Broadcrest Consulting Pty Ltd

2 Bloodwood Road, Ingleside NSW

On-Site Wastewater Report

November 2024

REF: 2567-WW-A-03

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DOCUMENT CONTROL

Approval and Authorisation

Title	2 Bloodwood Road, Ingleside NSW On-Site Wastewater Report
Authored on behalf of Broadcrest Consulting Pty Ltd by:	Kyle Ryan Engineer | Environmental & Civil
Signed:	
Dated:	25/11/2024

Document Status

Date	Internal Reference	Document Status	Prepared by	Reviewed by
2/02/2023	2567-WW-A-01	For Release	K. Ryan	K. Ferry
22/03/2023	2567-WW-A-02	Raised Subsurface	K. Ryan	K. Ferry
25/11/2024	2567-WW-A-03	Proposed Storage Shed	K. Ryan	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 Mark Willcocks to produce an On-Site Wastewater Management Report at 2 Bloodwood Road, Ingleside NSW (the site). The report will accompany plans to construct a Storage Shed with toilet and hand basin.. A site inspection was carried out on 16 January 2023 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	2 Bloodwood Road, Ingleside NSW
Lot Area:	2.08 Ha
Zoning:	RU2 Rural Landscape
Council / LGA:	Northern Beaches
Intended Water Supply:	Tank Water
Inspection Officer:	K. Ryan - 16/01/2023

2.2 General

At the time of inspection, the site was largely bushland. A portion of the being used as a parking area for vehicles and equipment. The landform of the proposed development is a gently inclined waning slope with a steep rise immediately upslope. To the south of the proposed development the landform is convergent.

The proposed development is to construct a storage shed with a toilet and hand basin.

Rock outcropping was observed at various locations and sandstone hardpan was exposed by the western boundary. Limited soil depth is a primary site limitation; therefore, a location has been chosen where soil depth was found to be maximal and vegetation density was sparse, suitable for establishment of a lawn. This area has been chosen to house a small raised Subsurface Irrigation field with minimal additional soils required to raise the EMA

Figure 2-1: South facing photographs over Approximate Proposed EMA Location

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 typically exceeds rainfall for all months of the year excluding an exceedance during June.	Moderate
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	Moderately Inclined : 15%	Minor
Landform	Linear planar	Minor
Run-on and Seepage	Raised EMA sensitive to excess hydraulic loading	Moderate
Site-drainage	No signs of soil saturation or ponding observed	Minor
Erosion Potential	Proposed raised EMA sensitive to wind/water erosion.	Moderate
Site and Soil Disturbances	During construction of the EMA vegetation and topsoil will be disturbed	Moderate
Groundwater Bores	Domestic groundwater bores have been identified within 100 m of the proposed EMA.	Moderate
Rock Outcropping	Rock outcropping observed within proximity to the proposed EMA	Moderate
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

2 Bloodwood Road, Ingleside NSW has a temperate climate, with Cool dry winters, with a hot wetter summer. Median annual rainfall is 1336.8 mm and evaporation 1432.5 mm. Monthly evaporation typically exceeds rainfall for all months of the year excluding an exceedance during June (Appendix B1) (*Moderate Limitation)*.

An upslope diversion bund is proposed to reduce run on causing excessive hydraulic loading to the EMA during the wetter months. The proposed system has been sized with the inclusion of water balance calculations to account for months where rainfall exceeds evaporation (See Appendix B2). The soils are highly permeable, water balance is not a limiting factor.

Average maximum and minimum temperatures range from 27.0 °C to 7.7 °C in January to July 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 (*Moderate Limitation*).

Landform Feature	Aspect	Solar Exposure	Wind Exposure	Limitation
A	West	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 15% (*Minor Limitation).*

Landform Feature	Approximate Slope Tangent (%)	Slope Classification	Disposal System	Limitation
A	15%	Moderately Inclined	Sub-surface Irrigation	Minor

Table 2.8.1 - 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	Minor
> 20	Steeply Inclined	Major	Major	Major	Moderate	Moderate

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.

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.

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

It is proposed to limit the potential hydraulic loading to the EMA via construction of a diversion bund (per Appendix E).

Seepage is a concern where the flow of effluent in the soil beneath the toe of the mound is primarily horizontal, that is, a limiting layer is present, the linear (toe) loading rate shall not exceed 50 L/m/day, (AS/NZS 1547:2012 CN2.2) the proposed linear loading rate is 7 L/m/day.

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.

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

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

2.13 Site & Soil Disturbances

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

2.14 Domestic Bore

WaterNSW Realtime data indicated Groundwater bores within proximity of the EMA, with the nearest domestic bore is located at approximately 60 meters from the EMA with a Standing Water Level recorded at 15.5 meters depth (Moderate Limitation).

