPJ <<DrawingFile>> 16/11/2021 16:14 Produced by gINT Professional, Developed by Datgel

Client:	Le Mottee Group	**RCA Australia**
Project:	Proposed Subdivision	
Location:	29 Fords Road, Clarence Town	**RCA Report No:** 15771-301

GEOTECHNICAL BOREHOLE LOG

BH03

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 15771
CLIENT: Le Mottee Group
PROJECT: Proposed Subdivision
LOCATION: 29 Fords Road, Clarence Town

DATE COMMENCED: 19/10/2021
DATE COMPLETED: 19/10/2021
SURFACE RL:
COORDS:
DRILL MODEL: Hand Auger & Shovel

Borehole Information					Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
SHOVEL	Not Encountered		D 0.20m	0.20		CL	TOPSOIL, Sandy Clay LOAM, brown, moderate structure, very few to few fine to medium gravels, with rootlets	M		TOPSOIL A Horizon
						CI-CH	Sandy CLAY, brown, common fine to coarse gravel, weak to massive structure, trace of rootlets	w~PL	St - VSt	ALLUVIUM B2 Horizon
			D 0.30m							
HA			D 0.40m	0.5						
				0.60		CH	Heavy CLAY, grey-brown mottled orange-brown, very few fine to medium gravels, massive structure	w>PL	VSt	B2 Horizon
				0.95		CI-CH	Sandy CLAY, brown-grey mottled orange, very few fine gravels, weakly structured	w~PL	VSt - H	RESIDUAL C Horizon
				1.0						
				1.40			BOREHOLE BH03 TERMINATED AT 1.40 m Practical hand auger refusal Note: Soils logged to AS/NZS 1517:2012 & Australian Soil & Land Survey - Field Handbook			

LOGGED: BG | CHECKED: MA | DATE: 15/11/2021

RCA_LIB_08.1_RCA_STANDARD.GLB Log RCA NON CORED LOG 15771-LOGS.GPJ <<DrawingFile>> 16/11/2021 16:14 Produced by gINT Professional, Developed by Datgel

Client: Le Mottee Group **RCA Australia**

Project: Proposed Subdivision

Location: 29 Fords Road, Clarence Town **RCA Report No:** 15771-301

Explanatory Notes – Soil Description

In engineering terms, soil includes every type of uncemented or partially cemented material found in the ground. In practice, if the material can be remoulded by hand in its field condition or in water it is described as a soil. The dominant soil constituent is given in capital letters, with secondary textures in lower case. The dominant feature is assessed from *AS 1726:2017 – Geotechnical Site Investigations* and a soil symbol is used to define a soil layer.

METHOD

Method	Description
AD/T	Auger Drilling with tungsten carbide bit
AD/V	Auger Drilling with V Bit
AS	Auger Screwing
AT	Air Track
BH	Backhoe
CT	Cable Tool Rig
DB	Washbore Drag Bit
DT	Diatube
E	Excavator
EH	Excavator with Hammer
HA	Hand Auger
HQ	Diamond Core-63mm diameter
N	Natural Exposure
NMLC	Diamond Core-52mm diameter
NQ	Diamond Core-47mm diameter
Percussion	Percussion Drilling
PT	Push Tube
RR	Rock Roller
V	Vacuum Excavation
WS	Washbore
X	Existing Excavation

WATER

Water level at date shown

Seepage

NOT ENCOUNTERED: The borehole/test pit was dry soon after excavation. Inflow may have been observed had the borehole/test pit been left open for a longer period.

NOT OBSERVED: The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit.

SAMPLING

Sample	Description
B	Bulk Disturbed Sample
D	Disturbed Sample
SPT	Standard Penetration Test
U50	Undisturbed Sample - 50mm diameter
U75	Undisturbed Sample - 75mm diameter
ES	Soil Sample, Environmental
EW	Water Sample, Environmental
G	Gas Sample

SOIL CLASSIFICATION

The appropriate symbols are selected based on the result of visual examination, field tests and available laboratory test results, such as particle size analysis, liquid limit and plasticity index.

