

Trine Solutions Pty Ltd

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On-site Wastewater Management Systems

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THE GENERAL MANAGER
BYRON SHIRE COUNCIL

ON-SITE WASTEWATER MANAGEMENT REPORT

For

RELOCATED 3-BEDROOM DWELLING

At

**LOT 1 DP: 631177
163 SADDLE ROAD BRUNSWICK HEADS**

OWNER

Peter & Vicki Ulrick

SITE INVESTIGATION

TRINE SOLUTIONS

DATE

17th May 2019

Report No: TS19722

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List of Attachments

OSMS Site Plan	- Michael Spiteri Architectural Drafting / Modified by Trine Solutions P/L (22/07/19)
Byron OSMS	
Design Spreadsheet	- 3-Bedroom Dwelling
Reed Bed Design	- Trine Solutions P/L
ETA Bed design	- Rob Aungle & Associates
Dwelling Floor Plan	- Michael Spiteri Architectural Drafting

1.0 INTRODUCTION

Trine Solutions Pty Ltd has been commissioned by the applicant to prepare an On-site Sewage Management Report for a proposed 3-Bedroom Dwelling Relocation to Lot 1 DP: 631177 / 163 Saddle Road Brunswick Heads.

The site is not connected to a centralised sewerage treatment system and will require approval for an on-site wastewater treatment system to service the proposed dwelling.

This report will identify and address the relevant matters for the effective and sustainable management of wastewater generated by the proposed development of the lot.

The report describes the site conditions as they effect the land application of effluent, presents the results of field testing, provides advice and recommendations on the available options for on-site wastewater management. Calculations for sizing of land area requirements are based on the methods set out in AS/NZ 1547:2012 – Appendix L - Land Application Methods and Byron OSMS Design Model.

The purpose of this report is to demonstrate to Byron Shire Council that appropriate arrangements can be made for Wastewater Management, which will minimise the environmental impact of the proposed dwelling at this site.

2.0 PROPOSED DEVELOPMENT

Relocated 3-Bedroom Dwelling

Therefore the **design** of the wastewater management system will be based on:

- 4.5 occupants (conservative)
- Water saving devices including 6/3 flush toilets, low flow shower roses, aerators etc
- Wastewater generated is say 517.5L per day (115L/person/day roof harvest water supply)
- Septic Tank / 3000L
- Horizontal Sub-Surface Flow Wetlands - 2 x 7.2m² cells (in series)
- ETA Beds - 2 x 18m x 1.2m

3.0 SITE DESCRIPTION

163 Saddle Road Brunswick Heads is a rural lot with an area of 5.846ha located to the east and fronting on to Saddle Road Brunswick Heads.

The lot is generally cleared with extensive areas of pasture. The relocated 3-bedroom dwelling will be located in the western corner of the lot close to access from Saddle Road.

The proposed wastewater treatment system and land application area is downslope to the south-east and in a grassed area with good sun and wind exposure.

The Site

Plate 1



Proposed OSMS Location

Plate 2



4.0 SOIL ASSESSMENT

Boreholes were examined for the purpose of classification and testing of the site soils. The soils consist of top soil to a depth of 100 to 300mm and consistent clay loam to a depth greater than 600mm.

Refer to photo plate 3:

- Borehole 1

The soil classification and profile description is consistent with published works by Morand titled 'Soil Landscapes of the Lismore - Ballina 1:100 000 Sheet'

Soil description

Soil Landscape	Erosional – Low rolling hills on Basalts
Grouping	bg – Bangalow
Description	Deep (100 - >200cm) well drained Krasnozems
Limitations	Strongly acid soils with high aluminium toxicity potential - *Not noted as this site

Soil sampling was undertaken on 17th May 2019 being a relatively dry climatic period.

The results indicated that the soils are not limited for the application of effluent and a percolation rate in the order of 0.3m/day can be achieved.

The complete results of the site assessment have been summarized in the table below.

TABLE OF SITE CHARACTERISTICS : Proposed Relocated 3-Bedroom Dwelling	
Soil:	Clay Loam
Land area:	Not limited
Flood Potential:	Nil
Exposure	Good wind & sun exposure
Slope %	8-10%
Landform	The sub-soils are moderately well-drained
Run-on and up-slope seepage	Nil (to be diverted)
Erosion potential	Nil
Site drainage	Good
Buffer distance	All buffers to be maintained
Depth to bedrock	>3m
Geology/regolith	The underlying stratum provides good internal drainage
Exchangeable Sodium Percentage	Not limiting
Permeability (Ksat)	0.3m/day

5.0 SITE & SOIL ASSESSMENT SUMMARY

Details of the site assessment undertaken, which included a soil assessment, are presented below.

Table of site characteristics	
Soil:	The soil profile for proposed land application area has the characteristics of a clay based soil
Flood Potential:	None
Exposure	There is good sun and wind exposure on the application area
Slope %	The general slope of the site proposed for application area is approximately 8-10%
Landform	Waxing divergent
Run-on and up-slope seepage	Due to design of bed any run-on will be shed & or diverted
Erosion potential	Although the soil type is moderately erodible, there are no signs of slope failure, slumping, rilling or active erosion on the site
Site drainage	There are no signs of surface wetness on the proposed application area that could be related to waterlogged soil.
Fill	There is no fill in the application area
Buffer distance	Buffer distance to groundwater bore addressed
Land Area Available	5.846ha
Rock and rock outcrops	None noted in proposed application area
Geology/regolith	The underlying stratum provides good internal drainage at this site
Exchangeable Sodium Percentage	Generally low in these soils
Depth to bedrock	The depth to bedrock is > 3m.
Depth to high episodic/seasonal Water table	>3m

SOIL ASSESSMENT – 163 Saddle Road Brunswick Heads						Date: 17 May 2019		
Borehole: 1								
SOIL UNIT (Morand, 1994): bg – Bangalow								
Horizon A & B	Depth (mm)	Texture	Structure	Colour	Soil Category (cf. Texture)	Course Fragments	Soil pH	Dispersive Class (Emerson)
.....	0 300 600 800 1000 1200	Clay loam Clay loam Clay loam Clay Content Increasing	Moderate Moderate Moderate Moderate	Brownish Red Brownish Red Brownish Red	4 - CL 4 - CL	0%	5.4	6
Tick box:			No limitation Limitation	(√) (X)	(√)	(√)	(√)	(√)
					Over all:	No limitation Limitation(s)		(√)