A Viral die-off assessment was produced to approximate the travel distance required for effective viral die-off to occur within the effluent. Consideration is given to standing water level, topography, soil conditions & proposed effluent quality (See Appendix E), a Safety adjusted Horizontal Setback Distance of 50m is recommended *(Moderate Limitation).*

2.15 Rock Outcropping

Exposed rock was identified within the vicinity to the EMA suggesting variable soil depth, it is proposed to construct a raised land application area to ensure adequate basal clearance to bedrock is achieved (*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	6m	3m	6/3m	Minor
Property Boundaries	12m	6m	6/3m	Minor
Driveways	6m	3m	>6/3m	Minor
Buildings	6m	3m	>6/3m	Minor
Pools	6m		>6m	Minor
Inground Potable Rainwater Tanks	4-15m		>15m	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 with the soil characteristics 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	450 mm within the EMA.	Moderate
Depth to high water table	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 Erosional Soil Landscape. The Landscape features –undulating to rolling rises and low hills on Hawkesbury Sandstone. Local relief 20–120 m, slopes 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 hallow (<50 cm) discontinuous Earthy Sands and Yellow Earths on crests and insides of benches; shallow (<20 cm) Siliceous Sands/Lithosols (Uc1.2) 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

- A1 – Loose, stony, yellowish-brown 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 seven bore holes within the potential EMA's identified. Borehole Samples were extracted via 100 mm Electric Auger, samples achieved approximately 450mm depth within the EMA. (*Moderate Limitation)*.

Shallow soil depth restricts the application of effluent in the proposed EMA; therefore, a raised land application area is proposed to overcome this limitation (See Section 4.4) (Moderate limitation).

3.4 Depth to High Watertable

No visible free water, soil saturation, grey mottling or similar was encountered within the sampling depth *(Minor 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 Irrigation Rates

Excavation #		BH6		
Lower Depth (mm)	Field Texture	Structure	Indicative Permeability K_{sat} (m/day)	Design Irrigation Rate (DIR) (mm/day)
0-(+)200	Loam Fill	Moderate	1.5 - 3.0	**4.0**
0-450	Sandy Loam	Massive	1.4 - 3.0	5.0

3.6 Soil Profiles

Table 3.6.1						
Excavation #	BH1-2	Sample size:	100	[mm]	Date Completed:	16/01/2023
Inspection Method:	100 mm Electric Auger				Water-table Encountered:	No

Layer Horizon	Lower Depth [mm]	Moisture	Colour	Field Texture	Structure	Coarse Fragment
1	100	Dry	Sand	Sand	Massive	<5%
Refusal:	Refusal encountered on underlying sandstone bedrock					
Photo:						

Table 3.6.2						
Excavation #	BH3	Sample size:	100	[mm]	Date Completed:	16/01/2023
Inspection Method:	100 mm Electric Auger				Water-table Encountered:	No

Layer Horizon	Lower Depth [mm]	Moisture	Colour	Field Texture	Structure	Coarse Fragment
1	610	Dry	Yellow Brown	Sandy Loam	Massive	<5%
Refusal:	Refusal encountered on underlying sandstone bedrock					
Photo:	1 meter Auger Bit. 390mm exposed – 610mm embedded					

Table 3.6.3						
Excavation #	BH4	Sample size:	100	[mm]	Date Completed:	16/01/2023
Inspection Method:	100 mm Electric Auger				Water-table Encountered:	No

Layer Horizon	Lower Depth [mm]	Moisture	Colour	Field Texture	Structure	Coarse Fragment
1	620	Dry	Yellow Brown	Sandy Loam	Massive	<5%
Refusal:	Refusal encountered on underlying sandstone bedrock					
Photo:	1 meter Auger Bit. 380mm exposed – 620mm embedded					

Table 3.6.4						
Excavation #	BH5	Sample size:	100	[mm]	Date Completed:	16/01/2023
Inspection Method:	100 mm Electric Auger				Water-table Encountered:	No

Layer Horizon	Lower Depth [mm]	Moisture	Colour	Field Texture	Structure	Coarse Fragment
1	750	Dry	Yellow Brown	Sandy Loam	Massive	<5%
Refusal:	Refusal encountered on underlying sandstone bedrock					
Photo:	1 meter Auger Bit. 250mm exposed – 750mm embedded					

Table 3.6.5						
Excavation #	BH6	Sample size:	100	[mm]	Date Completed:	16/01/2023
Inspection Method:	100 mm Electric Auger				Water-table Encountered:	No

Layer Horizon	Lower Depth [mm]	Moisture	Colour	Field Texture	Structure	Coarse Fragment
1	450	Dry	Yellow Brown	Sandy Loam	Massive	<5%
Refusal:	Refusal encountered on underlying sandstone bedrock					
Photo:	1 meter Auger Bit. 550mm exposed – 450mm embedded					

