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Proposed Subdivision
27 Lang Drive, Bolwarra Heights

Stormwater Management Strategy

SNL Pty Ltd

Revision: 4
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GCA Ref: 22218

LAND DEVELOPMENT • BUILDINGS • INFRASTRUCTURE

CIVIL, STRUCTURAL & ENVIRONMENTAL ENGINEERING,
WATER & WASTEWATER, BUILDING DESIGN & PROJECT ADVISORY

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3	General Amendments	TS	13/12/24	IH	13/12/24	IH	13/12/24
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List of Acronyms

GCA	GCA Engineering Solutions	ARR	Australian Rainfall and Runoff
AEP	Annual Exceedance Probability	MCC	Maitland City Council
MOES	Manual of Engineering Standards	DCP	Development Control Plan
IFD	Intensity Frequency Duration	RL	Reduced Level
IL	Invert Level	SL	Surface Level
TWL	Top Water Level	DA	Development Application

1 Introduction

1.1 Background

This stormwater management report is provided to support a Development Application (DA) for a proposed 15-lot subdivision located at 27 Lang Drive, Bolwarra Heights.

This report will size the proposed culvert crossing Road 1 (Culvert 1) to ensure flows from the local upstream catchment are conveyed without impacting the existing flood environment or the proposed development for the 5% and 1% AEP event. This report also sizes a proposed grass-lined channel and stormwater drainage line to convey flows from the external local catchment to the existing watercourse without impacting the proposed development for the 5% and 1% AEP event.

As the Site is a large lot low density development located on the fringe of the Paterson River floodplain stormwater detention is not considered warranted in this instance.

The Paterson River Flood Study will be reviewed to confirm the impact from backwater levels on the site from the Paterson River.

1.2 Study Area

The subject land currently comprises Lot 1 DP1156433 and is currently accessed via Lang Drive in the Maitland Local Government Area. A locality plan has been provided in Figure 1. The Site is currently zoned as R5 Large Lot Residential.

The Site is divided by a small ridge roughly in the centre of the Site where an existing dwelling resides, splitting the Site in the north-south direction. The Site is predominantly vegetated by lawn cover, with a few trees around the existing dwelling.

An existing unnamed second order watercourse that ultimately drains to the Paterson River traverses the Site. It generally enters the Site along its south-western boundary and outlets to the north. The proposed development includes a road crossing this existing second order watercourse. The sizing of the subsequent culvert crossing (Culvert 1) and its impact on the proposed development and the existing flood environment is detailed within this report.

Additionally, there is an existing catchment (Catchment 2) located to the south of the proposed development that ultimately drains to the unnamed second order watercourse located within the Site. A proposed grass-lined channel and stormwater drainage line has been considered as part of this report to ensure flows from Catchment 2 continue to drain to the existing watercourse without impacting the proposed development.

The eastern side of the Site contains an existing watercourse, as well as housing an existing farm dam and culvert system upstream of the site outlet point along the north-eastern boundary. Both water courses continue and eventually meet in a large wetland area on the opposite side of Lang Drive.

1.3 Proposed Development

The proposed development comprises 15 large residential lots with a minimum and maximum lot area of 4525m^2 and 6544m^2, respectively. A Site plan is provided in Figure 2.

1.4 Available Data

The following available information was utilised in the preparation of this strategy.

- The current subdivision layout plan prepared by GCA
- Maitland City Council Manual of Engineering Standards (MOES) 2014
- Australian Rainfall and Runoff, 1998 (Institution of Engineers Australia)
- NSW Government spatial Information eXchange (SIX) topographic maps
- Detail survey provided by David Cant Surveyors
- Nearmap
- Paterson River Flood Study, WMA Water (June 2017)

2 Stormwater Management Plan

The local catchment plan has been provided in Figure 3. The general arrangement of the proposed stormwater management plan is shown in Figure 4. The proposed stormwater management strategy involves:

- Sizing Culvert 1 to ensure flows from Catchment 1 are conveyed without negative impacts on neighbouring residences or the proposed development during the 5% and 1% AEP event.
- Capturing external flows from Catchment 2 via a proposed grass-lined channel at the rear of Lots 5-7 and conveying these flows to the existing watercourse to the north via an adequately sized drainage line. The proposed grass-lined channel and drainage line are to be sized to ensure flows do not bypass through Lots 5-7 for events up to and including the 1% AEP event.
- Reference the existing Paterson River Flood Study to confirm 1% AEP backwater levels and assess the proposed development against the current proposed 8.0m Flood Planning Level for the Site.
- Water quality for the system as a whole will meet MCC's targets as outlined in the MOES. This will be achieved by a treatment train approach comprising gross pollutant traps (GPTs) and bioretention basins. Water quality and modelling is discussed in detail in Section 4. Lots 2, 3 and 4 will bypass the proposed water quality treatment devices and discharge directly to the existing watercourse.

