Precise Planning

Preliminary Flood Study: 95 Great Southern Road, Bargo, NSW

P1504741JR05V01
June 2016

Limitations Statement

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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 Pty Ltd has prepared this preliminary flood study for the site known as 95 Great Southern Road, Bargo, NSW. This report has been prepared to support a proposed rezoning application for this site.

This report assesses the 1% Annual Exceedance Probability (AEP) and the Probable Maximum Flood (PMF) flood extent and characteristics to guide land use planning.

1.2 Project Scope

Project scope and objectives are:

1. Prepare a hydrologic model (DRAINS) for the site to determine the peak flows for the 1% AEP and the PMF storm events.

2. Prepare a hydraulic model (1D/2D SMS Tuflow) for the site under existing conditions for the 1% AEP and the PMF storm events.

3. Prepare relevant flood maps including flood extents, levels, depths, velocities and hazards.

1.3 Relevant Guidelines

This report has been prepared in accordance with the following guidelines and policies:

- Institution of Engineers, Australia (2006) – *Australian Rainfall and Runoff*.

- Wollondilly Council (2008) – Stormwater Drainage Design "Design Specification D5".

- Wollondilly Shire Council (2011) 'Development Control Plan 2011'

- Wollondilly Shire Council (2008) 'Design Specifications: Sub-Division and Engineering Standards'.

1.4 Description of Hydrological Features

Two main drainage elements dominate the site. These are described below as:

I. Main creek: a mapped unnamed water course draining from the south to the north is located in the eastern portion of the site. This creek is the predominant drainage feature on the site. It drains to the north east and into Dogtrap Creek (approximately 1.2km to the north east) and eventually into Bargo River (approximately 3.6 km to the north east).

II. Constructed stormwater channel: The main creek above is intercepted by a small constructed drainage channel which flows west to east and receives urban runoff from existing parts of Bargo town. This is a linear excavated channel with no riparian vegetation and does not contain any habitat or significant morphologic features.

2 Hydrology Modelling

2.1 Overview

A DRAINS hydrological model was developed to determine 100 year ARI flow rates for a range of storm durations between 10 mins to 6 hours to the site. DRAINS hydrographs for the critical storm events were used as hydrologic boundary condition inputs for the 2D/3D Tuflow hydraulic modelling.

2.2 Modelling Set-up

2.2.1 Hydrological Model parameters

Parameters used in the model are based on figures given in Council (2008) Engineering Design Specifications, and are shown in Table 1.

Table 1: Hydrologic modelling setup.

Parameter	Element	Value
IFD Data	2 year ARI 1 hour rainfall intensity[1]	31.0
	2 year ARI 12 hour rainfall intensity[1]	7.7
	2 year ARI 72 hour rainfall intensity[1]	2.2
	50 year ARI 1 hour rainfall intensity[1]	64.0
	50 year ARI 12 hour rainfall intensity[1]	15.0
	50 year ARI 72 hour rainfall intensity[1]	4.8
	G (skewness factor) [2]	0.02
	F2[2]	4.29
	F50[2]	15.75
Soil Properties	Paved (impervious) area depression storage (mm)	1.0
	Supplementary area depression storage (mm)	1.0
	Grassed (pervious) area depression storage	10.0
	Soil Type	3.0

Notes:
[1] Figures for Bargo from Wollondilly Shire Council (2008) Engineering Design Specification D5 - Drainage Design.
[2] Typical figures for Bargo given in ARR Chapter 2, Volume 1 (1987).

2.2.2 Sub-catchment Properties

Sub-catchments used in the modelling were based on available LIDAR data provided by NSW LPI and confirmed by site observations. Impervious area proportions were based on available aerial photography. Sub-catchment boundaries used for modelling are provided in Attachment A. Catchment parameters are summarised below in Table 2.

Table 2: Catchment parameters used in DRAINS modelling.

Sub- Catchment	Area (ha)	Impervious (%)	Pervious (%)	Time of Concentration (mins)
CAT 1	24.4	33	67	26.7
CAT 2	19.6	45	55	24.5
CAT 3	41.0	37	63	32.5
CAT 4	33.2	6	94	30.0
CAT 5	3.8	40	60	13.2
CAT 6	3.9	20	80	13.3
CAT 7	14.2	5	95	21.7
CAT 8	5.2	5	95	14.8

Notes:
[1] Catchment details measured off aerials and survey data.

2.2.3 *Results*

DRAINS modelling results indicated that storm duration of 120 min resulted in peak critical flows for 1% AEP and storm duration of 30 min resulted in peak critical flows for the PMF.

Results of peak flow rates for each sub-catchment for the 1% AEP and PMF storms are summarised in Table 3.

