1 GLENROCK ROAD, CAVAN

Effluent Disposal - Site & Soil Assessment

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Version 1

Franklin Consulting Australia Pty Limited

ACN: 611 394 953
ABN: 59 611 394 953

GPO Box 837
Canberra ACT 2601

Phone: (02) 6179 3491
Mobile: 0490 393 234
E-mail: soil.land.water@gmail.com

Servicing the agriculture, conservation and development sectors with soil and water management advice, land capability and soil assessment, erosion control and soil conservation planning, catchment and property planning, and natural resource management policy advice.

Contents

ASSESSOR DETAILS

John Franklin M App Sc, BSc, EIANZ

Franklin Consulting Australia Pty Ltd
(trading as) Soil and Water

GPO Box 837
Canberra ACT 2601

soil.land.water@gmail.com

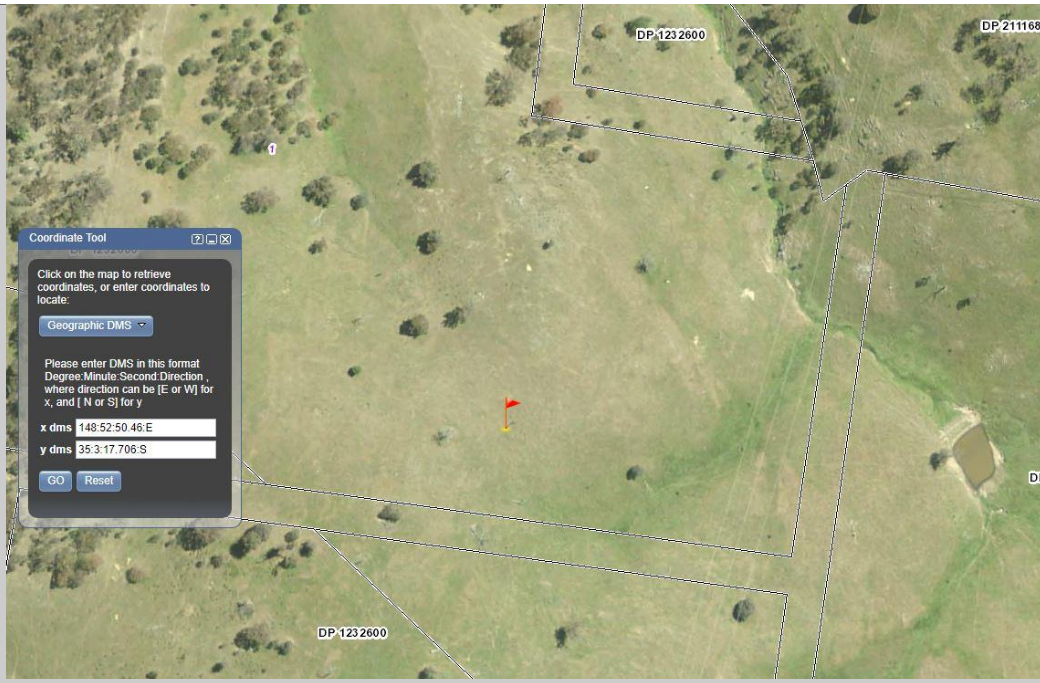
P (02) 6179 3491

M 0490 393 234

John Franklin has over 26 years' experience in natural resource management in the ACT and Upper Murrumbidgee region. This experience includes providing extensive soil and water management advice to State and Local Government and the urban / rural residential development sector across the region. John has detailed knowledge of water resource policy and developed the NSW Farm Dams Policy in 1999 for the Department of Land and Water Conservation and provided strategic support and direction to the NSW water reform process.

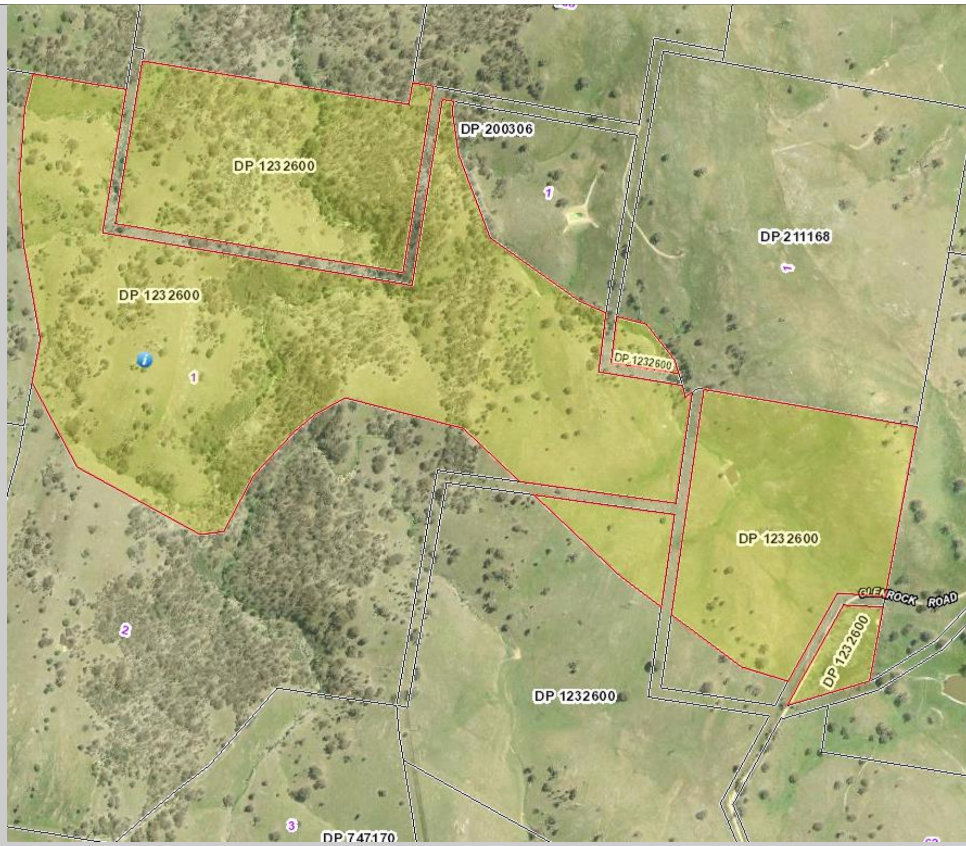
Franklin Consulting Australia Pty Ltd holds current Workers Compensation Insurance with CGU (Policy Number O/16-5885) and Professional Indemnity cover of $5,000,000 and Public Liability cover of $10,000,000 with Lloyds.

