SUMMARY

Introduction: This report provides results of a Land Capability Assessment for On-Site Domestic Wastewater Management at Lot 1, Number 69 Yverdon Drive, Bannockburn, Victoria. The report is prepared for Soil Industries on behalf of MI Projects and the landowner. This LCA is required to support subdivision of the allotment. A standard 4-bedroom home has been adopted for reporting.

To meet the requirements of Golden Plains Shire Council Shire Council for site development, the site must capable to support the disposal of domestic wastewater in accordance with EPA Victoria Publication 891.4 'Code of Practice Onsite Wastewater Management' (the 'Code') and the Australian/ New Zealand Standard 1547:2012 'On-Site Domestic Wastewater Management', where appropriate. The Golden Plains Domestic Wastewater Management Plan (DWMP) has been cited in preparation of this report. The site is not serviced by town sewerage.

It is recognised that in the Golden Plains Shire, 15% of the allotment should be set aside for domestic wastewater application. For a 4000m^2 allotment the area set aside should be approximately 600m^2. Furthermore, the minimum treatment standard for wastewater on allotments of this size is secondary treatment (20/30).

Results: Results are summarised in Tables A, B & C.

Table A. Results of the Land Capability Assessment – Desktop Review & Site Inspection.

Feature	Description & Comments
Zoning	LDRZ. Low Density Residential Zone.
Overlays	DDO5. Design and Development Overlay Schedule 5. This overlay limits building and works from 5 metres from a property boundary. This overlay does not impact use of the site for domestic wastewater application.
Land Parcel Size	4000 m^2
Number of Bedrooms	4-bedrooms in accordance with the Code. This must include all rooms that can be closed off with a door and inhabited, including sunrooms, studies or similar enclosed rooms.
Daily Wastewater Generation	150 litres/person/day. Total of 750 litres/day.
Landform & Geology (Geovic, 2019)	Quaternary, volcanic on gently undulating land.
Climate	Climate is Mediterranean with cold wet winters and warm dry summers. Rainfall is winter and spring dominant with falls averaging up to 53mm per month recorded in October. Evaporation exceeds rainfall in the months of June and July.
Vegetation & Exposure	Trees were observed on all boundaries, with some trees planted within the allotment. The site has moderate exposure.
Slope	Approximately 1:20 sloping to the north-east.
Rocks, Rock Outcrops or Coarse Fragments	Basalt rock was encountered in all four boreholes from 0.5-1.6 metres of depth.
Surface Water	No dams or surface water observed on or near the site. Nearest dam is over 400 metres south-east.
Presence of Waterways or Ephemeral Drainage Lines:	No waterways, water courses or drainage lines were observed on or near the site.
Flood Potential	There are no flood overlays.
Stormwater Run-On Potential	Low to moderate. Care will be required to ensure drainage is installed around the wastewater field to provide protection from overland flow.

Upslope Seepage	Not observed.
Erosion Potential	Low with actively growing pastures and maintenance of trees. Low to moderate poor pastures, an absence of vegetation or overgrazing. Soils are dispersive. Gypsum treatment will reduce erosion potential.
Groundwater (VVG, 2019)	Not observed in any boreholes. VGG (2019) note the groundwater conditions as: • Salinity: Approximately 3500-7000 mg/kg TDS. This is acceptable for stock water. • Depth: Approximately 10 metres of depth.
Available Land Application Area	Over 600 m^2.

Table B. Results of the Land Capability Assessment – Soil Conditions.

Soil Description / Horizon	A Horizon Topsoil	B1 Horizon Subsoil
Texture (EPA 891.4).	Clay-Loam	Heavy Clay.
Soil Category (EPA 891.4).	4a	6b
Indicative Permeability (K Sat) (m/day)	0.12-0.5 m/day.	<0.06 m/day.
Design Loading Rate (DLR) for a Wick Trenches & Beds, or ETA Absorption Beds & Trenches (mm/day).	10-12 mm/day.	3.5 mm/day.
Design Irrigation Rate (DIR) for Subsurface Irrigation (mm/day).	3.5 mm/day.	2.0 mm/day.
Soil pH (water) (SESW Test Results).	6.70, slightly acidic to neutral.	7.40, slightly alkaline.
Electrical Conductivity Sat. Ext (ECe) (SESW Test Results).	<2.0 dS/m. Low.	<2.0 dS/m. Low.
Slaking Class (SESW Test Results).	2. Swelling to partial slaking.	2. Swelling to partial slaking.
Emerson Dispersion Class (SESW Test Results).	5. Non-dispersive	1. Complete dispersion.
Surface Drainage & Profile Drainage	Moderate.	Poor.
Presence of Fill Material	Nil	Nil

Table C. Results of the Land Capability Assessment – Recommended Setback Distances (Table 5 EPA 891.4). Note: U/S = Upslope, D/S = Downslope.

Setback Feature	Minimum Distance (metres)	Requirements & Comments
Dwellings	Secondary treated WW: 3m D/S, 1.5m U/S.	WW field is at least 3.0 m away from buildings.
Property Boundaries	Secondary treated WW: 3m D/S, 1.5m U/S.	WW field is at least 3.0 m away from boundaries.
Adjacent Allotments	Secondary treated WW: 3m D/S, 1.5m U/S.	WW field is at least 3.0 m away from an adjacent allotment.
Services, including Water Pipes, Gas Pipes & Electricity	Not assessed as part of this commission.	To be confirmed by landowner, developer and relevant tradesman.
Waterways (and Ephemeral Water Courses) (non-potable)	Secondary treated WW: 30 metres.	Not applicable to this site. The nearest waterway is approximately 2.0 km north of the site.

Surface Waters, including Dams	Secondary treated WW: 30 metres.	No dams on the site. Nearest dam is 400 metres to the south-east on neighbouring land.
Groundwater Bores	Category 2b-6 Soils: • Secondary Treated WW: 50 metres • Adv Secondary Treated WW: 20 metres	No groundwater bores were observed on the property. According to VVG, the nearest groundwater bore is approx. 2.0 km north east of the site.
Recreational Areas	Children's grassed areas: • Secondary Treated WW: 3 metres In-ground swimming pool • Secondary Treated WW: 3 metres	N/A for this site.

Additional Notes: The Design Loading Rate (DLR) for this method of land application is 5mm/day for heavy clay soil, Category 6b. In accordance with the Code and AS/NZ 1547:2012, the following requirements are specified:

- *"To enable use of such soils for on-site wastewater land application systems, special design requirements and distribution techniques or soil modification procedures will be necessary. For any system designed on these soils, the effluent absorption rate shall be based upon soil permeability testing. Specialist soils advice and special design techniques will be required for clay dominant soils having dispersive (sodic) or shrink/swell behaviour. Such soils should be treated as Category 6 soils. In most situations, the design will need to rely on more processes than just absorption by the soil".*

- *If the Ksat <0.06m/day, a full water balance can be used to calculate the trench/bed size.*

Permeability has been advised in this report using 'Site-and-Soil Evaluation Procedures' detailed in the AS/NZ 1547:2012 standard and visual assessment from experience. Should local council require this work, it can be provided at an additional cost to the client. We expect that the shire will maintain consistency between this site and other sites close by and select a conservative approach, without on-site soil permeability testing.

For subsurface drip irrigation, Category 6b is also adopted as the 'restrictive' horizon. For this method of land application, secondary treatment will be required with a Design Irrigation Rate (DIR) of 2.0 mm/day.

Recommendations for Treatment & Land Application of Domestic Wastewater:

Treatment system: **Secondary treatment system**. Advanced secondary treatment is also suitable. This is based on the LDRZ zoning, allotment size and potential position of the wastewater field to site boundaries and minimum requirements by the Golden Plains DWMP.

Land application options and soil management requirements:

1. Wick trench and bed system, or ETA absorption beds and trenches with a DLR of 5.0 mm per day to suit heavy clay soil. Using the VCLAF spreadsheet with reference to the Code and the Golden Plains DWMP, the following recommendations are provided:

    a. To achieve a zero water balance, the minimum land area is 176 m^2.

b. The minimum land application area calculated for nitrogen application for use by pasture is 25 mg/l, requiring a wastewater field area of 249 m^2. This recommendation overrides the zero water balance land area listed above.

c. The minimum length of trench recommended is **136 metres**, based on calculations in Section 10 of this report.

d. Using the minimum length of trench with a trench and bed set on spacings of 3.0 metres (Golden Plains DWMP), the wastewater field should be at least **360m^2** (see Section 10 of this report). This requirement sets the minimum land area required for wastewater disposal using trenches. In accordance with the Golden Plains DWMP, a minimum area of 15% of the total land area must be set aside for wastewater application, totalling 600m^2. This site can comply with this requirement.

2. Subsurface drip irrigation, with a DIR of **2.0** mm/day to suit heavy clay soil. The minimum land area requirement is **593 m^2**. A wastewater field with dimensions of 36 x 20 metres will be required. In accordance with AS1547:2012, the minimum depth of 'good quality' topsoil required is 150mm. The following will be required:

   a. All soil within the disposal field should be ripped to 200-300mm prior to topsoil importation.

   b. This site will require importation of 150mm of 'good quality' loamy topsoil. Across 593m^2, the minimum topsoil to be imported is 89m^3. Subsurface drip tape should be installed into loamy topsoil.

3. Mounds: Not an available option in accordance with the Golden Plains DWMP for allotments of 4000m^2.

4. Low Pressure Effluent Distribution (LPED): Not an available option for Category 6b soils in accordance with the Code and the Golden Plains DWMP.

5. Surface irrigation: Not an available option for Category 6b soils in accordance with the Code and the Golden Plains DWMP.

Soil Treatment and Amelioration:

1. All disturbed dispersive soils including the topsoil and subsoil will require treatment with 1% w/v of gypsum.

2. Any imported loamy topsoil for subsurface drip or mound construction will require treatment with 0.5% w/v of Ag Lime.

Surface Drainage:

1. Surface drainage must be installed around the wastewater field to ensure that there is no ingress of surface water into the disposal area.

Setback Distances: In accordance with Table C listed above.

Conclusion: The site is suitable for disposal of on-site domestic wastewater in accordance with the Code. Care is required to ensure the wastewater field is positioned in accordance with the setback distances listed in this report. Secondary treatment of wastewater is the minimum standard applied to land via Wick Trench and Beds, Absorption Beds and Trenches or using Subsurface Drip Irrigation.

Monitoring of soil for Electrical Conductivity (EC - salinity), Exchangeable Sodium Percentage (ESP) and the Sodium Absorption Ration (SAR) of wastewater should be undertaken every 2-3 years to ensure the soils do not become dispersive or nutrient levels or other measured parameters including soil pH do not undergo major change.

A surface drainage system is recommended for installation around the wastewater field to divert overland flow from higher elevation around the wastewater field.

Water saving fixtures should be specified to reduce wastewater generation.

The findings of this investigation should be discussed with the Golden Plains Shire Council to ensure that any preferences of the local council are met in the approval process for disposal of domestic wastewater. If there are any queries relating to the findings of this investigation, please do not hesitate to call me on 0439 341 265.

Kind regards,

Christian Bannan.
Ba Ag (Hons), Adv. Dip. Ag.
Director, Soil Scientist
South East Soil & Water.
Certified Professional Soil Scientist No. S01479 with Soil Science Australia.

1. INTRODUCTION

1.1. Report Outline.

This report provides results of a Land Capability Assessment for On-Site Domestic Wastewater Management at Lot 2 Number 69 Yverdon Drive, Bannockburn, Victoria. This report is prepared South East Soil & Water (SESW) for Soil Industries on behalf of MI Projects and the landowner.

This report is prepared in accordance with the EPA publication 891.4 'Code of Practice Onsite Wastewater Management' and the Australian/ New Zealand Standard 1547:2012 'On-Site Domestic Wastewater Management'.

This report assesses the suitability of the site for onsite domestic wastewater management and lists the options and minimum requirements for a wastewater treatment, land application and calculated land application areas. A standard 4-bedroom home has been adopted for reporting.

The author has experience with the soils and landscapes in this region and the potential problems they pose when irrigated with wastewater.

1.2. Site Location.

The site located at Lot 1 Number 69 Yverdon Drive, Bannockburn, Victoria. The location of site with respect to the township of Bannockburn is displayed in Figure 1. The location of inspection boreholes across the new allotment 'Lot 1' are shown in Figure 2.

Figure 1. Location of the property with respect to Bannockburn (Google Earth, 2019).

Figure 2. Location of boreholes on the site.

1.3. Description of the Development.

1.3.1. Client Details.

Client details:

MI Projects
Lot 1, 69 Yverdon Drive, Victoria

1.3.2. Local Council Area.

Golden Plains Shire Council.

1.3.3. Zoning.

The property is zoned 'LDRZ' for Low Density Residential Zone (Victorian Government Planning Maps Online, 2019).

1.3.4. Allotment Size.

The property proposed for subdivision is approximately 4000m^2, or 0.4 hectares.

