BLUE MOUNTAINS
Geological and Environmental Services Pty. Ltd.
ACN 069 994 056

20 Fifth Avenue, Katoomba 2780
Phone (02) 4782 5981
Fax (02) 4782 5074

REPORT ON
INVESTIGATION AND ASSESSMENT FOR THE SITING OF A PROPOSED EFFLUENT MANAGEMENT SYSTEM AT LOT 8, No. 120 - 134 FARM ROAD, MULGOA

PREPARED FOR: MR. J. & MRS. N. FARRUGIA
SUBMITTED TO: PENRITH CITY COUNCIL

REF. No. 210705
JULY 2021

CONTENTS

1. INTRODUCTION

This report outlines the results of an investigation and assessment for the siting of a proposed effluent management system at Lot 8, No. 120 - 134 Farm Road, Mulgoa. The investigation was performed at the request of Mr. & Mrs. Farrugia. The report will be submitted to Penrith City Council and is prepared with due consideration and reference to the relevant parts of the 'On-Site Sewage Management and Greywater Reuse Policy' from April 2014. This document is further referred to as Penrith City Council (April 2014).

The unsewered property has an area of 3.82 hectares that comprises an existing dwelling and associated features. As shown in the accompanying plan, Figure 1, the proposed development the construction of a dwelling and the siting of an associated effluent management system.

It is understood that the existing dwelling is serviced with a Council approved aerated wastewater treatment system **(AWTS)** and surface spray irrigation area for land application. The existing dwelling and components of its effluent management are positioned well-away from the same for the proposed dwelling and both will operate independently to each other. Therefore, the operation of the existing effluent management system will not impact upon the same for the proposed new dwelling.

2. PROPOSED EFFLUENT MANAGEMENT SYSTEM AND DESIGN WASTEWATER VOLUME

As confirmed with Mr. & Mrs. Farrugia, the proposed effluent management scheme for the dwelling comprises an AWTS with single or dual pre-cast concrete or polymer processing tank or tanks from which the disinfected secondary treated effluent will be applied to the land by surface spray irrigation over a prescribed area.

The nominated location of the proposed AWTS as determined with Mr. & Mrs. Farrugia off the northern side of the dwelling, pending exact final confirmation, is shown in Figure 1.

At the point of report preparation, the particular brand and model of AWTS Is not known. When this choice is made, the manufacturers specifications, NSW Health Department Accreditation and other relevant details will be provided by the supplier for submission to Council in addition to this report.

This report is submitted to Council as part of the approval process for the proposed dwelling and associated effluent management system. Blue Mountains Geological and Environmental Services is not responsible or liable for the installation, operation, maintenance and on-going performance of both the proposed AWTS and area to be utilised for land application by surface irrigation.

The main environmental concern with the AWTS in general is considered to be the levels of nitrates, phosphates and faecal coliforms generated, particularly if prescribed treatment levels are not achieved. Reference to the Guidelines in Department of Local Government et. al. (1998) shows the expected quality of wastewater after treatment in an AWTS, which is given in Table 1. Design figures may not be indicative of long-term operational characteristics, and an AWTS must be well maintained and operated to achieve this quality on a continuous basis. Note that aerated systems currently on the market and accredited by the NSW Health Department provide a better wastewater quality with nitrogen **(N)** and phosphorus **(P)** concentrations typically not exceeding 15 - 20mg/litre and 10 - 12mg/litre respectively.

Aerated systems rely on biological activity for proper system operation. Changes to the effluent loadings, in the form of either a significant increase or decrease, may result in poor system performance. It is suggested that an AWTS must be operated continuously and the power must not be turned off, as intermittent use may require servicing of the system at each start up.

It would be prudent, as with on-site or reticulated sewer, to implement a water usage minimisation scheme in the proposed dwelling. Whilst the AWTS provides for re-use of all domestic effluent by application to the land, reducing the loads to be treated and discharged will significantly decrease the potential for adverse environmental impacts. As part of the BASIX scheme in Local Government, a set of highly rated water-reduction fixtures and devices will be installed which include low litreage dual-flush toilets, aerator taps, low-flow showerheads and what will be a front loading washing machine.

TABLE 1: EXPECTED QUALITY OF WASTEWATER AFTER TREATMENT IN AN AERATED SYSTEM

PARAMETER	CONCENTRATION	FAILURE INDICATOR
BIOCHEMICAL OXYGEN DEMAND (BOD)	<20mg/L	>50mg/L
SUSPENDED SOLIDS	<30mg/L	>50mg/L
TOTAL N	25 - 50mg/L*	not applicable
TOTAL P	10 - 15mg/L*	not applicable
FAECAL COLIFORMS NON-DISINFECTED EFFLUENT	up to 10^4 cfu/100mL	not applicable
FAECAL COLIFORMS DISINFECTED EFFLUENT	<30cfu/100mL	>100cfu/100mL
DISSOLVED OXYGEN	>2mg/L	<2mg/L

* Improved treatment levels with currently accredited systems.

It is suggested to utilise 'environmentally friendly' cleaning, washing and detergent products in the dwelling to reduce the levels of P, as well as sodium, discharged into the proposed AWTS and area to be utilised for land application. Furthermore, reducing the amounts of such products used would also be beneficial to the environment. Reference to the Figure in Appendix 1 shows the sodium contents in grams/wash for a variety of laundry detergents used in both front and top-loading washing machines (from Dr. R. Patterson, Lanfax Labs). It is recommended to utilise laundry detergents with the lowest sodium content as practical. Cross-matching low sodium products with low P ones would also be beneficial.