Group Symbol	Description
GW	Well graded gravel
GP	Poorly graded gravel
GM	Silty gravel
GC	Clayey gravel
SW	Well graded sand
SP	Poorly graded sand
SM	Silty sand
SC	Clayey sand
ML	Silt of low plasticity
CL	Clay of low plasticity
OL	Organic soil of low plasticity
CI	Clay of medium plasticity
MH	Silt of high plasticity
CH	Clay of high plasticity
OH	Organic soil of high plasticity
Pt	Peat, highly organic soil

MOISTURE CONDITION

For coarse grained soils, the following terms are used

Dry - Non-cohesive and free-running

Moist - Soil feels cool, darkened in colour
- Soil tends to stick together

Wet - Soil feels cool, darkened in colour
- Soil tends to stick together, free water forms when handling

For fine grained soils, the following moisture content (w) terms are used:

w < PL - Moist, dry of plastic limit

w ≈ PL - Moist, near plastic limit.

w > PL - Moist, wet of plastic limit.

w ≈ LL - Wet, near liquid limit.

w > LL - Wet, wet of liquid limit

PLASTICITY

Soil plasticity is a measure of the range of water content over which a soil exhibits plastic properties. The classification of the degree of plasticity in terms of the Liquid Limit (LL) is as follows.

Description of Plasticity	Range of Liquid Limit for Silt	Range of Liquid Limit for Clay
Non-plastic	Not applicable	Not applicable
Low plasticity	≤50	≤35
Medium plasticity	Not applicable	>35 and ≤50
High plasticity	>50	>50

COHESIVE SOILS – CONSISTENCY

The consistency of a cohesive soil is defined by descriptive terminology such as very soft, soft, firm, stiff, very stiff and hard. These terms are assessed by the shear strength of the soil as observed visually, by hand penetrometer, dynamic cone penetrometer or vane shear values and by resistance to deformation to hand moulding.
A hand penetrometer may be used in the field or the laboratory to provide an approximate assessment of the unconfined compressive strength (UCS) of cohesive soils. Undrained shear strength c_u = 0.5×UCS. Undrained shear strength values are recorded in kPa as follows:

Strength	Symbol	Indicative Undrained Shear Strength, c_u (kPa)
Very Soft	VS	≤12
Soft	S	>12 and ≤25
Firm	F	>25 and ≤50
Stiff	St	>50 and ≤100
Very Stiff	VSt	>100 and ≤200
Hard	H	>200
Friable	Fr	—

COHESIONLESS SOILS – RELATIVE DENSITY

Relative density terms such as very loose, loose, medium dense, dense and very dense are used to describe silty and sandy material, and these are usually based on resistance to drilling penetration, Standard Penetration Test (SPT) N values or Perth Sand Penetrometer resistance.

Term	Symbol	Density Index
Very Loose	VL	0 to 15
Loose	L	15 to 35
Medium Dense	MD	35 to 65
Dense	D	65 to 85
Very Dense	VD	>85

SOIL PARTICLE SIZE DESCRIPTIVE TERMS

Fraction	Name	Subdivision	Size (mm)
Oversize	Boulders		>200
	Cobbles		63 to 200
Coarse grained soil	Gravel	Coarse	19 to 63
		Medium	6.7 to 19
		Fine	2.36 to 6.7
	Sand	Coarse	0.6 to 2.36
		Medium	0.21 to 0.6
		Fine	0.075 to 0.21
Fine grained soil	Silt		0.002 to 0.075
	Clay		<0.002

Explanatory Notes - Rock Description

METHOD

Refer to soil description sheet.

WATER

Refer to soil description sheet.

ROCK QUALITY

The defect spacing is shown where applicable and the Rock Quality Designation (RQD) and Total Core Recovery (TCR) for each core run is given where:

$$TCR = \frac{\text{Length of core recovered}}{\text{Length of core run}} \times 100\%$$

$$RQD = \frac{\text{Sum of axial length of sound core pieces >100mm long}}{\text{Length of core run}} \times 100\%$$

ROCK MATERIAL WEATHERING

Rock material weathering is described using the abbreviations and definitions used in *AS1726:2017– Geotechnical Site Investigations*.

Term		Abbreviation		Definition
Residual Soil		RS		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely weathered		XW		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.
Highly Weathered	Distinctly Weathered	HW	DW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching or may be decreased due to deposition of weathering products in pores.
Moderately Weathered		MW		The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly Weathered		SW		Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh		FR		Rock shows no sign of decomposition of individual minerals or colour changes.

