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Land Capability Services

Site & Soil Assessment
for
On-site Effluent Disposal

Proposed Lot 4
in Lot 108 DP754923
59 Irvine Drive
Yass NSW 2582

November 2016

Richard Miller BSc (Ag.)
PO Box 682, Yass NSW 2582 *Ph: 0417 694 638* *Email: rgmiller@mac.com*

CONTENTS

INTRODUCTION

Scope

This report provides site and soil assessment for on-site effluent disposal at the applicant's proposed new subdivision. A four bedroom dwelling is assumed. An Aerated Wastewater Treatment System (AWTS) is proposed.

An AWTS coupled with surface or subsurface irrigation provides the most suitable form of effluent treatment for the site and soil characteristics of the land in question. The most suitable site for effluent application in the proposed subdivision is indicated in Figure 1. Alternative treatment and irrigation/dispersal areas may be suitable for other isolated areas subject to further site specific investigation at dwelling DA stage.

The management recommendations include the size and location of the proposed irrigation area.

References

AS/NZS 1547:2012 *On-site domestic wastewater management*

On-site sewerage management for single households (Anon, 1998)

Hird, C. *Soil Landscapes of the Goulburn 1:250 000 Sheet*

SITE CHARACTERISTICS

The terrain of the site comprises a gently inclined upper slope overlying Laidlaw volcanics. The slope across the proposed irrigation area is 4 degrees and has a linear planar configuration ensuring that runoff does not concentrate within the site.

The soil at the site is imperfectly drained. It comprises clay loam upper and lower topsoils to 8cm and 16cm respectively, overlying a light clay then medium clay subsoil to 40cm and 100cm+ respectively.

SITE EVALUATOR

Company	Land Capability Services
Name	Richard Miller
ph:	0417 694 638
email:	rgmiller@mac.com
Date of assessment	November 30, 2016
Signature of evaluator	

SITE INFORMATION

Address	Lot 108 DP754923, 59 Irvine Drive Yass NSW 2582
Council area	Yass Valley
Owner/developer	Ruth Condon
Area	12.9 ha
Site plan attached	Yes
Photograph attached	Yes
Intended water supply	Rainwater
Expected wastewater quantity (litres/day)	600 (Assumed 4 bedroom dwelling, potentially housing 5 occupants generating design flows of 120L/person/day = 600 litres/day)
Local experience	Aerated wastewater treatment systems provide adequate treatment of effluent on appropriate soils.

SITE ASSESSMENT

Climate	Warm to hot summers with a large evaporative deficit**.** Cool to cold winters with a small evaporative deficit

Where appropriate:	
Rainfall water balance attached	Yes
Land application area calculation attached	Yes
Wet weather storage area calculation attached	NA
Flood potential:	
Land application area above 1 in 20 year flood level	Yes
Land application area above 1 in 100 year flood level	Yes
Electrical components above 1 in 100 year flood level	Yes

Exposure	Well exposed with no shade.
Slope	Linear planar
Landform	Upper slope
Run-on	See management prescriptions
Seepage	None in irrigation area
Erosion Potential	Low – adequate vegetative cover
Site Drainage	Imperfectly drained
Fill	None in application area
Groundwater:	
Horizontal distance to groundwater well used for domestic water supply	>250m
Groundwater vulnerability map referred to	Yass LEP 2013 Sheet CL2_001
Vulnerability rating	Within vulnerability area
Bores in the area and their purpose	Stock & domestic
Buffer distance from wastewater management system to:	
Yass River	>100m
Dam	>40m
Drainage line	NA
Boundary of property & driveways	>6m
Swimming pools	>6m
Buildings	>15m
Is there sufficient land area for:	
Application system (including buffer distances)	Yes
Reserve application system (including buffer distances)	Yes
Surface rocks	None

SOIL ASSESSMENT

Depth to bedrock or hardpan		>100cm
Depth to soil watertable		>100cm
Hydraulic loading rate		
Soil structure		Moderate in topsoil Moderate in subsoil
Soil texture		Clay loam topsoil Light-medium clay subsoil
Permeability category	(4)	0.5-1.5m/day in topsoil
Hydraulic loading recommended for irrigation system		2mm/day irrigation
Coarse Fragments		10% to 10mm in topsoil
Bulk Density		Estimate 1.4
Ph (1:5 in water)		Topsoil 6.4 Subsoil 7.4
Electrical conductivity (uS)		Topsoil .10 (Low) Subsoil .09 (Low)
Geology & soil landscape survey		
Presence of discontinuities		None
Presence of fractured rock		None
Soil landscape reference		Cockatoo
Dispersiveness		None in topsoil EAT 8 Present in remoulded subsoil EAT 3(2)

SYSTEM SELECTION

Consideration of connection to a centralised sewerage system

Nearest feasible connection point	2km
Potential for future connection to centralised sewerage	None
Potential for future connection to reticulated water	Unknown

Type of land application system best suited to site:

Surface or subsurface irrigation

Reason Best suits site and soil characteristics, minimal environmental risk

Type of treatment system best suited to site and application system:

Aerated wastewater treatment

Reason Superior standard of treatment for site and soil conditions

GENERAL COMMENTS

Are there any specific environmental constraints? None so long as area designated as suitable for effluent application is adhered to. Dispersive subsoil is not suitable for subsoil dispersal via trenches or beds.

The site is within a mapped groundwater vulnerability area, however adequate soil depth and shallow or surface irrigation mitigates risk.

Are there any specific health constraints? None

MANAGEMENT PRESCRIPTIONS

Aerated wastewater treatment systems treat effluent to an improved, or secondary standard, reducing any impact on groundwater and making available water for landscaping and other purposes. The following prescriptions are site specific and must be strictly adhered to, in order to maximise water and nutrient uptake, and thus minimise runoff and seepage.

The AWTS must be accredited by NSW Health.

The treated wastewater must not be applied to bare ground, it must be applied to a well vegetated site, to maximise the effects of evapotranspiration.

