Broadcrest Environmental Pty Ltd

7 Boronia Road, Ingleside NSW

On-Site Wastewater Report

July 2025

REF: 4640-WW-A-01

1300 554 945 | contact@broadcrest.com.au | broadcrest.com.au

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DOCUMENT CONTROL

Approval and Authorisation

Title	7 Boronia Road, Ingleside NSW On-Site Wastewater Report
Authored on behalf of Broadcrest Environmental Pty Ltd by:	M. Kirby Engineer | Environmental & Civil
Signed:	
Dated:	24/07/2025

Document Status

Date	Internal Reference	Document Status	Prepared by	Reviewed by
24/07/2025	4640-WW-A-01	For Release	M. Kirby	C. Hudson

CONTENTS

1 INTRODUCTION

1.1 Foreword

An On-Site Wastewater Report is a technical document which specifies how the sewage produced on-site will be managed, treated, and then disposed. An On-Site Wastewater Report carefully considers the environment, health, cost, and long-term management options for the on-site management of sewage.

1.2 Background

Broadcrest Pty. Ltd. was engaged by M and M Green c/- Inhaus Designs to produce an On-Site Wastewater Management Report at 7 Boronia Road, Ingleside NSW (the site). The report will accompany plans to construct a Five (5) Bedroom Dwelling. A site inspection was carried out on 9 July 2025 which involved a visual assessment of the site and soil sampling. The assessment of the results, system design and recommendations are detailed in this report.

1.3 Objectives

The performance objectives of the On-Site Wastewater Assessment are to:

- Protect human health
- Protect ground and surface water
- Maintain and enhance the quality of the land and vegetation
- Maintain and enhance community amenity
- Ensure maximum re-use of resources
- Promote an ecologically sustainable development.

1.4 Scope of Works

The scope of works included the following:

- A site inspection
- Soil sampling and analysis
- Wastewater management assessment
- Drafting of the proposed system
- Reporting in accordance with the associated legislations and guidelines.

1.5 Compliance

This report has been produced in accordance with the following guiding documents:

- DLG 1998, On-site Sewerage Management for Single Households
- SCA 2012, Designing and Installing On-Site Wastewater Systems
- Australian Standard AS 1289.3.8.1:2006 Methods for testing soils for engineering purposes
- Australian Standard AS 1546.1-3:2008 On-site domestic wastewater treatment units
- Australian Standard AS 1547:2012 On-site domestic wastewater management.

2 SITE ASSESSMENT & INVESTIGATION

2.1 Site Information

Address / Locality	7 Boronia Road, Ingleside NSW
Lot Area:	2450m^2
Zoning:	RU2 Rural Landscape
Council / LGA:	Northern Beaches Council
Intended Water Supply:	Town Water
Inspection Officer:	M. Kirby - 9/07/2025

2.2 General

At the time of inspection, the site was unoccupied, the landform was an open grassy field adjacent sparse native bushland.

The site is proposed for development consisting of a Five (5) Bedroom Dwelling, Pool and associated driveway and landscaping.

The effluent generated within the Five (5) Bedroom Dwelling is proposed to be treated to a secondary standard prior to dispersal via Raised Pressure Dosed Beds.

A suitable EMA location was identified within the rear of the site that was gentle in slope, with excellent wind and solar exposure (See Figure 2-1). Soil depth was limited and so a raised application area is proposed.

The site was impacted by moderate stormwater run-on, to mitigate the impact of this on the EMA an up-slope diversion berm, with sub-soil line, should be installed as per Appendix A and Appendix D.

Figure 2-1: East facing photograph over proposed EMA

2.3 Assessment Methodology

The assessment methodology of this report follows that prescribed in DLG (1998), whereby the restriction imposed by a site/soil features are categorised by severity, and their impact forms the basis for subsequent system selection, design, and recommendations (Table 2.3.1).

Table 2.3.1 - Site / soil limitation assigned per DLG (1998)

Limitation	Description
Minor	This feature has been assessed and deemed to pose no obstacle to OSSM, given the recommended system and measures are implemented.
Moderate	This feature requires consideration. It may typically be overcome by site modifications or by appropriate selection, design and sizing of treatment / application systems.
Major	This feature precludes the use of a given treatment, land application method, or Effluent Management Area (EMA). Particular Major Limitations may prevent OSSM entirely, require an off-site management approach, or re-evaluation of the development scope.

2.4 Site Assessment Summary

A summary of limitations pertinent to the suitability of the site for On-Site Sewerage Management (OSSM) is provided in Table 2.4.1 below.

Table 2.4.1 – Assessment summary of site features

Factor Assessed	Description	Limitation
Climate	Monthly evaporation exceeds rainfall for majority of the year.	Minor
Temperature	Annual mean daytime maximum > 15°C.	Minor
Flood Potential	No flood study or flood levels have been provided. Site is located above any anticipated flood level.	Minor
Exposure	Excellent wind and solar exposure.	Minor
Slope	Gently Inclined : 6.1%	Minor
Landform	Linear planar	Minor
Run-on and Seepage	Moderate Potential interaction of stormwater within proposed EMA. To mitigate the impact of stormwater run-on to the EMA generated by upslope catchment it is proposed to divert run-on around EMA by installing an upslope diversion drain, with sub-soil line, as indicated by Appendix A and constructed as per Appendix D.	Moderate
Site-drainage	No signs of soil saturation or ponding observed	Minor
Erosion Potential	No erosion in proposed EMA identified.	Minor
Site and Soil Disturbances	Site/soil disturbances potentially impacting the EMA anticipated during construction of the proposed development, ensure EMA is vegetated via dense surface coverage prior to commissioning	Moderate
Groundwater Bores	WaterNSW Realtime data indicated one (1) domestic potable groundwater bores located within a 250m radius of the site. GW104265 was situated approximately 210m north-east of the site (up-gradient), and 250m north-east of the proposed EMA. The bore had a drill depth of 210mBGL and a standing water level of 43mBGL. A viral die-off calculation was undertaken for the site, which indicated a minimum up-gradient offsite of 38.10m from any groundwater drinking bore.	Minor
Rock Outcropping	No outcroppings identified within proposed EMA	Minor
Geology / Regolith	No geological discontinuities, fractures, or highly porous regolith are expected within and surrounding the EMA	Minor
Buffer Distances & Available land area	All minimum buffer requirements have been satisfied	Minor

2.5 Climate

7 Boronia Road, Ingleside NSW has a temperate climate, with cool dry winters, with a hot wetter summer. Median annual rainfall is 1423.5 mm and evaporation 1336.8 mm. Monthly evaporation exceeds rainfall for majority of the year. (Appendix B1) (*Minor Limitation)*.

Average maximum temperatures range from 16.3 °C to 27.0 °C in July and January respectively. Average minimum temperatures range from 7.7 °C to 18.5 °C in July and January respectively. The mean annual daytime maximum of 22.0 °C proves suitable for biological wastewater treatment systems (i.e. AWTS) (*Minor Limitation*).

2.6 Flood potential

No flood study or flood levels have been provided. The site lies above any anticipated flood level *(Minor Limitation)*.

2.7 Exposure

The proposed effluent management area (EMA) is well exposed to sun and wind (*Minor Limitation*).

