

On-site effluent management study

Lot 1 in the proposed subdivision of 51 Winter Lane, Summer Hill Creek NSW

Ref: R14064e1

Date: 25 February 2022

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Document control					
Client John and Michelle Eyles 51 Winter Lane Summer Hill Creek NSW					
Rev	Report number	Date	Prepared by	Checked by	Revision details/status
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1. Summary

Proposed development and situation	A rural-residential lot requires evaluation for suitability of on-site application of effluent for a proposed new residential dwelling. This report describes the assessment and recommends a suitable effluent treatment and application system.
Investigation	<p>A site assessment and soil assessment were undertaken using the Australian Standard 1547, <i>On-site domestic wastewater management</i>, and the Environment and Health Protection Guidelines, <i>On-site sewage management for single households</i> (1998), Department of Urban Affairs and Planning, as guidelines. Suitable wastewater application systems, sizing and location for the site are recommended.</p> <p>The evaluation is based on a dwelling with four bedrooms.</p>
Type of land application and treatment systems considered best suited to the site	<p>The recommended systems are:</p> <ul style="list-style-type: none"> • Surface or sub-surface irrigation with an irrigation area of 444 square metres. Gypsum should be applied to the application area during construction. • Secondary wastewater treatment system accredited by NSW Health
Location	The location of the effluent application area is identified in Appendix 1.
Notes	<p>Construction of the treatment and application systems should be according to AS1547.</p> <p>Gypsum should be applied to the application area during construction and annually to maintain permeability.</p> <p>Secondary treatment systems require regular maintenance to ensure effective operation. Maintenance scheduling should be undertaken in accordance with manufacturers and NSW Health guidelines.</p> <p>The water balance is calculated using full water saving devices such as dual flush toilets (6/3 litres water closets), water reduction cycles on dishwashers, aerator faucets fitted to taps, front loader washing machines and water reducing shower heads.</p>

2. Introduction

A rural-residential lot requires evaluation for on-site application of effluent for a proposed new residential dwelling. A site and soil assessment were undertaken on 28 January 2022. Boreholes were drilled to 1.5m depth and soil samples collected for analysis. This report describes the site and soil investigation and recommends a suitable effluent treatment and application system.

3. Scope

A site assessment and soil assessment were undertaken using the Australian Standard 1547, *On-site domestic wastewater management*, Sydney Catchment Authority guidelines, *Designing and Installing On-site Wastewater Systems* (2019) and the Environment and Health Protection Guidelines, *On-site sewage management for single households* (1998), Department of Urban Affairs and Planning, as guidelines. Suitable wastewater application systems, sizing and location for the site are recommended.

4. Site information

Address of site	Lot 1 in the proposed subdivision of 51 Winter Lane Summer Hill Creek NSW
Local government	Cabonne Shire Council
Client	John and Michelle Eyles
Size	Approximately 2.65ha
Location, shape, layout	A plan of the relevant areas of the site and proposed effluent application area is described in Appendix 1.
Photograph(s) attached	Yes
Intended water supply	Rainwater Reticulated water supply Bore/Groundwater
Development	New residential dwelling
Expected wastewater flows	<p>Number of bedrooms – 4</p> <p>Number of persons – 5</p> <p>Flows per person – 120 litres/person</p> <p>Total expected wastewater flow is 600 litres/day</p> <p>The water balance is calculated using full water saving devices such as dual flush toilets (6/3 litre water closets), water reduction cycles on dishwashers, aerator faucets fitted to taps, front loader washing machines and water reducing shower heads.</p> <p>Re-calculation of the hydraulic balance and application area is required for dwellings containing a differing number of potential bedrooms.</p>
Local experience of on-site management systems nearby	All systems are known to work satisfactorily in locality providing they are adequately designed and maintained.

Setting	This lot is in a rural-residential setting where the average dwelling density is less than 1 dwelling per 2 hectare and therefore less than the 1 per 0.4 hectares required for groundwater protection (Geary & Gardner 1996, Land Management for Urban Development, Australian Society of Soil Sciences, Qld).
Current land-use	Grazing
Climate	Summers are warm to hot and winters are cold with little or no effective evaporation. Rainfall is distributed evenly throughout the year with an average annual rainfall of 965mm and pan evaporation of 1,335mm (Bureau of Meteorology, Mullion Creek).

