LAND CAPABILITY ASSESSMENT
ONSITE DOMESTIC WASTEWATER SYSTEM MANAGEMENT REPORT

Client: [redacted]

Project: Land Capability Assessment (LCA) report for development of renovated church to a dwelling at 345 Hughes Road, Wangoom, 3279.

Date: August 16, 2024

Contact: Phase Building Design info@phasebuildingdesign.com.au

Landtech: [redacted]

Figure 1 – Oblique view of the subject lot with existing land cover and existing church within the north-west corner of the lot.

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Document control

Assessment	Land Capability Assessment (LCA) for development of church building into a residence, and design of compliant onsite wastewater management for the lot (based on AS1547 & EPA GOWM 2024).
Address	345 Hughes Road, Wangoom, 3279
Project number	3453279
LCA author	[redacted]
Client	[redacted]
Council	Moyne Shire Council

Acknowledgements

Disclaimer

Although Landtech Consulting have taken all the necessary steps to ensure that an accurate document has been prepared, the company accepts no liability for any damages or loss incurred as a result of reliance placed upon the report and its contents.

Figure 2 – Ground view of lightly western sloping lot and existing church and hall infrastructure.

SUMMARY

Landtech Consulting was commissioned by Phase Building Design (for owner) to conduct a Land Capability Assessment (LCA) for the conversion of an old church into a residence, within an unsewered lot, at 345 Hughes Road, Wangoom, 3279.

This assessment was undertaken to identify and characterise site and environmental constraints potentially impacting the existing/potential onsite wastewater systems. Proposed onsite wastewater system design and effluent disposal calculations are based on EPA Victoria's Guideline for Onsite Wastewater Management & EDRS (2024).[1]

NOTE: The amended *Environment Protection Act 2017* came into effect in Victoria on 1 July 2021. These new environment protection laws, and supporting regulations, focus on preventing waste and pollution impacts, rather than managing impacts after they have occurred.

Under the *Environment Protection Regulations 2021*, onsite wastewater management systems are a *prescribed permission activity (A20)*, and this is a permit activity that is administered by the council in whose municipal district the onsite wastewater management system is located.

It applies to proposed new systems and alterations to existing systems, which includes alterations that increase the system's flow or load, such as a house extension or installation of a spa.

A key method in minimising risk to the environment and public health from domestic wastewater, is to minimize the volume of wastewater produced. Minimising wastewater volumes can be achieved by:

- *Using water saving fixtures and fittings*
- *Installing a dry composting toilet*
- *Not installing a bath (low flow rate shower only)*
- *Not installing extra wastewater producing facilities (e.g. spa, kitchen food waste grinder)*
- *Adopting indoor recycling (toilet flushing and/or washing machine use) of advanced secondary-treated greywater.*

The *general environmental duty* is a centrepiece of the new laws and regulations. It applies to all Victorians. If you conduct activities that pose a risk to human health and the environment, you must understand those risks. You must also take reasonably practicable steps to eliminate or minimise them. Onsite wastewater management systems can be a risk to human health and the environment if they are poorly installed or maintained. The general environmental duty is underpinned by the *Environment Protection Regulations 2021* which set out duties and obligations for persons in management or control of land where an onsite wastewater management system is located. These include requirements for the landholder or land manager to:

- *Take all reasonable steps to operate the system so it does not pose a risk to human health or the environment*
- *Take all reasonable steps to maintain the system in good working order (for residential properties, this applies to the owner but not to a renter)*
- *Check for signs the system may be failing or is not in good working order and, from 1 July 2022, notify council if this is the case*
- *Respond to system failures*
- *Provide information to occupiers regarding the correct operation and maintenance* of the system
- Keep maintenance records and, on request, provide them to council.

Figure 3 – Recent site clearing works have removed shading aged conifer trees to enhance potential wastewater disposal.

[1] EPA 2024; EPA Victoria's Guideline for Onsite Wastewater Management (2024)

Table 1 – Onsite wastewater compliance summary

Proposal	Land Capability Assessment (LCA) for conversion of old church into a residence within the existing *Farming Zone (FZ)* lot; and required onsite wastewater system compliance for the proposed lot activity (based on AS1547, EPA Victoria Guideline for Onsite Wastewater Management 2024, EDRS 2024).
Property	Address: 345 HUGHS ROAD WANGOOM 3279. Lot and Plan Number: Lot 1 TP21295 Standard Parcel Identifier (SPI): 1\TP21295 Local Government Area (Council): MOYNE Council Property Number: 530744 Planning Scheme: Planning Scheme - MOYNE UTILITIES Southern Rural Water Wannon Water POWERCOR
Owner / Developer	[redacted]
Zoning/Overlays	FARMING ZONE (FZ) SCHEDULE TO THE FARMING ZONE (FZ)
Key regulatory site constraints	35-07-2 FARMING ZONE (FZ) Each dwelling, small second dwelling or rural worker accommodation must be connected to reticulated sewerage, if available. If reticulated sewerage is not available all wastewater from each dwelling must be treated and retained within the lot in accordance with the requirements of the Environment Protection Regulations under the *Environment Protection Act 2017* for an on-site wastewater management system.
Domestic water supply	Reticulated water supply available.
Anticipated wastewater load[2] [3]	4-bedroom dwelling = 4+1=5x180L/day=900L/day
Availability of sewer	The area is unsewered and is unlikely to be sewered in the short to medium term.
Local Government Area	MOYNE SHIRE COUNCIL
Area of lot	4006m²
Legislation	ASNZS 1547 Guideline for Onsite Wastewater Management & EDRS guideline 2024[4] Environment Protection Act 2017 (formerly 1970) State Environment Protection Policies (SEPPs) Planning and Environment Act 1987
Methods	A field assessment was undertaken on 1 July 2024 to obtain information on land capability of the selected study area and assessment of potential wastewater system able to be used sustainably within the lot. Soil sampling supported by ground-based and drone collected imagery and elevation data was collected for this report; to 1.2m (auger length) depth and based within proposed effluent envelope and reserve disposal areas. ArcMap and GlobalMapper GIS and mapping software was used to assist in the interpretation of site constraints and provision of proposed wastewater design location and infrastructure.
Results	Key summarised issues in relation to this LCA are based on the *Guideline for Onsite Wastewater Management 2024* and Silty Light Clay (5a) category and where Landtech recommends the following (see *Figures 25-28*):[5] [6] **PROPOSED CHURCH CONVERSION TO DWELLING** → The lot is small from an onsite wastewater perspective and will require secondary treatment for OWMS within-lot management (see *Figures 25-28*); → With renovation of the church to a dwelling an indicative 4-bedroom dwelling capacity has been used (4+1=5x180L/day=900 litres/day) (this can be varied as required); → The lot requires install of an AWTS (Aerated Wastewater Treatment System) that includes an internal pump for flexible disposal to 520m² (pressurised subsurface irrigation) land application area (grid area or lineal layout – garden beds etc) or soil absorption trenches equivalent (more information can be provided); → The existing aged and non-compliant septic tank must be decommissioned as per the Victorian EPA's GOWM 2024 guideline; → Land application areas should be inter-planted (vegetated using local sedges and tussock grasses) around and specifically downslope from effluent disposal areas (see *Appendix 18*); → Gate valves and inspection pits should be placed before and after all system components (and raised to ground level inspection) so system components can be isolated when maintenance is required;

[2] EPA Victoria 2024; Guideline for Onsite Wastewater Management; Accessed from: https://www.epa.vic.gov.au/about-epa/publications/onsite-wastewater-management-guidance
[3] AS/NZS 1547:2000 – Onsite Domestic Wastewater Management (Appendix 4.2D) for standard water reduction fixtures.
[4] EPA Victoria 2024; Guideline for Onsite Wastewater Management; Accessed from: https://www.epa.vic.gov.au/about-epa/publications/onsite-wastewater-management-guidance
[5] EPA Victoria 2024; Guideline for Onsite Wastewater Management; Accessed from: https://www.epa.vic.gov.au/about-epa/publications/onsite-wastewater-management-guidance
[6] AS/NZS 1547:2000 – Onsite Domestic Wastewater Management (Appendix 4.2D) for standard water reduction fixtures.

	→ Pump size used within AWTS must be matched to suit pumping requirements with alarm systems wired to the central power supply; and → Suggested use of low phosphorus and low sodium (liquid) detergents (no chlorine-based products) to protect the treatment system, improve effluent quality, and maintain soil properties for growing plants.
Site Limitations, Constraints	Reduced lot size for assimilation of wastewater Soil texture constraint (light clay)
Design Irrigation Rate (DIR)	3 mm/day (subsurface irrigation - secondary treatment)
Land Application Area (LAA)	518m²
Reserve area available	Reserve disposal areas can be provided but are not required using subsurface irrigation
Wet Weather Storage	Built into design flows
Recommended Effluent Quality Criteria	The domestic on-site effluent treatment systems must be able to provide an effluent of a quality to achieve compliance with the following criteria; secondary quality (20 mg/L BOD5, 30mg/L SS, 10 cfu/100mL).
Site Mitigation/Amelioration Measures	□ Re-use of wastewater to planted gardens, screen plantings etc; □ Within lot drainage designed to avoid cross site drainage (and into watercourse) in intense rain events (when wastewater systems can fail with surface discharge in such events) – completed at wastewater system application stage; □ System maintenance reporting to include treatment and disposal systems.
Operation and Maintenance	A basic operation and system maintenance plan should be incorporated when the system is installed with plumber input. The Plan will provide confirmation of manufacturer, treatment processes, and irrigation components. An operations and maintenance manual is to be included as an on-site tool for staff and service contractors. The EP Regulations[7] require OWMS to be operated and maintained correctly. The owner of land on which an OWMS is located must provide the person in management or control of an OWMS written information regarding correct operation and maintenance (regulation 160). Householders should keep a record of their treatment plant pump-outs and notify the council that a pump-out was undertaken where required in response to a written notice from the council requiring maintenance.

Figure 4 – The site forms part of depositional volcanic plain landforms and related soil landscapes.

[7] EPA Victoria 2024; Guideline for Onsite Wastewater Management; Accessed from: https://www.epa.vic.gov.au/about-epa/publications/onsite-wastewater-management-guidance

Figure 5 – The site exists within the northern part of the Russells Creek catchment (Source: Airbus 2024).

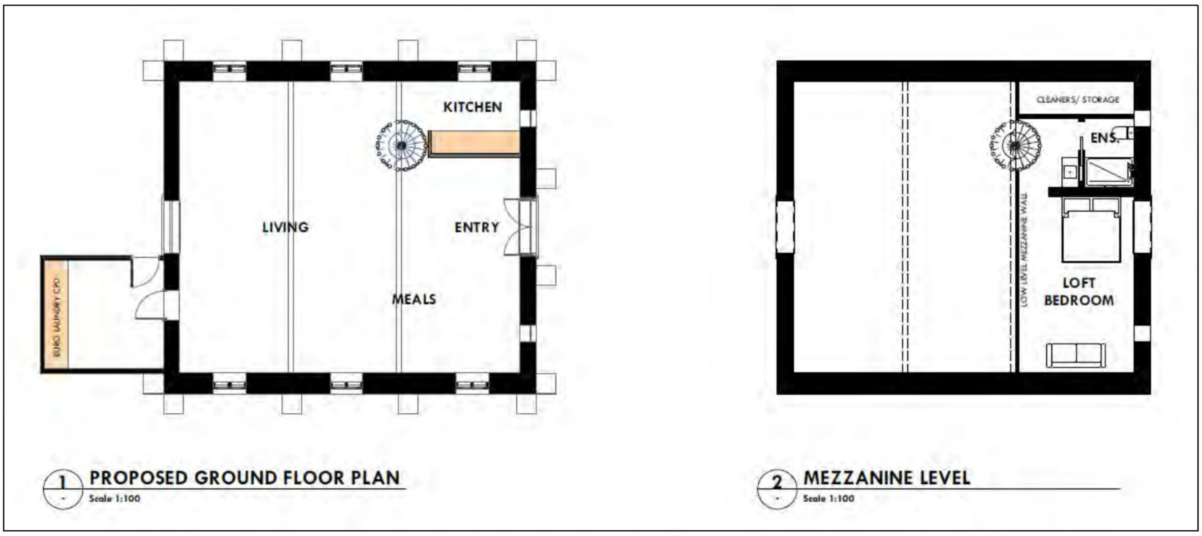

Figure 6 – Proposed renovation to church – floor plan (Source: Phase Building Design 2024).

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Figure 7 – View from the northern lot boundary across the reduced sized lot to the existing built infrastructure.

1. DESCRIPTION OF PROPOSED DEVELOPMENT

Landtech Consulting was engaged to undertake a Land Capability Assessment for a proposed church renovation to a residence/dwelling, within the lightly-westerly sloping lot, and required compliant onsite wastewater management at 345 Hughs Road, Wangoom, 3279, Victoria (see *Figures 1-18 & 25-28 & Table 2*).

This report will accompany a *Planning Permit* to be submitted to Moyne Shire Council for the development and the requirement for a compliant onsite wastewater system servicing the renovated church/residence.

The site is a 4006m^2 *Farming Zone (FZ)* lot within volcanic plain influenced landforms to the north-west of the Wangoom junction.

The surrounding area contains unsewered and typically large-acre lots under agricultural activity within fertile but typically heavier textured soil landscapes.[8]

The report will be based on wastewater load and best-practice onsite wastewater system for the proposed renovation and change to lot usage. This LCA report provides information regarding site and soil conditions and recommendations for the proposed treatment systems and land application methods (LAAs).

The owner can provide Council further specific information regarding future lot development/future site infrastructure intentions.

Figure 8 – The subject lot includes an aged existing church and hall building.

The LCA includes a conceptual design for suitable onsite wastewater systems for the proposed lot to meet the Victorian EPA's Guideline for Onsite Wastewater Management 2024, including recommendations for system monitoring and management.

The field investigation and report has been undertaken and prepared by suitably qualified and experienced staff. *Landtech Consulting* has appropriate qualifications, experience, and professional indemnity insurance and certification documents available on request.

The assessment was completed in accordance with the *Environment Protection Authority's* Guideline for Onsite Wastewater Management 2024 and the accompanying EDRS Guideline (2024), guidelines such as *Land Capability Assessment for On-Site Wastewater Management (EPA Publication No. 746.1*, March 2003), and *On-Site Domestic Wastewater Management (AS/NZS 1547:2012).*

Operation, maintenance, and management of any treatment and disposal system must be in accordance with the manufacturer's recommendations, the *EPA Certificate of Conformity*, the Guideline for Onsite Wastewater Management 2024, Australian Standards, Guidelines, and recommendations made in this report.

Prescriptions built into the Council Permit conditions may include strict quarterly servicing of any septic tank or treatment plant and effluent disposal area; including the required use of WELLS & AAA-rated appliances and plumbing fixtures (see *Appendix 9*).

[8] VRO soils 2024; Glenelg CMA soil landforms; Accessed from: https://vro.agriculture.vic.gov.au/dpi/vro/glenregn.nsf/pages/glenelg_soil_mm451

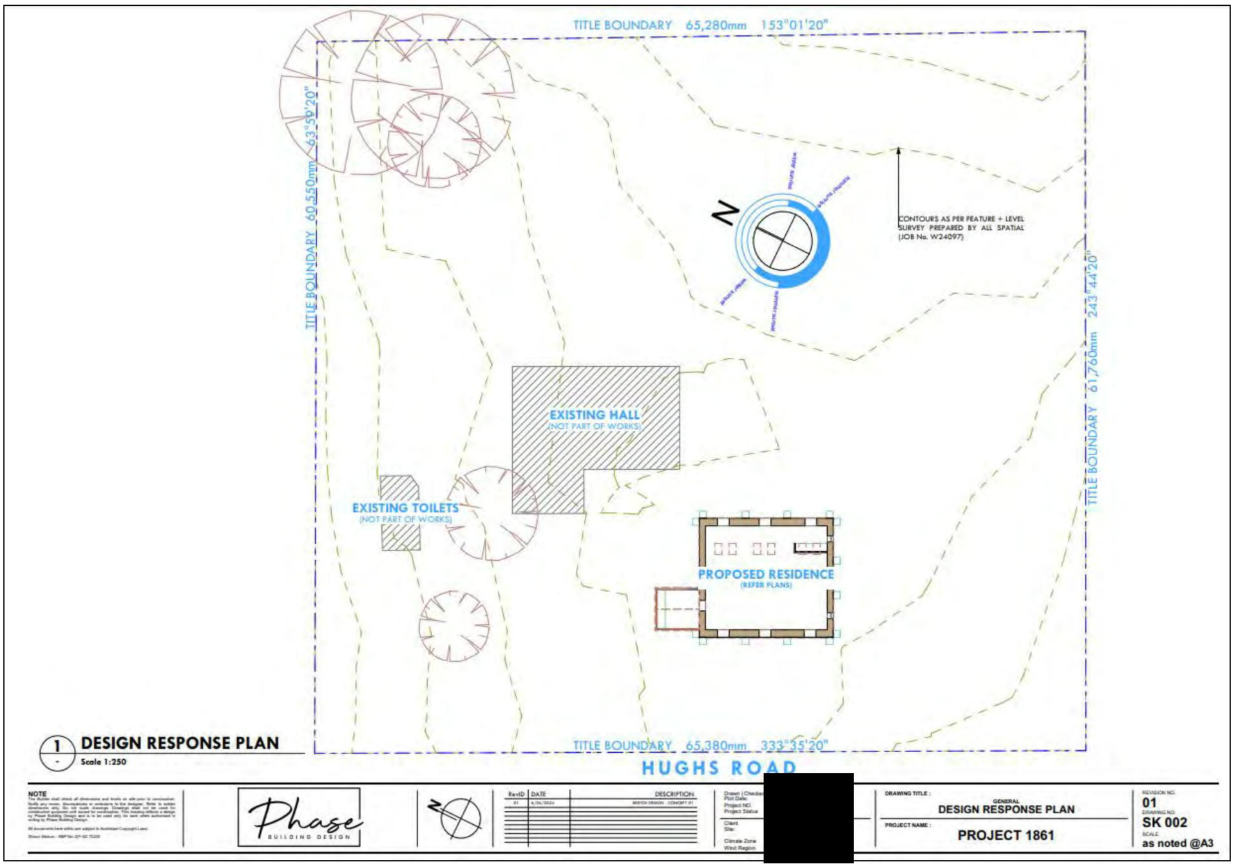


Figure 9 – Proposed church and site renovation plan (Source: Phase Building Design 2024).

