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REPORT ON INVESTIGATION AND ASSESSMENT FOR THE SITING OF A PROPOSED EFFLUENT MANAGEMENT SYSTEM AT LOT 16 DP 30325, No. 70 LANE COVE ROAD, INGLESIDE

PREPARED FOR: MR. M. & MRS. H. CONN

SUBMITTED TO: NORTHERN BEACHES COUNCIL

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CONTENTS

1. INTRODUCTION

This report outlines the results of an investigation and assessment for the siting of a proposed effluent management system at Lot 16 DP 30325, No. 70 Lane Cove Road, Ingleside. The investigation was performed at the request of Mr. & Mrs. Conn. The report will be submitted to Northern Beaches Council.

The unsewered property has an area of approximately 2.0 hectares. The property is occupied by an existing dwelling, garage, shed, tennis court, pond and associated features. The dwelling is serviced with an aerated wastewater treatment system **(AWTS)** and surface discharge method for land application.

The proposed development comprises the renovation and extension of the existing dwelling. As part of these works, at the discretion of Mr. & Mrs. Conn it is proposed to decommission the existing effluent management system and replace it with a new arrangement for the dwelling when renovated and extended which forms the basis of this report. The AWTS comprises a relatively small concrete septic tank that initially accepts all effluent from the dwelling and a second larger polyethylene treatment tank proper that is positioned at a considerable distance to the north-northeast of the septic tank.

Reference to the accompanying plan, Figure 1, shows the following features:

1. The dwelling when renovated and extended which will join with the existing garage at the northwestern side.
2. The proposed swimming pool and outdoor living area associated with the dwelling when renovated and extended.
3. The existing tennis court in the northwestern corner of the property.
4. An existing shed.
5. An existing pond.
6. A swimming pool that is no longer present.
7. A disused golf green that is no longer present and the landform is re-instated.
8. A chicken coup that is no longer present.

The proposed effluent management scheme for the dwelling when renovated and extended will result in a much improved scenario for the land application of treated wastewater, which provides an improved scenario and beneficial effects with regards to both public health and the environment.

2. PROPOSED EFFLUENT MANAGEMENT SYSTEM AND DESIGN WASTEWATER VOLUME

As confirmed with Mr. Conn, the proposed effluent management scheme for the dwelling when renovated and extended comprises an AWTS aerated wastewater treatment system **(AWTS)** with land application by surface spray irrigation.

The nominated location of the proposed AWTS as determined on the property with Mr. Conn at a considerable distance off the eastern side of the dwelling, pending exact final confirmation, is shown in Figure 1. It is understood that the proposed AWTS comprises the Econocycle ENC 10-1 model which consists of a single pre-cast concrete tank. The manufacturers specifications, NSW Health Department Accreditation and any other relevant details for the AWTS 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 new effluent management system to cater for the dwelling when renovated and extended. Blue Mountains Geological and Environmental Services is not responsible or liable for the installation, operation, maintenance and on-going performance of both the AWTS and area to be utilised for the land application of secondary treated effluent.

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 the 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.

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

PARAMETER	**CONCENTRATION**	**FAILURE INDICATOR**
BIOCHEMICAL OXYGEN DEMAND	<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.

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 continue a water usage minimisation scheme in the dwelling when renovated and extended to prolong the effective life span and performance of the effluent management system as a whole. Whilst the AWTS provides for re-use of all effluent generated by application to the land, reducing the loads to be treated and discharged will significantly decrease the potential for adverse environmental impacts. As confirmed with Mr. Conn, the dwelling already has a set of water limiting devices/appliances including low-flow showerheads, low litreage dual flush toilets, aerator taps and a water conserving front loading washing machine. Where applicable, such devices and fixtures will also be provided in the renovated and extended component of the dwelling.

It is suggested to utilise 'environmentally friendly' cleaning, washing and detergent products to reduce the levels of P, as well as sodium, discharged to the proposed AWTS and surface irrigation area. 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 Mr. Conn, the following details are provided in relation to wastewater generation:

- There is a tank water supply.
- The existing dwelling comprises three bedrooms that is occupied by the four members of the Conn family on a full-time basis.
- When extended, the dwelling will have six bedrooms and continue to be occupied by four persons.