5. Site assessment

Work undertaken	Details
Date	28 January 2022
Details	Site inspection, borehole construction, soil sampling
Weather on day and preceding week	Fine, <25mm rain in preceding week

Site feature	Assessment	Limitation
Vegetation	Pasture grasses, broadleaved weeds, dandelion, plantain	Minor
Flood potential: 1 in 20 year 1 in 100 year	Low Low	Minor
Exposure Site aspect Shelter belts Topographical feature or structure	High North east and south west Nil Nil	Minor
Slope	2 to 5%	Minor
Landform	Mid-slope	Minor
Run-on and seepage: Comment	Run-on and sub-surface seepage is expected to be moderate. Diversion banks will be required to divert surface water.	Moderate
Erosion potential: Erodibility Erosion hazard	The topsoil and subsoil have a low erodibility. Erosion hazard is low and is reduced with ground cover.	Minor

Site drainage	Moderate, mottles identified from 300mm in soil profile	Moderate
Fill	Nil	Minor
Groundwater: Level of protection Bores and wells in the area and their purpose	Low No groundwater bores are located within 100m of the recommended application area. Bores in the locality are licensed for stock and domestic supplies. Water bearing zones are located from 23m with standing water levels from 20m. No impact on groundwater is expected from the application of effluent on the site.	Minor
Surface water: Permanent waters, streams, lakes (Recommended buffer distance 100m) Other waters, intermittent waterways (Recommended buffer distance 40m)	Nil Drainage line and dam 40m from application area	Minor
Buffer distances from recommended application area to: Boundary premises (Recommended buffer distance 3-6m) Swimming pools (Recommended buffer distance 6m) Buildings (Recommended buffer distance 6m)	>6m Nil >6m	Minor
Area required for application system(s): Area available (including buffers):	66m ² minimum area required for trench systems 444m ² minimum area required for irrigation systems. Potential area of greater than 3,000m ² available (Appendix 1).	Minor
Surface rocks, rock outcrops	Nil	Minor
Geology/ regolith	The site is located within the Mookerawa Soil Landscape. Soils comprise red podzolic soils on crests and upper slopes and yellow soloths and yellow solodic soils on lower slopes and in drainage depressions. The geological unit is formations of Hill End Trough with shale, schist, greywacke, conglomerate, slate, phyllite and siltstone parent rock. (Environment.nsw.gov.au, 'Espade NSW Environment & Heritage' Version 2.1 2015).	Minor

Environmental concerns: Native plants intolerant of phosphorous	Nil	Minor
High water table	Nil	
Water way/wetland	None nearby	
Community water storage	None nearby	
Site stability: Is expert assessment necessary	No, not expected to affect system performance	Minor

6. Soil assessment

Soil was assessed on site on 28 January 2022 by borehole construction to a depth of 1.5 metres or drill refusal with a EVH auger drill.

The soil profile was described, and representative samples collected for the determination of physical and chemical properties. Soil physical property measurements undertaken included: dispersion description, texture, colour, pH, and salinity. The laboratory tests for physical properties were undertaken by Envirowest Testing Services and results are presented in the following table.

Depth (mm)	Description	Sampled (mm)	Texture group	Moisture	Emerson aggregate test*	pH (1:5 water)	ECe dS/m
Test hole 1							
0-300	Dark brown fine sandy clay loam with fine and medium gravel	100	FSCL	M	3	5.4	0.17
300-600	Reddish yellow light clay with trace fine and medium gravel, grey, yellow and red mottles	600	LC	M	5	5.4	0.08
600-1200	Reddish brown silty clay with grey, yellow and red mottles		ZC	M			
1200-1400	White light clay with grey and yellow mottles	1200	LC	M	5	5.9	0.08
1400	End of hole, drill refusal						
Test hole 2							
0-300	Dark brown fine sandy clay loam with coarse sand	100	FSCL	M	3	5.7	0.26
300-500	Brownish yellow light clay with coarse sand and fine gravel	500	LC	M	2	5.9	0.08
500-1200	Brownish yellow light clay with grey and yellow mottles	1000	LC	M	2	6.0	0.23
1200-1450	Brown sandy gravelly clay with fine and medium gravel		SGC	M			
1450	End of hole, drill refusal						