Plate 3 – Borehole 1



6.0 PROPOSED ON-SITE WASTEWATER MANAGEMENT SYSTEM

Relocated 3-Bedroom Dwelling

Therefore the **design** of the wastewater management system will be based on:

- 4.5 occupants (conservative)
- Water saving devices including 6/3 flush toilets, low flow shower roses, aerators etc
- Wastewater generated is say 517.5L per day (115L/person/day roof harvest water supply)
- 3000L Septic Tank with effluent outlet filter
- Horizontal Sub-Surface Flow Wetlands - 2 x 7.2m² cells - in series (see detail)
- Distribution box
- ETA Beds - 2 x 18m x 1.2m (see detail)

7.0 SIZING OF CONSTRUCTED WETLANDS

It is proposed to incorporate reed beds to achieve secondary treatment of all effluent generated from the proposed development. The design will be based on the hydraulic load generated from the premises.

The reed bed design will optimize the Theoretical Hydraulic Residence Time (HRT). The design is categorised as a subsurface flow system (SSF). The effluent will flow through the porous media, in this case gravel (20mm) in which the plants will be rooted.

Due to the expected nutrient (nitrogen) load the reed bed will be two (2) 7.2m² (concrete) cells in series to achieve the final pollutant removal.

The literature review of wetland design reveals three (3) methods of design namely:

- 'Rule of thumb' approach
- Reed et al 1995
- Kadlec and Knight (K-C* model) (1996)

The rule of thumb method according to the literature is accurate and useful for preliminary sizing (10 - 20m²) per m³ of effluent / day.

The Reed et al method is based on first order plug flow assumptions.

The Kadlec and Knight method presumes a first order decay, plug flow model for all pollutants. The model is based on areal (AREAL) rate constraints which are independent of temperature.

Rule of Thumb Method

At 20m²/m³/day a flow of 0.518m³ requires 10.36m²

Area required = 10.36m²

Notwithstanding the above, minimum reed bed area required is 14.4m².

8.0 SIZING OF ETA BEDS

AS/NZS 1547:2012 Method

Loading Rates for Trenches & Beds AS/NZS 1547:2012 - Table L1 (D.L.R. (mm/day) Secondary treated effluent)

Bed dimensions shall be determined from the relationship

Reference: L4.2 AS/NZS 1547:2012

$$L = \frac{Q}{DLR \times W}$$

∴

$$L = \frac{517.5L}{20 \times 1}$$

Area required = 26m² (2 x 13m x 1m beds)

Byron OSMS Design Model

The parameters discussed have been factored into the Byron Design Model resulting in a final application area of 68m² or 2 x 18m x 1.2m ETA beds.

Therefore final LAA required is a 2 x 18m x 1.2m ETA beds (Conservative)

9.0 CONCLUSION

It is possible to provide a safe on-site wastewater management system for the proposed relocated 3-Bedroom Dwelling to be constructed at Lot 1 DP: 631177 / 163 Saddle Road Brunswick Heads.

This is based on the following points:

Install

- **3000L Septic Tank with effluent outlet filter**
- **Horizontal Sub-Surface Flow Wetlands - 2 x 7.2m² cells - in series (see detail)**
- **Distribution box**
- **ETA Beds - 2 x 18m x 1.2m (see detail)**

Proposal is consistent with Councils adopted strategy for sewage management.

MAINTENANCE REQUIREMENTS

Maintenance for Septic Tank & ETA Bed

For longevity of the on-site sewage management system the following maintenance regime should be employed by the owner/occupier of the dwelling.

- It will be necessary to have the contents of the septic tank pumped out on average every three (3) to five (5) years. Generally speaking households of meat eaters would need to pump out their septic every 3 to 5 years and vegetarians every 4 to 6 years.
- Bleach, bleach-based products, whiteners, nappy soakers and spot removers shall not be disposed of into the on-site system. They shall be disposed of on a disused area of a garden, well away from the disposal area.
- Hygiene products, condoms, tampons, sanitary napkins, disposable nappies and cotton buds and the like shall not be disposed of via the on-site disposal system. They should be disposed of into garbage bins in sealed plastic bags.
- Only the recommended amounts of disinfectants should be used. Biodegradable products for septic systems are recommended.
- Runoff diversion banks to be inspected annually and maintenance as required undertaken to ensure that surface runoff is diverted around the disposal area.
- No vehicular, stock or pedestrian access should be made across the application area.
- Vegetation from the application area needs to be harvested to promote young growth
- Effluent from treatment system should not be discharged to the stormwater system or over the ground.

Constructed Sub-surface Flow Wetlands

1. Quarterly maintenance check of the wetland area including checking of water level, cleaning of drains and elimination of weeds
2. The wetland plantings should generally be thinned or harvested annually to maintain the nutrient removal capacity of the system.
3. Inlet and outlet towers should be inspected six monthly (by removing the push-on caps). Breaking or severing the roots and removing them should remedy any root intrusion into the towers.
4. Protective gloves must be worn to prevent contact with partially treated effluent.
5. The water level can be lowered for a month in summer to promote breakdown of accumulated organic solids in the upper layer of the gravel. Replace the 100mm PVC outlet standpipe with the shorter pipe provided.

REFERENCES

Australian Standard AS1547:2012 On-Site Domestic-Wastewater Management.

Plumbing Code of Australia – December 2012

Byron Shire Council (1 December, 2004). Design Guidelines for On-Site Sewage Management for Single Households. Protecting the Environment and Health of Byron Shire. *-Technical Guidelines for System Designers.*

Environmental Protection Authority, Dept. of Local Government, Department of Land & Water Conservation and NSW Department of Health (Feb 1998). Environment and Health Protection Guidelines - *On-Site Sewage Management Systems for Single Households.*

Crites – Tchobanoglous (1998) - *Small and Decentralized Wastewater Management Systems*

Department of Land and Water Conservation NSW - The Constructed Wetlands Manual Volume

Metcalf & Eddy – *Wastewater Engineering - Third Edition*

G. Swarbrick – *Short Course in Waste Management* – University N.S.W. 1996

Ratcliff (1983) Published Paper

Metcalf & Eddy (1991) *Wastewater Engineering* 3rd Edition

Morand, D.T. (1994) Soil Landscapes of the Lismore-Ballina 1:100,000 Sheet Report, Soil Conservation Service of NSW, Sydney.

