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PLANS AND DOCUMENTS
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DEVELOPMENT APPROVAL
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Queensland Government

STORMWATER MANAGEMENT PLAN

Riverbend – Precinct 1 Stormwater Report

Prepared for Celestino Pty Limited

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Glossary

TERM	DEFINITION
AEP	Annual Exceedance Probability
EDQ	Economic Development Queensland
IECA	International Erosion Control Association
IL/CL	Initial Loss and Continuing Loss Hydrological Model
LCC	Logan City Council
LGA	Local Government Area
ML	Megalitres
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
QUDM	Queensland Urban Drainage Manual
PDA	Priority Development Area
RFFE	Regional Flood Frequency Estimation
SBSMP	Site Based Stormwater Management Plan
SMP	Stormwater Management Plan
SPP	State Planning Policy
SQID	Stormwater Quality Improvement Device
WQO	Water Quality Objective
WSUD	Water Sensitive Urban Design

Executive Summary

Northrop Consulting Engineers Pty Ltd (Northrop) have been engaged by Celestino Pty Ltd to prepare a Stormwater Management Plan (SMP) for Precinct 1 of the proposed Riverbend subdivision. The proposed site is located within the Riverbend endorsed context plan area of the Greater Flagstone Priority Development Area (PDA). The proposed development will deliver a 73ha residential subdivision with associated facilities, transport and servicing infrastructure.

This SMP outlines the stormwater management strategy for the proposed development and demonstrates that the proposed development can be constructed and operated in accordance with all stormwater objectives required for the development. The primary outcomes of this SMP are to outline the following:

- Lawful point of discharge
- Stormwater Conveyance
- Flood management strategy
- Stormwater Quality management strategy
- Erosion and Sediment Control strategy
- Waterway stability assessment

Lawful Point of Discharge

The existing site has numerous site discharge points to the unnamed tributary of Logan River, existing roads and lots. The developed site will retain some existing site discharge points as the lawful point of discharge, with stormwater management measures proposed at the downstream point of each catchment prior to site discharge (refer to **Figure 4**).

Stormwater Conveyance

The subdivision is expected to include a stormwater pit and pipe network to appropriately manage the minor storm events. In major storm events detailed design will ensure any overland flow of stormwater is safe and controlled within the road reserve and any stormwater easements. Stormwater will be safely and effectively conveyed from the upper extent of each catchment to stormwater management facilities downstream prior to site discharge.

Flood Management Strategy

A TUFLOW model with XP-RAFTS inflows has been prepared to assess the flood behaviour and trunk stormwater measures across the site. A series of detention basins have been proposed to control flows onto adjoining private properties. Where the site adjoins the local creek to the south of Precinct 1 and the Logan River, discharge has been released un-detained. Modelling presented herein and in the SBSMP (Northrop, 2025) demonstrates no significant adverse impact is created by the removal of stormwater detention from these discharge points.

Stormwater Quality Management Strategy

Stormwater quality infrastructure has been included in the design to achieve the water quality objectives outlined by the SBSMP (Northrop, 2025) namely, the removal of gross pollutants, suspended solids, nitrogen and phosphorus. The proposed treatment train was modelled using MUSIC modelling software and includes bioretention basins to treat runoff from the site. The proposed development is split into multiple catchments, with each catchment having localised treatment prior to discharge to the downstream watercourse.

Erosion and Sediment Control Strategy

Erosion and Sediment Control measures are to be implemented during construction in accordance with the requirements of the International Erosion Control Association (IECA).

Waterway Stability

A waterway stability assessment has been performed herein which has determined that no additional mitigation measures are required to limit flows in discharging directly to the Logan River. Minor increases in velocity are predicted immediately downstream of the outlet locations, however we do not believe this will result in a significant erosion risk to due to the vegetated nature of the receiving corridors and the low velocities observed. Additional mitigation measures such as scour protection at the outlet of stormwater pipes will be investigated during future design development stages.

1 Introduction

Northrop Consulting Engineers Pty Ltd (Northrop) have been engaged by Celestino Pty Ltd to prepare a Stormwater Management Plan (SMP) for Precinct 1 of the proposed Riverbend masterplan.

A masterplan Site Based Stormwater Management Plan (SBSMP) was prepared by Northrop Consulting Engineers for the broader Riverbend masterplan dated March 2025, herein referred to as the SBSMP (Northrop, 2025). The masterplan was prepared in support of the proposed development within the Greater Flagstone Priority Development Area (PDA) and for submission to Economic Development Queensland (EDQ) and was endorsed on 27 May 2025.

This report specifically focuses on the Stormwater Management Plan for Precinct 1 of the site and is intended to be submitted to for the purposes of Reconfiguration of Lot (ROL) approval.

1.1. Background

1.1.1. RIVERBEND MASTERPLAN AND SBSMP (NORTHROP, 2025)

The Riverbend masterplan is located south of Teviot Road, Riverbend, within the Logan City Council (LCC) Local Government Area (LGA). The Riverbend masterplan comprises of six land parcels to be subdivided into a 550ha urban residential development including associated community infrastructure, roads and stormwater management measures. The six existing parcels of undeveloped land include:

- Lot 800 SP247625
- Lot 101 SP254145
- Lot 102 SP254145
- Lot 104 SP254145
- Lot 105 SP254145
- Lot 106 SP254145

The Riverbend masterplan is currently bound by:

- Teviot Road to the North-West
- Logan River to the East and South
- Residential lots and private properties to the North and South

As part of the submission to Economic Development Queensland (EDQ), Northrop Consulting Engineers prepared the Site Based Stormwater Management Plan (SBSMP) which outlined the stormwater management design objectives for the masterplan. This primary objective of the SBSMP (Northrop, 2025) was to define the following:

- Lawful point of discharge
- Stormwater Conveyance
- Stormwater Quantity and Flood management strategy
- Stormwater Quality management strategy
- Erosion and Sediment Control strategy
- Waterway Stability Assessment

This report has been prepared generally in accordance with the objectives of the SBSMP (Northrop, 2025) which are summarised in **Section 3.1** below.

1.1.2. PRECINCT 1

Precinct 1 of the Riverbend masterplan, which is the focus of this report, will deliver approximately a 73ha residential subdivision with associated facilities, transport and servicing infrastructure. Precinct 1, herein known as the “proposed development” or “site” is to be developed across three existing parcels. Property information for the site is summarised in **Table 1**.

Table 1 - Property Details for Precinct 1

CATEGORY	DESCRIPTION
Affected Lot Titles	Lot 102 SP254145 Lot 105 SP254145 Lot 106 SP254145
Total Site Area	73ha
Proposed Land Use	Urban Residential Centre

1.2. Related Reports and Documents

This report is to be read in conjunction with the following reference documents:

- Precinct 1 Reconfiguration of Lot Layout prepared by Place Design Group and dated 24th of September 2025.
- Civil Design surface and earthworks drawings prepared by Colliers Engineering and provided on the 6th of March 2026.
- Endorsed Site Based Stormwater Management Plan for Riverbend (prepared by Northrop Engineers, Revision C, dated March 2025).
- Flood Impact Assessment for Bulk Earthworks OPW for Riverbend (prepared by Northrop Engineers, Revision C, dated October 2023).

2 Site Context and Existing Characteristics

2.1. Site Location

The subject site is located south of Teviot Road, Riverbend, within the Logan City Council (LCC) LGA. The parcels of land relevant to the site are Lots 102, 105 and 106 of SP254145.

The subject site is currently bound by:

- Teviot Road to the north
- An existing water course (unnamed tributary of Logan River) to the west and south
- Priority development area to the east

In its current state the subject site is undeveloped with generally sparse, vegetated land and trees. The site is largely cleared and used as grazing land. Riparian vegetation is located around the existing watercourse. **Figure 1** below illustrates the site location, existing site characteristics and wider Riverbend masterplan area.

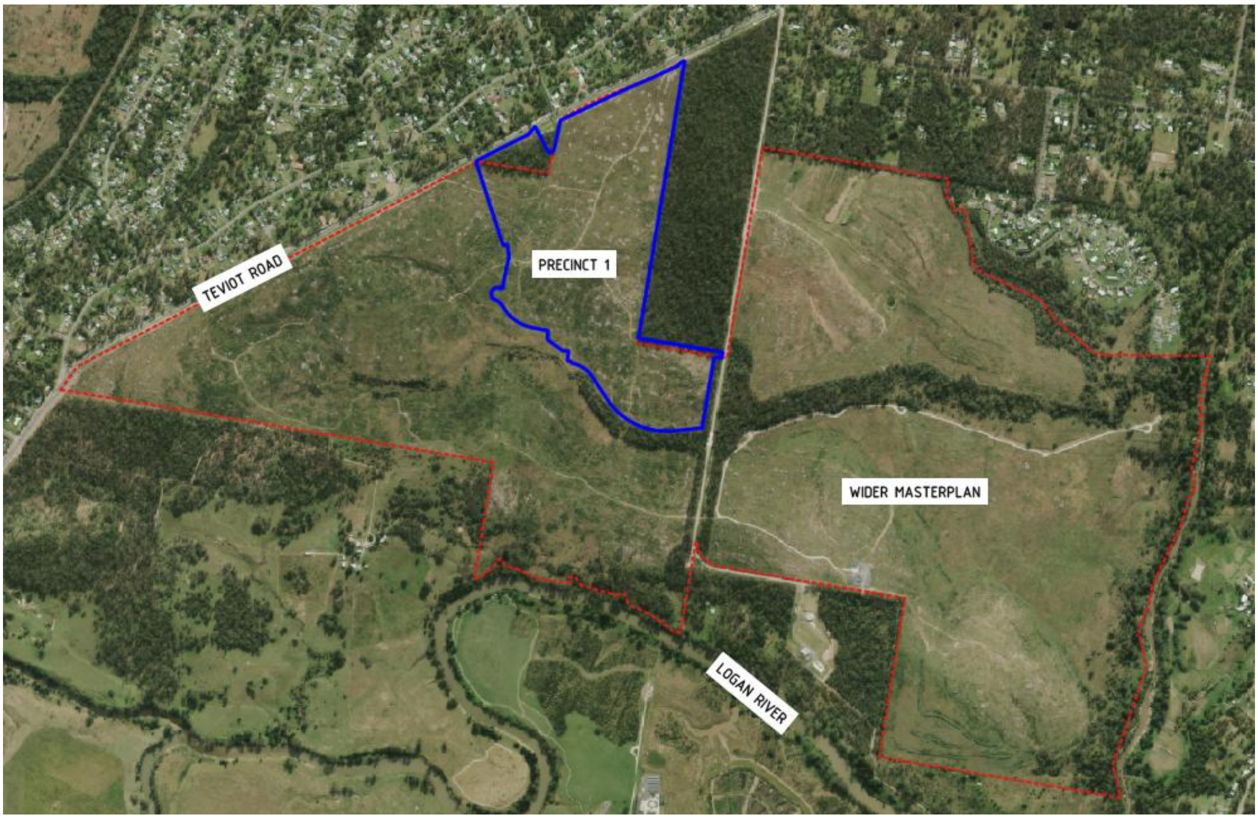


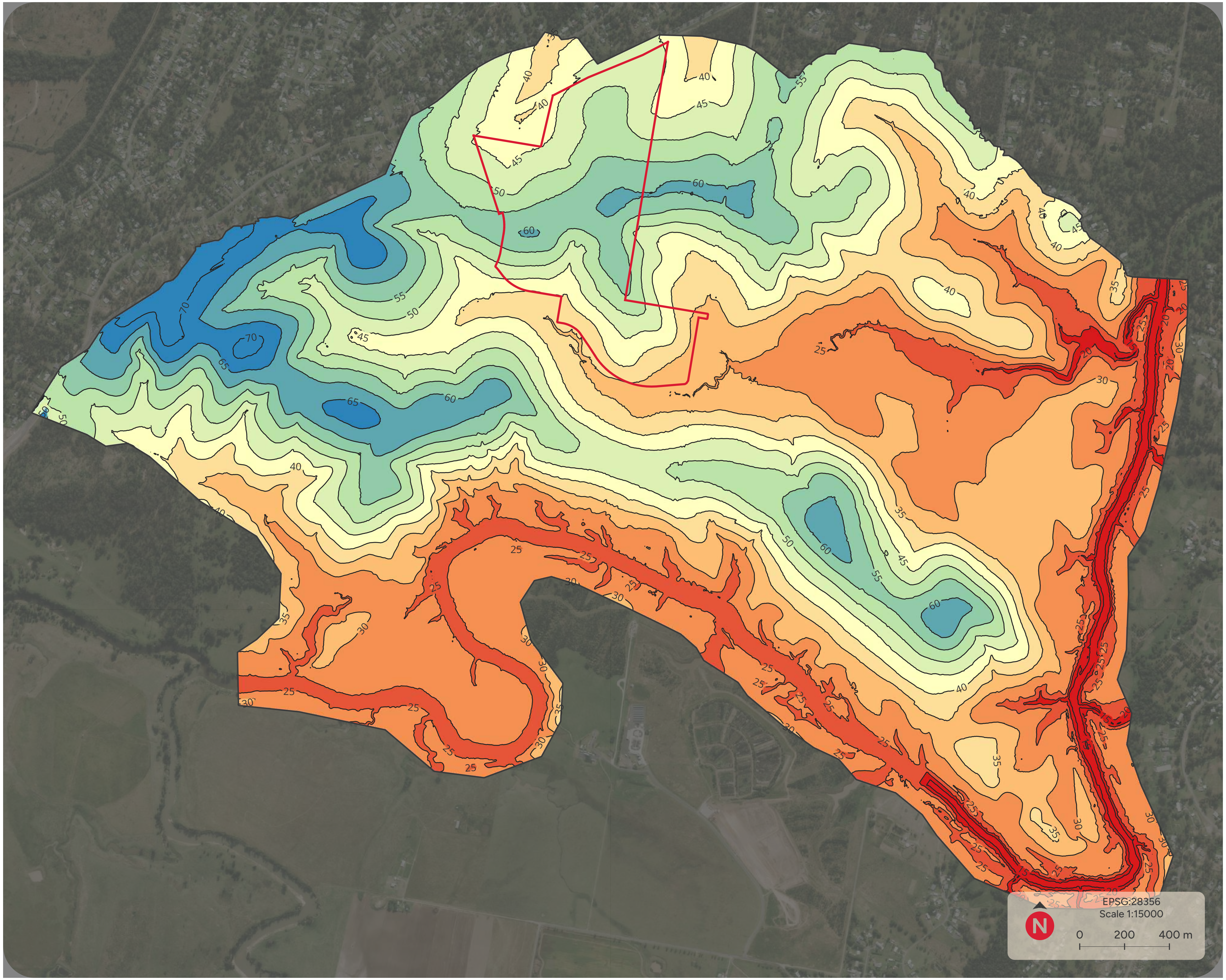
Figure 1 - Site Locality (SOURCE: Nearmap (Aerial dated November 2023))

2.2. Existing Lawful Point of Discharge

The site topography results in the site having numerous existing discharge points, including the following:

- To the existing watercourse to the south of the site
- To Teviot Road
- To the existing lot east of the site

Approximately half of the site grades toward an unnamed watercourse running west to east along the southern boundary of the site, which ultimately discharges to Logan River at the edge of the wider Riverbend masterplan. Refer to **Figure 2** overleaf for the existing site terrain.



