TSA Dreamscapes

Concept Stormwater Management and Overland Flow Study:

Lots 6 and 7 DP 1203674,

484 and 488 Bringelly Road, Austral, NSW

ENVIRONMENTAL

WATER

WASTEWATER

GEOTECHNICAL

CIVIL

PROJECT MANAGEMENT

P1705935JR04V01
July 2017

Limitations Statement

The sole purpose of this report and the associated services performed by Martens & Associates Pty Ltd is to provide a Flood Study in accordance with the scope of services set out in the contract / quotation between Martens & Associates Pty Ltd and TSA Dreamscapes (hereafter known as the Client). That scope of works and services were defined by the requests of the Client, by the time and budgetary constraints imposed by the Client, and by the availability of access to the site.

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All enquiries regarding this project are to be directed to the Project Manager.

Contents

1 Introduction

1.1 Overview

Martens & Associates have been engaged to prepare a concept stormwater management plan and overland flow study to support a Development Application (DA) for a proposed residential development at 484 and 488 Bringelly Road, Austral, NSW (Lot 6 and 7, DP1203674). Refer to Attachment A for site survey.

1.2 Project Scope

Project scope and objectives are given as follows:

- Documentation of results of water quality and water quantity assessment.
- Prepare a hydrologic model (DRAINS) to determine critical storm events of 5yr ARI, 20yr ARI and 1:100ARI.
- Prepare a hydraulical model (2D/3D SMS TuFlow) for the site under existing and proposed conditions for critical storm events of 5yr ARI, 20yr ARI and 100ARI.
- Prepare relevant flood maps including flood extents, depths, levels, and hazard.
- Assess flood impacts on downstream and upstream areas due to the proposed development.

1.3 Relevant Guidelines

This report has been prepared in accordance with the following guidelines/standards and policy:

- Liverpool City Council (2003) – Stormwater *Drainage Design*
- Liverpool City Council (2005) – *Engineering Guide for Development*
- Liverpool City Council (2008) – *Development Control Plan, Part 1.1 General Controls for all Development*
- NSW Department of Infrastructure, Planning and Natural Resources (2005) - *Floodplain Development Manual*
- Liverpool City Council WSUD Technical Guidelines (2016)

- Greater Sydney Local Land Services NSW MUSIC Modelling Guidelines (GSLLS)

2 Site Description

2.1 Location and Site Description

Table 1 provides a site description summary.

Table 1: General site description.

Element	Site Details
Address	484 and 488 Bringelly Road, Austral, NSW
Lot/DP	Lot 6&7, DP1203674
Site area [1]	1.742ha
Site grading [1]	Approx 3.0%
Neighbouring development	Surrounding by rural residential and farm land, Bringelly Road to the south
Local Government Area (LGA)	Liverpool City Council (LCC)

Notes

1. Based on information provided in site survey by SDG surveyor (2015) (Attachment A).

We note the following regarding existing site condition and local upstream catchment extents:

- The site is currently occupied by a one storey residential building and an agricultural shed.
- The site is affected by a local upstream catchment of 0.4ha to the west of the site mainly consisting of rural residential land. Extent of catchment area upstream of the site is based on LIDAR contours and shown on a catchment map (P1705935PS01 by Martens & Associates).

3 Concept Stormwater Management

3.1 Stormwater Quantity Assessment

3.1.1 Pit and Pipe

A concept pit and pipe layout with preliminary sizing of pipes is provided in P1705935PS01 by Martens & Associates. Hydraulic modelling of the pit and pipe shall be completed in accordance with Liverpool City Council policy at detailed design stage. Modelling shall ensure the system has been designed for the minor storm event (1 in 5 year ARI event) and overland flows for the major storm event (up to the 1 in 100 year event).

3.1.2 Concept OSD Management

A temporary OSD tank of approximately 385 m³ volume, constructed as an underground tank located under Block B is proposed for the development. An OSD catchment plan is included in PS01-E600.

Proposed site grading and drainage design for 484-488 Bringelly Road, Austral will split the site catchments into OSD group (Catchment Post to OSD) and bypass group (Catchment Post Bypass OSD).

