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Job: Proposed Residence
149 McCartin Street
Leongatha

Client: Glenda Marshman

Checked:

Date: 1 June 2015

Designed: SJA

Job No.: 355577

LAND CAPABILITY ASSESSMENT ON-SITE DOMESTIC WASTEWATER

149 McCartin Street, Leongatha

1.0 INTRODUCTION

Simon Anderson Consultants were engaged to undertake a land capability assessment for the purpose of on-site domestic wastewater management of the Proposed Residence at 149 McCartin Street, Leongatha. The field investigation and report have been undertaken by suitable experienced staff.

The assessment was completed in accordance with the Environment Protection Authority's *Code of Practice – Onsite Wastewater Management* (EPA Publication No. 891.3, Feb 2013), guidelines for *Land Capability Assessment For On-Site Wastewater Management* (EPA Publication No. 746.1, March 2003), and *On-Site Domestic Wastewater Management* (AS/NZS 1547:2012).

Information and results are presented in table form for clear data presentation and ease of identification of key points. **Detailed recommendations presented on page 7 of the report. LCA is to be read in conjunction with Site Features Plan 355577-LC1.**

Subject Land	149 McCartin Street, Leongatha
Client	Glenda Marshman
Postal Address	155 McCartin Street, Leongatha, Victoria 3953
Contact	Mobile: 0427 622 811
Map Reference	Vicroads 710 B11
Municipality	South Gippsland Shire Council
Proposed Development	3 Bedroom Residence (Potential Occupancy = No. of Bedrooms + 1)[1]
Design Flow	150 L/person/day [2] (for reticulated water supply and full water reduction fixtures)
Anticipated Wastewater Load	600 L/day
Treatment System Required	Secondary treated effluent to minimum 20/30 standard (ie. AWTS[3] or sand filter)
Disposal System Required	Sub-surface irrigation – Area of 260m²

[1] *As identified in Victorian EPA Draft Code of Practice – Onsite Wastewater Management (publication 891.3, Feb 2013) Section 3.4.1*
[2] *As identified in Victorian EPA Draft Code of Practice – Onsite Wastewater Management (publication 891.3, Feb 2013) Table 4*
[3] AWTS – Aerated Wastewater Treatment System (EPA approved)

2.0 PURPOSE/SCOPE OF ASSESSMENT

Purpose and Scope of Assessment	Broad-scale assessment for subdivisional purposes (often requires further lot-specific assessment at later date)	☐
	Detailed investigation for lot-specific management requirements	☒