Morand, D.T. (1994) Soil Landscapes of the Lismore-Ballina 1:100,000 Sheet Map, Soil Conservation Service of NSW, Sydney.

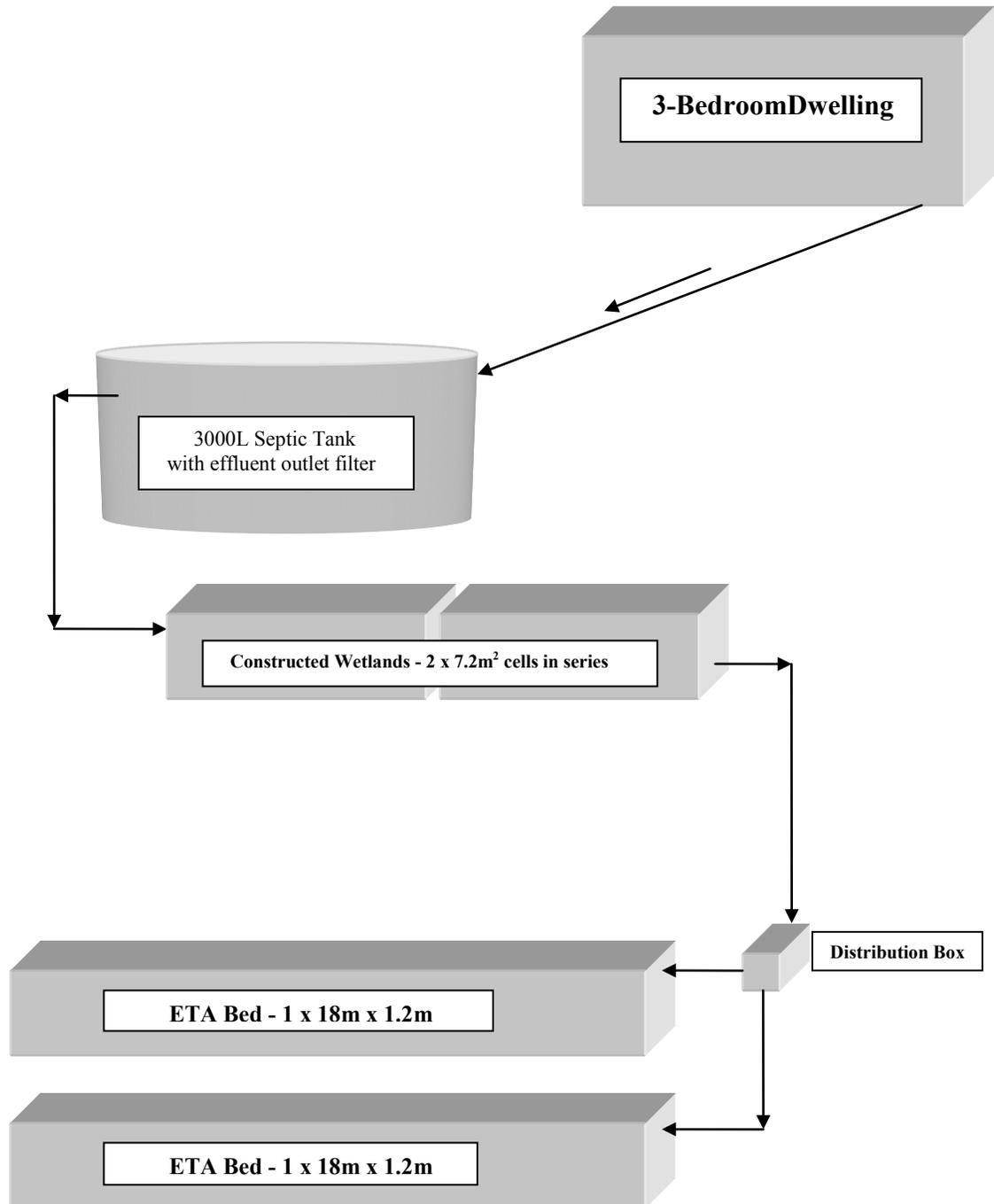
End of Report

Bradford Nicholson
Trine Solutions P/L

S.T.F. FLOW PLAN

For 3-Bedroom Dwelling – 163 Saddle Road Brunswick Heads

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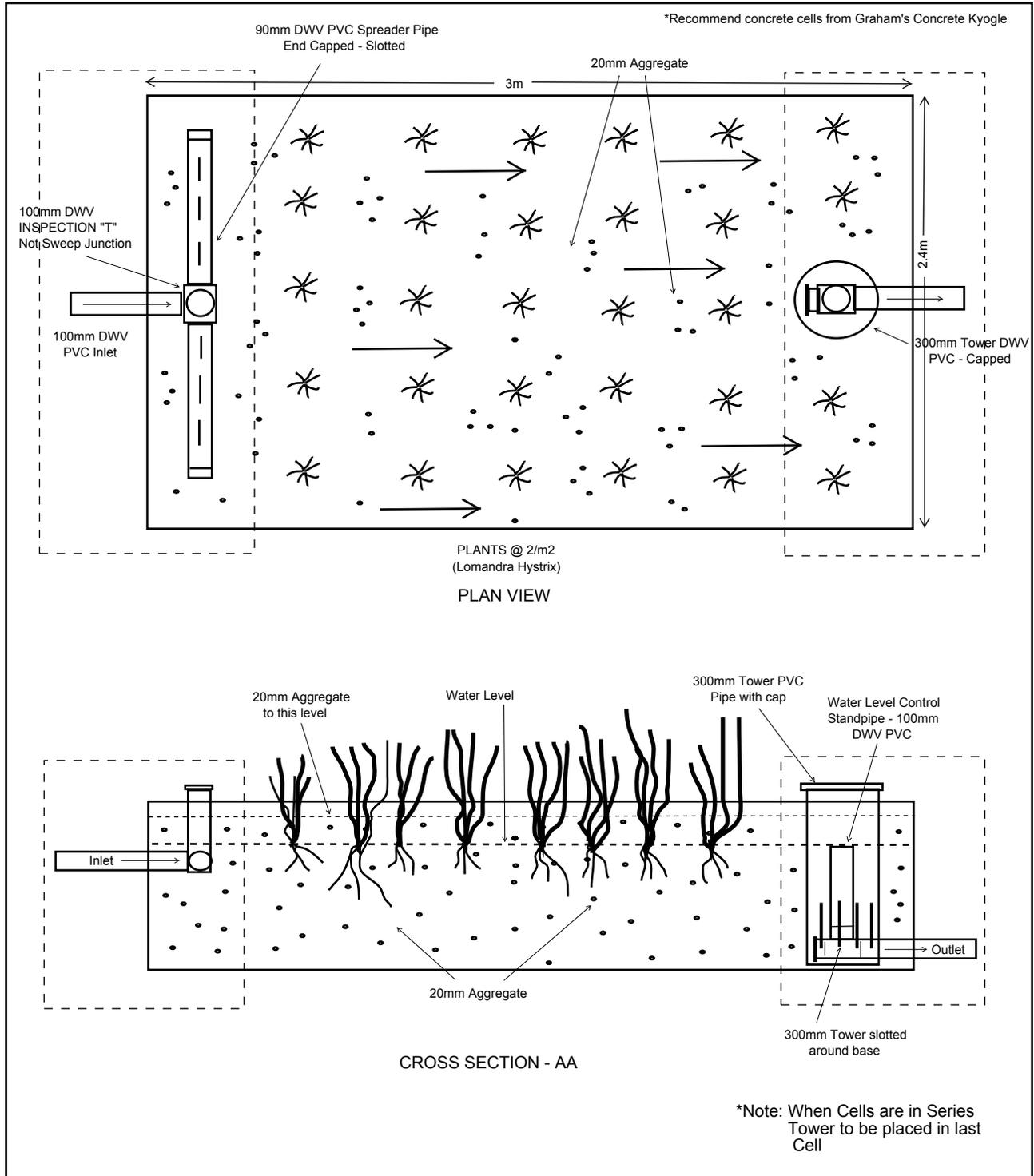


Head count by (1) bedrooms / (2) persons	1
Bedrooms (gp1)	3
Bedrooms (gp2)	0
Persons (grp 1)	5
Persons (grp 2)	0
Block size (ha)	58000
Setback type listbox	1
Setback distance (m)	100
Daily Effluent Flow per person (L/day)	115
Daily effluent water supply type listbox	4
toilet g1 tickbox	TRUE
bath g1 tickbox	TRUE
laundry g1 tickbox	TRUE
kitchen g1 tickbox	TRUE
toilet g2 tickbox	FALSE
bath g2 tickbox	FALSE
laundry g2 tickbox	FALSE
kitchen g2 tickbox	FALSE
Treatment system listbox	6
% black to total wastewater in a full system: Water	32%
N production per person per year (kg/person/yr)	4.2
% black to total wastewater in a full system: TN	70%
N loss in treatment system (% reduction)	50%
N loss in disposal bed (% reduction)	20%
N Plant Uptake rate (kg/ha/year)	200
P production per person per year (kg/person/yr)	0.6