PROJECT DESCRIPTION	
Summary	This site and soil assessment informs the appropriate on-site management of domestic effluent associated with the construction of a 5 bedroom residential dwelling and farm shed including bathroom facilities on Lot 1 DP 1232600, 1 Glenrock Road, Cavan. The exact specifications of the dwelling to be constructed are not known however a 5-bedroom home has been assumed for design purposes. The site is located in a generally free draining landscape dominated by moderate to steeply undulating landscape which with deep drainage features running towards the Murrumbidgee River. The site is extensively cleared for grazing and includes scattered remnant native vegetation particularly in association with some of the deeper drainage features. The site and soil conditions are well suited for an accredited secondary treatment system with effluent dispersal of treated and disinfected effluent through surface spray or drip irrigation. There is an adequate area contained within either of the building envelopes that is suitable for surface spray or drip irrigation of secondary treated effluent in accordance with the prescriptions contained in this report. The major site constraints in the area include soil depth and rocky outcrops, soil drainage and buffer distances from intermittent drainage depressions. The assessment also includes a Site Classification to inform the design of footings and foundations for the dwelling.
Technical References	*On-site Sewage Management for Single Households* (The Silver Book) NSW Govt, 1998. *AS 2870-2011 Residential slabs and footings* *ANZ Standard 1547:2012 On-site Domestic Wastewater Management* *Soil Landscapes of the Goulburn 1:250,000 Sheet*. Hird, C. (1991) Soil Conservation Service of NSW *Soil Landscapes of the Canberra 1:100,000 Sheet*. Jenkins, B.R. (2000) Department of Land and Water Conservation NSW

	Yass Valley Local Environment Plan 2013
Report Scope	The report assesses land in the vicinity of the proposed dwelling to identify land suited to effluent application. This involves excluding land with major physical constraints, such as rock outcrop and poor drainage, and areas within buffer distances of proposed buildings. Information required by council is contained in the report, including management prescriptions, site plan and photographs, with supporting information in this report including nutrient balance, water balance and limitation tables.
Dwelling Location	 **Lot 1 DP 1232600, 1 Glenrock Road, Cavan**
Landscape	The landscape is described as the Burrenjack Soil Landscape Unit in *Soil Landscapes of the Goulburn 1:250,000 Sheet*. Hird, C. (1991). This landscape includes undulating rises and hills formed on tuff, shale and siltstone with relief 40m and more, slopes 3-15% and localised areas of steeper slopes. Locally the landscape is dominated by deep drainage features with scattered remnant native vegetation along flowlines and on some hills and crests. Generally divergent slope form associated with sideslopes, hills and valley floors. Areas of convergent slope form correspond with lower parts of the landscape and drainage depressions which are generally unsuited to effluent dispersal.

Soils	Detailed soil profile descriptions are provided in **Appendix 1** of this report. The soils in the proposed building envelope and effluent dispersal areas range from shallow gravelly well drained Tenosols grading to shallow loamy earths. Soils comprise a weakly structured, gravelly loam to silty loam textured upper layer which extends to decomposed parent material. Total depth to decomposed parent material is typically 50, with shallower soil in the localised areas of rock outcrop. Extrapolating from the soil survey of the Canberra 1:100,000 sheet (Jenkins 2000), the deeper soils on the more gently sloping land fit the Williamsdale soil landscape. The representative analytical data in the survey report shows a moderate phosphorous sorption level, non-saline subsoils and low exchangeable sodium. As such the soils are free of any significant chemical limitations to effluent dispersal. The areas with moderate to steep slope grade generally have a shallow stony soil cover of Tenosols. Soil depths are a significant constraint to effluent dispersal and are generally less than 50cm with a high content of stone and gravel which significantly reduces moisture retention capacity. Lower lying poorly drained and seasonally waterlogged areas have Yellow Chromosol soils. These soils comprise a bleached silty loam upper layer to a depth of 40-50cm overlying a yellow or yellow brown coloured subsoil. The yellow colours of the subsoil clay and the bleached upper layer typically reflect slower drainage. These soils can be significantly constrained for effluent dispersal.

SITE INFORMATION

Local Government Area	Yass Valley Council
Address/locality	1 Glenrock Road, Cavan – Lot 1 1232600
Owner	Ryan Blake
Developer	Ryan Blake
Block configuration: plans attached photo attached	 **Lot 1 DP 1232600, 1 Glenrock Road, Cavan**
Intended water supply	Potable water to be supplied by roof catchment with tank storage.
Expected wastewater load (volume in litres/day)	The exact specification of the dwelling to be constructed is not known at this stage however a 5-bedroom dwelling using a non-reticulated tank water potable water supply has been adopted for design purposes, therefore daily wastewater load is based on design occupancy of 6 persons @ 120L/p/day: **Design Wastewater Load is 720 L/day[1]**

[1] As per AS 1547:2012

Local experience	Most secondary treatment and surface irrigation systems work adequately in the area provided they are on appropriate soil and site conditions. Systems commonly malfunction due to lack of ongoing maintenance. System to be maintained regularly, in accordance with council regulations and prescriptions in this report.

