On-site Sewage Management Design Report
Proposed Dwelling & Shed with Amenities

Location:

Lot 2 DP 880732
51 Rock Road
Bungalora NSW 2486

Prepared for:

Claire & Dainen Keogh

Report No:

HMC2020.155.02

September 2020

HMC environmental consulting pty ltd

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RE: Lot 2 DP 880732, 51 Rock Road, Bungalora, NSW, 2486.

HMC Environmental Consulting Pty Ltd is pleased to present our report for On-site Sewage Management Design for the abovementioned site.

We trust this report meets with your requirements. If you require further information please contact HMC Environmental Consulting directly on the numbers provided.

Yours sincerely

Helen Tunks
(B.Env.Sc.)

Document Control Summary			
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Title:	**On-site Sewage Management Design Report**		
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TABLE OF CONTENTS

ABBREVIATIONS

BOD_5	Biochemical oxygen demand over 5-day period
CFU	Colony forming unit
DLR	Design loading rate
ETA	Evapo-Transpiration Absorption (ETA) ETA beds will be used in reference to the construction of shallow sub surface effluent disposal trenches that utilise the principles of evaporation, transpiration and absorption. The method of construction for the ETA bed referred to in this report is in accordance with a “Conventional Bed” provided in Figure L5 of AS/NZS 1547: 2012.
LAA	Land application area
LTAR	Long term acceptance rate
OSSM	On-site sewage management
TN	Total nitrogen
TP	Total phosphorus
TSS	Total suspended solids

1 INTRODUCTION

HMC Environmental Consulting Pty Ltd has been commissioned to prepare an on-site sewage management (OSSM) assessment for a proposed 4-bedroom dwelling and shed/office with amenities located on an elevated knoll/plateau in the locality of Bungalora, NSW, 2486.

A site inspection was carried out on 3rd August 2020 by Helen Tunks of HMC. During the site inspection the site and soil characteristics were assessed in terms of wastewater disposal. A groundwater bore with a water bearing zone of 42m depth, is located at a distance of 45m upslope from the proposed effluent land application area.

Viral die-off modelling was carried out using the registered bore construction information to demonstrate that the viral load would be depleted before the time it took to move vertically downwards through the profile and reach the horizontal aquifer. The risk to groundwater quality was considered minimal. Adequate land application area is available on the subject site.

2 PROPOSAL

Proposal	Proposed OSSM Facility
Property	Lot 2 DP 880732 51 Rock Road Bungalora NSW 2486
Council Area/Approvals:	Tweed Shire Council
Council Property Number:	41342
Water Supply	Non-reticulated roof water supply
Design Daily Hydraulic Load & Design Occupancy	Proposed 4-bedroom dwelling Proposed Shed/studio with amenities to be used by householders only 720L/day Based on 6 persons @ 120L/p/day wastewater flow allowance (Table H1 AS/NZS 1547:2012)
Summary of OSSM Upgrade Recommendations.	See section 6.1 & 6.2 for design details. • Install minimum 4000L septic tank with NSW Health Accreditation • Install Taylex TFR biological filter in outlet baffle of proposed septic tank • Install a minimum 600L pumpwell & dosing siphon • Install 4 x passively dosed ETA beds, each 2m wide x 17m long x 0.45m sited on natural soil with effluent disposal through 100mm slotted PVC pipe laterals • Install 4-way concrete distribution box (eg. Grahams Tanks, Kyogle)

3 LAND CAPABILITY – SITE & SOIL ASSESSMENT

3.1 Site Information

Should conditions vary from those described during any stage of installation HMC is to be notified to ensure the recommendations of this report remain valid or alternative recommendations be made.

The following information relates to the general site but more specifically to the proposed effluent land application area (LAA).

Inspected by	Helen Tunks
Date & Time of Inspection	Monday 3rd August 2020 See Appendix 1 & 2 for site location, Appendix 13 for photos.
Site Conditions	Weather – Warm and dry during site inspection. Nil rainfall recorded for the week preceding site inspection. Rainfall recorded for the month preceding site inspection totalling approximately 213.8mm according to BOM Stn 58056 Tweed Heads Golf Club.
Site Constraints	Moderate slopes within LAA. High volume, seasonal rainfall Low soil permeability

SITE FEATURES	
Size of property	4.14 Ha
Slope of LAA	Gentle – moderate slopes of 15%. Linear planar slope shape
Soil Type	Clay Loam to 200mm overlying moderately structed Light Clay to 1m Soil Category 5
Exposure & Aspect of LAA	NW Minimal shading expected.
Boulders /Rock Outcrops	A few cobbles observed on surface and expected at depth
Run-on/Seepage	Minimal expected
Run-off	Expected on moderate slopes
Flooding Potential	Nil
Drainage	Poor drainage based on assumed soil texture of Light Clay, Category 5. Moderately sloping site.
Surface Condition	100% pasture grass cover
Erosion/mass movement	Nil expected.
Climate	Warm-temperate and high volume, seasonal rainfall typical of region.
Depth to Water Table Depth to artificial horizon	Expected >3m
Landscape element	Plateau
Estimated Phosphorus sorption	10000 kg P sorption/ha (Based on soil texture and assessment, Morand, 1996)
Permeability	Indicative K_{sat} 0.12-0.5m/day based on Light Clay soil with strong/moderate structure.
External Site Impacts e.g. neighbours, stormwater	Nil expected
Reserve LAA	100% available, subject to pumping

3.2 Site Compliance

SITE CONSTRAINTS		Complying?	Desired
Setback to Boundary	>30m to downslope property boundary	YES	6m
Setback to Watercourse	>200m to watercourse	YES	>100m
Setback to Water Bore	~45m to upslope GW073598	NO	250m
Setback to Buildings	>20m upslope to dwelling	YES	>3m
Reserve LAA	100% available, subject to pumping	YES	
Slope Gradient	15%	YES	<30%
Slope Stability	Not mapped	YES	
Flood Liability	Nil	YES	
Aquaculture	Not mapped	YES	
Water Catchment	Not mapped	YES	

4 LAND APPLICATION AREA SIZING AND DESIGN

4.1 Design Model Inputs

Model Used: Draft Richmond Tweed On-Site Regional Strategy (Alderson, 1999). Daily Time Step	
Climate Data	Tyalgum (1971 – 1984). Mean annual rainfall 1555mm.
Design Occupancy	6-persons assumed
Wastewater Design Flow Allowance	120L/p/day
Wastewater Design Hydraulic Load	720L/day
Nitrogen (TN)	3.8 kg/person/year (Whelan & Titammis,1982) See Appendix 6.
TN System Nutrient Reduction	Primary Effluent ~40% reduction achieved
Vegetation Removal of TN	Conservative rate of 300 kg/ha/year. Note: Kikuyu up to 520kg/ha/year (NSW Agriculture 1997)
Phosphorus (TP)	0.6 kg/person/year (Geary & Gardner, 1996)
Vegetation Removal of TP	20 kg/ha/year (Myers et al 1994)
Phosphorus Adsorption	~10000 kg/ha/ based on field texture and work carried out by Morand, 1996
Max Design Loading Rate (DLR) (AS/NZS 1547:2012)	8mm/day based on light clay texture
Proposed Long Term Acceptance Rate (LTAR)	8mm/day
Proposed Design Loading Rate (DLR)	4 mm/day

4.2 Design Model Sizing of Land Application Area

Analyte	Land Application Area Minimum Requirement (m2).	
	PROPOSED DWELLING & SHED/OFFICE WITH AMENITIES	
	Tweed SC - OSSM Design Model	LAA Configuration
Hydraulic Area	183m2	Proposed 4 x gravity fed ETA beds each, 2m wide x 17m long x 450mm deep Total area = 183m2
Nitrogen (TN)	456m2	
Phosphorus (TP)	69m2	
Design Hydraulic Load	720L/day	

A capillary action zone of 300mm within the native soil around the perimeter of each of the ETA beds is included in the hydraulic sizing capacity of the ETA beds. The nutrient management zone will extend approximately 9m downslope, complying with recommended setback distances to surface water and property boundaries on this large rural property.

No permeability tests were undertaken in the field. To provide a realistic assessment of permeability multiple tests are required. It is considered that the loading rates based on soil texture (AS/NZS 1547:2012) are adequate for design inputs in this case for a domestic situation.

5 SETBACK DISTANCE RISK ASSESSMENT

The setback distances adopted for this upgrade are those recommended within the following:

- the Environment & Health Protection Guidelines – On-site Sewage Management for Single Households (DLG et al. 1998)
- Table R1 of AS/NZS1547: 2012

The setback distances achieved are not in compliance with the above criteria regarding distance to groundwater bores/wells. The proposed new ETA beds are to be located approximately 45m downslope of a nearby groundwater bore (GW073598). These setbacks are assessed using the recommended setback distances from land application areas (LAAs):

- 15m – 50m (AS/NZS1547:2012)
- Minimum 250m (E&HP Guidelines, 1998)

A stock & domestic groundwater bore (GW073598) is located within the property boundary, according to the Water NSW online portal (https://realtimedata.waternsw.com.au/). The bore was located approximately 45m upslope of the proposed LAA during the site inspection. According the WaterNSW public records, the groundwater bore has a standing water level of 40m.