1.3.5. Domestic Water Supply.

Water will be supplied for domestic use from on-site rooftop rainwater collected from buildings and sheds. It is understood that there is also a freshwater pipeline to the property.

1.3.6. Anticipated Wastewater Load.

The design wastewater load for a 4-bedroom home based on the Australian Standard AS/NZ 1547:2000 and the EPA Victoria Code of Practice for the 'number of bedrooms plus one' to suit the 'potential occupancy'. The total wastewater generation is estimated at 150 L/person/day or 750 L/day.

1.3.7. Availability of Sewer.

No sewer is available at the site.

1.3.8. Overlays.

Overlays that exist on the site include:

- DDO5: Design and Development Overlay Schedule 5.

This overlay limits building and works from 5 metres from a property boundary. This overlay does not impact use of the site for domestic wastewater application.

Appendix A is a copy of the DELWP planning map with site overlays.

1.3.9. Access.

Access is gained from a gravel driveway from Yverdon Drive.

1.4. Subdivision Plan, Key Site Features, Surrounding Land Use & Vegetation.

The property for subdivision has a total allotment size of 8,000m^2. This proposed allotment, 'Lot 1', will form the eastern half of the site and contains an existing home which is planned for extension. An extract of the subdivision plan is included as Figure 3.

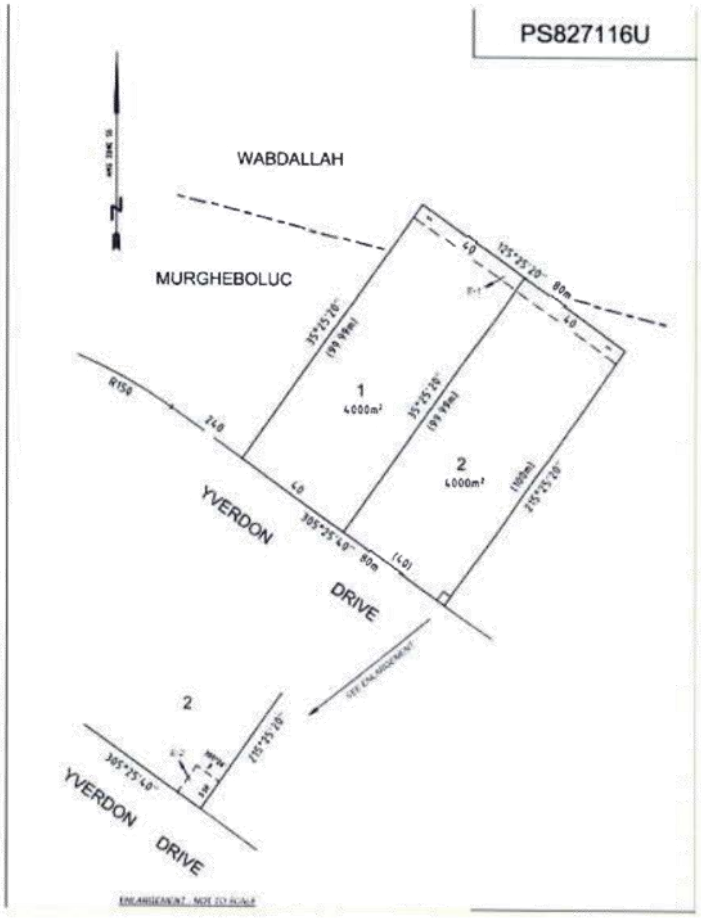

Figure 3. Plan showing the proposed subdivision (Lots 1 and 2). This allotment is Lot 2.

Grass pasture around the property has been managed by slashing or mowing. There are trees planted on the northern, eastern and southern boundaries. The boundary between this proposed allotment (Lot 1) and the new proposed allotment (Lot 1) is not yet fenced or bordered by trees.

Figures 4-7 are photographs of the site with notes in the captions.

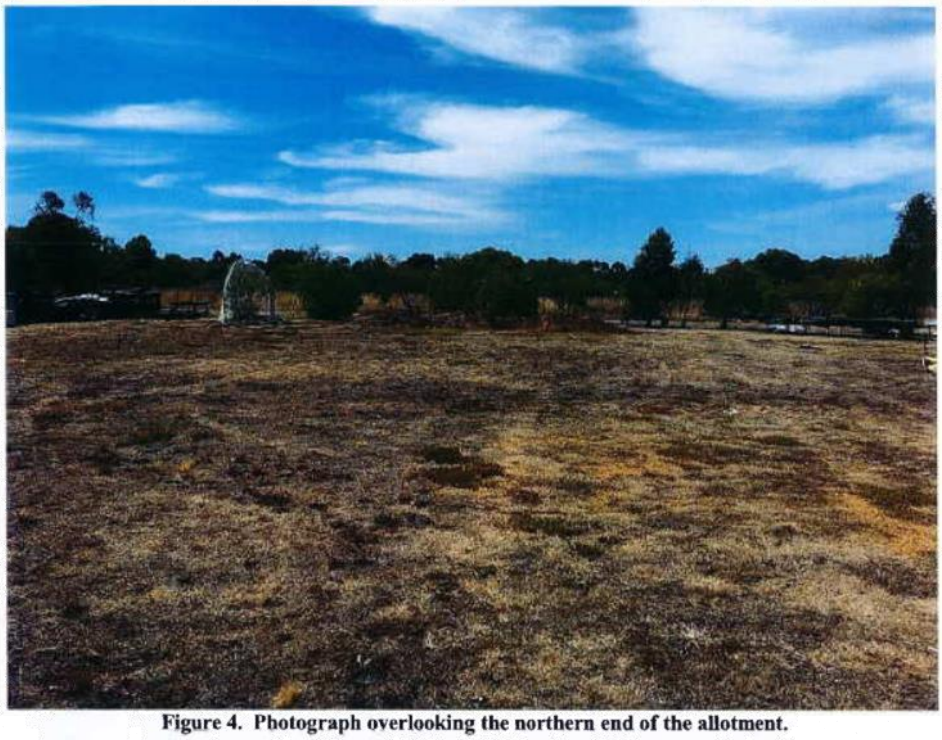

Figure 4. Photograph overlooking the northern end of the allotment.

Figure 5. Photograph overlooking part of the allotment to the west.

Figure 6. Photograph overlooking part of the allotment to the north.

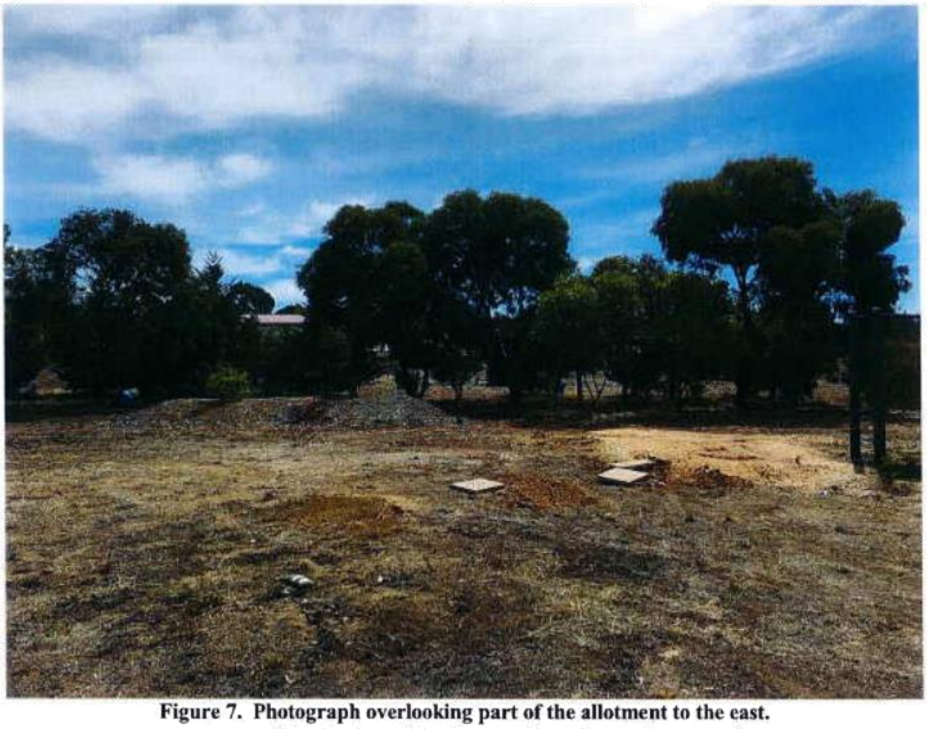

Figure 7. Photograph overlooking part of the allotment to the east.

2. BACKGROUND INFORMATION.

2.1. Personnel Undertaking this Assessment.

Christian Bannan. Soil Scientist.
B. Ag. (Hons), Adv. Dip. Ag, SSA, CPSS.

Personnel undertaking this investigation have more than 10 years of experience with site investigation and land capability assessment for domestic, environmental and agricultural land use in south eastern Australia. This is regularly updated through permanent and contracted commissions with commercial agencies, water authorities, shires, mining companies and developers.

The author is a Certified Professional Soil Scientist with Soil Science Australia, accreditation number S01479.

2.2. Referenced Documentation.

1. 'Code of Practice': EPA Victoria Publication 891.4 – July 2016. Code of Practice – Onsite Wastewater Management.

2. 'Australian Standard' or 'AS/NZS 1547:2012': Australian/New Zealand Standard – On-Site Domestic Wastewater Management.

3. Victorian Land Capability Assessment Framework, Municipal Association of Victoria. January 2014.

4. RMCG, 2015. Golden Plains Domestic Wastewater Management Plan, Volumes 1 and 2.

5. Land Capability Assessment for On-Site Domestic Wastewater Management. EPA Victoria Publication 746.1, March 2003.

3. METHODOLOGY FOR INVESTIGATION.

3.1. Background Desktop Literature.

A review of site geology, waterway and groundwater data from Victorian government planning maps has been reviewed prior to preparing this report. These details are included in Section 4.

A review of average annual and monthly rainfall and evaporation is provided in Section 5. Data is required for input into the VCLAF spreadsheet for calculating the required land area for domestic wastewater disposal, using a zero water balance. The results of calculations are provided in Appendix C.

3.2. Inspection Boreholes.

Boreholes were installed by Mr. Simon Christie of Soil Industries at four locations on the property shown in Figure 2. Logs reflecting the results of drilling are provided in Appendix B "Soil Industries – Bore Logs".

3.3. Soil Physical Analysis.

Soil physical properties for representative bore logs were assessed for each soil horizon identified by the driller in accordance with the '*Australian Soil & Land Survey Handbook*' (McDonald et al, 1990). The following parameters were recorded at each site:

- Depth to a major horizon change (cm)
- Texture (Northcote, 1979)
- Level of plasticity
- Visual colour.
- Soil structure (Weatherby, 1992)
- Drainage characteristics (McDonald et al. 1990)
- Presence of organic matter and plant roots
- Presence of a water table.
- Classification in accordance with EPA 891.4, the 'Code'.

Soil profile logs are included in the Soil Industries logs provided as Appendix B.

3.4. Inferring Infiltration & Soil Permeability.

Soil infiltration and permeability rates were determined using the Australian Standard guideline using the 'Site-and-soil evaluation procedures' outlined in AS/NZS 1547:2012, part 5.2. This method provides an estimate of soil permeability of the limiting soil layer (B horizon), as outlined in the Code of Practice (EPA 891.4, section 3.6.1).

We have a range of equipment to facilitate site measurements if site testing is required or specified by the local council. We have chosen the aforementioned method of estimation given that this is specified in the Code of Practice in preference to onsite testing given that this is the preferred method set by the Code.

3.5. Testing for Agronomics.

Agronomic testing of samples was conducted on samples to assist with identification of soil properties listed in Table 1. Details of the tests performed, test methods and the purpose of each test is outlined in Table 1. Tests are performed because the sustainable disposal of wastewater is dependent on the ability of the client to grow pasture, trees or a crop from the wastewater applied. Uptake of wastewater generated minimises the risk of runoff or accessions to groundwater.

Table 1. Parameters tested, test method and outcomes from each test performed.

Test Performed	Test Method	Purpose of the Test
Electrical conductivity	Rayment and Higginson, 1992.	Soil salinity criteria, changes in soil salt with depth, match plant root growth and depth of soil utilised by the crop with subsoil salinity.
Soil pH (water)	Rayment and Higginson, 1992.	Soil pH, acidity and/or alkalinity, nutrient availability, growing conditions and likely impact on soil biology.
Slaking class	Australian Standards, 1980	Assess soil behaviour when wet by rainfall, aggregate stability, identify if the soil has sufficient organic matter to limit breakdown of aggregates and deterioration of soil structure.
Emerson dispersion class	Emerson, 1967; Australian Standards, 1980; Charman (1978); Charman & Murphy (1991).	Assess clay dispersion when wet by rainfall, soil stability to wetting and saturation, likely/unlikely presence of sodic soil, likelihood of soil crusting.