- OSD group (1B1 to 1B4) – all proposed residential lot area including 4 blocks roof area and landscaped area.
- Bypass group (1C1 to 1C3) – 1) road reserved area and 2) overland flow path proposed for local upslope catchment - swale along western boundary of the site and the common open space between Block C and Block D.

Detailed design of the OSD tank will be undertaken during Construction Certificate (CC) stage of the development.

3.1.3 OSD Results

The DRAINS hydrological and hydraulic modelling package was utilised to determine OSD requirements for the proposed development. Storm duration of 10 minutes and 4.5 hours were run to compare pre – development and post development site discharges for 5, 10, 20, 50 and 100 year storm events. Results indicated that flows for all durations from the post development are lower than the pre-development. Peak flows of critical storm duration of each storm event are shown in

Table **2**.

Table 2: OSD DRAINS modelling results – simultaneous discharge from site (including bypass catchments.)

Storm Event	Critical Storm Duration Results	
	Pre Developed (m^3/s)	Post Developed (m^3/s)
5 Year ARI	0.37	0.261
10 year ARI	0.431	0.292
20 year ARI	0.519	0.335
50 year ARI	0.605	0.361
100 Year ARI	0.695	0.401

3.2 Stormwater Quality Assessment

3.2.1 Water Quality Objective

To address Liverpool City Council WSUD Technical Guidelines (2016) Section 3, the development aims to use treatment train methods to achieve the water quality objectives outlined below:

- Reduce the baseline annual pollutant load for litter and vegetation larger than 5mm by 90%.
- Reduce the baseline annual pollutant load total suspended solids by 85%.
- Reduce the baseline annual pollutant load for total phosphorus by 65%.
- Reduce the baseline annual pollutant load for total nitrogen by 45%.

The percentage reduction in the post development mean annual loads are relative to the loads from the proposed development without treatment applied.

3.2.2 Modelling Methodology

3.2.2.1 Overview

The Model for Urban Stormwater Improvement Conceptualisation (*MUSIC*, Version 6.2) was utilised to evaluate treatment train effectiveness (TTE) and post development pollutant generation from the site.

Modelling has been undertaken in accordance with Liverpool City Council WSUD Technical Guidelines (2016) with the developed site based on conceptual development layout and catchment area details provided in drawing PS01-E700 of the planset, with water quality treatment devices included to achieve adopted objectives.

3.2.2.2 Approach

An iterative approach was used for post development modelling to determine appropriate types, sizes and locations of stormwater treatment devices for modelling scenarios to achieve adopted objectives.

3.2.2.3 Model Parameters

All MUSIC modelling input, source and treatment node parameters are provided in Attachment C – MUSIC Modelling Parameters. Adopted node types for each catchment are provided in the planset.

3.2.2.4 Catchment Areas

The catchment areas with details of pervious/impervious areas is provided in the planset.

3.2.3 Treatment Train Philosophy

The stormwater treatment strategy for the site uses at source controls to ensure treatment objectives are satisfied. Individual stormwater quality improvement devices (SQIDs) are outlined in the following sections.

3.2.3.1 Rainwater Tanks

Two 20 kL rainwater tanks shall be included to capture roof water from Block B and D for reuse in landscape irrigation. In accordance with Liverpool City Council WSUD (2016):

- Outdoor irrigation reuse was estimated assuming an annual irrigation rate of 200L/m^2/year for pervious areas, scaled by the PET – Rain. The results are shown in Table 3.

Table 3: Annual Demand for Outdoor Irrigation

Block	Total Pervious Area (m^2)	Irrigation Rate (L/yr)	Annual Reuse Rate (kL/yr)
A & B	2252.57	450.51	450.51
C & D	1563.57	312.71	312.71

- As per Liverpool City Council WSUD Technical Guidelines, 50% of the total roof area was assumed to drain to rainwater tanks.

3.2.3.2 *Stormwater360: Enviropods*

All residential lot ground surfaces shall be diverted to a propriety Stormwater360 GPT device to capture litter, debris and other pollutants. A high flow bypass parameter of 20 L/s per unit has been applied as per manufacturer's specifications. Enviropods are to be placed to treat runoff entering all surface drain on the site.