In addition to the details above, it is important to ensure that chemical cleaning and detergent products are compatible for use with an on-site effluent treatment system. Such products can kill off bacteria in a treatment device, which results in ineffective treatment (particularly with respect to faecal coliforms). Use of harsh bleaches and disinfectants should be avoided, but only used sparingly if necessary. Alkalinity and P contents in cleaning products can also have an influence on performance and the treatment levels achieved. However, with low P products, a relatively higher alkalinity is required in order to get an appropriate level of cleaning, which can adversely impact upon a treatment system.

Further to discussions with Mrs. Farrugia, the following details are provided in relation to wastewater generation:

- The property is serviced with a reticulated water supply.
- The proposed dwelling comprises five bedrooms.
- The proposed dwelling will be occupied by the six members of the Farrugia family on a full-time basis.

With regards to the design effluent volume, reference is made to the approach in Table 2 of Penrith City Council (April 2014) where Note 3 shows that design effluent volume calculations are based on the following:

- 150 litres/person/day for town water supplies (conforms with AS/NZS 1547, 2012).
- One person/bedroom and two for a master or guest bedroom – i.e. equates with allowance for a maximum of six persons in the proposed dwelling.

Based on the details above, the maximum design effluent volume from the proposed dwelling is:

* 6 persons x 150L/person/day = 900L/day.

As previously detailed, it is important to ensure that appropriate water-conservation practices are carried out in the dwelling so the maximum design effluent volume above is not exceeded – i.e. ideally kept as low as possible.

3. SITE DESCRIPTION

The property comprises an elongate-shaped parcel of land that is situated off the eastern side of Farm Road. Reference to Figure 1 shows the location of the proposed dwelling and associated driveway in the elevated western part of the property in relatively close proximity to the frontage with Farm Road.

The proposed effluent disposal area **(EDA)** for secondary treated wastewater, i.e. where the surface spray irrigation lines will be established, is positioned 50m east-northeast of the dwelling and 6m from the nearest downslope northern boundary (Figure 1). The vegetation across the proposed EDA and adjacent parts comprises a grass cover with some low weeds and patchy parts. There is a typical grade ranging from 4^0 - 11^0 in a north to northeasterly direction across the EDA as measured on the site with a clinometer. This area on a convex crest to upper slope is relatively well-elevated and affords exposure to the open northerly aspect and prevailing winds.

The proposed surface spray irrigation area is situated at a typical elevation of about 80m. Observations during the site investigation on the site and reference to the Penrith 1:25,000 scale topographic map shows that the nearest defined 'water feature' within the relevant flow path of the EDA is an intermittent watercourse at a distance of approximately 250m in a northeasterly direction. From this point, the intermittent watercourse trends in an overall north-northwesterly direction for about 2.3km before attaining a perennial flow in Mulgoa Creek.

Climatic conditions at the site are generally temperate throughout the year, however hot to very hot weather in and around summer and cool to cold weather in and around winter is also experienced. Reference to the Penrith 1:25,000 scale topographic map shows that the average annual rainfall in the area is in the order of 868mm and the average daily maximum temperature ranges from 17 - 18^0C in winter to 26 - 28^0C in summer.

Further to observations during the site investigation and with reference to the site assessment guidelines in Table 1 of Penrith City Council (April 2014), the proposed EDA for surface irrigation has low limitations for flood potential, exposure to sun and wind, landform, run-on and upslope seepage, erosion potential, site drainage, rocks and rock outcrops (nil), environmentally sensitive areas, buffer distances (all in place from man-made and natural features and property boundaries) and land area for effluent disposal. Furthermore, there is typical a medium limitation for slope.

4. FIELDWORK METHODS

The initial phase of the fieldwork comprised a site inspection and ground survey on 16/7/21 aimed at delineating the preferred position of the EDA for secondary treated wastewater with respect to the location of the proposed dwelling and the geomorphological characteristics of the land.

Further to the ground survey, three 100mm diameter hand-auger holes were bored to a maximum depth of 1.2m across the proposed EDA. The auger holes were used to determine the nature and physical characteristics of the subsurface soil strata and provide a representative description of this.

To assess soil permeability, results of the auger holes are related to the textural/structural classification in Table E1 in AS/NZS 1547 (2012) which enables determination of the soil category and corresponding indicative permeability value. An indicative permeability value can be converted to a design irrigation rate **(DIR)** from Table M1 in AS/NZS 1547 (2012).

5. GROUND SURVEY AND PHYSICAL CONSTRAINTS

The location of the proposed EDA for surface spray irrigation has been carefully delineated on the site with Mrs. Farrugia (Figure 1). Results from the ground survey indicate that there are no significant physical constraints to the application of secondary treated effluent in the area containing the proposed dwelling because the land is not steeply sloping, whilst being cleared of native vegetation and well from the nearest intermittent watercourse and perennial watercourse.

In light of the lack of significant physical constraints and as outlined in Section 3, the proposed EDA is conveniently positioned in a locality that maintains appropriate buffers that well-exceed the requirements for surface spray irrigation from the proposed dwelling, conforms with the requirements from the nearest downslope northern boundary and well-exceeds the requirements from the nearest water feature in the relevant flow path in Penrith City Council (April 2014) and Department of Local Government et. al. (1998). The property also affords ample scope for the siting of additional area for surface spray irrigation if ever required in the future.

The proposed EDA affords exposure to the open northerly aspect and prevailing winds, which in conjunction with the grass cover to be improved and managed (see Section 7.1), will enhance the benefits of evapotranspiration and concurrently reduce the absorption loads of treated wastewater on the subsurface strata.