Table 3.6.6						
Excavation #	BH7	Sample size:	100	[mm]	Date Completed:	16/01/2023
Inspection Method:	100 mm Electric Auger				Water-table Encountered:	No

Layer Horizon	Lower Depth [mm]	Moisture	Colour	Field Texture	Structure	Coarse Fragment
1	450	Dry	Yellow Brown	Sandy Loam	Massive	<5%
Refusal:	Refusal encountered on underlying sandstone bedrock					
Photo:	1 meter Auger Bit. 5500mm exposed – 450mm embedded					

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 Consulting. The results were as follows:

Table 3.7.1: Soil Chemistry results

Excavation #		BH1			
Sample Depth (mm)	Test	Result	Description	Limitation	Recommendations
250	pH	6.01	Slightly Acidic	Minor	-
	EC (dS/cm)	0.53	Non-saline	Minor	-
	EAT_m	3+	Non-critical	Minor	-
600	pH	5.88	Moderately Acidic	Minor	-
	EC (dS/cm)	0.37	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:

PROPOSED OSSM SYSTEMS:

Treatment	→	Effluent Management
AWTS + disinfection or equivalent	(Pumped Dosing)	156 m^2 Subsurface Drip Irrigation 79m^2 Application Area + 77m^2 Nutrient Uptake Area

SITE WASTEWATER LOADING:

I.D	Equivalent Population [Persons]	Water Supply	Wastewater Generation Rate per Capita [L/Person/Day]	Design Wastewater Loading [L/Day]
Storage Shed with toilet and hand basin.	3	Tank Water	29 [2]	87 **(150)** [1]

[1]: Facility is designed for up to 3 staff, a conservative nominal minimum allowance of 150L/day has been allocated.
[1]: NSW Health Septic Tank and Collection Well Guidelines. Part 4 (2001). Factories and Offices (WC, urinal, basin & kitchen only)

4.2 Wastewater Treatment

It is proposed to treat all wastewater generated within the shed to a Secondary standard with disinfection and Advanced Nutrient Reduction via new NSW Health accredited Aerated Wastewater Treatment System (AWTS) or equivalent. The unit must be capable of Advanced Nutrient reduction and must be able to sustainably treat the design wastewater loading to the secondary treatment targets (per DLG 1998) detailed in Table 4.2.1.

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

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 4.2.1: - 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	**<3.5 mg/L***	Up to 10^4 cfu/100 mL	< 30 cfu/100 mL	> 2 mg/L

* Tank must have a certificate showing a phosphorus level of no more than 3.5mg/L post effluent treatment.

4.3 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 Storage Shed with toilet and hand basin. via **Subsurface Drip Irrigation.**

Sizing of the application method was undertaken via water & nutrient balance in accordance with DLG 1998 (see Appendix B), with a minimum area of 156 m^2 required.

- The EMA shall consist of 79m² Application Area, Sized by Annual Water Balance (see App B2) and shall consist of 77m² Nutrient Uptake Area, totalling 156m² Sized by Nutrient Balance (See App B3)
- The irrigation field should be positioned within the EMA nominated in Appendix A and shall be constructed as per Appendix D.
- A minimum of 600mm basal clearance to underlying bedrock is required for the installation of Effluent Management Area. Therefeore, installer should import Loam OR Sandy-Loam Excavated Natural Material (ENM) to increase the soil depth by at least 200+mm over the nominated EMA prior to re-vegetation.

Justification of the proposed treatment method is as follows:

- Irrigation maximises the surface disposal area and evapo-transpiration.
- An irrigation area is available onsite meeting the minimum buffer distances.
- Irrigation is a suitable OSSM method for the site landform and soil properties.

4.4 Recommended Site Modifications

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

- Following the implementation of the EMA, the field is to be maintained with dense grass coverage and excluded from vehicle traffic.
- Install an upslope diversion bund as indicated within Appendix A
- Import 200mm of Loam / Sandy Loam Fill to house the 79m² Application Area. Install dense surface vegetation coverage to ensure stability of imported fill.

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 Storage Shed with toilet and hand basin. at 2 Bloodwood Road, Ingleside NSW
- The anticipated wastewater loading rates generated by the Storage Shed with toilet and hand basin. is calculated to be **150 L/day.**
- It is proposed to treat all wastewater generated by the Proposed Storage Shed to a Secondary standard with disinfection and via a new NSW health accredited Aerated Wastewater Treatment System (AWTS). The unit must be able to sustainably treat the design wastewater loading to the secondary treatment targets detailed in Table 4.2.1.
- Application of the effluent is proposed via **156 m^2** Effluent Management Area consisting of a 79m^2 **Subsurface Drip Irrigation** field raised 200mm with Loam/Sandy Loam soils and a surrounding 77m^2 Nutrient Uptake Area nominated in Appendix A to remain undeveloped, maintaining a dense surface vegetation coverage.
- The Subsurface drip irrigation field shall be constructed per Appendix D.
- Site modifications are provided in section 4.4 which must be followed.
- The shed is to be fitted with standard-water reductive fixtures.