More recently, in 2019, the Water NSW issued a guideline, "*Designing and Installing On-site Wastewater Systems. A WaterNSW Current Recommended Practice*". In this WNSW publication, the recommended separation distance between secondary treated effluent irrigation area and a water bore used for human consumption is **100m**. This guideline also states that if the LAA is site within 100m, a draw-down analysis done using an appropriate methodology, such as *Cromer, Gardner and Beavers, 2001 "An improved viral die-off method to estimate setback distances*" is required.

A setback distance risk assessment of the site constraints in relation to protection of groundwater was carried out, and is detailed in Appendix 8. The risk assessment concludes that the proposed location of the new land application area presents a low risk to groundwater quality and that the low-range setback distances are appropriate to minimise risk.

Design and site factors mitigating the risk to groundwater quality for the proposed system include:

- Overdesigned LAA, subsequent low design loading rate (DLR)
- Splitting of effluent through 4 x ETA beds
- Passive dosing of proposed ETA beds to maximize distribution through beds

In accordance with the SCA Guidelines, a hydrogeological analysis was also carried out using viral die-off method. Using very conservative estimates in the *Trench 3.0 Wastewater Model*, and assuming saturated conditions, (very unlikely with very low application rate proposed for the ETA beds), the modelling concluded that the viral load would be depleted after 50 days. The time for the effluent to reach the groundwater aquifer in this clay/basalt soil profile would be approximately 73 days. The modelling indicates that all viruses would be dead before any effluent was able to enter the aquifer. The viral die-off calculations and modelling are provided in Appendix 10.

6 RECOMMENDATIONS

Based on the information presented in this report, it is considered that the recommendations listed below for the proposed septic system are sufficient enough to attain an acceptable level of environmental impact from the use and occupancy of the proposed dwelling on the subject site.

DESIGN HYDRAULIC LOADING	720L/day: assumed 6-persons @ 120L/p/day

RECOMMENDED ON-SITE SEWAGE MANAGEMENT SYSTEM

See section 6.1 & 6.2 for OSSM proposed layout and ETA bed construction.

- Install a minimum 4000L septic tank with NSW Health Accreditation to collect all wastewater generated by the proposed dwelling
- Install Taylex TFR biological filter in outlet baffle of septic tank, ensure tight fit
- Install a minimum 600L pumpwell with air admittance valve & dosing siphon (See Appendix 12)
- Construct 4 x passively dosed ETA beds, each 2m wide x 17m long x 0.45m deep sited on natural soil with effluent disposal through 1 x 100mm slotted PVC pipe lateral/bed
- Two monitoring ports to be installed at the end of each bed, comprised of 100mm slotted PVC, capped flush with ground surface
- Install 4-way concrete distribution box set on pre-caste concrete slab to split flow evenly via 100mm solid wall PVC DWV sewer pipes to each bed

ETA Bed Construction Notes:
ETA bed construction to include level base across width and length, and light scarification of base prior to placement of gravel. Agricultural lime (calcium carbonate) and gypsum (calcium sulfate) are to be incorporated into the soil at the base at a rate of 0.5kg/m2 (guide only).

A 300mm deep gravel (20-40mm aggregate) layer to be provided supporting the PVC pipe at the top with 50mm gravel cover, then overlain by the geotextile (filtercloth) and a 100-350mm layer of topsoil.

The finished surface of the final topsoil layer is to be smooth, not compacted. The topsoil layer is to be finished with a grade to merge with surrounding ground slope to enable mowing and to promote sheet flow of rainfall off the bed..
The surface is to be turfed or densely sown with lawn grasses to provide a vigorously growing and durable cover.

Agricultural lime (calcium carbonate) and gypsum (calcium sulfate) are to be incorporated into the native topsoil applied to the surface of the ETA bed at a rate of 0.5kg/m2 (guide only).

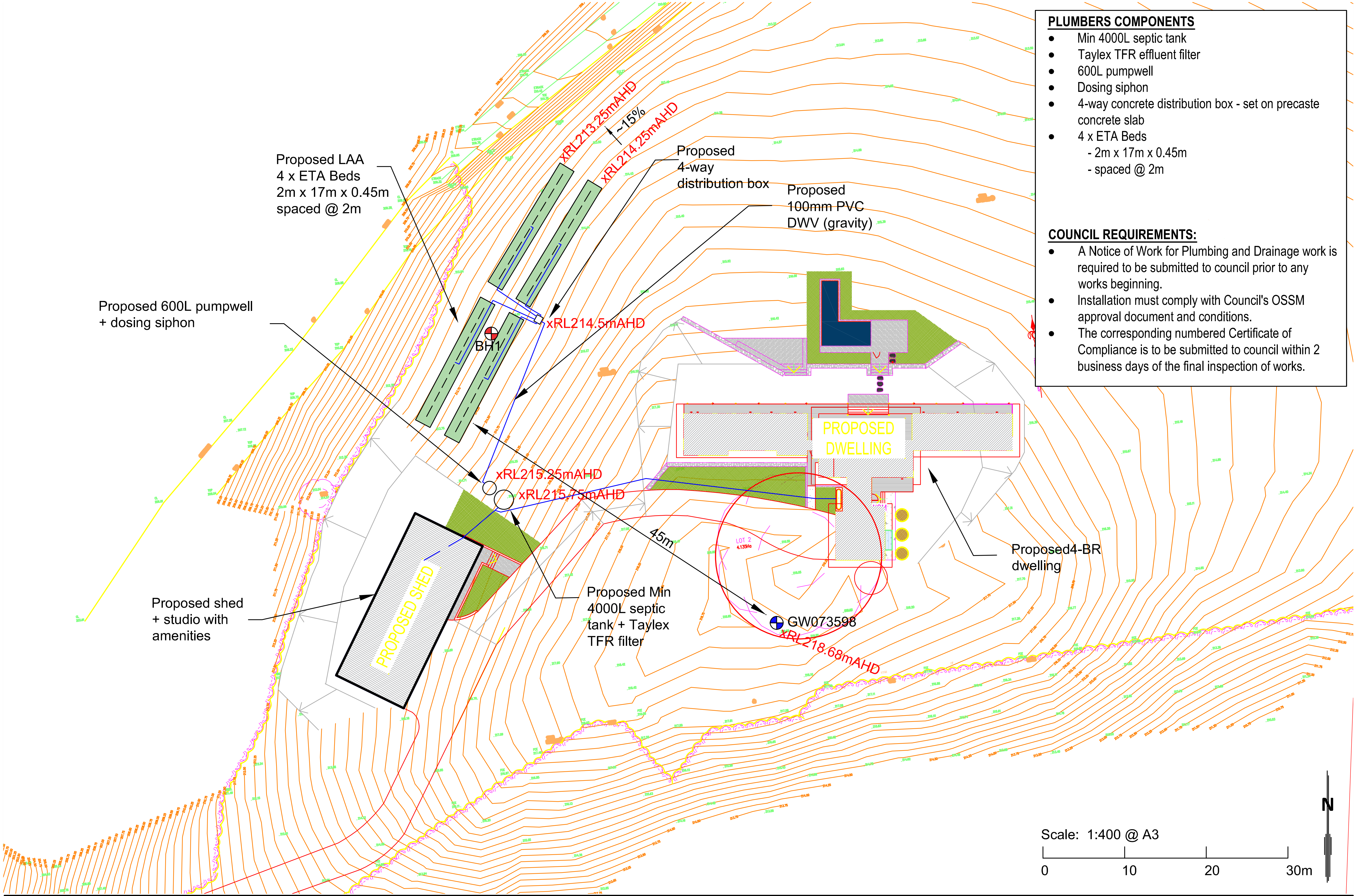
OPERATION & MAINTENANCE

- Vegetation situated within the proposed LAA are to be removed, as shown on site plan.
- Mow ETA beds and surrounding grass regularly
- Ensure vehicles and stock do not gain access to the ETA beds
- Do not allow cleaning bleach, stain removers, paint, solvents or nappy soakers to enter drains discharging to the septic system. Only use biodegradable products suitable for septic systems.
- Practice water conservation and avoid doing multiple loads of washing in one day.

Every 6 months:
Cap off one ETA bed at distribution box and rest. Rotate resting bed every 3- 6 months.
Remove biological effluent filter from within septic tank outlet and dislodge solids back into the main chamber of the septic tank.
Every 4-5 years:
Pump out septic tank to remove sludge and scum build up.

6.1 Proposed Layout of On-site Sewage Management System.

SEE NEXT PAGE



PLUMBERS COMPONENTS

- Min 4000L septic tank
- Taylex TFR effluent filter
- 600L pumpwell
- Dosing siphon
- 4-way concrete distribution box - set on precaste concrete slab
- 4 x ETA Beds
  - 2m x 17m x 0.45m
  - spaced @ 2m

COUNCIL REQUIREMENTS:

- A Notice of Work for Plumbing and Drainage work is required to be submitted to council prior to any works beginning.
- Installation must comply with Council's OSSM approval document and conditions.
- The corresponding numbered Certificate of Compliance is to be submitted to council within 2 business days of the final inspection of works.