Subsequent sections of this report will demonstrate that the stormwater strategy will achieve all the relevant target criteria.

3 Stormwater Runoff Hydrology

3.1 Methodology

Stormwater flow modelling of the proposed catchments was completed using the DRAINS computer software package. The DRAINS program is a time area hydrograph routing model that translates rainfall hyetographs into runoff hydrographs over sub catchments and subsequently adds the resulting hydrographs together to quantify design rates of flow and design runoff volumes.

The flow rates calculated by DRAINS for the 5% and 1% AEP events were then entered into 12D (Dynamic Drainage) to ensure Culvert 1, the proposed grass-lined channel at the rear of Lot 5 and the stormwater drainage line along the eastern boundary of Lot 5 were adequately sized for the required storm events.

3.2 Modelling Parameters

MCC's MOES provides some standard values for use when creating models. In accordance with MOES, the DRAINS model adopted an antecedent moisture content of 3, a grassed depression of 5mm, and a paved depression of 1mm. The local catchments are zoned as R5 (Large Lot Residential), so an impervious percentage of 40% and surface roughness coefficients (n*) of 0.01 (impervious areas) and 0.35 (pervious areas) were adopted.

3.3 Results

3.3.1 Design Summary

The design for Culvert 1 is summarised is Table 3-1.

Table 3-1: Culvert 1 Specifications.

Culvert 1	
Size	5x (2.7m x 0.9m Box Culvert)
Length	43.40m
Grade	0.92%
Controlling Spill Level (m AHD)	9.70
U/S IL (m AHD)	8.0
D/S IL (m AHD)	7.6

The grass-lined channel has been designed as a 2m wide trapezoidal channel with 1:4 internal batters and 1:6 external batters. The proposed stormwater drainage line comprises a ø1200mm RCP running from the rear of Lots 5-7 and discharging to the existing watercourse. This has been shown on Figure 4.

3.3.2 DRAINS Results

MCC's requirements for low-point culvert crossings is that it must satisfy both 5% (20-year ARI) and 1% AEP storm criteria.

Based on the DRAINS predicted flow rates, under normal flow (i.e. unblocked and without a downstream backwater control), the peak 1% AEP headwater level at the upstream sides of proposed Culvert 1 is 9m AHD. This level corresponds to 1 m of flow depth at the invert at the culvert inlet with approximately 0.7m freeboard to the proposed Road 1 design level (9.70m AHD)

However, MOES requires the inlet to be modelled with a 50% blockage factor for the major storm event. This results in a peak 1% AEP headwater level at the upstream side of proposed Culvert 1 of 9.62m AHD. This level corresponds to 1.71m of flow depth at the invert at the culvert inlet with approximately 0.08m freeboard to the proposed Road 1 design level.

Based on the DRAINS predicted flow rates, under normal flow (i.e. unblocked and without a downstream backwater control), the 1% AEP headwater at the headwall of the proposed stormwater drainage line in Lot 5 is 13.85m AHD, resulting in a freeboard level of approximately 0.5m to the channels top of bank. A 50% blockage factor for the major storm event was also applied and modelled to ensure external flows would not impact the proposed development. This resulted in a 1% AEP headwater at the headwall of 14.07m AHD and a freeboard level of approximately 0.3m to the channels top of bank.

Both the proposed culvert and grass-lined channel and stormwater drainage line were deemed safe, and a summary of key measured results can be found in Tables 3-2 and 3-3.

The full DRAINS input data and results is shown in Appendix A and B, respectively.

Table 3-2: Summary of Culvert 1 results data.

AEP	Peak Flow Rate (m^3/s)	Overflow Road Level (m AHD)	Water Level Reached (m AHD)	Freeboard (m AHD)
5%	11.9	9.70	8.72	0.98
1%	18.9	9.70	9	0.70
1% with 50% blockage	18.9	9.70	9.62	0.08

Table 3-3: Summary of grass-lined channel and stormwater drainage line results data.

