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On-Site Wastewater Management Feasibility Assessment

Proposed Rural Residential Subdivision at Lot 41 DP 1084516, Springrove Road, Springrove

For:	S. Dougherty
Report No:	16036_ww.docx
Date:	17 September 2015

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Revision summary	

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1. INTRODUCTION

Greg Alderson and Associates have been commissioned by Newton Denny Chapelle on behalf of Simon Dougherty to prepare an on-site wastewater management feasibility report to assist Richmond Valley Council in assessing a development application for a proposed subdivision of Lot 41 DP 1084516, Springrove Road, Springrove. The report describes the site, the tests and calculations undertaken to determine if wastewater management is feasible for the proposed new allotments.

The onsite wastewater management systems modelled in this report are representative of a 'worst case scenario'.

This is to ensure that the proposed dwelling envelopes within each allotment are not restrictive to wastewater management and can support wastewater management systems without causing unacceptable risk to human health and the environment.

1.1. Scope of Investigation and Assessment

A field investigation was undertaken to identify site constraints, map soil profiles and determine potential restrictions of the management of wastewater.

In order to determine the potential of the proposed subdivision at the site, the assessment was modelled using the Lismore Council's Wastewater Model (2013) as it is understood that Richmond Valley Council permits the use of this model, as it was based on the original Richmond –Tweed Strategy model in accordance with RVC wastewater management strategy (2001).

The report is based on the potential of the site accommodating 5 people and the following factors:

- 5 people;
- Duplex soil types;
- Five person dwelling;
- AWTS secondary treatment, 20% nitrogen removal;
- Subsurface Irrigation field for disposal;
- Light clays.

The use of secondary treatment and subsurface irrigation is discussed in more detail later in the report, however the use of this management is due to the duplex soil type and requiring a larger dispersal area therefore allowing for a conservative sizing.

1.2. Site Constraints

The following constraints are presented at the site:

- Flood prone land to the south, (but this is not part of the rural residential area);
- Duplex soils, shallow loam (variable depth of 300 mm to 600 mm) over light clays; and
- Setback to dam, gullies and licensed ground water bores

2. SITE DESCRIPTION

The subject property is approximately 43 ha in area, however the proposed rural residential area is about 17 ha as presented on the plan by Newton Denny Chapelle 07/684 (date 7 June, 2015). The rural residential area is within the higher portion of the site, with elevations ranging from approximately 36m AHD to 25 m AHD, and generally consists of the flood free areas of the site. The rural residential area consists of a knoll towards the centre of the area, which the site gently slopes away from in each direction, and a small saddle exists in the south west portion of the site.

The rural residential area contains a dwelling (dilapidated), cattle yards and remnants of previous buildings were observed (probably dairy bails and piggery).

A small dam is located in the north western portion of the site, however no other sensitive locations were observed in the rural residential area.

Exhibit No. 1 shows the entire property and **Exhibit No. 2** presents dwelling site locations.

2.1. Vegetation

The site is grazed by cattle and consists of pasture grasses with the occasional scattered paddock tree. The trees do not pose a problem to wastewater management as it would be expected that suitable area will be provided for wastewater that does not require the removal of vegetation.

2.2. Slope

The rural residential area of the site has a gentle gradient of less than 15% and therefore this does not pose a problem for wastewater management.

2.3. Aspect

The aspect of each of the allotment varies due to the knoll being approximately centre to the proposed rural residential area. The aspect is not considered to be a restriction at the site due to the gentle gradient and unrestricted areas that can manage wastewater.

2.4. Geology and Soil

The rural residential area is located on the Grafton Formation, consisting of sandstone, siltstone, claystone, coal, tertiary gravels (gravel, sand, sandstone and greybilly) Morand (1994). Morand (1994) presents that the majority of the proposed rural site is on the Soil Landscape Yorklea variant ‘a’, with a section along the western boundary and within the larger rural allotment being on the Leyceter Soil Landscape.

The Great Soil Group mapping aligns with the landscapes mapped by Morand, with the Yellow Earths covering the majority of the Yorklea ‘a’ soil landscape and Black Earths covering the Leycester Soil Landscape. The Great Soil Group and soil landscape mapping are presented in Figure 1 and 2 below.