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ONSITE SEWAGE MANAGEMENT LAND APPLICATION AREA (LAA) (SHEET 1)

Lot 2 DP 880732
51 Rock Road Bungalora

Base Drawing Source: Shane Denman Architects Locality Plan HMC Ref: HMCDWG2020.155.01

Job No: 2020.155
Date: September 2020
Revision Date:

6.2 ETA Bed Construction – Plan and Section Detail

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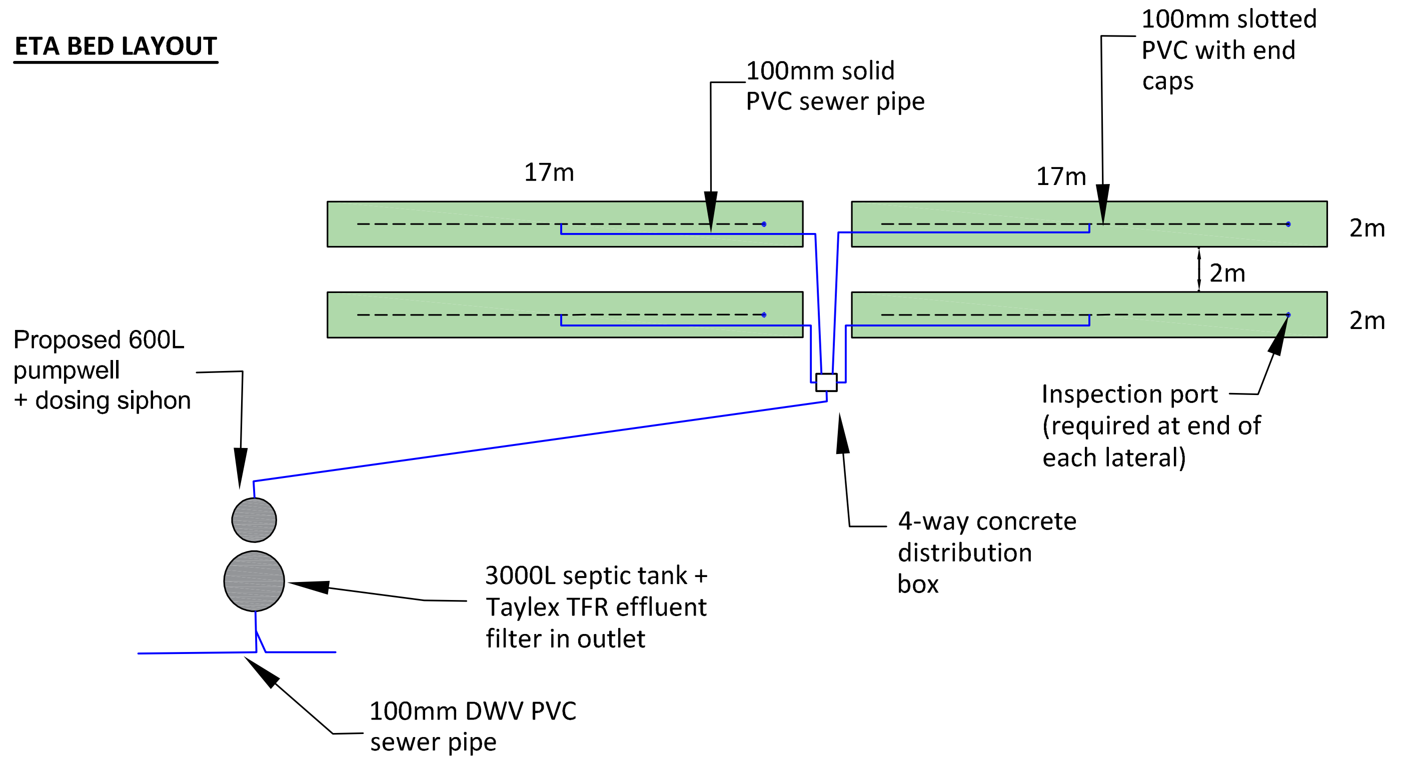

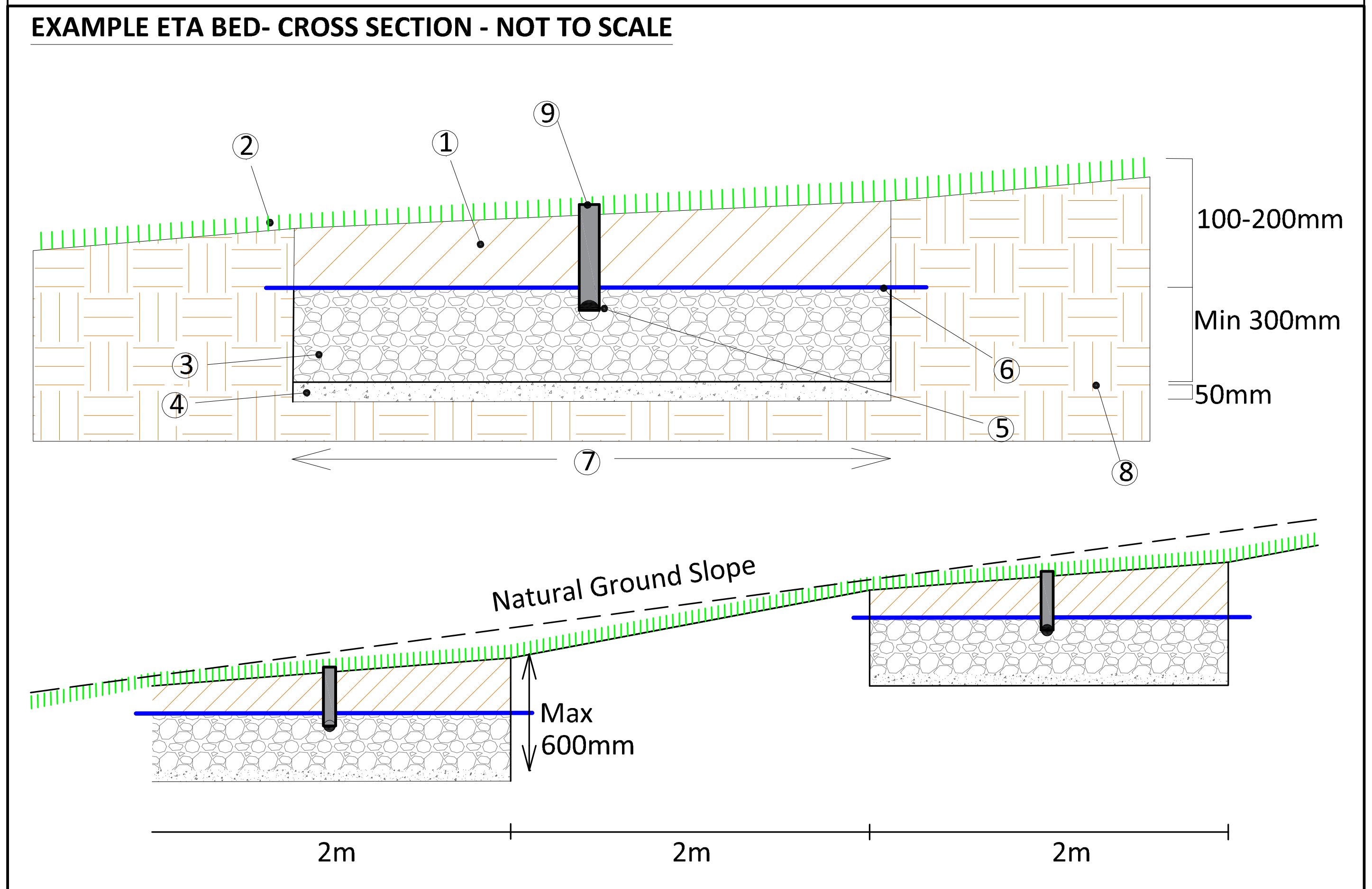

ETA Beds - Minimum Components and Design Requirements

1. 100-200mm of topsoil or backfilled local soils, mounded or graded to maximise sheet flow runoff of rainfall
2. Grass cover, suitable condition for mowing.
3. 300mm thick layer of up to 20-40mm aggregate.
4. Level base ETA bed, base and sidewalls raked to 5-10mm depth prior to placing gravel.
5. Lateral: 100mm pre-slotted sewer-grade PVC pipe. End caps required.
6. Geotextile filter cloth.
7. ETA bed width (2m)
8. Existing soil.
9. Inspection port at end of each lateral (100mm PVC slotted) within gravel layer and capped flush with the bed surface

Notes

a. Maximum bed length 20m for centrally-fed trenches, or 15m for end-fed trenches.
b. Sub-surface pipes as per manufacturers specifications, all pipework and fitting should comply with the Australian Standard 2698 "Plastic Pipes and Fittings for Irrigation and Rural Application". Effluent grade pipe work must be used.
c. Distribution box to be built from pre-cast concrete. Distribution box must be placed and leveled on 1000mm x 1000mm pre-cast slab or bedded in concrete.
d. In heavy clay soils, addition of gypsum at 0.5kg/m2 is recommended at the base of the disposal trench.
e. In acid soils, addition of lime at 0.5kg/m2 is recommended at the base of the disposal trench.
f. For dispersive soils addition of gypsum at 1kg/m2 is recommended at the base of the bed/trench.
g. On sloping blocks, effluent application fields may be terraced.
h. The commissioning of the piped dispersal system should include a test run/check for leaks and poorly distributed areas.
i. Shrubs to be planted no closer than 1m from the sidewall of the ETA bed. Small trees shold be no closer than 5m and large trees should be at least 20m from the ETA system.
j. The base of the ETA Bed must be at least 500mm from highest seasonal groundwater table.

