ST. QUENTIN
Surveyors • Town Planners • Engineers

LAND CAPABILITY ASSESSMENT FOR PROPOSED DEVELOPMENT

120 Russells Road, Mount Duneed

Prepared for:
Foundation 61 Inc.

Report No:
15468G-LCA

October 2018

CONTENTS

1.0 EXECUTIVE SUMMARY

Our land capability assessment has established that the proposed development is acceptable for effluent disposal. We have judged the proposed allotment size of about 8,000 m^2 is acceptable under the City of Greater Geelong requirements for domestic waste water disposal.

Our land capability assessment has identified some constraints (soil permeability rate, rock depth and proximity to surface waters) that will need to be considered to enable safe and sustainable effluent disposal on site. These constraints do not prevent the satisfactory completion of the proposed development however the effluent system does require appropriate planning and design.

Subject to constraints and our recommendations the dispersal of wastewater on the development poses a low and manageable environmental risk.

We understand the preferred building location is at the back of the lot with the effluent disposal field located at the front using a raised system. Therefore, we recommend raised ETA Beds be constructed to accommodate the effluent disposal field and positioned as suggested in Appendix A.

We recommend that the proposed household wastewater receive secondary treatment and that the treated effluent be dispersed using ETA beds. Secondary treatment is required to ensure that '20/30 standard' (i.e. 20 mg/l Biochemical Oxygen Demand and 30 mg/l Suspended Solids) effluent is produced prior to dispersal on the land using ETA beds. Treatment of household wastewater to '20/30 standard' with treated wastewater dispersion using ETA beds will maximise the potential for evapo-transpiration and minimise the risk of contamination of adjoining sites. This will maximise the likelihood for a safe and sustainable environmental outcome for the site and the surrounding sites.

We recommend a minimum ETA bed area of 200 m^2 be adopted for the proposed development (assuming an ETA Bed width of 2m).

The treated effluent field must be positioned in accordance with offset and siting requirements as outlined in section 7.4 of our report 'Effluent disposal area siting'.

We also recommend adding both lime and gypsum at a rate of 0.5 kg/m^2 to the base of irrigation excavations to assist sodicity, improve soil absorption and shrinkage characteristics of the underlying clay. We recommend re-application to the surface every 2-3 years due to long term leaching effects.

Onsite topsoil 'loam' (or similar imported material) can be used as bedding material to raise the surface level to the required level. It is important upslope and downslope cut-off drains are constructed for the effluent disposal area to reduce surface flows to and from the disposal field. The surface runoff should be directed away from the effluent area and ultimately connected to the legal point of discharge.

Guidance is given concerning the design and layout of a suitable system.

Final approval is subject to any specific policy requirements or other limiting environmental constraints not previously brought to our attention.

2.0 INTRODUCTION

St Quentin Consulting was commissioned by the client Foundation 61 Inc. to provide a Land Capability Assessment (LCA) report for the site.

The aims of the assessment were:

1. To assess various features of the site in their present condition in accordance with published standards and guidelines, principally various Septic Tanks Codes published by EPA Victoria and others.

2. Recommend an appropriate and environmentally sustainable treatment and disposal method for domestic wastewater.

3.0 PRACTITIONER

The author of this report is Omar Reyes who is a professional geotechnical engineer with a Bachelor of Civil Engineering degree and registered member of Engineers Australia. The author has more than 10 years of experience in the land capability assessment for effluent disposal.

4.0 PROPOSED DEVELOPMENT

This report provides recommendations for a thirteen (13) bedroom building. We expect that local council may require a “study” or other habitable room to be counted as a bedroom. If the building type is changed significantly this report may be inappropriate. Planning report is included in Appendix G.

5.0 SITE FEATURES

The subject site is on the south side of the street. The site slopes towards the south-east. The site aspect is good with respect to exposure to sunshine and wind. Surface drainage is considered to be fair. The natural soil types comprise silts, clays and shallow rock prominently developed from Quaternary age Basalt (Newer Volcanic Group). Existing vegetation consists mainly of grasses in the proposed effluent disposal area. A satellite view of the site is presented in Figure 1.

Figure 1: Aerial photograph of the site and surrounding area, nearmap.com.

6.0 TESTING PROGRAM AND RESULTS

6.1 Soil profile and geomorphology

Three (3) boreholes were assessed to investigate predominate soil types across the site. The visual and tactile estimation as outlined in the site and soil evaluation procedure AS1547:2012 was used to identify the relevant soil characteristics. Disturbed soil samples were sampled over the full depth of the soil profile and examined and classified. The soil profiles encountered were compared to soil descriptions in published reports, maps and charts from Department of Primary Industries (DPI) and other sources.

An experienced and qualified geotechnical engineer conducted a thorough geomorphological survey and visual appraisal of the site features the surrounding area to identify any important land features. Slope angles were measured with an inclinometer.

The resulting soil and land description is as follows:

Landform:	Plain
Geology:	Residual clay derived from Quaternary age Basalt
Aust. Soil Classification:	Brown vertosol

Our boreholes indicate silts, clays and shallow rock at about 0.95m or so.

Geology mapping with contours is presented in Figure 2. A description of the soils typically encountered during our drilling and sampling is presented on the attached sheet in Appendix B.

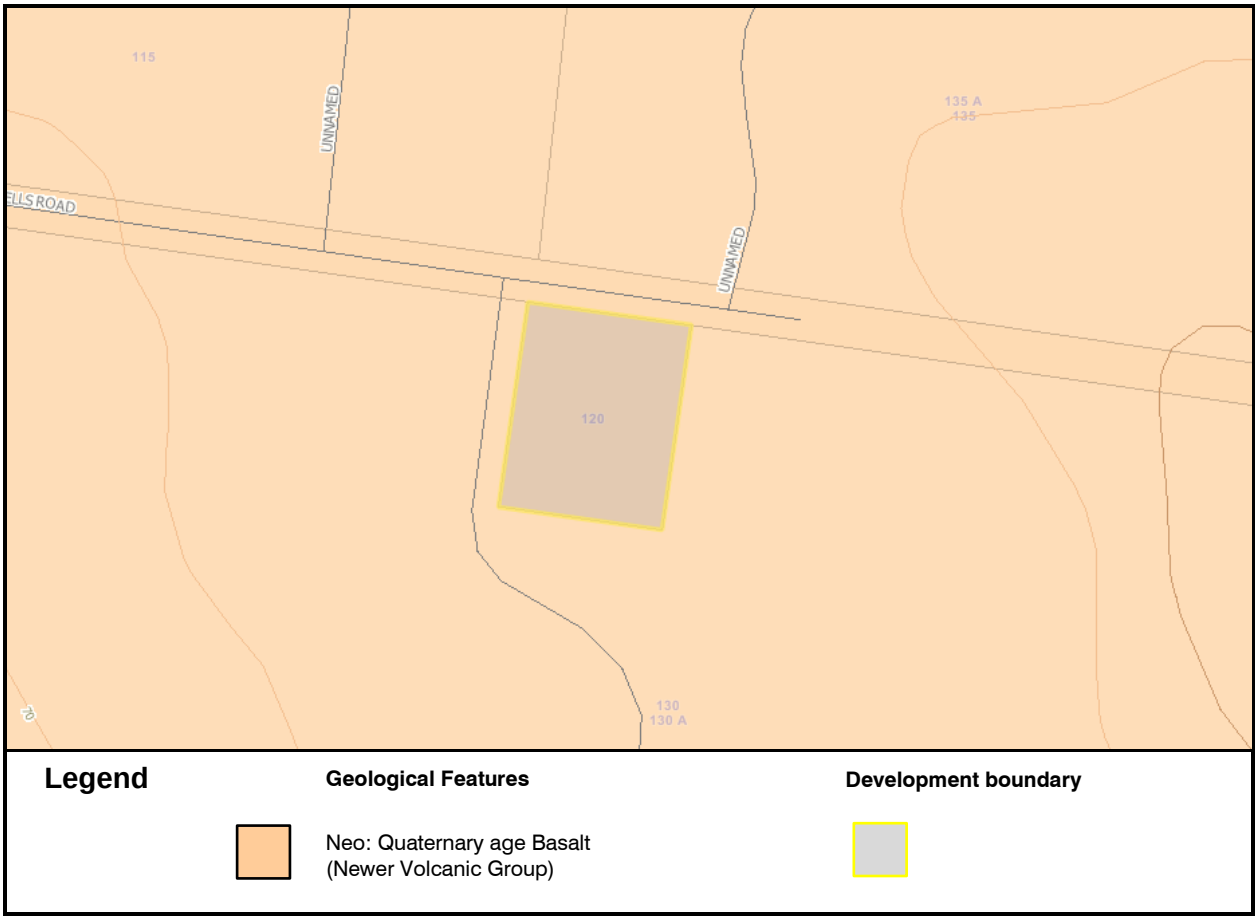


Figure 2: Site geology, source: geovic.vic.gov.au

6.2 Water table

No permanent or perched water table was encountered during testing however a transient perched water table may develop in very wet conditions above the clay layer. For this reason, it is important upslope and downslope cut-off drains are provided to prevent/reduce transient water flows near the effluent area.