An irrigation area of 300 m^2 should be sown to improved perennial pastures, which once established, should be regularly mown to improve rates of nitrogen uptake. The irrigation area should be fenced off from stock and vehicular access.

The treated effluent may be applied by surface irrigation. Surface sprays must be of the large droplet type that do not produce aerosols.

The treated effluent may also be applied by sub-surface irrigation.

Auto flush return to the tank should be installed to ensure flocculants in the lines are recycled back to the tank. Irrigation laterals to be installed on the contour at 100mm depth and at nominal 1000mm spacing.

The distribution line from the AWTS to the effluent irrigation area must be buried at least 300mm underground or 450mm where vehicles pass over.

The irrigation area must not be disturbed by any building activity such as stockpiles of excavated material or vehicle traffic.

Detergents should be selected for low levels of phosphorus and sodium.
(See appendix 3)

Water saving devices should be installed in the house, including dual flush toilets, shower-flow restrictors, aerator taps and water conserving washing machines.

Fig 1. Areas suitable for effluent application

Slope direction

Photo point

WATER BALANCE

A water balance model is helpful in assessing the sensitivity of the design to various input and output characteristics.

Irrigation area sizing using Nominated Area Water Balance for Zero Storage

Site Address:			**Lot 4 @ 59 Irvine Drive, Yass**	
Date:			**Assessor:**	

INPUT DATA

Design Wastewater Flow	Q	600	L/day	Based on maximum potential occupancy and derived from Table 4 in the EPA Code of Practice (2013)
Design Irrigation Rate	DIR	3.0	mm/day	Based on soil texture class/permeability and derived from Table 9 in the EPA Code of Practice (2013)
Nominated Land Application Area	L	300	m^2	
Crop Factor	C	0.6-0.8	unitless	Estimates evapotranspiration as a fraction of pan evaporation; varies with season and crop type[2]
Rainfall Runoff Factor	RF	1.0	unitless	Proportion of rainfall that remains onsite and infiltrates, allowing for any runoff
Mean Monthly Rainfall Data		Yass(Linton Hostel) (070014)		BoM Station and number
Mean Monthly Pan Evaporation Data		Canberra Airport (070091)		BoM Station and number

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
Rainfall	R		mm/month	50.3	45.5	46.7	49	49.9	57.9	59.6	59.3	56.8	64.5	56.6	55.8	651.9
Evaporation	E		mm/month	260.4	207.2	176.7	111	68.2	48	52.7	80.6	114	161.2	198	248	1726
Crop Factor	C		unitless	0.80	0.80	0.70	0.70	0.60	0.60	0.60	0.60	0.70	0.80	0.80	0.80	
OUTPUTS																
Evapotranspiration	ET	ExC	mm/month	208	166	124	78	41	29	32	48	80	129	158	198	**1290.73**
Percolation	B	DIRxD	mm/month	93.0	84	93.0	90.0	93.0	90.0	93.0	93.0	90.0	93.0	90.0	93.0	**1095.0**
Outputs		ET+B	mm/month	301.3	249.76	216.7	167.7	133.9	118.8	124.6	141.4	169.8	222.0	248.4	291.4	**2385.7**
INPUTS																
Retained Rainfall	RR	RxRF	mm/month	50.3	45.5	46.7	49	49.9	57.9	59.6	59.3	56.8	64.5	56.6	55.8	**651.9**
Applied Effluent	W	(QxD)/L	mm/month	62.0	56.0	62.0	60.0	62.0	60.0	62.0	62.0	60.0	62.0	60.0	62.0	**730.0**
Inputs		RR+W	mm/month	112.3	101.5	108.7	109.0	111.9	117.9	121.6	121.3	116.8	126.5	116.6	117.8	**1381.9**
STORAGE CALCULATION																
Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the month	S	(RR+W)-(ET+B)	mm/month	-189.0	-148.3	-108.0	-58.7	-22.0	-0.9	-3.0	-20.1	-53.0	-95.5	-131.8	-173.6	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Maximum Storage for Nominated Area	N		mm	0.00												
	V	NxL	L	0												
LAND AREA REQUIRED FOR ZERO STORAGE			m^2	74	82	109	152	221	296	266	227	159	118	94	79	

MINIMUM AREA REQUIRED FOR ZERO STORAGE: 296.0 m^2

Based on an expected quantity of 600l/day of wastewater, spread across 300 m^2 of irrigation area, the effluent application rate of 2mm/day results in a moisture deficit in all months of the year, albeit a smaller deficit in the winter months.

Importantly, the deficit is theoretical and it should be noted that saturation is possible at any time following periods of extended wet weather.

The application rate of 2mm/day is comparatively conservative, against the rate of 3.5mm/day determined from table M1 from AS1547:2012.

NUTRIENT BALANCE

The nutrient balance examines the discharge of nitrogen and phosphorus against the capacity of plants and soil to assimilate those nutrients. Excess nutrients may eventually impact upon watercourses via surface run-off or groundwater.

Nitrogen Balance

Site Address:	**Lot 4 @ 59 Irvine Drive, Yass**								
SUMMARY - LAND APPLICATION AREA REQUIRED BASED NITROGEN BALANCE								199	m^2
INPUT DATA[1]									
Wastewater Loading				**Nutrient Crop Uptake**					
Hydraulic Load	600	L/day		Crop N Uptake	220	kg/ha/yr	which equals	50.27	mg/m²/day
Effluent N Concentration	25	mg/L							
% N Lost to Soil Processes (Geary & Gardner 1996)	0.2	Decimal							
Total N Loss to Soil	3000	mg/day							
Remaining N Load after soil loss	12000	mg/day							
NITROGEN BALANCE BASED ON ANNUAL CROP UPTAKE RATES									
Minimum Area required with zero buffer			**Determination of Buffer Zone Size for a Nominated Land Application Area (LAA)**						
Nitrogen	199	m²	Nominated LAA Size			300	m²		
			Predicted N Export from LAA			-2.22	kg/year		
			Minimum Buffer Required for excess nutrient			0	m²		

600 litres/day wastewater quantity at 25mg/l total N concentration
= 5.5 kg nitrogen discharged per year, applied over an irrigation area of 300 m^2 = 183 kg/ha/yr.

