On-site effluent management study

Communal system and disposal area

Proposed industrial subdivision of 3660 The Escort Way, Cudal NSW 2864

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1. Summary

Proposed development and situation	A proposed 15-lot industrial subdivision requires evaluation for suitability of on-site application of effluent from a proposed new industrial sheds. This report describes the assessment and recommends a suitable effluent treatment and application system for a communal disposal area for the combined wastewater.
Investigation	A site assessment and soil assessment were undertaken using 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, as guidelines. Suitable wastewater application systems, sizing and location for the site are recommended. The evaluation is based on an industrial shed utilized by maximum of 4 people for each lot for 15 lots.
Type of land application and **treatment** systems considered best suited to the site	The recommended system is • **Surface or sub-surface irrigation** with an irrigation area of 840 square metres. Gypsum should be applied to the application area during construction and annually to maintain permeability. • **Holding tank** with a minimum capacity of 2,000 litres fitted with automatic pump and high wastewater alarm. Wastewater will be pumped from the holding tank to the secondary wastewater system where gravity fall cannot be achieved. • **Secondary wastewater treatment system** accredited by NSW Health with a capacity to treat at least 2100L/day and ability to reduce wastewater nitrogen to 20mg/L and phosphorous to 4mg/L.
Location	The location of the effluent application area is identified in Appendix 1. The communal wastewater application area will be situated within the proposed Lot 1 of the subdivision.
Notes	Construction of the treatment and application systems should be according to AS1547 and Sydney Catchment Authority guidelines, *Designing and Installing On-site Wastewater Systems* (2019). Gypsum should be applied to the application area during construction and annually to maintain permeability. Secondary treatment systems require regular maintenance to ensure effective operation. Maintenance scheduling should be undertaken in accordance with manufacturers and NSW Health guidelines. 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. A maintained grass sward is the recommended vegetation over the irrigation area. Appendix 4 is a checklist of do's and don'ts to ensure correct operation of the wastewater system.

2. Introduction

A proposed 15-lot industrial subdivision requires evaluation for suitability of combined on-site application of effluent from a proposed new industrial sheds with amenities. A site and soil assessment were undertaken on 4 September 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* (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 3 in the proposed subdivision of 3660 The Escort Way, Cudal NSW 2864
Local government	Cabonne Shire Council
Client	iPlan Projects
Size	Approximately 6.5ha in Lot 1 for communal disposal
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 industrial sheds with amenities including toilets, basin and kitchenette
Expected wastewater flows	Number of people per shed per lot – 4 Flows per person – 35 litres/person Total number of lots – 15 **Total** expected wastewater flow is 2,100 litres/day The water balance is calculated using full water saving devices such as dual flush toilets (6/3 litre water closets), water reduction cycles on aerator faucets fitted to taps. Re-calculation of the hydraulic balance and application area is required for dwellings containing a differing wastewater usage.

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	The lot is in an industrial setting where the average dwelling density is less than 1 building per 2ha 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	Existing concrete batching facility
Climate	Summers are warm to hot and winters are cold with little or no effective evapotranspiration. Rainfall is distributed evenly throughout the year with an average annual rainfall of 644mm and pan evaporation of 1,471mm (Bureau of Meteorology, Cudal NSW).

5. Site assessment

Work undertaken	**Details**
Date	4 September 2023
Details	Site inspection, borehole construction, soil sampling
Weather on day and preceding week	Fine, <25mm rain in preceding week

Site feature	**Assessment**	**Limitation**
Vegetation	Common oat, shepherd's purse and henbit	Minor
Flood potential: 1 in 20 year 1 in 100 year	 Low Low	Minor
Exposure Site aspect Shelter belts Topographical feature or structure	High South to east Nil Nil	Minor
Slope	0-1% in the application area	Minor
Landform	Mid-slope	Minor
Run-on and seepage: Comment	Run-on and sub-surface seepage is expected to be low. Diversion bank may not be required to divert surface water from upslope sources.	Minor
Erosion potential: Erodibility and erosion hazard	The topsoil and subsoil have a low erodibility. Erosion hazard is moderate and is reduced with ground cover.	Minor