6.3 Laboratory testing and interpretation of results

Laboratory testing was conducted on two (2) individual samples by NATA accredited laboratory ALS Laboratories, including pH, Sodium Adsorption Ratio, Phosphorous Sorption Capacity, Conductivity and Exchangeable Cations. Emmerson Class No. (dispersion) testing was conducted by St. Quentin Consulting. Results are included in Table 1.

The results generally indicate good characteristics for effluent disposal however the Cation Exchange Capacity and Exchangeable Sodium Percentage in the subsoil indicated potential for sodic soils when applied with wastewater discharge.

Table 1: Laboratory Results

Compound	Borehole 1 (100-200 mm)	Limitation	Borehole 1 (600-800 mm)	Limitation
pH (pH unit)	5.8 (moderately acid)	Nil	7.4 (mildly alkaline)	Nil
Electrical Conductivity (EC, dS/m)	0.056	Nil	0.494	Nil
Sodium Adsorption Ratio	5.37	Major	27.0	Moderate
Cation Exchange Capacity (me/100g)	3.8	Minor	35.3	Major
P Sorption Capacity (me/100g)	1030	Minor	1480	Minor
Exchangeable Sodium Percentage (%)	19.4	Major	22.1	Major
Emerson Aggregate Class	Class 7, no slaking some swelling	Minor	Class 1, dispersion	Major

6.4 Land assessment and constraints

Various features of the site were assessed in accordance with the guidelines of the EPA Publications and reported in accordance with constraint levels outlined in VLCA-2nd Ed. Field measurements and observations were made and where necessary, samples were returned to our laboratory for further analysis. The results are shown in Table 1.

Table 1: Land assessment

Land feature	Result	Level of Constraint	Mitigation
Buffer Distances	Buffer distances achievable. Refer to section 7.4 for relevant offset requirements	Minor	Not Required
Climate	Median rainfall* Torquay ~ 546 mm/yr, Median evaporation# Geelong Salines ~ 1425 mm/yr	Minor	Rainfall approximates evaporation in the wettest months. Adopt ETA beds and cut-off drains
Drainage	Proposed effluent area well drained	Minor	Adopt shallow subsurface irrigation and cut-off drains
Erosion or Landslide Risk	No evidence of previous landslide or erosion on the site	Nil	Not Required
Exposure & Aspect	Good exposure to wind and sun: surrounding area consisting of open grassland	Nil	Not Required
Flooding	Flooding not evident (>1:100 year flood level)	Nil	Not Required
Groundwater	Groundwater not evident above 0.95 m	Nil	Not Required
Imported Fill	Imported fill present on site (bluestone/bricks stockpile)	Moderate	Remove imported fill (bluestone/bricks)
Site Drainage	The site does not receive run-off and does not provides significant run-on	Nil	Not Required
Slope	< 5°	Minor	IInstall cut-off drains (upslope and downslope) to reduce infiltration in effluent disposal area
Landform	A single landform exists on this site. No significant features were noted on or near the site	Nil	Not Required
Vegetation	Good grass cover. Some trees occupy the site	Nil	Not Required
Surface Waters	Dam within 100m	Minor	Adopt secondary treatment '20/30 std' and maintain setback distance
Rock Outcrops	Shallow rock encountered	Moderate	Adopt shallow subsurface irrigation. Construct raised beds to meet treatment targets
Lot size	Considering the site constraints and proposed development size the allotment has sufficient area for effluent disposal	Nil	Not Required

* Closest / longest rainfall recording station record in the area.
# Closest / longest evaporation recording station record in the area.

Based on the land assessment criteria, we have judged the land capability of the site is acceptable, provided constraints are addressed with corresponding and appropriate mitigation measures.

6.5 Soil assessment and constraints

An appraisal of the soil was conducted by visual and tactile estimation in accordance with the site and soil evaluation procedure as outlined in AS1547:2012 and reported in accordance with constraint levels outlined in VLCA-2nd Ed.

Based on our analysis and the client preference of raised beds, we have determined the limiting geological stratum as weakly structured 'loam'. As outlined in AS/NZS1547:2012 we have adopted an indicative permeability (K_{sat}) of 0.5 - 1.5 m/day and a design loading rate of 10 mm/day.

Testing including pH, Emerson Class No. and salinity were also conducted and results are presented in Table 2.

Table 2: Soil assessment

Land feature	Result	Level of Constraint	Mitigation
Soil Depth	0.95 m*	Moderate	Adopt a low DIR. Import material if insufficient site derived material
Soil Structure	Topsoil: weakly structured silty loam (soil category 3, AS 1547:2012) Subsoil: weakly structured loam (soil category 6, AS 1547:2012)	Minor	Adopt a low DLR and ETA beds
Permeability	Limiting layer ~ 0.5 - 1.5 m/d	Moderate	Adopt a low DLR. Adopt ETA beds. Import material if insufficient site derived material available
Soil Plasticity	Moderate shrink swell potential	Moderate	Consider ameliorate with addition of **lime** at a rate of 0.5 kg/m^2
Emerson	Topsoil: silty loam (Sandy Silt): Class 7, no slaking some swelling Subsoil: loam (Silty Clay): Class 1, dispersion	Major	Ameliorate with addition of **gypsum** at a rate of 0.5 kg/m^2
Salinity	< 0.8 dS/m	Minor	Not Required
pH	7.4 (mildly alkaline)	Minor	Not Required

*Highly weathered basalt evident at about 0.95 m.

Based on the above soil assessment criteria, we have judged the soil capability of the site is acceptable subject to relevant outlined mitigation procedures.

6.6 Wastewater volume

In accordance with the EPA Code of Practice Onsite Wastewater Management 891.4 July 2016 and Australian Standard AS/NZS1547:2012 On-site Domestic Wastewater Management the following daily wastewater flows can be adopted:

Unlimited water supply (where a reticulated water supply is proposed)
Daily flow = (No of bedrooms + 1) x 150 litres per day

Limited water supply (where water is sourced only from rain water collection from roofs)
Daily flow = (No of bedrooms + 1) x 120 litres per day

Given the location of the site, and proximity to reticulated water supply we have adopted unlimited water supply.

We understand the proposed building includes 13 bedrooms and on this basis, we recommend the estimated wastewater volume produced to be **2,100 L/day**.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Our Land Capability Assessment has found the proposed site is acceptable for effluent disposal. We have judged the proposed allotment size of about 8,000 m^2 is acceptable under the City of Greater Geelong requirements for domestic waste water disposal.

Our assessment has identified some constraints (soil permeability rate, rock depth and proximity to surface waters) which will need to be considered to enable safe and sustainable on site effluent disposal. These constraints do not prevent the satisfactory completion of the proposed development however the effluent system does require appropriate planning and design. Subject to constraints and our recommendations the dispersal of wastewater on the development poses a low and manageable environmental risk.

We understand the preferred building location is at the back of the lot with the effluent disposal field located at the front using a raised system. Therefore, we recommend raised ETA Beds be constructed to accommodate the effluent disposal field and positioned as suggested in Appendix A.

We recommend that the proposed household wastewater receive secondary treatment and that the treated effluent be dispersed using ETA beds. Secondary treatment is required so that '20/30 standard' (i.e. 20 mg/l Biochemical Oxygen Demand and 30 mg/l Suspended Solids) effluent is finally produced prior to dispersal on the land using ETA beds. Treatment of household wastewater to '20/30 standard' with dispersal of the treated wastewater using ETA beds will maximise the potential for evapo-transpiration and minimise the risk of contamination of adjoining sites. This will ensure a sustainable environmental outcome for the site and the surrounding sites.