3.2.3.3 *Stormwater360: Stormfilter Chamber*

Stormwater360 PSorb Stormfilter devices provide a reduction in pollutant loads through propriety media filtration. The Stormfilter Chamber is located under Block B, contained within the OSD structure. A summary of Stormfilter treatment system specifications is provided in Table 4.

Table 4: Summary of Stormfilter treatment.

Tank Filter Area (m^2)	No. of Cartridges	High flow Bypass (m^3/s)	Low Flow Pipe Ø (mm)
29.8[1]	16	0.00736	69

1. Total tank surface area minus the total Stormfilter Cartridge surface area

3.2.4 MUSIC Results

Results extracted from MUSIC model P1705935MUS01V02 are provided in Table 5.

Table 5: MUSIC Treatment Train Effectiveness results.

Parameter	Sources	Residual Load	Achieved Reduction	Required Reduction	Complies (Y/N)
TSS (kg/year)	581	85.9	85.2	85%	Y
TP (kg/year)	1.46	0.482	66.9	65%	Y
TN (kg/year)	15.7	7.82	50.3	45%	Y
GP (kg/year)	201	0	100	90%	Y

3.2.5 Conclusions

The results indicate that post development water quality objectives will be met by the proposed treatment train. The proposed management system is consistent with the principles of Water Sensitive Urban Design (WSUD) as it uses 'at source' controls and a treatment train rather than relying solely on end of line structures. This approach is considered the most appropriate for the site and will provide an acceptable outcome for receiving environments.

Further refinement of the model at detailed design stage may alter the sizes and locations of proposed treatment structures; however

performance outcomes of final design are to achieve specification provided in this report. The acceptable treatment train solution for the site is:

- Two 20 kL rainwater tanks shall be included to capture roof water from Block B and D for reuse in landscape irrigation.
- Runoff from all proposed residential lot ground surface areas to be directed to Enviropod treatment system.
- Outflow from rainwater tanks & drainage from Enviropods to be treated by Stormfilters.
- The temporary water quality treatment structure will reach the water quality targets outlined in Liverpool City Council WSUD Technical Guidelines (2016) Section 3, until the completion of the regional basin.

4 Overland Flow Study

4.1 Hydrological Model

4.1.1 Overview

The site has a local upstream catchment of 3.37ha to the western side of the site. A swale has been proposed to convey the flow safely across the site for up to 100yr ARI storm event. DRAINS modelling has been used to determine the critical storm events for 5yr, 20yr and 100yrARI storm, and to size the swale.

4.1.2 Modelling Setup

ILSAX parameters used in the model are provided in Table 6. ILSAX parameters and rainfall data were based on BCC (2008) *Engineering Guide for Developments*.

Table 6: Rainfall data and soil properties used in RAFTS modelling.

Parameter	Element	Value
IFD data [1]	2 year 1 hour rainfall intensity (mm/h)	30.7
	2 year 12 hour rainfall intensity (mm/h)	6.23
	2 year 72 hour rainfall intensity (mm/h)	1.88
	50 year 1 hour rainfall intensity (mm/h)	59.7
	50 year 12 hour rainfall intensity (mm/h)	12.3
	50 year 72 hour rainfall intensity (mm/h)	4.02
	Skew (G)	0.00
	F2	4.29
	F50	15.8
ILSAX properties	Soil type - Normal	3.0
	Paved (Impervious) Area Depression Storage	1
	Supplementary Area Depression Storage	1
	Grassed (Pervious) Area Depression Storage	5

Notes

1. Obtained from IFD table, Australian Bureau of Meteorology.

Table 7: Catchment details.

Parameter	Upstream catchment
Catchment area (ha)	0.399
Impervious area (% of total) [1]	25
Sub-catchment slope (%) [2]	3.8

Notes

1. Based on Nearmap Aerial (accessed 2017).
2. Based on contours on Lidar (accessed 2017).

4.1.3 Modelling Results

4.1.3.1 Critical Stroms

Peak flow rate results for all storm events up to 270 minutes obtained from Drains modelling are provided in Table 8 for 5yr, 20yr and 100yr ARI storm events.

Table 8: 5yr, 20yr and 100 yr ARI peak flow rates.

