STORMWATER MANAGEMENT PLAN

Lot 542 DP1113791
Lot 53 DP836998
Lot 156 DP753202
The Bucketts Way,
Taree South

Report Prepared for:
McGlashan & Crisp

Project No. **1075**

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1.0 INTRODUCTION

Midcoast Consulting Engineers were commissioned by McGlashan & Crisp to prepare a Stormwater Management Plan for a proposed 125 lot staged subdivision at Bucketts Way, Taree South. The staging of the development is divided into the following lots:

- Stage 1: Lot 542 DP1113791
- Stage 2: Lot 156 DP753202
- Stage 3: Lot 53 DP836998

The Department of Planning issued Determination of Major Project No. 05_0038 on 5 April 2009 for the development. It is understood that a modification to the consent is to be submitted which includes a revised approach to dealing with stormwater and flooding within the development.

This report has been prepared to present the revised stormwater management plan for Stages 1 and 3. Refer to *Drainage Strategy Report For Proposed Development at Tinonee by PCB (February 2007)* for the stormwater management plan for Stage 2.

2.0 SITE DESCRIPTION

The proposed development site is generally rural in nature, being predominantly grass covered with some trees, and covers a total area of approximately 63ha (Stage 1 and 3). The site is bound by Carters Creek to the north, Bucketts Way to the south and private rural land to the east and west.

The majority of the site drains to Killawerra Creek which runs through the site generally from south to north. A small portion of the site on the eastern side of the development drains to an ephemeral stream which in turn drains to Killawerra Creek further downstream. A portion of the north-western area of the site drains via overland flow to the north to Carters Creek.

Grades across the site generally range from 0 to 10%.

Refer to *Figure 1* for the site location and layout.

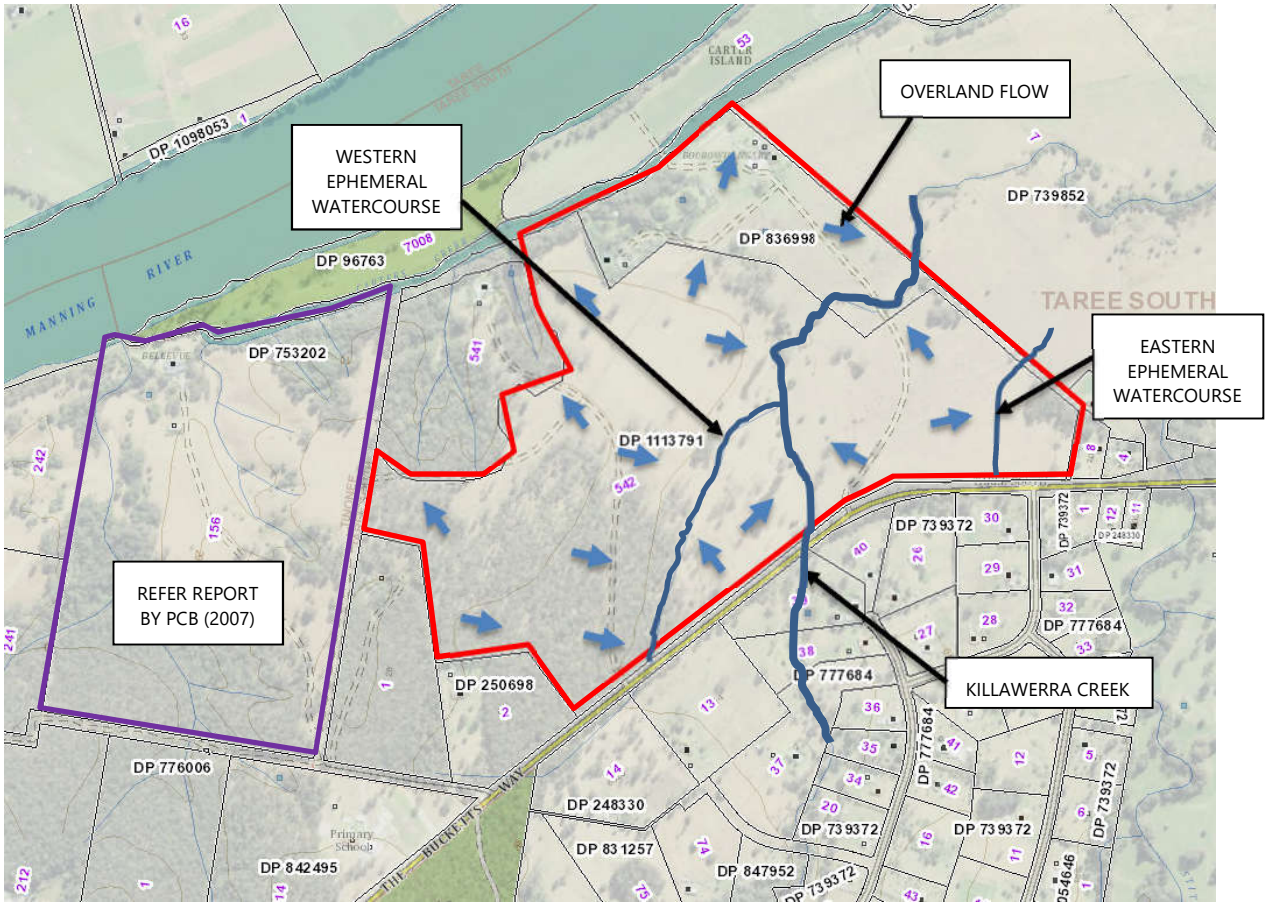


Figure 1: Site Location and Layout (SIX Viewer, Land & Property Information, NSW Government, 2019)

3.0 PROPOSED DEVELOPMENT

The proposed development for Stages 1 and 3 comprises a 101 lot rural residential subdivision. The subdivision will include:

- Lot areas generally 2000m^2 to 8000m^2
- Road construction
- Stormwater drainage infrastructure including culverts under roads
- Water Supply
- Services

The proposed development is shown in *Appendix A*.

4.0 FLOOD AND DRAINAGE STRATEGY

Refer to plan in *Appendix B* which shows the relevant sub-catchments for the subject development. This plan shows the creek alignments through the site and the 9 separate sub-catchments within the proposed development which drain to either Killawerra Creek or Manning River.

The stormwater strategy has been developed for the purposes of determining flood conveyance and water quality/quantity treatment opportunities.

4.1. Flood Conveyance

Three watercourses are present within the development site and are summarised as follows:

- Killawerra Creek – The primary watercourse through the site with a catchment of over 330Ha, primarily within State Forest.
- Western Ephemeral Watercourse – Drains into Killawerra Creek within the development site. Catchment area is approximately 20Ha upstream from the development site.
- Eastern Ephemeral Watercourse – Drains into Killawerra Creek downstream from the development site. Catchment area is approximately 12Ha and includes mainly rural residential development.

The primary flood issues within the site are due to Killawerra Creek. Killawerra Creek causes overland flooding to a significant portion of the site which is addressed in Section 5.0.

The primary flood strategies for development of the site are:

- To ensure sufficient building areas are available on each lot above the 100 year ARI flood level
- Road crossings over the creeks should ensure minimal impact on upstream flood levels

This is to be achieved primarily by use of filling for levees and filling for building platforms.

4.1. Stormwater Drainage and Treatment

Stormwater drainage for the proposed subdivision will be provided by means of a table drain and culvert system which caters for the minor event (5 year ARI), and overland flowpaths which are designed for the 100 year ARI stormwater flows.

Should on site detention be required for stormwater quantity treatment, basins will be detailed for each sub-catchment.

Water quality will be addressed by using a treatment train as specified in Section 6.0.

The design of the stormwater system will be addressed in a conceptual manner only in this report, and will be developed further as part of the detailed design for the development.

Refer to *Appendix B* for the stormwater concept plan for the proposed stormwater system for the development.

5.0 FLOODING

5.1. Manning River Floodplain

Flooding from the Manning River occurs close to or within the development site at two different levels/locations:

- Northern River Frontage: Where the site fronts the Carters Creek (effectively the Manning River during flooding) at its northern boundary, the 100 year ARI flood level is 7.05m AHD. This level of flooding does not affect the subject site.
- Killawerra Creek Backwater: Within the eastern site area, backwater from the Manning River extends up Stitts Creek and Killawerra Creek to a level of 6.47m AHD for the 100 year ARI flood. This flood level affects proposed lots 208, 209 & 210 at the eastern portion of the site.

Refer to *Figure 2* for details on the location of the flood affected areas of the site.