Table 2.7.1 – Site Exposure

Landform Feature	Aspect	Solar Exposure	Wind Exposure	Limitation
A	Eastern	Excellent	Excellent	Minor

2.8 Slope

Slope has the potential to become a restrictive landform feature for OSSM with increased slope increasing the risk of run-off and/or erosion. Slope within the proposed effluent management was determined to be 6.1% (*Minor Limitation).*

Table 2.8.1 – Site Slope

Landform Feature	Approximate Slope Tangent (%)	Slope Classification	Limitation
A	6.1%	Gently Inclined	Minor

Table 2.8.2 - Percentage Slope and Land Application Limitations

Slope Range [%]	Slope Classification	Limitation				
		Surface Irrigation (Spray & Drip)	Absorption Systems	Mounds	Conventional Trenches & LPEDs	Sub-surface Irrigation
0 – 1	Level	Minor	Minor	Minor	Minor	Minor
1 – 3	Very Gently Inclined	Minor	Minor	Minor	Minor	Minor
3 – 10	**Gently Inclined**	**Minor**	**Minor**	**Minor**	**Minor**	**Minor**
10 – 15	Moderately Inclined	Major	Major	Moderate	Moderate	Minor
15 – 20		Major	Major	Major	Moderate [2]	Minor
> 20	Steeply Inclined	Major	Major	Major	Moderate [3]	Moderate [1]

[1] 30% maximum slope without specific design (AS 1547:2012, p.133)
[2] >15% slope increase difficulty in construction (AS 1547:2012, Table K1)
[3] >25% slope creates difficulty in trenching, risk of erosion during construction (AS 1547:2012, Table K1)

2.9 Landform

The landform describes the surface shape and topographic position at the proposed EMA. Typical landform descriptors per AS1547:2012 are detailed below.

Table 2.9.1 – Landform Configuration

Landform Feature	Slope Configuration	Limitation
A	Linear planar	Minor

2.10 Surface Water and Seepage

Surface water and seepage flow is determined by the catchment preceding the EMA and the prevailing landform features. General assessment of the likely surface water interaction with the landform and EMA has been provided.

Table 2.10.1 – Site surface water

Landform Feature	Catchment		Surface Flow		Soil Moisture	Seepage Potential	Limitation
	Size	Surface Coverage	Run-on	Run-off			
A	Minor	Grass	Moderate	Minor	Dry	Minor	Moderate

To mitigate the impact of stormwater run-on to the EMA generated by upslope catchment it is proposed to divert run-on around EMA by installing an upslope diversion drain, with sub-soil line, as indicated by Appendix A and constructed as per Appendix D.

2.11 Site drainage

The proposed effluent management area appeared to consist of free draining soils with no soil saturation present, no noted presence of macrophytes were observed (i.e. sedges, ferns, juncus) *(Minor Limitation).*

2.12 Erosion potential

Erosion and surface soil movement results from the interaction of the existing landform, surface flows and surface coverage. The following existing erosion conditions were identified and assessed in proposing additional hydraulic loading in the form of effluent.

Table 2.12.1 – Site erosion potential

Landform Feature	Surface Flow Type	Erosion Hazard		Limitation
		Surface Flow	Wind	
A	Unconcentrated	Minor	Minor	Minor

Note that soils are potentially erodible where surface cover is broken and as such, the EMA should be appropriately preserved and if necessary, re-vegetated via establishment of dense (>85% coverage) perennial groundcover prior to commissioning (*Minor Limitation*).

2.13 Site & Soil Disturbances

During construction of the EMA vegetation and topsoil will be disturbed, ensure EMA is vegetated via dense surface coverage prior to commissioning *(Moderate Limitation).*

2.14 Domestic Bore

WaterNSW Realtime data indicated one (1) domestic potable groundwater bores located within a 250m radius of the site. GW104265 was situated approximately 210m north-east of the site (up-gradient), and 250m north-east of the proposed EMA. The bore had a drill depth of 210mBGL and a standing water level of 43mBGL. A viral die-off calculation was undertaken for the site, which indicated a minimum up-gradient offsite of 38.10m from any groundwater drinking bore (Minor Limitation).

2.15 Rock Outcropping

Rock outcroppings >200mm in diameter were observed across much of site, these areas have been avoided for the purposes of effluent dispersal (*Moderate Limitation)*.

2.16 Geology / Regolith

No geological discontinuities, fractures, or highly porous regolith are expected within and surrounding the EMA (*Minor Limitation*).

2.17 Buffer Distances & Available Land Area

Minimum offset distances are designated by local approval authorities within their guiding documents to ensure the ongoing protection of community health, sensitive ecosystems, and the maintenance of community amenity. Where LGA guidance on a constraint is not available, appropriate offsets have been nominated in accordance with AS1547:2012 and Table 5 DLG (1998).

The site-specific constraints for the proposed EMA and land application method have been assessed as per Table 2.17.1.

Table 2.17.1 – Minimum buffer distances from sensitive site features

Site Feature	Minimum Setback		Proposed Setback: EMA Upslope/Downslope	Limitation
	If EMA is upslope of feature	If EMA is downslope / level with feature		
Dwellings (Subsurface Absorption)	6m	3m	6/3m	Minor
Property Boundaries (Subsurface Absorption)	12m	6m	>12/6m	Minor
Driveways	6m	3m	>6/3m	Minor
Buildings	6m	3m	>6/3m	Minor
Pools	6m		>6m	Minor
Inground Potable Rainwater Tanks	10m		10m	Minor
Watercourses	100m		>100m	Minor
Domestic Bore / Well	250m from high water level		>250m	Minor
Dam / Drainage Depression	40m from high water level		>40m	Minor

3 SOIL ASSESSMENT

3.1 Soil Assessment Summary

Investigation of the site for suitability for OSSM was accompanied by soil assessment within the proposed EMA. Soil sampling was conducted at the time of inspection. Soil characteristics were assessed per AS 1547:2012, AS 1289.3.8.1:2006, and NSW DLG (1998) methodologies. The summary of the soil investigation is presented in Table 3.1.1.

Table 3.1.1 – Assessment summary of site features

Factor Assessed	Description	Limitation
Depth to bedrock / hardpan	700 mm within proposed EMA, approximately +500mm of ENM/VENM (Sandy Loam) should be imported to ensure minimum depth is met per App C.	Moderate
Depth to high watertable	NIL free water or waterlogging characteristics	Minor
Coarse Fragments	< 10% across all upper strata	Minor
pH	>5.5 across all samples	Minor
Electrical Conductivity (EC)	< 4 dS/m across all samples.	Minor
Dispersiveness (EAT_m)	3+. Non-critical with respect to OSSM	Minor

3.2 Soil Landscape Map

1:100,000 Soil Landscape Mapping indicates the site occurs on the Lambert Soil Landscape. The Landscape features undulating to rolling rises and low hills on Hawkesbury Sandstone. Local relief 20–120 m, slopes to 20%, rock outcrop >50%. Broad ridges, gently to moderately inclined slopes, wide rock benches with low broken scarps, small hanging valleys and areas of poor drainage. Open and closed-heathland, scrub and occasional low eucalypt open-woodland.

Soils typically shallow (<50 cm) discontinuous Earthy Sands and Yellow Earths on crests and insides of benches; shallow (<20 cm) Siliceous Sands/Lithosols on leading edges; shallow to moderately deep (<150 cm) Leached Sands, Grey Earths and Gleyed Podzolic Soils in poorly drained areas; localised Yellow Podzolic Soils associated with shale lenses. Dominant Soil Materials include:

- A1 – olive brown to dark brown loamy sand to sandy loam
- A2 – Earthy, yellow-brown, light sandy clay loam

Site landscape assessment conformed to the Soil Landscape mapping.