Maintenance and Management

- If effluent ponds on the surface or soils become soggy, seek advice from Council or a plumber immediately
- The ETA Beds must be maintained in such a manner as to prevent any run-off of effluent to adjoining allotments, public places and watercourses.
- The system operator should maintain the ETA Beds regularly to ensure adequate cover of the pipe work, elimination of weeds, maintenance and regular mowing.

Licensing, Notification & Inspection

- Plumbing and drainage works must be performed by trades persons licensed by NSW Dept of Fair Trading. A notice of work is required to be submitted to Council minimum of 2 days prior to work. Council inspection is required prior to backfilling and at completion. Plumber is to provide a Certificate of Compliance and Drainage Diagram to Council at completion of works.

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LAYOUT AND SECTION DETAIL

Lot 2 DP 880732
51 Rock Road Bungalora

Base Drawing Source: Shane Denman Architects Locality Plan HMC Ref: HMCDWG2020.155.01

Job No: 2020.155
Date: September 2020
Revision Date:

6.3 Upslope Diversion Bund

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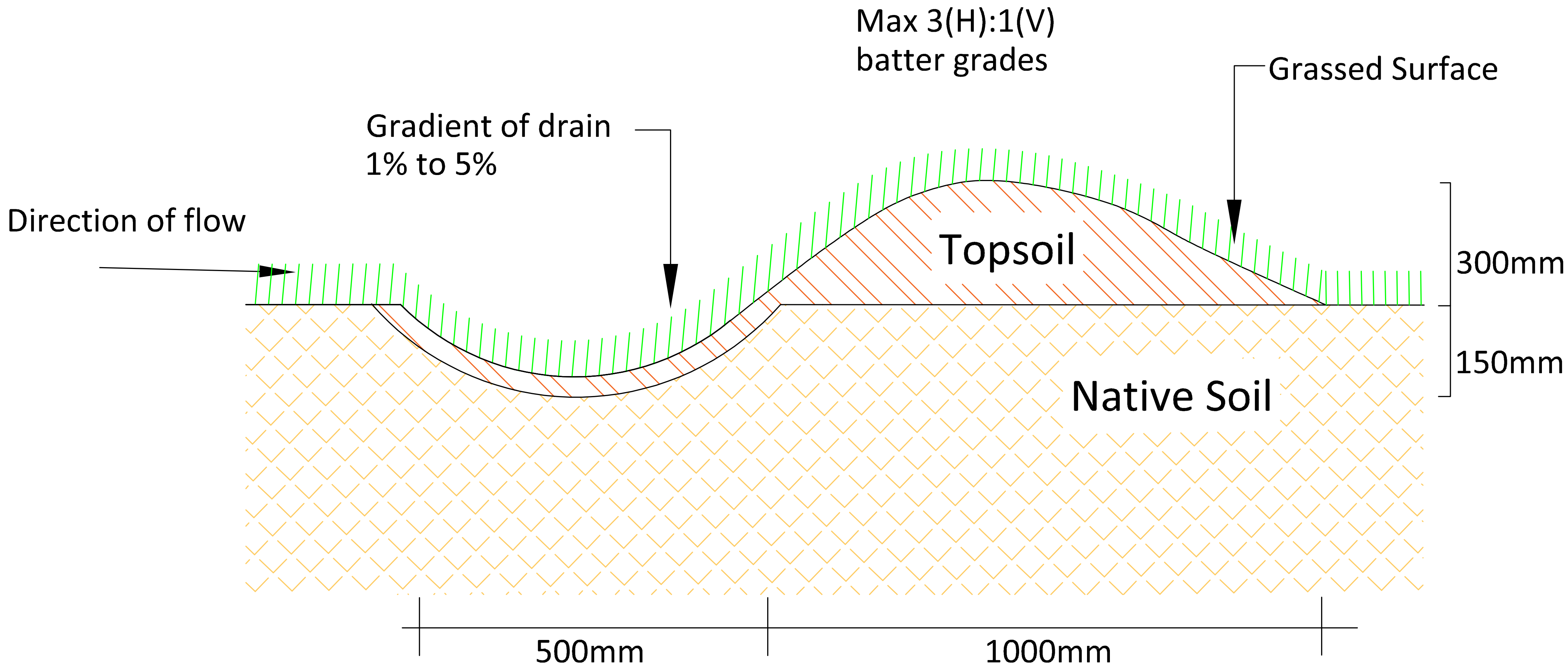
CROSS SECTION: UPSLOPE DIVERSION BUND



Source: Sydney Catchment Authority, 2013: Standard Drawing 8A

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UPSLOPE/DOWNSLOPE DIVERSION BUND

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Date: April 2020
Revision Date:

7 LIMITATIONS

The information within this document is and shall remain the property of HMC Environmental Consulting Pty Ltd.
This document was prepared for the sole use of client and the regulatory agencies that are directly involved in this project, the only intended beneficiaries of our work. No other party should rely on the information contained herein without the prior written consent of HMC Environmental Pty Ltd and client. The report and conclusions are based on the information obtained at the time of the assessment. Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary.

Because a report is based on conditions which existed at the time of the subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time, natural processes and the activities of man. Changes to the subsurface, site or adjacent site conditions may occur subsequent to the investigation described herein, through natural processes or through the intentional or accidental addition of imported material, and these conditions may change with space and time.

The findings of this report are based on the objectives and scope of work outlined within. HMC performed the services in a manner consistent with the normal level of care and expertise exercised by members of the environment assessment profession. No warranties or guarantees, expressed or implied, are made. Subject to the scope of work, HMC's assessment is limited strictly to identifying typical environmental conditions associated with the subject property, and does not include evaluation of any other issues. This report does not comment on any regulatory obligations based on the findings, for which a legal opinion should be sought. This report relates only to the objectives and scope of the work stated, and does not relate to any other works undertaken for the Client. All conclusions regarding the property area are the professional opinions of the HMC personnel involved with the project, subject to the qualifications made above.

While normal assessments of data reliability have been made by HMC, HMC assume no responsibility or liability for errors in any data obtained from regulatory agencies, or information from sources outside HMC's control, or developments resulting from situations outside the scope of this project.

8 REFERENCES

- Alderson, G. & Associates Pty Ltd, Draft Richmond Tweed On-site Regional Wastewater and Sewage Management Strategy, 1999 (OSSM Design Model)
- Australian/New Zealand Standard AS 1547: 2012 - *On-site domestic wastewater management*, February 2012
- Geary, P. and Gardner, T. *On-site disposal of effluen*t. Innovative Approaches to the On-Site Management of Waste and Water: A one day conference, Southern Cross University, Lismore NSW, 1996.
- Morand, D.T., *Soil Landscapes of the Lismore-Ballina 1:100 000 Sheet*, 1994
- NSW Department of Local Government, EPA (NSW), NSW Health, Land and Water Conservation and Department of Urban Affairs and Planning, *Environment & Health Protection Guidelines – On-site Sewage Management for Single Household*", February 1998
- Sydney Catchment Authority, "Designing and Installing On-site Wastewater Systems. A Sydney Catchment Authority Current Recommended Practice", SCA, May 2012
- NSW Office of Water, "Commenced Water Sharing Plan for the Tweed River Area unregulated and alluvial water sources", October 2010
- Whelan, B.R.. and Titammis, Z.V. Daily chemical variability of domestic septic tank effluent. *Water, Air and Soil Pollution **17***, 131-139