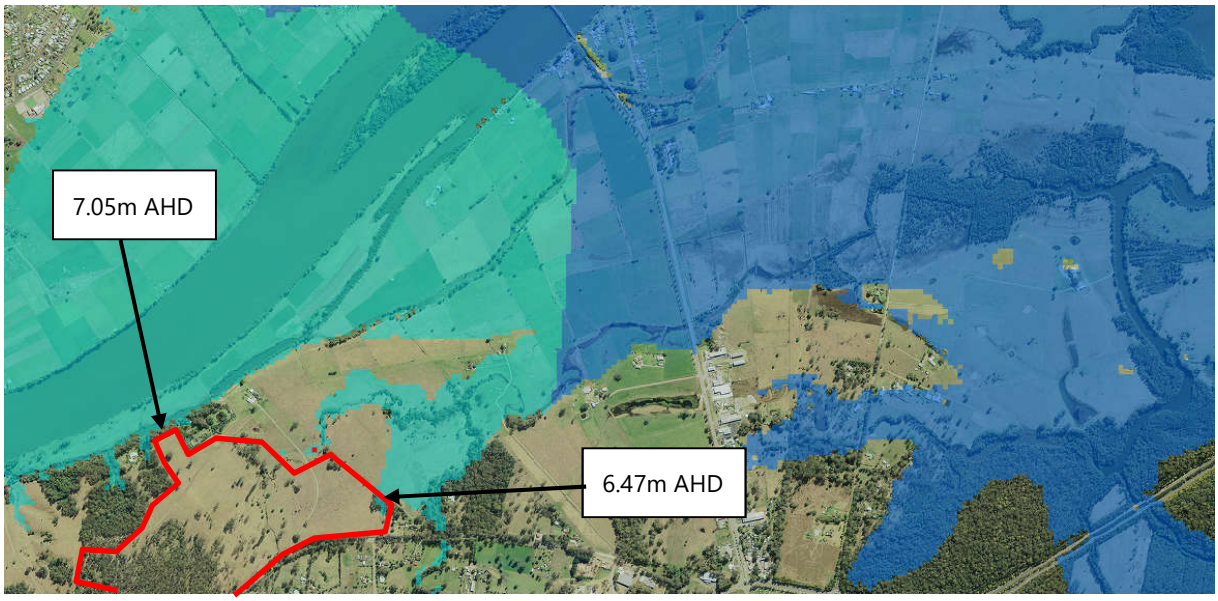


Figure 2: 100 year ARI Manning River flood levels in relation to development site

Refer to *Appendix C* for a plan showing the existing flood conditions on the site. This plan shows the localised flooding from Killawerra Creek which takes into account the flooding from the Manning River.

5.2. Localised Flooding

The existing watercourses within the development were modelled using HEC-RAS software. HEC-RAS was developed by the US Army Corps of Engineers and allows one-dimensional steady/unsteady flow calculations for flows within creeks and rivers. HEC-RAS is considered to be suitable for the analysis of the localised flooding for the subject development.

The HEC-RAS model was created by sampling the existing ground surface within AutoCAD Civil 3D. The existing ground surface was created from ALS contour data (supplied by Council) and detailed survey completed along Killawerra Creek.

Refer to *Table 1* for the modelling parameters used within the HEC-RAS model.

Table 1: HEC-RAS Modelling Parameters

Parameter	Value
Mannings 'n' for watercourses	0.035
Mannings 'n' for overbank areas	0.035
Flow simulation type	Steady Flow Analysis Mixed Flow Regime (subcritical & supercritical)

The flows within each watercourse used within the HEC-RAS model were determined from the DRAINS modelling completed as detailed in Section 7.0. The flow data used in the HEC-RAS modelling for pre and post development scenarios is shown in *Table 2*.

Table 2: HEC-RAS Flow Data

Watercourse	Location	100 year ARI Flow (m^3/s)	
		Pre-Development	Post-Development
Western Ephemeral Watercourse	Upstream site boundary	6.0	6.0
	Lot 332	6.9	7.0
	Culvert B crossing	7.4	7.5
Killawerra Creek	Upstream site boundary	47	47
	Culvert A crossing	48	49
	Confluence with Western Ephemeral Watercourse	51	51
Eastern Ephemeral Watercourse	Lot 208 upstream boundary	3.7	3.7
	Lot 209 upstream boundary	4.2	4.2
	Lot 210 upstream boundary	5.5	5.5

The boundary conditions for each watercourse are shown in *Table 3*.

Table 3: Boundary Conditions

Watercourse	Location	Boundary Condition
Western Ephemeral Watercourse	Upstream	Normal Depth: Slope = 1%
	Downstream	Normal Depth: Slope = 1%
Killawerra Creek	Upstream	Normal Depth: Slope = 1%
	Downstream	Known WS: 6.47m AHD
Eastern Ephemeral Watercourse	Upstream	Normal Depth: Slope = 1%
	Downstream	Known WS: 6.47m AHD

The downstream boundary conditions for watercourses affected by flooding from the Manning River was taken as the 100 year ARI flood level. This is a conservative approach and is considered suitable for the purposes of determining the developable land within the subject development.

5.2.1. Pre-Development Flooding

The HEC-RAS model was run for pre-development conditions to determine the flood extents and upstream flood levels for the existing site conditions.

Refer to Appendix C for the 100 year ARI pre-development flood extents.

The results show extensive flooding of the site whereby the Western Ephemeral Watercourse and Killawerra Creek combine and cause significant overland flooding.

5.2.2. Flood Mitigation (Post-Development)

Due to the extensive flooding across lower areas of the site for pre-development conditions, flood mitigation measures are required to allow the development of several lots. A HEC-RAS model was completed to determine required levee/fill levels to prevent flooding from the 100 year ARI flood. The 100 year ARI flood extents for the post- development scenario with levees/filling are shown in *Appendix D*.

It should be noted that the post-development model was completed without allowing for culverts/bridges for the road which crosses the Western Ephemeral Watercourse and Killawerra Creek. The HEC-RAS model therefore assumes that the road crossings will have no influence on the upstream flood levels. This approach has been taken so that the effects of flooding are minimised by the implementation of the road crossings.

During detailed design of the roads and earthworks for the subdivision, the road crossings should be modelled to ensure that the building envelopes on each lot upstream from the road remain flood free for the 100 year ARI event.

The following is a summary of the flood mitigation measures required:

- Building envelopes should be nominated for proposed lots 208, 209 & 210 which are above the 100 year ARI flood. Alternatively, the Eastern Ephemeral Watercourse may be realigned toward the eastern boundary subject to detailed design and re-modelling to ensure flooding in not increased on adjoining properties.
- A levee or filling of lots is required for lots 122 to 125 and lots 326 to 334. Relevant fill levels are shown in *Appendix D* which are equivalent to the 100 year ARI flood levels.
- The access road adjacent to lot 101 is to be raised to minimum levels as shown in *Appendix D*. This will allow access during flood conditions and prevent flooding of Lot 101.

The implementation of the mitigation measures for the Western Ephemeral Watercourse and Killawerra Creek as detailed above will cause an increase in flood levels at the upstream site boundary i.e. adjacent to Bucketts Way. This is discussed below:

- For the Western Ephemeral Watercourse the flood level is expected to increase by approximately 50mm which is considered to be minor and within the limitations of the modelling.
- At the upstream boundary of the site where Killawerra Creek crosses the boundary, the flood levels for the 100 year ARI are expected to increase from 11.17m (pre-development) to 11.42m AHD (post-development). The road level of Bucketts Way at this point is approximately 11.2m AHD, and the culverts under Bucketts Way are 5x 1800mm x 900mm box culverts. For a 100 year ARI flow of 47m^3/s the culverts are under capacity and it is estimated that the road will overtop by approximately 0.3m (i.e. level of 11.5m AHD). The road therefore forms the control for upstream flood levels, and the proposed filling within the subject site will not increase flooding upstream from Bucketts Way.

6.0 STORMWATER QUALITY

6.1. DCP Requirements

Councils DCP 2010, Part C Subdivision Requirements, Clause 3.5.3 states the following:

Drainage from subdivision sites should be consistent in both water quality and quantity terms with the predevelopment storm water patterns i.e., neutral or no net increase on water quality and quantity. (This clause overrules the Table 4.2 in Council's Stormwater Management Plan 2000)

6.2. Proposed Treatment Train

The proposed treatment train for each side of the development is shown in *Table 4* below.

Table 4: Proposed Treatment Train

Treatment Device	Proposed Within Development
Raintank for Roof Stormwater (5kL per lot assumed for BASIX)	Yes
Grassed Swale for road runoff conveyance	Yes (treatment only included where road grade <2%)
Vegetated Treatment Basin (bioretention or wetland)	If required

6.3. MUSIC Modelling Parameters

The proposed development was modelled within MUSIC stormwater quality modelling software. MUSIC was developed by the e-Water CRC and is a standard industry model for this purpose. MUSIC is suitable for simulating catchment areas of up to 100 km^2 and utilises a continuous simulation approach to model water quality.

The primary water quality constituents modelled in MUSIC and of relevance to this report include Gross Pollutants (GP), Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN).

The parameters used within the MUSIC model have been developed using the *NSW MUSIC Modelling Guidelines (August 2015)*.