Soil samples were collected from three depths within Borehole 1. The total number of samples collected was 3. The results of testing are provided in Table 3.

3.6. Access & Conditions.

Access was not limited at the time of investigation. The investigation was carried out in fine weather conditions. Boreholes were distributed across proposed sites for wastewater application to gain adequate site characterisation.

3.7. Calculations for Domestic Wastewater Generation, Irrigation & Management.

All calculations provided for soil hydraulic performance, wastewater generation, water balance and nutrient balances are consistent with the Code of Practice outlined in EPA Publication 891.4 and AS/NZS 1547. Where appropriate, personal experience with soils in the region has been drawn upon.

4. BACKGROUND DESKTOP LITERATURE - GEOLOGY, WATERWAYS & GROUNDWATER.

4.1. Geology.

Surface geology is listed by Geovic (2019) and Douglas and Ferguson (1988) as 'Qv' an abbreviation for Quaternary, Volcanics. Sediments on this formation consist of unconsolidated material with a dominance of clay. The geology map cited is included as

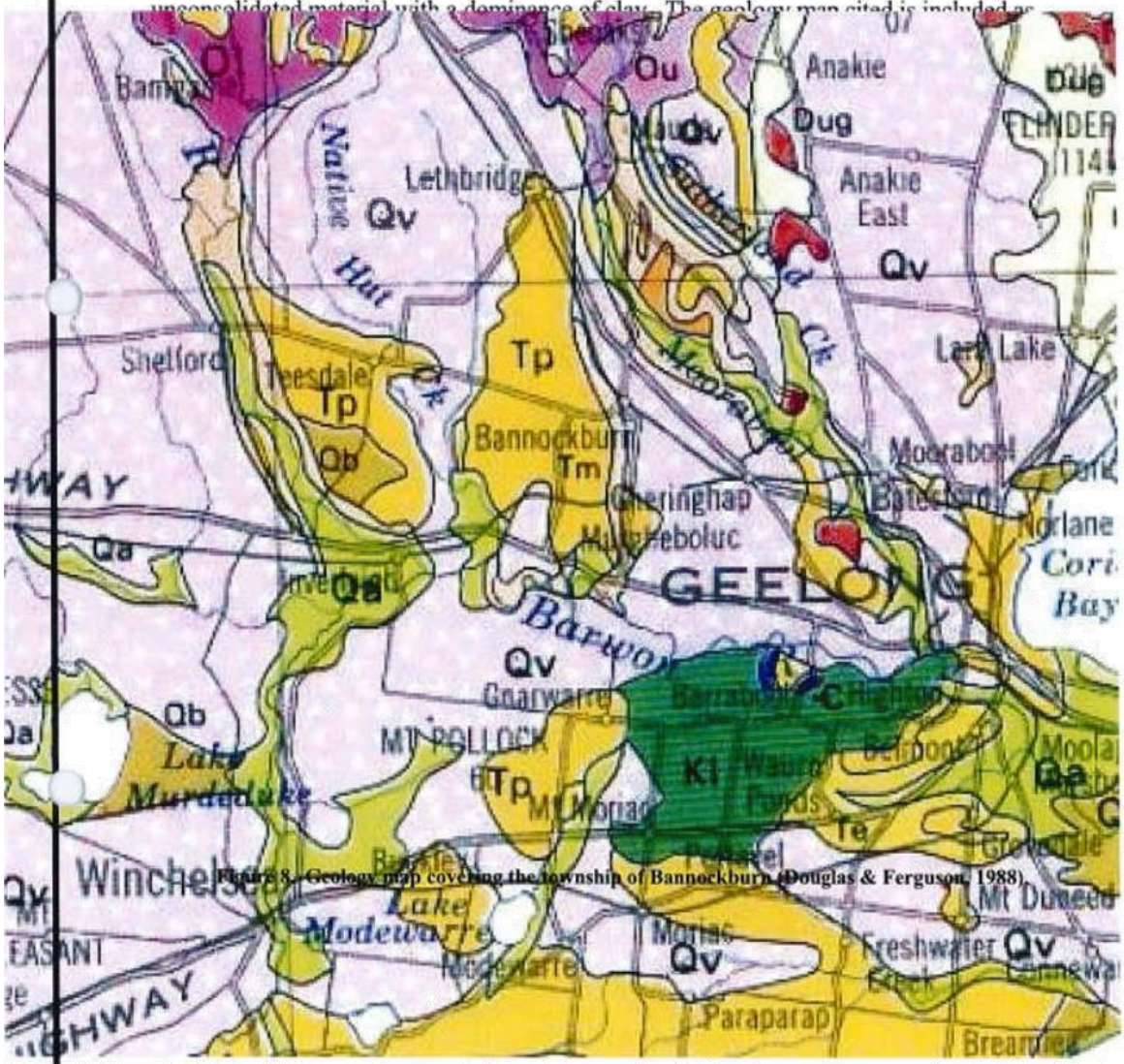

Figure 8. Geology map covering the township of Bannockburn (Douglas & Ferguson, 1988).

4.2. Waterways, Drainage Lines & Surface Water.

In accordance with Figure 9, there are no waterways on or close to the site. Figure 8 shows the location of a surface water body (dam) approximately 400 metres south-east on neighbouring land. There are no natural drainage lines on the site.

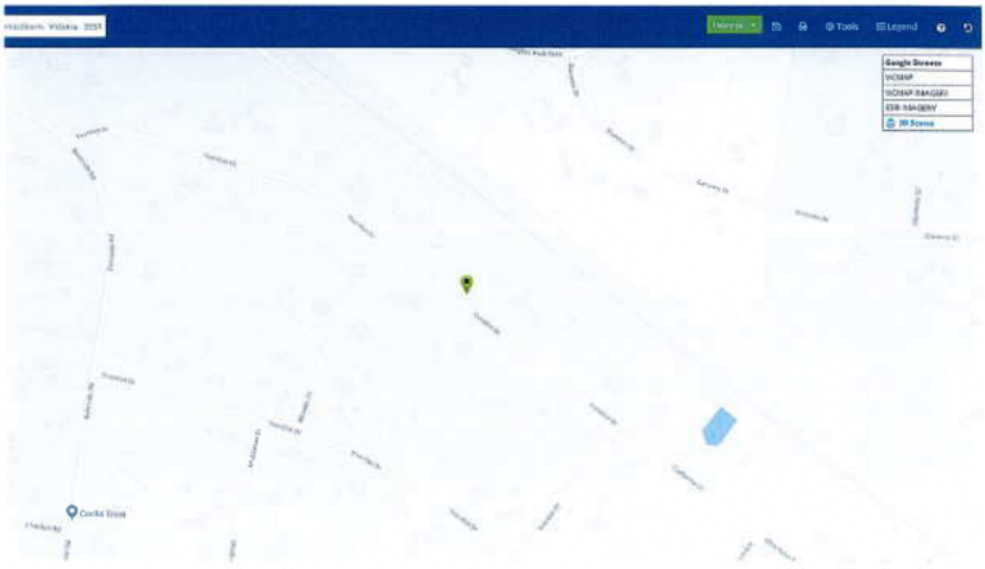

Figure 9. Extract of a groundwater map from VVG (2019), showing waterways and bore locations. There are no bores or waterways close to the site.

4.3. Groundwater.

Figure 9 shows lists the location of groundwater bores in the area (VVG, 2019). There are no groundwater bores within 500 metres of the property. The nearest registered groundwater bore is over 1.8 kilometres north-west at the Bannockburn township, or 1.8 kilometres north-east near a vineyard.

VVG (2019) indicates the following groundwater conditions in this region:

- Groundwater depth: Approximately 10 metres.
- Groundwater salinity: Approximately 3500-7000 mg/l TDS.

5. RAINFALL & EVAPORATION.

Rainfall and evaporation data for Bannockburn has been accessed from the nearest Bureau of Meteorology (BOM) website weather station number is 87009, approximately 2.0 kilometres from the site. Data ranges from 1899-2018 and has been used to calculate average monthly and annual rainfall, displayed in Figure 9. Evaporation data is obtained from the BOM records for this region. Average annual rainfall for Bannockburn is 513mm/year.

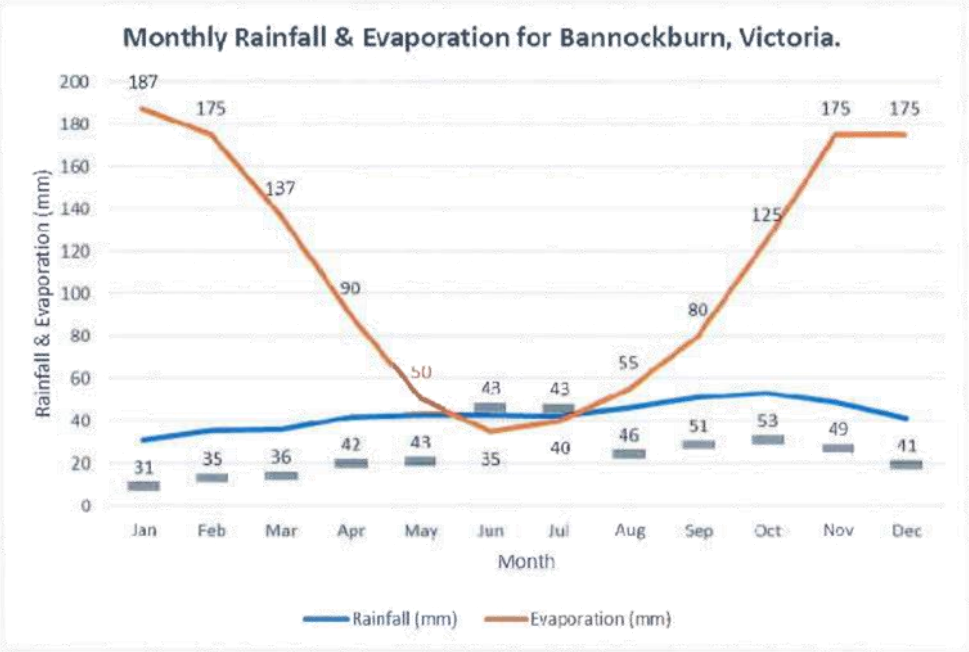

Figure 9. Monthly rainfall and evaporation for Bannockburn.

Rainfall exceeds evaporation from June to July in an average year indicating that there are periods where surface runoff or groundwater accessions are likely to occur after soils reach field capacity.

Treated wastewater can be used to irrigate pastures during the period from August to April. During the winter months, accessions and rainfall are inevitable in an average or above average rainfall year. A well-managed pasture will use water during the winter period and reduce the likelihood of surface runoff or groundwater accession. Pastures which are dominantly ryegrass or couch-grass based will aid the dewatering of soils leading into winter, providing increased stored soil moisture capacity.

6. RESULTS OF FIELD INVESTIGATIONS.

6.1. Land Levels & Slopes.

Land levels at the proposed wastewater field lie at approximately 97-98 metres AHD according to Google Earth. The site has an average slope of 1:20 to the north-east.

6.2. Average Soil Profile Description.

Soil profile descriptions are listed in Appendix B. Representative soil profile descriptions covering two differing soil profiles are provided in Table 2.

Table 2. Average soil profile descriptions – Borehole 2.

BORE LOG #2			
Depth mm	Material Description	Fill	Ground Water
0	CLAYEY LOAM moderate structure (4a) dark brown dry medium dense		
200	Heavy CLAY moderate structure (6b) dark brown dry stiff		
800	Weathered BASALT CLAY with seams of rock fragments grey dry stiff		
1000	Refusal on weathered BASALT		

6.3. Results of Testing.

6.3.1. Table of Results.

Table 3 lists the results of soil testing from Borehole 1. Table 4 is a soil salinity interpretation. Table 5 is a soil slaking interpretation. Table 6 is a Dispersion Class interpretation.

Table 3. Results of testing for Borehole 1.

Sample Number	Sample Name	EC 1:5 Soil/Water (uS/cm)	EC 1:5 Soil/Water (dS/m)	Texture Factor	EC 1:5 Soil/Water (dS/m) Sat Ext.	Soil pH (H^2O)	Slaking Class	Emerson Dispersion Class
1	BH1. 0.1m	109	0.109	10	1.09	6.70	2	5
2	BH1. 0.4m	163	0.163	6	0.97	6.80	2	1

Table 4. Soil salinity interpretation.

INTERPRETATION.

SOIL SALINITY - ECe SATURATION EXTRACT.

- <1.0 dS/m. Low level of soil salinity.
- 1.0-2.0 dSm. Low lever of soil salinity.
- 2.0-4.0 dS/m. Moderate EC. Sensitive species will be effected.
- 4.0-6.0 dS/m. Moderate - high EC. Salt tolerant species suited only.
- 6.0-10.0 dS/m. High EC.
- >10 dS/m. Very high EC.

Table 5. Soil slaking interpretation.

SOIL SLAKING CLASS.