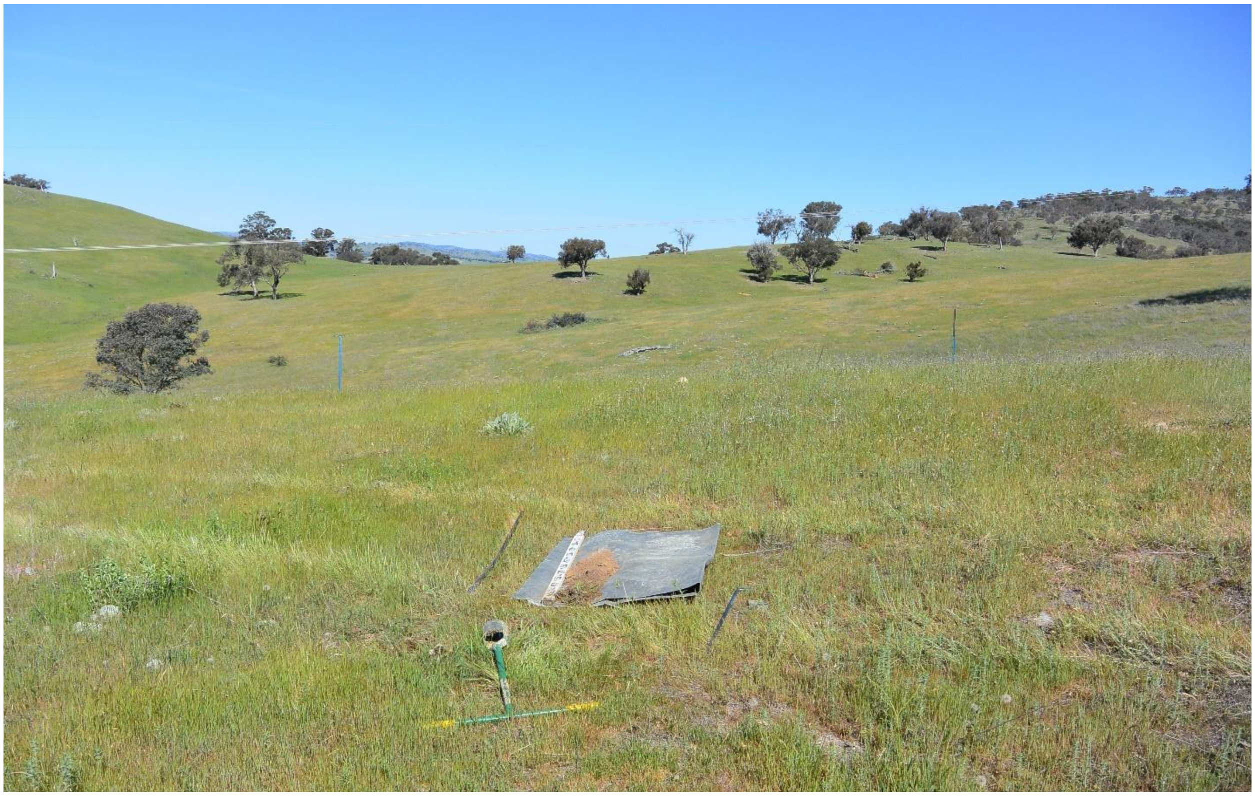


Figure 1: Looking over building envelope towards Glenrock Road (east)

Figure 2: Looking over building envelope towards Burrinjuck Dam (north west)

SITE ASSESSMENT

Climate	The climate is typically a cool and moderately dry climate. Average rainfall for the area is 600 – 800 mm. Warm summers with large evaporative deficit, cool winters with small evaporative deficit; median summer monthly rainfall for Canberra airport 49 mm; median monthly winter rainfall 38 mm; mean monthly summer evaporation is 177 mm, mean monthly winter evaporation is 60 mm.
Rainfall water balance attached	Yes
Land application area calculated	Yes
Wet weather storage calculation attached	NA
Flood potential land application area above 1:20 year flood: land application area above 1:100 year flood: electrical components above 1:100 year flood:	 Yes Yes Yes
Exposure	Site has no topographical or vegetative shading adjacent to the proposed dwelling and effluent disposal area. ***Exposure is suitable for the surface irrigation of effluent.***
Slope	Dwelling site and effluent dispersal area is located on an even slope of 10-15%. ***Steeper slopes on the site are a moderate constraint to effluent dispersal by surface irrigation and irrigation area with be restricted to lower less constrained slopes.***
Landform	Slope form of the site is divergent in the proposed effluent disposal area and building envelope and suited to the surface irrigation of effluent. ***Landform is suited to effluent dispersal by surface irrigation***
Run-on	Negligible to no run-on water will impact the effluent irrigation area due to elevated and divergent landform. ***Run-on water will not be a constraint on the site***
Seepage	***No seepage was observed on the lot.***
Erosion potential	Low-moderate erosion potential in the vicinity of the effluent disposal area and the proposed dwelling due to moderate slopes and shallow poorly structured erodible soils.