% black to total wastewater in a full system: TP	40%
P uptake by plants (Hp) (kg/ha/yr)	10
P soil sorption (Ps) (kg/ha/m depth)	10000
P soil sorption according to soil type listbox	3
Water Table Depth (Wtd) (m)	3
Buffer to Water Table (Bwt) (m)	0.5
Time for accumulation of P(years)	50
Crop factor(grass = 0.74)	1
Crop coefficient (TRUE) / crop factor (FALSE) tickbox	TRUE
% Effective Rainfall	65%
Effective Rainfall listbox	1
Percolation (mm/day)	27.36632336
Soil texture and structure beneath system listbox	6
Depth of root zone (m)	0.15
Effective porosity of root zone	0.37
Avail. Water of root zone	0.15
Soil texture in rootzone listbox	3
Depth of trench below root zone (m)	0.15
Effective porosity of trench below root zone	0.43
Avail. Water of trench below root zone	0
Permissible percentile exceedence	5.0000%
Trench width (m)	1.2
Lateral seepage width (m)	0.3
Disposal Type SSI (1) / ETA (2) listbox	2
Number of trenches (spinner button)	2
Hydraulic area (m2)	22.66
Nitrogen area (m2)	0.00
Phosphorus area (m2)	52.94
Water balance area (m2) - Cntl-q (see text)	67.50
Final area (m2)	67.50

Horizontal Flow Wetland Detail

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Client - Peter & Vicki Ulrick
163 Saddle Road Brunswick Heads