We recommend adding both lime and gypsum at a rate of 0.5 kg/m^2 to the base of irrigation excavations to assist sodicity, improve soil absorption and reduce shrinkage characteristics of the underlying clay. We recommend re-application every 2-3 years due to long term leaching effects.

Upslope and downslope cut-off drains must be provided to prevent/reduce transient water flows near the effluent area or building envelope. The surface runoff should be directed away from the effluent area and ultimately connected to the legal point of discharge.

7.1 Treatment system

'20/30 standard' can be achieved using both a septic tank (anaerobic treatment) and a pressure dosed sand filter (aerobic treatment) or by using a powered aerated water treatment system (AWTS).

Various AWTS are available on the market and these are generally the preferred method of treatment, note however that an AWTS may not be suitable where irregular or intermittent flows are likely such as from a holiday house.

All AWTS require a current EPA certificate of approval for operation. Regular maintenance of AWTS is essential to ensure correct performance and it is usually a requirement of the approval certificate that a service contract be maintained for the unit.

If a septic tank is preferred, we recommend the following minimum sand filter sizes and filter media characteristics, in accordance with EPA standards (CA 1.3/03).

Table 3: Sand Filter requirements

Number of bedrooms	Wastewater volume	Sand filter size	Dosage rate	Clay & Fine Silt Content	Effective Size*	Uniformity Coefficient**
13	2,100 L/day	42 m^2	≤50 L/m^2/day	<5 %	0.25 to 0.6mm	<4

*Effective size: maximum particle size of smallest 10% by mass of the sand
**Uniformity coefficient: the ratio of the maximum particle size of the smallest 60% by mass of sand to the maximum particle size of the smallest 10% by mass of the sand

7.2 Land application area

7.2.1 Disposal area and length based on material type

Based on the material type and through interpretation of Table 5.1 & 5.2 in AS/NZS1547:2012 for "loam", the minimum disposal area and ETA bed length required to successfully disperse treated household wastewater based on the material type on the site is **210 m²** and **105 m** respectively (assuming a bed width of 2m).

Note: this area may need to be further modified dependant on water balance calculations shown in section 7.2.2.

7.2.2 Disposal area and length based on water balance model

Based on the water balance model (refer Appendix D) minimum area and length required to successfully disperse treated household wastewater on the site is **200 m²** and **100 m** respectively.

The water balance model was calculated using the following input data:

- Design wastewater flow: 13 bedroom residence – 2,100 L/day (from AS1547:2012)
- Precipitation – Torquay ~ 546 mm/yr (the closest / longest rainfall data recording station).
- Evaporation – Geelong Salines ~ 1425 mm/yr (the closest / longest evaporation data recording station).
- Crop factor – seasonally variable from 0.6 to 0.8
- Coefficient of runoff – 0.75

7.2.3 Minimum design effluent area for combined blackwater/greywater treatment

Based on our tests and calculations and using design irrigation rates from AS/NZS1547:2012 we have determined the following minimum ETA bed area and length required to successfully disperse treated household wastewater for the proposed building as shown in Table 4.

Table 4: Design effluent area for 13-bedroom residence

Effluent Volume Produced	Minimum Effluent Disposal Area#	ETA Bed Width*	ETA Bed Length+
L/day	200 m²	2 m	100 m

Not including the spacing between the ETA Bed units
Recommended minimum spacing between trench/bed units: 1.0m
* Bed width range between 1m and 4m, designer may choose a different width
+ Maximum length of 20m recommended (i.e. use 5 trenches of 20m each)

7.3 Effluent system design

It is beyond the scope of this report to provide a detailed design and layout of the treatment and disposal system. We have provided an indicative suggestion of the effluent disposal area shape used for illustrative purposes in Appendix A. We endorse variation in effluent disposal form and location, provided the design is in accordance with our recommendations.

We recommend that an experienced contractor or consultant be engaged to design and install the system. The system manufacturer may be able to provide this service. A typical ETA bed system layout and cross section are shown on Appendix E & F (by way of example only).

Stormwater and roof runoff water must be diverted around the disposal field to an appropriate point of discharge for stormwater. Cut-off drains should be installed at the top and bottom of the effluent disposal field to reduce surface runoff. Drains should include lined agriculture drains and backfilled with free draining coarse aggregate.

Uneven effluent distribution is a significant factor in AWTS failure. We recommend that the capacity of the pump is verified prior to installation to select the adequate pump and ensure a uniform disposal of the effluent.

Trenches for the disposal system should be properly backfilled and field should be left as undisturbed as possible before and after construction and must be protected from traffic by vehicles.

7.4 Effluent disposal area siting

The effluent irrigation area must be located as follows:

1. In an area not subject to vehicular traffic.
2. No closer than 3.0m from a gas or water pipe (primary treatment).
3. No closer than 3.0m on the low side or 6.0m on the high side of a property boundary (primary treatment).
4. No closer than 1.5m from a gas or water pipe (secondary treatment).
5. No closer than 1.5m on the low side or 3.0m on the high side of a property boundary (secondary treatment).
6. No closer than 3.0m from a swimming pool or stormwater drain.
7. No closer than 7.5m from an underground tank, cutting or escarpment.
8. No closer than 10m from a non-potable groundwater bore.
9. No closer than 30m from a dam, stream or channel (non-potable).
10. No closer than 100m from a stream or river in a potable water supply catchment.

The disposal area must be permanently dedicated and marked with at least two clear warning signs.

Our analysis has shown there is sufficient available land for an effluent disposal area of 200 m^2, as shown in Appendix A.

7.5 Reserve field

The EPA Septic Tanks Code of Practice requires that provision for a “reserve” effluent disposal field in the event that the primary disposal field fails, proves to be inadequate or needs to be rested. The reserve field must be not less than the size of the primary field and must be located on the site in compliance with all the minimum setback distances etc. as described above.

Note that a reserve field is not required for wastewater that has been treated to '20/30 standard', as is proposed for this site.

7.6 Vegetation cover

Efficient effluent disposal assumes good vegetative cover. Therefore, it is recommended to establish and maintain grasses or suitable shrubs. Such vegetation can significantly assist the overall disposal process by transpiration from leaves and by maintaining soil permeability through fine root channels. Refer to the attached “Land Capability Assessment Addendum” for additional information and indicative list of suitable plant species.

Large trees should be retained wherever possible. Where large tree removal is necessary, they should be cut off at ground level with the root structures left intact.

7.7 Drainage management

Careful attention to drainage is essential to reduce risk of system failure. Surface water must therefore be prevented from ponding anywhere on or near the site.

We recommend installation of cut-off drains above and below the effluent disposal area with run-off directed to the legal point of discharge. In addition, diversion drains along the western and northern boundary are required to divert the surface run-on from the road and existing drainage channel.

The drains must be positioned and constructed with sufficient fall to discharge completely to prevent water from accumulating in the soil anywhere near the buildings. Any blockages must be cleared and repaired promptly.

Care must also be taken to ensure that all levelled areas (vehicle parking bays, recreation areas etc.) have a slight fall (≥2°) to prevent surface water from ponding or seeping into the ground and diverted away from the buildings.

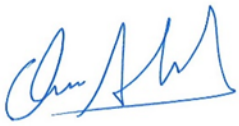
7.8 Monitoring, care and operation

A septic system requires regular servicing and maintenance by an approved contractor to meet the conditions on the council approval certificate and the requirements of the manufacturer to ensure that the minimum '20/30 standard' of effluent is consistently achieved.

The following guidelines regarding the care and operation of septic tanks as recommend in the EPA Septic Tanks Code of Practice:

- Restrict the use of germicides (strong detergents, disinfectants, nappy sanitisers, bleaches etc.),
- Use cleaning products, detergents etc. sparingly and check their suitability for septic tank systems,
- Use detergents with low levels of salt, phosphorus and chlorine. Detergents with low phosphorus and sodium are best suited for septic tanks and the environment. For more information regarding detergents we highly recommend visiting Lanfax Laboratories at lanfaxlabs.com.au under “Laundry Products Research” and click the downloadable “laundry brochure”.
- Do not flush sanitary napkins, disposable nappies or similar products into the system,
- Minimise the amounts of oil and fat washed into the system,
- Use a sink strainer to restrict food scrapes entering system,
- Do not use garbage disposal units,
- Do not modify the system without council approval,
- Conserve water.