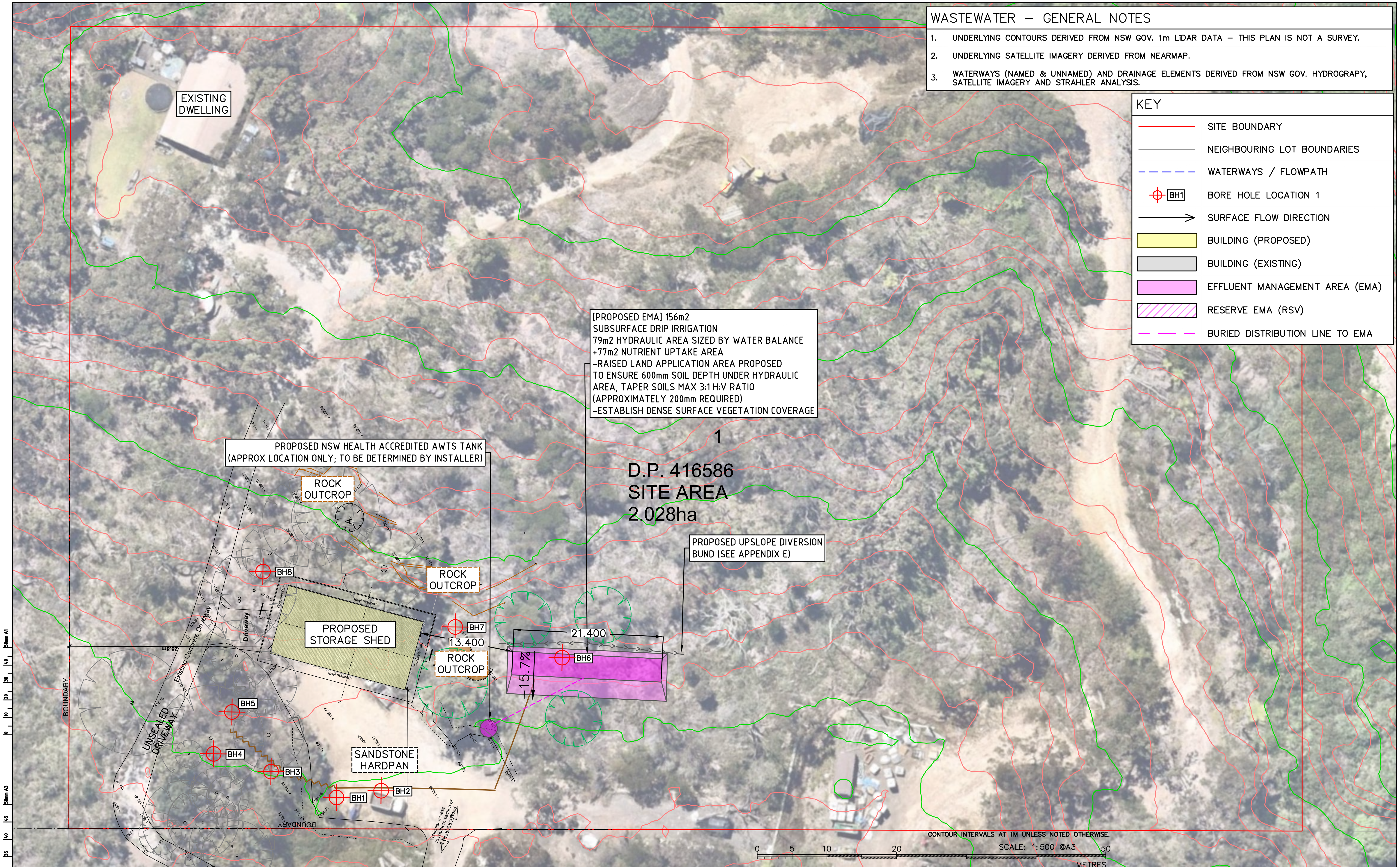
APPENDIX A: SITE PLAN

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.

