Strategic Environmental & Engineering Consulting

Wastewater Management: Site & Soil Evaluation & Disposal System Design

For Proposed Residential Development at: Lot 72 DP 32140 No. 263 Mount Vernon Road, Mount Vernon

Prepared by:

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Document Certification

This report has been developed based on agreed requirements as understood by SEEC at the time of investigation. It applies only to a specific task on the nominated lands. Other interpretations must not be made, including changes in scale or application to other projects. The contents of this report are based on a professional appraisal of the conditions that existed at the time of our investigation. Where subsurface investigations have been done the results are only applicable to the specific sampling or testing locations and only to the depth(s) investigated. Because of natural geological variability, and/or because of possible anthropogenic influences, the subsurface conditions reported can change abruptly. Such changes can also occur after the site investigation. The accuracy of the conditions provided in this report is limited by these possible variations and influences and/or is limited by budget constraints imposed by others and/or by adequate accessibility.

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Document Issue Table

Version	Date	Author	Reviewed	Notes
Draft A	1/12/2020	CB	LO	
01 Final	8/12/2020	CB	Client	

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1 EXECUTIVE SUMMARY

1.1 Scope of Work

Strategic Environmental and Engineering Consulting (SEEC) has been commissioned by Fowler Homes, on behalf of the property owner, to provide this wastewater site assessment. It is required to accompany an application to subdivide and develop Lot 72 DP 32140 No. 263 Mount Vernon Road, Mount Vernon. It is proposed to subdivide the land into two lots (Figure 1). A dwelling with seven potential bedrooms will be constructed on the northern lot and a dwelling with four potential bedrooms will be constructed on the southern lot (Figure 1).

At the time of inspection there was an existing dwelling and associated structures onsite (Figure 1). At the time of inspection wastewater generated by the existing dwelling was being treated in a septic tank and disposed via an absorption trench. The existing dwelling, associated structures and its wastewater management system have been scheduled for demolition to make way for the proposed development. Therefore, this assessment is required to show how treated wastewater generated from the proposed dwellings can be sustainably managed onsite.

1.2 Site Description

Lot 72 DP 32140 is a 2 ha (approx.) rural lot located on the northern side of Mount Vernon Road, Mount Vernon (Figure 1). The property will be subdivided to yield two new lots of approximately 1 ha each. The proposed dwellings are to be located on the southern extents of the new lots (Figure 1). The proposed Effluent Disposal Areas (EDAs) will be located to the north of the proposed dwellings where the site grades at between 10-20% to the west (Figure 1). There are two dams located on the proposed southern lot (Figure 1). The dam located on the central portion of the lot will be filled in and upslope water will be conveyed to the remaining dam via a vegetated swale (designed by others). All large woody vegetation will need to be removed from the proposed EDAs prior to their commissioning.

According to Penrith City Council's flood information for this site, both lots are affected by the 1% Average Exceedance Probability (AEP) flood height and the corresponding overland flow path (Appendix 1). It is proposed to manage onsite drainage by installing a drainage swale behind each proposed dwelling. The proposed EDA on the southern lot lies within 40 m proximity to the proposed swale and the extent of the 1:100 AEP overland flow path. This is in breach of Penrith City Council's '*On-site Sewage Management and Greywater Reuse Policy'.* As such the developer must apply for special considerations from Penrith City Council.

Soil investigations revealed 50-230 mm of strongly pedal dark brown sandy clay loam topsoil over strongly pedal light brown heavy clay down to 1,200+ mm in Test Pit 1 and 2 Test Pit 3 revealed 300 mm of strongly pedal dark brown sandy clay loam topsoil over strongly pedal brown medium clay down to 700 mm before refusal on rock. Soil chemistry testing revealed the soils are non-acidic but show strong dispersion potential. Ground

disturbance must be minimised to only what is required for the safe and efficient installation of the onsite wastewater management systems to minimise the risk of erosion.

1.3 Proposed Wastewater Management Systems

All existing structures onsite will be demolished and associated onsite wastewater management infrastructure must be decommissioned in accordance with 'Destruction, Removal or Reuse of Septic Tanks, Collection Wells, Aerated Wastewater Treatment Systems and other Sewage Management Facility Vessels (2006).

It is then proposed to install dedicated NSW Health approved Aerated Wastewater Treatment Systems (AWTSs) to secondary-treat all wastewater generated by each proposed dwelling. Secondary-treated effluent will then be disposed of by subsurface irrigation on each of the newly-created lots.

1.3.1 Proposed Four-bedroom Dwelling (Southern Proposed Lot)

The size of the EDA for the proposed four-bedroom dwelling was determined as 695 m^2. This was calculated by using a four-bedroom dwelling with reticulated water on clay soils from 'Table 2' of Penrith City Council's 'On-site Sewage Management and Greywater Reuse Policy (2014)'. Therefore the EDA for the four-bedroom dwelling will be 695 m^2 of subsurface irrigation split into two equal fields (Figure 1). A two way zone sequencing valve must be installed to alternately dose each irrigation field.

1.3.2 Proposed Seven-bedroom Dwelling (Northern Proposed Lot)

The size of the EDA for the proposed seven-bedroom dwelling was determined using a hydraulic and nutrient balance (Section 5). Hydraulic modelling requires a minimum EDA of 750 m^2. However, nutrient modelling requires a minimum total EDA of 1,095 m^2. This calculation has been based on the assumption that the vegetation over the EDA will be maintained as unmanaged lawn. This is considered the conservative approach in Penrith City Council. The larger of these two modelled areas must be adopted. Therefore the EDA for the proposed seven-bedroom dwelling will be 1,095 m^2 of subsurface irrigation split into three equal fields (Figure 1). A three way zone sequencing valve must be installed to alternately dose each irrigation field.

