PREPARED FOR INVESTA RESIDENTIAL GROUP PTY LTD
JULY 2016
15-003546-03A
ORIGINAL
WATER & ENVIRONMENT

Harmony Subdivision, Palmview
Concept Stormwater Management Plan

COMMERCIAL IN CONFIDENCE

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DOCUMENT CONTROL

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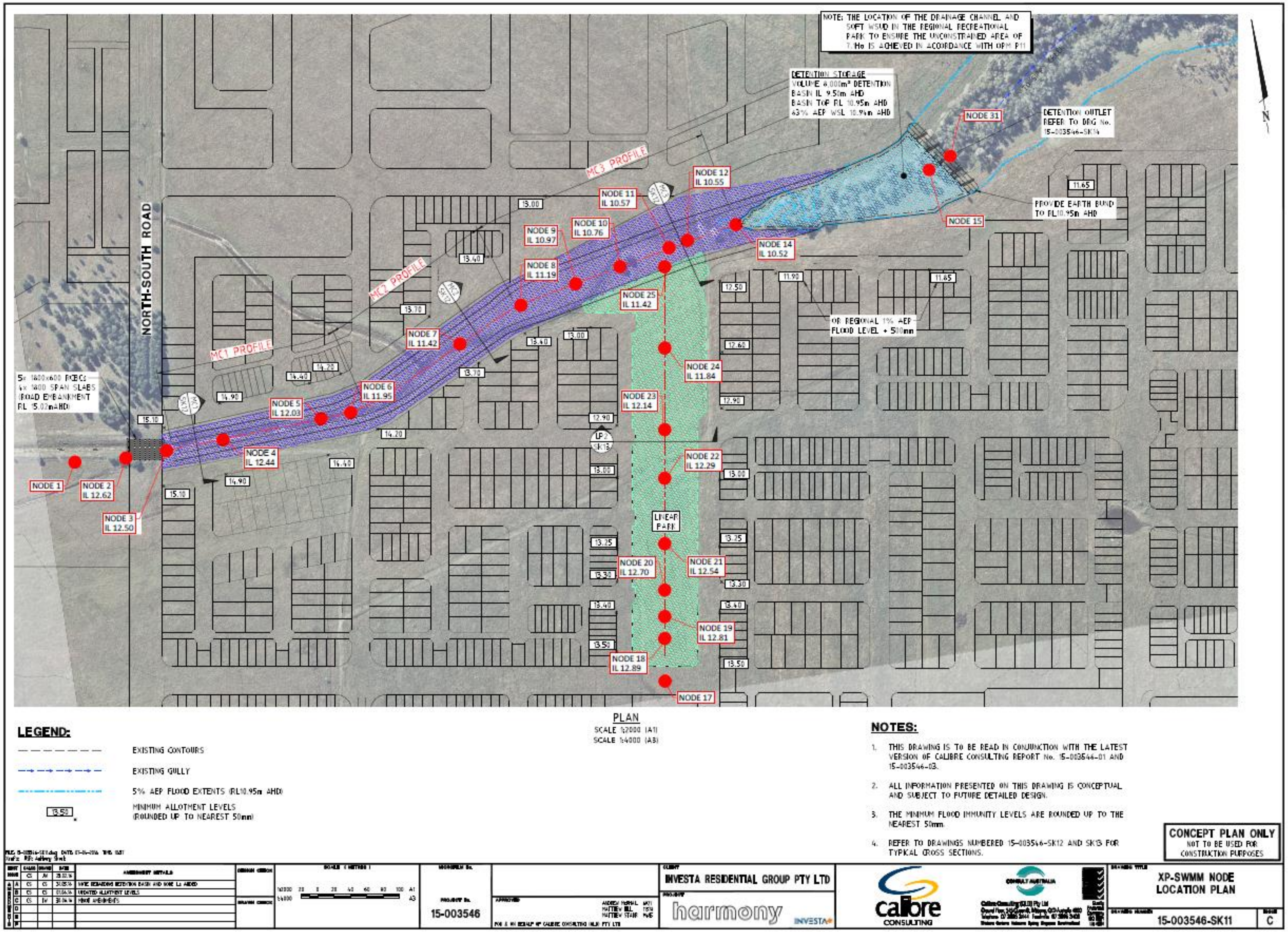
NOTE: THE LOCATION OF THE DRAINAGE CHANNEL AND SOFT WSUD IN THE REGIONAL RECREATIONAL PARK TO ENSURE THE UNCONSTRAINED AREA OF 7.1Ha IS ACHIEVED IN ACCORDANCE WITH OPM P11
DETENTION STORAGE
VOLUME 8,000m³ DETENTION
BASIN IL 9.50m AHD
BASIN TOP RL 10.95m AHD
63% AEP WSL 10.9m AHD
DETENTION OUTLET
REFER TO DRG No. 15-003546-SK14
PROVIDE EARTH BUND TO RL10.95m AHD
NORTH-SOUTH ROAD
MC1 PROFILE
MC2 PROFILE
MC3 PROFILE
5x 1800x600 RCBCs
4x 1800 SPAN SLABS
(ROAD EMBANKMENT RL 15.02mAHD)
OR REGIONAL 1% AEP FLOOD LEVEL + 500mm
LINEAR PARK
NODE 1
NODE 2 IL 12.62
NODE 3 IL 12.50
NODE 4 IL 12.44
NODE 5 IL 12.03
NODE 6 IL 11.95
NODE 7 IL 11.42
NODE 8 IL 11.19
NODE 9 IL 10.97
NODE 10 IL 10.76
NODE 11 IL 10.57
NODE 12 IL 10.55
NODE 14 IL 10.52
NODE 15
NODE 17
NODE 18 IL 12.89
NODE 19 IL 12.81
NODE 20 IL 12.70
NODE 21 IL 12.54
NODE 22 IL 12.29
NODE 23 IL 12.14
NODE 24 IL 11.84
NODE 25 IL 11.42
NODE 31
PLAN
SCALE 1:2000 (A1)
SCALE 1:4000 (A3)
LEGEND:
EXISTING CONTOURS
EXISTING GULLY
5% AEP FLOOD EXTENTS (RL10.95m AHD)
MINIMUM ALLOTMENT LEVELS (ROUNDED UP TO NEAREST 50mm)
NOTES:
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT No. 15-003546-01 AND 15-003546-03.
2. ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL AND SUBJECT TO FUTURE DETAILED DESIGN.
3. THE MINIMUM FLOOD IMMUNITY LEVELS ARE ROUNDED UP TO THE NEAREST 50mm.
4. REFER TO DRAWINGS NUMBERED 15-003546-SK12 AND SK13 FOR TYPICAL CROSS SECTIONS.
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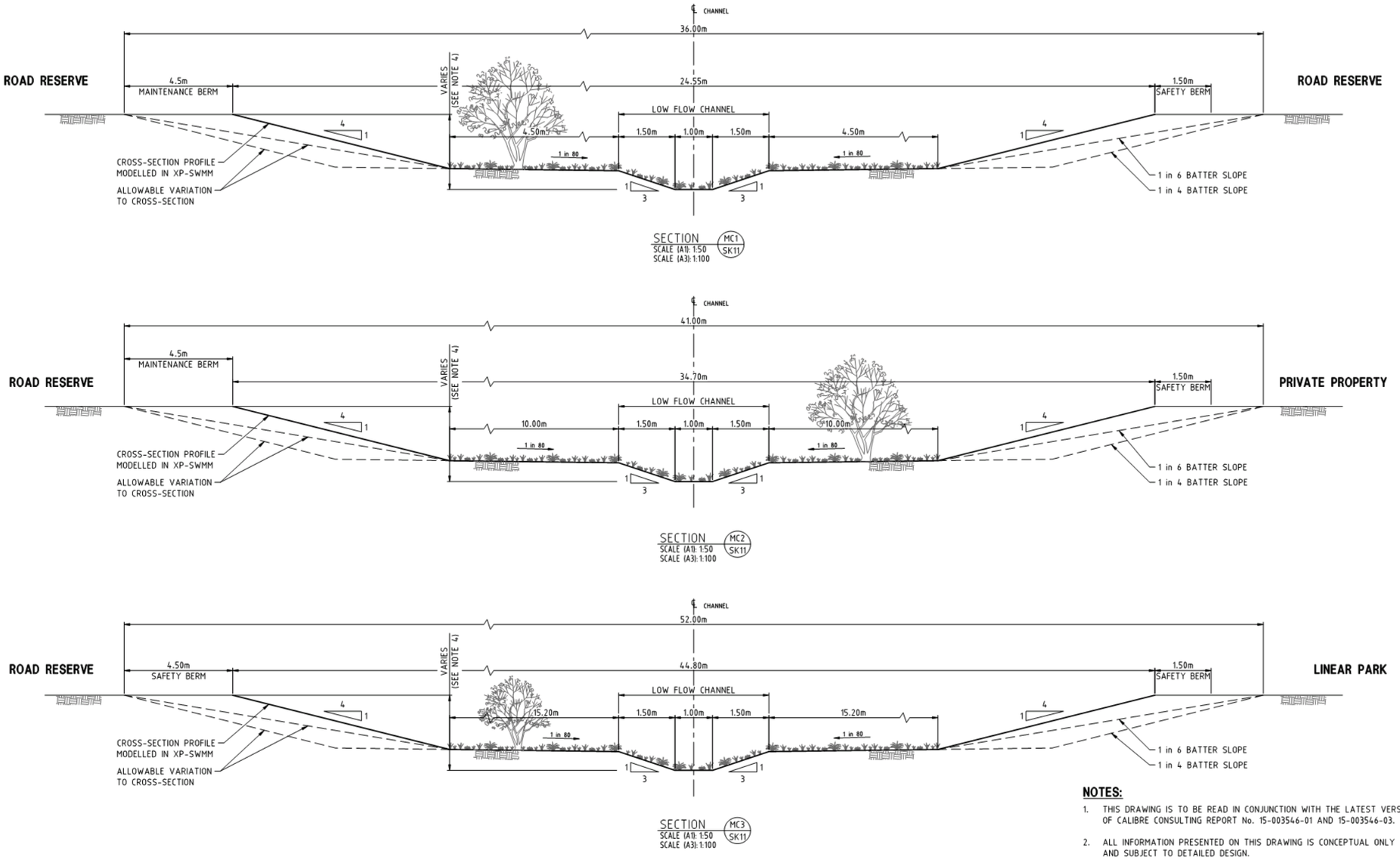
INVESTA RESIDENTIAL GROUP PTY LTD
harmony
15-003546
calibre CONSULTING
XP-SWMM NODE LOCATION PLAN
15-003546-SK11
C



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2. ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY AND SUBJECT TO DETAILED DESIGN.
3. REFER TO DRG. No. 15-003546-SK11 FOR SECTION LOCATIONS.
4. DEPTH VARIES BASED ON BATTER SLOPE AND TOE OF BATTER LOCATION. MINIMUM 2m DEPTH FROM TOP OF BATTER TO LOW FLOW CHANNEL INVERT.
5. FLOOD MODELLING BASED ON NARROWER CHANNEL THAN AVAILABLE IN DRAINAGE RESERVE.