Table 3: DRAINS modelling results - peak flow rates for the critical storm duration.

Sub- Catchment	Storm Event	Peak Flow (m^3/s)
CAT 1	1% AEP	6.6
CAT 2	1% AEP	5.6
CAT 3	1% AEP	9.9
CAT 4	1% AEP	8.0
CAT 5	1% AEP	1.4
CAT 6	1% AEP	1.4
CAT 7	1% AEP	4.1
CAT 8	1% AEP	1.7
CAT 1	PMF	30.7
CAT 2	PMF	26.3
CAT 3	PMF	44.3
CAT 4	PMF	38.0
CAT 5	PMF	5.9
CAT 6	PMF	5.9
CAT 7	PMF	19.6
CAT 8	PMF	7.8

3 Hydraulic Modelling

3.1 Overview

The SMS Tuflow 1D/2D hydraulic model (SMS 11.2.3, 23 Jul 2014) was used to determine existing condition flood extents and characteristics for the 1% AEP and PMF storm events.

3.2 Topographic Data

XYZ data provided by NSW LPI was used as the base of the model and meshed with detailed survey for the site area from Sydney Land Surveyors (drawing number: 150713, rev A, 17 August 2015).

3.3 Modelling Set-up

Tuflow model construction consisted of:

1. Development of a 1.0m x 1.0m topographic grid for the simulation.
2. Establishment of model boundary extents as shown in Attachment A.
3. Position inflow boundary conditions based on the 1% AEP and PMF DRAINS model hydrographs for the critical duration located in Attachment A.
4. A 5% computed water slope for the downstream model boundary extent was defined, based on existing downstream floodplain grades.
5. Assigning manning's roughness coefficients based on recent Nearmaps Aerials (2015) for hydraulic modelling as shown in Table 4.
6. Incorporation of blockages to simulate existing buildings.
7. Culverts were modelled as 50% blocked to simulate existing conditions. Location and size (surveyed by Sydney Land Surveyors) of culverts are shown in Attachment A.

Table 4: Mannings roughness coefficients used in SMS Tuflow modelling.

Catchment Material	Manning's Roughness Applied
Rural Residential	0.050
Grassed	0.033
Road	0.018

3.4 Results

Results of flood levels, depths, velocities and hazards (V x D) for the 1% AEP and PMF critical storm events for existing conditions are given in Attachment A.

3.5 Conclusions

There are two key flow paths through the site:

I. Main creek in the eastern portion of the site.

II. Stormwater drainage channel draining from west into the main creek.

Flows in the stormwater drainage channel and where they spill from the channel are mostly broad and shallow. It is recommended that the flows be controlled with a formal drainage system within the proposed development site. The existing drain is an artificial construction, and the most practical solution would be to create a formed pit and pipe network to carry these flows to the main creek line and where possible, integrate the drainage system with any future drainage corridor.

4 References

Institution of Engineers, Australia (2006) – *Australian Rainfall and Runoff*

Nearmaps (2015)

O'Loughlin, G., Stack, B., (2014) - *DRAINS User Manual*

Wollondilly Council (2008) – *Stormwater Drainage Design "Design Specification D5*".

Wollondilly Shire Council (2010) '*Development Control Plan 2010*';

Wollondilly Shire Council (2008) '*Design Specifications: Sub-Division and Engineering Standards*'.