1.4 Conclusions and Recommendations

We conclude that both sites are suited to dispose secondary-treated effluent by subsurface irrigation, pending approval by Penrith Council regarding constraints relating to drainage, flood risk and vegetation removal. Specifically, our recommendations are:

1. To decommission all existing onsite wastewater management infrastructure in accordance with 'Destruction, Removal or Reuse of Septic Tanks, Collection Wells, Aerated Wastewater Treatment Systems and other Sewage Management Facility Vessels (2006);

Proposed Seven-bedroom dwelling

2. To install a NSW Health approved AWTS to secondary-treat all wastewater by the proposed seven-bedroom dwelling;
3. To install at least "three-star" plumbing fixtures, or better, in the proposed seven-bedroom dwelling to reduce wastewater loads;
4. To ensure that no other structures (existing or planned) are connected to the proposed AWTS unless the proper approval is granted from the Council;
5. To remove all large woody vegetation from within the EDA. Given the vegetation has been classified as environmentally sensitive the developer must apply for special consideration from the Council to remove the vegetation;
6. To install 1,095 m^2 of subsurface irrigation split into three equal fields and built to the requirements of AS/NZS1547:2012 (in the area shown in Figure 1, following the details in Figure 2) to dispose treated wastewater from the AWTS;
7. To install a three way zone sequencing valve to alternately dose each irrigation field;

Proposed four-bedroom dwelling

8. To install a NSW Health approved AWTS to secondary-treat all wastewater by the proposed four-bedroom dwelling
9. To install at least "three-star" plumbing fixtures, or better, in the proposed four-bedroom dwelling to reduce wastewater loads;
10. To ensure that no other structures (existing or planned) are connected to the proposed AWTS unless the proper approval is granted from the Council;
11. To fill in the dam located centrally on the proposed lot prior to commissioning the EDA;
12. To remove all large woody vegetation from within the EDA. Given the vegetation has been classified as environmentally sensitive the developer must apply for special consideration from the Council to remove the vegetation;
13. To install 695 m^2 of subsurface irrigation split into two equal fields and built to the requirements of AS/NZS1547:2012 (in the area shown in Figure 1, following the details in Figure 2) to dispose treated wastewater from the AWTS;
14. To install a two way zone sequencing valve to alternately dose each irrigation field;

For Both

15. To protect the EDAs from vehicle and stock access (fence off if necessary);
16. To install upslope diversion berms/drains above the proposed EDAs to divert run-on around them;
17. To maintain a good cover of vegetation (preferably lawn grass) over the entire EDAs;
18. To minimise the amount of ground disturbance to only what is required for safe and efficient installation of the proposed onsite wastewater management systems;
19. To erect a minimum of two Warning Signs along the edge of the EDAs. Refer to Section 6.7;
20. To preferentially select low phosphorus, liquid detergents; and
21. To install and manage the wastewater system according to the details of this report, its appendices and the manufacturer's recommendations.

Note: This system design might be altered slightly by the Conditions of Consent. It is the responsibility of the owner/builder to check the conditions of consent prior to commencing works.

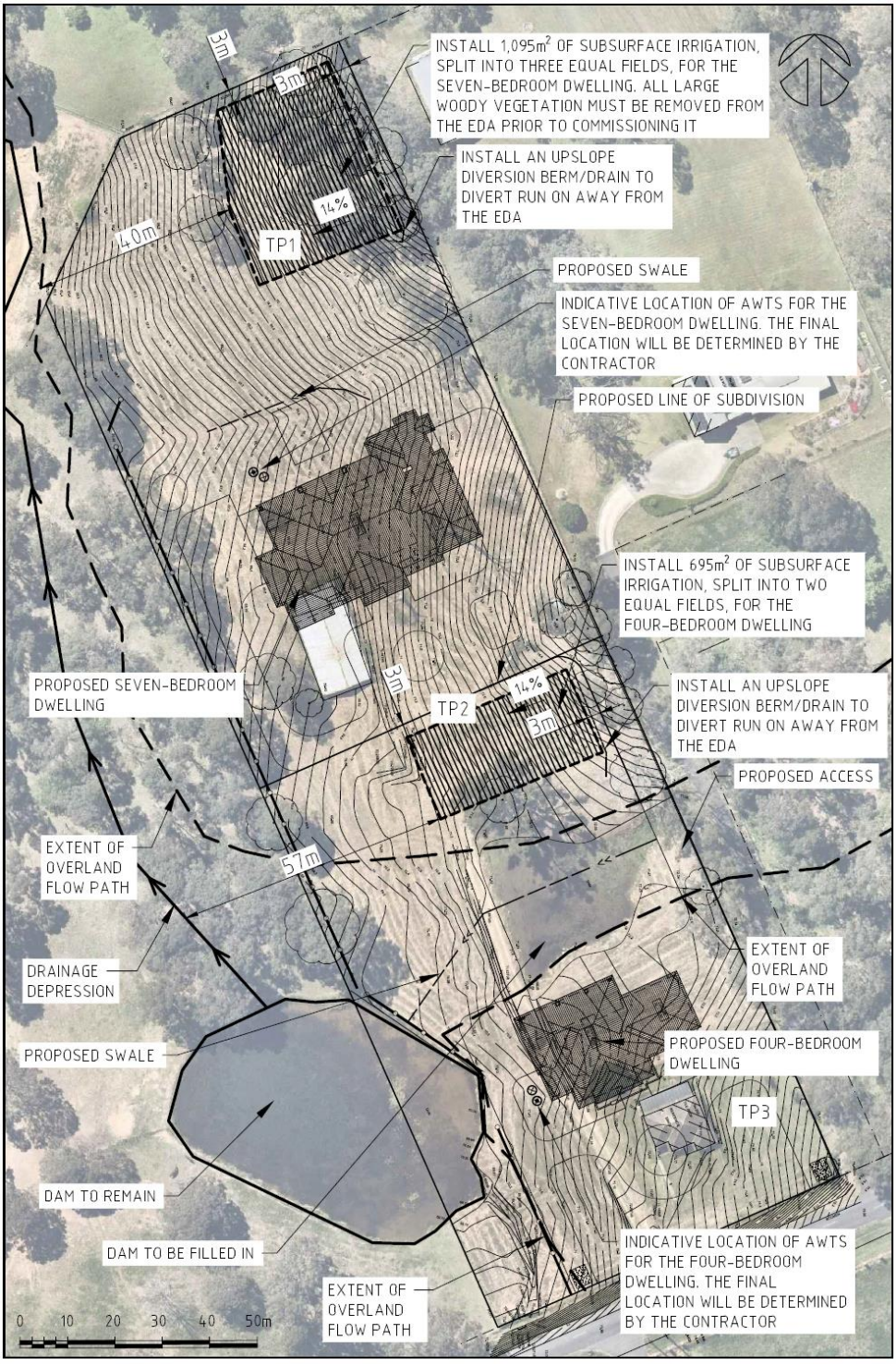


Figure 1 - Site map and Effluent Management Area. This Figure must be read in conjunction with the accompanying report by SEEC.