AEP	Peak Flow Rate (m^3/s)	Min Channel Top of Bank (m AHD)	Water Level Reached (m AHD)	Freeboard (m AHD)
5%	0.47	14.4	13.61	0.79
1%	0.89	14.4	13.85	0.55
1% with 50% blockage	0.89	14.4	14.07	0.33

The results demonstrate that the proposed culvert, grassed channel and drainage line are suitable to convey peak flows for the 5% and 1% AEP events.

4 Stormwater Run-off Quality

4.1 Criteria

Treatment targets for the proposed development were adopted from MCC's MOES and are shown in Table 4-1.

Table 4-1: Pollutant retention targets.

Pollutant	Stormwater treatment objective
Total Suspended Solids (TSS)	80% retention of average annual load
Total Phosphorous (TP)	45% retention of average annual load
Total Nitrogen (TN)	45% retention of average annual load
Gross Pollutants (GP)	70% retention of average annual load

4.2 Methodology

The development was modelled using MUSICX published by eWATER Limited, which is the current best practice tool for estimating the ameliorating effects of proposed stormwater quality improvement devices in a treatment train approach.

MUSICX uses real historical continuous rainfall records (over several years) as input and compares the theoretical pollutant generation within the catchment to the final theoretical export rate (usually expressed in kg/year) to determine a treatment train effectiveness expressed in percentage points that are directly comparable to the guidelines in Table 4-1.

4.2.1 Runoff quality

A MUSICX model was developed comprising pavement areas, road reserves and landscaping to design a treatment train that could achieve the required stormwater treatment objectives for the proposed development. The impervious percentage for road reserves and lots (>1000m^2) was assumed to be 70% and 40% in accordance with MCC's MOES. Due to the rural nature of the proposed development, only the road reserves and approximate development footprints for each residential dwelling was considered as a large percentage of the existing pervious area would remain unchanged.

It is noted that Lots 2, 3 and 4 will bypass the proposed water quality treatment devices and discharge directly to the existing watercourse.

The MUSICX model layout is provided in Appendix D. A MUSICX catchment plan is also provided in Appendix D.

4.2.2 Gross Pollutant Trap (GPT)

Three gross pollutant traps (Humes Humegard) are proposed as treatment devices for the road reserve areas and any lot areas that outlet to the street drainage network (Catchments 1 – 3). Table 4-2 provides the parameters used when modelling the GPT within MUSICX.

Table 4-2: Gross pollutant trap parameters.

Parameter	Value
High Flow Bypass (Treatment Flow Rate)	0.6m^3/s (assumed as a Humegard HG18, this flow will be a minimum treatable flow rate)
Total Suspended Solids (TSS) Removal Efficiency	50%
Total Phosphorous (TP) Removal Efficiency	40%
Total Nitrogen (TN) Removal Efficiency	26%
Gross Pollutant (GP) Removal Efficiency	90%

4.2.3 Bioretention Basin

Bioretention is proposed as a tertiary treatment device. It is proposed to locate a bioretention basin at the outlet of Catchments 1 – 6, as shown in Appendix D. Table 4-3 provides the parameters utilised when modelling the bioretention basins within MUSICX. Note the bioretention basins located on Lots 12, 14 and 15 (Catchments 4 – 6) have been kept consistent.

Bioretention basin locations and extents are indicative and will be confirmed during the construction certification phase.

Table 4-3: Bioretention basin details.

Parameter	Basin 1	Basin 2	Basin 3	On-lot Basins (Lots 12, 14 and 15)
Invert Surface Area (m^2)	120	50	50	20
Extended Detention Depth (m)	0.3	0.3	0.3	0.3
Filter Media Surface Area (m^2)	120	50	50	20
Filter Media Depth (m)	0.4	0.4	0.4	0.4
Filter Media Saturated Hydraulic Conductivity (mm/hr)	180	180	180	180

4.3 Results

The achieved pollutant retention achieved by the treatment train is provided in Table 4-4.

Table 4-4: Achieved pollutant retention.