6. SUBSURFACE PROFILE

Results from the auger holes are provided to assess the nature of the subsurface profile and also facilitate the categorisation of the soils into one of the two Types outlined in Table 2 of Penrith City Council (April 2014). The soil types and category have a direct bearing on the sizing of the EDA. Based on the findings of the auger holes to be detailed in this Section, the proposed EDA is designated as having 'Clay Soil Types' from Table 2 in Penrith City Council (April 2014). This is distinct to the 'Sandy Soil Types'.

Observations on the site and reference to the Penrith 1:100,000 scale Soil Landscape map indicates that the proposed EDA is underlain by the erosional 'Luddenham' soil group which occurs on undulating to rolling low hills on Wianamatta Group shales, often associated with Minchinbury Sandstone.

The soils of the Luddenham group comprise shallow (<100cm) Dark Podzolic Soils or massive Earthy Clays on crests; moderately deep (70 – 150cm) Red Podzolic Soils on upper slopes; and moderately deep (<150cm) Yellow Podzolic Soils and Prairie Soils on lower slopes and drainage lines (Bannerman and Hazelton, 1990). General limitations of the Luddenham group include high soil erosion hazard, localised impermeable highly plastic subsoil, moderate reactivity and strong acidity (Bannerman and Hazelton, 1990).

The subsurface profile observed has a 'duplex' structure as there is a well-defined textural and permeability contrast between the A and B horizon soils. With reference to Table E4 in AS/NZS 1547 (2012), it is considered that all soils have a moderate structure.

The soils are described in accordance with the classification schemes in Australian Soil and Land Survey: Field Handbook (1990) and Table E1 in AS/NZS 1547, 2012 (Appendix 1). The typical subsurface profile in the area containing the proposed EDA is detailed below.

(i) LOAM (TOPSOIL) – A1 horizon

- observed from the surface to a depth ranging from 0.1 - 0.15m.
- comprises dark-brown to dark grey-brown, fine grained loam with few ironstone fragments (i.e. 2 - 10% coarse fragments from Table E4 in AS/NZS 1547, 2012).
- soil category 3 for loams from Table E1 in AS/NZS 1547 (2012).

(ii) CLAY LOAM – A2 Horizon

- observed from 0.1 - 0.15m to a depth ranging from 0.15 - 0.3m.
- comprises dark-brown, fine grained clay loam with few ironstone fragments (i.e. 2 - 10% coarse fragments.
- soil category 4 for clay loams.

(iii) MEDIUM CLAY – B Horizon

- observed at a depth ranging from 0.15 - 0.3m to 1.2m.
- comprises firm to stiff, brown to orange-brown, red-brown and light-grey medium clay with few ironstone fragments (i.e. 2 - 10% coarse fragments). Some red-brown and light-grey colouring below 0.7m.
- soil category 6 for medium to heavy clays.

No free groundwater was observed in any of the auger holes to 1.2m depth. Whilst the exact depth to a consistent groundwater table below the EDA, it is considered that its minimum depth would be in the vicinity of at least about 30m.

7. SIZING OF THE PROPOSED EFFLUENT DISPOSAL AREA

The sizing of the EDA is required to be based on the following relevant data from Table 2 in Penrith City Council (April 2014):

- The site being classified as having clay soil types as outlined in Section 6.
- A reticulated town water supply.
- Five bedrooms in the proposed dwelling.

Further to the details above, reference to Table 2 in Penrith City Council (April 2014) shows that a surface spray irrigation area of 833m^2 is required for the proposed dwelling. This results in a minimal wastewater application rate of only 1.08 litres/m^2/day (or DIR of 1.08mm/day). This value is almost half the rate of 2 litres/m^2/day for the most-limiting medium to heavy clays in soil category 6.

In summary,

* PROPOSED EDA FOR SURFACE SPRAY IRRIGATION = 833m^2 for the maximum design effluent volume of 900 litres/day from the dwelling.

Reference to Figure 1 shows that the proposed EDA measures 40m in length across the slope in an east-west direction x 20.83m in width down the slope in a north-south direction.

7.1 Preparation and Management of the Effluent Disposal Area

Appropriate preparation and management are important factors that significantly affect the ability of an EDA to contain and assimilate treated wastewater. It is important to ensure that the surface irrigation lines utilised fully cover the area of 833m^2 as required by Council so the hydraulic and nutrient loads can be adequately catered for by the soils and vegetation cover.

Reference to Gardner et. al. (1997) indicates that loading rate should be balanced by allowable sinks. Allowable sinks for N are denitrification/volatilisation (typically 15 - 20% loss) and plant uptake, which depends on the plant yield and N concentration in the vegetation. Provided the vegetation in an effluent irrigation area is harvested and removed on a regular basis (years for trees, months for grasses/pasture), it will provide a sustainable and recurrent sink for N.

Allowable sinks for P are plant uptake (generally 8 - 10 times less than N uptake) and the storage capacity of the soil (may account for up to 30% of the N loading). Reference to Gardner et. al., (1997) indicates that for sandy soils, the P front moves downwards at a rate of about 20 years/metre of soil depth for a P concentration of about 10mg/litre of effluent. The many adsorption sites for P in soils and aquifers suggest that adverse groundwater consequences of P leaching are likely to be the exception rather than the rule.

To raise the pH of the expected strongly acidic soils as outlined for the Luddenham soil group in Section 6, decrease the potential for dispersion and address the sodium content in the treated wastewater, it is suggested to apply agricultural lime and gypsum across the EDA and adjacent parts and lightly incorporate into the top 50 - 100mm of soil. This will also assist to balance the soil chemistry, enhance soil structure, maintain soil drainage and fertility, and reduce the potential long-term adverse impacts that may arise from the discharge of treated effluent.