Duration (min)	Peak Flow (mm/hr)		
	100yr ARI	20yr ARI	5yr ARI
5	0.326	0.192	0.104
10	0.493	0.302	0.172
15	0.585	0.364	0.211
20	0.651	0.405	0.241
25	0.697	0.434	0.256
30	0.729	0.452	0.268
45	0.732	0.481	0.295
60	**0.738[1]**	**0.493[1]**	**0.303[1]**
90	0.689	0.455	0.282
120	0.635	0.442	0.274
180	0.494	0.356	0.224
270	0.473	0.333	0.192

Notes

1. Peak flow rates for critical storm event duration.

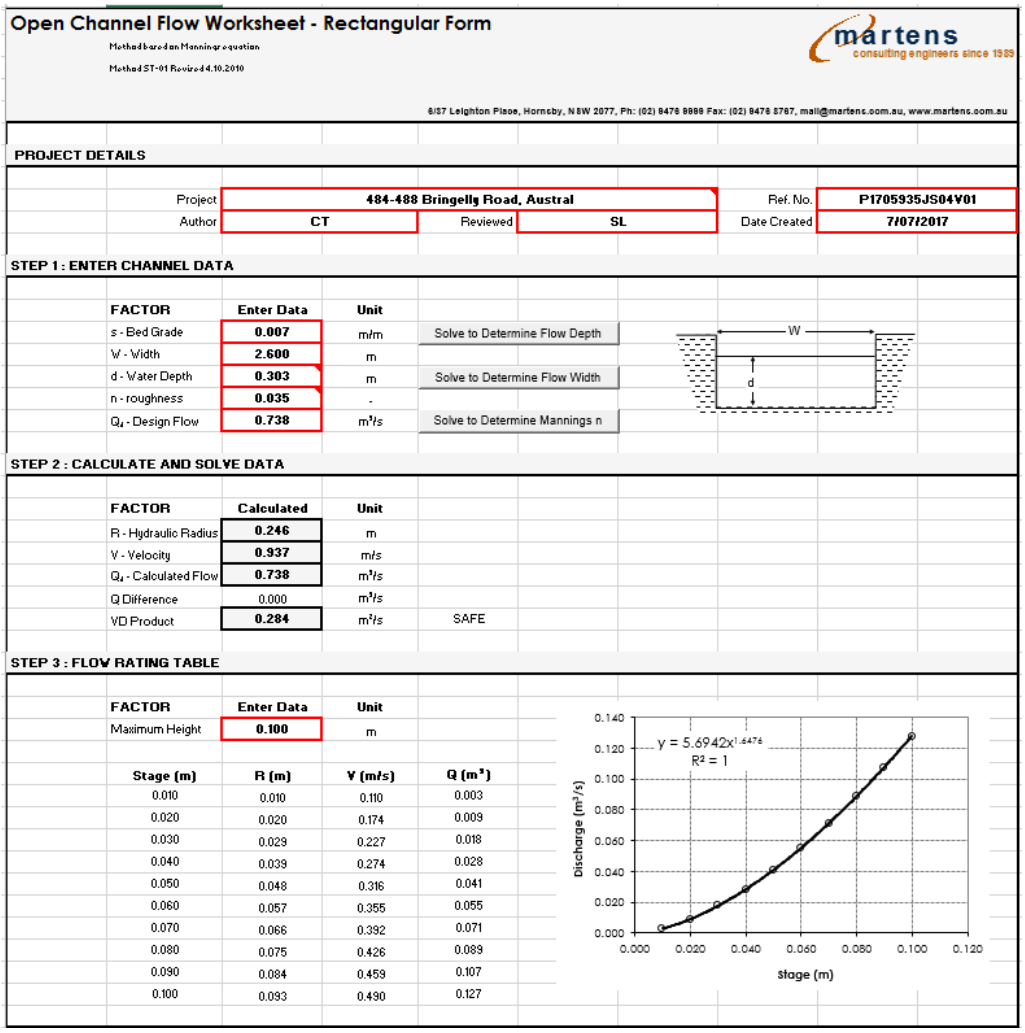
The critical storm event are all 60 minutes storms for 5yr, 20yr and 100yr ARI.

4.1.3.2 Swale sizing

The swale along western boundary of the site is proposed to be a flat base 2.6m wide swale with 0.7% gradient between Block C and D. By adopting the peak flow of 100yr ARI critical storm, the maximum water

depth of the proposed swale along the western boundary is 0.30m and the VD product is 0.28m²/s, which is safe for pedestrians (Figure 1).

