

## **On-site effluent management study**

Lot 5 in the proposed subdivision of 24 Flirtation Hill Lane  
Gulgong NSW

Ref: 43599-5.1

Date: 18 March 2024

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*Environmental  
Geotechnical  
Asbestos  
Services*



<b>Document control</b>					
<b>Client</b> Victoria Caroli 24 Flirtation Hill Lane Gulgong NSW 2852					
<b>Rev</b>	<b>Report number</b>	<b>Date</b>	<b>Prepared by</b>	<b>Checked by</b>	<b>Revision details/status</b>
0	43599-5	05/02/2024	Harish Kumar Thangarasu MEng Geotechnical Engineer	Eliza Hurst BSc & BNSc Environmental Scientist	Draft
1	43599-5.1	18/03/2024	Harish Kumar Thangarasu MEng Geotechnical Engineer		Amendment to map

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## 1. Summary

Proposed development and situation	A rural-residential lot requires evaluation for suitability of on-site application of effluent from a new proposed 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 potential bedrooms.</p>
<b>Type of land application and treatment</b> systems considered best suited to the site	<p>The recommended system is:</p> <ul style="list-style-type: none"> <li>• <b>Surface or sub-surface irrigation with an irrigation area of 444 square metres.</b> Gypsum should be applied to the application area during construction.</li> <li>• <b>Secondary wastewater treatment system</b> accredited by NSW Health</li> </ul>
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 and Sydney Catchment Authority guidelines, <i>Designing and Installing On-site Wastewater Systems</i> (2019).</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 litre water closets), water reduction cycles on dishwashers, aerator faucets fitted to taps, front loader washing machines and water reducing shower heads.</p> <p>A maintained grass sward is the recommended vegetation over the irrigation area. Appendix 3 is a checklist of dos and don'ts to ensure correct operation of the wastewater system.</p>

## 2. Introduction

A rural residential lot requires evaluation for on-site application of effluent from a proposed new residential dwelling. A site and soil assessment were undertaken on 11 December 2023 and soil samples analysed. 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* (2012) 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 5 in the proposed subdivision of 24 Flirtation Hill Lane Gulgong NSW
Local Government	Mid-Western Regional Council
Client	Victoria Caroli
Size	2000m <sup>2</sup>
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	<input checked="" type="checkbox"/> Rainwater <input type="checkbox"/> Reticulated water supply <input type="checkbox"/> Bore/Groundwater
Development	New residential dwelling
Expected wastewater flows	<p>Number of potential bedrooms – 4</p> <p>Number of persons – 5</p> <p>Flows per person – 120 litres/person</p> <p><b>Total</b> expected wastewater flow is 600 litres/day</p> <p>Flows are 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 the 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 0.5 dwelling per 2 ha 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 cool to cold with little or no effective evaporation. Rainfall is distributed evenly throughout the year with an average annual rainfall of 629mm and pan evaporation of 1755mm (Bureau of Meteorology, Mudgee NSW).

## 5. Site assessment

Work undertaken	Details
Date	11 December 2023
Details	Site inspection, borehole construction, soil sampling
Weather on day and preceding week	Fine on day, >25mm rain in preceding week

Site feature	Assessment	Limitation
Vegetation	Grasses	Minor
Flood potential: 1 in 20 year 1 in 100 year	Nil Nil	Minor
Exposure Site aspect Shelter belts Topographical feature or structure	High South Nil Nil	Minor
Slope	0-1% in application area	Minor
Landform	Mid-slope	Minor
Run-on and seepage	Run-on and sub-surface seepage is expected to be moderate. Diversion banks may be required to divert the water from upper slope sources.	Moderate
Erosion potential: Erodibility  Erosion hazard	The topsoil and subsoil have a low erodibility.  Erosion hazard is low and is reduced when vegetated.	Minor
Site drainage	Moderate. Mottled clay identified from 400mm.	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. One groundwater bore is located within 500m of the recommended application area. Bore is licensed for stock and domestic purposes. Standing water level is from 32.0m and water bearing zone is from 40.0m to 41.0m.  No impact on groundwater is expected from the application of effluent on the site.	Minor
Surface water: Permanent waters, streams, lakes <i>(Recommended buffer distance 100m)</i>  Other waters, intermittent waterways <i>(Recommended buffer distance 40m)</i>	Nil  Nil	Minor
Buffer distances from recommended application area to: Boundary premises <i>(Recommended buffer distance 3-6m)</i> Swimming pools <i>(Recommended buffer distance 6m)</i> Buildings <i>(Recommended buffer distance 3-6m)</i>	>3m  Nil  >6m	Minor
Area required for application system(s):    Area available (including buffers):	54m <sup>2</sup> minimum area required for trench systems  444m <sup>2</sup> minimum area required for irrigation systems.  Potential application area 888m <sup>2</sup> available (Appendix 1).	Minor
Surface rocks, rock outcrops	Nil	Minor
Geology	This site is located within the Gulgong Soil Landscape. This soil comprises intergrades Red Podzolic Soils on crests and mid to upper slopes, Non-calcic Brown Soils and Red Earths on mid to lower slopes, Greybrown Podzolic Soils and Brown Podzolic-Solodic Soils on lower slopes and flats beside drainage lines. The geological unit is Tinja Formation, Burrunah Formation and undifferentiated. The parent rock are	Minor