Pollutant	Average Annual Surface Generation	Average Annual Export	Achieved Reduction (Pollutants Retained)	Target Reduction (Pollutants Retained)
Total Suspended Solids (TSS; kg/year)	1991	393.2	80%	80%
Total Phosphorous (TP; kg/year)	3.98	1.98	50%	45%
Total Nitrogen (TN; kg/year)	27.63	14.24	48%	45%
Gross Pollutants (GP; kg/year)	472.3	89.5	81%	70%

4.4 Discussion

The proposed treatment train achieves MCC's stormwater treatment objectives for the proposed development. The above results indicate the proposed stormwater drainage strategy will produce an outcome for the proposed development that complies with Council's standards for water quality control.

5 Flood Study

5.1 Background

The Site lies in Bolwarra Heights and is susceptible to the 1% AEP backwater level from the Paterson River.

The Sites flood risk is best described by the Paterson River Flood Study conducted by WMA Water dated June 2017, which displays the 1% AEP flood level for the Site (refer to Appendix D). As expected, the backwater levels enter the Site through the two existing water courses on either side of the natural ridge.

The 1% AEP flood level is therefore identified to be 7.5m AHD, and consequently, the flood planning level was found to be 8.0m AHD. Additionally, the 1% AEP velocity at the Site is approximately 0-0.25 m/s.

WMA Water also produced a provisional hydraulics hazard for the Paterson River region, resulting in some parts of the Site being categorised as both low and high hazard for the 1% AEP event, refer Appendix D.

5.2 Discussion

Upon review of the Paterson River Flood Study by WMA Water, it is determined that the proposed flood planning level for the Site was 8.0m AHD and all lots shall be designed to have building envelopes at or above this level.

The extents of flooding from the Paterson River conclude inside the proposed site as the Site steepens toward the south and west boundaries. The relevant flooding depth on the eastern catchment can be assumed to be around the 0m-2m range based on the site detailed survey, remaining within the extents of the existing watercourse. Similarly, the western catchment shows the extent entirely being within the 0m-1m range, also within the watercourse extents.

Thus, the backwater levels will only affect a select few of the proposed lots and the layout will be designed to accommodate a 1% flood level of 7.5m AHD as required.

6 Summary and Conclusion

The purpose of this stormwater strategy is to support a Development Application for Lot 1 DP1156433. The subject land currently resides in the Maitland Local Government Area and is zoned as R5 Large Lot Residential.

The stormwater strategy primarily required analysis of a proposed culvert crossing to allow the construction of a proposed road, and a proposed grass-lined channel and stormwater drainage line to convey external flows to the existing watercourse without impacting the proposed development.

The report concluded that the following would be suitable for 5% and 1% AEP storms:

- Culvert 1: 5x 2700mm x 900mm Box Culverts
- The grass-lined channel has been designed as a 2m wide trapezoidal channel with 1:4 internal batters and 1:6 external batters. The proposed stormwater drainage line comprises a ø1200mm RCP running from the rear of Lot 5 and discharging to the existing watercourse. This has been shown on Figure 4.

Review of the Paterson River Flood Study was required to determine the effects of the backwater levels caused by the 1% AEP flooding of the Paterson River. It is confirmed that the backwater levels from the Paterson River would be the primary cause of flooding, however its extents are not problematic for the proposed development. The previously stated flood planning level of 8.0m AHD is accommodated in the proposed subdivision lot layout.

As the site is a large lot low density development located on the fringe of the Paterson River floodplain stormwater detention is not considered warranted in this instance.

The strategy for water quality treatment comprises of the following:

- Treatment of runoff from road reserve areas by gross pollutant traps and bioretention basins.
- Construction of on-lot basins to treat lots that bypass the street drainage network and discharge directly to existing watercourses.
- Lots 2, 3 and 4 will bypass the proposed water quality treatment devices and discharge directly to the existing watercourse.

Considering the above, stormwater management and flooding criteria do not form a basis for the development application to be refused.