Figure 10 – Internal church renovation detail (Source: Phase Building Design 2024).

Figure 11 – The lot straddles a localised ridgeline with fall to the west and east from the built area existing.

Figure 12 – Site feature map with existing site infrastructure and soil test pit locations.

Figure 13 – Overhead view of existing church to be renovated to a dwelling/residence with the adjoining hall shown.

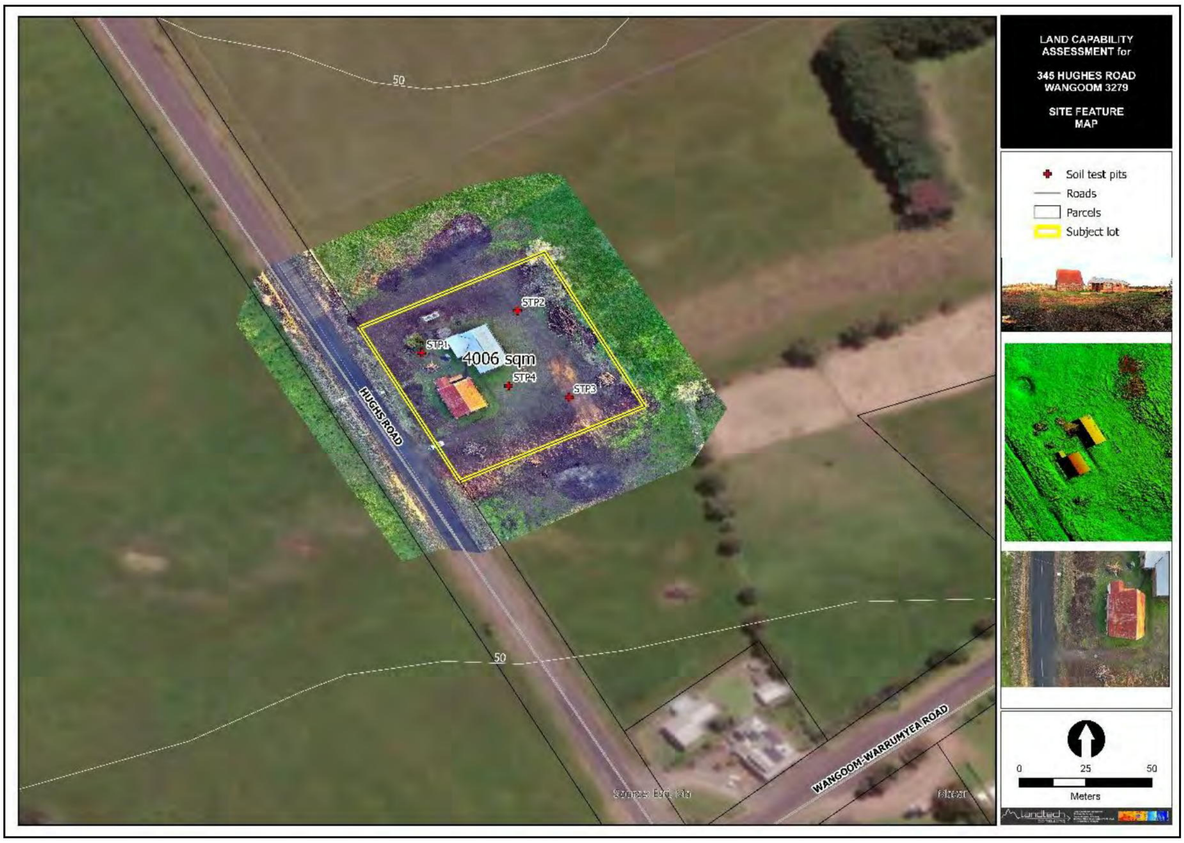


Figure 14 – Surrounding volcanic plain landform and broad-acre land use.

2. EXISTING SITE FEATURES & INFRASTRUCTURE

The subject lot forms part of flat to lightly-sloping volcanic plains landforms of relatively recent deposition based on geological time scales. Soil characteristics include high fertility and CEC, coupled with somewhat reduced infiltration. Such soil textures are enhanced by the use of subsurface irrigation for disposal therefore requiring secondary treatment.

The reduced-sized lot is free from major receptors and related constrains and includes an existing aged septic tank requiring decommissioning as part of site usage/development.

The lot contains an existing church, hall, and toilet out-building within the central part of the lot with associated open areas optimal for effective and sustainable effluent disposal.

The broadly rectangular north-west to south-east aligned lot has recently been cleared of most tree vegetation and ground works providing uniform sites for effluent land application.

The lot has a south-westerly aspect and lightly north-western sloping (0-4%) landform for subsurface evaporative-based disposal.

The lot is over 500m east of tributaries of Russells Creek, a major Warrnambool area catchment, and is clear of wetlands, depressions, and local drainage lines. Access to the lot is via Hughes Road along the lot's western boundary.

Figure 15 – Lightly western sloping lot with existing church and hall to the north east and surrounding areas available for disposal.

Figure 16 – The site exists within volcanic plain landforms of high fertility and CEC (Source: Airbus 2024).

3. DESCRIPTION OF SITE WASTEWATER CONSTRAINTS

Table 3 – Wastewater constraint issues and management within the site.

Wastewater constraint/issue	Information
Constraints	■ Reduced lot size for assimilation of wastewater ■ Soil texture constraint (light clay)
Service report to Council	■ Suggested use of secondary treatment (via an AWTS). ■ If sewer is extended to the site in the medium-term, secondary treatment systems can continue to be used if quarterly maintenance occurs during an expected 15-20 year life span (of system) and agreement with water authority. After such a period the lot must be connected to sewer.
Vegetate effluent disposal areas	■ Requirement to vegetate and protect effluent disposal areas and actively maintain all effluent disposal system and areas. ■ Proposed effluent disposal areas exhibit strong pasture/vegetation growth, potentially providing enhanced evapotranspiration rate potential. ■ It is recommended that vegetation plantings be designed into land application areas.
Reserve areas	■ Reserve land application areas provide long-term alternative effluent disposal areas if the proposed effluent disposal area fails. The proposed subsurface irrigation disposal system is relaced at the end of it's life and does not require a reserve area. Council can provide advice on the requirement for a reserve land application areas.
Sustainable wastewater treatment and disposal	■ Integrated mitigation requirements could be followed such as low water use fittings for all built structures, water saving appliances, quarterly system and disposal field maintenance, and report to Council (Health Unit), provision and protection of reserve fields, use of subsurface irrigation with strategically vegetated effluent disposal area.
Performance monitoring	■ The Victorian EPA suggests effective management of a wastewater treatment plant is essential in achieving consistently high levels of environmental performance. ■ Field tests are an integral part of any treatment plant operation as they provide the operator with a simple way to assess the performance of all facets of the treatment process. Test results should be recorded with the flow and/or applied loading rates, and any alterations to the plant or operational procedures should be noted at the appropriate time.

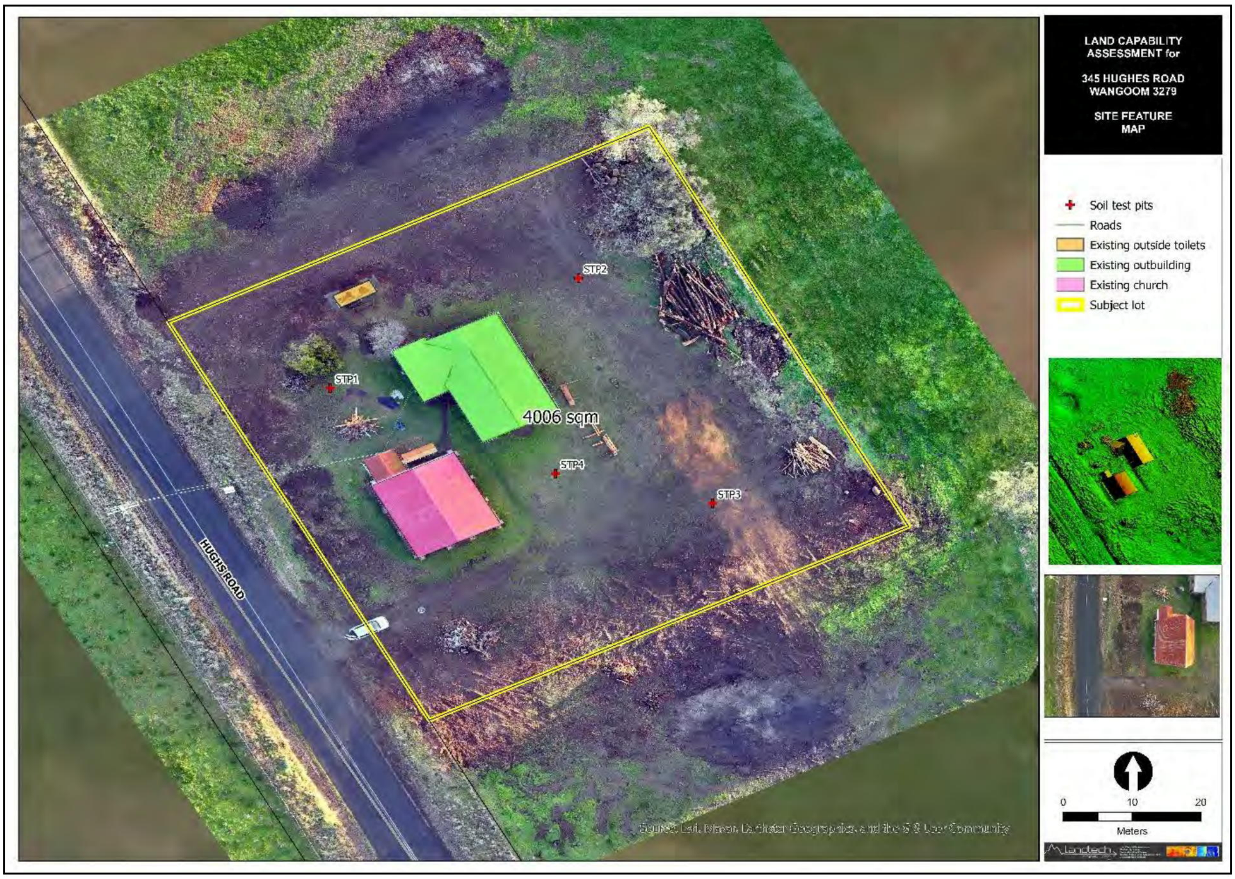


Figure 17 – Soil test pit sites within the reduced-sized lot for wastewater assimilation.

4. SITE KEY FEATURES

Site investigation was undertaken by Peter Austin on the 1 July 2024.

A range of site features were assessed in terms of the degree of limitation they present for a range of onsite wastewater management systems.

Reference is made to features described in Table 1 of EPA (2003)[9] & EPA Guideline (2024).[10]

-*Table 4* summarises the key features in relation to effluent management at the site.

-*Figures 1 – 18* provide site and locality plans indicating the location of the site/proposed development.

-*Figures 25-28* provides site plans describing the physical site features, location of proposed development, and proposed wastewater management system components.

NOTE:

- The proposed area available to contain effluent is not constraining if mitigatory measures detailed within this report/conclusion are prescribed actions.
- The site's proposed for the effluent disposal areas (LAA) have the potential to be impacted by minor to moderate stormwater run-on/off due to the lightly-sloping site.
- The lot is outside the 1 in 20-year and the 1 in 100-year flood coverage (and not within a *Declared Water Supply Catchment Area*).
- There is no evidence of a shallow watertable within 5km of the site reported to have groundwater at 29.8m depth (*VVG Groundwater Data; Bore:WRK39367 and virtual bore data, 2024*).[11]
- The site is moderate elevated relative to surrounding topography at 50m elevation.
- Reserve land application areas are considered within this report due to best-practice provision.
- The lot/activity proposed can be considered to have sufficient land available for sustainable onsite effluent management that maintains appropriate buffers to limiting receptors.
- Key site factors and proposed development descriptors are listed in *Tables 4-5*.

Figure 18 – The closest groundwater bore is over 100m from the lot (Source: VVG 2024).

[9] Land Capability Assessment for On-Site Wastewater Management (EPA Publication No. 746.1, March 2003); Table 1 of EPA (2003a).
[10] EPA Victoria 2024; Guideline for Onsite wastewater Management; Accessed from: https://www.epa.vic.gov.au/about-epa/publications/onsite-wastewater-management-guidance
[11] CERDI Visualising Victoria's Groundwater; Accessed from: https://www.vvg.org.au/view_bore.php?database=dse_gms&bore_id=4250136

Table 4 – Key site features.[12] (*NN: not needed).

	FEATURE	DETAIL	Nil or Minor	Moderate	Major	Level of constraint	MITIGATION MEASURES
1	Aspect	The site includes a south-eastern aspect.	*N NE NW*	*E W SE SW*	*South*	Moderate	NN*
2	Exposure	The site has high sun and wind exposure.	*Full sun, high wind, minimal shading*	*Dappled light*	*Limited patches of light to heavily shaded all day*	Nil	NN*
3	Climate	The site has a temperate climate with a warm to hot summers and cold winters with rainfall exceeding evaporation in few Winter months only. The site experiences an average annual rainfall of 856mm (Warrnambool – 090176) and an average of 89.3 rain days per year (>=0.1mm). Annual pan evaporation is taken as 1346mm (Warrnambool – 90176).	*Excess of evaporation over rainfall in the wettest months*	*Rainfall equal to evaporation*	*Excess of rainfall over evaporation in the wettest months*	Moderate	Calculate irrigation area using MAV guideline, EPA DIR's
4	Erosion potential	Minor evidence of sheet or rill erosion. The erosion hazard is minor with enhanced vegetation cover retained.	*Nil or minor*	*Moderate*	*Severe*	Nil	NN*
5	Fill	Natural soil profiles were observed throughout the site. No fill was observed and no filling is proposed in the effluent management area.	*No fill or minimal fill, or fill is good topsoil*	*Moderate coverage, fill is good quality*	*Extensive poor quality fill*	Nil	NN*
6	Flood potential	The potential house sites and areas available for application of treated effluent lie above the 1:20 & 1:100-year flood level (Source: DataVic 1%AEP).	*Less than 1 in 100 years*	*Between 100 and 20 years*	*More than 1 in 20 years*	Nil	NN*
7	Groundwater	There are no signs of shallow groundwater tables above 1.5m depth. References suggest groundwater depth is 29.8m depth (VVG Groundwater Data; Bore: WRK39367). There is no use of groundwater bore for domestic purposes within 5km of the proposed effluent management area (VVG 2017).	*No bores onsite or on neighbouring properties*	*Setback distance from bore complies (GOWM 2024)*	*Setback distance from bore does not comply with (GOWM 2024)*	Nil	NN*
8	Land suitability - available land application area	All buffer distances recommended in GOWM 2024 are achievable and do not significantly limit siting of the LAA in this case.	*Exceeds LAA, duplicate LAA, buffer distance requirements*	*Meets LAA, duplicate LAA, buffer distance requirements*	*Insufficient area for LAA*	Nil	NN*
9	Landform	The site consists of a 0-4% slope to the north-west with amenable sites for cross-slope/along contour land application.	*Convex or divergent side-slopes*	*Straight side-slopes*	*Concave or convergent side-slopes*	Minor	NN*
10	Rocks and rock outcrops	No surface rocks or outcrops evident at the immediate site.	*<10%*	*10-20%*	*>20%*	Nil	NN*
11	Recommended buffer distances	All buffer distances recommended in GOWM 2024 buffer requirements are achievable and do not limit the siting of the LAA (2 groundwater bores within the parent lot).	*Setback distance complies*		*Setback distance does not comply*	Nil	NN*
12	Site drainage and subsurface drainage	The existing church/dwelling site proposed and proposed effluent management areas are expected to receive minor stormwater run-on due to the lightly-sloping site. There is no evidence of groundwater seepage, soaks or springs nearby.	*Rapidly drained. No visible signs or likelihood of dampness*	*Moderately well drained. Some signs or likelihood of dampness*	*Very poorly drained. Sedges, mosses, surface water ponding*	Nil	NN*
13	Stormwater run-on, upslope seepage	The development area and proposed effluent management areas may receive minor stormwater run-on in intense rainfall events.	*Low likelihood of stormwater run-on*		*High likelihood stormwater run-on*	Nil	NN*
14	Slope	The overall site has sloping surfaces with an overall slope of 0-4% (based on DELWP 1:25000 elevation data and modelled DataVic data).	*<6%*	*6-15%*	*>15%*	Nil	NN*
15	Surface water	All setback distances can be complied with.	*Setback distance complies with GOWM 2024*		*Setback distance does not comply with GOWM 2024*	Nil	NN*
16	Vegetation	The site includes retained north-east corner native trees and open lawn/pasture areas dominating.	*Plentiful vegetation, good potential for nutrient uptake*	*Limited variety of vegetation*	*Sparse or no vegetation*	Nil	NN*
17	Landslip potential	Published (DataVic – Land Systems Victoria 2015) mapping and site survey suggests low-moderate landslip potential.	*Nil*	*Minor to moderate*	*High or Severe*	Nil	NN*

[12] Key resources used for this assessment include the following:
http://www.bom.gov.au/climate/data/, http://nremap-sc.nre.vic.gov.au/MapShare.v2/imf.jsp?site=water, http://maps.cerdi.com.au/vvg.php, http://data.water.vic.gov.au/monitoring.htm, http://mapshare2.dse.vic.gov.au/MapShare2EXT/imf.jsp?site=bim, http://services.land.vic.gov.au/maps/pmo.jsp#Planning%20maps%20online

5. SOIL ASSESSMENT AND CONSTRAINTS

The site's soils have been assessed for their suitability for onsite wastewater management by a combination of soil survey and desktop review of published soil survey information as outlined below.