It should be noted that grassed swales have been allowed for within the model alongside roads with longitudinal grades of <2% (Council requires that swales >2% are concrete lined). Grassed swales have also been allowed for where conveyance to creeks for the low point in the sub-catchment is required. Refer to *Appendix B* for sub-catchment boundaries.

A geotechnical investigation was undertaken by Regional Geotechnical Solutions to determine the soil classification. Refer to Appendix E for details. Refer to ***Table 5*** for the relevant soil texture parameters used in the model.

Table 5: Pervious Area Rainfall-Runoff Parameters

Soil Texture	Medium Clay
Soil Storage Capacity	94
Field Capacity	70
Infiltration Capacity co-efficient 'a'	135
Infiltration Capacity co-efficient 'b'	4.0
Daily Recharge Rate	10%
Daily Baseflow Rate	10%
Daily Deep Seepage Rate	0%

The land use modelling for determining pollutant loadings from source nodes in MUSIC was selected as follows:

- **Pre Development** conditions were modelled as *Agricultural* for the majority of the site, with some *Forested* areas used where standing trees exist and grazing is light. The NSW MUSIC Modelling Guidelines (2015) refer to land zoning RU1 to be modelled as *Quarries*, however this land use does not appear to reflect the actual site conditions which is *Rural Grazing (stocked areas)*. Therefore parameters for *Agricultural* land use were used which is in accordance with the widely accepted
- **Post Development** conditions were modelled as *Rural* in accordance with *NSW MUSIC Modelling Guidelines (2015)* (Table 5-8: Residential R5 zoning to be modelled as *Rural*). Within sub-catchment 9 the primary land use is open reserve and therefore for this area parameters for *Revegetated Land* have been adopted.

Other parameters used within each source node are detailed in Table 6. Treatment node parameters are detailed in Table 7.

Table 6: Source Node MUSIC Model Parameters

Sub-Catchment	1	2	3	4	5	6	7	8	9	10	11	12
Area (Ha)	5.9	3.6	1.5	8.0	4.7	1.5	5.1	6.0	3.0	2.2	4.2	5.8
Pre- Development Conditions												
Agricultural Land Use Area (Ha)	5.9	3.6	1.5	2.7	4.7	1.5	4.4	6	3	0.5	4.2	4.3
Forested Land Use Area (Ha)	0	0	0	5.3	0	0	0.7	0	0	1.7	0	1.5
Post- Development Conditions												
full width road length (m)	360	190	0	0	220	0	75	350	0	0	310	0
full road impervious width (m)	8	8	8	8	8	8	8	8	8	8	8	8
half width road length (m)	0	310	260	565	415	280	630	90	0	0	0	0
half road impervious width (m)	4	4	4	4	4	4	4	4	4	4	4	4
Road reserve width	20	20	20	20	20	20	20	20	20	20	20	20
Road Reserve Area (m2)	7200	6900	2600	5650	8550	2800	7800	7900	0	0	6200	0
Road Reserve impervious area	2880	2760	1040	2260	3420	1120	3120	3160	0	0	2480	0
Road Reserve - Pervious Area	4320	4140	1560	3390	5130	1680	4680	4740	0	0	3720	0
Road Reserve % impervious	40%	40%	40%	40%	40%	40%	40%	40%	0%	0%	0%	0%
number of lots	17	11	4	14	14	5	13	9	0	1	8	5
assumed impervious area per lot (m2)	500	500	500	500	500	500	500	500	500	500	500	500
Lot Area (m2)	51800	29100	12400	74350	38450	12200	43200	52100	30000	22000	35800	58000
Total Lot Impervious Area (m2)	8500	5500	2000	7000	7000	2500	6500	4500	0	500	4000	2500
Roof Area (assume 50%)(m2)	4250	2750	1000	3500	3500	1250	3250	2250	0	250	2000	1250
Other Impervious (m2)	4250	2750	1000	3500	3500	1250	3250	2250	0	250	2000	1250
Lot - Pervious Area (m2)	43300	23600	10400	67350	31450	9700	36700	47600	30000	21500	31800	55500
Lot % impervious	16%	19%	16%	9%	18%	20%	15%	9%	0%	2%	11%	4%
Roof Area - assume 100% to RWT (Ha)	0.425	0.275	0.1	0.35	0.35	0.125	0.325	0.225	0	0.025	0.2	0.125
Other Impervious Area (Ha)	0.425	0.275	0.1	0.35	0.35	0.125	0.325	0.225	0	0.025	0.2	0.125
Road Area - Impervious Only (Ha)	0.288	0.276	0.104	0.226	0.342	0.112	0.312	0.316	0	0	0.248	0
Other Pervious - road reserve & lots (Ha)	4.762	2.774	1.196	7.074	3.658	1.138	4.138	5.234	3	2.15	3.552	5.55

Table 7: Treatment Node MUSIC Model Parameters

Sub-Catchment	1	2	3	4	5	6	7	8	9	10	11	12
Rainwater Tanks												
Raintank Size (kL)	5	5	5	5	5	5	5	5	5	5	5	5
Total RWT's	17	11	4	14	14	5	13	9	0	1	8	5
Total RWT Volume (kL)	85	55	20	70	70	25	65	45	0	5	40	25
Tank Depth (m)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Total Tank Surface Area (m2)	56.67	36.67	13.33	46.67	46.67	16.67	43.33	30.00	0.00	3.33	26.67	16.67
Highflow bypass per tank (m3/s)	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Total High Flow Bypass (m3/s)	0.0850	0.0550	0.0200	0.0700	0.0700	0.0250	0.0650	0.0450	0.0000	0.0050	0.0400	0.0250
Daily External Demand per House (kL/day)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Total Daily External Demand (kL/day)	8.5	5.5	2	7	7	2.5	6.5	4.5	0	0.5	4	2.5
Total Annual External Demand, PET-Rain (kL/year)	3102.5	2007.5	730	2555	2555	912.5	2372.5	1642.5	0	182.5	1460	912.5
Daily Internal Demand per House (kL/day)	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Total Internal Demand (kL/day)	2.55	1.65	0.6	2.1	2.1	0.75	1.95	1.35	0	0.15	1.2	0.75
Swales												
Road Swale length available for treatment (m)	720	715	260	165	565	130	125	790	0	0	705	0
Swale base width (m)	0	0	0	0	0	0	0	0	0	0	0	0
Swale top width (m)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Swale Depth (m)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Vegetation height (m)	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15

6.4. MUSIC Modelling Results

The MUSIC model was analysed to determine if Neutral or Beneficial Effect (NorBE) could be achieved for the development simply using raintanks and grassed swales for stormwater quality treatment. *Table 8* shows the results of the MUSIC modelling.

Table 8: MUSIC Modelling Results (entire development)

Parameter	Pre-Development (Agricultural)	Post-Development (rural-residential)	% Reduction	Compliant with NorBE
Total Suspended Solids (kg/yr)	25500	19400	24%	Yes
Total Phosphorus (kg/yr)	106	45	58%	Yes
Total Nitrogen (kg/yr)	520	394	24%	Yes
Gross Pollutants (kg/yr)	915	680	26%	Yes

The results show that with the swale lengths available for treatment of stormwater within the development, NorBE can be easily achieved. The modelling also included a 5kL raintank on each dwelling for treatment of roof water, with standard parameters used for reuse within each dwelling and for irrigation.

No bioretention basins or wetlands are required within the development to achieve NorBE, and therefore the development will comply with Councils DCP without the use of basins.

The final layout and design should be modelled in MUSIC to determine pollutant load reductions for the detailed design of the subdivision.

7.0 STORMWATER QUANTITY

7.1. Hydrological Modelling

DRAINS software was used to model the catchment and determine the relevant flows for pre-development and post-development conditions. The ILSAX model was used within DRAINS for the hydrological modelling.

