

On-site effluent management study

Lot 14 in the proposed subdivision of 6 Flirtation Hill Lane
Gulgong NSW

Ref: R14644e5
Date: 26 April 2023

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Document control					
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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 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>
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"> • 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>

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 12 April 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 14 in the proposed subdivision of 6 Flirtation Hill Lane Gulgong NSW
Local Government	Mid-Western Regional Council
Client	Lee Cunningham
Size	6388m ²
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>Total 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	12 April 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 North 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 from 400mm	Minor

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>	>6m Nil >6m	Minor
Area required for application system(s): Area available (including buffers):	444m ² minimum area required for irrigation systems. Potential application area greater than 2,000m ² in total 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 Shale, siltstone, chert, limestone, arkose, andesite, tuff and tuffaceous sandstone. The soil parent material is	Minor

	made up of in situ and alluvial-colluvial material derived from the parent rock (eSPADEV2.2).	
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 12 April 2023 by borehole construction to a depth of 1.5 metres or drill refusal with a land cruiser mounted Eziprobe auger drill rig.

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	Strong brown sandy loam	100	SL	D	3	6.0	1.62
300-600	Yellow brown light clay with ironstone gravels and yellow and red mottles from 400mm	600	LC	D	5	7.0	0.15
600-1500	Yellow brown sandy clay with trace fine to coarse gravel	1000	SC	D	3	7.5	0.15
1500	End of hole at investigation depth						
Test hole 2							
0-300	Strong red brown sandy loam	100	SL	D	3	6.1	0.42
300-600	Reddish brown sandy clay with ironstone gravels and yellow and red mottles from 400mm	600	SC	D	3	7.1	0.15
600-1500	Yellow brown sandy clay with trace fine to coarse gravel	1000	SC	M	5	7.4	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 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
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 sandy clay to 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)	Slightly to non-dispersive sandy loam topsoil over sandy clay to 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 - 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:	>2km 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	Slightly dispersive subsoil Moderately drained subsoil	Nil	No
Evapotranspiration system	Septic tank	Slightly dispersive subsoil Moderately drained subsoil	Nil	No
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 system is: <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-liter water closets), water reduction cycles on dishwashers, aerator faucets fitted to taps, front loader washing machines and water reducing shower heads.</p>

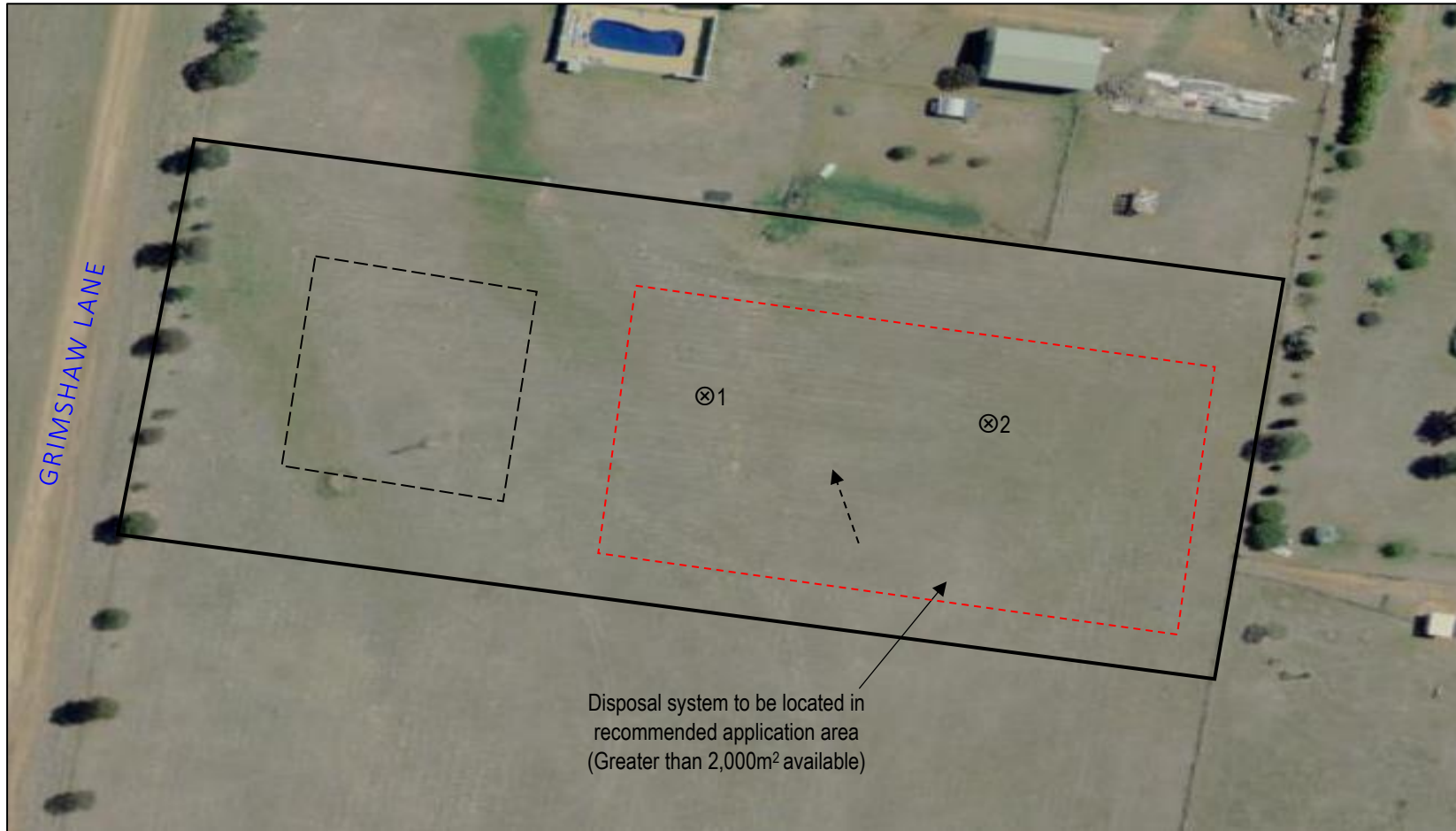
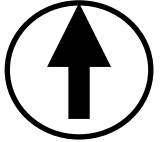
8. General comments

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?	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.

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

- Lot boundary
- ⊗ Borehole location
- - - Approximate building envelope
- - -> slope
- - - Recommended application areas (Greater than 2,000m² available)

Approximate Scale 1: 800



Appendix 1. Site plan and borehole location		
Lot 14 in the proposed subdivision of 6 Flirtation Hill Lane, Gulgong NSW		
	Envirowest Consulting Pty Ltd	
Job: R14644e5	Drawn by: HT	Date: 26/04/2023

Appendix 2. Photograph of the recommended application area



Looking west over the recommended the 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 ²	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
Inputs																
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
Outputs																
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	
Storage																
	V	largest M	mm	355.7												
		Soil storage	mm	372.0												
		Storage required	mm	-16.3												
		VxL/1000	m ³	-1.6												
Irrigation area			m ²													98

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

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 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 from table	444 m ²
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 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=		8,000	kg/ha
Phosphorus sorption capacity of profile=		12,000	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		
	3960		
	0.396	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	291.5	m²	

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.