A combination of existing native grasses and introduced pasture species should provide a rate of nitrogen uptake of around 220kg/ha/yr.
Total nitrogen loss to soil processes should account for 36kg/ha/yr.

Therefore the discharge of nitrogen should be balanced by plant uptake & soil processes.

Phosphorus Loading

600 litres/day wastewater quantity at 10mg/l of P
= 2.2 kg P discharged per year, applied over an irrigation area of 300 m^2 = 73kg/ha/yr.

A combination of existing native grasses and introduced pasture species should provide a rate of P uptake of around 20kg/ha/yr.

Balance of 53kg/ha/yr. applied to P sorption capacity of soil;

P sorption capacity of in-situ soil 4500kg/ha. [1]

Lifetime of irrigation area 85 years in terms of P sorption capacity.

[1] SCA "*Design and Installation of On-site Wastewater Systems",* P. Sorption Uptake Values (Typical)

APPENDIX 1: SOIL SURVEY SHEET

Soil Survey Sheet

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Land Capability Services

Date:

Site Address: LOT 4 OF 59 IRVINE DRIVE

Client: CONDON

	Depth	Boundary	Texture	Structure	Colour	Mottles	Coarse Frag	Consistence	Plasticity
A_1	0-80		CLAY LOAM	MODERATE	DARK YELLOWISH BROWN	-	10% TO 10mm	SLIGHTLY MOIST FIRM	SLIGHT
A_2	80-160	CLEAR	CLAY LOAM	WEAK	STRONG BROWN	-	-	DRY FIRM	VERY
B_1	160-400	SHARP	LIGHT CLAY	MODERATE	DARK REDDISH ORANGE	-	-	DRY FIRM	VERY
B_2	400-1000+	GRADUAL	MEDIUM CLAY	MODERATE	DARK REDDISH ORANGE	-	10% TO 10mm	DRY FIRM	VERY

APPENDIX 2: NSW HEALTH ACCREDITED

AWTS Model	Company	Contact
Envirocycle 10NR	Capital Waterworks	02 6258 1378
BioSeptic Performa	BioSeptic Pty Ltd	1300 658 111
Clearwater Biodigestor MK II	Clearwater Sewerage	1300 132 760
Earthsafe ES10PC	Eathsafe Environmental	1300 327 847
Econocycle ENC10-1, ENC10-2	Eco-Septic	02 4774 1316
Aqua Nova 10EP, NR, MBR10	Everhard Industries	02 9757 2799
Fuji Clean CE1200, CRX1500,	Fugi Clean Australia	0400 786 685
Ultra Clear Ultra10, ST8, ST10	Highland Tanks	02 4889 8288
Turbojet 2000	Icon-Septech	02 9724 7899
Krystel Kleer ADV5000	Capital Waterworks	02 6258 1378
Biocycle Model BIO 7000	JOWA Group	08 8381 9100
Waterboy HSTP, Model S	Magnesium Tech	07 4055 1141
Garden Master GM7100, MBR	Rainflow Storwater Solutions	02 4932 1011
Ozzi Kleen RP10	Suncoast Waste Water	07 5459 4900
Super-Treat SE 10, SB 10	Super-Treat Systems	02 4422 3861
Talylex Poly ABS, ABS, DMS	Taylex Industries Pty Ltd	07 3441 5200

Appendix 3: Important Reading

Phone Office/Lab (02) 6775 1157
Fax (02) 6775 1043
ABN: 72 212 385 096
email: rob@lanfaxlabs.com.au
Website: http://www.lanfaxlabs.com.au
493 Old Inverell Road
(P.O. Box W90) Armidale NSW 2350
Director: Dr Robert Patterson FIEAust, CPSS, CPAg
Soil Scientists and Environmental Engineers

Lanfax Laboratories

Performance certified by Aust. Soil & Plant Analysis Council

LAUNDRY PRODUCTS RESEARCH

Laundry products were purchased by ***Lanfax Labs*** from supermarkets in Armidale, NSW and a number of boutique products were provided by manufacturers. A total of 41 liquids and 54 powders were tested by mixing each product at the manufacturer's recommended dose for either front loading or top loading automatic washing machines. The dose was calculated at the full cycle load, that is 75 L for front loaders and 150 L for top loaders. The full cycle accounts for the water used in the wash, spin, rinse, deep rinse and spin rinse cycle. The quantities of 75 L for front loaders and 150 L for top loaders were taken from averaged rates for those machines (Patterson, 2004).

Each sample was mixed with cold (20°C) deionised water (to replicate good quality rainwater). Where town water supplies are used, the values reported for sodium concentrations may increase because of sodium in the reticulated water – that will vary from location to location, usually higher in inland than coastal towns. Each sample was shaken for 30 minutes to replicate the washing action.

The concentrations of sodium and phosphorus (and other elements) were measured on the samples using Inductively Coupled Plasma (ICP) technology in accordance with current Good Laboratory Practices at ***Lanfax Labs***.

Only sodium (g/wash) and phosphorus (mg/L) are reported in the graphs presented here.

Additional information on this unique research may be obtained at: www.lanfaxlabs.com.au/laundry.htm

Other papers on laundry detergents can be found at: www.lanfaxlabs.com.au/publications.html

HOW TO READ THE GRAPHS

Each product is represented by two bars: the top bar (if present) shows the phosphorus concentration (mg/L); while the lower bar shows the sodium load (g/wash). The graph is arranged in ranked order of sodium load. Figure F1 is for 54 detergents at the front loader rate, Figure T1 is for 89 detergents at the top loader rate.

Sodium Load

For all on-site systems that apply the effluent by surface or subsurface application, the levels of sodium in the discharge are critical to long term absorption. Choose the product with the lowest sodium load (g/wash). Levels above 20 g/wash are likely to be detrimental to plants and the soil although plant tolerance and soil types will vary. The shorter the bar, the lower the load. When in doubt, choose the lower sodium load.