5.1 PUBLISHED SOILS INFORMATION

Soils of the Wangoom local area have been mapped and described in the Colac (1:250 000 - 11614) map series (Geological Survey of Victoria) and related reports such as,[13]

- Soil and landforms of south-western Victoria; Part 1 Inventory of soils and their associated landscapes.[14]

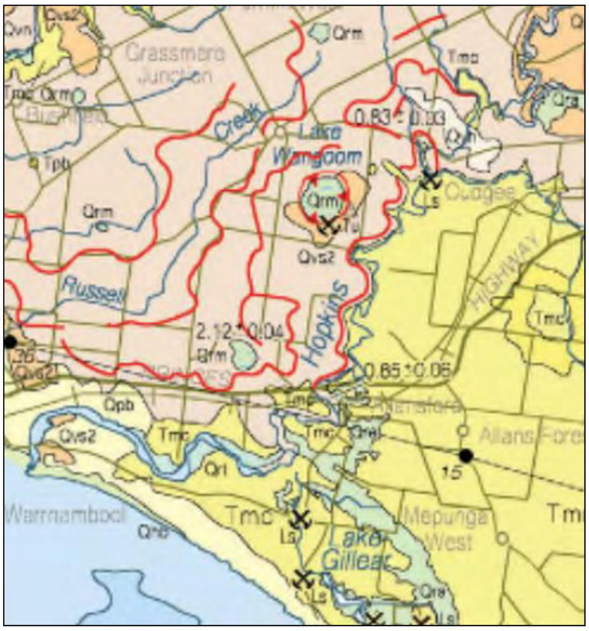
Plains with well-developed drainage and deep regolith

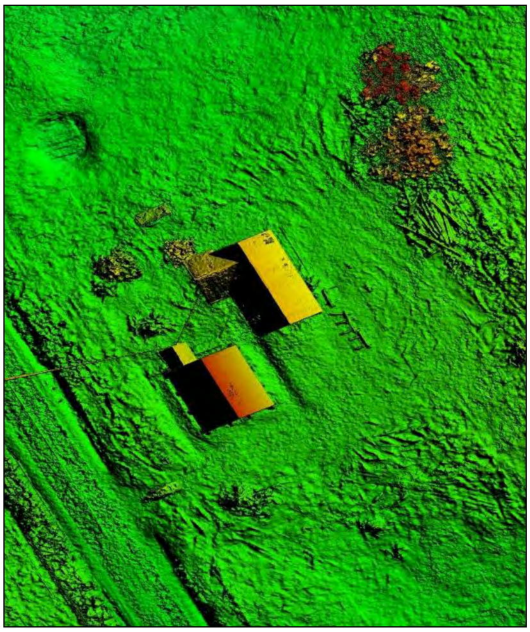
Plains with well-developed drainage represent the earlier Pliocene volcanic landscapes, from five million to two million years ago (mya), and are transitional to geomorphological unit 6.1.3.

Examples of this landform can be seen in the region north-west of Cressy and south-east of Wallinduc, and drainage is well established and ephemeral wetlands are relatively few. These areas are characterised by very planar landscapes with thicker soil development.

Regolith profiles on these old basaltic lavas have developed many metres of pallid kaolinitic clay, with ironstone at shallow depth. Associated soil types are predominantly black and brown sodic mottled texture contrast soils (Sodosols).

Scattered Red Gum cover is characteristic, and the areas of this unit are characteristically plateaus, with deep valleys incised at their margins.





Figures 19-20 – Areas of the Wangoom catchment with recent volcanic parent material origins (overlying marine sediments) (Agriculture Victoria 2023); digital surface model of site.

Dark brown (7.5YR3/2) with yellowish brown (10YR5/4) mottles; *light clay*; moderate medium polyhedral, parting to moderate fine polyhedral structure; strong consistence moderately moist; contains many (40%) ferruginous nodules (5-15 mm); variable yellowish brown (10YR5/4) weathered ash layer ('wombat rock'); pH 6.9; clear change to:

- ☐ Gradual increase in clay content with depth in the upper soil profile.
- ☐ The upper soil profile has developed on volcanic ash deposits.
- ☐ It overlies an older land surface (Vertic Sodosol soil) which developed on Tertiary limestone deposits at 120cm depth.

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[13] VRO Agriculture 2023; GH CMA soil pits SW16; Accessed from: https://vro.agriculture.vic.gov.au/dpi/vro/glenregn.nsf/pages/glenelg_soil_glenormiston_sw16
[14] Maher, J.M. (1952) Soil and Landforms of south-western Victoria. Part 1, Inventory of soils and their associated landscapes (Victoria. Dept. of Agriculture and Rural Affairs).

5.2 SOIL SURVEY AND ANALYSIS

A soil survey was carried out at the site to determine suitability for application of treated effluent.

Subsoil investigations were conducted at four locations in the vicinity of the proposed land application envelopes using hand dug test pits/bore holes (represented as TP1 and TP2 due to uniformity across the site) to 1.2m depth (see *Figures 17 & 21-22*).

Full profile descriptions are provided in *Appendix 2*. Samples of all discrete soil layers for each soil type were collected for subsequent analysis of pH, Electrical Conductivity, and Emerson Aggregate Class.

Appendix 3 describes the soil constraints in detail for the soils encountered and provides an assessment of the physical and chemical characteristics at both test pit locations.

Soils in the vicinity of the proposed effluent envelope (TP1 & TP2) are characterised as Silty Clay Loam topsoils overlying Silty Light Clay subsoils.

Subsoils of the A1 horizon exhibited a brown orange colouration (with minor <5% buckshot coarse fragments), with colour changing progressively to a darker orange brown A2 horizon.

The soil sample contained minor mottling within the lower portions of the A2 horizon although appears to provide a relatively free-draining soil profile (0.5-1m depth) for wastewater application.

The soils (within TP1 & TP2) are classified as graditional Brown Chromosol using the Australian Soil Classification[15].

After analysis of the most limiting soil texture and structure (TP1 & TP2 - most limiting / 0.5-1m depth) the soil category has been determined as a *Category 5a* in accordance with Table 5.*1 AS/NZS1547:2012* and Table 4.8 GOWM 2024.[16] The soil profile is free-draining reducing limitations to effluent application.

For the soil in the proposed land application areas, no soil characteristics present major constraints providing various options within compliant wastewater management solutions.

Figures 21-22 – Profile of TP1 & TP2.

[15] Isbell, R.F. (1996). The Australian Soil Classification. CSIRO Publishing, Melbourne.
[16] EPA Victoria 2024; Guideline for Onsite Wastewater Management; Accessed from: https://www.epa.vic.gov.au/about-epa/publications/onsite-wastewater-management-guidance

LAND CAPABILITY ASSESSMENT MATRIX

The land capability assessment matrix has been developed for the site and using the soils within the vicinity of the proposed effluent (LAA) envelope.

Table 5 – Land Capability Assessment Matrix[17]

Land features	Land Capability Class Rating					Site rating
	Very good (1)	Good (2)	Fair (3)	Poor (4)	Very poor (5)	
General characteristics						
Lot size	>10000m²	4000-10000m²	2000-4000m²	1000-2000m²	<1000m²	3
Site drainage	No visible signs of dampness	Moist soil but no standing water		Visible signs of dampness such as moisture-tolerant plants	Water ponding on surface	1
Run-off	None	Low	Moderate	High – need for diversionary structures	Very high – diversion not practical	2
Flood levels (1 in 100 yr)	Never		<1 in 100	<1 in 100 and <1 in 20	<1 in 20	2
Proximity to watercourses	>60m		30m		<60m	2
Slope %	0-2	2-8	8-12	12-20	>20	2
Landslip	No actual or potential failure		Low potential for failure	High potential for failure	Present or past failure	2
Groundwater (seasonal water-table depth in m)	>5	5-2.5	2.5-2	2-1.5	<1.5	1
Rock outcrop (% of land surface containing rocks > 200mm)	0	<10%	10-20%	20-50%	>50%	1
Erosion potential	No erosion	Minor	Moderate	High	Severe erosion potential	2
Exposure	High sun and wind exposure		Moderate	Low sun and wind exposure		2
Landform	Hill crests, convex side slopes and plains		Concave side slopes and foot slopes		Floodplains and incised channels	2
Vegetation type	Turf or pasture				Dense forest with little understorey	1
Average rainfall (mm/year)	<450	450-650	650-750	750-1000	>1000	3
Pan evaporation (mm/year)	>1500	1250-1500	1000-1250		<1000	2
Fill	No fill		Fill present			1
Soil profile characteristics						
Soil permeability category	2 and 3	4		5	1 and 6	4
Profile depth (m)	>2m	1.5m-2m	1.5m-1m	1m-0.5m	<0.5	1
Presence of mottling	None	Minor	Moderate		Extensive	2
Coarse fragments %	<10	10-20	20-40		>40	1
pH	6-8		4.5-6		<4.5, >8	1
Emerson aggregate	4,6,8	5	7	2,3	1	2
Electrical conductivity (Ec/dS/m)	<0.3	0.3-0.8	0.8-2	2-4	>4	2
OVERALL SITE RATING						**4**

As a guide, remedial measures should be considered whenever ratings of 3, 4, or 5 occur which may involve land improvement works, soil amelioration, or adoption of higher-level technologies to ensure environmental protection.

The rating consists of the highest (most limiting) single rating and not the average.

The assessed site has been determined to have an overall land capability assessment risk rating of 4.
See *Appendix 4* for Rating 4 wastewater management prescriptions.

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

6. WASTEWATER MANAGEMENT SYSTEM PROPOSED

This LCA will accompany a planning permit for a proposed church/residence renovation on the reduced-sized lot (including the requirement for a compliant onsite wastewater system within the lot).

Table 4.1 of the EPA Guideline 2024[18] and ASNZ1547 provides key flow-rate information to support effluent disposal calculation assumptions.

As such, this report provides recommendations for treatment and land application systems that are appropriate to the land capability, including sizing, design considerations, and justification for system selection.

Detailed design for the system should be undertaken at the time of the proposed development and submitted to Council.

It should also be noted that the lot has reduced flexibility to locate the proposed treatment system and land application area in alternative locations (due to reduced lot size and site fall/infrastructure locations) and should be based on future development plans and preferred site configurations.

Reductions in wastewater output can and should be achieved by installing high-water efficiency fittings such as with WELS-rated 3-star appliances and 4-star fittings and fixtures. Other suggested measures include; water-efficient front or top-loading washing machines, dual-flush toilets, water-efficient shower roses, water-efficient dishwashers, aerated taps, hot/cold water mixing taps, flow restrictors, hot water system with 'cold water diverter' (recirculates initial cold water flow when hot water tap used).

The proposed system should require maintenance, management, and performance monitoring and reporting. To ensure optimum performance of small wastewater treatment plants, it is important that maintenance personnel are adequately trained in maintenance and performance monitoring procedures.

Refer to the *Table 1 EDRS Guideline 2024* or the EPA website for the list of approved options (see *Appendix 16*) that are available: http://www.epa.vic.gov.au/en/your-environment/water/onsite-wastewater. Any of the treatment system options are capable of achieving the desired level of performance if they have adequate capacity.

Figure 23 – Area to the east of the existing hall with more elevated areas to the north of the lot.

[18] EPA 2024; Guideline for onsite wastewater management.

6.1 THE TREATMENT SYSTEM COMPONENTS

Based on site and desktop assessment Landtech suggests the following treatment process components.

PROPOSED CHURCH CONVERSION TO DWELLING

- → The lot is small from an onsite wastewater perspective and will require secondary treatment for OWMS within-lot management (see *Figures 25-28*);
- → With renovation of the church to a dwelling an indicative 4-bedroom dwelling capacity has been used (4+1=5x180L/day=900 litres/day) (this can be varied as required);
- → The lot requires install of an AWTS (Aerated Wastewater Treatment System) that includes an internal pump for flexible disposal to 520m² (pressurised subsurface irrigation) land application area (grid area or lineal layout – garden beds etc) or soil absorption trenches equivalent (more information can be provided);
- → The existing aged and non-compliant septic tank must be decommissioned as per the Victorian EPA's GOWM 2024 guideline;
- → Land application areas should be inter-planted (vegetated using local sedges and tussock grasses) around and specifically downslope from effluent disposal areas (see *Appendix 18*);
- → Gate valves and inspection pits should be placed before and after all system components (and raised to ground level inspection) so system components can be isolated when maintenance is required;
- → Pump size used within AWTS must be matched to suit pumping requirements with alarm systems wired to the central power supply; and
- → Suggested use of low phosphorus and low sodium (liquid) detergents (no chlorine-based products) to protect the treatment system, improve effluent quality, and maintain soil properties for growing plants.

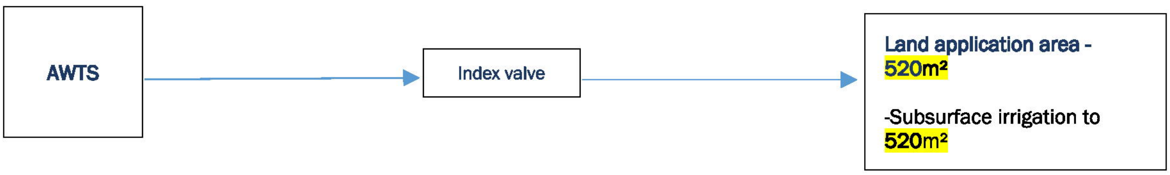


Figure 24 – Proposed system components – use of secondary treatment and subsurface irrigation.

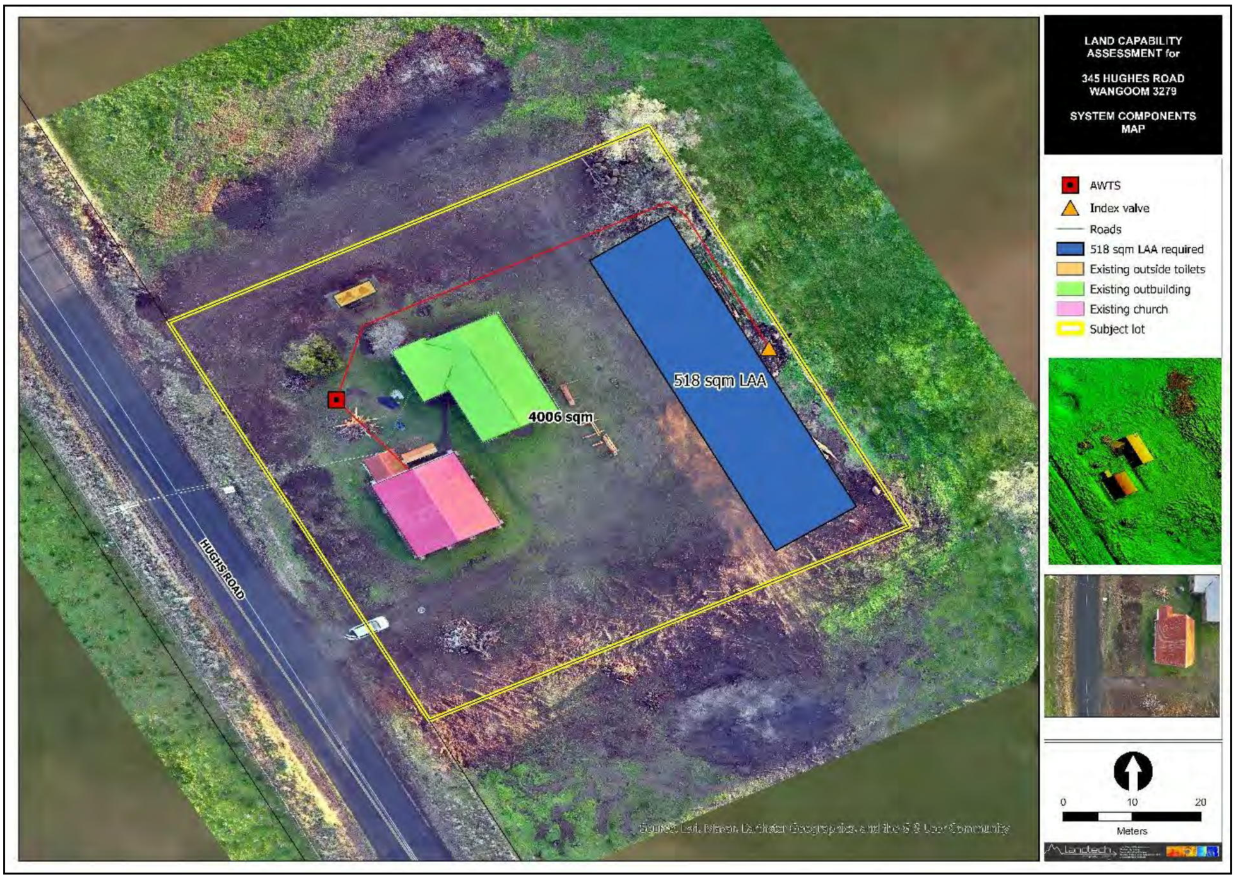


Figure 25 – Secondary treatment option using subsurface irrigation for disposal within a single grid area

Figure 26 – Secondary treatment option using subsurface irrigation for disposal with split fields and increased flexibility.