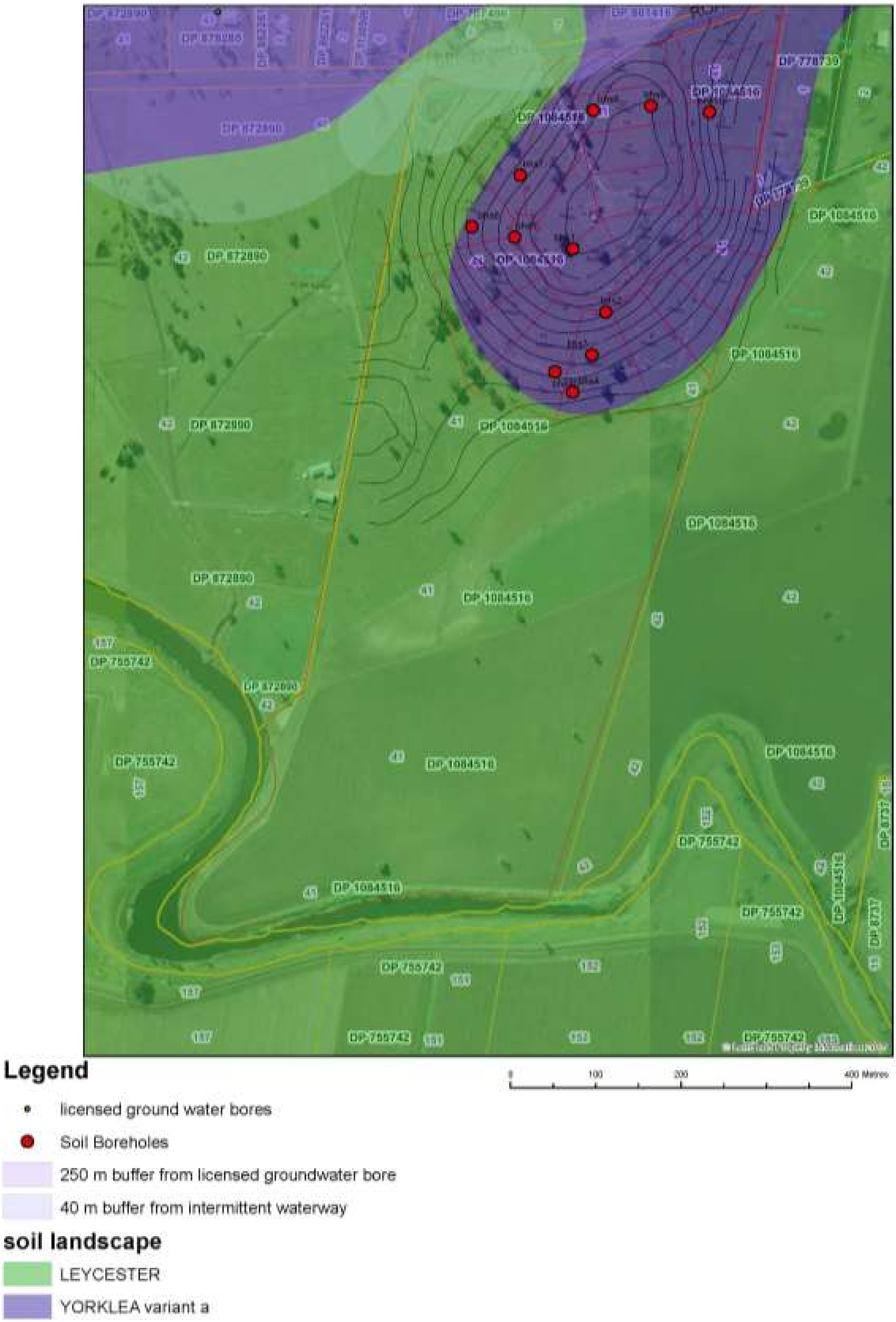

Figure 1: Soil Landscapes of Subject Site

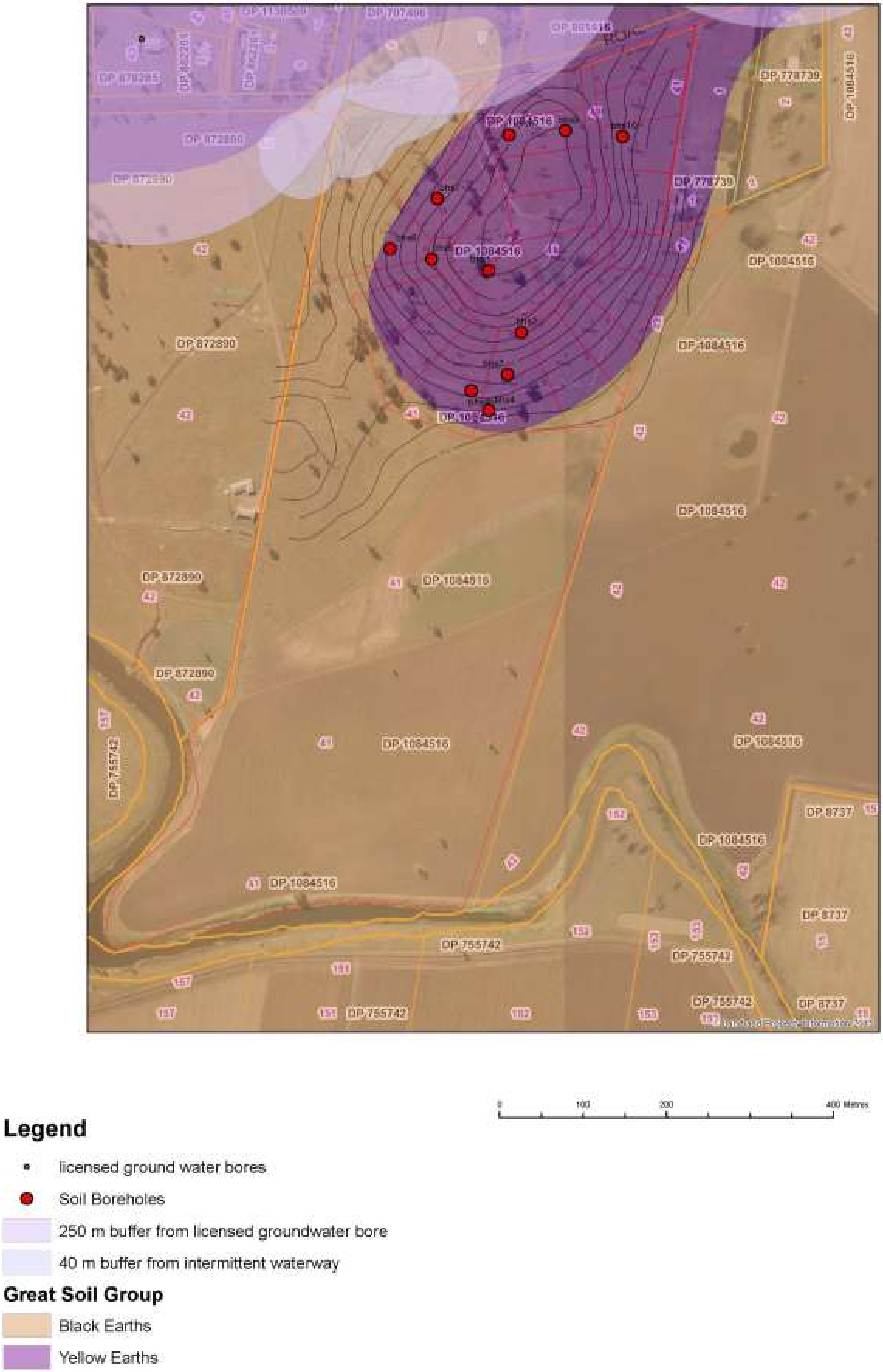

Figure 2: Great Soil Groups of Subject Site

The Yorklea variant 'a' soil landscape is summarised as follows (from Morand, 1994):

Soils:	Moderately well drained yellow earths on crests
Variant a:	Extremely to very low relief (2-10 m) slopes 2-5%
Limitations:	highly erodible, hardsetting, dispersible, slowly permeable, seasonaly water logged soils of low fertility
Permeability:	moderate to high in topsoil and slow in subsoil.

The Leycester soil landscape is summarised as follows (from Morand, 1994):

Soils:	Deep (>200cm) poorly to moderately well drained alluvial black earths
Limitations:	moderately erodible, moderately plastic soils with low wet bearing strength, moderate shrink swell and localised waterlogging, flooding and stream bank erosion
Permeability:	moderate in topsoil and slow to moderate in subsoil.

Borelogs were assessed at the site within the rural residential area as presented on Figure 1 and Figure 2. The soils generally consist of loams overlying medium clay soils. Shallow loam soils were located towards the north of the site, whilst deep loam soils were observed to the south, however, a moist layer was intersected between the loam and clay interface in one borelog to the south, most possibly due to percolation of rainwater through the profile and running along the clay subsoil.