Where it is not practicable to distinguish between 'Highly Weathered' and 'Moderately Weathered' rock the term 'Distinctly Weathered' may be used. 'Distinctly Weathered' is defined as follows: 'Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in the pores'. There is some change in rock strength.

ROCK MATERIAL STRENGTH

Rock strength is described using *AS1726:2017– Geotechnical Site Investigations* and *ISRM – Commission on Standardisation of Laboratory and Field Tests, 'Suggested method of determining the Uniaxial Compressive Strength of Rock materials and the Point Load Index'* as follows:

Term	Abbreviation	Uniaxial Compressive Strength (MPa)	Point Load Index Is_{50} (MPa)
Very Low	VL	0.6 to 2	0.03 to 0.1
Low	L	2 to 6	0.1 to 0.3
Medium	M	6 to 20	0.3 to 1
High	H	20 to 60	1 to 3
Very High	VH	60 to 200	3 to 10
Extremely High	EH	>200	>10

◀ Diametral Point Load Index test.

▼ Axial Point Load Index test.

DEFECT SPACING/BEDDING THICKNESS

Depending on the project, may be either described as mean perpendicular spacing within a set of defects or bedding, or as the spacing between all defects within the rock mass.

Term	Defect Spacing	Bedding
Extremely closely spaced	<6 mm	Thinly laminated
	6 to 20 mm	Laminated
Very closely spaced	20 to 60 mm	Very thin
Closely spaced	0.06 to 0.2 m	Thin
Moderately widely spaced	0.2 to 0.6 m	Medium
Widely spaced	0.6 to 2.0 m	Thick
Very widely spaced	>2 m	Very thick

DEFECT DESCRIPTION

Type	Definition
JT	Joint
BP	Bedding Parting
CO	Contact
CS	Clay Seam
CZ	Crush Zone
DK	Dyke
DZ	Decomposed Zone
FC	Fracture
FZ	Fracture Zone
FL	Foliation
FLT	Fault
VN	Vein
SM	Seam
IS	Infilled Seam
SZ	Shear Zone

Planarity	Roughness
PR – Planar	VR – Very Rough
CU – Curved	RF – Rough
U – Undulating	S – Smooth
ST – Stepped	POL – Polished
IR – Irregular	SL – Slickensided

Symbol	Coating or Infill
CA	Calcite
Clay	Clay
CN	Clean
Fe	Iron oxide
KT	Chlorite
Qz	Quartz
X	Carbonaceous
SN	Stain
VNR	Veneer

The inclinations of defects are measured from perpendicular to the core axis.

Appendix C

Laboratory Test Reports

eastwest
geo ag enviro

82 Plain Street Tamworth NSW 2340
e admin@eastwestonline.com.au
t 02 6762 1733
f 02 6765 9109
abn 82 125 442 382

eastwestonline.com.au

ANALYSIS REPORT SOIL

PROJECT NO: EW211454		**Date of Issue:**	**03/11/2021**
Customer:	RCA LABORATORIES	Report No:	1
Address:	92 Hill St CARRINGTON NSW 2294	Date Received:	22/10/2021
		Matrix:	Soil
Attention:	Connor Davies	Location:	15771
Phone:	0411 634 520	Sampler ID:	Client
Fax:	02 4902 9299	Date of Sampling:	21/10/2021
Email:	connord@rca.com.au	Sample Condition:	Acceptable

Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

Signed:

Stephanie Cameron
Laboratory Operations Manager

ASPAC
PROFICIENT LAB
Visit www.aspac-australasia.com to view our certification details.

East West is certified by the Australian-Asian Soil & Plant Analysis Council to perform various soil and plant tissue analysis. The tests reported herein have been performed in accordance with our terms of accreditation.

This report must not be reproduced except in full and EWEA takes no responsibility of the end use of the results within this report.

This analysis relates to the sample submitted and it is the client's responsibility to make certain the sample is representative of the matrix to be tested.

Samples will be discarded one month after the date of this report. Please advise if you wish to have your sample/s returned.