Prepared by:



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References

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EPA Publication 746.1 Land Capability Assessment for Onsite Domestic Wastewater Management, March 2003

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Australian Soil Resource Information System (ASRIS). Accessed October 2018 https://www.asris.csiro.au

Appendix A

Site Plan

Site Plan

Notes:

1. Dimensions and areas shown are approximate only.
2. Disposal area shape can be modified provided that the offsets requirements and minimum effluent disposal area is maintained.
3. Recommended minimum spacing between trench/bed units: 1.0m
4. Bed width range between 1m and 4m, designer may choose a different width

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Legend:

- Borehole Locations
- Development Area
- Site slope
- Suitable area
- Min. disposal area
- Setback distance
- Rock outcrop
- Rock stockpile
- Watercourse / waterbody

Site Plan

Location: 120 Russells Road
Mount Duneed, Victoria

Source: Nearmap.com - September 2018

Project No: 15468G-LCA
Inv. date: 11/10/2018
Drawing No: 1
Scale: NOT TO SCALE

Drawn by: O.R
Date: 11/10/2018
Approved by: C.F.
Date: 15/10/2018

N
mga zone 55

Appendix B

Borehole Logs

BOREHOLE LOG

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Client:	Foundation 61 Inc	**Project No.:**	15468G-LCA	**Sheet:**	1 of 1
Location:	120 Russells Road	**Borehole No:**	BH 1	**Logged by:**	O.R.
	Mount Duneed, Victoria	**Inv. Date:**	11/10/2018	**Checked by:**	C.F.

Depth (metres)	Graphic Log	Material Description Type, Plasticity, Colour, Particle characteristics	Soil Texture	Structure	Consistency / Density	Moisture	Sample / Test	Test Results	Geology and additional observations
0.2	0.20	Sandy SILT (Loam) Light grey Weakly structured Firm, slightly moist Grass cover	SCL	We	F	SM			Geology: Quaternary age Basalt Newer Volcanic Group (Neo)
0.4		Silty CLAY (Heavy Clay) Dark brown, some yellow Massive structure Stiff, slightly moist	HC	Ma	St	SM			
0.6	0.70								
0.8		XW Basalt (Heavy Clay) Light brown Strongly structured Stiff, slightly moist	HC	Ma	St	SM			
1.0	0.95								
1.2		Borehole 1 refused at 0.95m on Basalt							
1.4									
1.6									
1.8									
2.0									
2.2									

moisture:

D	Dry
SM	Slightly Moist
M	Moist
W	Wet
Sat	Saturated

Degree of Weathering

RS	Residual Soil
XW	Extremely Weathered Rock
HW	Highly Weathered Rock
MW	Moderately Weathered Rock
SW	Slightly Weathered Rock
FR	Fresh Rock

Consistency/density:

VS	very soft	Fb	friable
S	soft	VL	very loose
F	firm	L	loose
St	stiff	MD	medium dense
VSt	very stiff	D	dense
H	hard	VD	very dense

Structure

Ma	Massive
SG	Single grained
We	Weak
Mo	Moderate
Str	Strong

Method:

- [x] Hand Auger
- [ ] Auger Drilling
- [ ] Roller/Tricone
- [ ] Washbore
- [ ] Non Destructive Digging

BOREHOLE LOG

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Client: Foundation 61 Inc
Location: 120 Russells Road
Mount Duneed, Victoria

Project No.: 15468G-LCA
Borehole No: BH 2
Inv. Date: 11/10/2018

Sheet: 1 of 1
Logged by: O.R.
Checked by: C.F.

Depth (metres)	Graphic Log	Material Description Type, Plasticity, Colour, Particle characteristics	Soil Texture	Structure	Consistency / Density	Moisture	Sample / Test	Test Results	Geology and additional observations
0.2	0.10	Sandy SILT (Loam) Brown, firm, moist Weakly structured Grass cover	SCL	We	F	M			Geology: Quaternary age Basalt Newer Volcanic Group (Neo)
0.4		Silty CLAY (Heavy Clay) Dark brown, some yellow Massive structure Stiff, slightly moist	HC	Ma	St	SM			
0.6	0.70								
0.8	0.80	XW Basalt (Heavy Clay) Light brown, stiff, slightly moist Strongly structured	HC	Ma	St	SM			
1.0		Borehole 2 refused at 0.8m on Basalt							
1.2									
1.4									
1.6									
1.8									
2.0									
2.2									

moisture:

D	Dry
SM	Slightly Moist
M	Moist
W	Wet
Sat	Saturated

Degree of Weathering

RS	Residual Soil
XW	Extremely Weathered Rock
HW	Highly Weathered Rock
MW	Moderately Weathered Rock
SW	Slightly Weathered Rock
FR	Fresh Rock

Consistency/density:

VS	very soft	Fb	friable
S	soft	VL	very loose
F	firm	L	loose
St	stiff	MD	medium dense
VSt	very stiff	D	dense
H	hard	VD	very dense

Structure

Ma	Massive
SG	Single grained
We	Weak
Mo	Moderate
Str	Strong

Method:

- [x] Hand Auger
- [ ] Auger Drilling
- [ ] Roller/Tricone
- [ ] Washbore
- [ ] Non Destructive Digging

BOREHOLE LOG

ST. QUENTIN
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Client: Foundation 61 Inc
Location: 120 Russells Road
Mount Duneed, Victoria

Project No.: 15468G-LCA
Borehole No: BH 3
Inv. Date: 11/10/2018

Sheet: 1 of 1
Logged by: O.R.
Checked by: C.F.

Depth (metres)	Graphic Log	Material Description Type, Plasticity, Colour, Particle characteristics	Soil Texture	Structure	Consistency / Density	Moisture	Sample / Test	Test Results	Geology and additional observations
0.2	0.20	Sandy SILT (Loam) Brown, firm, moist Weakly structured Grass cover	SCL	We	F	M			Geology: Quaternary age Basalt Newer Volcanic Group (Neo)
		Borehole 3 refused at 0.2m on Basalt floater / cobble							
0.4									
0.6									
0.8									
1.0									
1.2									
1.4									
1.6									
1.8									
2.0									
2.2									

moisture:

D	Dry
SM	Slightly Moist
M	Moist
W	Wet
Sat	Saturated

Degree of Weathering

RS	Residual Soil
XW	Extremely Weathered Rock
HW	Highly Weathered Rock
MW	Moderately Weathered Rock
SW	Slightly Weathered Rock
FR	Fresh Rock

Consistency/density:

VS	very soft	Fb	friable
S	soft	VL	very loose
F	firm	L	loose
St	stiff	MD	medium dense
VSt	very stiff	D	dense
H	hard	VD	very dense

Structure

Ma	Massive
SG	Single grained
We	Weak
Mo	Moderate
Str	Strong

Method:

- [x] Hand Auger
- [ ] Auger Drilling
- [ ] Roller/Tricone
- [ ] Washbore
- [ ] Non Destructive Digging

Appendix C

Site Photographs

120 Russells Road - Photographs

Photo 1: Existing site conditions, south-western portion.

Photo 2: Existing site conditions, north-western portion.

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TELEPHONE (03) 5201 1811 FAX (03) 5229 2909

Title: Photographs
Locality: 120 Russells Road
Mount Duneed, Victoria

Project No: 15468G-LCA
Prepared by: O.R
Date: 11/10/2018

120 Russells Road - Photographs

Photo 3: Existing site conditions, detail of basalt outcrops on site.

Photo 4: Existing site conditions, bluestone / bricks stockpile.

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Title: Photographs
Locality: 120 Russells Road
Mount Duneed, Victoria

Project No: 15468G-LCA
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Date: 11/10/2018

120 Russells Road - Photographs

Photo 5: Existing site conditions, north-eastern portion.

Photo 6: Existing dam on adjacent lot.

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Title: Photographs
Locality: 120 Russells Road
Mount Duneed, Victoria

Project No: 15468G-LCA
Prepared by: O.R
Date: 11/10/2018

120 Russells Road - Photographs

Photo 7: View into borehole 1.