The soils of the site were investigated using a mechanical hand auger to a depth of 1000 mm. The following tables present the borehole logs undertaken at the site.

Table 1: Borehole 1 borelog

		SOIL DESCRIPTION					
Horizon	**Depth (mm)**	**Texture**	**Structure**	**Colour**	**Coarse Fragments**	**Soil pH**	**Dispersive Class**
	0					5.0-5.5	
		Sandy loam	Single grained, earthy. Loose when exposed	dark brown	None observed	(Morand, 1994)	Not dispersive
	100						
	200						
	300						
	400	Medium clay	Moderate structure	Brown with red/orange mottles			Dispersive
	500						
	600						
	700						
	800						
	900						
	1000						

Table 2: Borehole 2 borelog

		SOIL DESCRIPTION					
Horizon	**Depth (mm)**	**Texture**	**Structure**	**Colour**	**Coarse Fragments**	**Soil pH**	**Dispersive Class**
	0					5.0-5.5	
		Sandy loam	Single grained, earthy. Loose when exposed	dark brown	None observed	(Morand, 1994)	Not dispersive
	100						
	200						
	300						
	400	Medium clay	Moderate structure	Brown with red/orange mottles	Some small fragments		Dispersive
	500						
	600						
	700						
	800						
	900						
	1000						