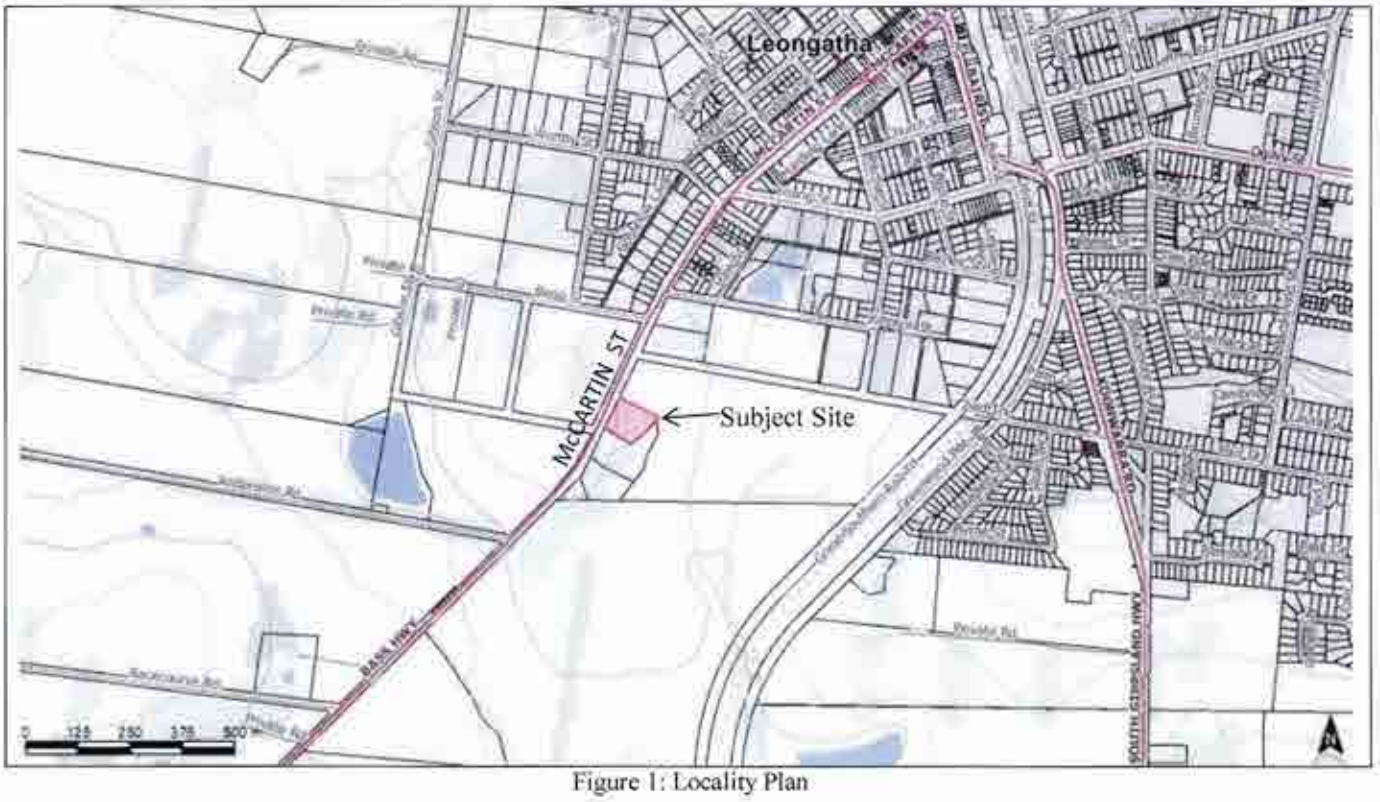

Figure 1: Locality Plan

Figure 2: Aerial view of subject site (approximate title boundaries shown)

3.0 SITE KEY FEATURES

Criteria / Feature	Description	Implications for Wastewater Management
Allotment/s		
Title details	Lot 3, PS634639, Council Property No:201589 (Part)	
No. of Lots Proposed	1	
Lot size (EPA recommended minimum lot size = 1.0 ha)	7846m²	Relatively small allotment, far less than the EPA recommended 1.0 ha. Will require well managed and designed disposal system (refer to criteria outlined in Recommendations)
Dwelling Usage	Likely to be permanent	
Adjoining Lot sizes	Rural lots varying from 1.17ha – 21.97 ha in size.	Overall volume of wastewater being disposed to land in the local district is low.
Current Land Use	Vacant	Current Wastewater generation is negligible
Infrastructure		
Zoning & Overlays	Farming Zone (FZ) Environ. Significance Overlay - Schedule 5 (ES05)	
Nearest Reticulated Sewer	Township of Leongatha	Not feasible to connect to reticulated sewer. The area is unlikely to be sewered in the short to medium term future.
Reticulated Water	Available on existing allotment	Increases the risk of excessive water usage by future dwellings.
Power	Available on existing allotment	Allows ready use of wastewater treatment plant
Land Features		
Geology	-Po (Pvo) Palaeogene (Igneous) deposits consisting of Extrusive: tholeiitic and minor alkaline basalts. (from 1:250,000 Geological Map Series WARRAGUL)	Observed Soils dominated by silty clay loams to a depth of 1.5m +
Elevation	Approx 60m AHD	
Landscape Elements	The site is situated midslope (Linear Planar) on a rolling low hill system, with a red ferrosol basaltic landscape.	Natural drainage becomes less effective with distance from the crest, with no spreading or acceleration
Fill	Natural soil profiles were observed throughout the site. No fill was observed.	No filling is proposed in the effluent management area.
Aspect	Area of investigation slopes to the East	Increases sun exposure for improved efficiency of effluent disposal fields
River/Stream Catchment	No creeks or waterways in allotment. A waterway is situated approximately 100m east of the subject site (refer aerial photo, fig. 2) Subject site located within declared water supply catchment zone (Tarwin River (Meeniyan))	Necessary setbacks are easily achieved with higher level of effluent treatment (ie. secondary treated)
Dams/Surface Water	A small agricultural dam is situated in adjoining lot	Necessary setbacks are easily achieved
Rock Outcrop	None	Reduces limitations and maximises efficiency of effluent disposal fields
Erosion	No evidence of sheet or rill erosion.	The erosion hazard is low.
Vegetation	Grass/Pasture	No vegetation clearing required for establishment of effluent disposal field or dwelling development
Climate	Temperate	Reduces variation in efficiency of effluent field
Solar Exposure	High. Minimum shading based on vegetation on the proposed boundaries only.	Maximises efficiency of effluent disposal fields
Recommended Buffer Distances	All buffer distances recommended in Table 5 of EPA Publication 891.3, (Feb 2013) are achievable and do not significantly limit siting of the LAA in this case	
Available Land Application Area (LAA)	Considering all site constraints and the buffers mentioned above, the site has ample land that is suitable and available for land application of treated effluent.	By using a system that provides secondary treatment and pressurized sub-surface irrigation, there will be ample protection for surface and groundwater