As distinct to the lesser number of occupants, design effluent volume and surface irrigation area calculations are based on the maximum potential occupancy level of the dwelling when renovated and extended, which is dependent on the number of bedrooms. Reference to Table J1 in AS/NZS 1547 (2012) shows that a six bedroom dwelling has a population equivalent of 9 - 10 persons. For use in this assessment, the maximum potential occupancy level of the dwelling when renovated and extended is set at ten persons. This represents an ample allowance for two persons/bedroom in four of the bedrooms and one person/bedroom in the remaining two bedrooms.

Reference to Table H1 in AS/NZS 1547 (2012) shows that the typical wastewater design flow from dwellings with tank water supplies is 120 litres/person/day.

Based on the details above, the maximum design effluent volume from the dwelling when renovated and extended applied to the sizing of the proposed AWTS and surface irrigation area calculations is:

* 10 persons x 120 litres/person/day = 1200 litres/day.

It is important to ensure that appropriate water-conservation practices are continued in the dwelling when renovated and extended so the maximum design effluent volume above is not exceeded – i.e. ideally kept as low as possible. However, for the four persons who will continue to reside in the dwelling when renovated and extended, the design output of effluent is 480 litres/day, or 40% of the maximum.

3. SITE DESCRIPTION

The property comprises an approximately rectangular-shaped parcel of land that is situated off the northern side of Lane Cove Road at a distance of about 1.2km east-northeast of the intersection with Mona Vale Road. There is a frontage of 96.11m onto Lane Cove Road and the property extends in a northerly direction for distances ranging from 209.7 - 227.09m. The existing and proposed features of development and effluent management are contained in the northern half of the property (Figure 1).

The proposed land application area **(LAA)** for secondary treated wastewater, i.e. where the surface spray irrigation lines will be established, maintains minimum set-back distances of 33.6m east of the dwelling proper when renovated and extended and 6m from the nearest downslope eastern boundary (Figure 1). The vegetation across the LAA comprises a well-developed grass lawn with a single native tree. This area on a convex upper slope, which has a typical grade ranging from 1 in 7.7 - 13.5 in a northeast to north-northeasterly direction based on the contours at 0.5m intervals in Figure 1, is well-elevated and affords exposure to the open northerly to easterly aspect and prevailing winds.

The proposed LAA is positioned at an elevation of about 130m. The pond in the northern part of the property and an easterly trending man-made drainage channel in the vicinity of the northern boundary are not within the land fall direction (or flow path) of the proposed surface irrigation area. In this instance prescribed set-back distances are irrelevant. Nonetheless, the pond and drainage channel are at considerable direct distances of approximately 68m to the north-northwest and 85m to the north respectively.

Observations on the site and reference to the Mona Vale 1:25,000 scale topographic map shows that the nearest 'water feature' within the relevant flow path of the LAA is an intermittent watercourse at a distance of approximately 300m in an overall east-northeasterly direction – note that this distance in plan view is considerably increased along the ground surface. From this point, the intermittent watercourse trends in an east-northeasterly direction and becomes poorly-defined for a distance of just under 2km before draining to Winererremy Bay in the southern part of Pittwater.

4. SITE ASSESSMENT METHODOLOGY

The initial phase of the fieldwork comprised a site inspection and ground survey on 12/2/20 aimed at delineating the preferred position of the proposed LAA with respect to the location of the existing and proposed features of development 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 1.1m across the proposed LAA. The auger holes were used to determine the physical characteristics of the subsurface strata and provide a representative description of this.

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

5. GROUND SURVEY AND PHYSICAL CONSTRAINTS

The location of the proposed LAA for surface spray irrigation has been carefully delineated on the site with Mr. Conn (Figure 1). Results from the ground survey indicate that the main physical constraints to the land application of treated effluent comprise the following:

- The pond in the northern part of the property.
- The easterly trending man-made drainage channel in the vicinity of the northern boundary.
- The relatively undisturbed native vegetation and rocky terrain in the approximate southern half of the property.
- The occurrence of relatively steeper terrain in parts.

In addition to the constraints, the area covered by the existing and proposed features of development and buffer distances from these and property boundaries also limits the land available for effluent disposal.

The physical constraints and considerations outlined provide substantial limitations to the area available for effluent disposal. This has led to the siting of the LAA as proposed to the east of the dwelling in terrain that is not within the flow path of the pond and drainage channel, where as detailed in Section 3, prescribed set-back distances are irrelevant.