9 APPENDICES

APPENDIX 1 Site Location

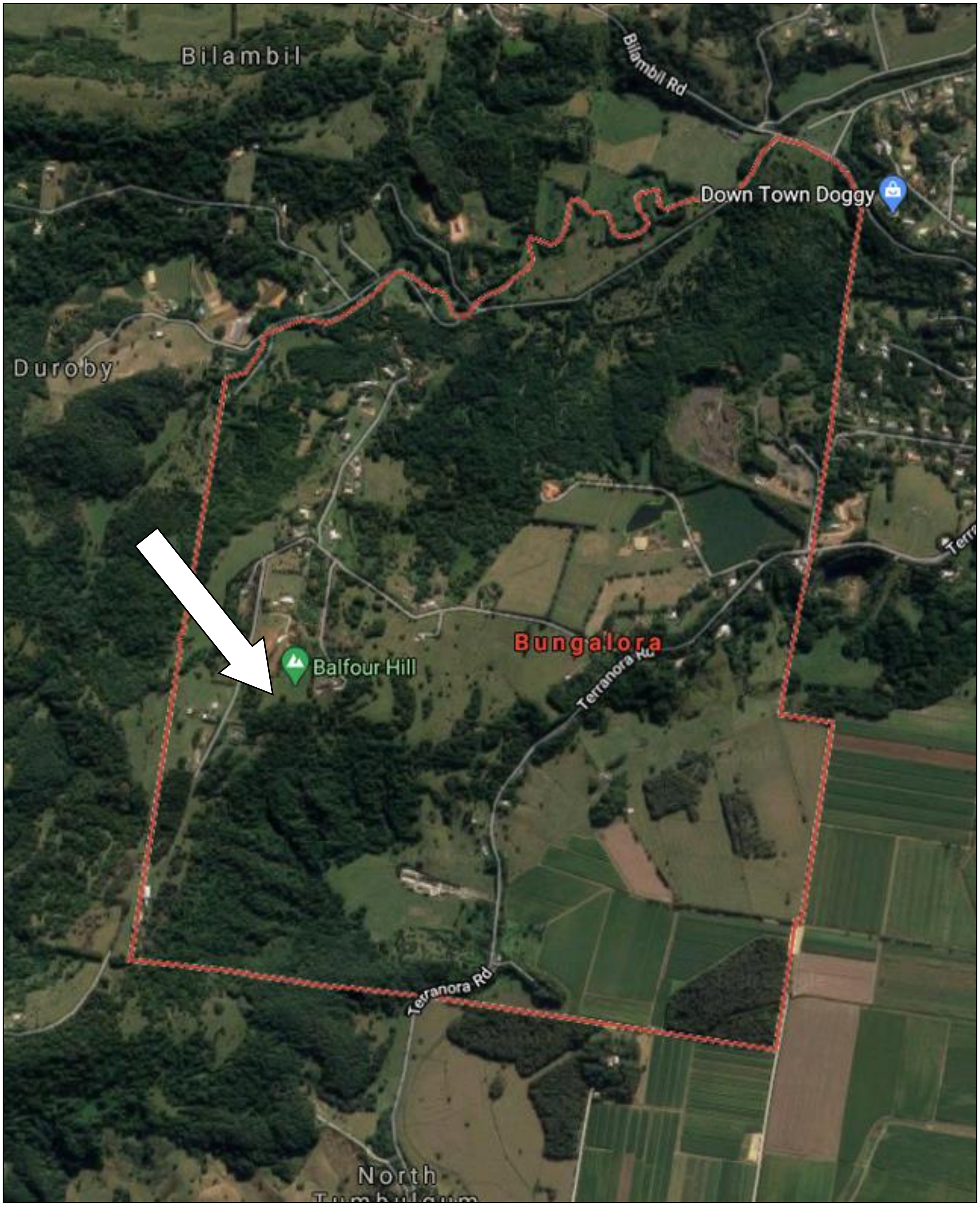


Figure 1 - Site Location (Google Maps)

APPENDIX 2 Property Boundary

Figure 2 - Site Boundary (NSW Land and Property Information 2012).

APPENDIX 3 LAA Modelling Existing Dwelling

Daily Effluent Disposal Model using Boughton Water Balance Model - Tyalgum
Greg Alderson & Associates Pty Ltd
Period of Rainfall & Evaporation Record: 01/01/1971 - 31/12/1984

Client:	Keogh			
Site:	Rock Road BUNGALORA			
Number of Persons	6	equivalent persons		
Daily Flow =	720	l/day		
Nitrogen Volume per year	22.8	kg/year	3.80	kg N /p/year - See Table 7 & table 8
Denitrification reduce to	13.68	kg/year	40.00	% reduction rate
Plant Uptake rate (N) =	300	kg/ha/year - See Table 6		
Phosphorus in Effluent (Ip) =	3.6	kg/year	0.6	kg P /person/year - see Table 11
P Uptake by plants (Hp) =	20	kg/ha/year - P which is taken up by vegetation, Table 9		
P sorption (Ps) =	10000	kg/ha/m depth - soil sorption capacity, Table 10		
Water Table Depth (Wtd) =	3	m - measured depth to the water table at the disposal site		
Buffer to W table (Bwt) =	0.5	m - adopted buffer to be set above water table		
Time for accumulation of P =	50.00	years		
Min. planted disposal area =	**456**	m^2 (based on N loading)		
Min. planted disposal area =	**69**	m^2 (based on P loading)		
Hydraulic Area	**183**	m^2 (ignored if less than Min. planted disposal area)		
Crop factor =	1	See Table 3 and Section- B2.8		
% Effective Rainfall =	75%	See Table 2		
Drainage below root zone/ Percolation =	8	mm/day - LTAR		
% of storage depth at which percolation occurs =	50%	See Section–B2.3		
Depth of topsoil/ Depth of trench =	0.45	m		
Available water/ Void space ratio =	0.3	Available water from Table 1 (m/m)		
Soil Moisture Holding Capacity/ Trench storage =	135	mm		
Permissible days overflow =	20	days/year		
Minimum effluent application =	3.93	$mm/day/m^2$	DLR	
Max cum stor =	19.66	mm		
Required permissible storage =	0.00	m^3		
Max cum stor =	3.60	m^3		

APPENDIX 4 Soil Investigation

Soil Landscape Description

NSW DLWC 1:100,000 Soil Landscape Map (Morand, 1996)	Carool (ca) soil landscape (Expected) Well drained Krasnozems on upper slopes and crests, Well drained chocolate soils on slopes and imperfectly drained brown earths elsewhere.
Geology	Lamington Volcanics – Tertiary, basalt, with members of rhyolite, tuff, agglomerate, conglomerate.

Soil Profile Investigation

Profile 1 via cutting within pad

Depth (mm)	Field Texture Determina tion	Structure	Colour (Munsell) Dry	Mottles	pH	Coarse Fragments	Emmerson Aggregate Test*
0-200	Clay Loam	Strong	Moist Very Dark Brown 7.5YR 2.5/3	NO	6.0	Nil	Class 7 Not limiting
200-800	Light Clay	Moderate	Moist Dark Brown 7.5YR 3/3	NO	6.0	Nil	Class 7 Not limiting

SOIL LIMITATIONS?
See recommendations below for soil amelioration required for long term management of LAA.

Soil Amelioration

Topdressing
Top dressing of the ETA bed may be required, especially for the first 6-12 months due to settling of the soil. Topsoil should be of a sandy loam texture with a neutral pH.

APPENDIX 5 Modified Emerson Aggregate Test

As described by Robert Patterson Lanfax Labs Technical Note T14-1 (November 2014)

Reporting Modified Emerson Test Results	
Class 1	*Severe dispersion maybe related to high sodicity which forces the clay particles apart in water. Amelioration with lime or gypsum may improve structural stability by increasing EC. Class 1 soils have a major limitation to wastewater application because of reduced permeability and potential to compact as the pores block.*
Class 2 -	*Moderate dispersion may be related to high sodicity. Amelioration may be effective by increasing EC. Without amelioration, this class has a major limitation to wastewater application as for class 1.*
Classes 3-6	*Remoulding, and 1:5 soil: water suspension tests are irrelevant to wastewater assessment, but one can report the test results with degree of slaking as: Slake 1 (slight), slake 2 (moderate) or slake 3 (completely slumped). Slake 1, 2, or 3 – no limitation to wastewater application, but may benefit from additional organic matter for surface irrigated soils.*
Classes 7 and 8	*These soils are water stable but may swell (Class 7) or retain original size and shape (Class 8). Neither of these classes is a limitation to wastewater application."*

APPENDIX 6 Nutrient Loading

In consideration of nutrients such as nitrogen and phosphorus, a mass balance was used to estimate the application rate and long-term management of the on-site sewage management system based on effluent quality, wastewater volume and land application system, plant uptake, site and soil characteristics.

In determination of LAA sizing in regard to TN the following data was used.

Table 1 Nitrogen Production Data

Study	Mean Annual Loading
Witt et al. 1974	2.2 kg/person/year
Whelan & Titammis 1982	3.8kg/person/year
Sarac, K et al 2001	4.0kg/person/year (based on 6 dwellings within tank)
Davison et al., 2002	4.2 kg/person/year (based on two dwellings within tank)
Patterson, R.A 2004	4.38 kg/person/year (using mean of 85.8mg/L^{-1} at 140L/person/day)
Mean of listed studies	3.73kg/person/year
Realistic annual loading rate based on above listed studies	3.8 kg/person /year (as per Whelan & Titammis 1982)

The mean of the above studies provides a TN of approximately 3.7kg/person/year therefore the previously quoted figure of 3.8kg/person/year by Whelan & Titammis, 1982, is considered realistic for this domestic installation.

APPENDIX 7 Effluent Quality

The method of land application chosen to suit the proposed dwelling size will determine the treated effluent quality target criteria. "Primary" effluent quality criteria as achieved by a septic tank is considered adequate by NSW Health for sub-soil land application via distribution of effluent at a depth of >300mm (see Table 2 below). It is proposed to construct an evapo-transpiration/absorption (ETA) bed to receive primary treated effluent.