Photo 8: Soil profile from borehole 1.

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Title: Photographs
Locality: 120 Russells Road
Mount Duneed, Victoria

Project No: 15468G-LCA
Prepared by: O.R
Date: 11/10/2018

120 Russells Road - Photographs

Photo 9: Soil profile from borehole 2.

Photo 10: Excavated material from borehole 3.

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Title: Photographs
Locality: 120 Russells Road
Mount Duneed, Victoria

Project No: 15468G-LCA
Prepared by: O.R
Date: 11/10/2018

Appendix D

Water Balance Model

VICTORIAN LAND CAPABILITY ASSESSMENT FRAMEWORK

WATER BALANCE MODEL - ETA SYSTEMS / TRENCHES / BEDS

ST. QUENTIN
Surveyors ·Town Planners ·Engineers

Client: Foundation 61 Inc.
Assessor: Omar Reyes

Location: 120 Russells Road
Nount Duneed, Victoria

Project No.: 15468G-LCA
Date: 11/10/2018

DISPOSAL AREA SIZING USING NOMINATED AREA WATER BALANCE

INPUT DATA

Number of Bedrooms:	13	Actual number of bedrooms of proposed building
Water Supply:	150	Limited (water sourced only from rain water collection) or unlimited (reticulated water supply proposed)
Design Wastewater Flow (Q):	2100 L/day	Based on maximum potential occupancy and derived from Table 4 in the EPA Code of Practice (July 2016)
Design Loading Rate (DLR):	10.0 mm/day	Based on soil texture class/permeability and derived from Table 9 in the EPA Code of Practice (July 2016)
Minimum Disposal Area:	210 m^2	Based on material type and through interpretation of Table 5.1 & 5.2 of AS/NZS 1547:2012
ETA Bed Width	2.0 m	As selected by designer
ETA Bed Length	105.0 m	
Crop Factor (C):	0.6-0.8	Estimates evapotranspiration as a fraction of pan evaporation; varies with season and crop type (suitable for pasture grass)
Rainfall Runoff Factor (RF):	0.75	Proportion of rainfall that remains onsite and infiltrates, allowing for any runoff
Rainfall Data:	Torquay (087160)	BoM Station and number or 70th Percentile from Council Specific Data
Pan Evaporation Data:	Geelong Salines (087184)	BoM Station and number
Design storage depth:	250 mm	Maximum storage depth of 550mm

Parameter	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	28.9	16.0	32.2	32.0	52.2	47.0	54.0	64.0	43.4	50.9	37.0	39.6	497.2
Evaporation (E):		mm/month	203.1	167.8	144.7	96.8	66.9	49.2	55.8	73.1	95.3	129.3	157.8	185.5	1425.3
Crop Factor (C):		unitless	0.8	0.8	0.7	0.7	0.6	0.6	0.6	0.6	0.7	0.8	0.8	0.8	
OUTPUTS															
Evapotranspiration (ET):	E x C	mm/month	162.5	134.2	101.3	67.8	40.1	29.5	33.5	43.9	66.7	103.4	126.2	148.4	1057.56
Percolation (B):	DLR x D	mm/month	310	280	310	300	310	300	310	310	300	310	300	310	3650
Outputs:	ET + B	mm/month	472.5	414.2	411.3	367.8	350.1	329.5	343.5	353.9	366.7	413.4	426.2	458.4	4707.6
INPUTS															
Retained Rainfall (RR):	R x RF	mm/month	22	12	24	24	39	35	41	48	33	38	28	30	372.9
Applied Effluent (W):	(Q x D) / L	mm/month	324.9	293.5	324.9	314.4	324.9	314.4	324.9	324.9	314.4	324.9	314.4	324.9	3825.4
Inputs:	RR+W	mm/month	346.6	305.5	349.0	338.4	364.0	349.7	365.4	372.9	347.0	363.1	342.2	354.6	4198.3
STORAGE CALCULATION															
Storage remaining from previous month		mm/month	0	0	0	0	0	46	113	187	250	184	16	0	
Storage for the month (S):	(RR+W) - (ET+B)	mm/month	-125.9	-108.8	-62.2	-29.3	13.9	20.1	21.9	19.0	-19.7	-50.4	-84.1	-103.8	
Increase in depth of stored effluent		mm/month	-419.7	-362.6	-207.5	-97.8	46.4	67.1	73.1	63.5	-65.8	-167.9	-280.3	-346.0	
Cumulative Storage (M):		mm/month	0.0	0.0	0.0	0.0	46.4	113.5	186.5	250.0	184.2	16.3	0.0	0.0	
Max. Storage for Nominated Area (N):		mm	250												
Max. Volume for Nominated Area (V):	N x L	L	50093												
LAND AREA REQUIRED FOR ZERO STORAGE		m^2	144.41	146.18	168.16	183.27	209.33	214.09	214.87	212.84	188.53	173.48	158.10	151.85	

Minimum ETA bed area for zero storage: 215 m^2

Area for design storage (L): 200 m^2

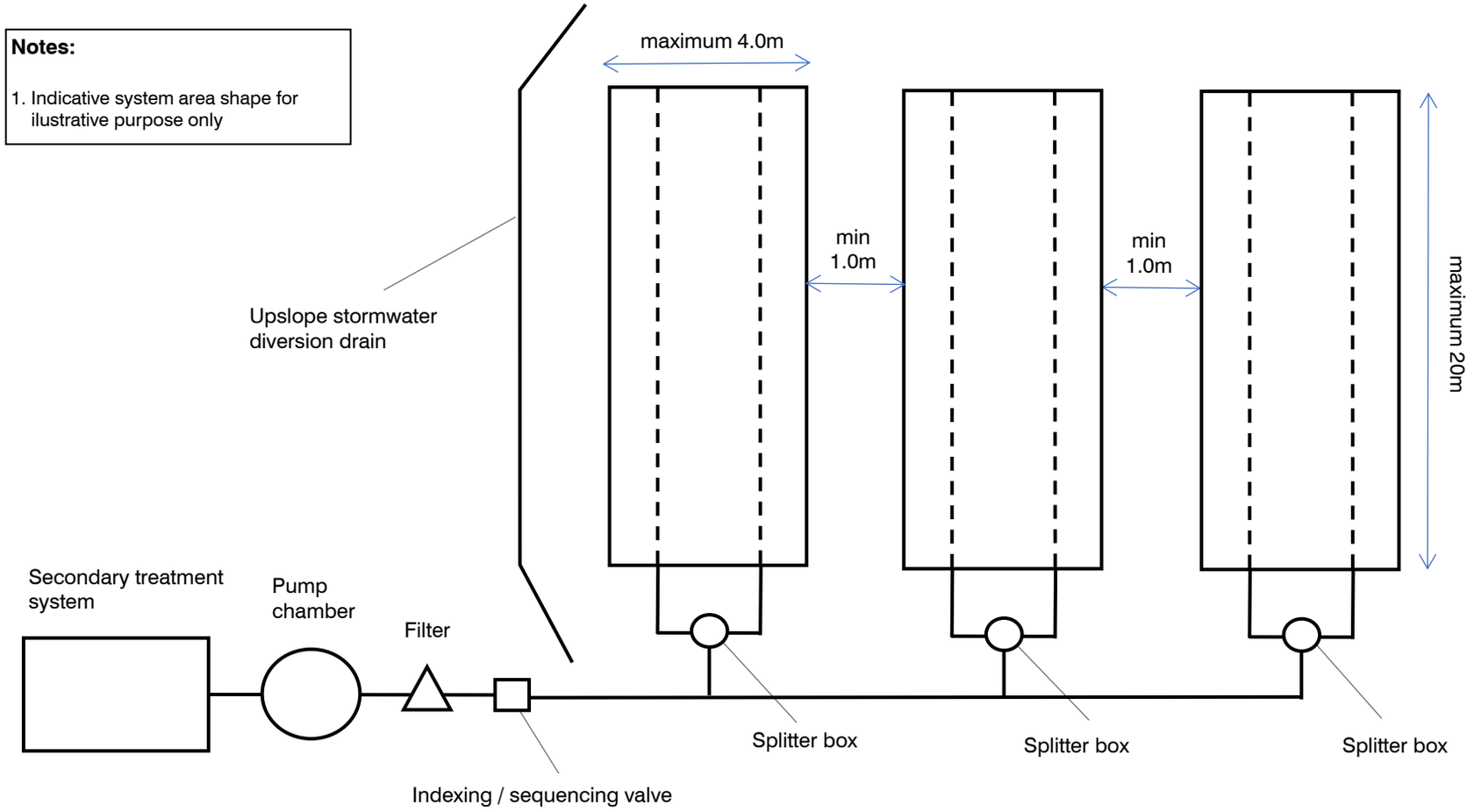
Nominated ETA bed length: 100 m

Appendix E

Typical ETA Bed System Layout

Notes:

1. Indicative system area shape for ilustrative purpose only



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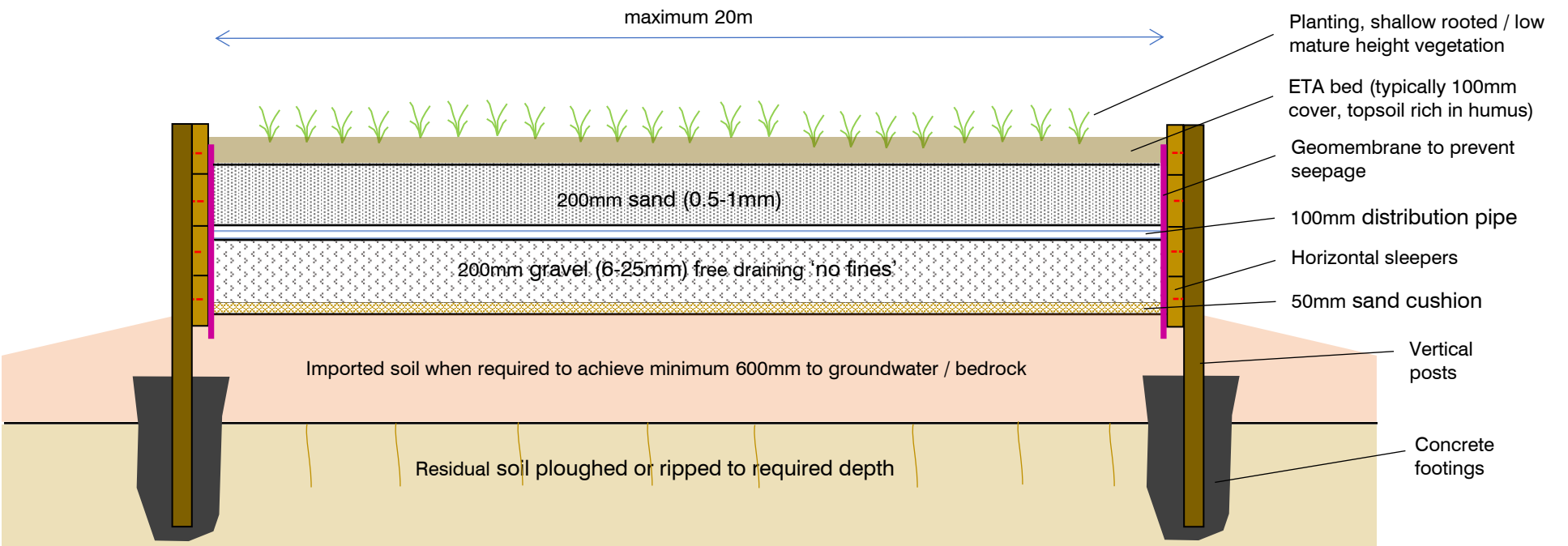
Typical ETA Bed Layout

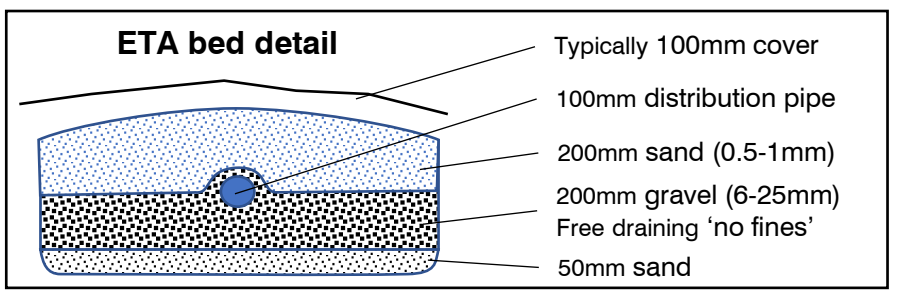
Location:	120 Russells Road
	Mount Duneed, Victoria
Project No:	15468G-LCA
Scale:	NOT TO SCALE

Drawn by:	O.R
Date:	26/10/2018
Approved by:	C.F.
Date:	26/10/2018

Appendix F

Typical Effluent Disposal Cross Section





Notes:

1. Indicative cross section for ilustrative purpose only
2. Spacing between trenches to be 1.0m as a minimum
3. Install cut-off drains to direct stormwater away from system

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Typical Terraced ETA Bed Cross Section

Location:	120 Russells Road	**Drawn by:**	O.R
	Mount Duneed, Victoria	**Date:**	26/10/2018
Project No:	15468G-LCA	**Approved by:**	C.F.
Scale:	NOT TO SCALE	**Date:**	26/10/2018

Appendix G

Planning Report

Department of Environment, Land, Water and Planning

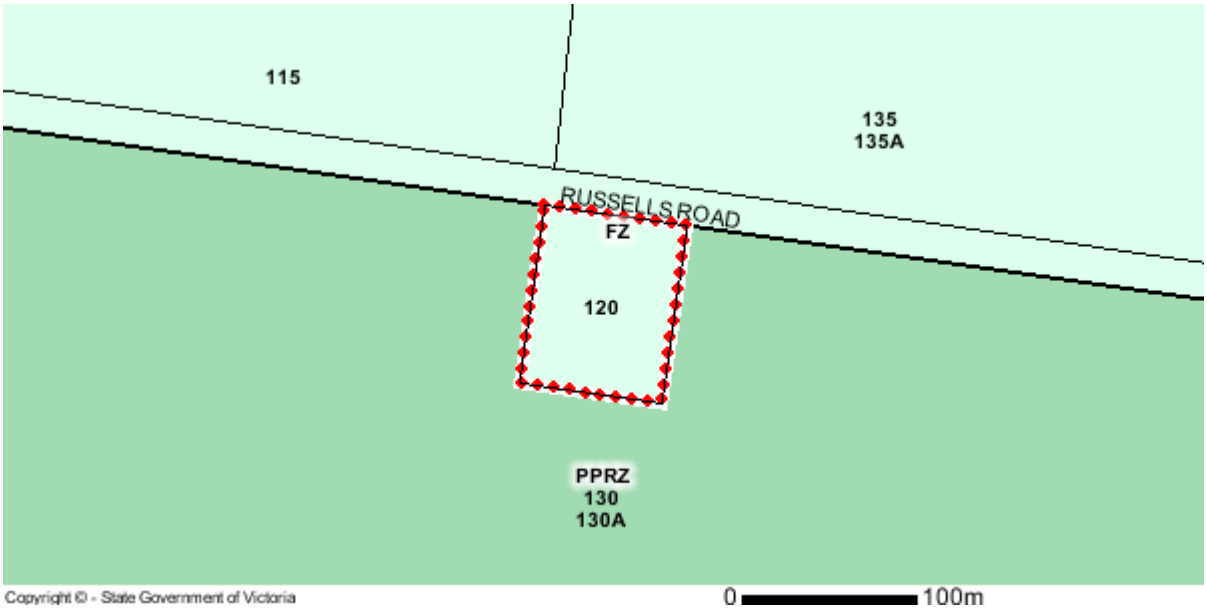
Planning Property Report

from **www.planning.vic.gov.au** on 15 October 2018 02:43 PM

Address: 120 RUSSELLS ROAD MOUNT DUNEED 3217
Crown Description: Allot. L2 Sec. 21 PARISH OF DUNEED
Local Government (Council): GREATER GEELONG **Council Property Number:** 327412
Directory Reference: Melway 479 A5

Planning Zone

FARMING ZONE (FZ)
SCHEDULE TO THE FARMING ZONE (FZ)



Note: labels for zones may appear outside the actual zone - please compare the labels with the legend.