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FIRST ISSUE	CALCS	DRAWN	DATE	AMENDMENT DETAILS
A	CS	JW	23.02.16	
B	CS	JW	31.05.16	MINOR AMENDMENTS
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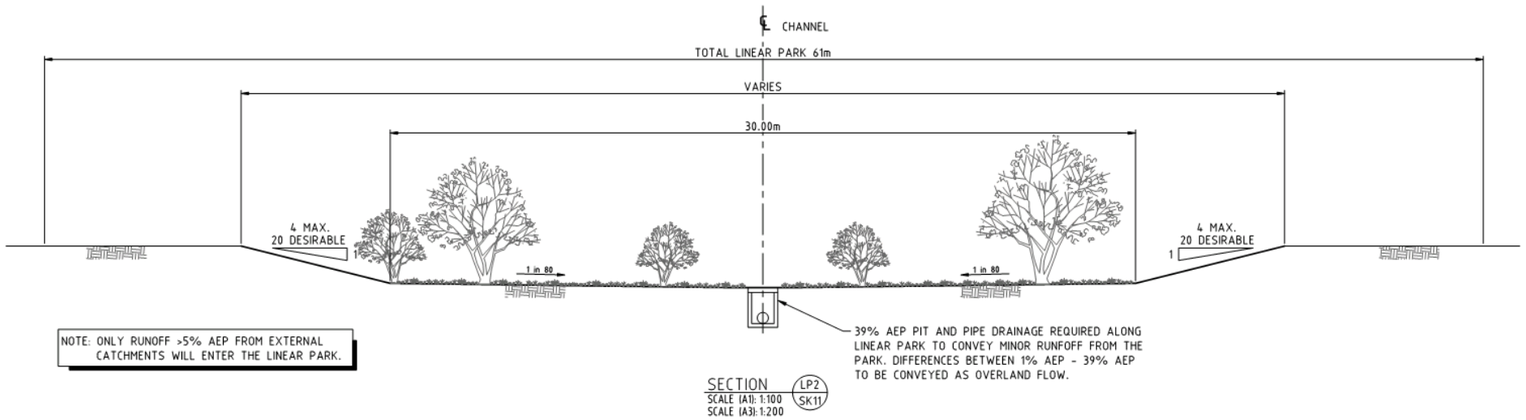
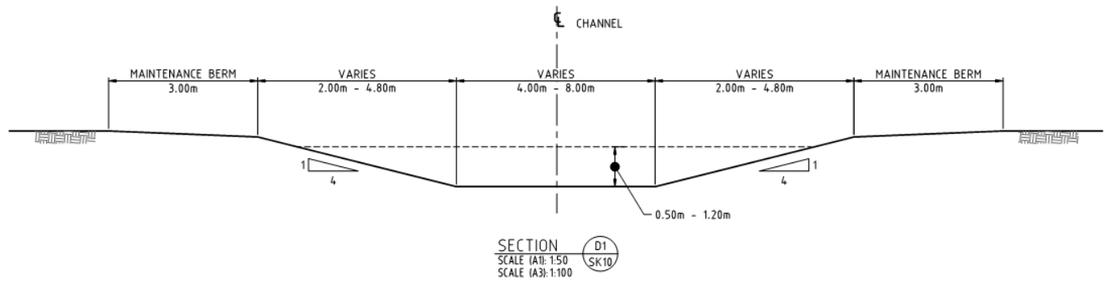


1% AEP FLOW CHARACTERISTICS THROUGH LINEAR PARK

DEPTH OF FLOW (mm)	79 TO 573
MAX. VELOCITY (m/s)	0.57
DEPTH-VELOCITY (m^2/s)	0.17



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Xref's: USR: Anthony Skaric

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	C				
	D				
	E				
	F				

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DRAWN CHECK
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MICROFILM No.
PROJECT No. 15-003546
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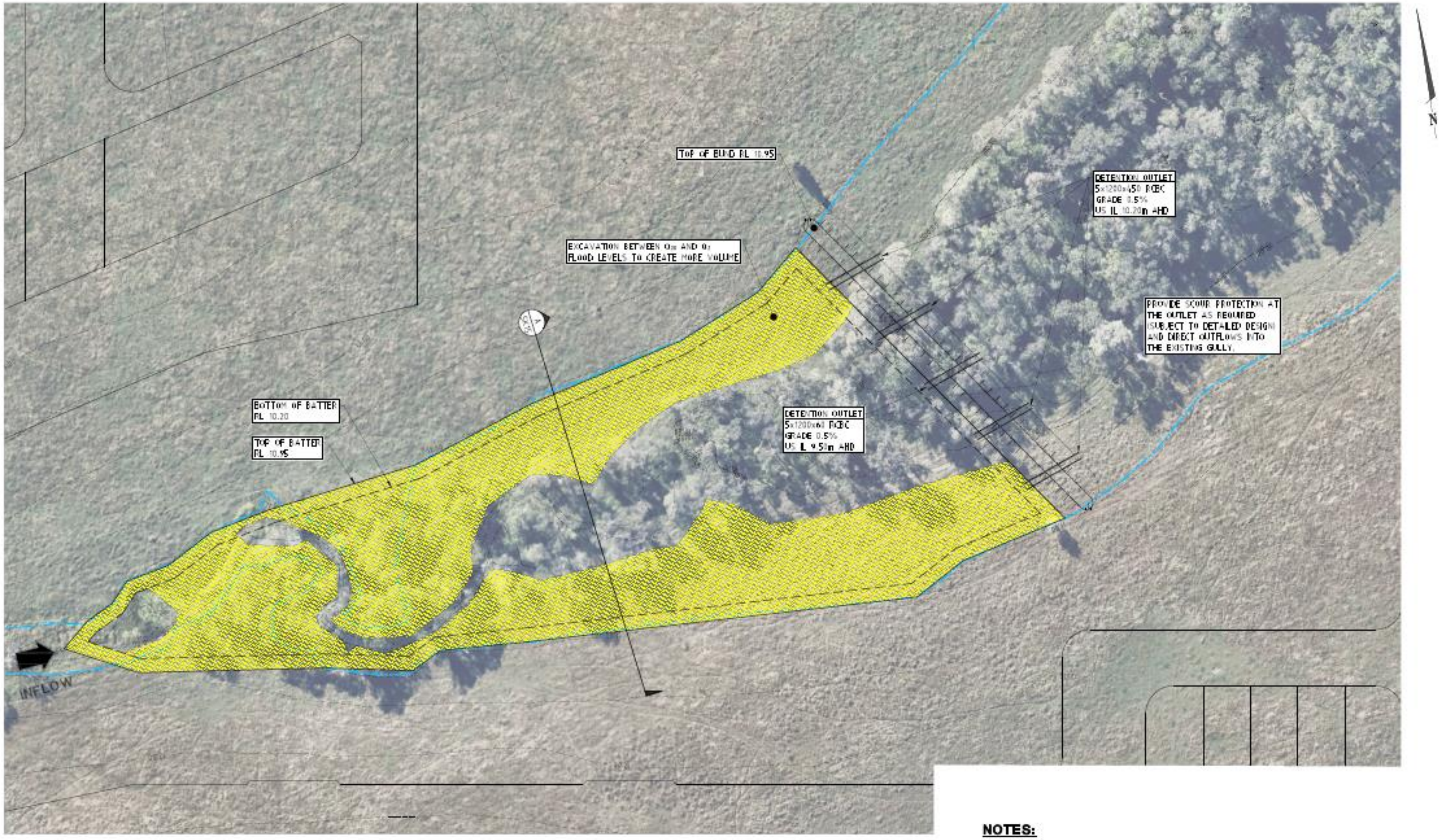
Quality Endorsed Company ISO 9001 Ltr 4054
DRAWING TITLE
LINEAR PARK AND D1 TYPICAL SECTIONS
DRAWING NUMBER 15-003546-SK13
ISSUE B



DETENTION BASIN
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– – – – – –	EXISTING CONTOURS
(yellow hatch)	AREA OF EXCAVATION
(blue dashed line)	Q FLOOD EXTENTS (RL10.95m AHD)

NOTES:

1. THE EXISTING CONTOURS SHOWN ARE BASED ON LIDAR DATA PROVIDED BY SUNSHINE COAST REGIONAL COUNCIL.
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PROJECT No. 15-003546

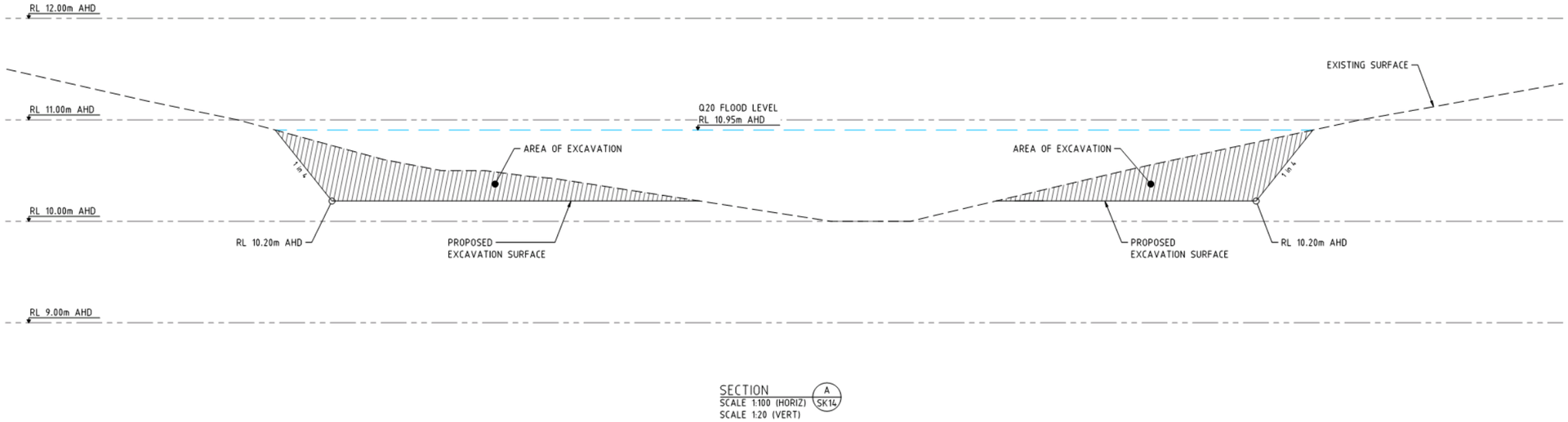
CLIENT: INVESTA RESIDENTIAL GROUP PTY LTD

PROJECT: harmony INVESTA

calibre CONSULTING

DRAWING TITLE: PROPOSED 63% AEP DETENTION BASIN CONCEPT PLAN

DRAWING NUMBER: 15-003546-SK14



SECTION A
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SCALE 1:20 (VERT)

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A	CS	JW	30.06.16

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VERTICAL

MICROFILM No.