ANALYSIS REPORT

PROJECT NO: EW211454 Location: 15771

					BH1	BH2		
			CLIENT SAMPLE ID					
			DEPTH		0.1-0.25m	0.15-0.25m		
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**211454-1**	**211454-2**		
pH (1:5 in H20)	Electrode	R&L 4A2	pH units	na	5.12	5.42		
Electrical Conductivity	Electrode	R&L 3A1	dS/m	0.01	0.04	0.07		
Phosphorus Buffer Index	UV-Vis	PMS-12	mg/kg	na	238	1325		
Phosphorus (Colwell)	Bicarb/UV-Vis	R&L 9B1	mg/kg	1	10.5	26.7		
Phosphorus Sorption Capacity	Calc	PMS-12	mg/kg	na	810	740		
Phosphorus Sorption Capacity	Calc	na	kg/ha	na	11300	10400		
Exchangeable Potassium	NH4Cl/ICP	R&L 15A1	mg/kg	10	151	135		
Exchangeable Calcium	NH4Cl/ICP	R&L 15A1	mg/kg	20	466	741		
Exchangeable Magnesium	NH4Cl/ICP	R&L 15A1	mg/kg	10	364	1171		
Exchangeable Sodium	NH4Cl/ICP	R&L 15A1	mg/kg	10	76.0	337		
Exchangeable Aluminium	KCl/ICP	R&L 15G1	mg/kg	1	106	130		
Exchangeable Potassium	R&L 15A1	R&L 15A1	cmol/kg	na	0.39	0.35		
Exchangeable Calcium	R&L 15A1	R&L 15A1	cmol/kg	na	2.33	3.71		
Exchangeable Magnesium	R&L 15A1	R&L 15A1	cmol/kg	na	3.03	9.76		
Exchangeable Sodium	R&L 15A1	R&L 15A1	cmol/kg	na	0.33	1.47		
Exchangeable Aluminium	Calculation	R&L 15J1	cmol/kg	na	1.18	1.44		
ECEC	Calculation	PMS-15A1	cmol/kg	na	7.26	16.7		
Ca/Mg Ratio	Calculation	PMS-15A1	cmol/kg	na	0.77	0.38		
K/Mg Ratio	Calculation	PMS-15A1	cmol/kg	na	0.13	0.04		
Exchangeable Potassium %	Calculation	PMS-15A1	%	na	5.33	2.07		
Exchangeable Calcium %	Calculation	PMS-15A1	%	na	32.1	22.2		

ANALYSIS REPORT

PROJECT NO: EW211454 **Location: 15771**

				CLIENT SAMPLE ID	BH1	BH2		
				DEPTH	0.1-0.25m	0.15-0.25m		
Test Parameter	**Method Description**	**Method Reference**	**Units**	**LOR**	**211454-1**	**211454-2**		
Exchangeable Magnesium %	Calculation	PMS-15A1	%	na	41.8	58.4		
Exchangeable Sodium %	Calculation	PMS-15A1	%	na	4.55	8.76		
Exchangeable Aluminium %	Calculation	PMS-15A1	%	na	16.2	8.64		
Mod Emerson Agg Test (SAR5)	513.01	PMS-21	Class	na	6	6		

This Analysis Report shall not be reproduced except in full without the written approval of the laboratory.

Soils are air dried at 40^{0}C and ground <2mm.

NB: LOR is the Lowest Obtainable Reading.

DOCUMENT END

Appendix D

Water Balance Calculations

RCA Australia
92 Hill Street
CARRINGTON, NSW 2294
Phone: +61 (02) 4902 9200

INPUT DATA

Design Wastewater Flow	Q	L/day	480
Design Irrigation Rate	DIR	mm/day	3.0
Nominated Land Application Area	L	m^2	255
Crop Factor	C	unitless	0.6-0.8
Retained Rainfall	RF	untiless	0.7
Mean Monthly Rainfall Data	Clarence Town - Prince St (061010)		
Mean Monthly Pan Evaporation Data	Paterson - Tocal (061250)		