M=Moist, D=Dry, W=Wet *1= highly dispersive (slakes, complete dispersion), 2= moderately dispersive (slakes, some dispersion), 3= slightly dispersive (slakes, some dispersion after remoulding), 4= non-dispersive (slakes, carbonate or gypsum present), 5= non-dispersive (slakes, dispersion in shaken suspension) 6= non-dispersive (slakes, flocculates in shaken suspension), 7= non-dispersive (no slaking, swells in water), 8= non-dispersive (no slaking, does not swell in water).

Site feature	Assessment	Limitation
Depth to bedrock	Greater than 1400mm in recommended application area (600mm below application base recommended)	Minor
Depth to high water table	Greater than 1400mm in recommended application area (600mm below application base recommended)	Minor
Coarse fragments	Fine and medium gravels identified in the soil profile	Minor

Bulk density	Good (estimated)	Minor
pH	Satisfactory (4.5-8.5 optimum range)	Minor
Salinity	Non-saline (<4.0 dS/m desirable threshold)	Minor
Phosphorus sorption index (SCA, 2012)	High 6,500 kg/ha estimated	Minor
Nutrient balance	Water is not expected to move off site, nutrients will be utilised by the vegetation and stored in the soil. The subsoil is a moderately drained silty clay to light clay that will immobilise large quantities of nitrogen (in ammonium and organic forms) as derived from primary treatment systems.	Minor
Cation exchange capacity	Moderate (estimated). Will provide adequate retention of nutrients for plant growth.	Minor
Dispersiveness (Emerson aggregate test)	Slightly dispersive fine sandy clay loam topsoil over a moderately dispersive to non-dispersive silty clay to light clay subsoil. Regular application of gypsum recommended at the rate of 1kg per square metre of application area.	Moderate
Soil structure	Strongly structured	Minor
Soil texture (subsoil) Permeability category	Clay Loam (100mm) CL Light Clay (600mm) LC	Minor

7. System selection

7.1 Estimation of land application areas from hydraulic loadings

Rainfall water balance and land application area calculations are presented in Appendix 3 and summarised in the following table. Design flow rates are 600L/day; however, these can be reduced with the use of water saving features. Wet weather storage areas included in the water balance utilise the storage capacity of the soil. The design loading rate was determined from Tables L1, M1, and N1 in AS1547 using the permeability classification of the subsoil.

Factors Affecting Design Loading and Sizing		Design application rate (AS1547) (mm/day)	Size required for effluent application
Hydraulic loading for different application systems			
- Absorption trench		8	66m ²
- Evapotranspiration / absorption trench		8	66m ²
- Surface/sub-surface irrigation		3	444m ²
Notes	The proposed loading will provide for leaching of salts out of the root zone and prevent the soil from becoming sodic. The proposed infiltration rates will protect the catchment against off-site nutrient movement.		

7.2 Centralised sewerage systems

Consideration of connection to a centralised sewerage system Approximate distance to nearest feasible connection: Potential for future connection to centralised sewerage: Potential for future connection to reticulated water:	>5km high / medium / low / already connected high / medium / low / already connected
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7.3 Suitability of application systems

Application system	Treatment system	Site limitations of the application system	Modifications to mitigate constraints	Suitability
Absorption system	Septic tank	Moderately dispersive subsoil	Nil	No
		Moderately drained soil	Nil	
Evapotranspiration absorption system	Septic tank	Moderately dispersive subsoil	Nil	No
		Moderately drained soil	Nil	
Surface irrigation	Secondary	Slightly dispersive topsoil	Regular application of gypsum	Yes
Sub-surface irrigation	Secondary	Slightly dispersive topsoil	Regular application of gypsum	Yes