KEY

- SITE BOUNDARY
- NEIGHBOURING LOT BOUNDARIES
- WATERWAYS / FLOWPATH
- BORE HOLE LOCATION 1 (BH1)
- SURFACE FLOW DIRECTION
- BUILDING (PROPOSED)
- BUILDING (EXISTING)
- EFFLUENT MANAGEMENT AREA (EMA)
- RESERVE EMA (RSV)
- BURIED DISTRIBUTION LINE TO EMA



ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
A-03	25/11/24	KR	KR	CH	PROPOSED STORAGE SHED
A-02	22/03/23	KR	KR	KF	RAISED SUBSURFACE
A-01	25/01/23	KR	KR	CH	ISSUE FOR RELEASE

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PROJECT DESCRIPTION: PROPOSED TRAINING FACILITY	SHEET: APPENDIX A - SITE LAYOUT PLAN
PROJECT SITE: 2 BLOODWOOD ROAD, INGLESIDE NSW	PLAN: ON-SITE WASTEWATER MANAGEMENT PLAN
LGA: NORTHERN BEACHES COUNCIL	CLIENT: MARK WILLCOCKS

PROJECT ID: 2567-WW
SCALE: 1:500 @ 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	3.58
Precipitation	66183	INGLESIDE (ANIMAL WELFARE LEAGUE NSV	1.44
Evaporation	66131	RIVERVIEW OBSERVATORY	19.29

Figure B.1 - Monthly Cimate Statistics

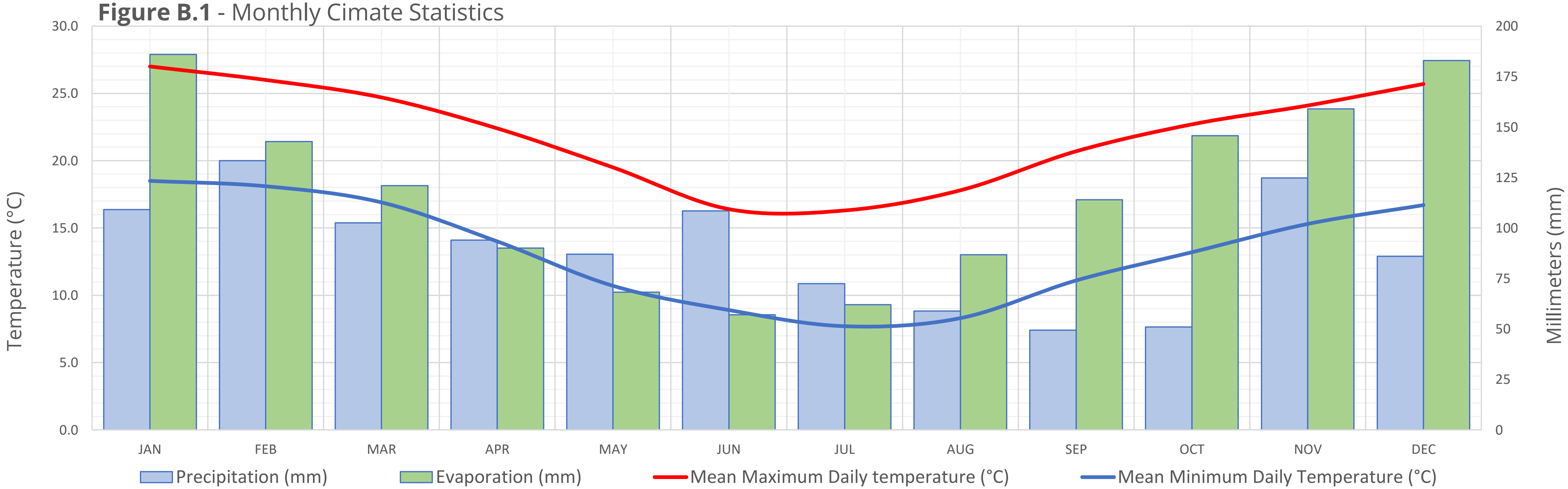


Table B1.2. Site Climate Statistics

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

B2. - Water Balance

Table B2.1. Site & Soil Parameters

Parameter	Symbols	Values	Units
Design Wastewater Flowrate	Q	150	L/day
Soil Texture		Loam	
Soil Structure		Weak	
Indicative Permeability	K_{sat}	0.5 to 1.5	m/day
Design Irrigation Rate	DIR_{day}	4	mm/day

Table B2.2. Effluent water balance

Site Factors	Symbol	Units	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Days per Month	D	days	31	28	31	30	31	30	31	31	30	31	30	31	365
Crop Factor	C		0.8	0.8	0.8	0.7	0.6	0.55	0.5	0.55	0.65	0.75	0.8	0.8	0.69167
Run-off Coefficient	C_{RO}		0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Effluent Irrigation	(Q x D)	mm/month	4650	4200	4650	4500	4650	4500	4650	4650	4500	4650	4500	4650	54750
Evapotranspiration	(E xC)	mm/month	148.8	114.24	96.72	63	40.92	31.35	31	47.74	74.1	109.275	127.2	146.32	984.588
Design Irrigation Rate	DIR_{Month}	mm/month	124	112	124	120	124	120	124	124	120	124	120	124	1460
Minmum Area Requirec	$A_{wb.min}$	m^2	26	38	35	44	52	**79**	51	39	30	25	32	24	43