	Shale, siltstone, chert, limestone, arkose, andesite, tuff and tuffaceous sandstone. The soil parent material is made up of in situ and alluvial-colluvial material derived from the parent rock (eSPADE v2.2).	
Environmental concerns: Native plants intolerant of phosphorous  High water table  Water way/wetland Community water storage	Nil  Nil  None nearby	Minor
Site stability: Is expert assessment necessary	No, not expected to affect system performance	Minor

## 6. Soil assessment

Soil was assessed on site on 11 December 2023 by borehole construction to a depth of 1.5 metres or drill refusal with a truck mounted 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
<b>Test hole 1</b>							
0-300	Brown fine sandy clay loam	100	FSCL	D	5	6.0	0.28
300-900	Red-light clay with fine gravel, yellow mottles, and Ironstone nodules	600	LC	D	3	6.5	0.08
900-1500	Brown light clay with trace fine gravel with fine gravel, yellow mottles, and Ironstone nodules	1000	LC	D	3	6.7	0.15
1500	End of hole at investigation depth						

M=Moist, D=Dry \*1= highly dispersive (slakes, complete dispersion), 2= moderately dispersive (slakes, some dispersion), 3= slightly dispersive (slakes, some dispersion after remoulding), 4=M 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 1,500mm in recommended application area (600mm below application base recommended)	Minor
Depth to high seasonal or episodic water table	Approximately 400mm in recommended application area (600mm below application base recommended)	Moderate
Coarse fragments	Gravel identified in subsoil profile	Minor
Bulk density	Good (estimated)	Minor
pH	Satisfactory (4.5-8.5 optimum range)	Minor

Site feature	Assessment	Limitation
Salinity	Non-saline (<4.0 dS/m desirable threshold)	Minor
Phosphorus sorption capacity (SCA, 2012)	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 light clay that will immobilise moderate quantities of nitrogen (in ammonium and organic forms) as derived from primary treatment systems.	Moderate
Cation exchange capacity	Moderate (estimated). Will provide adequate retention of nutrients for plant growth.	Minor
Dispersiveness (Emerson aggregate test)	Non-dispersive fine sandy clay loam topsoil over slightly dispersive light clay subsoil. Regular application of gypsum recommended at the rate of 1kg per square metre of application area.	Minor
Soil structure	Strongly structured	Minor
Soil texture and permeability category	Clay Loam CL (100mm)  Light clay LC (600mm)	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 for the dwelling are 600L/day based on the use of water saving features. Wet weather storage areas included in the water balance utilise the storage capacity of the soil. The design application rate was determined from Tables L1, M1, 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	54m <sup>2</sup>
- Evapotranspiration		8	54m <sup>2</sup>
- Surface/sub-surface irrigation		3	444m <sup>2</sup>
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:	>2km
Potential for future connection to centralised sewerage:	high / medium / low / already connected



Potential for future connection to reticulated water:	high / medium / <b>low</b> / 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 drained subsoil	Nil	No
Evapotranspiration system	Septic tank	Moderately drained subsoil	Nil	No
Surface irrigation	Secondary	Nil	Nil	Yes
Sub-surface irrigation	Secondary	Nil	Nil	Yes

### 7.4 System recommendation

Type of land application and treatment systems considered best suited to the site	<p>The recommended system is:</p> <ul style="list-style-type: none"> <li>• <b>Surface or sub-surface irrigation with an irrigation area of 444 square metres.</b> Gypsum should be applied to the application area during construction.</li> <li>• <b>Secondary wastewater treatment system</b> accredited by NSW Health</li> </ul>
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 and Sydney Catchment Authority guidelines, <i>Designing and Installing On-site Wastewater Systems</i> (2019).</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 litre water closets), water reduction cycles on dishwashers, aerator faucets fitted to taps, front loader washing machines and water reducing shower heads.</p> <p>A maintained grass sward is the recommended vegetation over the irrigation area. Appendix 3 is a checklist of dos and don'ts to ensure correct operation of the wastewater system.</p>