3.3 Depth to Bedrock / Hardpan

Soil depth was ascertained via three bore holes within the potential EMA's identified. Borehole Samples were extracted via 50 mm Direct Push Tube, sample achieved 700+mm depth before encountering refusal within the proposed EMA. EMA extent is proposed for terracing and filling, which will result in a greater than 1200mm soil depth within the EMA Ensure fill materials consist of Sandy Loam ENM/VENM. (*Moderate Limitation)*.

3.4 Depth to High Watertable

Soil saturation was encountered across the site residual soil surface and within boreholes extended across the site, to mitigate stormwater on-flow, a up-slope diversion berm with sub-soil line should be installed as per Appendix A and Appendix D. *(Moderate Limitation).*

3.5 Soil Permeability Category

Soil permeability has been assigned per Table 5.2 of AS1547:2012 for the excavation site(s) most representative of the EMA location. The hydraulically limiting strata for the application system is bolded within Table 3.5.1 below.

Table 3.5.1: Soil permeability and Design Loading Rates

Excavation #		BH1		
Lower Depth (mm)	Field Texture	Structure	Indicative Permeability K_{sat} (m/day)	Design Loading Rate (DLR) (mm/day)
300	Sandy Loam	Weak	1.4 - 3.0	50*
700	**Sand**	**Massive**	**> 3.0**	**50***

Reduced DLR of **30mm/day** has been conservatively selected to allow for maximised wetted front across the pressure dosed beds on variable soil depth.

3.6 Soil Profiles

Table 3.6.1						
Excavation #	BH1	Sample size:	50	[mm]	Date Completed:	9/07/2025
Inspection Method:	50 mm Direct Push Tube				Water-table Encountered:	No

Layer Horizon	Lower Depth [mm]	Moisture	Colour	Field Texture	Structure	Coarse Fragment
1	300	Moist	Dark Brown	Sandy Loam	Weak	<5%
2	**700**	**Moist**	**Pale Brown**	**Sand**	**Massive**	**<5%**
Refusal:	Refusal encountered on underlying sandstone bedrock					
Photo:						

Table 3.6.2						
Excavation #	BH2	Sample size:	50	[mm]	Date Completed:	9/07/2025
Inspection Method:	50 mm Direct Push Tube				Water-table Encountered:	No

Layer Horizon	Lower Depth [mm]	Moisture	Colour	Field Texture	Structure	Coarse Fragment
1	400	Moist	Dark Brown	Sandy Loam	Weak	<5%
2	500	Slightly Moist	Red-Orange	Weathered Sandstone	Massive	<5%
Refusal:	Refusal encountered on underlying sandstone bedrock					
Photo:						

Table 3.6.3						
Excavation #	BH3	Sample size:	50	[mm]	Date Completed:	9/07/2025
Inspection Method:	50 mm Direct Push Tube				Water-table Encountered:	No

Layer Horizon	Lower Depth [mm]	Moisture	Colour	Field Texture	Structure	Coarse Fragment
1	300	Slightly Moist	Dark Brown	Sandy Loam	Weak	<5%
2	500	Moist	Grey-Brown	Sand	Massive	<5%
Refusal:	Refusal encountered on underlying sandstone bedrock					
Photo:						

3.7 Soil Chemistry

One sample from each horizon of the most descriptive excavation site was tested for acidity, Electrical Conductivity, and Dispersiveness (pH, EC, and EAT_m) by Broadcrest Environmental. The results were as follows:

Table 3.7.1: Soil Chemistry results

Excavation #		BH1			
Sample Depth (mm)	Test	Result	Description	Limitation	Recommendations
300	pH	6.19	Slightly Acidic	Minor	-
	EC (dS/cm)	0.14	Non-saline	Minor	-
	EAT_m	3+	Non-critical	Minor	-
700	pH	6.08	Slightly Acidic	Minor	-
	EC (dS/cm)	0.21	Non-saline	Minor	-
	EAT_m	3+	Non-critical	Minor	-

Tested soil parameters indicated no restrictive properties to OSSM within the sample location.

4 NOMINATED WASTEWATER MANAGEMENT

4.1 Proposed OSSM Summary

Site and soil constraints were evaluated in selection of appropriate treatment and effluent management method. A summary of the recommended OSSM system and application sizing is presented below:

Treatment	→	Effluent Management
AWTS + disinfection or equivalent	(Pumped Dosing)	50 m^2 Pressure Dosed Absorption Bed

4.2 Site Wastewater Loading

Table 4.2.1: Site Wastewater Loading

I.D	Equivalent Bedrooms [1]	Population per Bedroom [1]	Equivalent Population [Persons]	Wastewater Generation Rate per Capita [L/Person/Day]	Design Wastewater Loading [L/Day]
Five (5) Bedroom Dwelling	5	2	10	150	1500

[1] Note: Design occupancy estimates per LGA & Industry standard.

4.3 Wastewater Treatment

It is proposed to treat all wastewater generated within the Five (5) Bedroom Dwelling to a Secondary standard with disinfection via new Aerated Wastewater Treatment System (AWTS). The unit must be capable of sustainably treating the design wastewater loading to the secondary treatment targets (per DLG 1998) detailed in Table 4.3.1.

Justification of the proposed secondary treatment method is as follows:

- Accidental or deliberate discharges are less detrimental to the environment and have less potential to adversely impact on health
- Higher quality effluent produced
- High commercial availability
- Higher quality effluent produced reduces likelihood of bed clogging and facilitates and increased DLR

A list of accredited AWTS systems and suppliers is available on the NSW Health website:

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

Table 4.3.1: - Secondary Treatment Targets (per DLG 1998)

Biochemical Oxygen Demand (BOD^5)	Suspended Solids (TSS)	Total Nitrogen (TN)	Total Phosphorus (TP)	Faecal coliforms		Dissolved Oxygen (DO)
				Non-disinfected effluent	Disinfected effluent	
< 20 mg/L	< 30 mg/L	25 - 50 mg/L	10 - 15 mg/L	Up to 10^4 cfu/100 mL	< 30 cfu/100 mL	> 2 mg/L

4.4 Effluent Management

Given the development proposed and site and soil conditions encountered, it is proposed to dispose of effluent from the treatment system servicing the Five (5) Bedroom Dwelling via **Pressure Dosed Absorption Bed.**

Sizing of the **Raised Pressure Dosed Absorption Bed** was conducted per AS1547:2012 methodology below:

Area Required = Wastewater loading (Q) / Design Loading Rate (DLR)
= **1500** L/Day / 30 mm/Day
= 50m^2

The proposed **Raised Pressure Dosed Absorption Bed** should be positioned within the EMA nominated in Appendix A

It is proposed to provide the two (2) x 25.00m^2 Pressure Dosed Absorption Bed dimensioned **[L]:10.00m [W]:2.50m [D]:0.50m.** The Pressure Dosed Absorption Bed should be positioned within the EMA nominated in Appendix A.

Justification of the proposed treatment method is as follows:

- A pressure dosed absorption system ensures even effluent coverage over entire bed.
- An absorption area is available onsite meeting the minimum buffer distances.