Figure 27 – Secondary treatment option using subsurface irrigation for disposal with split fields and increased flexibility.

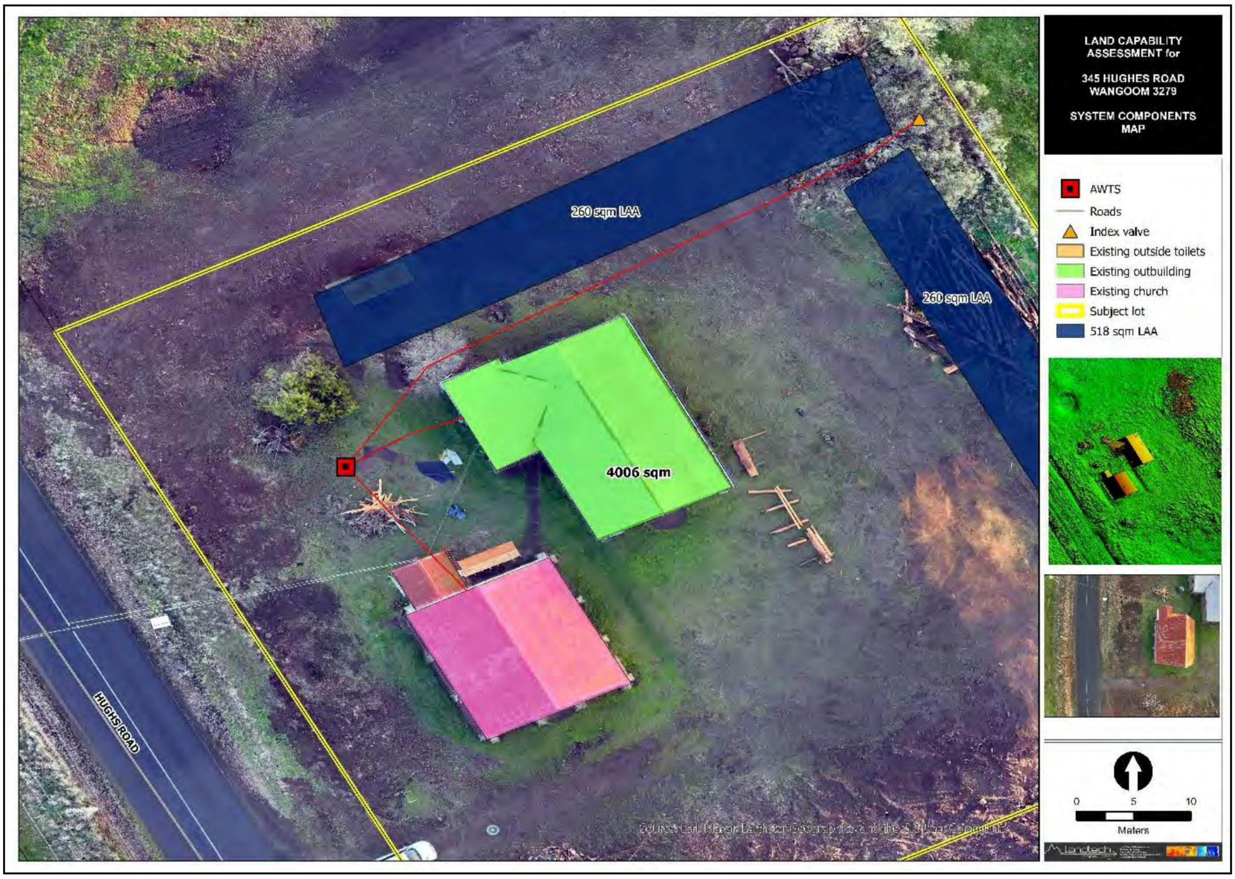


Figure 28 – Closer view of secondary treatment option using subsurface irrigation for disposal with split fields and increased flexibility.

6.2 TREATMENT SYSTEM FURTHER INFORMATION

The author recommends the use of secondary treatment (AWTS) due to reduced lot size with the flexible use of subsurface irrigation within the lot to suit future landscape plantings.

Secondary treatment (AWTS) requires the capability to treat to 20:30:10 effluent quality including required quarterly (AWTS) servicing requirements.

Using secondary treatment, unlike primary (septic tank) treatment, owners will gain the benefit of wastewater re-use via plant/pasture uptake, useful in periods of low rainfall, and the requirement on the site to retain maximum vegetation cover.

This is a significant benefit in the long term using secondary treatment systems over primary treated effluent which limits disposal options and increases disposal footprint areas required (including cost).

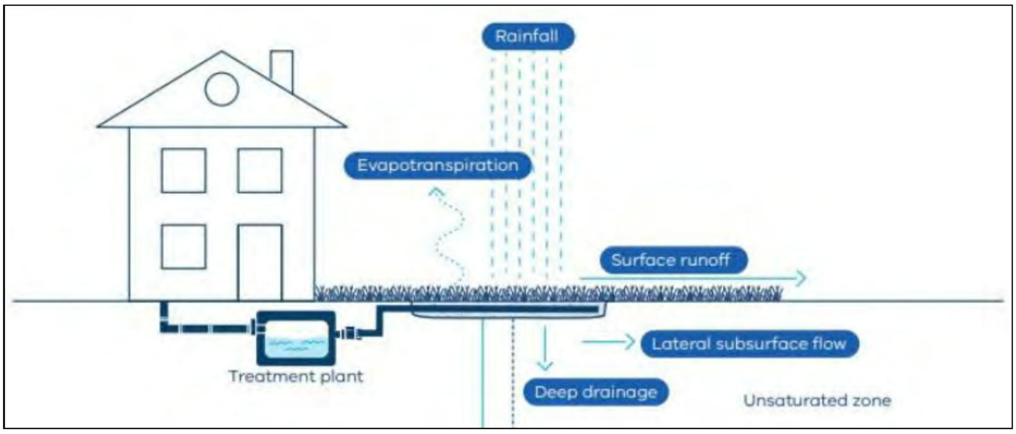


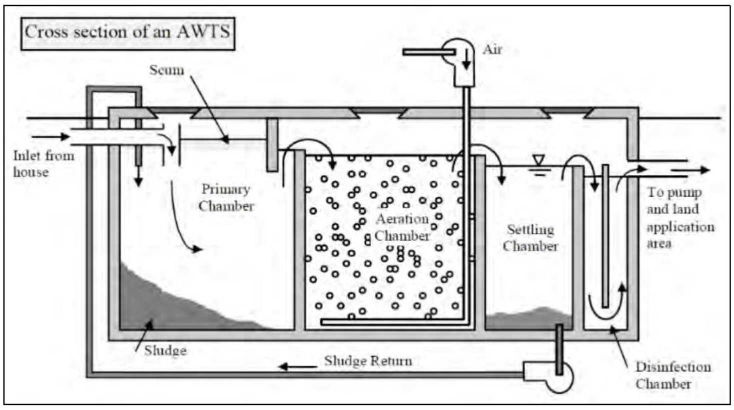
Figure 29 – Cross-section of simplified treatment and disposal proposed – AWTS disposed to subsurface irrigation (Source: Victorian EPA 2024).

AWTS's – Aerated Wastewater Treatment Systems

Commercial AWTS's are prefabricated, mechanically aerated wastewater treatment systems, designed to treat wastewater flows of >2,000L/day.

AWTS's are tank-based systems, comprising either one or two discrete tanks that typically employ the following processes: [19]

- Settling of solids and flotation of scum in an anaerobic primary chamber or separate primary tank (effectively operating as a septic tank). This stage is omitted in some models.
- Oxidation and consumption of organic matter through aerobic biological processes using (active or passive) mechanical aeration.
- Clarification – secondary settling of solids.
- Disinfection – usually by chlorination but occasionally using ultraviolet irradiation.
- Regular removal of sludge to maintain the process.



Figures 30-31 – Cross-sectional view of an aerated wastewater treatment system (AWTS); Aerated Wastewater Treatment System (Source: EHPA, Ozzikleen 2017).

[19] Corangamite Shire Council (2014). Corangamite Shire Council Domestic Wastewater Management Plan; Accessed from: https://www.corangamite.vic.gov.au/Property/Building/Wastewater-systems/Domestic-Wastewater-Management-Plan-DWMP-2014

AWTS's treat wastewater through a combination of biological treatment and aeration, resulting in a higher standard of wastewater effluent. This provides greater options for the disposal of treated effluent, although AWTS will require power to operate, and be subject to regular quarterly maintenance. Treated effluent is normally disposed of via pressure compensating sub-surface irrigation to a suitably sized and vegetated area, although dosed soil absorption trenches can be used in certain situations.

The extra treatment provided by an aerated septic tank reduces pathogen levels, (and can sometimes reduce nutrients) as long as the system is kept well maintained and the disinfection unit is functioning properly. AWTS's may also be used to treat greywater to a standard suitable for garden watering of non-food plants. AWTS are typically supplied as stand-alone, proprietary systems. They require regular maintenance in accordance with the EPA Certificate of Approval for the specific model (usually quarterly) to ensure satisfactory performance and adequate disinfection.

The operating (power) costs of AWTS are relatively high compared to more passive systems such as trickling filters and reed beds, as the aerobic treatment phase requires air blowers to be run for several hours each day.[20] AWTS's must not be switched off when not in use as the deprivation of oxygen will kill the aerobic bacteria within a few days and populations can take weeks to be re-established when the system is turned on and wastewater supply resumes. Some AWTS models have a low-flow switch which re-circulates effluent to keep aerobic bacteria alive when not in use.

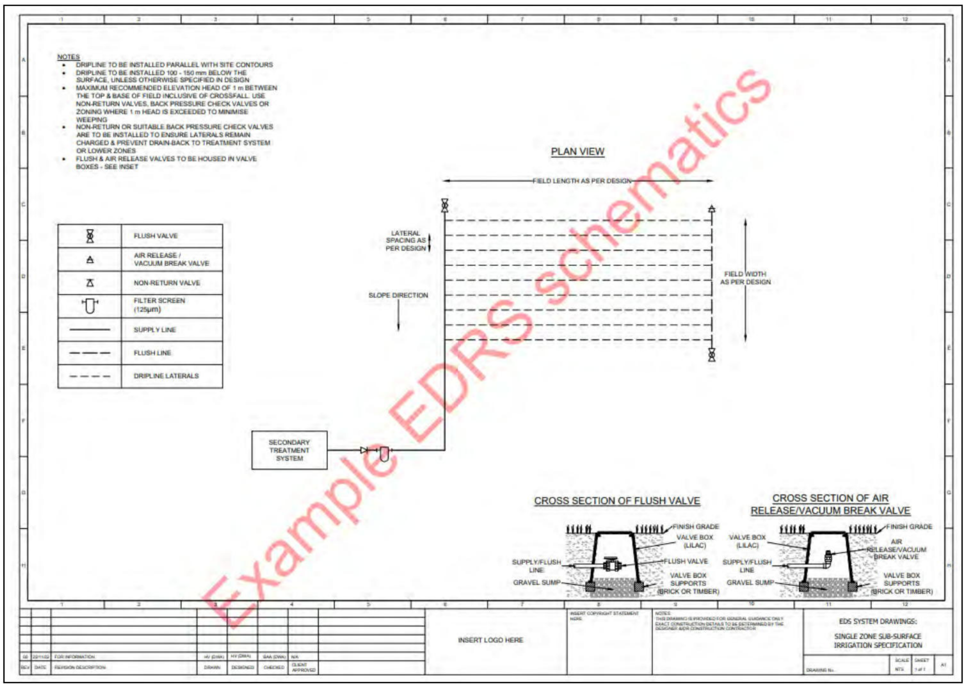


Figure 32 – Subsurface irrigation system schematic – grid-based (EPA Victoria 2024).

Figure 33 – Oblique view of existing site condition, land cover, and site infrastructure.

[20] Colac Otway Shire (2016). Colac Otway Shire Council Domestic Wastewater Management Plan - Technical Document, Accessed from: http://www.colacotway.vic.gov.au/files/assets/public/trimfiles/my-property/domestic-wastewater-management-plan/dwmp-webpage-locality_info_cororooke.pdf

7. LAND APPLICATION SYSTEM (EFFLUENT DISPOSAL)

A range of possible land application systems have been considered such as Subsurface Irrigation, Evapo-transpiration-absorption (ETA) trenches, Soil absorption trenches, and Wick-Trenches.

All methods listed above could be used with the proposed secondary treatment system with varying footprint areas resulting. Further information can be provided regarding trench-based systems if the owner has preference for such methods.

The use of subsurface irrigation allows increased flexibility of use and application of effluent over large areas within topsoil and root zones of pastures, grasses, and trees, in addition for the potential usage via targeted tree and shrub plantings (based on a lineal (m), or area (^{2}) measure, of required irrigation.

Future lot owners are encouraged to plant areas of indigenous grasses and sedges (such as *Lomandra sp., Lepidosperma sp., Poa sp.*) in blocks and linear multi-row plantings above and below the LAA.

This will assist in ensuring the risk of effluent transported off-site (to groundwater or watercourses) should be negligible or highly-mitigated.

The proposed land application area must be permanently protected from stock, person activity, or compacting machinery / parked vehicles etc. Failure to complete this will inevitably reduce the long-term sustainability of the system and lost investment.

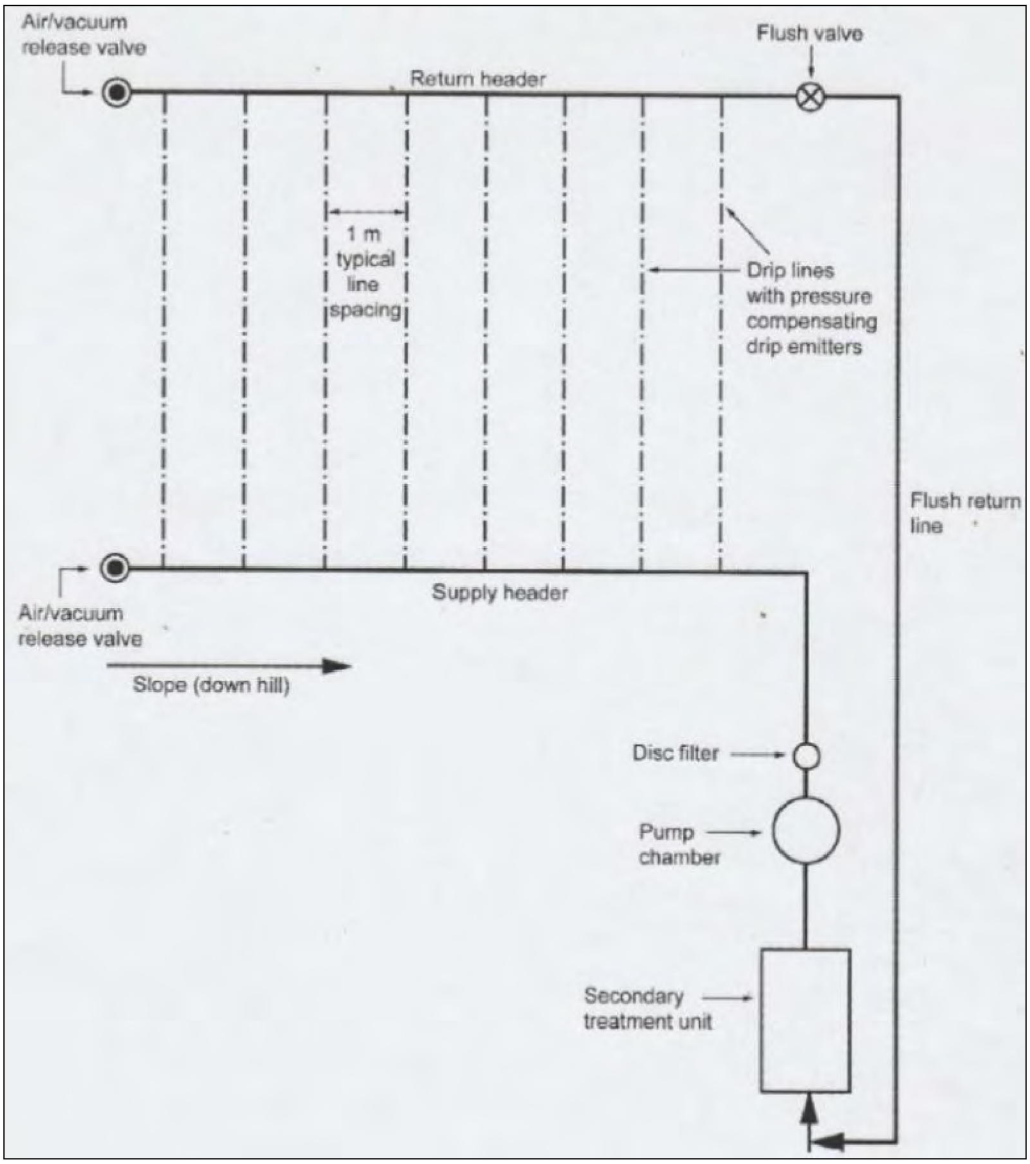


Figure 34 – Subsurface irrigation configuration (Source: ASNZS 1547).