Legend

Contours (5M)

Precinct 1 Stage Boundary

Tuflow Extent

Topography (m AHD)

<= 20	
20 - 25	
25 - 30	
30 - 35	
35 - 40	
40 - 45	
45 - 50	
50 - 55	
55 - 60	
60 - 65	
> 65	

Existing Terrain

Figure 2

Riverbend Precinct 1
(NL230370)

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3 Proposed Development

The proposed Precinct 1 of the Riverbend development consists of a range of residential densities. The development involves the residential subdivision works and associated transport and servicing infrastructure.

The development is proposed to be an urban residential centre with access to recreational areas and education facilities. The proposed Concept Block Layout outlining the general layout of the development prepared by Place Design Group Pty Ltd is shown below in **Figure 3**.

Yield Summary Precinct 1 Summary	Typical Dimensions	Typical Area	Precinct 1		
			No. of Lots	%	Area (ha)
Lot Type					
30m Deep Attached (Terrace) Allotment (30 dw/ha)					
7.5m Front-Loaded Terrace Allotment	7.5m x 30.0m	225m²	23	2.64%	0.57
9.0m Front-Loaded Terrace Allotment	9.0m x 30.0m	270m²	22	2.53%	0.75
7.5m Rear-Loaded Terrace Allotment	7.5m x 30.0m	225m²	144	16.53%	3.60
9.0m Rear-Loaded Terrace Allotment	9.0m x 30.0m	270m²	78	8.96%	2.66
Sub Total			**267**	**30.65%**	**7.58**
30m Deep Detached Allotment (18 dw/ha)					
10.0m Villa Allotment	10.0m x 30.0m	300m²	231	26.52%	7.38
12.5m Premium Villa Allotment	12.5m x 30.0m	375m²	163	18.71%	6.56
14.0m Courtyard Allotment	14.0m x 30.0m	420m²	160	18.37%	7.17
16.0m Premium Courtyard Allotment	16.0m x 30.0m	480m²	34	3.90%	1.91
Sub Total			**588**	**67.51%**	**23.02**
Sub Total Residential Allotment Yield			**855**	**98.16%**	**30.60**
Additional Allotment Type					
Medium Density Site	-	-	3	0.34%	2.72
Primary School	-	-	1	0.11%	7.00
Local Linear Park	-	-	3	0.34%	3.76
Local and Neighbourhood Recreation Park	-	-	4	0.46%	1.53
Stormwater Management	-	-	5	0.57%	2.05
Total Additional Allotment Type Yield			**16**	**1.84%**	**17.06**
Total Allotments			**871**	**100.00%**	**47.66**
Maximum Potential Residential Dwellings					
Optional Duplex Allotments	-	-	12	-	-
Medium Density Sites (site density 40 dw/ha)	-	-	107	-	-
Sub Total Maximum Potential Residential Dwellings			**119**	-	-
Total Maximum Potential Residential Dwellings			**974**	-	**33.32**
Maximum Potential Net Residential Density				19.35 dw/ha	

Land Budget Summary Precinct 1 Summary	Summary	
	Area (ha)	%
Land Use Type		
Residential		
Low Density Residential	23.02	31.35%
Low-Medium Density Residential	7.58	10.32%
Medium Density Site	2.72	3.70%
Sub Total	**33.32**	**45.38%**
Open Space		
Local Linear Parks	4.66	6.35%
Local and Neighbourhood Recreation Parks	1.43	1.95%
Linear Pockets and Stormwater Management (incl. Earth Mounds and Pedestrian Links)	4.34	5.91%
Sub Total	**10.43**	**14.20%**
Education		
Primary School	7.00	9.53%
Sub Total	**7.00**	**9.53%**
Services and Street Network		
Trunk and Neighbourhood Connectors	9.21	12.54%
Local Street Network	13.47	18.34%
Sub Total	**22.68**	**30.89%**
Proposed Total	**73.43**	**100.00%**
Existing road reserve	*-2.80*	-
Proposed total area less existing road reserve	*70.63*	-

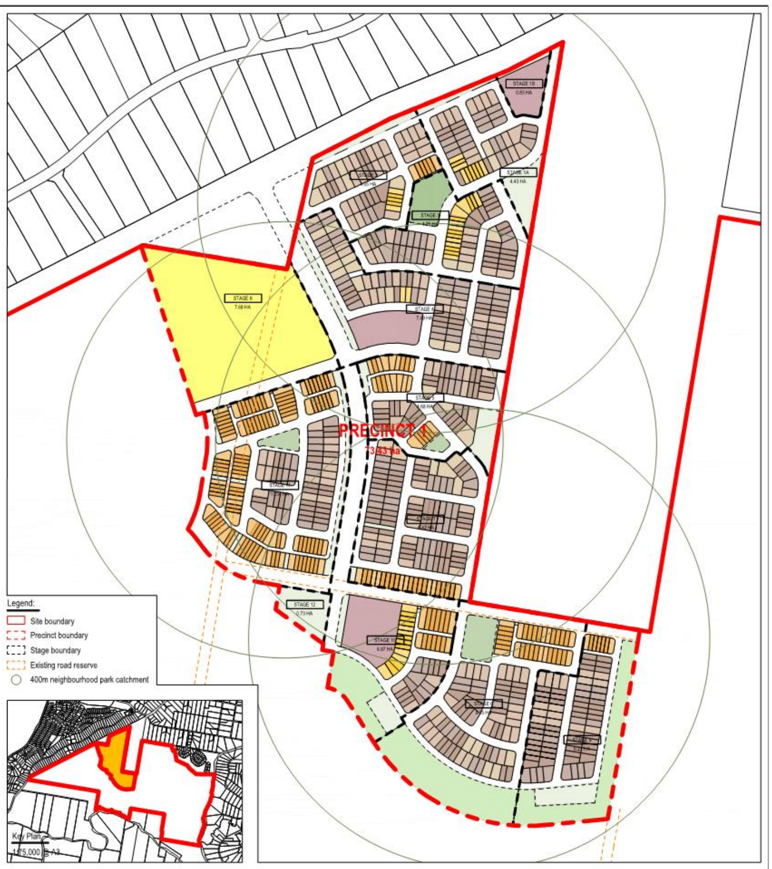


Figure 3 - Proposed Precinct 1 Development (Place Design Group)

Please refer to the Precinct 1 Reconfiguration of Lot Layout prepared by Place Design Group (dated 24th of September 2025) and the Riverbend Precinct 1 Proposed development Application prepared by Colliers (dated 6th March 2026) for further information.

3.1. Proposed Stormwater Management Strategy

The proposed Stormwater Management Strategy presented herein is generally consistent with the strategy adopted as part of the SBSMP (Northrop, 2025).

3.1.1. PROPOSED STORMWATER CONVEYANCE

The development will include a stormwater pit and pipe network which will follow the road alignment. Pit spacing will adhere to Council maximum spacing and pipe size and grades to Council minimum requirements. The stormwater pit and pipe network will be designed with capacity to appropriately manage minor storm events, with adherence to Council requirements including freeboard and flow widths in the minor events.

In major storm events, detailed design will ensure any overland flow of stormwater is safe and controlled within the road reserve. Easements for drainage of stormwater will be applied where required for appropriate management of stormwater.

Maximum velocity x depth (vd) and flow depths will comply to ensure safe conveyance in the street and lots not inundated with stormwater. Confirmation will be provided during future detailed design phases.

3.1.2. WATER QUALITY STRATEGY

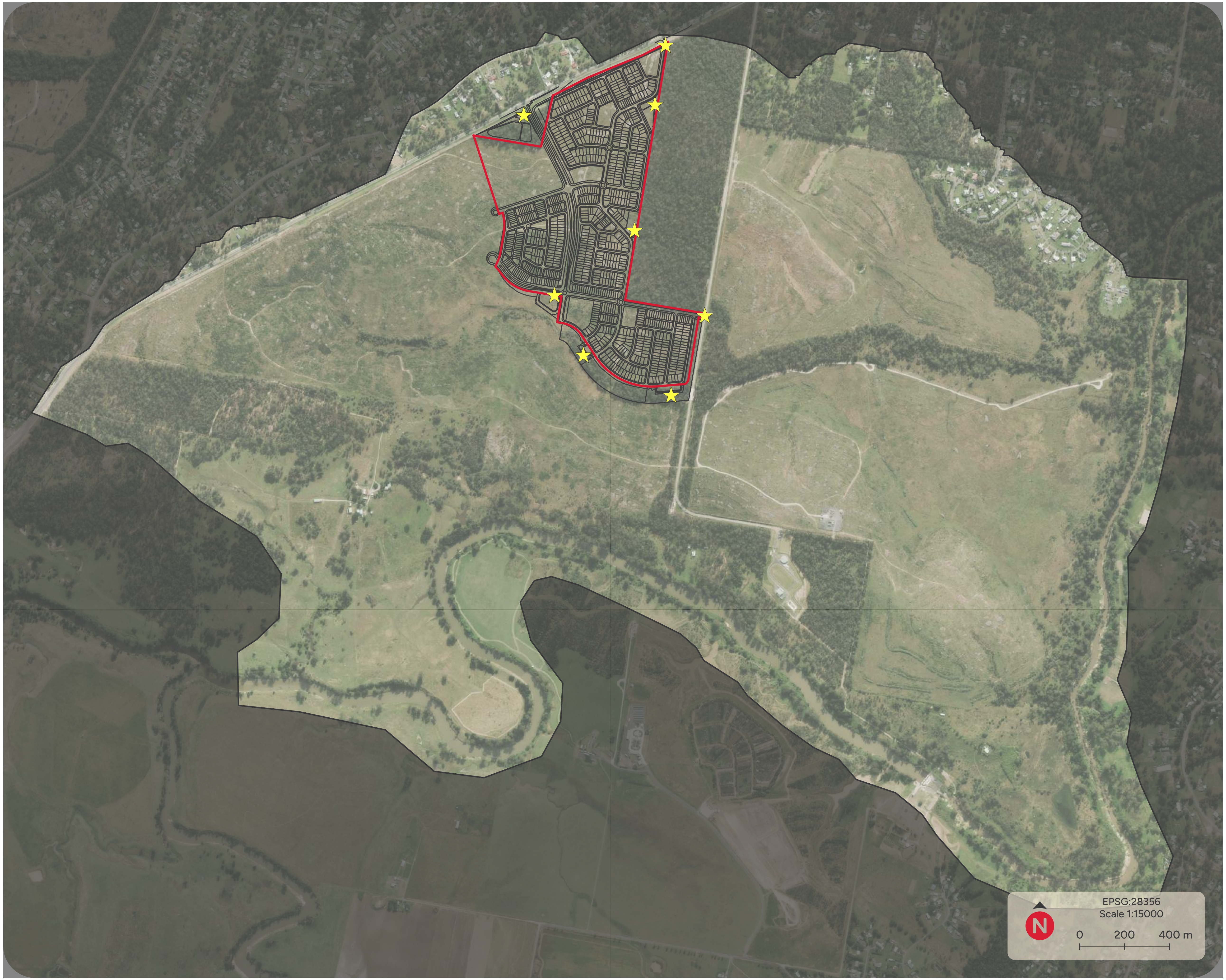
Stormwater will be designed to be safely and effectively conveyed from the upper extent of each catchment to bioretention and downstream prior to site discharge. The bioretention basins have been designed to treat stormwater to meet the water quality targets outlined in **Section 4**.

3.1.3. WATER QUANTITY (TRUNK) STRATEGY

The trunk stormwater network for Precinct 1 primarily includes the proposed detention basins and overland flow paths. These items have been modelled herein and are outlined in greater detail in **Section 5** of this report. The Strategy excludes stormwater detention for discharge points to the existing watercourse south of the site, which connects to Logan River downstream. This is generally consistent with the strategy outlined by the SBSMP (Northrop, 2025).

3.1.4. LAWFUL POINT OF DISCHARGE

The development proposes to retain the existing site discharge points as the lawful points of discharge. Proposed site grading will generally work with the natural land formation, such that existing discharge points are utilised. Stormwater management at the downstream point of each catchment prior to site discharge, as described in this report, will minimise adverse impacts downstream of the discharge point. The points of discharge are presented overleaf in **Figure 4**.



Legend

- Development Layout
- Discharge Points
- Precinct 1 Stage Boundary
- Tuflow Extent

Discharge Locations

Figure 4

Riverbend Precinct 1
(NL230370)

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4 Stormwater Management Objectives

4.1. Development Control Plan Objectives

Stormwater management for the proposed development has been designed in accordance with the following documents:

- Logan City Council Planning Scheme
- State Planning Policy (SPP), 2017
- Environmental Protection (Water) Policy, 2009
- Queensland Urban Drainage Manual (QUDM) Fourth Edition, 2016
- Water By Design MUSIC Modelling Guidelines, Version 3.0, 2018
- Water by Design - Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands V1.1, 2010
- Australian Rainfall and Runoff Guideline (ARR)

The stormwater management objectives for the development are summarised below:

Stormwater quality to achieve the minimum design requirements of the State Planning Policy (2017) and achieve water quality objectives in accordance with Environmental Protection (Water) Policy (2009), as follows in **Table 2** below.

Table 2 - Water Quality Objectives

POLLUTANT	PERCENT REDUCTION
Gross Pollutants (>5mm), GP	90%
Total Suspended Solids, TSS	80%
Total Phosphorous, TP	60%
Total Nitrogen, TN	45%

5 Flood Impact Assessment

5.1. Regional Flood Impact Assessment

The modelling prepared for the purposes of the original SBSMP (Northrop, 2025) was updated using the revised topography, basin and culvert arrangement for Precinct 1. Modelling included the use of XP-RAFTS for hydrology and detention basin design, while TUFLOW was used to analyse the overland flow behaviour.

The model setup is discussed below, with the results presented in **Appendix A**.

5.2. Local Study Catchment and Proposed Development

The local study catchment predominantly falls to the east and south into an approximately six kilometres long section of the Logan River.

A major ephemeral watercourse traverses the catchment, flowing from the west to the east and a series of minor watercourses and gullies discharges to the south. There are also two minor drainage paths discharging to the north. The study catchment is presented in **Figure 5** overleaf.