It is understood that lime and gypsum can be purchased from selected plant nurseries and landscape/rural supply stores. Lime and gypsum can be applied at suggested rates of approximately 0.2 - 0.3kg/m^2 (i.e. 2 - 3kg/m^3) in and adjacent to the EDA. The soil additives can also be re-applied and lightly incorporated into the top 50 - 100mm of soil as required every three to five years for example. Note that it would be prudent to contact the NSW Agriculture Department to assess any advice they can provide regarding types of soil additives, application methods and rates. It is understood that liquefied versions of lime and gypsum are also available.

Studies undertaken by NSW Agriculture indicate that to assist with the spreading of soil additives such as lime and gypsum across areas of pasture and increase their positive attributes, it is suggested to introduce the ‘Long Worm’ (deep burrowing), ‘Turgid Worm’ (topsoil burrowing) and ‘Trap Worm’ (middle layers) in the EDA proper. This will assist to ensure that lime and gypsum do not remain on the surface or runoff, as typically occurs when spread, but will be transferred to the subsoil to effectively raise pH.

To obtain a complete grass coverage with a vigorous year-round growth period, it is suggested to intersow by seeding with a blend such as paspalum, fescue, perennial rye and kentucky blue for example (or similar). Consideration can also be given to lightly aerating the topsoil to address the partly hard-set surface, with care taken to avoid intermixing separate soil layers and bringing clay closer to the surface.

Once the EDA is established, it is important to ensure that grass is properly managed by being mown regularly to promote vigorous growth with the cuttings harvested and removed to avoid recycling nutrients back into the soils. Furthermore, it is suggested to ensure that grass is not cut to a level that is too low as this will limit the depth and density of root growth.

Any upslope runoff must be maintained away from the proposed EDA so that it has to ideally cater only for the treated wastewater and direct rainfall. This can be achieved with use of a small contour bank or dish drain in the area above an EDA. However, due to the limited sub-catchment above the EDA which is vegetated, anomalous levels of run-on would not be expected. Therefore, it is considered that an upslope diversion drain is not required in the first instance but could be installed if ever required in the future.

In the event of weed proliferation due to the discharge of treated effluent, it is suggested that adequate eradication measures are implemented to prevent their possible spread beyond the margins of the EDA.

Ensure that construction activities do not adversely impact on the area delineated for the land application of treated effluent such as the compaction/stripping of topsoil, placement of soil filling/building material and unnecessary vehicular movements for example – i.e. maintain existing soil depth and condition and can partition this area if required.

Stormwater provisions associated with the proposed dwelling must not be directed towards the proposed EDA or be too close to it so as not to impede its proper functioning.

Once the EDA is established, it is important to ensure that there are no vehicular movements or inclusion of hoofed animals (if relevant) as this will have a detrimental impact on soil drainage and structure. Furthermore, treated effluent should not come into direct contact with the occupants of the dwelling or any other persons.

8. INSTALLATION, OPERATION AND MAINTENANCE

For an effluent management system to work well the supplier, installer, service agent, owners and occupants must be committed to its management. An AWTS must also be installed by an appropriately experienced and certified person and serviced on a quarterly basis. Quarterly services as part of maintenance agreements normally involve inspection of the mechanical, electrical and functioning parts of the system to ensure they are operating properly, replacement of chlorine tablets for disinfection and a check of the discharge sprinklers to ensure they are not blocked. A properly operated and maintained system should meet the expected parameters for wastewater quality (see Section 2).

Newly installed systems often require a lead-in time before satisfactory performance is achieved. This time can often be reduced by promoting establishment of the bacteria in the treatment system. The effectiveness of a system will, in part, depend on how it is used and maintained. A guide to good maintenance procedures, from Department of Local Government et. al. (1998), is listed below:

DO

- have the system inspected and serviced four times per year by an approved contractor.
- have the system service include assessment of sludge and scum levels and the performance of the EDA.
- have the AWTS desludged at least every three years.
- have the disinfection chamber inspected and tested quarterly to ensure correct disinfection levels.
- have the grease trap (if installed) cleaned out at least as required on a regular basis.
- keep a record of pumping, inspections, and other maintenance.
- learn the location and layout of the treatment system and EDA.
- use biodegradable liquid detergents such as concentrates with low sodium and P levels (see Appendix 1).
- conserve water – deliberate attention to water conservation is considered to be important not only due to the potential to over-use this resource from the reticulated supply, but to also enhance the performance of the AWTS and EDA by reducing the hydraulic and nutrient

loadings and allowing treated wastewater to be properly accepted in the medium to long term periods.

DON'T

- put bleaches, disinfectants, whiteners, nappy soakers and spot removers in large quantities into the AWTS via sinks, toilets or washing machines.
- allow any foreign material such as nappies, sanitary napkins, condoms and other hygiene products to enter the system.
- use more than the recommended amounts of detergents.
- put fats and oils down the drain and keep food waste out of the system – this is considered to be particularly important because food scraps can result in a higher than acceptable BOD level and excess oils/fats can overload or hinder the performance of any type of effluent treatment system. Use of strainer in the kitchen sink is required and removing excess food waste/oils from plates with paper towelling before washing would reduce the input of fats and organic material into the AWTS (used paper towels can be composted).
- switch off the power to the system, even when the dwelling is unoccupied.

9. CONCLUSION

(i) An investigation and assessment has been undertaken for the siting of a proposed effluent management system at Lot 8, No. 120 - 134 Farm Road, Mulgoa. The unsewered property has an area of 3.82 hectares.

(ii) The proposed development comprises the construction of a five bedroom dwelling and the siting of an associated effluent management system.