Table 2 Recommended Final Use of Treated Effluent based on Treatment

Treatment	Standard	Recommended Final Use / Application
Primary Treatment (sewage or greywater) e.g., septic tank, greywater tank, wet composting closet system, greywater diversion device	Solids separation and digestion- no effluent standard	Sub-soil at greater than 300mm depth below finished ground level e.g., absorption trenches, mounds, and evaporation-transpiration beds.
Secondary Treatment without Disinfection	• BOD < 20 mg/L • TSS < 30 mg/L • Service person performs compliance inspection and reports condition of land application system • Local council develops risk management	• Sub-soil > 300mm depth • Sub-surface (300 mm to 150 mm) • LPED • Shallow Sub-surface Drip Irrigation
Secondary Treatment with Disinfection	• BOD < 20 mg/L • TSS < 30 mg/L • E. coli <30 cfu/100mL	• Sub-soil > 300mm depth • Sub-surface (300 mm to 150 mm) • * LPED • Shallow sub-surface drip irrigation • Surface and spray irrigation (100 mm to above GL)
Advanced Secondary Treatment without Disinfection	• BOD < 10 mg/L • TSS < 10 mg/L • Service person performs compliance inspection and reports condition of land application system • Local council develops risk management monitoring strategy	• Sub-soil > 300mm depth • Sub-surface (300 mm to ground level (no spray) • * LPED • ** Shallow Sub-surface drip irrigation
Advanced Secondary Treatment with Disinfection	• BOD < 10 mg/L • TSS < 10 mg/L • E. coli <10 cfu / 100mL	• Sub-soil > 300mm depth • Sub-surface (300 mm to 150 mm) • * LPED • ** Shallow sub-surface drip irrigation • Surface and spray irrigation (100 mm to above GL) • Greywater may be used for toilet flushing and washing machines
From NSW Health AdNote 4 (4 January 2017) *Low Pressure Effluent Distribution (LPED) Irrigation Lines if installed in accordance with AS/NZS 1547:2012 On-site domestic wastewater management; Appendix M **Shallow sub-surface drip irrigation if installed in accordance with AS/NZS 1547:2012 On-site domestic wastewater management; Appendix M		

APPENDIX 8 Setback Distance Risk Assessment

Table 3 Site Features Not Achieving Maximum Setback Distances

Site Feature	Horizontal Setback Distance Range	Site Constraint Items
Ground Water Bore	15-50m	A, C, H, J

Table 4 Site Constraint Risk Assessment

Item	Site/system feature	Constraint Scale Factors		Risk Level of Constraint
		Lower ⟷	Higher	
A	Microbial quality of effluent [3]	Secondary treatment	Primary treatment	High-Primary treatment
C	Groundwater	Category 5 and 6 soils, low resource/environmental value	Category 1 and 2 soils, gravel aquifers, high resource/environmental value.	Low-category 5 soils
H	Geology and Soils	Category 3 and 4 soils, low porous regolith, deep, uniform soils.	Category 1 and 6 soils, fractured rock, gravel aquifers, highly porous regolith.	Medium-Category 5 soils
J	Application method	Drip irrigation or subsurface application of effluent.	Surface/above ground application of effluent.	Low-subsurface application in ETA beds
AVERAGE RISK LEVEL				
Groundwater				**LOW**

APPENDIX 9 Setback Guidelines

Table R1 – AS/NZS 1547:2012 Guidelines for Horizontal and Vertical Setback Distances (to be used in conjunction with Table R2)		
Site Feature	**Setback Distance range (m)1**	**Site constraint items of specific concern (from table R2)1**
	Horizontal Setback Distance (m)	
Property Boundary	1.5-502	A, D, J
Buildings/houses	2.0->63	A, D, J
Surface Water4	15-100	A, B, D, E, F, G, J
Bore, Well5	15-50	A, C, H, J
Recreational areas (Children's play areas, swimming pools and so on)7	3-158,9	A, E, J
In-Ground water tank	4-1510	A, E, J
Retaining wall and Embankments, escarpments, cuttings11	3.0m or 45o angle from toe of wall (whichever is greatest)	D, G, H
	Vertical Setback Distance (m)	
Groundwater 5,6,12	0.6->1.5	A, C, F, H, I, J
Hardpan or bedrock	0.5->1.5	A, C, J

Notes:

The overall setback distance should be commensurate with the level of risk to public health and the environment. For example, the maximum setback distance should be adopted where site/system features are on the high end of the constrain scale. The setback distance should be based on an evaluation of the constraint items and corresponding sensitive features in Table R2 and how these interact to provide a pathway or barrier for wastewater movement.

Subject to local regulatory rules and design by a suitably qualified and experienced person, the separation of a drip line system from an upslope boundary, for slopes greater than 5%, may be reduced to 0.5m.

Setback distances of less than 3m from houses are appropriate only where a drip irrigation land application system is being used with low design irrigation rates, where shallow subsurface systems are being used with equivalent low areal loading rates, where the risk of reducing the bearing capacity of the foundation or damaging the structure is low, or where tan effective barrier (designed by a suitably qualified and experienced person) can be installed. This may require consent from the regulatory authority.

Setback distance from surface water is defined as the areal edge of the land application system to the edge of the water. Where land application areas are planned in a water supply catchment, advice on adequate buffer distances should be sought from the relevant water authority and hydrogeologist. Surface water, in this case, refers to any fresh water or geothermal water in a river, lake, stream, or wetland that may be permanently or intermittently flowing. Surface water also includes water in the coastal marine area and water in man-made drains, channels, and dams unless these are to specifically divert surface water away from the land application area. Surface water excludes any water in a pipe or tank.

Highly permeable stony soils and gravel aquifers potentially allow microorganisms to be readily transported up to hundreds of metres down the gradient of an on-site system (see R3, Table 1 in Pang et al. 2005). Maximum

setback distances are recommended where site constraints are identified at the high scale for items A, C and H. For reading and guidance on setback distances in highly permeable soils and coarse-grained aquifers see R2. As microbial removal is not linear with distance, data extrapolation of experiments should not be relied upon unless the data has been verified in the field. Advice on adequate buffer distances should be sought from the relevant water authority and a hydrogeologist. Setback distances from water supply bores should be reviewed on a case-by-case basis. Distances can depend on may factors including soil type, rainfall, depth and casing of bore, direction of groundwater flow, type of microorganisms, existing quality of receiving waters, and resource value of waters. Where effluent is applied to the surface by covered drip or spray irrigation, the maximum value is recommended. In the case of subsurface application of primary treated effluent by LPED irrigation, the upper value is recommended. In the case of surface spray, the setback distances are based on a spray plume with a diameter not exceeding 2m or a plume height not exceeding 0.5m above finished surface level. The potential for aerosols being carried by the wind also needs to be taken into account. It is recommended that land application of primary treated effluent be down gradient of in-ground water tanks. When determining minimum distances from retaining walls, embankments, or cut slopes, the type of land application system, soil types, and soil layering should also be taken into account to avoid wastewater collecting in the subsoil drains or seepage through cuts and embankments. Where these situations occur setback clearances may need to be increased. In areas where slope stability is of concern, advice from a suitably qualified and experienced person may be required. Groundwater setback distance (depth) assumes unsaturated flow and is defined as the vertical distance from the base of the land application systems to the highest seasonal water table level. To minimise potential for adverse impacts on groundwater quality, minimum setback distances should ensure unsaturated, aerobic conditions in the soil. These minimum depths will vary depending on the scale of the site constraints identified in Table R2. Where groundwater setback is insufficient, the ground level can be raised by importing suitable topsoil and improving effluent treatment. The regulatory authority should make the final decision in this instance. (See also the guidance on soil depth and groundwater clearance in Tables K1 and K2.

Table R2 - AS/NZS 1547:2012
Site Constraint Scale for Development of Setback Distances
(used as a guide in determining appropriate setback distances from ranges given in Table R1)

Item	**Site/system feature**	**Constraint Scale 1** **Lower** ⟷	**Higher** **Examples of constraint factors2**	**Sensitive features**
A	Microbial quality of effluent 3	Effluent quality consistently producing ≤106 cfu/100mL E.coli (for example, primary treated effluent)	Effluent quality consistently producing ≥106 cfu/100mL E.coli (for example, primary treated effluent)	Groundwater and surface pollution hazard, public health hazard
B	Surface water 4	Category 1 to 3 soils 5 no surface water down	Category 4 to 6 soils, permanent surface	Surface water pollution hazard for low permeable

		gradient within > 100m, low rainfall area	water <50m down gradient, high rainfall area, high resource/environmental value6	soils, low lying or poorly draining areas
C	Groundwater	Category 5 & 6 soils, low resource/environmental value	Category 1 and 2 soils, gravel aquifers, high resource/environmental value	Groundwater pollution hazard
D	Slope	0-6% (surface effluent application)	>10% (surface effluent application), >30% subsurface effluent application	Off-site export of effluent erosion
E	Position of land application area in landscape 6	Downgradient of surface water, property boundary, recreational area	Upgradient of surface water, property boundary, recreational area	Surface water pollution hazard, off-site export of effluent
F	Drainage	Category 1 and 2 soils, gently sloping area	Category 6 soils, sites with visible seepage, moisture tolerant vegetation, low lying area	Groundwater pollution hazard
G	Flood potential	Above 1 in 20 year flood contour	Below 1 in 20 year flood contour	Off-site export of effluent, system failure, mechanical faults
H	Geology and Soils	Category 3 and 4 soils, low porous regolith, deep, uniform soils	Category 1 and 6 soils, fractured rock, gravel aquifers, high porous regolith	Groundwater pollution hazard for porous regolith and permeable soils
I	Landform	Hill crests, convex side slopes and plains	Drainage plains and incise channels	Groundwater pollution hazard, resurfacing hazard
J	Application method	Drip irrigation or subsurface application of effluent	Surface/above ground application of effluent	Off-site export of effluent, surface water pollution