7.1.1. IFD Chart

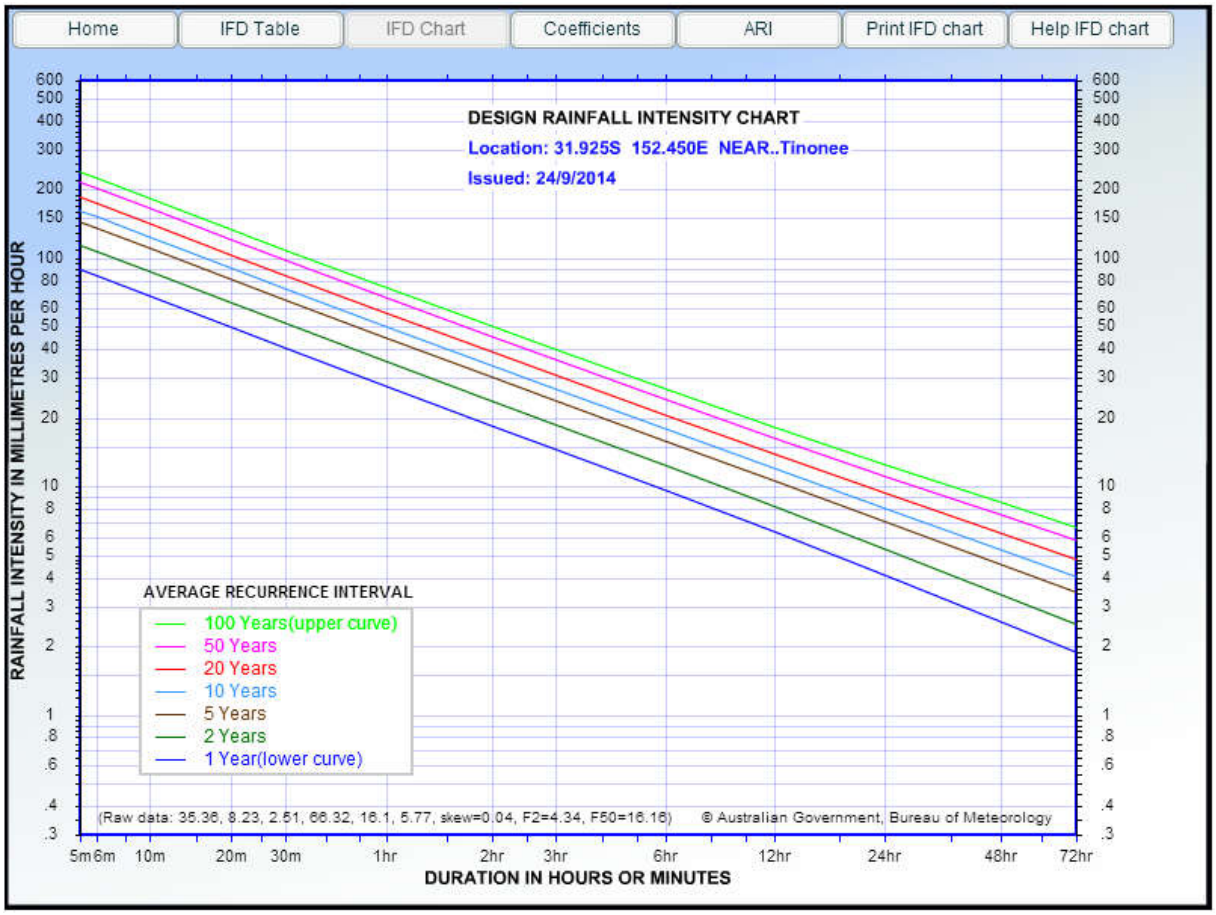


Figure 3: IFD Chart for the site (courtesy of Bureau of Meteorology)

7.1.2. DRAINS Modelling Parameters

Table 9: DRAINS modelling parameters

Parameter	Value
Paved (impervious) area depression storage	1mm
Grassed (pervious) area depression storage	5mm
Soil Type	3 (slow infiltration rates)

Hydraulic modelling was undertaken for the purposes of determining the peak flows for creeks flowing through the development and the requirement for On Site Detention (OSD) basins required to match pre-development and pre-development flows. The ILSAX model was used for these purposes.

Refer to **Figure 4** for the catchment plan which shows the various catchments draining through and within the site. The catchment has been modelled from the upper Killawerra Creek catchment area to the confluence with Stitts Creek.

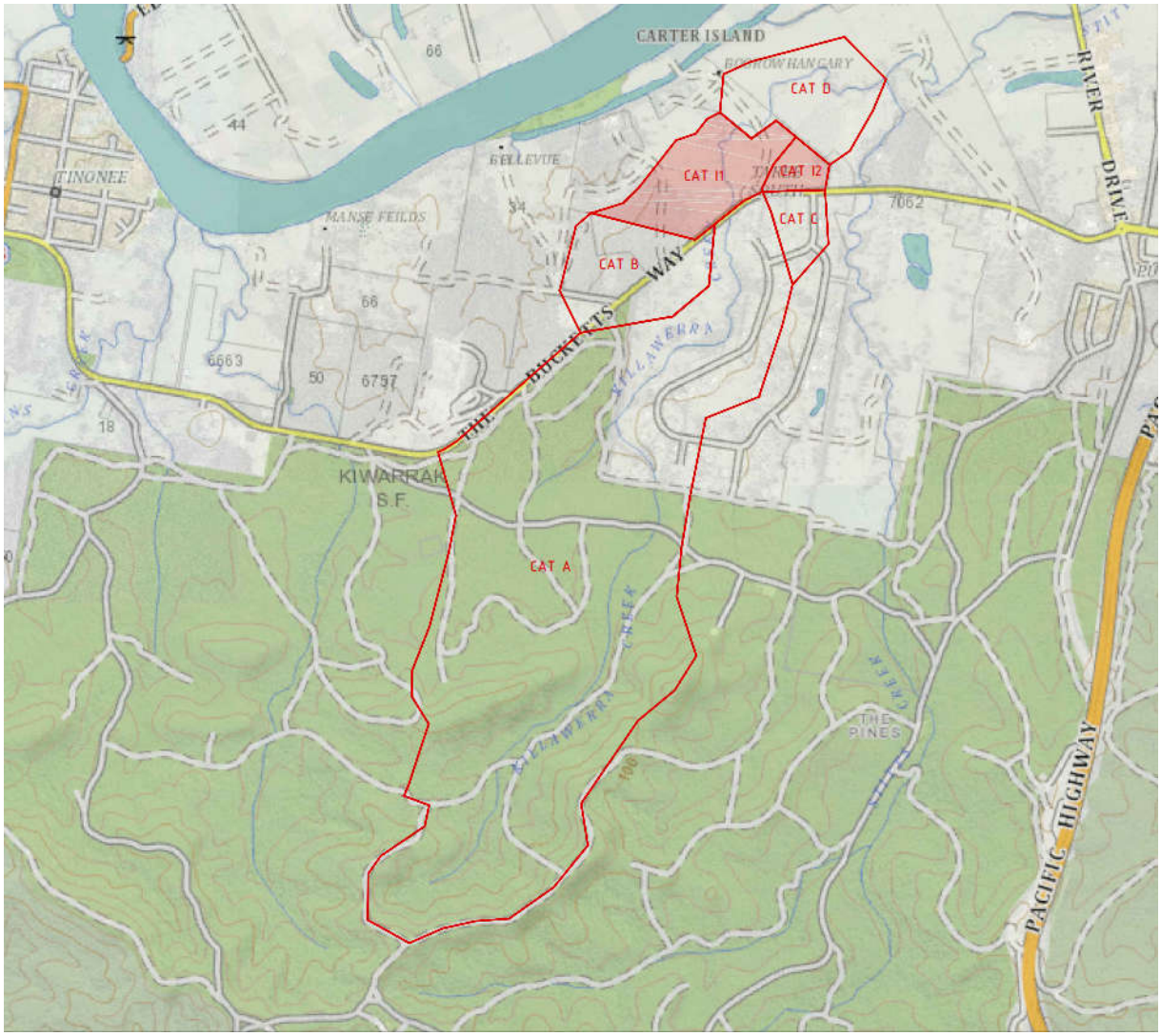


Figure 4: Catchment Plan

A summary of the catchments as shown in *Figure 4* is detailed within *Table 10*.

Table 10: Catchment Summary

CATCHMENT	AREA (Ha)	LENGTH (m)	SLOPE (%)	% IMPERVIOUS		COMMENTS
				PRE-DEV	POST-DEV	
CAT A	330.8	4100	3.0%	2%	2%	Large Killawerra Creek upstream catchment
CAT B	20	650	3.0%	5%	5%	Small upstream catchment draining through site
CAT C	12.4	470	1.7%	5%	5%	Small rural residential catchment
CAT D	30.5	800	0.5%	0%	0%	Downstream catchment to Stitts Creek confluence
CAT I1	27.7	650	1.0%	0%	12%	Internal Catchment (within subject development)
CAT I2	5.4	300	1.6%	0%	12%	Internal Catchment (within subject development)

It is noted that post development impervious areas have considered the potential for future development of the catchment. Generally upstream and adjacent to the site the development potential is limited, as upstream areas have already been developed or are within State Forest. The downstream catchments have no development potential as they are in the Manning River Floodplain where no development is permitted.

7.2. OSD Basins

It is recognised that post development flows from the development site will be higher than that of the pre development flows. However, the requirement for OSD should be assessed on the benefits it will provide to downstream waterways and downstream development.

Pre and post development flows entering Stitts Creek for several ARI were compared to determine the need for OSD. Refer to *Table 11* for the comparison.

Table 11: Peak Flows Entering Stitts Creek (m^3/s)

STORM EVENT	PRE DEVELOPMENT	POST DEVELOPMENT
1 YEAR ARI	5.9	5.9
5 YEAR ARI	22.7	22.7
20 YEAR ARI	37.3	37.2
100 YEAR ARI	57	57

Table 11 shows that the low density nature of the development does not increase peak flows significantly, and as shown by the DRAINS modelling the peak flows from the development have no effect on overall peak flows from the Killawerra Creek catchment entering Stitts Creek.