7.1 SIZING THE EFFLUENT DISPOSAL SYSTEM

To determine the necessary size of the land application/effluent disposal areas, water and nutrient balance modelling has been undertaken in accordance with EPA Victoria 2024; Guideline for Onsite wastewater Management and AS/NZS1547.[21]

The *nominated land application area (LAA) method* has been used to calculate the area required to balance all inputs and outputs to the water balance of the system and soil profiles presenting.

For the site MAV Irrigation spreadsheets (using 3mm DIR as per Silty Light Clay soil texture) were used to calculate such areas. [22]

INDICATIVE 4-BEDROOM DWELLING LOAD	HYDRAULIC	NITROGEN	PHOSPHOROUS	LAA REQUIRED
900L/day	518	299	397	518

As a result of hydraulic balance calculations, the lot requires the above-listed required areas to achieve zero wet weather storage.



Figures 35-37 – Subsurface irrigation site preparation and piping network; flush valve (Source: Aquascope 2024).

[21] EPA Victoria 2024; Guideline for Onsite Wastewater Management and AS/NZS1547.
[22] EPA Victoria 2024; Guideline for Onsite Wastewater Management and AS/NZS1547.

7.2 SITING AND CONFIGURATION OF THE EFFLUENT DISPOSAL SYSTEM

Notwithstanding the impact of reduced lot size and minor soil texture constraints there is adequate area for location and configuration of secondary treatment-based disposal systems (LAA) within the lot.

Figures 25-28 show effluent envelopes on landscapes suitable for effluent management according to the water and nutrient balance calculations.

Reserve land application areas provide long-term alternative effluent disposal areas if the (proposed) effluent disposal area fails. The current proposal does not require reserve areas as any subsurface irrigation system is replaced at the end of it's life.

The location of the system is based on plans, previous technical assessement documents, and advice, provided by the owner and architect/surveyor. It is recommended that the owner consult an appropriately registered plumbing/drainage practitioner to quote, supply, and install the system.

Final placement and configuration of the effluent system will be determined by the client/owner and plumber, with prescriptive input from Council (and Landtech if required).

Whilst there is area for application of the effluent, it is important that appropriate buffer distances to boundaries and proposed built structures such as dwellings, embankments, driveways, rainwater tanks, and sheds (refer *EPA Victoria's Guideline for Onsite Wastewater Management 2024 and AS/NZS 1547*).

7.3 BUFFER DISTANCES

All buffer distances are achievable. The relevant buffer distances for this site, taken from *Table 4.10 of GOWM 2024* are:

- *50 metres from groundwater bores in sandy soils; and*
- *60 metres from non-potable watercourses; and*
- *100m from potable watercourses (declared water supply catchment area); and*
- *3 metres if area up-gradient and 1.5 metres if area down-gradient of property boundaries, swimming pools and buildings (secondary treatment).*

Figure 38 – Perspective view to the south-west over the existing church, hall, and adjacent areas for disposal.

7.4 INSTALLATION OF THE EFFLUENT DISPOSAL SYSTEM

Careful design and specific installation of the proposed effluent disposal system is required in light silty clay textured soils such as occurs at the subject site (see *Figures 25-28*).

- → The addition of organic matter to disposal area footprints additionally improves nutrient retention and treatment due to increased microbial activity, enhanced soil structure, and increased colloidal sites for nutrient store and treatment. Moisture is held for longer periods enhancing the surface-based (top 150mm) treatment and evapotranspiration of wastewater.

- → The addition of gypsum can assist with clodding unstructured clay soils and thus improving potential wastewater infiltration.

Other key issues include installation via:

1. A suitably qualified, licensed plumber must carry out installation of the effluent disposal system as per AS/NZS 1547;

2. The effluent disposal area must be vegetated or revegetated immediately following installation of the system, preferably with turf or native sedges and grasses (border of entire effluent area if possible); and

3. The area should be fenced or otherwise isolated (such as by landscaping), to prevent vehicle and stock access; and

4. Signs should be erected to inform householders and visitors of the extent of the effluent irrigation area, and to limit their access and impact on the area.

Figures 39-41 – Subsurface irrigation ground preparation; in-line valve, in-line filter.

Shallow subsurface irrigation

Subsurface irrigation delivers secondary treated wastewater direct to plant roots, providing recycling through plant uptake and growth. When appropriately designed and installed this option will promote transpiration of secondary treated effluent, limit evaporation and significantly reduce the likelihood of surface runoff. It is suited to a range of soil types and enables flexible garden designs.

This approach also includes covered surface drip irrigation as described in Appendix M of AS/NZS 1547:2012.

The dripline is pinned to the topsoil surface and covered with mulch or another suitable material. The mulch should be secured using measures such as bird resistant netting.

Key requirements include: • use of a pressure compensating dripline trenched or ploughed into the topsoil to a depth of 100–150 mm to evenly distribute wastewater throughout the irrigation area • installation of filters to protect the irrigation system from solids being carried over from the treatment system • installation of flush/scour valves or an equivalent system to enable periodic flushing to clean the pipes in the irrigation system • installation of vacuum breakers to stop soil and other particles being sucked into, and clogging drippers.

8. CONCLUSION

As a result of our investigations we conclude that sustainable onsite wastewater management is feasible with appropriate mitigation measures as outlined.

PROPOSED CHURCH CONVERSION TO DWELLING

→ The lot is small from an onsite wastewater perspective and will require secondary treatment for OWMS within-lot management (see *Figures 25-28*);

→ With renovation of the church to a dwelling an indicative 4-bedroom dwelling capacity has been used (4+1=5x180L/day=900 litres/day) (this can be varied as required);

→ The lot requires install of an AWTS (Aerated Wastewater Treatment System) that includes an internal pump for flexible disposal to 520m² (pressurised subsurface irrigation) land application area (grid area or lineal layout – garden beds etc) or soil absorption trenches equivalent (more information can be provided);

→ The existing aged and non-compliant septic tank must be decommissioned as per the Victorian EPA's GOWM 2024 guideline;

→ Land application areas should be inter-planted (vegetated using local sedges and tussock grasses) around and specifically downslope from effluent disposal areas (see *Appendix 18*);

→ Gate valves and inspection pits should be placed before and after all system components (and raised to ground level inspection) so system components can be isolated when maintenance is required;

→ Pump size used within AWTS must be matched to suit pumping requirements with alarm systems wired to the central power supply; and

→ Suggested use of low phosphorus and low sodium (liquid) detergents (no chlorine-based products) to protect the treatment system, improve effluent quality, and maintain soil properties for growing plants.

→ *Figures 25-28* depict areas that could support adequate effluent envelopes within the lot (required for effluent management) (and according to the water and nutrient balance calculations);

→ System maintenance and report to Council prescriptions could be built into the Council Permit to Use (with conditions such as quarterly servicing of AWTS and effluent disposal areas, pumps, and alarm systems);

→ Operation, maintenance, and management of the treatment and disposal system must be in accordance with the manufacturer's recommendations, the *EPA Certificate of Conformity*, the *EPA Guideline 2024,* Council permit conditions, and the recommendations made in this report;

→The effluent irrigation area must be located as follows:

1. *In an area that is not subject to vehicular traffic.*
2. *>3.0m from a gas or water pipe (primary treatment).*
3. *>3.0m on the low side or 6.0m on the high side of a property boundary (primary treatment).*
4. *>1.5m from a gas or water pipe (secondary treatment).*
5. *>1.5m on the low side or >3.0m on the high side of a property boundary (secondary treatment).*
6. *>3.0m from a swimming pool or stormwater drain.*

→ A *Permit to Install* an all waste system must be lodged and approved by the Responsible Authority prior to the commencement of works on any lot. Such system shall be designed and installed to the satisfaction of the Responsible Authority before a *Permit to Use* the system can be issued; and

→ Future development could include installation WELLS & AAA-rated appliances, plumbing fixtures, and water-saving appliances to minimise effluent load (see *Appendix 9*).

APPENDIX 1 - COUNCIL REGULATORY REQUIREMENTS

Council regulatory requirements[23]

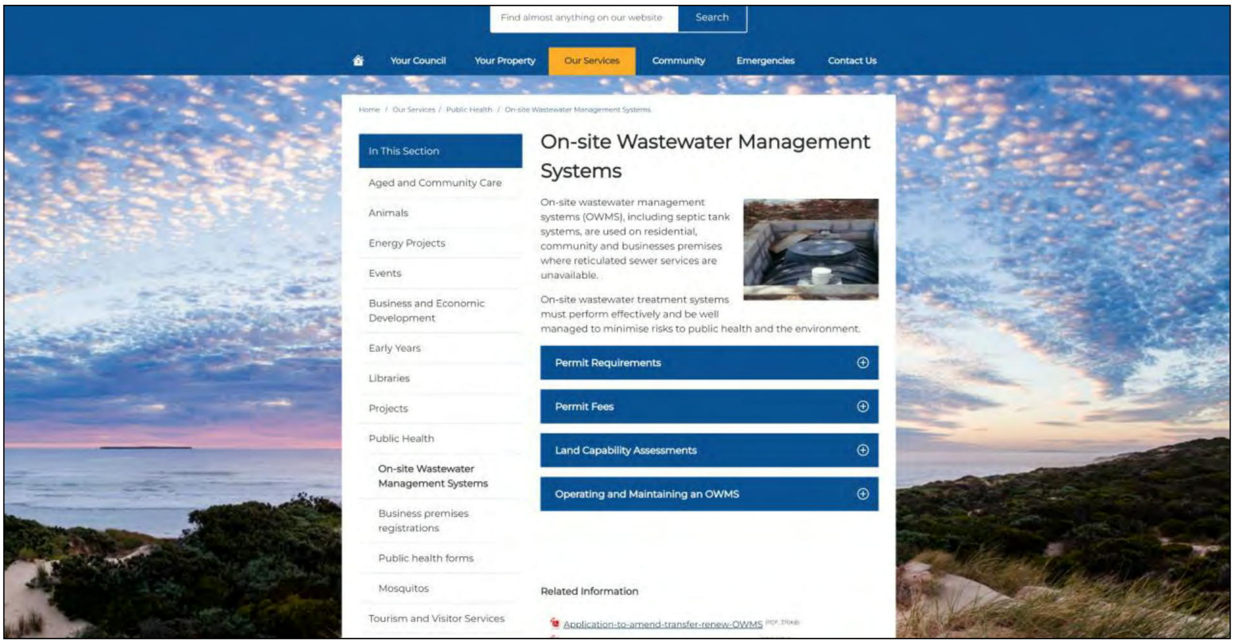


Figure 42 – Reduced information regarding onsite wastewater management is provided (Source: Moyne Shire Council 2023).

[23] Moyne Shire Council 2023; Onsite Wastewater Information.

APPENDIX 2: SOIL BORE LOG

SOIL BORE LOG		LANDTECH CONSULTING	
Client	Dean Field	**Test pit no.**	1 & 2
Site	345 Hughes Road, Wangoom, 3279.	**Excavated by**	Landtech Consulting
Date	1.7.2024	**Excavation type**	Hand-auger
Notes	Refer *Figure 17* for position of Test Pits		

PROFILE DESCRIPTION										
Depth mm	**Graphic log**	**Sample name**	**Horizon**	**Texture**	**Structure**	**Colour**	**Mottles**	**Coarse fragments**	**Moisture condition**	**COMMENTS**
0-250		TP1 & TP2	A1	Silty Loam	Moderate	Orange Brown	Nil	Nil	Moist	Nil
250-600		TP1 & TP2	A2	Silty Clay Loam	Moderate	Orange Brown	Nil	Minor buckshot	Dry	Nil
600-1200		TP1 & TP2	A2	Silty Light Clay	Moderate	Dark Orange Brown	Nil	Minor buckshot	Dry	Nil

KEY TO SOIL BORELOGS					
Watertable depth	**W**	Depth of refusal	**X**	Sample collected	•
S - Sand **LS** - Loamy sand **CS** - Clayey sand		**CL** – Clay loam **SCL** – Sandy clay loam **SiCL** – Silty clay loam		Gravel (G)	
SL – Sandy loam		**LC** - Light clay **SC** - Sandy clay		Parent material (stiff)	
L – Loam **LFS** – Loam fine sand **SiL** – Silty loam		**MC** – Medium clay **HC** – Heavy clay		Parent material (weathered)	

APPENDIX 3 – SOIL SURVEY – RISK ASSESSMENT IDENTIFICATION.[24]

TEST PITS 1 & 2 – BROWN CHROMOSOL			Nil or Minor	Moderate	Major	Assessed Level of Constraint
Soil Depth	Soil depth greater than 1200mm and no hardpans occur. Topsoil: <600mm; Subsoil: >1200 mm.		>1.5 m	1.5 – 1 m	<1 m	Nil
Depth to watertable	Groundwater not encountered; test hole terminated at 1.2m. Mapping indicates groundwater depth 29m (VVG 2024).		>2 m	2 – 1.5 m	<1.5 m	Nil
Coarse Fragments (%)	Minor coarse buckshot fragments occur within the soil profile.		0 – 10%	10 – 20 %	>20%	Nil
	TOPSOIL	**SUBSOIL**				
Soil texture AS/NZS/1547:2012	Silty Loam	Silty Light Clay	Cat. 2b, 3a, 3b, 4a	Cat. 4b, 4c, 5a, (5b)	Cat. 1, 2a, 5c, 6	Moderate
Soil colour	Brown 7.5YR/5/3	Dark Brown 5YR/4/3				
Soil structure	Moderately structured	Moderately structured	Highly or Moderately structured	Weakly-structured	Structureless, Massive or hardpan	Nil
Soil Permeability AS/NZS1547:2012	1.5 - 3m/day saturated conductivity (K_{sat})	0.12 – 0.5m/day saturated conductivity (K_{sat})	0.5 – 3m/day	0.06 – 0.5m/day	>3 or <0.06m/day	Moderate
Gleying (see Munsell Soil Colour Chart)	Nil	Nil	Nil	Some evidence greenish grey / black or bluish grey / black soil colours	Predominant greenish grey / black, bluish grey / black colours	Nil
Mottling (Munsell Soil Colour Chart)	Nil	Minor	Very well to well-drained soils - uniform brownish or reddish colour	Moderately well to imperfectly drained soils - grey and/or yellow brown mottles higher in the profile	Poorly drained soils, dominant grey colours, yellow brown or reddish brown mottles	Nil
Soil Category EPA Victoria Guideline for Onsite Wastewater Management (2024).	3a	5a	Cat. 2b, 3a, 3b, 4a	Cat. 4b, 4c, 5a, (5b)	Cat. 1, 2a, 5c, 6	Nil
Design Irrigation Rate	4 (DIR mm/day) for Subsurface Irrigation	3 (DIR mm/day) for Subsurface Irrigation	*(Table 4.8 – GOWM 2024) Inferred with reference to GOWM 2024; describes conservative design loading rates (DLRs) and Design Irrigation Rates (DIRs) for various effluent application systems according to soil texture. Reduced loading rates applies to primary treatment systems.*			
Design Loading Rate	5 (DLR mm/day) primary treatment for Wick Trenches	12 (secondary treatment) (DLR mm/day) for Wick Trenches				
pH The pH of 1:5 soil/water using a *Hanna* hand-held pH/EC meter.	6.7 - slightly acid. Soil conditions do not appear to be affecting plant growth.	6.9 - slightly acid. Soil conditions do not appear to be affecting plant growth.	5.5 - 8	4.5 - 5.5	<4.5, >8	Nil
Electrical Conductivity (Ec) (dS/m) measure of soil salinity.	0.114 deciSiemens per metre. Negligible salinity exists and will therefore not impact long-term operation of the system.	0.161 deciSiemens per metre. Negligible salinity exists and will therefore not impact long-term operation of the system.	<0.8	0.8 - 2	>2	Nil
Emerson Aggregate Class	EA Class 5 (some slaking, no dispersion or swelling)	EA Class 5 (some slaking, some dispersion or swelling)	4, 5, 6, 8	7	1, 2, 3	Nil

[24] Municipal Association of Victoria, Department of Environment and Sustainability and EPA Victoria (2013) Victorian Land Capability Assessment Framework.