2 SITE DETAILS

Table 1 Site details.

Site Address	Lot 72 DP 32140 No. 263 Mount Vernon Road, Mount Vernon
GPS Reading	N. -33.871625 E. 150.810175
Owner	-
Owner Address	-
Owner Phone	-
Developer	Fowler Homes
Developer Address	405A Victoria Street,, Wetherill Park NSW 2164
Developer Phone	02 8788 9300
Allotment Size	2 ha (approx.)
Proposed Development	2 lot subdivision and development of the land
Water Supply	Town/Bore
Local Government Authority	Penrith City Council

Table 2 Design wastewater loading calculations (for a dwelling) (AS/NZS 1547:2012)

Source	Typical wastewater design flows (L/person/day)	
Residential premises	On-site roof tank supply	Reticulated water supply
	120	150

2.1 Design Wastewater Loading

AS/NZS 1547:2012, Table H1 gives a per person loading of 120L/day or 150L/day for tank water or town water supply respectively. This assumes that at least three-star rated plumbing appliances are fitted.

It is proposed to build a seven-bedroom dwelling on the proposed northern lot and four-bedroom dwelling on the proposed southern lot at this site. Based off the proposed floor plan of the seven-bedroom dwelling the Design Wastewater Loading Rate is 1,200 L/day based of a maximum occupancy of eight people. Based off the proposed floor plan of the four-bedroom dwelling the Design Wastewater Loading Rate is 750 L/day based of a maximum occupancy of five people.

Maximum occupancies have been calculated as two people per master and guest bedroom and one person for each additional bedroom (Penrith City Council, 2014).

3 PHYSICAL SITE ASSESSMENT

The site and soil evaluation has been undertaken following AS/NZS 1547:2012: *On-site Domestic Wastewater Management,* Sections 2.1 & 2.2 of the WaterNSW's *Designing and Installing On-Site Wastewater Systems* (2019) and Appendix 2 of the Environment & Health Protection Guidelines: *On-site Sewage Management for Single Households* (the 'Silver Book', Department of Local Government, 1998).

3.1 Climate

Climate is an important factor in onsite wastewater management. It is particularly important when designing irrigation areas as the dual parameters of incidental rainfall and evaporation have a direct effect on the required size. Areas that have high evaporation and low rainfall are better suited to effluent management by irrigation than those with a cold and/or wet climate. In particularly wet and/or cold areas, wet weather storage might be required, especially during the winter months. We have found the site is in an area where evaporation exceeds rainfall for most, if not all of, the year.

3.2 Flood Potential

It is required to locate all effluent management areas (EDAs) above the 1:20 ARI flood level. This is to reduce the risk of effluent being transported off the site. In addition all electrical components, vents and inspection holes must be located above the 1:100 year flood level. This might involve locating the electrical components remote from the tanks, e.g. on a wall or similar. According to Penrith City Council's flood information for this site, the site affected by the 1% Average Exceedance Probability (AEP) flood height and the corresponding overland flow path (Appendix 1). The proposed EDA on the southern lot lies within proximity to the extent of the 1:100 AEP overland flow path. This is in breach of Penrith City Council's '*On-site Sewage Management and Greywater Reuse Policy'*. As such the developer must apply for special considerations from Penrith City Council.

3.3 Exposure

Sun and wind exposure on the EDA must be maximised to help with evaporation. Factors that affect this are local topography, vegetation and the built environment. Improper location of an EDA in the shade can reduce evaporation by up to 30 percent. We have found that the proposed EDAs are subject to some shading due to trees. Trees must be removed from the EDAs prior to commissioning them.

3.4 Slope Gradient

Slope is an important parameter affecting the choice of effluent management systems. Excessive slope increases the risk of effluent leaving the site, particularly during wet weather. The design irrigation rates are adjusted to account for slope. We have found that slope in the proposed EDAs are between 10 and 20 percent. This is considered a moderate limitation and subsurface irrigation must be adopted to prevent runoff. Further, AS/NZS 1547:2012 recommends a 20% reduction of the design irrigation rate (DIR) for slopes of between 10 to 20%.

3.5 Landform

Different landforms pose different limitations to effluent management. The risk of run-on and hence the risk of runoff from an EDA is directly related to the type of landform and the position of the EDA on it. We have found that the proposed EDAs are either on a lower sideslope, a footslope or in saddle. Therefore, the risk of run-on, and hence runoff, is high. The EDAs must be protected by an upslope diversion berm that will divert surface stormwater away. Subsurface disposal is preferred.

3.6 Run on and Seepage

Surface stormwater run-on must not be permitted onto an effluent management area. This is because it could transport effluent offsite and into receiving waters. In addition regular run-on might inhibit vegetative growth. We have found that there might be a risk of surface stormwater run-on. This is because the EDAs might be in the mid to lower parts of a side slope or there might be some run-on from road(s). An upslope diversion berm should be constructed to control this run-on.

3.7 Erosion Potential

Sites where there is active erosion must be avoided for effluent management. We have found that there are no signs of erosion at this well vegetated site.

3.8 Site Drainage

An EDA must not be placed in wet or damp areas. This is to reduce the risk of effluent leaving the site by either surface waters or groundwater. The type of vegetation and the condition of the soils give good indications of the site's drainage. We have found that there are no signs of moisture tolerant vegetation such as sedges, ferns or Juncus sp. In addition there are no signs of grey mottling in the subsoils within 500 mm of the surface.

3.9 Fill

The presence of fill might affect the choice of an effluent management system, particularly if very high or very low permeability soils have been imported. Fill might also be prone to settlement and might also be detrimental to the establishment of good vegetative cover. We have found that there are no signs of fill in close proximity to the EDAs.

3.10 Surface Rock

The presence of frequent rock outcrops is usually an indication of shallow and variable soils and/or erosion. In such conditions it might be necessary to import soil to enable the establishment of a good vegetative cover suitable for irrigation. We have found the site has less than 10 percent rock outcrops.

3.11 Groundwater Use

The NSW Department of Health recommends that effluent management areas are not located within 250 m of bores that are used for domestic potable water. A search of WaterNSW's groundwater map did not identify a bore within close proximity to the EDAs.