4.5 Recommended Site Modifications

To address present site constraints, the following modifications are recommended:

- Install up-slope diversion berm, with sub-soil line, as per Appendix A and Appendix D.
- Imported ENM / VENM Sandy Loam (or similar soil permeability) should be used to meet minimum soil depth requirements during installation of Raised Pressure Dosed Beds, as per Appendix A. In this regard an additional +500mm is anticipated.
- Following the implementation of the EMA, the field is to be maintained with dense grass coverage and excluded from vehicle and livestock traffic.
- Provide reclaimed effluent warning signage around the perimeter of the EMA.

5 ADDITIONAL INFORMATION

5.1 Pipework Detail

All associated plumbing / drainage work is to be in accordance with AS 3500.2:2015 *Sanitary Plumbing Drainage*. Positioning of the receiving treatment system is to ensure drainage from internal plumbing fixtures achieves the minimum grade and cover of the excerpts below.

Table 6.1 – Excerpts of AS3500.2:2015

Nominal Pipe Diameter (DN)	Minimum Grade	
(mm)	(%)	(Ratio)
65	2.50	1:40
80	1.65	1:60
100	1.65*****	1:60*****
125	1.25	1:80
150	1.00	1:100

*Drains from treatment plants may be 1.00% Min.

	Minimum depth of cover (mm)	
Location	Cast iron & Ductile iron	Other materials
Subject to vehicular loading	300	500
All other locations	NIL	300

5.2 Licensing

Operating a system of sewage management is a Prescribed Activity under the Local Government Act 1993 and clause 45 of the Local Government (Approvals) Regulation 1999. This means that an 'Approval to Operate' a system of sewage management must be obtained from Council.

5.3 Detailed Design

A detailed system design may still be requested at the 'Application to Install' stage. This design will include the size and location of all system components including tanks, distribution lines, valves, etc. These additional requirements will be furnished by the nominated treatment system suppliers / licensed installers. Additional information for the property owner is available in Appendix C.

6 CONCLUSION

- It is proposed to construct a Five (5) Bedroom Dwelling at 7 Boronia Road, Ingleside NSW
- The anticipated wastewater loading rates generated by the Five (5) Bedroom Dwelling is calculated to be **1500 L/day.**
- It is proposed to treat all wastewater generated within the Five (5) Bedroom Dwelling to a Secondary standard with disinfection via new Aerated Wastewater Treatment System (AWTS). The unit must be capable of sustainably treating the design wastewater loading to the secondary treatment targets (per DLG 1998) detailed in Table 4.3.1.
- Application of the effluent is proposed via **50 m^2 Pressure Dosed Absorption Bed** within the area(s) nominated in Appendix A.
- Site modifications are provided in section 4.4 which must be followed.
- Install up-slope diversion berm, with sub-soil line, as per Appendix A and Appendix D.
- Imported ENM / VENM Sandy Loam (or similar soil permeability) should be used to meet minimum soil depth requirements during installation of Raised Pressure Dosed Beds, as per Appendix A. In this regard an additional +500mm is anticipated.
- The residences are to be fitted with standard-water reductive fixtures.

APPENDIX A: SITE PLAN

POOL BACK-FLUSH DISCHARGE TRENCH MINIMUM SIZING:
ASSUMING SAND/GLASS FILTER WITH A BACKFLUSH FLOWWRATE OF UP TO 300LPM FOR A 2 MIN DURATION
= 600 L TOTAL DISCHARGE.
GRAVEL TRENCH VOLUME REQUIRED AT 0.35 VOID RATIO
= 0.6m³/0.35 = 1.714m³.
PROPOSED TRENCH SIZE= L: 4.8m W: 0.6m D:0.6m = 1.714m³.

APPROX. 500mm OF ENM / VENM FILL MATERIALS TO MEET MINIMUM SOIL DEPTH REQUIREMENTS AS PER APPENDIX C

[PROPOSED EMA] 50m2
PRESSURE DOSED ABSORPTION BEDDING
1x [L]:10.000m [W]:2.500m [D]:0.500m BED
-ALTERNATE DOSING BETWEEN BEDS VIA AUTOMATIC SEQUENCING VALVE
-ENSURE MIN. 600mm DEPTH BELOW BED TO BEDROCK
-FILL BATTER TO FLUSH TO NATURAL LANDSCAPE (MIN 1:4 RATIO)

STORMWATER LEVEL SPREADER REQUIRING RELOCATION

UPSLOPE DIVERSION BERM, INSTALL AS PER APPENDIX D. INCLUDE SUB-SOIL LINE

AUTOMATIC SEQUENCING VALVE TO ENSURE EVEN EFFLUENT DISTRIBUTION BETWEEN SUB-FIELDS

EXISTING 10-EP AWTS SYSTEM SERVICING RESIDENCE (CONTINUED USE RECOMMENDED)

5.000
4.800
BH2
BH3
BH1
6.100
5.800
6.800
3.800
10.000
3.000
3.180
12.100
3.000
6.300
9.400
1.000
2.500
6.1% GRADE
PROPOSED RESIDENCE
DWELLING WITH SWIMMING POOL
BANK
PEG RD

KEY

- SITE BOUNDARY
- NEIGHBOURING LOT BOUNDARIES
- WATERWAYS / FLOWPATH
- BH1 BORE HOLE LOCATION 1
- SURFACE FLOW DIRECTION
- BUILDING (PROPOSED)
- BUILDING (EXISTING)
- EFFLUENT MANAGEMENT AREA (EMA)
- RAISED BED ENM/ VENM FILL EXTENT
- BURIED DISTRIBUTION LINE TO EMA
- UP-SLOPE DIVERSION BERM

CONTOUR INTERVALS AT 1M UNLESS NOTED OTHERWISE.
SCALE: 1:300 @A3
0 5 10 30
METRES

WASTEWATER – GENERAL NOTES

1. UNDERLYING CONTOURS DERIVED FROM NSW GOV. 1m LiDAR DATA – THIS PLAN IS NOT A SURVEY.
2. UNDERLYING SATELLITE IMAGERY DERIVED FROM NEARMAP.
3. WATERWAYS (NAMED & UNNAMED) AND DRAINAGE ELEMENTS DERIVED FROM NSW GOV. HYDROGRAPY, SATELLITE IMAGERY AND STRAHLER ANALYSIS.

ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
A-01	17/07/25	MK	MK	CH	ISSUE FOR RELEASE

BROADCREST
ENGINEERING AND ENVIRONMENTAL CONSULTANTS
broadcrest.com.au | contact@broadcrest.com.au | 1300 554 945
ENVIRONMENTAL FLOOD STORMWATER ACOUSTICS WASTEWATER
BROADCREST ENVIRONMENTAL PTY LTD | ABN 11 677 727 749

PROJECT DESCRIPTION: PROPOSED RESIDENCE AND POOL	SHEET: APPENDIX A - SITE LAYOUT PLAN
PROJECT SITE: 7 BORONIA ROAD, INGLESIDE NSW	PLAN: ON-SITE WASTEWATER MANAGEMENT PLAN
LGA: NORTHERN BEACHES COUNCIL	CLIENT: M & M GREEN C/- INHAUS DESIGNS