7.4 System recommendation

Type of land application and treatment systems considered best suited to the site	The recommended systems are: <ul style="list-style-type: none"> Surface or sub-surface irrigation with an irrigation area of 444 square metres. Gypsum should be applied to the application area during construction. Secondary wastewater treatment system accredited by NSW Health
Location	The location of the effluent application area is identified in Appendix 1.
Notes	<p>Construction of the treatment and application systems should be according to AS1547.</p> <p>Gypsum should be applied to the application area during construction and annually to maintain permeability.</p> <p>Secondary treatment systems require regular maintenance to ensure effective operation. Maintenance scheduling should be undertaken in accordance with manufacturers and NSW Health guidelines.</p> <p>The water balance is calculated using full water saving devices such as dual flush toilets (6/3 liters water closets), water reduction cycles on dishwashers, aerator faucets fitted to taps, front loader washing machines and water reducing shower heads.</p>

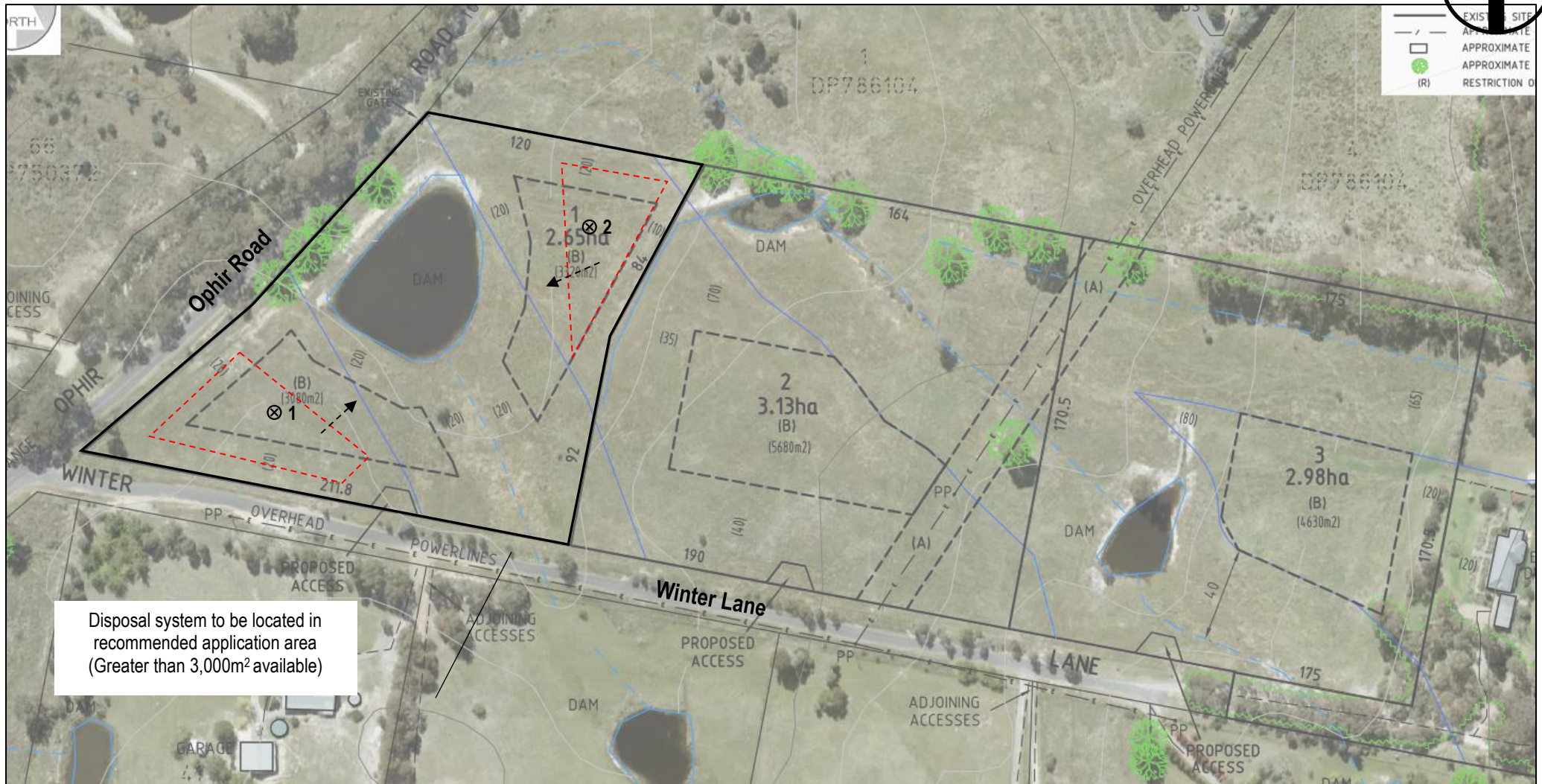
8. General comments

Are there any specific environmental constraints?	Wastewater should be evenly applied over the application area.
Are there any specific health constraints?	Restrict access to people and stock as recommended in AS1547 and summarised in Appendix 4.
Any other comments?	<p>The topsoil is capable of supporting plant growth that will optimise evapotranspiration and wastewater usage.</p> <p>Secondary treatment systems require regular maintenance to ensure effective operation. Maintenance scheduling should be undertaken in accordance with manufacturers and NSW Health guidelines.</p>

9. Report limitations and intellectual property

This report has been prepared for the use of the client to achieve the objectives given the clients requirements. The Australian Standard 1547, *On-site domestic wastewater management*, and the Environment and Health Protection Guidelines, *On-site sewage management for single households* (1998) Department of Urban Affairs and Planning, have been used as guidelines in this report. Where system limitations or uncertainties are known, they are identified in the report. No liability can be accepted for failure to identify conditions or issues which arise in the future and which could not reasonably have been predicted using the scope of the investigation and the information obtained. No guarantee can be made that the wastewater system will achieve all performance criteria because of operational factors and the inherent variable and unpredictable nature of the soil. All components of the wastewater system have a limited life.

