8 Water Reduction Fixtures and Detergent Choice

AAA rated plumbing and low phosphate, low sodium detergents are recommended to conserve limited water supplies and maintain optimal performance of the irrigation, soil and plant systems. In addition, "Insinkerator" style kitchen garbage disposal units should be avoided as they increase water consumption and nutrient and BOD concentrations of household effluent.

Water saving devices are recommended to reduce the volume of water that needs to be applied to the site, and thus reduce the risk of any runoff. The National Water Conservation Labelling Scheme indicates that the average family can save about 50 KL per year by adopting AAA rated hardware in their showers, kitchen and laundry.

Using the following water saving devices, the average household's water consumption can be reduced from 900 litres to 750 litres per day:

- dual flush 6/3 L pan and cistern (average household savings of 93 L/day) [7];
- AAA rated shower heads to limit flow to 6 L/minute [19]
- AAA rated dishwasher (not more than 18 litres for each wash cycle) [8];
- AAA rated washing machine (not more than 22 litres per dry kg of clothes)**;

Low sodium detergents ensure that the soil structure, and hence its absorption capacity, is maintained as close as possible to a natural condition. Low phosphorus detergents ensure that optimum plant growth is maintained and that excess phosphorus is not leached into the environment. Detergents which are low in both sodium and phosphorus should be chosen from the table in Appendix F which has been produced by Lanfax Laboratories, Armidale. Sodium in laundry powders is used as a filler. Therefore, in general, liquid detergents are preferred over powder.

7 Source: Independent Pricing and Regulation Tribunal of NSW (1996) , Water Demand Management: A Framework for Option Assessment

8 Source: Sydney Water Demand Management Strategy, October 1995

9 Mitigation Measures

9.1 Protection of Effluent Management Area

During future house construction the proposed land application areas should be fenced off to exclude access by heavy construction machinery. This will avoid compaction and degradation of the site's soils and will help maintain the existing groundcover to reduce the erosion hazard. Furthermore, stock must not be allowed access to effluent management areas.

9.2 Landscaping

Lawn and/or garden beds should be established in all land application areas prior to commencement of irrigation. This is important to reduce the erosion hazard, to help prevent effluent runoff from the site and to maximise the uptake of water and nutrients. To facilitate nutrient removal lawns and gardens should be cut regularly and all clippings removed from the site. Planting of low growing trees and shrubs will also help with the uptake of water and nutrients. A list of suitable plants for land application areas is contained in Appendix G (DLG 1998).

10 Conclusions

Morse McVey & Associates have undertaken site and soil investigations of lands at the southern end of Hawthorne Rd, Bargo for the purpose of assessing site suitability for a proposed rural residential subdivision. Our investigations focus on proposed one acre lots where onsite effluent management is proposed. We recommend that all proposed allotments can effectively manage domestic wastewater onsite, based on the following:

(i) installation of an approved secondary wastewater treatment system, such as an aerated wastewater treatment system (AWTS), to treat all household wastewater from the residence;

(ii) disposal of treated wastewater in a properly sized, designed and managed irrigation area. Based on a standard 5-bedroom residence, a total irrigation area of 820 square metres is required. The total irrigation area must be broken up into at least two separate zones with manual or automatic switching valves used to switch between the different areas. The irrigation design must ensure even and widespread dispersal of effluent throughout the entire irrigation area;

(iii) spray irrigation may only be adopted on category 1 sites, i.e sites that have more than 1500 m^2 of land available. Lots with less than 1500 m^2 must use subsurface irrigation. To some extent this will not be known until a site - specific onsite wastewater management report is done for each lot. However all lots have enough land to fit the required 860 m^2 as shown in figures 2 to 6;

(iv) all irrigation areas must be well vegetated either with lawn or established garden beds prior to commencing effluent disposal – a landscape plan must be prepared;

(v) proposed effluent management areas must be fenced during construction activities to prevent compaction and soil degradation by construction equipment;

(vi) installation of water saving devices to conserve water and minimise overloading of the irrigation area;

(vii) selection of low phosphorus, low sodium detergents and cleaning compounds to reduce the levels of chemical contaminants in wastewater. Generally, liquid detergents are preferred over powders; and

(viii) no additional wet weather storage is required.

11 References

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12 Appendixes

Appendix A: Site & Soil Assessment Rating for Onsite Systems
Appendix B: Water and nutrient balance calculations
Appendix C: Soil Borelogs
Appendix D: Laboratory Soil Test Results
Appendix E: Irrigation Options
Appendix F: Laundry Detergent Research
Appendix G: Vegetation Suitable for Land Application Areas

Appendix A – Site Assessment: Rating for On-site Systems

Adapted from: *Environment and Health Protection Guidelines: Onsite Sewage Management for Single Households (Department of Local Government, 1998)*

SITE FEATURE	RELEVANT SYSTEM(S)	MINOR LIMITATION	MODERATE LIMITATION	MAJOR LIMITATION	RESTRICTIVE FEATURE
Flood potential	All land application systems	Rare, above 1 in 20 year flood contour		Frequent, below 1 in 20 year flood contour	Transport of wastewater off-site
	All treatment systems	Vents, openings, electrical components above 1 in 100 year flood contour		Vents, openings, & electrical components below 1 in 100 year flood contour	Transport of wastewater off-site, Systems failure & electrocution hazard
Exposure	All land application systems	High sun & wind exposure		Low sun & wind exposure	Poor evapotranspiration
Slope %	Surface irrigation	0-6	6-12	>12	Run-off, erosion
	Sub-surface irrigation	0-10	10-20	>20	Run-off, erosion
	Absorption system	0-10	10-20	>20	Run-off, erosion
Landform	All systems	Hill crests, convex side slopes, plains	Concave side slopes, footslopes	Drainage plains & incised channels	Groundwater pollution hazard
Run-on & upslope seepage	All land application systems	None - low	Moderate	High - diversion not practical	Transport of wastewater off -site
Erosion potential	All land application systems	No signs of erosion potential present		Signs of erosion, e.g. rills, mass movement, slope failure, present	Soil degradation & transport, system failure
Site Drainage	All land application systems	No visible signs of surface dampness		Visible signs of surface dampness, such as moisture-tolerant vegetation (seges & ferns), soaks & springs	Groundwater pollution hazard Resurfacing hazard
Fill	All systems	No fill	Fill present		Subsidence. Variable permeability
Buffer distances	All land application systems	(see report)			Health & pollution risks
Land area	All systems	Area is available		Area is not available	Health & pollution risks
Rocks & rock outcrops (% of land surface containing rocks > 200mm dia)	All land application systems	<10%	10-20%	>20%	Limits system performance