PROJECT ID: 4640-WW
SCALE: 1:300 @ A3 - @ A1
SHEET NO.: 1 OF 1

APPENDIX B: CLIMATE DATA

B1. - Climate Statistics

Table B1.1. Weather Stations

Statistic	Station No.	Station Name	Distance from site [km]
Temperature	66059	TERREY HILLS AWS	4.74
Precipitation	66183	INGLESIDE (ANIMAL WELFARE LEAGUE NSW	0.69
Evaporation	66131	RIVERVIEW OBSERVATORY	19.84

Figure B.1 - Monthly Cimate Statistics

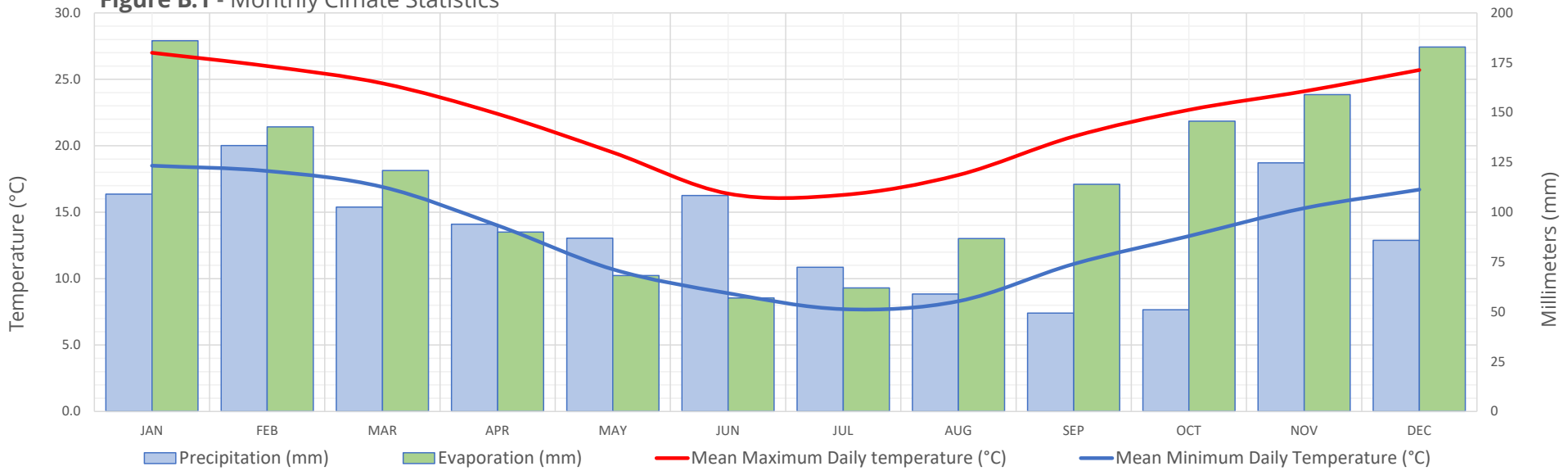


Table B1.2. Site Climate Statistics

Site Factors	Symbol	Units	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Mean Max. Temperature	[T]	[°C]	27.0	26.0	24.7	22.4	19.5	16.4	16.3	17.8	20.7	22.7	24.1	25.7	22.0
Mean Min. Temperature	[T]	[°C]	18.5	18.1	16.9	14.0	10.7	8.9	7.7	8.3	11.1	13.2	15.3	16.7	13.3
Days	[D]		31	28	31	30	31	30	31	31	30	31	30	31	365
Precipitation[1]	[P]	[mm/month]	109.1	133.4	102.6	94	87	108.4	72.4	58.9	49.4	51	124.8	85.9	1336.8
Evaporation	[E]	[mm/day]	6	5.1	3.9	3	2.2	1.9	2	2.8	3.8	4.7	5.3	5.9	3.9
		[mm/month]	186	142.8	120.9	90	68.2	57	62	86.8	114	145.7	159	182.9	1423.5
Natural Site Balance[2]	[P-E]	[mm/month]	-76.9	-9.4	-18.3	4	18.8	51.4	10.4	-27.9	-64.6	-94.7	-34.2	-97	

[1] Median historic precipitation. Note: total is not equivalent to annual median.

[2] Negative value indicates monthly mean evaporation > precipitation

APPENDIX C: INFORMATION FOR THE PROPERTY OWNER

ON-SITE SEWAGE MANAGEMENT SYSTEMS

If you live in or rent a house that is not connected to the main sewer then chances are that your yard contains an on-site sewage management system. If this is the case then you have a special responsibility to ensure that it is working as well as it can.

The aim of this pamphlet is to introduce you to some of the most popular types of on-site sewage management systems and provide some general information to help you maintain your system effectively. You should find out what type of system you have and how it works.

More information can be obtained from the pamphlets:

Your Septic System
Your Aerated Wastewater Treatment System
Your Composting Toilet
Your Land Application Area

You can get a copy of these pamphlets from your local council or the address marked on the back of this pamphlet.

It is important to keep in mind that maintenance needs to be performed properly and regularly. Poorly maintained on-site sewage management systems can significantly affect you and your family's health as well as the local environment.

What is an on-site sewage management system?

A domestic on-site sewage management system is made up of various components which - if properly designed, installed and maintained - allow the treatment and utilisation of wastewater from a house, completely within the boundary of the property.

Wastewater may be blackwater (toilet waste), or greywater (water from showers, sinks, and washing machines), or a combination of both.

Partial on-site systems - eg. pump out and common effluent systems (CES) - also exist. These usually involve the preliminary on-site treatment of wastewater in a septic tank, followed by collection and transport of the treated wastewater to an off-site management facility. Pump out systems use road tankers to transport the effluent, and CES use a network of small diameter pipes.

How does an on-site sewage management system work?

For complete on-site systems there are two main processes:

1. treatment of wastewater to a certain standard
2. its application to a dedicated area of land.

The type of application permitted depends on the quality of treatment, although you should try to avoid contact with all treated and untreated wastewater, and thoroughly wash affected areas if contact does occur.

Treatment and application can be carried out using various methods:

Septic Tank
Septic tanks treat both greywater and blackwater, but they provide only limited treatment through the settling of solids and the flotation of fats and greases. Bacteria in the tank break down the solids over a period of time. Wastewater that has been treated in a septic tank can only be applied to land through a covered soil absorption system, as the effluent is still too contaminated for above ground or near surface irrigation.

AWTS
Aerated wastewater treatment systems (AWTS) treat all household wastewater and have several treatment compartments. The first is like a septic tank, but in the second compartment air is mixed with the wastewater to assist bacteria to break down solids. A third compartment allows settling of more solids and a final chlorination contact chamber allows disinfection. Some AWTS are constructed with all the compartments inside a single tank. The effluent produced may be surface or sub-surface irrigated in a dedicated area.

Composting Toilets
Composting toilets collect and treat toilet waste only. Water from the shower, sinks and the washing machine needs to be treated separately (for example in a septic tank or AWTS as above). The compost produced by a composting toilet has special requirements but is usually buried on-site.

These are just some of the treatment and application methods available, and there are many other types such as sand filter beds, wetlands, and amended earth mounds. Your local council or the NSW Department of Health have more information on these systems if you need it.

Regulations and recommendations

The NSW Department of Health determines the design and structural requirements for treatment systems for single households. Local councils are primarily responsible for approving the installation of smaller domestic septic tank systems, composting toilets and AWTSs in their area, and are also responsible for approving land application areas. The NSW Environment Protection Authority approves larger systems.