PROJECT No. 15-003546

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DRAWING TITLE
DETENTION BASIN
CROSS SECTION

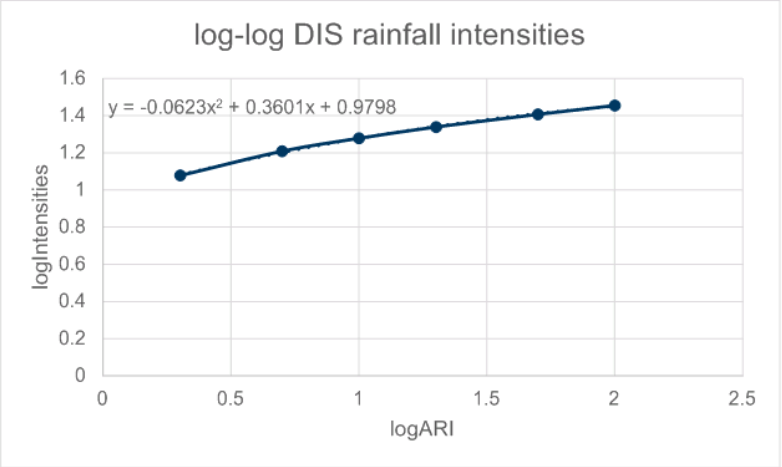
DRAWING NUMBER 15-003546-SK15

ISSUE

APPENDIX C – 63% AEP DIS RAINFALL INTENSITIES

ARI	logARI	Intensity (mm/5 minutes)	logIntensity
1*	0.00	9.54	0.97
2	0.30	11.98	1.07
5	0.69	16.17	1.20
10	1.00	18.99	1.27
20	1.30	21.83	1.33
50	1.69	25.51	1.40
100			

*extrapolated data



TABLES

FIGURES

APPENDICES

1 INTRODUCTION

Calibre Consulting (Qld) Pty Ltd has been commissioned by Investa Residential Group Pty Ltd (the Client) to prepare a *Concept Stormwater Management Plan* to support the Area Development Application for the proposed Harmony Development at Palmview. Refer to **Appendix A** for the Harmony Development area plan.

This document specifically provides details regarding the local flooding and waterway stability management strategies relating to the Ultimate Northern Harmony Development. For clarity and consistency the Ultimate Norther Harmony Development area will herein be referred to as the "site". Refer to **Figure 2-1.**

The analysis presented in this report is consistent with the Calibre Consulting's *Concept Stormwater Management Plan* (Report No. **15-003546-01**) prepared for the ROL and Area Development Application – MCU16/0085 and also provides responses to items 5 to 9 of SCRC's *Information Request* dated 29 June 2016 associated with MCU16/0085.

The analyses demonstrate that the development will comply with relevant Local and State Government requirements with respect to stormwater drainage and waterway stability management.

This report does not include stormwater quality management details. The stormwater quality management strategy is presented in the overall masterplan strategy for the Harmony development:

- *Water Sensitive Urban Design Strategy for Harmony Issue D* dated July 2016 by Netgain Environments.

A local flood analysis has been undertaken for the main drainage channel proposed through the Ultimate Northern Harmony Development. A regional flood analysis of Sippy Creek has also been undertaken and is presented in a separate report titled *Flood Impact Assessment*, prepared by Calibre Consulting (Report No. **15-003546-02**).

In accordance with the *Palmview Structure Plan* acceptable outcome *AO33.2*, soft elements of Water Sensitive Urban Design (WSUD) are proposed within the regional recreational and district recreational parks. Soft elements of WSUD are proposed to consist of grassed swales, bioretention, wetlands and dry detention basins.

One of the soft elements of WSUD proposed within a regional recreation park is a dry detention basin to satisfy the waterway stability management criteria. A bund is proposed to create a dry detention basin controlled by RCBC outlet culverts at the downstream end of the channel, within the regional recreational park. This dry detention basin will mitigate the 63% AEP peak flows from the development. The detention basin will be located at levels below the 5% AEP regional flood level and the park will achieve the total unconstrained area provision as detailed on *OPM P11*. The regional recreational park will be provided in accordance with *Planning Scheme Policy* for *Palmview Structure Plan*, *Table SC6.20J – Urban Open Space Infrastructure Network Attributes*.

1.1 SCOPE OF THIS REPORT

The scope of this report includes the following:

- A Local flood analysis for sizing of the drainage channel through the Ultimate Northern Harmony Development area. This includes:
    a. Delineation of post-development catchments discharging runoff to the drainage channel;
    b. Hydrological modelling using Unified River Basin Simulator (URBS) model for the 1% Annual Exceedance Probability (AEP) storm event for the 2100 climate change horizon;
    c. Hydraulic modelling of the drainage channel using XP-SWMM 1D for the 1% AEP climate change scenario and a sensitivity scenario using a higher hydraulic roughness Manning's n value of 0.15; and
    d. Nomination of minimum allotment levels based on 500mm freeboard to the 1% AEP or the sensitivity scenario (whichever produces the higher flood level) from flood levels from the nearest XP-SWMM cross section;
- Conceptual design of a dry detention basin to address the waterway stability management criteria in accordance with the *SPP* (2014) and SCRC's *Stormwater Management Code* (2014).

2 SITE CHARACTERISTICS

2.1 LOCATION & SITE DETAILS

The proposed development is located in the suburb of Palmview within the Sunshine Coast Regional Council (SCRC) Local Government Area. The proposed Ultimate Northern Harmony Development area is approximately 172ha and is comprised of a number of existing titles best described as Lot 505 on SP235650, Lots 1-3 on RP165741 and Lot 345 on CG5011.

The Ultimate Harmony Development is bound by the Bruce Highway to the west, the suburb of Sippy Downs to the north, open space to the east and the Palmview Conservation Park to the south. **Figure 2-1** illustrates the approximate locations of the Ultimate Harmony Development and the Northern Harmony Development area.

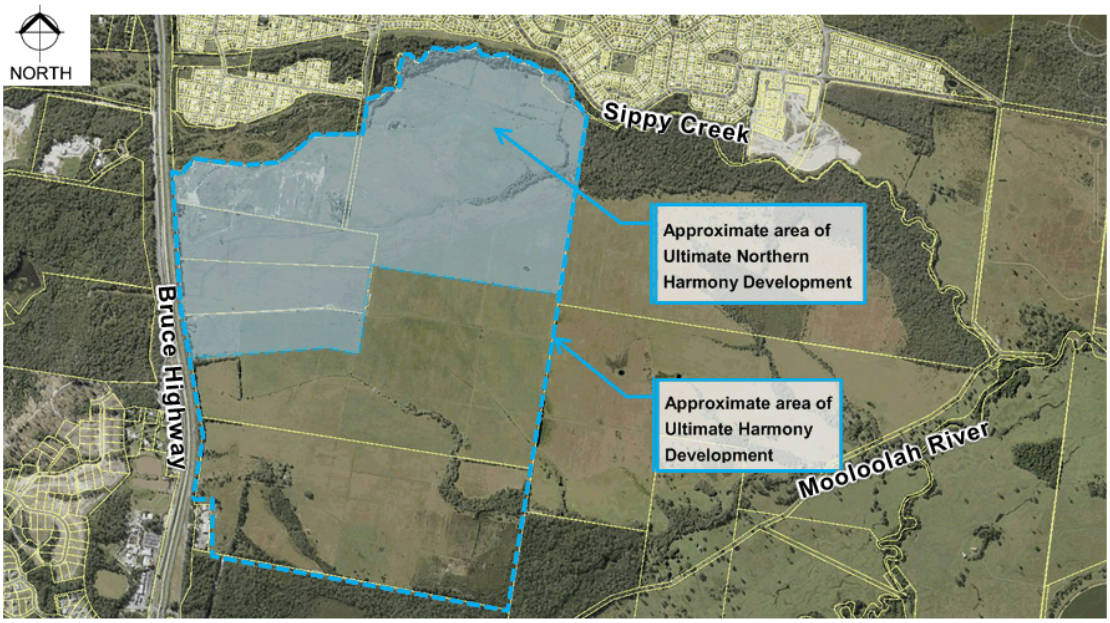


Figure 2-1: Indicative Site Location (Source: Nearmap)

2.2 EXISTING LAND USE, TOPOGRAPHY & DRAINAGE

The site is located on low-lying land adjacent to Sippy Creek and the Mooloolah River and forms part of the lower coastal floodplain of the Mooloolah River and the Sippy Creek. The topography across most of the site is very flat with typical slopes of between 0.5% and 1%.

The current land use of the site is grazing with the majority of the site cleared to accommodate rural activities. Under existing conditions, rainfall runoff occurs via sheet flow across much of the site before entering either shallow man-made drains or more natural vegetated channels. There is one major drainage channel through the northern portion of the site which discharges through a vegetated drainage corridor to Sippy Creek and then to the Mooloolah River. Two major drainage channels exist through the southern portion of the site which drain to the Mooloolah River. These southern drainage lines also receive flows from small external catchments located west of the Bruce Highway.

3 LOCAL FLOODING

This section provides details regarding the local flood analysis undertaken for the proposed internal drainage channel within the Ultimate Northern Harmony Development. Refer to Calibre Drawing No. **15-003546-SK11** in **Appendix B** for a plan of the proposed drainage channel. The proposed drainage channel runs from the internal north-south road of the development and joins the existing gully line through the proposed regional recreational park before discharging to Sippy Creek to the east.

The conceptual sizing of this drainage channel has been undertaken using XP-SWMM 1D hydraulic analysis. The hydrological analysis of the contributing catchments were undertaken using URBS modelling for 1% AEP storm event for the 2100 climate change horizon.

The subsequent sections present these hydrological and hydraulic analyses.

3.1 HYDROLOGY

Hydrological modelling of the catchments discharging to the proposed drainage channel has been undertaken using an existing calibrated URBS model for the Sippy Creek catchment supplied by SCRC. The SCRC URBS model had already been calibrated for the Sippy Creek catchment, no additional calibration was undertaken as part of the current analysis. The Duration Independent Storm (DIS) temporal patters and rainfall intensities provided by SCRC in their URBS model were utilised for this assessment.

3.1.1 CATCHMENTS

The catchment parameters adopted for the hydrologic analysis for local inflows into the proposed drainage channel are shown below in **Table 3-1**. Refer to Calibre Drawing No. **15-003546-SK10** in **Appendix B** for the catchment plan.