Soil Assessment: Rating for On-site Systems

SOIL FEATURE	RELEVANT SYSTEM(S)	MINOR LIMITATION	MODERATE LIMITATION	MAJOR LIMITATION	RESTRICTIVE FEATURE
Geology/ Regolith	All land application systems			Major geological discontinuities, fractured, ect.	Groundwater pollution hazard
Depth to bedrock or hardpan (m)	Surface irrigation Sub-surface irrigation	>1.0	0.5-1.0	<0.5	Groundwater pollution hazard Resurfacing hazard
	Absorption system	>1.5	1.0-1.5[2]	<1.0	Potential for groundwater pollution
Soil permeability Category [3]	Surface irrigation Sub-surface irrigation	2b, 3 & 4	2a, 5	1 & 6	Excessive run-off, waterlogging, percolation
	Absorption system [4]	3 & 4		1,2,5 & 6	
Coarse fragments (%)	All land application systems	0-20	20-40	>40	May restrict plant growth, affect trench installation
Bulk density (g/cm^3)	All land application systems				Restricts plant growth, indicator of permeability
Sandy Loam Loam & Clay Loam, Clay	<1.8 <1.6 <1.4			>1.8 >1.6 >1.4	
pH_{CaCl}	All land application systems	>6.0	4.5-6.0		Reduces optimum plant growth
Electrical conductivity (dS/m)	All land application systems	<4	4-8	>8	Excessive salt may restrict plant growth
Sodicity (exchangeable sodium percentage)[5]	Surface irrigation Sub-surface irrigation (0-40cm)	0-5	5-10	>10	Potential for structural degradation
	Absorption system (0-1.2m)				
Cation exchange capacity ($cmol^+/kg$) (0-40cm)	Surface irrigation Sub-surface irrigation	>15	5-15	<5	Unable to hold plant nutrients
Phosphorus sorption (kg/ha) (0-100cm for irrigation) (100cm below intended base of trench)	All land application systems	>6000	2000-6000	<2000	Unable to immobilise any excess P
Modified Emerson Aggregate Test	All land application systems	Class 3, 4, 5, 6, 7 & 8	Class 2	Class 1	Potential for structural degradation

Appendix B - Water and Nutrient Balance Calculations

Table A1 : Minimum Area Method
Water Balance and Wet Weather Storage Calculations

Rainfall Station: Buxton
Expected wastewater quantity: *5 bedroom/7 person at 145L per person* *1015 litres/day*

Expected wastewater *1015 litres/day*

Design Wastewater Flow	(Q)	l/day	1015
Design Percolation Rate	(R)	mm/wk	28

Parameter	Symbols	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	87.3	70.3	81.6	39.9	37.9	31.7	25.0	27.0	42.2	51.6	80.2	63.0	897.2
Evaporation	(E)		mm/month	200.0	180.0	130.0	100.0	75.0	55.0	85.0	87.0	110.0	150.0	175.0	260.0	1957.0
Crop factor	(C)			0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	
Outputs																
Evapotranspiration	(ET)	E x C	mm/month	160.0	126.0	104.0	70.0	52.5	38.5	45.5	60.9	77.0	120.0	140.0	200.0	1196.4
Percolation	(B)	(R / 7) x D	mm/month	124.0	112.0	124.0	120.0	124.0	120.0	124.0	124.0	120.0	124.0	120.0	124.0	1480.0
Outputs		(ET + B)	mm/month	284.0	240.0	228.0	190.0	176.5	158.5	169.5	184.9	197.0	244.0	260.0	324.0	2656.4
Inputs																
Precipitation	(P)		mm/month	87.3	70.3	81.6	39.9	37.9	31.7	25.0	27.0	42.2	51.6	80.2	63.0	897.2
Possible Effluent Irrigation	(W)	(ET + B) - P	mm/month	196.7	169.7	146.4	150.1	138.6	128.8	144.5	157.9	154.8	192.4	179.8	261.0	2016.7
Actual Effluent Production	(I)	H / 12	mm/month	168.2	168.2	168.2	168.2	168.2	168.2	168.2	168.2	168.2	168.2	168.2	168.2	2016.7
Inputs		(P + I)	mm/month	255.5	238.5	249.8	208.1	206.1	199.9	193.2	195.2	210.4	219.8	248.4	231.2	2656.4
Storage	(S)	(P +I)-(ET +B)	mm/month	-28.5	-1.5	21.8	18.1	29.6	41.4	23.7	10.3	13.4	-24.2	-11.6	-92.8	
Cumulative Storage	(M)		mm	0.0	0.0	21.8	39.9	69.6	111.0	134.7	145.0	158.5	134.3	122.7	29.9	
Irrigation Area	(L)	(365 X Q) / H	m^2	184												
Storage	(V)	Largest M	mm	158.5												
		(V X L) / 1000	m^3	29.1												

Buxton 5(1015).qpw

Morse McVey & Associates Pty Ltd

Table A2 : Nominated Irrigation Area Method

Water Balance and Wet Weather Storage Calculations

Rainfall Station: Buxton

Expected Wastewater Quantity:

5 bedroom/7 person at 145L per person *1015 litres/day*

Expected wastewater *1015 litres/day*

Design Wastewater Flow	(Q)	l/day	1015
Design Percolation Rate	(R)	mm/wk	28
Land Area	(L)	square metres	250

Parameter	Symbols	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	87.3	70.3	81.6	39.9	37.9	31.7	25.0	27.0	42.2	51.6	80.2	63.0	897.2
Evaporation	(E)		mm/month	200.0	160.0	130.0	100.0	75.0	55.0	65.0	87.0	110.0	150.0	175.0	250.0	1557.0
Crop factor	(C)			0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	
Inputs																
Precipitation	(P)		mm/month	87.3	70.3	81.6	39.9	37.9	31.7	25.0	27.0	42.2	51.6	80.2	63.0	897.2
Effluent Irrigation	(W)	(Q x D) / L	mm/month	125.9	113.7	125.9	121.8	125.9	121.8	125.9	125.9	121.8	125.9	121.8	125.9	1481.9
Inputs		(P + W)	mm/month	213.2	184.0	207.5	161.7	163.8	153.5	150.9	152.9	164.0	177.5	202.0	188.9	2119.6
Outputs																
Evapotranspiration	(ET)	E x C	mm/month	160.0	128.0	104.0	70.0	52.5	38.5	45.5	60.9	77.0	120.0	140.0	200.0	1196.4
Percolation	(B)	(R / 7) x D	mm/month	124.0	112.0	124.0	120.0	124.0	120.0	124.0	124.0	120.0	124.0	120.0	124.0	1460.0
Outputs		(ET + B)	mm/month	284.0	240.0	228.0	190.0	176.5	158.5	169.5	184.9	197.0	244.0	260.0	324.0	2656.4
Storage	(S)	(P +W)-(ET +B)	mm/month	-70.8	-56.0	-20.5	-28.3	-12.7	-5.0	-18.6	-32.0	-33.0	-66.5	-58.0	-135.1	
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	

Storage	(V)	Largest M	mm	0.0
		(V X L) / 1000	m^3	0.0

Table A3 : Balancing Table

Rainfall Station:	Buxton	
Expected Wasetwater quantity:		
5 bedroom/7 person at 145L per person	1015	l/day
Expected Wasetwater	1015	l/day

Maximum storage month: July
Number of days in month: 31 days

Irrigation Area (m^2)	Jan 31	Feb 28	Mar 30	Apr 31	May 30	Jun 30	Jul 31	Aug 31	Sep 30	Oct 31	Nov 30	Dec 31	Annual Storage (m^3)
184	171	155	166	171	166	166	171	171	166	171	166	171	29.1
200	157	142	152	157	152	152	157	157	152	157	152	157	14.0
200	157	142	152	157	152	152	157	157	152	157	152	157	14.0
200	157	142	152	157	152	152	157	157	152	157	152	157	14.0
200	157	142	152	157	152	152	157	157	152	157	152	157	14.0
200	157	142	152	157	152	152	157	157	152	157	152	157	14.0
200	157	142	152	157	152	152	157	157	152	157	152	157	14.0
250	126	114	122	126	122	122	126	126	122	126	122	126	0.0

Table A4 : Nutrient Balance

Rainfall Station: Buxton

Expected Wastewater Quantity:

5 bedroom/7 person at 145L per person 1015 l/day

Expected wastewater 1015 l/day

Nitrogen Balance

The formula used to determine area requirements based on organic matter and nutrient loads is as follows:

$$A = \frac{C \times Q}{L_x}$$

Where:

A = Land area (m^2)

C = Concentration of nutrient or BOD (mg/l)
= 20 mg/l

Q = treated wastewater flow rate (l/d)
= 1015 l/d

L_x = critical loading rate of nutrient or BOD ($mg/m^2/d$)
= 25 $mg/m^2/d$

Nitrogen Loading

A = 812 m^2 minimum area for total nitrogen

Phosphorus Loading

Determine the amount of phosphorus that can be absorbed without reaching over 50 years.

$P_{absorbed}$ = 12320 x 1/2
= 6160 kg/ha
= 0.616 kg/m^2

Determine the amount of vegetation uptake over 50 years.

P_{uptake} = 3 x 365 x 50
= 54 750 mg/m^2
= 0.055 kg/m^2

Determine the amount of phosphorus generated over that time.

C = Concentration of phosphorus (mg/l)
= 12 mg/l

$P_{generated}$ = total phosphorus concentration x volume of wastewater
= 222.285 kg

Irrigation area = $P_{generated}/(P_{absorbed} + P_{uptake})$
= 331 m^2

Appendix C - Soil Borelogs

Engineering Log, Excavations

Morse McVey & Associates Pty Ltd | **Job Nº: 036039**

Client:	Mr Michael Avinou	Date excavated:	28/3/03
Project	subdivision – Hawthorne Rd, Bargo	Logged by:	Adam Bishop
		Datum:	
Pit location:	refer Site Plan	Slope (%):	< 5

Excavation dimensions: length: width: orientation: RL surface

Test Pit Nº 1

Method	Sampling / testing	Depth (m)	Graphic log	Material description	Moisture condition	Consist.y / strength	Remarks
ES		0.5		Dark brown loam topsoil, moderately pedal, good organic matter content	D		many roots
				Reddish brown light clay subsoil, weak to moderate pedality, slight grey mottling towards base	MM		platy shale horizon at 0.8 m
		1.0		Pale grey medium to heavy clay, strongly pedal, < 10% coarse fragments	MM		
		1.5		Layer continues			
		2.0					

Excavation dimensions: length: width: orientation: RL surface

Test Pit Nº 2

Method	Sampling / testing	Depth (m)	Graphic log	Material description	Moisture condition	Consist.y / strength	Remarks
ES		0.5		Brown loam topsoil, moderate to strong pedality, no coarse fragments	D		many roots
				Light orangish brown clay loam subsoil, weak to moderate pedality, no coarse fragments	MM		
		1.0		Mottled red and grey light clay, weak to moderate pedality, no coarse fragments	MM		
		1.5		Light grey heavy clay with some red mottling, weakly pedal, no coarse fragments	MM		
		2.0					