4.0 SOIL ASSESSMENT & CONSTRAINTS

The sites soils have been assessed for their suitability for onsite wastewater management by a combination of soil survey and desktop review of published soil survey information as outlined below.

4.1 Published Soils Information

Soils of the site have been mapped and described in Department of Environment and Primary Industries *"Soils and Landforms of West Gippsland – Sale 1:100 000 map sheet"* and are described as belonging to the Warragul (Wg) map unit. This unit occurs on rolling low hills and is comprised of Mid-Tertiary basalts commonly called "Older Volcanics".

Most of the soils have a dark reddish brown or dark brown very friable clay loam surface grading into red or brownish red crumbly clay loam or light clay at about 20 to 40cm. Textures generally increase to medium clay at about 1m. In the deeper subsoil (between 1m and 1.8m) the soil may remain red, or be mottled red, brown and brownish yellow. The soils are generally classified as Red Ferrosols using the Australian Soil Classification.

FERROSOLS: Soil Order of the Australian Soil Classification (Isbell, 2002). These soils lack strong texture contrast between the A and B horizons. The B2 horizon has structure more developed than weak **and** a fine earth fraction which has a free iron oxide content greater than 5% (as opposed to a Dermosol).

Road cutting - Leongatha →

4.2 Soil Survey and Analysis

A Soil survey was carried out at the site to determine suitability for application of treated effluent. Subsoil investigations were conducted at two locations in the vicinity of the proposed building, as shown on the Site Features Plan, using a hand auger (B1-2). This was sufficient to adequately characterise the soils, as only minor variation would be expected throughout the area of interest.

Samples of all discrete soil layers for test bore 1 were collected for subsequent laboratory analysis of pH[4], electrical conductivity[5] and Emerson Aggregate Class[6]. The soil profile of bore 2 is detailed below.

	Depth (m)	Description	Horizon
	0.0 0.1	**TOPSOIL:** Red/Brown, Moist, Loamy	A1
	0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.5+	**SILT:** Dark Red, Moist, Dense, Clayey	B1

[4] *The pH of 1:5 soil/water suspensions was measured using a Merck pH strip*
[5] *EC (dS m^{-1}) was calculated by measuring the electrical conductivity of 1:5 soil water suspension.*
[6] *Appendix C shows photographic results of Emerson Aggregate Test (Slaking/Dispersion)*

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Soil Horizon	A1	B1
Depth (mm)	0-200	200+
Field Texture Grade[7]	ZCL	ZCL
Structure	Moderate	Massive
pH	7	7
EC (dS m^{-1})	0.02	0.04
Salinity Hazard	Non-Saline	Non-Saline
Dominant Colour	5YR 4/4 Reddish Brown	2.5 YR 3/6 Dark Red
Mottles	0	0
Dispersion	5	5
Coarse Fragments (% Volume)	0	0
Soil Category[8] (AS/NZ1547:2012)	**4a**	**4c**
Design Irrigation Rate[9] (DIR mm/day)	3.5	3.5
Design Loading Rate[10] (DLR mm/day)	4	4

NA: Not Applicable NR: Not Recommended

Depth (m)	Description	Horizon
0.0 0.1	**TOPSOIL:** Moist, Loamy	**A1**
0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.2 1.5+	**SILT:** Moist, Dense, Clayey	**B1**

Soil Bore Log Profile

Test Pit TP1

[7] *Refer Appendix D for description details(all soil samples have been sieved to minus 2mm and air-dried before being analized)*
[8] *As identified in Victorian EPA Code of Practice – Onsite Wastewater Management (publication 891.3, Feb 2013) Appendix A, Table 9*
[9] *For sub-surface irrigation (Refer Table M1 of AS/NZS 1547:2012)*
[10] *For absorption trenches/beds*