This is primarily due to the significantly higher time of concentration for Killawerra Creek compared with that of the development itself. Killawerra Creek has a catchment area of >330ha, whist the development site has a catchment of approximately 30ha. Therefore, peak flows from the development will occur while the creek is still rising and will not affect peak flows within the creek.

OSD will therefore not achieve any benefit with respect to peak flows within the creek. Also, development potential is non-existent downstream from the site as all areas downstream are within the Manning River Floodplain.

OSD is therefore not considered to be required for the site. This was agreed by Council in a meeting at Greater Taree City Council on 19 August 2015.

It is noted that there are some minor site areas to the north of catchment I1 which drain north to the Manning River. These catchments were not considered within the analysis of OSD as they will discharge directly to the Manning River floodplain which has a very large catchment, and therefore the effect of OSD on peak flows within the Manning River are insignificant.

7.3. Bridges/Culverts

As detailed in Section 5.2.2, it should be noted that the post-development model was completed without allowing for culverts/bridges for the road which crosses the Western Ephemeral Watercourse and Killawerra Creek. This will reduce the fill required within the site and will not exacerbate flooding issues on the site.

The bridges/culverts should therefore be designed for the 100 year ARI flood event (bridges would be recommended). During detailed design of the roads and earthworks for the subdivision, the road crossings should be modelled to ensure that the building envelopes on each lot upstream from the road remain flood free for the 100 year ARI event.

Alternatively, the detailed design could opt for lower capacity road crossings, however, further modelling would be required to determine the effect on upstream properties. This task should be assessed during detailed design when more information is available regarding road levels and fill available.

The peak flows for the 100 year ARI events at the road crossings are available in *Table 2*.

8.0 CONCLUSIONS

The proposed rural residential development of Lot 542 DP1113791 (Stage 1) and Lot 53 DP836998 (Stage 3) has been assessed with respect to flooding and stormwater quality/quantity. The following is a summary of the conclusions:

- The Eastern Ephemeral Watercourse may be realigned toward the eastern boundary (subject to detailed design and re-modelling) to allow for increased building area on Lots 108, 109 & 110.
- Building envelopes should be nominated for proposed lots 108, 109 & 110 which are above the 100 year ARI flood.
- A levee or overall filling of the area is required to provide flood protection to Lots 122 to 125 and Lots 133 to 141.
- Water quality treatment comprising of raintanks and grassed swales is sufficient to achieve NorBE as required by Council's DCP. No bioretention or wetland basins are required.
- No OSD is required for the development due to the minimal influence the development has on creek flows, and due to the lack of developable land downstream from the subject site.
- Culverts/bridges for the road crossings should be designed for the 100 year ARI flows. Upon design of earthworks, roads and crossings, the design should be modelled and checked to ensure all lots remain flood free during the 100 year ARI event. Alternatively, lower capacity road culvert crossings may be applicable subject to further investigation during detailed design.
- Future Development Applications for the dwellings within the subdivision will need to consider stormwater conveyance from impervious areas to avoid affecting neighbouring properties.

The stormwater and flooding for Lot 156 DP753202 (Stage 2) has been addressed in *Drainage Strategy Report For Proposed Development at Tinonee by PCB (February 2007)*. Boundaries within Stage 2 have been subject to minor amendments since the PCB report was compiled. These boundary alterations are not expected to have any impact with respect to stormwater or flooding.

APPENDIX A

Proposed Development

PROPOSED SUBDIVISION LAYOUT
OVERALL STAGE PLAN

LEGEND

- PLANT LOCATIONS OF PALE YELLOW DOUBLETAIL GROUND ORCHID LOCATED BY GREAT LAKES SURVEYS
- PROPOSED FIRETRAIL 10m WIDE
- APPROXIMATE 1:100 YEAR FLOOD LEVEL
- CREEK LINE
- DENOTES PROPOSED ASSET PROTECTION ZONES

THE MANNING RIVER

LOT 333 17.9 ha
LOT 334 3.23 ha
LOT 332 1 ha
LOT 331 3044m²
LOT 336 2420m²
LOT 329 2398m²
LOT 328 2398m²
LOT 327 2406m²
LOT 326 3408 m²
LOT 325 3864 m²
LOT 324 2579m²
LOT 323 2715m²
LOT 322 3243m²

LOT 174 2511. m²
LOT 175 2699. m²
LOT 173 2502. m²
LOT 176 2699. m²
LOT 172 2500. m²
LOT 187 2592 m²
LOT 171 2500. m²
LOT 186 2523. m²
LOT 188 2555 m²
LOT 177 2668 m²
LOT 178 2601 m²
LOT 185 2774. m²
LOT 179 2643 m²
LOT 184 3346. m²
LOT 180 3071 m²
LOT 181 2813. m²
LOT 183 3413. m²
LOT 182 3503. m²
LOT 167 3155. m²
LOT 168 3995 m²
LOT 166 4793. m²
LOT 169 2596 m²
LOT 170 2545 m²
LOT 165 2580 m²
LOT 164 2880 m²
LOT 163 4995 m²
LOT 162 8187 m²
LOT 148 2738 m²
LOT 147 2616 m²
LOT 146 2587 m²
LOT 149 2267 m²
LOT 145 2631 m²
LOT 150 3220 m²
LOT 142 3205 m²
LOT 161 5122 m²
LOT 144 6870 m²
LOT 160 3018 m²
LOT 151 4361 m²
LOT 143 5076 m²
LOT 159 3111 m²
LOT 158 3188 m²
LOT 157 4341.1 m²
LOT 152 3665.1 m²
LOT 153 4100.1 m²
LOT 154 4877 m²
LOT 156 2.26 ha
LOT 155 1.54 ha

LOT 122 2853. m²
LOT 123 3213. m²
LOT 124 4977 m²
LOT 125 3760 m²
LOT 118 2605. m²
LOT 119 2501. m²
LOT 120 2500. m²
LOT 121 2559. m²
LOT 132 2503. m²
LOT 131 2504. m²
LOT 130 2505. m²
LOT 126 2513. m²
LOT 127 2504. m²
LOT 128 2508. m²
LOT 129 2509. m²
LOT 116 2503. m²
LOT 117 3230. m²
LOT 115 2500. m²
LOT 114 2500. m²
LOT 113 2500. m²
LOT 112 2481. m²
LOT 111 2517. m²
LOT 110 6993. m²
LOT 109 4560. m²
LOT 108 5239. m²
LOT 102 2566. m²
LOT 101 3249. m²
LOT 103 2597. m²
LOT 104 2528. m²
LOT 105 2542. m²
LOT 106 2556. m²
LOT 107 2669. m²

LOT 141 2574 m²
LOT 133 2565 m²
LOT 140 3305 m²
LOT 134 3090 m²
LOT 139 3062 m²
LOT 135 3015 m²
LOT 138 3336 m²
LOT 136 3832 m²
LOT 137 5492 m²

LOT 917
LOT 920 9980 m²
LOT 919 5800 m²
LOT 921 5912 m²
LOT 918 4093 m²
LOT 922 7849m²
LOT 917 6800 m²
LOT 923 7043m²
LOT 909 4802m²
LOT 910 4790m²
LOT 911 4036m²
LOT 916 6225 m²
LOT 924 9820m²
LOT 912 4716 m²
LOT 908 4215m²
LOT 913 5541. m²
LOT 914 5901. m²
LOT 907 7066m²
LOT 915 6000 m²
LOT 925 14.46 ha
LOT 906 5484m²
LOT 905 6543m²
LOT 903 5600 m²
LOT 904 7400 m²
LOT 902 8880 m²

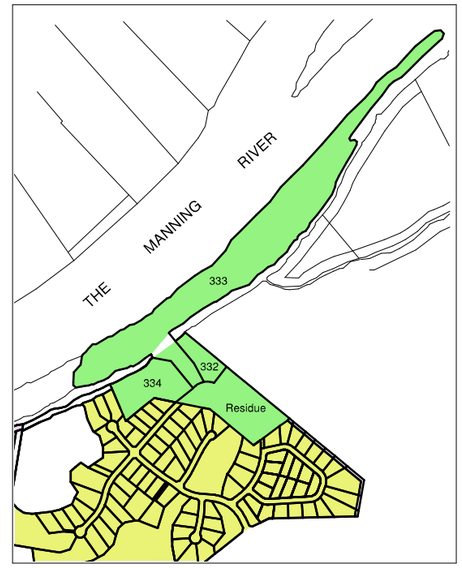
Access
Access
PROPOSED FIRE TRAIL
PROPOSED FIRE TRAIL

541
NOT INCLUDED IN PROJECT APPLICATION

LOT 189
TO BE DEDICATED TO COUNCIL AS PUBLIC RESERVE

2
DP 250698

URRAY ROAD
THE BUCKETTS WAY



NOTES:

- EACH STAGE ABOVE WILL BE REQUIRED TO PREPARE & GAIN APPROVAL FOR A CONSTRUCTION CERTIFICATE FOR ROADS, DRAINAGE, SEWER, WATER SUPPLY, COMMUNICATIONS & ELECTRICITY FOR ALL LOTS WITHIN THE STAGE.
- ALL LOTS IN EACH NOMINATED RELEASE OF A SUBDIVISION CERTIFICATE SHALL BE CONSTRUCTED IN ACCORDANCE WITH THAT RELEVANT PART OF THE CONSTRUCTION CERTIFICATE.
- THE NUMBER OF LOTS TO BE RELEASED WITHIN THE CONSTRUCTION CERTIFICATE SHALL BE NOMINATED BY THE DEVELOPER.
- ALL DIMENSIONS AND AREAS SUBJECT TO MODIFICATION APPROVAL, CIVIL DESIGN & FINAL SURVEY.