Key

Method

N	natural exposure
A	hand auger
ES	excavation, shovel
EB	excavation, backhoe
ED	excavation, bulldozer blade
EG	excavation, grader
G	gully
C	undisturbed core sample 50 mm diameter
O	other

Sampling/testing

HP	hand penetrometer test (kPa)
DCP	dynamic cone penetrometer test (blows/150 mm)
O	other

Moisture condition

D	dry
MM	moderately moist
M	moist
W	wet

Consistency / strength

VS	very soft	Fb	friable
S	soft	VL	very loose
F	firm	L	loose
St	stiff	MD	medium dense
VSt	very stiff	D	dense
H	hard	VD	very dense

The classification symbols and soil descriptions are based on the Unified Soil Classification System (Corps of Engineers, 1953) and AS 1726-1993, Geotechnical Site Investigations

Comments:

This log must be read with the accompanying explanation sheets and report by Morse McVey & Associates Pty Ltd

Engineering Log, Excavations

Morse McVey & Associates Pty Ltd

Job Nº: 036039

Client: Mr Michael Avinou
Project: subdivision – Hawthorne Rd, Bargo
Pit location: refer Site Plan

Date excavated: 28/3/03
Logged by: Adam Bishop
Datum:
Slope (%): < 5

Test Pit Nº 3

Excavation dimensions: length: width: orientation: RL surface

Method	Sampling / testing	Depth (m)	Graphic log	Material description	Moisture condition	Consist.y / strength	Remarks
ES		0.5		Dark brown loam topsoil, no coarse fragments, weakly pedal	D	Fb	
				Light greyish brown medium/heavy clay subsoil, weakly pedal, no coarse fragments	D	St	
		1.0		Mottled light grey and brown medium/heavy clay, weakly pedal, no coarse fragments	MM	St	
		1.5		Test pit terminated in fine sandstone bedrock			
		2.0					

Test Pit Nº 4

Excavation dimensions: length: width: orientation: RL surface

Method	Sampling / testing	Depth (m)	Graphic log	Material description	Moisture condition	Consist.y / strength	Remarks
ES		0.5		Brown loam topsoil, strongly pedal, no coarse fragments,	D	S/Fb	
				Light brown light clay, minor mottling – red and grey, moderately pedal, 20% coarse fragments, many roots, well drained			Stone layer at 0.25 m, fine sandstone
		1.0		Light grey/white medium clay, red mottles, weakly pedal, 30% coarse fragments,			
		1.5					
		2.0					

Key

Method

N	natural exposure
A	hand auger
ES	excavation, shovel
EB	excavation, backhoe
ED	excavation, bulldozer blade
EG	excavation, grader
G	gully
C	undisturbed core sample 50 mm diameter
O	other

Sampling/testing

HP	hand penetrometer test (kPa)
DCP	dynamic cone penetrometer test (blows/150 mm)
O	other

Moisture condition

D	dry
MM	moderately moist
M	moist
W	wet

Consistency / strength

VS	very soft	Fb	friable
S	soft	VL	very loose
F	firm	L	loose
St	stiff	MD	medium dense
VSt	very stiff	D	dense
H	hard	VD	very dense

The classification symbols and soil descriptions are based on the Unified Soil Classification System (Corps of Engineers, 1953) and AS 1726-1993, Geotechnical Site Investigations

Comments:

This log must be read with the accompanying explanation sheets and report by Morse McVey & Associates Pty Ltd

Engineering Log, Excavations

Morse McVey & Associates Pty Ltd

Job Nº: 036039

Client:	Mr Michael Avinou	Date excavated:	28/3/03
Project	subdivision – Hawthorne Rd, Bargo	Logged by:	Adam Bishop
		Datum:	
Pit location:	refer Site Plan	Slope (%):	< 5

Excavation dimensions: length: width: orientation: RL surface

Test Pit Nº 5

Method	Sampling / testing	Depth (m)	Graphic log	Material description	Moisture condition	Consist.y / strength	Remarks
ES		0.5		Light grey/brown topsoil, loam fine sandy, weakly pedal, 10% coarse fragments	D		
				Orangish brown light/medium clay subsoil, weakly pedal, 10-20% coarse fragments	MM		ironstone layer at 0.6 to 0.8 m
		1.0		Pale grey medium clay, minor red mottling, 50% coarse fragments (ironstone),	MM		
		1.5		Layer continues			
		2.0					

Excavation dimensions: length: width: orientation: RL surface

Test Pit Nº 6

Method	Sampling / testing	Depth (m)	Graphic log	Material description	Moisture condition	Consist.y / strength	Remarks
ES		0.5		Blackish brown clay loam topsoil, weakly pedal, no coarse fragments	MM		moist profile
				Orangish brown light clay subsoil, structure not evident, no coarse fragments, mottled grey towards base	MM		thin A2 horizon at 0.25 m
		1.0		Light grey sandy clay, structure not evident, no coarse fragments	W		
		1.5		Ironstone layer at 1.1 m			free water at 1.1 m
		2.0					

Key

Method

N	natural exposure
A	hand auger
ES	excavation, shovel
EB	excavation, backhoe
ED	excavation, bulldozer blade
EG	excavation, grader
G	gully
C	undisturbed core sample 50 mm diameter
O	other

Sampling/testing

HP	hand penetrometer test (kPa)
DCP	dynamic cone penetrometer test (blows/150 mm)
O	other

Moisture condition

D	dry
MM	moderately moist
M	moist
W	wet

Consistency / strength

VS	very soft	Fb	friable
S	soft	VL	very loose
F	firm	L	loose
St	stiff	MD	medium dense
VSt	very stiff	D	dense
H	hard	VD	very dense

The classification symbols and soil descriptions are based on the Unified Soil Classification System (Corps of Engineers, 1953) and AS 1726-1993, Geotechnical Site Investigations

Comments:

This log must be read with the accompanying explanation sheets and report by Morse McVey & Associates Pty Ltd

Appendix D - Soil Laboratory Test Results

Department of Lands

SOIL TEST REPORT

Scone Research Service Centre

REPORT NO:	SCO03/097R1
REPORT TO:	Adam Bishop Morse McVey & Associates PO Box 138 Picton 2571
REPORT ON:	Six soil samples Hawthorne Road, Bargo
PRELIMINARY RESULTS ISSUED:	Not issued
REPORT STATUS:	Final
DATE REPORTED:	15 April 2003
METHODS:	Information on test procedures can be obtained from Scone Research Service Centre

TESTING CARRIED OUT ON SAMPLE AS RECEIVED.