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	**365**
Rainfall	R		mm/month	105	111.7	124.8	99.9	86.4	101.3	68	60.3	61.9	68.9	78	99.8	**1066**
Evaporation	E		mm/month	192.2	148.4	130.2	96	74.4	63	74.4	102.3	132	161.2	174	204.6	**1553**
Crop Factor	C		unitless	0.80	0.80	0.75	0.70	0.65	0.60	0.60	0.60	0.65	0.70	0.75	0.80	
OUTPUTS																
Evapotranspiration	ET	ExC	mm/month	154	119	98	67	48	38	45	61	86	113	131	164	**1122**
Percolation	B	DIRxD	mm/month	93.0	84	93.0	90.0	93.0	90.0	93.0	93.0	90.0	93.0	90.0	93.0	**1095**
Outputs		ET+B	mm/month	246.8	202.72	190.7	157.2	141.4	127.8	137.6	154.4	175.8	205.8	220.5	256.7	**2217**
INPUTS																
Retained Rainfall	RR	RxRF	mm/month	73.5	78.19	87.36	69.93	60.48	70.91	47.6	42.21	43.33	48.23	54.6	69.86	**746**
Applied Effluent	W	(QxD)/L	mm/month	58.4	52.7	58.4	56.5	58.4	56.5	58.4	58.4	56.5	58.4	56.5	58.4	**687**
Inputs		RR+W	mm/month	131.9	130.9	145.7	126.4	118.8	127.4	106.0	100.6	99.8	106.6	111.1	128.2	**1433**
STORAGE CALCULATION																
Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the month	S	(RR+W)-(ET+B)	mm/month	-114.9	-71.8	-44.9	-30.8	-22.5	-0.4	-31.7	-53.8	-76.0	-99.3	-109.4	-128.5	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Max. Storage for Nom. Area	N		mm	**0.00**												
Storage Volume Required	V	NxL	L	**0**												
LAND AREA REQUIRED FOR ZERO STORAGE			m^2	86	108	144	165	184	253	165	133	109	94	87	80	
MINIMUM AREA REQUIRED FOR ZERO STORAGE			m^2	**254.0**												

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92 Hill Street
CARRINGTON, NSW 2294
Phone: +61 (02) 4902 9200

INPUT DATA

Wastewater Loading

Hydraulic Load	480	L/day
Effluent N Concentration	30	mg/L
% N Lost to Soil Processes (Geary & Gardner 1996)	0.2	Decimal
Total N Loss to Soil	2880	mg/day
Remaining N Load after soil loss	11520	mg/day
Effluent P Concentration	12	mg/L
Design Life of System	50	yrs

Nutrient Crop Uptake

Crop N Uptake	250	kg/ha/yr	which equals	68 mg/m^2/day
Crop P Uptake	30	kg/ha/yr	which equals	8 mg/m^2/day

Phosphorus Sorption

P-sorption result	740	mg/kg	which equals	6216 kg/ha
Bulk Density	1.4	g/cm^2		
Depth of soil	0.6	mg/kg		
% of predicted P-sorp[2]	0.5	Decimal		

NUTRIENT BALANCE BASED ON ANNUAL CROP UPTAKE RATES

Minimum Area required with zero buffer

Nitrogen	168	m^2
Phosphorus	228	m^2

Determination of Buffer Zone Size for the Nominated Land Application Area (LAA)

Nominated LAA Size	255	m^2
Predicted N Export from LAA	-2.17	kg/year
Predicted P Export from LAA	-0.25	kg/year
Phosphorous Longevity of LAA	59	Years
Minimum Buffer Required for excess nutrient	0	m^2

PHOSPHORUS BALANCE

Nominated LAA Size	255	m^2				
Daily P load	0.006	kg/day	→	Phosphorus generated over life of system	105.120	kg
Daily Uptake	0.002	kg/day	→	Phosphorus vegetative uptake for lilfe of system	0.150	kg/m^2
Measured p-sorption capacity	0.622	kg/m^2				
Assumed p-sorption capacity	0.311	kg/m^2	→	Phosphorus absorbed in 50 years	0.311	kg/m^2
Site p-sorption capcaity	79.254	kg	→	Desired Annual P Application Rate	2.350	kg/year
				which equals	0.006	kg/day
P-load to be sorbed	1.337	kg/year				

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INPUT DATA

Design Wastewater Flow	Q	L/day	600
Design Irrigation Rate	DIR	mm/day	3.0
Nominated Land Application Area	L	m^2	320
Crop Factor	C	unitless	0.6-0.8
Retained Rainfall	RF	untiless	0.7
Mean Monthly Rainfall Data	Clarence Town - Prince St (061010)		
Mean Monthly Pan Evaporation Data	Paterson - Tocal (061250)		