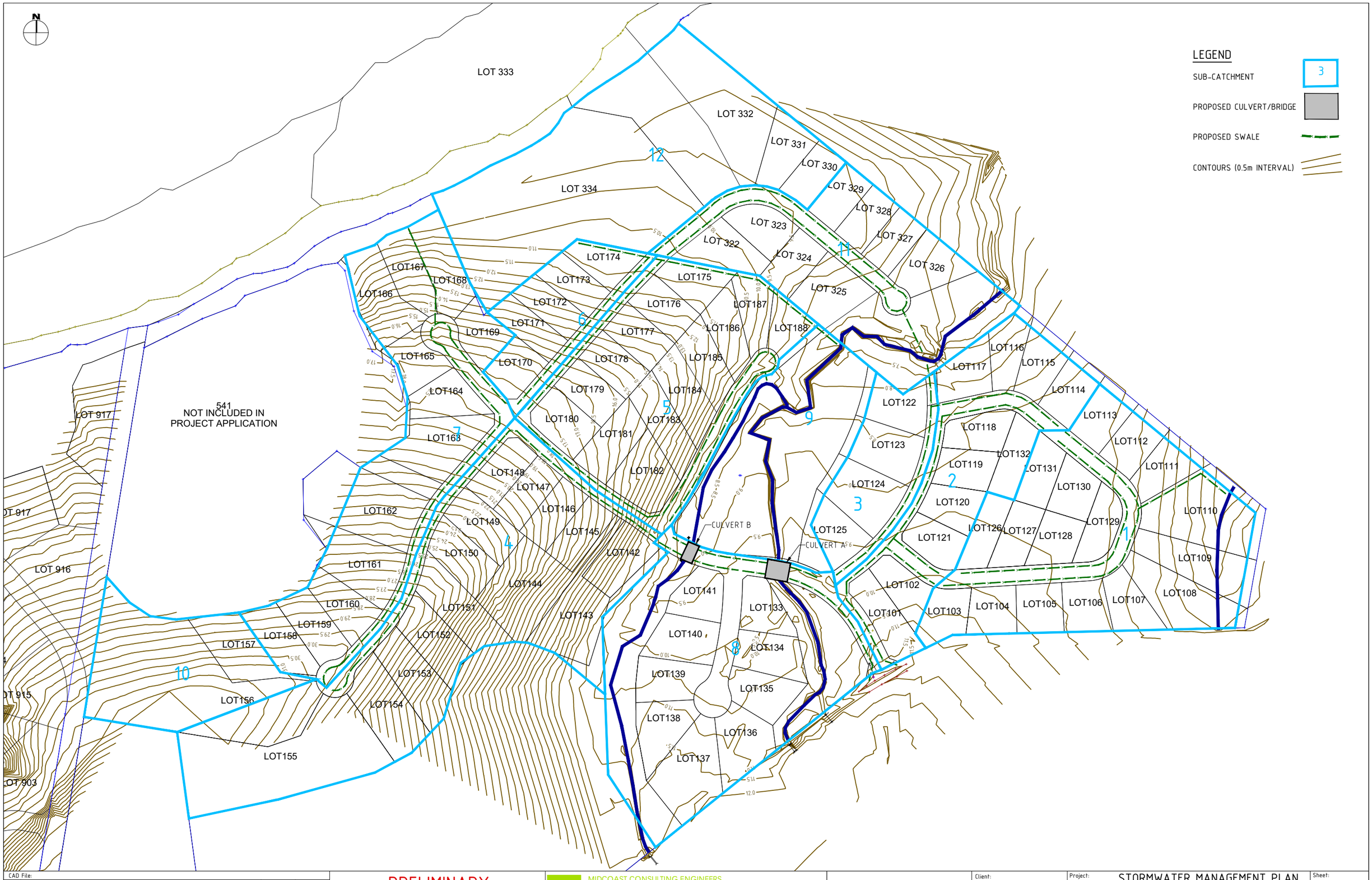
STAGE 1 - CARTERS CREEK	88 LOTS & PUBLIC RESERVE (SEE RELEASE PLAN)
STAGE 2 - R & J ILLIDGE	24 LOTS
STAGE 3 - DONNELLY	13 LOTS & PUBLIC RESERVE (FIRST RELEASE LOTS 332, 334 & 333 WITH RESIDUE)

0 40 80 120 160 200 400

REVISION	SCALE: 1:3500 @ A2	CLIENT: RTS SUPER	McGLASHAN & CRISP Pty Ltd CONSULTING SURVEYORS 117 VICTORIA STREET, TAREE 2430. Ph:02 65521566. DX 7009 Email: admin@mcglashancrisp.com.au	PLAN: PROPOSED SUBDIVISION OF LOT 156 DP753202, 542 DP1113791 AND LOT 53 DP836998 THE BUCKETTS WAY, TINONEE	REFERENCE: F57A/3513/2017
	DRAWN: GAC/LTD	DATUM: APPROXIMATE MGA & AHD	L.G.A.: MID-COAST		COMPUTER FILE: CARTERS CREEK.mjo
	DATE: 10/06/2020				

APPENDIX B

Stormwater Concept Plan



CAD File:

Rev.	Revision Description	Designed	Date

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FOR COMMENT

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Designed: B.FARR Approved:
Drafted: B.FARR Date:

Client:
RTS Super Ltd c/- Stacks Finance
1 Pulteney St
TAREE NSW 2430

Date: 28.09.20

Project: STORMWATER MANAGEMENT PLAN
6941 THE BUCKETTS WAY
TINONEE NSW

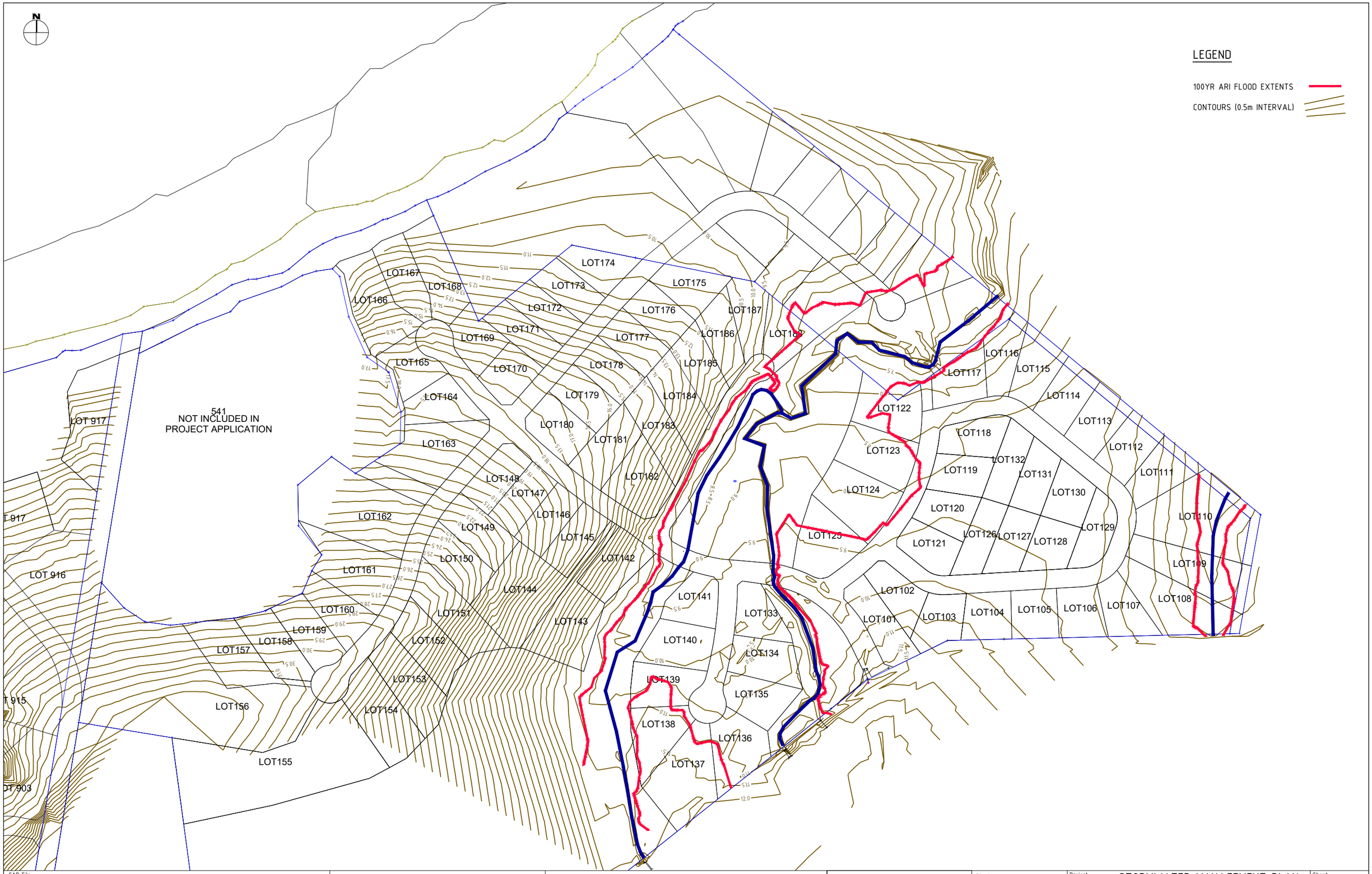
Drawing Title: STORMWATER CONCEPT PLAN

Drawing Number: 1075 -

Sheet: B
of:
Original Sheet Size: A1

APPENDIX C

Pre-Development Flood Extents



CAD File:			
Rev.	Revision Description	Designed	Date

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Designed: B.FARR Approved:
Drafted: B.FARR Date:

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RTS Super Ltd c/- Stacks Finance
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TAREE NSW 2430

Date: 28.09.20

Project: STORMWATER MANAGEMENT PLAN
6941 THE BUCKETTS WAY
TINONEE NSW

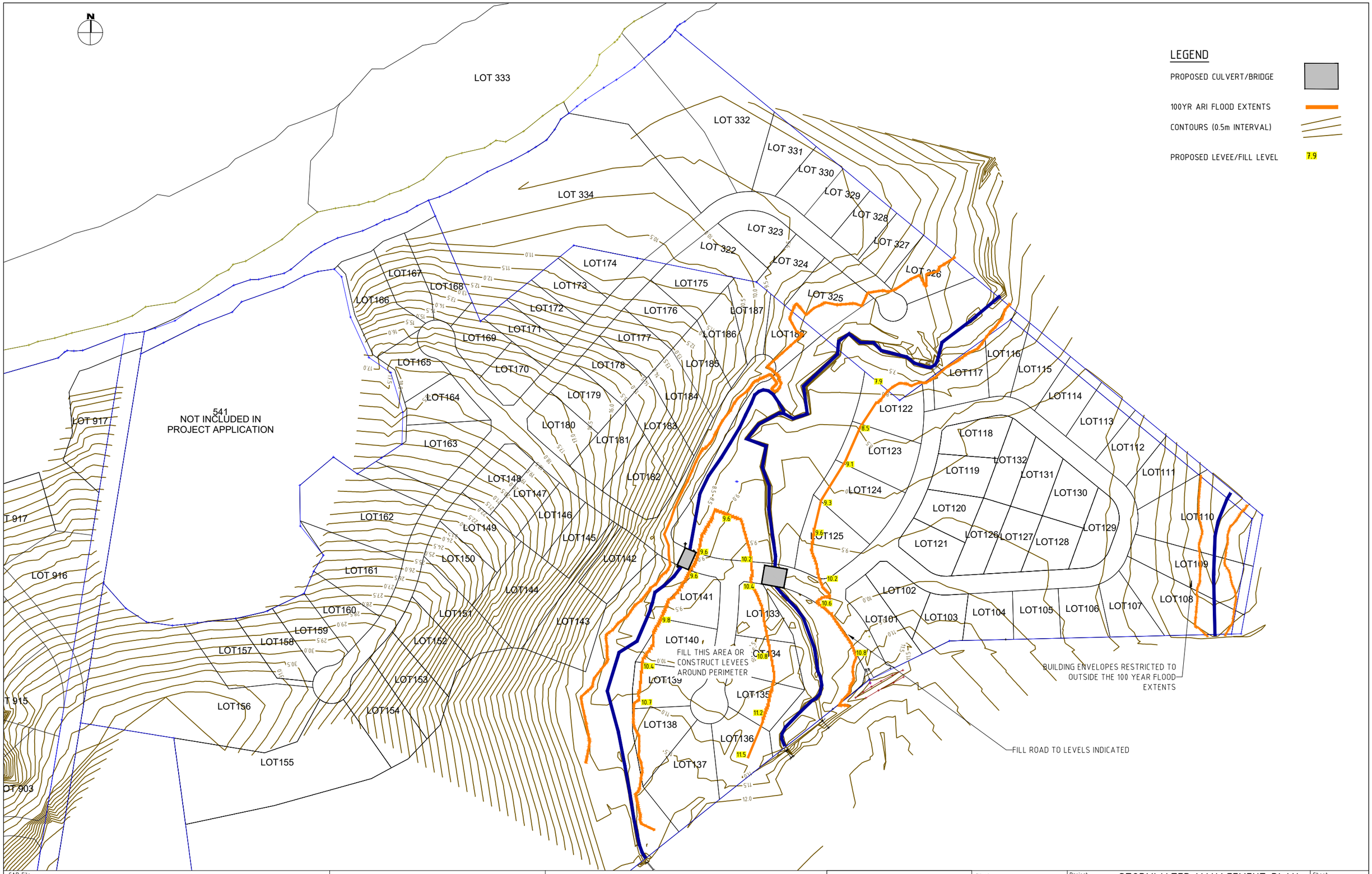
Drawing Title: PRE DEVELOPMENT FLOOD EXTENTS

Drawing Number: 1075 -

Sheet: C
of:
Original Sheet Size: A1

APPENDIX D

Post-Development Flood Extents



CAD File:

Rev.	Revision Description	Designed	Date

PRELIMINARY
FOR COMMENT

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Designed: B.FARR Approved:
Drafted: B.FARR Date:

Client:
RTS Super Ltd c/- Stacks Finance
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TAREE NSW 2430

Date: 28.09.20

Project: STORMWATER MANAGEMENT PLAN
6941 THE BUCKETTS WAY
TINONEE NSW

Drawing Title: POST DEVELOPMENT FLOOD EXTENTS

Drawing Number: 1075 -

Sheet: D
of:
Original Sheet Size: A1

APPENDIX E

Geotechnical Report

REGIONAL GEOTECHNICAL SOLUTIONS

Manning-Great Lakes
Port Macquarie
Coffs Harbour

RGS01890.1-AB

12 July 2018

PDA Planning
PO Box 468
TAREE NSW 2430

Attention: Tony Fish

Dear Tony

RE: Proposed Subdivision – 6941 The Bucketts Way, Tinonee

Soil Profiling

1 INTRODUCTION

As requested, Regional Geotechnical Solutions Pty Ltd (RGS) has undertaken subsurface investigations to log the soil profile within the proposed subdivision at 6941 The Bucketts Way, Tinonee.

It is understood that profiling of soil types across the site is required to assist with the design of stormwater management infrastructure.

The work was commissioned by Mr Tony Fish of PDA Planning.

2 METHODOLOGY

Field work involved a general site walkover and observation of the site conditions. Six boreholes were drilled at nominated locations by a 4WD mounted drilling rig and hand auger (BH1 only) to a depth of 1m below ground surface.

Borehole locations are shown on the attached Figure 1.

3 RESULTS

The soil profile encountered within the boreholes is summarised in Table 1. Borehole logs are attached.

Table 1: Summary of Infiltration Test Results

Material Unit	Material Name	Material Description	Depth to Material Layer (m)					
			BH1	BH2	BH3	BH4	BH5	BH6
1	Topsoil	Clayey or Sandy SILT, or Silty CLAY, low to medium plasticity, dark grey / brown, sand, fine grained, trace gravel, fine grained	0.2	0.15	0.2	0.3	0.2	0.3
2	Slopewash	Silty CLAY, medium plasticity, pale brown / pale grey / pale orange / grey, silt of low plasticity, some gravel, fine to medium grained, trace sand, fine to medium grained	--	0.35	--	--	0.35	--
3	Residual Soil	CLAY, high plasticity, pale brown / grey / orange, trace gravel, fine grained, trace sand, fine grained	≥1.0	≥1.0	≥1.0	≥1.0	0.9	≥1.0
4	Extremely Weathered Siltstone	SILTSTONE, pale grey / pale orange / grey, fractured	--	--	--	--	≥1.0	--

Note: ≥ Indicates that base of material layer was not encountered
-- Indicates that the material was not encountered at the test location

Groundwater was encountered in the boreholes during the limited time they remained open on the day of the field investigations.