Table 3 - Study Catchment Characteristics

CHARACTERISTICS	VALUE
Total Area (ha)	834.5
Average Elevation (m AHD)	25
Highest Elevation (m AHD)	74
Lowest Elevation (m AHD)	11
Average Slope (%)	7

5.3. Model Parameters

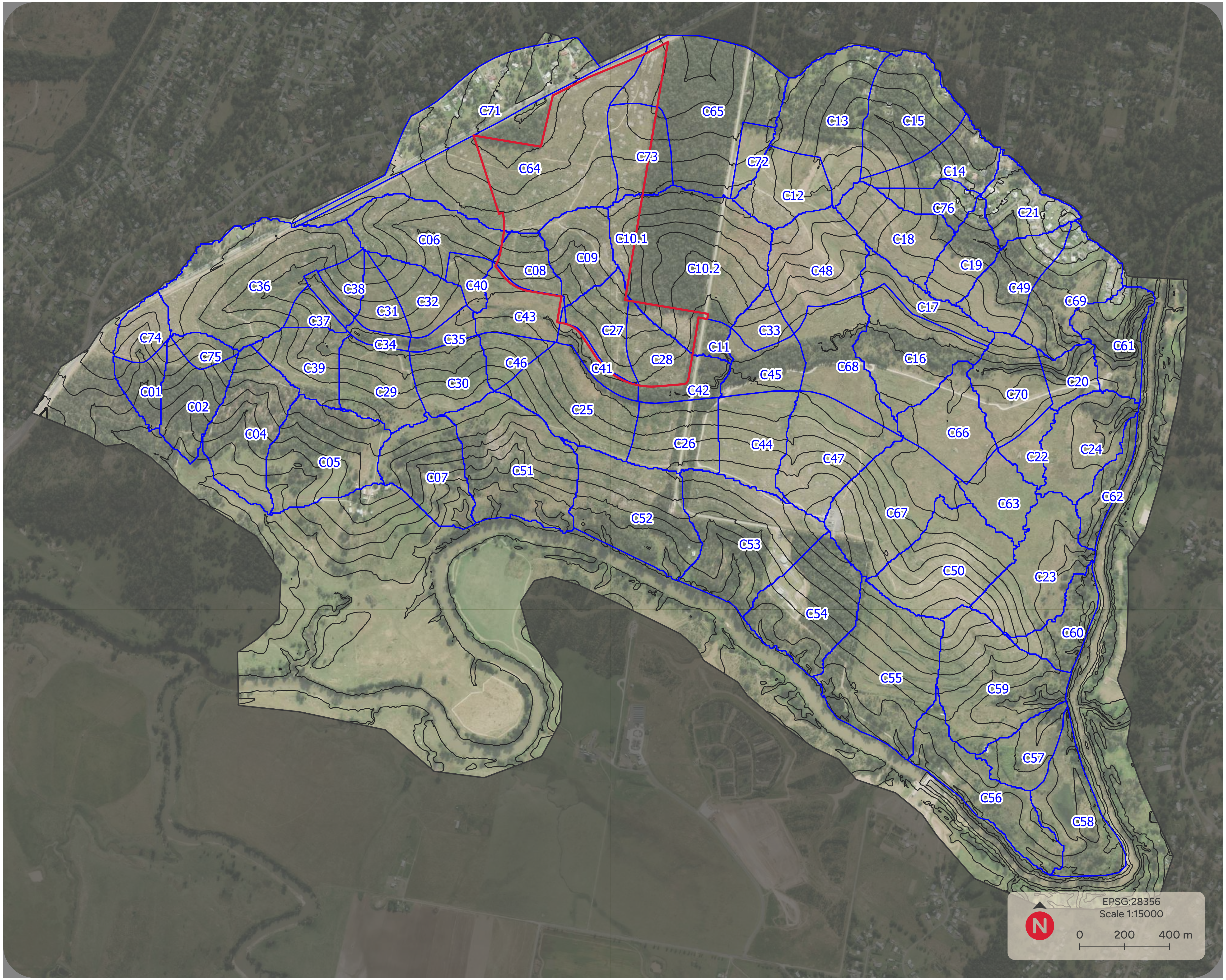
Detailed two-dimensional hydraulic modelling was undertaken using the two-dimensional TUFLOW hydrodynamic modelling software. XP-RAFTS hydrological modelling software has been used to generate inflows for the TUFLOW model. The hydrological and hydraulic model parameters are presented below. The flood modelling prepared herein has been based on the original modelling prepared as part of the SBSMP (Northrop, 2025).

5.3.1. HYDROLOGICAL MODEL

The hydrological model used for the analysis was the XP-RAFTS software with Laurenson hydrology. As recommended by the latest Australian Rainfall and Runoff (ARR) 2019 guidelines, the Initial and Continuing Loss (ILCL) model, coupled with median pre-burst rainfall has been adopted in this study. The input data for the XP-RAFTS model used in this study includes sub-catchment data, design rainfall, temporal patterns, pre-burst rainfall and the Initial and Continuing Losses. These are summarised below.

Sub-Catchment Properties

Sub-catchments have been delineated using a combination of LiDAR, aerial imagery, cadastral boundaries, detailed survey and the design surface. The following **Table 4** presents the existing sub-catchment properties while, the catchment extents are presented in **Figure 5** overleaf. Sub-catchments over the extent of the proposed development have been further refined to capture proposed modifications to the terrain and land use introduced as part of the development. A typical 80% impervious fraction has been adopted over the extent of the proposed development. A summary of the developed catchments is presented in **Table 5** and are presented in **Figure 6** overleaf.



Legend

- Contours (5M)
- Precinct 1 Stage Boundary
- Rafts Existing Catchments
- Tuflow Extent

Hydrological Model
Existing Case
Catchment extents

Figure 5

Riverbend Precinct 1
(NL230370)

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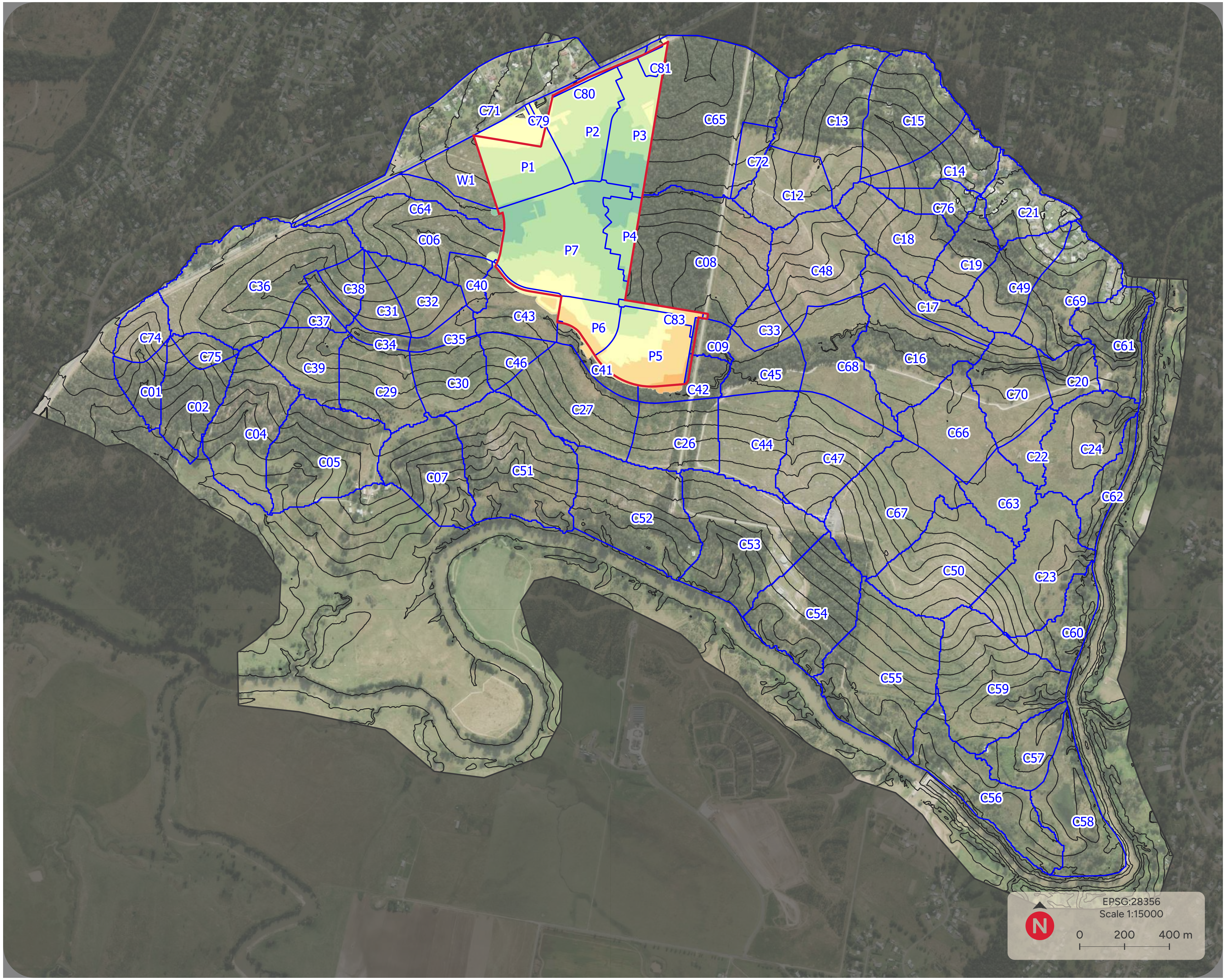

Legend

- Contours (5M)
- Precinct 1 Stage Boundary
- Rafts Developed Catchments
- Tuflow Extent

Civil Design Surface (m AHD)

- <= 20
- 20 - 25
- 25 - 30
- 30 - 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- > 65

Hydrological Model
Developed Case
Catchment extents

Figure 6

Riverbend Precinct 1
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Table 4 – Existing Sub-catchments

CATCHMENT REFERENCE	AREA (HA)	EFFECTIVE IMPERVIOUS (%)	VECTORED SLOPE (%)	CATCHMENT REFERENCE	AREA (HA)	EFFECTIVE IMPERVIOUS (%)	VECTORED SLOPE (%)
C01	4.5	0	8.9	**C39**	8.31	0	7.1
C02	9.21	0	8.4	**C40**	2.97	0	5.7
C03	1.59	0	7.5	**C41**	3.25	0	4.5
C04	15.3	0	7.8	**C42**	4.08	0	2.3
C05	17.21	0	7.8	**C43**	7.48	0	5.4
C06	13.55	0	6.8	**C44**	11.02	0	5.9
C07	12.53	0	10.2	**C45**	6.77	0	2.5
C08	4.86	0	7.9	**C46**	4.21	0	7.7
C09	8.77	0	6.4	**C47**	15.6	0	7.2
C10.1	3.29	0	7.4	**C48**	14.64	0	7.9
C10.2	29	0	5.3	**C49**	10.03	2	6.9
C11	2.17	0	2.4	**C50**	17.48	0	7.5
C12	8.97	0	4.7	**C51**	21.48	0	9
C13	17.46	0	5.4	**C52**	19.09	0	7.3
C14	8.36	10	6.8	**C53**	21.9	0	8.5
C15	15.12	0	6.7	**C54**	16.71	0	8
C16	15.36	0	4.9	**C55**	23.49	0	7.2
C17	6.09	0	8.1	**C56**	14.41	0	7.5
C18	10.77	0	5.3	**C57**	7.23	0	5.6
C19	7.1	2	6	**C58**	12.94	0	8.4
C20	4.56	0	10.5	**C59**	21.15	0	8.7
C21	8.2	15	6.8	**C60**	6.82	0	8.4
C22	3.54	0	1.2	**C61**	9.86	0	11.4
C23	16.04	0	7	**C62**	4.96	0	13.2
C24	12.14	0	5	**C63**	7.01	0	1.3

CATCHMENT REFERENCE	AREA (HA)	EFFECTIVE IMPERVIOUS (%)	VECTORED SLOPE (%)
C25	14.95	0	6.8
C26	10.2	0	6.3
C27	7.21	0	6.7
C28	6.26	0	5.5
C29	10.28	0	7.2
C30	8.14	0	7.2
C31	4.24	0	7.1
C32	7	0	6.5
C33	3.79	0	5.8
C34	1.59	0	4.7
C35	2.5	0	4.2
C36	26.93	0	6.1
C37	2.53	0	7.9
C38	2.99	0	8.9

CATCHMENT REFERENCE	AREA (HA)	EFFECTIVE IMPERVIOUS (%)	VECTORED SLOPE (%)
C64	39.96	0	4.2
C65	27.91	0	4
C66	11.22	0	2.7
C67	18.96	0	6.8
C68	12.14	0	2.2
C69	12.79	3	7.8
C70	10.68	0	6.6
C71	19.86	25	3
C72	3.07	0	4.5
C73	8.94	0	4.5
C74	4.71	0	8.9
C75	2.56	0	8.4
C76	4.54	10	6.8

Table 5 – Developed Sub-catchments

CATCHMENT REFERENCE	AREA (HA)	EFFECTIVE IMPERVIOUS (%)	VECTORED SLOPE (%)	CATCHMENT REFERENCE	AREA (HA)	EFFECTIVE IMPERVIOUS (%)	VECTORED SLOPE (%)
C01	4.5	0	8.9	**C47**	15.6	0	7.2
C02	9.21	0	8.4	**C48**	14.64	0	7.9
C03	1.59	0	7.5	**C49**	10.03	2	6.9
C04	15.3	0	7.8	**C50**	17.49	0	7.5
C05	17.21	0	7.8	**C51**	21.48	0	9
C06	13.55	0	6	**C52**	19.09	0	7.3
C07	12.53	0	10.2	**C53**	21.9	0	8.5
C08	26.33	0	8	**C54**	16.71	0	8
C09	2.37	0	1.4	**C55**	23.49	0	7.2
C12	8.97	0	4.7	**C56**	14.41	0	7.5
C13	17.46	0	5.4	**C57**	7.23	0	5.6
C14	8.36	10	6.8	**C58**	12.94	0	8.4
C15	15.12	0	6.7	**C59**	21.15	0	8.7
C16	15.36	0	4.9	**C60**	6.82	0	8.4
C17	6.09	0	8.1	**C61**	9.86	0	11.4
C18	10.77	0	5.3	**C62**	4.96	0	13.2
C19	7.1	2	6	**C63**	7.01	0	1.3
C20	4.56	0	10.5	**C64**	5.8	0	1.5
C21	8.2	15	6.8	**C65**	28.46	0	4
C22	3.54	0	1.2	**C66**	11.22	0	2.7
C23	16.04	0	7	**C67**	18.96	0	6.8
C24	12.14	0	5	**C68**	12.14	0	2.2
C26	10.2	0	6.3	**C69**	12.79	3	7.8
C27	14.95	0	10	**C70**	10.68	0	6.6
C29	10.28	0	7.2	**C71**	19.73	0	3.67

CATCHMENT REFERENCE	AREA (HA)	EFFECTIVE IMPERVIOUS (%)	VECTORED SLOPE (%)	CATCHMENT REFERENCE	AREA (HA)	EFFECTIVE IMPERVIOUS (%)	VECTORED SLOPE (%)
C30	8.14	0	7.2	**C72**	3.07	0	4.5
C31	4.24	0	7.1	**C74**	4.71	0	8.9
C32	7	0	6.5	**C75**	2.56	0	8.4
C33	3.79	0	5.8	**C76**	4.54	10	6.8
C34	1.59	0	4.7	**C79**	0.18	90	2.3
C35	2.5	0	4.2	**C80**	1.84	80	1.6
C36	26.93	0	6.1	**C81**	0.97	80	1.75
C37	2.53	0	7.9	**C83**	1.21	80	6.25
C38	2.99	0	8.9	**C87**	0.68	0	5.3
C39	8.31	0	7.1	**P1**	10.63	80	4.4
C40	2.97	0	5.7	**P2**	9.64	80	4.28
C41	2.86	0	4.4	**P3**	8.14	80	4
C42	4.28	0	2.3	**P4**	3.47	80	6.6
C43	7.45	0	7.5	**P5**	9.75	80	3
C44	11.02	0	5.9	**P6**	4	0	8.1
C45	6.77	0	2.5	**P7**	20.61	80	3
C46	4.21	0	7.7	**W1**	5.38	80	5.6

Burst Rainfall

The latest ARR 2019 rainfall has been obtained from the Bureau of Meteorology (BoM) while the accompanying rainfall temporal patterns have been obtained by the ARR Data Hub for a location over the study catchment. ARR 2019 recommends the use of the storm ensemble method using 10 temporal patterns for each storm duration. For this investigation, storm durations ranging from the 15, 20, 25, 30, 45-minute, 1, 1.5, 2, 3, 4.5, 6-hour events were assessed in the hydrological model. The following **Table 6** presents the rainfall depths used for the investigation.