3.12 Biodiversity

Treated effluent has the potential to cause adverse harm to sensitive terrestrial biodiversity. According to the Department of Planning, Industry and Environment (DPIE) Biodiversity Values Map and Threshold tool (accessed, 2020) this site is affected by threatened species or communities with potential for serious and irreversible impacts. Penrith City Council does not allow an EDA to be established under existing trees. As a result all trees from within the EDAs must be removed. Given the vegetation has been classified as environmentally sensitive the developer must apply for special consideration from the Council to remove the vegetation.

3.13 Vegetation

The suitability of the existing vegetation (if any) must be considered. The most common, and one of the most suitable, types of vegetation for effluent management is turf. Turf efficiently covers large areas and provides a good opportunity for evapotranspiration and nutrient uptake (particularly nitrogen). Some native vegetation, particularly that which has developed on poor sandy soils, will not respond well to nutrient-rich wastewater and, if possible, must be avoided or replaced with more suitable species. We have found the existing vegetation onsite is improved pasture grasses and scattered native vegetation where the proposed EDAs have a good cover of turf or pasture grasses.

3.14 Proximity to Watercourses

The proximity of natural watercourses or dams is one of the most important factors in the selection of an EDA. It will be necessary to maintain buffers anywhere from 40 m to 150 m between the EDA and a watercourse or dam.

A 40 m buffer is required between an EDA and a drainage depression or a dam, a 100 m buffer is required from a watercourses named by NSW Spatial Services.

Section 6.4 provides further information on buffer distances.

We have found that there are drainage depressions affecting the proposed lots. The proposed EDAs are outside all required buffer distances to drainage lines (Figure 1). However, they are in proximity to proposed drainage swales. Given the natural slope of the land it is unlikely that effluent will enter the swales. As a factor of safety, subsurface irrigation has been adopted to minimise the risk of effluent leaving the site.

3.15 Land Availability

After summarising all of the above, particularly regarding buffer distances, land that is suitable for effluent management on site has been identified. We have found that land is limited at this site and has either affected the choice of the most suitable effluent management system and/or has affected the size of the EDAs. Figure 1 identifies the lands that are suitable and unsuitable for effluent management. The developer will need to seek special permission from Penrith City Council because the EDAs cannot be positioned on each lot with the required buffers to drainage features.

3.16 Stock Present

Stock can cause damage to irrigation systems and must be kept out of the EDAs by fencing or other physical barrier. During the site inspection no stock were observed onsite. Considering this is a rural property stock may be introduced onsite in the future. If this occurs the EDAs must be fully fenced from stock.

3.17 Risk of Frost

Frost can affect the irrigation system. All distribution pipes must be well buried to protect them. All irrigation pipes must drain after pumping. There is a low risk of frost on this site.

4 SOIL ASSESSMENT

The site and soil evaluation has been undertaken following AS/NZS 1547:2012: *On-site Domestic Wastewater Management* and Appendix 2 of the 'Environment & Health Protection Guidelines: *On-site Sewage Management for Single Households* (the 'Silver Book', Department of Local Government, 1998).

4.1 Geology and Soil Landscape

The eSPADE, 2020 mapping identifies the site to be on the Luddenham Soil Landscape.

4.2 Soil Description

4.2.1 Soil Profile Descriptions

Test Pit 1

Layer 1	0	to	230	Strongly dark brown sandy clay loam topsoil. 40 mm ribbon.
Layer 2	230	to	1,200+	Strongly pedal light brown heavy clay. 100+ mm ribbon.

Test Pit 2

Layer 1	0	to	50	Strongly dark brown sandy clay loam topsoil. 40 mm ribbon.
Layer 2	50	to	1,200+	Strongly pedal light brown heavy clay. 100+ mm ribbon.

Test Pit 3

Layer 1	0	to	300	Strongly dark brown sandy clay loam topsoil. 40 mm ribbon.
Layer 2	300	to	700+	Strongly pedal light brown medium clay. 75 mm ribbon. Refusal on rock.

4.2.2 Soil Classification and Design Irrigation Rate

Table 3 Selected soil classification and corresponding design Irrigation rate.

Soil Category	Soil Texture	Structure	Indicative Permeability		Design Irrigation Rate (DIR) (mm/day) (AS/NZS 1547:2012) Drip Irrigation 10-20% Slope
1	Gravels & Sands	Massive	>3.0		
2	Sandy Loams	Weak	>3.0		
		Massive	1.4 - 3.0		
3	Loams	High/ Moderate	1.5 - 3.0		
		Weak or Massive	0.5 - 1.5		
4	Clay Loams	High/ Moderate	0.5 - 1.5		
		Weak	0.12 - 0.5		
		Massive	0.06 - 0.12		
5	Light Clays	Strong	0.12 - 0.5		
		Moderate	0.06 - 0.12		
		Weak/ Massive	< 0.06		
6	Medium to Heavy Clays	Strong	0.06 - 0.5	x	1.6
		Moderate	< 0.06		
		Weak/ Massive	< 0.06		

4.3 Soil Constraints

4.3.1 Soil Depth to a Limiting Layer (e.g. bedrock or watertable)

Soil depth is an important factor in choosing a suitable effluent disposal method. The depth of soil is measured to a limiting layer - i.e. bedrock or a periodically high watertable (shown by grey mottling in the soils). Generally, soil is a very good medium for providing treatment to effluent. As the effluent passes through soil it is filtered and there is adsorption of chemicals (particularly phosphorous) onto the soil particles. In addition, this allows time for viruses to die (as they are usually outside of their preferred environment). At least 500 mm of soil is required to provide treatment in an irrigation area. We have found that the soil depth is more than 1.0 m. This is considered a minor limitation

4.3.2 Coarse Fragments

Coarse fragments are those over 2 mm in diameter. They can pose limitations to vegetative growth by lowering the soil's ability to supply water and nutrients. We have found that there are less than 20 percent coarse fragments present.

4.3.3 pH of Soils

The pH of a soil influences its ability to supply nutrients to vegetation. If the soil is too acidic vegetative growth would be inhibited. We have found that the pH of the soil is more than 6.0. This is unlikely to inhibit vegetative growth.

4.3.4 Electrical Conductivity

The electrical conductivity of the soil relates to the amount of salts present. A high salt concentration would inhibit vegetative growth. Electrical conductivity has been measured in deci Semens per metre (dS/m). We have found the electrical conductivity of the soil is less than 4 dS/m. This is unlikely to inhibit vegetative growth.