Site drainage	Moderately drained subsoil from approximately 300mm as indicated by mottled clays in the 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. Three groundwater bores were identified within 500m of the application area. Bores in the locality are licensed for stock, irrigation and domestic use with a standing water level range from 7m and water bearing zone range from 33m to 33m. No impact on groundwater is expected from the application of effluent to the site.	Minor
Surface water: Permanent waters, streams, lakes *(Recommended buffer distance 100m)* Other waters, intermittent waterways *(Recommended buffer distance 40m)*	 Boree Creek approximately 150m west Nil	Minor
Buffer distances from recommended application area to: Boundary premises *(Recommended buffer distance 3-12m)* Swimming pools *(Recommended buffer distance 6m)* Buildings *(Recommended buffer distance 3-12m)*	 >6m Nil >6m	Minor
Area required for application system(s): Area available (including buffers):	840m^2 minimum area required for irrigation systems. 230m^2 minimum area required for trench systems. Potential application area of greater than 2,000m^2 available (Appendix 1).	Minor
Surface rocks, rock outcrops	Nil	Minor
Geology/ regolith	The site is located within the Lachlan, Canowindra and Cudal soil landscape. <u>Cudal soil landscape</u> The soil landscape comprises the undulating rises, undulating low hills and dissected plateaux around Cudal, with a small area northeast of Molong and to the south of Cowra. The dominant soils are Euchrozems	Minor

	with non-calcic brown soils on lower slopes. Geological unit comprises tertiary basalt, parent rock is basalt and parent material is in-situ and colluvial deposits of parent rock. <u>Canowindra soil landscape</u> This soil landscape covers an extensive area of undulating rises to undulating low hills southwest of Cudal and Canowindra. The main soils are non-calcic brown soils, yellow and brown solodic soils and red earth with depositional sands. Geological unit comprises undifferentiated, Canowindra Porphyry, alluvial and Kenyu formation. Parent rock is Quartz feldspar porphyry with sparse garnets, shale, limestone and alluvium. The parent material is in-situ and colluvial-alluvial deposits of above parent rock. <u>Lachlan soil landscape</u> The soil landscape comprises the alluvial plains and terraces of Lachlan, Molong, Bell and lower Belubula Rivers as well as the Winburndale Rivulet and other minor streams. The geological unit and parent material is alluvium. The parent rock is alluvium including granite materials, metasediments and Molong geanticline volcanics (eSPADE v2.2).	
Environmental concerns: Native plants intolerant of phosphorous High water table Water way/wetland Community water storage	 Nil Nil None nearby Nil	Minor
Site stability: Is expert assessment necessary	 No, not expected to affect system performance	Minor

6. Soil assessment

Soil was assessed on site on 4 September 2023 by borehole construction to a depth of 1.5 metres or drill refusal with a Landcruiser mounted eziprobe drill rig with flight auger.

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
Borehole 1							
0-300	Dark reddish brown silty clay loam with coarse sand to fine gravels	100	ZCL	M	3	7.0	1.81
300-700	Dark brown silty clay with ironstone gravels and grey and yellow mottled clays	600	ZC	M	5	7.3	0.30
700-1000	Very dark brown sandy clay with abundant fine gravels and heavily mottled clays	900	SC	M	5	7.5	0.45
1000	End of hole, refusal on rock						
Borehole 2							
0-300	Dark reddish brown silty clay loam with coarse sand to fine gravels	100	ZCL	M	3	7.1	0.69
300-400	Red silty gravelly clay with coarse sand	-	ZGC	M	-	-	-
400-1200	Yellowish red silty clay with grey mottles, ironstone gravels and weathered rock inclusions	600	ZC	M	3	7.0	0.23
1200-1500	Greyish brown sandy clay with ironstone gravels and heavily mottled grey clays	1000	SC	M	2	7.8	0.30
1500	End of hole at investigation depth						

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 1,500mm in recommended application area *(600mm below application base recommended)*	Minor
Depth to high water table	Approximately 300mm in recommended application area *(600mm below application base recommended)*	Moderate
Coarse fragments	Coarse sand to fine gravels identified throughout 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, 2019)	6,500 kg/ha estimated	Minor
Nutrient balance	Water is not expected to move off site as nutrients will be utilised by the vegetation and stored in the soil. The subsoil is a moderately drained silty clay that will immobilise large 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)	Slightly dispersive silty clay loam topsoil over a non-dispersive to moderately dispersive silty clay and sandy clay subsoil. Regular application of gypsum is 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 2100L/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 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 - Surface/subsurface irrigation - Evapotranspiration absorption trench	 3 8	 840m^2 230m^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:	 >2km high / medium / low / already connected high / medium / low / already connected

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	Trench length exceeding 100m Moderately dispersive subsoil Moderately drained subsoil	Nil	No
Evapotranspiration absorption system	Septic tank	Trench length exceeding 100m Moderately dispersive subsoil Moderately drained subsoil	Nil	No

Surface irrigation	Secondary	Slightly dispersive topsoil	Regular application of gypsum at a rate of 1kg/m^2	Yes
Sub-surface irrigation	Secondary	Slightly dispersive topsoil	Regular application of gypsum at a rate of 1kg/m^2	Yes