Table 3: Borehole 3 borelog

		SOIL DESCRIPTION					
Horizon	**Depth (mm)**	**Texture**	**Structure**	**Colour**	**Coarse Fragments**	**Soil pH**	**Dispersive Class**
	0 100 200 300 400 500	Sandy loam	Single grained, earthy. Loose when exposed	dark brown	None observed	5.0-5.5 (Morand, 1994)	Not dispersive
	600 700 800 900 1000	Medium clay	Moderate structure	Brown with red/orange mottles			Dispersive

Table 4: Borehole 4 borelog

		SOIL DESCRIPTION					
Horizon	**Depth (mm)**	**Texture**	**Structure**	**Colour**	**Coarse Fragments**	**Soil pH**	**Dispersive Class**
	0 100 200 300 400 500 600	Sandy loam	Single grained, earthy. Loose when exposed	dark brown	None observed	5.0-5.5 (Morand, 1994)	Not dispersive
	700 800 900 1000	Medium clay	Moderate structure	Moist. Brown with red/orange mottles			Dispersive

Table 5: Borehole 5 borelog

		SOIL DESCRIPTION					
Horizon	**Depth (mm)**	**Texture**	**Structure**	**Colour**	**Coarse Fragments**	**Soil pH**	**Dispersive Class**
	0					5.0-5.5	
		Sandy	Single grained, earthy.	dark brown	None observed	(Morand,	Not dispersive
	100	loam	Loose when exposed			1994)	
	200						
	300						
	400						
		Medium	Moderate structure	Brown with			
	500	clay		red/orange			Dispersive
				mottles			
	600						
	700						
	800						
	900						
	1000						

Table 6: Borehole 5 borelog

		SOIL DESCRIPTION					
Horizon	**Depth (mm)**	**Texture**	**Structure**	**Colour**	**Coarse Fragments**	**Soil pH**	**Dispersive Class**
	0					5.0-5.5	
		Sandy	Single grained, earthy.	dark brown	None observed	(Morand,	Not dispersive
	100	loam	Loose when exposed			1994)	
	200						
	300	Medium	Moderate structure	Brown with			Dispersive
		clay		red/orange			
	400			mottles			
	500						
	600						
	700						
	800						
	900						
	1000						

Table 7: Borehole 7 borelog

		SOIL DESCRIPTION					
Horizon	**Depth (mm)**	**Texture**	**Structure**	**Colour**	**Coarse Fragments**	**Soil pH**	**Dispersive Class**
	0					5.0-5.5	
		Sandy loam	Single grained, earthy. Loose when exposed	dark brown	None observed	(Morand, 1994)	Not dispersive
	100						
	200						
	300						
	400						
	500						
	600	Medium clay	Moderate structure	Brown with red/orange mottles			Dispersive
	700						
	800						
	900						
	1000						

Table 8: Borehole 8 borelog

		SOIL DESCRIPTION					
Horizon	**Depth (mm)**	**Texture**	**Structure**	**Colour**	**Coarse Fragments**	**Soil pH**	**Dispersive Class**
	0					5.0-5.5	
		Sandy loam	Single grained, earthy. Loose when exposed	dark brown	None observed	(Morand, 1994)	Not dispersive
	100						
	200						
	300						
	400						
	500	Medium clay	Moderate structure	Brown with red/orange mottles			Dispersive
	600						
	700						
	800						
	900						
	1000						

Table 9: Borehole 9 borelog

		SOIL DESCRIPTION					
Horizon	**Depth (mm)**	**Texture**	**Structure**	**Colour**	**Coarse Fragments**	**Soil pH**	**Dispersive Class**
	0 100	Sandy loam	Single grained, earthy. Loose when exposed	dark brown	None observed	5.0-5.5 (Morand, 1994)	Not dispersive
	200 300 400 500 600 700 800 900 1000	Medium clay	Moderate structure	Brown with red/orange mottles			Dispersive

Table 10: Borehole 10 borelog

		SOIL DESCRIPTION					
Horizon	**Depth (mm)**	**Texture**	**Structure**	**Colour**	**Coarse Fragments**	**Soil pH**	**Dispersive Class**
	0 100	Sandy loam	Single grained, earthy. Loose when exposed	dark brown	None observed	5.0-5.5 (Morand, 1994)	Not dispersive
	200 300 400 500 600 700 800 900 1000	Medium clay	Moderate structure	Brown with red/orange mottles			Dispersive

The soil boreholes are representative of the Yorklea soil landscape (albeit the relief of the site is greater than that described under the variant ‘a’ description).

Using the Richmond Valley Council On-site Sewage Management Strategy (RVC-OSMS) the soil description and location indicate that the soil would be classified as Sandy Duplex Soils as described in Table 4 of RVC-OSMS. It is expected that the soil towards the western boundary will tend to have a reduced topsoil layer and contain more clay within the upper profile.

The soils of the site are generally restrictive to wastewater management due to the clay subsoils which have low permeability and are dispersive tendencies.