Table 6 - IFD Rainfall Depths

DURATION	20% AEP (MM)	10% AEP (MM)	5% AEP (MM)	1% AEP (MM)
15 min	27.1	32.1	37	47.9
20 min	31.4	37.2	42.8	55.6
25 min	34.6	41.1	47.4	61.8
30 min	37.3	44.3	51.1	66.9
45 min	42.9	51.1	59.1	78.3
1 hour	46.7	55.8	64.8	86.5
1.5 hour	52.2	62.5	72.8	98.4
2 hour	56.2	67.5	78.9	107
3 hour	62.7	75.5	88.6	122
4.5 hour	70.7	85.3	100	139
6 hour	77.7	93.8	111	153

Pre-Burst Rainfall

The median (50%-percentile) pre-burst rainfall depths have been adopted for the purposes of the investigation. These were obtained from the ARR Data Hub for a location over the study catchment. Pre-burst rainfall depths were distributed across six timesteps prior to the storm burst. **Table 7** presents the median pre-burst rainfall depths used for the assessment.

Table 7 - Median Pre-Burst Rainfall Depths

DURATION	20% AEP (MM)	10% AEP (MM)	5% AEP (MM)	1% AEP (MM)
15 min	1.7	2.7	3.6	4.3
20 min	1.9	3.1	4.1	5.0
25 min	2.1	3.4	4.6	5.6
30 min	2.3	3.7	4.9	6.0
45 min	2.7	4.2	5.7	7.0
1 hour	2.9	4.6	6.2	7.8
1.5 hour	2.0	3.2	4.5	17.4
2 hour	3.6	6.1	8.4	20.8
3 hour	5.1	8.2	11.2	31.4

DURATION	20% AEP (MM)	10% AEP (MM)	5% AEP (MM)	1% AEP (MM)
4.5 hour	6.4	10.5	14.4	36.2
6 hour	7.8	12.8	17.7	40.3

Infiltration Losses and Catchment Roughness

As mentioned above, the Initial and Continuing Loss (ILCL) model has been used for this study with the latest ARR 2019 storm losses obtained from the ARR Data Hub for a location over the study area. The ILCL method simulates catchment storage as an initial loss in rainfall followed by a constant loss rate (continuing loss). The following **Table 8** presents the Initial and Continuing losses used for the analysis.

Table 8 - Loss Parameters

LAND USE	INITIAL LOSS (MM)	CONTINUING LOSS (MM/HR)
Modelled (ARR data hub) Pervious	24.0	1.6
Modelled Effective Impervious	1.5	0.0

A hydrological roughness of 0.015 has been used for impervious areas which is consistent with concrete surfaces and sealed roads. Roughness values of 0.060 and 0.040 have been adopted for pervious areas in the existing and developed cases respectively, consistent with predominantly grassed areas expected over rural and urban catchments respectively.

5.3.2. HYDRAULIC MODEL

The hydraulic model used for this study is the combined one-dimensional/ two-dimensional (1D/2D) TUFLOW hydrodynamic engine. For this study, TUFLOW version 2023-03-AC with HPC GPU solver has been used.

Model Domain

The TUFLOW model extent is presented in **Figure 7** and **Figure 8** overleaf for both existing and developed conditions. The TUFLOW model terrain was developed using a combination of the latest LiDAR and topographical surveys. A four-meter grid size was adopted in this flood assessment as it was determined to provide a reasonable balance between model run time and the representation of catchment overland flow and flood behaviour through watercourses.

Boundary Conditions

Sub-catchment flows derived by the XP-RAFTS model were applied directly to the two-dimensional grid via a series of inflow polygons. Inflow and outflow boundaries for Logan River and outlet boundaries for the northern sub-catchments of the model are shown in **Figure 7** and **Figure 8.** The 5% AEP flood levels for Logan River were adopted in this assessment and sourced from the latest Logan River Flood Study. A “HQ” boundary was used for each northern outlets with a “free outflow” tailwater condition and slopes generally consistent with the observed existing terrain grades at the location of the outlet boundaries.

Hydraulic Structures

An overview of proposed detention basin configurations for the site is outlined in the following **Table 9.**

Table 9 - Proposed Detention Basins

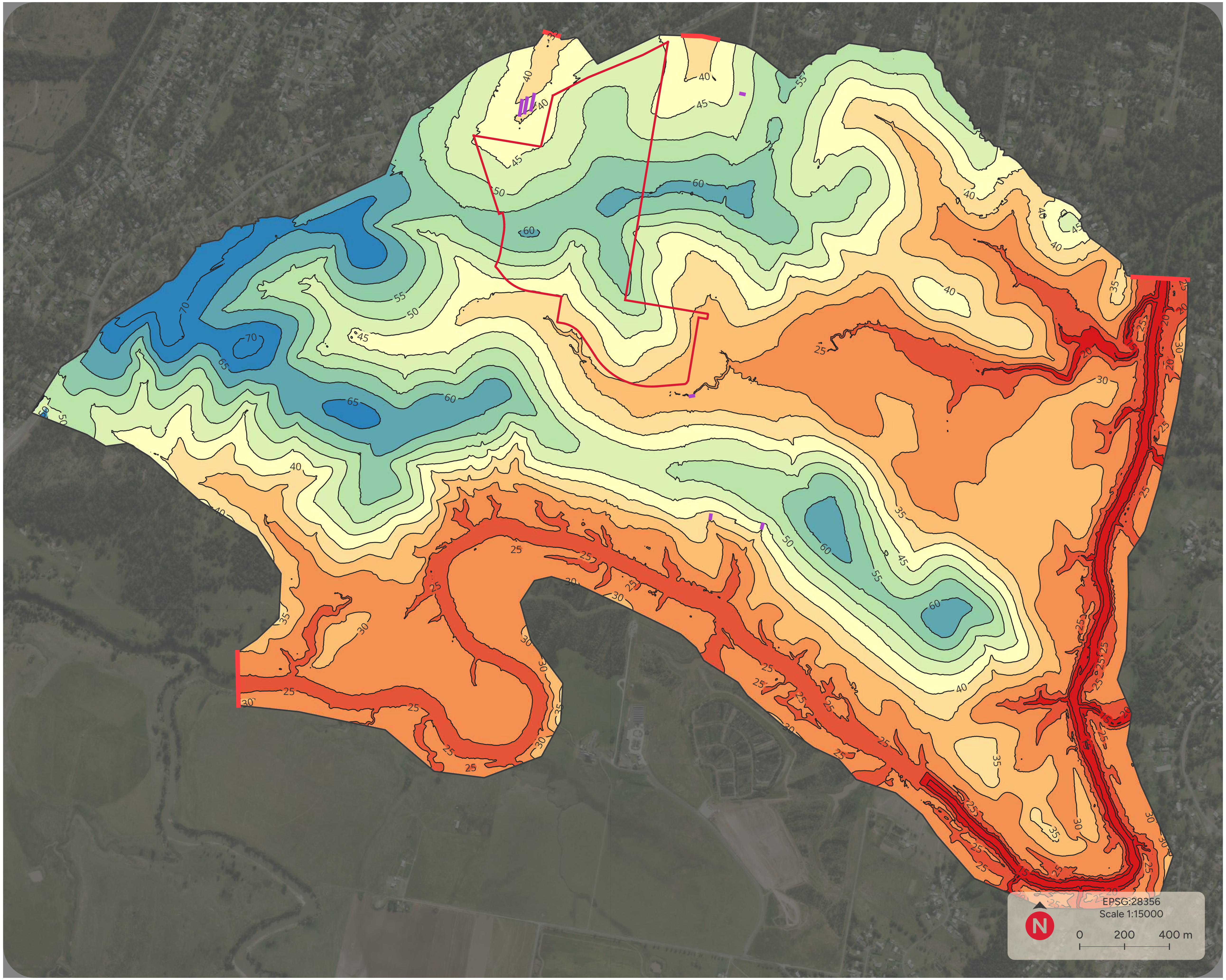
BASIN REF	EMBANKMENT	CATCHMENT (HA)	TOW OR ROAD SHOULDER ELEVATION (M AHD)	OUTLET	WEIR	1% AEP STORAGE (M3)
1	Wall / Bund	31.29	43.67	RCBC 2 x 0.6m x 0.9m Slope 1.2%	Width 20m IL 42.87mAHD	11,600
4	Wall / Bund	8.715	45.45	RCP 1 x 0.525m Slope 1.05%	Width 3m IL 44.65mAHD	4,900
7	Wall / Bund	3.32	52.8	RCP 1 x 0.45m Slope 1.02%	N/A	2,300

Hydraulic Roughness

The following **Table 10** below present the modelled land use and the adopted surface roughness values. The adopted surface roughness values are consistent with the latest flood study for Logan River.

Table 10 - Land Use Roughness (Manning's value)

LAND USE	ROUGHNESS (MANNING'S)
Dense Vegetation	0.100
Medium Dense Vegetation	0.070
Open Water	0.020
Grassland	0.055
Creeks	0.035
Roads Sealed, Concrete Surfaces	0.018
Unsealed Roads	0.025
Rural Residential	0.065
Logan River Channel	0.035
Old Logging	0.050
New Logging	0.045
Development Lots	0.057



Legend

- Contours (5M)
- Precinct 1 Stage Boundary
- Stormwater Pipes
- Tuflow Extent

Topography (m AHD)

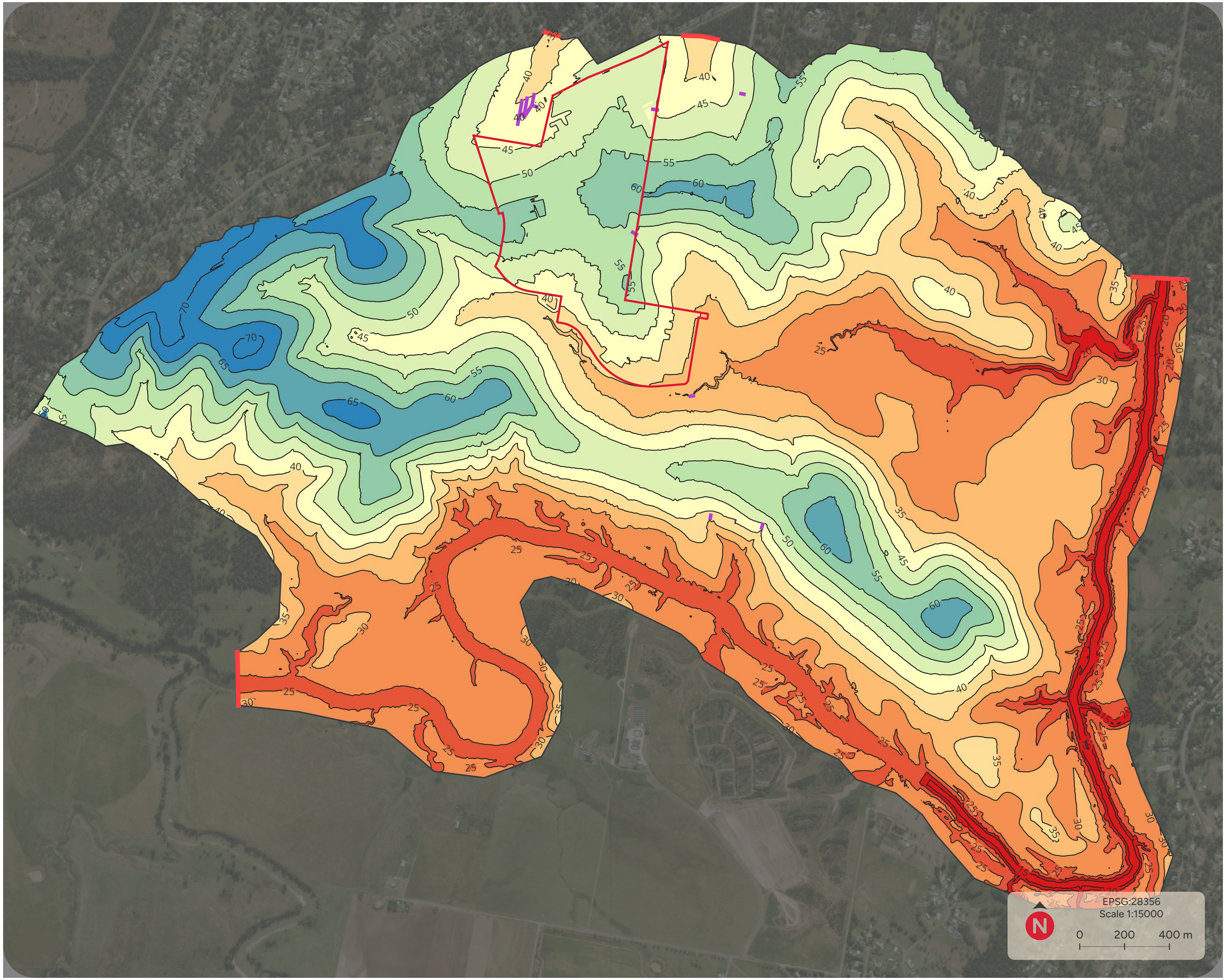
- <= 20
- 20 - 25
- 25 - 30
- 30 - 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- > 65

Hydraulic Model
Existing Case
TUFLOW Setup

Figure 7

Riverbend Precinct 1
(NL230370)

NORTHROP



Hydraulic Model
Developed Case
TUFLOW Setup

Figure 8

Riverbend Precinct 1
(NL230370)

NORTHROP

5.4. Results

5.4.1. CRITICAL DURATION

The results for all ten rainfall patterns for the 15, 20, 25, 30, 45, 60-minute and 1.5, 2, 3, 4.5, and 6-hour durations were enveloped to present the results herein. During the 1% AEP design storm events, the 45-minute duration was generally observed to be critical in detention basins at the primary Precinct 1 outlets. Downstream of the site, in the un named watercourse, the 1.5hr duration was observed to be critical.

5.4.2. FLOOD BEHAVIOUR

Maximum modelled flood depth, elevations, velocities and hazard for the 20%, 10%, 5% and 1% AEP and PMF local catchment flood events during the existing and developed case scenarios are presented in **Figures C1-1** to **C5-3** of **Appendix A**.

5.4.3. FLOOD EFFECTS

Figures C1-1 to **C5-3** of **Appendix A** present the flood impact to flood level for the modelled 20%, 10%, 5% and 1% AEP flood events.

The comparison results presented in **Figures C7-1** to **C7-4** of **Appendix A** suggest that flood levels typically decrease in properties adjacent to the development suggesting the proposed detention basins successfully attenuate peak flows during all modelled flood events.

A localised increase of up to 14mm is observed at the discharge point from Basin 1 during the 20% AEP event. This increase is isolated and does not occur in the vicinity of existing buildings or infrastructure. Modifications of the outlet configuration are proposed in detailed design stage to mitigate this issue.

At the discharge points on the southern side of Precinct 1, localised increases occur directly downstream of the basins. However, these quickly dissipate and eventuate into a decrease downstream of Precinct 1. As such this is not expected to create a significant adverse impact.

5.5. Discussion

5.5.1. LOGAN RIVER MECHANISM

It is noted that the modelling presented herein has a focus on the Local Catchment flooding mechanism outlined by the SBSMP (Northrop, 2025). An addition mechanism is recognised by the SBSMP (Northrop, 2025) with the potential for flood affection from the Regional Logan River Mechanism.

Figure C2 of the SBSMP (Northrop, 2025) notes a maximum flood level of 32.92m AHD derived by the Logan River Mechanism during the 1% AEP RCP 6.5 Climate Change scenario. Minimum lot levels of 33.60m AHD have been adopted for Precinct 1 suggesting the proposed lots are raised above the Local River 1% AEP plus Climate Change plus 500mm.