7.4 System recommendation

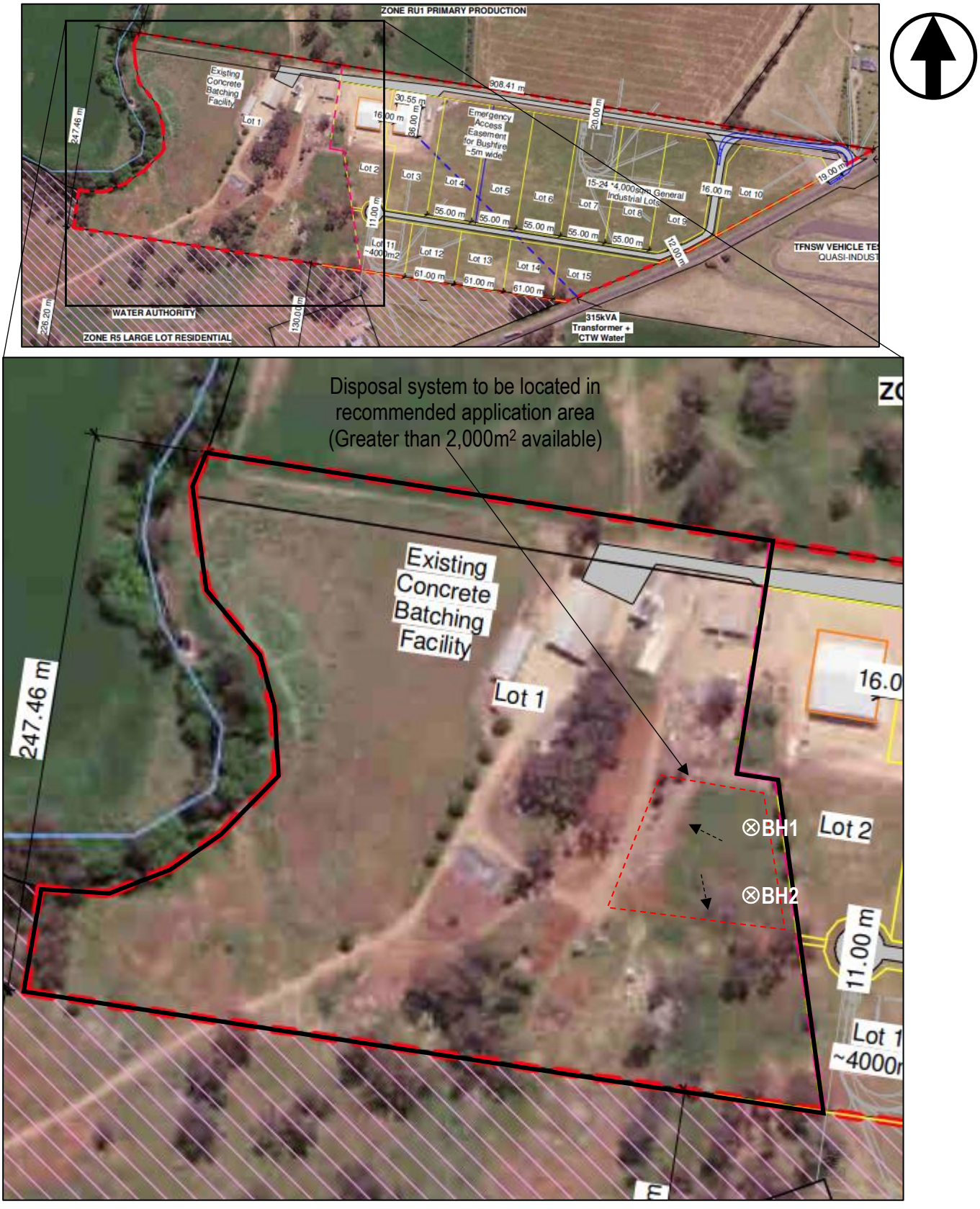
Type of land application and **treatment** systems considered best suited to the site	The recommended system is • **Surface or sub-surface irrigation** with an irrigation area of 840 square metres. Gypsum should be applied to the application area during construction and annually to maintain permeability. • **Holding tank** with a minimum capacity of 2,000 litres fitted with automatic pump and high wastewater alarm. Wastewater will be pumped from the holding tank to the secondary wastewater system where gravity fall cannot be achieved. • **Secondary wastewater treatment system** accredited by NSW Health with a capacity to treat at least 2100L/day and ability to reduce wastewater nitrogen to 20mg/L and phosphorous to 4mg/L.
Location	The location of the effluent application area is identified in Appendix 1.
Notes	Construction of the treatment and application systems should be according to AS1547 and Sydney Catchment Authority guidelines, *Designing and Installing On-site Wastewater Systems* (2019). Geotextile shall be laid over the distribution aggregate and arching to prevent ingress by the cover material for trench systems. Gypsum should be applied to the application area during construction and annually to maintain permeability. Secondary treatment systems require regular maintenance to ensure effective operation. Maintenance scheduling should be undertaken in accordance with manufacturers and NSW Health guidelines. 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. A maintained grass sward is the recommended vegetation over the irrigation area. Appendix 4 is a checklist of do's and don'ts to ensure correct operation of the wastewater system.