Zones Legend

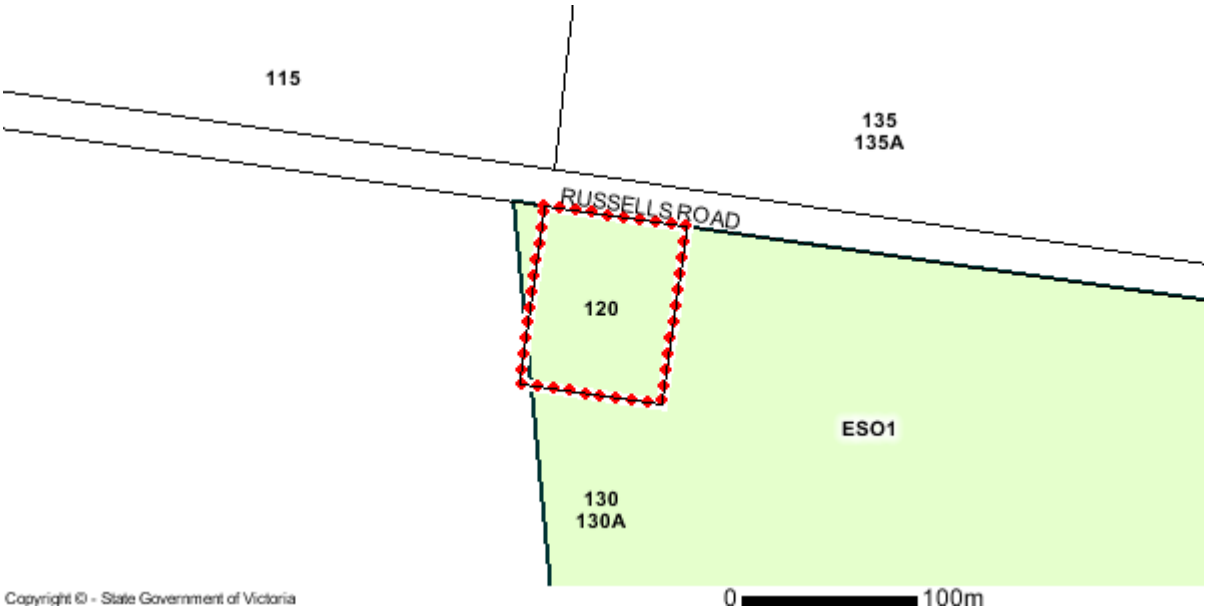
- ACZ - Activity Centre
- B1Z - Commercial 1
- B2Z - Commercial 1
- B3Z - Commercial 2
- B4Z - Commercial 2
- B5Z - Commercial 1
- C1Z - Commercial 1
- C2Z - Commercial 2
- CA - Commonwealth Land
- CCZ - Capital City
- CDZ - Comprehensive Development
- DZ - Dockland
- ERZ - Environmental Rural
- FZ - Farming
- GRZ - General Residential
- GWAZ - Green Wedge A
- GWZ - Green Wedge
- IN1Z - Industrial 1
- IN2Z - Industrial 2
- IN3Z - Industrial 3
- LDRZ - Low Density Residential
- MUZ - Mixed Use
- NRZ - Neighbourhood Residential
- PCRZ - Public Conservation & Resource
- PDZ - Priority Development
- PPRZ - Public Park & Recreation
- PUZ1 - Public Use - Service & Utility
- PUZ2 - Public Use - Education
- PUZ3 - Public Use - Health Community
- PUZ4 - Public Use - Transport
- PUZ5 - Public Use - Cemetery/Crematorium
- PUZ6 - Public Use - Local Government
- PUZ7 - Public Use - Other Public Use
- PZ - Port
- R1Z - General Residential
- R2Z - General Residential
- R3Z - General Residential
- RAZ - Rural Activity
- RCZ - Rural Conservation
- RDZ1 - Road - Category 1
- RDZ2 - Road - Category 2
- RGZ - Residential Growth
- RLZ - Rural Living
- RUZ - Rural
- SUZ - Special Use
- TZ - Township
- UFZ - Urban Floodway
- UGZ - Urban Growth
- Urban Growth Boundary

Railway | Tram | River, stream | Lake, waterbody

Planning Overlay

ENVIRONMENTAL SIGNIFICANCE OVERLAY (ESO)

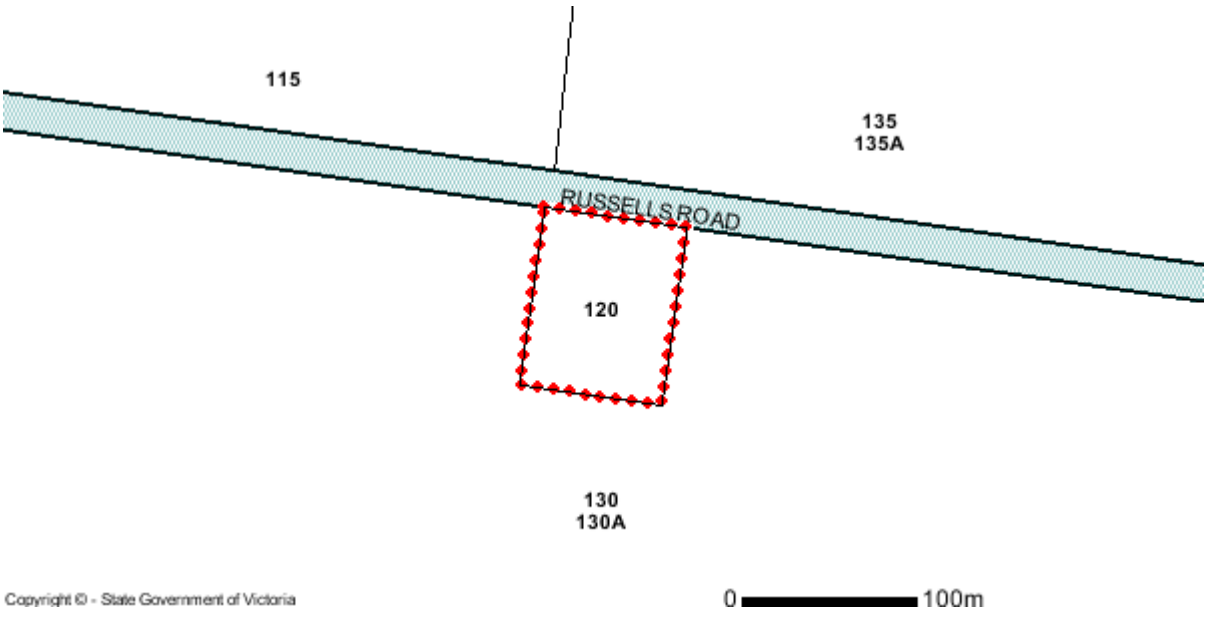
ENVIRONMENTAL SIGNIFICANCE OVERLAY - SCHEDULE 1 (ESO1)



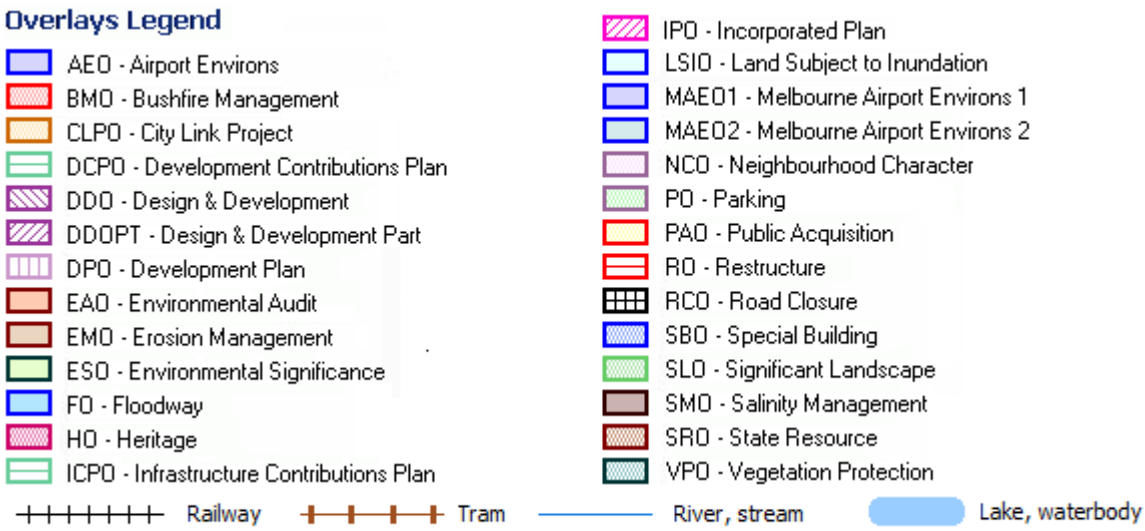
OTHER OVERLAYS

Other overlays in the vicinity not directly affecting this land

VEGETATION PROTECTION OVERLAY (VPO)



Planning Overlays Legend



Note: due to overlaps some colours on the maps may not match those in the legend.