Similarly, flood impacts on the Logan River Mechanism have been assessed by the SBSMP (Northrop, 2025) which determined no significant adverse flood impacts are expected to occur for the full masterplan. As such, the proposed Precinct 1 works are also not expected to create a significant adverse flood impact during the Logan River Mechanism.

5.5.2. CLIMATE CHANGE CONSIDERATION

The 1 in 500 AEP flood event has been modelled as a proxy for a future Local Catchment 1% AEP scenario whereby increased rainfall due to climate change is considered. The modelled flood depth and elevation is provided in **Figure 9**.

The results suggest that flood elevations have the potential to increase by approximately 50-100mm adjacent to the site when compared to the current day 1% AEP. Similarly, all lots are observed to remain outside of the extent of future flood as shown in **Figure 9**.

5.5.3. LOCAL CATCHMENT FLOOD PLANNING LEVEL

Figure 10 presents the extent of the flood planning level (FPL), which is equivalent to the 1% climate change scenario plus a 500 mm freeboard. This is consistent with the FPL adopted as part of the SBSMP (Northrop, 2025).

All proposed residential lots within Precinct 1 remain outside this extent. As such, the risk to property due to the proposed development is expected to be appropriately managed.

5.5.4. FLOOD EMERGENCY RESPONSE

To minimise risk to life, onsite refuge is recommended for major and extreme flood events as the proposed lots are situated well above the FPL and remain outside the flood extent of the PMF event. It is also recommended that egress from the site not be attempted during a major flood event due to the potential for the external local road network to be compromised.

This is appropriate due to the relatively small urban upstream catchment, the lack of effective warning time to coordinate an evacuation, and short time water takes to peak and recede around rainfall events.

This recommendation is generally in alignment with the flood emergency management measures specified by the Logan Planning Scheme (City of Logan, 2025).

5.5.5. DETENTION

The site detention strategy has been reviewed with the purpose of mitigating flows onto adjoining property. The strategy adopted herein is consistent with the masterplan SBSMP (Northrop, 2025).

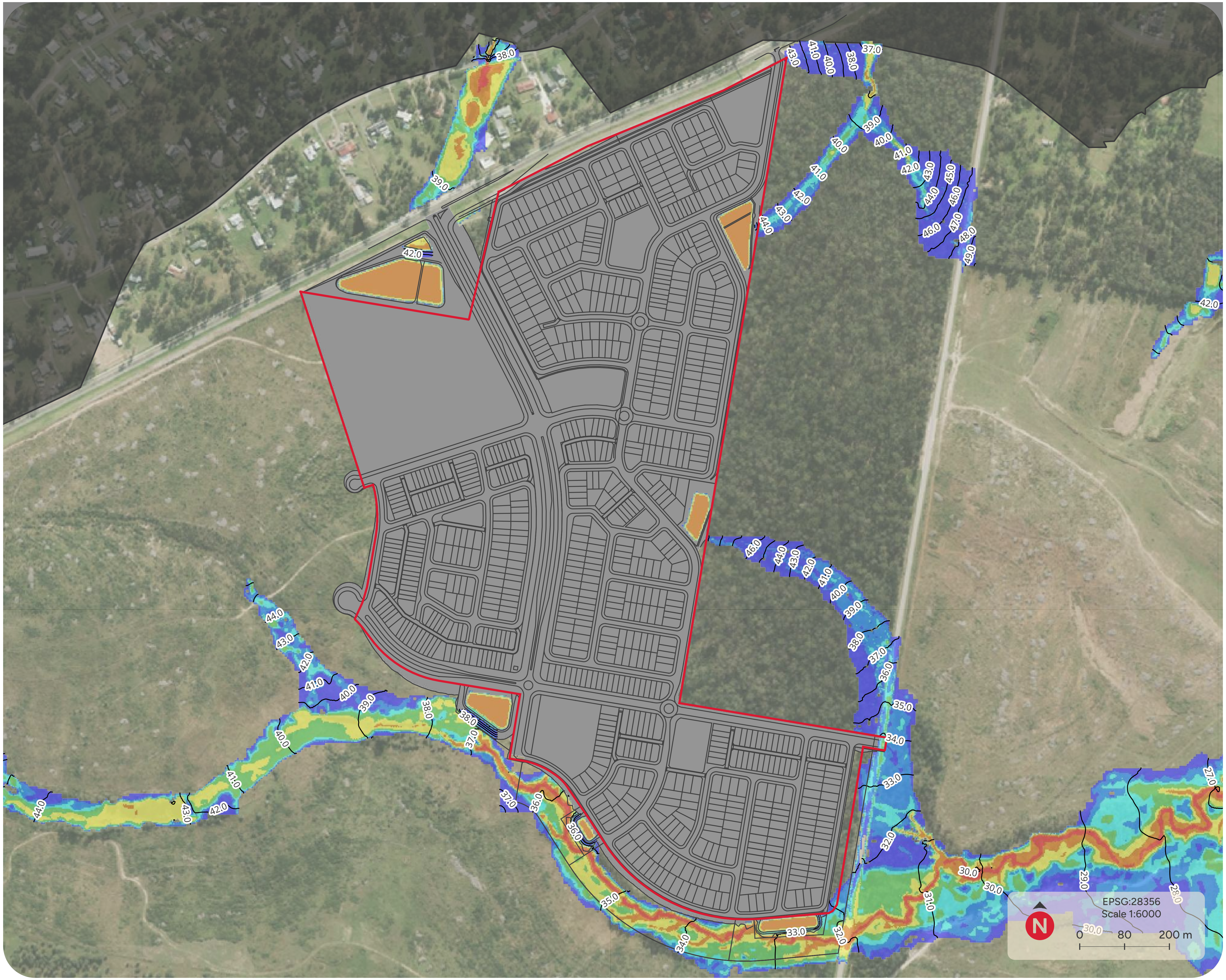
On-site detention is proposed at site discharge points into the eastern lot and towards Teviot Road. Where the site adjoins the local catchment creek to the south of the precinct, discharge has been released un-detained.

The below **Table 11** presents the pre-to-post peak flow comparisons for the 20, 10, 5 and 1% AEP events for Onsite Detention Basins 1, 4 and 7. As in **Figures C7-1** to **C7-4** of **Appendix A**, modelling has determined there is no significant adverse impacts on private property from the development.

Table 11 - Peak Flow Comparison

Basin Ref	20% AEP Peak Flow Rate (m3/s)			10% AEP Peak Flow Rate (m3/s)		
	Pre	Post	Difference	Pre	Post	Difference
1	2.59	2.46	-0.13	3.58	2.86	-0.72
4	0.72	0.46	-0.26	1.02	0.53	-0.49
7	0.38	0.28	-0.10	0.56	0.30	-0.26
	5% AEP Peak Flow Rate (m3/s)			1% AEP Peak Flow Rate (m3/s)		
	Pre	Post	Difference	Pre	Post	Difference
1	4.56	3.19	-1.37	7.37	6.24	-1.13
4	1.36	0.88	-0.48	2.15	1.63	-0.53
7	0.72	0.32	-0.40	1.06	0.36	-0.70

The results presented in **Table 11** above show the proposed detention basins successfully attenuate peak flows from the proposed development back to pre-developed conditions.



Legend

- Contours (1M)
- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Flood Depth (m)

- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- Greater than 2.0

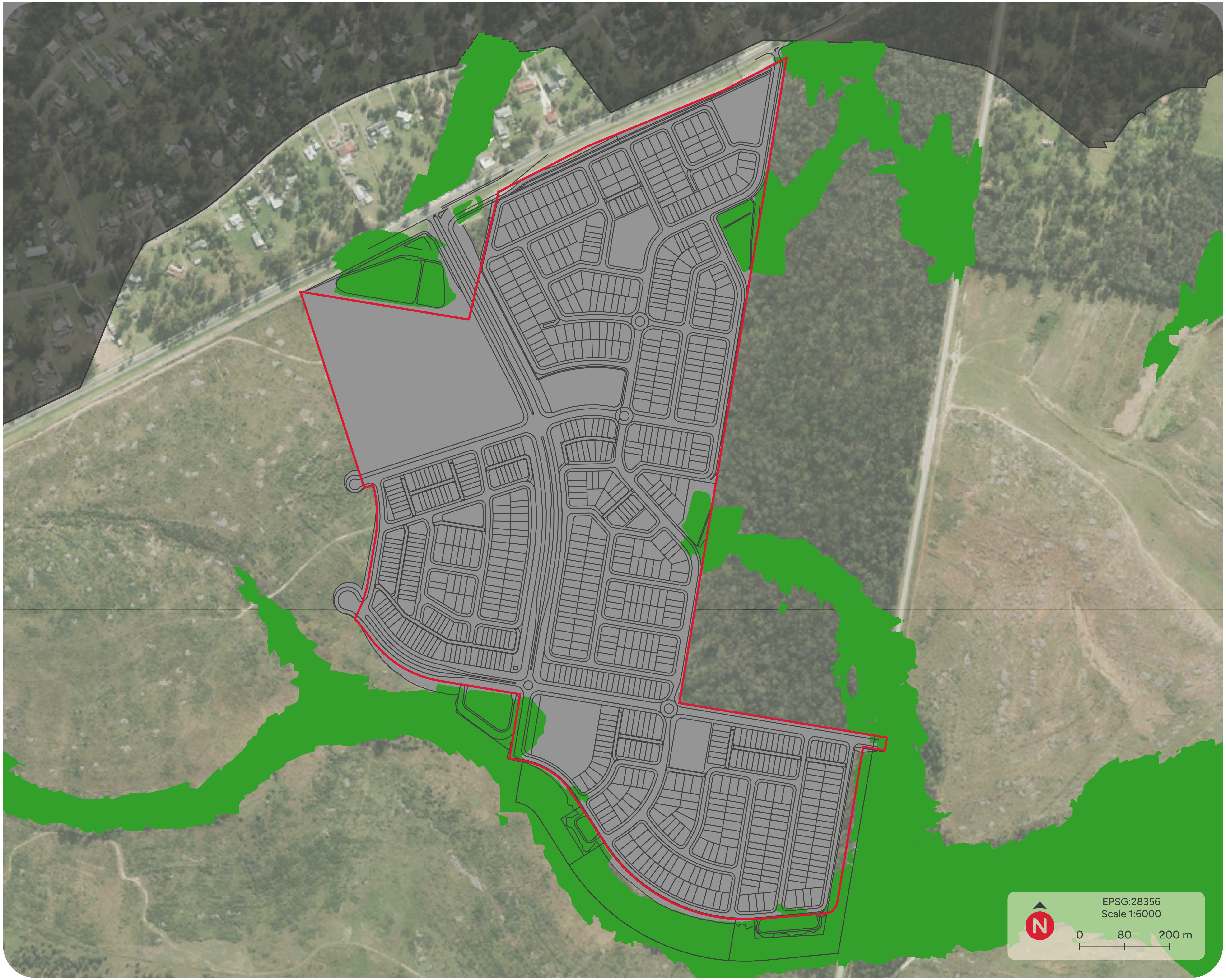
1 in 500 AEP
Future 1% AEP Climate Change Consideration
Flood Depth and Elevation

Figure 9

Riverbend Precinct 1
(NL230370)

NORTHROP

1/4/2026 \\192.168.5.11\ncl-nas5\FLOODING\PROJECTS\NEWCASTLE\YEAR 2023 Jobs\NL230370 - Riverbend - Logan River\PRECINCT 1\QGIS\260225 Updated Layout\Precinct1_DEV07_Figures.qgz



Legend

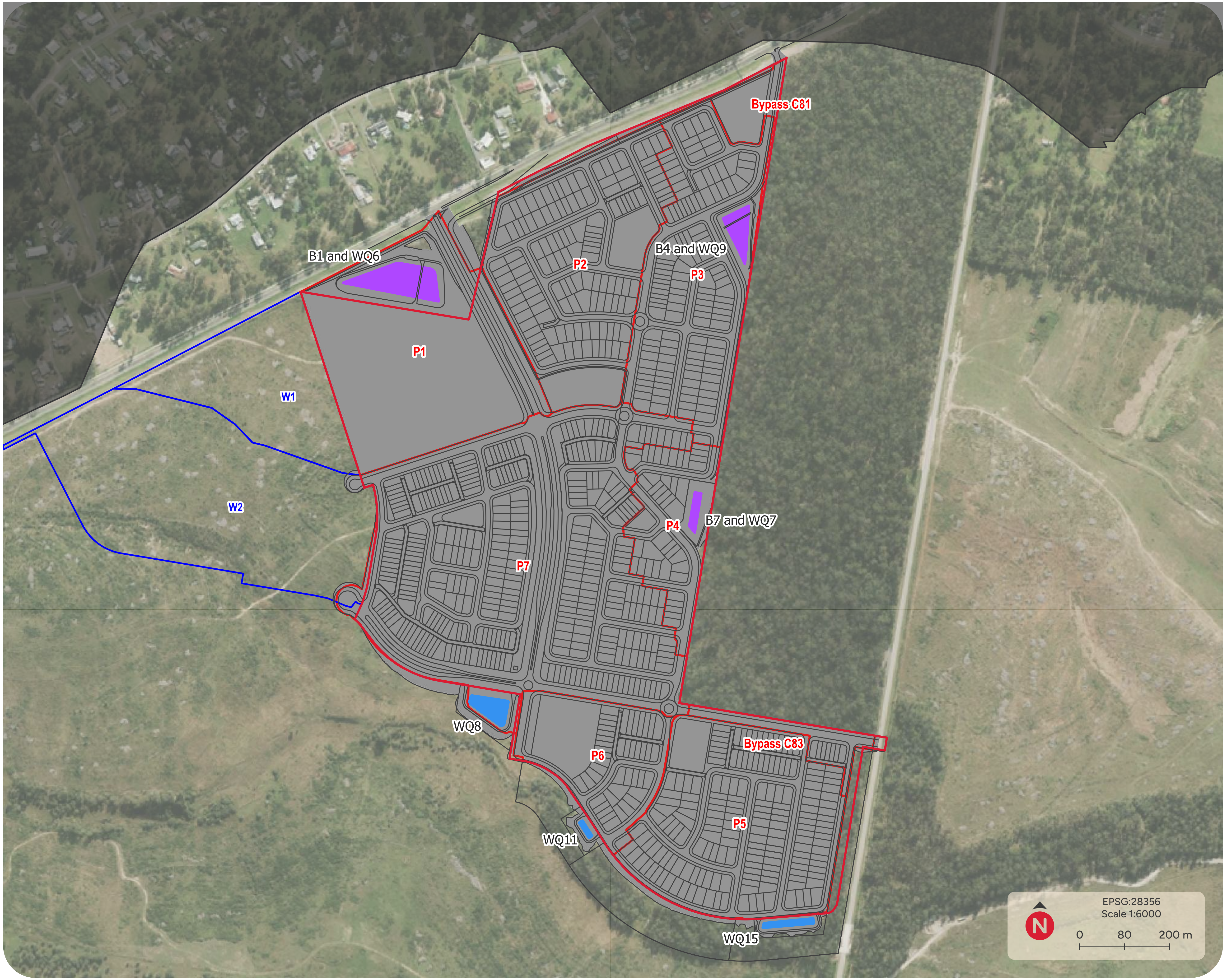
- Development Layout
- Flood Planning Level
- Precinct 1 Stage Boundary
- Tuflow Extent

Flood Planning Level
1% + CC + 500mm

Figure 10

Riverbend Precinct 1
(NL230370)

NORTHROP



Legend

- Site Catchments
- Development Layout

Indicative Basins

- Bioretention Basin
- Combined Bioretention and Onsite Detention Basin
- Precinct 1 Stage Boundary
- Tuflow Extent
- Western Catchments

Stormwater Management Strategy

Figure 11

Riverbend Precinct 1 (NL230370)

NORTHROP

6 Stormwater Quality Management – Construction Phase

6.1. Erosion and Sediment Control

Prior to construction commencing, it is the contractor's responsibility to ensure adequate erosion and sediment control measures are installed around the subject site to minimise disturbance and ensure the quality of runoff discharging from the site is of an acceptable standard.