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 1.
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.



Legend

- ⊗ Borehole
- Slope
- Lot boundary
- Existing shed
- Recommended application area (Greater than 2,000m² available)

Approximate Scale 1:2400

0 24 48 96m

Appendix 1. Aerial image and borehole locations		
3660 The Escort Way, Cudal NSW		
	Envirowest Consulting Pty Ltd	
Job: R16134e3	Drawn by: TS	Date: 30/11/2023

Appendix 2. Photographs of the site

Looking north over the recommended application area

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

Design wastewater flow	Q	L/day	2100	35	L/person/day	60	persons
Design percolation rate	R	mm/wk	21	3	mm/day		
Land area	L	m2	385				
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	64	52	52	44	57	53	52	52	48	56	54	60	644
Evaporation	E		mm/month	220	176	152	96	62	42	47	65	93	133	165	220	1471
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	57.6	46.8	46.8	39.6	51.3	47.7	46.8	46.8	43.2	50.4	48.6	54	580
Effluent irrigation	W	QXD/L	mm/month	169.1	152.7	169.1	163.6	169.1	163.6	169.1	169.1	163.6	169.1	163.6	169.1	1991
Inputs		P+W	mm/month	226.7	199.5	215.9	203.2	220.4	211.3	215.9	215.9	206.8	219.5	212.2	223.1	2571
Outputs																
Evapotranspiration	ET	ExC	mm/month	198	158.4	136.8	86.4	55.8	37.8	42.3	58.5	83.7	119.7	148.5	198.0	1324
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	291.0	242.4	229.8	176.4	148.8	127.8	135.3	151.5	173.7	212.7	238.5	291.0	2419
Storage	S	(EP+W)-(ET+B)	mm/month	-64.3	-42.9	-13.9	26.8	71.6	83.5	80.6	64.4	33.1	6.8	-26.3	-67.9	
Cumulative storage	M		mm	0.0	0.0	0.0	26.8	98.4	182.0	262.6	326.9	360.1	366.9	340.6	272.7	
Storage	V	largest M	mm	366.9												
		Soil storage	mm	372.0												
		Storage required	mm	-5.1												
		VxL/1000	m^3	**-2.0**												
Irrigation area			m^2	**385**												

	water holding capacity	depth (mm)	Totals(mm)
Topsoil	34%	200	68
Subsoil	38%	800	304
			372

Appendix 3b. Estimation area requirement from organic matter and nutrient balances (Irrigation systems)

Estimated effluent flow	(Q)	2100	L/day
Soil depth		1	m

Organic matter balance

BOD (C)	40	mg/L
treated wastewater flow rate (Q)	2100	L/day
critical loading rate of BOD (Lx)	3000	mg/m^2/day
land area required (A)	**28.0**	m^2

Nitrogen balance

nutrient concentration	20	mg/L
treated wastewater flow rate	2100	L/day
critical loading rate of nutrient	50	mg/m^2/day
land area required (A)	**840**	m^2

Determination of nitrogen critical loading rate

Nitrogen load (kg/year)	15.3	kg/year			
Loss 20% denitrification	12.3	kg/year			
Load to soil	146.0	kg/ha/year	assumed irr. area	840	m2
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/m2/day
Pine	350 kg/ha/year	96 mg/m2/day
Eucalypts	180 kg/ha/year	49 mg/m2/day

Phosphorus balance

Phosphorus sorption capacity per metre=		6,500	kg/ha
Phosphorus sorption capacity of profile=		6,500	kg/ha
Soil factor		0.33	
Critical loading=		3 mg/m^2/day	
P concentration*=		4	mg/L
P adsorbed=	phosphorus sorption capacity x soil factor		
	2145		
	0.2145	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		
	153300000		
	153	kg	
	Pgenerated / (Padsorbed + Puptake)		
Land area required	**569.4**	**m^2**	

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.