CONTOUR

ENGINEERING SERVICES REPORT

PLANS AND DOCUMENTS
referred to in the PDA
DEVELOPMENT APPROVAL

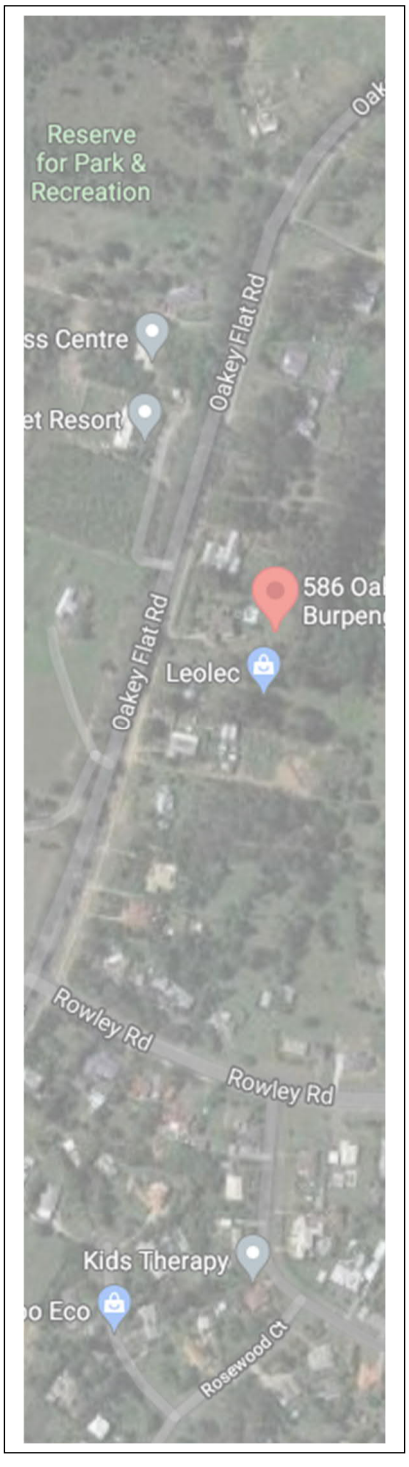
Approval no: DEV2021/1238

Date: 11 March 2022

Queensland Government

PROPOSED CHILDCARE CENTRE

25 PROMENADE STREET CARSELDINE



Prepared For:

Town Planning Alliance

Ref: CIV02936

17 September 2021

Final Issue Approval			
Date	**Name**	**Signature**	**Document Status**
19/10/2021	Marcus Olive (RPEQ NO.20961)		Issue for Approval

Revision Record					
Rev	**Date**	**Comments**	**Status**	**Author**	**Reviewer**
A	22/09/2021	Preliminary Report	A	RS	MO
B	19/10/2021	Driveway plan amended	**B**	RS	MO
C	22/10/2021	Driveway & Access Deleted	C	RS	MO

A - Approval	B - Building Approval	C - Construction	P - Preliminary
R - Revision	T - For Tender	X - Information	D-Draft

PLANS AND DOCUMENTS
referred to in the PDA
DEVELOPMENT APPROVAL

Approval no: DEV2021/1238

Date: 11 March 2022

Queensland Government

CONTOUR

Sunshine Coast Office:
Building A, Level 1,
6 Innovation Parkway
Birtinya QLD 4575
PO Box 474
Buddina QLD 4575
P: 07 5493 9777
F: 07 5493 6888
E: admin@contource.com.au
W: **contource.com.au**

North Lakes Office: Corporate Suite A Building 2
2 - 4 Flinders Parade
North Lakes QLD 4509
PO Box 474
Buddina QLD 4575
P: 07 5493 9777
M: 0457 939 777
E: admin@contource.com.au

TABLE OF CONTENTS

1 INTRODUCTION

Contour have prepared an Engineering Services Report for land contained within the Brisbane City Council municipality. The development comprises of a proposed childcare centre located at Carseldine Urban Village in the Stage 3 precinct. The land is described as Lot 3001 on SP324677 and is situated at 25 Promenade Street, Carseldine. The proposed site is shown below in Figure 1-1. The development is located within Urban Utilities (UU) catchment as the designated retail water authority.

Figure 1-1 – Development Proposal Layout (Source: Nearmap 2021)

This report covers issues related to civil infrastructure required to suitably support the Development Application with Economic Development Queensland (EDQ). The civil infrastructure to be addressed includes, earthworks and potential retaining walls, stormwater infrastructure, water connection and sewer connection servicing, service vehicle and carparking accessibility. The objective of this report is to demonstrate that the proposed development can be supported by the existing infrastructure, serviced by new infrastructure and that the development is compliant with the Brisbane City Council Planning Scheme.

The site is part of Stage 3B of a previous planning approval for Carseldine Village at 520 Beams Road Carseldine. A master approval was granted for Carseldine Village in December 2018 (EDQ Ref: DEV2018/932/2). Proposed architectural plans for the childcare centre are provided in Appendix A on drawing SD-200-P1.

2 SITE DESCRIPTION

The total site area is 3,535m^2 and is part of a Economic Development Queensland (EDQ) master planned site located in the Stage 3 precinct. The site is bound to the North by Promenade Street, to the West by Plaza Street, to the South by aged care facility under construction and to the East by a sportsground complex. The site grades from the North to the South with an average slope of 1%. There are no external catchments contributing to stormwater runoff onto the site. The site is currently surrounded by all necessary utilities including road access, stormwater, water, sewerage and electrical/communications services.

3 AVAILABLE DATA

Contour has sourced As Constructed data provided by surveyors (Land Partners) over Stage 3B of Carseldine Village to determine current levels of the site and services available.

4 EARTHWORKS & RETAINING WALLS

The site has a gentle 1% grade sloping from Promenade Street to the North to the southern boundary. Levels range from RL15.3 along the northern boundary to RL.15.05 along the southern boundary. It is proposed to set the building level at FFL.15.350 with carparking levels designed relatively close to existing surface levels. Earthworks proposed for the building include reshaping of the existing surface levels to achieve building pads and pavement grading. It is anticipated that approximately 500m3 of earthworks would be required to reshape the site. Retaining walls are not required on the site to achieve design levels.

Geotechnical and Acid Sulphate Soil Investigations have been conducted as part of the master planning of the site and are identified in the approved Stage 3 reports by KN Group.

5 STORMWATER MANAGEMENT AND LAWFUL POINT OF DISCHARGE

Cabbage Tree Creek is located South of the site and has been assessed as part of the master planning stormwater report prepared for Carseldine Urban Village by DesignFlow. The report was approved by the Queensland Government 4th August 2021 and included Lot 3001 in the stormwater management strategy. The Stormwater Technical Memorandum prepared by DesignFlow, approved 26 March 2020, confirms the stormwater management of the development and is included in Appendix B. The works identified in the master planning report that support this development, have been constructed with a bioretention basin located south of the site. Stormwater flow from the developed site will discharge to this infrastructure. The flood analysis modelling for the above report demonstrates that increased runoff from the proposed development site is not expected to coincide with peak flows in the creek and that no adverse impacts are predicted.

The approved lawful point of discharge is at a connection point identified in the KN Group Report approved 7 September 2021 as shown in Appendix A on drawing 20-180-FL 104 Rev C. The stormwater connection is located at the south-east corner of the proposed site and will be provided by EDQ.

The proposed development is required to meet or exceed the stormwater management design objectives under the State Planning Policy (SPP) and Council's planning scheme and guidelines. Bioretention basin (B2) is identified as the treatment point for the subject site as shown in Figure below.

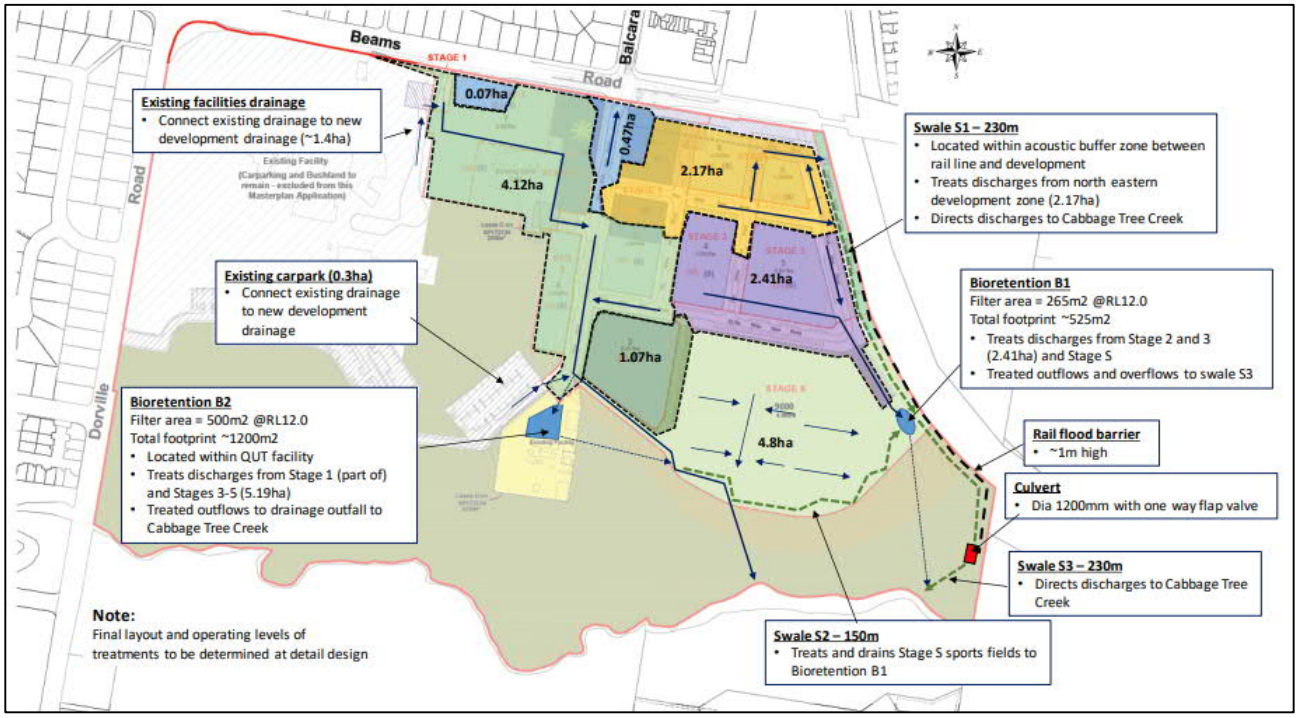


Figure 7.1 Stormwater Management Strategy Carseldine Urban Village (Source: DesignFlow)

The minimum load reduction targets, in mean annual load from unmitigated development, are achieved for the post-development scenario as identified in the approved reports. The bio-retention basin has been constructed and is operational. Therefore, it is considered that no additional on-site treatment train is required for the proposed site.

The stormwater connection point provided for the site will convey post-development flows to the bioretention basin identified above. In addition to the above, the following permanent stormwater quality best management practices have been identified for the operational phase of the development to assist in the protection of water quality.

- Rubbish bins provided on site.
- Street sweeping of pavement areas.
- Litter basket devices installed on all stormwater inlet pits within the carpark.
- Maintenance of all stormwater quality improvement devices.

5.1 FLOODING

The overall subdivision is being developed as per a precinct wide Stormwater Management Plan prepared by Design Flow. The following documents and associated flood modelling were undertaken as part of the overall subdivision works:

- Technical Memorandum - “Carseldine Urban Village – Local Flood Assessment to Support Stage 1 Development” by Design Flow, approved 26 March 2020.
- Updated Stormwater Management Plan – “Carseldine Urban Village” by DesignFlow, approved 4th August 2021.

The technical memorandums advise that parts of the site are affected by flooding and specifies the relevant Designated Flood Level (DFL). The approved technical memorandum is attached in Appendix B. Mapping on the BCC website indicates part of the site are located in a Creek/Waterway Area Type 4 & 5. Based on the master stormwater DesignFlow report approved 4th August 2021, node 18 identified in the Creek modelling specifies a post-development level of 14.849m. Technical memorandums provide the 0.2% AEP flood level of 15.23m AHD. As per Councils Flood Overlay Code, the proposed levels for the childcare centre are summarised in Table 7.1 below. The proposed floor levels comply with BCC flood planning levels within Creek/Waterways.

Development Type & Category	Category	Flood Source	Required Minimum Flood Planning Level Criteria	Proposed Levels
Building Floor Level for Habitable Rooms (Childcare)	0.2% AEP	Creek/Waterway	15.23mAHD	15.350m AHD
Vehicle Access & Manoeuvring Area	Category D	Creek/Waterway	1% AEP	14.850m AHD
Essential Electrical Services	Category A	Creek/Waterway	1% AEP + 500mm	15.350m AHD

Table 7.1 Relevant Flood Levels

6 WATER & SEWER CONNECTION TO UNITYWATER INFRASTRUCTURE

The proposed site is located in an Urban Utilities Connection area for water supply with an existing DN250 water main along the northern boundary of the site as shown in Figure 8.1 below. The development will require a new connection to existing mains as shown in Appendix A on drawing 2936-SK02. The connection will require an Urban Utilities Non-Standard Connection Application.

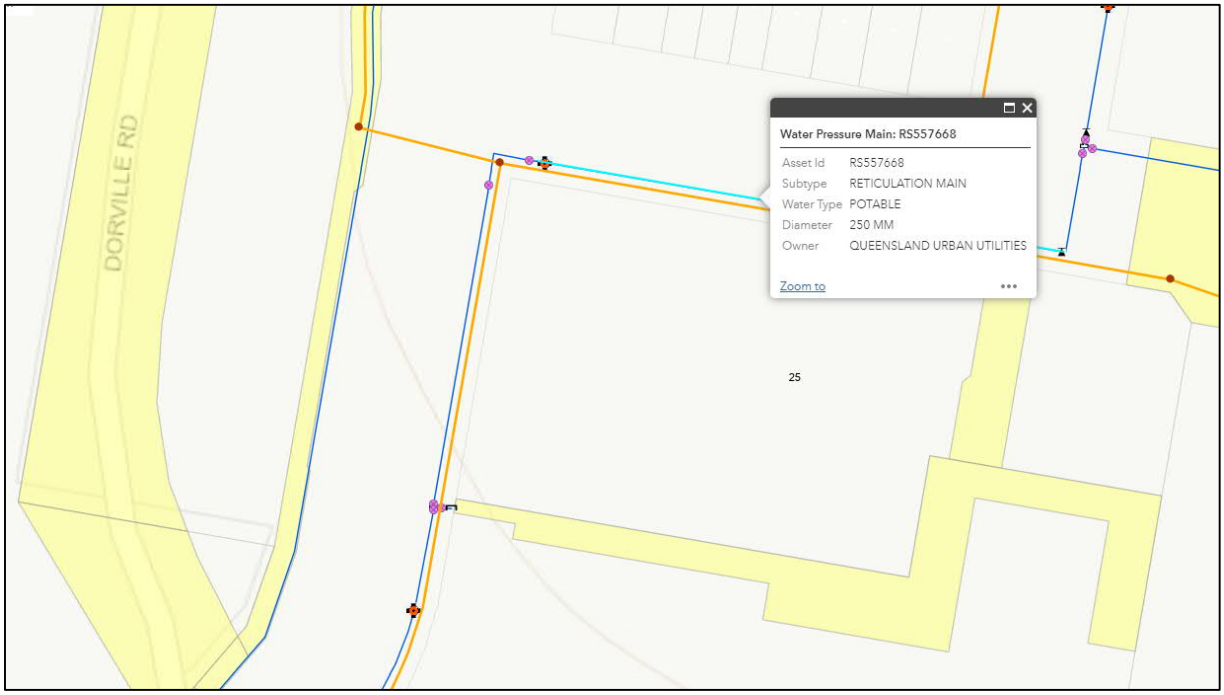


Figure 8.1 Water Reticulation Network (Source: Urban Utilities)

The site has an existing DN250 sewer main along the northern and western boundaries as shown in Figure 8.2 below. It is proposed to apply for a sewer connection to the existing sewer manhole on Promenade Street with a Non-Standard Connection Application to Urban Utilities. Refer to Appendix A drawing 2936-SK02 for preliminary connection details.

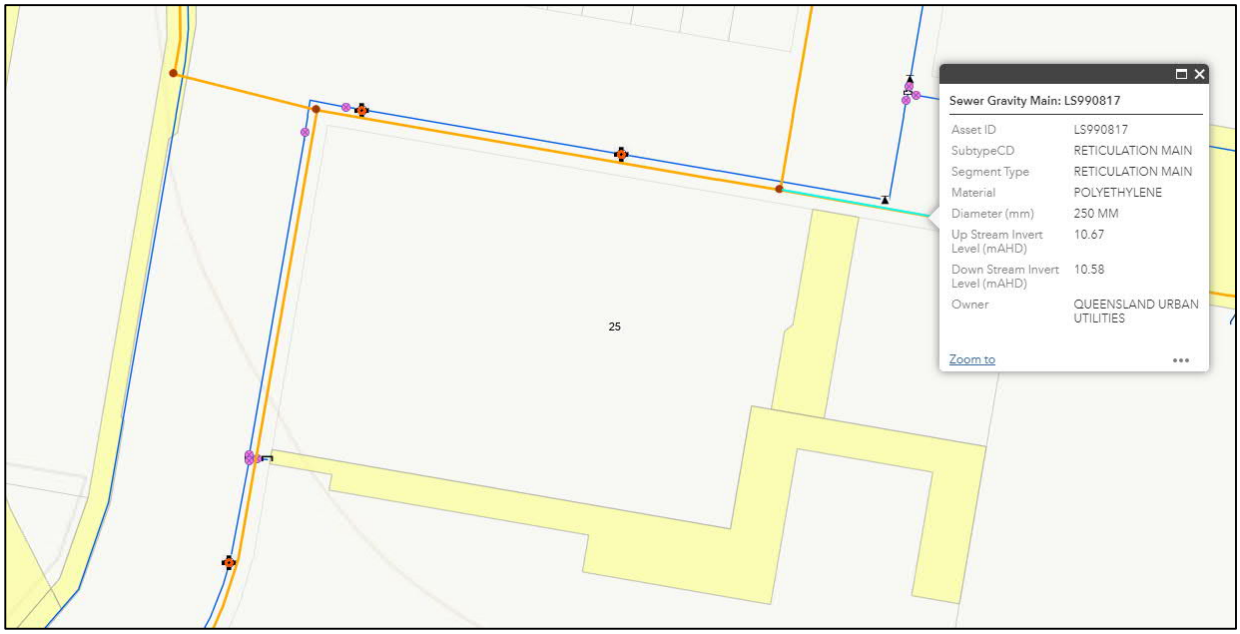


Figure 8.2 Sewer Reticulation Network (Source: Urban Utilities)

7 ELECTRICAL & TELECOMMUNICATIONS

It is recommended that an appropriately qualified electrical and telecommunications consultant is engaged to provide detailed advice on servicing availability and capacity for the proposed development. The proposed site will be serviced with underground electricity and telecommunication (NBN) services in accordance with the relevant service providers. Detailed design will be undertaken at the Building Application stage to ensure the additional buildings are adequately serviced. As Constructed data indicates that NBN & Telecommunications are currently available along the site frontage.

8 CONSTRUCTION MANAGEMENT PLAN

The contractor will be required to submit a site-specific Construction Management Plan (CMP) for approval prior to commencement of site works. The CMP will address Health and Safety, Traffic Management, Environmental Management, Quality Management, Construction Methodology (Work Method Statement) and Programme of Works. This plan will also cover dust controls, noise and vibration management, site stability and construction site access.

9 CONCLUSIONS

Services including water, sewer, stormwater, electrical and NBN, are currently available to the site and will service the proposed development. Stormwater infrastructure (to manage both quantity and quality) being designed and constructed as part of the master planning for Carseldine Village has made allowance for the proposed development of Lot 3001. On-site detention and stormwater quality treatment is not required for the site.

Parts of the site are affected by creek flooding. Relevant flood levels for the proposed building and carparking areas have been provided in accordance with the Brisbane City Council Planning Scheme and all levels are above the relevant flood planning levels.

10 QUALIFICATIONS

This report has been prepared to document the location and primary capacity check of the site to be developed to its full potential.

This report is only to be used in full and may not be used to support objectives other than those set out herein, except where written approval is provided by Contour Consulting Engineers.

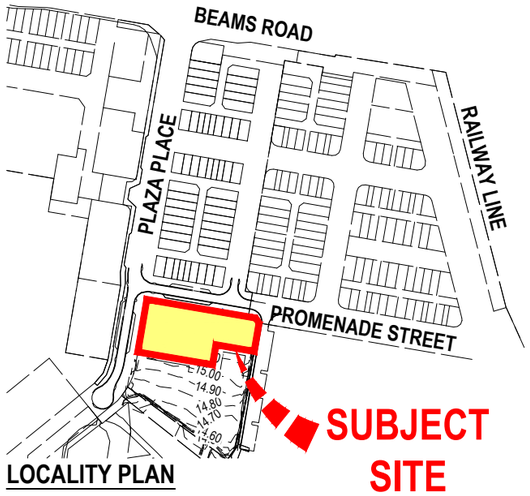
Contour Consulting Engineers accept no responsibility for the accuracy of information supplied by third parties.

Appendix A.

ENGINEERING SERVICES REPORT

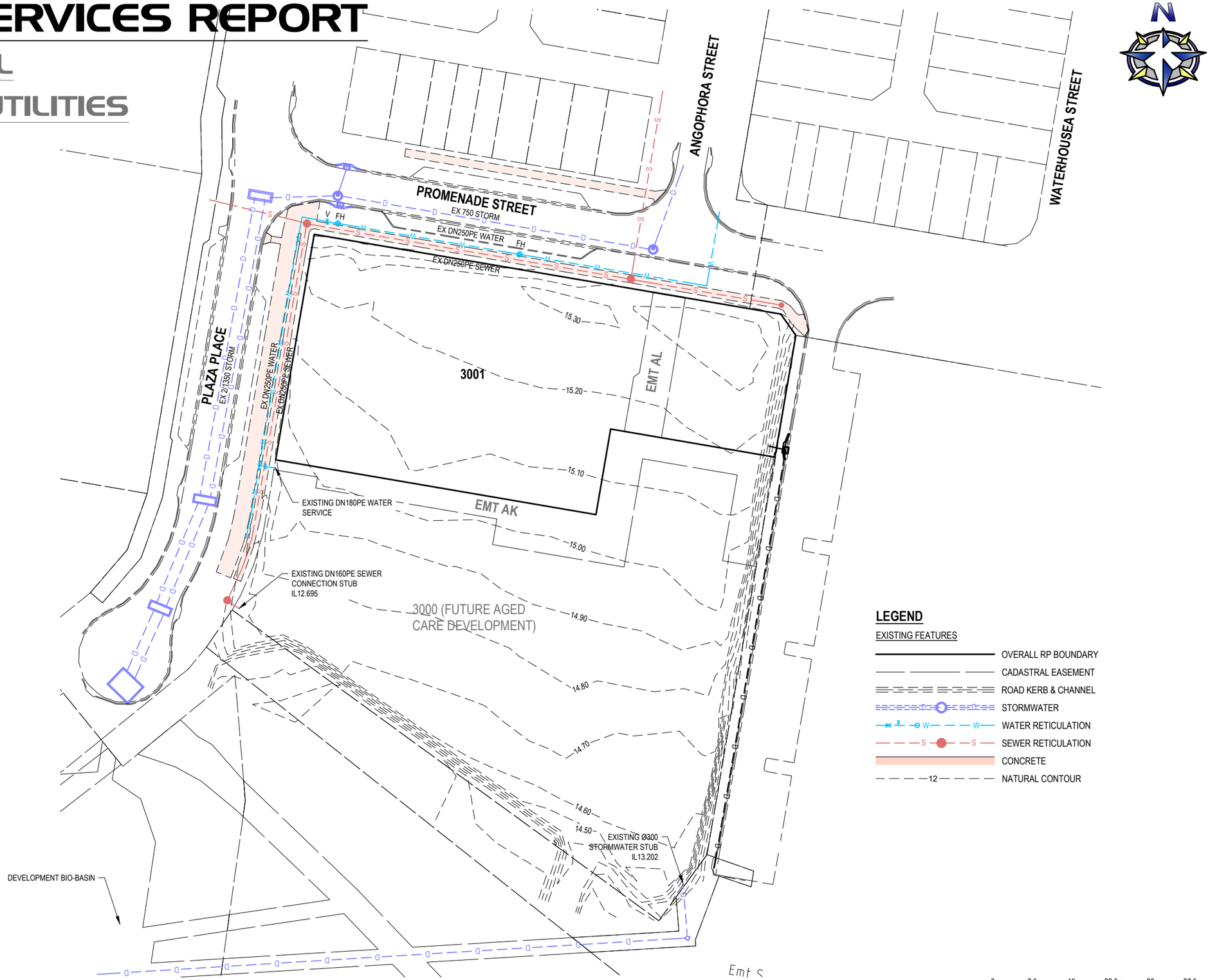
BRISBANE CITY COUNCIL

QUEENSLAND URBAN UTILITIES



LOCALITY PLAN

SUBJECT SITE
(STAGE 3B PRECINCT
CARSELDINE VILLAGE)



LEGEND

EXISTING FEATURES

- OVERALL RP BOUNDARY
- CADASTRAL EASEMENT
- ROAD KERB & CHANNEL
- STORMWATER
- WATER RETICULATION
- SEWER RETICULATION
- CONCRETE
- NATURAL CONTOUR

0m 7.5m 15m 22.5m 30m 37.5m

SCALE 1:750 A3

PROPERTY DESCRIPTION

Lots 3001 on SP324677 (3538m²)
Local Government - Brisbane City
SEQ Service Provider - Urban Utilities
Locality - Carseldine

CONTOUR

SUNSHINE COAST OFFICE
Building A, Level 1,
6 Innovation Parkway,
Birtinya 4575, Qld

NORTH LAKES OFFICE
Corporate Suite A, Bld 2
2 - 4 Flinders Parade,
North Lakes 4509, Qld

Ph. (07) 5493 9777

www.ContourCE.com.au
admin@contource.com.au

A.B.N. 62 117 061 659
ISO 9001 8327
UKAS MANAGEMENT SYSTEMS
Trading name of SN Registers (Holdings) Ltd
Quality Assured International 3rd Party Accredited

PLAN DETAILS:

Designed:	BH
Drawn:	BH
Checked:	RS
Datum:	AHD
Date:	SEPT 2021

-RPEQ-
(FOR & ON BEHALF OF CONTOUR C/E PTY LTD)

PLAN AMENDMENTS:

Rev	Date	Comment	Altered	Checked
A	16.09.21	ENGINEERING SERVICING PLAN	BH	RS

ENGINEERING SERVICES REPORT AT PLAZA PARADE, CARSELDINE QLD FOR INK DEVELOPMENTS

PLAN TITLE:

EXISTING SERVICES

FOR APPROVAL - NOT FOR CONSTRUCTION

PLAN No: ***2936 - SK01*** **REVISION:** ***A***

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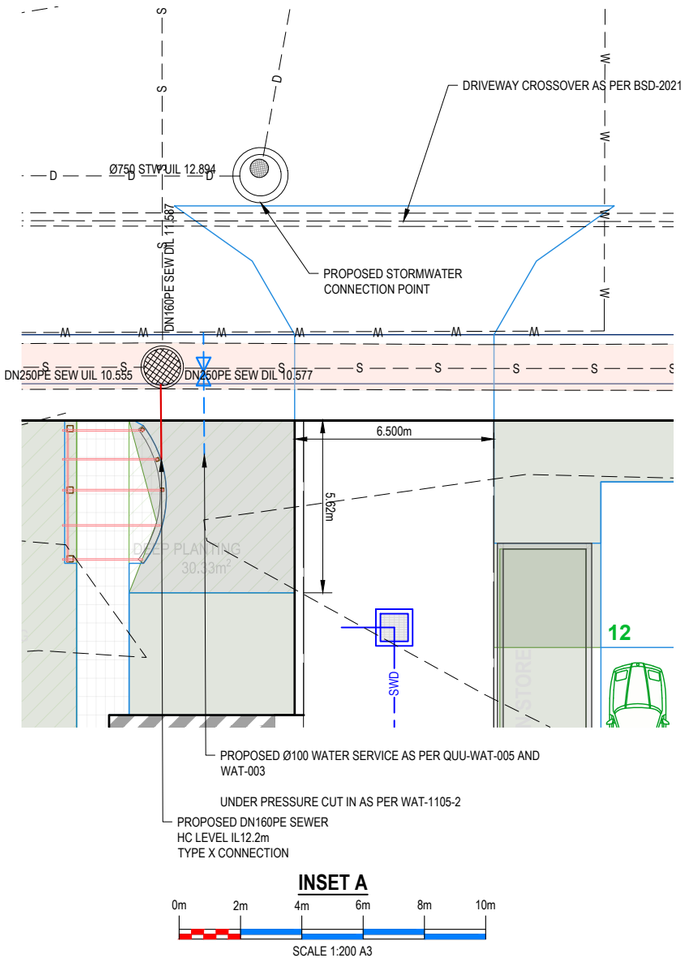

INSET A

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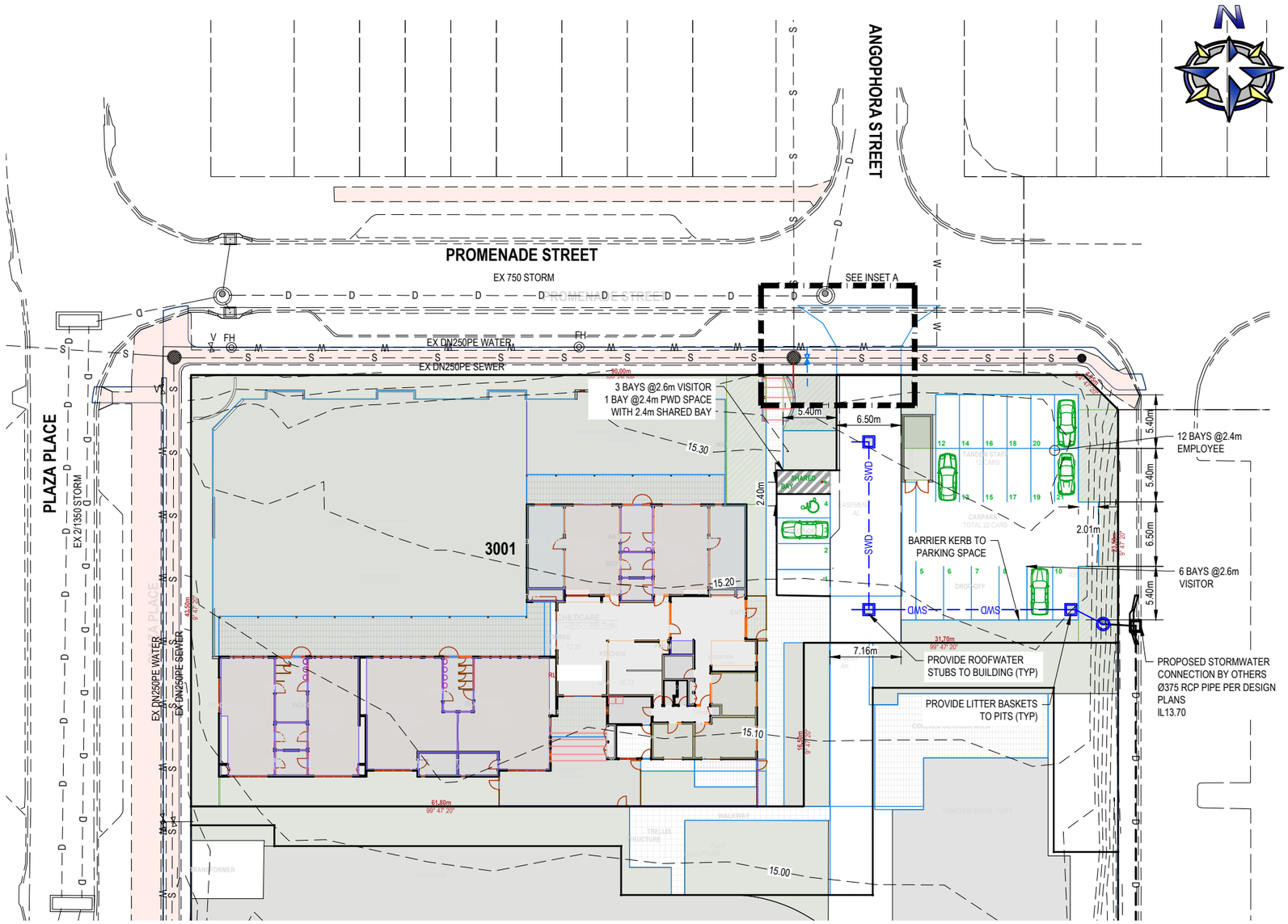
SCALE 1:200 A3



PROPOSED MINIMUM DESIGN LEVELS

TYPE	IL
CARPARK	14.85m
HABITABLE BUILDING FFL	15.35m
NON-HABITABLE FFL	15.15m

LEGEND

EXISTING FEATURES

- OVERALL RP BOUNDARY
- CADASTRAL EASEMENT
- ROAD KERB & CHANNEL
- STORMWATER
- WATER RETICULATION
- SEWER RETICULATION
- CONCRETE
- NATURAL CONTOUR

PROPOSED FEATURES

- STORMWATER DRAINAGE

0m 5m 10m 15m 20m 25m

SCALE 1:500 A3

PROPERTY DESCRIPTION

Lots 3001 on SP324677 (3538m²)
Local Government - Brisbane City
SEQ Service Provider - Urban Utilities
Locality - Carseldine

CONTOUR
SUNSHINE COAST OFFICE
Building A, Level 1,
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PLAN DETAILS:

Designed:	BH
Drawn:	BH
Checked:	RS
Datum:	AHD
Date:	SEPT 2021

RPEQ-
(FOR & ON BEHALF OF CONTOUR C/E PTY LTD)

PLAN AMENDMENTS:

Rev	Date	Comment	Altered	Checked
A	16.09.21	ENGINEERING SERVICING PLAN	BH	RS
B	19.10.21	UPDATED TO ALTO ARCHITECT VERSION D	BH	RS

ENGINEERING SERVICES REPORT AT PLAZA PARADE, CARSELDINE QLD FOR INK DEVELOPMENTS

PLAN TITLE:

PROPOSED SERVICES PLAN

FOR APPROVAL - NOT FOR CONSTRUCTION

PLAN No: 2936 - SK02 **REVISION:** B

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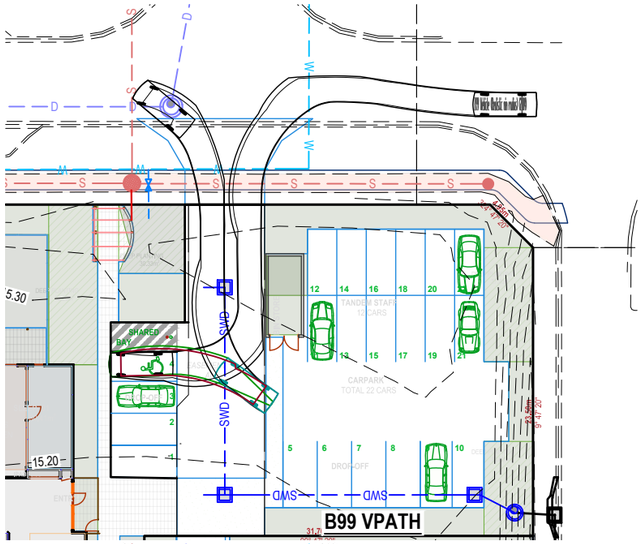
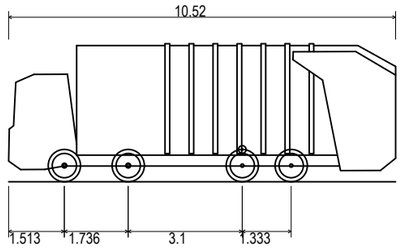
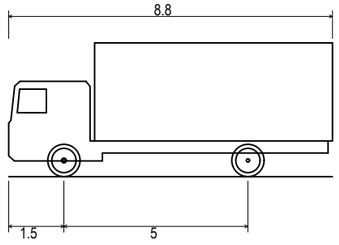




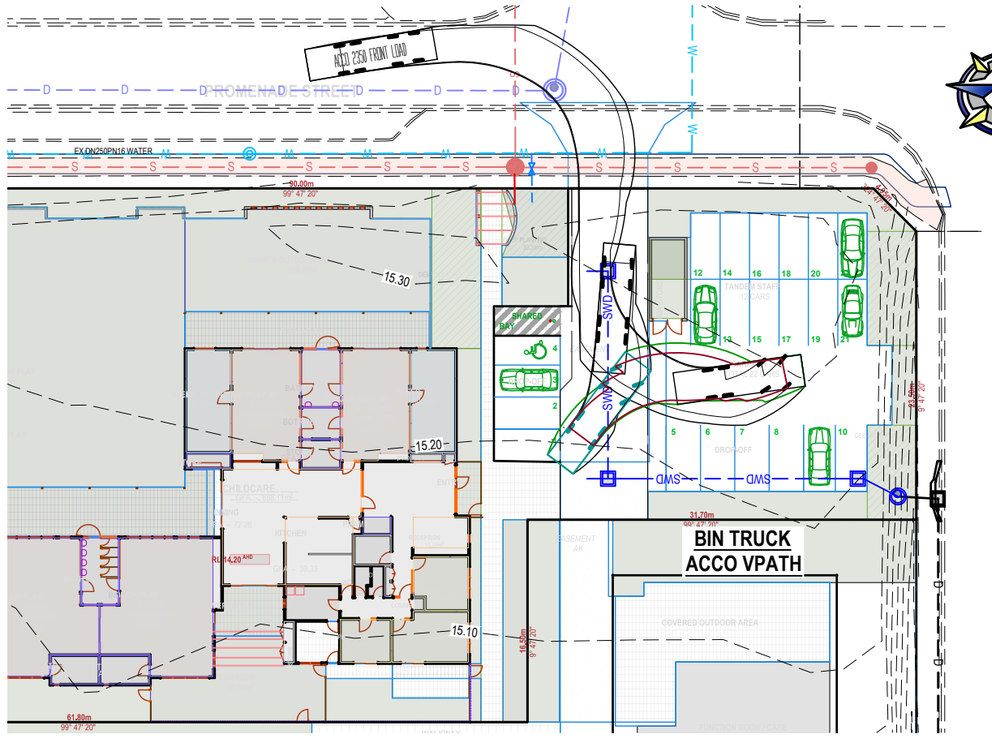
ACCO 2350 FRONT LOAD PER BCC -3009

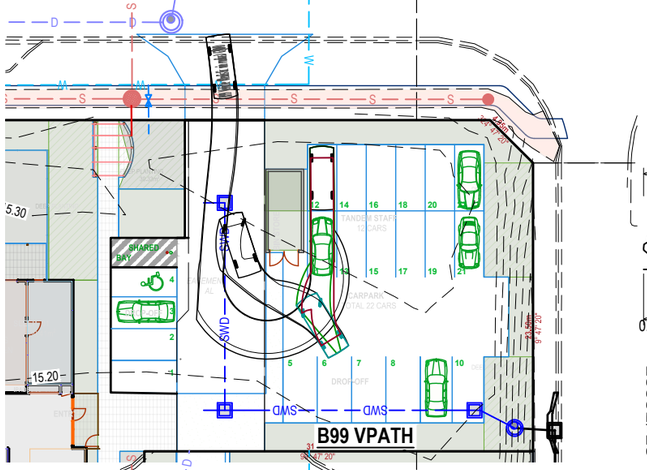
Overall Length	10.520m
Overall Width	2.600m
Overall Body Height	3.751m
Min Body Ground Clearance	0.304m
Track Width	2.500m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	9.757m

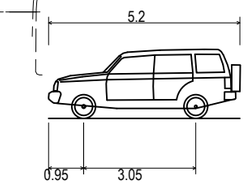


MRV - Medium Rigid Vehicle

Overall Length	8.800m
Overall Width	2.500m
Overall Body Height	3.633m
Min Body Ground Clearance	0.428m
Track Width	2.500m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	10.000m