5.0 LAND CAPABILTY ASSESSMENT MATRIX

Land features	Land capability class rating				
	Very good (1)	Good (2)	Fair (3)	Poor (4)	Very Poor (5)
General characteristics					
Site drainage	No visible signs of dampness	Moist soil, but no water in pit		Visible signs of dampness	Water ponding on surface
Runoff	None	Low	Moderate	High - diversionary structures req'd	Very High - diversion not practical
Flood/inundation potential (yearly return exceedence)	Never		< 1 in 100	< 1 in 30	> 1 in 20
Proximity to watercourses	> 60m				< 60m
Slope (%)	0 - 2	2 - 8	8 - 12	12 - 20	> 20
Landslip	None Evident		Low potential for failure	High potential for failure	Present or past failure
Seasonal water table depth (m) (incl. purched water tables)	>5	5 - 2.5	2.5 - 2.0	2.0 - 1.5	< 1.5
Rock Outcrop (% of land surface containing rocks > 200mm)	0	< 10%	10-20%	20-50%	>50%
Vegetation Type	Turf or pasture				Dense forest with little understorey
Average Rainfall (mm/yr)	< 450	450 - 650	650 - 750	750 - 1000	> 1000
Pan Evaporation (mm/yr)	> 1500	1250 - 1500	1000 - 1250	-	< 1000
Fill	No Fill		Fill present		
Soil profile characteristics*					
Structure	High	Moderate	Weak	Massive	Single Grained
Profile depth (of limiting Horizon B1)	> 2.0m	1.5m - 2.0m	1.5m - 1.0m	1.0m - 0.5m	<0.5m
Soil permeability category[11]	2 and 3	4		5	1 and 6
Presence of mottling	None				Extensive
Coarse Fragments (% volume)	<10	10-20	20-40		>40
pH	6 - 8		4.5 - 6		<4.5, >8
Emerson Aggregate Test (dispersion/slaking)	4, 6, 8	5	7	2, 3	1
Salinity (dS/m) (Electrical Conductivity)	<0.3	0.3 - 0.8	0.8 - 2	2 - 4	>4
Overall Site Rating[12]			**Fair**		3

* relevant to the sites most restrictive soil layer(s)

[11] *Refer Table 5.1 (Determination of Soil Category) of AS/NZS 1547:2012*
[12] *A description of each Land Capability Class Rating is provided in Appendix A.*

6.0 CONCLUSION

This LCA has been prepared to accompany a development application to South Gippsland Shire Council for a Proposed Residence and associated necessary wastewater management system. As such, this report provides recommendations for treatment and land application systems that are appropriate to the land capability.

The following section provides an overview of a suitable system, with sizing and design considerations. **Detailed design for the system is beyond the scope of this study, but should be undertaken at the time of building application and submitted to Council.**

7.0 RECOMMENDATIONS

It is recommended based on this LCA, that if the development of a Proposed Residence on 149 McCartin Street, at the location indicated on the Site Features Plan 355577 - LC1:

- Install a system that provides secondary treatment with disinfection to meet EPA requirements for irrigation. Indicative target effluent quality is a minimum EPA standard 20mg/L BOD and 30mg/L SS. Suitable options are available, including aerated wastewater treatment systems (AWTS). Final selection is the responsibility of the property owner, who will forward details to Council for approval.

- On-site disposal of domestic wastewater should occur within the proposed Land Application Area (refer Site Features Plan 355577 - LC1). The client is allowed flexibility in selecting the final location and configuration of the irrigation system, provided it remains within this envelope and in accordance with the relevant codes/standards.

- Calculation of Irrigation Area based on AS/NZ 1547 equation $A = Q/DIR$
  - Q – 600 L/day;
  - DIR – 3.5 mm/day;
  - Irrigation Area – 172 m^2

- To determine if the irrigation area recommended above is adequate, a water balance[11] modelling has been undertaken to achieve a maximum wet weather storage depth of less than 50mm. The calculations are summarized below, with full details in Appendix B.
  - Average daily effluent load – 600 L
  - Design irrigation rate (DIR) – 3.5mm/day;
  - Crop factor – 0.6 to 0.85; and
  - Retained Rainfall – 75%.
  - **Irrigation Area – 260m^2**
  - Max Wet Weather Storage Depth – 47mm (therefor area shown in bold to be adopted)

- Minimum setbacks and buffer distances must be obtained when establishing effluent disposal envelopes, as per *EPA Code of Practice – Onsite Wastewater Management, publication 891.3, (Feb 2013).*

- The owner shall consult an irrigation expert familiar with wastewater irrigation equipment, to help design and install the irrigation system. The irrigation plan must ensure good, even application of effluent.