Figure 1 : Swale sizing spreadsheet



Open Channel Flow Worksheet - Rectangular Form

Method based on Manning equation

Method ST-01 Revised 4.10.2010

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PROJECT DETAILS

Project	484-488 Bringelly Road, Austral			Ref. No.	P1705935JS04V01
Author	CT	Reviewed	SL	Date Created	7/07/2017

STEP 1 : ENTER CHANNEL DATA

FACTOR	Enter Data	Unit	
s - Bed Grade	0.007	m/m	Solve to Determine Flow Depth
W - Width	2.600	m	
d - Water Depth	0.303	m	Solve to Determine Flow Width
n - roughness	0.035	-	
Q_d - Design Flow	0.738	m³/s	Solve to Determine Mannings n

STEP 2 : CALCULATE AND SOLVE DATA

FACTOR	Calculated	Unit	
R - Hydraulic Radius	0.246	m	
V - Velocity	0.937	m/s	
Q_d - Calculated Flow	0.738	m³/s	
Q Difference	0.000	m³/s	
VD Product	0.284	m²/s	SAFE

STEP 3 : FLOW RATING TABLE

FACTOR	Enter Data	Unit
Maximum Height	0.100	m

Stage (m)	R (m)	V (m/s)	Q (m³)
0.010	0.010	0.110	0.003
0.020	0.020	0.174	0.009
0.030	0.029	0.227	0.018
0.040	0.039	0.274	0.028
0.050	0.048	0.316	0.041
0.060	0.057	0.355	0.055
0.070	0.066	0.392	0.071
0.080	0.075	0.426	0.089
0.090	0.084	0.459	0.107
0.100	0.093	0.490	0.127

The swale conveys overland flow from the entire upstream of the site to the common open space between Block C and D, and to the proposed road, which links to the main road to the north of the site.

4.2 Hydraulic Model

4.2.1 Overview

The SMS Tuflow 1D/2D hydraulic model was used to determine overland flow characteristics including flood extents, levels, depth and impact on neighbouring properties for the 5yr ARI, 20yr ARI and 100yr ARI storm event for existing and proposed conditions.

4.2.2 Modelling Parameters

4.2.2.1 Terrain Data

The following terrain data was used to create the 3D surface in the hydraulic model:

- Detailed site survey DTM data provided by SDG Surveys (Attachment A).
- Topographic contours based on LIDAR data (accessed 2017).

4.2.2.2 Roughness Data

Manning's roughness coefficients used in hydraulic modelling are provided in Table 9 and were assigned based on recent aerial photography sourced from Nearmap.

Table 9: Manning's roughness values for Tuflow modelling.

Surface Type	Adopted Manning's Roughness
Roads	0.015
Grass	0.035
Water	Roughness by depth[1]
Building	0.1

Notes

1. Use manning of 0.04 for 0m depth, manning of 0.01 for 0.1m depth and interpolate. Also include an initial hydrologic loss of 12.5 and continuing hydrologic losses of 6.5.

4.2.2.3 Model extent

The model area has included upstream and downstream of the site to allow for flows from the full existing upstream catchment and ensure localised flow nuances associated with model boundary conditions are located away from the site.

4.2.2.4 Rainfall data

According to the critical 60 minutes storm event determined by DRAINS model, the rainfall data inputted into Tuflow are listed in Table 10 below:

Table 10: 100 year ARI peak flow rates.

Time (min)	Rainfall intensity (mm/hr)		
	100yr ARI	20yr ARI	5yr ARI
0	0	0	0
5	34.06	23.87	18.44
10	57.82	42.84	33.1
15	127.51	102.82	79.43
20	91.87	73.44	56.74
25	171.86	141.98	109.69
30	79.2	61.81	47.75
35	71.28	54.47	42.08
40	47.52	34.88	26.95
45	41.18	29.38	22.69
50	27.72	18.97	14.66
55	23.76	15.91	12.29
60	18.22	11.63	8.98

4.2.3 Modelling Setup

4.2.3.1 Existing Condition

The existing condition Tuflow model consisted of:

- 1.0 m x 1.0 m topographic grid based on survey and Lidar data.
- Direct rainfall method was utilised by adopting the rainfall data of critical storm event in DRAINS.
- Flow obstructions, such as impermeable buildings, were modelled as inactive cells in the model domain.