(iii) The proposed effluent management scheme for the dwelling comprises an AWTS from which the disinfected secondary treated effluent will be applied to the land by surface spray irrigation over a prescribed area.

(iv) With allowance for the reticulated town water supply, the maximum design effluent volume from the dwelling is 900 litres/day.

(v) The proposed EDA is appropriately located with regards to the proposed dwelling, all property boundaries and the nearest water feature in the relevant flow path.

(vi) Results in this report show that a considerable area of $833m^2$ is required for surface irrigation from the proposed dwelling based on the maximum design effluent volume and requirements in Penrith City Council (April 2014). Preparation and management measures detailed with respect to the proposed AWTS and EDA should also be implemented.

GRANT AUSTIN
Engineering Geologist
Member Australian Institute of Geoscientists
Affiliate Institution of Engineers Australia

REFERENCES

Bannerman, S.M. and Hazelton, P.A. (1990): Soil Landscapes of the Penrith 1:100,000 Sheet. Map and Report. Department of Conservation and Land Management, Sydney.

Department of Local Government, NSW EPA, NSW Health Department, Department of Land and Water Conservation and Department of Urban Affairs and Planning (February 1998): On-site Sewage Management for Single Households. Environment and Health Protection Guidelines.

Gardner, T., Geary, P. and Gordon, I. (1997): Ecological Sustainability and On-Site Effluent Treatment Systems. Australian Journal of Environmental Management – Volume 4, Number 2 pp 34 - 156.

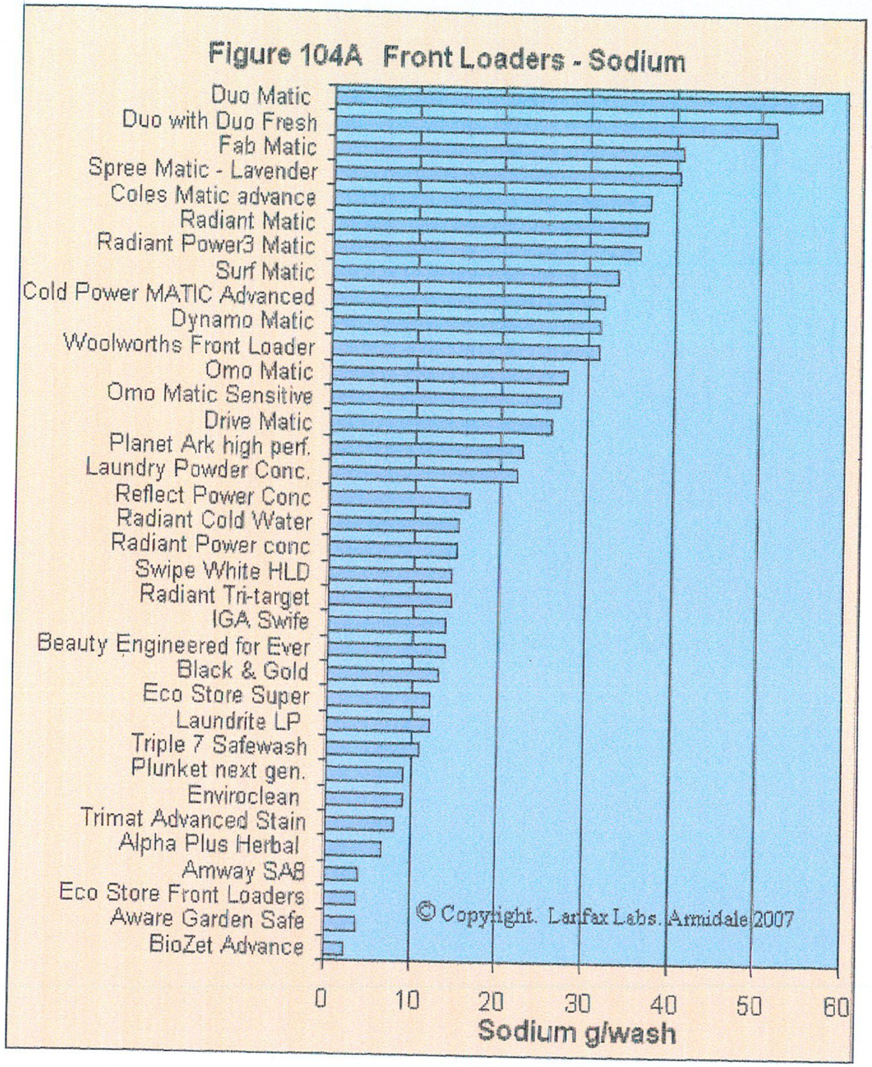
McDonald, R.C., Isbell, R.F., Spreight, J.G., Walker, J. and Hopkins, M.S. (1990): Australian Soil and Land Survey: Field Handbook. Second Edition. Inkata Press, Melbourne.