2.5. Flooding

It is understood that the recommended habitable floor level for the site is 20.1 m AHD, assuming the flood level is 19.6 m AHD. The flood level is below the proposed rural residential area and the disposal field area. There is adequate area available for suitable wastewater management fields above the flood line.

2.6. Sensitive Locations

The site contains a dam and gully in the north western corner. Groundwater bore details were provided from the National Groundwater Information System obtained from the Bureau of Meteorology. The closest licensed bores are located to the north of the subject site and no bores were located on the subject property.

A setback of 40 m was applied to the dam and gully, and 250 m setback from the ground water bores from the disposal area to ensure that adequate area is available for the management of wastewater from these sensitive locations. These buffers are presented in Figure 1 and Figure 2.

2.7. Site Constraints and Proposed Best Practice

The potential site constrains are the soil profile, consisting of duplex soils, shallow towards the north and deeper towards the south of the proposed rural residential area. However, these soils also are slightly acidic and the subsoils have dispersive tendencies. These soils are typical to the Richmond Valley Council LGA and hence typical amelioration measures can be applied as part of the construction of these disposal areas (as required for at the dwelling construction stage).

2.7.1. Soil acidity

Increased acidity affects cation exchange capacity and can lead to deficiencies in calcium and magnesium while mobilising aluminium, which is toxic to plant growth. Lime can be applied to the disposal field area at the time of constructing the individual wastewater management systems for the future dwellings. A recommended liming rate is suggested of 0.4 kg/m^2 to raise the pH by about 1pH unit, and this will enable plants to take up nutrients within the wastewater.

2.7.2. Dispersive Soils

The subsoils at the site are naturally dispersive and the application of wastewater which can contain sodium will further aid in the potential degradation of the soil profile, especially where evapotranspiration/absorption beds may be used. Gypsum is to be added to the soil also to prevent soil structure degradation at a rate of about 0.5 kg/m² over the disposal field area at the time of construction for the dwellings.

3. WASTEWATER MANAGEMENT

3.1. Introduction

For the purpose of determining that the sites are not restrictive to wastewater treatment and disposal, modelling of disposal areas is based on a theoretical five person dwelling. Furthermore, the wastewater management system modeled in this report will incorporate an AWTS for secondary treatment providing 20% nitrogen removal and a Sub Surface Irrigation (SSI) field for disposal. Generally the sites towards the northern section of the knoll are shallower soils which will require the use of subsurface irrigation, deeper soils were found at the south of the knoll within the rural residential area and in some areas it is possible that evapotranspiration/absorption beds could be utilised for disposal provided that more than primary treatment was achieved.

At this stage, no building envelopes have been nominated and hence it is possible that future dwellings can build in desired locations at the proposed site, subject to Council approval.

3.2. Volume of Effluent

Based on the Lismore On-Site Wastewater Management Model (single rural household) a household with standard water saving devices on roof water supply will use 140L/person/day. To allow for a conservative figure, 5 persons has been used for the modelling. Hence the modelled wastewater flow from the proposed sites will each be **700 L/day.**

3.3. Nutrient Loadings

The Environment and Health Protection Guidelines (1998) and Council’s Strategy requires wastewater disposal systems are to be designed on the most limiting factor of either hydraulic or nutrient loadings. The nutrients of concern include phosphorus and nitrogen.

3.3.1. Nitrogen

The expected chemical forms of nitrogen include ammonia, nitrite and nitrate. Although Nitrate is readily taken up by plants it is very mobile and will move through the soil profile and has the potential to leach to groundwater. A 20% nitrogen reduction has been calculated with the use of the AWTS, allowing the export of 15kg/year of nitrogen from each site (based on the Lismore model 2013).

Further reduction would be expected if the following passive systems were used at the site:

- Compost toilet;
- Subsurface flow wetland

These could achieve in excess of 50% TN reduction.

3.3.2. Phosphorous

The forms of phosphorous after treatment within the AWTS are orthophosphate, polyphosphate and organic phosphate. EPA (1995) state that the orthophosphates are available immediately for biophysical reactions in the soil/plant system, the availability of polyphosphates is limited by their hydrolysis which proceeds very slowly in most soils. Organic phosphates are broken down biologically to polyphosphates and then to orthophosphates. Phosphorous is removed from effluent through biological, chemical and physical process in soil with minor uptake by vegetation.

Further reduction would be expected if the following passive systems were used at the site:

- Compost toilet;
- Subsurface flow wetland

These would achieve in excess of 10% TP reduction.

3.4. Modelled Treatment of Wastewater

It is proposed that all wastewater from the modelled dwelling is collected for secondary treatment within an AWTS system with the disposal field being sub-surface drip irrigation. It is expected that future dwellings are most likely also going to require subsurface irrigation due to Council's requirements to design for the use of 5 people regardless of the number of bedrooms in the dwelling (above 4 bedrooms will require a design for more people). However, in the south eastern portion of the rural residential area where topsoils are deeper and where future dwellings, it is possible that passive wastewater management systems could be utilised consisting of evapotranspiration/absorption beds provided that secondary treatment was utilised.