APPENDIX 4 – SITE RISK RATING LIMITATIONS[25]

Rating	Degree of limitation	Detail
Rating 1	None to very slight	The effluent envelope is suitable for on-site disposal of septic discharge. The limitations or environmental hazard from long-term use is considered very slight. Standard performance measures for design, installation and management should prove satisfactory.
Rating 2	Slight	The site has been identified as generally suitable for on-site effluent disposal but there is a slight associated environmental hazard expected. One or more land limitations are present, which may not be compatible with straight forward conventional on-site disposal. The wastewater management program will require careful planning, adherence to specifications and adequate supervision.
Rating 3	Moderate	The site has only a fair capability for on-site effluent disposal with a moderate associated environmental risk always present. Very careful site selection, preparation and specialised design will be required to address the identified land constraints. A management program should be delivered to the responsible authority with the development application and prior to earthworks commencing. It is recommended that in order to achieve BPEM, wastewater processing systems which can attain a higher level of treatment with basic monitoring should be considered as an alternative to standard conventional trench disposal.
Rating 4	High	Areas have poor capability rating with a high associated environmental risk. Considerable difficulties are expected during siting and installation of the wastewater treatment system and during routine operation. A very high engineering input and close supervision would be needed to minimise the environmental impact. Alternative wastewater processing systems capable of consistently producing high quality secondary effluent (such as aerated wastewater treatment plants) together with a close monitoring program should be seriously investigated and adopted.
Rating 5	Severe	Areas have a very poor capability and there is a severe associated environmental risk. The areas are not generally considered suitable for disposal of septic tank effluent by trench systems. The high levels of engineering input and management needed at all stages are unlikely to adequately address the identified land constraints and achieve a sustainable outcome.

[25] Standards Australia / Standards New Zealand (2012). AS/NZS 1547:2012 On-Site Domestic Wastewater Management.

APPENDIX 5 - THE WATER BALANCE

The water balance can be expressed by the following equation:

Precipitation + Effluent Applied = Evapotranspiration + Percolation

Based on the use of secondary treatment and sub-surface irrigation use and site soil texture, the design loading rate based on the *EPA Victoria Guideline for Onsite Wastewater Management (2024)*[26] is 3mm/day.

A conservative approach has been taken in this instance where higher rainfall totals have been used in water and nutrient balance calculations to maximise buffering of the selected treatment system.

- Mean monthly rainfall Warrnambool Airport 090186) and mean monthly pan evaporation (Warrnambool Airport 090186);
- Average daily effluent load – 900L/day (from Table 4.1 of the EPA Guideline 2024);
- Design loading rate (DLR) – 3mm/day used (from Table 4.8 of the EPA Guideline 2024);
- Crop factor – 0.7;
- Retained rainfall – 60%

The nominated area method is used to calculate the area required to balance all inputs and outputs to the water balance.

As a result of these calculations the lot requires 518m² land application area required to achieve zero wet weather storage (see *Figure 43*).

1	Victorian Land Capability Assessment Framework				
2					
3	**Please read the attached notes before using this spreadsheet**				
4	**Irrigation area sizing using Nominated Area Water Balance for Zero Storage**				
5	**Site Address:**	**345 Hughes Road, WANGOOM 3279**			
6	**Date:**	1.7.2024	**Assessor:**	Landtech Consulting	
7	**INPUT DATA**				
8	Design Wastewater Flow	Q	900	L/day	Based on maximum potential occupancy and derived from Table 4 in the EPA Code of Practice (2016)
9	Design Irrigation Rate	DIR	3.0	mm/day	Based on soil texture class/permeability and derived from Table 9 in the EPA Code of Practice (2016)
10	Nominated Land Application Area	L	267	m²	1
11	Crop Factor	C	0.6-0.8	unitless	Estimates evapotranspiration as a fraction of pan evaporation; varies with season and crop type[2]
12	Rainfall Runoff Factor	RF	0.6	unitless	Proportion of rainfall that remains onsite and infiltrates, allowing for any runoff
13	Mean Monthly Rainfall Data	Warrnambool Airport (090186)			BoM Station and number
14	Mean Monthly Pan Evaporation Data	Warrnambool Airport (090186)			BoM Station and number
15					

	Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
17	Days in month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	**365**
18	Rainfall	R		mm/month	44.2	35.5	36.4	64.5	94.4	105.1	106.4	127.5	71.1	58.3	53	59.7	**856.1**
19	Evaporation	E		mm/month	198.4	162.4	136.4	87	52.7	42	46.5	65.1	93	124	153	186	**1346.5**
20	Crop Factor	C		unitless	0.80	0.80	0.70	0.70	0.60	0.60	0.60	0.60	0.70	0.80	0.80	0.80	
21	**OUTPUTS**																
22	Evapotranspiration	ET	ExC	mm/month	159	130	95	61	32	25	28	39	65	99	122	149	**1004.3**
23	Percolation	B	DIRxD	mm/month	93.0	84	93.0	90.0	93.0	90.0	93.0	93.0	90.0	93.0	90.0	93.0	**1095.0**
24	Outputs		ET+B	mm/month	251.7	213.92	188.5	150.9	124.6	115.2	120.9	132.1	155.1	192.2	212.4	241.8	**2099.3**
25	**INPUTS**																
26	Retained Rainfall	RR	RxRF	mm/month	26.52	21.3	21.84	38.7	56.64	63.06	63.84	76.5	42.66	34.98	31.8	35.82	**513.66**
27	Applied Effluent	W	(QxD)/L	mm/month	104.5	94.4	104.5	101.1	104.5	101.1	104.5	104.5	101.1	104.5	101.1	104.5	**1230.3**
28	Inputs		RR+W	mm/month	131.0	115.7	126.3	139.8	161.1	164.2	168.3	181.0	143.8	139.5	132.9	140.3	**1744.0**
29	**STORAGE CALCULATION**																
30	Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	36.5	85.5	132.9	181.9	170.6	117.8	38.3	
31	Storage for the month	S	(RR+W)-(ET+B)	mm/month	-120.7	-98.2	-62.1	-11.1	36.5	49.0	47.4	48.9	-11.3	-52.7	-79.5	-101.5	
32	Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	36.5	85.5	132.9	181.9	170.6	117.8	38.3	0.0	
33	Maximum Storage for Nominated Area	N		mm	**181.87**												
34		V	NxL	L	**48558**												
35	**LAND AREA REQUIRED FOR ZERO STORAGE**			m²	124	131	167	241	410	518	489	502	240	177	150	135	
36																	
37	**MINIMUM AREA REQUIRED FOR ZERO STORAGE:**				518.0	m²											
38																	

Figure 43 – Water balance calculations (MAV 2016).

[26] EPA Victoria Guideline for Onsite Wastewater Management and EDRS (2024).

APPENDIX 6 - THE NUTRIENT BALANCE

A nutrient balance (nitrogen / phosphorous) has been undertaken to check that the proposed LAA is of sufficient size to ensure nutrients are effectively assimilated by soils and vegetation (see *Figure 44 and the table below*).

The model used here is based on a simplistic methodology but improves on this by incorporating more variables in the respective nutrient cycles to more accurately model actual processes.

It acknowledges that a proportion of nitrogen will be retained in the soil through processes such as mineralisation (the conversion of organic nitrogen to ammonia) and volatilisation.[27] It also accounts for crop growth rates (and hence nutrient uptake rates) for a typical pasture.

Some assumptions used in the modelling follow:

- Hydraulic loading – 900L/day
- Nitrogen concentration in effluent – 30 mg/L
- Nitrogen percentage lost to soil processes – 20%
- Phosphorus concentration in effluent – 10 mg/L
- Critical nutrient loading rates – 220 kg/ha/year (60 mg/m²/day) for nitrogen and 50 kg/ha/year (14mg/m²/day) for P
- Soil phosphorus sorption capacity – 3375 kg/ha of soil
- Proportion of phosphorus sorption capacity utilised – 50%
- Design life of system - 50 years

1	Victorian Land Capability Assessment Framework									
2										
3	Please read the attached notes before using this spreadsheet									
4	**Nitrogen Balance**									
5	**Site Address:**	**345 Hughes Road, WANGOOM 3279**								
6	**SUMMARY - LAND APPLICATION AREA REQUIRED BASED NITROGEN BALANCE**								299	m²
7	**INPUT DATA[1]**									
8	**Wastewater Loading**				**Nutrient Crop Uptake**					
9	Hydraulic Load		900	L/day	Crop N Uptake	220	kg/ha/yr	which equals	60.27	mg/m²/day
10	Effluent N Concentration		25	mg/L						
11	% N Lost to Soil Processes (Geary & Gardner 1996)		0.2	Decimal						
12	Total N Loss to Soil		4500	mg/day						
13	Remaining N Load after soil loss		18000	mg/day						
14	**NITROGEN BALANCE BASED ON ANNUAL CROP UPTAKE RATES**									
15	**Minimum Area required with zero buffer**				**Determination of Buffer Zone Size for a Nominated Land Application Area (LAA)**					
16	Nitrogen	299	m²		Nominated LAA Size		267	m²		
17					Predicted N Export from LAA		0.70	kg/year		
18					Minimum Buffer Required for excess nutrient		32	m²		

Figure 44 - Nutrient balance calculations (MAV 2016).

PHOSPHOROUS BALANCE	
1 Determine the daily P load	Effluent concentration P – 10mg/L Daily hydraulic load – 900 L/day 10 x 900 = 9000 mg/day
2 Determine the annual P load	9000 mg/day x 365 days = 3285000 mg - Annual P load = 3.285 kg
3 Allow for an uptake by plants (application rate) of 50 kg P/ha/yr	This figure is suitable for a regularly maintained grass cover.
4 Determine P sorption each year for 50 years	3285 / 50 x 0.5 (actual field sorption multiplier) = 3.285 kg/ha/year
5 Determine total annual application rate	Plant uptake + P sorption = 32.85 + 50 (Total P application rate) = 82.85 kg/ha/year
6 Divide the annual P load by the application rate	3.285 / 82.85 = 0.03964 ha - multiply by 10 000 m²
Minimum area required for P assimilation over 50 years	The area required for phosphorous assimilation requires 396.4 **(397m²).**

[27] Geary, P. and Gardner, E. (1996). On-site Disposal of Effluent. In Proceedings from the one day conference Innovative Approaches to the Management of Waste and Water, Lismore 1996.

APPENDIX 7 - MONITORING, OPERATION AND MAINTENANCE

Maintenance is to be carried out in accordance with the *EPA Certificate of Approval/Conformity* of the selected wastewater system, manufacturer's warranty, and Council's permit conditions. The system will only function adequately if appropriately and regularly maintained.

To ensure the system functions adequately, residents must:

- Use household cleaning products that are suitable for wastwater systenms;
- Keep as much fat and oil out of the system as possible; and
- Conserve water (AAA rated fixtures and appliances ar recommended).

To ensure the land application system functions adequately, residents must:

- Regularly harvest (mow) vegetation within the Land Application Area (LAA) and remove this to maximise uptake of water and nutrients;
- Not erect any structures and paths over the LAA;
- Avoid vehicle and livestock access to the LAA, to prevent compaction and damage; and
- Ensure that the LAA is kept level by filling any depressions with good quality topsoil (not clay).

Monitoring and Maintenance suggested scheduling.

Item	System components	Service regularity	Details	Report to Council
1	5K AWTS 3.2K - 5K septic tanks	3 months	Desludge Blowers Electrical Disinfection (if applicable)	Yes
2	Pump-wells	3 months	Electrical Operation Desludge if required	Yes
3	Indexing valve	3 months	Check operation and manufacturer service requirements	Yes
4	Subsurface irrigation fields	6 months	Wetting patterns Blockages System flushing Effectiveness	Yes
5	Alarms	3 months	Electrical Operation Off-site signalling	Yes
6	Performance testing	3 months	Series of tests detailed in EPA Publication 500	Yes
7	Maintenance report	Annual	Report annual tests/service completed to Council	Yes

WATER CONSERVATION, WATER QUALITY, AND STORMWATER MANAGEMENT

Effective water conservation is an important aspect in the overall management of onsite systems. It will be important for the ongoing performance of both the treatment and land application system that they are not overloaded hydraulically.

Stormwater run-on may be a moderate concern for the proposed land application area. An upslope (of LAA) diversion drain should be installed during the construction of the system. Stormwater from roofs and other impervious surfaces must not be disposed of into the wastewater treatment system or onto the effluent management area.

APPENDIX 8 - PUMP-WELL SYSTEMS

The following issues should be taken into consideration when designing pump-wells into the treatment system (see *Appendix 6*).[28]

a) The location of a pump well is normally determined by site conditions but if practicable they should be located after a settling tank;
b) The selection of pumps should be governed by the volume of waste to be pumped;
c) Pumps may also serve as a dosing device and/or flow equaliser for the plant; and
d) Multiple pumps with automatic operation and changeover must be installed in all systems except for single dwellings or premises where the daily flow is less than 1000 litres.

<u>Section 8.2 Suggested Measures of EPA Publication 500:</u>

- Pump wells are constructed in accordance with diagrams provided;
- Pump stop and start (cut-out/in) levels to be located so that the duty pump will discharge a volume of liquid equal to approximately one (1) hour of MDF;
- In emergency situations – such as power failure the well has an additional liquid storage capacity of at least (1) hour of MDF between pump cut-in and well inlet levels.
- Alarm systems and controls are provided in an accessible location to indicate failure of the pumping system.
- The system has a suitable and permanently installed visual/audible warning device with mute facility.
- In the case of remote systems – such as those serving subdivisions – a telemetry alarm system with interrogation should be provided.

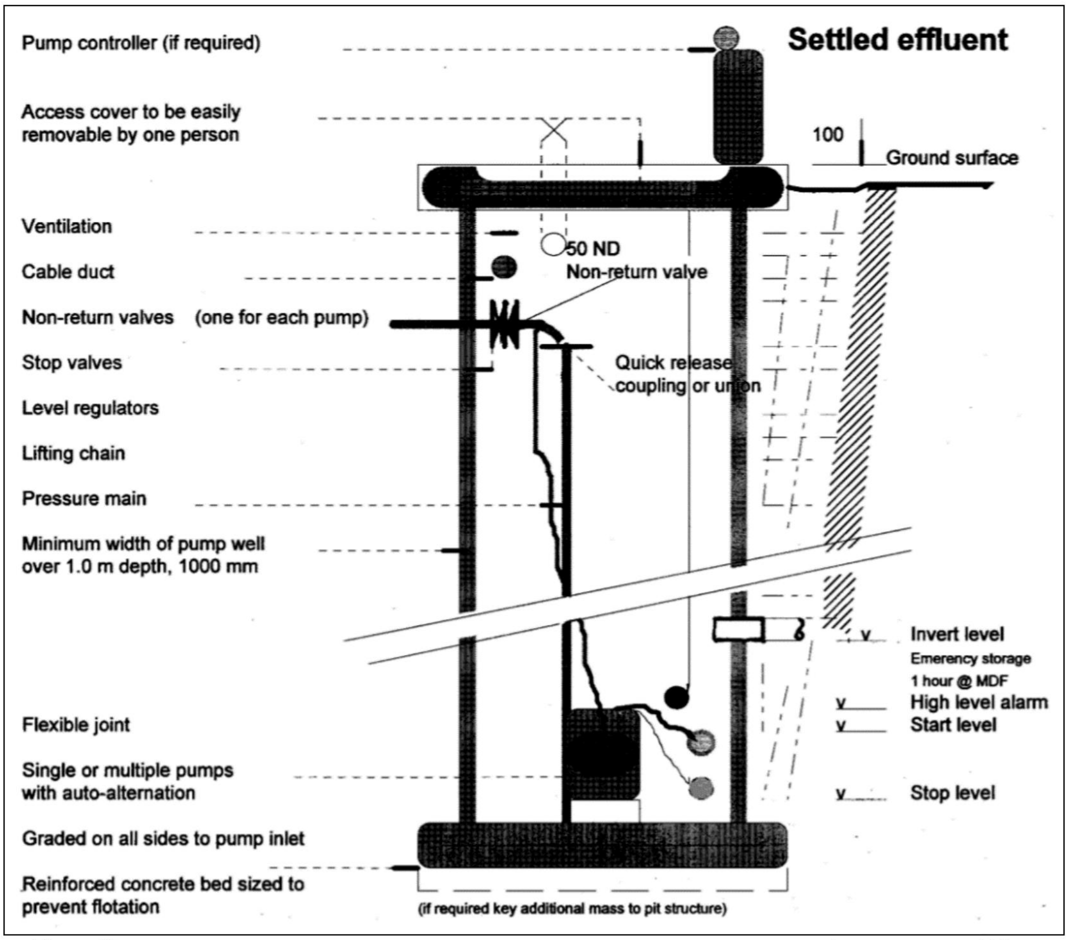


Figure 45 - Pump-well system template cross-section with system components required (Source: Vic EPA 1997).