The distance in plan view of about 300m to the nearest intermittent watercourse well-exceeds the minimum recommended buffer of 40m in Table 5 of the guidelines in Department of Local

Government et. al. (1998). Furthermore, the buffer of 6m from the nearest downslope northern boundary conforms with the minimum recommendation in Department of Local Government et. al. (1998), whilst the set-back distance of 33.6m from the closest point of the dwelling when renovated and extended well-exceeds the requirement of 15m in the 1998 guidelines.

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

6. SUBSURFACE PROFILE

Observations on the site and reference to the Sydney 1:100 000 scale Soil Landscape map indicate that the proposed LAA and adjacent parts are underlain by the residual 'Somersby' group which occurs on gently undulating to rolling rises on deeply weathered Hawkesbury Sandstone.

The Somersby group comprises moderately deep to deep (100 - 300cm) Red Earths and Yellow Earths overlying laterite gravels and clays on crests and upper slopes; Yellow Earths and Earthy Sands on mid slopes; Grey Earths, Leached Sands and Siliceous Sands on lower slopes and drainage lines; and Gleyed Podzolic Soils in low lying poorly drained areas (Chapman and Murphy, 1989).

General limitations of the Somersby group include localised permanently high water tables, areas of laterite and stony soil, very low soil fertility, highly permeable soil, high to very high aluminium toxicity and strong to very strong acidity (Chapman and Murphy, 1989).

The subsurface profile observed in the auger holes has a 'duplex' structure, as there is a well-defined textural and permeability contrast between the A and B soil horizons. With reference to Table E4 in AS/NZS 1547 (2012), it is considered that the A1 and upper and lower A2 soil horizons have a single grained structure, whilst the B horizon soil has 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 of AS/NZS 1547, 2012 (Appendix 1). The typical subsurface profile observed in the auger holes across the proposed LAA is detailed below.

(i) LOAMY SAND (TOPSOIL) – A1 Horizon

- observed from the surface to a depth ranging from 0.15 - 0.25m.
- comprises dark-brown to dark grey-brown and dark-grey to black, fine to medium grained loamy sand with few ironstone, weathered sandstone and quartz fragments (i.e. 2 - 10% coarse fragments from Table E2 in AS/NZS 1547, 2012).
- soil category 2 for sandy loams from Table E1 in AS/NZS 1547 (2012).

(ii) SANDY LOAM – Upper A2 Horizon

- observed from 0.15 - 0.25m to a depth ranging from 0.3 - 0.4m.
- comprises brown, fine to medium grained sandy loam with few ironstone, weathered sandstone and quartz fragments (i.e. 2 - 10% coarse fragments).
- soil category 2 for sandy loams.

(iii) SAND – Lower A2 Horizon

- observed from 0.3 - 0.4m to an average depth of 0.7m.
- comprises brown and grey, fine to medium grained slightly clayey sand with few ironstone, weathered sandstone and quartz fragments (i.e. 2 - 10% coarse fragments).
- soil category 1 for gravels and sands.

(iv) SANDY CLAY LOAM – B Horizon

- observed from an average of 0.7m to a depth of 1.1m.
- comprises brown and grey, fine to medium grained sandy clay loam with few ironstone, weathered sandstone and quartz fragments (i.e. 2 - 10% coarse fragments).
- soil category 4 for clay loams.

7. DESIGN IRRIGATION RATE AND LAND APPLICATION AREA

Results from the auger holes in Section 6 and reference to Table M1 in AS 1547 (2012) correspond with soil category 4 for clay loams based on the most-limiting sandy clay loam subsoil in the B horizon. This corresponds with an indicative permeability value of 0.5 - 1.5m/day for a moderate structure. The indicative permeability value can be converted to a DIR.

Reference to Table M1 in AS/NZS 1547 (2012) shows that for soil category 4 and surface spray irrigation as proposed, the corresponding DIR is 3.5mm/day. This value equates with a wastewater application rate of 3.5 litres/m^2/day. Based on this value, the area required for surface irrigation from the existing dwelling when renovated and extended is:

* 1200L/day divided by 3.5L/m^2/day = 342.9m^2
* Rounded-up = 350m^2.

In summary,

* PROPOSED LAA = 350m^2 for the maximum design effluent volume of 1200 litres/day from the dwelling when renovated and extended.