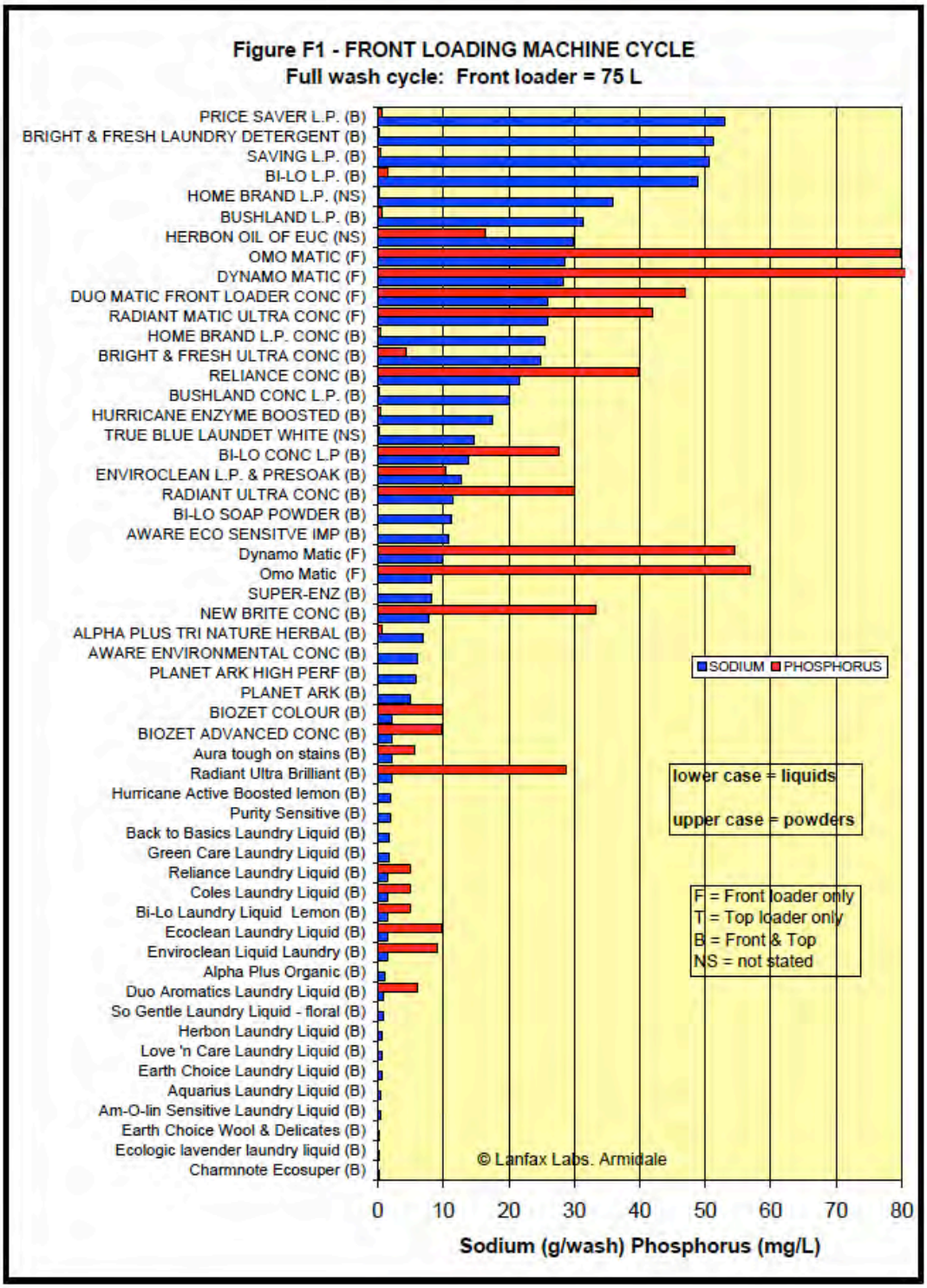
The detergents with long sodium bars (greater than 20 g/wash) should not be thrown onto your favourite garden as the sodium may be detrimental to the plants. High pH (see the website for pH data) is also detrimental to plants and soil. The pH of liquids (average pH 8) is generally lower than pH of powder detergents (average pH 10.5).