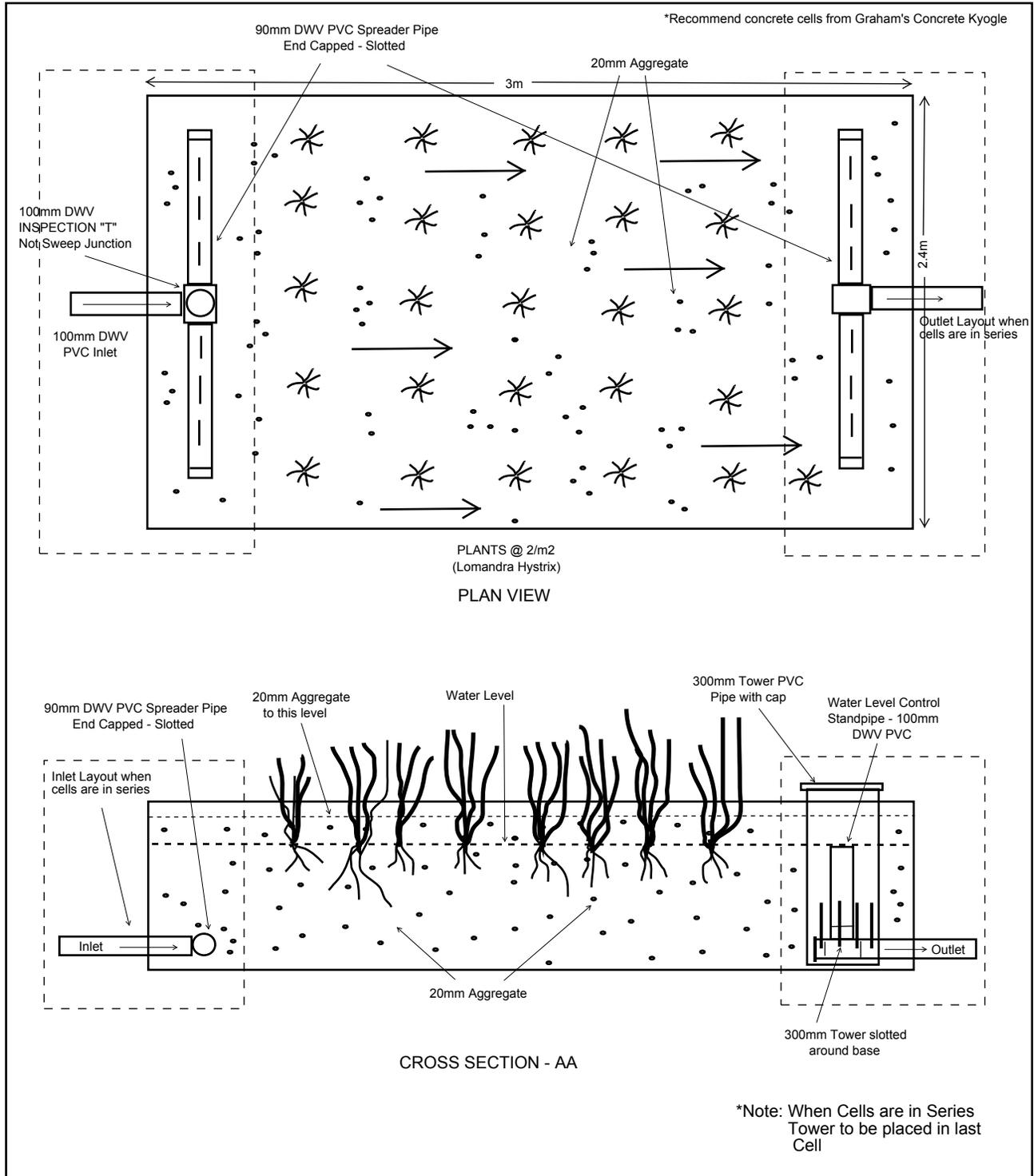


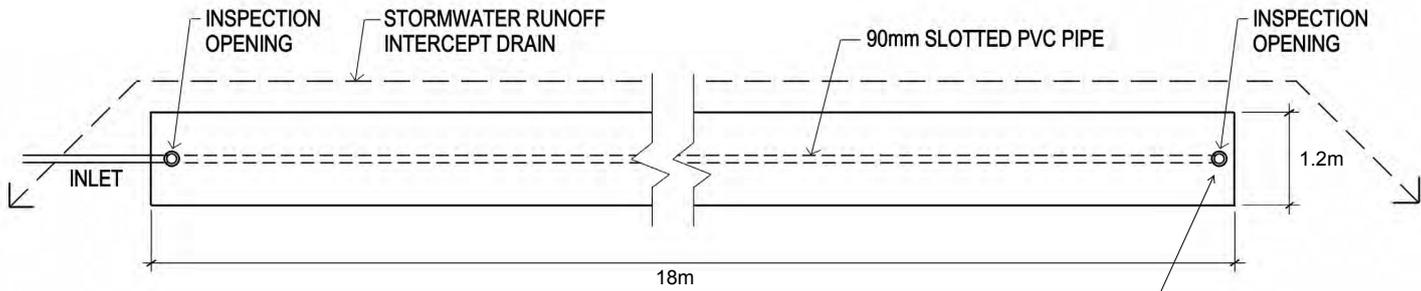
Horizontal Flow Wetland Detail

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Client - Peter & Vicki Ulrick
163 Saddle Road Brunswick Heads

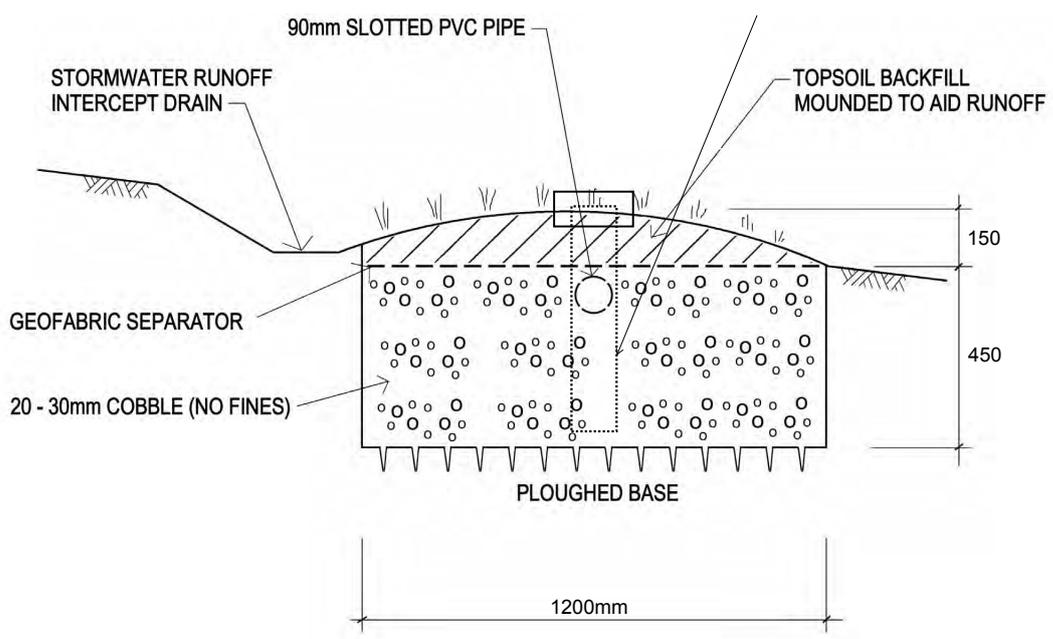
Plan B - Wetland Cells in series





PLAN VIEW not to scale

100mm Inspection Port perforated in gravel zone at end of Bed



TYPICAL CROSS SECTION 1:20

ON-SITE WASTEWATER MANAGEMENT DETAILS

3-Bedroom Dwelling
163 Saddle Road Brunswick Heads

Client: Peter & Vicki Ulrick

ETA Bed

TRINE SOLUTIONS PTY LTD
ON-SITE WASTEWATER MANAGEMENT SYSTEMS
P.O. BOX 8 NEW BRIGHTON NSW 2483

Drawn R.A.