G. Holman
(Technical Officer)

Gundy Road Scone NSW 2337 P.O. Box 263 Scone NSW 2337 DX 4206
Telephone (02) 65451666 Facsimile (02)65452520

SOIL AND WATER TESTING LABORATORY
Scone Research Service Centre

Report No.: SCO03/097R1
Client Reference: Adam Bishop
Morse McVey & Associates
PO Box 138
Picton 2571

Lab. No.	Method	CSA/3 CEC & exchangeable cations (mc/100g)						C8B/1	
	Sample Id.	CEC	Na	K	Ca	Mg	Al	P sorp (mg/kg)	P sorp index
1	Bargo Site 1 layer 1	12.7	0.3	0.5	3.5	3.2	1.4	791	5.3
2	Bargo Site 1 layer 2	16.4	0.4	0.3	0.9	3.5	6.0	846	6.5
3	Bargo Site 3 layer 2	18.5	0.3	0.5	0.9	6.2	5.4	860	6.4
4	Bargo Site 3 layer 3	18.2	0.3	0.4	0.5	4.4	6.8	772	5.3
5	Bargo Site 5 layer 1	7.1	0.1	0.5	1.9	1.4	0.7	552	3.7
6	Bargo Site 5 layer 3	15.8	0.4	0.3	1.1	2.7	6.8	603	4.0

END OF TEST REPORT

Appendix E - Irrigation Options

A general discussion of the various irrigation types for secondary treated effluent follows.

Semi-Fixed Spray Irrigation

If spray irrigation is used we recommend a semi fixed, surface spray, irrigation system (Standard Drawing W3). A semi fixed irrigation system confines sprinklers to suitable irrigation fields and will ensure reasonably even and widespread distribution of the effluent if properly used. The system should contain the following:

(i) a fixed and buried main distribution line/s to transfer effluent from the tanks to the nominated irrigation field;
(ii) a series of take-off points (stand-pipes) spaced evenly within the irrigation field. These takeoff points may be quick release valves or as recommended by an irrigation expert. In this case, at least two take-off points should be provided, per field, and should be spaced at least 10 metres apart; and
(iii) a minimum of two flexible, moveable, irrigation lines, each line having three sprinklers. These can be easily connected, detached and moved between the different take-off points and fields, to service different areas.

In total the irrigation system will comprise no less than six sprinklers. The lines and sprinklers should be switched and moved regularly to ensure even and widespread application of effluent throughout the entire irrigation area. This is very important to ensure long term sustainability of the irrigation area. The setup of the main distribution line and flexible lines must be designed to ensure that the recommended buffer distances described below are not compromised.

Subsurface Irrigation

Subsurface irrigation (Standard Drawing W4) is suitable on this site and offers the advantage of reduced buffers from residences. Subsurface irrigation involves the installation of a series of buried (approx. 0.1 m deep), roughly parallel, drip irrigation lines (approx. 13-16 mm diameter and 1.0 m apart) containing pressure compensated emitters (typically 0.6 to 1.0 m spacing). A filter, vacuum breaker valves and flushing valves are installed to improve the performance and longevity of the system.

Irrigation lines should be flushed approximately yearly according to the installer's recommendations. This should be done during periods of fine weather when the threat of runoff is low. The effluent filter should be cleaned about every two months. The irrigation area must not be subject to high traffic movement, to avoid compaction around emitters.

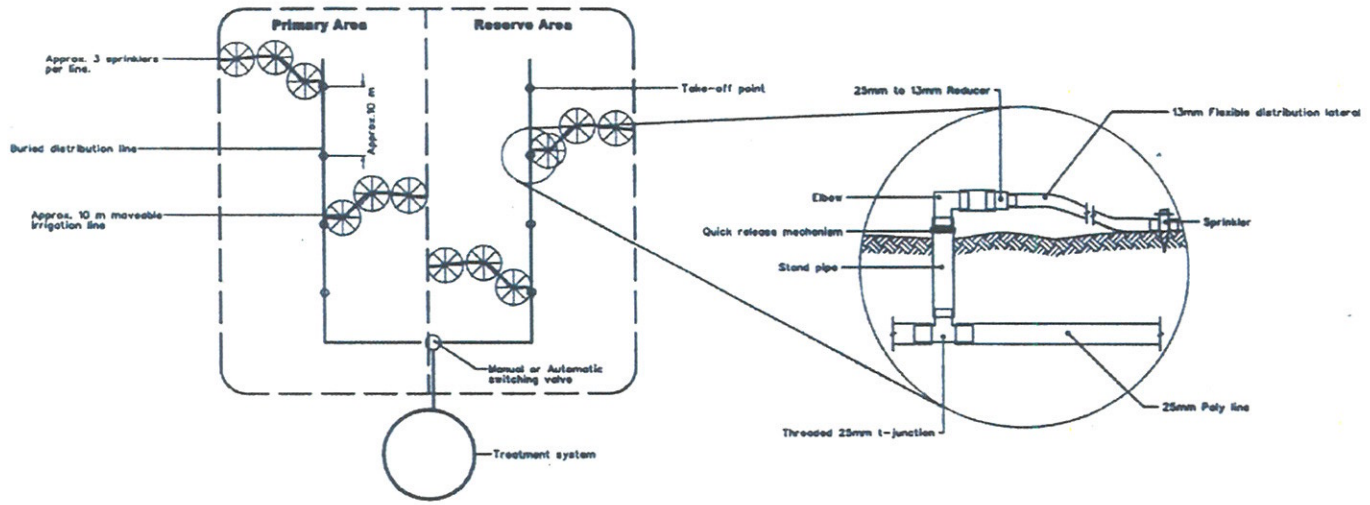
Fixed Spray Irrigation

Fixed spray irrigation involves fixed and buried distribution lines, with a series of fixed sprinklers. Generally pop-ups are the preferred type of sprinkler as they allow the area