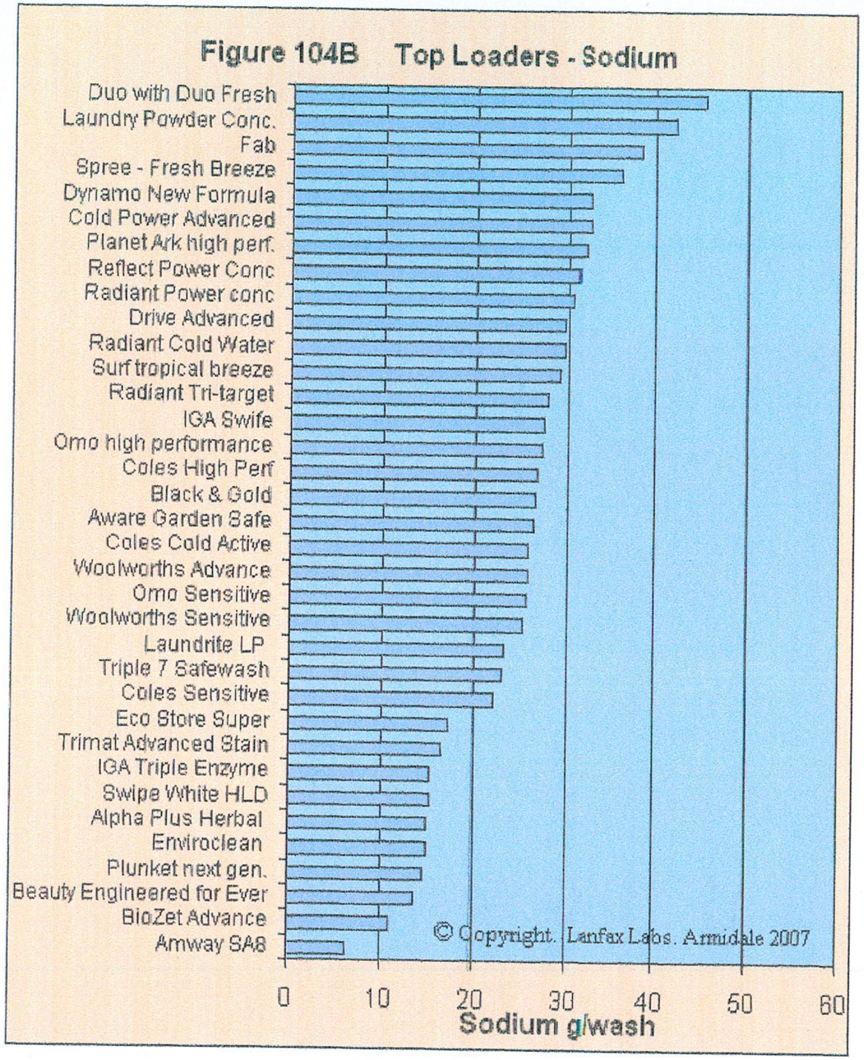
Penrith City Council (April 2014): On-Site Sewage Management and Greywater Reuse Policy.

Standards Australia & New Zealand (2012): Australian/New Zealand Standard 1547 – On site domestic wastewater management.

APPENDIX 1

SODIUM CONTENTS FOR A VARIETY OF LAUNDRY DETERGENTS AND SOIL CLASSIFICATIONS





Dr Robert Patterson, Lanfax Labs, Armidale NSW. Laundry Products Research **49 Laundry Detergents Powders (updated 24th November 2007) www. lanfaxlabs.com.au Accessed 9/5/08.**

TABLE E1
ASSESSMENT OF SOIL TEXTURES

Soil category	Classification	Properties	Typical clay content% (see Note)
1	Sand	Very little to no coherence; cannot be moulded; single grains stick to fingers	Less than 5
2	Loamy sand	Slight coherence; forms a fragile cast that just bears handling; gives a very short (5 mm) ribbon that breaks easily: discolours the fingers	5 – 10
	Sandy loam	Forms a cast but will not roll into a coherent ball; individual sand grains can be seen and felt; gives a ribbon 15 – 25 mm long	10 – 20
3	Fine sandy loam	As for sandy loams, except that individual sand grains are not visible, although they can be heard and felt; gives a ribbon 15 – 25 mm long	10 – 20
	Loam	As for sandy loams but cast feels spongy, with no obvious sandiness or silkiness; may feel greasy if much organic matter is present; forms a thick ribbon about 25 mm long	10 – 25
	Silty loam	As for loams but not spongy; very smooth and silky; will form a very thin ribbon 25 mm long and dries out rapidly	10 – 25
4	Sandy clay loam	Can be rolled into a ball in which sand grains can be felt; forms a ribbon 25 – 40 mm long	20 – 30
	Fine sandy clay	As for sandy clay loam, except that individual sand grains loam are not visible although they can be heard and felt; forms a ribbon 40 – 50 mm long	20 – 30
	Clay loam	Can be rolled into a ball with a rather spongy feel; slightly plastic; smooth to manipulate; will form a ribbon 40 – 50 mm long	25 – 35
	Silty clay loam	As for clay loams but not spongy; very smooth and silky; will form a ribbon about 40 – 50 mm long; dries out rapidly	25 – 35
5	Sandy clay	Forms a plastic ball in which sand grains can be seen, felt or heard; forms a ribbon 50 – 75 mm long	35 – 45
	Light clay	Smooth plastic ball that can be rolled into a rod; slight resistance to shearing between thumb and forefinger; forms a ribbon 50 – 75 mm long	35 – 40
	Silty clay	As for light clay but very smooth and silky; will form a ribbon about 50 – 75 mm long but very fragmentary; dries out rapidly	40 – 50
6	Medium clay	Smooth plastic ball, handles like plasticine and can be moulded into rods without fracture; some resistance to ribboning, forms a ribbon 75 mm or more long	40 – 55
	Heavy clay	Smooth plastic ball that handles like stiff plasticine; can be moulded into rods without fracture; firm resistance to ribboning; forms a ribbon 75 mm or more in length	50 or more

NOTE: The typical clay content figures are included for information only.