Certified *Rob Aungle*

Date 22/07/2019

Scale As shown

Drawing No 00-001

Rob Aungle & Associates

CONSULTING ENGINEERS
Civil, Structural & Geotechnical

STANDARD NOTES:

ALL CONSTRUCTION WILL COMPLY WITH THE BUILDING CODE OF AUSTRALIA

DO NOT SCALE FROM DRAWING

ENSURE ALL BUILDING CONSTRUCTION WITHIN BUILDING ENVELOPE.

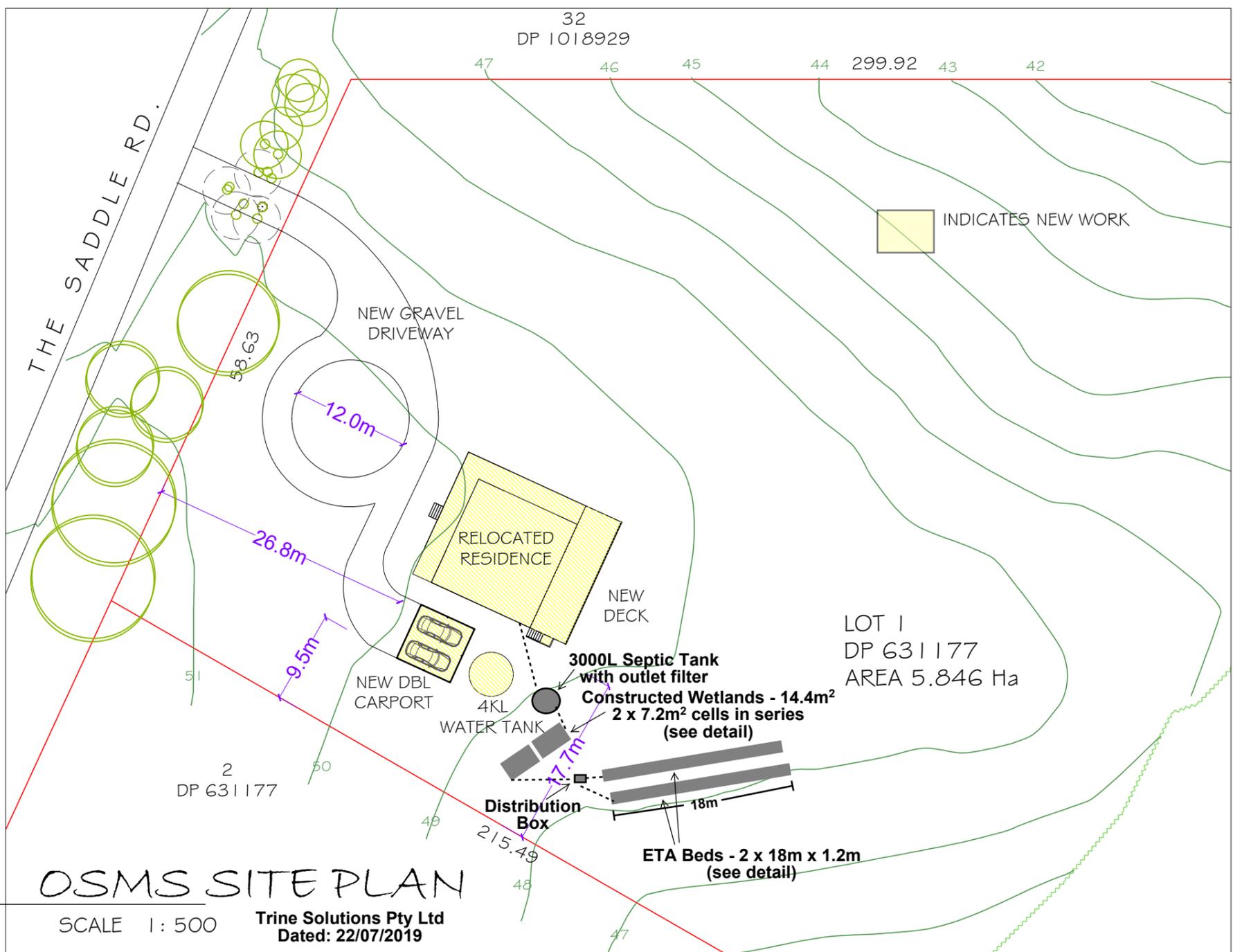
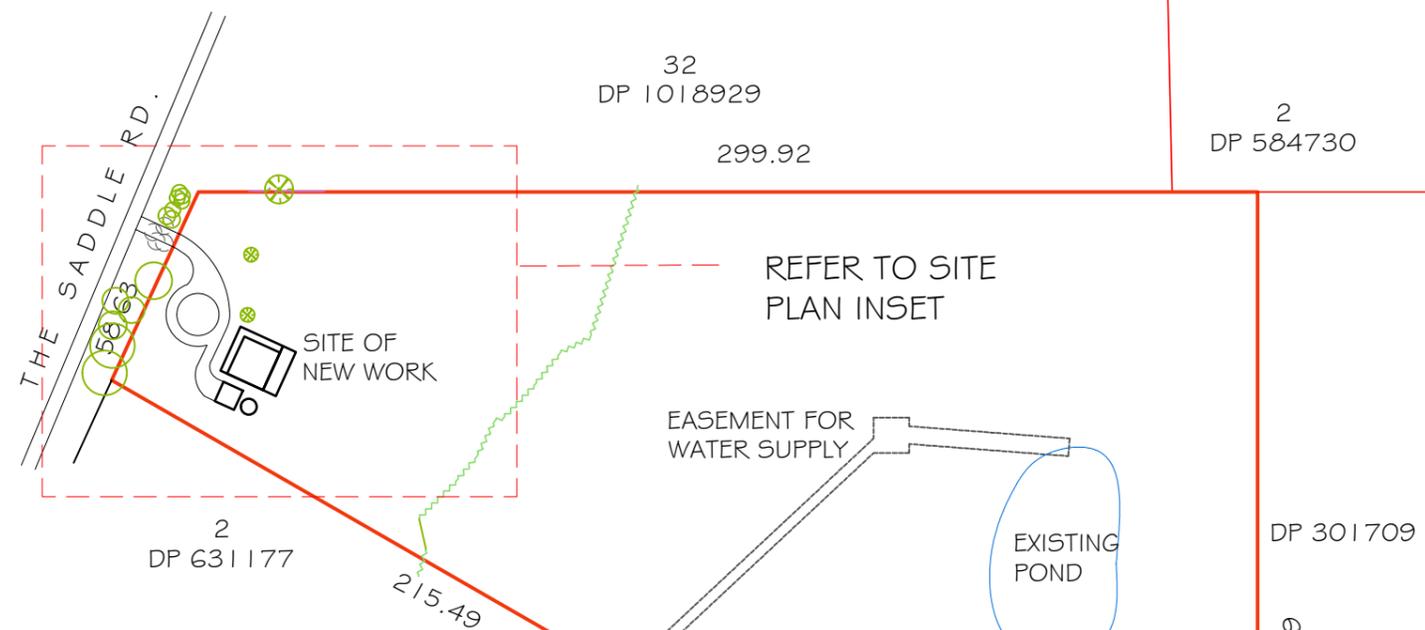
CHECK FOR UNDERGROUND OBSTACLES PRIOR TO CONSTRUCTION