to be easily mowed without the risk of damaging the sprinkler head. The sprinklers should be spaced so as to evenly service the entire irrigation area. They should produce a coarse droplet to avoid spray drift, and have a plume height less than 400mm and a plume diameter less than 4 metres.

Surface Drip/Trickle Irrigation

Surface drip/trickle irrigation involves laying pressure compensated drip lines or leaky pipe within garden beds, and covered with mulch, pine bark or other surface covering. In larger garden beds several separate lines may be needed, and a series of manual or automatic switching valves should be used to select the desired area for irrigation. Because this method is often used to service relatively small areas, the irrigation design must ensure that such areas are not proportionally over-serviced.



NOTES:-

1. Sprinklers shall be selected to provide a coarse droplet; the throw on sprinklers should not extend beyond designated disposal area/s
2. To avoid saturation and aid soil remediation of wastewater the owner shall ensure that movable sprinklers are periodically rotated
3. Avoid walking on disposal areas during irrigation to prevent compaction and human contact
4. Main distribution lines buried to approximately 100mm
5. The position of all take-off points and the length of moveable lines will be determined so that appropriate buffers are not compromised.

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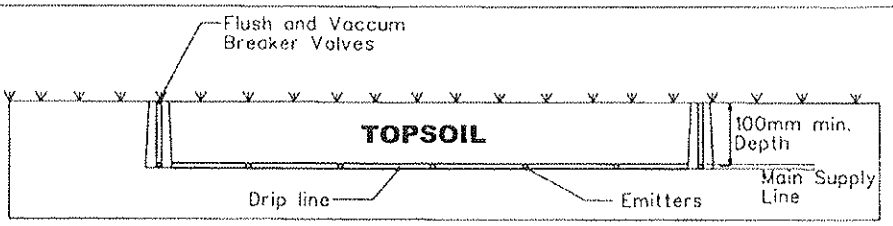
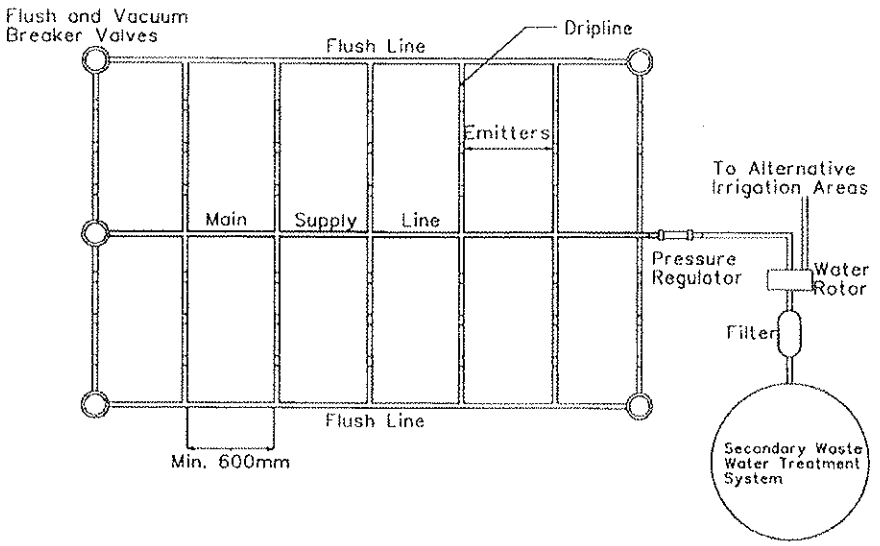
STANDARD DRAWING : W3

TYPICAL SEMI-FIXED SPRAY IRRIGATION DESIGN





NOTES:-

1. Drip line shall be either :
   (1) Low-pressure percolating pipe pressurised to no more than 70 kPa or as recommended by manufacturers.

   (2) Propriety drip feed pipe (eg. wasteflow) with emitters fixed inside the pipe and pressurised to manufactures recommendations. Commonly, 4.3 L/hr emitters are spaced 600mm along drip line.
2. Drip line depth and spacing : Buried to 100mm depth in which it will fall within rootzone of vegetative cover. Drip line laterals spaced 1m apart (may be subject to soil assessment) and main line 25mm PVC.
3. Flush and vacuum : fitted to prevent ingress of soil into the irrigation lines under negotive pipeline pressure.
4. Filter : Grooved disk or screen filter (150-200 mesh) to remove sediment carried over from wastewater treatment unit.
5. Water rotor or manually operated lever action ball valve to distribute effluent to multiple irrigation areas (if required).
6. Marking : Buried pipes marked to AS/NZS 2648.1 with prominent signage "DO NOT DIG"

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STANDARD DRAWING : W4

TYPICAL SUBSURFACE IRRIGATION DESIGN

C:\Troy\ACADD\Standard\W4 Irrigation\Standard W4 D.VCD 6/11/2003

Appendix F - Laundry Product Research
(Lanfax Laboratories, Armidale)

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Lanfax Laboratories

Accredited by Aust. Soil & Plant Analysis Council

LAUNDRY PRODUCTS RESEARCH

The data, from which the graph on the reverse of this page was produced, were from research financed and undertaken by Lanfax Laboratories in July 1999, independent of any other organisation.