Further Planning Information

Planning scheme data last updated on 10 October 2018.

A **planning scheme** sets out policies and requirements for the use, development and protection of land. This report provides information about the zone and overlay provisions that apply to the selected land. Information about the State, local, particular and general provisions of the local planning scheme that may affect the use of this land can be obtained by contacting the local council or by visiting Planning Schemes Online

This report is NOT a **Planning Certificate** issued pursuant to Section 199 of the Planning & Environment Act 1987. It does not include information about exhibited planning scheme amendments, or zonings that may abut the land. To obtain a Planning Certificate go to Titles and Property Certificates

For details of surrounding properties, use this service to get the Reports for properties of interest

To view planning zones, overlay and heritage information in an interactive format visit Planning Maps Online

For other information about planning in Victoria visit www.planning.vic.gov.au

Appendix H

Laboratory Test Results

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EM1816483**	Page	: 1 of 3
Client	: **ST QUENTIN**	Laboratory	: Environmental Division Melbourne
Contact	: Omar Reyes	Contact	: Customer Services EM
Address	: 51 Little Fyans St South Geelong Vic 3220	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: +61 03 5229 2011	Telephone	: +61-3-8549 9600
Project	: 15648G	Date Samples Received	: 12-Oct-2018 14:35
Order number	: ----	Date Analysis Commenced	: 15-Oct-2018
C-O-C number	: ----	Issue Date	: 22-Oct-2018 17:26
Sampler	: St Quentin Consulting		
Site	: 120 Russells Road, Mount Duneed		
Quote number	: ME/566/18		
No. of samples received	: 2		
No. of samples analysed	: 2		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity ($H^+ + Al^{3+}$).
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	BH1, 100-200mm	BH1, 600-800mm	----	----	----
			Client sampling date / time	11-Oct-2018 08:00	11-Oct-2018 08:15	----	----	----
Compound	CAS Number	LOR	Unit	EM1816483-001	EM1816483-002	--------	--------	--------
				Result	Result	----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**5.8**	**7.4**	----	----	----
EA006: Sodium Adsorption Ratio (SAR)								
Sodium Adsorption Ratio	----	0.01	-	**5.37**	**27.0**	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**56**	**494**	----	----	----
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	----	**8.2**	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	----	**19.0**	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	----	**0.4**	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	----	**7.8**	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	----	**35.3**	----	----	----
ø Exchangeable Calcium Percent	----	0.2	%	----	**23.1**	----	----	----
ø Exchangeable Magnesium Percent	----	0.2	%	----	**53.6**	----	----	----
ø Exchangeable Potassium Percent	----	0.2	%	----	**1.1**	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	----	**22.1**	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	----	**0.4**	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	----	**48.6**	----	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	**1.5**	----	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	**1.6**	----	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	<0.1	----	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	**0.6**	----	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	**3.8**	----	----	----	----
EK072: Phosphate Sorption Capacity								
Phosphate Sorption Capacity	----	250	mg P sorbed/kg	**1030**	**1480**	----	----	----
Phosphate Sorption Index	----	1	mgkg-1/log10 ugL-1	**37**	**67**	----	----	----

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LAND CAPABILITY ASSESSMENT ADDENDUM

TESTING PROGRAMME & REPORT

1. Report has been prepared by qualified persons and based on current available standards.
2. Recommendations are based on the assumption that limited test positions are representative of the sub-surface profile.
3. Whilst care has been taken to accurately report on the sub-surface conditions across the site it is not possible to anticipate unexpected sub-surface variations given the limited testing performed.
4. Changes in legislative policy may require report update or additional testing.

The purpose of this report is to determine the capability of the site to contain effluent with regard to the soil and land constraints. It is beyond the scope of this report to provide specific effluent system design. Where any variation or anomalies are encountered, we recommend additional investigation and reporting by us to resolve any potential issues.

EFFLUENT DISPOSAL CARE & MAINTENANCE

We recommend the following to assist in long term system serviceability and safe on site disposal:

1. Restrict germicides such as strong detergents, disinfectants, toilet clears with high acid content, nappy sanitisers, bleaches etc. that are likely to kill bacteria and affect the operation of the septic system.
2. Only use detergents with low alkaline salts and chlorine.
3. Sanitary napkins or disposable nappies must not be flushed into the system.
4. Limit the amount of fat and oils into the system.
5. Use sink strainer to limit the food that enters the system.
6. Do not use garbage disposal units.
7. Where odours occur, we recommend flushing approximately one cup of lime each day.
8. To reduce odours, we recommend filling the tank with water after installation or after desludging.
9. Grease trap should be checked for blockages and pumped every 6-12 months.
10. Inspect the system once a year by a qualified plumber or drainer.
11. Tank should be pumped concurrently every three years.

VEGETATION FOR TRANSPIRATION

Good vegetative cover is important to achieve effective transpiration of effluent disposal. It is therefore recommended to establish and maintain good grass cover over distribution areas and suitable shrubs or trees between distribution lines. Where trees are planted near drainage line, difficulties with root invasion can be anticipated. We do not recommend planting crops in disposal area.

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www.stqc.com.au ACN: 120 048 857 ABN: 45 120 048 857

The following list includes some suitable water tolerant plants:

Botanical Names	**Common Names**
Alyxia buxifolia	Sea Box
Atriplex semibaccata	Creeping Saltbush
Atriplex paludosa	Marsh Saltbush
Baumea acuta	Pale Twig-sedge
Baumea juncea	Bare Twig-sedge
Carex appressa	Tall sedge
Carex breviculmis	Common Grass-sedge
Dianella longifolia	Pale Flax-lily
Dianella tasmanica	Tasman Flax-lily
Eleocharis acuta	Common Spike-sedge
Eleocharis sphacelata	Tall Spike-sedge
Gahnia filum	Chaffy Saw-sedge
Gahnia sieberiana	Red-fruited Saw-sedge
Goodenia ovata	Hop Goodenia
Indigofera australis	Austral Indigo
Isolepis inundata	Swamp Club-sedge
Isolepis nodosa	Knobby Club-rush
Juncus kraussii	Sea Rush
Juncus procerus	Tall Rush
Leptospermum lanigerum	Woolly Tea-tree
Leptospermum myrsinoides	Heath Tea-tree
Lomandra longifolia	Spiny-headed Mat-rush
Melaleuca ericifolia	Swamp Paperbark
Melaleuca lanceolata	Moonah
Melaleuca squarrosa	Scented Paperbark
Patersonia fragilis	Short Purple-flag
Patersonia occidentalis	Long Purple-flag
Prosanthera melissifolia	Balm Mint Bush
Schoenus brevifolius	Zig-zag Bog-sedge
Schoenus lepidosperma	Slender Bog-sedge
Schoenus tesquorum	Soft Bog-sedge

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www.stqc.com.au ACN: 120 048 857 ABN: 45 120 048 857

GENERAL COMMENTS

St Quentin Consulting does not accept responsibility for our report where it has been altered or not reproduced in full, including addendum.

Dimensions, slope, test locations are approximate only and must not be used for calculation of positioning.

Recommendations are based on information regarding the site and development type provided by the client or agent. If information supplied is not accurate or if significant changes are required our report may be inappropriate. We cannot accept responsibility for significant changes and anticipate additional fees should further tests or report update be required.

Offset distance to septic tanks or any subsurface excavations must not exceed the minimum angle of repose for the in-situ naturally occurring soil. We estimate the maximum angle of repose for sand is 30 and 45 for clay soils. We do not recommend steeper angles unless competent rock is encountered.

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