Slaking Class	Interpretation
0	No change
1	Aggregate breaks open but remains intact
2	Aggregate breaks down into smaller aggregates
3	Aggregate breaks down completely into sand grains

Reference: Australian Standards (1980).

Table 6. Soil dispersion interpretation.

SOIL DISPERSION CLASS.

Emerson Class	Interpretation
1	Slaking, complete dispersion
2	Slaking, partial dispersion
3	Slaking, slight dispersion after remoulding and immersing in water
4	Slaking, nil dispersion, carbonate or gypsum present
5	Slaking, carbonate or gypsum absent, remould, reshake, dispersion
6	Slaking, carbonate or gypsum absent, remould, reshake, non-dispersive
7	No slaking, swelling, nil dispersion
8	No slaking, swelling

Orange: Dispersive soil. Reference: Emerson (1967), Australian Standards (1980).

6.3.2. Soil Electrical Conductivity.

Both topsoil and subsoil samples recorded low salinity results. Based on these tests there is no salinity issue. Salt from wastewater can be managed.

6.3.3. Soil pH.

Soil pH (water) test results for samples collected range from 6.7-6.8, slightly acidic. These results are expected in this region. These results are normal and expected in this region. It is likely over time that the soils receiving wastewater will become more alkaline over time with the application of salts, including sodium and potassium. Ag Lime is not required.

6.3.4. Slaking.

Soil slaking results reveal that all soil samples slaked upon wetting. Slaking is the process where aggregates break down from larger to smaller aggregates or particles due to chemical instability and a lack of organic matter. Slaking indicates that a soil layer has insufficient organic matter to maintain a stable condition. Soil structural improvement is likely to be observed from the accumulation of organic matter.

Figure 10 is a photograph of slaking and dispersion testing of samples provided.

Figure 10. Slaking and dispersion tests of samples tested.

6.3.5. Dispersion.

Soil dispersion was noted in the subsoil sample tested. The results confirm that dispersion is likely to impact impede infiltration. A response to gypsum is likely for controlling dispersion and improving soil permeability. The SAR of wastewater and ESP of soil will require monitoring over time to ensure the soils in the wastewater field do not become higher in sodicity.

Figure 10 is a photograph of slaking and dispersion testing of samples from Borehole 1.

7. ESTIMATED SOIL PERMEABILITY.

Observations from bore logs and testing of samples has allowed soil permeability to be estimated in accordance with the AS/NZS 1547:2012 and Table 9 of the Code of Practice. Estimations are as follows:

A Horizon – Non-limiting soil layer:

- Soil category: 4a.
- Soil texture: Clay Loam.
- Depth: 0-0.1/0.3 metres.
- Structure: Moderate to strongly structured.
- Indicative permeability (K sat): 0.5-1.5m/day.

B Horizon – limiting soil layer:

- Soil category: 6b
- Soil texture: Heavy clay.
- Depth: 0.1/0.3 - 0.6 metres.
- Structure: Moderate to strongly structured.
- Indicative permeability (K sat): <0.06 m/day.

For wick trenches and beds, or ETA absorption trenches and beds, the author recommends adopting **0.06 m/day** as a conservative guide for permeability of the B horizon, or limiting soil layer.

These values are recommended for adoption by Local Council. The results should be checked and compared with other sites close by that have effluent disposal systems on the same landform which have operated efficiently for some time.

The soils will require amelioration with gypsum. Under these conditions permeability is expected to increase.

8. DAILY WASTEWATER GENERATION.

Calculations for daily wastewater generation for a typical household with five bedrooms are provided below using:

Standard Water Fixtures.

= (No. of bedrooms + 1) x litres per person per day
= (4 + 1) x 150 litres per person per day
= 750 litres per day.

Based on the above calculations, wastewater generation volume is estimated at 900 litres per day, or 273,750 litres per year. This is an equivalent of 274 m^3.

9. WATER QUALITY PARAMETRES, DESIGN LOADING RATES, DESIGN IRRIGATION RATES & SOIL AMELIORATION.

9.1. Target Water Quality Parameters.

Secondary Treatment: Secondary treatment is the minimum recommended treatment standard, based on zoning and proximity to neighbours. Target water quality parameters for domestic wastewater treated to Secondary effluent standard are:

- Biochemical oxygen demand (BOD): <20 mg/l
- Total suspended solids (TSS): <30 mg/l.
- E. Coli: <10 mg/l.

Advanced Secondary Treatment: Advanced secondary treatment is also an available option for this site. Target water quality parameters for domestic wastewater treated to an Advanced Secondary level of treatment are:

- Biochemical oxygen demand (BOD): <10 mg/l
- Total suspended solids (TSS): <10 mg/l.
- E. Coli: <10 mg/l.

9.2. Design Loading Rate & Irrigation Area – Wick Trench & Bed Systems & ETA Absorption Beds & Trenches.

For Wick Trenches and Beds or ETA Beds and Trenches, the Design Loading Rate (DLR) that the author recommends adopting for effluent treated to a secondary standard is **5 mm/day, with conditions.** The Code of Practice states that Note 2 from Table L1 in the AZ/NZ 1547:2012 be adhered to under these conditions. The note states that:

- "*To enable use of such soils for on-site wastewater land application systems, special design requirements and distribution techniques or soil modification procedures will be necessary. For any system designed on these soils, the effluent absorption rate shall be based upon soil permeability testing. Specialist soils advice and special design techniques will be required for clay dominant soils having dispersive (sodic) or shrink/swell behaviour. Such soils should be treated as Category 6 soils. In most situations, the design will need to rely on more processes than just absorption by the soil*".

- *If the Ksat <0.06m/day, a full water balance can be used to calculate the trench/bed size.*

9.3. Design Irrigation Rate & Irrigation Area – Subsurface Drip Irrigation.

For subsurface drip irrigation on this site, the Design Irrigation Rate that the author recommends adopting for effluent treated to a secondary standard is **2.0 mm/day** to reflect medium clay soil from 0-0.6 metres.

In accordance with AS1547:2012, the minimum depth of 'good quality' topsoil required. Details are provided in the recommendations.

9.4. Non-Permitted or Non-Suitable Application Systems.

Land application systems that are not suitable for this site in accordance with the Code or the Golden Plains DWMP (RMCG, 2015) include:

- LPED – Low Pressure Effluent Distribution.
- Surface Irrigation.
- Mounds.

10. SPECIFICATION FOR WICK TRENCH & BED SYSTEMS & ETA ABSORPTION BEDS & TRENCHES.

10.1. Minimum Length of Trench Calculation.

Note: The length of trench for remains the same under varying wastewater generation levels because the Daily Loading Rate (DLR) for both types of effluent are based on soil, which is 5mm per day. This is based on textures of medium clay with moderate structure.

Water Saving Fixtures.

Q	= Max. Design Flow Rate (l/day)	= 750
W	= Width of trench and bed (m)	= 1.6
DLR	= Daily Loading Rate (mm/day)	= 5
F	= Factor of Safety of 1.2	= 1.2

Calculated length of trench is as follows:

= Q / (DLR x (W/F))
= 750 / (5 x (1.6/1.2))
= 750 / (5 x 1.3)
=750 / 6.6
= **114 metres.**

Based on the Code of Practice the maximum length of one single trench is 30 metres. Therefore, any number of trenches can be installed if a single trench does not exceed 30 metres. To remain conservative, we recommend that at least 4 x 30 metre lengths of trench which branch out from one primary feeder line to provide **120 metres of trench**.

The minimum land area required set by nitrogen application is 249m^2.

The Golden Plains DWMP requires at least a 3.0 metre buffer between trenches. The total area required for installation of a wick trench and beds is:

= 120 metres (length) x 3.0 metres (spacing).
= **360m^2.**

This area exceeds the minimum requirement of 249m^2 (minimum for nitrogen application) or 136m^2 for a zero water balance.

10.2. Wick Trench & Bed Depth & Design.

As per the guidelines in EPA publication 891.4, the depth of trench should be at least 540mm. This will ensure that the trenches are founded into subsoils. Recommendations for design are as per Figure 11 which is an extract from the Appendix E in the Code of Practice. Spacings of 3.0 metres are required between trenches (RMCG, 2015).

For secondary treated effluent

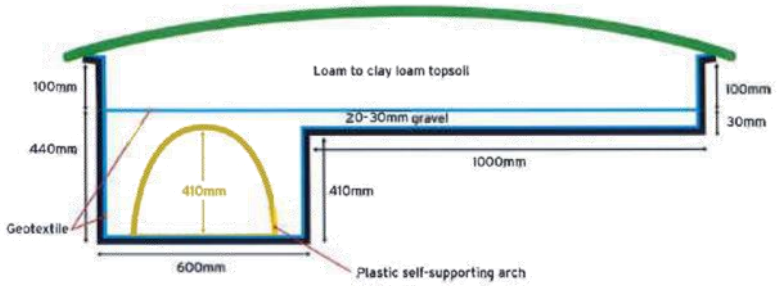

Figure 11. Wick Trench & Bed System for Secondary Treated Effluent.

10.3. ETA Absorption Beds & Trench Design.

For ETA absorption beds and trenches, AS/NZS 1547:2012 sets the minimum standard for design. In accordance with the standard, the following specifications are required at a minimum:

- Depth: 450mm
- Width: 1500mm
- Thickness of gravel or scoria in base of trench with distribution pipe: 200mm
- Thickness of sand above gravel and scoria to natural surface: 200mm
- Thickness of topsoil: 100mm.

An example cross-section from the AS/NZS showing a typical ETA trench and bed is shown in Figure 12.

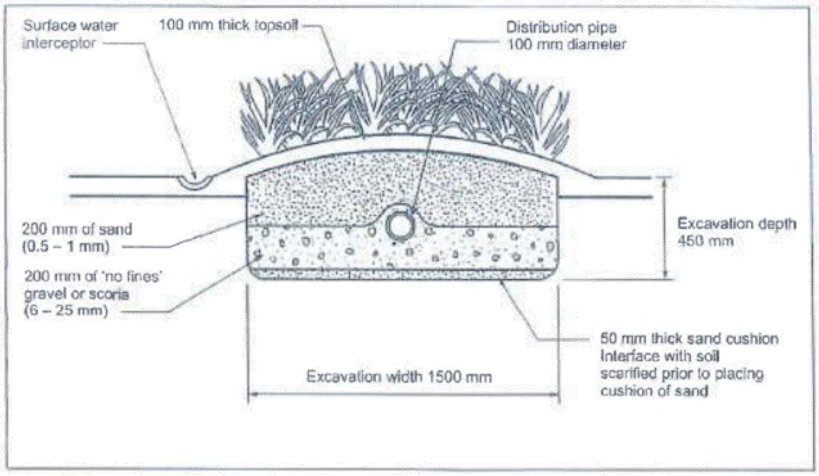

Figure 12. ETA absorption bed and trench design in accordance with AS/NZS 1547:2012.

11. SPECIFICATION FOR SUBSURFACE DRIP IRRIGATION.

11.1. Calculations.

If subsurface drip irritation is preferred the manufacturer's specifications will need to be checked for suitability. Based on the code of practice the and the AS/NZ 1547:2012 standard, the Design Irrigation Rate (DIL) for this site is **2.0 mm/day.** Drip irrigation lines must be distributed on 1.0 metre spacings across the wastewater field, providing 0.5m of wetting on either side of the tape.

The minimum land area in accordance with the VCLAF is **593 m²**. Appendix D provides the results of calculations using the VCLAF.

11.2. Depth of Tape.

As per guidelines within EPA publication 891.4 and the AZ/NZS 1547:2012 standard, notes state that '*For category 1, 2 and 6 soils, the drip irrigation system has a depth of 100-150mm in good quality topsoil.* To comply with this guideline, 150mm of topsoil will be required from elsewhere on the site for importation.

Soil from the house site may be used to increase the depth of topsoil across the effluent disposal area where subsurface drip irrigation is to be installed, should the house site require topsoil stripping.

11.3. Other Requirements for Subsurface Drip Irrigation & Configuration.

Other requirements for this type of system:

- Filters
- Pumps
- Flush valves
- Monitoring
- Pressure compensating valves (if specified by the designer).

We recommend utilising one of the major septic tank manufacturers and the manufacturers guidelines for installation of a system suitable for your requirements.

The configuration of each system is not provided given that the author has no understanding of the proposed subdivision. This is the subject of an independent LCA for each dwelling on each allotment.

Figure 13 is an example of a typical subsurface drip arrangement based in accordance with AS/NZ 1547:2012.