The design and installation of on-site sewage management systems, including plumbing and drainage, should only be carried out by suitably qualified or experienced people. Care is needed to ensure correct sizing of the treatment system and application area.

Heavy fines may be imposed under the Clean Waters Act if wastewater is not managed properly.

Keeping your on-site sewage management system operating well

What you put down your drains and toilets has a lot to do with how well your system performs. Maintenance of your sewage management system also needs to be done well and on-time. The following is a guide to the types of things you should and should not do with your system.

DO

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

DON'T

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

Reducing water usage

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

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

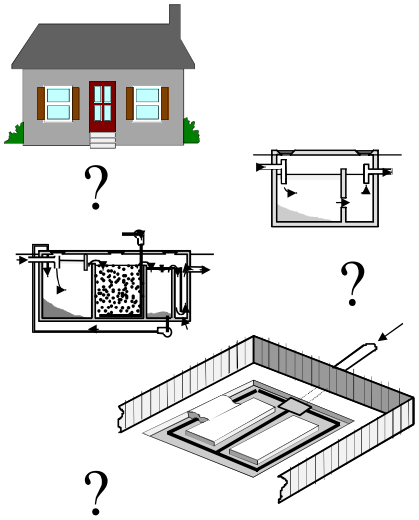
HELP PROTECT YOUR HEALTH AND THE ENVIRONMENT

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

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

For more information please contact:

Managing Wastewater In Your Backyard



Aerated Wastewater Treatment Systems (AWTS)

In unsewered areas, the proper treatment and utilisation of household wastewater on-site is critical in preserving the health of the public and the environment. AWTS have been developed as a way of achieving this.

What is an AWTS?

An AWTS is a purpose built system used for the treatment of sewage and liquid wastes from a single household or multiple dwellings.

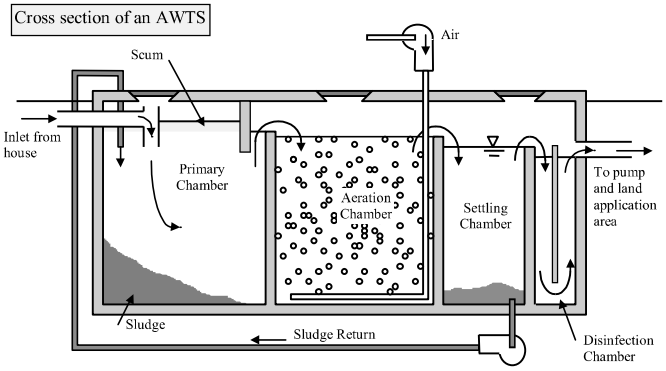
It consists of a series of treatment chambers combined with an irrigation system. An AWTS enables people living in unsewered areas to treat and utilise their wastewater.

How does an AWTS work?

Wastewater from a household is treated in stages in several separate chambers. The first chamber is similar to a conventional septic tank. The wastewater enters the chamber where the solids settle to the bottom and are retained in the tank forming a sludge layer. Scum collects at the top, and the partially clarified wastewater flows into a second chamber. Here the wastewater is mixed with air to assist bacteria to further treat it. A third chamber allows additional clarification through the settling of solids, which are returned for further treatment to either the septic chamber (as shown) or to the aeration chamber. The clarified effluent is disinfected in another chamber (usually by chlorination) before irrigation can take place.

Bacteria in the first chamber break down the solid matter in the sludge and scum layers. Material that cannot be fully broken down gradually builds up in the chamber and must be pumped out periodically.

Cross section of an AWTS



Regulations and recommendations

Local councils are primarily responsible for approving the smaller, domestic AWTSs in their area. The Environment Protection Authority (EPA) approves larger units, whilst the NSW Department of Health determines the design and structural requirements for all AWTSs.

At present AWTSs need to be serviced quarterly by an approved contractor at a cost to the owner. Local councils should also maintain a register of the servicing of each system within their area.

AWTSs should be fitted with an alarm having visual and audible components to indicate mechanical and electrical equipment malfunctions. The alarm should provide a signal adjacent to the alarm and at a relevant position inside the house. The alarm should incorporate a warning lamp which may only be reset by the service agent.

Maintaining your AWTS

The effectiveness of the system will, in part, depend on how it is used and maintained. The following is a guide on good maintenance procedures that you should follow:

DO

- ✓ Have your AWTS inspected and serviced four times per year by an approved contractor. Assessment should be applicable to the system design.
- ✓ Have your system service include assessment of sludge and scum levels in all tanks, and performance of irrigation areas.
- ✓ Have all your tanks desludged at least every three years.
- ✓ Have your disinfection chamber inspected and tested quarterly to ensure correct disinfectant levels.
- ✓ Have your grease trap (if installed) cleaned out at least every two months.
- ✓ Keep a record of pumping, inspections, and other maintenance.
- ✓ Learn the location and layout of your AWTS and land application area.
- ✓ Use biodegradable liquid detergents such as concentrates with low sodium and phosphorous levels.
- ✓ Conserve water.

DON'T

- ✗ Don't put bleaches, disinfectants, whiteners, nappy soakers and spot removers in large quantities into your AWTS via the sink, washing machine or toilet.
- ✗ Don't allow any foreign materials such as nappies, sanitary napkins, condoms and other hygiene products to enter the system.
- ✗ Don't use more than the recommended amounts of detergents.
- ✗ Don't put fats and oils down the drain and keep food waste out of your system.
- ✗ Don't switch off power to the AWTS, even if you are going on holidays

Reducing water usage

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

Conservative water use around the house will reduce the amount of wastewater which is produced and needs to be treated.

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

Warning signs

You can look out for a few warning signs that signal to you that there are troubles with your AWTS. Ensure that these problems are attended to immediately to protect your health and the environment.

Look out for the following warning signs:

- Water that drains too slowly.
- Drain pipes that gurgle or make noises when air bubbles are forced back through the system.
- Sewage smells, this indicates a serious problem.
- Water backing up into your sink which may indicate that your system is already failing.
- Wastewater pooling over the land application area.
- Black coloured effluent in the aerated tank.
- Excess noise from the blower or pumping equipment
- Poor vegetation growth in irrigated area.

Odour problems from a vent on the AWTS can be a result of slow or inadequate breakdown of solids. Call a technician to service the system.

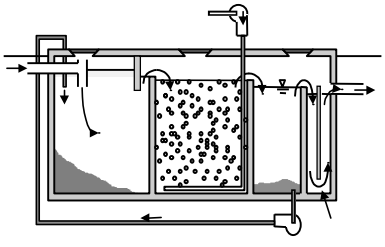
HELP PROTECT YOUR HEALTH AND THE ENVIRONMENT

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

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

If you would like more information please contact:

Your Aerated Wastewater Treatment System



LAND APPLICATION AREAS

The reuse of domestic wastewater on-site can be an economical and environmentally sound use of resources.

What are land application areas?

These are areas that allow treated domestic wastewater to be managed entirely on-site.

The area must be able to utilise the wastewater and treat any organic matter and wastes it may contain. The wastewater is rich in nutrients, and can provide excellent nourishment for flower gardens, lawns, certain shrubs and trees. The vegetation should be suitably tolerant of high water and nutrient loads.

How does a land application area work?

Treated wastewater applied to a land application area may be utilised or simply disposed, depending on the type of application system that is used. The application of the wastewater can be through a soil absorption system (based on disposal) or through an irrigation system (based on utilisation).