Table 3-1: Developed Catchment Parameters

Catchment	Area (ha)	Adopted Fraction Impervious (%)	Slope (%)	Approx. Flow Path Length (m)
L1	34.32	55%	0.50%	550
L2	1.36	65%	0.70%	250
L3	4.50	65%	1.00%	200
L4	5.45	70%	0.80%	250
L5	1.69	55%	1.30%	150
L6	0.94	60%	1.00%	100
L7	6.79	55%	0.60%	250
L8	4.59	55%	0.60%	200
L9	1.22	60%	0.80%	250
L10	4.68	65%	0.75%	200
L11	3.70	65%	0.65%	150

Under existing conditions, an upstream catchment is conveyed into the development site by culverts under the Bruce Highway. It is proposed to divert this upstream catchment directly north to Sippy Creek. As such, only the areas east of Bruce Highway will contribute runoff to the proposed drainage channel. Refer to the latest version of the report titled *Flood Impact Assessment* prepared by Calibre Consulting (Report No. **15-003546-02**) for regional catchment management.

The adopted fraction impervious values were calculated based on 70% fraction impervious for development areas and 5% fraction impervious for drainage channel and linear park areas. This is consistent with the assumptions in the regional *Flood Impact Assessment* which utilised a lumped catchment approach for the Ultimate Northern Harmony Development

3.1.2 PEAK FLOWS

The catchments identified in **Table 3-1** were included into the URBS model provided by Council and local hydrographs were extracted for the 1% AEP storm event for the 2100 climate change horizon. The URBS model incorporated proportional loss of 0.89 (11% loss) and Manning's n value of 0.055. **Table 3-2** presents the local peak flows obtained from URBS model.

Table 3-2: 1% AEP Climate Change Peak Flows

Catchment	Peak Flow (m^3/s)
L1	16.8
L2	1.0
L3	3.4
L4	3.7
L5	1.6
L6	1.0
L7	4.4
L8	3.2
L9	1.1
L10	3.3
L11	2.6

The 1% AEP storm event for the 2100 climate change horizon local hydrographs have been used for XP-SWMM hydraulic modelling.

3.2 HYDRAULICS

As mentioned previously, hydraulic modelling was undertaken using the XP-SWMM 1D software package. The following sections present the hydraulic model setup and the corresponding flood results.

3.2.1 XP-SWMM MODEL LAYOUT

The XP-SWMM model was set for a channel length of approximately 800m through the Ultimate Northern Harmony Development. The model extended from upstream of the internal north-south road crossing to Sippy Creek at the downstream end. The model extent is shown in **Figure 3.1**.

A 8,000m^3 detention storage is proposed at the downstream end of the channel. The basin is created with a bund at RL 10.95m AHD to mitigate the 63% AEP storm event and achieve the waterway stability management requirement. Refer to **Section 4** for details of the dry detention storage and its performance during 63% AEP storm event.

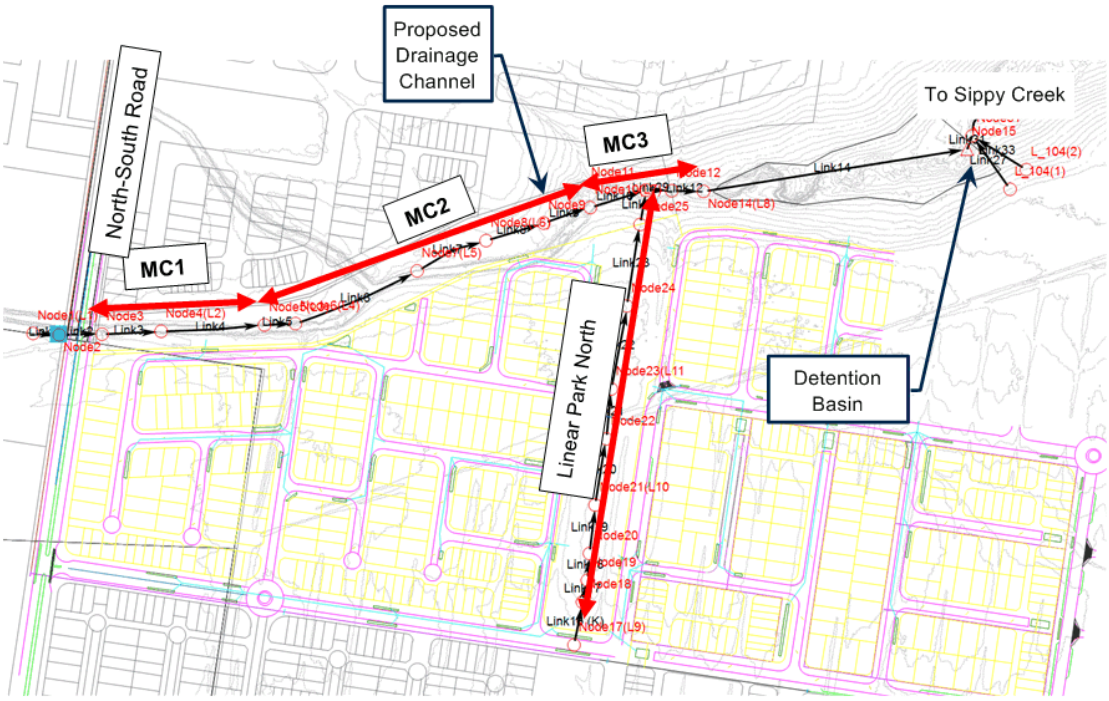


Figure 3.1: XP-SWMM Extent

A pit and pipe system will be provided within the linear park for conveying flows up to and including the 39% AEP from the linear park. Refer to Calibre Consulting Drawing No. **15-003546-SK12** in **Appendix B.** This underground drainage network has not been included in current modelling but will be sized during the detailed design.

3.2.2 CROSS SECTIONS

The proposed drainage channel was analysed in segments in order to represent the inflow locations of stormwater drainage from the Ultimate Northern Harmony Development. The channel cross sections modelled for each channel reach identified in **Figure 3.1** are shown on Calibre Drawings Numbered **15-003546-SK12** and **SK13** in **Appendix B** and are summarised below. The manning's n value of 0.12 has been adopted in accordance with *Schedule 6* of the SCRC *Planning Scheme Policy for Development Works* (2014) for the proposed drainage channel. A Manning's n value of 0.04 has been adopted for the linear park to represent the turf area that will convey runoff.

Table 3-3: Drainage Channel Cross Sections Modelled

Parameter	MC1	MC2	MC3	Linear Park
Top Width (m)	30	40	50	42
Total Depth (m)	2	2	2	1
Low Flow Drain	1m base width 0.5m depth	1m base width 0.5m depth	1m base width 0.5m depth	Pit and Pipe system, sized during detailed design
Drain Batters	Maximum of 1V:4H (with variations to 1V:6H)	Maximum of 1V:4H (with variations to 1V:6H)	Maximum of 1V:4H (with variations to 1V:6H))	1V:4H
Adopted Manning's 'n'	0.12	0.12	0.12	0.04
Ave. Long Slope (%)	0.3	0.4	0.45	0.4

As mentioned earlier, a pit and pipe system will be provided within the linear park for conveying flows up to and including the 39% AEP from the linear park. Refer to Calibre Consulting Drawing No. **15-003546-SK12** in **Appendix B.** This underground drainage network will be sized during the detailed design. The linear park has been modelled with a 30m base and 1 in 4 side batters, however the batter profile will vary subject to landscape design. The 30m wide base represents the minimum width through the linear park. A wider base can be achieved across the grass kick and throw areas.

3.2.3 INFLOWS

The local inflow hydrographs from the URBS modelling were input directly into the XP-SWMM model. **Figure 3.2** below illustrates the inflow node names and locations and the corresponding inflow catchment name (in brackets). Refer to Calibre Drawing No. **15-003546-SK10** in **Appendix B** for the catchment delineation.

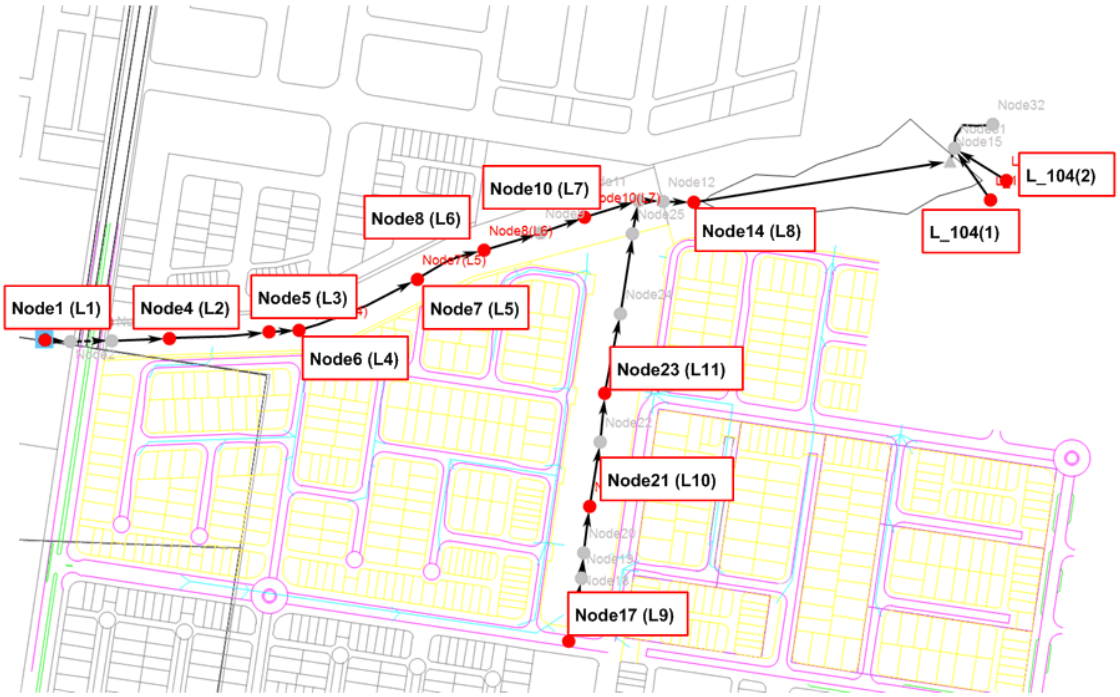


Figure 3.2: XP-SWMM Inflow Nodes

The 5% AEP runoff from all the catchments are proposed to discharge directly into the proposed drainage channel via the urban drainage network. Only runoff in excess of the 5% AEP from Catchments L9, L10 and L11 will enter the linear park. Therefore the linear park will maintain flood immunity to the 5% AEP storm event. Moreover, the barbecues, shelters and play areas will be located above the 1% AEP flood levels.

The diversion of the 5% AEP flow has been incorporated in the 1% AEP XP-SWMM model.

3.2.4 DOWNSTREAM BOUNDARY CONDITION

In accordance with *Table 3* of SCRC's *Planning Scheme Policy for the Flood Hazard Overlay (SC6.9)*, a review of the Local to Regional Catchment at the downstream end of the XP-SWMM model has been undertaken to determine the relevant downstream tailwater level. Refer to **Table 3-4** for the flood event combination.