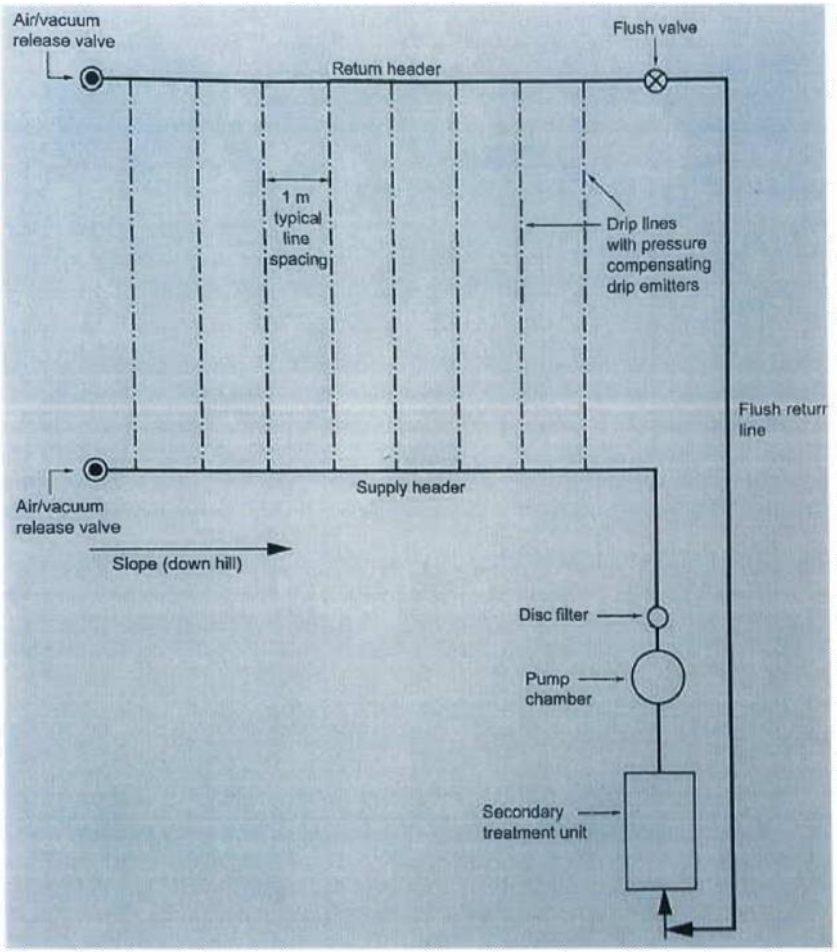

Figure 13. Example subsurface drip irrigation design in accordance with AS/NZ 1547:2012.

12. NUTRIENT BALANCE CALCULATIONS.

In accordance with the VCLAF, the minimum land application area to apply domestic wastewater generated from this development is 249m^2. This calculation is based upon a typical nitrogen content of 25 mg/l for domestic wastewater and crop nitrogen uptake of 220 kg/Ha.

A copy of the VCLAF calculator is provided in Table 7.

Table 7. VCLAF calculator with the minimal land area required for nitrogen application.

Nitrogen Balance

Site Address:	**69 Yverdon Drive, Bannockburn.**							
SUMMARY - LAND APPLICATION AREA REQUIRED BASED NITROGEN BALANCE							**249**	m^2
INPUT DATA[1]								
Wastewater Loading				Nutrient Crop Uptake				
Hydraulic Load	768	L/day		Crop N Uptake	220	kg/ha/yr	which equals 60.27	mg/m^2/day
Effluent N Concentration	25	mg/L						
% N Lost to Soil Processes (Geary & Gardner 1996)	0.2	Decimal						
Total N Loss to Soil	3750	mg/day						
Remaining N Load after soil loss	15000	mg/day						
NITROGEN BALANCE BASED ON ANNUAL CROP UPTAKE RATES								
Minimum Area required with zero buffer			**Determination of Buffer Zone Size for a Nominated Land Application Area (LAA)**					
Nitrogen	249	m^2	Nominated LAA Size			600	m^2	
			Predicted N Export from LAA			-7.73	kg/year	
			Minimum Buffer Required for excess nutrient			0	m^2	

CELLS

	Please enter data in blue cells
XX	Red cells are automatically populated by the spreadsheet
XX	Data in yellow cells is calculated by the spreadsheet, DO NOT ALTER THESE CELLS

NOTES

[1] Model sensitivity to input parameters will affect the accuracy of the result obtained. Where possible site specific data should be used. Otherwise data should be obtained from a reliable source such as:

- *EPA Guidelines for Effluent Irrigation*
- *Appropriate Peer Reviewed Papers*
- *Environment and Health Protection Guidelines: Onsite Sewage Management for Single Households*
- *USEPA Onsite Systems Manual*

13. SET BACK DISTANCES.

13.1. Boundaries & Dwellings.

According to the Code of Practice for Onsite Wastewater Management, the setback distances are listed in Table 8.

Table 8. Setback distances from boundaries and dwellings.

Feature	Wastewater Treated to Secondary Standard	Wastewater Treated to Advanced Secondary Standard
Property boundary – wastewater field upslope of adjacent allotment.	3 metres	1 metre
Property boundary – wastewater field down slope of adjacent allotment.	1.5 metres	0.5 metres
Dwelling / Building – wastewater field upslope	3 metres	3 metres
Dwelling / Building – wastewater field down slope	1.5 metres	1.5 metres

The wastewater field for effluent treated to a secondary standard is recommended to be at least 3.0 metres from a property boundary or dwelling. Special consideration into the positioning of the wastewater field is required to ensure the field fits in theme with the slope, drainage, preferred locations for dwellings and other infrastructure including sheds.

13.2. Waterways.

Table 5 in the Code of Practice lists the required set-back distances from a waterway of at least 30 metres for secondary treated effluent. This development complies with this requirement. Figure 14 provides an approximate sketch of where the wastewater field can be positioned on the allotment.

13.3. Groundwater.

In accordance with VVG (2019), there are no groundwater bores close to the site. No groundwater was intercepted in any boreholes.

14. STORMWATER MANAGEMENT.

Management of stormwater and interaction with wastewater must be considered to meet the Code of Practice. The wastewater field on this site is positioned level to very slightly downslope of the proposed building envelope.

To prevent stormwater from higher elevations entering the wastewater field or impacting the dwelling, drainage should be installed around both areas to provide protection from overland flow.

Figure 14. Recommended potential area for domestic wastewater application.

15. SUMMARY OF LCA FEATRUES INCLUDING MINIMUM SETBACK DISTANCES.

Tables 8-10 are summaries of key site features, which address all points within Table 3 in the Model LCA. Setback distances, notes and recommendations are listed.

Table 8. Results of the Land Capability Assessment – Desktop Review & Site Inspection.

Feature	Description & Comments
Zoning	LDRZ. Low Density Residential Zone.
Overlays	DDO5. Design and Development Overlay Schedule 5. This overlay limits building and works from 5 metres from a property boundary. This overlay does not impact use of the site for domestic wastewater application.
Land Parcel Size	4000 m^2
Number of Bedrooms	4-bedrooms in accordance with the Code. This must include all rooms that can be closed off with a door and inhabited, including sunrooms, studies or similar enclosed rooms.
Daily Wastewater Generation	150 litres/person/day. Total of 750 litres/day.
Landform & Geology (Geovic, 2019)	Quaternary, volcanic on gently undulating land.
Climate	Climate is Mediterranean with cold wet winters and warm dry summers. Rainfall is winter and spring dominant with falls averaging up to 53mm per month recorded in October. Evaporation exceeds rainfall in the months of June and July.
Vegetation & Exposure	Trees were observed on all boundaries, with some trees planted within the allotment. The site has moderate exposure.
Slope	Approximately 1:20 sloping to the north-east.
Rocks, Rock Outcrops or Coarse Fragments	Basalt rock was encountered in all four boreholes from 0.5-1.6 metres of depth.
Surface Water	No dams or surface water observed on or near the site. Nearest dam is over 400 metres south-east.
Presence of Waterways or Ephemeral Drainage Lines:	No waterways, water courses or drainage lines were observed on or near the site.
Flood Potential	There are no flood overlays.
Stormwater Run-On Potential	Low to moderate. Care will be required to ensure drainage is installed around the wastewater field to provide protection from overland flow.
Upslope Seepage	Not observed.
Erosion Potential	Low with actively growing pastures and maintenance of trees. Low to moderate poor pastures, an absence of vegetation or overgrazing. Soils are dispersive. Gypsum treatment will reduce erosion potential.
Groundwater (VVG, 2019)	Not observed in any boreholes. VGG (2019) note the groundwater conditions as: • Salinity: Approximately 3500-7000 mg/kg TDS. This is acceptable for stock water. • Depth: Approximately 10 metres of depth.
Available Land Application Area	Over 600 m^2.

Table 9. Results of the Land Capability Assessment – Soil Conditions.

Soil Description / Horizon	A Horizon Topsoil	B1 Horizon Subsoil
Texture (EPA 891.4).	Clay-Loam	Heavy Clay.
Soil Category (EPA 891.4).	4a	6b
Indicative Permeability (K Sat) (m/day)	0.12-0.5 m/day.	<0.06 m/day.
Design Loading Rate (DLR) for a Wick Trenches & Beds, or ETA Absorption Beds & Trenches (mm/day).	10-12 mm/day.	3.5 mm/day.
Design Irrigation Rate (DIR) for Subsurface Irrigation (mm/day).	3.5 mm/day.	2.0 mm/day.
Soil pH (water) (SESW Test Results).	6.70, slightly acidic to neutral.	7.40, slightly alkaline.
Electrical Conductivity Sat. Ext (ECe) (SESW Test Results).	<2.0 dS/m. Low.	<2.0 dS/m. Low.
Slaking Class (SESW Test Results).	2. Swelling to partial slaking.	2. Swelling to partial slaking.
Emerson Dispersion Class (SESW Test Results).	5. Non-dispersive	1. Complete dispersion.
Surface Drainage & Profile Drainage	Moderate.	Poor.
Presence of Fill Material	Nil	Nil

Table 10. Results of the Land Capability Assessment – Recommended Setback Distances (Table 5 EPA 891.4). Note: U/S = Upslope, D/S = Downslope.

Setback Feature	Minimum Distance (metres)	Requirements & Comments
Dwellings	Secondary treated WW: 3m D/S, 1.5m U/S.	WW field is at least 3.0 m away from buildings.
Property Boundaries	Secondary treated WW: 3m D/S, 1.5m U/S.	WW field is at least 3.0 m away from boundaries.
Adjacent Allotments	Secondary treated WW: 3m D/S, 1.5m U/S.	WW field is at least 3.0 m away from an adjacent allotment.
Services, including Water Pipes, Gas Pipes & Electricity	Not assessed as part of this commission.	To be confirmed by landowner, developer and relevant tradesman.
Waterways (and Ephemeral Water Courses) (non-potable)	Secondary treated WW: 30 metres.	Not applicable to this site. The nearest waterway is approximately 2.0 km north of the site.
Surface Waters, including Dams	Secondary treated WW: 30 metres.	No dams on the site. Nearest dam is 400 metres to the south-east on neighbouring land.
Groundwater Bores	Category 2b-6 Soils: • Secondary Treated WW: 50 metres • Adv Secondary Treated WW: 20 metres	No groundwater bores were observed on the property. According to VVG, the nearest groundwater bore is approx. 2.0 km north east of the site.
Recreational Areas	Children's grassed areas: • Secondary Treated WW: 3 metres In-ground swimming pool • Secondary Treated WW: 3 metres	N/A for this site.

16. CONCLUSION & RECOMMENDATIONS.

The site is suitable for disposal of on-site domestic wastewater in accordance with the Code. Care is required to ensure the wastewater field is positioned in accordance with the setback distances listed in this report. Secondary treatment of wastewater is the minimum standard applied to land via Wick Trench and Beds, Absorption Beds and Trenches or using Subsurface Drip Irrigation.

Monitoring of soil for Electrical Conductivity (EC - salinity), Exchangeable Sodium Percentage (ESP) and the Sodium Absorption Ration (SAR) of wastewater should be undertaken every 2-3 years to ensure the soils do not become dispersive or nutrient levels or other measured parameters including soil pH do not undergo major change.

A surface drainage system is recommended for installation around the wastewater field to divert overland flow from higher elevation around the wastewater field.

Water saving fixtures should be specified to reduce wastewater generation.

The findings of this investigation should be discussed with the Golden Plains Shire Council to ensure that any preferences of the local council are met in the approval process for disposal of domestic wastewater. If there are any queries relating to the findings of this investigation, please do not hesitate to call me on 0439 341 265.

Kind regards,

Christian Bannan.
Ba Ag (Hons), Adv. Dip. Ag.
Director, Soil Scientist
South East Soil & Water.
Certified Professional Soil Scientist No. S01479 with Soil Science Australia.