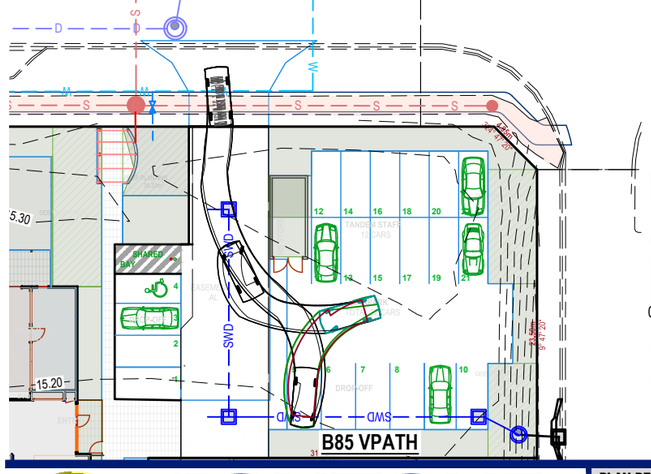


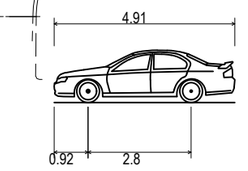




B99 Vehicle (Realistic min radius) (2004)

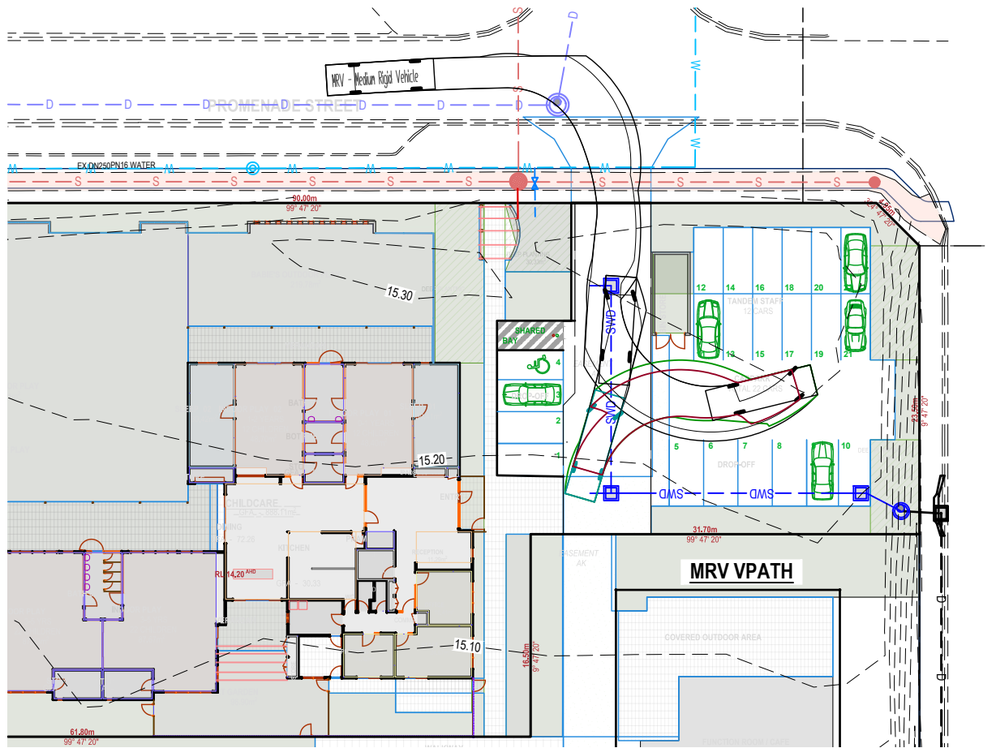
Overall Length	5.200m
Overall Width	1.940m
Overall Body Height	1.878m
Min Body Ground Clearance	0.272m
Track Width	1.840m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	6.250m





B85 Vehicle (Realistic min radius) (2004)

Overall Length	4.910m
Overall Width	1.870m
Overall Body Height	1.421m
Min Body Ground Clearance	0.159m
Track Width	1.770m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	5.750m



PROPERTY DESCRIPTION

Lots 3001 on SP324677 (3538m²)
Local Government - Brisbane City
SEQ Service Provider - Urban Utilities
Locality - Carseldine

0m 5m 10m 15m 20m 25m

SCALE 1:500 A3

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Date:	SEPT 2021
-	RPEQ-
(FOR & ON BEHALF OF CONTOUR C/E PTY LTD)	

PLAN AMENDMENTS:

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A	16.09.21	ENGINEERING SERVICING PLAN	BH	RS
B	19.10.21	UPDATED TO ALTO ARCHITECT VERSION D	BH	RS

ENGINEERING SERVICES REPORT AT PLAZA PARADE, CARSELDINE QLD FOR INK DEVELOPMENTS

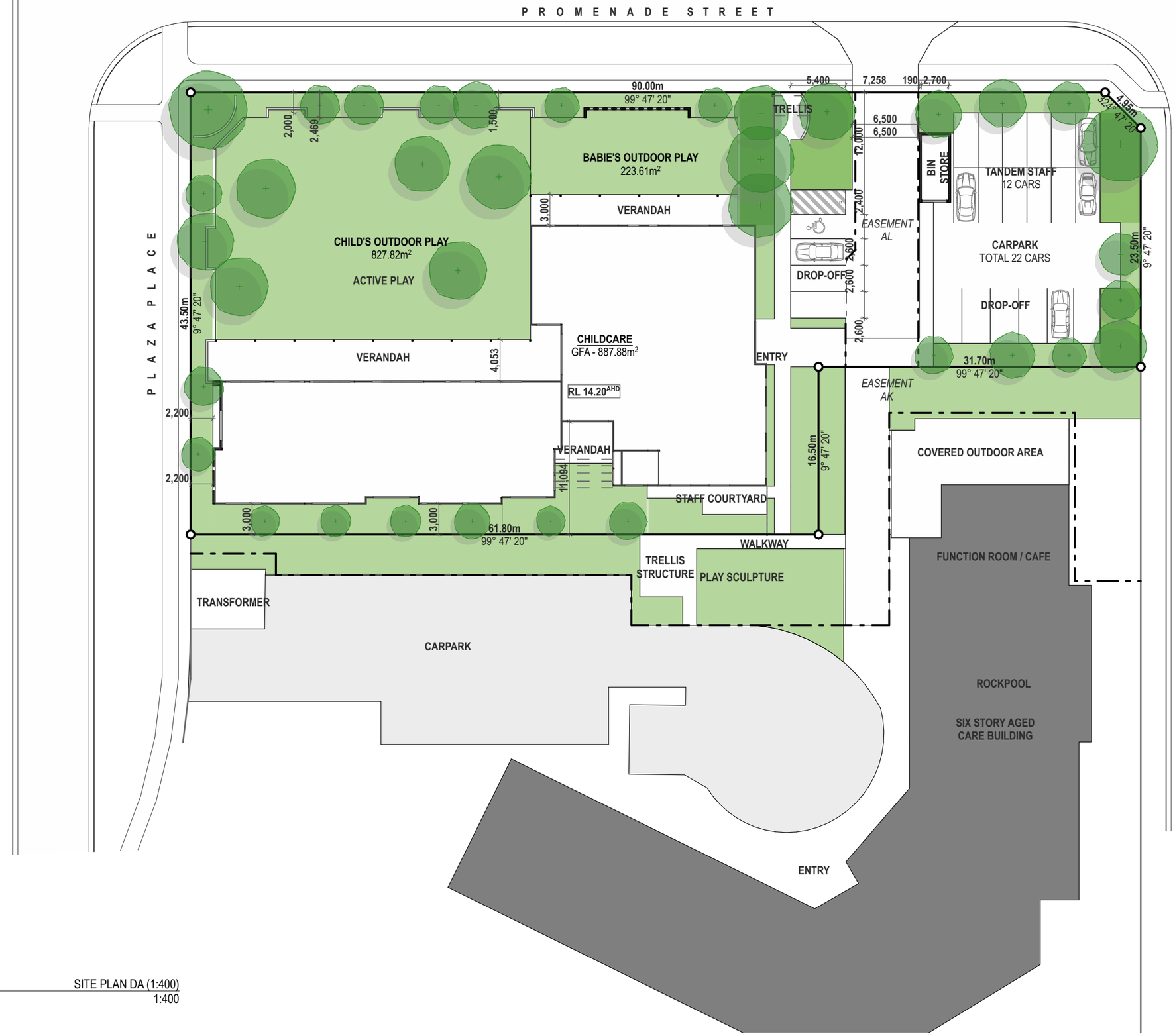
PLAN TITLE:

PROPOSED VPATH, MRV AND REFUSE TRUCK

FOR APPROVAL - NOT FOR CONSTRUCTION

PLAN No: 2936 - SK03 **REVISION:** B

FILE LOCATION: C:\12DS\DATA\CCE2K16DC01\02936 - LOT 3001- EDQ CARSEDINE VILLAGE ESTATE_410\DESIGN - CIVIL\AUTOCAD\ENG SERVICES REPORT\2936 SERVICING REPORT.DWG



1 SITE PLAN DA (1:400)
1:400

PROJECT STATISTICS

Total Site Area: 3538m²

Total GFA: 888m²
~ 10.3m² / Child

Total Outdoor Play: 1,056m²
~ 10.5m² / Child

Carparking: 22 Cars
16 Staff
6 Drop Off

ALTO ARCHITECTS PTY LTD
e. alice@altoarchitects.com.au w. altoarchitects.com.au m. 0410 6363 64 acn. 603 623 623

DATE	ISSUE	DETAILS
08/09/21	A	Client Issue - Floor Plan Review
21/09/21	B	Preliminary Elevations
22/09/21	C	Operator review
15/10/21	D	Carpark & Western Elevation Changes

PROJECT NAME: **Proposed Childcare Centre**

CLIENT:

ADDRESS: PROMENADE STREET, CARSELDINE, QLD

DRAWING NO. SD-100

LAYOUT NAME Site Plan

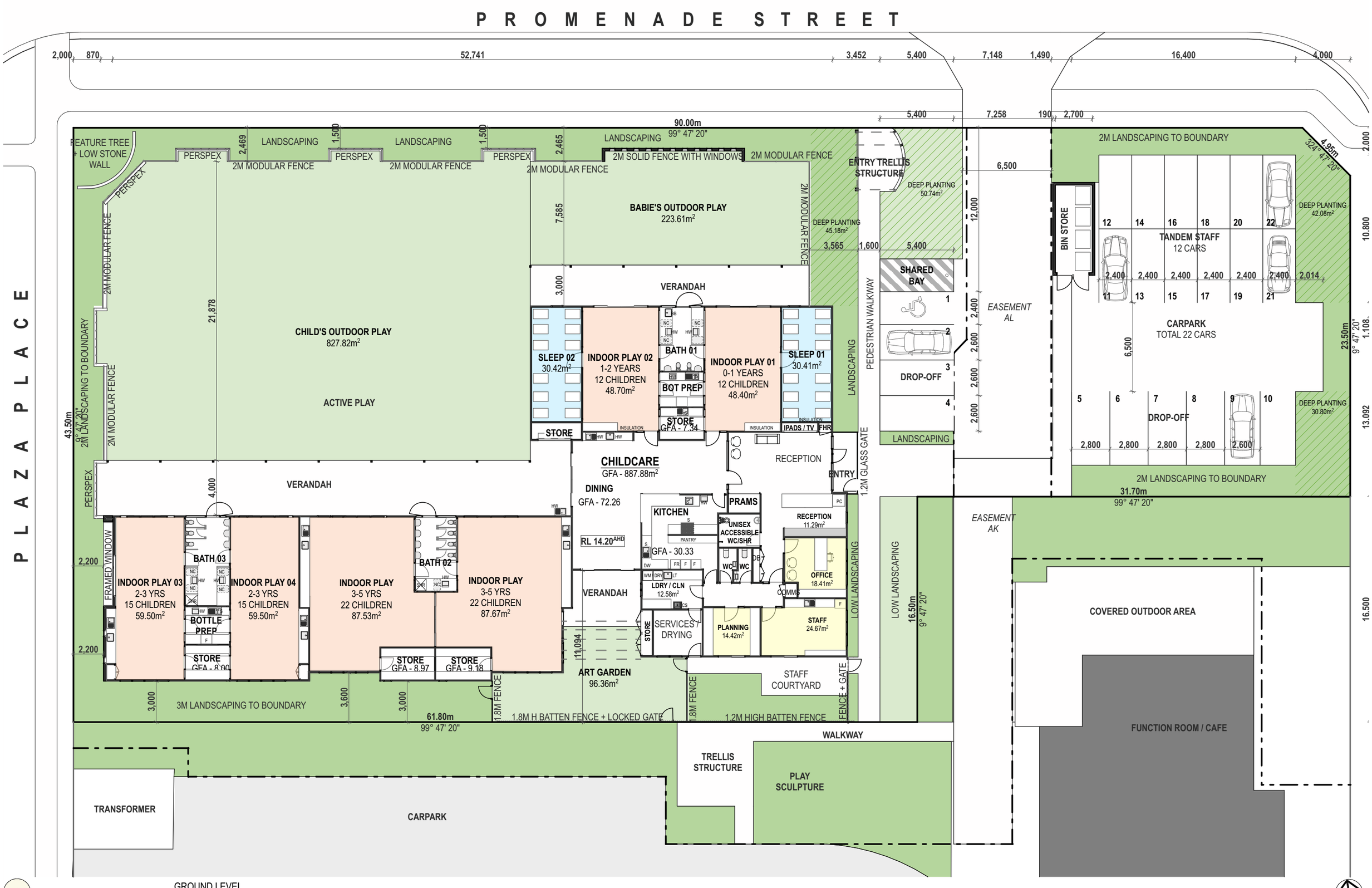
ISSUE NO. **D**

Scale @ **A3 - 0, 1:400, 1:1**

210801CAR-Master 24.pln

210801CAR

Printed : 15/10/21



4 GROUND LEVEL
1:250

ALTO ARCHITECTS PTY LTD
e. alice@altoarchitects.com.au w. altoarchitects.com.au m. 0410 6363 64 acn. 603 623 623

DATE	ISSUE	DETAILS
08/09/21	A	Client Issue - Floor Plan Review
21/09/21	B	Preliminary Elevations
22/09/21	C	Operator review
15/10/21	D	Carpark & Western Elevation Changes

PROJECT NAME: **Proposed Childcare Centre**

CLIENT:

ADDRESS: PROMENADE STREET, CARSELDINE, QLD

DRAWING NO. SD-101

LAYOUT NAME Ground Level

ISSUE NO. **D**

Scale @ **A3 - 0, 1:1**

210801CAR-Master 24.pln

210801CAR

Printed : 15/10/21

PROMENADE STREET

PLAZA PLACE

ENTRY TRELLIS STRUCTURE

EASEMENT AL

EASEMENT AK

Metal roof sheeting

high level north facing glazing

high level north facing glazing

Metal roof sheeting

Metal roof sheeting

PERGOLA

1 ROOF LEVEL
1:250

ALTO ARCHITECTS PTY LTD
e. alice@altoarchitects.com.au w. altoarchitects.com.au m. 0410 6363 64 acn. 603 623 623

DATE	ISSUE	DETAILS
08/09/21	A	Client Issue - Floor Plan Review
21/09/21	B	Preliminary Elevations
22/09/21	C	Operator review
15/10/21	D	Carpark & Western Elevation Changes

PROJECT NAME: **Proposed Childcare Centre**

CLIENT:

ADDRESS: PROMENADE STREET, CARSELDINE, QLD

DRAWING NO. SD-102

LAYOUT NAME Roof Plan

ISSUE NO. **D**

Scale @ **A3 - 0**

210801CAR-Master 24.pln

210801CAR

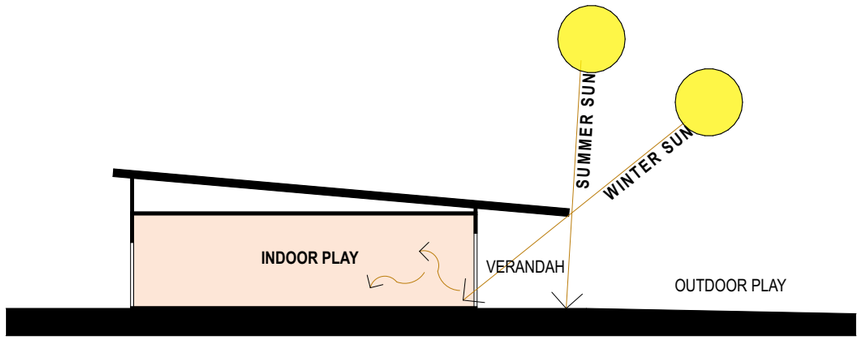
Printed : 15/10/21

SUSTAINABLE BUILDING DESIGN

An education and care service premises must make sure that the indoor spaces contain ample natural light, ventilation and thermal comfort. Natural light contributes to a sense of wellbeing, is important to the development of children & creates comfortable learning environments.

With the correct orientation and building envelope, solar heat gain can be excluded in summer and admitted in winter, minimising energy use for air-conditioning and heating.

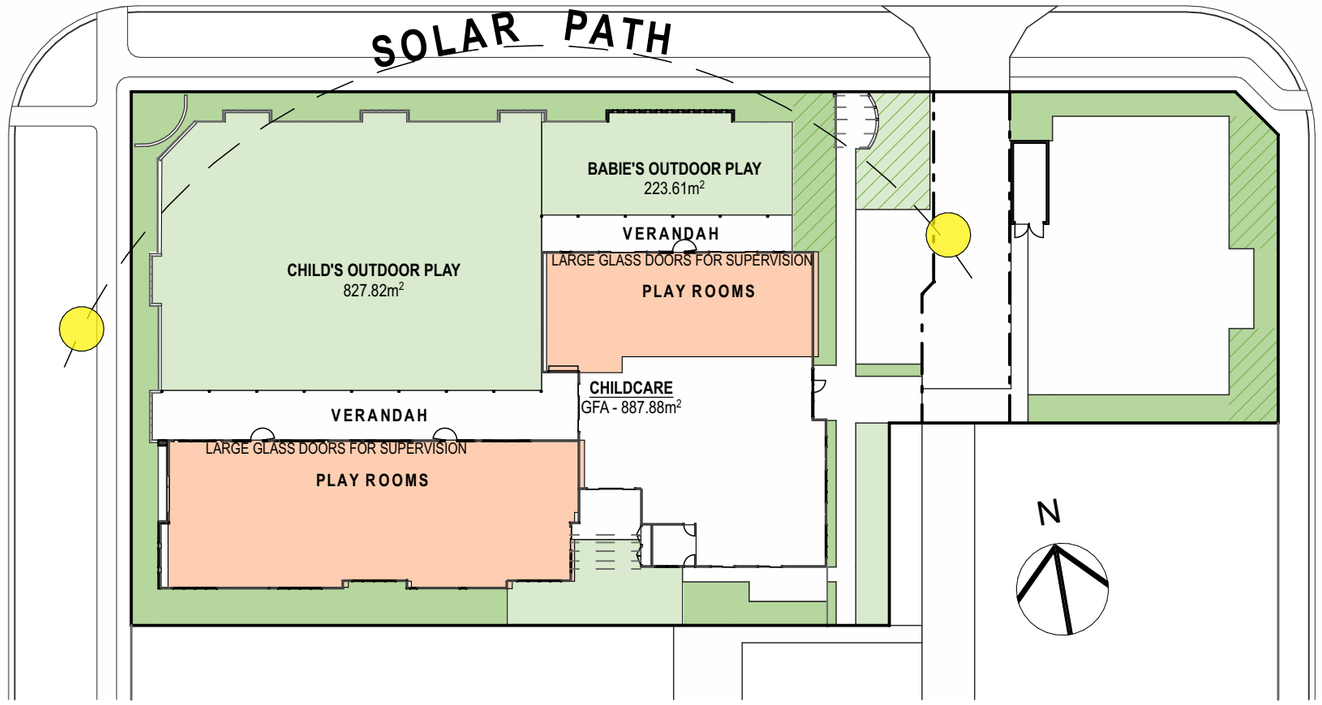
NORTH FACING VERANDAHS SHIELD THE BUILDING FROM UNWANTED HEAT GAIN IN SUMMER, AND ALLOWS PASSIVE HEATING IN WINTER



- LARGE EXPANSES OF GLAZING ARE REQUIRED FROM THE INDOOR PLAY AREAS TO THE OUTDOOR PLAY TO FACILITATE SUPERVISION OF CHILDREN
- NORTH FACING VERANDAHS SHADE THE GLAZING IN SUMMER PREVENTING SOLAR HEAT GAIN
- NORTH FACING VERANDAHS ALLOW WINTER SUN TO PASS THROUGH THE GLASS, RE-RADIATED INSIDE AS LONG WAVE RADIATION THAT WARMS THE INDOOR PLAY ROOMS
- NORTH FACING VERANDAHS ARE SHIELDED BY THE SOUTHERLY COLD WINTER WINDS
- NORTH FACING GLAZING MAXIMISES DIFFUSE SUNLIGHT TO INDOOR PLAY ROOMS FOR AMPLE NATURAL LIGHT TO PROMOTE WELLBEING

NORTH

1 SOLAR DIAGRAM - SECTION
1:200



2 SOLAR DIAGRAM - PLAN
1:500

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PROJECT NAME: **Proposed Childcare Centre**

CLIENT:

ADDRESS: PROMENADE STREET, CARSELDINE, QLD

DRAWING NO. SD-103

LAYOUT NAME Solar Diagram

ISSUE NO. **D**

Scale @ **A3 - 0, 1:500**

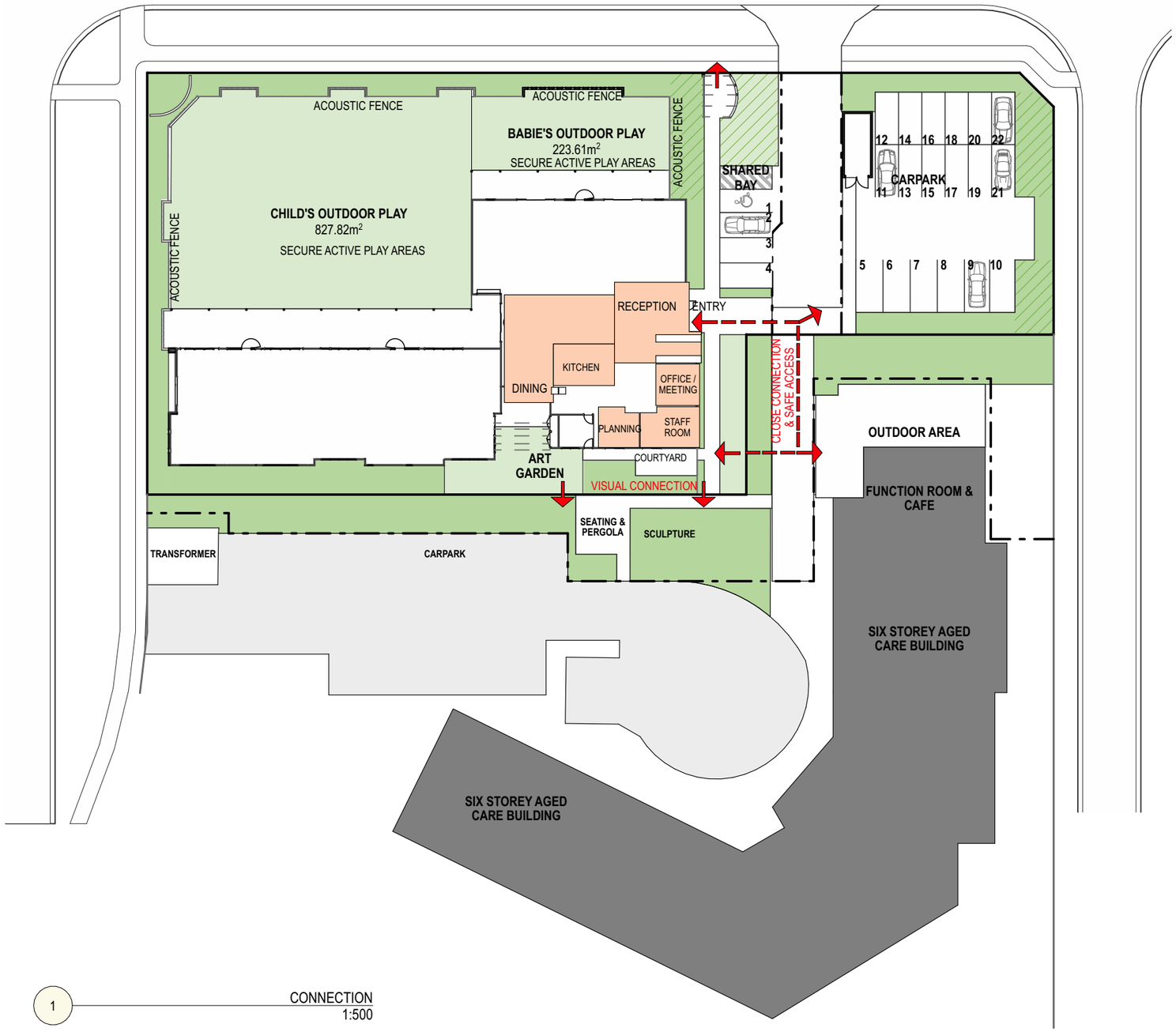
210801CAR-Master 24.pln

210801CAR

Printed : 15/10/21

CONNECTIVITY WITH ROCKPOOL

Childcare centres require a single point of entry for security. Locating the reception & staff areas close to the function room and cafe area creates a visual connection and physical proximity between the centre and Rockpool, encouraging interaction and safe access between the buildings.



1 CONNECTION
1:500

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DATE	ISSUE	DETAILS
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22/09/21	C	Operator review
15/10/21	D	Carpark & Western Elevation Changes

PROJECT NAME: **Proposed Childcare Centre**

CLIENT:

ADDRESS: PROMENADE STREET, CARSELDINE, QLD

DRAWING NO. SD-104

LAYOUT NAME Connection

ISSUE NO. **D**

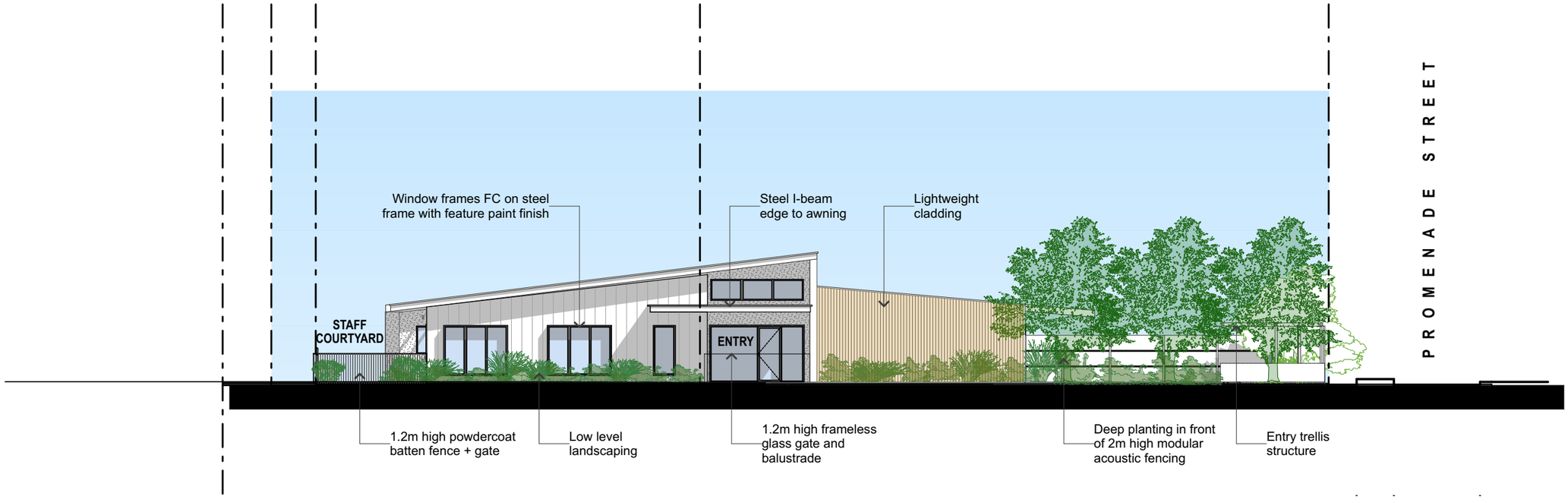
Scale @ **A3 - 0**

210801CAR-Master 24.pln

210801CAR

Printed : 15/10/21

2 BUILDING ELEVATION NORTH
1:200



1 BUILDING ELEVATION EAST
1:200

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DATE	ISSUE	DETAILS
08/09/21	A	Client Issue - Floor Plan Review
21/09/21	B	Preliminary Elevations
22/09/21	C	Operator review
15/10/21	D	Carpark & Western Elevation Changes

PROJECT NAME: **Proposed Childcare Centre**

CLIENT:

ADDRESS: PROMENADE STREET, CARSELDINE, QLD

DRAWING NO. SD-400

LAYOUT NAME Building North & East Elevations

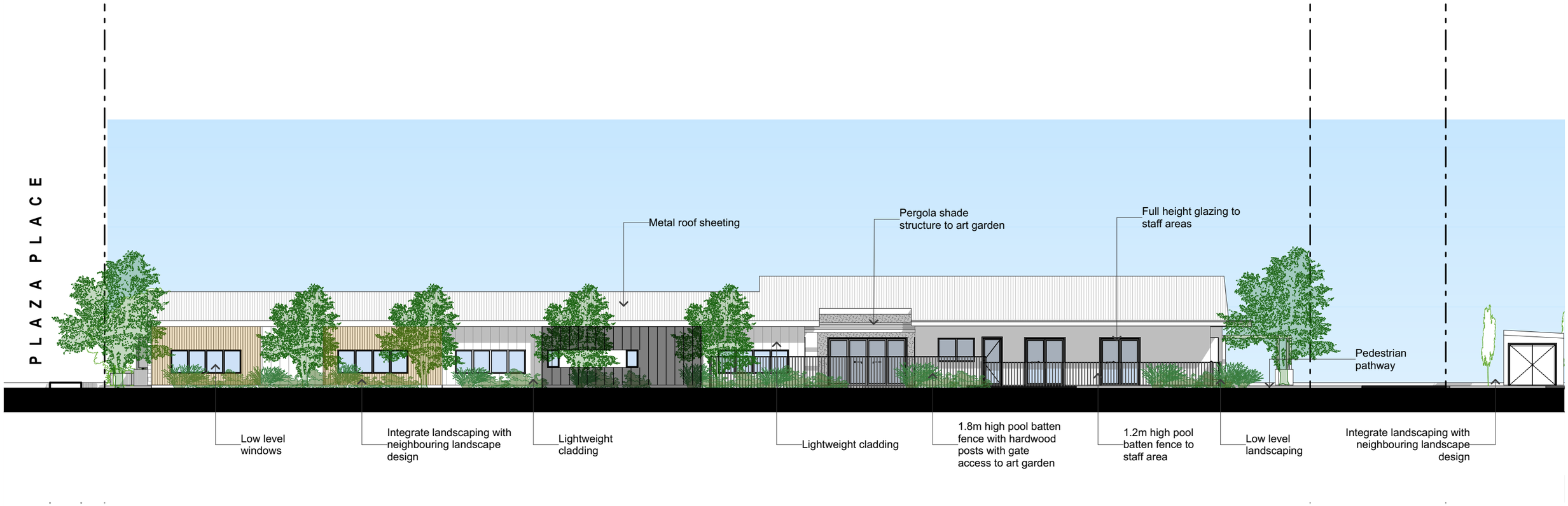
ISSUE NO. **D**

Scale @ **A3 - 0**

210801CAR

210801CAR-Master 24.pln

Printed : 15/10/21



1 BUILDING ELEVATION SOUTH
1:200

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DATE	ISSUE	DETAILS
08/09/21	A	Client Issue - Floor Plan Review
21/09/21	B	Preliminary Elevations
22/09/21	C	Operator review
15/10/21	D	Carpark & Western Elevation Changes

PROJECT NAME: **Proposed Childcare Centre**

CLIENT:

ADDRESS: PROMENADE STREET, CARSELDINE, QLD

DRAWING NO. SD-401

LAYOUT NAME South Elevation

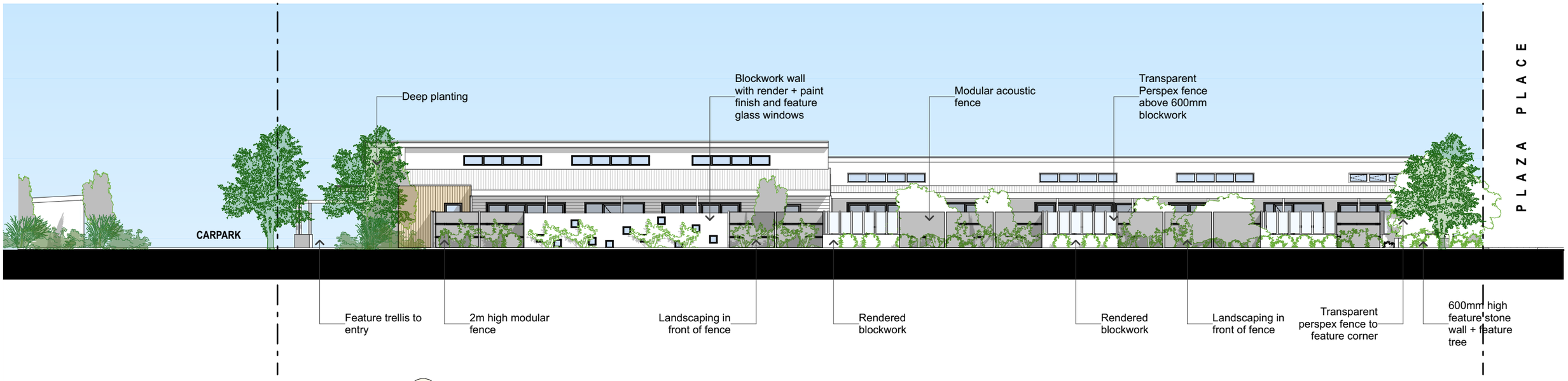
ISSUE NO. **D**

Scale @ **A3 - 0**

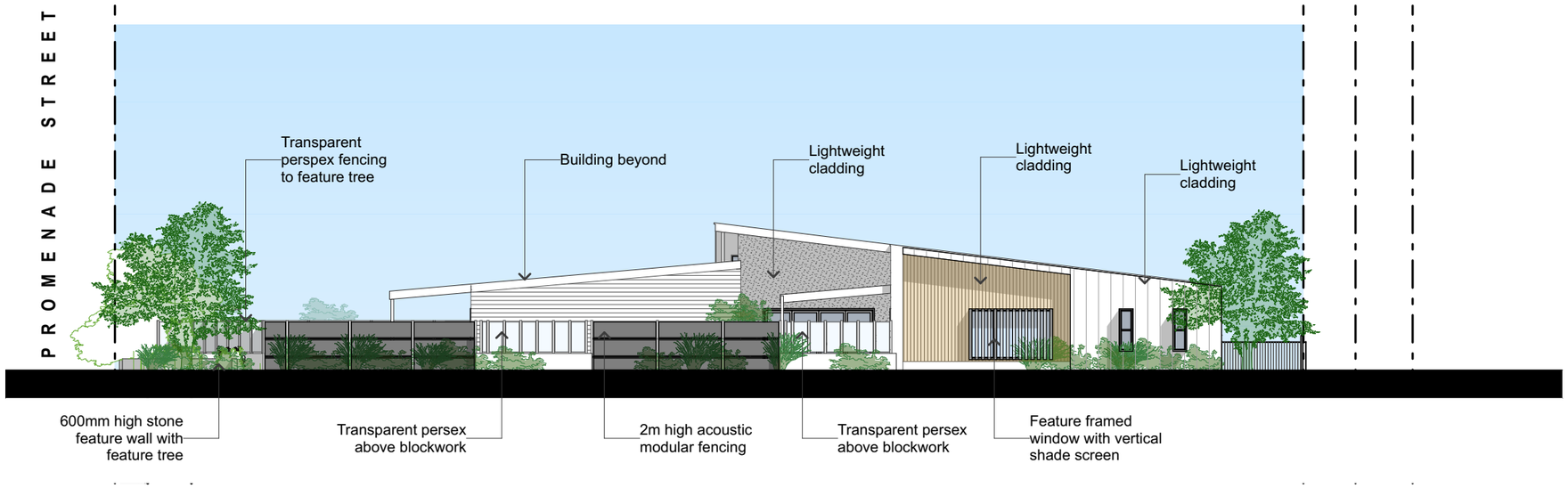
210801CAR-Master 24.pln

210801CAR

Printed : 15/10/21



1 FENCE ELEVATION NORTH
1:200



2 FENCE ELEVATION WEST
1:200

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DATE	ISSUE	DETAILS
08/09/21	A	Client Issue - Floor Plan Review
21/09/21	B	Preliminary Elevations
22/09/21	C	Operator review
15/10/21	D	Carpark & Western Elevation Changes

PROJECT NAME: **Proposed Childcare Centre**

CLIENT:

ADDRESS: PROMENADE STREET, CARSELDINE, QLD

DRAWING NO.	LAYOUT NAME	ISSUE NO.
SD-402	North & West Fence Elevations	**D**

Scale @ **A3 - 0, 1:200**
210801CAR-Master 24.pln

210801CAR
Printed : 15/10/21

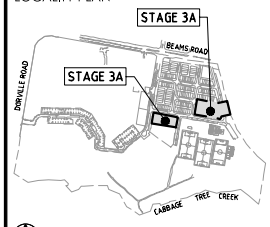
FUNCTIONAL LAYOUT - STORMWATER PLAN
SCALE 1:500

SCALE
10 5 0 10 20 30 40 50m
1 : 500 (A1 UNREDUCED)

DO NOT SCALE THIS DRAWING
IF IN DOUBT - ASK!

NORTH

LOCALITY PLAN



REVISIONS

No	Description	Date	By
A	FOR APPROVAL	01.04.2021	RW
B	STAGE 3B TO LOT 3001	16.07.2021	DES
C	STAGE 3A LOTS REVISED	16.08.2021	DES

Client
ECONOMIC DEVELOPMENT QUEENSLAND (EDQ)

Project
FUNCTIONAL LAYOUT
CARSELDINE VILLAGE
STAGE 3

kn group
ABN 35 112 53 611
L1, 62 Astor Tce
Spring Hill Q 4000
07 3017 1900
www.kngroup.com.au

Approved

Drawing Title
FUNCTIONAL LAYOUT
STORMWATER

Drawn	Designed	Checked	Date
RW	JB	MS	APR '21

Scale	Sheet
AS SHOWN	5 of 10

A1	Drawing No	Revision
	20-180-FL 104	C

M:\2020\20180 Carseldine Village Stage 3\Engineering\Acad\FUNCTIONAL\20-180-10-SW.dwg Plotted by: DS on 16/08/2021 1:05:42 PM

Appendix B.

Queensland Government

TECHNICAL MEMORANDUM

To:	Richard Bender - EDQ
From:	Ralph Williams - DesignFlow
Reviewed:	Shaun Leinster (RPEQ15637) - DesignFlow
Date:	10 October 2019
Subject:	Carseldine Urban Village – Local flood assessment to support Stage 1 development
Attachments	1. Peak flood depths – Existing case - 50%, 5%, 1% AEP event 2. Peak flood depths – Proposed case 50%, 5%, 1% AEP 3. Peak flood level impacts – 50%, 5%, 1% AEP

1 INTRODUCTION

This technical memorandum provides a summary of local flood assessments for the Carseldine Urban Village to support Stage 1 development. This modelling captures in detail the potential local flood impacts and potential drainage upgrades at the following locations:

- Beams Road;
- Railway at the eastern boundary of the site; and
- Local drainage to Cabbage Tree Creek

The outcomes of this assessment provide minimum drainage requirements associated with Stage 1 development to manage local flood impacts. Outcomes from this assessment are to inform the detail design of the Stage 1.

When reading this technical memorandum reference should be made to *Carseldine Urban Village – Updated Stormwater Management Plan* (DesignFlow report Version 3 2019). Figure 1 shows the current masterplan for the development from which this assessment has been based, including the Stage 1 development boundary.

2 BACKGROUND

The regional flood assessment of the Carseldine Urban Village development has been completed, as outlined in *Carseldine Urban Village – Updated Stormwater Management Plan* (DesignFlow report Version 3 2019), based on Brisbane City Council (BCC) supplied URBS and TUFLOW regional flood models for Cabbage Tree Creek. These models were updated as necessary to make suitable for regional flood impact assessment of the Carseldine Urban Village development.

The Cabbage Tree Creek modelling is at a regional scale and not suitable for a detailed assessment of the various local catchments that influence the site. Therefore, a separate local scale flood modelling exercise has been completed to capture potential flood impacts associated with the development, including local impacts at Beams Road and the railway at the eastern boundary of the site. Additional drainage survey was completed at the northern boundary of the site along Beams Rd and within the site to inform this local flood modelling.