Table 3-4: Local to Regional Flood Event Combination

Parameter	Value
Regional Catchment Area (ha)	1,602
Local Catchment Area (ha)	70.3
Ratio of Local to Regional Catchment Area (A_L/A_R)	0.04
Event Combination (Regional + Local)	5% AEP + 1% AEP

The Regional flood modelling determined the 5% AEP flood level on Sippy Creek to be 10.95m AHD. This was used as the downstream boundary condition for the 1% AEP local flooding XP-SWMM model.

3.2.5 CULVERT SETUP

The culverts proposed under the internal north-south road crossing and the culvert outlet from the detention basin were conceptually sized and included in the Local flood analysis. Refer to **Table 3-5** for the culvert parameters modelled. The design blockage values were adopted in accordance with *Table 10.4.1* of the *Queensland Urban Drainage Manual* (*QUDM*, 2013) for the upstream culverts.

Table 3-5: Culvert Crossing

Parameter	Upstream Culvert	Downstream Culvert
Culvert	5 \ 1800 x 600 RCBCs and 4\1800 span slabs	4 \ 1200 x 450 RCBCs and 1 \ 1200 x 600 RCBC
Manning's n	0.013	0.013
Slope (%)	0.3	0.5
Design Blockage	25% bottom-up culvert blockage	25% bottom-up culvert blockage

3.2.6 LOCAL FLOOD RESULTS

The flood level results at the XP-SWMM node locations identified in **Figure 3.2** are presented in **Table 3-6**. Refer to Calibre Drawing No. **15-003546-SK11** in **Appendix B** for the node locations in relation to the development area.

Table 3-6: 1% AEP Climate Change Flood Levels

Node	Flood Level (m AHD)	Flood Depth (m)	Location Description
Node2	15.17	2.55	Upstream headwall of culvert crossing.
Node3	14.56	2.06	Upstream end of the drainage channel / downstream headwall culvert crossing, cross section MC1
Node4(L2)	14.37	1.93	
Node5(L3)	13.90	1.86	
Node6(L4)	13.69	1.74	Start of cross section MC2
Node7(L5)	13.17	1.75	
Node8(L6)	12.86	1.67	
Node9	12.50	1.53	Start of cross section MC3
Node10(L7)	12.30	1.54	
Node11	11.99	1.42	Junction with linear park
Node12	11.97	1.42	
Node14(L8)	11.39	0.87	Entrance to detention basin (refer to **Section 4**)
Node15	11.33	1.83	Detention Basin
Node33	11.12	1.67	Downstream of Detention Basin
Node18	12.98	0.08	Upstream end of the linear park
Node19	12.89	0.08	
Node20	12.79	0.09	
Node21(L10)	12.71	0.17	
Node22	12.48	0.19	
Node23(L11)	12.37	0.22	
Node24	12.06	0.22	
Node25	11.99	0.57	Downstream end of the linear park, joins to proposed drainage channel

The results demonstrate that the 1% AEP storm event for the 2100 climate change horizon for the proposed drainage channel will be contained within the designed channel cross sections (MC1, MC2 and MC3 on Drg No. **15-003546-SK10**). The flood depths within the linear park do not exceed 0.6m and are significantly below the adjacent allotment levels.

The model predicts that the flood level upstream of the north-south road culvert crossing is 15.21m AHD. It is understood that in the ultimate development scenario the upstream headwall of these culverts will be reconfigured to allow for upstream pipe connections from future stormwater drainage. The configuration will be determined during subsequent Development Applications. Depth-velocity (DV) products within the drainage channel and linear park are provided below in **Table 3-7.**

Table 3-7: 1% AEP Climate Change Flow Velocities & DV Products

U/S – D/S Nodes	Max. Flow (m^3/s)	Max. Velocity (m/s)	Max. DV Product (m^2/s)	Cross Section
Node2 – Node3 (culvert)	15.63	2.10	4.52	Culvert crossing
Node2 – Node3 (road)	0.91	0.28	0.03	North-South Road
Node3 – Node 4(L2)	16.47	0.55	1.096	MC1
Node4(L2) – Node5(L3)	16.75	0.62	1.176	MC1
Node5(L3) – Node6(L4)	17.98	0.71	1.28	MC1
Node6(L4) – Node7(L5)	19.63	0.57	0.99	MC2
Node7(L5) – Node8(L6)	19.96	0.57	0.98	MC2
Node8(L6) – Node9	20.14	0.63	1.01	MC2
Node9 – Node10 L7)	20.15	0.53	0.82	MC3
Node10 (L7) – Node11	22.28	0.59	0.88	MC3
Node11 – Node12	22.72	0.24	0.34	MC3
Node12 – Node14(L8)	22.72	0.76	0.87	MC3
Node18 – Node19	0.77	0.31	0.03	Linear Park
Node19 – Node20	0.74	0.31	0.03	Linear Park
Node20 – Node21 (L10)	0.65	0.23	0.03	Linear Park
Node21 (L10) – Node22	2.51	0.48	0.09	Linear Park
Node22 – Node23 (L11)	2.47	0.42	0.09	Linear Park
Node23 (L11) – Node24	3.85	0.57	0.12	Linear Park
Node24 – Node25	3.62	0.49	0.17	Linear Park

The results demonstrate that both the drainage channel and the linear park have generally low velocities. The average velocity within the drainage channel is 0.94m/s while the average velocity within the linear park is 0.40m/s.

The predicted DV products within the drainage channel are above the recommended safety limit of $0.6m^2/s$ primarily due to flow depths. Appropriate safety in design measures (batter slopes for egress, appropriate bollards and signage) may be implemented to manage the safety risks associated with the drainage channel during high flow events. The predicted DV products within the linear park are well below $0.4m^2/s$.

The north-south road at the upstream end of the drainage channel is overtopped during the 1% AEP Climate Change scenario. The upstream flood level is 15.17m AHD. The road embankment RL of this road is 15.02m AHD. This results in 150mm transverse flow depth and is below the maximum flow depth limit outlined in *Table 7.4.4* of the *QUDM* (2013). Refer to **Table 3-8** for road flow results compared against the *QUDM* (2013) limits.

Table 3-8: 1% AEP Climate Change Road Flow

Parameter	XP-SWMM Model Results	QUDM (2013) Limit
Flow Depth (mm)	150	200*
DV product (m^2/s)	0.03	0.3

*Note 200mm flow depth limit is where there is risk to life (e.g. causeway). The flow depth limit is 300mm where there is no risk to life.

3.2.7 SENSITIVITY SCENARIO

In accordance with SCRC's *Planning Scheme Policy for the Flood Hazard Overlay (SC6.9)*, a sensitivity analysis has been undertaken. A conservative (high) Manning's n value of 0.15 has been used for the sensitivity analysis. The flood levels are presented in **Table 3-9**.

Table 3-9: 1% AEP Climate Change Sensitivity Scenario Flood Levels

Node	Flood Level (m AHD)	Flood Depth (m)	Location Description
Node2	15.24	2.62	Upstream headwall of culvert crossing.
Node3	14.73	2.23	Upstream end of the drainage channel / downstream headwall of culvert crossing, cross section MC1
Node4 (L2)	14.53	2.10	
Node5 (L3)	14.06	2.02	
Node6 (L4)	13.84	1.90	Start of cross section MC2
Node7 (L5)	13.32	1.90	
Node8 (L6)	12.99	1.81	
Node9	12.62	1.65	Start of cross section MC3
Node10 (L7)	12.41	1.66	
Node11	12.09	1.52	Junction with linear park
Node12	12.06	1.51	
Node14 (L8)	11.40	0.87	Entrance to detention basin (refer to **Section 4**)
Node15	11.34	1.84	Detention Basin
Node18	13.06	0.17	Upstream end of the linear park
Node19	12.96	0.15	
Node20	12.89	0.19	
Node21 (L10)	12.86	0.32	
Node22	12.64	0.35	
Node23 (L11)	12.53	0.38	
Node24	12.22	0.38	
Node25	12.09	0.67	Downstream end of the linear park, joins to the drainage channel.

It was noted that at the upstream portion of the drainage channel (Node3, Node4 and Node5), the flood depths exceeded the channel depth (2m). This is considered acceptable for the following reasons:

- The sensitivity scenario modelled is a maximum conservative sensitivity test based on DIS temporal pattern hydrology, with a 20% increase in intensities to account for climate change conditions combined with a high Manning's n value representing unmaintained, densely vegetated channel conditions;
- The drainage channel is adjacent to roads, which will convey any overtopped flood water; and
- The minimum allotment levels will be located at or above the sensitivity scenario flood levels (refer **Section 3.2.8**).

For all other node locations, the depth of inundation during the sensitivity scenario is below the minimum channel depth.

The flood depths increased by 70mm to 160mm along linear park during the sensitivity scenario. The velocities, however decreased due to high surface roughness adopted and consequently the DV products reduced to below 0.1m²/s during the sensitivity scenario.

3.2.8 FLOOD IMMUNITY

In accordance with *Table 8.2.7.3.3* of SCRC's *Flood Hazard Overlay Code* (2014), the following minimum allotment levels are proposed based on Local flood conditions through the proposed drainage channel and the linear park. Refer to Drawing No. **15-003545-SK11** in **Appendix B** for the node locations and corresponding minimum allotment levels on plan.

Table 3-10: Local Flooding - Flood Immunity Levels

Node	1% AEP Flood Level (m AHD)	+ 0.5m Freeboard (m AHD)	Sensitivity Scenario Flood Level (m AHD)	Min. Allotment Level* (m AHD)	Location Description
Node3	14.56	15.06	14.73	15.10	Upstream end of the channel
Node4 (L2)	14.37	14.87	14.53	14.90	
Node5 (L3)	13.90	14.40	14.06	14.40	
Node6 (L4)	13.69	14.19	13.84	14.20	Start of cross section MC2
Node7 (L5)	13.17	13.67	13.32	13.70	
Node8 (L6)	12.86	13.36	12.99	13.40	
Node9	12.50	13.00	12.62	13.00	Start of cross section MC3
Node10 (L7)	12.30	12.80	12.41	12.80	
Node11	11.99	12.49	12.09	12.50	Junction with linear park
Node12	11.97	12.47	12.06	12.50	
Node14 (L8)	11.39	11.89	11.40	11.90	Upstream of Detention Basin
Node15	11.33	11.83	11.34	11.85	Detention Basin
Node31	11.12	11.62	11.06	11.65	Downstream of Detention Basin
Node18	12.98	13.48	13.06	13.50	Upstream end of the linear park
Node19	12.89	13.39	12.96	13.40	
Node20	12.79	13.29	12.89	13.30	
Node21 (L10)	12.71	13.21	12.86	13.25	
Node22	12.48	12.98	12.64	13.00	
Node23 (L11)	12.37	12.87	12.53	12.90	
Node24	12.06	12.56	12.22	12.60	
Node25	11.99	12.49	12.09	12.50	Downstream end of the linear park, joins to the channel.

*Min. allotment level rounded up to nearest 50mm.