[28] Victorian EPA Publication 500, 1997: Accessed from: https://www.epa.vic.gov.au/about-epa/publications/500

DESIGN EXAMPLE – PUMP WELL AND PUMPS

Requirement

Settled wastewater from a septic tank serving a 20 site camping park is required to be pumped to a stabilisation pond system located 150m away. The invert depth of the tank outlet is 1.6 m below the surface level and the proposed pond water level is 3 m above this level.

1. Determine the daily flow (MDF) and peak hourly flow (PHF)

Assume 3.5 people per site @ 100 litres per person and a peak to average hourly flow ratio of 6 (Table 2 and Figure 4)

a)	Daily flow	= 20 sites x 3.5 people x 100 litres/person	
		= 7,000 litres per day	(7 kL/d)
b)	Average hourly flow	= 7,000/24	
		= 292 litres per hour	
c)	Peak hourly flow	= 292 x 6	
		= 1,752 litres per hour	

2. Determine size of pump well

a) Pump well capacity between well inlet and invert to accommodate discharge volume and emergency storage (Figure 12)

= Pump cycle + emergency storage

= 2h@MDF

= 2 x 292

= 584 litres

b) Calculated pump cycle capacity plus emergency storage – assuming a pump well diameter of 1,050 mm

Well depth = $4 \times 0.584/3.14 \times (1.05)^2$

= 0.67m (Cut-in /out 350 mm)

(Inlet/cut-in 350 mm)

c) Check if mass of pump well is sufficient to prevent well floating to external hydrostatic forces when empty.

Mass of pump well = mass of liquid displaced

Mass of RCP + T & B slabs = mass of water displaced by well

= 2.4×655 kg/m + $3.14/4\ (1.05 + 0.15)^2 \times 2{,}500$ kg/m^3 x

= $3.14/4\ (1.2)^2 \times 2.4 \times 1{,}000$ kg/m = m^3

Depth of top and bottom slabs 'd' = 0.4 m

Construction pump well using 2 No. 1.2 m x 1,050 mm RCPs walls 70 mm thick, top slab 100 mm and base slab 300 mm deep.

3. Selection of pump size

i)	Hydraulic capacity (PHF)	= 1,752 L/h	(0.5 L/s)
ii)	Total pumping head	= static discharge head + other head losses	

From pump manufacturer's tables and data sheets select pumps (duty and standby) for hydraulic capacity of 0.5 L/s at total pumping head.

Figure 46 – Pump-well design example (Source: Victorian EPA 1997).

APPENDIX 9 - REDUCE THE VOLUME OF WASTEWATER GENERATED[29]

Based on Table 4-1: Design flow rates for households *and in accordance with the principles of the waste hierarchy*, the following steps are recommended to limit the amount of wastewater generated and beneficially use the resultant water resource onsite.

1. High 'Water Efficiency Labelling Scheme' (WELS)-rated water-efficient fittings (minimum '3 Stars' for appliances and minimum '4 Stars' for all fittings and fixtures):
2. Water-efficient clothes washing machines (front or top loading)
3. Dual-flush (6.5/3.5L or less) toilets
4. Water-efficient shower roses
5. Water-efficient dishwashers
6. Aerated taps
7. Hot and cold-water mixer taps (especially for the shower)
8. Flow restrictors
9. Hot water system fitted with a 'cold water diverter' which recirculates the initial flow of cold water until it is hot enough for a shower.

In addition, general steps may include avoiding generating excess wastewater by:

1. constructing a house with fewer bedrooms

2. installing a dry composting toilet

3. not installing a spa

4. not installing a bath (low flow rate shower only)

5. not installing a kitchen food waste grinder.
II. Reduce the volume of wastewater generated by installing:

6. High 'Water Efficiency Labelling Scheme' (WELS)-rated water-efficient fittings (minimum '3 Stars' for appliances and minimum '4 Stars' for all fittings and fixtures):
a. water-efficient clothes washing machines (front or top loading)
b. dual-flush (6.5/3.5L or less) toilets
c. water-efficient shower roses
d. water-efficient dishwashers
e. aerated taps
f. hot and cold water mixer taps (especially for the shower)
g. flow restrictors
h. hot water system fitted with a 'cold water diverter' which recirculates the initial flow of cold water until it is hot enough for a shower.
III. Reuse (another use without any treatment) wastewater by:

7. washing fruit and vegetables in tap water in a container and reusing the water for another purpose in the house such as watering pot plants

8. collecting the initial cold water from showers in buckets and using it for another purpose such as soaking feet, hand washing clothes or washing the car on the lawn.

[29] EPA Victoria Guideline for Onsite Wastewater Management and EDRS (2024).

APPENDIX 10 - SYSTEM INSTALLATION, USE AND MAINTENANCE

A Council Permit to Install is required before the installation of any treatment system and the associated effluent recycling/disposal system. Once installed, the onsite wastewater management system may not be used until Council has issued a Certificate to Use.

Before commissioning, Council must be given suitable notice (the required timeframe will vary between Councils) that the treatment and irrigation systems have been installed (but not buried) and are ready for Council inspection.

The Certificate to Use is issued after Council has received the Plumbing Compliance Certificate and is satisfied the treatment and irrigation systems were installed in accordance with the Permit to Install and this Code.

APPENDIX 11 - SERVICE CONTRACTS[30]

The treatment and irrigation/disposal systems must be operated and maintained in accordance with the conditions in the Council Permit to Install/Alter and this Code to ensure that human health and the environment are protected.

Where a property is served by a treatment system other than a gravity-flow primary treatment and land application system, it is mandatory that the property owner has a service contract with an accredited and trained service technician who will routinely service and maintain the treatment unit and land application system in accordance with the Permit conditions.

Council may fine a property owner under section 53N and Schedule A of the Act for failing to have the treatment system *regularly serviced* on an ongoing basis in accordance with the conditions on the Council Septic Tank Permit.

APPENDIX 12 - MAINTAINING LAND APPLICATION AREA (LAA)

To ensure that a LAA functions efficiently long-term, all the following actions should be undertaken by the land application designer and/or property owner:

• Realistic estimates of water, salt and sodium balances should be made to ensure that sufficient leaching occurs and no salts or sodium can accumulate in the root zone of vegetation. Sufficient gypsum should be applied to the garden to displace sodium from the soil particles and replace lost calcium.

• New land application areas should be vegetated immediately after installation (see list of suitable plants).

• Care should be taken to protect the vegetation growing across soil absorption trenches because plants, together with sunlight and wind, play a vital role in supporting the utilisation and dispersal of wastewater.

• Effluent recycling/disposal areas should be isolated as much as possible from other domestic facilities and activities to protect people and pets from potential contamination with wastewater and to protect the land from disturbance.

• Signs should be erected to inform householders and visitors of the proximity of the LAA and to limit their access and impact on the area.

• Paving, driveways, patios, fences, building extensions, sheds, children's playgrounds, utility service trenching must not be built over or encroach on the disposal/recycling area.

• The long-term functionality of the LAA will depend on the actual (as distinct from the proposed) hydraulic loading, the composition of the wastewater, and the ongoing maintenance of the treatment plant and LAA system.

[30] EPA Victoria Guideline for Onsite Wastewater Management and EDRS (2024).

APPENDIX 13 – SUBSURFACE IRRIGATION INSTALLATION

Subsurface drip irrigation or covered-surface drip irrigation systems are becoming more popular in recent years. Properly designed systems apply effluent at much lower volumetric rates and over larger areas than absorption or ETA trenches/beds or mounds. Coverage is often better than can be achieved by surface irrigation.

Effluent is applied in the root zone of plants (100-150mm below the surface) at a rate that more closely matches plant and soil requirements (evapotranspiration), leading to more effective effluent reuse. The reliance on soil absorption is relatively low and hence the risk of contaminants accumulating in the soil or leaching to groundwater is also low.

Subsurface drip irrigation typically comprises a network of proprietary, pressure-compensating drip-irrigation line that is specially designed for use with effluent and contains specially designed emitters that reduce the risk of blockage, biofilm development and root intrusion.

Subsurface irrigation virtually eliminates the risk of people inadvertently coming into contact with effluent and also minimises the risk of effluent being transported off-site, even during rain.

Subsurface irrigation may be installed on sloping properties/parcels, provided the application rate is reduced accordingly to ensure that effluent migration down slope is taken up adequately within the root system (as per Table M2 of AS/NZS 1547:2012).

When properly designed, installed and operated, the system will ensure good distribution of effluent at uniform, controlled application rates. By properly sizing the land application areas to ensure sustainable hydraulic and nutrient loading rates, water and nutrients can be effectively utilised and are unlikely to seep to groundwater or run-off to surface waters.

Care must be taken in designing and installing irrigation systems in areas that experience temperatures below freezing. Table 4.8 of the EPA Guideline for Onsite Wastewater Management (2024) and Table 5.2 of AS1547:2012 provide Design Irrigation Rates (DIRs) for subsurface irrigation systems.

These requirements are not exhaustive but summarise the main requirements under the EPA Guideline for Onsite Wastewater Management (2024) *and AS/NZS 1547:2012*.

The default land application system for sustainably recycling secondary treated sewage or greywater effluent to land is pressure-compensating sub-surface irrigation (with disc or mesh filters and scour and vacuum valves), which evenly distributes effluent throughout the irrigation area.

A detailed irrigation system design is beyond the scope of this report; however a general description of subsurface irrigation is provided here for the information of the client and Council.

Subsurface irrigation comprises a network of drip-irrigation lines that is specially designed for use with wastewater. The pipe contains pressure compensating emitters (drippers) that employ a biocide to prevent build-up of slimes and inhibit root penetration.

The lateral pipes are usually 0.8 apart, installed parallel along the contour. Installation depth is 100-150 mm in accordance with *AS/NZS 1547:2012*. It is critical that the irrigation pump be sized properly, to ensure adequate pressure and delivery rate to the irrigation network.

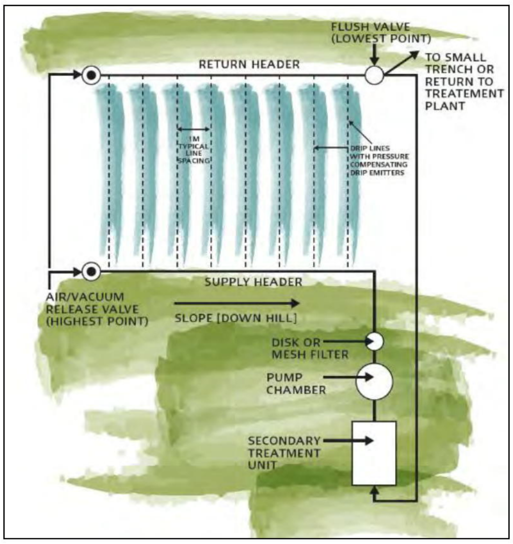
The distribution pipes (drip-lines) fill up with effluent until a certain pressure is reached which opens the emitter valves. For a $450m^2$ irrigation field with 13mm diameter pipes, at least 60L may be required to be pumped into the pipes to reach the required pressure to open the emitters.
More controlled pressure can be applied when the field is divided into two or more zones with alternate areas intermittently dosed using a sequencing valve.

A filter is installed in the main line to remove fine particulates that could block the emitters. This must be cleaned regularly (typically monthly) following manufacturer's instructions.

Vacuum breakers should be installed at the high point/s in the system to prevent air and soil being sucked back into the drippers when the pump shuts off.

Flushing valves are an important component and allow periodic flushing of the lines, which should be done at six monthly intervals. Flush water can be either returned to the treatment system or should be released to a small, dedicated gravel-based trench.

All trenching used to install the pipes must be backfilled properly to prevent preferential subsurface flows along trench lines.



Figures 47-48 – Technical specifications for subsurface irrigation; recently completed irrigation field (Source: EHPA 2012).

Irrigation areas must not be subject to high foot traffic movement, and vehicles and livestock must not have access to the area otherwise compaction around emitters can lead to premature system failure.

Gravity-flow effluent irrigation systems are not allowed, due to the lack of even distribution. Irrigation distribution pipes must not have dripper-holes drilled or cut into them after purchase because the effluent will flow out of the holes in the first few metres of pipe at a far higher rate than the system is designed for, and higher than the soil is capable of sustainably absorbing.

Secondary treated effluent should be applied using the *Design Irrigation Rates* specified as a maximum. Secondary quality effluent is a valuable water and nutrient resource and should be used beneficially to support vegetation growth, and not be discharged deep in the soil profile where it provides very little beneficial use to the land or vegetation.

The default for recycling secondary quality effluent is sub-surface irrigation because water is not wasted by evaporation or runoff, flexible garden designs are possible, water is delivered to the plants' roots in the topsoil layer, and it provides the highest protection for environmental and public health.

Subsurface irrigation can be flexibly used and for example run (1.5m setback) along fence lines to water trees and shrubs. Trenches only required to be dug to 150-200mm in depth (as compared to soil absorption trenches 450mm).

All irrigation pipe must be laid in 3-8mm gravel/aggregate and covered with strips of geotextile fabric. This is also required due to the high failure rate experienced by systems installed directly into topsoil.

• The international colour-coded pipe for plumbing installations for recycled water is lilac, but it is generally referred to as purple in Victoria (i.e. 'purple pipe') for pipework connecting the treatment unit and irrigation area.

The new irrigation field must have appropriate signage in accordance with the most recent version of *AS/NZS 3500: Drainage and Plumbing*.

Where a treatment system is retrofitted to existing irrigation pipes that are not purple-coloured, the above-ground fixtures such as taps, pumps and hatches, must be covered with purple paint or tape.

• If the permeability of the soil is very low (i.e. heavy clay), the soil in the irrigation area must be improved by rotary hoeing and adding gypsum to the dedicated wastewater disposal area.

• The irrigation area must be a permanent dedicated area for effluent disposal and must not be parked or driven on.

• For pressure compensating pipe vacuum breakers (air valve) must be installed at the high point of the disposal area and a flushing valve must be installed at the low point of the disposal area.

This allows for the disposal area to be flushed out preventing any blockages from sludge/scum build-up and therefore prolonging the life of the system. The flushing valve must either be connected so the wastewater is returned to the system (preferable option) or disposed of via sub-soil absorption trenches.

The effluent disposal area must be vegetated or revegetated immediately following installation of the system, preferably with turf or native sedges and grasses (planted surrounding the border of the effluent area).

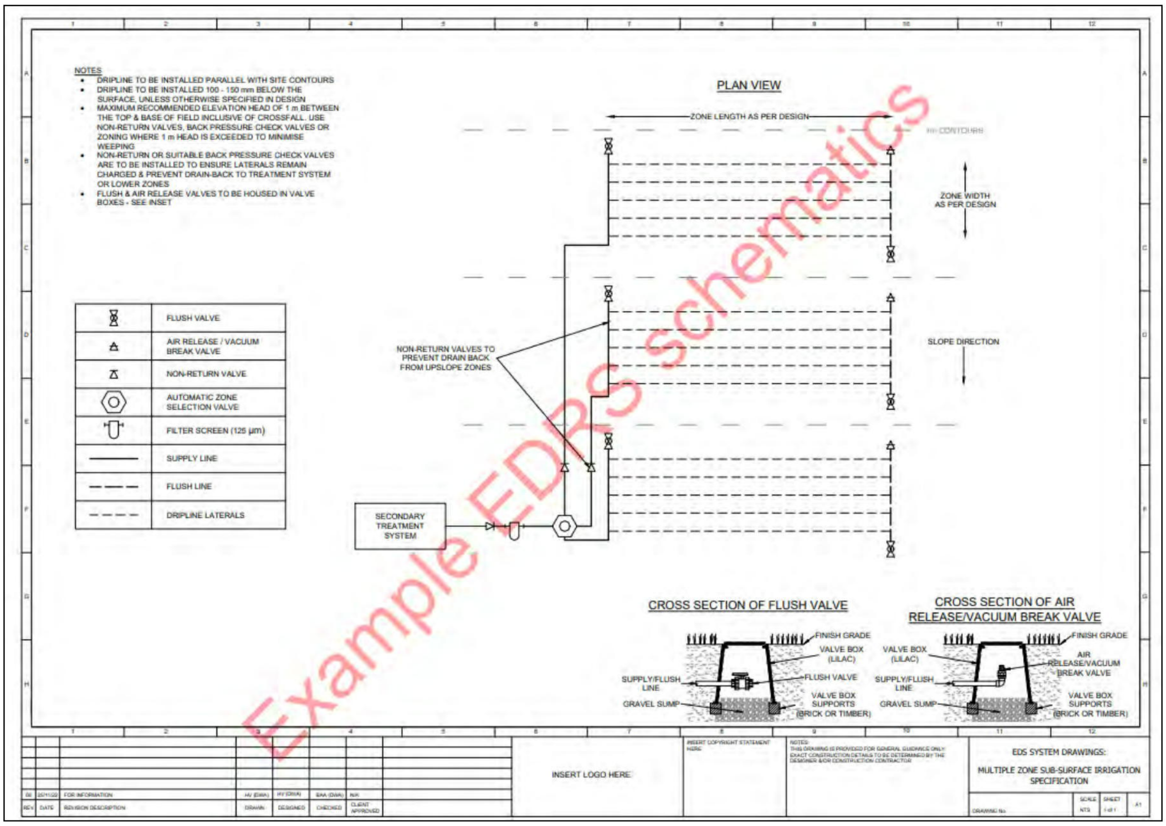


Figure 49 – Multi-field subsurface irrigation schematic (Source: EPA Victoria 2024).