CONFIRM DIMENSIONS AND RELEVANT INFORMATION ON SITE BEFORE COMMENCING WORK.

DRAWINGS TO BE READ IN CONJUNCTION WITH ENGINEERING DRAWINGS



NEW DRIVEWAY CROSSOVER IN ACCORDANCE WITH NORTHERN RIVERS LOCAL GOVERNMENT STANDARD DRAWING R14 NON KERBED ROADS

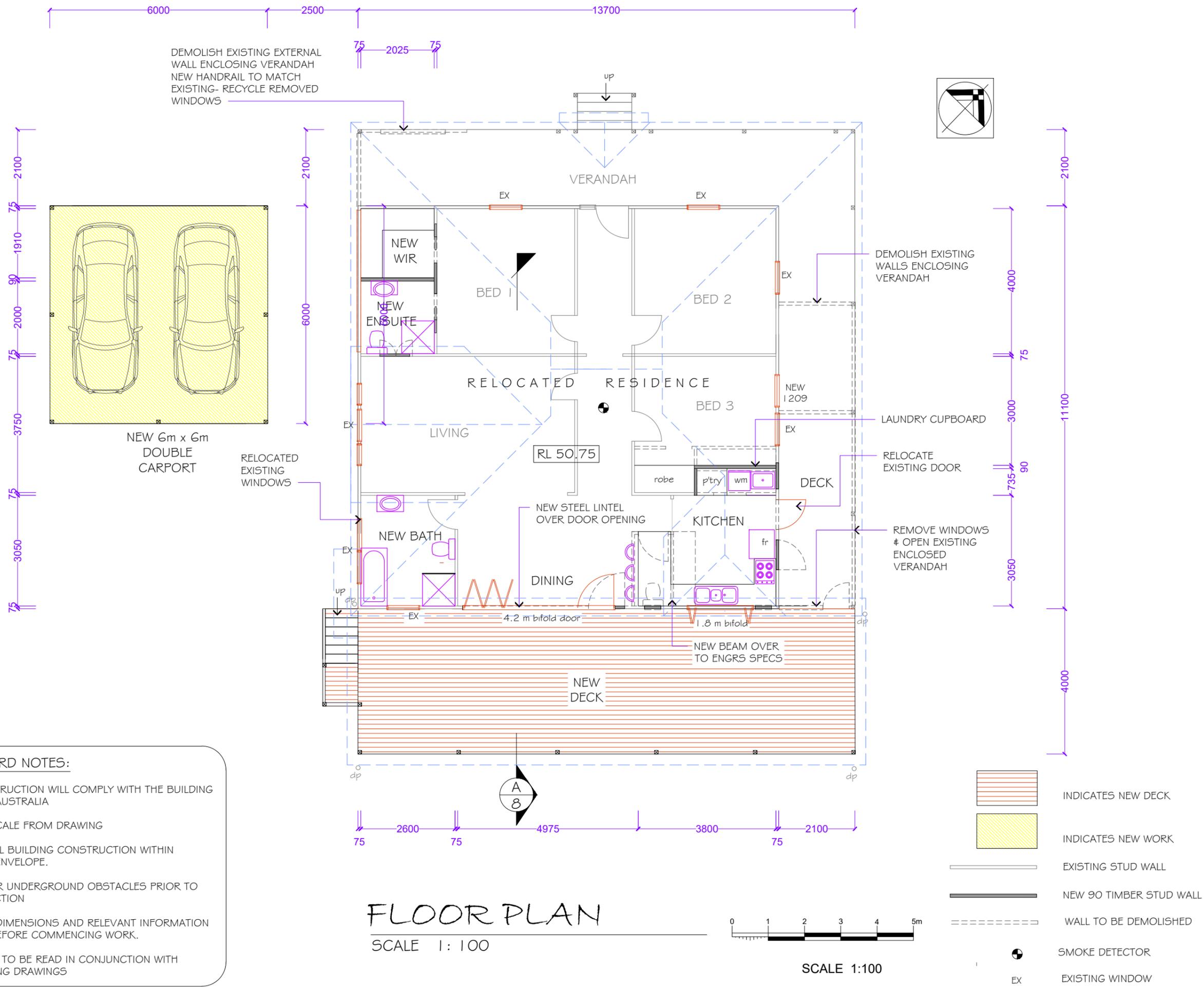


LOT 1
DP 631177
AREA 5.846 Ha

SITE PLAN
SCALE 1:2000

- Wastewater Notes:**
1. All wastewater to be treated on-site
 2. All wastewater via gravity flow to S.T.F.
 3. Install 3000L septic tank with effluent outlet filter
 4. Install constructed wetlands - 2 x 7.2m² cells in series (see detail)
 5. Install distribution box
 6. Install ETA beds - 2 x 18m x 1.2m (see detail)
 7. Beds to be laid on contour
 8. Installation to comply with AS3500 & AS1547:2012

OSMS SITE PLAN
SCALE 1:500
Trine Solutions Pty Ltd
Dated: 22/07/2019



STANDARD NOTES:

ALL CONSTRUCTION WILL COMPLY WITH THE BUILDING CODE OF AUSTRALIA

DO NOT SCALE FROM DRAWING

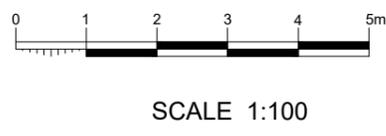
ENSURE ALL BUILDING CONSTRUCTION WITHIN BUILDING ENVELOPE.