Figures

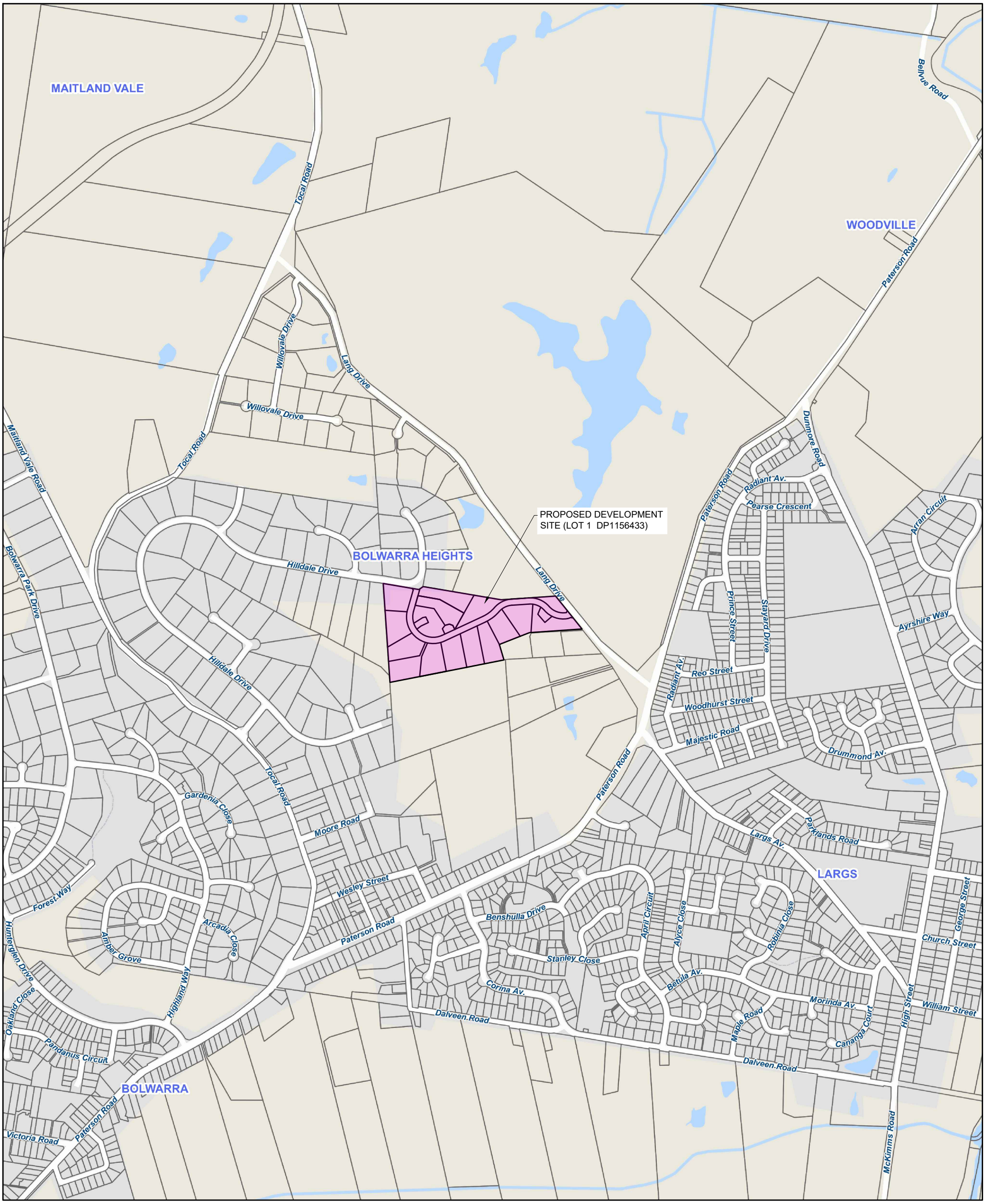


FIGURE 1
LOCALITY PLAN

1:10000 0 200 400 600m

DATE: 11/03/25

FIGURE 2
SITE PLAN

1:2500 0 50 100 150 m

DATE: 11/03/25

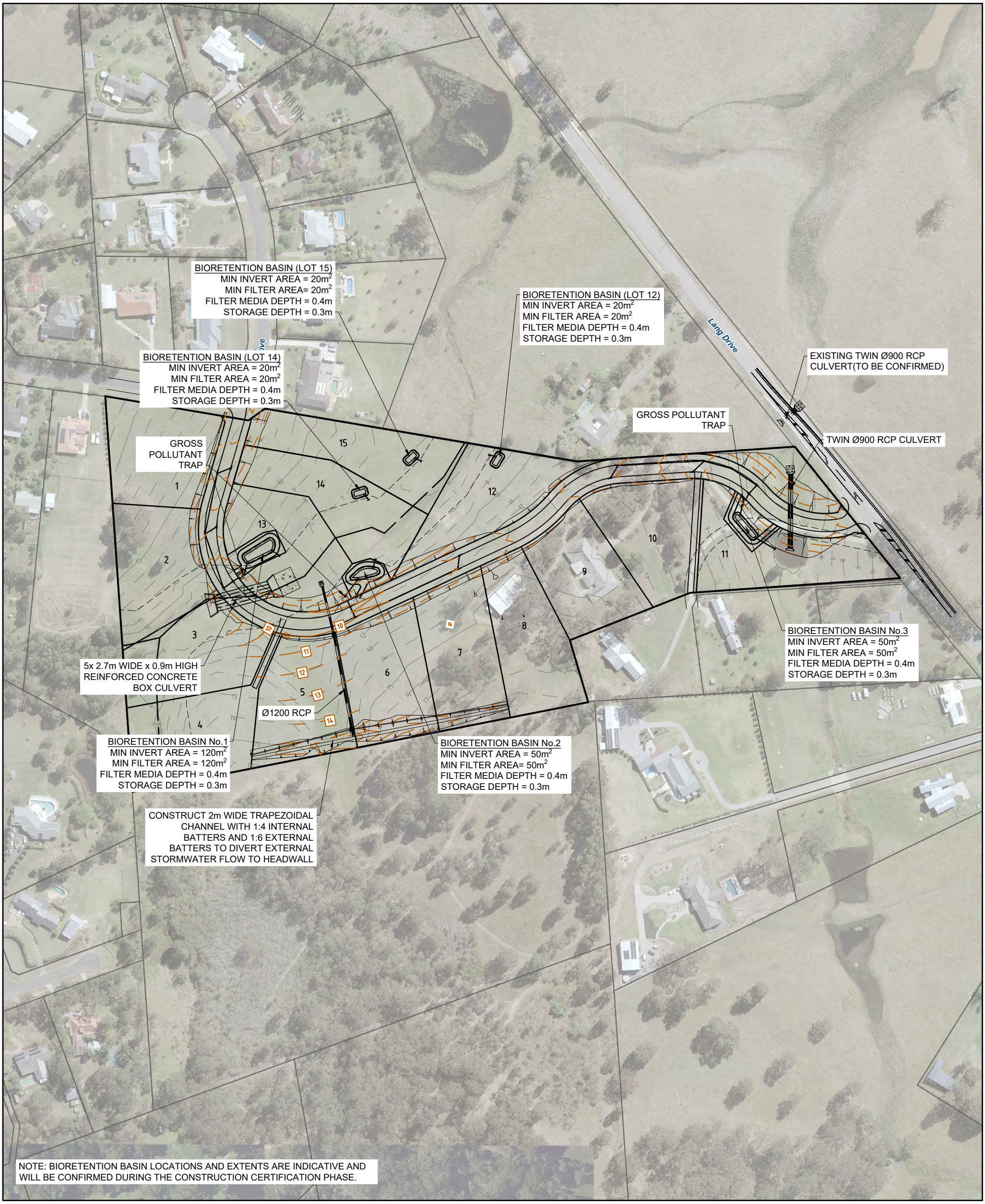
CATCHMENT 1
69.16ha

CATCHMENT 2
5.12ha

FIGURE 3
CATCHMENT PLAN

1:8000 0 160 320 480 m

DATE: 11/03/25



N

FIGURE 4
STORMWATER MANAGEMENT PLAN

1:2500 0 50 100 150 m

DATE: 11/03/25

Appendix A

DRAINS Data


CATCHMENT 1
N_CAT 1
CATCHMENT 2
N_CAT 2

DRAINS Data

PIT / NODE DETAILS

Version 15

Name	Type	Family	Size	Ponding Volume (cu.m)	Pressure Change Coeff. Ku	Surface Elev (m)	Max Pond Depth (m)	Base Inflow (cu.m/s)	Blocking Factor	x	y	Bolt-down id lid	Part Full Shock Loss	Inflow Hydrograph	Pit is	Internal Width (mm)	Inflow is Misaligned	Minor Safe Pond Depth (m)	Major Safe Pond Depth (m)
N_CAT 2	Node							0		565.6	-188.8	59335		No					
N_CAT 1	Node							0		379.6	-187.6	84705		No					

DETENTION BASIN DETAILS

Name	Elev	Surf. Area	Not Used	Outlet Typ	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Leng	id