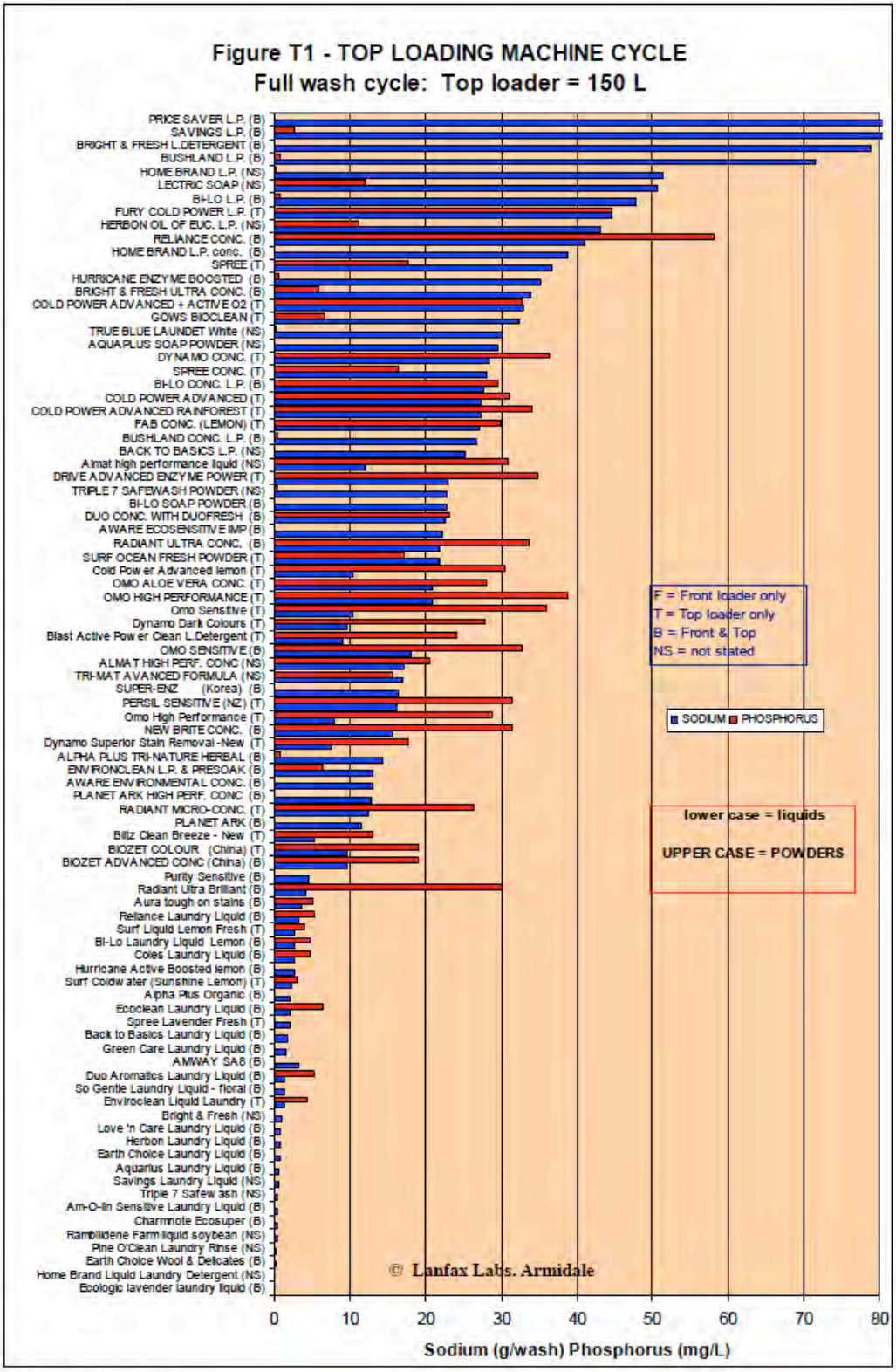
Phosphorus Concentration

The choice of a suitable level of phosphorus in the greywater (laundry water discharge) will depend upon the soil type and the use of the effluent. In some soils, phosphorus is not a real concern because of the natural ability of the soil to immobilize the phosphorus and limit its leaching from the disposal site. In other soils, phosphorus is likely to build up to high levels and leach from the soil. It is preferable to choose the lower phosphorus values as well as the low sodium values. The load of phosphorus for each product is available in the website data.

This research was funded by Lanfax Labs and was independent of any manufacturer or other organisation.

Caution: Formulations may have changes since these products were purchased in 2005.





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Scope

This report provides site and soil assessment for on-site effluent disposal at the applicant's proposed new subdivision. A four bedroom dwelling is assumed. An Aerated Wastewater Treatment System (AWTS) is proposed.

An AWTS coupled with surface or subsurface irrigation provides the most suitable form of effluent treatment for the site and soil characteristics of the land in question. The most suitable site for effluent application in the proposed subdivision is indicated in Figure 1. Alternative treatment and irrigation/dispersal areas may be suitable for other isolated areas subject to further site specific investigation at dwelling DA stage.

The management recommendations include the size and location of the proposed irrigation area.

References

AS/NZS 1547:2012 *On-site domestic wastewater management*

On-site sewerage management for single households (Anon, 1998)

Hird, C. *Soil Landscapes of the Goulburn 1:250 000 Sheet*

SITE CHARACTERISTICS

The terrain of the site comprises a gently to moderately inclined mid slope overlying mudstones and limestones of the Cliftonwood Limestone member. The site was selected for adequate soil depth, avoiding outcropping granite on the higher and steeper slopes. The slope across the proposed irrigation area is 4 - 6 degrees and has a linear planar configuration ensuring that runoff does not concentrate within the site.

The soil at the site is well drained. It comprises fine sandy loam upper and lower topsoils to 4cm and 40cm respectively, overlying a sandy clay loam subsoil to 100cm+.

SITE EVALUATOR

Company	Land Capability Services
Name	Richard Miller
ph:	0417 694 638
email:	rgmiller@mac.com
Date of assessment	November 30, 2016
Signature of evaluator	

SITE INFORMATION

Address	Lot 108 DP754923, 59 Irvine Drive Yass NSW 2582
Council area	Yass Valley
Owner/developer	Ruth Condon
Area	10 ha
Site plan attached	Yes
Photograph attached	Yes
Intended water supply	Rainwater
Expected wastewater quantity (litres/day)	600 (Assumed 4 bedroom dwelling, potentially housing 5 occupants generating design flows of 120L/person/day = 600 litres/day)
Local experience	Aerated wastewater treatment systems provide adequate treatment of effluent on appropriate soils.

SITE ASSESSMENT

Climate	Warm to hot summers with a large evaporative deficit**.** Cool to cold winters with a small evaporative deficit

Where appropriate:	
Rainfall water balance attached	Yes
Land application area calculation attached	Yes
Wet weather storage area calculation attached	NA
Flood potential:	
Land application area above 1 in 20 year flood level	Yes
Land application area above 1 in 100 year flood level	Yes
Electrical components above 1 in 100 year flood level	Yes

Exposure	Well exposed with no shade.
Slope	Linear planar
Landform	Mid slope
Run-on	See management prescriptions
Seepage	None in irrigation area
Erosion Potential	Low – adequate vegetative cover
Site Drainage	Well drained
Fill	None in application area
Groundwater:	
Horizontal distance to groundwater well used for domestic water supply	>250m
Groundwater vulnerability map referred to	Yass LEP 2013 Sheet CL2_001
Vulnerability rating	Within vulnerability area
Bores in the area and their purpose	Stock & domestic
Buffer distance from wastewater management system to:	
Yass River	>100m
Dam	NA
Drainage line	NA
Boundary of property & driveways	>6m
Swimming pools	>6m
Buildings	>15m
Is there sufficient land area for:	
Application system (including buffer distances)	Yes
Reserve application system (including buffer distances)	Yes
Surface rocks	None