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	**365**
Rainfall	R		mm/month	105	111.7	124.8	99.9	86.4	101.3	68	60.3	61.9	68.9	78	99.8	**1066**
Evaporation	E		mm/month	192.2	148.4	130.2	96	74.4	63	74.4	102.3	132	161.2	174	204.6	**1553**
Crop Factor	C		unitless	0.80	0.80	0.75	0.70	0.65	0.60	0.60	0.60	0.65	0.70	0.75	0.80	
OUTPUTS																
Evapotranspiration	ET	ExC	mm/month	154	119	98	67	48	38	45	61	86	113	131	164	**1122**
Percolation	B	DIRxD	mm/month	93.0	84	93.0	90.0	93.0	90.0	93.0	93.0	90.0	93.0	90.0	93.0	**1095**
Outputs		ET+B	mm/month	246.8	202.72	190.7	157.2	141.4	127.8	137.6	154.4	175.8	205.8	220.5	256.7	**2217**
INPUTS																
Retained Rainfall	RR	RxRF	mm/month	73.5	78.19	87.36	69.93	60.48	70.91	47.6	42.21	43.33	48.23	54.6	69.86	**746**
Applied Effluent	W	(QxD)/L	mm/month	58.1	52.5	58.1	56.3	58.1	56.3	58.1	58.1	56.3	58.1	56.3	58.1	**684**
Inputs		RR+W	mm/month	131.6	130.7	145.5	126.2	118.6	127.2	105.7	100.3	99.6	106.4	110.9	128.0	**1431**
STORAGE CALCULATION																
Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the month	S	(RR+W)-(ET+B)	mm/month	-115.1	-72.0	-45.2	-31.0	-22.8	-0.6	-31.9	-54.0	-76.2	-99.5	-109.7	-128.7	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Max. Storage for Nom. Area	N		mm	**0.00**												
Storage Volume Required	V	NxL	L	**0**												
LAND AREA REQUIRED FOR ZERO STORAGE			m^2	107	135	180	206	230	316	207	166	136	118	108	100	
MINIMUM AREA REQUIRED FOR ZERO STORAGE			m^2	**317.0**												

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Phone: +61 (02) 4902 9200

INPUT DATA

Wastewater Loading

Hydraulic Load	600	L/day
Effluent N Concentration	30	mg/L
% N Lost to Soil Processes (Geary & Gardner 1996)	0.2	Decimal
Total N Loss to Soil	3600	mg/day
Remaining N Load after soil loss	14400	mg/day
Effluent P Concentration	12	mg/L
Design Life of System	50	yrs

Nutrient Crop Uptake

Crop N Uptake	250	kg/ha/yr	which equals	68	$mg/m^2/day$
Crop P Uptake	30	kg/ha/yr	which equals	8	$mg/m^2/day$

Phosphorus Sorption

P-sorption result	740	mg/kg	which equals	6216	kg/ha
Bulk Density	1.4	g/cm^2			
Depth of soil	0.6	mg/kg			
% of predicted P-sorp[2]	0.5	Decimal			

NUTRIENT BALANCE BASED ON ANNUAL CROP UPTAKE RATES

Minimum Area required with zero buffer

Nitrogen	210	m^2
Phosphorus	285	m^2

Determination of Buffer Zone Size for the Nominated Land Application Area (LAA)

Nominated LAA Size	320	m^2
Predicted N Export from LAA	-2.74	kg/year
Predicted P Export from LAA	-0.32	kg/year
Phosphorous Longevity of LAA	60	Years
Minimum Buffer Required for excess nutrient	0	m^2

PHOSPHORUS BALANCE

Nominated LAA Size	320	m^2				
Daily P load	0.007	kg/day	→	Phosphorus generated over life of system	131.400	kg
Daily Uptake	0.003	kg/day	→	Phosphorus vegetative uptake for lilfe of system	0.150	kg/m^2
Measured p-sorption capacity	0.622	kg/m^2				
Assumed p-sorption capacity	0.311	kg/m^2	→	Phosphorus absorbed in 50 years	0.311	kg/m^2
Site p-sorption capcaity	99.456	kg	→	Desired Annual P Application Rate	2.949	kg/year
				which equals	0.008	kg/day
P-load to be sorbed	1.668	kg/year				

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INPUT DATA

Design Wastewater Flow	Q	L/day	720
Design Irrigation Rate	DIR	mm/day	3.0
Nominated Land Application Area	L	m^2	380
Crop Factor	C	unitless	0.6-0.8
Retained Rainfall	RF	untiless	0.7
Mean Monthly Rainfall Data	Clarence Town - Prince St (061010)		
Mean Monthly Pan Evaporation Data	Paterson - Tocal (061250)		