4.2.3.2 Proposed Condition

- The existing 1.0m x 1.0m topographic grid was modified using a 12D tin based on proposed site grading.
- Model domain was not changed from the existing condition.
- Flow obstructions, such as impermeable buildings, were modelled as inactive cells in the model domain.
- All pits and pipes were assumed to be 100% blocked for modelling purposes.

- Manning coefficients were assigned based on values provided in Table 9

4.2.4 Modelling Results

The flood result map including 5yr, 20yr and 100yr ARI flood level, depth, and hazard for the existing and proposed condition are provided in Attachment B.

4.2.5 Summary

We note the following:

- Existing overland flows from adjoining properties has been managed through the site by accommodating flow into proposed swale along the western boundary, common space between Block C and D and road (refer to civil plans P1705935PS01 by Martens for detail).

- Flood hazard mapping shows that hydraulic hazard of the 100yr ARI overland flows across the entire site and the streets to the north and south of the site is generally safe being <0.4m^2/s.

- Tuflow results indicated that no significant adverse impacts to upstream or downstream properties were observed due to the proposed development for the storm event analysis. The proposal will likely have a negligible impact in terms of overland flows in the local catchment.

5 References

Australian Standard 3500.3 (2006) *Plumbing and drainage - Stormwater drainage*

Australian Rainfall and Runoff (2006)

Austroads (2010) *Guide to Road Design, Part 5: Drainage Design*

Liverpool City Council (2003) – Stormwater *Drainage Design*

Liverpool City Council (2005) – *Engineering Guide for Development*

Liverpool City Council (2008) – *Development Control Plan, Part 1.1 General Controls for all Development*

Liverpool City Council WSUD Technical Guidelines (2016)

Greater Sydney Local Land Services (GSLLS) (2015) NSW MUSIC Modelling Guidelines.

NSW Department of Infrastructure, Planning and Natural Resources (2005) - *Floodplain Development Manual*

NSW Department of Infrastructure, Planning and Natural Resources (2005), *Floodplain Development Manual, The Management of Flood Liable Land*

6 Attachment A – Site Survey Details

MGA

ROAD

BRINGELLY

SINGLE STOREY
FIBRO RESIDENCE
No. 488

DP 1203674

8°14'50"
169.205

METAL AWNING
GARAGE

AVIARY

METAL
AWNING

CONCRETE

FIBRO
SHED

DOG KENNEL

BRICK
BUILDING

AWNING AND CONCRETE

PAVEMENT

PORCH
FL 81.50

PORCH

AVIARY

FIBRO
SHED

DOG KENNEL

METAL
SHED

THICK
HEDGE

6
DP 1203674
8713 m² (Calc)

POND

CACTUS

TOTAL AREA
CALC = 1.74 Hectares

Stormwater Pit:
Grate RL82.07
Invert RL80.46

Stormwater Pit:
Grate RL80.50
Invert RL78.94

Stormwater Pit:
Grate RL79.10
Invert RL77.50

BENCHMARK
NAIL IN KERB
RL80.61 A.H.D.

METAL AWNING
AND CONCRETE
GARAGE

METAL
GARAGE

METAL
SHED

FL 79.32

DOG
KENNEL

7
DP 1203674
8708 m² (Calc)

277°47'45"
44.515

269°43"
7.115

167.46
188°14'50"

103.2
98°13'50"