[11] *Water Balance undertaken in accordance with EPA Publication 168 (1991), Guidelines for Wastewater Irrigation.*

8.0 MANAGEMENT PROGRAM

8.1 Installation Issues

To ensure the satisfactory installation and operation of the AWTS and sub surface irrigation, the following measures are to be implemented:

- Construction of a shallow table or cut-off drain along the high sides of the effluent disposal area, extending to below the effluent disposal field;
- Overflow from any water storage tanks to be directed into a table drain, or equivalent, to discharge below the effluent disposal field in a manner to avoid scouring or washing away downstream of the discharge point;
- Stormwater flows from the roof must be discharged at a point well clear of the effluent disposal field and runoff from paved surfaces and driveways must be directed away from the disposal site;
- Installation of the sub-surface irrigation system to be undertaken when the soils are dry or moist, not when the ground is saturated;
- Sub-surface irrigation system to be designed to minimise root intrusion from trees;
- Sub-surface irrigation system to utilise pressure dosing to ensure effluent is applied uniformly throughout the effluent disposal area.

8.2 Ongoing Management & Maintenance Issues

To ensure the satisfactory ongoing performance of the proposed AWTS and sub surface irrigation, the owners/occupiers will need to ensure that:

- No buildings or impermeable surfaces are constructed on or over the effluent disposal areas;
- Heavy equipment is kept away from effluent disposal areas whilst the soil is saturated;
- The primary effluent disposal field is maintained as a grassed area, or planted out with shrubs that tolerate wet conditions, have high evapo-transpiration capacity and can tolerate phosphorus levels typically found in treated effluent;
- Trees and/or thick shrubs **are not** to be planted out along the northern or western edges of the effluent disposal areas to prevent exposure to both wind and sun .

The installer of the AWTS and sub surface irrigation is to ensure that the owners/occupants are aware of and fully understand their responsibilities in relation to operating the treatment system, maintenance requirements and what should be done in the event of any problems. The satisfactory ongoing performance and longevity of the AWTS and sub surface irrigation can be enhanced by:

- Ensuring that maintenance requirements are undertaken regularly in accordance with the systems' requirements and that both they and future owners/occupiers are aware of the systems capabilities, limitations and ongoing requirements;
- Using biodegradable soaps, low phosphorous detergents and detergents that have low salt, sodium and chlorine levels;
- Limiting the use of germicides (such as strong detergents, disinfectants, toilet cleaners, whiteners and bleaches);
- Not flushing disposable nappies, sanitary napkins or other hygiene products into the systems;
- Not flushing chemicals, paint or similar substances into the systems.

NOTE: This report and associated plan(s) does not constitute a Septic Tank Permit. Such a permit should be obtained separately from the Environmental Health Department of South Gippsland Shire Council after development approval is obtained and prior to plumbing works commencing.

APPENDIX A

Capability Class	Degree of Limitation	General Description
Rating 1	None to Very Slight	The proposed subdivision is suitable for on-site disposal of septic tank discharge. The limitations or environmental hazard from long-term use are considered very slight. Standard performance measures for design, installation and management should prove satisfactory.
Rating 2	Slight	The site has been identified as generally suitable for on-site effluent disposal but there is a slight associated environmental hazard expected. One or more land limitations are present, which may not be compatible with 'straight forward' conventional on-site disposal. The wastewater management program will require careful planning, adherence to specifications and adequate supervision.
Rating 3	Moderate	The site has only a fair capability for on-site effluent disposal with a moderate associated environmental risk always present. Very careful site selection, preparation and specialized design will be required to address the identified land constraints. A management program should be delivered to the responsible authority with the development application and prior to earthworks commencing. It is recommended that, in order to achieve BPEM, wastewater-processing systems which can attain a higher level of treatment with basic monitoring should be considered as an alternative to standard conventional trench disposal.
Rating 4	High	Areas have a poor capability rating with a high associated environmental risk. Considerable difficulties are expected during siting and installation of the wastewater treatment system and during routine operation. A very high Engineering input and close supervision would be needed to minimize the environmental impact. Alternative wastewater processing systems capable of consistently producing a high quality secondary effluent (such as aerated wastewater treatment plants) together with a close monitoring program should be seriously investigated and adopted.
Rating 5	Severe	Areas have a very poor capability and there is severe associated environmental risk. The areas are not generally considered suitable for disposal of septic tank effluent by trench systems. The high levels of Engineering input and management needed at all stages are unlikely to adequately address the identified land constraints and achieve a sustainable outcome. Reticulated sewerage is usually the only acceptable option.