SOIL ASSESSMENT

Depth to bedrock or hardpan		>100cm
Depth to soil watertable		>100cm
Hydraulic loading rate		
Soil structure		Weak in topsoil Moderate in subsoil
Soil texture		Sandy loam topsoil Sandy clay loam subsoil
Permeability category	(2)	>3.0m/day in topsoil
Hydraulic loading recommended for irrigation system		2.4 mm/day irrigation
Coarse Fragments		10% to 10mm in topsoil
Bulk Density		Estimate 1.5
Ph (1:5 in water)		Topsoil 5.7 Subsoil 6.7
Electrical conductivity (uS)		Topsoil .08 (Low) Subsoil .07 (Low)
Geology & soil landscape survey		
Presence of discontinuities		None
Presence of fractured rock		None
Soil landscape reference		Cockatoo
Dispersiveness		None in topsoil EAT 8 None in subsoil EAT 5(2)

SYSTEM SELECTION

Consideration of connection to a centralised sewerage system

Nearest feasible connection point	2km
Potential for future connection to centralised sewerage	None
Potential for future connection to reticulated water	Unknown

Type of land application system best suited to site:

Surface or subsurface irrigation

Reason Best suits site and soil characteristics, minimal environmental risk. Evapotranspiration/absorption beds may be suitable dependant on further investigation at dwelling DA stage.

Type of treatment system best suited to site and application system:

Aerated wastewater treatment

Reason Superior standard of treatment for site and soil conditions

GENERAL COMMENTS

Are there any specific environmental constraints? None so long as area designated as suitable for effluent application is adhered to.

The site is within a mapped groundwater vulnerability area, however ample soil depth and shallow or surface irrigation mitigates risk.

Are there any specific health constraints? None

MANAGEMENT PRESCRIPTIONS

Aerated wastewater treatment systems treat effluent to an improved, or secondary standard, reducing any impact on groundwater and making available water for landscaping and other purposes. The following prescriptions are site specific and must be strictly adhered to, in order to maximise water and nutrient uptake, and thus minimise runoff and seepage.

The AWTS must be accredited by NSW Health.

The treated wastewater must not be applied to bare ground, it must be applied to a well vegetated site, to maximise the effects of evapotranspiration.

An irrigation area of 250 m^2 should be sown to improved perennial pastures, which once established, should be regularly mown to improve rates of nitrogen uptake. The irrigation area should be fenced off from stock and vehicular access.

The treated effluent may be applied by surface irrigation. Surface sprays must be of the large droplet type that do not produce aerosols.

The treated effluent may also be applied by sub-surface irrigation.

Auto flush return to the tank should be installed to ensure flocculants in the lines are recycled back to the tank. Irrigation laterals to be installed on the contour at 100mm depth and at nominal 1000mm spacing.

The distribution line from the AWTS to the effluent irrigation area must be buried at least 300mm underground or 450mm where vehicles pass over.

The irrigation area must not be disturbed by any building activity such as stockpiles of excavated material or vehicle traffic.

A reserve irrigation area of the same dimensions should be set aside and developed after 30 years to spread nutrient discharges.

Detergents should be selected for low levels of phosphorus and sodium.
(See appendix 3)

Water saving devices should be installed in the house, including dual flush toilets, shower-flow restrictors, aerator taps and water conserving washing machines.

Fig 1. Area suitable for effluent application

WATER BALANCE

A water balance model is helpful in assessing the sensitivity of the design to various input and output characteristics.

Irrigation area sizing using Nominated Area Water Balance for Zero Storage

Site Address:			**Lot 3 @ 59 Irvine Drive, Yass**	
Date:			**Assessor:**	

INPUT DATA

Design Wastewater Flow	Q	600	L/day	Based on maximum potential occupancy and derived from Table 4 in the EPA Code of Practice (2013)
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Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
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Rainfall	R		mm/month	50.3	45.5	46.7	49	49.9	57.9	59.6	59.3	56.8	64.5	56.6	55.8	**651.9**
Evaporation	E		mm/month	260.4	207.2	176.7	111	68.2	48	52.7	80.6	114	161.2	198	248	**1726**
Crop Factor	C		unitless	0.80	0.80	0.70	0.70	0.60	0.60	0.60	0.60	0.70	0.80	0.80	0.80	
OUTPUTS																
Evapotranspiration	ET	ExC	mm/month	208	166	124	78	41	29	32	48	80	129	158	198	**1290.73**
Percolation	B	DIRxD	mm/month	108.5	98	108.5	105.0	108.5	105.0	108.5	108.5	105.0	108.5	105.0	108.5	**1277.5**
Outputs		ET+B	mm/month	316.8	263.76	232.2	182.7	149.4	133.8	140.1	156.9	184.8	237.5	263.4	306.9	**2568.2**
INPUTS																
Retained Rainfall	RR	RxRF	mm/month	50.3	45.5	46.7	49	49.9	57.9	59.6	59.3	56.8	64.5	56.6	55.8	**651.9**
Applied Effluent	W	(QxD)/L	mm/month	62.0	56.0	62.0	60.0	62.0	60.0	62.0	62.0	60.0	62.0	60.0	62.0	**730.0**
Inputs		RR+W	mm/month	112.3	101.5	108.7	109.0	111.9	117.9	121.6	121.3	116.8	126.5	116.6	117.8	**1381.9**
STORAGE CALCULATION																
Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the month	S	(RR+W)-(ET+B)	mm/month	-204.5	-162.3	-123.5	-73.7	-37.5	-15.9	-18.5	-35.6	-68.0	-111.0	-146.8	-189.1	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Maximum Storage for Nominated Area	N		mm	0.00												
	V	NxL	L	0												
LAND AREA REQUIRED FOR ZERO STORAGE			m^2	70	77	100	135	187	237	231	191	141	108	87	74	

MINIMUM AREA REQUIRED FOR ZERO STORAGE: 238.0 m^2

Based on an expected quantity of 600l/day of wastewater, spread across 250 m^2 of irrigation area, the effluent application rate of 2.4mm/day results in a moisture deficit in all months of the year, albeit a smaller deficit in the winter months.