This report including data contained, its findings and conclusions remain the intellectual property of Envirowest Consulting Pty Ltd. A licence to use the report for the specific purpose identified is granted after full payment for the services involved in preparation of the report. This report should not be used by persons or for purposes other than those stated, and not reproduced without the permission of Envirowest Consulting Pty Ltd.



Legend

- ⊗ Borehole
- Proposed building envelope
- Slope
- Lot boundary
- Recommended application area (greater than 3,000m² available)

Approximate Scale 1: 2,300



Appendix 1. Site plan and borehole locations

Lot 1 in the proposed subdivision of 51 Winter Lane,
Summer Hill Creek NSW



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Job: R14064e1

Drawn by: LD

Date: 18/02/2022

Appendix 2. Photograph of site



Looking west over the recommended application area

Appendix 3a. Monthly water balance determine the wastewater application area required (irrigation systems)

Design wastewater flow	Q	L/day	600	120	L/person/day	5	persons
Design percolation rate	R	mm/wk	21	3	mm/day		
Land area	L	m ²	142				
Effective precipitation	EP		0.9	(10% runoff)			

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
Precipitation	P		mm/month	89	78	62	63	80	80	93	96	79	92	80	73	965
Evaporation	E		mm/month	216	157	137	94	51	41	38	51	81	114	152	203	1335
Crop factor	C		-	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	10.8
Inputs																
Effective Precipitation	EP		mm/month	80.46	70.47	55.53	57.06	72.18	71.73	83.43	86.58	71.01	82.35	72.09	65.61	869
Effluent irrigation	W	QXD/L	mm/month	131.0	118.3	131.0	126.8	131.0	126.8	131.0	131.0	126.8	131.0	126.8	131.0	1542
Inputs		P+W	mm/month	211.4	188.8	186.5	183.8	203.2	198.5	214.4	217.6	197.8	213.3	198.9	196.6	2411
Outputs																
Evapotranspiration	ET	ExC	mm/month	194.4	141.3	123.3	84.6	45.9	36.9	34.2	45.9	72.9	102.6	136.8	182.7	1202
Percolation	B	R/7xD	mm/month	93.0	84.0	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	287.4	225.3	216.3	174.6	138.9	126.9	127.2	138.9	162.9	195.6	226.8	275.7	2297
Storage	S	(EP+W)-(ET+B)	mm/month	-76.0	-36.5	-29.8	9.2	64.3	71.6	87.2	78.7	34.9	17.7	-27.9	-79.1	
Cumulative storage	M		mm	0.0	0.0	0.0	9.2	73.5	145.1	232.3	311.0	345.8	363.6	335.6	256.5	
Storage																
	V	largest M	mm	363.6												
		Soil storage	mm	368.0												
		Storage required	mm	-4.4												
		VxL/1000	m ³	-0.6												
Irrigation area			m ²	142												