A range of laundry products was purchased from the local supermarkets comprising 20 liquid and 40 powder products. The selection covered the major brands, as determined from previous research, but included some lesser known brands, and five dishwashing detergents.

For each of the detergents, the mass of a 40 mL freshly poured sample was determined. Using the manufacturers' recommended loading rates for an average wash in a top loading automatic washing machine, an equivalent weight of each product was mixed with water from a rainwater system to represent the recommended dose of product with the full water load, that is, 160 litres of wash, rinse, deep rinse and spin cycle.

The samples were shaken for 1 hour at room temperature and the concentration of each of the elements of interest determined at the University of New England using an Inductively Coupled Plasma (ICP). Other chemical properties were measured by Lanfax Labs.

Other information from the research is available at our web site

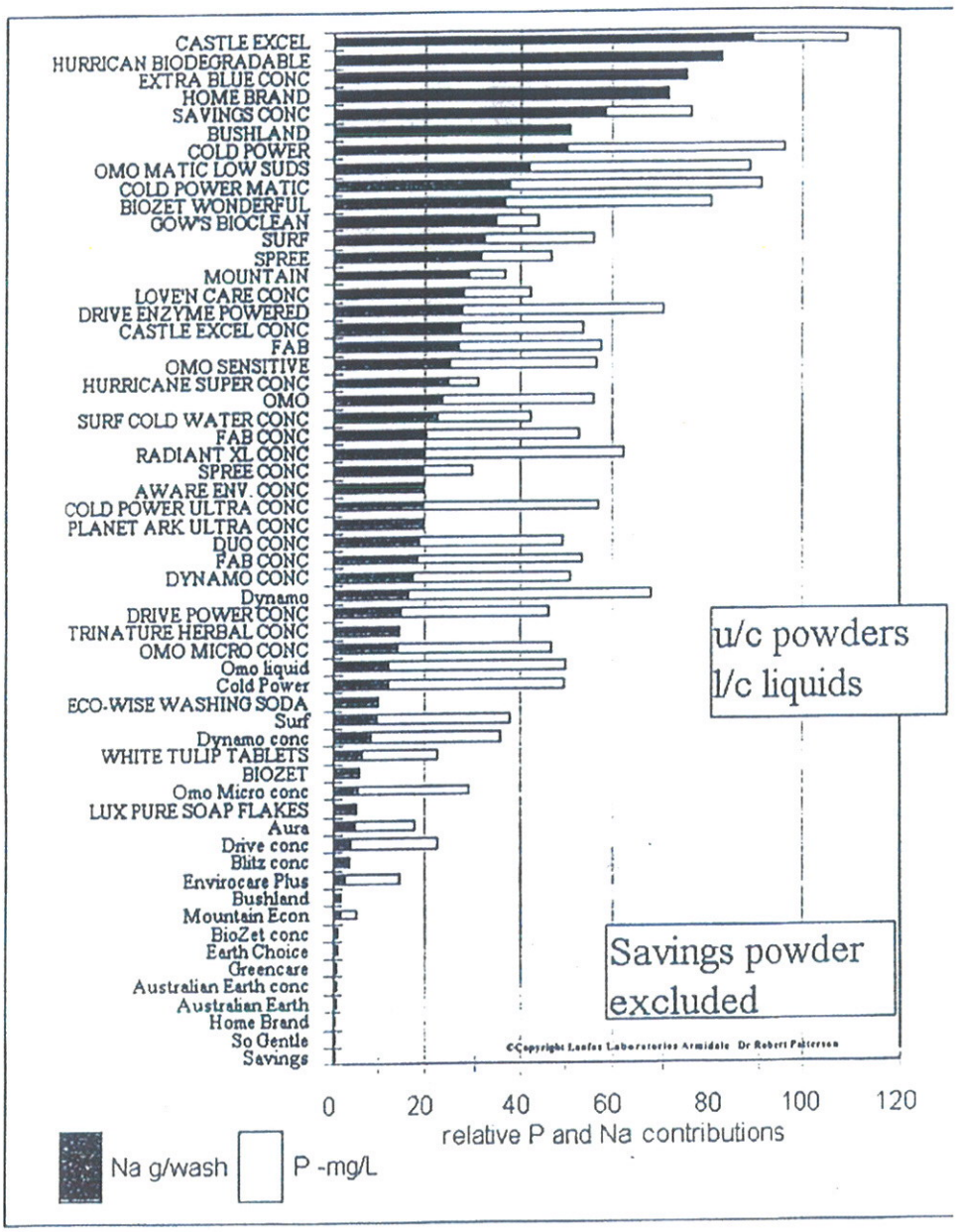
www.lanfaxlabs.com.au/publications.html

PATTERSON, R.A. (2000). *Water Quality Relationships with Reuse Options*. in 3rd International Symposium on Waste Water Reclamation, Recycling and Reuse. 3-5 July 2000. Paris France. International Water Association .Preprint Book 8, pp 205-212.

and

PATTERSON, R.A. (1999) *Reuse Initiatives Start in the Supermarket*. NSW Country Convention. Institution of Engineers Australia. 6-8 August 1999. Northern Group, Institution of Engineers Australia, Armidale.

Figure 1. Ranking of laundry products according to sodium concentration with phosphorus concentration shown as tail. Ideal choice for on-site systems is one with a low sodium and a low phosphorus concentration.