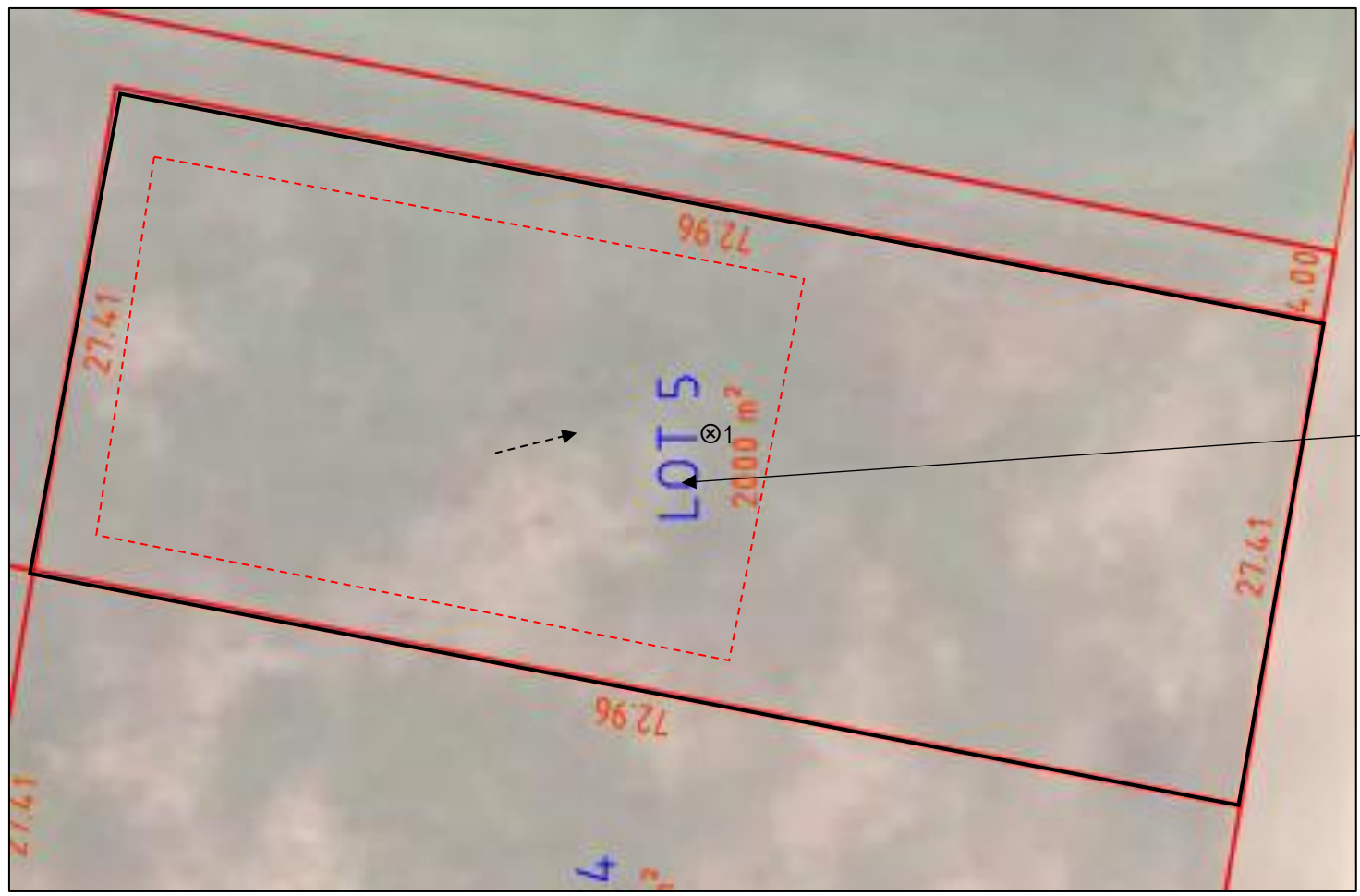
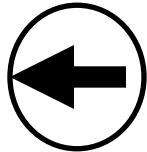
## 8. General comments

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?	The topsoil is capable of supporting plant growth that will optimise evapotranspiration and wastewater usage.