For the four persons residing on the site and design effluent volume of 480 litres/day, an area of 350m^2 results in a wastewater application rate of only 1.37 litres/m^2/day, or DIR of 1.37mm/day. This is considerably less than the DIR of 2mm/day for medium to heavy clays in Table M1 of AS/NZS 1547 (2012).

As shown in Figure 1, the proposed LAA measures 29.2m in length in a north-south direction x 12m in width in an east-west direction.

7.1 Preparation and Management of the Land Application Area

Appropriate preparation and management are important factors that significantly affect the ability of a LAA to contain and assimilate treated wastewater. It is important to ensure that the surface irrigation system utilised fully covers the area of 350m^2 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 to very strongly acidic soils and address the high to very potential aluminium toxicity as outlined in Section 6, as well as the sodium content in the treated wastewater and potential for dispersion, it is suggested to apply agricultural lime and gypsum across the LAA and 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 liquefied forms of lime and gypsum can also be considered.

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 0.3kg/m^2 (i.e. 3kg/m^3) and 0.1kg/m^2 (i.e. 1kg/m^3) respectively in and adjacent to the LAA. 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.

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 LAA 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.

Note that once the LAA 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. Also, grass must not be cut to a level that is too low as this will limit the depth and density of root growth.

It is important to ensure that any upslope runoff is maintained away from the proposed LAA so that it has to ideally cater only for the treated wastewater and direct rainfall. This can be achieved with use of a contour bank or dish drain in the area above the LAA. However, there is limited localised sub-catchment above the LAA, so a formalised runoff diversion device could be installed if ever required in the future.

Any stormwater provisions associated with the dwelling, proposed swimming pool and tank water supply must not be directed towards the LAA or adversely impact upon its proper functioning. In addition, clean watering of vegetation in and immediately adjacent to the proposed LAA must not be carried out.

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 LAA.

Once the LAA is established, it is important to ensure that there are no vehicular movements or provision of hoofed animals (if relevant) as this will have a detrimental impact on soil drainage and structure – i.e. should be fenced-off if required.

8. INSTALLATION, OPERATION AND MAINTENANCE

For the effluent management system to work well the supplier, installer, service agent and owners/residents must be committed to its management, whilst the AWTS must be 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 LAA. A properly operated and maintained system should meet the expected parameters for wastewater quality (see Table 1, 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 the system will, in part, depend on how it is used and maintained. A guide to good maintenance procedures, from Department of Local Government (1998), is listed below:

DO

- have the AWTS inspected and serviced four times per year by an approved contractor.
- have the system service include assessment of sludge and scum levels and performance of the LAA.
- 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 cleaned out at least every three months.
- keep a record of pumping, inspections, and other maintenance.
- learn the location and layout of the treatment system and LAA.
- 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 due not only to the limited tank supply, but to also enhance the performance of the AWTS and LAA 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 and spot removers for example in large quantities into the AWTS via the sinks or toilets.

- 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/greases can overload or hinder the performance of any type of effluent treatment system. Use of a strainer in the kitchen sink is required, along with promoting the removal of excess food waste/oils from plates with paper towelling before washing which reduces the input of fats and organic material into the AWTS (paper towelling can be composted).
- switch off the power to the AWTS, 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 16 DP 30325, No. 70 Lane Cove Road, Ingleside. The unsewered property has an area of approximately 2.0 hectares.

(ii) The property is occupied by an existing three bedroom dwelling, garage, shed, tennis court, pond and associated features. The dwelling is serviced with an AWTS and surface discharge method for land application.

(iii) The proposed development comprises the renovation and extension of the existing dwelling that will result in six bedrooms. The current effluent management system will also be decommissioned and replaced it with a new arrangement.

(iv) The proposed effluent management scheme for the dwelling when renovated and extended comprises an AWTS and surface spray irrigation arrangement for land application.

(v) The design effluent volume for a maximum of ten full-time occupants in the dwelling when renovated and extended with a tank water supply is 1200 litres/day. However, for the four persons residing who will continue to reside in the dwelling when the works are completed, the design output of effluent is only 480 litres/day.