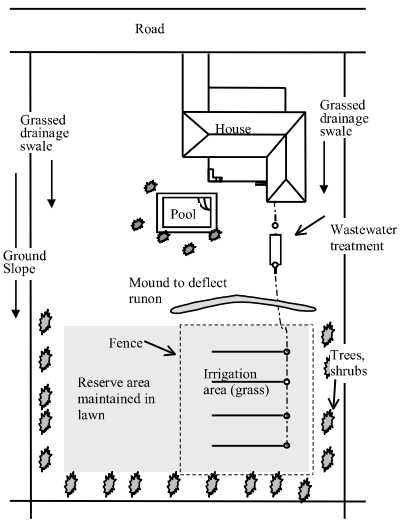
Soil absorption systems do not require highly treated effluent, and wastewater treated by a septic tank is reasonable as the solids content in the effluent has been reduced. Absorption systems release the effluent into the soil at a depth that cannot be reached by the roots of most small shrubs and grasses. They rely mainly on the processes of soil treatment and then transmission to the water table, with minimal evaporation and up-take by plants. **These systems are not recommended in sensitive areas as they may lead to contamination of surface water and groundwater.**

Irrigation systems may be classed as either subsurface or surface irrigation. If an irrigation system is to be used, wastewater needs to be pre-treated to at least the quality produced by an aerated wastewater treatment system (AWTS).

Subsurface irrigation requires highly treated effluent that is introduced into the soil close to the surface. The effluent is utilised mainly by plants and evaporation.

Surface irrigation requires highly treated effluent that has undergone aeration and disinfection treatments, so as to reduce the possibility of bacteria and virus contamination.

Typical Site Layout (not to scale)



The effluent is then applied to the land area through a series of drip, trickle, or spray points which are designed to eliminate airborne drift and run-off into neighbouring properties.

There are some public health and environmental concerns about surface irrigation. There is the risk of contact with treated effluent and the potential for surface run-off. Given these problems, subsurface irrigation is arguably the safest, most efficient and effective method of effluent utilisation.

Regulations and recommendations

The design and installation of land application areas should only be carried out by suitably qualified or experienced people, and only after a site and soil evaluation is done by a soil scientist. Care should be taken to ensure correct buffer distances are left between the application area and bores, waterways, buildings, and neighbouring properties.

Heavy fines may be imposed under the Clean Waters Act if effluent is managed improperly.

At least two warning signs should be installed along the boundary of a land application area. The signs should comprise of 20mm high Series C lettering in black or white on a green background with the words:

RECLAIMED EFFLUENT
NOT FOR DRINKING
AVOID CONTACT

Depending on the requirements of your local council, wet weather storage and soil moisture sensors may need to be installed to ensure that effluent is only irrigated when the soil is not saturated.

Regular checks should be undertaken of any mechanical equipment to ensure that it is operating correctly. Local councils may require periodic analysis of soil or groundwater characteristics

Humans and animals should be excluded from land application areas during and immediately after the application of treated wastewater. The longer the period of exclusion from an area, the lower the risk to public health.

The householder is required to enter into a service contract with the installation company, its agent or the manufacturer of their sewage management system, this will ensure that the system operates efficiently.

Location of the application area

Treated wastewater has the potential to have negative impacts on public health and the environment. For this reason the application area must be located in accordance with the results of a site evaluation, and approved landscaping must be completed prior to occupation of the building. Sandy soil and clayey soils may present special problems.

The system must allow even distribution of treated wastewater over the land application area.

Maintaining your land application area

The effectiveness of the application area is governed by the activities of the owner.

DO

- ✓ Construct and maintain diversion drains around the top side of the application area to divert surface water.
- ✓ Ensure that your application area is kept level by filling any depressions with good quality top soil (not clay).
- ✓ Keep the grass regularly mowed and plant small trees around the perimeter to aid absorption and transpiration of the effluent.
- ✓ Ensure that any run off from the roof, driveway and other impermeable surfaces is directed away from the application area.
- ✓ Fence irrigation areas.
- ✓ Ensure appropriate warning signs are visible at all times in the vicinity of a spray irrigation area.
- ✓ Have your irrigation system checked by the service agent when they are carrying out service on the treatment system.

DON'T

- × Don't erect any structures, construct paths, graze animals or drive over the land application area.
- × Don't plant large trees that shade the land application area, as the area needs sunlight to aid in the evaporation and transpiration of the effluent.
- × Don't plant trees or shrubs near or on house drains.
- × Don't alter stormwater lines to discharge into or near the land application area.
- × Don't flood the land application area through the use of hoses or sprinklers.
- × Don't let children or pets play on land application areas.
- × Don't water fruit and vegetables with the effluent.
- × Don't extract untreated groundwater for potable use.

Warning signs

Regular visual checking of the system will ensure that problems are located and fixed early.

The visual signs of system failure include:

- surface ponding and run-off of treated wastewater
- soil quality deterioration
- poor vegetation growth
- unusual odours

Volume of water

Land application areas and systems for on-site application are designed and constructed in anticipation of the volume of waste to be discharged. Uncontrolled use of water may lead to poorly treated effluent being released from the system.

If the land application area is waterlogged and soggy the following are possible reasons:

- ∧ Overloading the treatment system with wastewater.
- ∧ The clogging of the trench with solids not trapped by the septic tank. The tank may require desludging.
- ∧ The application area has been poorly designed.
- ∧ Stormwater is running onto the area.

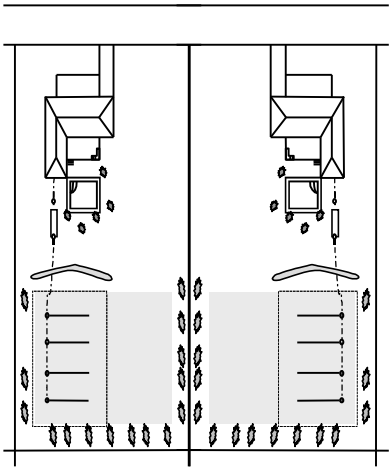
HELP PROTECT YOUR HEALTH AND THE ENVIRONMENT

Poorly maintained land application areas are a serious source of water pollution and may present health risks, cause odours and attract vermin and insects.