This technical memorandum provides a summary of the local flood modelling.

Figure 1 – Carseldine Urban Village masterplan (source: RPS)

3 EXISTING CASE MODELLING

Local modelling has been carried out using a WBNM rainfall runoff model that feeds local catchment hydrographs into a 1D/2D TUFLOW hydraulic model. The existing case WBNM model sub-catchments are shown on Figure 2 which also indicates the general direction of overland flow (yellow arrows). Figure 2 also shows the existing pipe drainage network as modelled in TUFLOW for this investigation (aqua/black lines). It is noted that in some areas these drainage lines have been laid against the natural fall of the land and therefore their alignment does not necessarily match that of the overland flow as represented by the yellow arrows. Sub-catchment details are provided on Table 1.

A summary of the existing site drainage characteristics is as follows:

- The existing Beams Rd catchments flow to the east and north away from the site.
- Catchment B1 drains to the West Outfall Pipe to Cabbage Tree Creek (refer Figure 2). When this pipe is at capacity, runoff flows eastwards through the site.
- The majority of the proposed development area currently drains to the East Outfall Pipe to Cabbage Tree Creek (refer Figure 2). When this pipe is at capacity, site runoff will generally collect over the low-lying areas around the playing fields. Runoff will then drain southwards via the open drain adjacent to the railway. Modelling also predicts that during large events, overland flow from the site heads north and east toward the railway and Beams Rd.
- The Cabbage Tree Creek outfall pipes are predicted to flow in reverse direction when Cabbage Tree Creek flood levels are high.

Figure 2 - Existing case WBNM sub-catchments

Table 1 - Existing case WBNM sub-catchment details

WBNM ID	Area (ha)	Fraction Impervious (%)	Downstream ID
A1	10.546	59.64	A3
A2	4.582	65.43	A3
A3	3.424	28.42	A4
A4	0.902	45.53	A5
A5	0.799	49.91	A6
A6	2.738	83.29	A7
A7	13.295	52.13	SINK
B1	10.021	9.47	B2
B2	3.177	18.72	B3
B3	5.454	5.56	B6
B4A	1.291	84.66	B4B
B4B	1.054	20.26	B4C
B4C	2.282	12.26	B5
B5	2.514	0.00	B7
B6	1.746	0.00	B7
B7	3.345	4.20	B8
B8	5.174	3.63	SINK

The WBNM model has been run using ARR2016 ensemble patterns with burst durations ranging from 5 minutes to 6 hours. The results of the WBNM model have then been used to select ensemble patterns with a central tendency for the following durations that have then been run in the TUFLOW model; 15min, 30min, 45min, 60min, 120min and 180min. These durations were selected based on a review of critical durations across the local catchment study area. Modelling has been carried out for the 1%, 5% and 50% AEP events.

A WBNM lag parameter of 1.4 has been selected based on a Rational Method validation of peak flows at WBNM ID B8 (refer Validation Section for details).

Rainfall intensities and loss rates are based on values from the ARR 2016 data hub. Rainfall intensities relevant to the Carseldine site for varying AEP and storm durations are provided in Table 2.

Table 2 – Rainfall intensities (mm/hr) - Carseldine

	AEP						
Duration	63.20%	50%	20%	10%	5%	2%	1%
5 min	115.20	129.60	176.40	207.60	237.60	278.40	309.60
10 min	94.20	106.20	144.00	169.20	193.20	225.00	248.40
15 min	80.00	90.40	122.00	143.20	163.60	190.40	210.40
20 min	69.60	78.60	106.50	124.80	142.80	166.20	183.90
25 min	61.92	69.84	94.56	111.12	127.20	148.32	164.16
30 min	55.80	63.00	85.40	100.40	115.00	134.40	149.00
45 min	43.60	49.20	66.80	78.80	90.67	106.27	118.40
1 hour	36.10	40.80	55.60	65.70	75.70	89.10	99.60
1.5 hour	27.40	31.00	42.40	50.33	58.27	68.67	77.33
2 hour	22.45	25.40	34.90	41.55	48.20	57.50	64.50
3 hour	16.90	19.17	26.50	31.70	37.00	44.33	50.00
4.5 hour	12.78	14.51	20.24	24.22	28.44	34.22	38.89
6 hour	10.50	11.97	16.83	20.33	23.83	28.67	32.67
9 hour	8.02	9.18	13.00	15.78	18.67	22.56	25.67
12 hour	6.65	7.64	10.92	13.25	15.75	19.08	21.83
18 hour	5.12	5.94	8.56	10.50	12.44	15.22	17.44
24 hour	4.25	4.96	7.21	8.88	10.58	12.96	14.92
30 hour	3.70	4.30	6.33	7.80	9.30	11.43	13.20
36 hour	3.28	3.83	5.67	6.97	8.36	10.31	11.92
48 hour	2.71	3.17	4.73	5.85	7.02	8.69	10.08
72 hour	2.03	2.39	3.58	4.47	5.38	6.69	7.81

An initial loss/continuing loss approach is adopted. Initial and continuing losses for impervious areas are taken at 0mm/hr, whilst continuing losses for pervious areas are taken at 2.2mm/hr. Initial losses for pervious areas vary depending on the AEP and the storm duration. These are listed in Table 3.

Table 3 Pervious area initial loss (mm) modelled

Duration	50% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
10 min	10.4	7.6	5.8	4.1	2.9	2.1
15 min	10.4	7.6	5.8	4.1	2.9	2.1
20 min	10.4	7.6	5.8	4.1	2.9	2.1
25 min	10.4	7.6	5.8	4.1	2.9	2.1
30 min	10.4	7.6	5.8	4.1	2.9	2.1
45 min	10.4	7.6	5.8	4.1	2.9	2.1
1 hour	10.4	7.6	5.8	4.1	2.9	2.1
1.50 hour	11.1	3.2	0	0	0	3.2
2 hours	11.9	3.7	0	0	0	0
3 hours	8.9	0	0	0	0	0
6 hours	5.9	0	0	0	0	0
12 hours	8.3	0	0	0	0	0
18 hours	7.7	0	0	0	0	0
24 hours	6.3	2.9	0.6	0	0	0
36 hours	13	8	4.7	1.6	0	0
48 hours	13	9.5	7.2	5	0	0
72 hours	13	12.3	11.8	11.4	3.3	0

Local catchment inflow hydrographs from the existing case WBNM model have been input to the existing case TUFLOW model. The existing case TUFLOW model layout is shown on Figure 3 and details are summarised below:

- TUFLOW HPC Build 2018-03-AB_64_iSP.
- Model grid size of 1m to provide detail resolution of potential flood impacts
- Run for 1%, 5% and 50% AEP events for ensemble temporal patterns with a central tendency for the events durations ranging from 15 minutes to 3 hours.
- WBNM local catchment inflow hydrographs are input to TUFLOW using TUFLOW's 2d_sa polygon approach.
- Topography based on aerial LiDAR survey and defined using a TUFLOW 1m grid.
- Manning's 'n' values of; Road – 0.02, Urban Lots – 0.18, Vegetated Area – 0.075, Cleared Open space – 0.03
- Existing on-site pipe drainage associated with the two existing outfalls to Cabbage Tree Creek have been incorporated using 1D pipe elements. Details are based on a recent survey completed by Land Partners (June, 2019). In addition to survey of the main site drainage lines, additional pipe network data has been sourced from BCC records. The existing drainage pipes included in the existing case TUFLOW modelling are shown on Figure 4. Pipe diameters shown in metres.
- Cabbage Tree Creek upstream boundary is a Q5 flow rate extracted from the Cabbage Tree Creek regional model. The Cabbage Tree Creek downstream boundary is a Q5 water level. The remaining two external boundary conditions are normal depth rating curves calculated by TUFLOW based on a slope of 1%. Note: a Q5 boundary condition is in accordance with standard modelling procedures for coincident regional flood events for local modelling. The ratio of local to regional catchment associated with the Carseldine Urban Village is 0.018.

Peak depth maps for the Existing Case modelling are provided in Attachment 1.

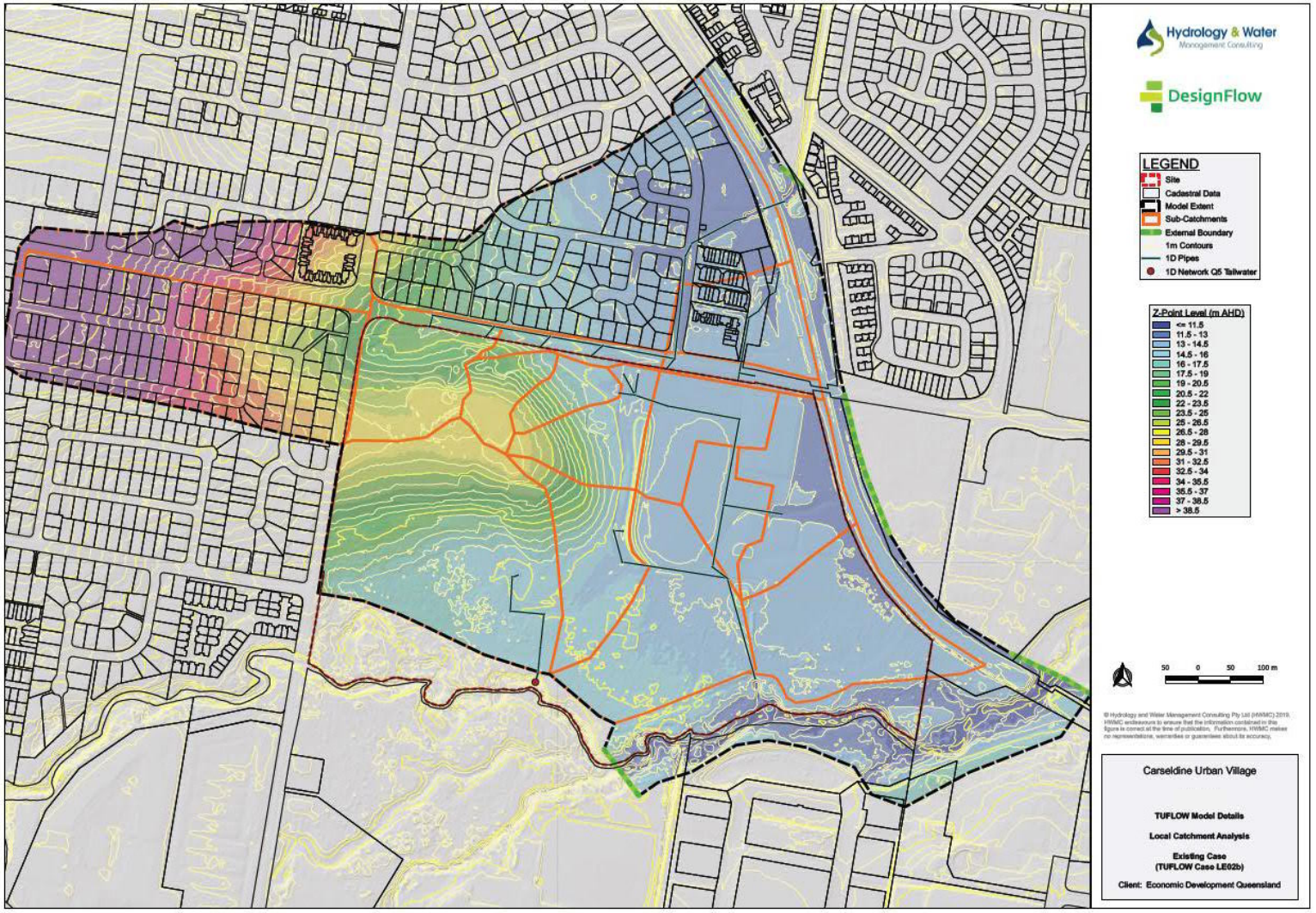


Figure 3 Existing case TUFLOW model layout

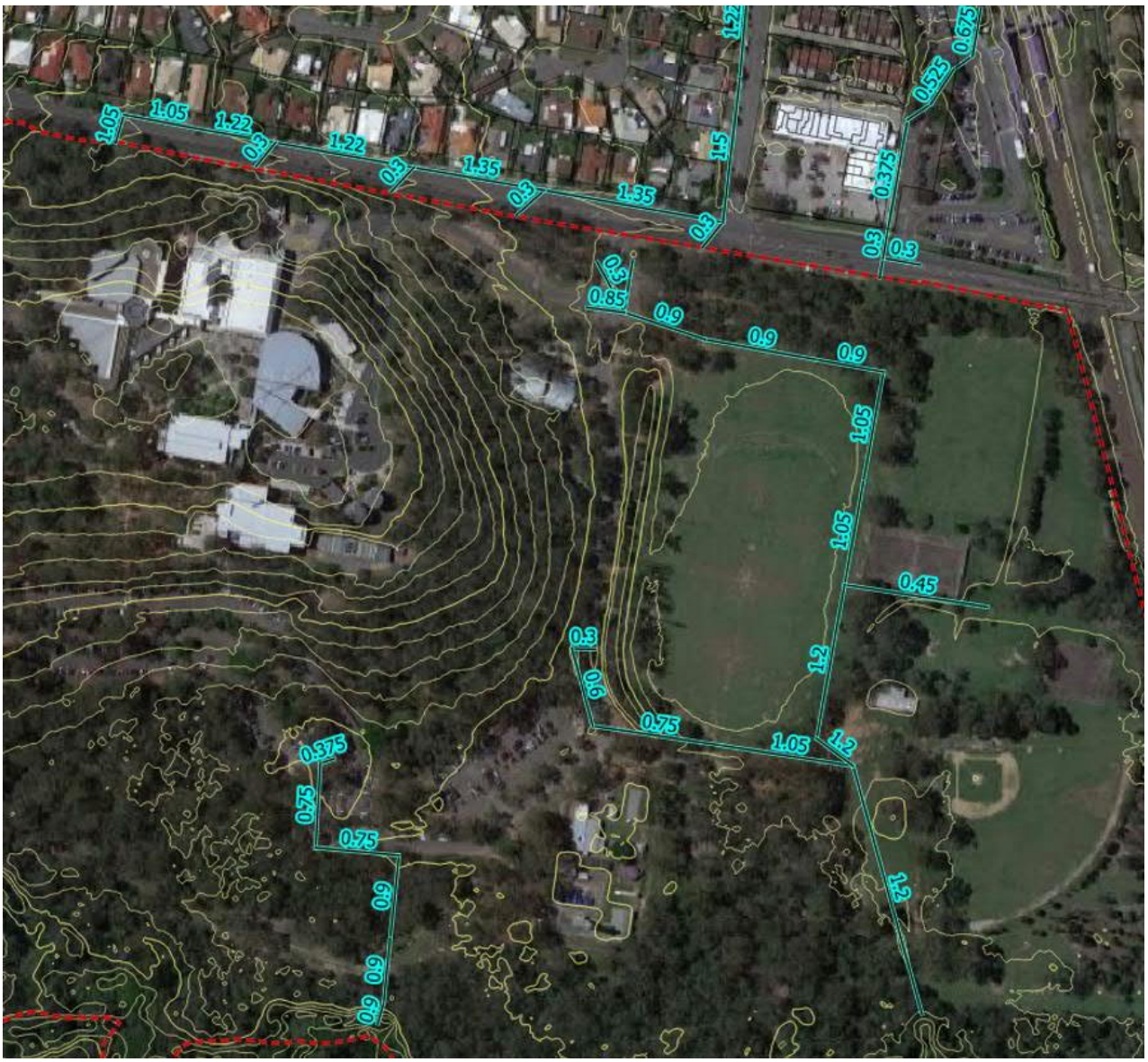


Figure 4 - Existing case pipe drainage and diameters (m)

4 VALIDATION

It is not possible to validate peak flows or levels in the hydraulic model because of storage effects and breakout flows from the defined hydrologic flow paths. Instead, a Rational Method peak flow validation has been carried out based on the existing case WBNM peak flows at the local catchment outlet near Cabbage Tree Creek (WBNM ID B8).

The 1% AEP Rational Method peak flow calculated at the outlet of B8 is 10.4 m^3/s. This is based on a Tc of 43 minutes, a catchment area of 36.1 Ha and a C10 value of 0.71. The peak flow predicted by the WBNM model at this location is 10.5 m^3/s which compares well.

5 DEVELOPED CASE MODELLING

The WBNM sub-catchments were updated to reflect the proposed development. For the purpose of this assessment to inform Stage 1 development, the ultimate site development has been applied to the hydrology model (refer to Figure 1 – Carseldine Urban Village Masterplan). All development areas have been assigned a Fraction Impervious of 90%. The proposed case WBNM sub-catchments are shown on Figure 5 and details are provided in Table 4.

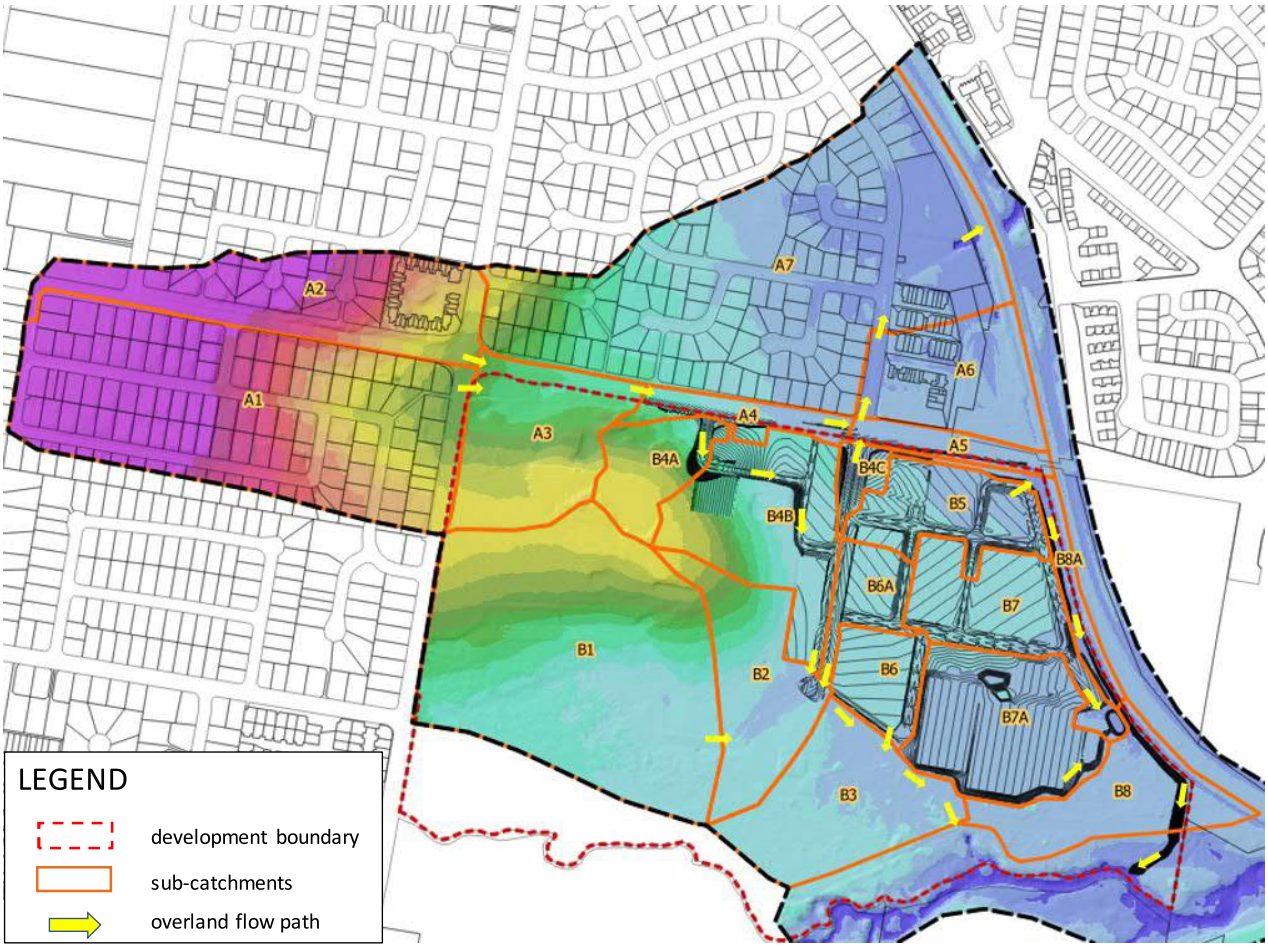


Figure 5 - Proposed case WBNM sub-catchments

Table 4 - Developed case WBNM sub-catchment details

WBNM ID	Area (ha)	Fraction Impervious (%)
A1	10.546	59.64
A2	4.582	65.43
A3	3.424	28.40
A4	0.958	57.19
A5	0.799	49.89
A6	2.738	83.29
A7	13.295	52.13
B1	10.021	9.48
B2	2.952	22.21
B3	3.504	8.63
B4A	1.481	89.20
B4B	3.679	75.04
B4C	0.452	88.32
B5	2.099	89.93
B6	1.235	84.88
B6	1.014	90.00
B7	2.545	83.70
B7A	3.528	22.59
B8	2.567	5.20
B8A	0.927	31.15

The developed case TUFLOW model is shown on Figure 6. It is equivalent to that of the existing case except for the following changes that have been made to represent the development site:

- Run with developed case WBNM hydrology
- Latest earthworks design tin by Calibre has been incorporated into the model topography (June 2019) – note bioretention extended detention depth is excluded from the flood storage
- Overland flow paths through the site have a Manning's 'n' value of 0.075 (medium vegetation).
- A bund with a crest a RL 13.7 has been applied across the south eastern outlet drain. This crest level ties in approximately with the natural ground level at this location. A one-way flapped 1200mm dia RCP has been placed through this bund.

  Note: this outlet arrangement has been designed to allow development flows to discharge to Cabbage Tree Creek, but prevent Cabbage Tree Creek flows from backing up northwards through this drain and into the development zone. Inclusion of the one-way flap valve was deemed necessary based on scenario testing of frequent local storm events, coupled with a relatively high

creek water level in Cabbage Tree Creek, which may cause local flooding (e.g. a 2 year local event with a 5 year tailwater level in Cabbage Tree Creek).

- Diversion of runoff from the north west of the site (CatB4A) via the new drainage network that discharges flows to Cabbage Tree Creek – this diversion manages development flows as well as existing drainage that reports to the Stage 1 western entry road from beams road (CatB4A). This diversion is designed to avoid flood impacts at Beams Road.
- Drainage of flows from the new eastern access road along Beams Rd (Cat B4C) to the existing Beams Rd drainage network via 450mm RCP
- Drainage sump at the low point just south of Stage 1 Lot 3
- Duplication of the existing 1200mm dia outfall to Cabbage Tree Creek

Peak depth maps for the Developed Case modelling are provided in Attachment 2.

Figure 6 TUFLOW developed case model setup

6 IMPACT ASSESSMENT

Peak flood level impact maps are provided in Attachment 3. In summary the flowing is noted:

- Flood level reductions are predicted at Beams Rd and areas to the north for all events modelled.
- Flood level reductions are predicted along the rail corridor for all events modelled.

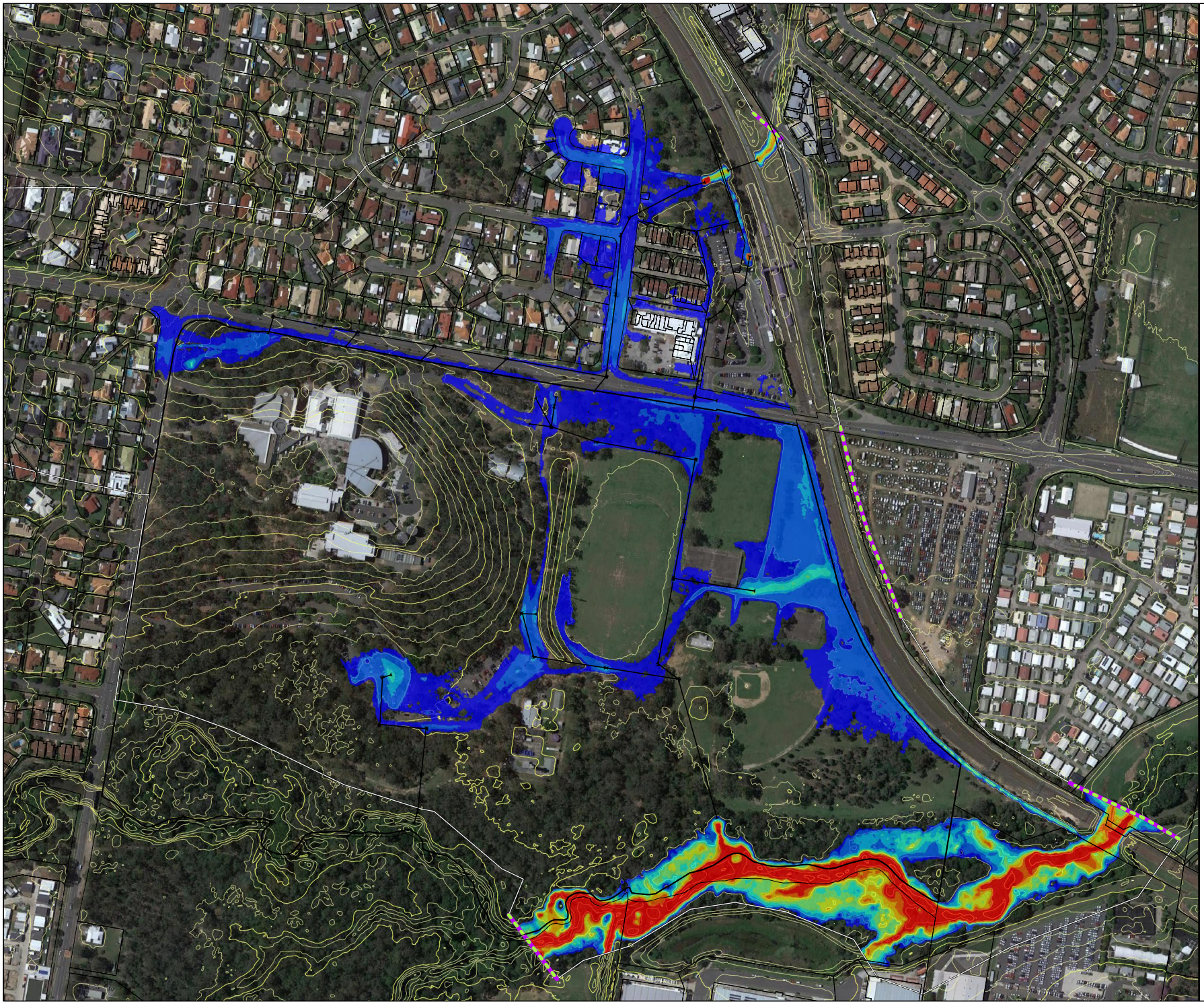
Note: Impacts shown within Cabbage Tree Creek are not realistic and should be dismissed because Cabbage Tree Creek has been run in steady state for the purpose of assigning a tailwater level of the local catchment analysis. Therefore, catchment timing effects are not properly considered in the local hydraulic model. The separate Cabbage Tree Creek regional flood analysis (refer to Carseldine Urban Village Updated Stormwater Management plan (DesignFlow Version 3 2019) has demonstrated that the increased runoff from the proposed development site is not expected to coincide with peak flows in the creek and that no adverse impacts are predicted.

7 RECOMMENDATIONS

Based on the local flood modelling results for the Carseldine Urban Village the following is recommended to be implemented as part of Stage 1 works:

- All flows associated with the Stage 1 north western entry road are diverted south to discharge to Cabbage Tree Creek. This includes the existing catchment to the west of this entry road (CatB4A – refer to Figure 5), where 1% AEP flows of up to 1.4m^3/s are to be captured and directed southward.
- Existing drainage pipes impacted by the development are connected to the new drainage and adequately allowed for in the drainage design based on the general drainage assumptions outlined in this document.
- The minor catchment draining to the new eastern Stage 1 entry road off Beams Rd (CatB4C – refer to Figure 5) can be connected to the existing Beams Road drainage network to the north (450mm dia pipe connection). This should only occur after the drainage at the western entrance road is constructed to avoid an impact on the Beams Rd drainage.
- Ensure Stage 1 flows (except for the eastern entry road as mentioned above) are discharged to Cabbage Tree Creek. The drainage system must have capacity to discharge development flows as well as existing discharges that are connected to the Stage 1 drainage.
- Include a drainage pit that connects to the new drainage for Stage 1 in the low lying area south of Stage 1 lot 3 to manage flooding in this low lying zone.
- Final development fill levels and finished floor levels should be based on whatever is the highest flood level from the following:
    - Cabbage Tree Creek regional flooding (refer to the *Carseldine Urban Village – Updated Stormwater Management Plan*, DesignFlow 2019)
    - Local catchment flooding (this assessment)
    - Internal road drainage (future detail design)

ATTACHMENT 1 – PEAK FLOOD DEPTHS – EXISTING CASE



Hydrology & Water Management Consulting

DesignFlow

LEGEND

- Site
- Cadastral Data
- Model Extent
- External Boundary
- 1D Pipes - Existing
- 1m Contour (LiDAR)

Depth (m)

- <= 0.2
- 0.2 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.25
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2
- > 2

40 0 40 80 m

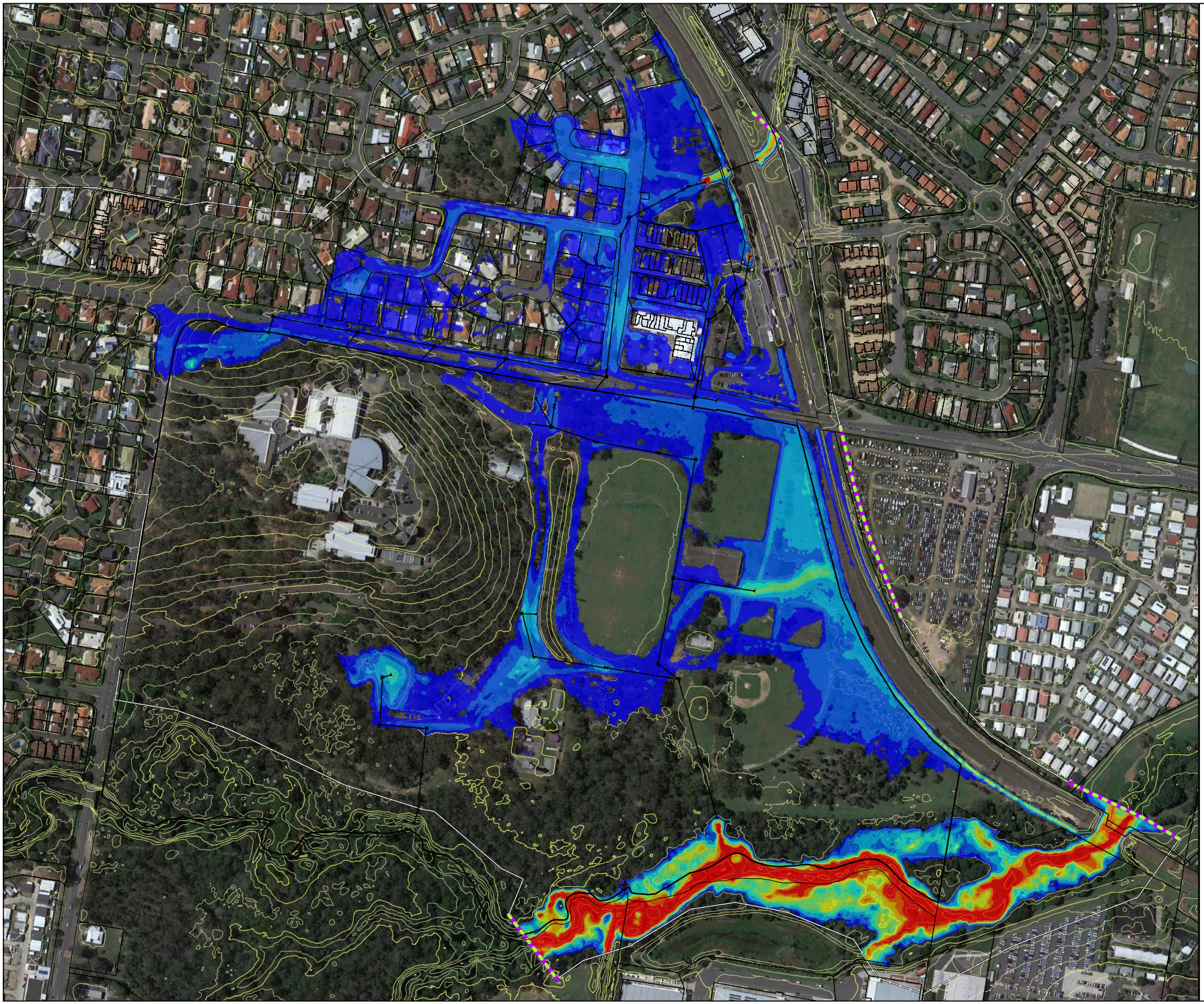
Carseldine Urban Village

Peak Flood Depths
Local Catchment Analysis

Existing Case
(TUFLOW Case LE02c)

50%AEP Event

Client: Economic Development Queensland



Hydrology & Water Management Consulting

DesignFlow

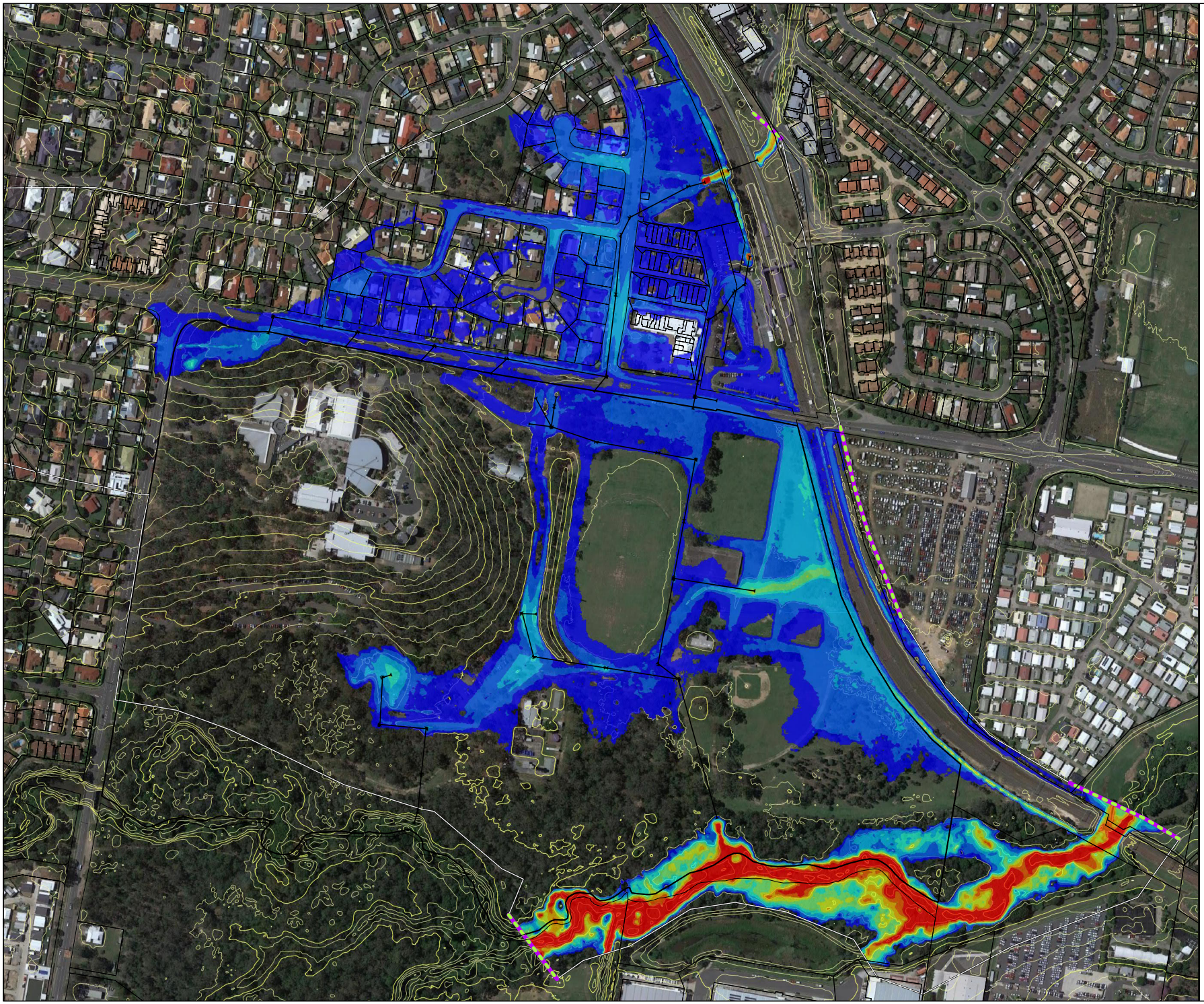
Carseldine Urban Village

Peak Flood Depths
Local Catchment Analysis

Existing Case
(TUFLOW Case LE02b)

5%AEP Event

Client: Economic Development Queensland



Hydrology & Water Management Consulting

DesignFlow

Carseldine Urban Village

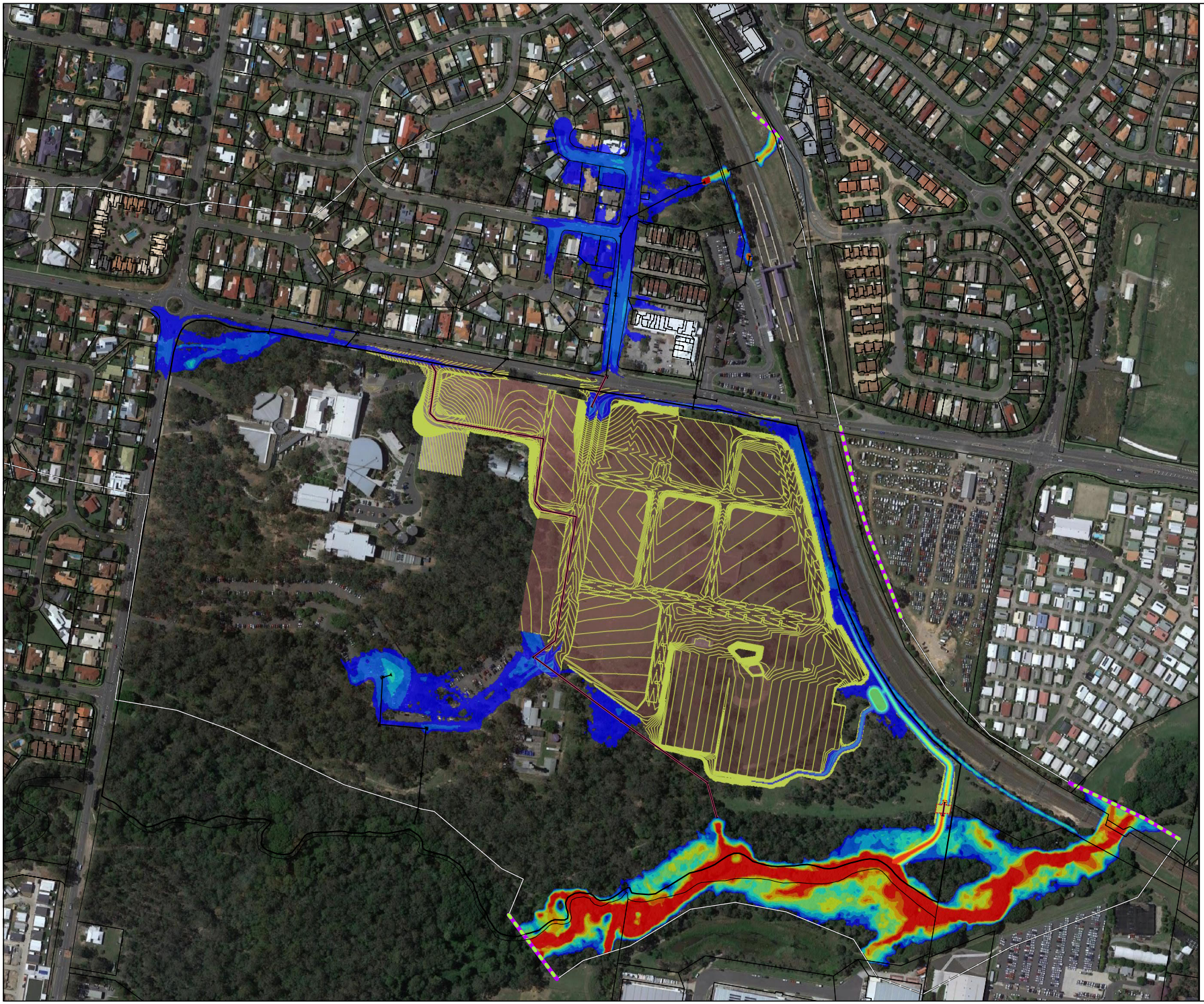
Peak Flood Depths
Local Catchment Analysis