4.3.5 Emerson Aggregate Test (EAT)

The Emerson Aggregate Test (EAT) is a measure of soil dispersibility and susceptibility to erosion. It assesses the physical changes that occur to a single ped of soil when immersed in water - specifically whether it slakes and falls apart or disperses and clouds the water. We have classed the soil as Class 1 which means that the soils show strong dispersion potential but the land is well vegetated and this will minimise excessive erosion if the vegetation is maintained. Ground disturbance must be minimised to only what is required for the safe and efficient installation of the onsite wastewater management systems to minimise the risk of erosion.

4.3.6 Phosphorus Sorption

The capacity of a soil to adsorb phosphorus is expressed as its phosphorus sorption capacity. Soils with a high capacity to sorb phosphorous are preferred and can result in smaller application areas. The phosphorous sorption capacity is used in the nutrient balance. Phosphorous sorption values were sourced from WaterNSW, 2019

TOPSOIL Estimated P-Sorp (mg/kg) = 400
SUBSOIL Estimated P-Sorp (mg/kg) = 600

5 HYDRAULIC AND NUTRIENT BALANCE (SEVEN-BEDROOM DWELLING)

Wastewater Volume	1,200 (L/day)
Vegetation in EMA	Lawn - Unmanaged
Soil in EMA	Med-Heavy Clays

Hydraulic Balance

A=Q/DIR
Where:
A=Area (m^2)

Q = Wastewater Flow =	1200	L/day
DLR=Design Irrigation Rate =	1.6	(mm/day)

Area Requred:

A=	750	m^2

Nitrogen Balance

A = 3.65(C x Q) / Lx
Where:
A = Area (m^2)

C = Concentration of Nutrient =	30	mg/L
Q = Wastewater Flow =	1200	L/day
Lx = Critical Loading Rate =	120	(Kg/ha/year)

Area Required:

A =	1095	m^2 of	Lawn - Unmanaged

Phosphorus Balance

$A=3.65(CxQ)/U_R+0.2d(1-n_p)G_sX_{sorp}$ Basalt soils?

Where:

Phosphorus Sorption (X_{sorp})=	600	mg/kg
Design Soil Depth (d)=	0.8	mm
Bulk Density	1.3	g/cm^3
G_s=	2.65	g/cm^3
P uptake (U_R)=	12	kg/ha/year
Concentration of phosphorus =	12	mg/L

Area Required:

A =	384	m^2 of	Lawn - Unmanaged

Adapted from WaterNSW, 2015 and WaterNSW, 2019

6 RECOMMENDATIONS

Note: This system design might be altered slightly by the Conditions of Consent. It is the responsibility of the owner/builder to check the conditions of consent prior to commencing works.

6.1 Wastewater System

The following disposal method has been chosen by the client and/or is considered the most suitable:

Subsurface irrigation following treatment in a NSW Health approved AWTS.

6.2 Sizing of the Disposal System

6.2.1 Proposed Four-bedroom Dwelling (Southern Proposed Lot)

The size of the EDA for the proposed four-bedroom dwelling was determined as 695 m^2. This was calculated by using a four-bedroom dwelling with reticulated water on clay soils from 'Table 2' of Penrith City Council's 'On-site Sewage Management and Greywater Reuse Policy (2014)'. Therefore the EDA for the four-bedroom dwelling will be 695 m^2 of subsurface irrigation split into two equal fields (Figure 1). A two way zone sequencing valve must be installed to alternately dose each irrigation field.

6.2.2 Proposed Seven-bedroom Dwelling (Northern Proposed Lot)

The size of the EDA for the proposed seven-bedroom dwelling was determined using a hydraulic and nutrient balance (Section 5). Hydraulic modelling requires a minimum EDA of 750m^2. However, nutrient modelling requires a minimum total EDA of 1,095 m^2. This calculation has been based on the assumption that the vegetation over the EDA will be maintained as unmanaged lawn. This is considered the conservative approach in Penrith City Council. The larger of these areas must be adopted. Therefore the EDA for the seven-bedroom dwelling will be 1,095 m^2 of subsurface irrigation split into three equal fields (Figure 1). A three way zone sequencing valve must be installed to alternately dose each irrigation field.

6.3 Professional Construction

A typical irrigation design is given in Figure 2, however, a licensed irrigation contractor or plumber must be used to install the irrigation system. Council (or an approved certifier) will be responsible for monitoring the installation and ensuring it is done to the requirements of this document.

The irrigation system must incorporate a flushing line connected to either the settling chamber of the AWTS or to a small absorption trench/pit.

The effluent distribution pipe from the AWTS to the EDA must be buried at a minimum depth of 300 mm (or 500 mm when crossing an access way), and laid to maximise protection against mechanical damage or deformation.

The distribution laterals in the EDA must be buried at a minimum depth of 100 mm (or 250 mm for Category 6 subsoils).

The installer must provide a pump of sufficient capacity to ensure even distribution of effluent throughout the EDA. If required an Auto/Manual Zone Sequencing Valve must be installed to ensure the even distribution of effluent over multiple irrigation fields. The licensed contractor will submit a certificate of installation that will clearly refer to this wastewater design. The certificate will be presented to Council.

6.4 Buffer Distances

DLG (1998) (The Silver Book) requires buffers to be maintained from an effluent management area to different land application areas. These are outlined in Table 4.

Table 4 Specified Buffer Distances (Penrith City Council).

All Systems including tanks	100 m to permanent waters (rivers and lakes) 40 m to intermittent water features (dams, stormwater easements, overland flow paths, intermittent waterways and drainage areas) 15 m from an in-ground tank 1 m from the drip-line od native trees and shrubs 250 m to potable water bores 1.5 m minimum between a treatment tank and a structure
Spray Irrigation	6 m if area upslope and 3 m if area downslope of property boundaries and driveways 15 m to dwellings 3 m to walkways and paths 6 m to swimming pools
Subsurface and Drip Irrigation	6 m if area upslope and 3 m if area downslope of swimming pools, boundaries driveways and buildings

The proposed wastewater management systems are in breach of some of the required buffers set by Penrith City Council. The developer must apply for special considerations from the council to install the systems. Refer to Figure 1 for the recommended positioning of the EDAs.

6.5 Detergent Use

Liquid detergents must be used in the household as powders contain elevated concentrations of salt which could alter the soil's chemistry and reduce its ability to percolate water. All cleaning products must be "Septic Friendly".