Allotments adjacent to Sippy Creek should adopt minimum allotment levels based on the maximum of either the Local or Regional flood levels. Refer to the latest version of the report titled *Flood Impact Assessment*, prepared by Calibre Consulting (Report No. **15-003546-02**) for Regional flooding details.

4 WATERWAY STABILITY MANAGEMENT

To satisfy the waterway stability management criteria within Council's *Planning Scheme Policy for Development Works Code (SC6.14,* 2014) and the *SPP* (2014), 63% AEP peak flows from the development site need to be mitigated to below or equal to existing conditions.

It is proposed to provide a small dry detention basin using a bund and outlet downstream of the central drainage channel (within the regional recreational park) to mitigate total peak flows from the development. The detention system will be limited to below the regional 5% AEP regional flood level (10.95m AHD) and the primary outlets will be located at the regional 39% AEP regional flood level (10.20m AHD).

4.1 63% AEP DIS STORM ESTIMATE

The 63% AEP DIS peak rainfall intensity (for each 5 minute time period within the DIS hyetographs) were extrapolated from the rainfall intensities from SCRC provided 39, 10, 5, 2 and 1% AEP events. This was undertaken using a log-log extrapolation. Supporting calculations are provided in **Appendix C**.

Table 4-1: 63% AEP Rainfall Intensity Estimate

AEP (%)	DIS Peak Rainfall Intensity (mm/5 minutes)
63*	9.5*
39	11.9
20	16.1
10	18.9
5	21.8
2	25.5
1	28.4

*extrapolated data

4.2 EXISTING SCENARIO

URBS has been used to determine the existing 63% AEP peak flow at the downstream end of the regional park. A catchment area of 79.2ha has been identified for the existing scenario based on aerial imagery and the existing contour information. The existing scenario catchment delineation is presented in **Figure 4-1** and the existing scenario catchment parameters are presented in **Table 4-2.**

Table 4-2: Existing Catchment Parameters

AEP (%)	Area (ha)	Adopted Fraction Impervious (%)	Slope (%)	Approx. Flow Path Length (m)
401	4.62	20%	8%	205
402	2.86	30%	7%	100
165	71.69	11%	0.08%	1,076

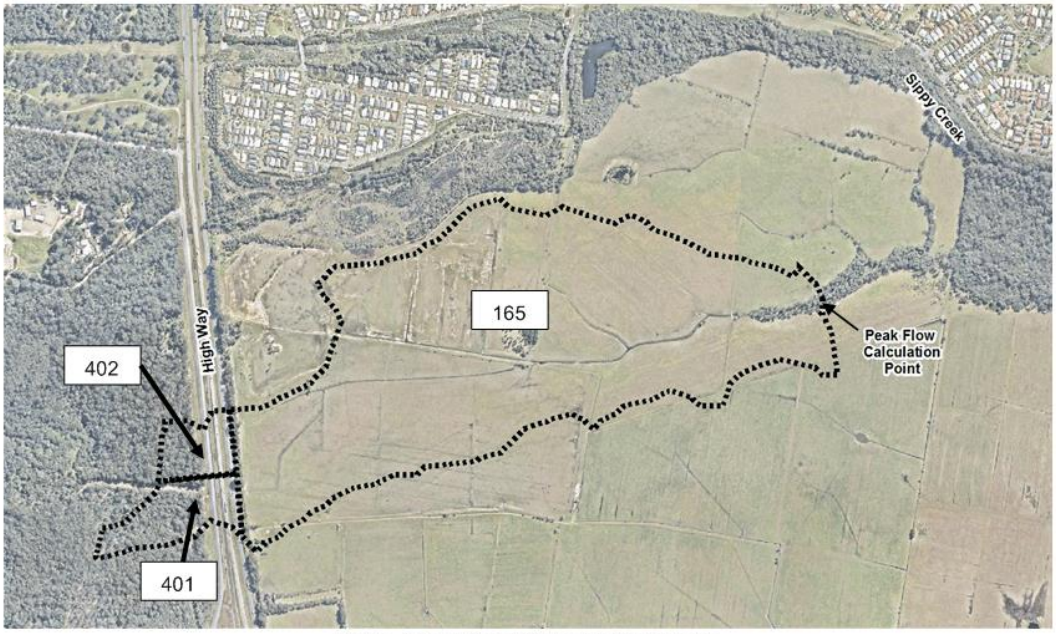


Figure 4-1: Existing Scenario Catchments

An URBS model was set up for the existing scenario 63% AEP using a proportional loss value of 0.9 (i.e 10% loss) and Manning's n value of 0.1. The DIS temporal patterns and 63% AEP rainfall intensity estimate calculated in **Table 4-1** were utilised for this assessment.

Table 4-3 presents the calculated existing scenario peak discharge at the downstream end of the regional park.

Table 4-3: Existing 63% AEP Peak Flow

AEP (%)	DIS Peak Discharge (m^3/s)
63	6.64

4.3 DEVELOPED SCENARIO

The developed scenario 63% AEP hydrological modelling has been undertaken using URBS and the detention basin was modelled using XP-SWMM 1D hydraulic model.

4.3.1 DEVELOPED CATCHMENTS

The catchment parameters adopted for the hydrologic analysis are consistent with the catchments adopted for the conceptual channel design presented in **Section 3.** The developed scenario catchment boundaries are shown on Calibre Drawing No. **15-003546-SK10** in **Appendix B.**

The developed scenario 63% AEP URBS model was set up using a proportional loss value of 0.9 (i.e 10% loss) and Manning's n value of 0.055. The DIS temporal patterns and 63% AEP rainfall intensity estimate calculated in **Table 4-1** were utilised for this assessment.

Table 4-4 presents the calculated 63% AEP peak discharge for each developed scenario catchment.

Table 4-4: Developed 63% AEP Local Peak Flow

Catchment	DIS Peak Discharge (m^3/s)
L1	4.07
L2	0.26
L3	0.79
L4	0.90
L5	0.35
L6	0.22
L7	1.07
L8	0.76
L9	0.25
L10	0.80
L11	0.65
104(1)	0.89
104(2)	1.56

The DIS hydrograph of the abovementioned catchments were utilised in the XP-SWMM model. **Table 4-5** presents the 63% AEP peak discharge at the downstream end of the regional park.

Table 4-5: Developed Unmitigated 63% AEP Peak Flow

AEP (%)	Existing Scenario Peak Discharge (m^3/s)	Developed Unmitigated Peak Discharge (m^3/s)
63	6.64	7.69

The results demonstrate that if left unmitigated, the 63% AEP peak discharge will increase at the downstream end of the regional recreational park.

In order to comply with the *SPP* (2014) waterway stability management criteria, a detention basin is proposed at the downstream end of the regional park.

4.3.2 DETENTION BASIN

The dry detention basin will be created with a small bund constructed to RL 10.95m AHD which is the 5% AEP regional flood level. Refer to Calibre Drawings Numbered **15-003546-SK14** and **SK15** in **Appendix B** for the conceptual location of this dry detention basin.

Excavation is proposed between RL 10.20m and 10.95m AHD as shown on Calibre Drawings Numbered **15-003546-SK14** and **SK15** in **Appendix B.** The proposed excavation is between the 39% and 5% AEP regional flood levels and does not significantly encroach into existing vegetation.

Some vegetation removal will be required for the construction of the bund, however the extent of the area of disturbance will be kept to a minimum, subject to detailed design.

The location of the proposed dry detention basin is located within an area that is already encumbered with 5% AEP flooding from Sippy Creek. Therefore, this detention basin will not compromise the functionality of the regional recreational park.

The outflow is controlled by 1 / 1200 x 600 RCBC at IL 9.50m AHD and 4 / 1200 x 450mm RCBCs at IL 10.20m AHD. The top of the bund has been modelled as a 50m wide weir at RL 10.95m AHD. Scour protection will be provided at the culvert outlets with details subject to detailed design. The outflows will be directed to the existing natural gully which discharges into Sippy Creek.

The following stage-storage relationship has been determined based on the basin topography.

Table 4-6: Basin Storage Characteristics

RL (m)	Area 182(m^2)	Accumulated Volume (m^3)
9.5	182	0
9.6	559	35
9.7	1,084	116
9.8	1,773	257
9.9	2,709	480
10	3,499	789
10.1	4,216	1,175
10.2	7,684	1,761
10.3	7,867	2,539
10.4	8,050	3,334
10.5	8,237	4,149
10.6	8,424	4,982
10.7	8,611	5,833
10.8	8,802	6,704
10.9	8,993	7,594
10.95	9,087	8,046

The above detention basin was incorporated into the XP-SWMM 1D hydraulic model. **Section 4.3.3** provides the results.

4.3.3 PEAK FLOWS

Table 4-7 below presents the 63% AEP peak flow at the downstream end of the regional park, with the abovementioned detention system.

Table 4-7: Developed Mitigated 63% AEP Peak Flow

AEP (%)	Existing Scenario Peak Discharge (m^3/s)	Developed Mitigated Peak Discharge (m^3/s)	Detention RL (m AHD)	Detention Storage (m^3)
63	6.64	6.34	10.94	7,956

The results demonstrate that peak flow mitigation can be achieved for the 63% AEP with approximately 8,000m^3 detention storage. The waterway stability management criteria is therefore achieved. Moreover, the dry detention basin is contained below the regional 5% AEP flood level.

Figure 4-2 below shows a graph of the dry detention basin characteristics over 24 hour period. As cab be seen, the basin will not retain a ponding depth of greater than 300mm for a period of more than 17 hours.

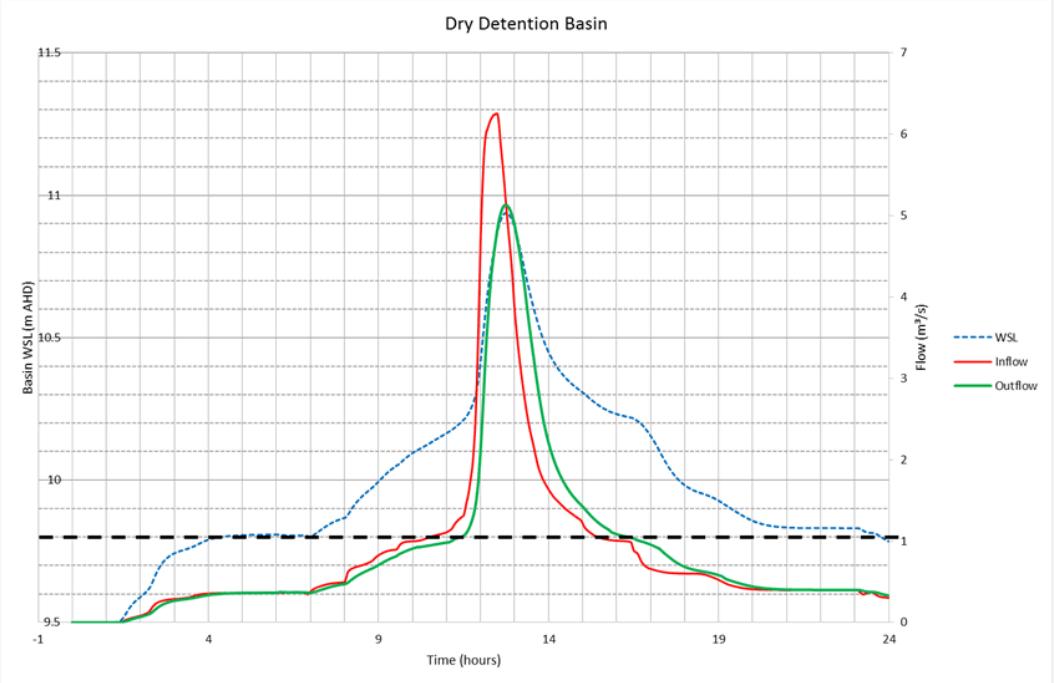


Figure 4-2: 63% AEP Dry Detention Basin

5 CONCLUSION

This *Concept Stormwater Management Plan* has been prepared to support the Section 242 application for the proposed Harmony Development Area. The outcomes of the investigations undertaken are listed below.