Existing Case
(TUFLOW Case LE02b)

1%AEP Event

Client: Economic Development Queensland

ATTACHMENT 2 – PEAK FLOOD DEPTHS – PROPOSED CASE



Hydrology & Water Management Consulting

DesignFlow

LEGEND

- Site
- Cadastral Data
- Model Extent
- External Boundary
- Design Conts (0.1m)
- Proposed Case Z-Point Modifiers
- 1D Pipes - Existing
- 1D Pipes - Proposed

Depth (m)

- <= 0.2
- 0.2 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.25
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2
- > 2

40 0 40 80 m

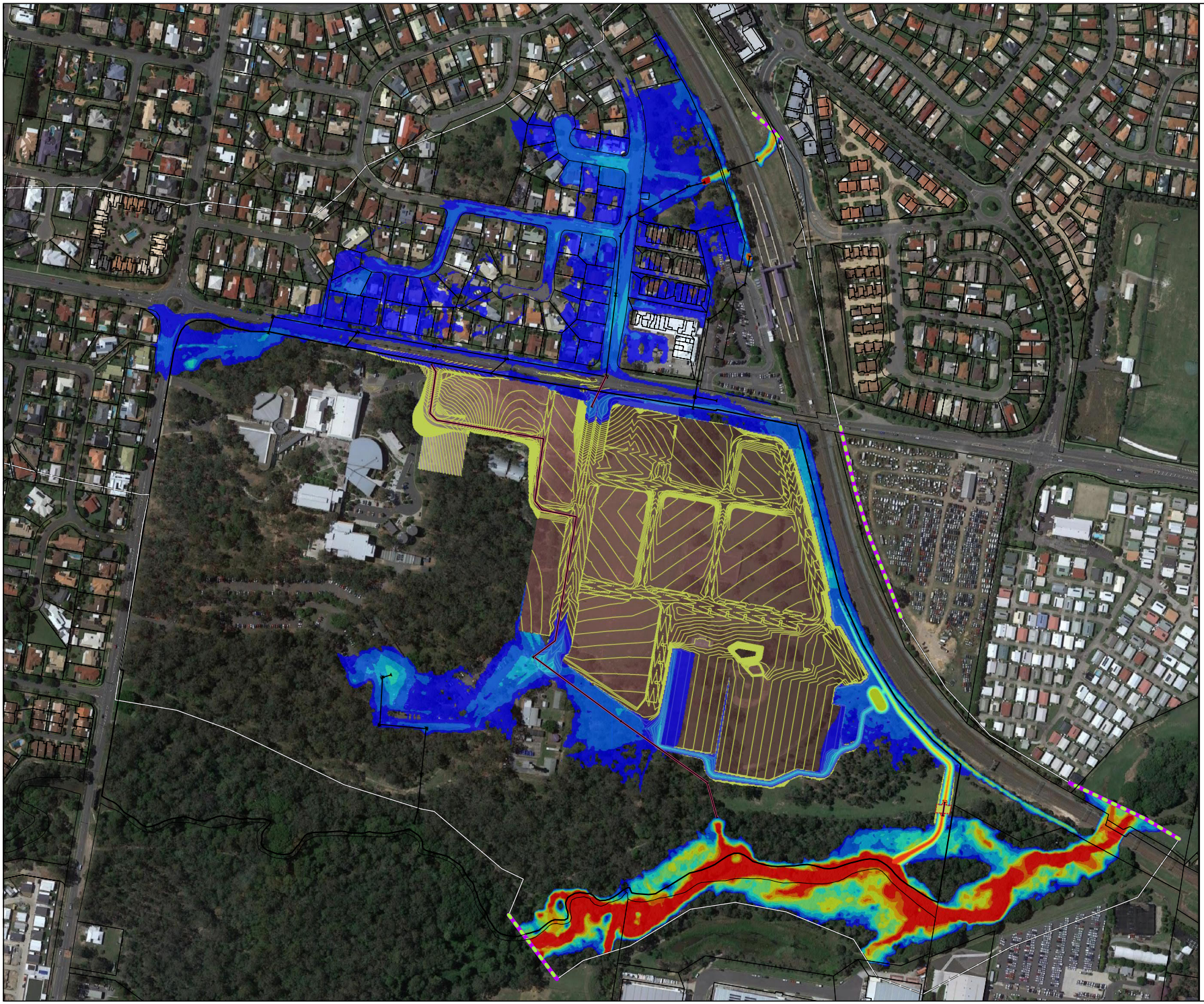
Carseldine Urban Village

Peak Flood Depths
Local Catchment Analysis

Proposed Case
(TUFLOW Case LP02d)

50%AEP Event

Client: Economic Development Queensland



Hydrology & Water Management Consulting

DesignFlow

LEGEND

- Site
- Cadastral Data
- Model Extent
- External Boundary
- Design Conts (0.1m)
- Proposed Case Z-Point Modifiers
- 1D Pipes - Existing
- 1D Pipes - Proposed

Depth (m)

- <= 0.2
- 0.2 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.25
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2
- > 2

40 0 40 80 m

Carseldine Urban Village

Peak Flood Depths
Local Catchment Analysis

Proposed Case
(TUFLOW Case LP02c)

5%AEP Event

Client: Economic Development Queensland

Hydrology & Water Management Consulting

DesignFlow

LEGEND

- Site
- Cadastral Data
- Model Extent
- External Boundary
- Design Conts (0.1m)
- Proposed Case Z-Point Modifiers
- 1D Pipes - Existing
- 1D Pipes - Proposed

Depth (m)

- <= 0.2
- 0.2 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.25
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2
- > 2

40 0 40 80 m

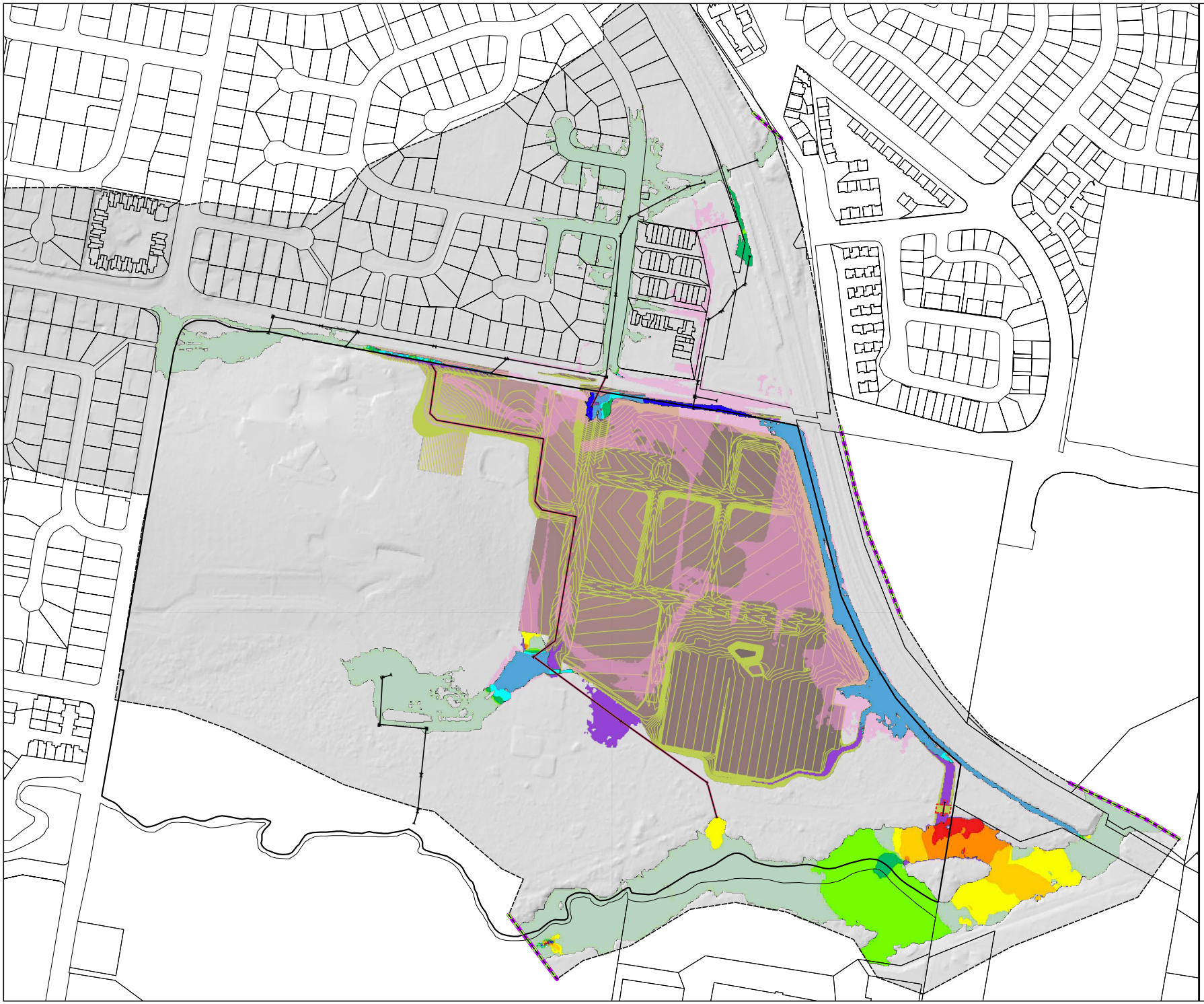
Carseldine Urban Village

Peak Flood Depths
Local Catchment Analysis

Proposed Case
(TUFLOW Case LP02c)

1%AEP Event

Client: Economic Development Queensland



Hydrology & Water Management Consulting

DesignFlow

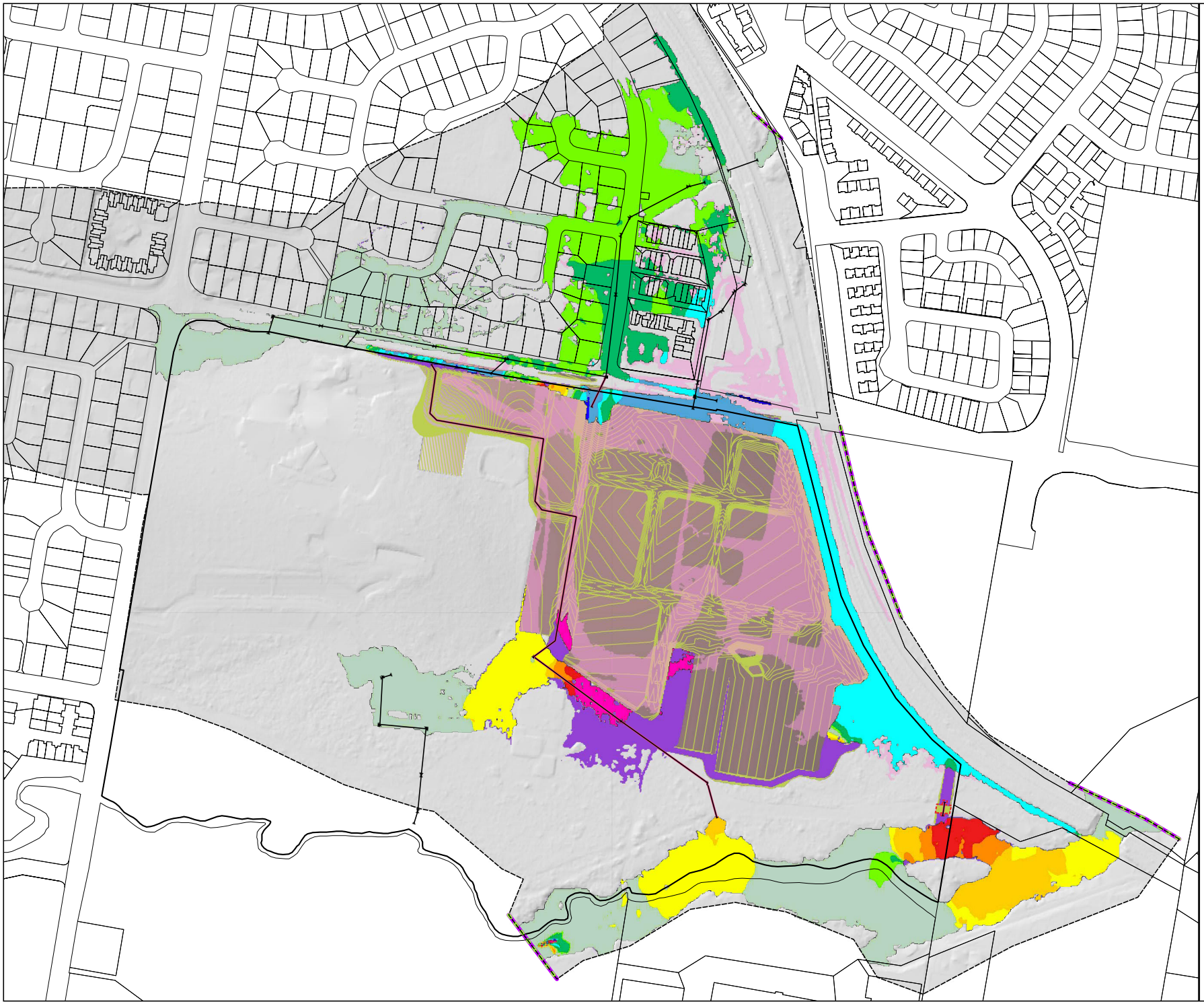
Carseldine Urban Village

Peak Flood Level Impacts
Local Catchment Analysis

(TUFLOW Case LP02d Vs LE02c)

50%AEP Event

Client: Economic Development Queensland



Hydrology & Water Management Consulting

DesignFlow

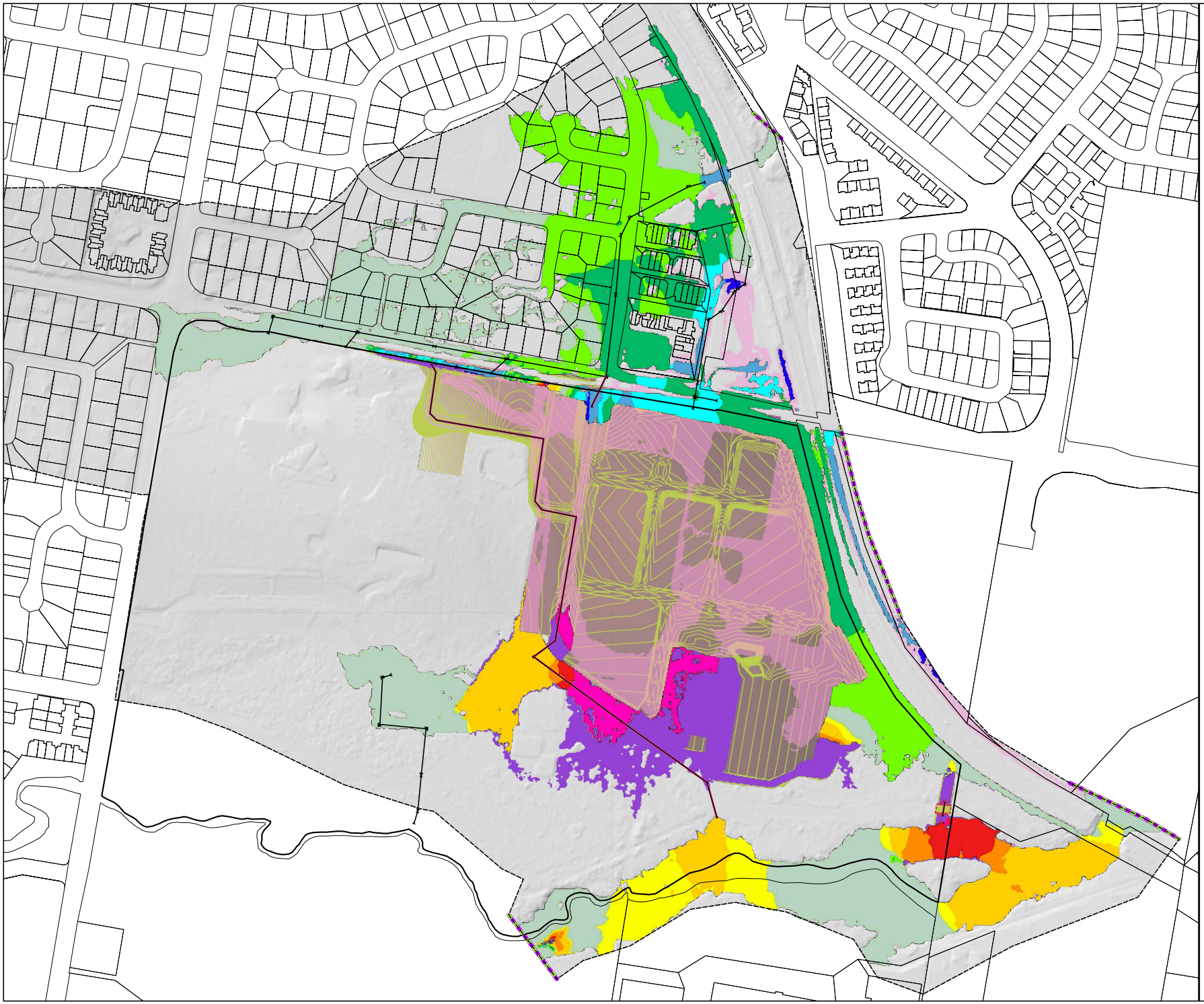
Carseldine Urban Village

Peak Flood Level Impacts
Local Catchment Analysis

(TUFLOW Case LP02c Vs LE02b)

5%AEP Event

Client: Economic Development Queensland



Hydrology & Water Management Consulting

DesignFlow

Carseldine Urban Village

Peak Flood Level Impacts
Local Catchment Analysis

(TUFLOW Case LP02c Vs LE02b)

1%AEP Event

Client: Economic Development Queensland

Queensland Government

TECHNICAL MEMORANDUM

To:	Richard Bender - EDQ
From:	Ralph Williams / Shaun Leinster DesignFlow
Date:	24 February 2020
Subject:	Carseldine Urban Village - Addendum to Carseldine Urban Village – Local flood assessment to support Stage 1 development
Attachments	1. Flood barrier works for Stage 1

1 INTRODUCTION

This technical memorandum provides recommended outcomes for stormwater related items for Carseldine Urban Village Stage 1 development, based on 3rd party reviews by BMT of the Stage 1 flood impact assessments and subsequent discussions with EDQ.

2 BACKGROUND

In support of the Carseldine Urban Village Stage 1 application, DesignFlow completed a detailed local flood assessment, as detailed in *Carseldine Urban Village – Local flood assessment to support Stage 1 development (DesignFlow 10 October 2019).* This shall be referred to as the *Stage 1 Local Flood Assessment* in this technical memorandum.

The flood modelling presented in the *Stage 1 Local Flood Assessment* was completed to inform detail drainage design for Stage 1 development to manage local impacts and demonstrate no flood impacts external to the site as a result of Stage 1 development. The local modelling was completed using the a WBNM rainfall runoff model that feeds local catchment hydrographs into a 1D/2D TUFLOW hydraulic model. Full details of the model setup are provided in the *Stage 1 Local Flood Assessment*. A summary of the model setup is reproduced here in Figure 1.

Local modelling for Stage 1 did not include the flood bund along the eastern boundary of the site as this was not originally intended to be included with Stage 1 works.

Outcomes from the flood impact assessments included:

- Flood level reductions at Beams Rd and areas north of Beams Rd for all events modelled
- Flood level reductions along the rail corridor for all events modelled.

Figure 1 – Local TUFLOW model setup

3 3RD PARTY REVIEW

BMT completed a 3rd party review of the flood modelling associated with Stage 1 development (BMT – *Carseldine Urban Village – Dev 2017/864 – Stage 1 Drainage Peer Review – 21st October 2019*). Formal responses to the 3rd party review were provided by DesignFlow to EDQ (refer to DesignFlow letter response *Carseldine Urban Village Development – Stage 1 drainage peer review – 1st November*, 2019). BMT provided a subsequent letter response (Carseldine Urban Village – Dev 2017/864 Stage 1 Drainage Peer Review - 11th November 2019) and following this a telecom meeting with EDQ, BMT and DesignFlow occurred on the 28th November, 2019 to resolve an agreed outcome for Stage 1 approval. The agreed remaining items to be resolved for Stage 1 development included:

- Item 1 - Flood barrier along the eastern boundary of the site – consultation be held with TMR/QR
- Item 2 - Testing the requirement of the proposed flap valve on the 1200mm pipe culvert
- Item 3 - Review flood storage volumes within the BCC waterway corridor extent
- Item 4 - Model updates and sensitivity testing – post Stage 1

The following provides a summary of the actions completed for each item above and the recommendations relevant to Stage 1 approval.

3.1 ITEM 1 – FLOOD BARRIER ALONG EASTERN BOUNDARY

Since the Stage 1 3rd party review, EDQ have had discussions with TMR regarding flood impacts along the rail corridor zone. TMR have stated that they will not accept any impact in this zone. Although local modelling for Stage 1 had indicated no impacts along the rail corridor with no flood barrier included, there remains a risk in the regional flood case that impacts could occur in this corridor with no flood barrier in place. Whilst this does not cause flooding of the rail line, EDQ have advised that the flood bund is to be constructed as part of Stage 1 works to eliminate the risk of flooding along the rail corridor zone.

Attachment 1 provides details of the proposed flood barrier works. This flood barrier will be combined with the acoustic fence, where applicable. This is consistent with what was previously proposed to eliminate impacts along the rail corridor zone, as detailed in the Carseldine Urban Village - Updated Stormwater Management Plan (DesignFlow October 2019). The top flood barrier levels are based on predicted 100 year flood levels associated with ultimate development conditions, with a minimum 300mm freeboard applied. These flood barrier levels are insensitive to the flap valve on the 1200mm RCP and are related to regional flood effects.

RECOMMENDED ACTION RELEVANT TO STAGE 1: INSTALL THE FLOOD BARRIER ALONG EASTERN BOUNDARY OF THE SITE AS PART OF STAGE 1 WORKS AS PER ATTACHMENT 1

3.2 ITEM 2 – FLAP VALVE

Previous Stage 1 local modelling was completed without the inclusion of the flood barrier along the eastern boundary. This required the inclusion of a flap valve on the 1200mmRCP to avoid impacts within the rail corridor as a result of backwatering from Cabbage Tree Creek, particularly during more frequent local storm events. Given the rail bund will now be completed as part of Stage 1 works to avoid impacts in the rail corridor, the requirement for the flap valve will be tested with the rail bund included. Should a flap valve be required this will be installed prior to plan sealing for Stage 1.

Please note that the current design of the 1200mm RCP has taken into consideration the possibility of installing a flap at a future date. Refer to Calibre plans for details.

RECOMMENDED ACTION RELEVANT TO STAGE 1: ENSURE THE DESIGN OF THE CULVERT CROSSING CAN ACCOMMODATE A FLAP VALVE AND TEST THE REQUIREMENT FOR THE FLAP VALVE AND INSTALL IF REQUIRED PRIOR TO STAGE 1 PLAN SEALING

3.3 ITEM 3 – FLOOD STORAGE

Previous flood storage volume calculations presented in the Carseldine Urban Village Updated Stormwater Management Plan (DesignFlow, October 2019) indicated a loss of storage as a result of development. This value was based on the full extent of flooding within the development site for pre and post conditions.

Compliance with BCC flood overlays for loss of flood plain storage is only required within the waterway extents defined for Cabbage Tree Creek. Revised flood storage calculations within the development were completed for flood storage volumes within the BCC waterway extent only. The following volumes were determined under ultimate development conditions, with the influence of the pedestrian bridge crossing Cabbage Tree Creek included:

- Existing flood storage: 99,276 m^3
- Ultimate developed case flood storage: 99,608 m^3

- Overall gain in flood storage = 332 m^3

RECOMMENDED ACTION FOR STAGE 1: NO FURTHER ACTION REQUIRED – COMPLIANCE WITH BCC FLOOD OVERLAY DEMONSTRATED FOR ULTIMATED DEVELOPMENT CONDITIONS

3.4 MODEL UPDATES AND SENSITIVITY TESTING – POST STAGE 1

Model updates and sensitivity testing scenarios were recommended as part of the 3rd party review. The agreed model updates and sensitivity testing to occur as part of future modelling exercises include:

- Remove Cabbage Tree Creek from the local model and adopt a fixed tailwater based on a 5 year flood regional level
- Sensitivity testing of local modelling results using ARR 1987 procedures
- Sensitivity testing of blockage of the 1200mm RCP

It was agreed with BMT that the above be completed post Stage 1 and be included with necessary model updates required to support Stage 2 application.

RECOMMENDED ACTION FOR STAGE 1: NO FURTHER ACTION REQUIRED – MODEL UPDATES AND SCENARIO TESTING TO OCCUR POST STAGE 1 AS AGREED WITH BMT

Based on 3rd party reviews and subsequent discussions with EDQ no further stormwater related items remain outstanding for Stage 1 development.

Prepared by:

Ralph Williams

Reviewed/Certified by:

Shaun Leinster

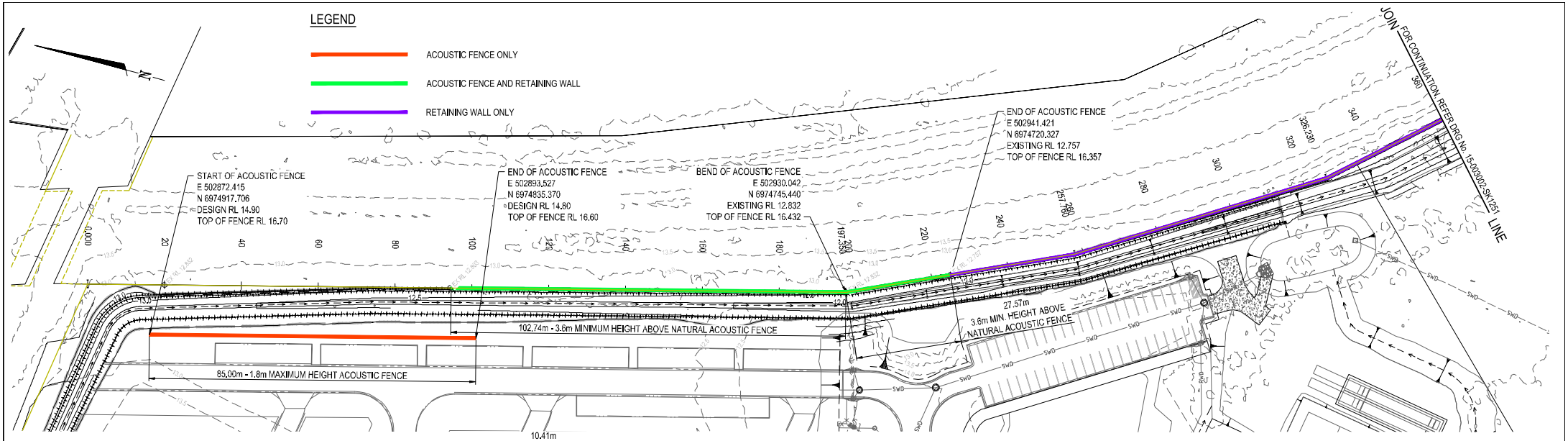
RPEQ 15637

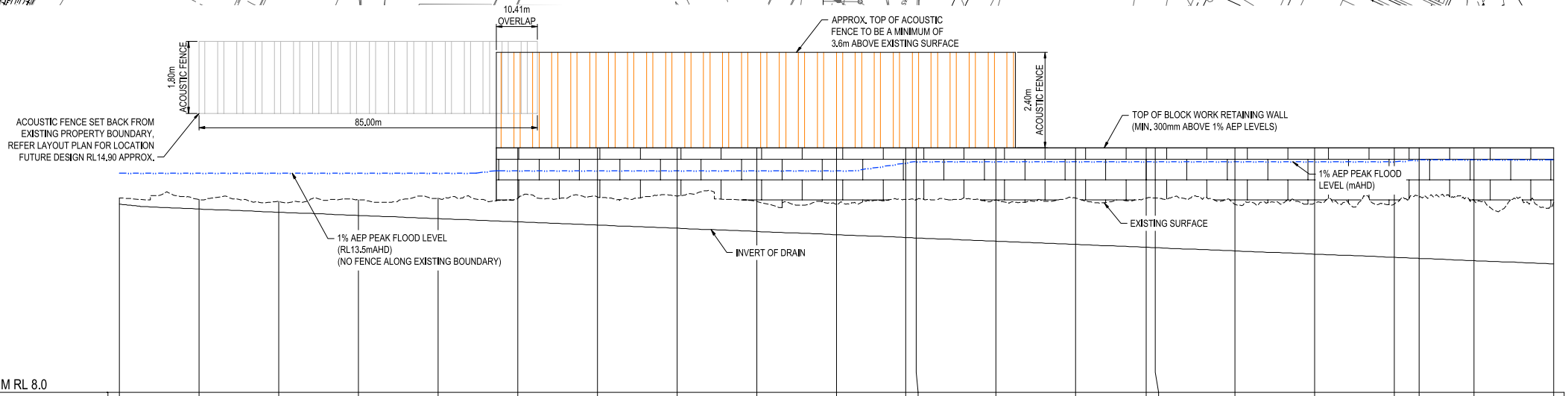
DesignFlow

Attachments:

1. Flood barrier works for Stage 1

ATTACHMENT 1 – FLOOD BARRIER WORKS FOR STAGE 1





DATUM RL 8.0

DRAIN INVERT LEVEL	12.717	12.596	12.516	12.435	12.355	12.274	12.194	12.113	12.033	11.952	11.883	11.869	11.789	11.708	11.635	11.626	11.545	11.465	11.384	11.359	11.300	11.219
RETAINING WALL LEVEL						14.130	14.130	14.130	14.130	14.130	14.130	14.130	14.130	14.130	14.130	14.130	14.130	14.130	14.130	14.130	14.130	14.130
EXISTING SURFACE	12.879	12.832	12.788	12.827	12.870	12.863	12.899	12.923	12.780	12.709	12.832	12.826	12.819	12.872	12.870	12.873	12.717	12.741	12.718	12.914	12.810	12.761
CHAINAGES	0.000	20.000	40.000	60.000	80.000	100.000	120.000	140.000	160.000	180.000	197.350	200.000	220.000	240.000	257.760	260.000	280.000	300.000	320.000	326.230	340.000	360.000

LONGITUDINAL SECTION - EXISTING RAIL BOUNDARY

HORIZ SCALE: 500
VERTICAL SCALE: 50

PDA. REF NO. DEV—/—

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	21.02.20	ISSUED FOR INFORMATION	AA	AA

DRAWN CHECK
DESIGN CHECK

STATUS: FOR APPROVAL
NOT FOR CONSTRUCTION

APPROVED: DANIEL COLLINS RPEQ 18631

FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

SCALE: 1:500 / 1:1000 — 10 5 0 10 20m — A1 / A3

CLIENT: ECONOMIC DEVELOPMENT QUEENSLAND

calibre
calibregroup.com

PROJECT: CARSELDINE URBAN VILLAGE STAGE 1

DISCLAIMER
ALL DIMENSIONS TO BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY, DO NOT SCALE.

DRAWING TITLE: ACOUSTIC FENCE LAYOUT PLAN SHEET 1 OF 2

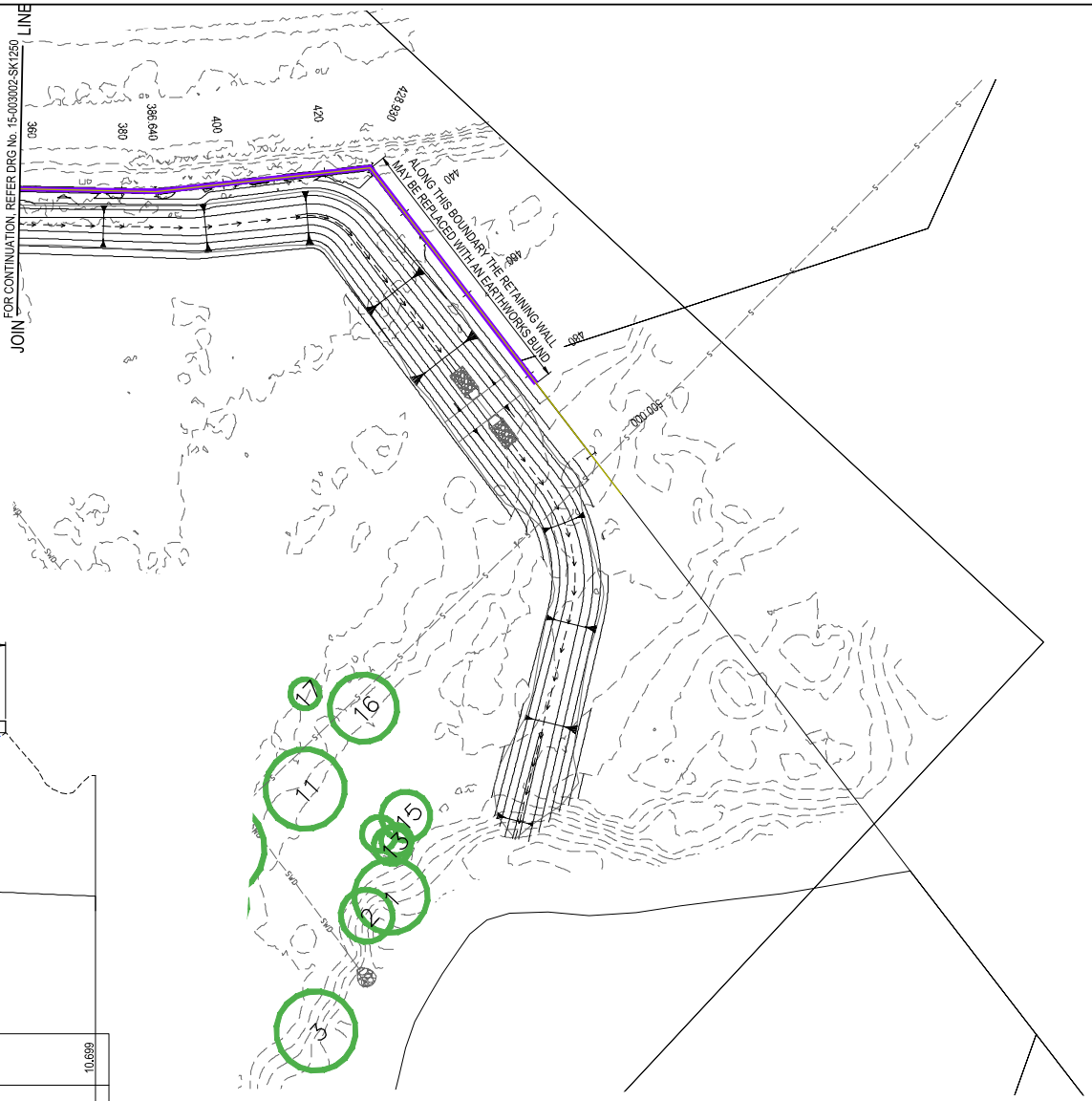
PROJECT No.	DRAWING No.	REVISION
15-003002.01	SK1250	1

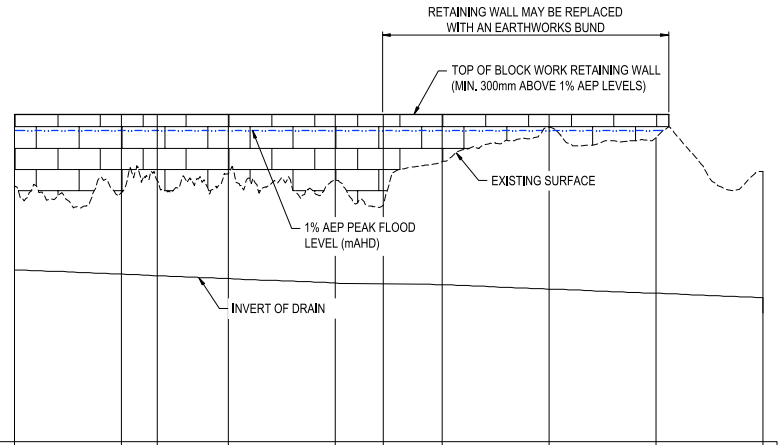
LEGEND

ACOUSTIC FENCE ONLY

ACOUSTIC FENCE AND RETAINING WALL

RETAINING WALL ONLY





DATUM RL 8.0

DRAIN INVERT LEVEL	11.219	11.139	11.108	11.054	10.973	10.991	10.940	10.860	10.779	10.699
RETAINING WALL LEVEL	14.130	14.130	14.130	14.130	14.130	14.130	14.130	14.130	14.130	
EXISTING SURFACE	12.761	12.669	12.891	13.011	12.898	12.422	13.244	13.893	13.697	13.060
CHAINAGES	360.000	380.000	386.640	400.000	420.000	428.930	440.000	460.000	480.000	500.000

LONGITUDINAL SECTION - EXISTING RAIL BOUNDARY (CONTINUED)

HORIZ SCALE: 500
VERTICAL SCALE: 50

PDA. REF NO. DEV—/—

REVISION	DATE	ISSUE DETAILS	DRAWN	DESIGN
1	21.02.20	ISSUED FOR INFORMATION	AA	AA

DRAWN CHECK

DESIGN CHECK

STATUS: FOR APPROVAL
NOT FOR CONSTRUCTION

APPROVED: DANIEL COLLINS RPEQ 18631

FOR & ON BEHALF OF CALIBRE CONSULTING (QLD) PTY LTD

SCALE
1:500 10 5 0 10 20m A1
1:1000 A3
HORIZONTAL
1:50 1 0.5 0 1 2m A1
1:100 A3
VERTICAL

CLIENT: ECONOMIC DEVELOPMENT QUEENSLAND

calibre
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PROJECT: CARSELDINE URBAN VILLAGE STAGE 1

DISCLAIMER
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DRAWING TITLE: ACOUSTIC FENCE LAYOUT PLAN SHEET 2 OF 2

PROJECT No.	DRAWING No.	REVISION
15-003002.01	SK1251	1

DesignFlow

26 November 2020

Richard Bender
Development Manager
Economic Development Queensland
Level 14, 1 William St Brisbane QLD 4000

Dear Richard

RE: CARSELDINE URBAN VILLAGE DEVELOPMENT –LOT 3 DESIGN FLOOD LEVELS

The following provides the design flood levels relevant to Lot 3 retirement village at the Carseldine Urban Village development. This advice is based on recent regional flood modelling completed for the Carseldine Urban Village, as reported in the *Carseldine Urban Village – Updated Stormwater Management Plan Version 4* (DesignFlow, dated October 2019) and *Carseldine Urban Village - Updated Flood Assessments to Support Stage 1 development* (15 May, 2020).

Figure 1 attached shows the modelled flood levels adjacent to Lot 3 for the 1% AEP (Q100) and 0.2% AEP (Q500) events under ultimate developed conditions. Flood levels have been derived from flood modelling based on Brisbane City Council (BCC) supplied URBS and TUFLOW regional models for Cabbage Tree Creek. These models have been updated as necessary to make suitable for a flood assessment of the Carseldine Urban Village development. This includes the new pedestrian bridge linking CUV with Aspley State school. Modelling assumptions are detailed in the Updated Stormwater Management Plan Version 4.

Modelled percent impervious values for developed areas of CUV are assumed at 90%, this includes Lot 3 development.