A detailed Erosion and Sediment Control Plan (ESCP) will be prepared and submitted to Council prior to commencement of works. It is expected that the ESCP will be prepared in accordance with the Best Practice Erosion and Sediment Control Manual prepared by International Erosion Control Association (IECA 2009) based on Type 1 techniques. Erosion and sediment control techniques used for the site will generally include:

- Sediment barriers to be installed on all entrances to stormwater inlet pits.
- Construction of entry and exit shakedown areas.
- Sediment fences are to be installed on the downstream boundaries of the subject site.
- Sediment fences to be installed on the downstream side of any stockpiles.
- Construction of temporary bunds at the top of all earthworks batters to ensure runoff is directed away from exposed batters.
- Construction of temporary diversion drains to divert water to sediment basins and around any stockpiles.
- Construction of temporary diversion drains to divert upstream clean water around disturbed areas.
- Stabilisation of all batters upon reaching the finished earthworks levels.
- Dust control measures which include covering stockpiles, maintain site fences and watering exposed areas.
- Sediment basin in accordance with IECA Best Practice Erosion and Sediment Control

With implementation of erosion and sediment control management in accordance with the IECA, it is expected the site can appropriately manage water quality during the construction phase to have no adverse effect on downstream watercourses.

During construction, maintenance of the control measures will be necessary to ensure they continue to function. A monitoring schedule shall be followed, with repairs or additional controls are to be carried out as identified during monitoring.

7 Stormwater Quality Management – Operational Phase

7.1. Proposed Stormwater Quality Improvement Devices (SQID's)

7.1.1. RAINWATER TANKS

It is noted that rainwater tanks were considered in the masterplan, however they have not been included in the MUSIC modelling or in the proposed treatment train for Precinct 1. Modelling prepared herein sized the bioretention basins so that pollutant reduction targets are achieved without rainwater tanks.

7.1.2. GPT

Gross pollutant traps (GPTs) have not been included in the MUSIC modelling or in the proposed treatment train to remain consistent with the strategy presented in the original SBSMP (Northrop, 2025).

7.1.3. BIORETENTION BASIN

Bioretention systems are effective at removing suspended pollutants from stormwater. Stormwater ponds on the surface of the bioretention system and slowly filters through the soil media. This filter media retains the pollutants through fine filtration, absorption, and some biological uptake from plant roots. The filter media also allows for the growth of plants.

Treated stormwater is collected at the base of the system via a network of perforated pipes located within the gravel drainage layer which is then discharged into outlet pits. Bioretention basins are proposed prior to each discharge point, with filter media surface areas to suit the catchment**.** Extended detention depths of 0.3m have been proposed. A filter media depth of 0.5m has been proposed for all basins with the exception of basins WQ7 and WQ9 which, due to depth constraints in these areas, a filter media depth of 0.4m is proposed. Parameters for the bioretention basins were adopted in accordance with the Water By Design MUSIC Modelling Guidelines, Version 3.0, 2018 (herein referred to as "Water by Design guidelines").

7.2. Stormwater Quality Modelling (MUSIC) Methodology

Stormwater quality modelling for the site was prepared using 'Model for Urban Stormwater Improvement Conceptualisation' (MUSIC) Version 6.3. The model has been prepared to assess the effectiveness of the proposed water quality control measures against the WQO's for the development. A partial diagrammatic layout of the MUSIC Model is presented in **Figure 12**, which is representative of the full model arrangement.

For the analysis of the MUSIC modelling, Meteorological data (average potential evapotranspiration (PET) and Rainfall Station) was based on the recommendations listed for Southeast Queensland and Logan City Council (East) in the Water By Design guidelines for SEQ, Tables 3.1, A1.1 and A1.2. The rainfall data was obtained from the Bureau of Meteorology for Station No. 40659 at Greenbank Thomas Road. The analysis was undertaken using a 6 minute time step for the period 1/1/1980 to 31/12/1989.

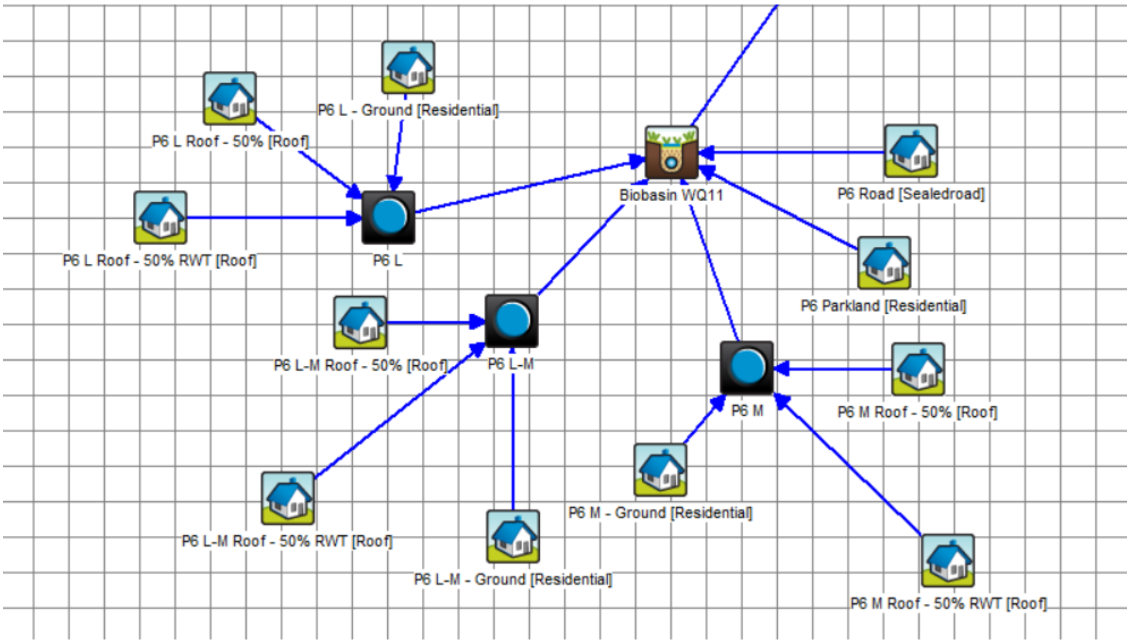


Figure 12 - MUSIC Model Arrangement

The site was divided into seven stormwater catchments (P1-P7) as shown in **Figure 11**. The catchments consider the existing topography, as well as the site grading as proposed as part of the development works. A small portion of the development, including catchments C81 and C83, bypass the proposed water quality infrastructure. Two catchments to the west of the site (W1 and W2) will drain into Precinct 1 Basins WQ6 and WQ8 in the developed case. W1 and W2 were included in the model to ensure the water quality basins were sized to account for these catchments (which will be developed as part of a separate Precinct). Land use categories adopted for W1 and W2 included low-medium density residential and district/neighbourhood centres as per the Riverbend Masterplan (prepared by Place Design Group, dated March 2025).

The catchments modelled in MUSIC were broken down into specific land use categories to accurately model the rainfall runoff parameters and pollutant concentration parameters for each category. Source nodes used for each category were as follows:

- All roads were modelled as 'urban - sealed road'.
- All roofs were modelled as 'urban – roof'.
- Ground surfaces in all residential areas (i.e. low density, low-medium density and medium density) were modelled as 'urban – residential'. The ground surface for the school catchment was also modelled as 'urban – residential' (as outlined in the Water by Design guidelines, Table 3.1).
- Ground surfaces in the district and neighborhood centres were modelled as 'urban – commercial' (as outlined in the Water by Design guidelines, Table 3.1).
- All Parkland areas were modelled as 'urban – residential' (as outlined in the Water by Design guidelines, Table 3.1).

Rainfall-runoff parameters have been adopted in accordance with Table A1.2 in the Water By Design guidelines. Refer to **Table 12** for the rainfall-runoff parameters for residential source nodes (including low density, low-medium density, medium density, schools and parkland areas) as well as commercial source nodes (district and neighbourhood centres).

The pollutant concentration parameters adopted in the model were based on those outlined in the Water By Design guidelines. The parameters are listed in **Table 13**.

Table 12 – Rainfall-Runoff Parameters for Source Nodes

PARAMETER	VALUE	
Land Use Category	Urban Residential	Urban Commercial
Rainfall Threshold (mm/day)	1	1
Soil Storage Capacity (mm)	500	18
Initial Storage (% of Capacity)	10	10
Field Capacity (mm)	200	80
Infiltration Capacity Coefficient – a	211	243
Infiltration Capacity Exponent – b	5.0	0.6
Initial Depth (mm)	50	50
Daily Recharge Rate (%)	28	0
Daily Base flow Rate (%)	27	31
Daily Deep Seepage Rate (%)	0	0

* Parameter based on Water By Design guidelines, Table A1.2

Table 13 – Pollutant Concentration Parameters for Source Nodes

LAND- USE CATEGORY		LOG TSS (MG/L)		LOG TP (MG/L)		LOG TN (MG/L)	
		Storm Flow	Base flow	Storm Flow	Base Flow	Storm Flow	Base Flow
Roof Areas (Urban roof)	Mean	1.30	N/A	-0.89	N/A	0.26	N/A
	Std Dev	0.39	N/A	0.31	N/A	0.23	N/A
Roads (Urban Sealed Road)	Mean	2.43	1.00	-0.30	-0.97	0.26	0.20
	Std Dev	0.39	0.34	0.31	0.31	0.23	0.20
Ground (Urban Residential)	Mean	2.18	1.00	-0.47	-0.97	0.26	0.20
	Std Dev	0.39	0.34	0.31	0.31	0.23	0.20
Roof (Urban Commercial)	Mean	1.30	N/A	-0.89	N/A	0.37	N/A
	Std Dev	0.38	N/A	0.34	N/A	0.34	N/A
Roads (Urban Commercial)	Mean	2.43	0.78	-0.30	-0.60	0.37	0.32
	Std Dev	0.38	0.39	0.34	0.50	0.34	0.30
Ground (Urban Commercial)	Mean	2.16	0.78	-0.39	-0.60	0.37	0.32
	Std Dev	0.38	0.39	0.34	0.50	0.34	0.3

*Parameters based taken from Water by Design guidelines Table 3.9.

For areas where the internal layout is not yet confirmed (i.e. the school site and the western catchments W1 and W2), the following area breakdown percentages shown in **Table 14** were adopted in modelling.

Table 14 – MUSIC Node Areas for School Site and Western Catchments

LAND USE	ROAD	ROOF	GROUND
School Site	26%	33%	41%
Western Catchment – District/Neighbourhood Centres	30%	50%	20%
Western Catchment – Low-Medium Density Residential (30 dw/ha)	29%	34%	37%

*Note that areas were interpolated based on Water by Design Guidelines, Table 3.4

For the remainder of the site, the road and lot areas were measured from the development layout prepared by Place Design Group. The roof to ground ratio for the residential lots was based on those outlined in the Water By Design guidelines. The area breakdown is summarised in **Table 15**.

Table 15 – MUSIC Node Areas for Residential Catchments

LAND USE	ROOF	GROUND
Low Density Residential (18 dw/ha)	44.1%	55.9%
Low-Medium Density Residential (30 dw/ha)	47.3%	52.7%
Medium Density Residential (40 dw/ha)	50%	50%
Parkland	0%	100%

*Note that areas were interpolated based on Water by Design Guidelines, Table 3.4

The impervious percentage assigned for each source node is summarised in **Table 16** below. Note that the roof area across all lots including residential areas, the school site and district/ neighbourhood centres was assumed to be 100% impervious.

Table 16 – MUSIC Fraction Impervious Assumptions

SOURCE NODE	IMPERVIOUS
Roof	100%
Ground - Low Density Residential	21%
Ground - Low-Medium Density Residential	26%
Ground - Medium Density Residential	30%
Parkland	20%
Road	70%

*Note fraction impervious values were interpolated based on Water by Design guidelines, Table 3.6.

The catchment areas and their associated land use types are summarised in **Table 17**.

Table 17 – Catchment Source Node Summary

CATCHMENT	TOTAL AREA (HA)	LAND USE
P1	2.762 0.324 5.063	Road Parkland School
P2	4.935 0.458 0.816 2.643 0.802	Low Density Residential Low-Medium Density Residential Medium Density Residential Road Parkland
P3	4.289 0.583 3.213	Low Density Residential Low-Medium Density Residential Road
P4	1.648 1.401 0.136	Low Density Residential Road Parkland
P5	5.524 0.875 2.569 0.504	Low Density Residential Low-Medium Density Residential Road Parkland
P6	0.695 0.969 1.171 1.311 0.129	Low Density Residential Low-Medium Density Residential Medium Density Residential Road Parkland
P7	5.851 4.450 9.283 0.995	Low Density Residential Low-Medium Density Residential Road Parkland
Western Catchment W1	6.046	Medium Density Residential
Western Catchment W2	9.097 3.210	Medium Density Residential District and Neighbourhood Centres
Bypass C81	0.726 0.195	Medium Density Residential Road
Bypass C83	0.178 1.03	Low-Medium Density Residential Road

7.3. Modelling Results and Summary

Design parameters adopted for the bioretention systems are summarised below in **Table 18**. Contributing catchments to each bioretention system, as well as filter areas are outlined in **Table 19**.

Results from the MUSIC model shown in **Table 20** demonstrate that the overall treatment train should achieve the water quality targets outlined in **Table 2**. The model also demonstrates compliance with water quality targets at each individual water quality basin. Indicative water quality basin locations are presented in **Figure 11.**

Table 18 – Bioretention Parameters

PARAMETER	VALUE
Extended Detention Depth (mm)	300
Minimum Filter Media Depth (mm)	500 (400 for WQ7, WQ9)
Saturated Hydraulic Conductivity (mm/hour)	200
TN Filter Media Content (mg/kg)	400
Orthophosphate Filter Media Content (mg/kg)	30

Table 19 – Bioretention System Areas

PLAN ID	CONTRIBUTING CATCHMENTS	BIORETENTION FILTER AREA (M^2)
WQ6	P1 P2	1800
WQ7	P4	350
WQ8	P7	2150
WQ9	P3	640
WQ11	P6	450
WQ15	P5	950
	TOTAL	**6340**

Table 20 – MUSIC Model Results

POLLUTANT	ANNUAL LOADS (KG/YR)		% REDUCTION		COMPLIANT
	Source	**Residual**	**Actual**	**Target**	
TSS	79300	15000	81.1	80	Yes
TP	153	39	74.4	60	Yes
TN	829	390	53	45	Yes
GP	10800	625	94.2	90	Yes

8 Waterway Stability Assessment

This section addresses the waterway stability management required under the SPP (2017). This requires development to limit the 63% AEP (1-year ARI) event velocities within the receiving waterway to the pre-development peak.

The TUFLOW modelling presented herein has been used to estimate the 63% AEP flood behaviour in the existing and developed cases. Results are presented in **Figure C6-2** and **C8-1 Appendix A.** Consideration has been given to the various discharge points as outlined below.