	water holding capacity	depth (mm)	Totals(mm)
Topsoil	34%	300	102
Subsoil	38%	700	266
			368

Appendix 3b. Estimation area requirement from organic matter and nutrient balances

(irrigation systems)

Estimated effluent flow	(Q)	600	L/day
Soil depth		1.4	m

Organic matter balance

BOD (C)	20	mg/L
treated wastewater flow rate (Q)	600	L/day
critical loading rate of BOD (Lx)	3000	mg/m ² /day
land area required (A)	4.0	m²

Nitrogen balance

nutrient concentration	37	mg/L
treated wastewater flow rate	600	L/day
critical loading rate of nutrient	50	mg/m ² /day
land area required (A)	444	m²

Determination of nitrogen critical loading rate

Nitrogen load (kg/year)	8.1	kg/year		
Loss 20% denitrification	6.5	kg/year		
Load to soil	146.0	kg/ha/year	assumed irr. area	444 m ²
Vegetation usage	200.0	kg/ha/year	from table	
Residual (potential leaching)	-54.0	kg/ha/year		

Typical nitrogen uptake (Myers et al. 1984)

Pastures	300 kg/ha/year	82 mg/m ² /day
Pine	350 kg/ha/year	96 mg/m ² /day
Eucalypts	180 kg/ha/year	49 mg/m ² /day

Phosphorus balance

Phosphorus sorption capacity per metre=	6,500	kg/ha
Phosphorus sorption capacity of profile=	9,100	kg/ha
Soil factor	0.33	
Critical loading=	3 mg/m ² /day	
P concentration*=	12	mg/L
P adsorbed=	phosphorus sorption capacity x soil factor	
	3003	
	0.3003	kg/m ²
Puptake=	critical loading x days/year x	50 years
	54750	
	0.0548	kg/m ²
Pgenerated=	total phosphorus concentration x wastewater volume in	50 years
	131400000	
	131	kg
	Pgenerated / (Padsorbed + Puptake)	
Land area required	370.1	m²

Appendix 4. Checklist for effective management of wastewater systems

Domestic wastewater system

DOs

- Check household products for suitability of use with a septic tank.
- Conserve water, prolonged period of high water use can lead to application area failure. For optimum operation, avoid daily and weekly surges in water flows. Spas are not recommended.
- Scrape cooking dishes and plates prior to washing to reduce solid load.
- Maintain the system with regular servicing as per the manufacturer's instructions.

DON'Ts

- Dispose of excessive solid material, fats, lint, or large water volumes into drains.

Land application area

- Construct and maintain diversion drains around the top-side of the application area to divert surface water.
- The application area should be a grassed area, which is maintained at 10-30cm height.
- The area around the perimeter can be planted with small shrubs to aid transpiration of the wastewater.
- Ensure run-off from the roof or driveway is directed away from the application area.
- Periodic application of gypsum may be necessary to maintain the absorptive capacity of the soil.
- **Do not** erect any structures or paths on the land application area.
- **Do not** graze animals on the land application area.
- **Do not** drive over the land application area.
- **Do not** plant large trees that shade the land application area thereby reducing transpiration of water.
- **Do not** let children or pets play on the land application area.
- **Do not** extract untreated groundwater for potable use.