Design Flow Consulting P/L
ATF Design Flow Unit Trust
ABN: 50 978 863 990

T/ 07 5528 1148
PO Box 1250 Southport BC,
Southport QLD 4215 Australia

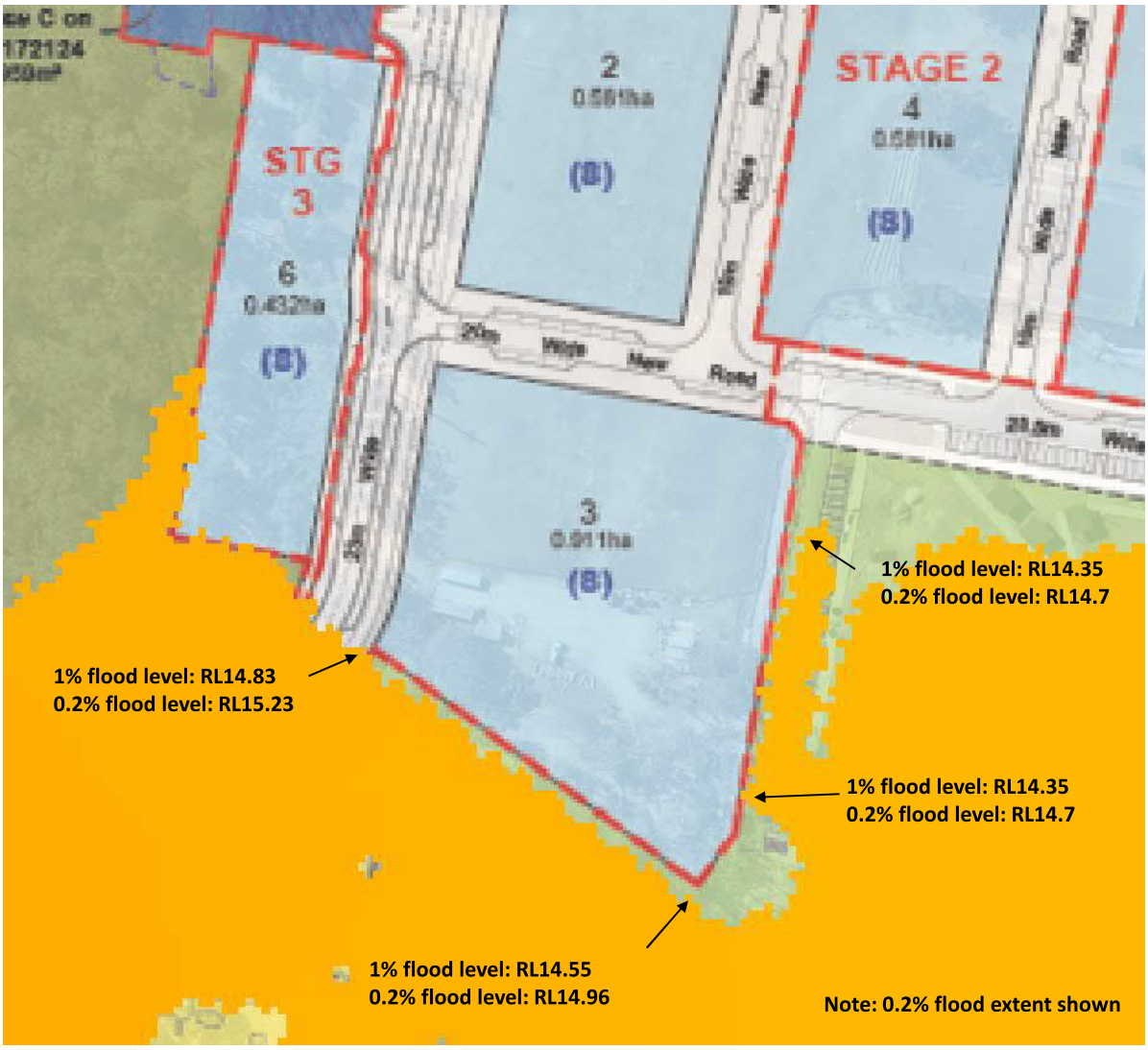

Figure 1 – 1% and 0.2% flood levels adjacent to Lot 3

Please call me on 0405 715 523 if you have any queries on the above.

Yours sincerely

R. Williams

Ralph Williams
DesignFlow

CARSELDINE URBAN VILLAGE

UPDATED STORMWATER MANAGEMENT PLAN

DesignFlow

Prepared for Economic Development Queensland

October 2019

PLANS AND DOCUMENTS
referred to in the PDA
DEVELOPMENT APPROVAL

Approval no: DEV2019/1074

Date: 26 March 2020

Queensland Government

Document Control Sheet

Report Title:	Carseldine Urban Village – Updated Stormwater Management Plan
Suggested Reference:	Carseldine Urban Village – Updated Stormwater Management Plan (DesignFlow, 2019)
Version:	04
Client:	Economic Development Queensland
Author(s):	Ralph Williams
Reviewed By:	Shaun Leinster
Approved By:	Shaun Leinster RPEQ15637 
Date:	10/10/2019
File Location:	S:\Projects\4306
Circulation:	Electronic Copies: Economic Development Queensland

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Qualifications & Limitations

In preparing this report, Designflow has relied upon and assumed accurate data provided by Brisbane City Council (BCC) and other sources. Unless otherwise stated in this report, Designflow has not attempted to verify the accuracy or completeness of any such information. The accuracy of this report is reliant upon the accuracy of this information.

This investigation is based upon BCC's established flood model of the Cabbage Tree Creek floodplain. While some refinements have been made to BCC's models to suit the current project, overall the modelling approach and assumptions have been applied consistently with that of the established models. Consequently, the model accuracy limitations of BCC's flood models also generally apply to this investigation.

Modelling for this investigation is based on a design event approach and assumptions that are consistent with current industry practice. It is important to be aware that real world flood events are random and highly variable. Consequently, observed and future flooding characteristics may not reflect those described in this report.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Designflow for use of any part of this report in any other context.

Study results should not be used for purposes other than those for which they were prepared.

Table of Contents

EXECUTIVE SUMMARY

Carseldine Urban Village (Lot 322 on SP172124) is a proposed development on a 45ha site, currently occupied by Queensland Government facilities and community sports fields. The development is currently being undertaken by Economic Development Queensland (EDQ) and involves the creation of lots for a mix of uses including commercial and retail, residential, retirement living and a sporting complex.

This report presents the details of an Updated Stormwater Management Plan for the development to meet the requirements under:

- *State Planning Policy* – SPP (DLGIP, 2017) for the operational stormwater quality objectives;
- *Queensland Urban Drainage Manual* (QUDM) for stormwater quantity management; and
- *Brisbane City Council Planning Scheme*

This report supersedes the previously issued stormwater management plan for the site (DesignFlow, April 2018). This updated stormwater management plan captures the following updates and information that has been made available since the issue of the April 2018 report:

- Updated and approved overall masterplan for the development (source: RPS, October 2019)
- Latest earthworks associated with the development (source: Calibre Consulting, June 2019)
- Existing site pipe drainage survey (completed June 2019 – source: Land Partners)

STORMWATER QUALITY MANAGEMENT

The updated stormwater treatment strategy includes two (2) bioretention basins that treat development runoff prior to discharge to Cabbage Tree Creek:

- Bioretention Basin B1 265m^2 filter area treating Stages 2, 3 (part of) and S
- Bioretention Basin B2 500m^2 filter area total treating the remainder of the development (Stages 1,3 (part of), 4 and 5)

These basins are located outside of the Cabbage Tree Creek riparian corridor and will have low impact on existing vegetation. The proposed locations also avoid conflicts with the future busway corridor.

Drainage swales along the eastern boundary of the site and at the southern boundary of the Stage S sports fields also provide additional treatment.

FLOOD MANAGEMENT

Flood impact assessment demonstrates no significant impacts occurring external to the site as a result of development. Some afflux (~50mm) is observed immediately south east of the development boundary, however this afflux occurs within a low-lying flood prone bushland area and is not considered an actionable nuisance.

Improved flood conditions are observed at Beams Road and the rail line at the north-east end of the site. This is because much of the site drainage will be directed to Cabbage Tree Creek. Furthermore, during larger magnitude events, the proposed development fill restricts Cabbage Tree Creek breakout flow from entering this area.

Required mitigation measures to manage flood impacts external to the site include:

- Providing flood storage over the sports field zone for events greater than the 5% AEP (20 year ARI).
- Incorporation of a 1200mm dia pipe with one-way flap valve along the new drainage swale draining the eastern half of the development. This minimizes the impacts of Cabbage Tree Creek flows into the site via this new connection to Cabbage Tree Creek.
- Inclusion of a flood barrier (~1m high) along the eastern boundary of the site. This avoids increases in flood levels along the rail line adjacent to the site.

This report is based on regional flood modelling based upon the Brisbane City Council (BCC) flood model for Cabbage Tree Creek. Updated regional modelling and detailed local modelling will occur as part of continuing design development for the site.

1 SITE CHARACTERISTICS

1.1 SITE LOCATION

The Carseldine Urban Village development is located approximately 14km north of Brisbane. The site is bounded by Beams road to the north, Cabbage Tree Creek to the south, Brisbane rail to the east and Dorville Road to the west.

Figure 1 shows the location of the site.

Figure 1: Locality plan

1.2 CLIMATE

Figure 2 provides a summary of the monthly rainfall based on climate statistics for Brisbane (station No 40223).

The annual average rainfall is 1,190 mm, whilst annual evaporation is approximately 1,950mm. The figure clearly indicates the seasonal nature of rainfall and evaporation with lower rainfall and evaporation periods during the winter months.

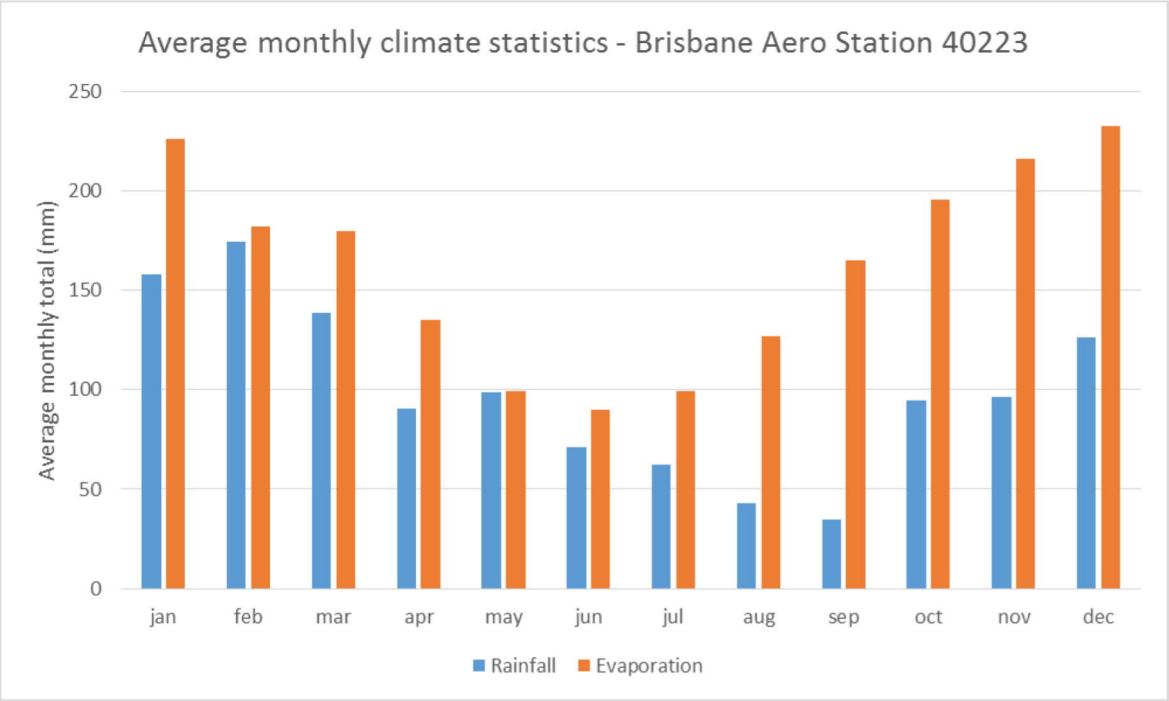


Figure 2 Average monthly climate statistics

1.3 TOPOGRAPHY, CATCHMENTS AND DRAINAGE

Ground levels across the site range from approximately RL28 at the high point located at the north western boundary of the development to approximately RL9.5 at the south eastern corner at Cabbage Tree Creek. Grades across the site are flat to moderate typically ranging from 0.5 to 10%.

The site is characterised by areas of low lying and poorly drained topography. Figure 3 shows the existing topography and general drainage of the current site. The majority of the site drainage is toward Cabbage Tree Creek to the south, whilst the north west section of the site drains northward. Poorly drained areas are also noted at the north east of the site.

Pipe drainage within the site discharges at two (2) outfalls to Cabbage Tree Creek. This drainage system minimises localised site flooding in the more frequent events, when regional flooding from Cabbage Tree Creek does not occur.

In general, the northern bank of Cabbage Tree Creek is higher than adjacent ground levels further north within the site. This means flood flows are initially contained within Cabbage Tree Creek but then break out of the banks of the creek over the high point on the northern bank and inundate low lying and poorly drained areas within the site.

At the north eastern end of the site, low lying areas occur adjacent to the rail line and at the northern boundary of the existing sports fields adjacent to Beams Road. This area appears to be providing an overland flow path for flood flows.

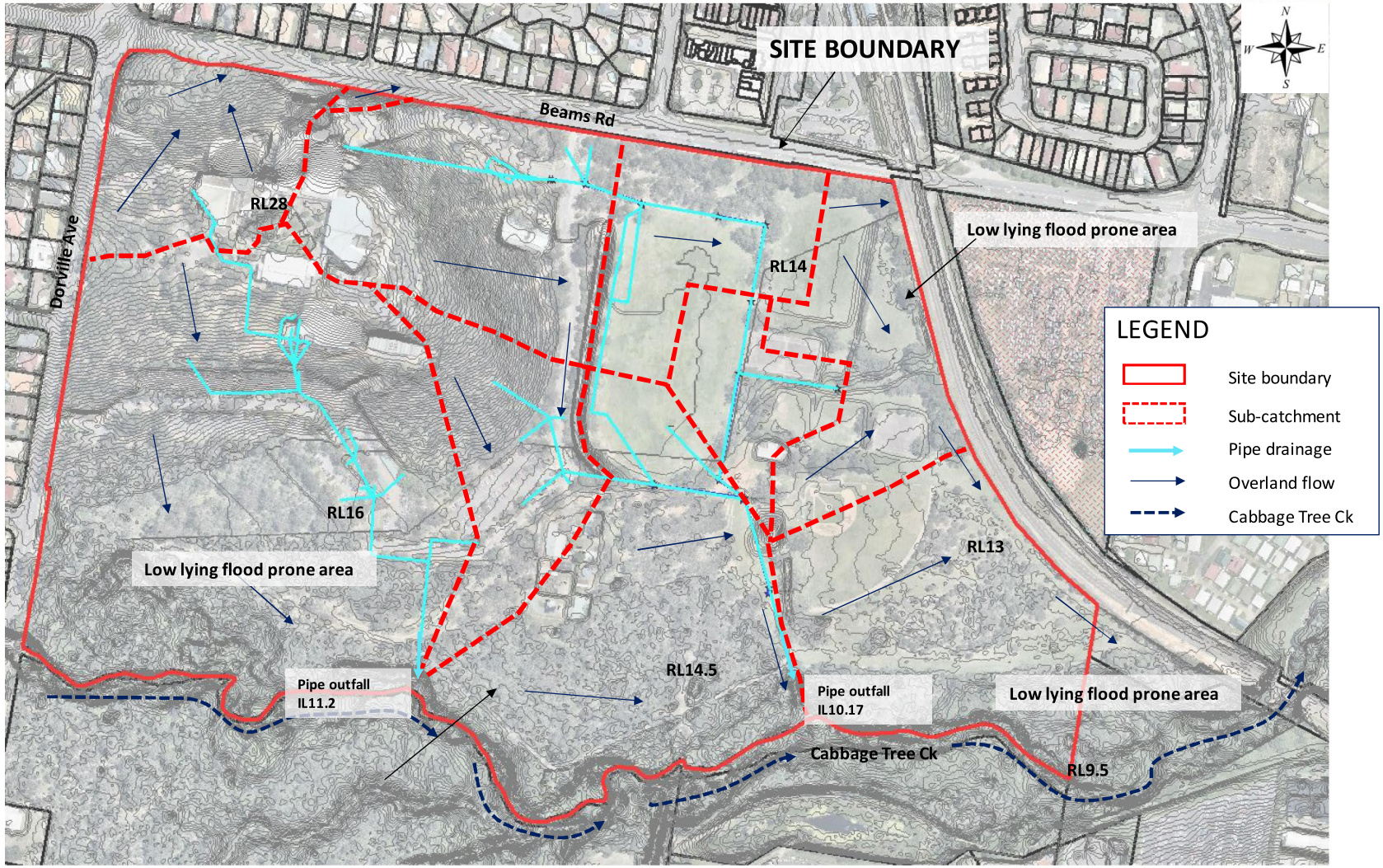


Figure 3: Topography and drainage

1.4 SOILS AND VEGETATION

Soils across the site are generally characterised by alluvial soils comprising surface clayey silt overlying medium to high plasticity silty clay and sandy clay, with interbedded layers of clayey sand, gravelly sand and gravel (SGS, 2017).

The site comprises of sports fields and government buildings in the northern half of the site. Extensive good value bushland occurs in the southern half of the site including the Cabbage Tree Creek riparian corridor (refer Figure 1).

1.5 PROPOSED DEVELOPMENT

The Carseldine Urban Village development is located within a 45ha site. The site includes existing government facilities at the north western end of the development that are to be retained. Existing sports fields at the north eastern corner of the site are to be redeveloped, whilst a new sporting precinct will be constructed at the south eastern corner of the site. A future busway is planned at the southern end of the site. The existing QUT research facility at the southern end of the site is planned to be decommissioned in 2020.

The overall development will include approximately 10.3ha of new commercial and residential development, and an approximated 5 ha of new sporting complex area.

The current development layout for Carseldine Urban Village is shown in Figure 4.

Figure 4 Proposed Carseldine Urban Village development (Source: RPS 2019)

2 STORMWATER DESIGN OBJECTIVES

Stormwater management objectives have been established based on the following:

- *State Planning Policy* (DLGIP, 2017)
- *Queensland Urban Drainage Manual* (2016)
- *Brisbane City Council (BCC) Planning Scheme*

2.1 STORMWATER QUALITY

The stormwater quality management objectives that apply to the operational phase of the development are defined in the State Planning Policy (DLGIP, 2017) which applies load based objectives presented in Table 1.

Table 1 – Stormwater quality objectives

Constituent	Discharge criteria
Total suspended solids (TSS)	80% reduction in post developed mean annual load
Total phosphorous (TP)	60% reduction in post developed mean annual load
Total nitrogen (TN)	45% reduction in post developed mean annual load
Gross pollutants	90% reduction in post developed mean annual load

Construction phase erosion and sediment control objectives are outlined in Table A Appendix 2 of SPP (DLGIP, 2017). Detailed erosion and sediment control plans will be provided with the Operational Works application.

2.2 FLOODING

The flood management objectives applicable to the site are presented in Table 2. Carseldine Urban Village development lies within Brisbane City Council (BCC) mapped City Wide Waterway corridor zone.

Table 2 Flood objectives

Criterion	Design Objective
No worsening hydraulic conditions	No worsening hydraulic impact to be demonstrated external to the site for the critical duration storm for the 39% AEP to 1% AEP events
BCC flood overlay code PO2 Development within a creek/waterway flood planning area	a) Maintains conveyance of flood waters to allow flow and debris to pass predominantly unimpeded through the site b) Does not concentrate, intensify or divert floodwater onto upstream, downstream or adjacent properties c) Will not result in a material increase in flood levels or flood hazard on upstream, downstream or adjacent properties
BCC Flood overlay code PO8 Development for filling or excavation in an area affected by creek/waterway flooding	Does not directly, indirectly or cumulatively cause any material increase in flooding or hydraulic hazard or involve significant redistribution of flood storage from high to lower areas in the floodplain

3 STORMWATER MANAGEMENT STRATEGY

The stormwater management strategy for the Carseldine Urban Village development has been developed based on discussions with EDQ, the design team and field inspections to identify opportunities and constraints.

When developing the strategy, several guiding principles were considered:

- achieve obligations under the *State Planning Policy*, *BCC planning scheme policy* and *Queensland Urban Drainage Manual*
- ensure stormwater management systems are functionally feasible within the constraints of the development and drainage levels
- avoid numerous stormwater management sites
- avoid works within the Cabbage Tree Creek riparian buffer zone
- minimize impacts on existing good value vegetation
- avoid works encroaching into the future busway corridor
- minimize the need for an on-site flood basin, where possible
- utilization of the 10m wide acoustic barrier at the eastern boundary of the site for drainage conveyance and treatment

Figure 5 shows the stormwater management strategy for the Carseldine Urban Village development. The strategy has been developed considering the proposed drainage for the development (source: Calibre Consulting). This includes pipe drainage for minor storm events and overland flows for flows exceeding pipe capacity.

Performance assessments of the proposed management strategy are presented in Section 4 (stormwater quality) and Section 5 (flooding).

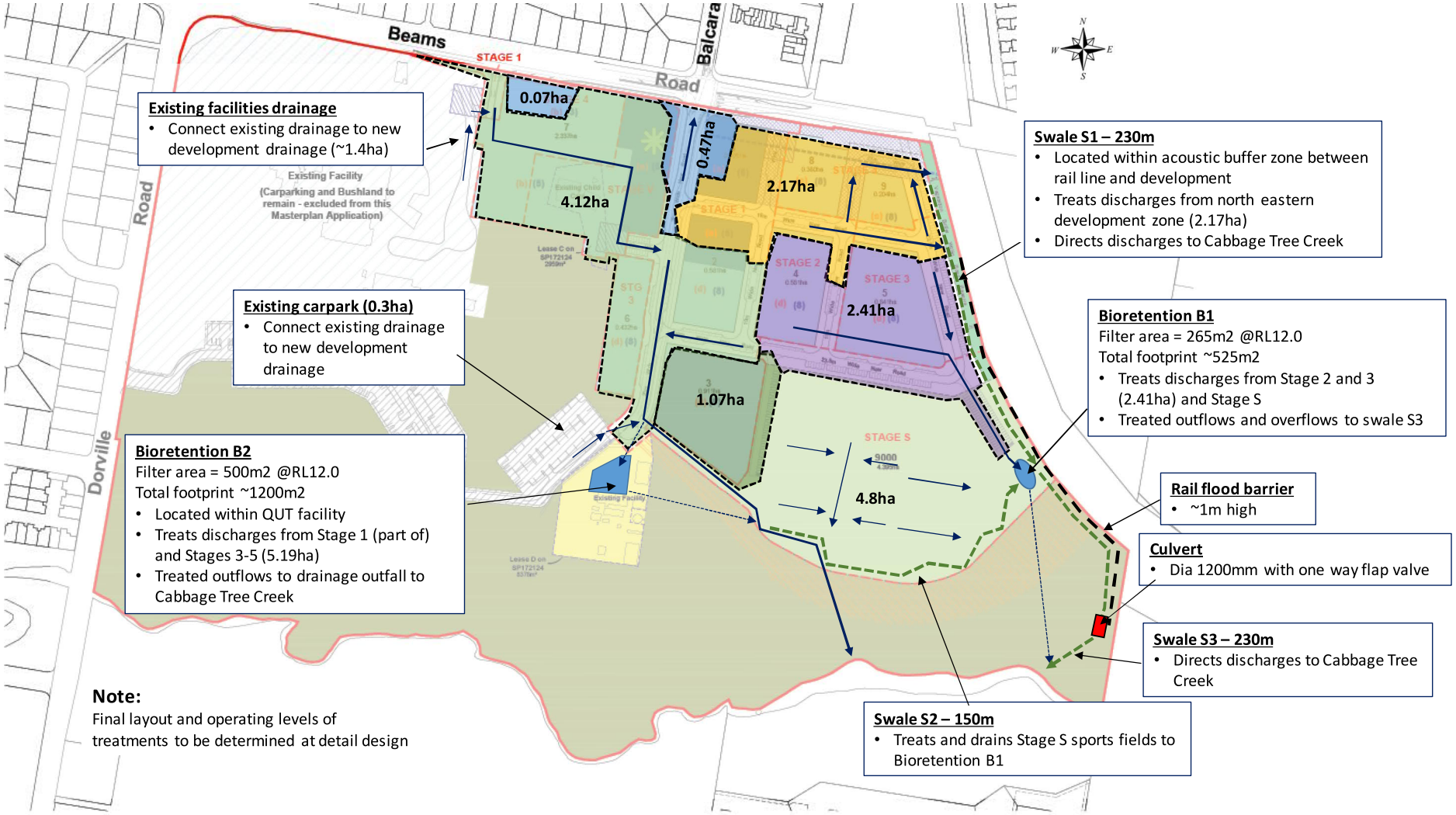


Figure 5 Stormwater Management Strategy Carseldine Urban Village

Table 3 Stormwater treatment elements

ID and Stages Treated	Treatment		Catchment	Comment
	Type	Area/length	ha	
B1 – Stages 2,3 (part of) and S	Bioretention	265m²	2.41	Located within Stage S. Treats discharges from Stage 2 and 3 (part of). Receives treated flows from Stage S sports fields. Treated flows and overflows to swale S3.
B2 – Stages 1 and 3 (part of) and 4-5	Bioretention	500m²	5.19	Located within the QUT facility. Treats Stages 1 and 3 (part of) and Stages 4 and 5. Receives low from diversion from main drainage pipe. Treated outflows to drainage outfall to Cabbage Tree Ck.
S1 – Stages 1, 2 and 3 (part of) and 4	Swale	230m	2.17	Treats north eastern development zone (Stage 1, 2 and 3 (part of) and Stage 4).
S2 – Stage S	Swale	150m	4.8	Treats and drains Stage S sports fields to Bioretention B1
S3 – Stages 1 and 3 (part of) and 2,4 and S	Swale	230m	B1+S1+S2	Conveys eastern development zone discharges to Cabbage Tree Ck. Provides additional treatment for upstream discharges prior to discharge to Cabbage Tree Creek
Stage 1 (part of) – Beams Rd	untreated		0.54	Development treatment upsized to offset this untreated portion of the development
TOTAL			15.11	

3.1 STORMWATER TREATMENT

The treatment strategy includes two (2) bioretention basins treating the development zones as shown in Figure 5. Swales along the southern boundary of the Stage S sports fields and at the eastern boundary of the site will also provide a treatment function prior to discharge to Cabbage Tree Creek.

Two small development areas (0.54ha total) adjacent to Beams Road at the northern end of the development do not report to the treatments proposed. The stormwater treatment proposed as part of this strategy have been sufficiently sized to compensate (i.e. over-treat) for the treatment of this area. Refer to Section 4 for performance assessments.

It should also be noted that the proposed drainage strategy will connect existing drainage from the existing facilities at the north west of the site to drainage that will report to Bioretention basin B2. This provides treatment of an area that previously was untreated.

Bioretention Basin B1

Bioretention Basin B1 (filter area 265m² at RL12.0) treats Stage 2 development and the eastern Stage 3 development and receives treated discharges from the swale (S2) draining Stage S sports fields. This basin is located at the eastern boundary of the site, just south of Stage S carpark. Pipe discharges enter the basin from the development zone via the Stage S carpark.

Treated outflows from the bioretention basin discharge to swale S3. Overflows from the bioretention connect directly to swale S3 via an overflow weir.

Detail designs for this bioretention basin have now been completed and construction is currently underway as part of Stage S works. A general arrangement of the bioretention basin is shown in Figure 6.

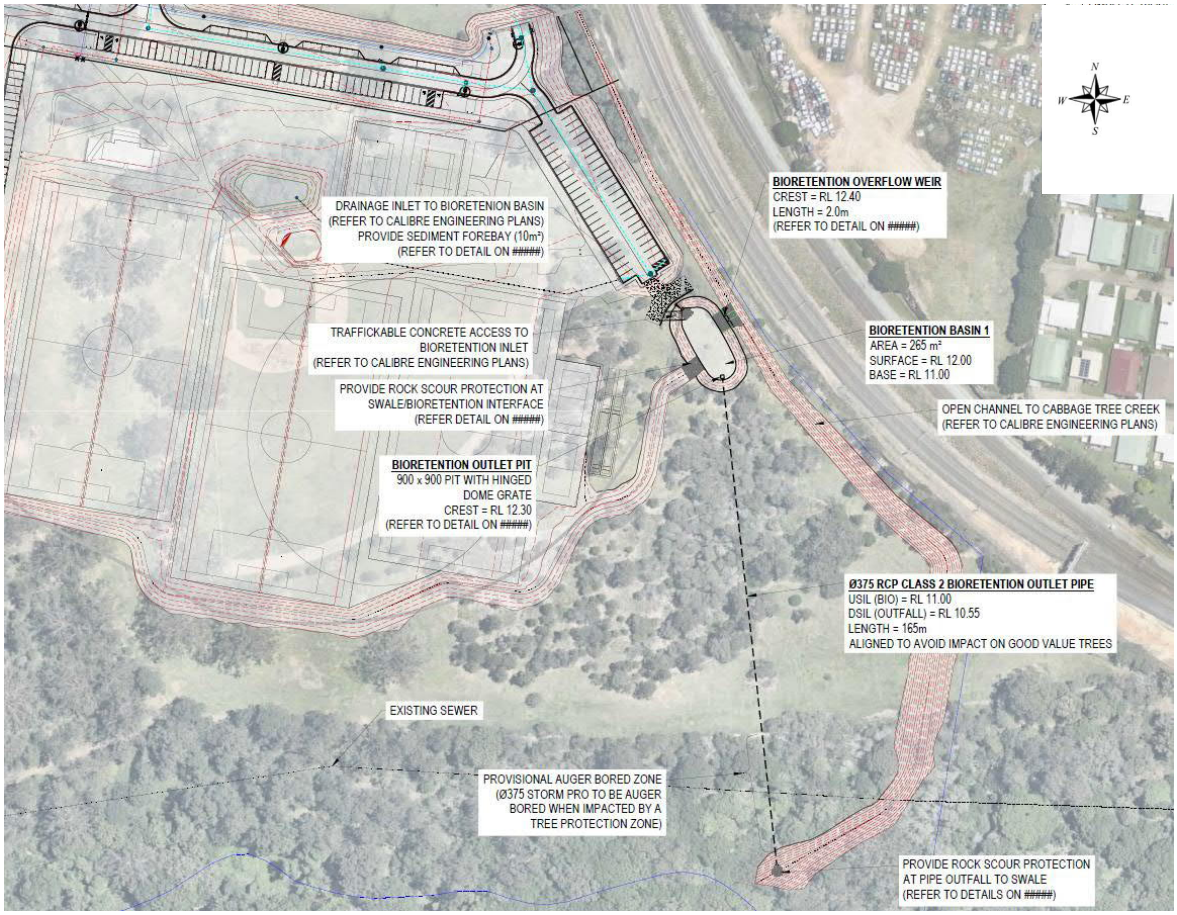


Figure 6 Bioretention basin B1 general arrangement

Bioretention Basin B2

Bioretention Basin B2 (filter area 500m² at RL12.0) treats parts of Stage 1 and 3 (west) development as well as Stages 4 and 5. The basin is proposed to be located within the footprint of the existing QUT research facility at the southern end of the site. This area, covering approximately 6,500m², is due to be decommissioned in 2020.

This treatment site could be incorporated as part of a future stormwater reuse scheme, by directing treated stormwater from the bioretention basin to an adjacent storage pond, which can then be used to supply harvested water for sports field irrigation.

Detail designs have now been completed for this bioretention. A general arrangement is shown in Figure 7.

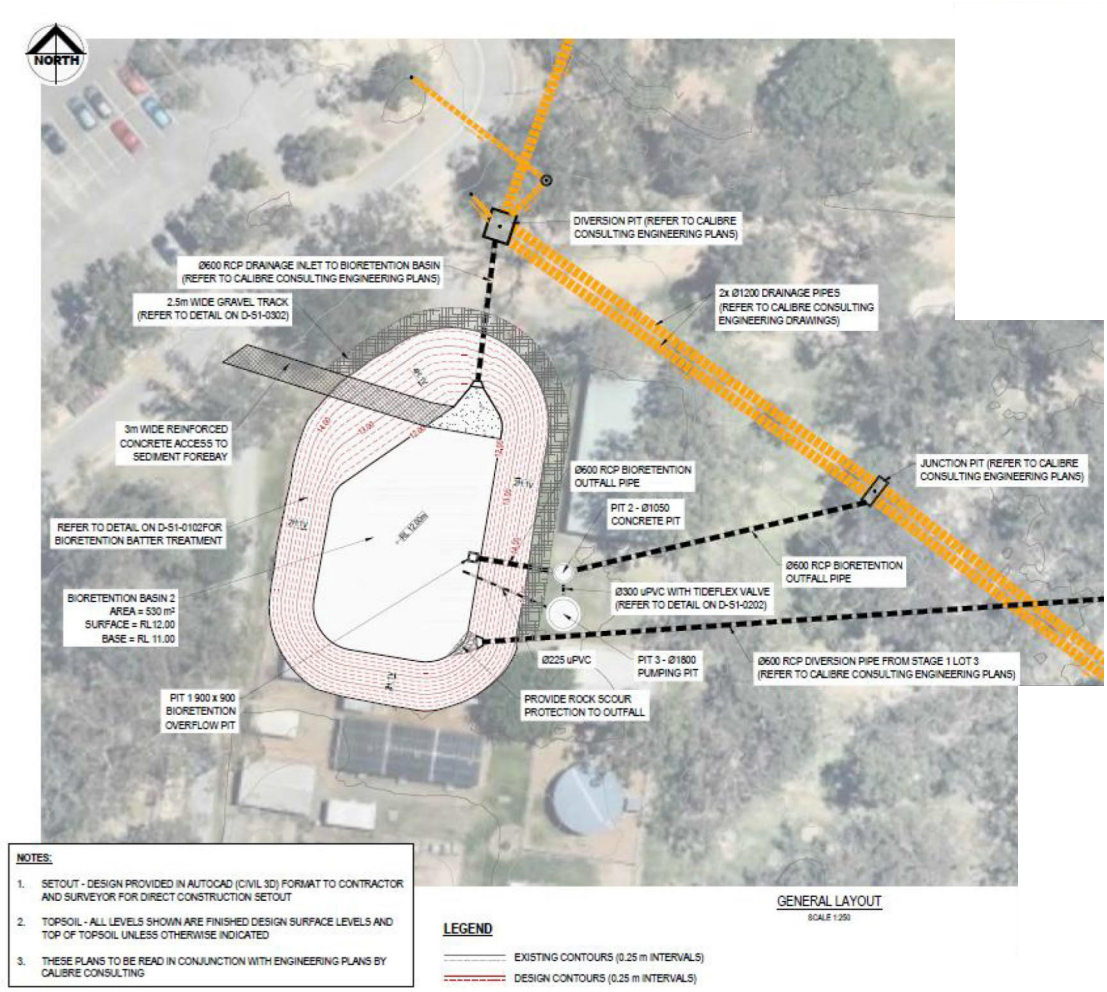


Figure 7 Bioretention basin B2 general arrangement

A diversion pit will direct development low flows to the bioretention basin at the northern end. In addition, a diversion pipe (600mm dia) will direct drainage from Stage 1 Lot 3 (1.07ha) to the bioretention basin at the southern end. High flows will continue to the drainage outfall to Cabbage Tree Creek via twin 1200mm dia pipes.

Treated outflows and bioretention overflows will be piped from the bioretention basin to the proposed 2x1200 mm dia drainage outfall pipes to Cabbage Tree Creek. A dia 1800mm pit is included with the bioretention basin works to facilitate connection to a future stormwater harvest scheme, should this proceed. This will allow the retrofit of future pumping infrastructure within this pit to pump bioretention treated outflows to a future holding pond. Regardless, the bioretention basin can operate under gravity to drain treated flows and overflows to the outfall of Cabbage Tree Creek i.e. the bioretention basin is not reliant on the inclusion of a stormwater harvest scheme and can operate entirely independently and under gravity.

Swale S1 (~230m)

Swale S1 (~230m) represents the drainage reserve formed at the eastern boundary of the development. Drainage from part of Stages 1 to 3 and Stage 4 will discharge to this

drainage reserve. This area is a minimum 10m wide and will be grassed and treed to form a buffer to the rail corridor. Drainage gradients along this zone are typically flat (~0.3%).

Swale S2 (~150m)

Swale S2 receives and treats drainage from the Stage S sports fields and directs this drainage to Bioretention Basin B1. This swale is turfed with 6H:1V batters. Drainage gradients are typically 0.6%.

Swale S3 (~230m)

Swale S3 connects drainage from the eastern half of the development zone to Cabbage Tree Creek. To minimise the impact on vegetation within the Cabbage Tree Creek riparian zone, batter slopes of 3H:1V are used. Drainage gradients along this zone are typically 0.6%. The swale will be vegetated with a mix of groundcovers and riparian vegetation to provide a treatment function and aid stability.

3.2 FLOOD MANAGEMENT

The majority of development runoff is directed southward to discharge to Cabbage Tree Creek. Development earthworks are configured to facilitate overland flows eastward and southward to allow the majority of development drainage to Cabbage Tree Creek. Developed lots are above 1% AEP levels (Q100), however the sports field earthworks allow flooding of the sports fields in events higher than the 5% AEP (Q20) . This aids in offsetting loss of flood storage as a result of development and avoids flood impacts along Cabbage Tree Creek.

A new swale along the eastern boundary of the site drains stormwater from the eastern half of the site to Cabbage Tree Creek. A 1200mm dia culvert is included along this swale with a one-way flap valve to minimise backwatering effects of Cabbage Tree Creek flows into the development from this new swale.

A flood barrier is also included along the eastern boundary of the site to contain development flows within the site and avoid impacts along the rail corridor. This flood barrier can take the form of a low block wall (~1m high) and/or bund and can be incorporated with the future acoustic fence along this boundary. Further details are provided in Section 5.2.2.

4 STORMWATER QUALITY TREATMENT ASSESSMENT

MUSIC modelling was conducted to quantitatively assess the stormwater treatment performance of the proposed stormwater treatment strategy. MUSIC version 6.3 was used for the assessment and the parameters have been established in accordance with the MUSIC Modelling Guidelines for South East Queensland (Water by Design, 2010).

Details of the modelling assumptions, parameters used and results are presented in the following sections.

4.1 MODEL STRUCTURE

The structure of the MUSIC model is shown in Figure 8 with the general data upon which the model is based provided in Table 4.

Catchments have been derived from the proposed masterplan layout, considering the pipe drainage system that would apply (refer to Figure 5 previously). Only areas under development are included in the model.

The model adopts a lumped catchment approach.

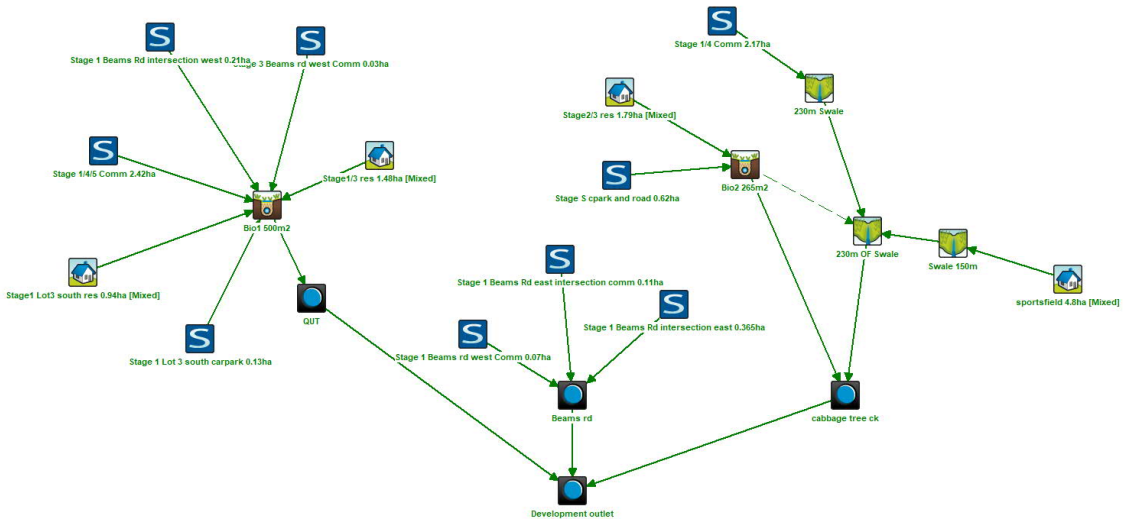


Figure 8 MUSIC model

Table 4 MUSIC model data summary

Parameter	Value
Source Data	
Rainfall data set	1990-1900 – Brisbane Aero Station No. 40223
Modelled time step	6 minute
Mean annual rainfall 1980--1990	1155 mm (for the period used)
Potential evapotranspiration	1,526mm (Table 3.1 Music modelling guidelines for SEQ)
Soil properties (runoff generation parameters)	Table 3.7 Music Modelling Guidelines for SEQ
Pollutant concentrations (base and storm flow concentration parameters)	Table 3.9 Music Modelling Guidelines for SEQ
Percent impervious	Table 3.6 Music Modelling Guidelines for SEQ Residential/mixed use (50dw/ha): 80% impervious Retail/commercial: 90% impervious Road: 90% impervious
Treatment Devices	
Bioretention	Filter media depth = 0.6 m Extended detention depth = 0.3 m Seepage = 0 mm/hr Saturated hydraulic conductivity 200mm/hr TN content[1] 400 mg/kg Orthophosphate content[1] 30mg/kg
Swale	Base width = 1m Top width = 10m Depth = 0.5m (S1 and S2); 1.5m (S3) Vegetation height = 0.05m (S1 and S2); 0.25m (S3) Slope 0.3% (S1); 0.6% (S2 and S3)

Note:

1. Water By Design have recently completed a review of important default values for bioretention basins. In terms of bioretention the parameters adopted are consistent with new values for filter media OP and TN content recently adopted by Healthy Waterways

4.2 RESULTS

The results of the MUSIC modelling are presented in Table 5.