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

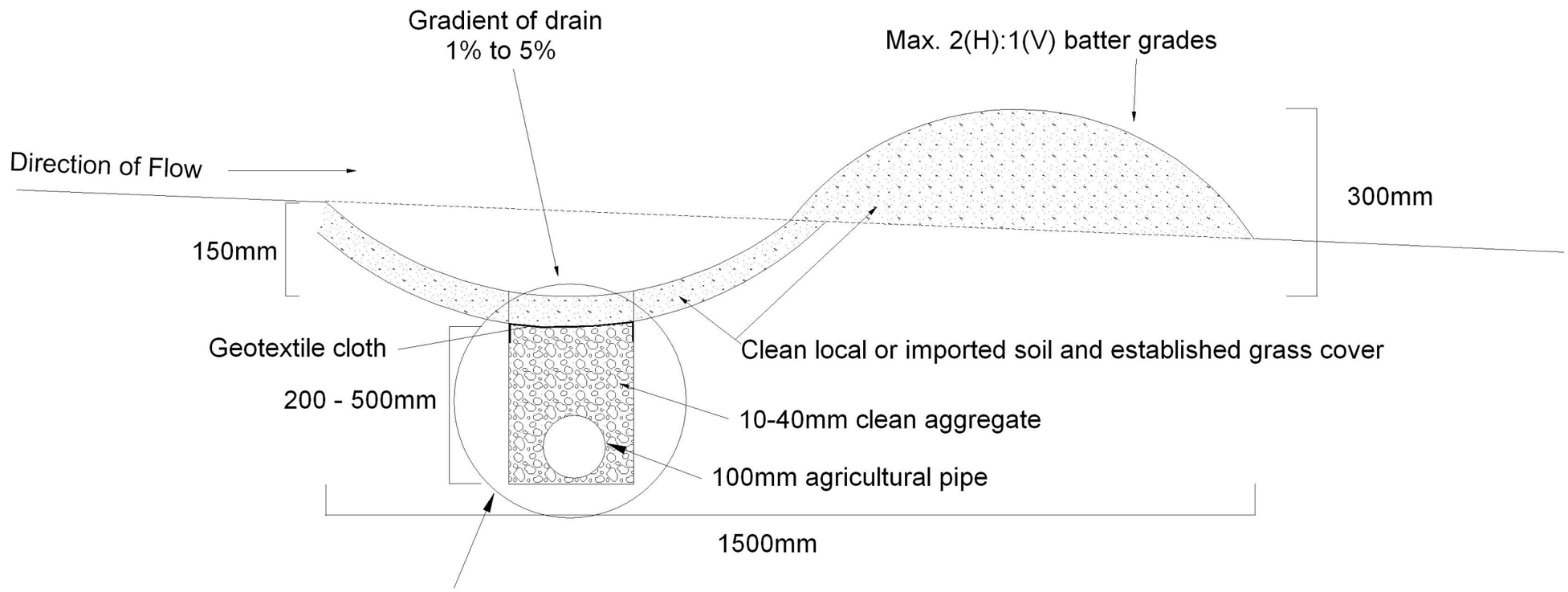
For more information please contact:

Your Land Application Area



APPENDIX D: WATERNSW SD-A8 UPSLOPE DIVERSION DRAIN

Cross Section: Upslope Diversion Drain



Standard Drawing 8A – Upslope Diversion Drain

(not to scale)

APPENDIX E: VIRAL DIE-OFF CALCULATION

Viral Die-Off Calculation - Groundwater Setback, Drawdown & Seepage Distance

(Cromer, Gardner & Beavers, 2001)

Climate Data - 68239 Moss Vale AWS

Maximum Mean Annual Temperature for Coldest Month (˚C): 16.3

1. Calculated Time For Viral Die-off:

$$\frac{M_t}{M_o} = e^{-kt} \quad ; \quad \text{And where T > 8.5˚C :} \quad k = \frac{T - 8.5}{20}$$

Ratio of Viral Concerntration (M_t/M_o)

Greywater	1.00E-05
Primary	1.00E-07
Secondary	1.00E-03

Time for Viral Die-Off Calculator

Parameter	Value	Unit	Parameter Discriptor
$Treat_{LVL}$	Secondary		Effluent Treatment Level
$T_{m.m}$	16.3	[˚C]	Groundwater Temp. (≈Max. Mean. Air Temp.)
k (Max)	0.39		First Order rate of Viral Die-off Coefficient
M_t/M_o	0.001		Dimsionless ratio of viral concentrations

t (max)	17.7	[days]	Travel Time required to acheive 3 orders of magnitude of Viral concentration reduction

2. Calculate the Horizontal Distance for Viral Die-off (dg) and the Radius of influence of the bore due to drawdown:

Horizontal Setback Distance (dg) to achieve Viral die-off

$$d_g = \frac{t - d_v \cdot \frac{P}{K}}{\frac{P}{K.i}}$$

Parameter	Value	Unit	Parameter Discriptor
t (max.)	17.7	[days]	Travel Time
d_v	43	[m]	Vertical Distance (to water table)
P	0.2		Effective Porosity (Worst Case)
K(above limiting layer)	4	[m/day]	Saturated Hydraulic Conductivity (permeability)
K(subsoil)	4	[m/day]	Saturated Hydraulic Conductivity (permeability)
i	0.08	[m/m]	Gradient of Groundwater table

$d_{g(surface)}$	**24.80**	**[m]**	Horizontal Distance to achieve Viral die-off within the upper & subsoil strata respectively
$d_{g(bore)}$	24.80	[m]	

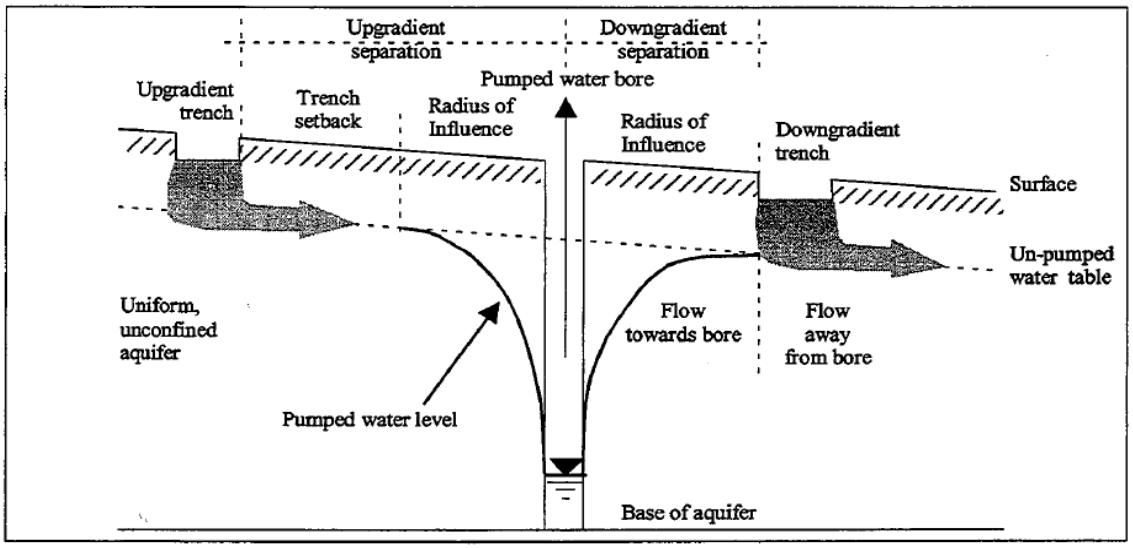
Radius of Influence (r) of the bore due to drawdown

$$r = 1.5\sqrt{(\frac{kHt}{S})}$$

Parameter	Value	Unit	Parameter Discriptor
K	3	[m/day]	Saturated Hydraulic Conductivity (permeability)
t	1	[days]	Pump Duration
S	0.2		Specific yeild = Effective Proposity (Assumed)
H	43	[m]	Height to water column

r	38.10	[m]	Estimated Radius of influence

3. Select the appropriate separation distance (EMA upgradient or Downgradient)



Cromer et al.2001 - An Improved Viral Die off Method for Estimating Setback Distances, Figure 4.

a) Minimum Upgradient Separation Distance to Bore

$d_{g(bore)+ r}$	**62.9**	[m]

b) Minimum Downgradient Separation Distance to Bore or

r	**38.1**	[m]

c) Minimum Upgradient Separation Distance to Surface Water where limiting layer present

$d_{g(surface)}$	**24.8**	[m]