SUB-CATCHMENT DETAILS

Name	Pit or Node	Total Area (ha)	Paved Area %	Grass Area %	Supp Area %	Paved Time (min)	Grass Time (min)	Supp Time (min)	Paved Length (m)	Grass Length (m)	Supp Length (m)	Paved Slope(%) %	Grass Slope %	Supp Slope %	Paved Rough	Grass Rough	Supp Rough	Lag Time or Factor	Gutter Length (m)	Gutter Slope %	Gutter Flow	Rainfall Factor	Multiplier
CATCHMENT 2	N_CAT 2	5.12	0	100	0	0	0	0	0	393	0	0	7	0	0	0.35	0	0					1
CATCHMENT 1	N_CAT 1	69.16	40	60	0	0	0	0	900	950	0	3	4	0	0.011	0.35	0	0					1

PIPE DETAILS

Name	From	To	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Type	Dia (mm)	I.D. (mm)	Rough	Pipe Is	No. Pipes	Chg From	At Chg	Chg (m)	Rl (m)	Chg (m)	RL (m)	etc (m)

DETAILS of SERVICES CROSSING PIPES

Pipe	Chg (m)	Bottom Elev (m)	Height of S (m)	Chg (m)	Bottom Elev (m)	Height of S (m)	Chg (m)	Bottom Elev (m)	Height of S (m)	etc etc

CHANNEL DETAILS

Name	From	To	Type	Length (m)	U/S IL (m)	D/S IL (m)	Slope (%)	Base Width (m)	L.B. Slope (1:?)	R.B. Slope (1:?)	Manning n	Depth (m)	Roofed

PIPE COVER DETAILS

Name	Type	Dia (mm)	Safe Cover	Cover (m)

This model has no pipes with non-return valves

Appendix B

DRAINS Results

DRAINS Results - 5% AEP

DRAINS results prepared from Version 2023.10.8682.19045

PIT / NODE DETAILS

Version 8

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
CATCHMENT 2	0.469	0	0.469	0	59.28	0	5% AEP, 1 hour burst, Storm 1
CATCHMENT 1	11.886	10.563	1.323	10.56	79.8	0	5% AEP, 10 min burst, Storm 1

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level

Run Log for 22218 r3 CULVERT SIZING Due to Storm

DRAINS Results - 1% AEP

DRAINS results prepared from Version 2023.10.8682.19045

PIT / NODE DETAILS

Version 8

Name	Max HGL	Max Pond HGL	Max Surfac Flow Arrivi (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
CATCHMENT 2	0.891	0	0.891	0	51.93	0	1% AEP, 1 hour burst, Storm 5
CATCHMENT 1	18.862	16.335	2.527	9.22	69.66	0	1% AEP, 10 min burst, Storm 7