4. ON-SITE DISPOSAL OF WASTEWATER

4.1. Disposal Area Calculation

In order to ascertain the size of the disposal area required for the theoretical dwellings, the model within the Lismore City Council On-Site Sewage and Wastewater Management Strategy was used, as it is understood that Richmond Valley Council accepts the use of this model, which takes into account the allotment size for the management of nutrients. This model determines the required area in accordance to the most limiting factor, being nitrogen, phosphorous or hydraulic loadings.

The sites have been modeled based on the site characteristics which will affect the sizing of the disposal field based on nitrogen loading, being the land area and proximity to the gullies.

The smallest proposed lot size is 5000 m² at the site and this size has been used to determine the potential disposal area required. The following parameters have been used to size typical disposal fields required, and hence determine the adequacy of the proposed subdivision layout:

- 5 people
- 5000 m^2
- Roof water (140L/person/day)
- AWTS (20%) treatment
- Conservative 3m to water table
- weakly structured light clays (used due to the loam topsoil at the site)
- Duplex soils

- Subsurface irrigation
- Generic setbacks

The area required for each of the loadings is as follows:

Area Required for Phosphorous: 61.9 m^2
Area Required for Nitrogen: 89.3 m^2
Area Required for Hydraulics: 457.6 m^2

It ETA beds were used with secondary treatment, three ETA beds each at 17 m long and 2 m wide could be utilised in areas where a minimum of 600 mm of loam soil is provided.

4.2. Disposal Areas

The proposed layout is suitable for wastewater management on each of the allotments which caters for setbacks to boundaries, drainage lines and dam and groundwater bores. **Exhibit No. 2** presents the possible locations of wastewater areas on the smaller allotments, 1000 m^2 has been used to allow for the 100% reserve area.

Although soil was moist at the interface between the sandy loam and clay layers at the southern portion of the site, it is not considered that this will be a restriction for wastewater management on these allotments, as this was not considered to be groundwater and subsurface irrigation would be recommended on these allotments.

4.3. Maintenance

The chosen system for the future dwelling may require a service contract depending on which treatment system (eg. AWTS) is utilised and a maintenance program will be required for the specific wastewater management system adopted.

5. CONCLUSION

It is proposed that a 23 lot, Torrens title, rural residential subdivision will be created from Lot 41 DP 1084516, Springrove Road, Springrove which will require on-site wastewater management for each of the proposed allotments.

The site was assessed to determine site constraints based on sensitive areas, topography and soil type and it was found that the soil type at the property creates the largest constraint, as all setback distances to sensitive locations can be achieved, and the site has a gentle gradient suitable for wastewater management. The soil type varies from relatively shallow loam soils to the north of the site to deeper topsoils at the south of the site, however soils were moist at the interface between the sandy loam and clay layer.

The subdivision layout proposed by Newton Denny Chapelle (07/684 date 7 June, 2015) provides for suitably sized allotments to accommodate wastewater management for future dwellings, with wastewater management systems most likely comprising of Aerated Wastewater Treatment Systems and subsurface irrigation areas due to the soil type. These systems are common with the Richmond Valley LGA due to the dominance of duplex soil types and Council's requirement to design on 5 people. It is possible however, that passive wastewater management systems, consisting of reed beds and evapotranspiration/absorption beds could also be used at the site where the soil depth is suitable. As with the majority of soils within the Richmond Valley LGA, amelioration measures are recommended, consisting of using lime and gypsum within the disposal field areas at the time of construction of the dwellings.

It is concluded that the subdivision layout is suitable to achieve wastewater management from the future allotments with little impact to the surrounding environment and human health.

6. References

Australian Standard AS 1547 - 2012 *Disposal Systems for Effluent from Domestic Premises.*

Environment Protection Authority, Dept. of Local Government, Department of Land & Water Conservation and NSW Department of Health (1998). *Environment and Health Protection Guidelines - On-Site Wastewater Management Systems for Domestic Households*.

Lismore City Council (2013). *On-Site Sewage and Wastewater Management Strategy*. Lismore City Council Planning and Development Group.

Morand, D.T. (1994). *Soil Landscapes of the Lismore - Ballina 1:100,000 Sheet* Map, Soil Conservation Service of NSW, Sydney.