Importantly, the deficit is theoretical and it should be noted that saturation is possible at any time following periods of extended wet weather.

The application rate of 2.4mm/day is comparatively conservative, against the rate of 5mm/day determined from table M1 from AS1547:2012.

NUTRIENT BALANCE

The nutrient balance examines the discharge of nitrogen and phosphorus against the capacity of plants and soil to assimilate those nutrients. Excess nutrients may eventually impact upon watercourses via surface run-off or groundwater.

Nitrogen Balance

Site Address:	**Lot 3 @ 59 Irvine Drive, Yass**								
SUMMARY - LAND APPLICATION AREA REQUIRED BASED NITROGEN BALANCE								199	m^2
INPUT DATA[1]									
Wastewater Loading				**Nutrient Crop Uptake**					
Hydraulic Load	600	L/day		Crop N Uptake	220	kg/ha/yr	which equals	50.27	mg/m²/day
Effluent N Concentration	25	mg/L							
% N Lost to Soil Processes (Geary & Gardner 1996)	0.2	Decimal							
Total N Loss to Soil	3000	mg/day							
Remaining N Load after soil loss	12000	mg/day							
NITROGEN BALANCE BASED ON ANNUAL CROP UPTAKE RATES									
Minimum Area required with zero buffer			**Determination of Buffer Zone Size for a Nominated Land Application Area (LAA)**						
Nitrogen	199	m²	Nominated LAA Size			300	m²		
			Predicted N Export from LAA			-2.22	kg/year		
			Minimum Buffer Required for excess nutrient			0	m²		

600 litres/day wastewater quantity at 25mg/l total N concentration
= 5.5 kg nitrogen discharged per year, applied over an irrigation area of 250 m^2 = 220 kg/ha/yr.

A combination of existing native grasses and introduced pasture species should provide a rate of nitrogen uptake of around 220kg/ha/yr.
Total nitrogen loss to soil processes should account for 44kg/ha/yr.

Therefore the discharge of nitrogen should be balanced by plant uptake & soil processes.

Phosphorus Loading

600 litres/day wastewater quantity at 10mg/l of P
= 2.2 kg P discharged per year, applied over an irrigation area of 250 m^2 = 88kg/ha/yr.

A combination of existing native grasses and introduced pasture species should provide a rate of P uptake of around 20kg/ha/yr.

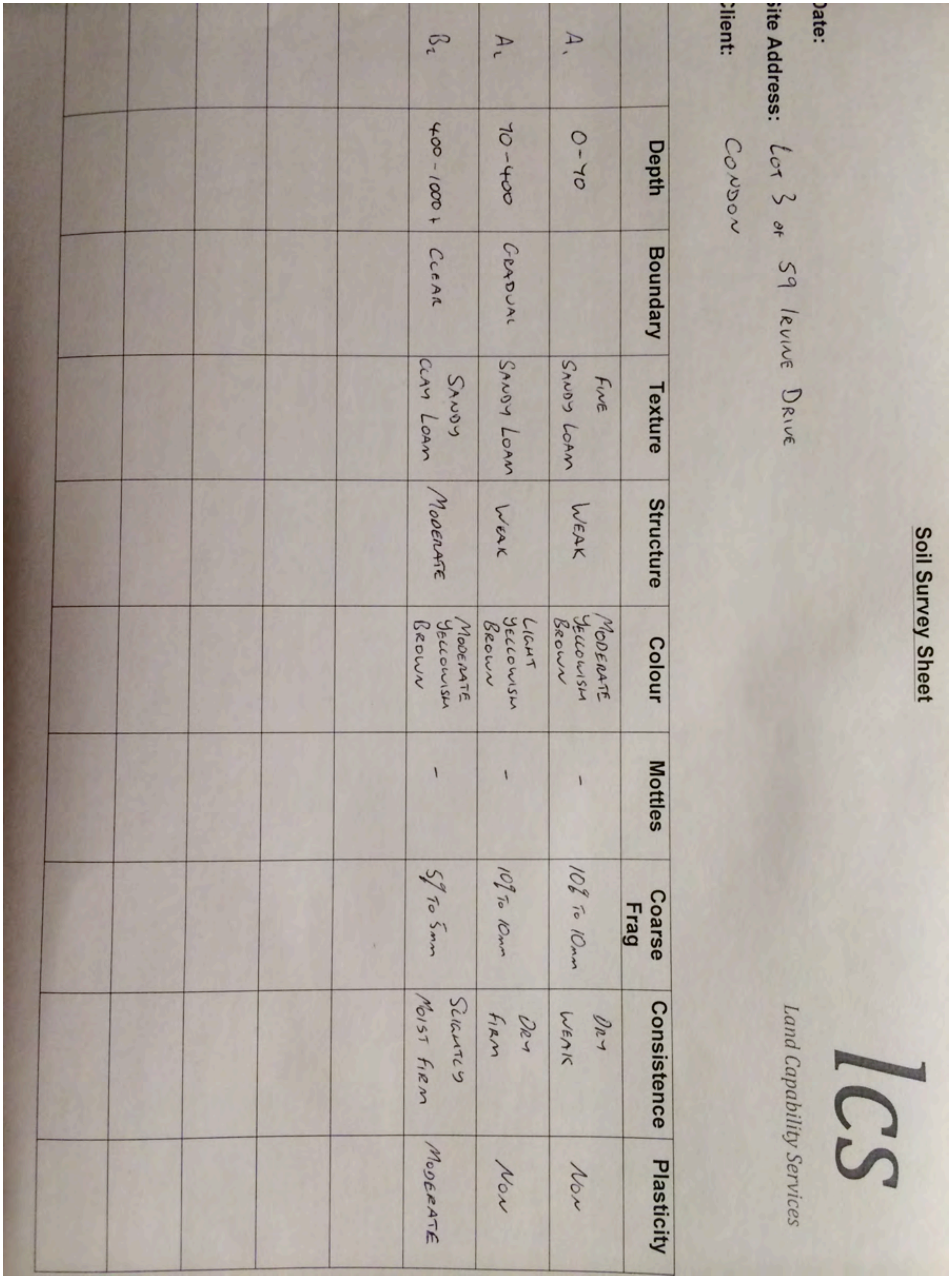
Balance of 68kg/ha/yr. applied to P sorption capacity of soil;

P sorption capacity of in-situ soil 2250kg/ha. [1]

Lifetime of irrigation area 33 years in terms of P sorption capacity.