	Erosion risk will need to be mitigated by retaining 100% groundcover on effluent irrigation area including mulching should grass/pasture groundcover decline.
Site drainage	Site drains through overland surface flow on the crests and slopes which become first order streams in the deeper drainage depressions. There are some farm dams located on these 1st order streams. ***A 40m drainage buffer is required from the 1st order streams adjacent to the proposed dwelling and effluent dispersal areas, refer Figure 3.***
Fill	No fill was detected on the property in the vicinity of the effluent disposal area during the inspection. Extensive groundworks will be required to create a dwelling and shed site which will involve a large cut and fill site using in-situ soil material. ***The cut and fill required to create a level construction site should not impact the effluent dispersal area. If possible the soil depth in the effluent dispersal area should be built up with suitable loam material recovered from the groundworks which should then be sown with suitable grass/pasture species and mulched to provide an immediate groundcover.***
Groundwater Horizontal distance to groundwater well used for domestic supply: Groundwater vulnerability map category: Bores in area and purpose:	 No known domestic wells used for drinking water purposes in the vicinity. The area is Moderate Vulnerability on the Department of Land and Water Conservation, Murrumbidgee Groundwater Vulnerability Map. The site is not included in the Yass Valley LEP (2013) Groundwater Vulnerability Map. There are no registered bores located within 500m of the property. The nearest registered Stock and Domestic bore (GW 404444) is 2,400m northeast of the site and is 56 m deep. Water bearing zones in bores in this local area are around 18-24m deep and yields less than 1L/sec. ***The effluent management practices proposed in this report will not impact this bore or the groundwater aquifer due to the spatial separation of >2400 m, vertical depth to groundwater table of >18m, low transmissivity of fractured rock aquifer systems and low application rate of secondary treated and disinfected effluent to the surface.***

Buffer distance from treatment system to	
Perennial rivers and creeks:	NA
Drainage depressions/dams:	40 m
Other sensitive environments:	NA
Boundary of premises:	3 m (from upslope boundary)
Swimming pools:	NA
Buildings:	15 m
[Buffers distances as per AS 1547:2012]	
Is there sufficient land area for	
Application system including buffers:	Yes, adequate area identified, refer **Figure 3**
Reserve application system:	Yes, adequate area identified, refer **Figure 3**
Surface rock outcrop	***None*** in the area identified as suitable for effluent dispersal area.

SOIL ASSESSMENT	
Depth to bedrock or hardpan	0.5 - 1 m
Depth to high soil water table	>1.5 m
Hydraulic loading rate Soil texture: Soil structure: Permeability *(from table M1 of AS1547:2012)*: Recommended design irrigation rate for disposal system (mm/day) *(from table M1 of AS1547:2012)*:	 Sandy loam Weak-moderate 0.5 – 1.5 4
Coarse fragments	None
Bulk density (g/cm^3)	1.6 topsoil, 1.5 subsoil
pH field (1)	5.4 topsoil, 6.0 subsoil
Electrical conductivity Ds/M (1)	0.10 topsoil, 0.11 subsoil
Exchangeable sodium %(1)	0.10 topsoil, 4.2 subsoil
Cation exchange capacity (mequiv/100g) (1)	5.5 topsoil, 11.4 subsoil
Phosphorous sorption capacity mg/kg (1)	122 (1,952kg/ha) topsoil, 447 subsoil (6,705kg/ha)
Geological feature Discontinuities: Fractured rock:	 None None
Soil landscape reference (1)	Canberra 1:100,000 (2000), Williamsdale Units – comparable to the Burrenjack Soil Landscape Unit
Dispersiveness EAT class (1):	3(2) topsoil, 2(1) subsoil
AS2870 Site Class (for in situ soil material):	**M** (Moderately Reactive)

1 extrapolated from Jenkins (2000) *Soil Landscapes of the Canberra 1:100,000 Sheet*. DLWC

SYSTEM SELECTION	
Consideration of connection to centralized sewerage system Distance: Potential for future connection: Potential for reticulated water:	 >5 kilometres None None
Type of land application system best suited Justification:	Surface spray or drip irrigation irrigation to improved pasture/grass &/or landscaped areas. Suited to site and soil conditions. Enables beneficial reuse of effluent in a water constrained environment.
Type of treatment system best suited Justification:	NSW Health accredited secondary treatment system. Reliable system with high quality disinfected effluent then available for beneficial reuse.

EFFLUENT MANAGEMENT PRESCRIPTIONS

Effluent treatment

The following site specific recommendations are made in respect of the AWTS:

1. Effluent will be treated by a NSW Health accredited system capable of achieving secondary standard treatment, see below:

Table 1: NSW Health accredited secondary treatment systems

AWTS		
AWTS Maintenance	Envirocycle 10NR	1800688588
Bioseptic	Performa	1300 658 111
Clearwater Sewage and Watertanks	Biodigester II	1300 132 760
Earthsafe Environmental	Earthsafe ES10PC	1300 327 847
Eco Septic	Econocycle ENC 10-1, ENC 10-2	(02) 4774 1316
Everhard Industries	Aqua Nova 10EP, NR, MBR10	(02) 9757 2799
Fuji Clean	Fuji Clean CE 1200, CRX 1500, CE 1500	1300 733 619
Graf Plastics Australia Pty Ltd	Graf Klaro EPro SBR 10EP AWTS 002	1300 131 971
Highland Tanks Pty Ltd	Ultra Clear – Ultra 10 AWTS ST8 AWTS ST10 AWTS	(02) 4889 8288
Icon Septech	Turbojet 2000	1300 557 143
Jowa Group	Biocycle Bio 7000	(08) 8381 9100
Krystel Kleer	Krystel Kleer ADV 5000	(07) 3382 7666
Magnesium Tech	Waterboy - Model 10, Model S HSTP Model 10 Magnesium Tech DMS	(07) 4055 1141
Rainflow Stormwater Solutions	Gardenmaster GM7100, MBR	(02) 4932 1011
Sun Coast Wastewater Management	Ozzie Kleen RP10	1800 450 767
Super Treat Systems	Super Treat SE 10	(02) 4422 3861
Taylex Industries	Taylex DMS, ABS, Poly ABS	07 34415200
Toowoomba Tanks	Super Treat 1T AST	(07) 4634 3860
Wastewater Equipment Supplies	Alpha Treat DP 10	(07) 3205-3666