6.6 Water Saving Fixtures

This design assumes at least three-star rated plumbing fixtures are used in any new home. If required by the council “four-star” rated fixtures must be installed.

6.7 Signs

A minimum if two Warning Signs must be installed along the edge of the EDA. The signs shall read "WARNING: RECLAIMED EFFLUENT/RECYCLED WATER, DO NOT DRINK, AVOID CONTACT" or similar. Lettering must be clearly visible from three meters away.

6.8 Summary of Recommendations

We conclude that both sites are suited to dispose secondary-treated effluent by subsurface irrigation, pending approval by Penrith Council regarding constraints relating to drainage, flood risk and vegetation removal. Specifically, our recommendations are:

1. To decommission all existing onsite wastewater management infrastructure in accordance with 'Destruction, Removal or Reuse of Septic Tanks, Collection Wells, Aerated Wastewater Treatment Systems and other Sewage Management Facility Vessels (2006);

Proposed Seven-bedroom dwelling

2. To install a NSW Health approved AWTS to secondary-treat all wastewater by the proposed seven-bedroom dwelling;
3. To install at least "three-star" plumbing fixtures, or better, in the proposed seven-bedroom dwelling to reduce wastewater loads;
4. To ensure that no other structures (existing or planned) are connected to the proposed AWTS unless the proper approval is granted from the Council;
5. To remove all large woody vegetation from within the EDA. Given the vegetation has been classified as environmentally sensitive the developer must apply for special consideration from the Council to remove the vegetation;
6. To install 1,095 m^2 of subsurface irrigation split into three equal fields and built to the requirements of AS/NZS1547:2012 (in the area shown in Figure 1, following the details in Figure 2) to dispose treated wastewater from the AWTS;
7. To install a three way zone sequencing valve to alternately dose each irrigation field;

Proposed four-bedroom dwelling

8. To install a NSW Health approved AWTS to secondary-treat all wastewater by the proposed four-bedroom dwelling
9. To install at least "three-star" plumbing fixtures, or better, in the proposed four-bedroom dwelling to reduce wastewater loads;
10. To ensure that no other structures (existing or planned) are connected to the proposed AWTS unless the proper approval is granted from the Council;
11. To fill in the dam located centrally on the proposed lot prior to commissioning the EDA;
12. To remove all large woody vegetation from within the EDA. Given the vegetation has been classified as environmentally sensitive the developer must apply for special consideration from the Council to remove the vegetation;

13. To install 695 m^2 of subsurface irrigation split into two equal fields and built to the requirements of AS/NZS1547:2012 (in the area shown in Figure 1, following the details in Figure 2) to dispose treated wastewater from the AWTS;
14. To install a two way zone sequencing valve to alternately dose each irrigation field;

For Both

15. To protect the EDAs from vehicle and stock access (fence off if necessary);
16. To install upslope diversion berms/drains above the proposed EDAs to divert run-on around them;
17. To maintain a good cover of vegetation (preferably lawn grass) over the entire EDAs;
18. To minimise the amount of ground disturbance to only what is required for safe and efficient installation of the proposed onsite wastewater management systems;
19. To erect a minimum of two Warning Signs along the edge of the EDAs. Refer to Section 6.7;
20. To preferentially select low phosphorus, liquid detergents; and
21. To install and manage the wastewater system according to the details of this report, its appendices and the manufacturer's recommendations.

7 SYSTEM DESIGN

Note: This system design might be altered slightly by the Conditions of Consent. It is the responsibility of the owner/builder to check the conditions of consent prior to commencing works.

This design assumes a certain design wastewater load. It will be invalidated if that load were to significantly increase (>10 percent): This might occur due to (but not limited to):

- If a spa bath or in-sink food grinder were installed.
- If a home is occupied by more than 2 persons per bedroom.
- If water fixtures are not at least three-star rated.
- If plumbing leaks are not attended to.

The design is warranted to meet the required design guidelines and standards at the time of writing. However, that does not preclude the requirement of the land owner to satisfactorily use and maintain the system to the requirements of the manufacturers and to the generic guidelines given in the following Appendix. In particular there are requirements to:

- Ensure that only "septic-friendly" substances are disposed into the system (materials and chemicals).
- Periodically (once per 3-5 years) clean out the septic tank or septic chamber of the AWTS.
- Regularly (once per three months) clean the septic outlet filter or the in-line filter.
- Regularly (once per three months) manually flush the system.
- Periodically (one per year) check the disposal area for signs of seepage.
- Periodically (one per year) check the upslope diversion drain (if applicable) to ensure stormwater is adequately diverted.

Your system will be inspected as required by Council. The Wastewater Contractor must inspect both the treatment system and the disposal area following the checklist given in Appendix 1 and submit the results to Council. Should there be a problem with your system you must initially consult the licensed contractors who installed the system and/or your regular maintenance contractor.