Table B2.3. Water Balance Minimum Area Requirement

	Symbols	Area m^2
Minimum Area Required to Satisfy Water Balance:	A_{wb}	**79**

B3. - Nutrient Balance & Minimum irrigation area

Table B3.1. Nitrogen Balance

Parameter	Symbols	Values	Units
Design Wastewater Flowrate	Q	150	L/day
Surface Vegetation	Lawn - fully managed (clippings removed)		
Effluent Total Nitrogen (TN) Concentration[1]	TN	23	mg/L
Critical TN Loading Rate[2]	$L_{n.sfc}$	66	$mg/m^2/day$
Minimum Application Area	$A_{n.sfc}$	**51**	m^2

[1] Nominal ATWS Nutrient Concerntrations (DLG 1998, AS1547.3:2012)

[2] Appendix 6, 'On-site sewage management for single households' (DLG 1998, AS1547.3:2012)

Table B3.2. Phosphorus Balance

Parameter	Symbols	Values	Units
Design Wastewater Flowrate	Q	150	L/day
Surface Vegetation	Lawn - fully managed (clippings removed)		
Effluent Total Phosphorus (TP) Concentration[1]	TP	12	mg/L
Phosphorus Generated 50_{YR}	P_{gen}	32.85	kg
Soil Phosphorus Sorption Capacity	P_{sorp}	1,800	kg/Ha
Phosphorus Absorped 50_{YR}	P_{absorb}	0.060	kg/m^2
Critical TP Loading Rate[2]	$L_{p.sfc}$	8	$mg/m^2/day$
Phosphorus Uptake 50YR	$P_{uptake.sfc}$	0.150	kg/m^2
Minimum Application Area	$A_{p.sfc}$	**156**	m^2

[1] Nominal ATWS Nutrient Concerntrations (DLG 1998, AS1547.3:2012)

[2] Appendix 6, 'On-site sewage management for single households' (DLG 1998, AS1547.3:2012)

B4. - Minimum Effluent Irrigation Areas

Table B4.1. Minimum Irrigation Area Requirement

Balance	Area Required (m^2)
Water	79
Nitrogen	51
Phosphorus	156
Minimum Irrigation Area	**156**

APPENDIX C: INFORMATION FOR THE PROPERTY OWNER

APPENDIX C - Information For the Property Owner SOURCE: NSW DLG, 1998

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.

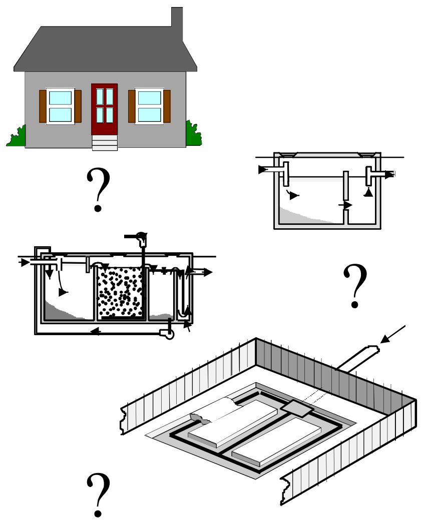
HELP PROTECT YOUR HEALTH AND THE ENVIRONMENT

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.

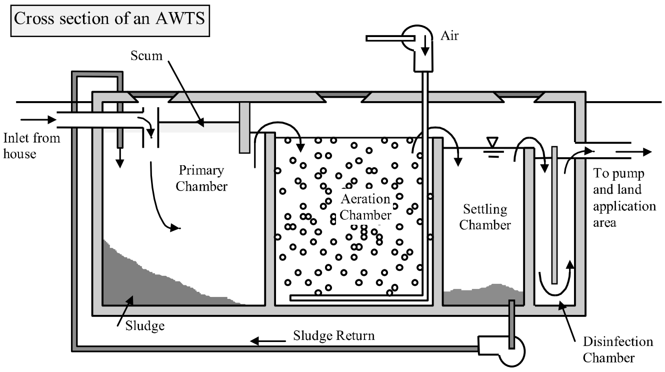
It consists of a series of treatment chambers combined with an irrigation system. An AWTS enables people living in unsewered areas to treat and utilise their wastewater.

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.

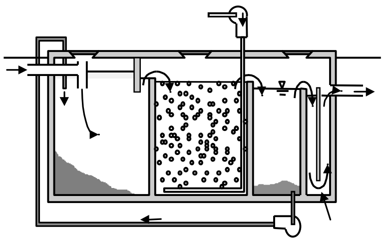
HELP PROTECT YOUR HEALTH AND THE ENVIRONMENT

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).