APPENDIX G – Vegetation Suitable for Land Application Areas (taken from DLG, 1998)

Botanical Name	Approximate Height	Common Name or Variety
Grasses		
Carex spp. Lomandra longifolia Microlaena stipoides Oplismenus imbicillis Pennisetum alopecuroides Poa lab Stipa spp.	40 - 80 cm	Available as lawn turf
Ground cover / Climbers		
Hibbertia scandens Hibbertia stellaris Isotoma fluviatalis Kennedia rubicunda Scaevola albida Scaevola ramosissima Veronica plebeia Viola hederacea	 Prostrate Climber 	Snake Vine Dusky coral pea Native violet
Sedges / Grasses / Small Plants		
Anigozanthus flavidus Baumea acuta Baumea articulata Baumea juncea Baumea nuda Baumea rubiginosa Baumea teretifolia Blandfordia grandifora Blandfordia nobilis Brachyscome diversifolia Carex appressa Cotula coronopifolia Crinum pedunculatum Cyperus polystachyos Dianella careulea Epacris microphylla Ferns Gahnia spp. Juncus spp. Lobelia trigonocaulis Lomandra spp. Patersonia fragilis Patersonia glabrata	2m Sedge Sedge Sedge Sedge Sedge 30-90cm 30-90cm Clump Sedge 10-20cm <2m Sedge Low plant 50cm to 1m Tall Grass 0.5m Rush 5-10cm Grass 	Kangaroo Paw Christmas Bell Christmas Bell Native Daisy Waterbutton Swamp Lily Blue Flax Lily Native Iris Native Iris

Botanical Name	Approximate Height	Common Name or Variety
Patersonia occidentalis	5cm	Native Iris
Ranunculus granditicola	Reed	
Restio australis	1m	
Resito tetraphyllus	Sedge	
Sowerbaea juncea	<30cm	Rush Lily
Tetratheca juncea	<1m	
Xyris operculata		Tall Yellow Eye
Shrubs		
Agonis flexuosa nana		
Baekea linifolia	1-2.5m	
Baekea utilis	1-2.5m	
Baekea virgata	<4m	
Banksia aemula	1-7m	
Banksia robur	0.5-2m	
Bauera ruboides	0.5-1.5m	
Callistemon	2-3m	Burgundy
Callistemon	2-4m	Eureka
Callistemon	3-4m	Harkness
Callistemon	3-4.5m	Kings Park Special
Callistemon	2-3m	Mauve Mist
Callistemon	1-2.5m	Red Clusters
Callistemon	2-3m	Reeves Pink
Callistemon citrinus	50-80cm	Austraflora Firebrand
Callistemon citrinus	2-4m	Splendens
Callistemon citrinus	60cm-1m	White Ice
Callistemon linearis	1-3m	
Callistemon macropunctatus	2-4m	
Callistemon pachyphyllus	2-3m	
Callistemon pallidus	1.5-4m	
Callistemon paludosus	3-7m	
Callistemon pinifolius	1-3m	
Callistemon rigidus	1.5-2.5m	
Callistemon salignus	3-10m	
Callistemon shiresii	4-8m	
Callistemon sieberi	1.5-2m	
Callistemon sieberi	50-80cm	Austraflora Little Cobber
Callistemon subulatus	1-2m	
Callistemon viminalis	1-2m	Captain Cook
Callistemon viminalis	5-10m	Dawson River
Callistemon viminalis	3-5m	Hannah Ray
Callistemon viminalis	50cm-1m	Little John
Callistemon viminalis	1.5-2m	Rose Opal
Callistemon viminalis	2-3m	Western Glory
Goodenia ovata	1-1.5m	
Hibiscus diversifolius	1-2m	Swamp hibiscus
Kunzea capitata	1-2m	
Leptospermum flavescens	<2m	Tea-Tree
Leptospermum juniperinum	1m	Tea-Tree

Botanical Name	Approximate Height	Common Name or Variety
Leptospermum lanigerum	1-2m	Woolly tea-tree
Leptospermum squarrosum	<2m	T ea-Tree
Melaleuca alternifolia	4-7m	
Melaleuca decussata	1-2m	Cross-leaved honey myrtle
Melaleuca lanceolata	4-6m	
Melaleuca squamea	1-2m	
Melaleuca thymifolia	>2m	
Trees		
Acacia elongata	2-4m	
Acacia floribunda	5-6m	Gossamer wattle
Agonis flexuosa	1.5m	Willow myrtle
Allocasuarina diminuta	0.5-5m	
Allocasuarina paludosa	Large tree	
Angophora floribunda	Large tree	
Angophora subvelutina	<4m	
Callicoma serratifolia	10-30m	
Casuarina cunninghamiana	6-12m	River she-oak
Casuarina glauca	Large tree	Swamp oak
Elaeocarpus reticulatis	Large tree	Blueberry ash
Eucalyptus amplifolia	10-30m	Cabbage gum
Eucalyptus botryoides (coastal areas)	15-20m	
Eucalyptus camaldulensis (west of ranges)	Large tree	River red gum
Eucalyptus deanei	Large tree	Blue Mountains blue gum
Eucalyptus elata		River Peppermint
Eucalyptus grandis	10-20m	Flooded gum
Eucalyptus longifolia	20m	Wollybutt
Eucalyptus pilularis	30-40m	Blackbutt
Eucalyptus punctata	<35m	Greygum
Eucalyptus robusta	20-30m	Swamp mahogany
Eucalyptus saligna	30-50m	Sydney blue gum
Eucalyptus tereticornus	30-40m	Forest red gum
Eucalyptus viminalis (ranges)	20-40m	Ribbon gum
Acmena smithii	10-20m	Lilli Pilli
Flindersia australis	<40m	Native teak
Hymenosporum flavuum	3-6m	Native frangipane
Melaleuca armillaris	3-4m	Bracelet honey myrtle
Melaleuca decora	4-7m	
Melaleuca ericifolia	6m	
Melaleuca halmaturorum	4-6m	
Melaleuca hypericifolia	2-3m	
Melaleuca linariifolia	4-8m	Snow in summer
Melaleuca quinquenervia	5-7m	Broad paperbark
Melaleuca squarrosa	6m	
Melaleuca stypheloides	6-15m	
Melia azedarach	15-20m	
Pittosporum spp.	8-10m	

Botanical Name	Approximate Height	Common Name or Variety
Syzgium paniculatum Tristania laurina Viminaria juncea	5-15m 2-3m	Bush cherry Kanuka Golden spray