SINGLE STOREY
BRICK RESIDENCE
No. 484

DP 2475

1127

1128

SEE SHEET 2 FOR TREE TABLE

GENERAL NOTES:-

1. THIS SURVEY IS NOT A 'LAND SURVEY' AS DEFINED BY THE SURVEYING AND SPATIAL INFORMATION ACT, 2002.
2. THE BOUNDARIES OF THE LAND HAVE NOT BEEN SURVEYED. THE RELATIONSHIP BETWEEN THE BOUNDARIES SHOWN AND FEATURES SURVEYED ARE APPROXIMATE AND SUITABLE FOR PLOTTING PURPOSES ONLY.
3. ONLY THOSE SERVICES VISIBLE AT THE TIME OF SURVEY HAVE BEEN LOCATED AND ARE QUALITY LEVEL A AS DEFINED BY AS 5488-2013.
4. NO UNDERGROUND SURVEY SEARCH HAS BEEN UNDERTAKEN. THERE MAY BE ADDITIONAL SERVICES WITHIN THE SURVEY AREA.
5. ONLY TREES GREATER THAN 3.5 METRES IN HEIGHT ARE SHOWN ON THIS PLAN AND THEIR POSITIONS AREA DIAGRAMMATIC ONLY AND MAY REQUIRE ADDITIONAL SURVEY WHERE CRITICAL TO DESIGN.
6. CONTOURS ARE INDICATIVE AT GROUND FORM ONLY. SPOT LEVELS ONLY SHOULD BE USED FOR CALCULATIONS OF QUANTITIES WITH CAUTION.
7. CONTOUR INTERVAL 0.5 m.
8. ALL SETOUT LEVELS MUST BE REFERRED TO THE BENCH MARK.
9. THE ORIGIN OF AHD COMES FROM GPS AND IS BASED ON CORSNET DATA PROVIDED BY LPI NSW.
10. THE ORIENTATION OF THIS PLAN IS MGA NORTH AS DETERMINED FROM DP 1203674. THE VARIATION FROM MGA NORTH TO TRUE NORTH IS APPROXIMATELY 1°06'.
11. LOT 6 IN DP 1203674 IS AFFECTED BY:
    * COVENANT (H30461)
12. LOT 7 IN DP 1203674 IS AFFECTED BY:
    * COVENANT (H30461)
13. COVENANTS AND RESTRICTIONS NOTED ON THE TITLE HAVE NOT BEEN INVESTIGATED.

LEGEND:-

VC denotes VEHICLE CROSSING
TK denotes TOP OF KERB
COM denotes COMMUNICATIONS PIT
PP denotes POWER POLE
LP denotes LIGHT POLE
SWP denotes STORMWATER PIT
SL denotes SURFACE LEVEL
IL denotes INVERT LEVEL
FL denotes FLOOR LEVEL
US denotes UNKNOWN SERVICES
D:S:H denote DIAMETER, SPREAD and HEIGHT of TREE

2 4 6 8 10 20 30
1:300

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ISSUE	DATE	AMENDMENT
A	05/04/17	ORIGINAL ISSUE
B	01/05/17	MGA COORDINATES

CLIENT:
DREAMSCAPES ARCHITECTS PTY LTD

SCALE 1:300
ORIGIN OF LEVELS: PM 178462 RL 70.537
DATUM: A.H.D

REF.: 7317
DATE: 01/05/2017
SURV/CHK: SY/PD
SHEET 1 OF 2 SHEETS

PLAN A1
ISSUE B

DETAIL AND LEVEL SURVEY OF LOT 6 IN DP1203674
& LOT 7 IN DP1203674
484 & 488 BRINGELLY ROAD
AUSTRAL

SDG LAND DEVELOPMENT SOLUTIONS
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7 Attachment B – Flood Modelling Results