(vi) The proposed LAA for secondary treated wastewater where the surface spray irrigation lines will be established maintains minimum set-back distances of 33.6m east of the dwelling proper when renovated and extended and 6m from the nearest downslope eastern boundary. This area also maintains appropriate set-back distances from all other existing and proposed features of development and property boundaries, as well as the nearest water features in the relevant flow path.

(vii) Based on calculations in this report and the maximum design effluent volume, an area of $350m^2$ is proposed for surface irrigation from the dwelling when renovated and extended. Guidelines in relation to the installation, operation and management of the proposed AWTS and LAA should also be followed.

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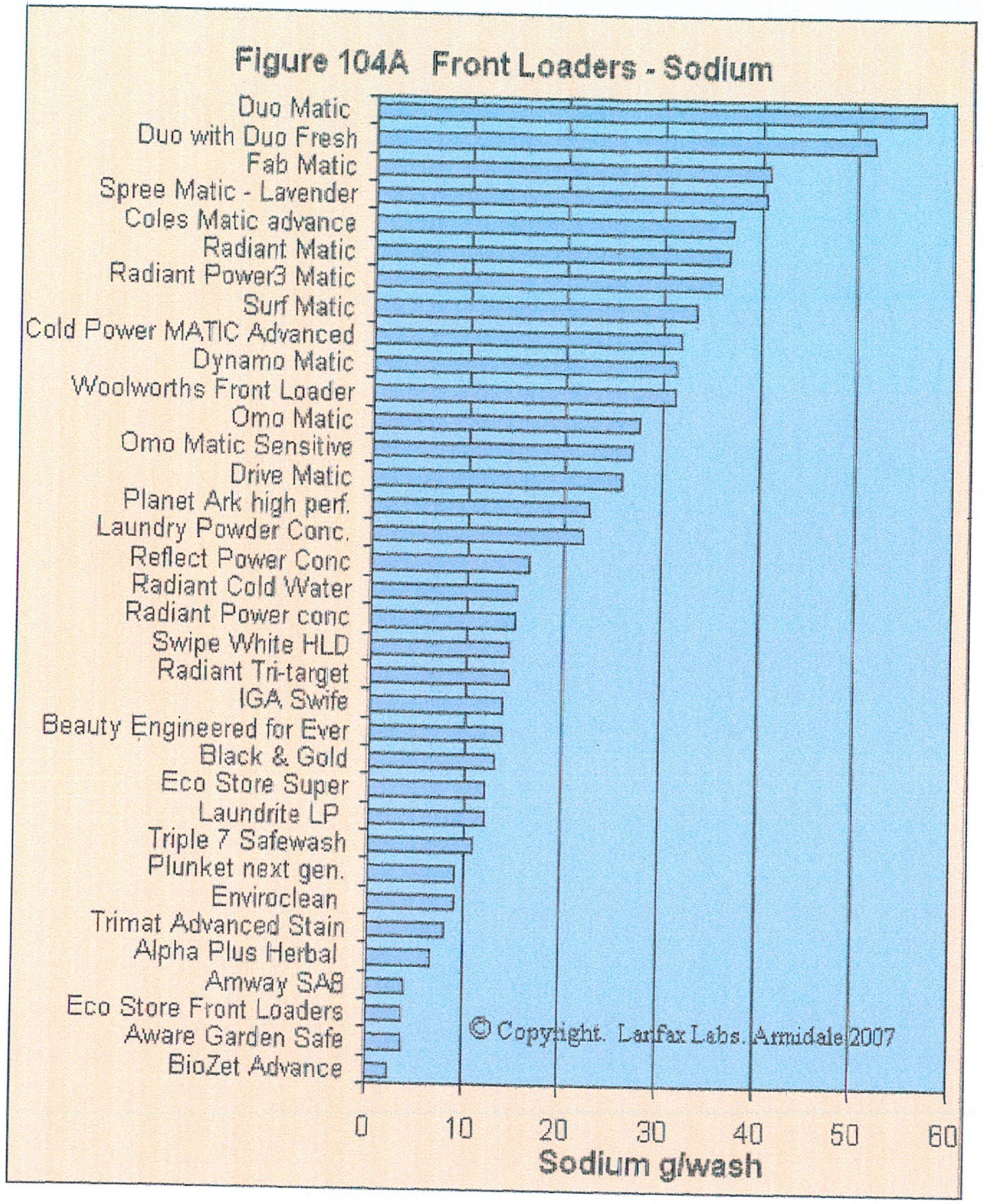
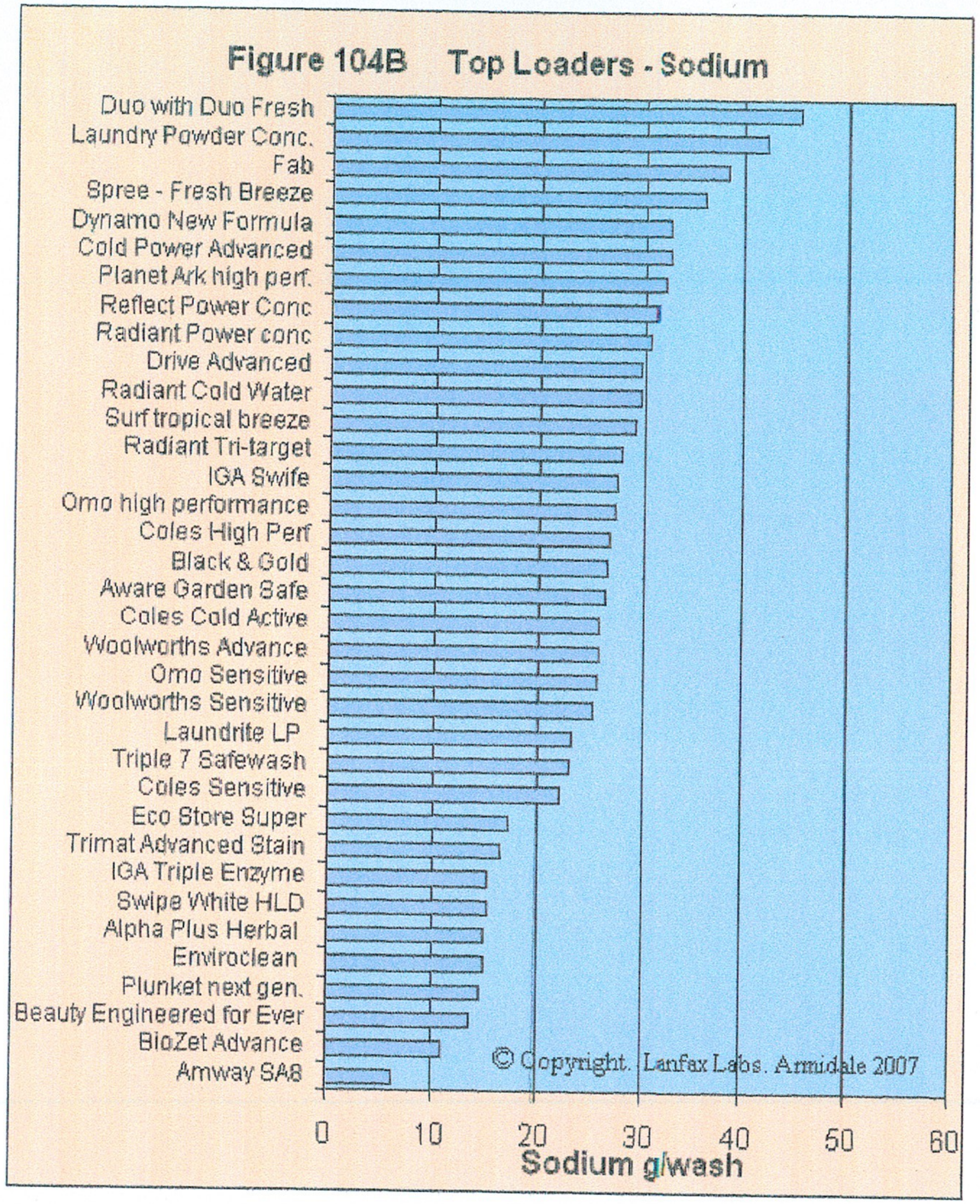
APPENDIX 1