17. REFERENCES.

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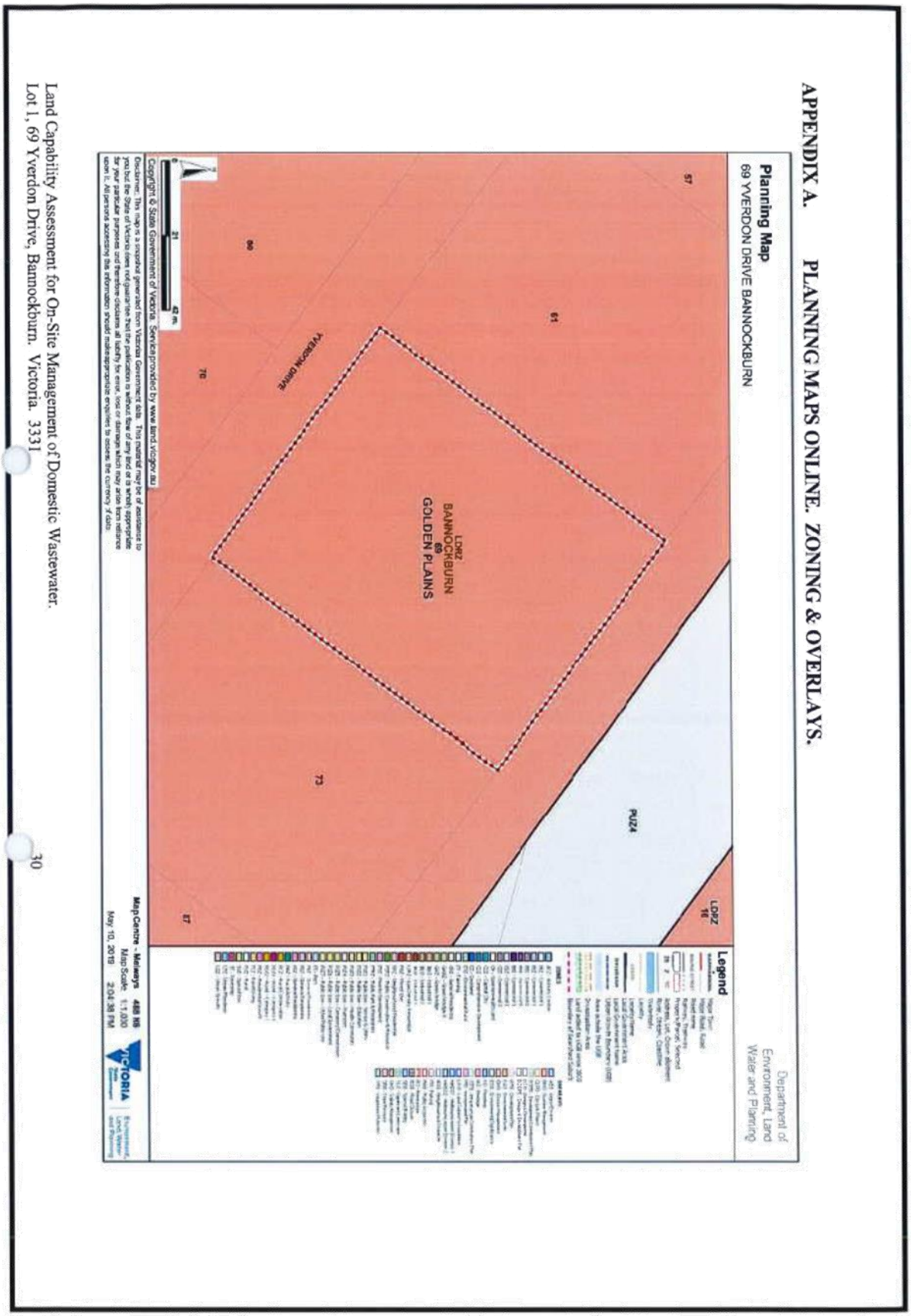
APPENDIX A. PLANNING MAPS ONLINE. ZONING & OVERLAYS.



Land Capability Assessment for On-Site Management of Domestic Wastewater.
Lot 1, 69 Yverdon Drive, Bannockburn. Victoria. 3331

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APPENDIX B. SOIL INDUSTRIES BORE LOGS.

Soil Industries Pty. Ltd. Site: 1903011

BORE LOGS	
Site: Vacant Lot Lot 1 Number 69 Yverdon Street Bannockburn	Site Ref: 1903011
Date:	Sampler: Simon Christie

BORE LOG #1

Depth mm	Material Description	Fill	Ground Water
0	CLAYEY LOAM moderate structure (4a) dark brown dry medium dense		
300	Heavy CLAY moderate structure (6b) dark brown dry stiff		
900	Weathered BASALT CLAY with seams of rock fragments grey dry stiff		
1100	Refusal on weathered BASALT		

BORE LOG #2

Depth mm	Material Description	Fill	Ground Water
0	CLAYEY LOAM moderate structure (4a) dark brown dry medium dense		
200	Heavy CLAY moderate structure (6b) dark brown dry stiff		
800	Weathered BASALT CLAY with seams of rock fragments grey dry stiff		
1000	Refusal on weathered BASALT		

BORE LOG #3

Depth mm	Material Description	Fill	Ground Water
0	CLAYEY LOAM moderate structure (4a) dark brown dry medium dense		
200	Heavy CLAY moderate structure (6b) dark brown dry stiff		
1000	Weathered BASALT CLAY with seams of rock fragments grey dry stiff		
1600	Refusal on weathered BASALT		

BORE LOG #4

Depth mm	Material Description	Fill	Ground Water
0	CLAYEY LOAM moderate structure (4a) dark brown dry medium dense		
100	Heavy CLAY moderate structure (6b) dark brown dry stiff		
500	Refusal on weathered BASALT possible floater		

APPENDIX C. LAND CAPABILITY ASSESSMENT FRAMEWORK SPREADSHEET – WICK TRENCHES & BEDS OR ETA ABSORPTION BEDS & TRENCHES.

Irrigation area sizing using Nominated Area Water Balance for Zero Storage

Site Address:	69 Yverdon Drive, Bannockburn.		
Date:	10th May 2019	**Assessor:**	Christian Bannan. South East Soil & Water.

INPUT DATA

Design Wastewater Flow	Q	750	L/day	Based on maximum potential occupancy and derived from Table 4 in the EPA Code of Practice (2013)
Design Irrigation Rate	DIR	5.0	mm/day	Based on soil texture class/permeability and derived from Table 9 in the EPA Code of Practice (2013)
Nominated Land Application Area	L	690	m^2	[1]
Crop Factor	C	0.6-0.8	unitless	Estimates evapotranspiration as a fraction of pan evaporation; varies with season and crop type[2]
Rainfall Runoff Factor	RF	1.0	unitless	Proportion of rainfall that remains onsite and infiltrates, allowing for any runoff
Mean Monthly Rainfall Data		BOM Bannockburn 87309		BoM Station and number
Mean Monthly Pan Evaporation Data		Local Data from BOM		BoM Station and number

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	365
Rainfall	R		mm/month	33	35	36	42	43	43	43	46	51	53	49	41	513
Evaporation	E		mm/month	187	175	137	90	50	35	40	55	80	125	175	275	1324
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	
OUTPUTS																
Evapotranspiration	ET	ExC	mm/month	150	140	96	63	30	21	24	33	56	100	140	140	992.5
Percolation	B	DIR-D	mm/month	155.0	140	155.0	150.0	155.0	150.0	155.0	155.0	150.0	155.0	150.0	155.0	1825.0
Outputs		ET+B	mm/month	304.8	280	250.9	213.0	185.0	171.0	179.0	188.0	206.0	255.0	290.0	295.0	2817.5
INPUTS																
Retained Rainfall	RR	RxRF	mm/month	31	35	36	42	43	43	43	46	51	53	49	41	513
Applied Effluent	W	(DxC)/L	mm/month	38.8	35.0	38.8	37.5	38.8	37.5	38.8	38.8	37.5	38.8	37.5	38.8	456.3
Inputs		RR+W	mm/month	69.8	70.0	74.8	79.5	81.8	80.5	81.8	84.8	88.5	91.8	86.5	79.8	969.3
STORAGE CALCULATION																
Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the month	S	(RR+W)-(ET+B)	mm/month	-234.9	-210.0	-176.2	-133.5	-103.2	-90.5	-97.2	-103.3	-117.5	-163.2	-203.5	-215.3	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Maximum Storage for Nominated Area	N		mm	0.00												
	V	NxL	L	0												
LAND AREA REQUIRED FOR ZERO STORAGE			m^2	85	88	108	132	164	176	171	164	145	115	93	92	

MINIMUM AREA REQUIRED FOR ZERO STORAGE: 176.0 m^2

CELLS

	Please enter data in blue cells
XX	Red cells are automatically populated by the spreadsheet
XX	Data in yellow cells is calculated by the spreadsheet, DO NOT ALTER THESE CELLS

NOTES

[1] This value should be the largest of the following: land application area required based on the most limiting nutrient balance or minimum area required for zero storage

[2] Values selected are suitable for pasture grass in Victoria

APPENDIX D. LAND CAPABILITY ASSESSMENT FRAMEWORK SPREADSHEET – SUBSURFACE DRIP IRRIGATION.

Irrigation area sizing using Nominated Area Water Balance for Zero Storage

Site Address:	69 Yverdon Drive, Bannockburn.			
Date:	10th May 2019	**Assessor:**	Christian Bannan. South East Soil & Water.	

INPUT DATA

Design Wastewater Flow	Q	750	L/day	Based on maximum potential occupancy and derived from Table 4 in the EPA Code of Practice (2013)
Design Irrigation Rate	DIR	2.0	mm/day	Based on soil texture class/permeability and derived from Table 9 in the EPA Code of Practice (2013)
Nominated Land Application Area	L	600	m²	[1]
Crop Factor	C	0.6-0.8	unitless	Estimates evapotranspiration as a fraction of pan evaporation; varies with season and crop type[2]
Rainfall Runoff Factor	RF	1.0	unitless	Proportion of rainfall that remains onsite and infiltrates, allowing for any runoff
Mean Monthly Rainfall Data		BOM Bannockburn 87147		BoM Station and number
Mean Monthly Pan Evaporation Data		Local Data from BOM		BoM Station and number

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	365
Rainfall	R		mm/month	31	35	56	42	43	43	43	46	51	53	49	41	513
Evaporation	E		mm/month	187	175	137	90	50	35	40	55	90	125	175	175	1324
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	
OUTPUTS																
Evapotranspiration	ET	ExC	mm/month	150	140	96	63	30	21	24	33	56	100	140	140	992.5
Percolation	B	DIR-D	mm/month	62.0	56	62.0	60.0	62.0	60.0	62.0	62.0	60.0	62.0	60.0	62.0	730.0
Outputs		ET+B	mm/month	212.5	196	157.9	123.0	92.0	81.0	86.0	95.0	116.0	162.0	200.0	202.0	1722.5
INPUTS																
Retained Rainfall	RR	RxRF	mm/month	31	35	56	42	43	43	43	46	51	53	49	41	513
Applied Effluent	W	(Q×D)/L	mm/month	38.8	35.0	38.8	37.5	38.8	37.5	38.8	38.8	37.5	38.8	37.5	38.8	450.3
Inputs		RR+W	mm/month	69.8	70.0	74.8	79.5	81.8	80.5	81.8	84.8	88.5	91.8	86.5	79.8	963.3
STORAGE CALCULATION																
Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the month	S	(RR+W)-(ET+B)	mm/month	-141.8	-126.0	-83.2	-43.5	-10.3	-0.5	-4.3	-10.3	-27.5	-70.3	-113.5	-122.3	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Maximum Storage for Nominated Area	N		mm	0.00												
	V	Max.	L	0												
LAND AREA REQUIRED FOR ZERO STORAGE			m²	129	130	191	276	474	592	541	474	346	203	149	144	
MINIMUM AREA REQUIRED FOR ZERO STORAGE:				593.0	m²											