Richmond Valley Council (2001) *On-Site Sewage & Wastewater Management Strategy*

End of Report

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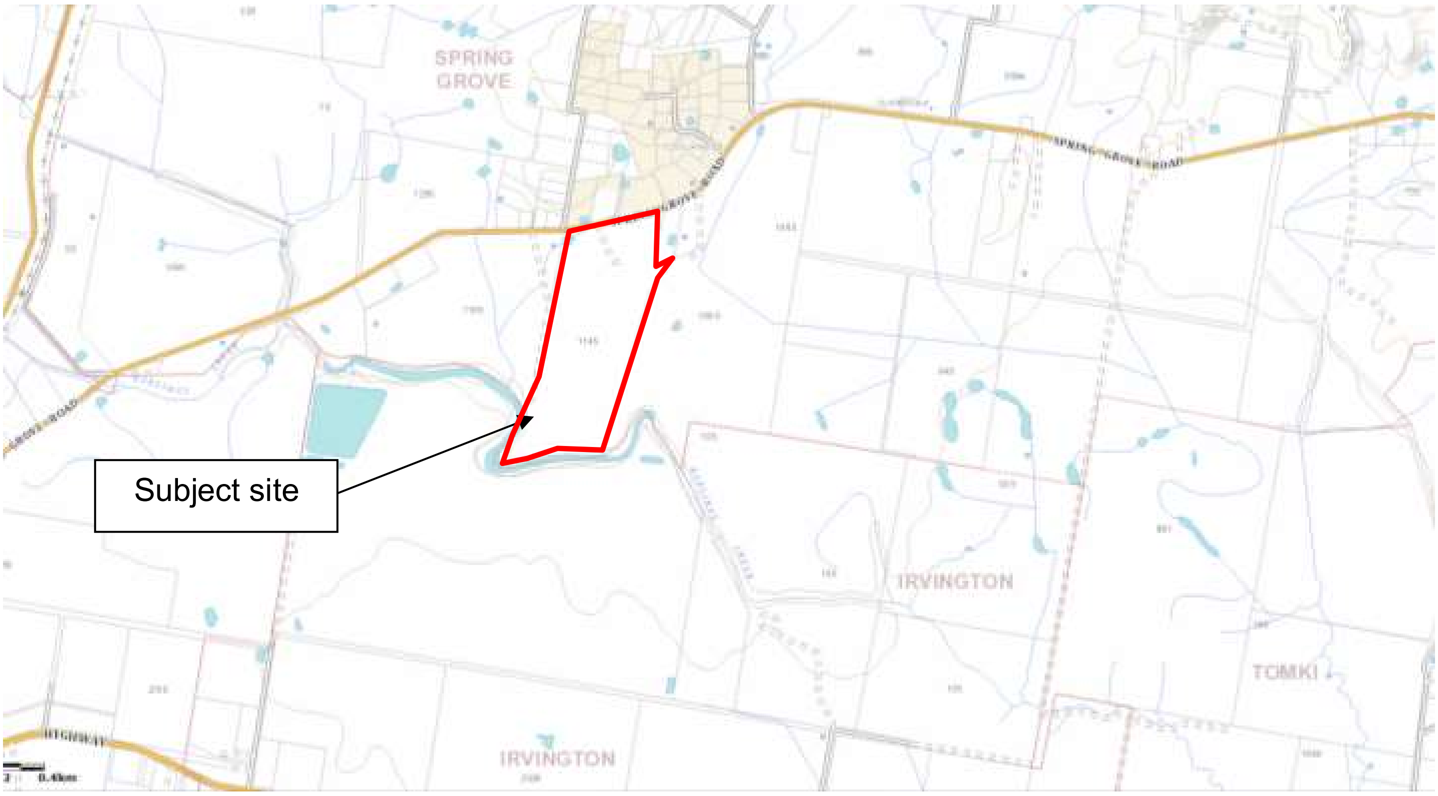
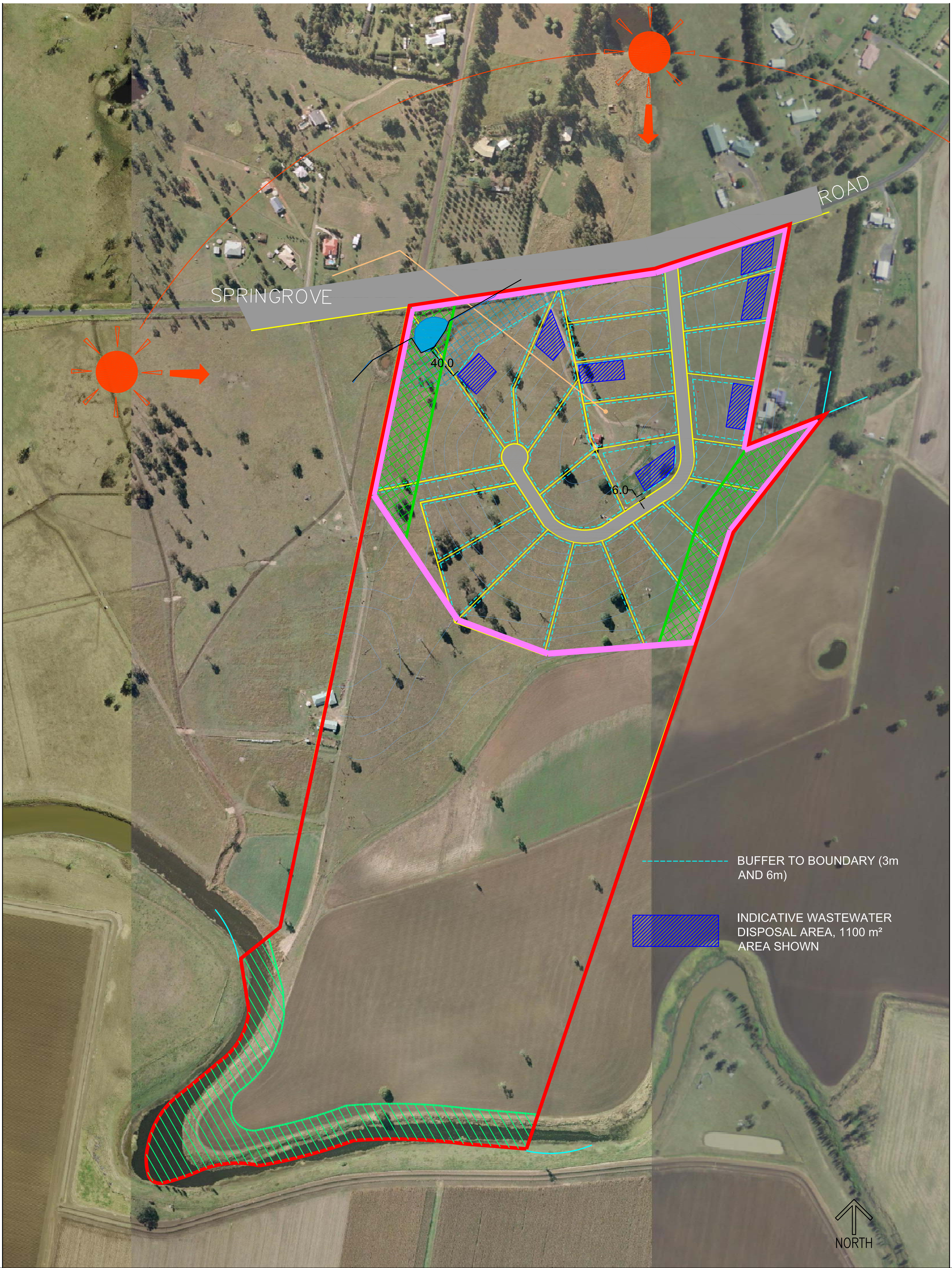