PROJECT: RESIDENTIAL FLAT BUILDING DEVELOPMENT

PLANSET: OVERLAND FLOW STUDY

CLIENT: TSA DREAMSCAPES

DRAWING LIST		
DWG NO.	REV	DWG TITLE
GENERAL		
PS03-A000	A	COVER SHEET
FLOODING		
PS03-K100	A	EXISTING 5YR ARI WATER DEPTH (M)
PS03-K101	A	EXISTING 5YR ARI WATER LEVEL (MAHD)
PS03-K102	A	EXISTING 5YR ARI VELOCITY DEPTH PRODUCT (M^2/S)
PS03-K103	A	EXISTING 20YR ARI WATER DEPTH (M)
PS03-K104	A	EXISTING 20YR ARI WATER LEVEL (MAHD)
PS03-K105	A	EXISTING 20YR ARI VELOCITY DEPTH PRODUCT (M^2/S)
PS03-K106	A	EXISTING 100YR ARI WATER DEPTH (M)
PS03-K107	A	EXISTING 100YR ARI WATER LEVEL (MAHD)
PS03-K108	A	EXISTING 100YR ARI VELOCITY DEPTH PRODUCT (M^2/S)
PS03-K200	A	PROPOSED 5YR ARI WATER DEPTH (M)
PS03-K201	A	PROPOSED 5YR ARI WATER LEVEL (MAHD)
PS03-K202	A	PROPOSED 5YR ARI VELOCITY DEPTH PRODUCT (M^2/S)
PS03-K203	A	PROPOSED 20YR ARI WATER DEPTH (M)
PS03-K204	A	PROPOSED 20YR ARI WATER LEVEL (MAHD)
PS03-K205	A	PROPOSED 20YR ARI VELOCITY DEPTH PRODUCT (M^2/S)
PS03-K206	A	PROPOSED 100YR ARI WATER DEPTH (M)
PS03-K207	A	PROPOSED 100YR ARI WATER LEVEL (MAHD)
PS03-K208	A	PROPOSED 100YR ARI VELOCITY DEPTH PRODUCT (M^2/S)

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NOT TO SCALE

LGA: LIVERPOOL CITY COUNCIL

484-488 BRINGELLY ROAD, AUSTRAL, NSW.

LOT 6&7 DP1203674

DEVELOPMENT APPLICATION

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DRAWING TITLE: COVER SHEET

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P1705935	PS03	R01	PS03-A000	A

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DRAWING TITLE: EXISTING 5YR ARI WATER DEPTH (M)

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P1705935	PS03	R01	PS03-K100	A

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DRAWING TITLE: EXISTING 5YR ARI WATER LEVEL (MAHD)

PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1705935	PS03	R01	PS03-K101	A

DRAWING ID: P1705935-PS03-R01-K101

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DRAWING TITLE
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PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1705935	PS03	R01	PS03-K102	A

DRAWING ID: P1705935-PS03-R01-K102

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PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
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P1705935	PS03	R01	PS03-K105	A

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DRAWING ID: P1705935-PS03-R01-K106

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DRAWING TITLE: EXISTING 100YR ARI WATER LEVEL (MAHD)

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DRAWING TITLE:
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PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1705935	PS03	R01	PS03-K202	A

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DRAWING TITLE

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DRAWING ID: P1705935-PS03-R01-K208

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8 Attachment C – MUSIC Modelling Parameters

Element	Factor	Input	Source
Setup	Climate File	Rainfall Station 067035 Liverpool (Whitlam Centre). 6 minute timestep 1967-1976 Parramatta PET data	eWater
Source Nodes	Node Type	Residential, Roof	Liverpool City Council WSUD Technical Guidelines (2016)
	Rainfall Threshold	Based on land use type or surface type as specified in Table 6 of the LCC WSUD Technical Guidelines	Liverpool City Council WSUD Technical Guidelines (2016)
	Pervious Area Parameters	By Design	By Design
	EMC's	Based on land use type or surface type as specified in Table 6 of the LCC WSUD Technical Guidelines	Liverpool City Council WSUD Technical Guidelines (2016)
	Estimation Method	Stochastically generated	Liverpool City Council WSUD Technical Guidelines (2016)
Enviropod Per Unit	Low Flow By-pass	0 m^3/s	Stormwater 360
	High Flow By-pass	0.0200 m^3/s	Stormwater 360
	Transfer Functions		Stormwater 360
Detention Basin	Low Flow By-pass	0 m^3/s	Stormwater 360
	High Flow By-pass	100.00 m^3/s	Stormwater 360
	Surface Area	24.6.0 m^2	By Design
	Extended Detention Depth	0.54 m	Stormwater 360
	Exfiltration Rate	0.00 mm/hr	Stormwater 360
	Evaporative loss as % of PET	0.00	Stormwater 360
	Low Flow Pipe Diameter	69 mm	Stormwater 360
	Overflow Weir Width	2.0 m	Stormwater 360
Stormfilter PSorb Per cartridge (460mm)	Low Flow By-pass	0.00 m^3/s	Stormwater 360
	High Flow By-pass	0.00046 m^3/s	Stormwater 360
	Transfer Functions		Stormwater 360

9 Attachment D – Civil Engineering Services Planset