The area should be fenced or otherwise isolated (such as by landscaping), to prevent vehicle and stock access; and signs should be erected to inform householders and visitors of the extent of the effluent irrigation area, and to limit their access and impact on the area. Installation of the irrigation system must be carried out by a suitably qualified, licensed plumber or drainer experienced with effluent irrigation systems.

To ensure even distribution of effluent, it is essential that the pump capacity is adequate for the size and configuration of the irrigation system, taking into account head and friction losses due to changes in elevation, pipes, valves, fittings etc. An additional, optional measure to achieve even coverage is to divide the irrigation area into two or more separate sub-zones of minimum 300m² each; dosed alternately using an automatic indexing or sequencing valve.

The irrigation area and surrounding area must be vegetated or revegetated immediately following installation of the system, preferably with turf or native sedges and grasses (planted surrounding the border of the effluent area).

The area should be fenced or otherwise isolated (such as by landscaping), to prevent vehicle and stock access; and signs should be erected to inform householders and visitors of the extent of the effluent irrigation area, and to limit their access and impact on the area.

APPENDIX 14 - ISSUES TO CONSIDER WHEN SELECTING WASTEWATER TREATMENT SYSTEM

- The sustainability of the proposed system;
- The expectations of the owners of the development;
- Current property owners' ability to adequately manage the system;
- Site suitability, including environmental sensitivity;
- The availability of service agents in the area;
- System costs (both capital and on-going);
- The need for the proposed system to be replaced or refurbished at some later date;
- The development of contingency plans in the event of system failure
- The impact of the system on the amenity of the area

APPENDIX 15 - MITIGATION MEASURES FOR LAND APPLICATION AREAS

This information may be required for sites or LAAs requiring specific measures to mitigate observed constraints, usually prior to or during installation/construction of the effluent management system.

Examples of mitigation measures include (but are not limited to):

- Terracing for steep slopes;
- Imported topsoil fill to increase soil quality and depth;
- Application of gypsum or lime to improve soil condition;
- Construction of stormwater diversion berms or swales upslope of the LAA;
- Flood mitigation – such as installing seals, access risers and backflow prevention devices on treatment systems (in accordance with manufacturers' requirements), raising or bunding LAAs;
- Ripping of compacted or low-permeability soils (particularly for mound systems)
- Vegetation clearing over LAA; and
- Manual removal of coarse rock fragments or unsuitable fill materials.

APPENDIX 16 - APPROVED TYPES OF WASTEWATER & GREYWATER TREATMENT SYSTEMS

EPA Guideline for Onsite Wastewater Management (2024)[31] specifies the approved types of wastewater and greywater treatment systems and effluent reuse and disposal systems for both sewered and unsewered areas. Any wastewater treatment system proposed for installation in Victoria must have a current CA (*Certificate of Conformity*) issued by EPA and displayed on the EPA website. There is a broad range of treatment systems with current *Certificates of Conformity* including:

- Wet or dry composting toilets (greywater treatment system also required);
- Septic tanks;
- Aerobic biological filters (wet composting, vermiculture);
- Aerated wastewater treatment systems (AWTS);
- Ozonation;
- Textile filters;
- Sand filters (following primary treatment);
- Trickling aerobic filters (using foam, plastic or similar media);
- Membrane filtration;
- Reed beds (following primary treatment);
- Sand mounds (following primary or secondary treatment).

The default for recycling secondary quality effluent is <u>sub-surface irrigation</u> because water is not wasted by evaporation or runoff, flexible garden designs are possible, water is delivered to the plants' roots in the topsoil layer, and it provides the highest protection for environmental and public health.

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[31] EPA Guideline for Onsite Wastewater Management (2024).

Table 4-7: Treated effluent dispersal and recycling options

Management category	Dispersal and recycling option	Suitable effluent standard	Description and application scenario
Options for primary and secondary treatment standards			
Soil absorption and evapotranspiration systems	Conventional trenches/beds	Primary or secondary	Dispersal of wastewater to subsoils. Not recommended for sandy soils or heavy clays. Special design required in these soils.
	Evapotranspiration absorption (ETA) trenches/beds	Primary or secondary	Dispersal of wastewater to subsoils and some recycling through plants grown. Not recommended for sandy soils.
	Wick trench and bed system	Primary or secondary	Similar to ETA systems but with enhanced wicking due to plants grown.
	Vegetated recirculating evapotranspiration beds	Primary or secondary	The treated effluent can be fully contained inside the bed. Treated effluent is recirculated while undergoing evapotranspiration and no seepage to the soil.
	Amended soil systems	Primary or secondary	Importing a media, soil or engineered material to enhance the distribution of effluent. Can be used to increase the pollutant removal capacity of an effluent dispersal system, which may result in a reduced system footprint.
Mound systems		Primary or secondary	Dispersal of wastewater to subsoils following sand filtration.
Shallow subsurface and surface irrigation systems	Shallow subsurface irrigation	Secondary	Provides recycling through plants irrigated. Flexible garden designs possible.
	Low pressure effluent distribution	Primary or secondary	Dispersal of wastewater to subsoils. Not recommended for sandy soils or heavy clays.

Figure 50 – Treatment and recycling options in Victoria (Source: Victorian EPA 2024)

APPENDIX 17 – BUFFER REQUIREMENTS

Table 4-10: Setback distances (m) [20,21]

Landscape feature or structure	OWMS with primary treated effluent	OWMS with secondary treated effluent or Level 3 greywater effluent	OWMS with Level 1 and 2 greywater effluent
Building/allotment boundary			
Up-slope of building (See Note 1)	6	3	3
Down-slope of building	3	1.5	1.5
Up-slope of adjacent lot	6	3	1
Down-slope of adjacent lot	3	1.5	0.5
Services			
Water supply pipe	3	1.5	1.5
Up-slope of potable supply channel (stock and domestic)	300	150	150
Down-slope of potable water supply	20	10	10

[20] Setback distances are measured horizontally from the external wall of the treatment plant and the boundary of the land application area, except for soil depth as per Note 10.
[21] The setback distances for flat land are equivalent to down-slope setback distances.

Landscape feature or structure	OWMS with primary treated effluent	OWMS with secondary treated effluent or Level 3 greywater effluent	OWMS with Level 1 and 2 greywater effluent
channel (stock and domestic)			
In-ground water tank (See Note 2)	15	7.5	3
Closed stormwater drain	6	3	2
Open stormwater drain	50	30	10
Gas supply pipe	3	1.5	1.5
Recreational areas			
Children's grassed playground (See Note 3)	6	3	2
In-ground swimming pool	6	3	2
Surface waters			
Dam, lake or reservoir (used as source water for drinking or within a special water supply catchment) (See Notes 5, 6)	300	300	150
Waterways (used as a source of water for drinking or within a special water supply catchment) (See Notes 4, 5)	100	100	50
Waterways not used as source of water for drinking or within a special water supply catchment (for example, wetlands (continuous or ephemeral); estuaries (See Note 4)	60	30	30
Ocean beach at high-tide mark; dams, reservoirs or lakes not used as source of water for drinking or within a special water supply catchment (See Note 6)	60	30	30
Dam, lake or reservoir (used as source water for drinking or within a special water supply catchment) (See Notes 5, 6)	300	300	150
Drainage lines (See Note 7)	40	20	20

Landscape feature or structure	OWMS with primary treated effluent	OWMS with secondary treated effluent or Level 3 greywater effluent	OWMS with Level 1 and 2 greywater effluent
Up-slope of cutting/escarpment (See Note 8)	15	15	15
Groundwater bores			
Groundwater bores – category 1 and 2a soils	NA	50	20
Groundwater bores – category 2b to 6 soils	20	20	20
Soil depth (See Note 9)			
Depth to highest seasonal water table (See Note 10)	1.5	1.5	1.5
Depth to hydraulically limiting layer (for example, bedrock)	1.5	0.6	0.6

Notes to Table 4-10:

1. Establishing an OWMS up-slope of a building may have implications for the structural integrity of the building. This should be examined by a building surveyor on a site-by-site basis.
2. It is recommended that OWMS are installed down-slope of an in-ground water tank.
3. Means a school, council, community or other children's grassed playground managed by an organisation which may contain play equipment but does not mean a sports field.
4. Means a waterway as defined in the *Water Act 1989*.
5. Applies to land adjacent to a dam, lake, reservoir or waterway that provides source water used for the supply of public drinking water or, which is subject to an environmental significance overlay (ESO) that designates maintenance of water quality as the environmental objective to be achieved, or within a special water supply catchment area listed in Schedule 5 of the *Catchment and Land Protection Act 1994*.
6. Does not apply to dams, lakes or reservoirs located above ground level that cannot receive runoff.
7. An intermittent stream that is found to be a drainage line (drainage depression) with no defined banks and the bed is not incised. The topography of the drainage line should be demonstrated in writing and photographs in the LCA report.
8. A cutting/escarpment from which water is likely to emanate.
9. Depth is measured vertically through the soil profile from the base of absorption/ETA trenches/beds or from the irrigation pipes.
10. The highest seasonal water table occurs when groundwater is closest to the ground surface. This usually occurs in the wettest months of the year.

Figure 51 – Setbacks to site features (Source: Victorian EPA 2024)

APPENDIX 18 – INDIGENOUS WASTEWATER PLANTS

Common plant name	*soil type*							*Botanical name*
Common plant name	**Wet**	**Dry**	**Margin**	**Clay**	**Sand**	**Loam**	**Salt tolerant**	**Genus and species**
Grasses & sedges								**Grasses & sedges**
southern cordrush	✔		✔	✔	✔	✔		*Baloskion australe*
tassel cordrush	✔		✔	✔	✔	✔		*Baloskion tetraphyllum*
tall sedge	✔		✔	✔		✔		*Carex appressa*
tassell sedge	✔		✔	✔		✔		*Carex fascicularis*
curly sedge		✔	✔	✔		✔		*Carex tasmanica*
spreading flaxlily		✔	✔	✔	✔	✔		*Dianella revoluta*
forest flaxlily	✔	✔	✔	✔	✔	✔		*Dianella tasmanica*
western flag-iris	✔		✔	✔	✔	✔		*Diplarrena latifolia*
white flag-iris	✔	✔	✔	✔	✔	✔		*Diplarrena moraea*
knobby clubsedge	✔	✔	✔	✔	✔	✔	✔	*Ficinia nodosa*
cutting grass	✔		✔	✔		✔		*Gahnia grandis*
sea rush	✔		✔	✔	✔	✔	✔	*Juncus kraussii*
pale rush	✔		✔	✔	✔	✔		*Juncus pallidus*
sagg		✔	✔	✔	✔	✔		*Lomandra longifolia*
silver tussockgrass	✔	✔	✔	✔	✔	✔		*Poa labillardierei*
velvet tussockgrass		✔	✔	✔		✔		*Poa rodwayi*
Low shrubs (up to 1.5m)								**Low shrubs (up to 1.5m)**
wiry bauera			✔			✔		*Bauera rubioides*
hop native-primrose	✔	✔	✔	✔	✔	✔		*Goodenia ovata*
slender honeymyrtle	✔		✔	✔		✔		*Melaleuca gibbosa*
Tall shrubs/trees (2-5m)								**Tall shrubs/trees (2-5m)**
silver wattle		✔	✔		✔	✔		*Acacia dealbata*
blackwood	✔		✔	✔		✔		*Acacia melanoxylon*
arching wattle	✔		✔	✔		✔		*Acacia riceana*
prickly moses			✔	✔	✔	✔		*Acacia verticillata*
yellow bottlebrush		✔	✔	✔		✔		*Callistemon pallidus*
prickly bottlebrush	✔		✔	✔		✔		*Callistemon viridiflorus*
native hop		✔	✔	✔	✔	✔		*Dodonaea viscosa*
smoky teatree		✔	✔		✔	✔		*Leptospermum glaucescens*
woolly teatree	✔	✔	✔	✔		✔		*Leptospermum lanigerum*
shiny teatree	✔		✔	✔		✔		*Leptospermum nitidium*
river teatree	✔		✔	✔		✔		*Leptospermum riparium*
common teatree		✔	✔	✔	✔	✔		*Leptospermum scoparium*
warty paperbark	✔		✔	✔		✔		*Melaleuca pustulata*
swamp honeymyrtle	✔		✔	✔		✔		*Melaleuca squamea*
scented paperbark	✔		✔	✔		✔		*Melaleuca squarrosa*
common dogwood	✔		✔	✔		✔		*Pomaderris apetala*
Trees (>10m)								**Trees (>10m)**
black gum	✔		✔	✔		✔		*Eucalyptus ovata*
Exotics								
Pittosporum bicolor								
Pittosporum Tenuifolium								
coleonema								
acemena (lillypilly)								
ceanothus								
hebe all varieties are very good with the exception of hebe emerald green								
penstemon								
abelia								
buxus sempervirens								
*Fruit trees are not recommended in an irrigation area.								

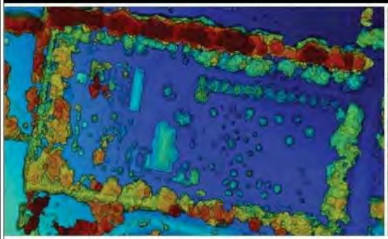
Figure 52 – Vegetation able to be used to assimilate wastewater.

LAND CAPABILITY ASSESSMENTS (LCA)

ONSITE WASTEWATER SYSTEM DESIGN + CONSULTANCY SERVICES

Completed by a qualified and experienced Environmental Scientist, Environmental Health Officer (Vic, NSW), and onsite wastewater specialist

SERVICING NORTH-EAST, CENTRAL, WESTERN + SOUTH-WEST VICTORIA



What is an LCA?

A comprehensive LCA report provides recommendations on suitability of particular on-site wastewater treatment and effluent disposal systems for the site context, and identifying environmental constraints that may influence sustainable wastewater management, treatment, and disposal.

For all proposed unsewered residential developments, an LCA should be undertaken prior to a residential development proceeding. Typically your Council will advise if an LCA is required and the level of investigation required.

The objective of the LCA process is:

1. To assess the capability of the site to sustainably manage wastewater within allotment boundaries; and
2. To identify a management program to minimise health and environmental impacts of the onsite wastewater management system.

Landtech Consulting has developed relationships with local government EHO's across Victoria and understand their specific requirements regarding onsite wastewater management and land capability assessment. Landtech Consulting will complete all necessary negotiation with Council to streamline the LCA and planning/building permit approval processes.

Landtech Consulting has appropriate qualifications, experience, and public and professional indemnity insurance with certification documents available on request.

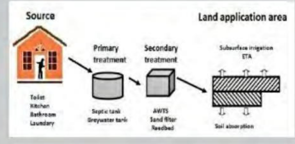


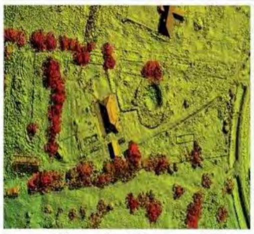
Services include desktop scoping, site inspection, drone elevation mapping, soil sampling and analysis, wastewater system and effluent disposal design, and identification of innovative and best-practice wastewater treatment options.


Services

LCA reporting for:

+ New/existing dwellings
+ Subdivisions
+ Commercial, Municipal
+ Broad-area LCA projects





Landtech Consulting

Peter Austin (Landtech Consulting) is a qualified and experienced Environmental Scientist and Environmental Health Officer (EHO at Moyne, Warrnambool & Coffs Harbour Shire Councils) with extensive experience (Vic, NSW) and working knowledge of wastewater approvals regulation and planning processes.

LCA reports are consistent with the MAV's (Municipal Association of Victoria) Model LCA Report which is the procedure recommended by the EPA and is the minimum LCA standard expected by Victorian Councils. LCA's are based on key legislation/guidelines such as:

+AS/NZS 1547, EP Act, SEPP Waters, EPA Code of Practice 891.4 (2016).
+Vic EPA commercial system (>5000L/day) guidelines, publications 500, 168.



Landtech has completed the following projects

-150+ LCA/consultation reports - dwellings, subdivisions, commercial;
-Warrnambool City & Moyne Shire Council DWMPs 2018, 2020;
-Whole of subdivision wastewater LCA reports and consultancy services;
-Coffs Harbour City Council Onsite Wastewater Policy & Strategy 2021;
-Expert Witness VCAT, NSW L&E Court;
-EPA Works Approvals - sport facility, microbrewery, accommodation;
-Broad-area LCA Reports Nth Wangoom, Cudgee, Winslow townships;
-Risk mapping as part of DWMP's;
-Wastewater educational materials for web use and/or publication;
-Risk-based database mapping and GIS analysis.

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LCA Land Capability Assessment (Vic)
OSMS Site & Soil Assessment (NSW)
Onsite Wastewater Consultancy Services
Bushfire Management Statements (BMS, BALs)
Biodiversity Assessment Services
Drone Mapping & GIS Analysis