http://www.health.nsw.gov.au/environment/domesticwastewater/Pages/default.aspx

2. The treatment system must be housed in a concrete tank

	3. The secondary treatment system must include disinfection 4. The AWTS model should be selected in consultation with the designer, installer and the client and considering which model best suits the expected loading, usage patterns and the site-specific conditions 5. The final location for the AWTS unit should be chosen by the installer, in consultation with the client, and provide a minimum 3 m buffer from the dwelling or other buildings**.** 6. The tank should also be installed so that the lid remains at least 100 mm above final ground level to avoid stormwater entering the tank 7. AWTS tanks should be installed in compliance with the manufacturer's recommendations, 'AS/NZS 3500.2:2003 Plumbing and Drainage Part 2 Sanitary Plumbing and Drainage' and Council requirements.
Effluent dispersal	An area of **400 m^2** will be designated as the *primary* effluent irrigation area. Areas suitable for effluent irrigation are identified in **Figure 3**. Within the area identified as suitable for effluent irrigation an alternative *reserve* irrigation area of equal size shall has been identified for future use if required. Within the *primary* irrigation area, effluent can be dispersed by: 1. surface spray irrigation, which is effective for dispersing effluent on established areas of improved pasture as exist in the proposed irrigation area, or 2. surface drip irrigation, which is effective for dispersing effluent on areas of landscaping and garden beds (not for edible produce), or The following specific recommendations are made in respect of effluent dispersal: ***Surface Spray Irrigation*** 1. The effluent irrigation area of **400 m^2** should be divided into two sections, one half should be used in the warmer months, October to April, when plants can fully utilise the applied effluent. During the period May to September, both halves should be used as plants cannot fully utilise the moisture. 2. Effluent may be delivered through a moveable irrigation line of adequate length to access the entire area identified as suitable for effluent irrigation, refer **Figure 3**, typically a 50-60 m length is sufficient. 3. The moveable sprinkler line must consist of suitable irrigation line which is clearly identifiable as for effluent irrigation only (purple) and should be fitted with 5 X 2 metre radius heavy droplet (non-aerosol) sprinklers spaced at 5 m centres. 4. Alternatively, effluent may be delivered through a permanent surface sprinkler system of two buried distribution lines joined by a manual valve to enable either line to operated independently. Each line should be equipped with four, two metre radius decoupling heavy droplet (non-aerosol) sprinkler heads should be fitted on risers to each of the distribution lines at approximate 5 m centre spacings, (alternative system specifications may be appropriate provided they can deliver effluent to the **400 m^2** area required).

	5. Effluent distribution lines should be buried a minimum of 300mm, and 450mm in areas of high traffic. ***Surface Drip Irrigation*** 1. The irrigation area should be divided into at least two sections, connected by a valve which permits each half of the irrigation area to be isolated. One half should be used in the warmer months, October to April, when plants can fully utilise the applied effluent. During the period May to September, both halves should be used as plants cannot fully utilise the moisture. 2. The two irrigation fields should be connected by a sequencing valve (automatic or manual) to enable flows to be directed independently to the two fields 3. A 100-150 micron high capacity disc filter (i.e. >500cm^2 filterable area) should be installed and cleaned a minimum of every three months 4. Air release valves should be installed at high points in the system ***All systems*** 1. All components are to be installed according to 'PCA 2004 Plumbing Code of Australia' and the conditions of consent 2. Treated effluent must be applied to growing vegetation and not bare ground. 3. Effluent needs to be applied to perennial vegetative groundcover within the area identified in **Figure 3.** Suitable grass/pasture cover will need to be maintained across the **400 m^2** area identified for effluent dispersal. 4. Grass/pasture should be slashed when it is >10 cm long 5. Alternatively, the effluent may also be applied to either a landscaped area or a shelter belt of trees and shrubs developed specifically for effluent application. 6. Species suitable for landscaping and effluent irrigation include Callistemon pallidus, C. palludosis, Kunzea ericoides, K. parvifolia, K. phyllicoides (burgen), Leptospermum continentale (prickly ti tree), L. multicaule, L. flavescens, L. squarrosum, Melaleuca armillaris (honey myrtle), M. decussata, M. squamea, M. thymifolia, M. ericifolia, M. hypericifolia, M. linariifolia. 7. Effluent is not suitable for vegetables or lawns regularly used for play and foot traffic. 8. Adequate signage should be installed to indicate that the area is being irrigated with treated effluent. 9. Where vehicles, animals or children could access the effluent irrigation area, the effluent irrigation area should be protected by fencing or by planting suitable shrubs around the outside boundary. 10. The aerated wastewater treatment system must be serviced regularly to provide adequate treatment and ensure that the irrigation system does not become clogged with suspended solids or organic material. 11. The following buffers will be applied to the effluent irrigation area: 15 m from dwellings, 3 m from upslope driveways and property boundaries, 40 m from drainage depressions.