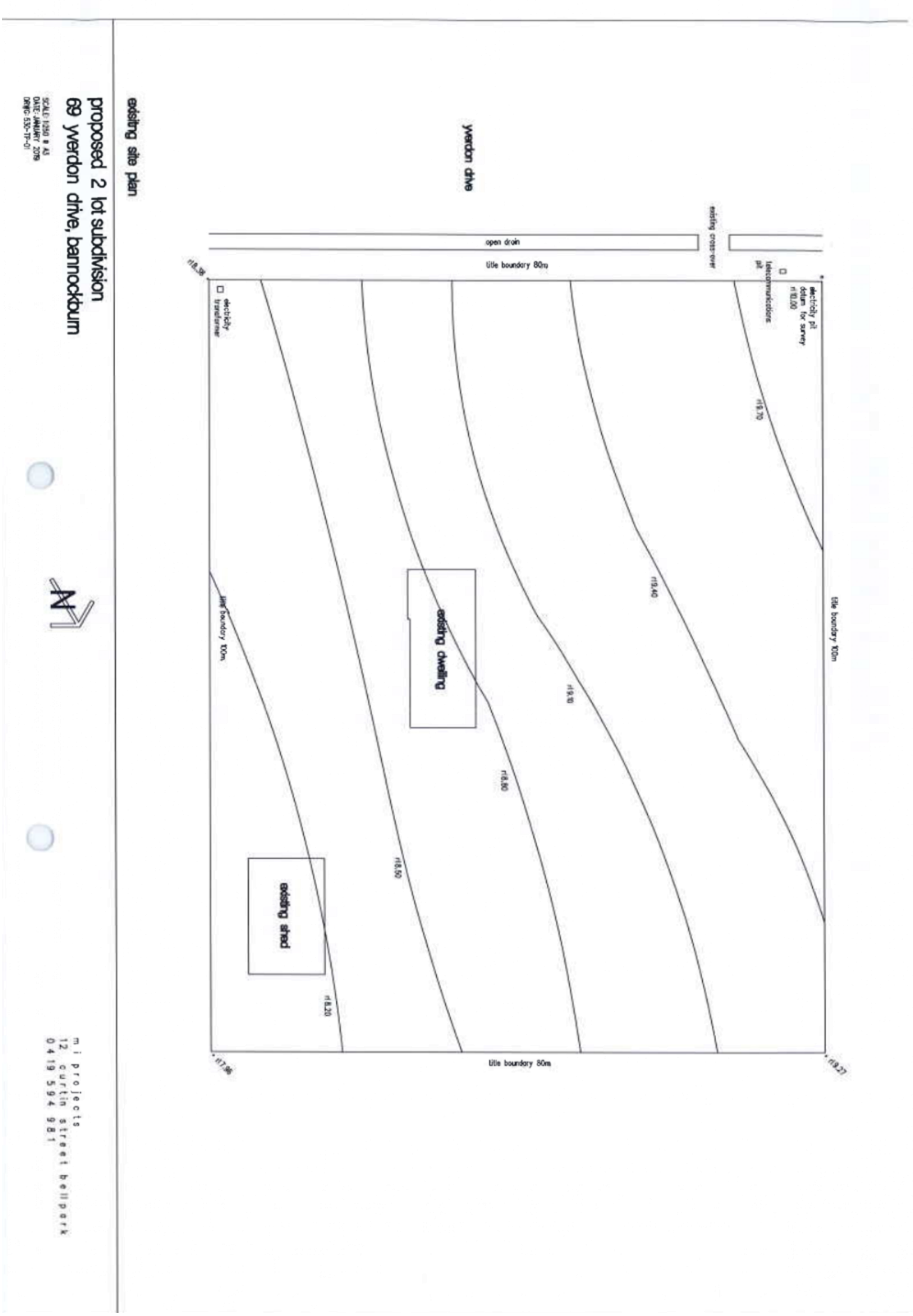
CELLS

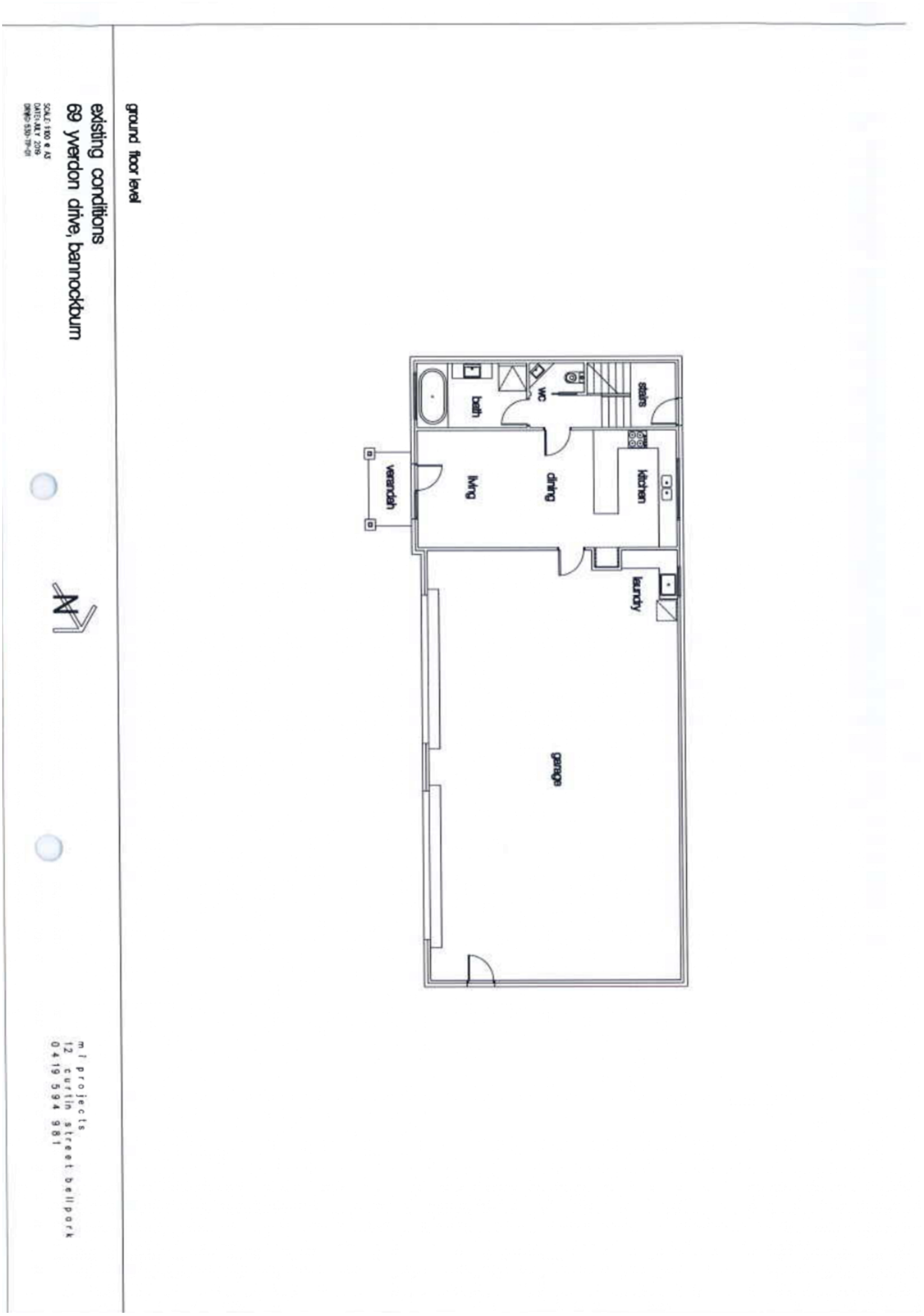
	Please enter data in blue cells
XX	Red cells are automatically populated by the spreadsheet
XX	Data in yellow cells is calculated by the spreadsheet, DO NOT ALTER THESE CELLS

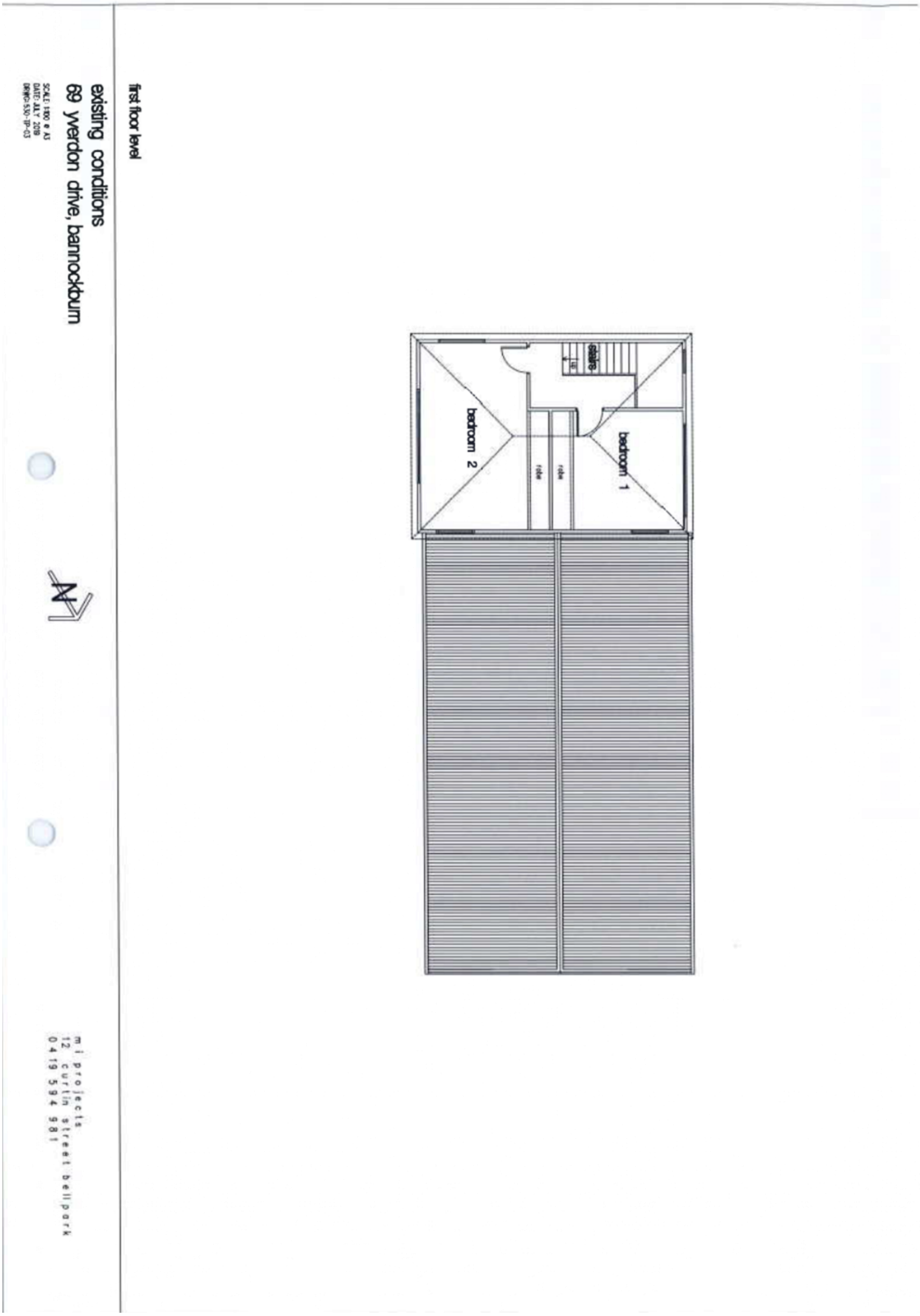
NOTES

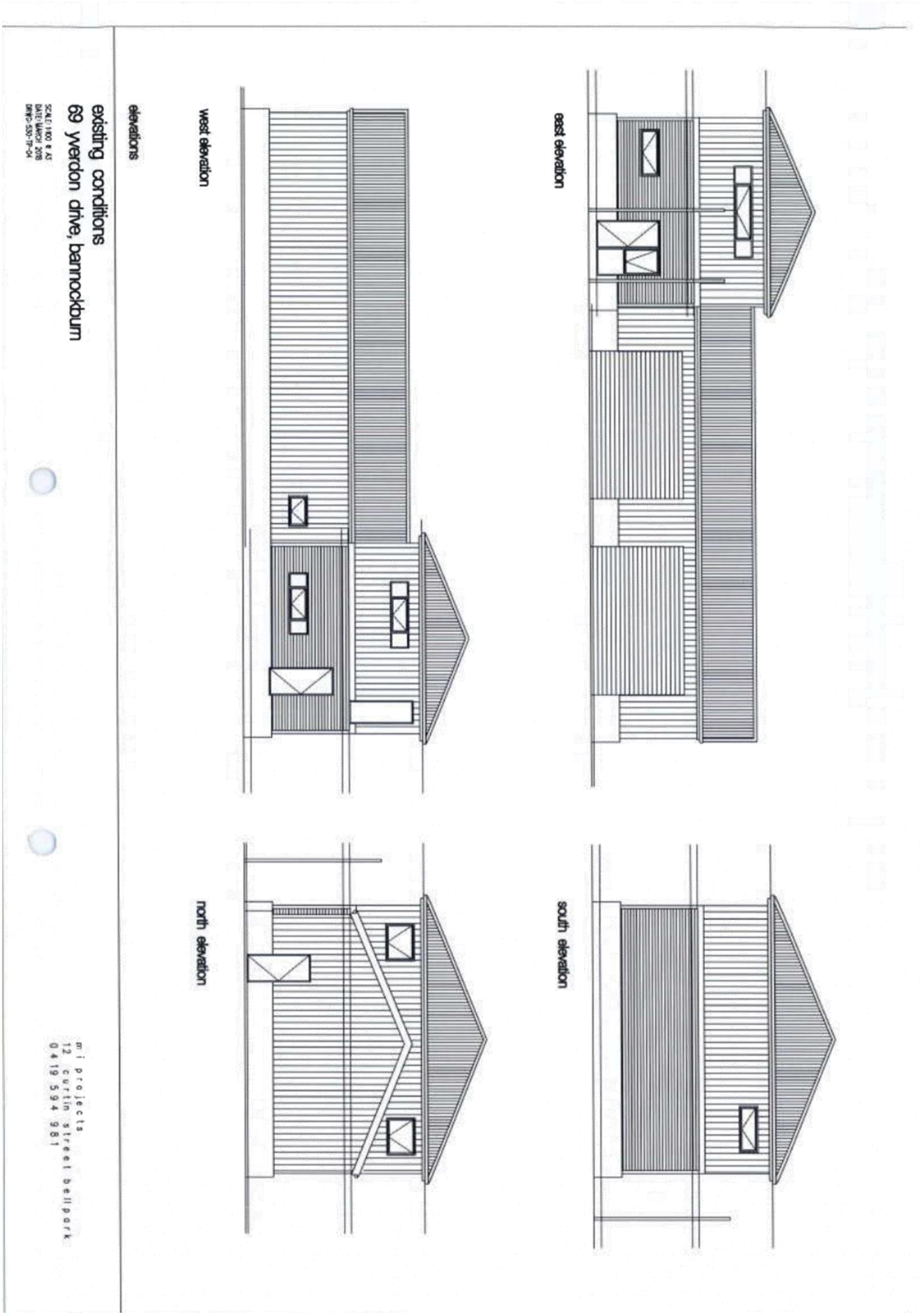
[1] This value should be the largest of the following: land application area required based on the most limiting nutrient balance or minimum area required for zero storage