[1] SCA "*Design and Installation of On-site Wastewater Systems",* P. Sorption Uptake Values (Typical)

APPENDIX 1: SOIL SURVEY SHEET



LCS
Land Capability Services

Soil Survey Sheet

Date:

Site Address: Lot 3 of 59 Irvine Drive

Client: Condon

	Depth	Boundary	Texture	Structure	Colour	Mottles	Coarse Frag	Consistence	Plasticity
A1	0-70		Fine Sandy Loam	Weak	Moderate Yellowish Brown	-	10% to 10mm	Dry Weak	Non
A2	70-400	Gradual	Sandy Loam	Weak	Light Yellowish Brown	-	10% to 10mm	Dry Firm	Non
B2	400-1000+	Clear	Sandy Clay Loam	Moderate	Moderate Yellowish Brown	-	5% to 5mm	Slightly Moist Firm	Moderate

APPENDIX 2: NSW HEALTH ACCREDITED

AWTS Model	Company	Contact
Envirocycle 10NR	Capital Waterworks	02 6258 1378
BioSeptic Performa	BioSeptic Pty Ltd	1300 658 111
Clearwater Biodigestor MK II	Clearwater Sewerage	1300 132 760
Earthsafe ES10PC	Eathsafe Environmental	1300 327 847
Econocycle ENC10-1, ENC10-2	Eco-Septic	02 4774 1316
Aqua Nova 10EP, NR, MBR10	Everhard Industries	02 9757 2799
Fuji Clean CE1200, CRX1500,	Fugi Clean Australia	0400 786 685
Ultra Clear Ultra10, ST8, ST10	Highland Tanks	02 4889 8288
Turbojet 2000	Icon-Septech	02 9724 7899
Krystel Kleer ADV5000	Capital Waterworks	02 6258 1378
Biocycle Model BIO 7000	JOWA Group	08 8381 9100
Waterboy HSTP, Model S	Magnesium Tech	07 4055 1141
Garden Master GM7100, MBR	Rainflow Storwater Solutions	02 4932 1011
Ozzi Kleen RP10	Suncoast Waste Water	07 5459 4900
Super-Treat SE 10, SB 10	Super-Treat Systems	02 4422 3861
Talylex Poly ABS, ABS, DMS	Taylex Industries Pty Ltd	07 3441 5200

Appendix 3: Important Reading

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Director: Dr Robert Patterson FIEAust, CPSS, CPAg
Soil Scientists and Environmental Engineers

Lanfax Laboratories

Performance certified by Aust. Soil & Plant Analysis Council

LAUNDRY PRODUCTS RESEARCH

Laundry products were purchased by ***Lanfax Labs*** from supermarkets in Armidale, NSW and a number of boutique products were provided by manufacturers. A total of 41 liquids and 54 powders were tested by mixing each product at the manufacturer's recommended dose for either front loading or top loading automatic washing machines. The dose was calculated at the full cycle load, that is 75 L for front loaders and 150 L for top loaders. The full cycle accounts for the water used in the wash, spin, rinse, deep rinse and spin rinse cycle. The quantities of 75 L for front loaders and 150 L for top loaders were taken from averaged rates for those machines (Patterson, 2004).

Each sample was mixed with cold (20°C) deionised water (to replicate good quality rainwater). Where town water supplies are used, the values reported for sodium concentrations may increase because of sodium in the reticulated water – that will vary from location to location, usually higher in inland than coastal towns. Each sample was shaken for 30 minutes to replicate the washing action.

The concentrations of sodium and phosphorus (and other elements) were measured on the samples using Inductively Coupled Plasma (ICP) technology in accordance with current Good Laboratory Practices at ***Lanfax Labs***.

Only sodium (g/wash) and phosphorus (mg/L) are reported in the graphs presented here.

Additional information on this unique research may be obtained at: www.lanfaxlabs.com.au/laundry.htm

Other papers on laundry detergents can be found at: www.lanfaxlabs.com.au/publications.html

HOW TO READ THE GRAPHS

Each product is represented by two bars: the top bar (if present) shows the phosphorus concentration (mg/L); while the lower bar shows the sodium load (g/wash). The graph is arranged in ranked order of sodium load. Figure F1 is for 54 detergents at the front loader rate, Figure T1 is for 89 detergents at the top loader rate.

Sodium Load

For all on-site systems that apply the effluent by surface or subsurface application, the levels of sodium in the discharge are critical to long term absorption. Choose the product with the lowest sodium load (g/wash). Levels above 20 g/wash are likely to be detrimental to plants and the soil although plant tolerance and soil types will vary. The shorter the bar, the lower the load. When in doubt, choose the lower sodium load.

The detergents with long sodium bars (greater than 20 g/wash) should not be thrown onto your favourite garden as the sodium may be detrimental to the plants. High pH (see the website for pH data) is also detrimental to plants and soil. The pH of liquids (average pH 8) is generally lower than pH of powder detergents (average pH 10.5).

Phosphorus Concentration

The choice of a suitable level of phosphorus in the greywater (laundry water discharge) will depend upon the soil type and the use of the effluent. In some soils, phosphorus is not a real concern because of the natural ability of the soil to immobilize the phosphorus and limit its leaching from the disposal site. In other soils, phosphorus is likely to build up to high levels and leach from the soil. It is preferable to choose the lower phosphorus values as well as the low sodium values. The load of phosphorus for each product is available in the website data.

This research was funded by Lanfax Labs and was independent of any manufacturer or other organisation.

Caution: Formulations may have changes since these products were purchased in 2005.