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	**365**
Rainfall	R		mm/month	105	111.7	124.8	99.9	86.4	101.3	68	60.3	61.9	68.9	78	99.8	**1066**
Evaporation	E		mm/month	192.2	148.4	130.2	96	74.4	63	74.4	102.3	132	161.2	174	204.6	**1553**
Crop Factor	C		unitless	0.80	0.80	0.75	0.70	0.65	0.60	0.60	0.60	0.65	0.70	0.75	0.80	
OUTPUTS																
Evapotranspiration	ET	ExC	mm/month	154	119	98	67	48	38	45	61	86	113	131	164	**1122**
Percolation	B	DIRxD	mm/month	93.0	84	93.0	90.0	93.0	90.0	93.0	93.0	90.0	93.0	90.0	93.0	**1095**
Outputs		ET+B	mm/month	246.8	202.72	190.7	157.2	141.4	127.8	137.6	154.4	175.8	205.8	220.5	256.7	**2217**
INPUTS																
Retained Rainfall	RR	RxRF	mm/month	73.5	78.19	87.36	69.93	60.48	70.91	47.6	42.21	43.33	48.23	54.6	69.86	**746**
Applied Effluent	W	(QxD)/L	mm/month	58.7	53.1	58.7	56.8	58.7	56.8	58.7	58.7	56.8	58.7	56.8	58.7	**692**
Inputs		RR+W	mm/month	132.2	131.2	146.1	126.8	119.2	127.8	106.3	100.9	100.2	107.0	111.4	128.6	**1438**
STORAGE CALCULATION																
Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the month	S	(RR+W)-(ET+B)	mm/month	-114.5	-71.5	-44.6	-30.4	-22.1	0.0	-31.3	-53.4	-75.6	-98.9	-109.1	-128.1	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Max. Storage for Nom. Area	N		mm	**0.00**												
Storage Volume Required	V	NxL	L	**0**												
LAND AREA REQUIRED FOR ZERO STORAGE			m^2	129	162	216	248	276	380	248	199	163	142	130	119	
MINIMUM AREA REQUIRED FOR ZERO STORAGE			m^2	**380.0**												

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Phone: +61 (02) 4902 9200

INPUT DATA

Wastewater Loading

Hydraulic Load	720	L/day
Effluent N Concentration	30	mg/L
% N Lost to Soil Processes (Geary & Gardner 1996)	0.2	Decimal
Total N Loss to Soil	4320	mg/day
Remaining N Load after soil loss	17280	mg/day
Effluent P Concentration	12	mg/L
Design Life of System	50	yrs

Nutrient Crop Uptake

Crop N Uptake	250	kg/ha/yr	which equals	68 mg/m^2/day
Crop P Uptake	30	kg/ha/yr	which equals	8 mg/m^2/day

Phosphorus Sorption

P-sorption result	740	mg/kg	which equals	6216 kg/ha
Bulk Density	1.4	g/cm^2		
Depth of soil	0.6	mg/kg		
% of predicted P-sorp[2]	0.5	Decimal		

NUTRIENT BALANCE BASED ON ANNUAL CROP UPTAKE RATES

Minimum Area required with zero buffer

Nitrogen	252	m^2
Phosphorus	342	m^2

Determination of Buffer Zone Size for the Nominated Land Application Area (LAA)

Nominated LAA Size	380	m^2
Predicted N Export from LAA	-3.19	kg/year
Predicted P Export from LAA	-0.35	kg/year
Phosphorous Longevity of LAA	59	Years
Minimum Buffer Required for excess nutrient	0	m^2

PHOSPHORUS BALANCE

Nominated LAA Size	380	m^2			
Daily P load	0.009	kg/day	→	Phosphorus generated over life of system	157.680 kg
Daily Uptake	0.003	kg/day	→	Phosphorus vegetative uptake for lilfe of system	0.150 kg/m^2
Measured p-sorption capacity	0.622	kg/m^2			
Assumed p-sorption capacity	0.311	kg/m^2	→	Phosphorus absorbed in 50 years	0.311 kg/m^2
Site p-sorption capcaity	118.104	kg	→	Desired Annual P Application Rate	3.502 kg/year
				which equals	0.010 kg/day
P-load to be sorbed	2.014	kg/year			