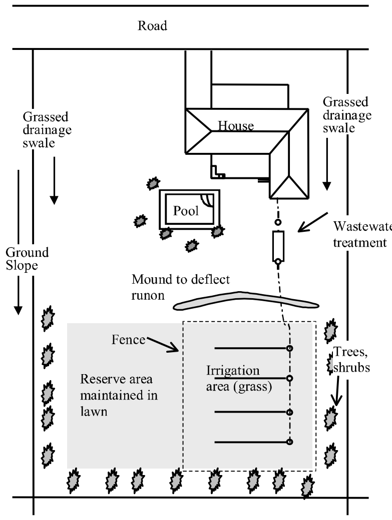
Soil absorption systems do not require highly treated effluent, and wastewater treated by a septic tank is reasonable as the solids content in the effluent has been reduced. Absorption systems release the effluent into the soil at a depth that cannot be reached by the roots of most small shrubs and grasses. 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.

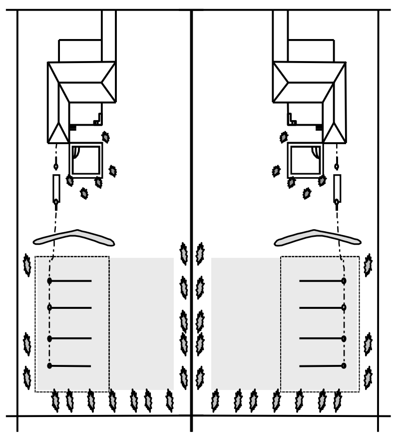
HELP PROTECT YOUR HEALTH AND THE ENVIRONMENT

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

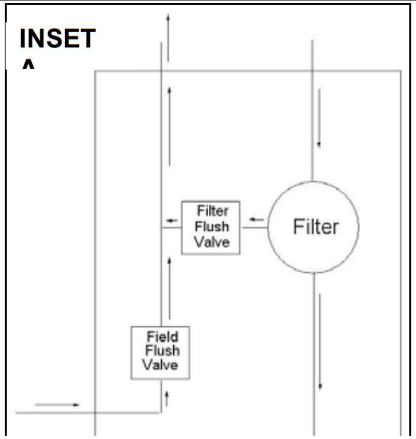
By looking after your sewage management system you can do your part in helping to protect the environment and the health of you and your family.

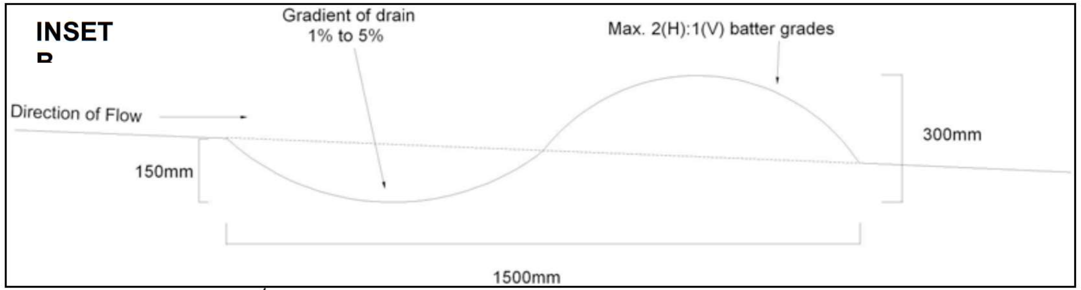
For more information please contact:

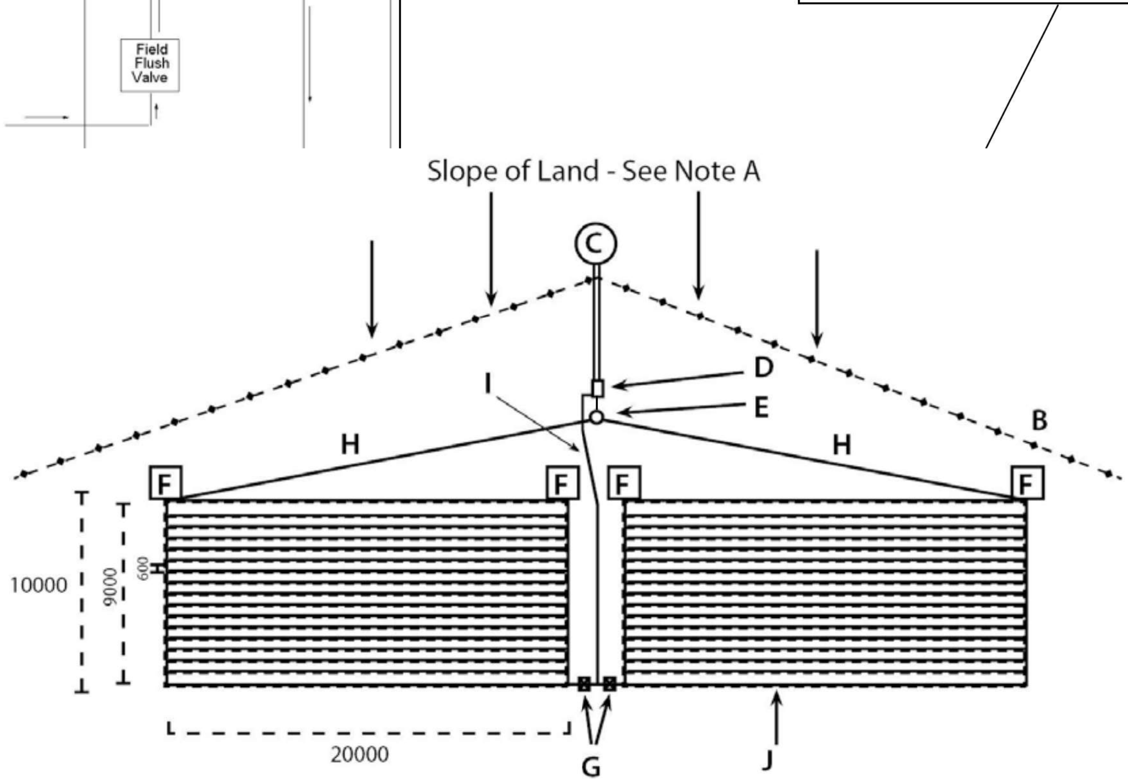
Your Land Application Area



APPENDIX D: SUBSURFACE DRIP IRRIGATION FIELD







This standard design has been based on a generic area of 400 m^2 for irrigation based on typical conditions. It does not eliminate the need for a site and soil evaluation to be carried out or any additional consideration of site specific issues. It should be used as a generic guide only.

Subsurface Irrigation Area Construction

A Design for relatively uniform slope. Additional design work may be required where slope exceeds 12% or if system is to be installed over undulating ground.

B An earth bank diversion drain must be constructed upslope of the area to divert stormwater run-on if this is appreciable (see Inset B and Standard Drawing No.13A).

C Secondary treatment system – the irrigation pump must provide a *minimum* 20 m head and a flow rate that matches the design output of the selected dripline. Flow rate will vary depending on emitter spacing, flow rate and lineal metres of line. A full hydraulic design must be carried out. Each area should be capable of discharging a minimum of 80 L/min.

D Filtration and flushing mechanism (see Inset A) – a field flush valve must be installed on the return line to facilitate periodic flushing to the treatment tank. An additional filter flush valve should be installed downstream of the field flush valve. A 100-150 micron cylindrical filter should be installed and cleaned regularly. Where there are potential problems in returning irrigation field flush back to the treatment tank, a small (approximately 3 m x 0.6 m) absorption area sited below the effluent irrigation area can be used to accommodate the flushed effluent.

E An automatic, hydraulically operated sequencing valve should be installed to deliver effluent evenly to the two areas.

F Air release valves must be installed at high points in each area. Additional air release valves may be required in undulating terrain.

G Check valves are required for each irrigation field to facilitate periodic flushing.

H Distribution manifolds should be 25 mm uPVC or polyethylene pipe buried 300 mm below the ground surface.

I Flushing return manifold should be 25 mm uPVC or polyethylene pipe buried 100-150 mm below the ground surface within the irrigation area. Outside this area, the pipe must be buried at a minimum of 300 mm depth.

J Pressure compensating (PC) subsurface drip line laterals (typically 16 mm) with emitters and laterals at approximately 600 mm spacings (maximum 1,000 mm spacings) and buried to a depth 100-150 mm. Only subsurface dripline specifically designed for effluent irrigation must be used.

Standard Drawing 13B - Subsurface Effluent Irrigation

(not to scale)

APPENDIX E: VIRAL DIE-OFF ASSESSMENT

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

(Cromer, Gardner & Beavers, 2001)

Climate Data - 66059 Terrey Hills AWS (3.58km from site)

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

1. Calculated Time For Viral Die-off:

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

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. (Appoximate to 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

2. Calculated Horizontal Setback Distance:

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

Parameter	Value	Unit	Parameter Discriptor
t (max.)	17.7	[days]	Travel Time
d_v	15.5	[m]	Vertical Distance (to water table)
P	0.2		Effective Porosity (Worst Case)
K	3	[m/day]	Saturated Hydraulic Conductivity (permeability)
i	0.1	[m/m]	Gradient of Groundwater table

d_g	25.018	[m]	Estimated Horizontal Setback Distance
a_s	2.0		Safety Factor Coefficient
d_s	**50.037**	[m]	Safety adjusted Horizontal Setback Distance