General	1. Stock and vehicular access must be excluded from the irrigation area as they compact the soil, thereby reducing the infiltration rate and water holding capacity. 2. Water conservation measures should be adopted to the greatest extent possible in the house, particularly in relation to the high water use activities of showering, clothes washing and toilet flushing. AAA+ plumbing appliances and fittings should be used. Measures including use of front loading washing machines, low volume shower roses and dual flush toilets reduce water usage by 30 to 40%. 3. Detergents low in phosphorous and sodium should be used as much as possible (see details in appendix) in order to protect the soil's capacity to absorb water.

Figure 3: Site and Soil Constraints

SIZING EFFLUENT DISPOSAL AREA

Using the DIR for surface spray or drip irrigation on clay loam soils of 4 mm/day and design loading of 720 L/day, the following land application areas are required to manage additional hydraulic loading, nitrogen and phosphorous generated.

Water balance	• **Sizing based on hydraulic loading:** A = Q (l/day)/DIR (mm/day) where A = area; Q = 800 l/day; DIR = 4 mm/day A = 720/4 = 180 m^2 **Area required = 200 m^2**
Nitrogen balance	• **Sizing based on nitrogen balance:** A = Q(l/day) X TN (mg/l)/L_n (critical loading of TN, mg/m^2/day) where A = area; Q = 720 l/day; TN = 25mg/l (from Silver Book) Assume 20% loss by denitrification; 25mg/l – (25 X .2) = 20mg/l L_n = 15,000mg/m^2/yr (ie 150kg/ha/yr, for introduced species) A = 720 X 20 X 365/15,000 = 350.4 m^2 **Area required = 360 m^2**
Phosphorous balance	• **Sizing based on phosphorous balance** A = P_{gen}/(P_{uptake} + P_{sorb}) [P sorption capacity in upper 50cm & 50 year design period] P_{gen} = 10mg/l X 720 X 365 X 50 = 131.4 kg P_{uptake} = 4.4mg/m^2/day X 365 X 50 = .080kg/m^2 P_{sorb} = 2,500kg/ha = .25kg/m^2 A = 132/(.08+ .25) = 400 m^2 **Area required = 400m^2**
Design effluent disposal area	Therefore, a land application area of **400 m^2** will account for phosphorous, nitrogen and water applied based on estimated connections and usage patterns associated with the construction of a 5-bedroom house. An allowance of a reserve land application area will double this area to **800 m^2**.

SITE AND SOIL LIMITATION ASSESSMENT

The following two limitation tables are a standardised guide to the site and soil characteristics which may limit the suitability of the site for effluent disposal and which would require attention through specific management practices. The tables have been reproduced from *On-site Sewage Management for Single Households* (tables 4 and 6, Anon, 1998). The highlighted categories represent site and soil conditions of the land covered in this report. The tables show that the land designated for effluent application has slight to moderate limitations, but no severe limitations.

Site limitation assessment

Site feature	Relevant system	Minor limitation	Moderate limitation	Major limitation	Restrictive feature
Flood potential	All land application systems	> 1 in 20 yrs.		Frequent, below 1 in 20 yrs	Transport in wastewater off site
	All treatment systems	components above 1 in 100 yrs.		Components below 1 in 100 yrs.	Transport in wastewater off site, system failure
Exposure	All land application systems	High sun and wind exposure	Moderate sun and wind exposure	Low sun and wind exposure	Poor evapo-transpiration
Slope %	Surface irrigation	0-6	6-12	>12	Runoff, erosion potential
	Sub-surface irrigation	0-10	10-20	>20	Runoff, erosion potential
	Absorption	0-10	10-20	>20	Runoff, erosion potential
Landform	All systems	Hillcrests, convex side slopes and plains	Concave side slopes and foot slopes	Drainage plains and incised channels	Groundwater pollution hazard, resurfacing hazard
Run-on and seepage	All land application systems	None-low	Moderate	High, diversion not practical	Transport of wastewater off site

Site feature	Relevant system	Minor limitation	Moderate limitation	Major limitation	Restrictive feature
Erosion potential	All land application systems	No sign of erosion potential		Indications of erosion e.g. rills, mass failure	Soil degradation and off-site impact
Site drainage	All land application systems	No visible signs of surface dampness		Visible signs of surface dampness	Groundwater pollution hazard, resurfacing hazard
Fill	All systems	No fill	Fill present		Subsidence
Land area	All systems	Area available		Area not available	Health and pollution risk
Rock and rock outcrop	All land application systems	<10%	10-20%	>20%	Limits system performance
Geology	All land application systems	None		Major geological discontinuities, fractured or highly porous regolith	Groundwater pollution hazard

Soil limitation assessment

Soil feature	Relevant system	Minor limitation	Moderate limitation	Major limitation	Restrictive feature
Depth to bedrock	Surface and sub surface irrigation	> 1.0	.5-1.0[2]	< 0.5	Restricts plant growth
or hardpan (m)	Absorption	> 1.5	1.0-1.5	< 1.0	Groundwater pollution hazard
Depth to seasonal water table (m)	Surface and sub surface irrigation	> 1.0	0.5-1.0	< 0.5	Groundwater pollution hazard
	Absorption	> 1.5	1.0-1.5	< 1.0	Groundwater pollution hazard
Permeability	Surface and sub surface irrigation	2b, 3 and 4	2a, 5	1 and 6	Excessive runoff and waterlogging
Class	Absorption	3, 4		1, 2, 5, 6	Percolation
Coarse fragments %	All systems	0-20	20-45	>40	Restricts plant growth, affects trench installation
Bulk density (g/cc)	All land application systems				restricts plant growth, indicator of permeability
SL		< 1.8		> 1.8	
L, CL		< 1.6		> 1.6	
C		< 1.4		>1.4	
pH	All land application systems	> 6.0	4.5-6.0	-	Reduces plant growth
Electrical conductivity (dS/m)	All land application systems	<4	4-8	>8	Restricts plant growth