SOIL CLASSIFICATION

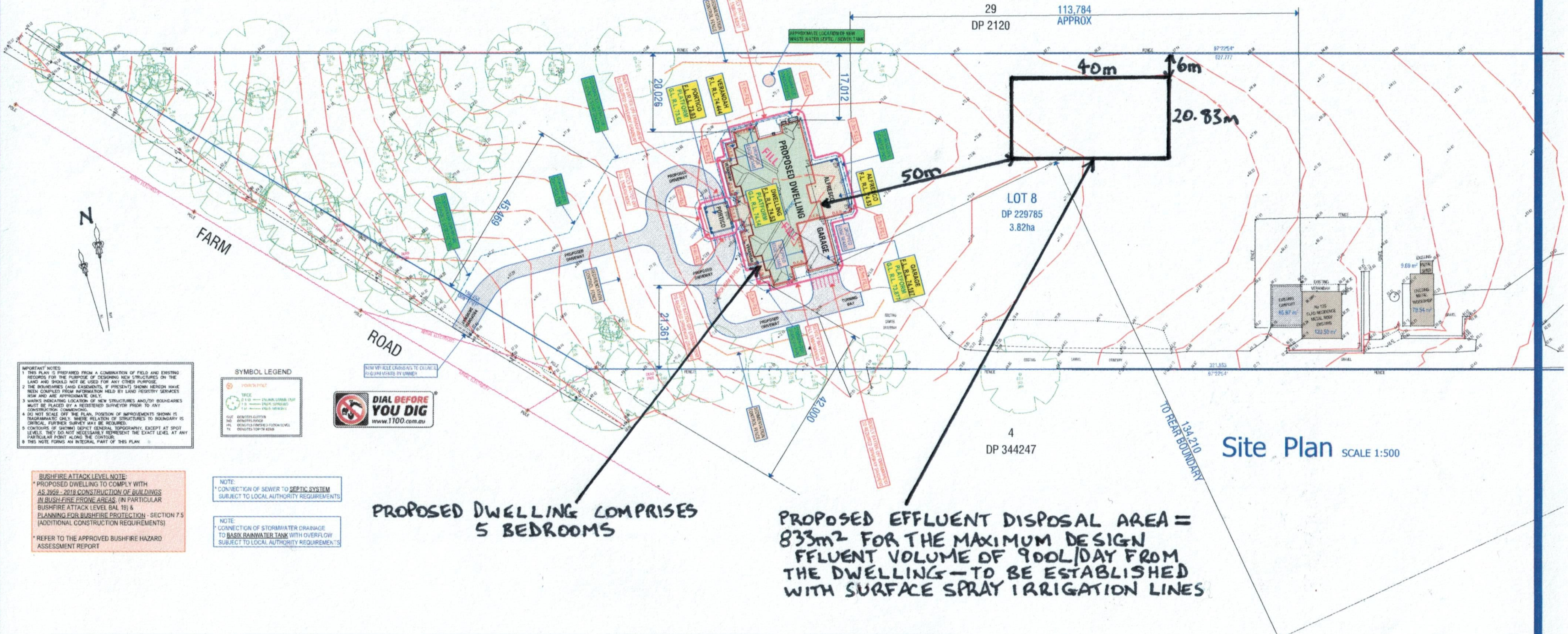
Field Texture Grade		*Behaviour of moist bolus*	*Approximate clay content (%)*
S	*Sand*	coherence nil to very slight; cannot be moulded; sand grains of medium size; single sand grains adhere to fingers.	commonly less than 5%
LS	*Loamy sand*	slight coherence; sand grains of medium size; can be sheared between thumbs and forefinger to give minimal ribbon of about 5mm.	about 5%
CS	*Clayey sand*	slight coherence; sand grains of medium size; sticky when wet; many sand grains stick to fingers; will form minimal ribbon of 5-15mm; discolours fingers with clay stain.	5%-10%
SL	*Sandy loam*	bolus coherent but very sandy to touch; will form ribbon of 15-25mm; dominant sand grains are of medium size and are readily visible.	10%-20%
L	*Loam*	bolus coherent and rather spongy; smooth feel when manipulated but with no obvious sandiness or 'silkiness'; may be somewhat greasy to the touch if much organic matter is present; will form ribbon of about 25mm.	about 25%
ZL	*Silty Loam*	coherent bolus; very smooth to often silky when manipulated; will form ribbon of about 25mm.	about 25% and with silt 25% or more
SCL	*Sandy clay loam*	strongly coherent bolus; sandy to touch; medium size sand grains visible in finer matrix; will form ribbon of 25-40mm.	20%-30%
CL	*Clay loam*	coherent plastic bolus; smooth to manipulate; will form ribbon of 40-50mm.	30%-35%
CLS	*Clay loam, sandy*	coherent plastic bolus; medium size sand grains visible in finer matrix; will form ribbon of 40-50mm.	30%-35%
ZCL	*Silty clay loam*	coherent plastic bolus; plastic and often silky to the touch; will form ribbon of 40-50mm.	30%-35% and with silt 25% or more
LC	*Light clay*	plastic bolus; smooth to touch; slight resistance to shearing between thumb and forefinger; will form ribbon of 50-75mm.	35-40%
LMC	*Light medium clay*	plastic bolus; smooth to touch; slight to moderate resistance to ribboning shear; will form ribbon of about 75mm.	40%-45%
MC	*Medium clay*	smooth plastic bolus; handles like plasticine and can be modelled into rods without fracture; has moderate resistance to ribboning shear; will form ribbon of 75mm or more.	45%-55%
MHC	*Medium heavy clay*	smooth plastic bolus; handles like plasticine; can be modelled into rods without fracture; has moderate to firm resistance to ribboning shear; will form ribbon of 75mm or more.	50% or more
HC	*Heavy clay*	smooth plastic bolus; handles like stiff plasticine; can be modelled into rods without fracture; has firm resistance to ribboning shear; will form ribbon of 75mm or more.	50% or more