- Local Flooding:
  - The proposed 2m deep drainage channel through the development will convey the 1% AEP ultimate development runoff for the 2100 climate change horizon;
  - The linear park proposed will also act as a drainage reserve during 1% AEP major storm event for the 2100 climate change horizon and will convey development runoff between the 5% and the 1% AEP storm event for the 2100 climate change horizon without inundating allotments;
  - Conceptual sizing of the culverts under the internal road crossing is 5 / 1800 x 600mm RCBCs with 4/1800 spanning slabs;
  - The linear park will have low risk flood depths, velocities and DV products during the 1% AEP storm event;
  - Minimum allotment levels have been nominated based on 0.5m freeboard to the 1% AEP ultimate development runoff for the 2100 climate change horizon; and
  - A sensitivity analysis with a higher Manning's roughness value confirmed the appropriateness of the 0.5m freeboard proposed.
- Waterway stability:
  - A 8,000m³ dry detention basin will be created with a bund to RL 10.95m AHD located within the downstream of the drainage channel;
  - The dry detention basin will mitigate 63% AEP peak flows from the development site to achieve the waterway stability management requirement.

The above outcomes a demonstrate compliance with the relevant stormwater quantity management requirements.

6 RECOMMENDATIONS

It is recommended that this *Concept Stormwater Management Plan* be approved on the basis that the development area provides suitable local flooding and waterway stability management strategies.

It is recommended that the strategies presented in this report be incorporated into future designs and applications. The concepts to the strategies proposed may change during future design phases, however the design objectives are to be maintained.

7 REFERENCES

- Department of Energy and Water Supply (31 October 2013), Queensland Urban Drainage Manual (Vol. 1 3rd Ed.).
- Department of State Development, Infrastructure and Planning (July 2014), State Planning Policy.
- Sunshine Coast Regional Council (2014), Sunshine Coast Planning Scheme 2014.

8 DISCLAIMER

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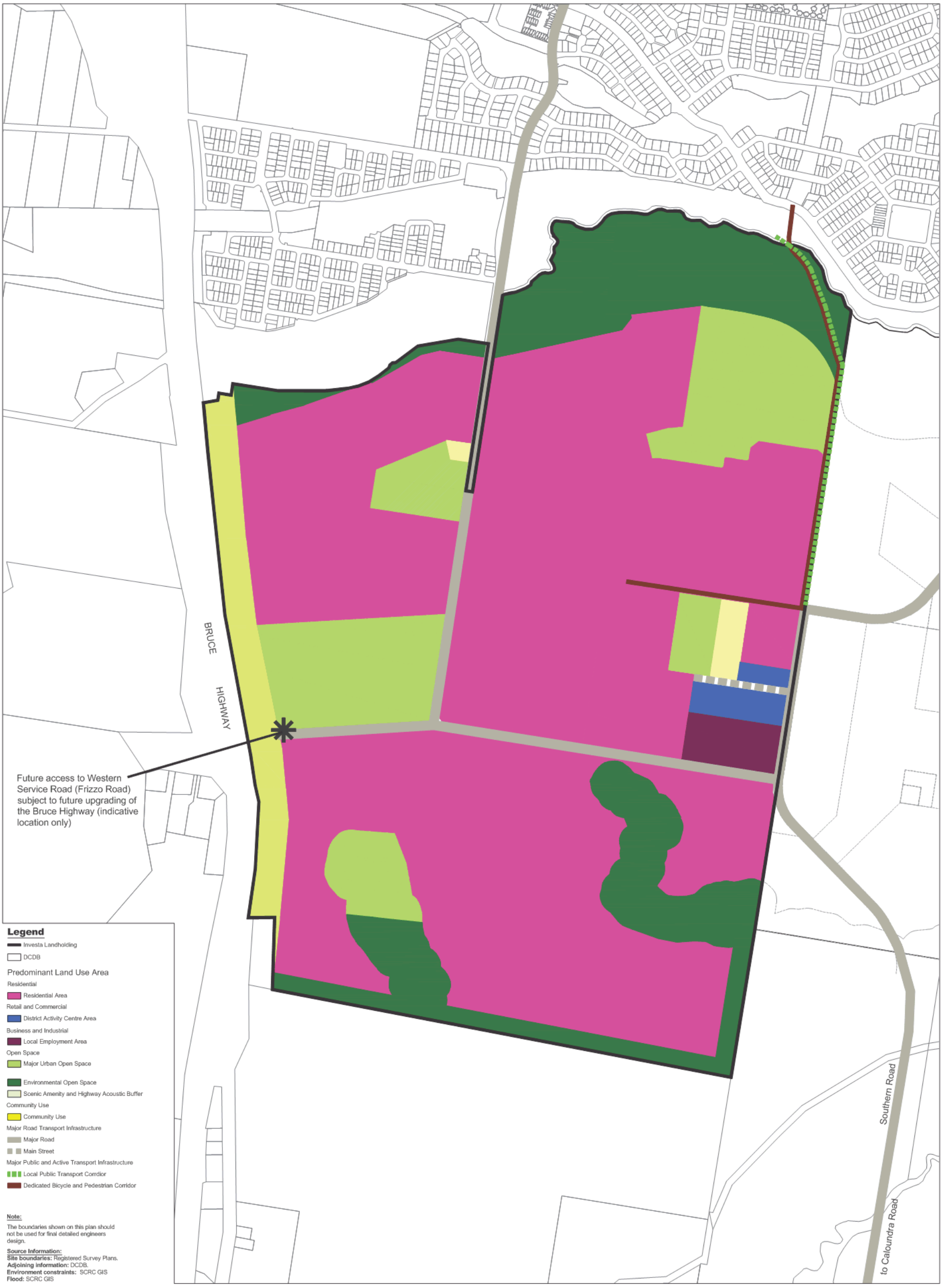
APPENDICES

APPENDIX A – DEVELOPMENT AREA
APPENDIX B – CALIBRE CONSULTING CONCEPT DRAWINGS
APPENDIX C – 63% AEP DIS RAINFALL INTENSITIES

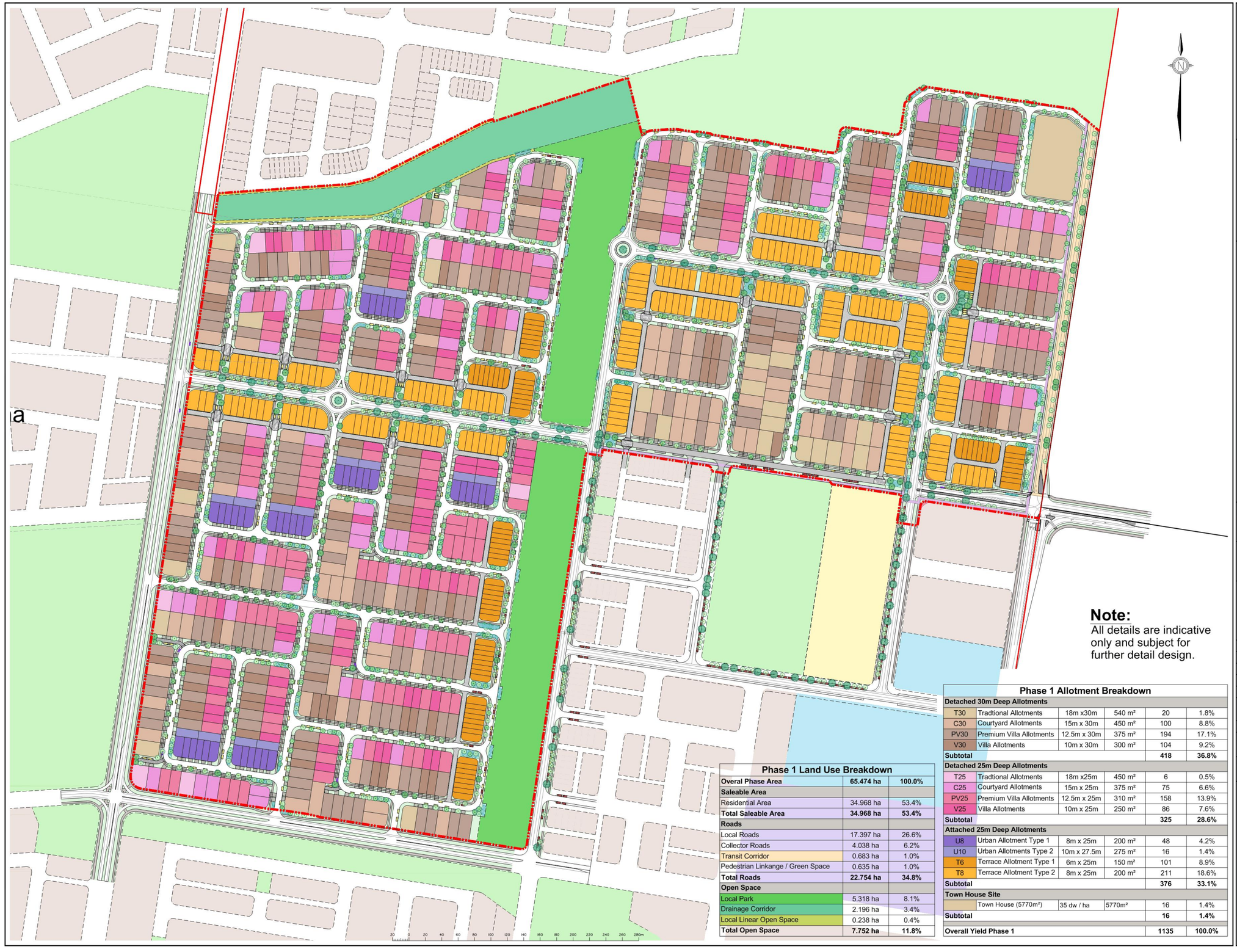
APPENDIX A – DEVELOPMENT AREA



OPM P3 - Area Development Plan (Land Use Structure)

harmony RPS

SCALE 1 : 5000 @ A1 | DATE MAR 2016 | DWG # 22470 - 279c



REVISION
A: 16/12/15 Layout Changes
B: 16/03/16 Layout Changes
C: 24/03/16 Layout Changes

Note:
All Lot Numbers, Dimensions and Areas are approximate only, and are subject to survey and Council approval.