[2] Potential to build up the soil depth using suitable loam from the site groundworks

Soil feature	Relevant system	Minor limitation	Moderate limitation	Major limitation	Restrictive feature
Sodicity (ESP)	Irrigation 0-40cm; absorption 0-1.2mtr	0-5	5-10	> 10	Potential for structural degradation
CEC **mequiv/100g**	Irrigation systems	> 15	5-15	< 5	Nutrient leaching
P sorption kg/ha	All land application systems	> 6000	2000-6000	< 2000	Capacity to immobilise P
Aggregate stability	All land application systems	Classes 3-8	class 2	class1	Erosion hazard

Appendix 1: Soil Profile Description

Soil Profile 1: Within effluent disposal area (refer Figure 3 for location)

Soil classification	Depth (cm)	Properties
Brown Tenosol	0-20 20-50	A Dark to medium brown coarse gravelly loam, moist and friable, 10 % coarse fragments, weak structure, gradual colour change to B Light brown coarse gravelly loam, moist and friable, 10-15% coarse fragments, massive, degrades to parent material

NB: Soil profile is presented as an expanded profile (expansion factor approximately X2)

Soil Profile 2: Within effluent disposal area (refer Figure 3 for location)

Soil classification	Depth (cm)	Properties
Brown Tenosol	0-20	A Dark to medium brown coarse gravelly loam, moist and friable, 10 % coarse fragments, weak structure, gradual colour change to
	20-50	B Light brown coarse gravelly loam, moist and friable, 10-15% coarse fragments, massive, degrades to parent material

NB: Soil profile is presented as an expanded profile (expansion factor approximately X2)

Appendix 2: Supporting Information

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

Lanfax Laboratories

Proficiency tested with 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.

Only the sodium and phosphorus results are reported here. 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

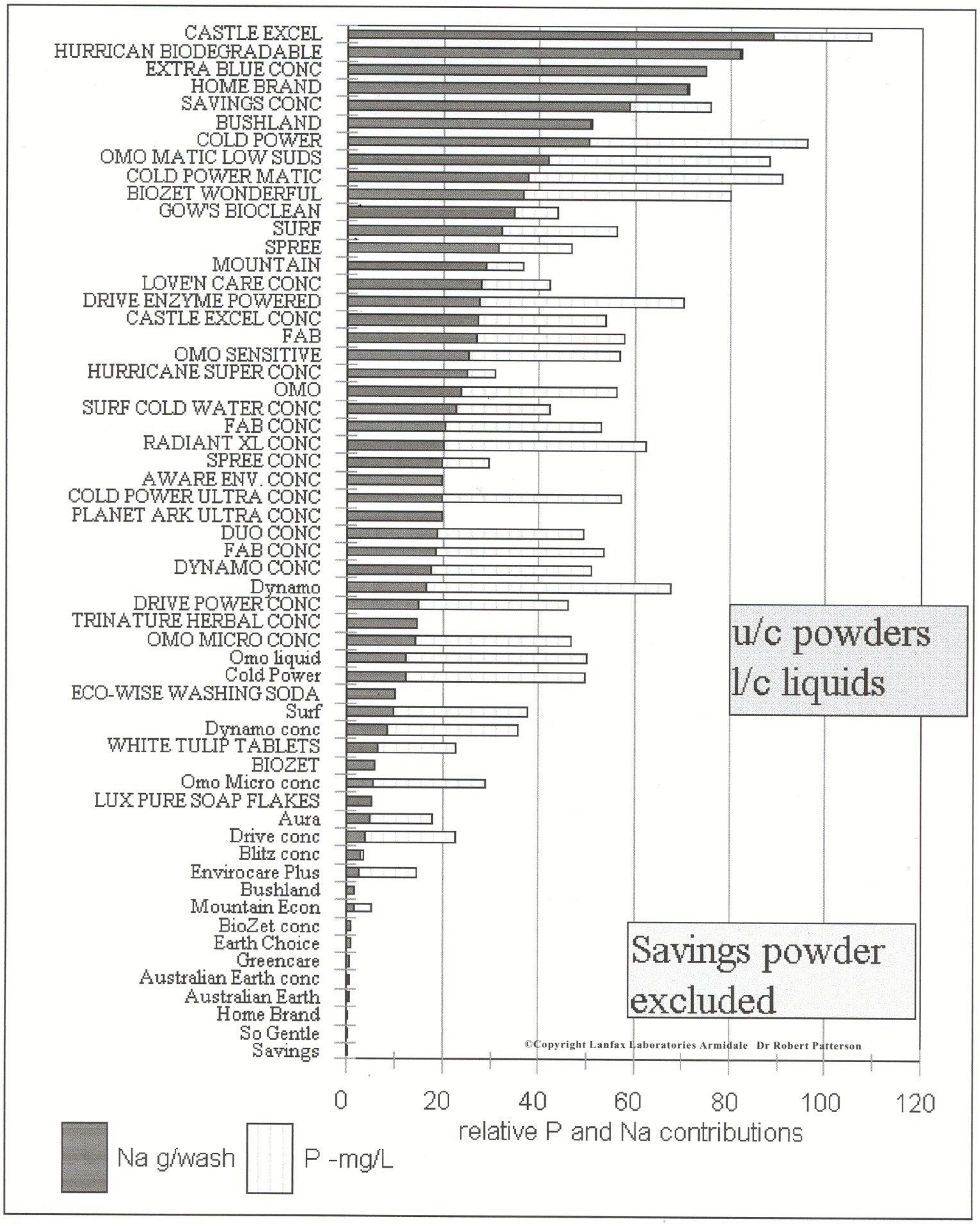
PATTERSON, R.A. (1999) *Reuse Initiatives Start in the Supermarket.* NSW Country Convention. Institution of Engineers Australia. 6-8 August 1999. Northern Group, Institution of Engineers Australia, Armidale.