5 Attachment A: Flood Study Planset

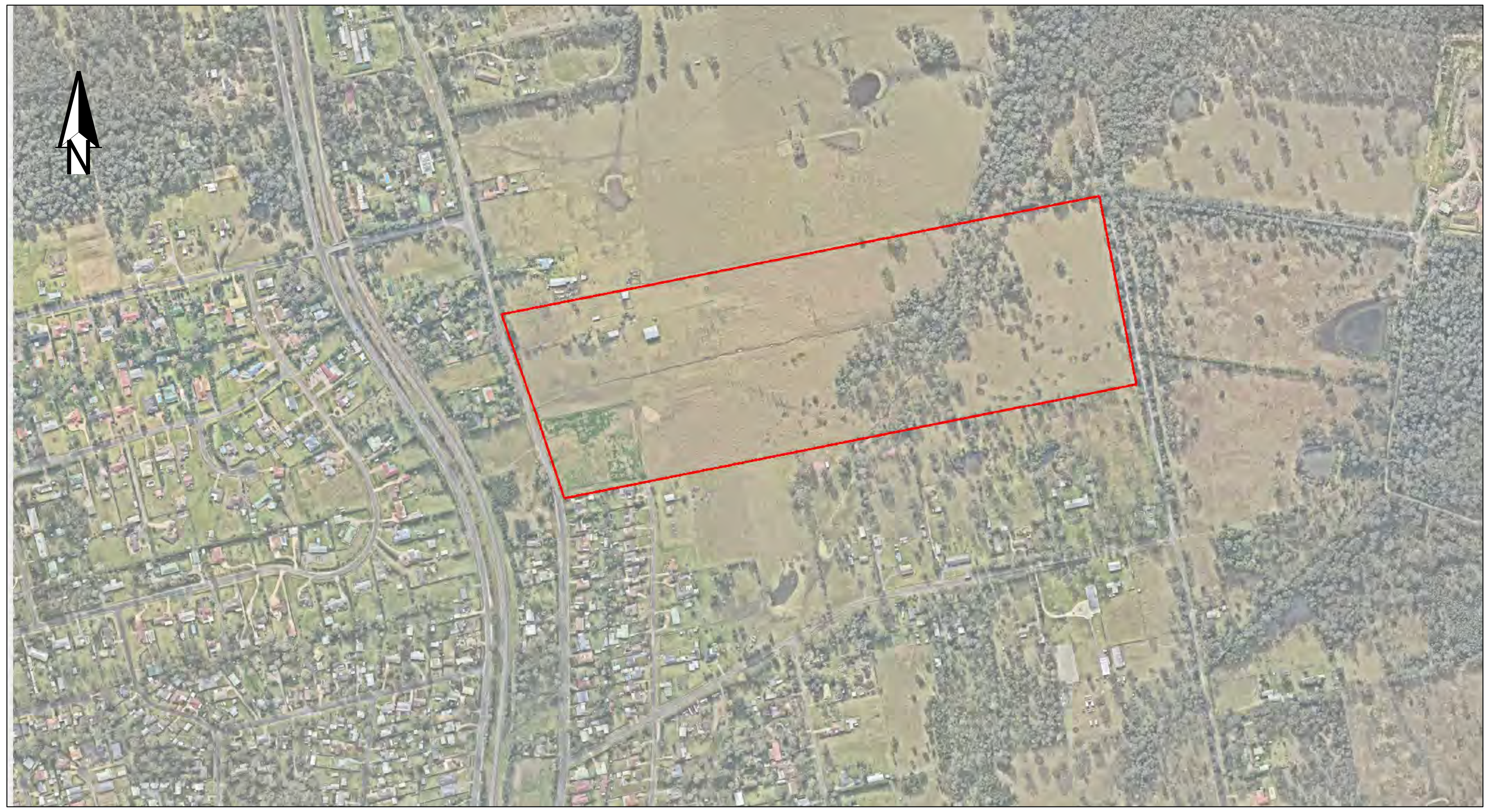
PROJECT: ENGINEERING SERVICES FOR REZONING

PLANSET: FLOOD STUDY

CLIENT: PRECISE PLANNING

DRAWING LIST

DWG No.	REV	DWG TITLE
GENERAL		
PS01-A000	A	COVERSHEET
DRAINAGE		
PS01-D100	A	CATCHMENT PLAN
PS01-D400	A	DRAINS MODEL LAYOUT
PS01-D401	A	DRAINS MODEL RESULT (100YR ARI)
PS01-D402	A	DRAINS MODEL RESULT (PMF)
PS01-D101	A	TUFLOW BOUNDARY CONDITIONS AND CULVERT MAP
FLOODING		
PS01-F100	A	FLOODING RESULTS PLAN - 100 YR ARI EXISTING FLOOD DEPTH (m)
PS01-F101	A	FLOODING RESULTS PLAN - 100 YR ARI EXISTING FLOOD LEVELS (mAHD)
PS01-F102	A	FLOODING RESULTS PLAN - 100 YR ARI EXISTING FLOOD VELOCITY (m/s)
PS01-F103	A	FLOODING RESULTS PLAN - 100 YR ARI EXISTING HYDRAULIC HAZARD (m2/s)
PS01-F104	A	FLOODING RESULTS PLAN - PMF EXISTING FLOOD DEPTH (m)
PS01-F105	A	FLOODING RESULTS PLAN - PMF EXISTING FLOOD LEVELS (mAHD)
PS01-F106	A	FLOODING RESULTS PLAN - PMF EXISTING FLOOD VELOCITY (m/s)
PS01-F107	A	FLOODING RESULTS PLAN - PMF EXISTING HYDRAULIC HAZARD (m2/s)



SITE LOCALITY PLAN
N.T.S.