CHECK FOR UNDERGROUND OBSTACLES PRIOR TO CONSTRUCTION

CONFIRM DIMENSIONS AND RELEVANT INFORMATION ON SITE BEFORE COMMENCING WORK.

DRAWINGS TO BE READ IN CONJUNCTION WITH ENGINEERING DRAWINGS

FLOOR PLAN
 SCALE 1:100



Byron OSMS Design Model

Version: Copy of OSMS_Design_Model_70 (Autosaved).xls

Set Defaults

STEP 1 bedrooms: 3, persons: 3

STEP 2 # bedrooms (Grp 1): 3

STEP 3 Buffer to permanent water: 100, Buffer to intermittent water: 100

STEP 4 Block size (m²): 58000

STEP 5 Daily effluent flow accord. water supply type: Reticulated supply (bore, spring, creek) 180L/p.d, Reticulated + std. water saving devices 145L/p.d, Roof water harvesting 140L/p.d, Roof water harvesting + std. water sav. 115L/p.d

STEP 6 Wastewater stream: Toilet, Bathroom, Laundry, Kitchen

STEP 7 Treatment system: Septic (primary treatment only), AWTS, Septic + single pass sandfilter (SPF), Septic + SPF, 25% septic return flow, Septic + recirculating sandfilter, Septic + reedbed

STEP 8 P soil sorption accord. soil type: "Alluvial" Soils 1 (dp, mu, my, te) 10,000 kg/ha/m, "Alluvial" Soils 2 (cr) 2,000 kg/ha/m, Red Basaltic Soils (bg, ca, co, el, ew, mb, ro, wo) 10,000 kg/ha/m, Duplex Soils (ba, bi, bu, mi, ni) 8,000 kg/ha/m, Podzol Soils (ab, bo, br, eb, fh, ki, ku, og, po, ty, wy) 1,000 kg/ha/m

STEP 9 Soil texture & structure beneath system: Gravels, Sands (Ksat > 3.0m/d), Sandy loams - weakly structured (Ksat > 3.0m/d), Sandy loams - massive (Ksat 1.4 - 3.0m/d), Loams - high/moderate structured (Ksat 1.5 - 3.0m/d), Loams - weakly structured or massive (Ksat 0.5 - 1.5m/d), Clay loams - high/mod structured (Ksat 0.5 - 1.5m/d), Clay loams - weakly structured (Ksat 0.12 - 0.5m/d), Clay loams - massive structured (Ksat 0.06 - 0.12m/d), Light clays - strongly structured (Ksat 0.12 - 0.5m/d), Light clays - moderately structured (Ksat 0.06 - 0.12m/d), Light clays - weak. structured or massive (Ksat < 0.06m/d), Med. to heavy clays - strong. struct. (Ksat 0.06-0.5m/d), Med. to heavy clays - mod. structured (Ksat < 0.06m/d), Med. to hvy clays - weak. struct. or massive (Ksat < 0.06m/d), DISPERSIVE soil (Modified Emerson Aggregate test)

STEP 10 Water Table/ Bedrock Depth (m): 3.00

STEP 11 % Effective Rainfall: Mounded bed

STEP 12 Soil texture in root zone: Coarse Sand, Fine sand, Sandy loams, Loams, Clay loams, Silt, Clay (light, med, heavy)

STEP 13 Land Application Type: SSI, ETA

STEP 14 Calculate (or Cntl- q)

STEP 15 ETA trench separation: 1.50

Final area (m²): 68

Phosphorus area (m²): 53

Water balance area (m²): 68

Water Table/ Bedrock Depth (m): 3.00

Buffer to Water Table (Bwt) (m): 0.5

Time for accumulation of P (years): 50

Water balance area (m²): 68

Specific Crop Coeff. (grass=1.00): 1.00

% Effective Rainfall: 65%

Percolation (mm/d): 27

Avg depth of root zone (m): 0.15

Avg depth bluemetal (etc) in trench below root zone (m): 0.15

Soil Moisture Holding Capacity: saturation & AWC (mm): 116.81, 30.48

Permissible percentile exceedence: 5.00%

Minimum effluent application (mm/day/m²): 7.67

Exceedence (L): 0.00000, 94.52%

ETA trench width (m): 1.20

ETA trench separation: 0.300

ETA bed separation: 0.90

Wetted depth (m): 0.50

TN% removal: 50.0%

Reed bed area (m²): 10.2

BOD target of 20mg/L is equiv. to ~68.0% TN

Current Inlet BOD conc. ~ 250 mg/L

Current Outlet BOD conc. ~ 50 mg/L

Soil texture & structure beneath system

Soil Type	Ksat (m/d)
Gravels, Sands	> 3.0
Sandy loams - weakly structured	> 3.0
Sandy loams - massive	1.4 - 3.0
Loams - high/moderate structured	1.5 - 3.0
Loams - weakly structured or massive	0.5 - 1.5
Clay loams - high/mod structured	0.5 - 1.5
Clay loams - weakly structured	0.12 - 0.5
Clay loams - massive structured	0.06 - 0.12
Light clays - strongly structured	0.12 - 0.5
Light clays - moderately structured	0.06 - 0.12
Light clays - weak. structured or massive	< 0.06
Med. to heavy clays - strong. struct.	0.06 - 0.5
Med. to heavy clays - mod. structured	< 0.06
Med. to hvy clays - weak. struct. or massive	< 0.06

Nitrogen Report

Parameter	Value
N plant uptake (kg/yr)	1.35
Total N-load	7.56 kg/yr
N load exceedence	0.00
N load percolated (kg/yr)	6.21
N released (perc+exceed.) (kg/yr)	6.21
Enviro.N limit (kg/yr)	9.97

Relocated 3-Bedroom Dwelling
163 Saddle Road Brunswick Heads