Source: NSW LPI Spatial Information Exchange (2014) Date Project No. 15305_ww Scale: NTS	**GREG ALDERSON AND ASSOCIATES** **ABN 58 594 160 789** 133 Scarrabelottis Road Nashua NSW 2479 Phone: (02) 6629 1552 Email: office@aldersonassociates.com.au	**Exhibit No. 1.** **SITE LOCATION** Lot 41 DP 1084516, Springrove Road, Springrove



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Tab: SITE PLAN

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NEWTON DENNY CHAPELLE

Site address:
Lot 41 DP 1084516
SPINGROVE ROAD, SPRINGROVE

WASTEWATER MANAGEMENT LAYOUT

Drawn: WA	Source: NEWTON DENNY CHAPELLE 07/684	EXHIBIT NO: 2	Date: 25-9-15
Scale: 1:300 at A3	Original Size: A3	Project: PROPOSED SUBDIVISION	Revision: 0
Job Number: 16004	Drawing Number: 16036-aerial_coord mga56.dwg		

Lismore CC On-site Wastewater Model (Single Rural Households) OSmodel300614.xls
Printed 29-9-2015

		Default	User-defined
Client			
Address			
Site	Block size (m2)		5000
	Buffer (m) from land application area to: gully	>40	
	Water (L/p.d) from: Roof water harvesting	140	
	Persons		5
	☐ Internal wastewater sources split? ☐ Multiple households? How many?		
Wastewater components per system	Toilet ☑		
	Bathroom ☑		
	Laundry ☑		
	Kitchen ☑		
	Total wastewater flow (L/d) [needs caution if user-defined]	700	
Treatment system	Secondary: AWTS		
	Nitrogen removal %	20%	
Land application	Land application type: Subsurface drip irrigation	Slope%	
	Design depth of root zone (mm)	300	
Soil information	Morand code: Duplex Soils = ba, cc, ck, cl, mi, ni		
	Phosphorus sorption (kg/ha.m)	8000	
	Depth to water table or bedrock (for P calcs) (m)		3
	Texture/structure: Light clays - weak. structured or massive		
	Maximum deep drainage rate (mm/d) 3		
Area calculations	Hydraulic area (m2)	457.6	
	Nitr. area (m2) [N perc.granted/plant.avail:11.65 / 13.44kg/yr]	89.3	
	Phos. area (m2)	61.9	
	Required land application area (m2)	**457.6**	