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APPENDIX B

Leongatha 085048 Evap data **Yallorn 085103**

Mean — average Pan evaporation

Source: AS1547-1994 - Table G1 (Prepared by R.A. Patterson, Lanfax Labs. Armidale updated April 2006)

1			2	3	4	5	6	7	8	9
Month	Days per month	daily pan Eo (B.Met)	Pan Eo	Et +Cf*Eo	Rainfall P	Retained Rainfall Re=(1-r)P	LTAR*N 3.5	Disposal rate/month (Et-Re)+ LTAR*N	Effluent applied per month 600	Size of area (8)/(7)
		mm	mm	mm	mm	mm	mm	mm	L	m2
Jan	31	5.9	182.9	155	69	44.3	108.5	219.7	18600	85
Feb	28	5.6	156.8	133	60.7	45.5	98	185.8	16800	90
Mar	31	3.9	120.9	103	70.4	52.8	108.5	158.5	18600	117
Apr	30	2.7	81.0	49	87.7	65.8	105	87.8	18000	205
May	31	1.7	52.7	32	84.7	63.5	108.5	76.6	18600	243
Jun	30	1.2	36.0	22	94.6	71.0	105	55.7	18000	323
Jul	31	1.3	40.3	24	82.9	62.2	108.5	70.5	18600	264
Aug	31	1.6	49.6	30	94.7	71.0	108.5	67.2	18600	277
Sep	30	2.4	72.0	43	87.8	65.7	105	82.5	18000	218
Oct	31	3.3	102.3	87	95.6	71.7	108.5	123.8	18600	150
Nov	30	4.4	132.0	112	82.3	61.7	105	155.5	18000	116
Dec	31	5.0	155.0	132	67.5	50.6	108.5	189.6	18600	98
		Totals	1181.5	921	967.7	725.8				

TABLE G2 - Depth of stored effluent First trial - choose from col.9 table above

1	2	3	4	5	6	7	8	9	10	11
month	first trial area (m2)	application rate (8)*1/(2)	Disposal rate per month (above)	(3)-(4)	increase depth of stored effluent (5)/porosity	Starting depth effluent for month	increase depth effluent +(6)	computed depth effluent (X)	reset if Et deficit <0	equivalent storage 10 x area
		(mm)	(mm)	(mm)	(5)/porosity	month	+(6)	(mm)	(mm)	(L)
Dec								0.0	0	
Jan	260	72	220	-148	-370	0	-370	-370	0	0
Feb		65	186	-121	-303	0	-303	-303	0	0
Mar		72	158	-87	-217	0	-217	-217	0	0
Apr		69	88	-19	-46	0	-46	-46	0	0
May		72	77	-5	-13	0	-13	-13	0	0
Jun		69	56	14	34	0	34	34	34	2648
Jul		72	71	1	3	34	3	37	37	2850
Aug		72	67	4	11	37	11	47	47	3689
Sep		69	83	-13	-33	47	-33	14	14	1101
Oct		72	124	-52	-131	14	-131	-116	0	0
Nov		69	155	-86	-216	0	-216	-216	0	0
Dec		72	190	-118	-295	0	-295	-295	0	0
Jan		72	220	-148	-370	0	-370	-370	0	0
Feb		65	186	-121	-303	0	-303	-303	0	0
Mar		72	158	-87	-217	0	-217	-217	0	0
Apr		69	88	-19	-46	0	-46	-46	0	0
May		72	77	-5	-13	0	-13	-13	0	0

From calculations in tables above for optimised drainfield area, using Appendix G AS1547-1994

	Porosity in disposal area	40%	
Variables Table	Runoff Coeff =	0.25	percentage runoff
	Summer Crop Factor =	0.85	crop transpiration rate Oct-Mar
	Winter Crop Factor	0.6	crop transpiration rate -Apr-Sep
Change as required	LTAR =	3.5	L/m2/day
	FLOWS=	600	L/day