Table 5 Summary of MUSIC modelling – Carseldine Urban Village

Treatment ID	Pollutant	Inflows (kg/yr)	Outflows (kg/yr)	Reduction achieved (%)	Water quality objective
CARSELDINE URBAN VILLAGE					
Bio B1 Filter area 265m²	TSS TP TN	5720 10.8 65.6	802 2.2 26.7	86.0 79.7 59.2	Water quality objective applies to the combined site discharge
Bio B2 Filter area 500m²	TSS TP TN	11000 25.0 151	1910 6.08 66.7	82.6 75.7 55.8	
Swale S1 Length = 230m	TSS TP TN	4660 12.2 70.5	535 3.44 50.4	88.5 71.9 28.5	
Swale S2 Length = 150m	TSS TP TN	1570 4.06 32.6	654 2.48 27.6	58.2 39.1 15.3	
Swale S3 Length = 230m	TSS TP TN	1950 7.75 94.5	1200 6.41 86.2	38.4 17.3 8.8	
Stage 1 – Beams Rd 0.54ha untreated	**TSS** **TP** **TN**	1820 3.45 17.4	1820 3.45 17.4	**0** **0** **0**	
TOTAL	**TSS** **TP** **TN**	**24700** **55.6** **337**	**4970** **16.3** **181**	**80.0** **70.7** **46.4**	**80** **60** **45**

The results demonstrate that load based objectives are achieved for the Carseldine Urban Village Development with the proposed stormwater treatment strategy.

5 FLOOD ASSESSMENT

Flood modelling has been based on Brisbane City Council (BCC) supplied URBS and TUFLOW regional flood models for Cabbage Tree Creek. These models have been updated as necessary to make suitable for an impact assessment of the Carseldine Urban Village development.

The following describes model updates made to the Council supplied URBS and TUFLOW models to complete assessments on the impacts of the development.

5.1 URBS

URBS has been used to generate flows for the pre-developed and developed case scenarios for incorporation into TUFLOW. The following describes the model updates and assumptions used.

5.1.1 Pre-developed catchments

The Council supplied URBS model includes 70 sub catchments that delineate the approximate 43.1km^2 Cabbage Tree Creek catchment. URBS catchments covering the Carseldine Urban Village development zone within the Cabbage Tree Creek catchment have been refined to allow better representation of local catchment flooding characteristics in and around the development.

Sub-catchment 29 in the URBS model covers the proposed Carseldine Urban Village development zone. This has been split into 5 sub-catchments (291 to 295) to represent in finer detail site drainage based on existing topography obtained from Council supplied DEM model and ground truthing of current drainage.

Pervious and impervious fractions have been updated for these catchments, together with catchment slopes. Catchment slopes have been updated and estimated using the equal area method for each new sub catchment modelled.

All other URBS catchments have been retained as per the original Council supplied model setup, including catchment slopes.

Figure 9 shows the predeveloped catchments relevant to the Carseldine Urban Village development. Table 6 provides a summary of sub-catchment land uses, areas and slopes modelled in and around the development. URBS model land use is applied by using various land use categories within each sub-catchment. URBS model land use categorisation has been adopted in accordance with the BCC model. Land use categories and associated fractions impervious values are:

- Urban Low Density (10% Impervious)
- Urban Medium Density (50% Impervious)
- Urban High Density (90% Impervious)
- Rural (0% Impervious)

Table 6 Pre-developed catchments

ID	Area	Land use (%)				Catchment
	ha	Low density	Medium density	High density	Rural	Slope %
291	18.63	0%	0%	18.0%	82.0%	1.14
292	6.57	0%	0%	9.7%	90.3%	2.04
293	6.52	0%	0%	3.6%	96.4%	0.63
294	5.09	0%	0%	0%	100%	0.55
295	82.15	0%	19.3%	38.3%	42.4%	0.70
32	36.52	0%	83.3%	3.8%	12.8%	1.30

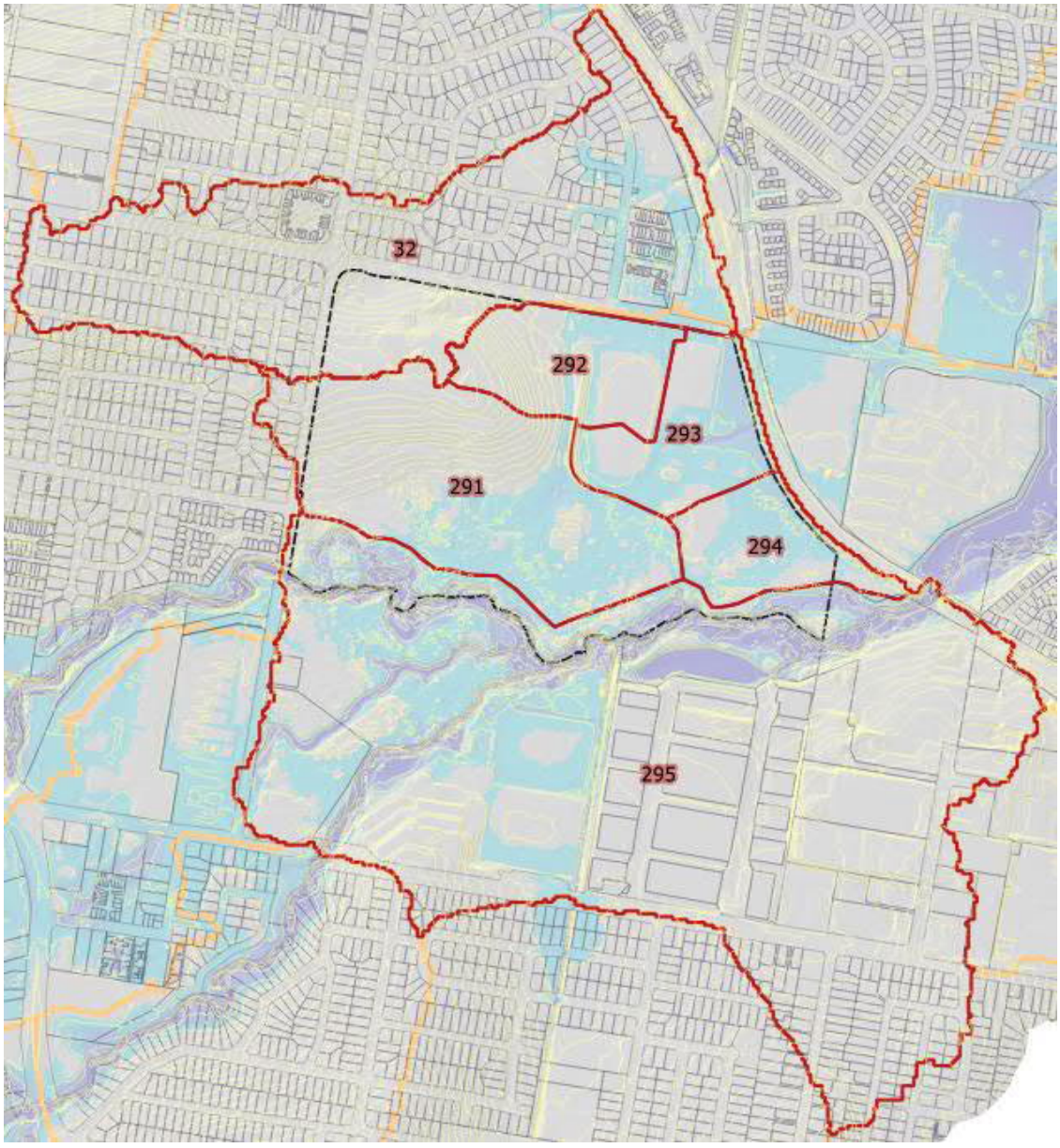


Figure 9 Refined URBS sub-catchments relevant to the development – base case

5.1.2 Developed case catchments

Sub-catchments where development applies were adjusted to represent the proposed development for Carseldine Urban Village. This applies to sub catchments 291, 292, 293, 294 and 32. These sub-catchments are shown in Figure 10.

Catchment land uses have been adjusted to account for the increased impervious area associated with the development. Adjustments to sub-catchment boundaries have also been applied, where necessary to align with the drainage strategy of the developed site.

Sub-catchments 293 and 294 drain southwards to Cabbage Tree Creek via a new drainage swale between the railway line and the development. Sub-catchments 291 and 292 will drain to Cabbage Tree Creek via stormwater pipes that will discharge in the vicinity of the two existing outfalls. The final details of this drainage configuration will be undertaken as part of future detail design phases.

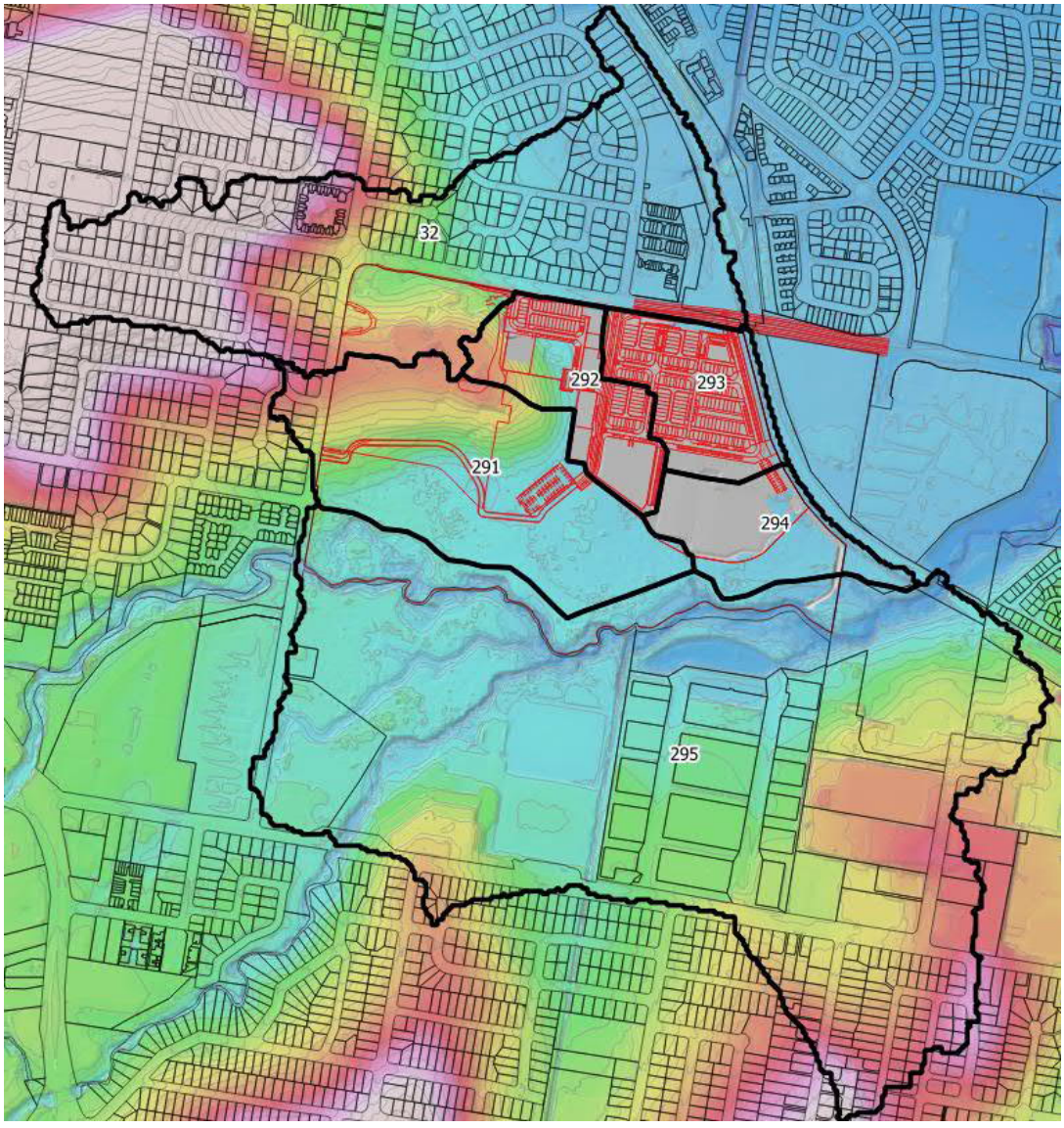


Figure 10 Developed case sub-catchments

Pervious and impervious areas were derived based on expected fraction impervious values for the various land uses. Percent impervious values applied to each land use were based on recommended values in QUDM (2007). The following values have been applied:

- pre-developed vegetation: 0%
- Urban residential: 90%
- Retail/commercial: 90%
- Sports fields: 0%

Modelled catchment areas and slopes for post developed conditions are summarised in Table 7.

Table 7 Carseldine Urban Village development - modelled catchment areas and slopes

ID	Area	Land use (%)				Catchment
	ha	Low density	Medium density	High density	Rural	Slope %
291	17.98	0%	0%	16.11%	83.89%	1.14
292	6.63	0%	0%	88.00%	12.00%	2.04
293	6.47	0%	0%	87.83%	12.17%	0.63
294	6.01	0%	0%	1.78%	98.22%	0.55
295	82.15	0%	19.28%	38.3%	42.4%	0.70
32	36.24	0%	83.98%	3.87%	12.15%	1.30

5.1.3 Rainfall

Design event modelling has been undertaken using Australian Rainfall and Runoff (ARR, 1987) industry standard approach of modelling multiple design rainfall burst durations and extracting the maximum values from these events.

Rainfall parameters were based on the following:

- Temporal Patterns were based on the Australian Rainfall and Runoff (1987) publication. Zone 3 is applied to this site.
- Rainfall Intensity Frequency Duration (IFD) data used is consistent with that used in previous modelling, based on AR&R.

Design storms for the 39%, 20%, 10%, 5%, 2% and 1% AEP events have been modelled for the 60, 90, 120, 180 and 360 minute duration storms.

Design event rainfall is retained as per the Council supplied URBS model.

Rainfall losses and roughness values

Loss rates are retained as per the Council supplied URBS model. The following loss rates are used for the pervious areas for all events modelled:

- initial loss – 10 mm
- continuing loss – 0mm/hr

Zero initial and continuing loss is applied to the impervious fractions.

5.2 TUFLOW

Flood modelling has been carried out using a refined version of BCC's Cabbage Tree Creek TUFLOW model. The following updates have been made to the model for this investigation:

- The model has been updated to a recent version of TUFLOW (2016-03-AE_64 _iSP_w64)
- Inflow hydrographs have been extracted from the refined URBS sub-catchments.
- TUFLOW 'gully' lines have been incorporated to improve model representation of local gullies in the study area. In particular, the existing drain adjacent to the railway has been modelled using a 'gully' line.
- Inflow hydrographs from the refined URBS sub-catchments have been applied using 2d_sa polygons that have been trimmed to control where flows are input to the TUFLOW model.
- The major drainage pipes associated with the two existing outfalls to Cabbage Tree Creek have been incorporated using 1D pipe elements

Existing stormwater drainage pipes and inlets pits within the site have been incorporated into the pre-developed case TUFLOW model as shown in Figure 11. This is based in recent survey of the existing pipe infrastructure (June 2019). Pipe diameters are shown in metres in Figure 11.

All other model parameters and assumptions remain unchanged.

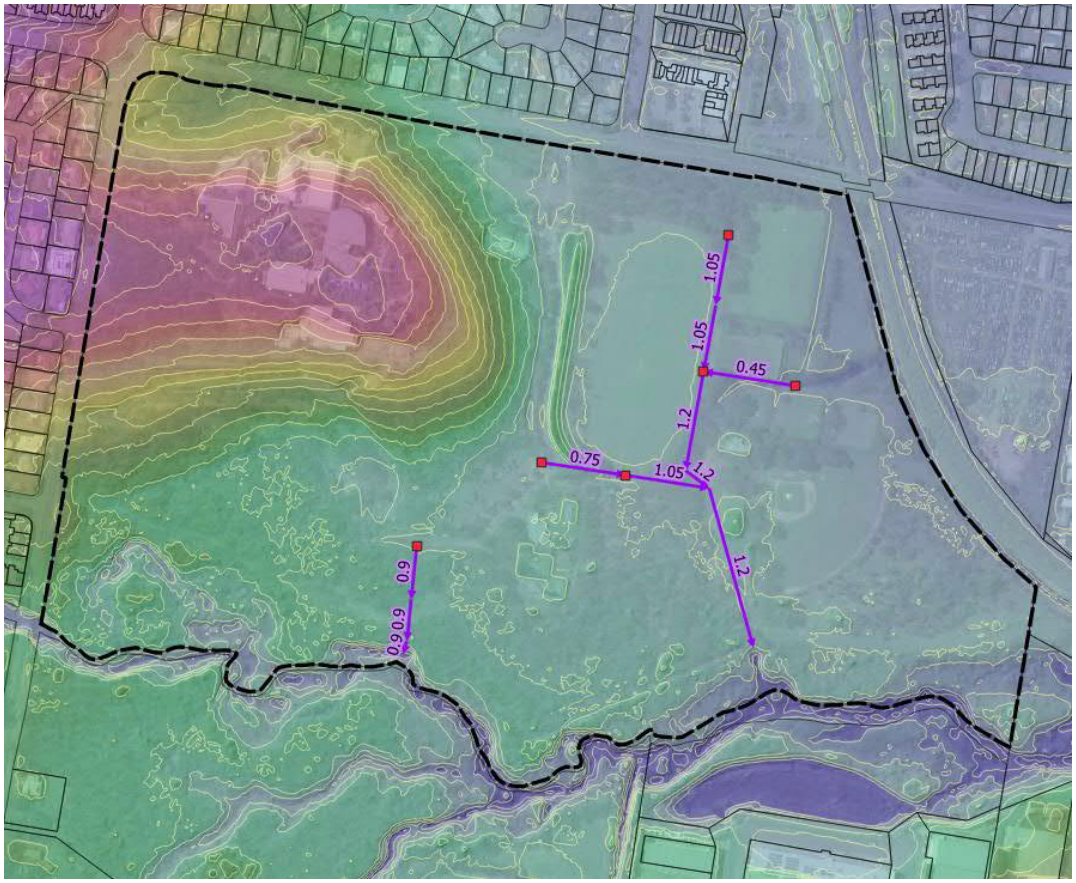


Figure 11 Existing site pipe drainage

5.2.1 Development earthworks

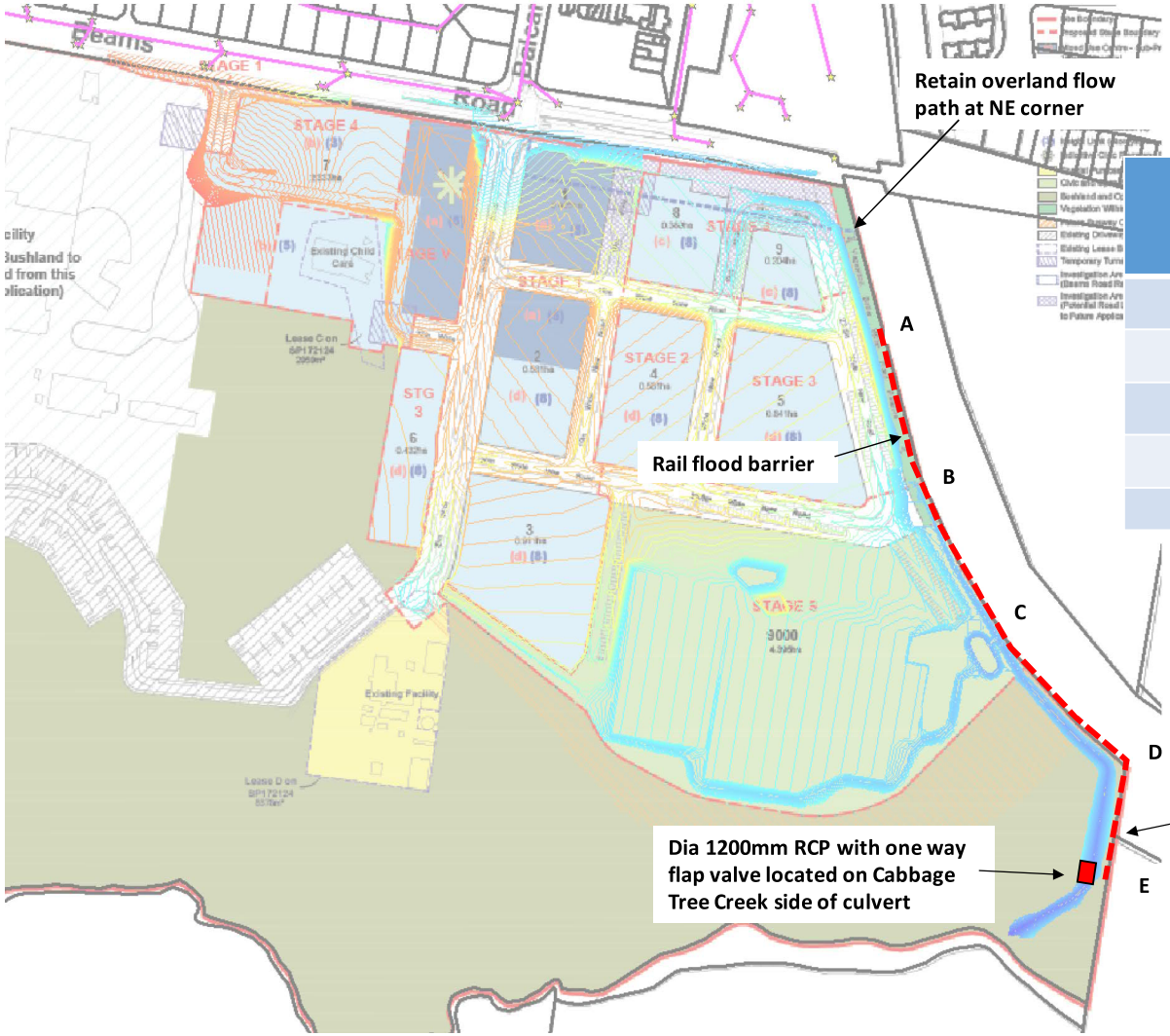
The proposed development has been incorporated into the TUFLOW model based on the latest earthworks design tin provided by the project civil engineers (Calibre Consulting).

5.2.2 Mitigation measures

Extensive iterative model assessments identified the following mitigation measures were required to avoid impacts external to the site:

- Sports field earthworks are designed to allow flooding during less frequent events (5% AEP and above)
- A 1200mm diameter culvert with a flood valve is included along the proposed eastern swale to minimize backwatering from Cabbage Tree Creek into the development via this swale – this minimizes the impacts of Cabbage Tree Creek flows into the site via this new connection to Cabbage Tree Creek.
- The rail corridor external to the property boundary will be protected from any increase in flood levels through the incorporation of an engineered flood barrier (~1m high) along the eastern boundary of the site - this avoids increases in flood levels external to the site adjacent to the rail line.

Details of the above mitigation measures are provided in Figure 12.



Pt ID	Ground Height (mAHD)	1% AEP Peak Flood Level (mAHD)	Suggested rail flood barrier top level mAHD
A	13.0	13.56	13.86
B	12.9	13.78	14.08
C	13.0	13.83	14.13
D	13.1	13.83	14.13
E	13.7	13.83	14.13

Figure 12 Proposed mitigation measures

The proposed rail flood barrier along the eastern boundary can take the form of a low blockwork wall and/or an earthen bund where space permits. This barrier can be combined with the future acoustic fence along the eastern boundary of the site e.g. the bottom of the acoustic fence takes the form of a blockwork wall with the acoustic fence installed above.

The extent and minimum flood levels for the flood barrier are provided Figure 12. This provides a 300mm freeboard to the expected 100 year developed flood levels. It should be noted that the flood barrier extends to the 1200mm dia culvert at the southern end and not to Cabbage Tree Creek to avoid constraining Cabbage Tree Creek flood flows and causing flood impacts downstream. The existing overland flow path at the north eastern end of the site is retained i.e. the rail flood barrier does not extend all to way to Beams Road.

5.3 RESULTS

Table 8 summarises peak flows immediately upstream of the Railway Bridge at Cabbage Tree Creek (reporting point 10), whilst Table 9 summarises peak water levels for pre and post conditions at various reporting location both within and external to the site. Figure 13 provides locations of reporting points.

Appendix A provides flood depth and impact maps for model runs. These include:

- Figure A1: Base case 39%AEP (Q2) flood depth
- Figure A2: Base case 5% AEP (Q20) flood depth
- Figure A3: Base case 1% (Q100) flood depth
- Figure A4: Developed case 39% AEP (Q2) flood depth
- Figure A5: Developed case 5% AEP (Q20) flood depth
- Figure A6: Developed case 1% AEP (Q100) flood depth
- Figure A7: Flood impact map 39% AEP (Q2)
- Figure A8: Flood impact map 20%AEP (Q5)
- Figure A9: Flood impact map 10% AEP (Q10)
- Figure A10: Flood impact map 5% AEP (Q20)
- Figure A11: Flood impact map 2% AEP (Q50)
- Figure A12: Flood impact map 1% AEP (Q100)
- Figure A13: Regional flood impact map 39% AEP (Q2)
- Figure A14: Regional flood impact map 1% AEP (Q100)

Table 8 Peak flows – Cabbage Tree Creek - Railway Bridge (Point 10)

AEP	Peak flow (m^3/s)			Difference
	Pre	Post	Difference	%
39% (Q2)	74.80	74.66	-0.14	-0.2%
20% (Q5)	103.39	103.54	0.15	0.1%
10% (Q10)	122.74	122.59	-0.15	-0.1%
5% (Q20)	146.77	147.19	0.42	0.3%
2% (Q50)	176.57	176.68	0.11	0.1%
1% (Q100)	202.1	202.8	0.70	0.3%

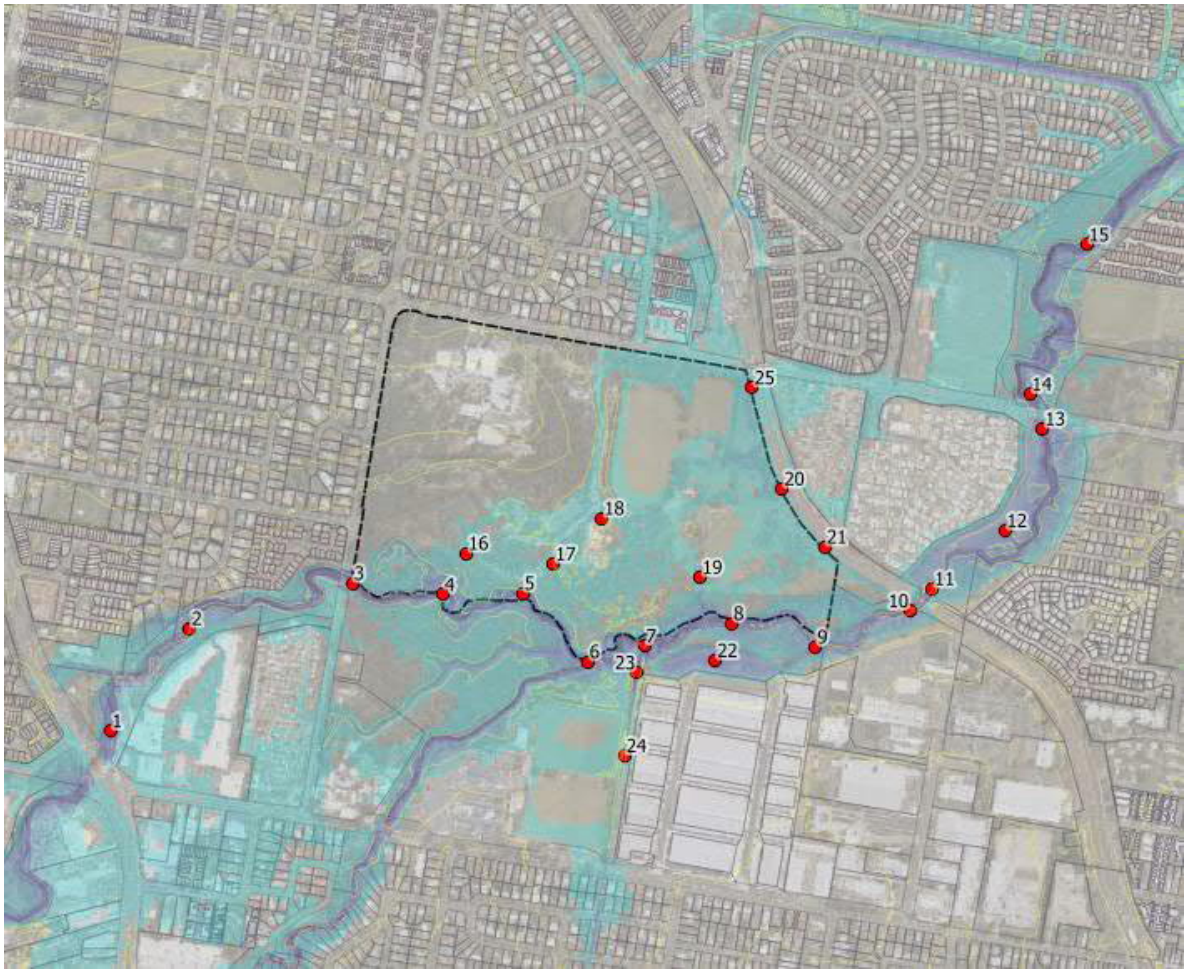


Figure 13 Reporting locations

Table 9 Peak water levels

ID	Water levels (mAHD)																	
	39%AEP			20%AEP			10%AEP			5%AEP			2%AEP			1%AEP		
	pre	post	difference	pre	post	difference	pre	post	difference	pre	post	difference	pre	post	difference	pre	post	difference
1	17.791	17.791	0.000	18.270	18.270	0.000	18.53221	18.5323	0.000	18.804	18.804	0.000	18.999	18.999	0.000	19.077	19.077	0.000
2	16.866	16.866	0.000	17.364	17.364	0.000	17.638	17.639	0.000	17.941	17.942	0.000	18.169	18.169	0.000	18.262	18.262	0.000
3	15.475	15.476	0.001	16.008	16.010	0.002	16.272	16.274	0.001	16.542	16.543	0.001	16.717	16.717	0.000	16.779	16.779	0.000
4	15.165	15.167	0.002	15.693	15.696	0.003	15.953	15.955	0.002	16.217	16.218	0.001	16.372	16.373	0.001	16.428	16.428	0.000
5	14.553	14.557	0.004	15.083	15.090	0.006	15.318	15.322	0.004	15.543	15.545	0.002	15.703	15.705	0.002	15.796	15.797	0.001
6	13.739	13.742	0.003	14.217	14.222	0.006	14.462	14.467	0.005	14.734	14.739	0.005	15.044	15.048	0.004	15.267	15.270	0.003
7	13.387	13.388	0.001	13.831	13.835	0.004	14.064	14.067	0.004	14.331	14.337	0.006	14.635	14.638	0.003	14.875	14.879	0.004
8	12.934	12.932	-0.002	13.306	13.306	-0.001	13.499	13.498	-0.001	13.715	13.718	0.004	13.961	13.964	0.003	14.191	14.197	0.007
9	12.299	12.301	0.002	12.664	12.663	-0.002	12.867	12.859	-0.008	13.126	13.122	-0.004	13.443	13.437	-0.006	13.739	13.740	0.001
10	11.684	11.683	-0.002	12.084	12.086	0.002	12.338	12.335	-0.002	12.692	12.695	0.003	13.098	13.101	0.003	13.462	13.470	0.009
11	11.405	11.402	-0.002	11.799	11.800	0.001	12.039	12.037	-0.002	12.309	12.311	0.002	12.565	12.567	0.002	12.755	12.759	0.004
12	11.134	11.131	-0.003	11.573	11.575	0.001	11.835	11.834	-0.002	12.120	12.122	0.002	12.376	12.378	0.002	12.561	12.565	0.004
13	11.029	11.027	-0.002	11.484	11.485	0.001	11.750	11.748	-0.002	12.035	12.038	0.002	12.286	12.288	0.002	12.464	12.468	0.004
14	10.955	10.953	-0.002	11.395	11.396	0.001	11.643	11.642	-0.002	11.901	11.903	0.002	12.118	12.119	0.002	12.272	12.275	0.003
15	9.854	9.851	-0.003	10.346	10.346	0.001	10.596	10.594	-0.001	10.846	10.848	0.002	11.067	11.071	0.005	11.244	11.245	0.001
16	dry	dry	NA	dry	dry	NA	dry	dry	NA	16.109	16.109	0.000	16.240	16.240	0.001	16.282	16.282	0.000
17	dry	dry	NA	dry	dry	NA	dry	dry	NA	15.037	15.039	0.001	15.148	15.148	0.001	15.206	15.207	0.001
18	dry	dry	NA	dry	dry	NA	dry	dry	NA	dry	dry	NA	14.824	14.753	-0.071	14.919	14.849	-0.070
19	dry	dry	NA	dry	dry	NA	dry	dry	NA	dry	dry	NA	dry	dry	NA	14.252	14.307	0.055
20	12.810	dry	NA	12.911	dry	NA	13.037	dry	NA	13.213	12.865	-0.347	13.426	13.175	-0.251	13.529	13.481	-0.048
21	12.401	dry	NA	12.618	12.041	-0.577	12.791	12.310	-0.482	13.095	12.690	-0.406	13.383	13.122	-0.261	13.520	13.457	-0.063
22	11.961	11.964	0.003	12.720	12.717	-0.003	12.942	12.934	-0.008	13.254	13.254	-0.001	13.692	13.692	0.001	14.024	14.030	0.007
23	13.402	13.403	0.001	13.855	13.861	0.005	14.103	14.107	0.005	14.385	14.390	0.005	14.715	14.718	0.003	14.979	14.984	0.005
24	14.969	14.969	0.000	15.222	15.228	0.006	15.275	15.285	0.010	15.318	15.313	-0.005	15.357	15.358	0.000	15.403	15.403	0.000
25	12.860	dry	NA	13.061	dry	NA	13.118	12.992	-0.126	13.247	13.234	-0.013	13.442	13.401	-0.040	13.518	13.467	-0.051

5.3.1 Peak flows

Peak flows upstream at the Railway Bridge over the range of storm events up to the 1% AEP (100yr ARI) are effectively retained at predeveloped levels (+0.3% to -0.2%). For the 1% AEP a minor increase is observed and represents a 0.3% increase. No adverse impacts downstream of the Bridge are observed in all events tested.

5.3.2 Flood inundation – existing case

Existing case flood inundation maps indicate flooding of low-lying areas at the north eastern corner of the site occurs on a frequent basis. Existing drainage within the site directs this more frequent drainage to the existing drainage outfalls to Cabbage Tree Creek. No flooding of Beams Rd is expected for the more frequent flood events. Figure 14 shows inundation mapping for the minor 39% AEP (2 yr) event.

At the 5% AEP (20 yr ARI event - see Figure 15) breakout from Cabbage Tree Creek occurs along the northern bank at the western end of the site. These breakout flows are then predicted to flow generally in a north-east direction at shallow depths through the site. Inundation in the north-east of the site is constrained west of the rail corridor. Shallow flooding of Beams Road is expected in this case and is anticipated to extend north of Beams Road.

In the 1% AEP event (refer to Figure 16) there is a significant increase in the inundation area of breakout flows through the site. While there is a large increase in the inundation extent, the actual flood depths predicted over most of this area remain typically less than 250mm. Inundation is also predicted to occur across the rail corridor at the north eastern boundary of the site and extends along Beams Road and adjacent existing developed areas to the north and east. Flow depths are noted to be mostly less than 250mm in this case, except for low lying areas adjacent to the rail corridor.

Flooding across the site resulting from Cabbage Tree Creek breakout flows is characterised by shallow (typically less than 250mm), conveyance dominated flows. Consequently, flood storage influences are expected to be minor. For this reason, it would be expected that a loss of floodplain storage in these areas would be unlikely to cause significant adverse flood impacts. This is discussed in the following sections.