NOTES:
Scale shows the level of constraint to sitting on an on-site system due to the constraints identified by SSE evaluator or regulatory authority. See Figures R1 and R2 for examples of on-site system design boundaries and possible site constraints
Examples of typical siting constraint factors that may be identified either by SSE evaluator or regulatory authority. Site constraints are not limited to this table. Other site constraints may be identified and taken into consideration when determining setback distances.
The level of microbial removal for any on-site treatment system needs to be determined and it should be assumed that unless disinfection is reliably used then the microbial concentrations will be similar to primary treatment. Low risk microbial quality value is based on the values given in ARC (2004), ANZECC and ARMCANZ

(2000), and EPA Victoria (Guidelines for environmental management: Use of reclaimed water 2003) Surface water, in this case, refers to any fresh water or geothermal water in a river, lake, stream, or wetland that may be permanently or intermittently flowing. Surface water also includes water in the coastal marine area and water in man-made drains, channels, and dams unless these are to specifically divert surface water away from the land application area. Surface water excludes any water in a pipe or tank. The soil categories 1 to 6 are described in Table 5.1 Surface water or groundwater that has high resource value may include potable (human or animal) water supplies, bores, wells, and water used for recreational purposes. Surface water or groundwater of high environmental value include undisturbed or slightly disturbed aquatic ecosystems as described in ANZECC and ARMCANZ (2000). The regulatory authority may reduce or increase setback distance at their discretion based on the distances of the land application up or downgradient of sensitive receptors.

Table 5 Guidelines for Horizontal and Vertical Setback Distances (DLG, 1998)

System	Recommended Buffer Distances
All land application systems	100 metres to permanent surface waters (eg. River, streams, lakes etc) 250 metres to domestic groundwater well 40 metres to other waters (eg. Farm dams, intermittent waterways and drainage channels, etc)
Surface spray irrigation	6 metres if area up-gradient and 3 metres if area down-gradient of driveways and property boundaries 15 metres to dwellings 3 metres to paths and walkways 6 metres to swimming pools
Surface drip and trickle irrigation	6 metres if area up-gradient and 3 metres if area down-gradient of swimming pools, property boundaries, driveways and buildings
Subsurface irrigation	6 metres if area up-gradient and 3 metres if area down-gradient of swimming pools, property boundaries, driveways and buildings
Absorption System	12 metres if area up-gradient and 6 metres if area down-gradient of property boundary 6 metres if area up-gradient and 3 metres if area down-gradient of swimming pools, driveways and buildings

APPENDIX 10 Groundwater Risk Assessment – Viral Die-Off & Drillers Report (Form A)

The Trench 3.0 wastewater model (Australian institute of Health, 1999) was used to assess the separation distance recommended to minimise the risk of the effluent moving through the soil profile and impacting on the water bore. The estimated viral die-off of microbial contaminants in the effluent was calculated as viruses are the more resistant to environmental degradation.

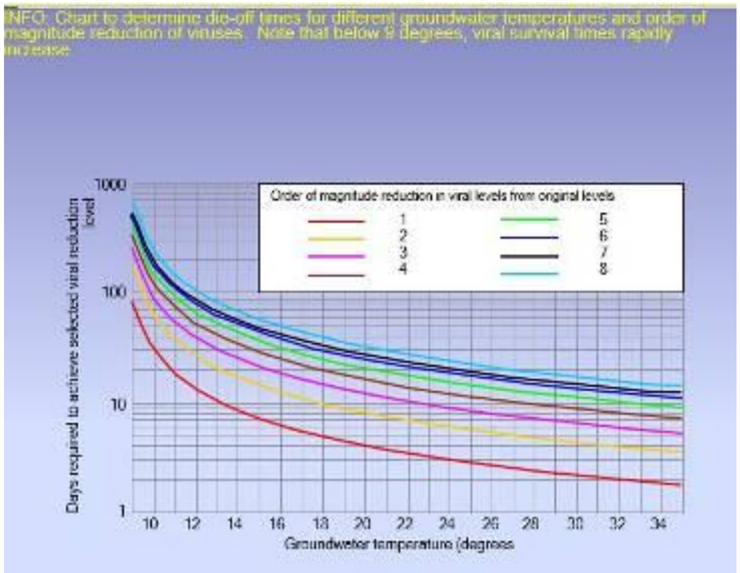


Figure 3 Viral Die-off Rates

The soil profile information presented by the Drillers Log (see Figure 4) recorded Clay from 1m depth to 14m, with 12m of shale, 4m of broken rock/basalt, 4m of red shale, 8m of basalt, 16m of shale and a further 2m of basalt rock recorded. Two water bearing zones were recorded, both consolidated at depth of 45-46m and 56-57m depth. The buffer from the proposed ETA beds to the groundwater would be approximately 4m vertically and 45m horizontally. It is likely, the groundwater flow will reflect the topography and slope from the groundwater bore towards the proposed LAA.

The soil profile indicates it is likely to be confining, with no connection between the surface and the underlying aquifer. The very low application rate proposed also shows saturated conditions would not likely exist through the soil profile.

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	ROUS	TERRANORA	LOT 2 DP880732
Licensed:	ROUS	TERRANORA	Whole Lot 2//880732

Region: 30 - North Coast
CMA Map:

River Basin: 201 - TWEED RIVER
Grid Zone:
Scale:
Area/District:

Elevation: 0.00 m (A.H.D.)
Northing: 6874909.000
Latitude: 28°15'03.4"S

Elevation Source: Unknown
Easting: 545888.000
Longitude: 153°28'04.1"E

GS Map: -
MGA Zone: 56
Coordinate Source: GD.,ACC.GIS

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	60.00	168			Rotary Air
1	1	Casing	Pvc Class 9	-0.30	60.00	160			Seated on Bottom, Glued
1	1	Opening	Slots - Vertical	42.00	60.00	160		1	Sawn, PVC Class 9, SL: 150.0mm, A: 3.00mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
45.00	46.00	1.00	Consolidated			0.24			
56.00	57.00	1.00	Consolidated	40.00		0.37		01:00:00	

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	1.00	1.00	Topsoil	Topsoil	
1.00	2.00	1.00	Clay	Clay	
2.00	14.00	12.00	Boulder / Clay	Clay	
14.00	26.00	12.00	Shale	Shale	
26.00	30.00	4.00	Broken Rock / Basalt	Rock	
30.00	34.00	4.00	Red Shale	Shale	
34.00	42.00	8.00	Basalt	Basalt	
42.00	58.00	16.00	Shale	Shale	
58.00	60.00	2.00	Basalt	Basalt	

Figure 4 – Extract from Form A - Driller Log

The conservative assumptions used in the modelling are detailed in the table below.

Table 6 Modelling Assumptions – Viral Die-off

Site characteristics	Inputs
Minimum water bearing zone	44m
Groundwater gradient	0.02 (2%)
Hydraulic conductivity	0.06m/day (AS/NZS1547:2012)
Effective porosity	Clay 10%
Required viral die-off	7 orders of magnitude (10^7) (PRIMARY TREATMENT/SEPTIC TANK)
Minimum Groundwater temperature	15°C