8.1. Discharge to Teviot Road

Modelling presented in **Figure C8-1** of Appendix A shows minor increases in velocity pre to post for the 63% AEP in this location. We do not believe there is significant potential for erosion in this event due to absolute velocities being generally less than 1.0m/s and the vegetated nature of the corridor, as presented in **Figure C6-2** of **Appendix A**.

8.2. Discharge to Eastern Lot

Modelling presented in **Figure C8-1** of Appendix A generally shows decreases in velocity pre to post for the 63% AEP in this location, with minor increases to the south within the existing roadway. We do not believe there is significant potential for erosion in this event due to absolute velocities being generally less than 1.0m/s, as presented in **Figure C6-2** of **Appendix A**.

8.3. Discharge to Main Riparian Corridor

Modelling presented in **Figure C8-1** of **Appendix A** shows minor increases in velocity pre to post for the 63% AEP in this location. It is understood this unnamed watercourse is expected to be realigned in the future and will also incorporate passive detention behind culvert crossings, scour protection, pool and riffle design, and riparian corridor planting which are expected to be reviewed during future project phases.

9 Conclusion

Northrop Consulting Engineers has prepared this SMP for Precinct 1 of the proposed urban residential development south of Teviot Road in the Logan City Council Local Government Area. Based on investigations, analyses and designs, it has been demonstrated that the proposed precinct's development can be constructed and operated in accordance with all stormwater objectives listed in **Section 4.** The primary outcomes of this SMP are as follows:

STORMWATER QUANTITY

A flood impact assessment has been prepared for the proposed urban residential development at Riverbend. It is concluded that the proposed development with implemented flood mitigation measures is not expected to create a significant adverse impact to the existing flood behaviour on the subject site and adjacent properties.

STORMWATER QUALITY

Erosion and sediment controls per the International Erosion Control Association will be installed to ensure disturbance of the site during construction is appropriately managed to limit impacts to water quality.

Stormwater quality infrastructure has been included in the design to achieve the water quality objectives for South East Queensland specified in the State Planning Policy 2017. The proposed treatment train was modelled using MUSIC modelling software to confirm the objectives were met and includes bioretention basins to treat runoff from the precinct. Each catchment will have localised treatment prior to discharge to the downstream watercourse.

LAWFUL POINT OF DISCHARGE

The developed site will retain the existing site discharge points as the lawful point of discharge, with stormwater management at the downstream point of each catchment prior to site discharge to ensure no adverse impacts downstream.

STORMWATER CONVEYANCE

The subdivision will include a stormwater pit and pipe network to appropriately manage the minor storm events and ensure any overland conveyance is safe and controlled within the road reserve and any stormwater easements to the lawful point of discharge.

WATERWAY STABILITY

A waterway stability assessment has determined that no additional mitigation measures are required to limit flows in discharging directly to the Logan River. Minor increases in velocity are predicted at some discharge locations and we do not believe this will result in a significant erosion risk to due to the vegetated nature of the receiving corridors and limited velocity of 1m/s.

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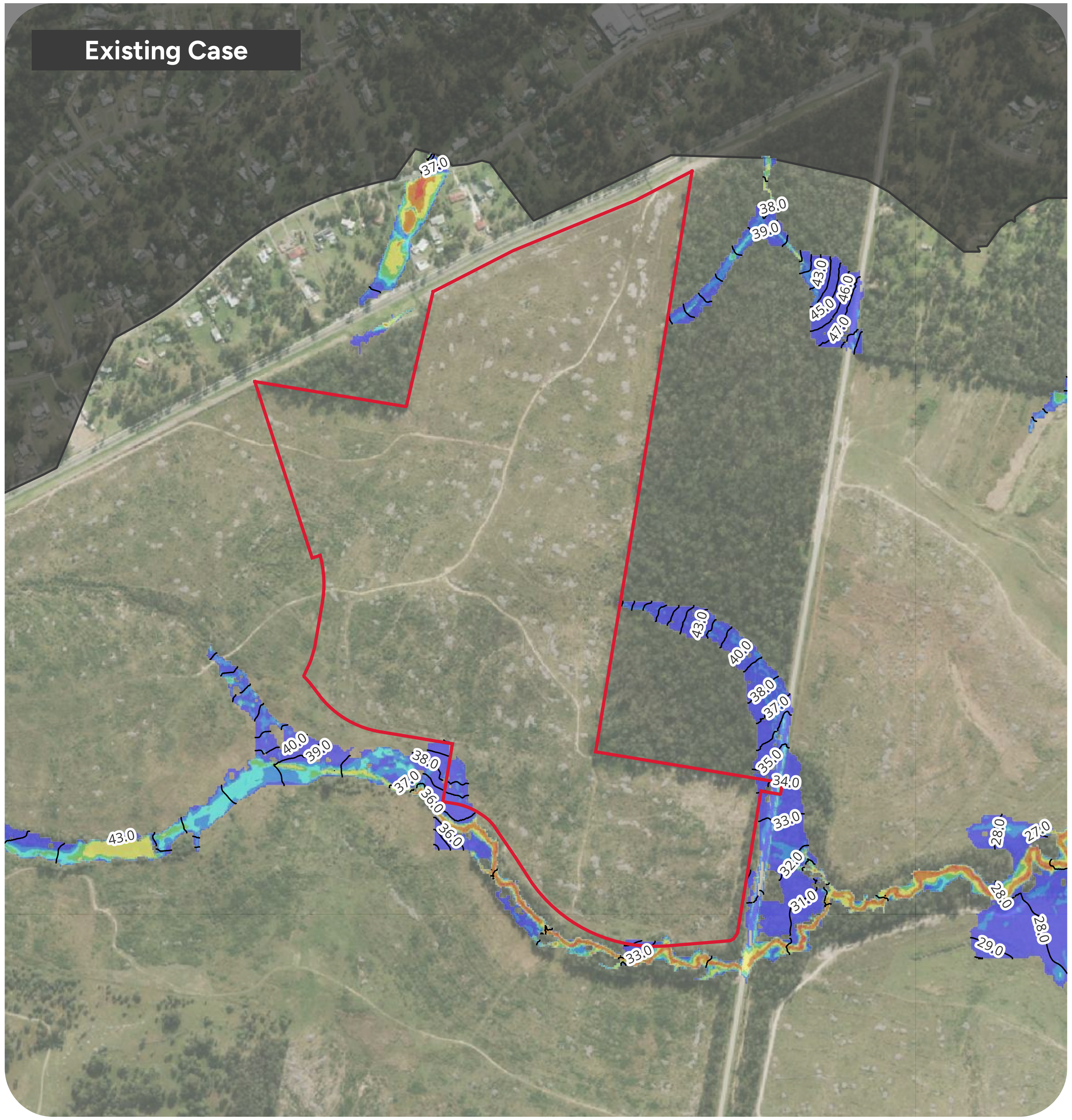
10 Appendix A - Flood Figures



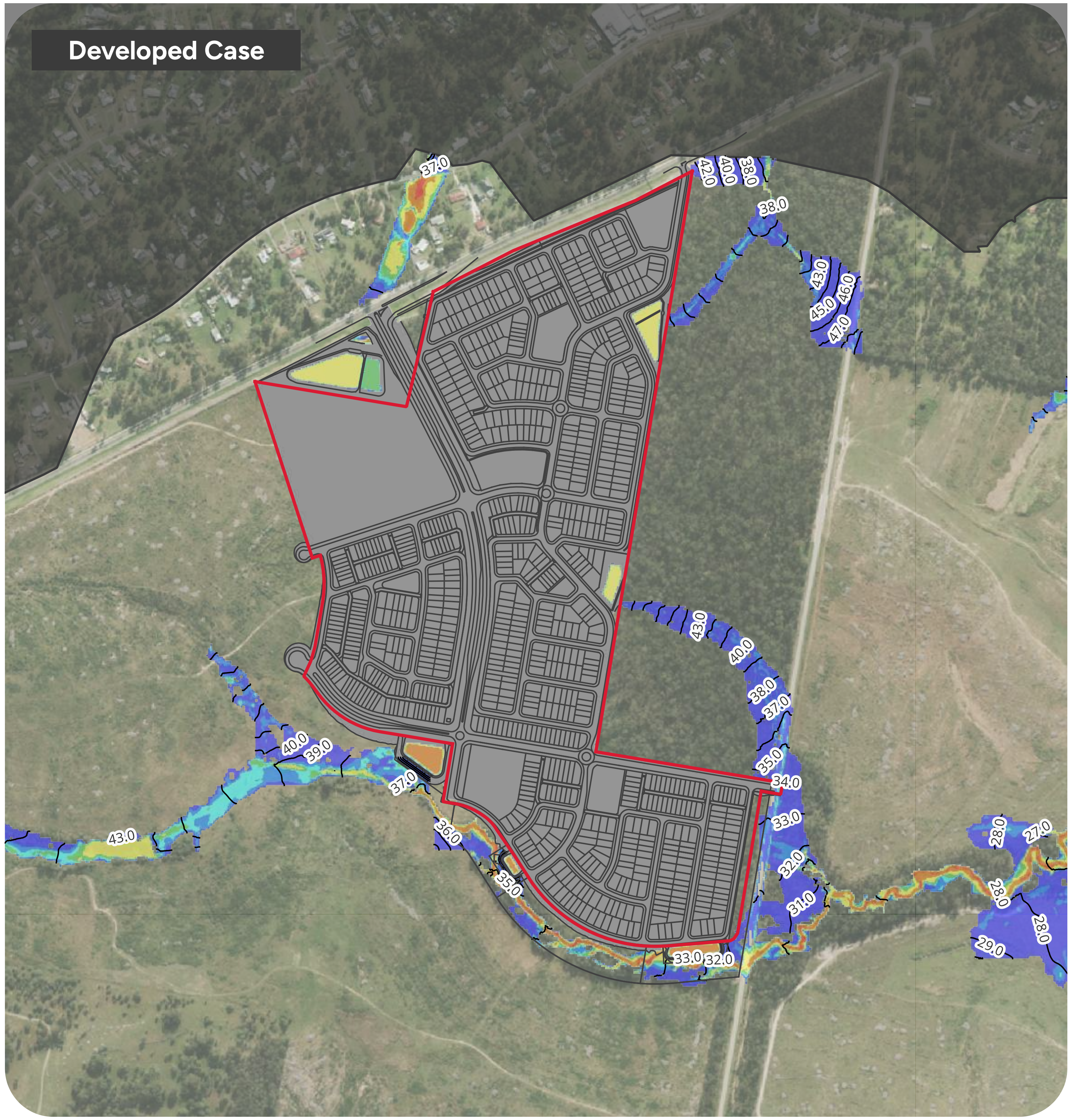


Figure C1-1

20% AEP
Local Catchment
Flood Depth and Elevation

Legend

- Contours (1M)
- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Flood Depth (m)

- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- Greater than 2.0

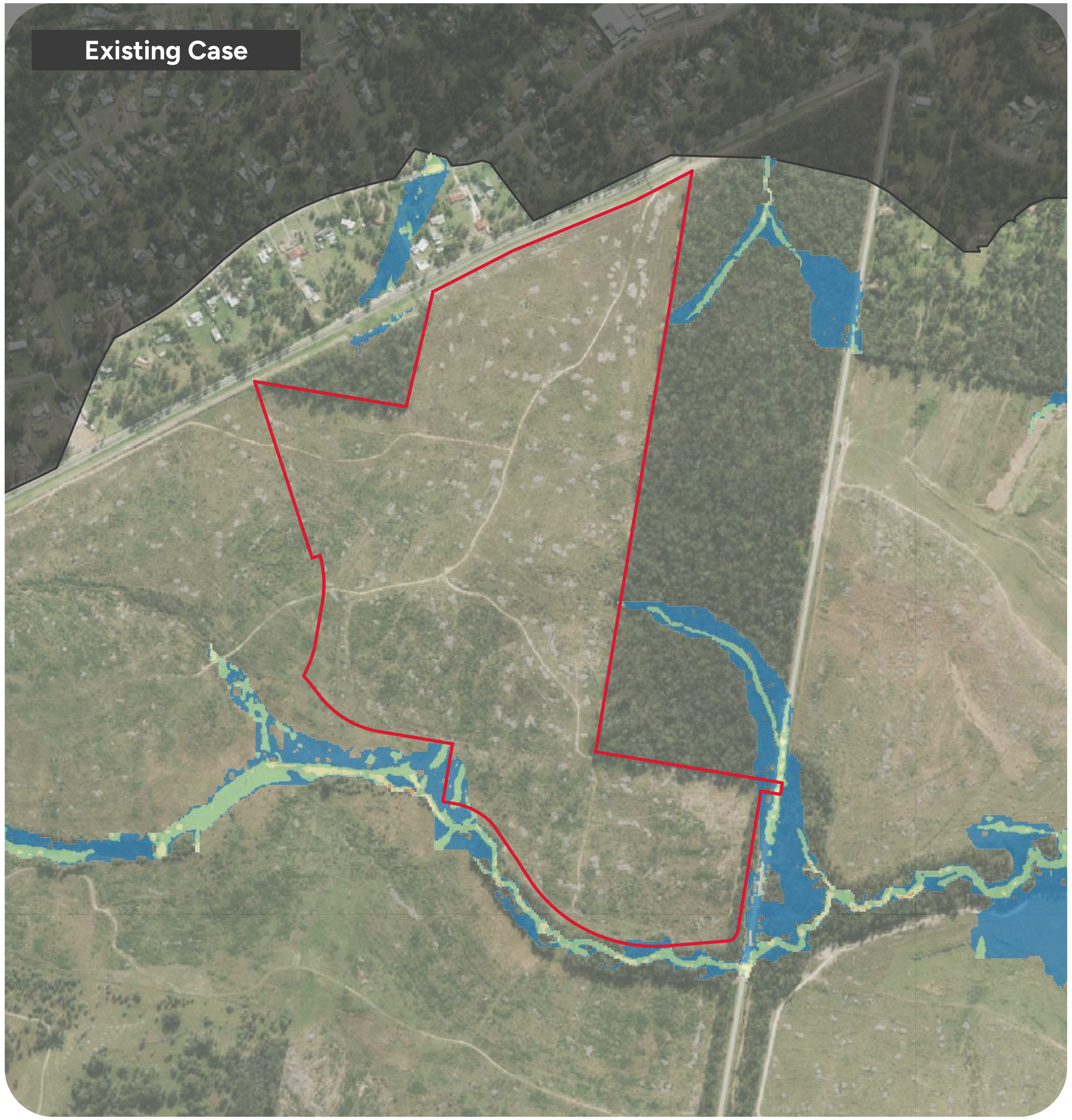
N

EPSG:28356
Scale 1:10000

0 100 300 m

Riverbend Precinct 1
(NL230370)