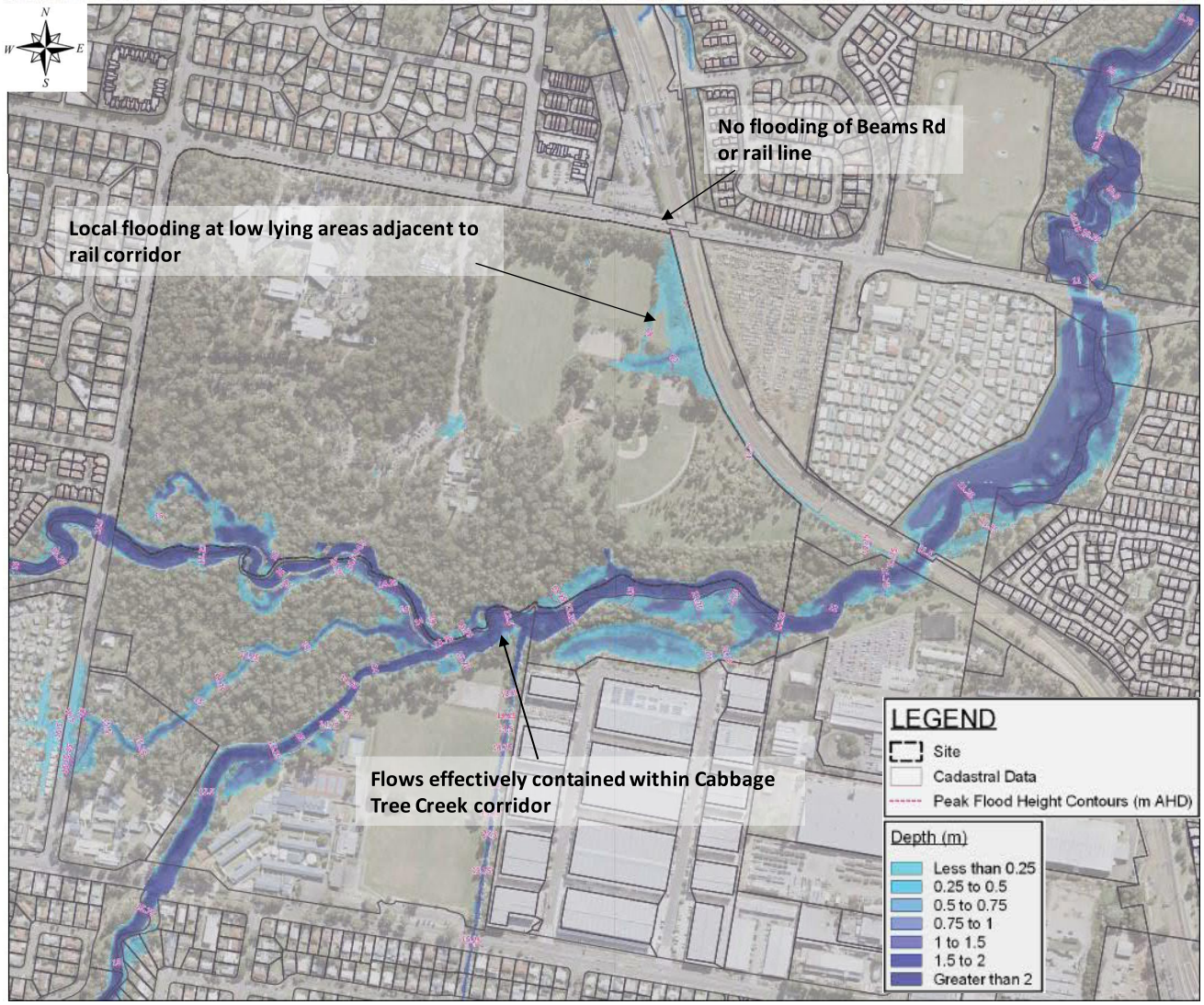


Figure 14 39% AEP flood inundation - existing conditions

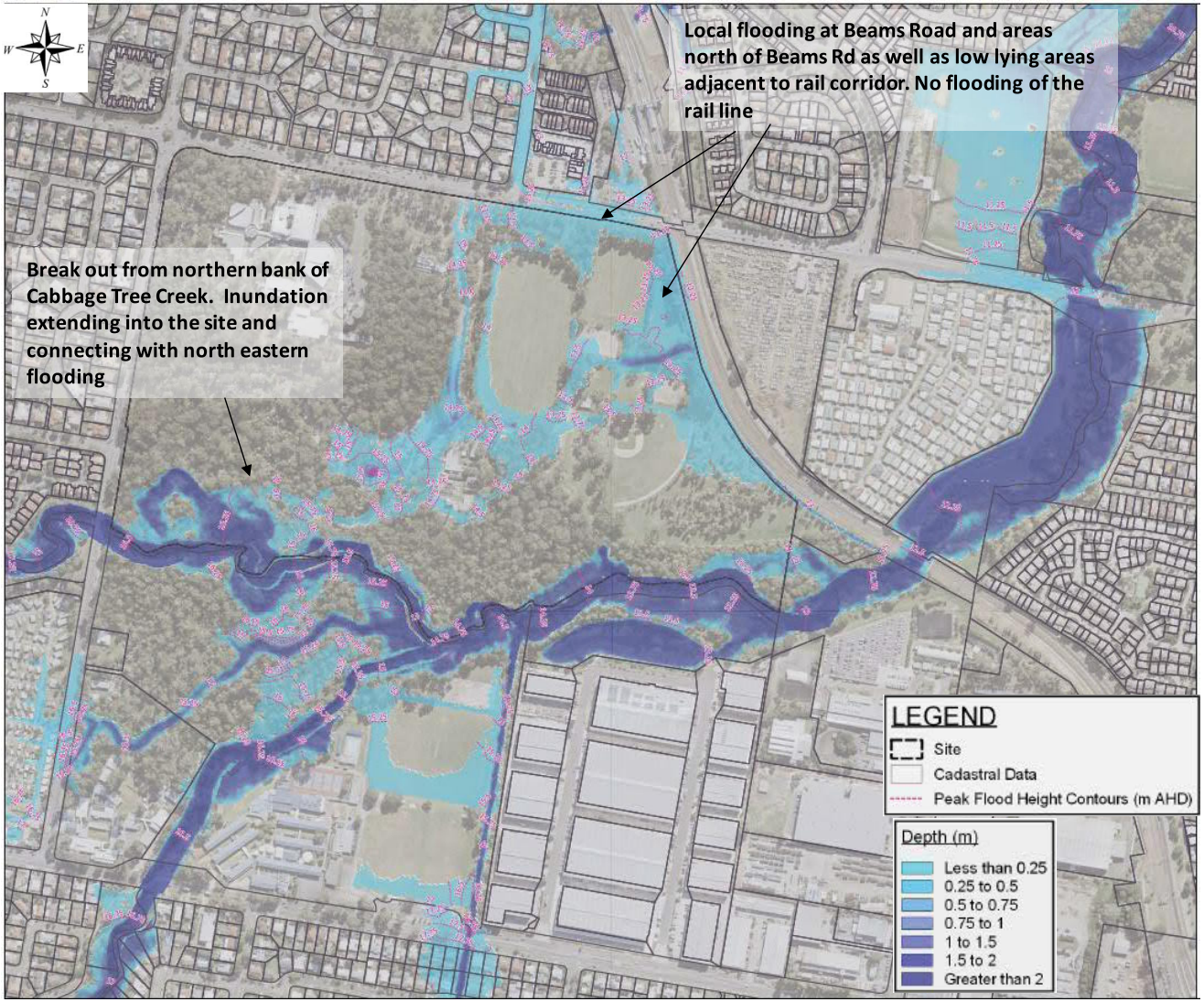


Figure 15 5% AEP flood inundation - existing conditions

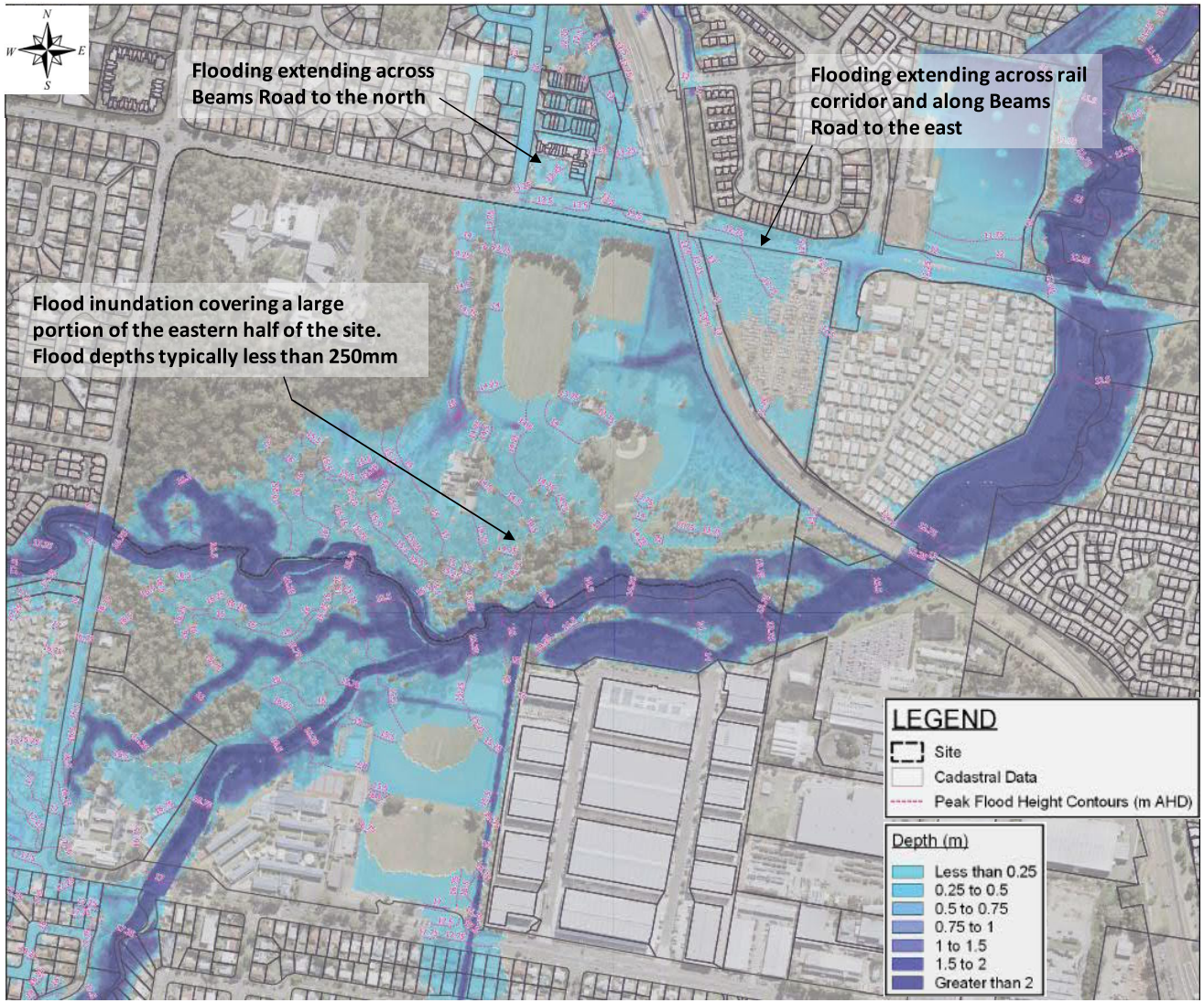


Figure 16 1% AEP flood inundation - existing conditions

5.3.3 Flood impacts

Table 9 previously summarises peak water levels for pre and post conditions at various reporting locations for the 39% AEP to 1% AEP model runs. Flood impacts maps for the 39% AEP to 1% AEP are included in Appendix A.

Flood impact maps demonstrate no significant adverse impacts occurring external to the site as a result of the development, with the proposed mitigation measures included.

Improved flood conditions are observed at Beams Road and the rail line at the north-east corner of the site. This is because much of the site drainage is directed to Cabbage Tree Creek as part of the development. Furthermore, during larger magnitude events, the proposed development filling restricts Cabbage Tree Creek breakout flow from entering this area.

Impacts noted on the afflux maps are typically contained within the site boundary and are associated with flooding of the sports fields (above 5% AEP event) and the operation of the development drainage swales. This is expected. Other low-lying riparian bushland areas already subject to flooding within the site also experience localised increases in flooding south west of the sports fields, however this does not impact on any existing facilities or infrastructure. Increases in flooding within the site as described above help offset loss of flood storage. Commercial and residential lots are protected from flooding during the 1% AEP (100 year ARI) event.

Minor impacts (typically up to 50mm) external to the site at the south eastern boundary are noted, however these occur in a low-lying bushland area currently subject to flooding from Cabbage Tree Creek and is not considered an actionable nuisance.

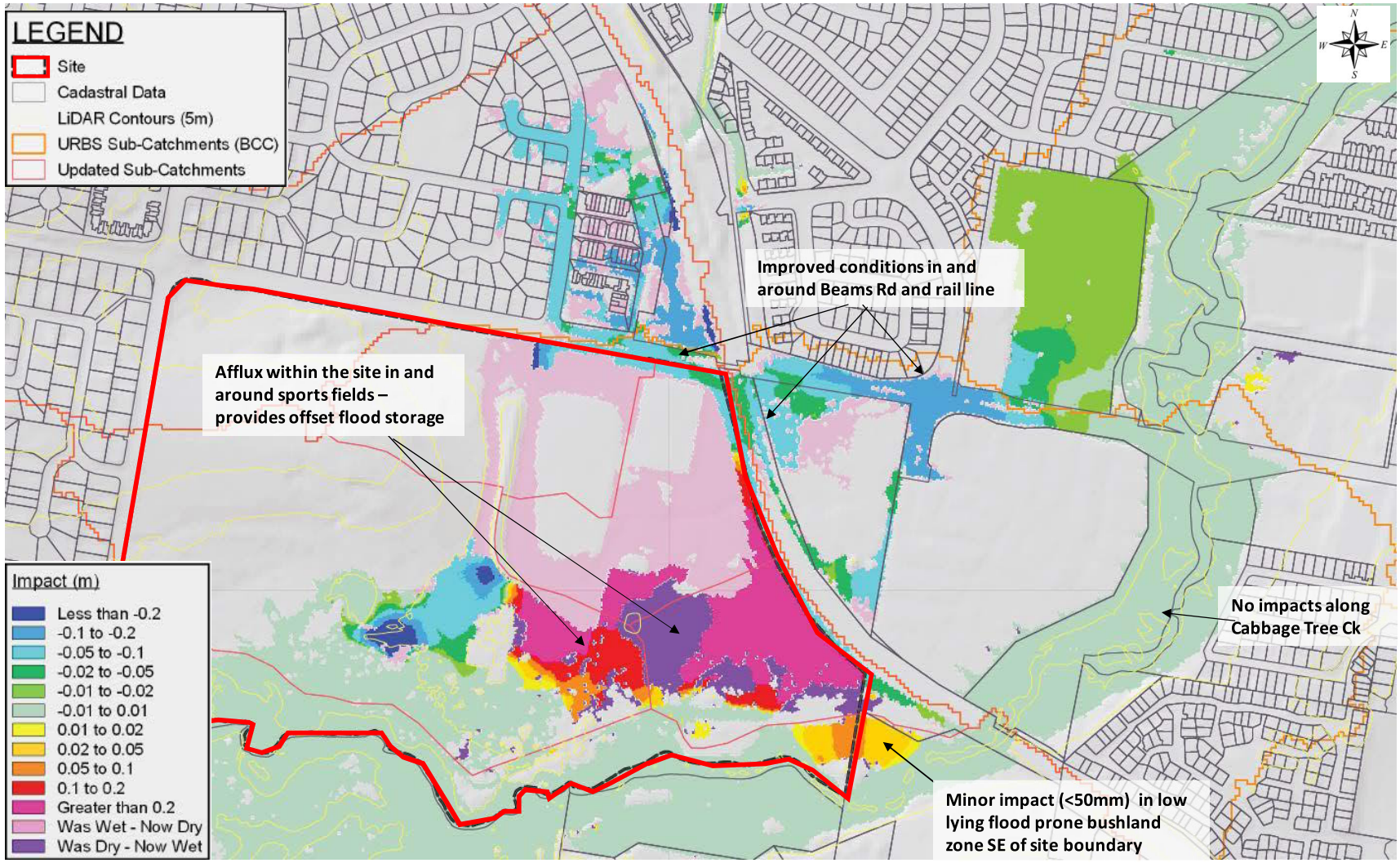


Figure 17 1% AEP flood impacts

5.3.4 Flood storage

An assessment of the impacts of development on flood storage has been completed for the 1% AEP event. This is to review compensatory earthworks, in line with BCC compensatory earthworks planning scheme policy for developments within mapped creek corridors.

Flood storage volumes within the site boundary have been calculated for the existing case and developed case scenarios. Table 10 summarises the estimated flood storage volumes, based on the current model assumptions.

Table 10 Flood storage volumes – 1% AEP

Scenario	Flood storage (m^3)
Existing conditions	44,929
Developed case	38,208
Loss in storage	6,721

Overall, the flood modelling predicts that a loss of flood storage will occur (~15%). Despite this, the modelling also demonstrates that no significant adverse offsite flood impacts are expected to occur along Cabbage Tree Creek and improved flood conditions can be expected at both Beams Road and the rail line at the north east of the site. This is because the storage loss is relatively minor in the context of the regional floodplain and the site largely serves a flood conveyance (or overland flow) function as opposed to a flood storage function for Cabbage Tree Creek floodwaters.

6 MAINTENANCE

WSUD infrastructure such as bioretention basins require ongoing inspection and maintenance to ensure they establish and operate in accordance with the design intent. Potential problems associated with WSUD as a result of poor maintenance include:

- Decreased aesthetic amenity;
- Reduced functional performance;
- Public health and safety risks; and
- Decreased habitat diversity (dominance of exotic weeds).

6.1 MAINTENANCE PLAN

A Maintenance Plan will be required prior to handover of WSUD assets. The plan will provide detailed guidance around maintenance of WSUD assets, as well as frequency of maintenance activities. The manual will include performance inspection checklists. The document will be consistent with the methodologies and principles detailed in Maintaining WSUD Assets (Water by Design, 2012).

The maintenance plan and checklists will be a living document and can be refined where required in collaboration with Council assets and maintenance departments to ensure the structure and frequency of maintenance is consistent with current Council procedures. This will also provide an opportunity for transfer of knowledge in this regard to allow Council to effectively operate the sediment ponds and bioretention basin.

6.1.1 Bioretention basins

Typical maintenance of bioretention systems during operation will involve:

- Routine inspection of the bio-retention system profile to identify any areas of obvious increased sediment deposition, scouring from storm flows, rill erosion of the batters from lateral inflows, damage to the profile from vehicles and clogging of the bio-retention system (evident by a 'boggy' filter media surface).
- Routine inspection of inflows systems, overflow pits and under-drains to identify and clean any areas of scour, litter build up and blockages.
- Removal of sediment where it is smothering the bio-retention system vegetation.
- Repairing any damage to the profile resulting from scour, rill erosion or vehicle damage by replacement of appropriate fill (to match onsite soils) and revegetating.
- Tilling of the bioretention system surface, or removal of the surface layer, if there is evidence of clogging.
- Regular watering/ irrigation of vegetation until plants are established and actively growing.
- Removal and management of invasive weeds (herbicides should not be used).

- Removal of plants that have died and replacement with plants of equivalent size and species as detailed in the plant schedule.
- Pruning to remove dead or diseased vegetation material and to stimulate growth.
- Vegetation pest monitoring and control.

Maintenance should only occur after a reasonably rain free period when the soil in the bioretention system is dry. Inspections are also recommended following large storm events to check for scour and other damage.

7 CONCLUSION

An updated stormwater management strategy has been developed for the Carseldine Urban Village to meet the requirements of the *State Planning Policy* (DLGIP, 2017), QUDM and *Brisbane City Council Planning Scheme*.

STORMWATER TREATMENT

The updated strategy includes two (2) bioretention basins that treat development runoff prior to discharge to Cabbage Tree Creek:

- Bioretention Basin B1 265m² filter area treating Stages 2, 3 (part of) and S
- Bioretention Basin B2 500m² filter area total treating the remainder of the development (Stages 1,3 (part of), 4 and 5)

Drainage swales along the eastern boundary of the site and at the southern boundary of the Stage S sports fields also provide additional treatment.

FLOODING

Flood impact assessment demonstrates no significant impacts occurring external to the site as a result of development. Some afflux (~50mm) is observed immediately south east of the development boundary, however this afflux occurs within a low-lying flood prone bushland area and is not considered an actionable nuisance.

Improved flood conditions are observed at Beams Road and the rail line at the north-east end of the site. This is because much of the site drainage will be directed to Cabbage Tree Creek. Furthermore, during larger magnitude events, the proposed development fill restricts Cabbage Tree Creek breakout flow from entering this area.

Required mitigation measures to manage flood impacts external to the site include:

- Providing flood storage over the sports field zone for events greater than the 5% AEP (20 year ARI)
- incorporation of a 1200mm dia pipe with one-way flap valve along the new drainage swale draining the eastern half of the development – this minimizes the impacts of Cabbage Tree Creek flows into the site via this new connection to Cabbage Tree Creek
- inclusion of a flood barrier along the eastern boundary of the site (~1m high) – this avoids increases in flood levels external to the site adjacent to the rail line

Updated regional modelling and detailed local modelling will occur as part of continuing design development for the site.

8 REFERENCES

Australian Rainfall and Runoff (1987). *A Guide to Flood Estimation*. Engineers Australia

Calibre (2017). *Flood Impact Assessment & Concept Stormwater Management Plan – Carseldine Urban Village (Master Plan).* Prepared for Economic Development Queensland.

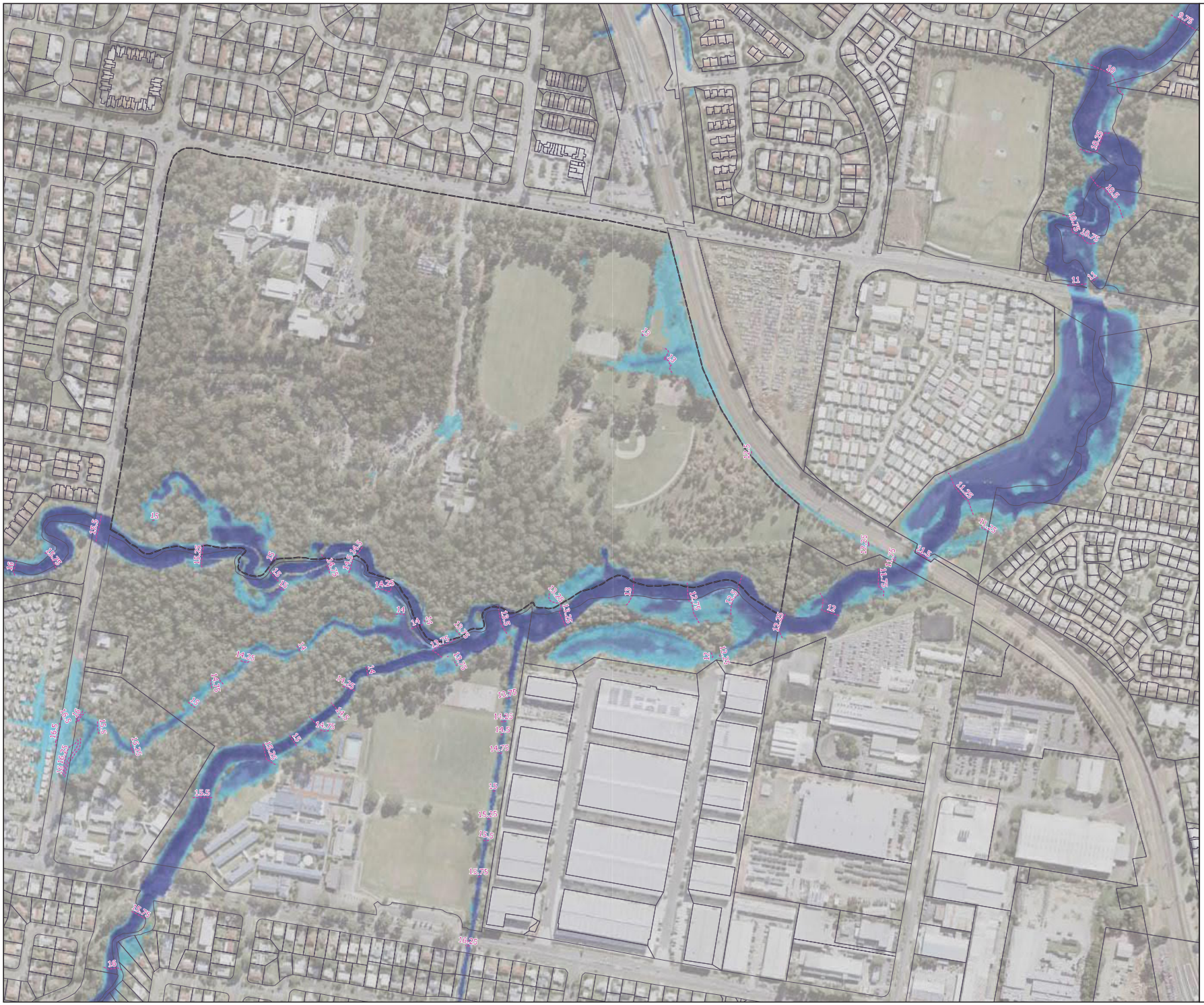
DLGIP (2017). *State Planning Policy*

Healthy Waterways (2010). *MUSIC Modelling Guidelines*

QUDM (2007). *Queensland Urban Drainage Manual*. Second Edition 2007. Department of Natural Resources and Water

SGS (2017). *Geotechnical Investigation Report – Carseldine Urban Village, Beams Road, Carseldine*. Prepared for Economic Development Queensland.

APPENDIX A – TUFLOW MODEL OUTPUTS



Hydrology & Water Management Consulting

DesignFlow

LEGEND

- Site
- Cadastral Data
- Peak Flood Height Contours (m AHD)

Depth (m)

- Less than 0.25
- 0.25 to 0.5
- 0.5 to 0.75
- 0.75 to 1
- 1 to 1.5
- 1.5 to 2
- Greater than 2

FIGURE A1

N

50 0 50 100 m

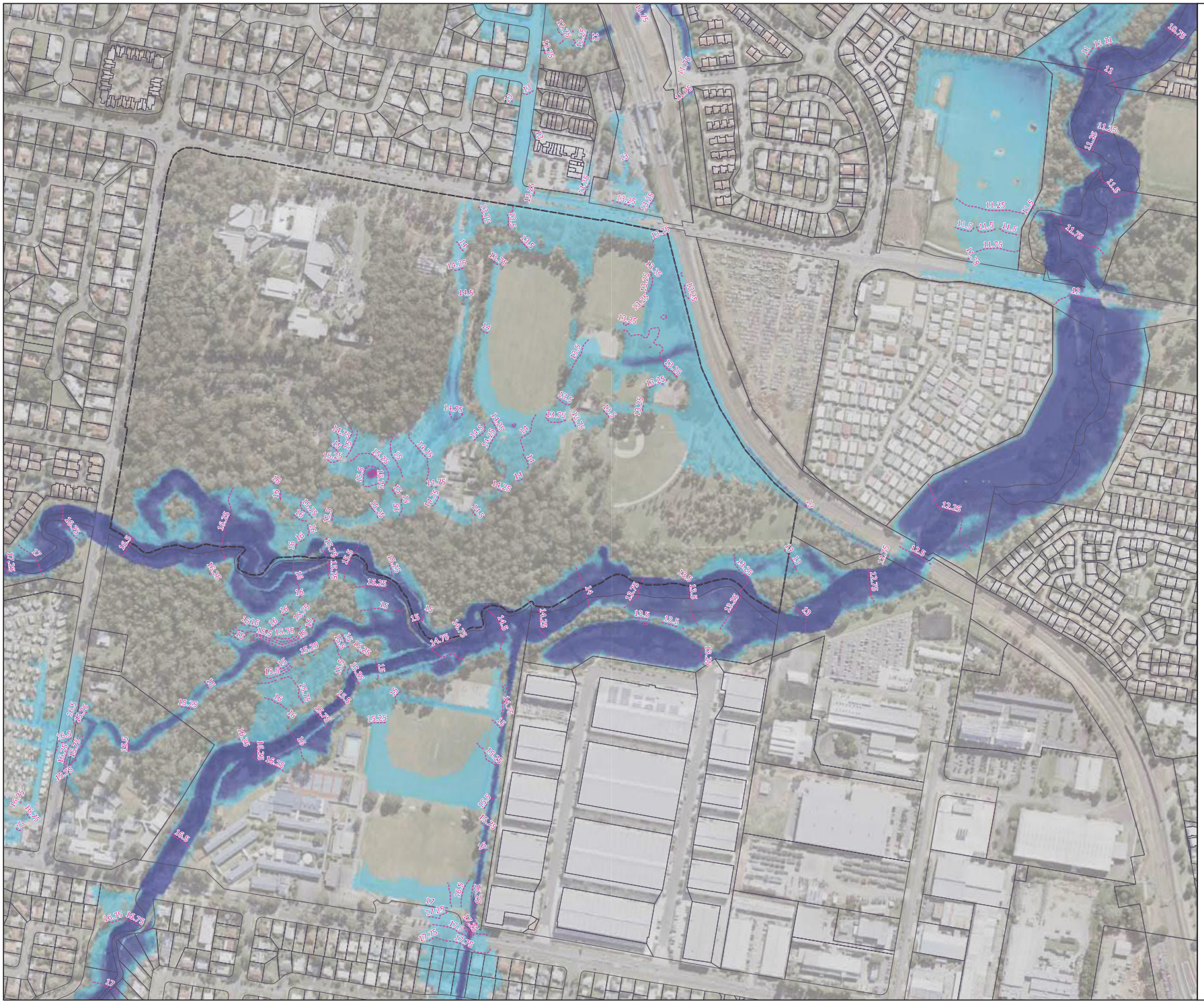
Carseldine Urban Village

Peak Flood Depth & Peak Flood Level Contours

Existing Case (TUFLOW ID B01d)

39%AEP Event (Q002)

Client: Economic Development Queensland



Hydrology & Water Management Consulting

DesignFlow

LEGEND

- Site
- Cadastral Data
- Peak Flood Height Contours (m AHD)

Depth (m)

- Less than 0.25
- 0.25 to 0.5
- 0.5 to 0.75
- 0.75 to 1
- 1 to 1.5
- 1.5 to 2
- Greater than 2

FIGURE A2

N

50 0 50 100 m

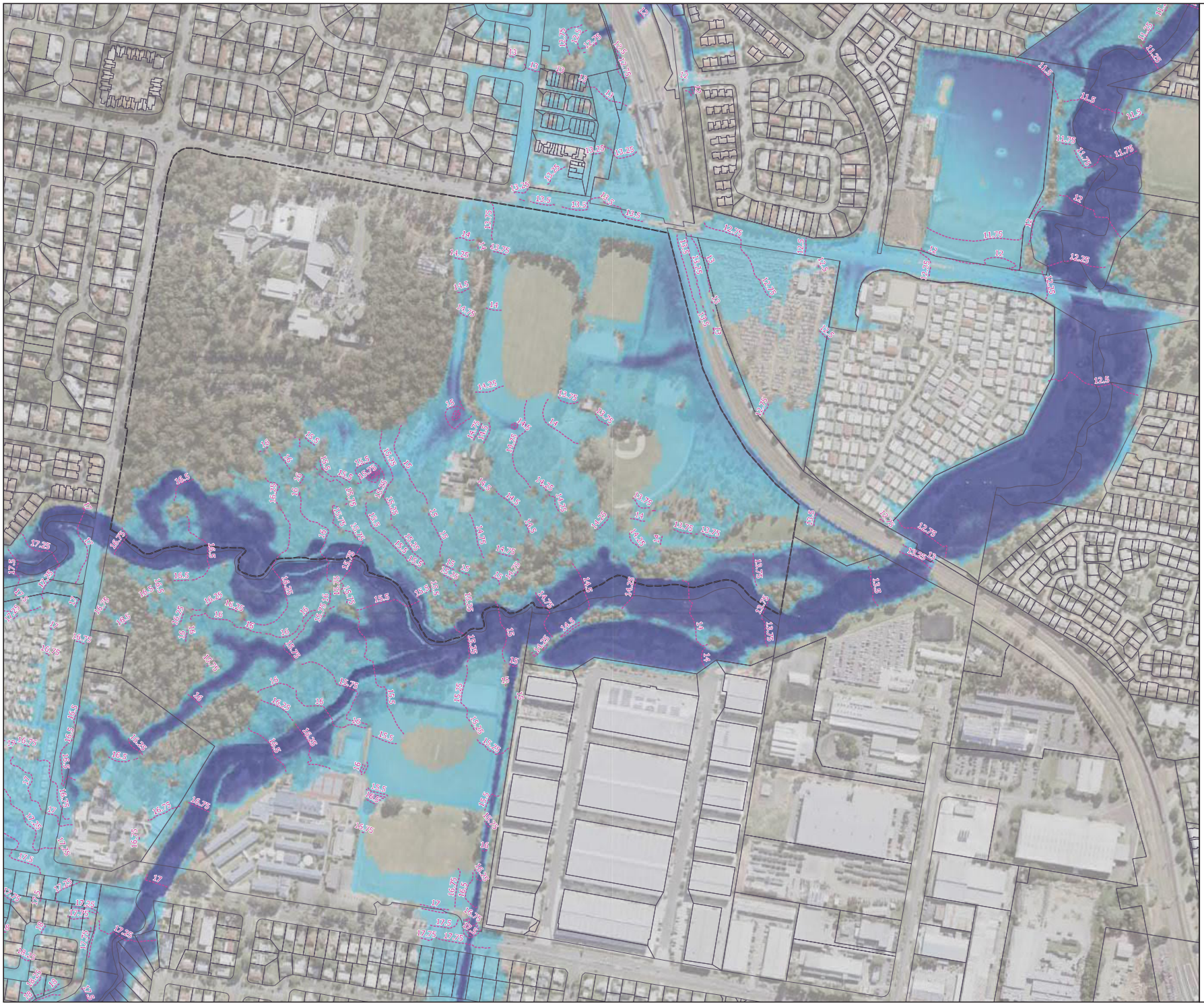
Carseldine Urban Village

Peak Flood Depth & Peak Flood Level Contours

Existing Case (TUFLOW ID B01d)

5%AEP Event (Q020)

Client: Economic Development Queensland



Hydrology & Water Management Consulting

DesignFlow

LEGEND

- Site
- Cadastral Data
- Peak Flood Height Contours (m AHD)

Depth (m)

- Less than 0.25
- 0.25 to 0.5
- 0.5 to 0.75
- 0.75 to 1
- 1 to 1.5
- 1.5 to 2
- Greater than 2

FIGURE A3

N

50 0 50 100 m

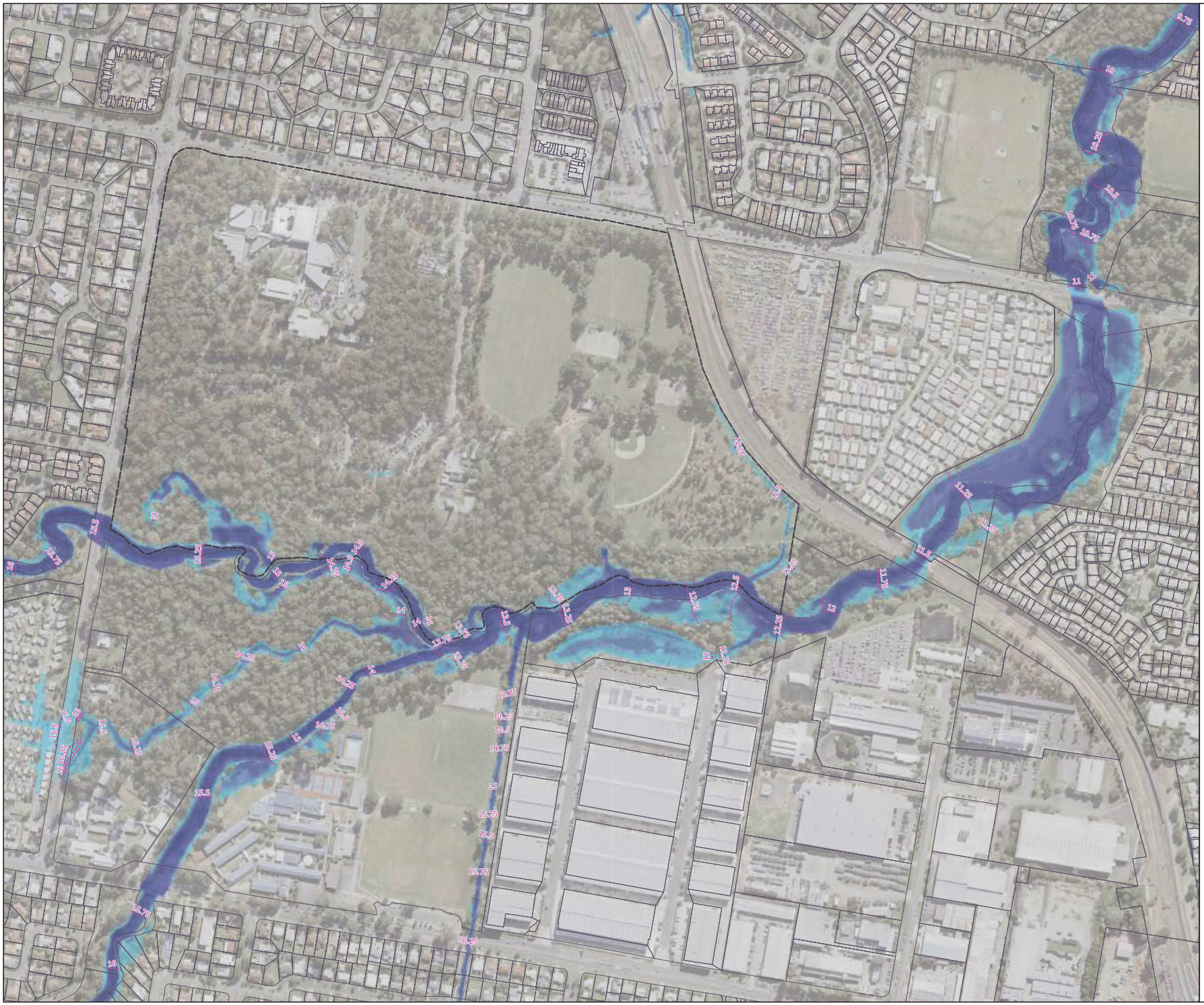
Carseldine Urban Village

Peak Flood Depth & Peak Flood Level Contours

Existing Case (TUFLOW ID B01d)

1%AEP Event (Q100)

Client: Economic Development Queensland



Hydrology & Water Management Consulting

DesignFlow

LEGEND
- Site
- Cadastral Data
- Peak Flood Height Contours (m AHD)

Depth (m)
- Less than 0.25
- 0.25 to 0.5
- 0.5 to 0.75
- 0.75 to 1
- 1 to 1.5
- 1.5 to 2
- Greater than 2

FIGURE A4

N

50 0 50 100 m

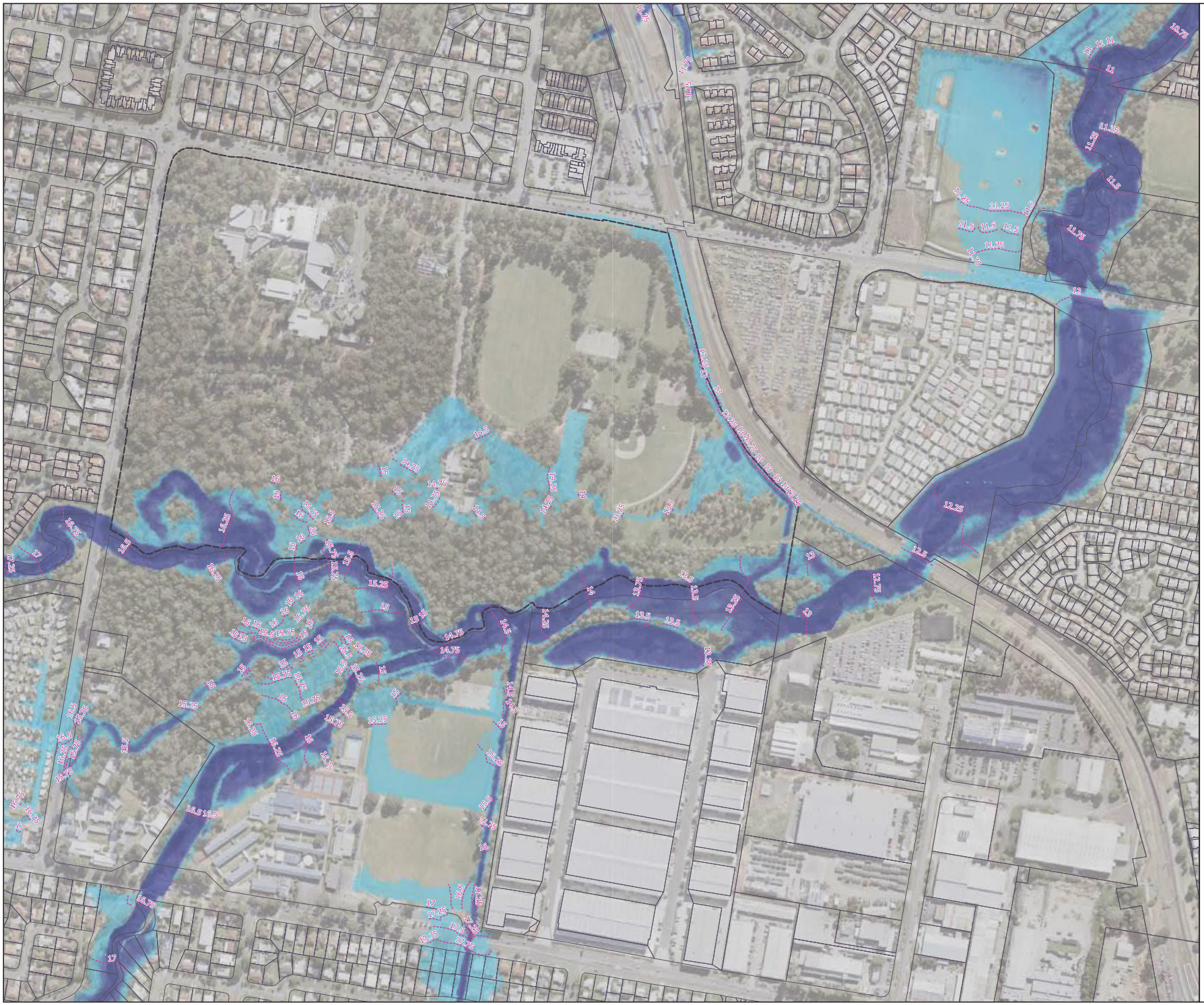
Carseldine Urban Village

Peak Flood Depth & Peak Flood Level Contours

Proposed Case (TUFLOW ID P02j)

39%AEP Event (Q2)

Client: Economic Development Queensland



Hydrology & Water Management Consulting

DesignFlow

LEGEND
- Site
- Cadastral Data
- Peak Flood Height Contours (m AHD)

Depth (m)
- Less than 0.25
- 0.25 to 0.5
- 0.5 to 0.75
- 0.75 to 1
- 1 to 1.5
- 1.5 to 2
- Greater than 2