The boundaries shown on this plan should not be used for final detailed engineers design.

Source Information:
Site boundaries: RPS Survey.
Adjoining information: DCDB.
Aerial photography: Nearmap
Environment constraints: SCRC
Flood: SCRC

Legend

- Site Boundary
- Indicative Road Pavement
- Indicative Laneway
- Indicative Threshold
- Indicative Shared Access Driveway
- Indicative Verge
- Indicative Footpath
- Indicative Indented Parking Bays
- Indicative Public Transit Corridor
- Dedicated Ped / Cycle Corridor
- Indicative WSUD
- Indicative Driveway Location
- Indicative On Street Carparking
- Indicative On Street Parking for Park
- Indicative Street Trees
- Future Open Space
- Future Community Use
- Future Employment
- Future District Activity Centre
- Future Residential Allotments

Note:
All details are indicative only and subject for further detail design.

Phase 1 Land Use Breakdown

Overal Phase Area	**65.474 ha**	**100.0%**
Saleable Area		
Residential Area	34.968 ha	53.4%
Total Saleable Area	**34.968 ha**	**53.4%**
Roads		
Local Roads	17.397 ha	26.6%
Collector Roads	4.038 ha	6.2%
Transit Corridor	0.683 ha	1.0%
Pedestrian Linkange / Green Space	0.635 ha	1.0%
Total Roads	**22.754 ha**	**34.8%**
Open Space		
Local Park	5.318 ha	8.1%
Drainage Corridor	2.196 ha	3.4%
Local Linear Open Space	0.238 ha	0.4%
Total Open Space	**7.752 ha**	**11.8%**

Phase 1 Allotment Breakdown

Detached 30m Deep Allotments					
T30	Tradtional Allotments	18m x30m	540 m²	20	1.8%
C30	Courtyard Allotments	15m x 30m	450 m²	100	8.8%
PV30	Premium Villa Allotments	12.5m x 30m	375 m²	194	17.1%
V30	Villa Allotments	10m x 30m	300 m²	104	9.2%
Subtotal				**418**	**36.8%**
Detached 25m Deep Allotments					
T25	Tradtional Allotments	18m x25m	450 m²	6	0.5%
C25	Courtyard Allotments	15m x 25m	375 m²	75	6.6%
PV25	Premium Villa Allotments	12.5m x 25m	310 m²	158	13.9%
V25	Villa Allotments	10m x 25m	250 m²	86	7.6%
Subtotal				**325**	**28.6%**
Attached 25m Deep Allotments					
U8	Urban Allotment Type 1	8m x 25m	200 m²	48	4.2%
U10	Urban Allotments Type 2	10m x 27.5m	275 m²	16	1.4%
T6	Terrace Allotment Type 1	6m x 25m	150 m²	101	8.9%
T8	Terrace Allotment Type 2	8m x 25m	200 m²	211	18.6%
Subtotal				**376**	**33.1%**
Town House Site					
	Town House (5770m²)	35 dw / ha	5770m²	16	1.4%
Subtotal				**16**	**1.4%**
Overall Yield Phase 1				**1135**	**100.0%**

CLIENT
INVESTA

PROJECT
harmony

CONCEPT LAYOUT
PHASE 1
OVERALL
ALLOTMENT DETAILS

Date	24 MARCH 2016
Comp By.	WNW/KCH
Checked By.	FK / PHE
DWG Name.	22470 - PHASE 1
Job Reference	22470
Local Authority	SUNSHINE COAST REGIONAL COUNCIL
Locality	PALMVIEW
Scale	1 : 2000
Sheet	A1
Plan Ref	22470 – 288
Rev	C

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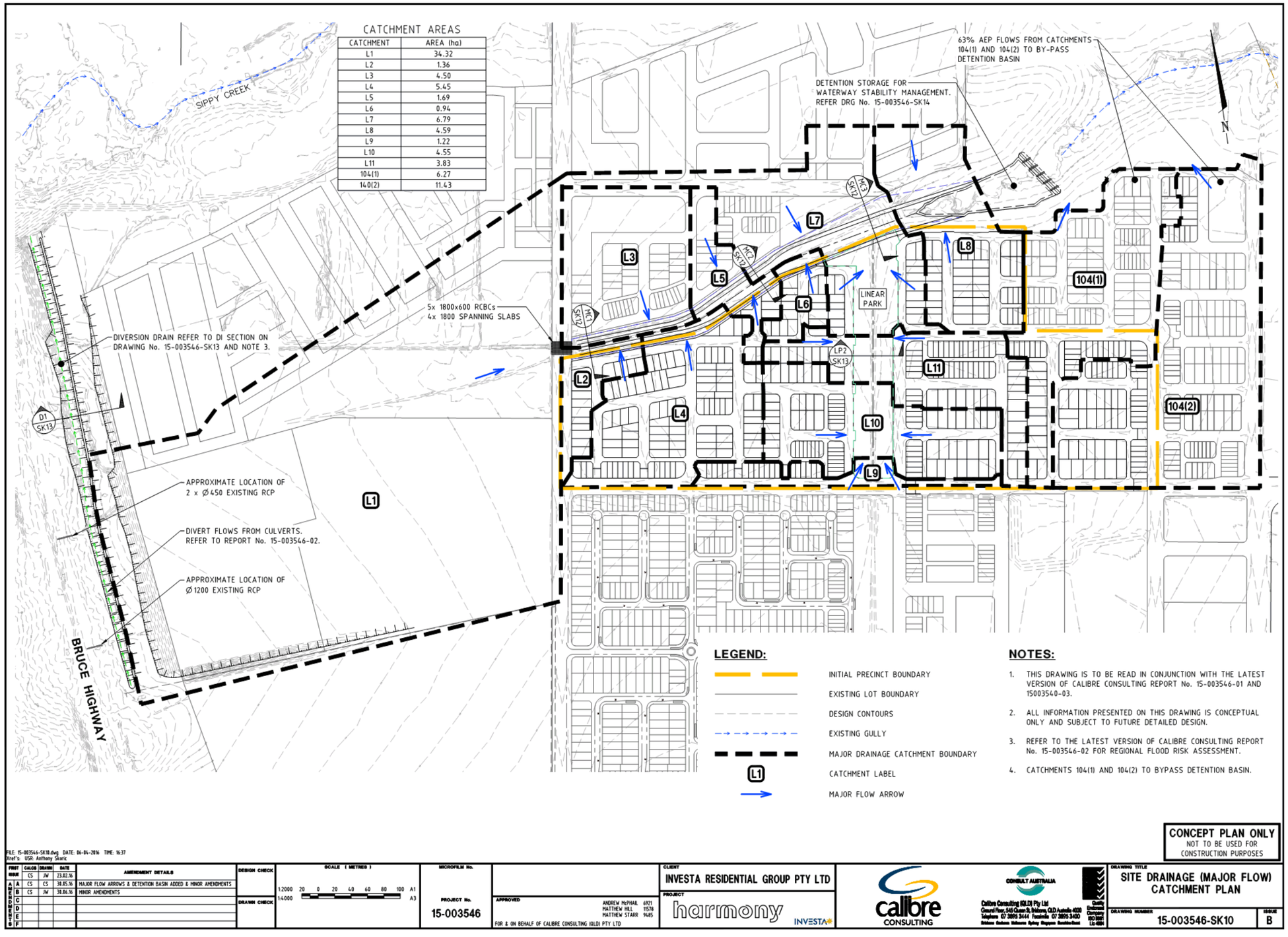
APPENDIX B – CALIBRE CONSULTING CONCEPT DRAWINGS


CATCHMENT AREAS
CATCHMENT | AREA (ha)
L1 | 34.32
L2 | 1.36
L3 | 4.50
L4 | 5.45
L5 | 1.69
L6 | 0.94
L7 | 6.79
L8 | 4.59
L9 | 1.22
L10 | 4.55
L11 | 3.83
104(1) | 6.27
104(2) | 11.43
SIPPY CREEK
63% AEP FLOWS FROM CATCHMENTS 104(1) AND 104(2) TO BY-PASS DETENTION BASIN
DETENTION STORAGE FOR WATERWAY STABILITY MANAGEMENT. REFER DRG No. 15-003546-SK14
N
5x 1800x600 RCBCs
4x 1800 SPANNING SLABS
DIVERSION DRAIN REFER TO DI SECTION ON DRAWING No. 15-003546-SK13 AND NOTE 3.
LINEAR PARK
APPROXIMATE LOCATION OF 2 x Ø450 EXISTING RCP
DIVERT FLOWS FROM CULVERTS. REFER TO REPORT No. 15-003546-02.
APPROXIMATE LOCATION OF Ø1200 EXISTING RCP
BRUCE HIGHWAY
LEGEND:
INITIAL PRECINCT BOUNDARY
EXISTING LOT BOUNDARY
DESIGN CONTOURS
EXISTING GULLY
MAJOR DRAINAGE CATCHMENT BOUNDARY
CATCHMENT LABEL
MAJOR FLOW ARROW
NOTES:
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF CALIBRE CONSULTING REPORT No. 15-003546-01 AND 15003540-03.
2. ALL INFORMATION PRESENTED ON THIS DRAWING IS CONCEPTUAL ONLY AND SUBJECT TO FUTURE DETAILED DESIGN.
3. REFER TO THE LATEST VERSION OF CALIBRE CONSULTING REPORT No. 15-003546-02 FOR REGIONAL FLOOD RISK ASSESSMENT.
4. CATCHMENTS 104(1) AND 104(2) TO BYPASS DETENTION BASIN.
CONCEPT PLAN ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES
FILE: 15-003546-SK10.dwg DATE: 06-04-2016 TIME: 16:37
Xref's: USR: Anthony Skaric
AMENDMENTS
FIRST ISSUE | CS | JW | 23.02.16
A | CS | CS | 30.05.16 | MAJOR FLOW ARROWS & DETENTION BASIN ADDED & MINOR AMENDMENTS
B | CS | JW | 30.06.16 | MINOR AMENDMENTS
DESIGN CHECK
DRAWN CHECK
SCALE (METRES)
1:2000 20 0 20 40 60 80 100 A1
1:4000 A3
MICROFILM No.
PROJECT No. 15-003546
APPROVED ANDREW McPHAIL 6921 MATTHEW HILL 1578 MATTHEW STARR 9485
FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD
CLIENT INVESTA RESIDENTIAL GROUP PTY LTD
PROJECT harmony INVESTA
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Quality Endorsed Company ISO 9001 Lic 4004
DRAWING TITLE
SITE DRAINAGE (MAJOR FLOW) CATCHMENT PLAN
DRAWING NUMBER 15-003546-SK10
ISSUE B