Estimated area of effluent drainfield = 260 square metres

Maximum depth of stored effluent = 47 mm depth

Water Balance Model for 3 bedroom dwelling
(prepared by R.A. Patterson, Lanfax Labs. Armidale April 2007)

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APPENDIX C

RECORD OF FIELD TEXTURE DETERMINATION						
Soil	**Grittiness**	**Stickiness**	**Plasticity**	**Stain**	**Ribbon (mm)**	**Grade**
A1	None	Very	Very	Very	40	ZCL
B1	None	Extrermely	Very	Very	40	ZCL

TEST BORE B1

Emerson's Aggregate Testing & pH Testing

NONE **SLIGHT** **MODERATE** **VERY** **EXTREMELY**

APPENDIX D

Soil Category	Field Texture Grade		Behaviour of moist blobs	Ribbon length (mm)	Approx clay content %
1	S	Sand	coherence nil to very slight, cannot be moulded; sand grains of medium size; single sand grains stick to fingers	nil	< 5%
2	LS	Loamy sand	slight coherence; sand grains of medium size; can be sheared between thumb and forefinger to give minimal ribbon of about 5mm	about 5	about 5%
	CS	Clayey sand	slight coherence; sand grains of medium size; sticky when wet; many sand grains stick to fingers; discolours fingers with clay stain	5 - 15	5% to 10%
	SL	Sandy loam	bolus coherent but very sandy to touch; will form ribbon; dominant sand grains of medium size and readily visible	15 - 25	10% to 20%
3	FSL	Fine sandy loam	as for sandy loams, except that individual sand grains are not visible, although they can be heard and felt	15 - 25	10% to 20%
	L	Loam	bolus coherent and rather spongy; smooth feel when manipulated but with no obvious sandiness or "silkiness"; may be somewhat greasy to touch if much organic material present	25	about 25%
	ZL	Silty loam	coherent bolus, very smooth to silky when manipulated, will form a very thin ribbon and dries out rapidly	25	10% to 25%
4	SCL	Sandy clay loam	strongly coherent bolus, sandy to touch; medium size sand grains visible in finer matrix	25 - 40	20% to 30%
	FSCL	Fine sandy clay loam	as for sandy clay loam, except that individual sand grains are not visible although they can be heard and felt.	40 - 50	20% to 30%
	CL	Clay loam	coherent plastic bolus, smooth to manipulate	40 - 50	30% to 35%
	ZCL	Silty clay loam	as for clay loams but not spongy; very smooth and silky; dries out rapidly	40 - 50	30% to 35%
	SC	Sandy clay	plastic bolus; fine to medium sand can be seen, felt or heard in clayey matrix	50 - 75	35% to 40%
5	SiC	Silty clay	plastic bolus; smooth and silky to manipulate; long but very fragmentary ribbon; dries out rapidly	50 - 75	30% to 40%
	LC	Light clay	plastic bolus; smooth to touch; slight resistance to shearing between thumb and forefinger	50 - 75	35% to 40%
	LMC	Light medium clay	plastic bolus; smooth to touch; slight to moderate resistance to ribboning shear	75	40% to 45%
6	MC	Medium clay	smooth plastic bolus; handles like plasticine and can be moulded into rods without fracture; has moderate resistance to ribboning shear	> 75	45% to 55%
	HC	Heavy clay	smooth plastic bolus; handles like stiff plasticine; can be moulded into rods without fracture; has firm resistance to ribboning shear	> 75	50% +

Soil Texture Grade Table (International System, soil sieved < 2mm) & Table E1 (Assessment of Soil Textures) pg 106 of AS/NZS 1547:2012

9.0 REFERENCES

Environment Protection Authority (Feb 2013). Publication No. 891.3, *Code of Practice – Onsite Wastewater Management*.

Environment Protection Authority (Mar 2013). Publication No. 746.1, *Land Capability Assessment For On-Site Wastewater Management*.

Environment Protection Authority (1991). Publication 168, *Guidelines for Wastewater Irrigation*.

McDonald, R.C., Isbell, R.F., Spreight, J.G., Walker, J and Hopkins, M.S. (1990). *Australian Soil and Land Survey: Field Handbook. Second Addition*. Inkata Press, Melbourne.

Standards Australia / Standards New Zealand (2012). AS/NZS 1547:2012 *On-Site Domestic Wastewater Management*.