Groundwater levels do fluctuate due to tidal influences, climatic variations or due to reasons that may not have been apparent on the day of the site investigations.

If you have any questions regarding this project, or require any additional consultations, please contact the undersigned.

For and on behalf of

Regional Geotechnical Solutions Pty Ltd

Andrew Hills

Senior Environmental Engineer

Attachments: Figure 1
Borehole Logs

REGIONAL GEOTECHNICAL SOLUTIONS	**Client:**	PDA Planning	Job No.	RGS01890.1
	Project:	Proposed Subdivision	Drawn By:	APH
			Scale:	As Shown
		6941 The Bucketts Way, Tinonee	Date:	12.07.18
	Title:	Test Location Plan	Drawing No.	**Figure 1**

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - BOREHOLE

BOREHOLE NO: BH1

CLIENT: PDA Planning | **PAGE:** 1 of 1

PROJECT NAME: Proposed Subdivision | **JOB NO:** RGS01890.1

SITE LOCATION: 6941 The Bucketts Way, Tinonee | **LOGGED BY:** CN

TEST LOCATION: See Figure 1 | **DATE:** 10/7/18

DRILL TYPE: Hand Auger | **EASTING:** | **SURFACE RL:**

BOREHOLE DIAMETER: 100 mm | **INCLINATION:** 90° | **NORTHING:** | **DATUM:** AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
HAND AUGER	Not Encountered					ML	**TOPSOIL:** Clayey SILT, low plasticity, dark grey, brown, pale brown, trace Sand fine grained, trace Gravel fine grained					TOPSOIL
							0.20m			HP	110	
						CH	**CLAY:** High plasticity, pale brown, grey		St / VSt			RESIDUAL SOIL
				0.5						HP	220	
							At 0.8m, grey, orange, pale brown		VSt	HP	220	
										HP	240	
				1.0			1.00m					
							Hole Terminated at 1.00 m					
				1.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - BOREHOLE

BOREHOLE NO: BH2

CLIENT: PDA Planning | **PAGE:** 1 of 1

PROJECT NAME: Proposed Subdivision | **JOB NO:** RGS01890.1

SITE LOCATION: 6941 The Bucketts Way, Tinonee | **LOGGED BY:** CN

TEST LOCATION: See Figure 1 | **DATE:** 10/7/18

DRILL TYPE: Toyota 4WD Mounted Drill Rig | **EASTING:** | **SURFACE RL:**

BOREHOLE DIAMETER: 100 mm | **INCLINATION:** 90° | **NORTHING:** | **DATUM:** AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
AD/TC	Not Encountered					CI	**TOPSOIL:** Silty CLAY, medium plasticity, dark grey, brown, Silt of low plasticity, trace Gravel fine grained	M > w_P				TOPSOIL
							0.15m					
						CI	**Silty CLAY:** Medium plasticity, pale brown, pale grey, pale orange, grey, Silt of low plasticity, trace to some Gravel, fine grained, trace Sand fine to medium grained					SLOPEWASH
							0.35m					
						CH	**CLAY:** High plasticity, pale brown, pale orange, grey	M > w_P	St / VSt	HP	110	RESIDUAL SOIL
				0.5						HP	220	
							At 0.7m, becoming orange, brown		VSt	HP	350	
										HP	300	
				1.0			1.00m					
							Hole Terminated at 1.00 m					
				1.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - BOREHOLE

REGIONAL GEOTECHNICAL SOLUTIONS

BOREHOLE NO: BH3
CLIENT: PDA Planning
PAGE: 1 of 1
PROJECT NAME: Proposed Subdivision
JOB NO: RGS01890.1
SITE LOCATION: 6941 The Bucketts Way, Tinonee
LOGGED BY: CN
TEST LOCATION: See Figure 1
DATE: 10/7/18

DRILL TYPE: Toyota 4WD Mounted Drill Rig **EASTING:** **SURFACE RL:**
BOREHOLE DIAMETER: 100 mm **INCLINATION:** 90° **NORTHING:** **DATUM:** AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
AD/TC	Not Encountered					CI	**TOPSOIL:** Silty CLAY, medium plasticity, dark grey, brown, Silt of low plasticity, trace Gravel fine grained	M > w_P				TOPSOIL
							0.20m			HP	110	
						CH	**CLAY:** High plasticity, orange, brown, trace Gravel fine grained	M > w_P	St			RESIDUAL SOIL
				0.5					VSt	HP	330	
										HP	380	
				1.0			1.00m			HP	420	
							Hole Terminated at 1.00 m					
				1.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - BOREHOLE

BOREHOLE NO: BH4

CLIENT: PDA Planning | **PAGE:** 1 of 1

PROJECT NAME: Proposed Subdivision | **JOB NO:** RGS01890.1

SITE LOCATION: 6941 The Bucketts Way, Tinonee | **LOGGED BY:** CN

TEST LOCATION: See Figure 1 | **DATE:** 10/7/18

DRILL TYPE: Toyota 4WD Mounted Drill Rig | **EASTING:** | **SURFACE RL:**

BOREHOLE DIAMETER: 100 mm | **INCLINATION:** 90° | **NORTHING:** | **DATUM:** AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
AD/TC	Not Encountered					CI	**TOPSOIL:** Silty CLAY, medium plasticity, dark grey, brown, SIlt of low plasticity, trace Gravel fine grained	M > w_P				TOPSOIL
							0.30m			HP	80	RESIDUAL SOIL
						CH	**CLAY:** High plasticity, orange, pale orange, pale brown, trace to some Gravel fine grained	M > w_P	F / St	HP	110	
				0.5			At 0.5m, becoming orange, brown, pale brown		VSt	HP	380	
										HP	400	
				1.0			1.00m					
							Hole Terminated at 1.00 m					
				1.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - BOREHOLE

BOREHOLE NO: BH5

CLIENT: PDA Planning | **PAGE:** 1 of 1

PROJECT NAME: Proposed Subdivision | **JOB NO:** RGS01890.1

SITE LOCATION: 6941 The Bucketts Way, Tinonee | **LOGGED BY:** CN

TEST LOCATION: See Figure 1 | **DATE:** 10/7/18

DRILL TYPE: Toyota 4WD Mounted Drill Rig | **EASTING:** | **SURFACE RL:**

BOREHOLE DIAMETER: 100 mm | **INCLINATION:** 90° | **NORTHING:** | **DATUM:** AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
AD/TC	Not Encountered					CI	**TOPSOIL:** Silty CLAY, medium plasticity, dark grey, Silt of low plasticity, trace Gravel fine grained	M > w_P				TOPSOIL
							0.20m					
						CI	**Silty CLAY:** Medium plasticity, pale grey, grey, pale brown, trace Sand fine grained, Gravel fine to medium grained		F	HP	80	SLOPEWASH
							0.35m					
						CH	**CLAY:** High plasticity, pale brown, pale orange, grey	M > w_P	St / VSt	HP	220	RESIDUAL SOIL
				0.5								
										HP	330	
							0.90m					
							SILTSTONE: Pale grey, pale orange, grey, fractured	M	H			EXTREMELY WEATHERED SILTSTONE
				1.0			1.00m					
							Hole Terminated at 1.00 m					
				1.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
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VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - BOREHOLE

REGIONAL GEOTECHNICAL SOLUTIONS

BOREHOLE NO: BH6
CLIENT: PDA Planning
PAGE: 1 of 1
PROJECT NAME: Proposed Subdivision
JOB NO: RGS01890.1
SITE LOCATION: 6941 The Bucketts Way, Tinonee
LOGGED BY: CN
TEST LOCATION: See Figure 1
DATE: 10/7/18

DRILL TYPE: Toyota 4WD Mounted Drill Rig **EASTING:** **SURFACE RL:**
BOREHOLE DIAMETER: 100 mm **INCLINATION:** 90° **NORTHING:** **DATUM:** AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
AD/TC	Not Encountered					ML	**TOPSOIL:** Sandy SILT, low plasticity, grey, dark grey, Sand fine grained, with some Gravel fine grained	M > w_P				TOPSOIL/SLOPEWASH
							0.30m			HP	80	RESIDUAL SOIL
						CH	**CLAY:** High plasticity, pale brown, pale orange, grey, trace to some Sand fine grained, trace Gravel fine grained	M > w_P	St / VSt	HP	220	
				0.5						HP	440	
							At 0.7m, orange, pale orange, grey mottling			HP	400	
				1.0			1.00m					
							Hole Terminated at 1.00 m					
				1.5								

RG LIB 1.04.3.GLB Log RG NON-CORED BOREHOLE - TEST PIT RGS01890.1 LOGS.GPJ <<DrawingFile>> 12/07/2018 10:34 8.30.004 Datgel Lab and In Situ Tool

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
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