WOLLONDILLY COUNCIL

95 GREAT SOUTHERN ROAD BARGO NSW

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REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
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SCALE

GRID	DATUM	PROJECT MANAGER
N/A	N/A	JF

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DRAWING TITLE: COVERSHEET

PROJECT NO.	PLANSET NO.	ISSUE NO.	DRAWING NO.	REVISION
P1504741	PS01	02	PS01-A000	B

DRAWING ID: P1504741-PS01V02-A000

A1 / A3 LANDSCAPE (A1LC-V1.1)

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SCALE: 0 40 80 120 160 200 240 280 320 360 400 METRES
A1 (A3) 1:4,000 (1:8,000)

GRID	DATUM	PROJECT MANAGER
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DRAWING TITLE: CATCHMENT PLAN

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A1 / A3 LANDSCAPE (A1LC-V1.1)

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A1 (A3) 1:2,000 (1:4,000)

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DRAWING TITLE: BOUNDARY CONDITIONS PLAN

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P1504741	PS01	02	PS01-D101	B

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A1 / A3 LANDSCAPE (A1LC-V1.1)

Table 2: Catchment details and peak flow results.

Sub- Catchment	Area (ha)	Impervious (%)	Pervious (%)	Time of Concentration (mins)
CAT 1	24.4	33	67	26.66
CAT 2	19.6	45	55	24.52
CAT 3	41.0	37	63	32.50
CAT 4	33.2	6	94	30.00
CAT 5	3.8	40	60	13.16
CAT 6	3.9	20	80	13.25
CAT 7	14.2	5	95	21.73
CAT 8	5.2	5	95	14.81

Notes:
[1] – Catchment details measured off aerials and survey data.

DRAINS MODEL LAYOUT

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A1 / A3 LANDSCAPE (A1LC-V11)

DRAINS MODEL RESULTS
(100YR ARI)

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DRAWING TITLE: DRAINS MODEL RESULT (100YR ARI)

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A1 / A3 LANDSCAPE (A1LC-V1.1)

DRAINS MODEL RESULTS (PMF)

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FLOODING RESULTS PLAN –
100 YR ARI EXISTING FLOOD DEPTH (m)

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100 YR ARI EXISTING FLOOD LEVELS (mAHD)

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A1 / A3 LANDSCAPE (A1LC-V11)

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FLOODING RESULTS PLAN –
100 YR ARI EXISTING FLOOD VELOCITY (mAHD)

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P1504741	PS01	02	PS01-F102	B

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FLOODING RESULTS PLAN -
100 YR ARI EXISTING HYDRAULIC HAZARD (m2/s)

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FLOODING RESULTS PLAN –
PMF EXISTING FLOOD DEPTH (m)

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DRAWING TITLE

FLOODING RESULTS PLAN – PMF EXISTING FLOOD LEVELS (mAHD)

PROJECT NO.	PLANSET NO.	ISSUE NO.	DRAWING NO.	REVISION
P1504741	PS01	02	PS01-F105	B

A1 / A3 LANDSCAPE (A1LC-V1.1)

REZONING APPLICATION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
B	**REZONING APPLICATION**	**29/06/2016**	**RK**	**GL**		
A	FOR CLIENT REVIEW	23/11/2015	RK	GL		

SCALE

GRID	DATUM	PROJECT MANAGER
MGA	MAHD	JF

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This plan must not be used for construction unless signed as approved by principal certifying authority.

All measurements in millimetres unless otherwise specified.

CLIENT

PRECISE PLANNING

PROJECT NAME/PLANSET TITLE

ENGINEERING SERVICES FOR REZONING

FLOOD MODELLING RESULTS

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DRAWING TITLE

FLOODING RESULTS PLAN –
PMF EXISTING FLOOD VELOCITY (mAHD)

PROJECT NO.	PLANSET NO.	ISSUE NO.	DRAWING NO.	REVISION
P1504741	PS01	02	PS01-F106	B

DRAWING ID: P1504741-PS01V02-F106
A1 / A3 LANDSCAPE (A1LC-V1.1)

REZONING APPLICATION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
B	**REZONING APPLICATION**	**29/06/2016**	**RK**	**GL**		
A	FOR CLIENT REVIEW	23/11/2015	RK	GL		

SCALE

GRID	DATUM	PROJECT MANAGER
MGA	MAHD	JF

CLIENT

PRECISE PLANNING

PROJECT NAME/PLANSET TITLE

ENGINEERING SERVICES FOR REZONING

FLOOD MODELLING RESULTS

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DRAWING TITLE

FLOODING RESULTS PLAN –
PMF EXISTING HYDRAULIC HAZARD (m2/s)

PROJECT NO.	PLANSET NO.	ISSUE NO.	DRAWING NO.	REVISION
P1504741	PS01	02	PS01-F107	B

DRAWING ID: P1504741-PS01V02-F107

A1 / A3 LANDSCAPE (A1LC-V1.1)