How to read this graph:
For all on-site systems that apply the effluent by surface or subsurface application, the levels of sodium are critical. Choose the product with the lowest sodium. Levels over 20 g/wash are likely to be detrimental to plants and the soil.

The levels of phosphorus will depend upon the soil type and the use of the effluent. In some soils, phosphorus is not a real concern because it is immobile. In other soils it is likely to build up to high levels. It is preferable to choose the lower phosphorus values as well as the low sodium.

The detergents with long sodium bars (greater than 20 g/wash) should not be thrown out on your favourite garden as the sodium may be detrimental to the plants. High pH is also detrimental to plants and soils.

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.



DO

- ✓ Learn how your sewage management system works and its operational and maintenance requirements.
- ✓ Learn the location and layout of your sewage management system.
- ✓ Have your AWTS (if installed) inspected and serviced four times per year by an approved contractor. Other systems should be inspected at least once every year. Assessment should be applicable to the system design.
- ✓ Keep a record of desludgings, inspections, and other maintenance.
- ✓ Have your septic tank or AWTS desludged every three years to prevent sludge build up, which may 'clog' the pipes.
- ✓ Conserve water. Conservative water use around the house will reduce the amount of wastewater which is produced and needs to be treated.
- ✓ Discuss with your local council the adequacy of your existing sewage management system if you are considering house extensions for increased occupancy.

DON'T

- ✗ Don't let children or pets play on land application areas.
- ✗ Don't water fruit and vegetables with effluent.
- ✗ Don't extract untreated groundwater for cooking and drinking.
- ✗ Don't put large quantities of bleaches, disinfectants, whiteners, nappy soakers and spot removers into your system via the sink, washing machine or toilet.
- ✗ Don't allow any foreign materials such as nappies, sanitary napkins, condoms and other hygiene products to enter the system.
- ✗ Don't put fats and oils down the drain and keep food waste out of your system.
- ✗ Don't install or use a garbage grinder or spa bath if your system is not designed for it.

Reducing water usage

Reducing water usage will lessen the likelihood of problems such as overloading with your septic system. Overloading may result in wastewater backing up into your house, contamination of your yard with improperly treated effluent, and effluent from your system contaminating groundwater or a nearby waterway.

Your sewage management system is also unable to cope with large volumes of water such as several showers or loads of washing over a short period of time. You should try to avoid these 'shock loads' by ensuring water use is spread more evenly throughout the day and week.

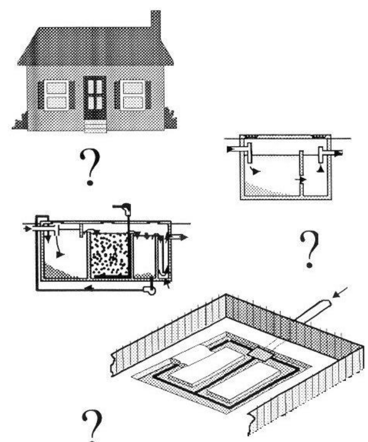
HELP PROTECT YOUR HEALTH AND THE ENVIRONMENT

Poorly maintained sewage management systems are a serious source of water pollution and may present health risks, cause odours and attract vermin and insects.

By looking after your management system you can do your part in helping to protect the environment and the health of you and your community.

For more information please contact:

Managing Wastewater In Your Backyard



Foundation Maintenance and Footing Performance: A Homeowner's Guide

CSIRO

BTF 18 replaces Information Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes
H	Highly reactive clay sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes
A to P	Filled sites
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures

Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures

Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.

Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing

Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage

In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

Protection of the building perimeter

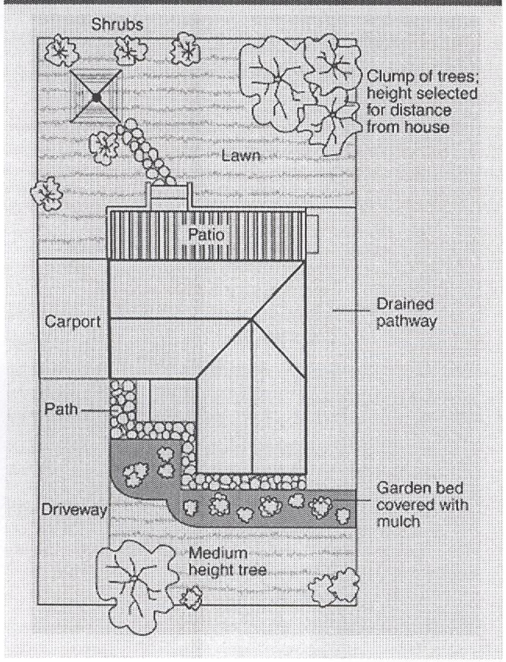
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted	15–25 mm but also depend on number of cracks	4

Gardens for a reactive site



should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

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CSIRO PUBLISHING PO Box 1139, Collingwood 3066, Australia

Freecall 1800 645 051 Tel (03) 9662 7666 Fax (03) 9662 7555 www.publish.csiro.au

Email: publishing.sales@csiro.au