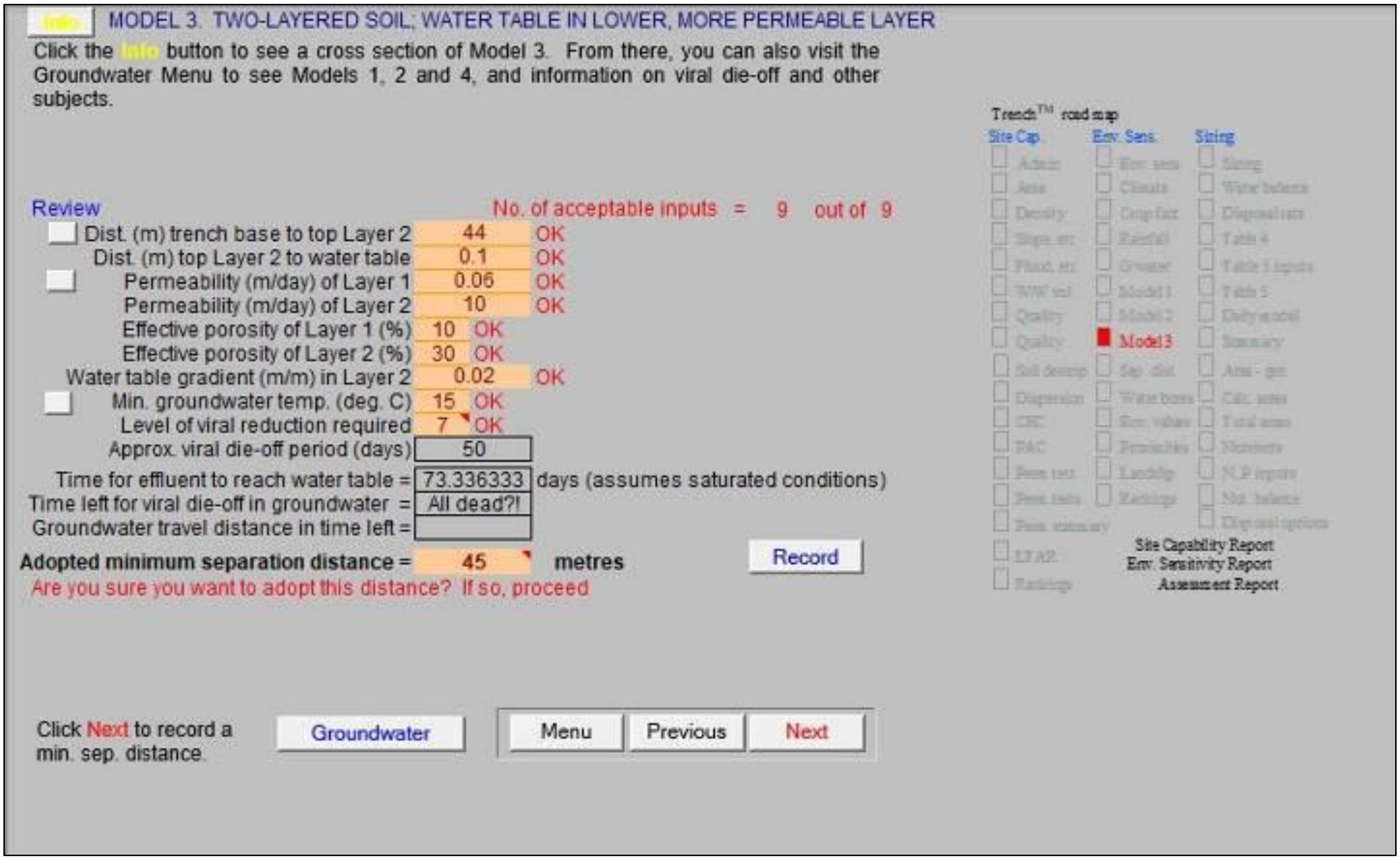


Figure 5 – Trench 3.0 Model Inputs and calculations – Viral Die-Off.

Using these very conservative estimates in the *Trench 3.0 Wastewater Model*, the viral load would be depleted after 21 days. The time for the effluent to travel vertically to reach the groundwater would be approximately 50 days - all viruses would be dead before any effluent was able to enter the aquifer and begin moving horizontally.

Viral die-off modelling via Trench 3.0 (see Figure 4) has therefore demonstrated that there is minimal risk of groundwater contamination from the future Land Application Area (LAA) based on bore design, soil profile and setback distances. With the proposed 45m horizontal setback , the proposed effluent land application area is considered to present a very low risk of contaminating the groundwater bore.

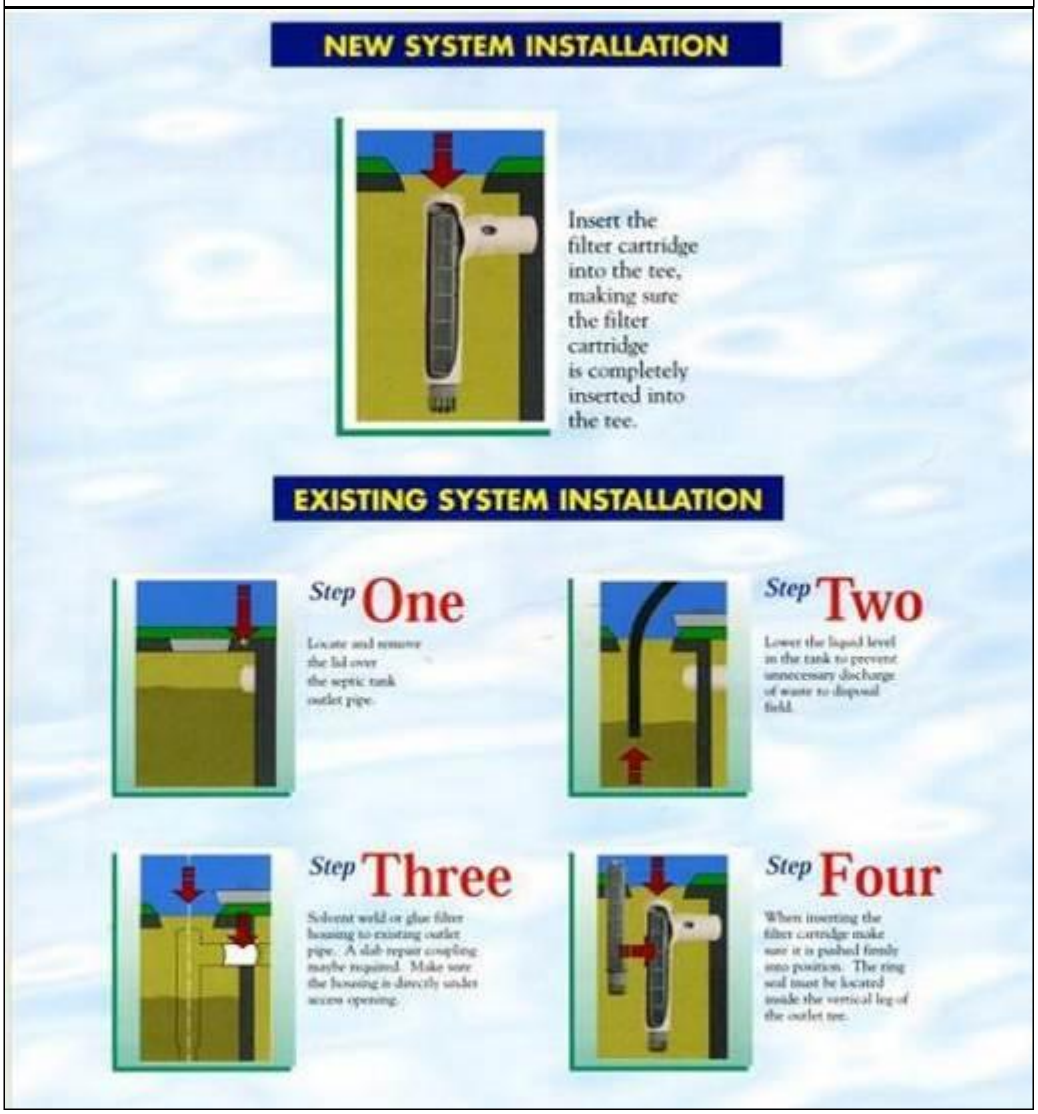
APPENDIX 11 Biological Effluent Filter – Installation & Operation

The TFR (Taylex Filter Residential)

This filter has ben designed to fit into existing septic tanks to extend the trench and irrigation fields life span.

This filter fits down the outlet inspection pipe.

Taylex Filter Residential (TFR)



APPENDIX 12 Dosing Siphon Specifications

Dosing siphon and 600L pumpwell package available locally from JH Williams Building Supplies, Buchanan Street, Murwillumbah.

ecoteam
natural solutions for environmental challenges

surge-flow100

Flow-with-nature dosing siphon

The **Surgeflow 100** dosing siphon is a completely passive device that utilises natural hydrostatic air pressure and gravity to create a surge of liquid with an average flow rate of 100L/min.

Designed and manufactured by **Ecoteam** parent company **Ecotechnology Australia Pty Ltd.**

Surgeflow 100 does not require electricity and has no moving parts.

This simple device:

- Facilitates even distribution of effluent in gravity-fed trench application systems.
- Improves trench life.
- Reduces downstream blockages by scouring lines.
- Can be used in auto-flush applications and sand-filters.

Registered plumbers and qualified tradespeople can install these devices efficiently, backed by **Ecoteam** technical advice.

Specifications

Height:	780 mm
Width:	420 mm
Flow rate:	approx. 100L/min
Fall required:	300 mm (min.)

Dose estimates

600 mm diam. sump:	approx. 75 L
900 mm diam. sump:	approx. 170 L
1000 mm diam. sump:	approx. 295 L

Design service

Ecotechnology Australia Pty Ltd can design and manufacture **Surgeflow** units to suit a variety of applications. Purpose-designed units can be produced based on required flow rate and dose volume.

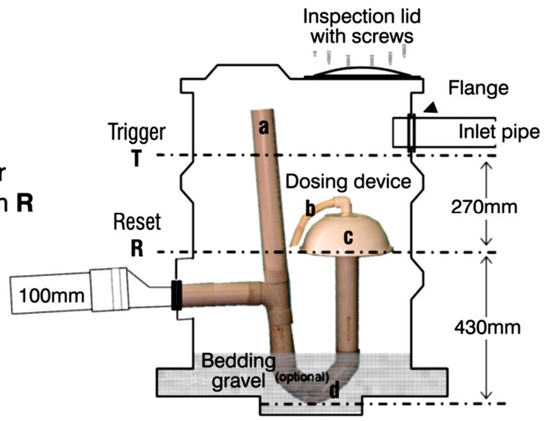
Prices

Discounts apply for trade and bulk orders. Please contact Ecoteam on (02) 6621 5123 for latest prices.

Operation

The primed Surgeflow 100 triggers when the water level reaches **T** and resets automatically when the water level drops below the bell rim **R**

a vent and failure overflow
b balance tail
c bell
d trap



APPENDIX 13 Site Photos

Photo 1: View S overlooking proposed LAA.

Photo 2: View SE and upslope showing location of proposed LAA, at arrow.

Photo 3: View NE showing location of existing groundwater bore and boulders on surface.

Photo 4: Soil profile retrieved within proposed LAA via hand auger.