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level

Run Log for 22218 r3 CULVERT SIZING Due to Storm

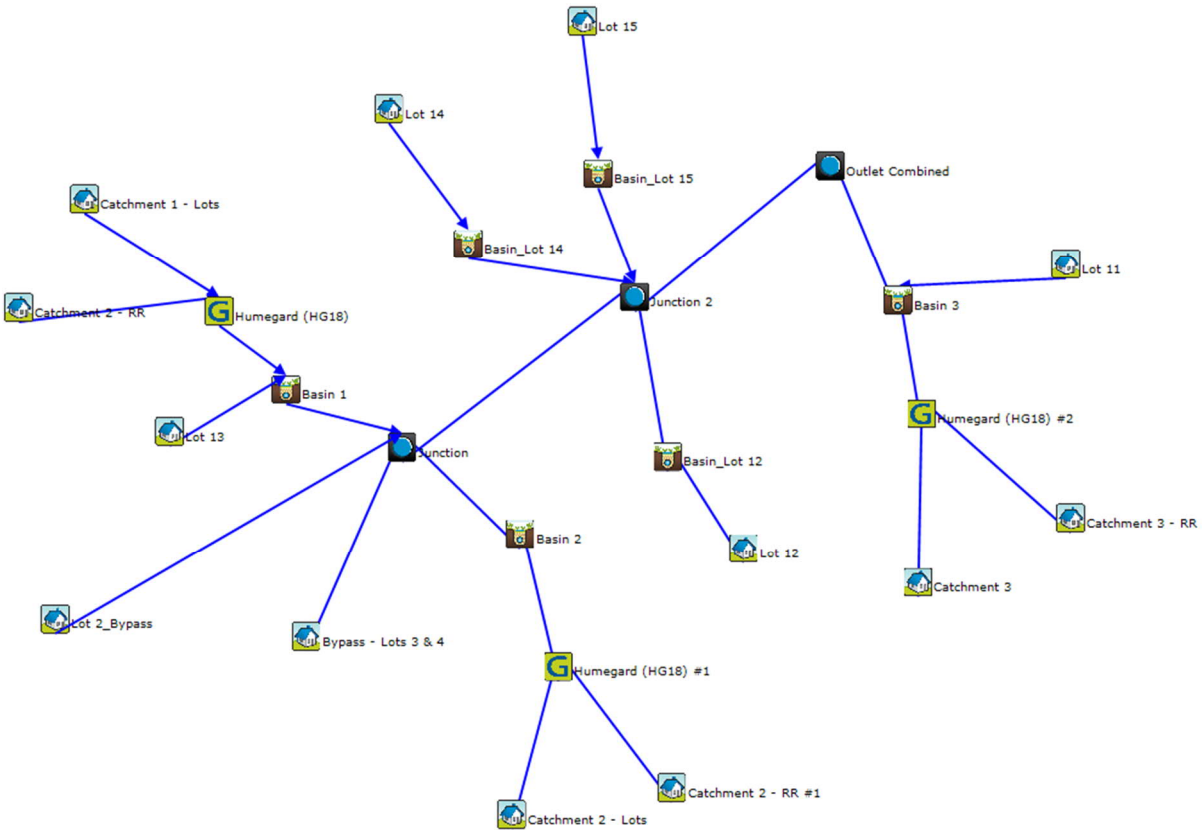
Appendix C

MUSICX Model Layout

MUSIC CATCHMENT PLAN

1:2500 0 50 100 150 m

DATE: 11/03/25


Lot 15
Lot 14
Basin_Lot 15
Outlet Combined
Catchment 1 - Lots
Basin_Lot 14
Lot 11
Catchment 2 - RR
Humegard (HG18)
Junction 2
Basin 3
Basin 1
Humegard (HG18) #2
Lot 13
Junction
Basin_Lot 12
Catchment 3 - RR
Basin 2
Lot 12
Catchment 3
Lot 2_Bypass
Bypass - Lots 3 & 4
Humegard (HG18) #1
Catchment 2 - RR #1
Catchment 2 - Lots

Appendix D

Council Flood Study and Flood Risk Management Plan Figures

FIGURE C5B
PEAK FLOOD DEPTHS AND LEVELS
PATERSON RIVER CATCHMENT
TOCAL TO HINTON
1% AEP EVENT

3.52
6.05
6.11
6.55
6.42
6.44
6.57
6.56
10.17
10.63
6.86
6.86

STUDY AREA

Peak Flood Levels (mAHD)
Study Area
Hunter 1% AEP Flood Extent
Depth (m)
0 - 1
1.0 - 2.5
2.5 - 5.0
5.0 - 10
> 10

N

0 0.5 1 2 3 4 Km

J:\Jobs\114084\ArcIArcMaps\AppendixC\FigureC05B_PeakFloodDephtsLevels_100yr_Event.mxd

FIGURE C13B
PEAK VELOCITIES
PATERSON RIVER CATCHMENT
TOCAL TO HINTON
1% AEP EVENT

STUDY AREA

N

Study Area

Velocity (m/s)

- 0 - 0.25
- 0.25 - 0.5.0
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

0 0.5 1 2 3 4 Km

J:\Jobs\114084\ArcIArcMaps\AppendixC\FigureC13B_Velocities_100yr_Event.mxd

FIGURE C18B

PROVISIONAL HYDRAULIC HAZARD
PATERSON RIVER CATCHMENT
TOCAL TO HINTON
1% AEP EVENT

STUDY AREA

N

Study Area

Provisional Hydraulic Hazard

Low Hazard

High Hazard

0 0.5 1 2 3 4 Km

J:\Jobs\114084\ArcMaps\AppendixC\FigureC18B_Provisional_Hydraulic_Hazard_100yr_Event.mxd

FIGURE B27
BOLWARRA HEIGHTS AND PHONIEX PARK
FLOOD EXTENT MAP
APRIL 2015 EVENT

15

STUDY AREA

18

N

Study Area
SurveyPoints
Depth (m)
0 - 1
1.0 - 2.5
2.5 - 5.0
5.0 - 10
> 10

0 0.125 0.25 0.5 0.75 1 Km

J:\Jobs\114084\Arc\ArcMaps\AppendixB\FigureB27_BolwarraHeights_PhoenixPark_April2015.mxd