## 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.

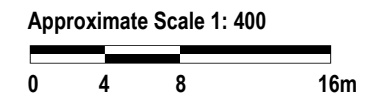
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Disposal system to be located in recommended application area.  
(Required application area of 444m<sup>2</sup> plus reserve area of 444m<sup>2</sup> available)

**Legend**

- Lot boundary
- ⊗ Borehole location
- - - Approximate building envelope
- - - slope
- - - Recommended application areas (Required application area of 444m<sup>2</sup> plus reserve area of 444m<sup>2</sup> available)



<b>Appendix 1. Site plan and borehole location</b>		
Lot 5 in the proposed subdivision of 24 Flirtation Hill Lane, Gulgong NSW		
	Envirowest Consulting Pty Ltd	
Job: 43599-5.1	Drawn by: HT	Date: 18/03/2024

**Appendix 2.** Photograph of the recommended application area



Looking East over the recommended application area.

**Appendix 3. Monthly water balance determines 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 <sup>2</sup>	98				
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	70	72	46	32	36	41	42	36	49	56	78	72	629
Evaporation	E		mm/month	272.8	221.2	195.3	126	77.5	48	52.7	74.4	102	158.1	207	220	1755
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
<b>Inputs</b>																
Effective Precipitation	EP		mm/month	62.73	64.62	41.4	28.98	32.13	37.17	37.62	32.22	43.83	50.4	70.2	64.8	566
Effluent irrigation	W	QXD/L	mm/month	189.8	171.4	189.8	183.7	189.8	183.7	189.8	189.8	183.7	189.8	183.7	189.8	2235
Inputs		P+W	mm/month	252.5	236.0	231.2	212.7	221.9	220.8	227.4	222.0	227.5	240.2	253.9	254.6	2801
<b>Outputs</b>																
Evapotranspiration	ET	ExC	mm/month	245.52	199.1	175.8	113.4	69.8	43.2	47.4	67.0	91.8	142.3	186.3	198.0	1580
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	338.5	283.1	268.8	203.4	162.8	133.2	140.4	160.0	181.8	235.3	276.3	291.0	2675
Storage	S	(EP+W)-(ET+B)	mm/month	-86.0	-47.0	-37.6	9.3	59.2	87.6	87.0	62.1	45.7	4.9	-22.4	-36.4	
Cumulative storage	M		mm	0.0	0.0	0.0	9.3	68.4	156.1	243.1	305.1	350.8	355.7	333.3	296.9	
<b>Storage</b>																
	V	largest M	mm	355.7												
		Soil storage	mm	372.0												
		Storage required	mm	-16.3												
		VxL/1000	m <sup>3</sup>	-1.6												
<b>Irrigation area</b>			m <sup>2</sup>													<b>98</b>

water holding capacity		depth (mm)	Totals(mm)
Topsoil	34%	300	68
Subsoil	38%	700	304
			<b>372</b>

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

(irrigation systems)

Estimated effluent flow	(Q)	600	L/day
Soil depth		1.5	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 <sup>2</sup> /day
<b>land area required (A)</b>	<b>4.0</b>	<b>m<sup>2</sup></b>

**Nitrogen balance**

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

**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 from table	444 m <sup>2</sup>
Vegetation usage	200.0	kg/ha/year		
Residual (potential leaching)	-54.0	kg/ha/year		

**Typical nitrogen uptake (Myers et al. 1984)**

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

**Phosphorus balance**

Phosphorus sorption capacity per metre=		8,000	kg/ha
Phosphorus sorption capacity of profile=		12,000	kg/ha
Soil factor		0.33	
Critical loading=	3	mg/m <sup>2</sup> /day	
P concentration*=	12	mg/L	
P adsorbed=	phosphorus sorption capacity x soil factor		
	3960		
	0.396	kg/m <sup>2</sup>	
Puptake=	critical loading x days/year x	50	years
	54750		
	0.0548	kg/m <sup>2</sup>	
Pgenerated=	total phosphorus concentration x wastewater volume in		50 years
	131400000		
	131	kg	
	Pgenerated / (Padsorbed + Puptake)		
<b>Land area required</b>	<b>291.5</b>	<b>m<sup>2</sup></b>	

## Appendix 4. Checklist for effective management of wastewater systems

### Domestic wastewater system

#### DO

- 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'T

- 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.
- **Don't** erect any structures or paths on the land application area.
- **Don't** graze animals on the land application area.
- **Don't** drive over the land application area.
- **Don't** plant large trees that shade the land application area thereby reducing transpiration of water.
- **Don't** let children or pets play on the land application area.
- **Don't** extract untreated groundwater for potable use.