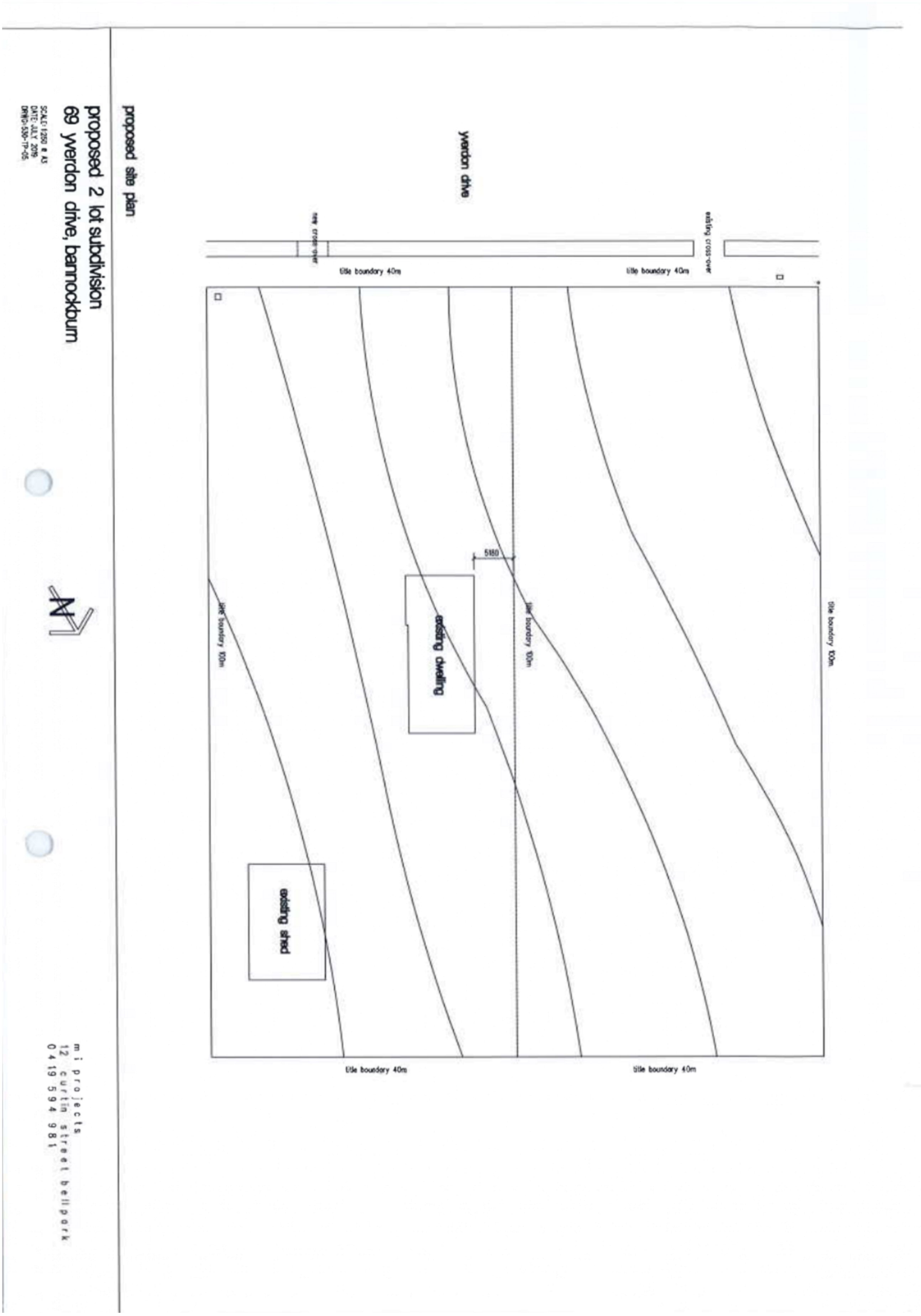
[2] Values selected are suitable for pasture grass in Victoria


existing site plan
proposed 2 lot subdivision
69 yerdon drive, bannockburn
yerdon drive
open drain
title boundary 80m
title boundary 100m
existing dwelling
existing shed
m i projects
12 curtin street bell park
0419 594 981


ground floor level
existing conditions
69 yverdon drive, bannockburn
SCALE: 1:100 @ A3
DATE: JULY 2019
stairs
wc
bath
kitchen
dining
living
verandah
laundry
garage
m l projects
12 curtin street bell park
0419 594 981


first floor level
existing conditions
69 yerdon drive, bannockburn
SCALE: 1:100 @ A3
DATE: JULY 2019
DRWG: 530-TP-03
m i projects
12 curtin street bell park
0 4 19 5 9 4 9 8 1
stairs
bedroom 2
bedroom 1
robe
robe


east elevation
west elevation
south elevation
north elevation
elevations
existing conditions
69 yverdon drive, bannockburn
SCALE: 1:100 @ A3
DATE: MARCH 2018
DRWG: 530-TP-04
m i projects
12 curtin street bell park
0419 594 981


proposed site plan
proposed 2 lot subdivision
69 yerdon drive, bannockburn
yerdon drive
new cross-over
existing cross-over
title boundary 40m
title boundary 40m
title boundary 100m
title boundary 100m
title boundary 100m
5180
existing dwelling
existing shed
title boundary 40m
title boundary 40m
m i projects
12 curtin street bellpark
0 4 19 5 9 4 9 8 1

PLAN OF SUBDIVISION

EDITION 1

PS827116U

LOCATION OF LAND

PARISH: WABDALLAH / MURGHEBOLUC

TOWNSHIP: -

SECTION: - / 20

CROWN ALLOTMENT: 2001 (PART) / 16 (PART)

CROWN PORTION: -

TITLE REFERENCE: VOL. 10663 FOL. 366

LAST PLAN REFERENCE: PS448124H (LOT 62)

POSTAL ADDRESS: 69 YVERDON DRIVE,
(at time of subdivision) BANNOCKBURN, 3331.

MGA CO-ORDINATES: E: 253 326 ZONE: 55
(of approx centre of land in plan) N: 5 784 352 MGA 94

VESTING OF ROADS AND/OR RESERVES

IDENTIFIER	COUNCIL/BODY/PERSON
NIL	NIL

NOTATIONS

DEPTH LIMITATION - 15m (VOL.10654 FOL.694)

SURVEY:
This plan is based on survey.

STAGING:
This is not a staged subdivision.
Planning Permit No.

This survey has been connected to permanent marks No(s).

In Proclaimed Survey Area No. N/A

NOTATIONS

EASEMENT INFORMATION

LEGEND: A - Appurtenant Easement E - Encumbering Easement R - Encumbering Easement (Road)

Easement Reference	Purpose	Width (Metres)	Origin	Land Benefited/In Favour Of
E-1	DRAINAGE	5	PS448124H	GOLDEN PLAINS SHIRE
E-2	POWERLINE	3	PS448124H, SECTION 88 OF THE ELECTRICITY INDUSTRY ACT 2000	POWERCOR AUSTRALIA LIMITED

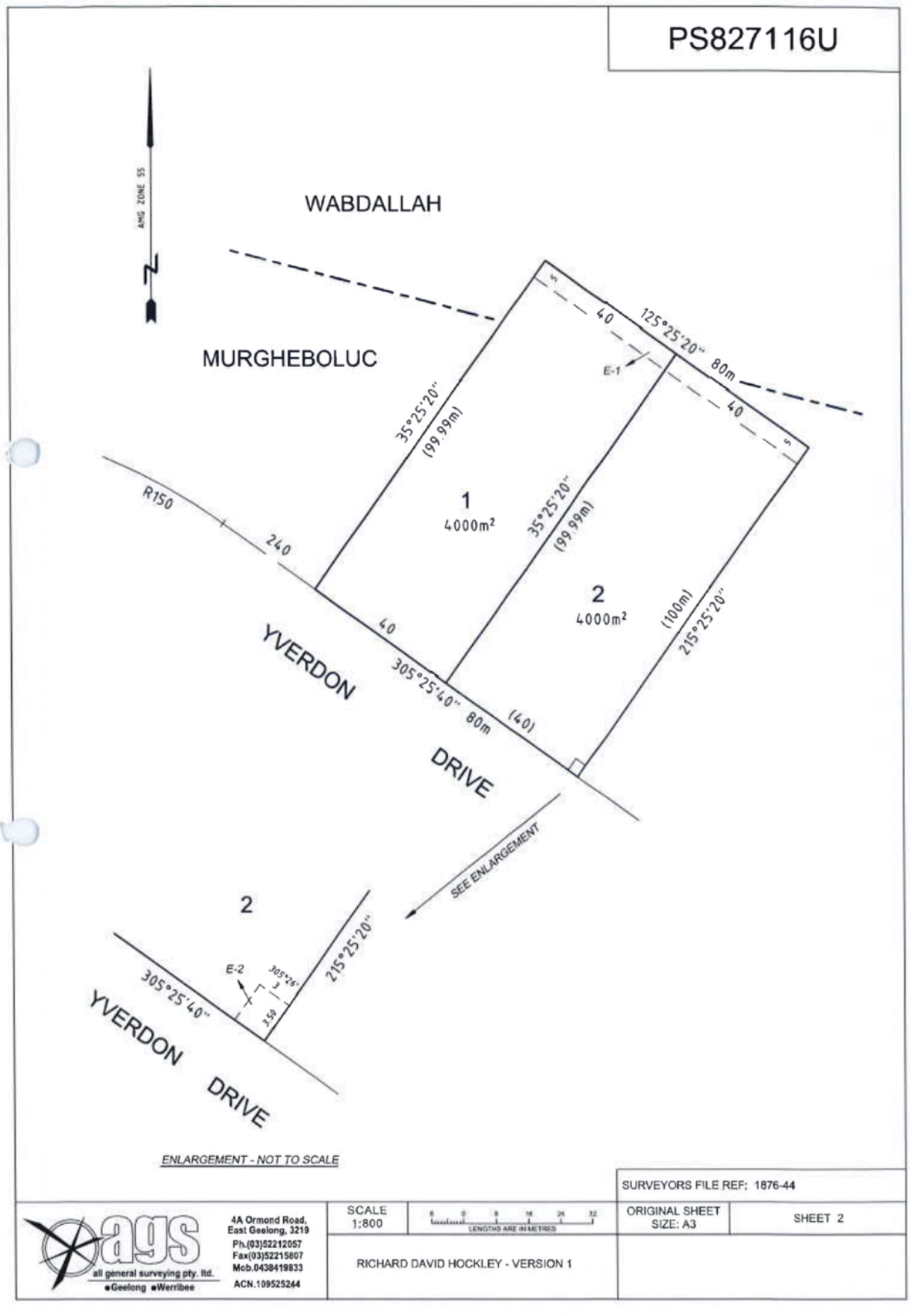
ags
all general surveying pty. ltd.
•Geelong •Werribee
4A Ormond Road,
East Geelong, 3219
Ph.(03)52212057
Fax(03)52215807
Mob.0438419833
ACN.109525244

SURVEYORS FILE REF: 1876-44

ORIGINAL SHEET SIZE: A3

SHEET 1 OF 2

RICHARD DAVID HOCKLEY - VERSION 1


PS827116U
AMG ZONE 55
N
WABDALLAH
MURGHEBOLUC
125°25'20" 80m
40
5
E-1
35°25'20"
(99.99m)
1
4000m²
2
4000m²
(100m)
215°25'20"
R150
240
40
YVERDON
305°25'40" 80m
(40)
DRIVE
SEE ENLARGEMENT
2
E-2
305°25'40"
215°25'20"
YVERDON
DRIVE
ENLARGEMENT - NOT TO SCALE
SURVEYORS FILE REF: 1876-44
ags
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ACN.109525244
SCALE
1:800
LENGTHS ARE IN METRES
ORIGINAL SHEET
SIZE: A3
SHEET 2
RICHARD DAVID HOCKLEY - VERSION 1