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

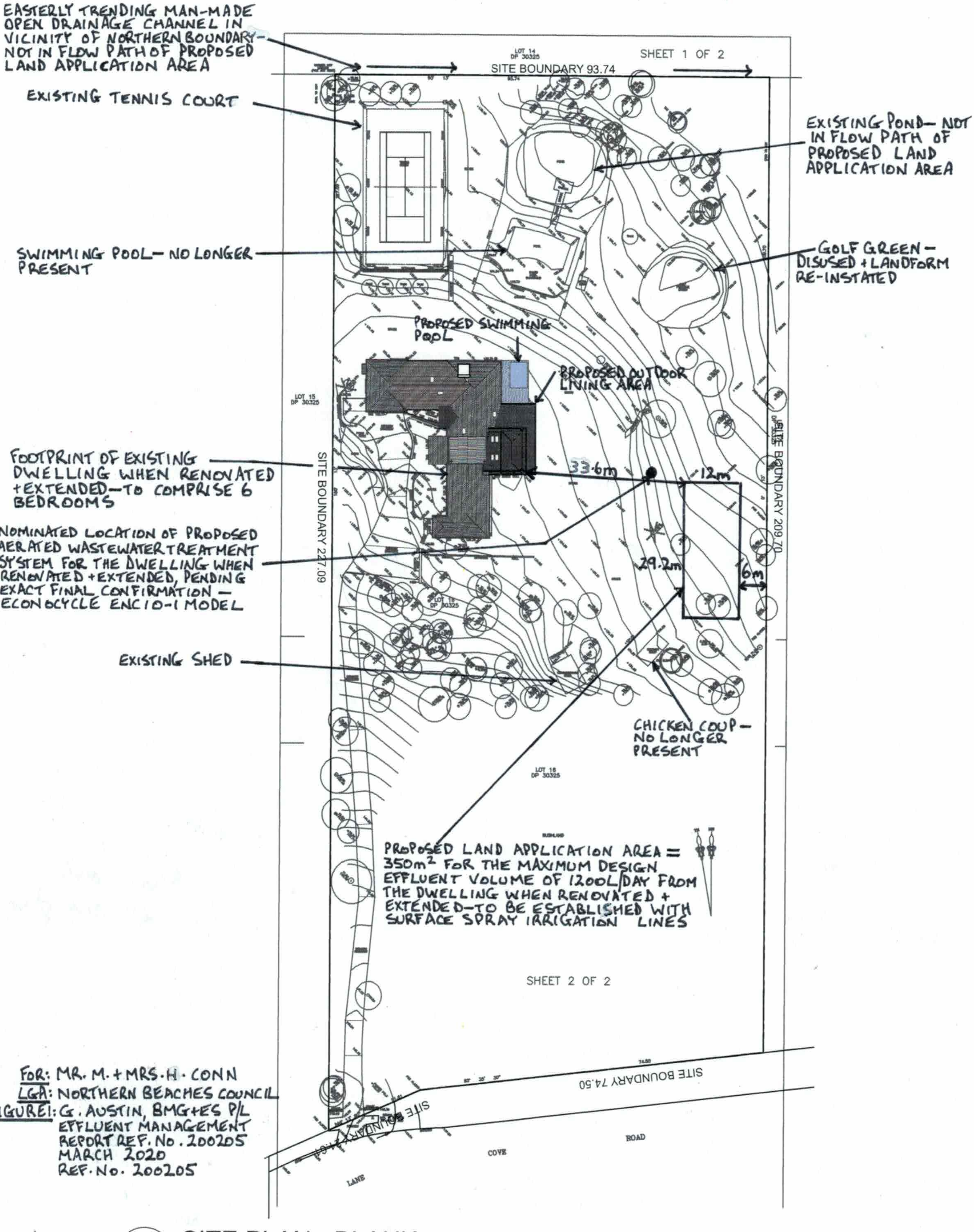
NOTE: The typical clay content figures are included for information only.

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

FIGURE 1: PLAN SHOWING THE LOCATION OF THE EXISTING DWELLING WHEN RENOVATED AND EXTENDED AND ASSOCIATED FEATURES, AS WELL AS THE PROPOSED LAND APPLICATION AREA FOR SECONDARY TREATED WASTEWATER AT LOT 16 DP 30325, No. 70 LANE COVE ROAD, INGLESIDE



FOR: MR. M. + MRS. H. CONN
LGA: NORTHERN BEACHES COUNCIL
FIGURE 1: G. AUSTIN, BMG+ES P/L
EFFLUENT MANAGEMENT REPORT REF. No. 200205
MARCH 2020
REF. No. 200205

SITE PLAN - BLANK

SCALE - 1:1045 AT A4

CONTOUR INTERVAL = 0.5m