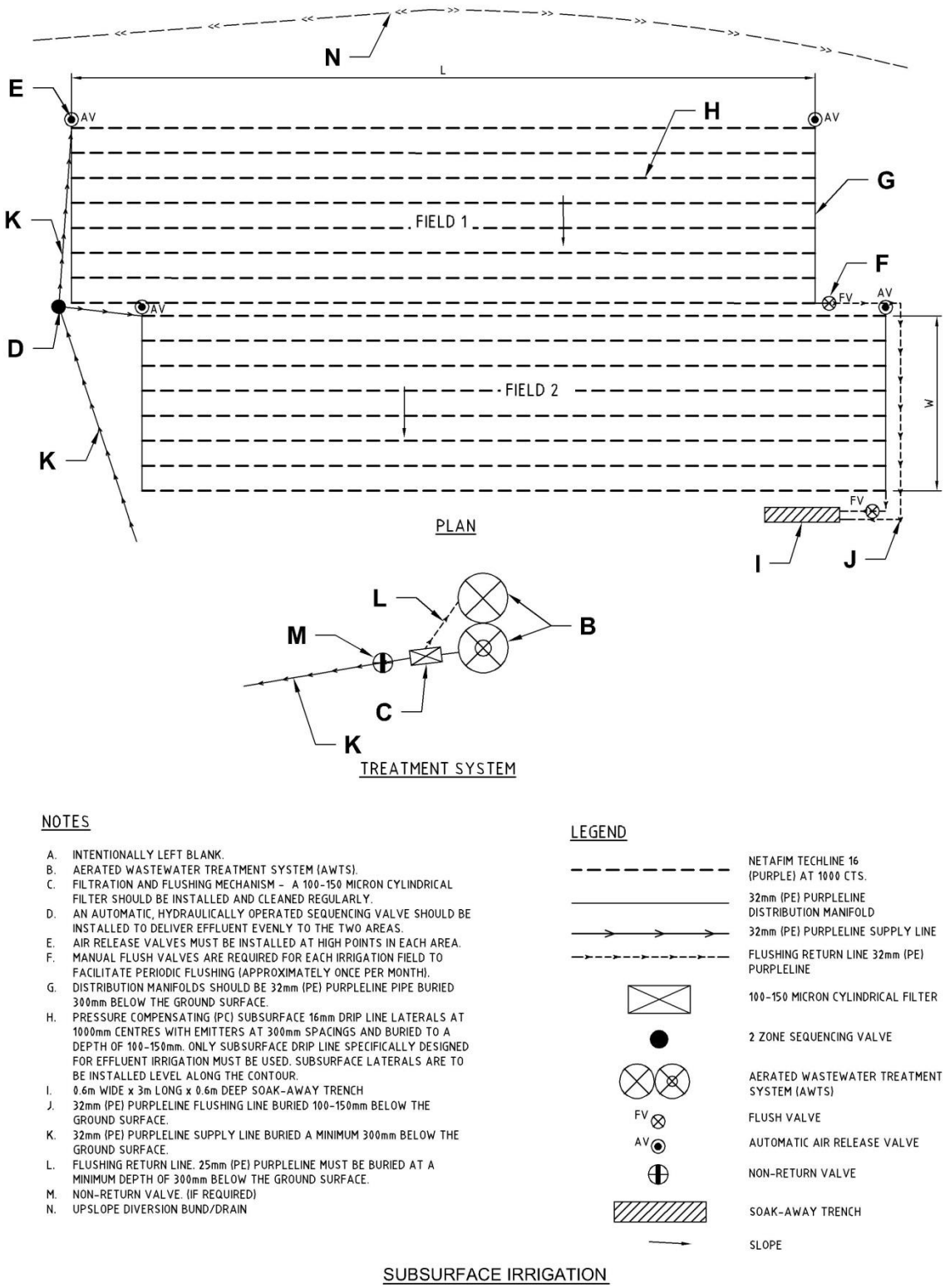


Figure 2 – Proposed Disposal System (Typical details). This Figure must be read in conjunction with the accompanying report by SEEC.

8 REFERENCES

Department of Local Government (1998). Environment and Health Protection Guidelines: *Onsite Sewage Management for Single Household.*

eSPADE (2020). NSW Office of Environment and Heritage.

Penrith City Council (2014) '*On-site Sewage Management and Greywater Reuse Policy*'.

Standards Australia / Standards New Zealand (2012). AS/NZS 1547:2012 *On-site Domestic Wastewater Management.*

WaterNSW (2019), *Designing and Installing On-Site Wastewater Systems. A WaterNSW Current Recommended Practice.*

PENRITH

Flood Information
Lot 72 DP 32140 - No. 263-269 Mt Vernon Road Mount Vernon

Date of issue: 18 November 2020

The 1% AEP local overland flow flood levels affecting the above property are estimated to vary from RL70.6m AHD at the front boundary to RL60.5m AHD at the rear boundary and RL72.4m AHD at the eastern boundary, as showing in white colour on the map below.

Property less than 0.5m above the 1% AEP flood level is subject to Penrith Development Control Plan 2014 Section C3.5 Flood Planning. The Penrith Development Control Plan 2014 is available from Council's website www.penrithcity.nsw.gov.au.

Definitions

AEP – *Annual Exceedance Probability* – the chance of a flood of this size occurring in any one year.

AHD – *Australian Height Datum* – A standard level datum used throughout Australia, approximately equivalent to mean sea level.

Legend

	Extent of 1% AEP local catchment overland flow path. Generally depths less than 150mm is not shown.

Notes:

1. The contours shown above in yellow numbering are at 0.5m intervals and are based on Aerial Laser Scanning (ALS) Survey undertaken in 2002. The contour levels are approximate and for general information only. Accurate ground levels should be obtained by a Registered Surveyor.
2. The flood level is based on current information available to Council at the date of issue. The flood level may change in the future if new information becomes available. The 1% AEP flood is the flood adopted by Council for planning controls. Rarer and more extreme flood events will have a greater effect on the property.
3. You are strongly advised if you propose to carry out development upon the property, that you retain the assistance of an experienced flooding engineer and have carried out a detailed investigation.
4. Council accepts no liability for the accuracy of the flood levels (or any other data) contained in this certificate, having regard to the information disclosed in Notes "1", "2". As such you should carry out and rely upon your own investigations.

Penrith City Council
PO Box 60, Penrith
NSW 2751 Australia
T 4732 7777
F 4732 7958
penrithcity.nsw.gov.au

[redacted]