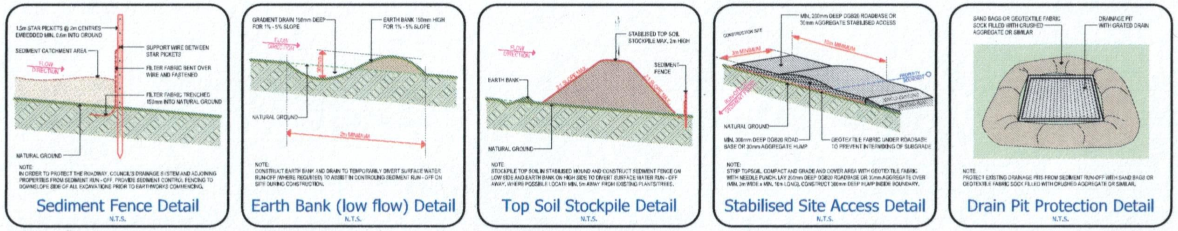
From: Australian Soil and Land Survey: Field Handbook 1990

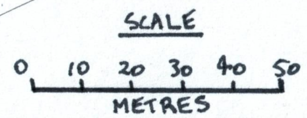
ANOTHER HANDCRAFTED DRAWING BY PYRAMID DESIGN & DRAFTING

A1
SHEET

FIGURE 1: PLAN SHOWING THE PROPOSED DWELLING AND COMPONENTS OF THE EFFLUENT MANAGEMENT SYSTEM AT LOT 8, No. 120-134 FARM ROAD, MULGOA







LGA: PENRITH CITY COUNCIL
FIGURE 1: G. AUSTIN, BMG+ES PL
EFFLUENT MANAGEMENT REPORT
REF. No. 210705
JULY 2021
PHONE 4782-5981

GENERAL NOTES :

- BRICK EXPANSION JOINTS ARE TO BE PROVIDED AS SPECIFIED BY THE STRUCTURAL ENGINEER AND IN ACCORDANCE WITH THE N.C.C. - B.C.A.
- STAIRS. AS SPECIFIED OR (TREAD: 250 MIN-300 MAX & RISER: 170 MIN-190 MAX)
- HANDRAILING : (AT STEPS : 865 MIN. HIGH) (AT LANDING : 1000 MIN. HIGH)
- ALL DOOR SIZES AS SPECIFIED ON PLAN.
- MECHANICAL VENTILATION TO OUTSIDE AIR PROVIDED WHERE REQUIRED AND IN ACCORDANCE WITH THE N.C.C. - B.C.A.
- WC DOOR(S) REMOVABLE WHERE REQUIRED & FITTED WITH LIFT OFF HINGES IN ACCORDANCE WITH THE N.C.C. - B.C.A.
- HARDWIRED INTERCONNECTED SMOKE ALARM(S) SHOWN THUS :

GENERAL NOTES :

- ALL BUILDING WORKS TO COMPLY WITH RELEVANT AUSTRALIAN STANDARDS, N.C.C. - BUILDING CODE OF AUSTRALIA AND COUNCIL REQUIREMENTS.
- REINFORCED CONCRETE SLAB AND FOOTINGS, STEEL BEAMS AND RETAINING WALLS TO SEPERATE ENGINEERS DETAIL.
- PREFABRICATED ROOF TRUSSES TO MANUFACTURERS SPECIFICATIONS.
- THIS DRAWING TO BE READ IN CONJUNCTION WITH THE GENERAL BUILDING SPECIFICATION.
- WRITTEN DIMENSIONS WILL TAKE PRECEDENCE OVER SCALE. ALL DIMENSIONS TO BE CONFIRMED BY THE BUILDER AND SURVEYOR PRIOR TO CONSTRUCTION.
- WET AREAS IN ACCORDANCE WITH N.C.C. - B.C.A. REQUIREMENTS.

SITE DATA :

LOT No. :	8
D.P. No. :	229785
COUNCIL :	PENRITH
DATUM :	AHD
Contour Interval :	1.0 m

SURVEYOR :
ENSURE CONSULTING PTY LTD
PH: 0412 757 706
JOB REF: 210796 DE-01

SITE PLAN LEGEND :
SEWER MAIN
STORMWATER
SEDIMENT FENCE
RETAINING WALL
DROP EDGE BEAM
EXISTING FENCE
POOL FENCE
CUT BATTER
PLATFORM RL.
FILL BATTER

DEVELOPMENT DATA :

SITE AREA : 3.82 ha

SITE COVERAGE :

PROPOSED DWELLING	= 721.18 m2
EXISTING DWELLING	= 120.59 m2
EXISTING CARPORT	= 85.97 m2
EXISTING WORKSHOP	= 79.54 m2
EXISTING SHED	= 9.69 m2
TOTAL	= 1,016.97 m2

(EXCLUDES VERANDAHS, PORCH AND ALFRESCO)

Pyramid design & drafting
Building Design & Architectural Drafting Services
Web site: www.buildingdesign.net.au
Phone : (02) 4573 0533 PO Box 330
Mobile : 0412 186 275 Kurrajong NSW 2758
Email: pyramid@buildingdesign.net.au

ISSUE :	AMENDMENTS :	DATE :

DRAWING : WORKING DRAWINGS - DA/CC
PROJECT : PROPOSED BRICK VENEER DWELLING
FOR : MR & MRS FARRUGIA
AT : Lot : 8, No. 120 - 134 FARM ROAD, MULGOA NSW 2745

DATE : 1 /04 /21	SCALE : (A1 SHEET)	1:500	SHEET NUMBER :	A05
JOB No. : PYR 726	DRAWN :	D. Grima		(SHEET 6 of 7)
ISSUE : A	CHECKED :	D. Grima		