FIGURE A5

N

50 0 50 100 m

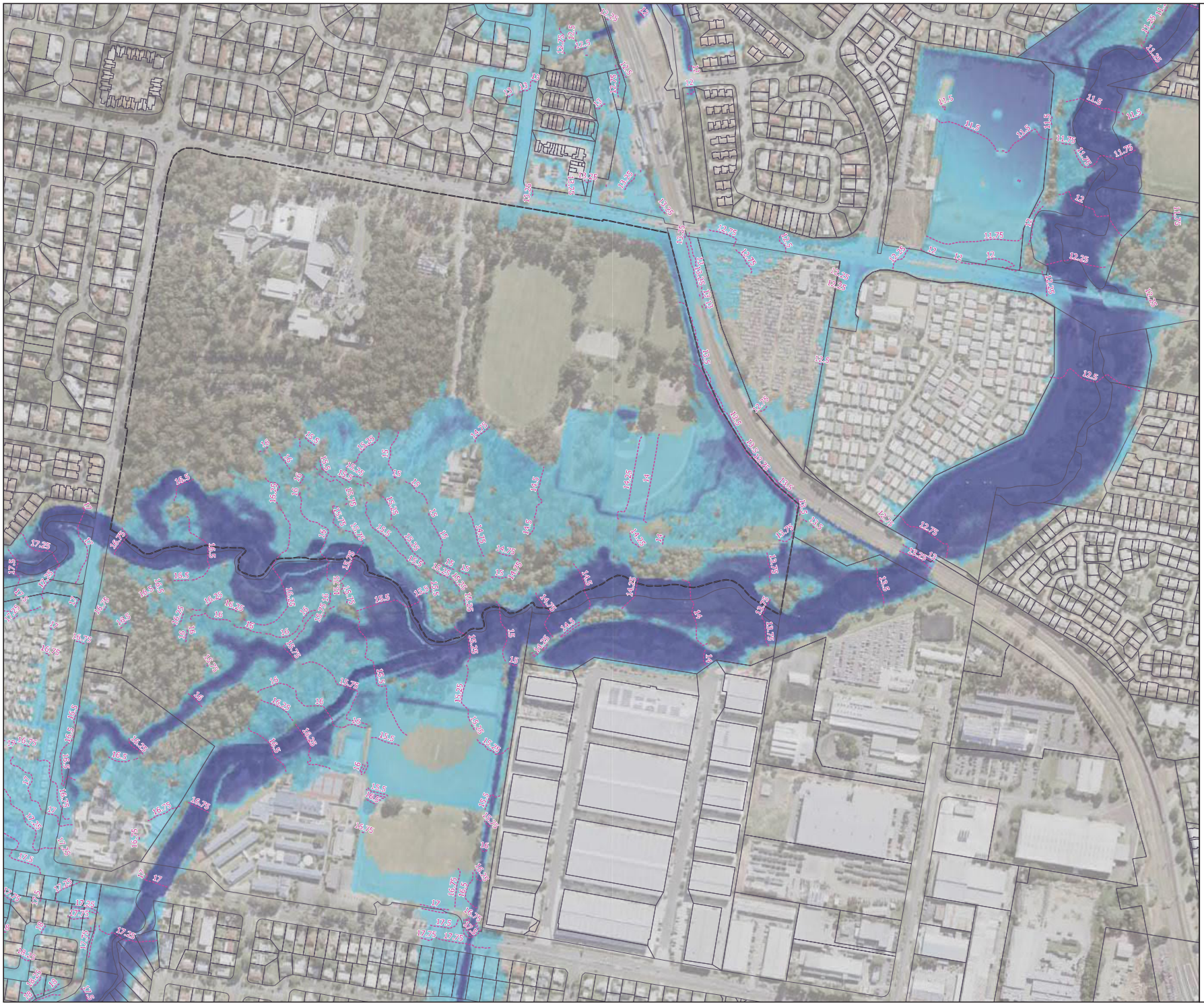
Carseldine Urban Village

Peak Flood Depth & Peak Flood Level Contours

Proposed Case (TUFLOW ID P02j)

5%AEP Event (Q20)

Client: Economic Development Queensland



Hydrology & Water Management Consulting

DesignFlow

LEGEND

- Site
- Cadastral Data
- Peak Flood Height Contours (m AHD)

Depth (m)

- Less than 0.25
- 0.25 to 0.5
- 0.5 to 0.75
- 0.75 to 1
- 1 to 1.5
- 1.5 to 2
- Greater than 2

FIGURE A6

N

50 0 50 100 m

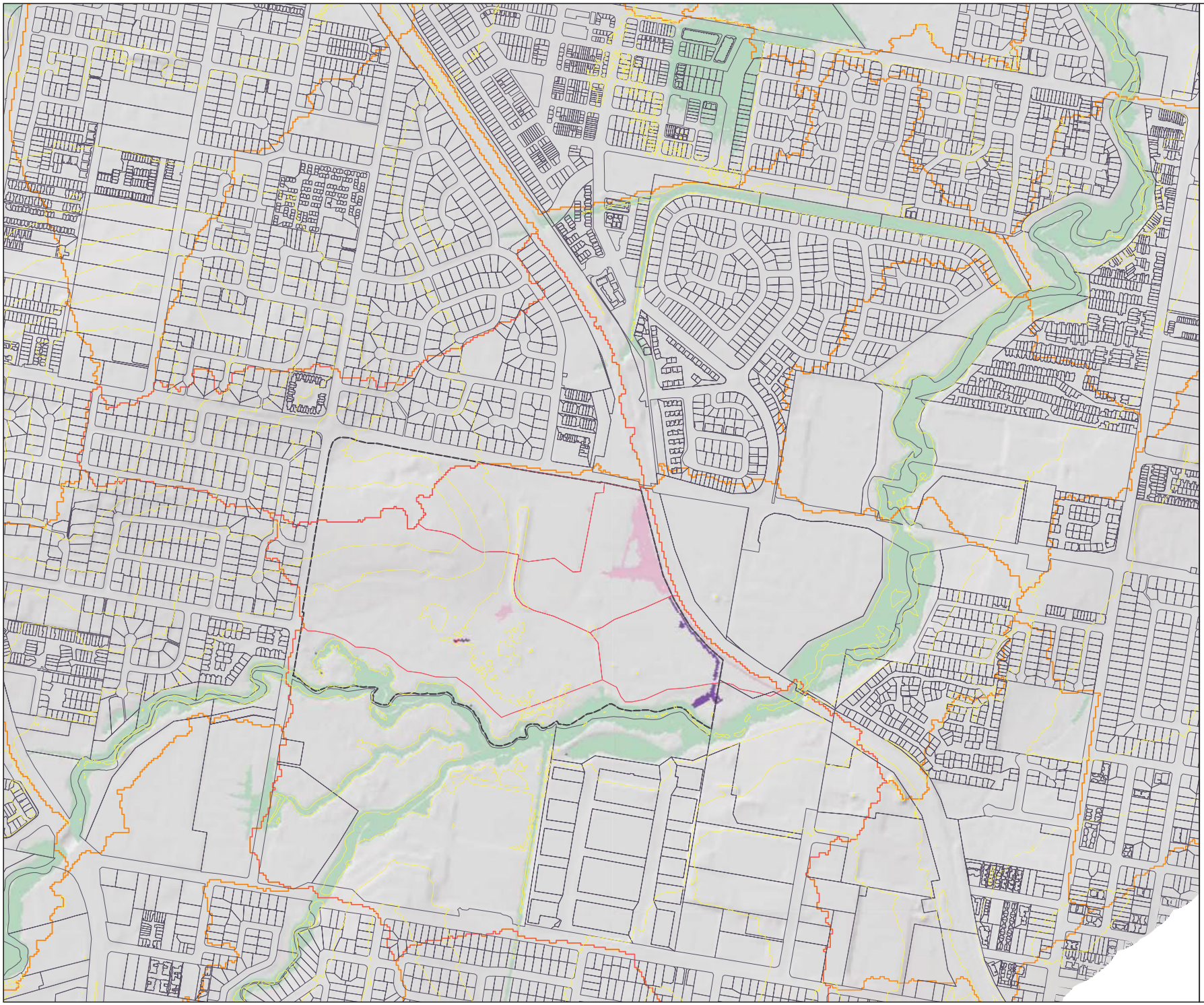
Carseldine Urban Village

Peak Flood Depth & Peak Flood Level Contours

Proposed Case (TUFLOW ID P02j)

1%AEP Event (Q100)

Client: Economic Development Queensland



Hydrology & Water Management Consulting

DesignFlow

LEGEND
- Site
- Cadastral Data
- LiDAR Contours (5m)
- URBS Sub-Catchments (BCC)
- Updated Sub-Catchments

Impact (m)
- Less than -0.2
- -0.1 to -0.2
- -0.05 to -0.1
- -0.02 to -0.05
- -0.01 to -0.02
- -0.01 to 0.01
- 0.01 to 0.02
- 0.02 to 0.05
- 0.05 to 0.1
- 0.1 to 0.2
- Greater than 0.2
- Was Wet - Now Dry
- Was Dry - Now Wet

FIGURE A7

80 0 80 160 m

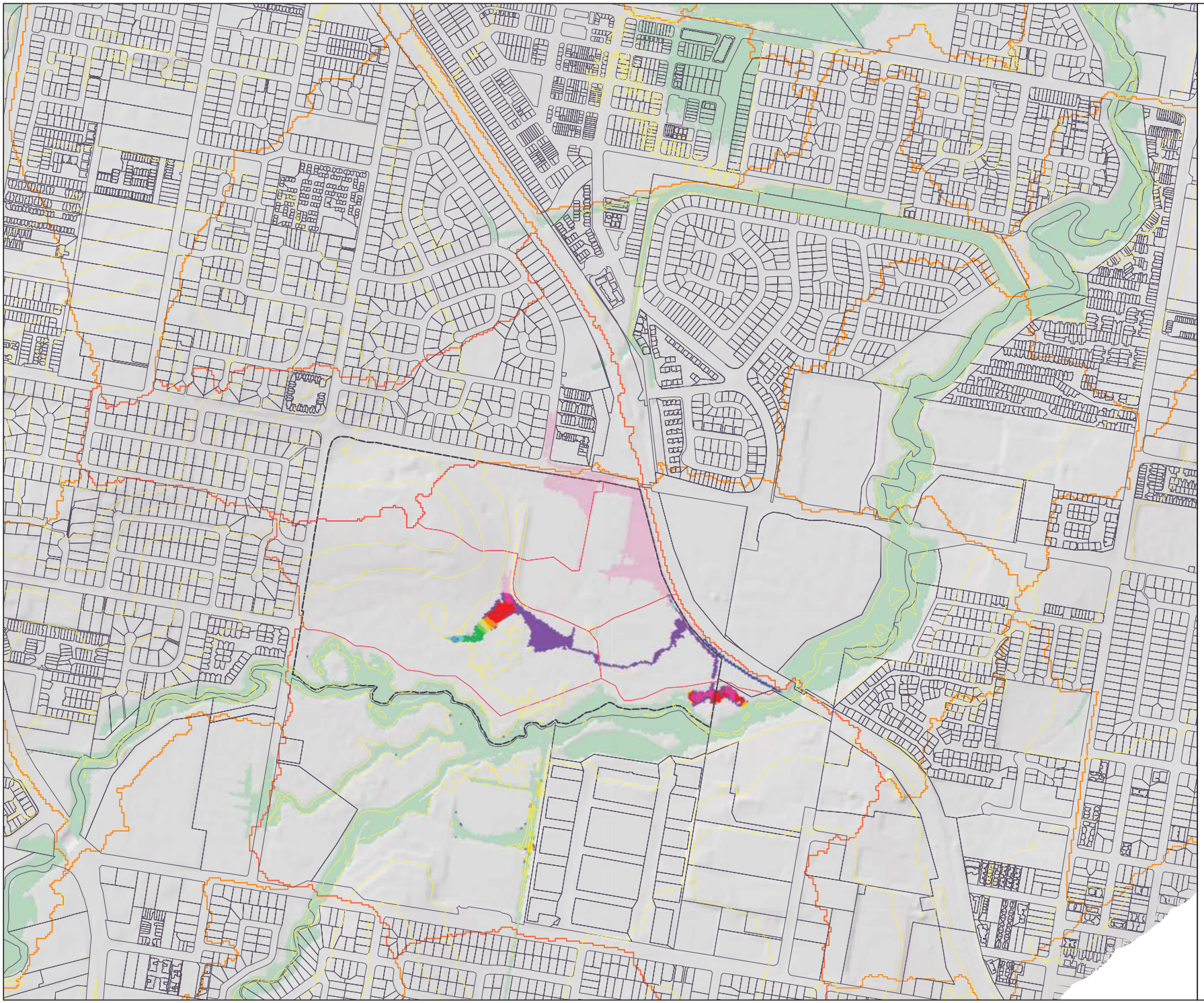
Carseldine Urban Village

Peak Flood Level Impacts
Proposed Vs Existing Case

(TUFLOW Case P02j Vs B01d)

39%AEP Event (Q002)

Client: Economic Development Queensland



Hydrology & Water Management Consulting

DesignFlow

LEGEND
- Site
- Cadastral Data
- LiDAR Contours (5m)
- URBS Sub-Catchments (BCC)
- Updated Sub-Catchments

Impact (m)
- Less than -0.2
- -0.1 to -0.2
- -0.05 to -0.1
- -0.02 to -0.05
- -0.01 to -0.02
- -0.01 to 0.01
- 0.01 to 0.02
- 0.02 to 0.05
- 0.05 to 0.1
- 0.1 to 0.2
- Greater than 0.2
- Was Wet - Now Dry
- Was Dry - Now Wet

FIGURE A8

80 0 80 160 m

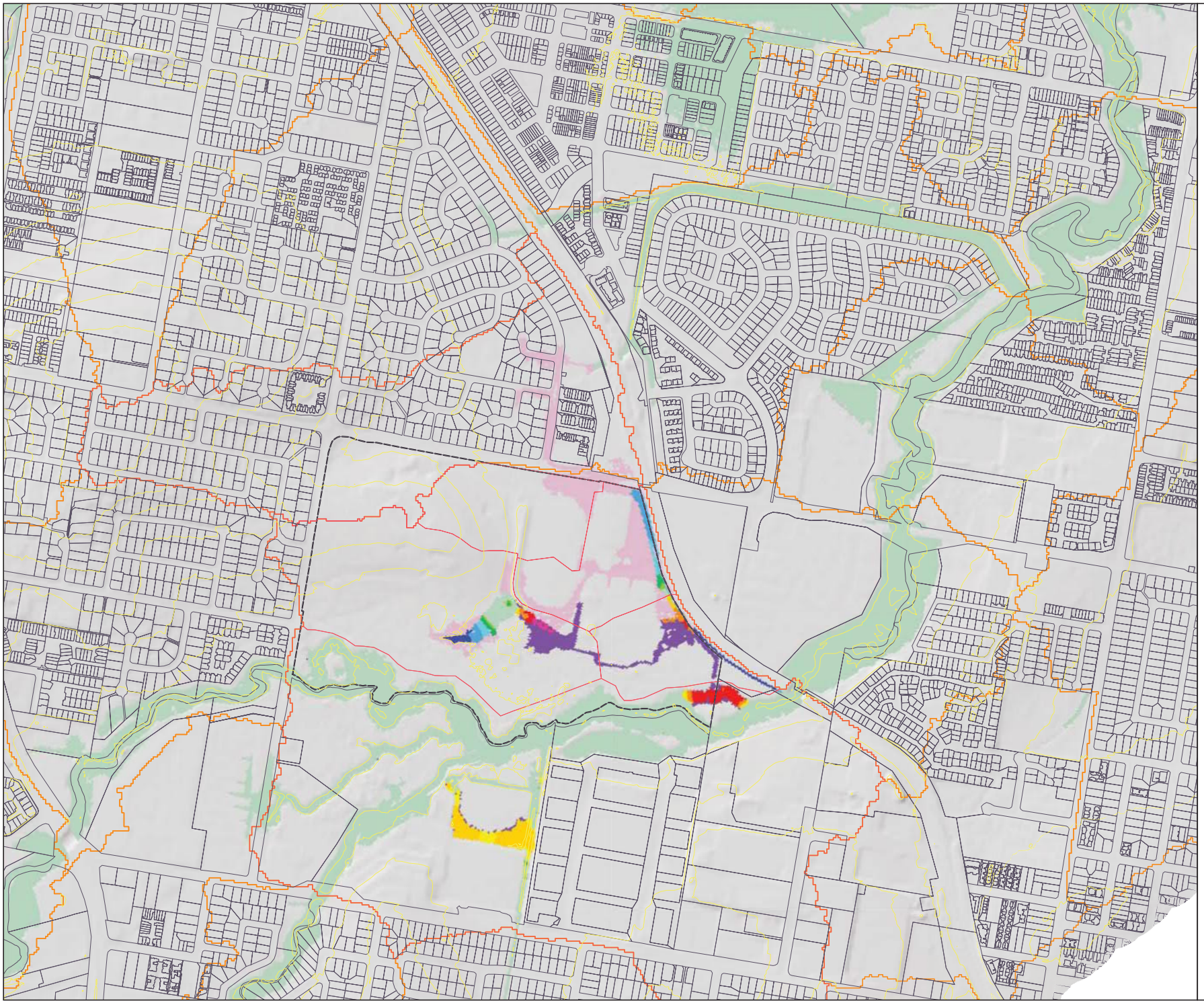
Carseldine Urban Village

Peak Flood Level Impacts
Proposed Vs Existing Case

(TUFLOW Case P02j Vs B01d)

20%AEP Event (Q5)

Client: Economic Development Queensland



Hydrology & Water Management Consulting

DesignFlow

LEGEND

- Site
- Cadastral Data
- LiDAR Contours (5m)
- URBS Sub-Catchments (BCC)
- Updated Sub-Catchments

Impact (m)

- Less than -0.2
- -0.1 to -0.2
- -0.05 to -0.1
- -0.02 to -0.05
- -0.01 to -0.02
- -0.01 to 0.01
- 0.01 to 0.02
- 0.02 to 0.05
- 0.05 to 0.1
- 0.1 to 0.2
- Greater than 0.2
- Was Wet - Now Dry
- Was Dry - Now Wet

FIGURE A9

80 0 80 160 m

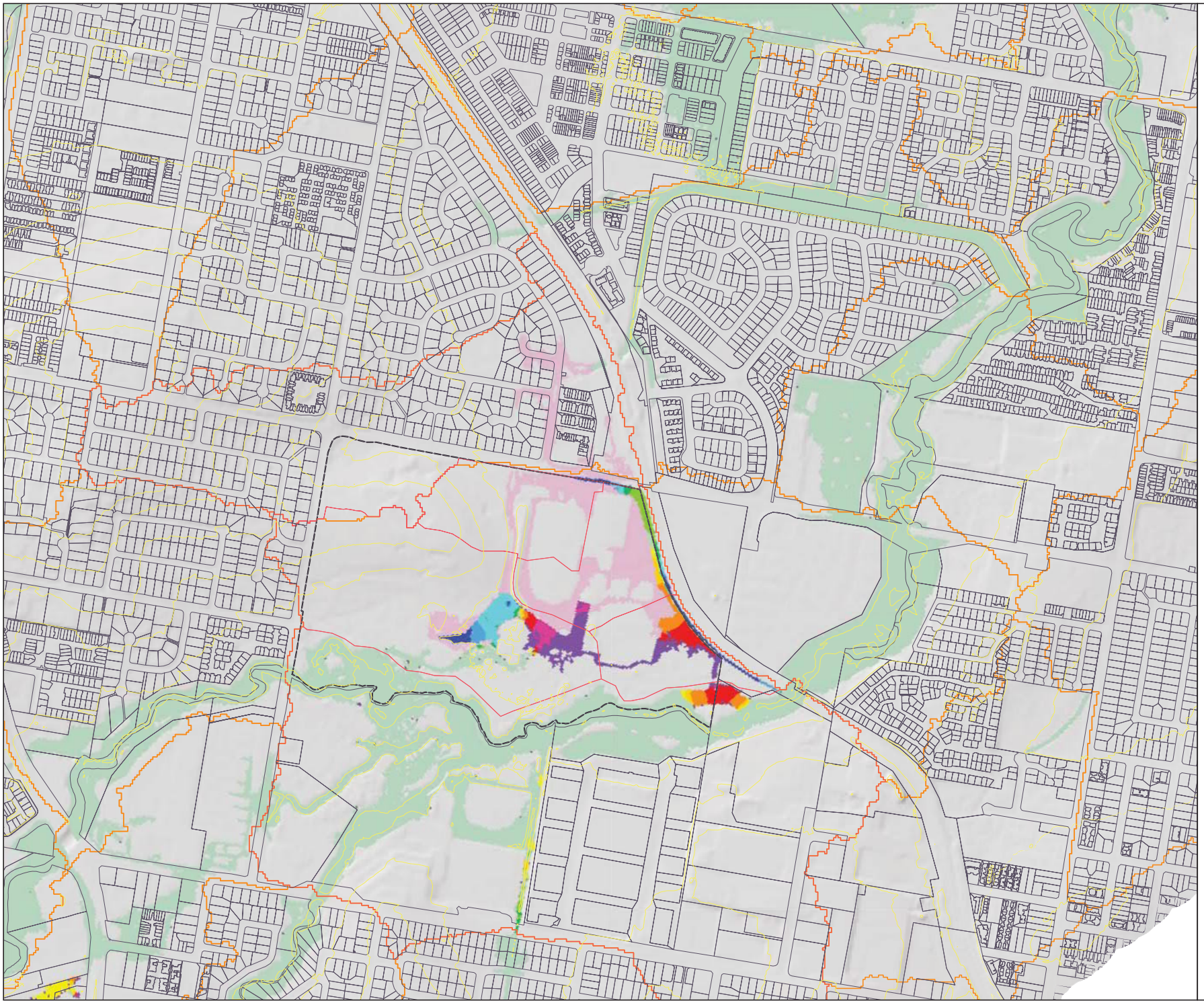
Carseldine Urban Village

Peak Flood Level Impacts
Proposed Vs Existing Case

(TUFLOW Case P02j Vs B01d)

10%AEP Event (Q10)

Client: Economic Development Queensland



Hydrology & Water Management Consulting

DesignFlow

LEGEND

- Site
- Cadastral Data
- LiDAR Contours (5m)
- URBS Sub-Catchments (BCC)
- Updated Sub-Catchments

Impact (m)

- Less than -0.2
- -0.1 to -0.2
- -0.05 to -0.1
- -0.02 to -0.05
- -0.01 to -0.02
- -0.01 to 0.01
- 0.01 to 0.02
- 0.02 to 0.05
- 0.05 to 0.1
- 0.1 to 0.2
- Greater than 0.2
- Was Wet - Now Dry
- Was Dry - Now Wet

FIGURE A10

80 0 80 160 m

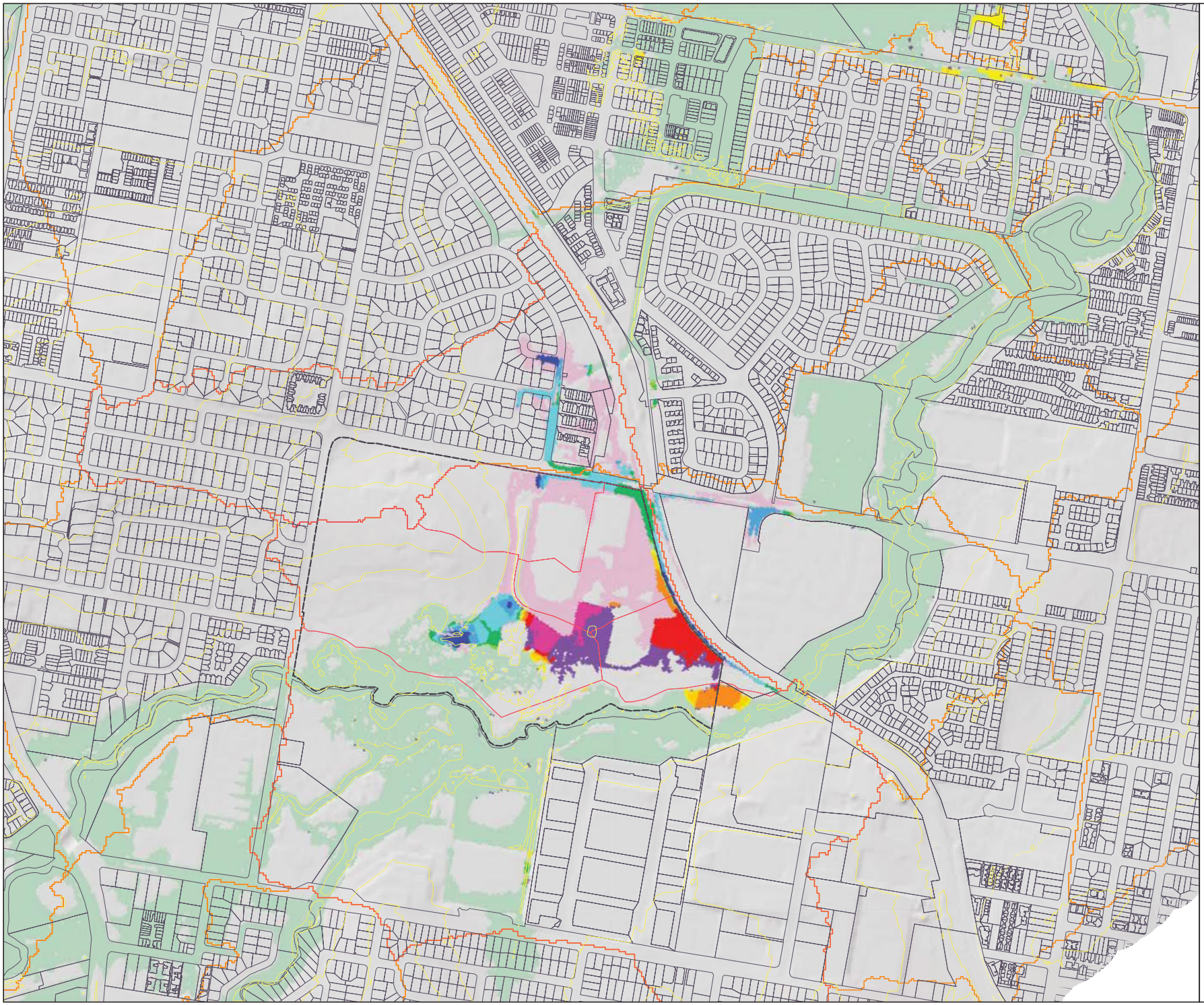
Carseldine Urban Village

Peak Flood Level Impacts
Proposed Vs Existing Case

(TUFLOW Case P02j Vs B01d)

%A QEP Event (5 20)

Client: Economic Development Queensland



Hydrology & Water Management Consulting

DesignFlow

LEGEND

- Site
- Cadastral Data
- LiDAR Contours (5m)
- URBS Sub-Catchments (BCC)
- Updated Sub-Catchments

Impact (m)

- Less than -0.2
- -0.1 to -0.2
- -0.05 to -0.1
- -0.02 to -0.05
- -0.01 to -0.02
- -0.01 to 0.01
- 0.01 to 0.02
- 0.02 to 0.05
- 0.05 to 0.1
- 0.1 to 0.2
- Greater than 0.2
- Was Wet - Now Dry
- Was Dry - Now Wet

FIGURE A11

80 0 80 160 m

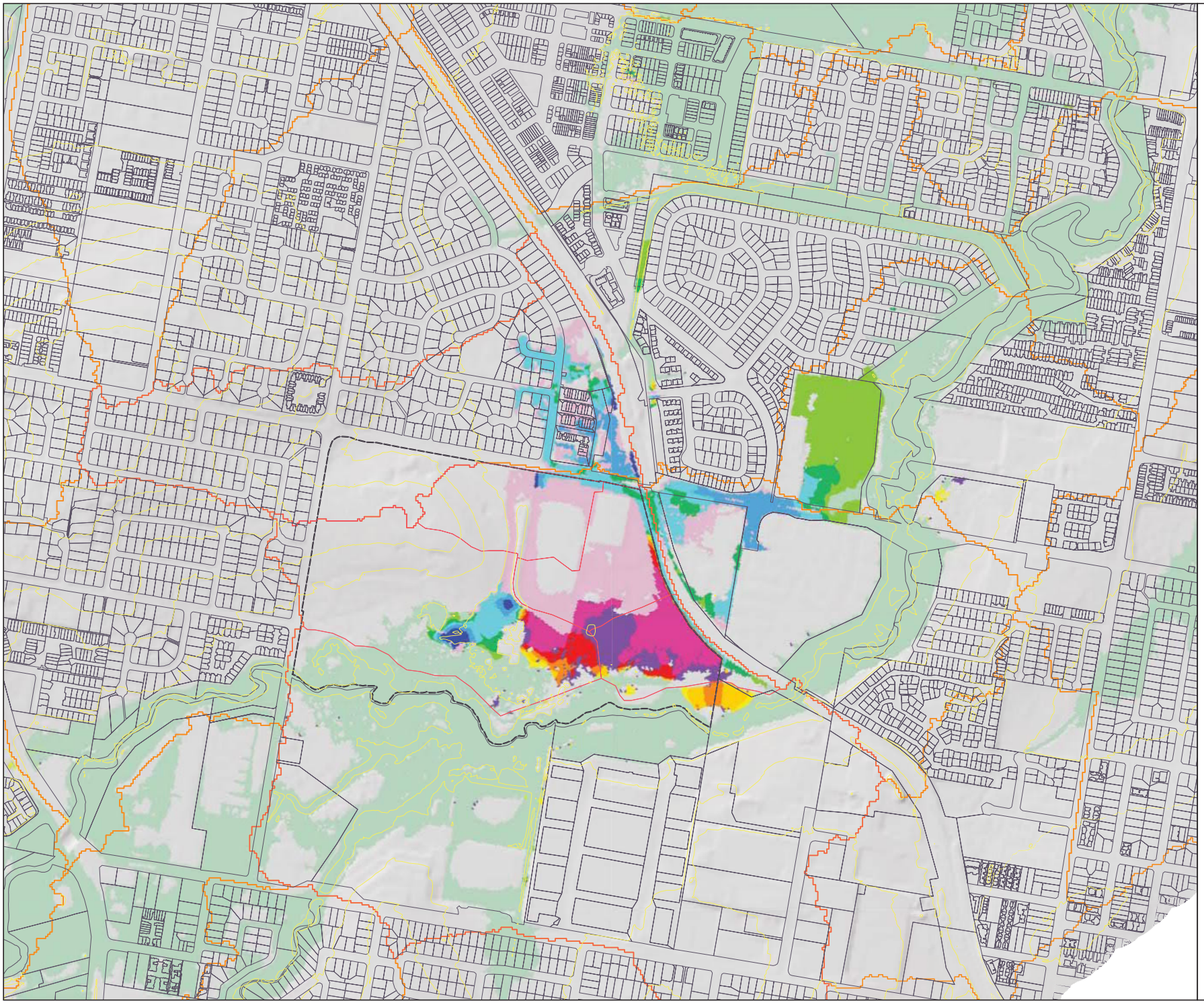
Carseldine Urban Village

Peak Flood Level Impacts
Proposed Vs Existing Case

(TUFLOW Case P02j Vs B01d)

2%AEP Event (Q050)

Client: Economic Development Queensland



Hydrology & Water Management Consulting

DesignFlow

LEGEND
- Site
- Cadastral Data
- LiDAR Contours (5m)
- URBS Sub-Catchments (BCC)
- Updated Sub-Catchments

Impact (m)
- Less than -0.2
- -0.1 to -0.2
- -0.05 to -0.1
- -0.02 to -0.05
- -0.01 to -0.02
- -0.01 to 0.01
- 0.01 to 0.02
- 0.02 to 0.05
- 0.05 to 0.1
- 0.1 to 0.2
- Greater than 0.2
- Was Wet - Now Dry
- Was Dry - Now Wet

FIGURE A12

80 0 80 160 m

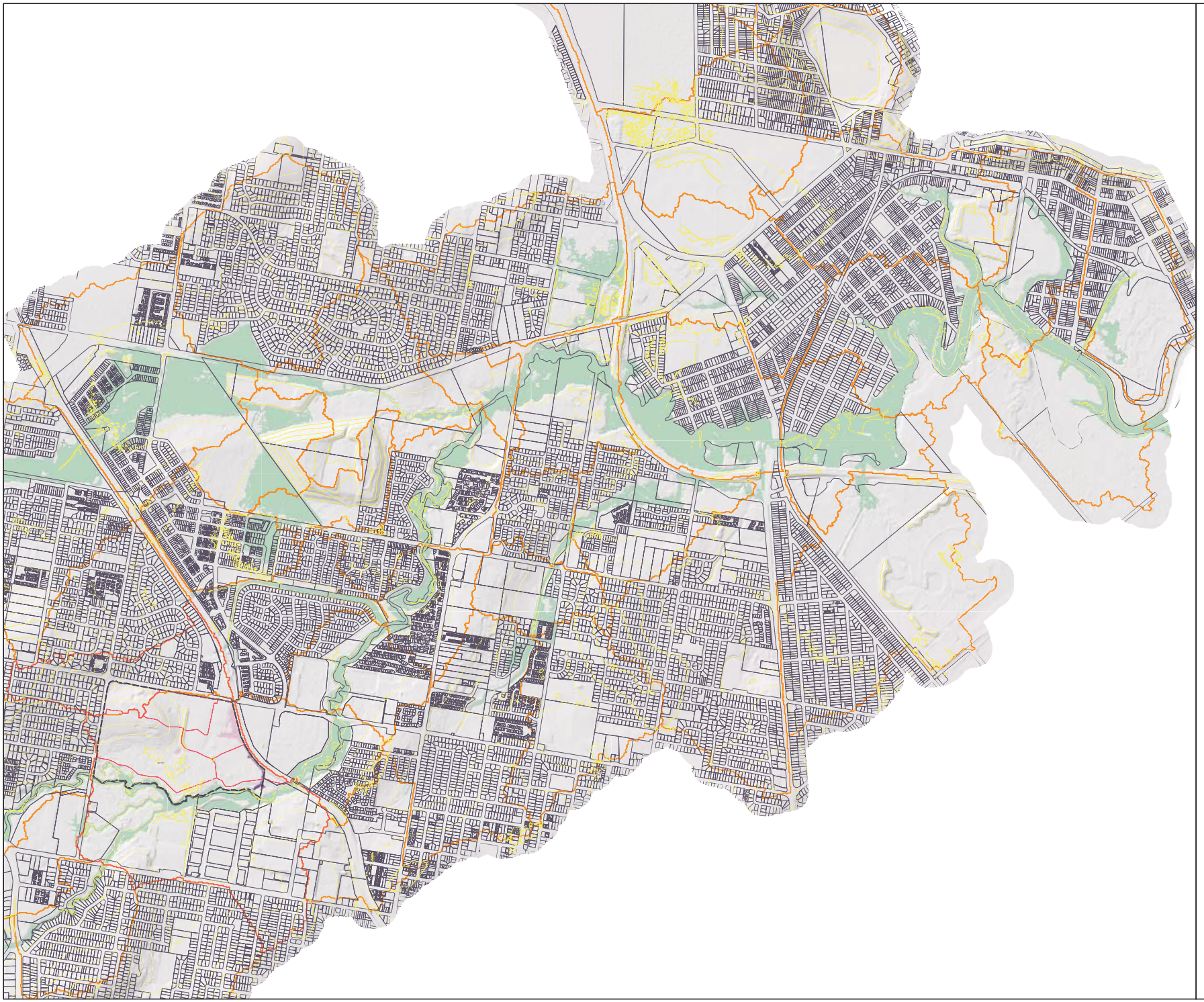
Carseldine Urban Village

Peak Flood Level Impacts
Proposed Vs Existing Case

(TUFLOW Case P02j Vs B01d)

1%AEP Event (Q100)

Client: Economic Development Queensland



Hydrology & Water Management Consulting

DesignFlow

LEGEND

- Site
- Cadastral Data
- LiDAR Contours (5m)
- URBS Sub-Catchments (BCC)
- Updated Sub-Catchments

Impact (m)

- Less than -0.2
- -0.1 to -0.2
- -0.05 to -0.1
- -0.02 to -0.05
- -0.01 to -0.02
- -0.01 to 0.01
- 0.01 to 0.02
- 0.02 to 0.05
- 0.05 to 0.1
- 0.1 to 0.2
- Greater than 0.2
- Was Wet - Now Dry
- Was Dry - Now Wet

FIGURE A13

200 0 200 400 m

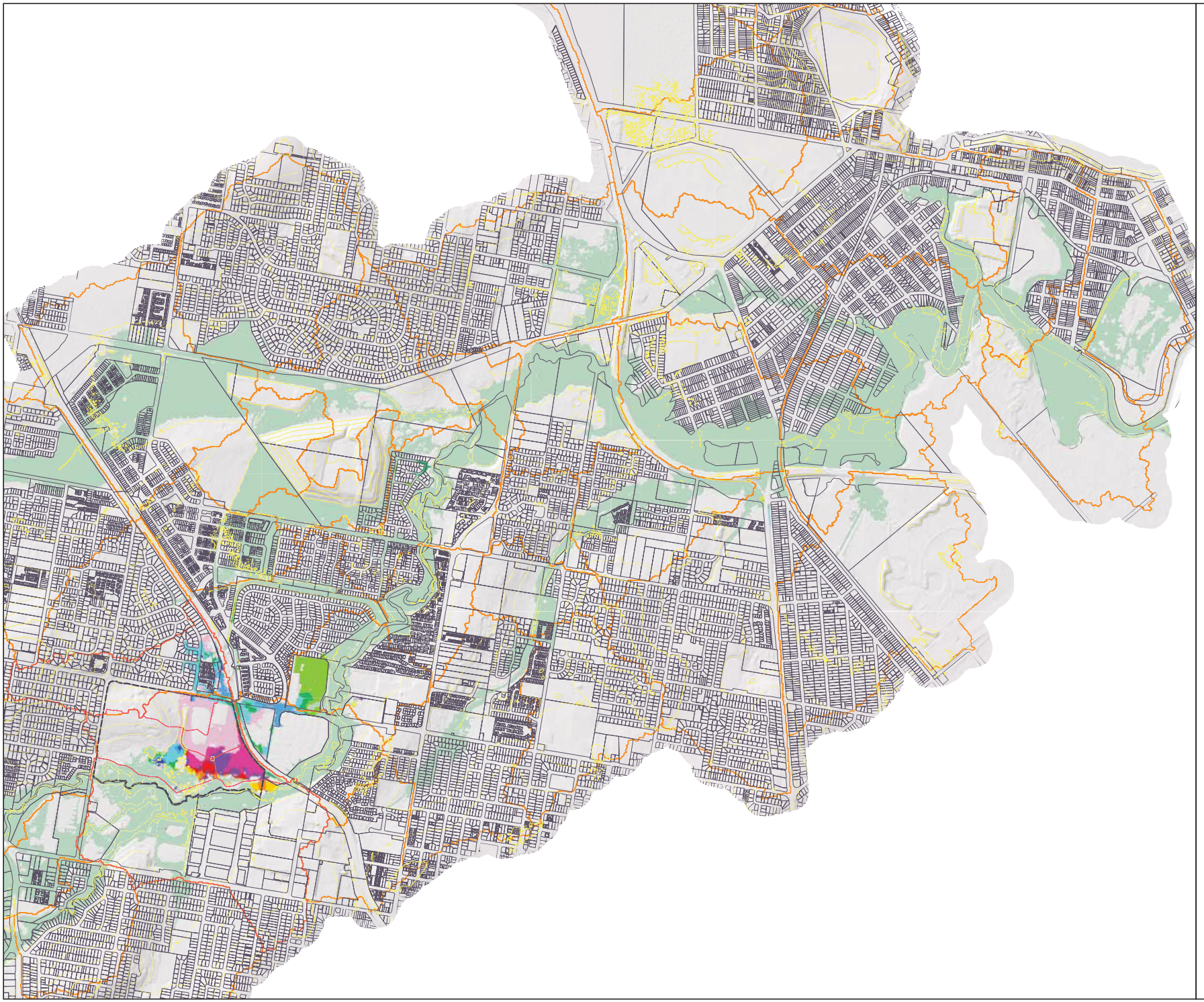
Carseldine Urban Village

Peak Flood Level Impacts
Proposed Vs Existing Case

(TUFLOW Case P02j Vs B01d)

39%AEP Event (Q2)

Client: Economic Development Queensland



Hydrology & Water Management Consulting

DesignFlow

LEGEND

- Site
- Cadastral Data
- LiDAR Contours (5m)
- URBS Sub-Catchments (BCC)
- Updated Sub-Catchments

Impact (m)

- Less than -0.2
- -0.1 to -0.2
- -0.05 to -0.1
- -0.02 to -0.05
- -0.01 to -0.02
- -0.01 to 0.01
- 0.01 to 0.02
- 0.02 to 0.05
- 0.05 to 0.1
- 0.1 to 0.2
- Greater than 0.2
- Was Wet - Now Dry
- Was Dry - Now Wet

FIGURE A14

200 0 200 400 m

Carseldine Urban Village

Peak Flood Level Impacts
Proposed Vs Existing Case

(TUFLOW Case P02j Vs B01d)

1%AEP Event (Q100)

Client: Economic Development Queensland