Dr Elias Ishak
Senior Engineer – Floodplain Management

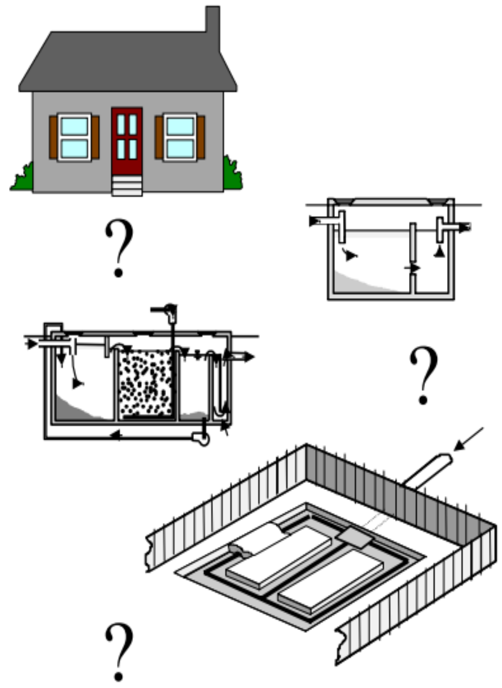
PENRITH CITY COUNCIL

9.2 Appendix 2 – Annual Checklist for Owners

Checklist 13.2 Operation inspection(1) of land application area for use by service agents, Council inspectors and system owners			
Does the system owner have a set of plans of the irrigation system and an Operational and Maintenance Manual?		☐ Yes	☐ No
Land Application Area			
Is there evidence of irrigation area damage by vehicle, livestock or domestic animal activities?	☐ Yes ☐ No	Comment:	
Is a good vegetation cover established over the effluent irrigation area?	☐ Yes ☐ No	Comment:	
Are there any green or boggy areas or surface ponding of effluent liquid in the irrigation area?	☐ Yes ☐ No	Comment:	
Are there dry areas or areas lacking vegetation in the irrigation area?	☐ Yes ☐ No	Comment:	
Is the effluent irrigation area associated with an unpleasant smell that would suggest untreated or poorly treated effluent is being used to irrigate?	☐ Yes ☐ No	Comment:	
Has the effluent irrigation area been mown to maintain the grass short?		☐ Yes	☐ No
Treatment and Irrigation System			
Is any stormwater run-on effectively diverted around the irrigation area?		☐ Yes	☐ No
Is the irrigation pump working?		☐ Yes	☐ No
Is the irrigation system working without leaks?		☐ Yes	☐ No
Has the effluent irrigation area been back flushed?		☐ Yes	☐ No
Have the irrigation filters been checked and cleaned?		☐ Yes	☐ No
Does the system require air bleeding?		☐ Yes	☐ No
If an automatic sequencing valve is fitted, does it appear to switch between the different fields sequentially?		☐ Yes	☐ No
If a manual valve is fitted, has it been switched between the different fields?		☐ Yes	☐ No
Is the irrigation area still adequately protected from livestock, vehicles, children etc through the use of fencing, or shrub barriers etc.		☐ Yes	☐ No
Is there any inappropriate use of the irrigation area eg vegetable growing?		☐ Yes	☐ No
Note, if as a system owner, you answered 'No' to any of the above questions, or there are any other problems, you should contact your service provider immediately.			
Service provider: **Contact number:**			

9.3 Appendix 3 – Fact Sheets for Owners

Managing Wastewater In Your Backyard



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:

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.

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.

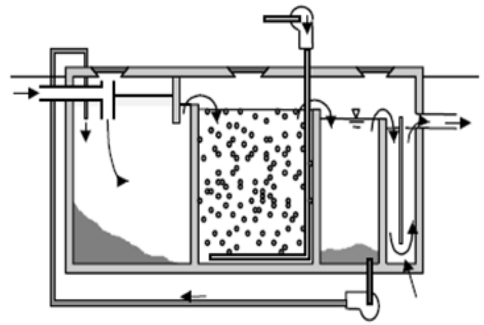
HELP PROTECT YOUR HEALTH AND THE ENVIRONMENT

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



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.

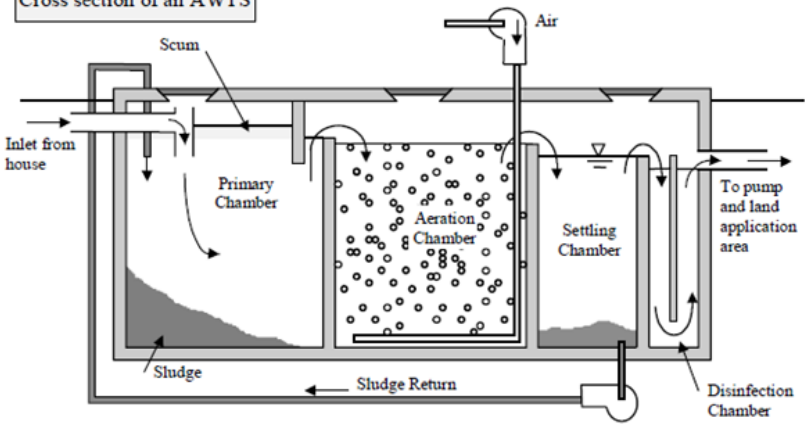
It consists of a series of treatment chambers combined with an irrigation system. An AWTS enables people living in unsewered areas to treat and utilise their wastewater.

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:

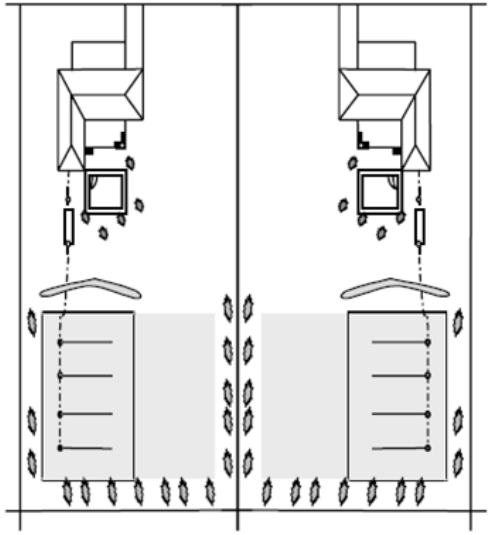
DO

- ✓ 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

Your 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:

SEEC

20000363-WW-01

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?

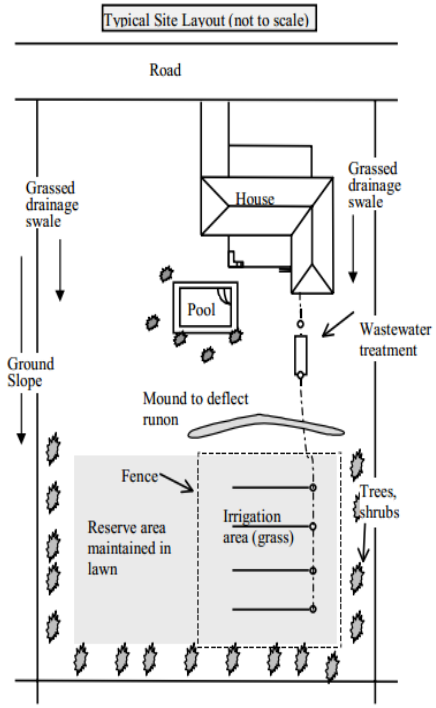
Treated wastewater applied to a land application area may be utilised or simply disposed, depending on the type of application system that is used. The application of the wastewater can be through a soil absorption system (based on disposal) or through an irrigation system (based on utilisation).

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.



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.