NORTHROP



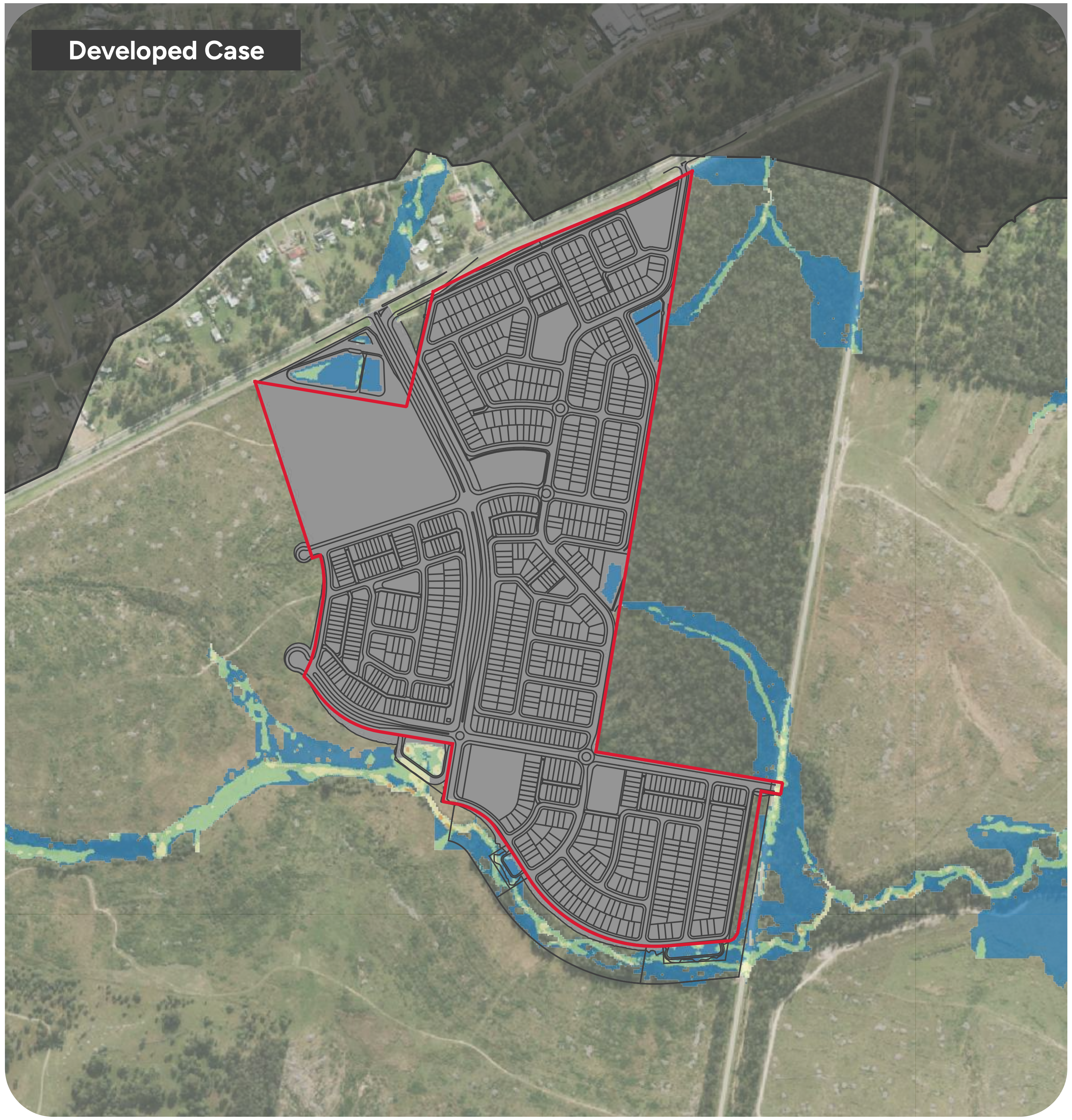


Figure C1-2

20% AEP
Local Catchment
Flood Velocity

Legend

- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Velocity (m/s)

- < 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- 4.0 - 6.0
- > 6.0

N

EPSG:28356
Scale 1:10000
0 100 300 m

Riverbend Precinct 1
(NL230370)

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1/4/2026 \\192.168.5.11\ncl-nas5\FLOODING\PROJECTS\NEWCASTLE\YEAR 2023 Jobs\NL230370 - Riverbend - Logan River\PRECINCT 1\QGIS\260225 Updated Layout\Precinct1_DEV07_Figures.qgz

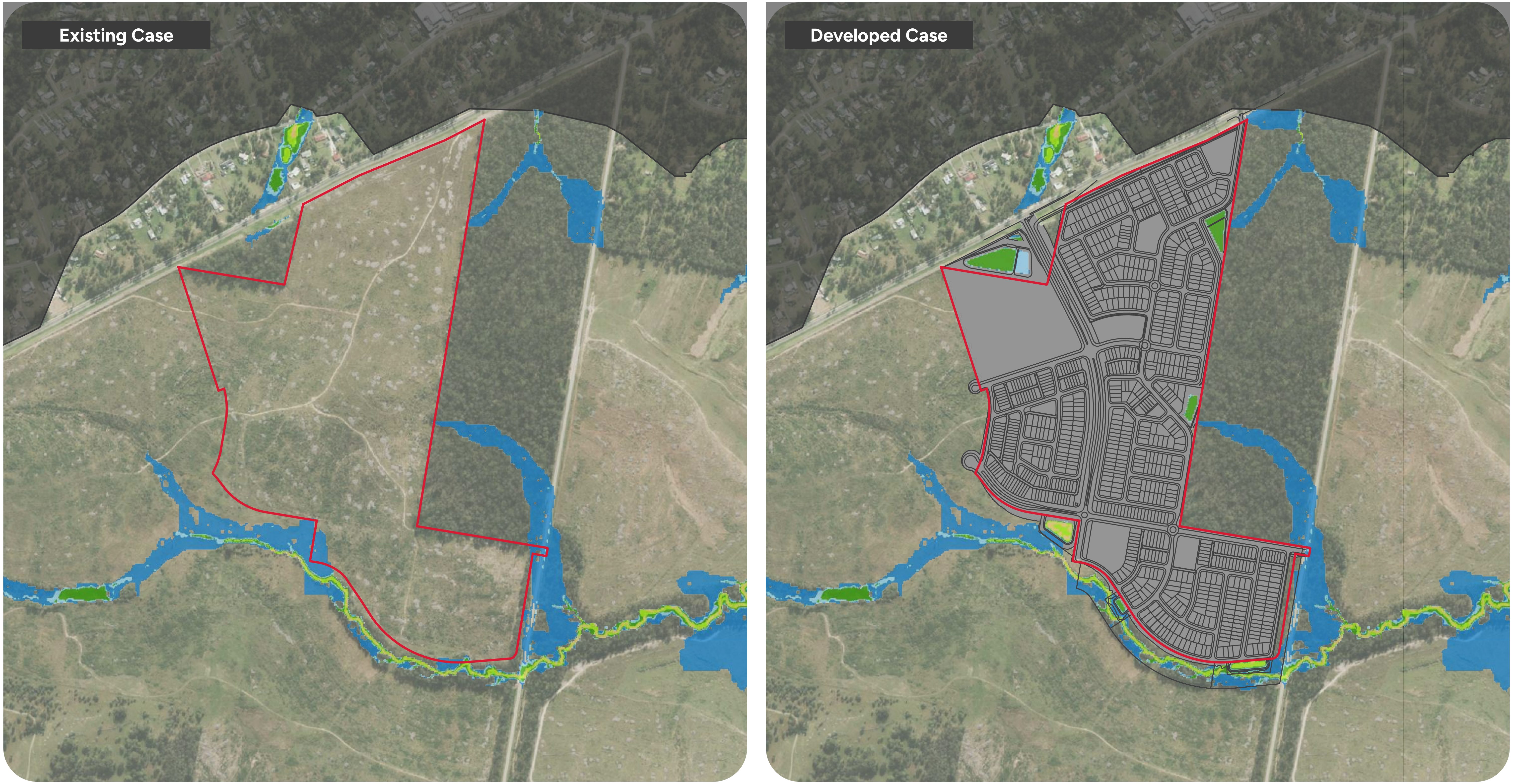


Figure C1-3

20% AEP
Local Catchment
Flood Hazard

Legend

- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Flood Hazard

- H1
- H2
- H3
- H4
- H5
- H6

N

EPSG:28356
Scale 1:10000

0 100 300 m

Riverbend Precinct 1
(NL230370)

NORTHROP

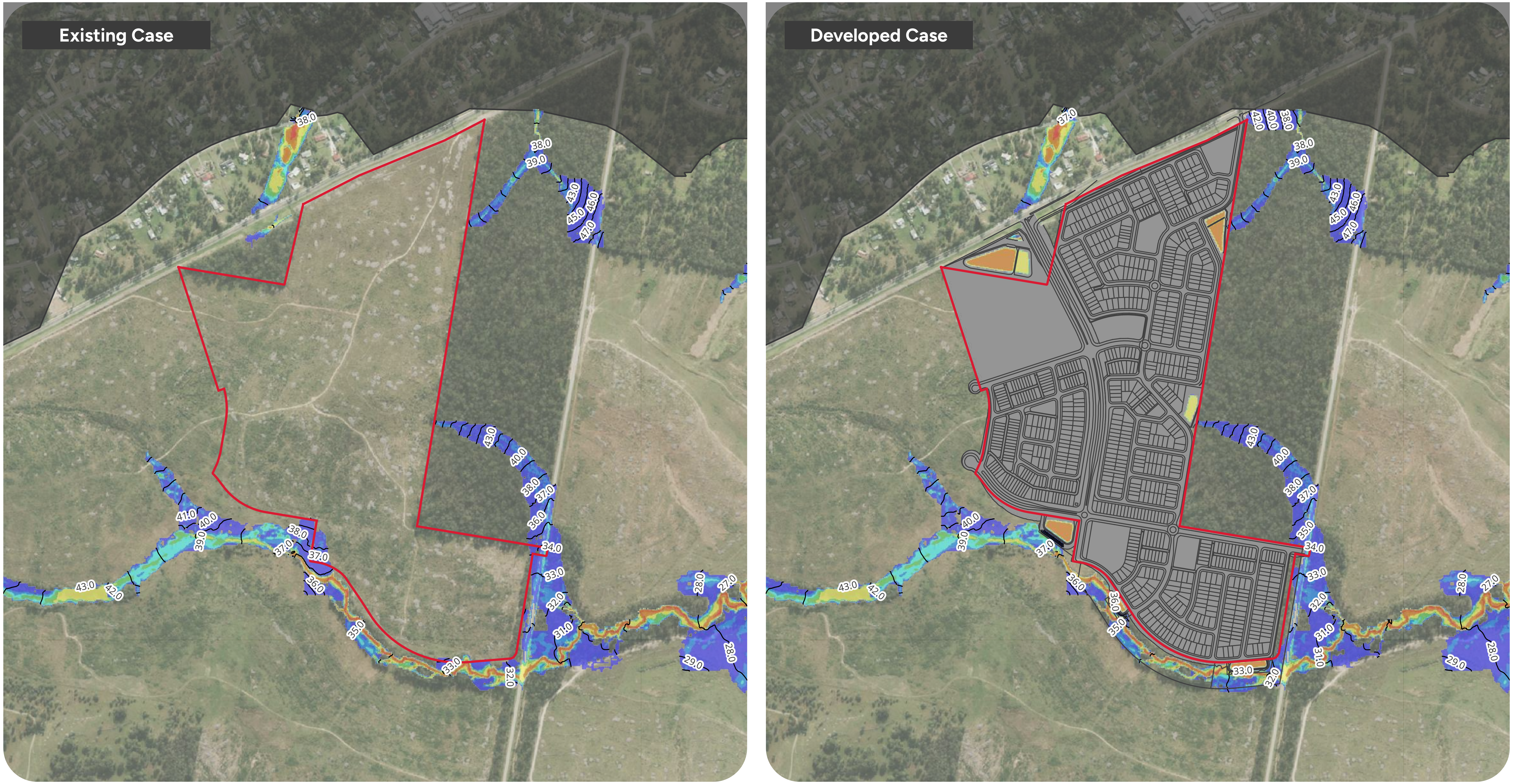


Figure C2-1

10% AEP
Local Catchment
Flood Depth and Elevation

Legend

- Contours (1M)
- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Flood Depth (m)

- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- Greater than 2.0

N

EPSG:28356
Scale 1:10000

0 100 300 m

Riverbend Precinct 1
(NL230370)

NORTHROP

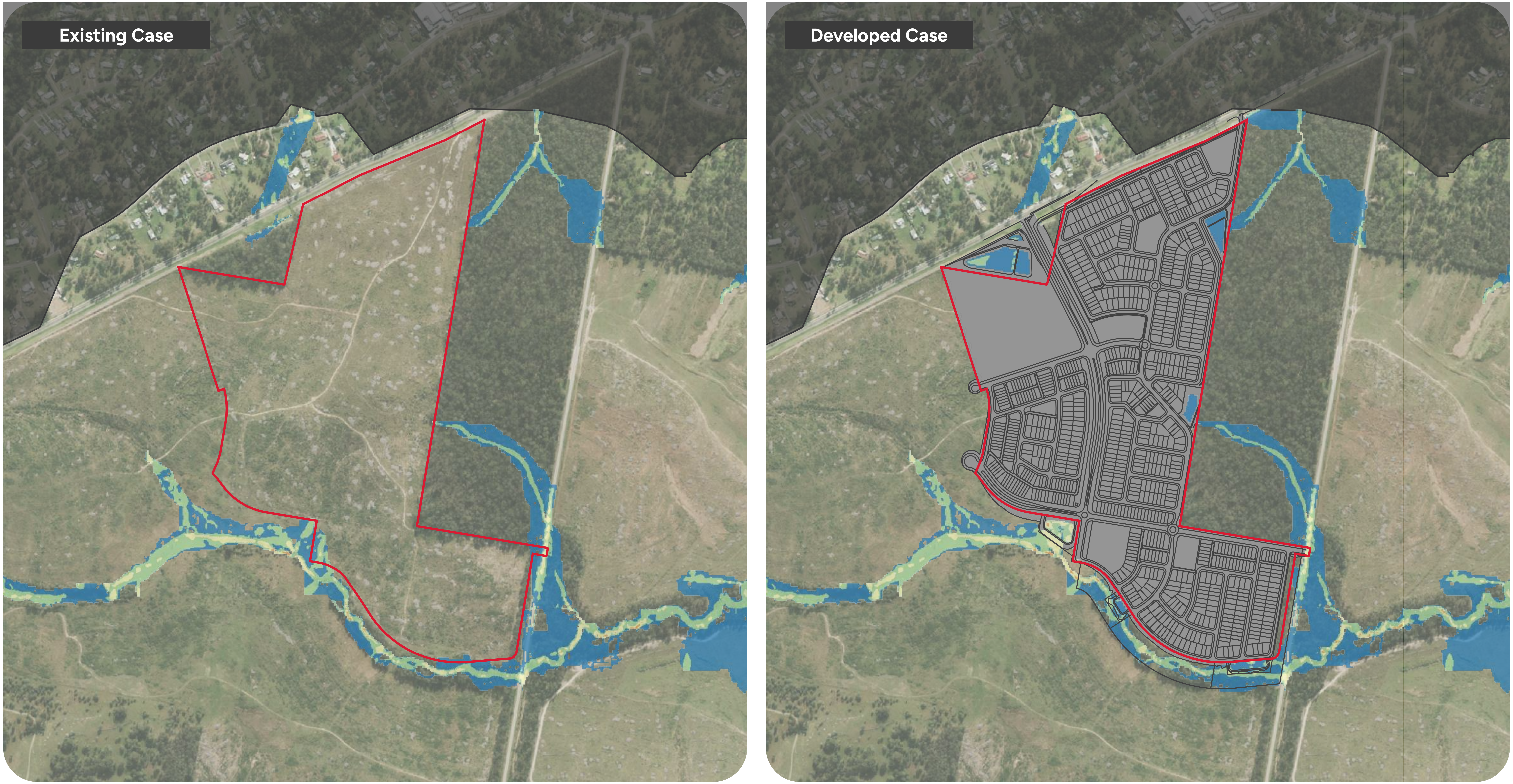


Figure C2-2

10% AEP
Local Catchment
Flood Velocity

Legend

- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Velocity (m/s)

- < 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- 4.0 - 6.0
- > 6.0

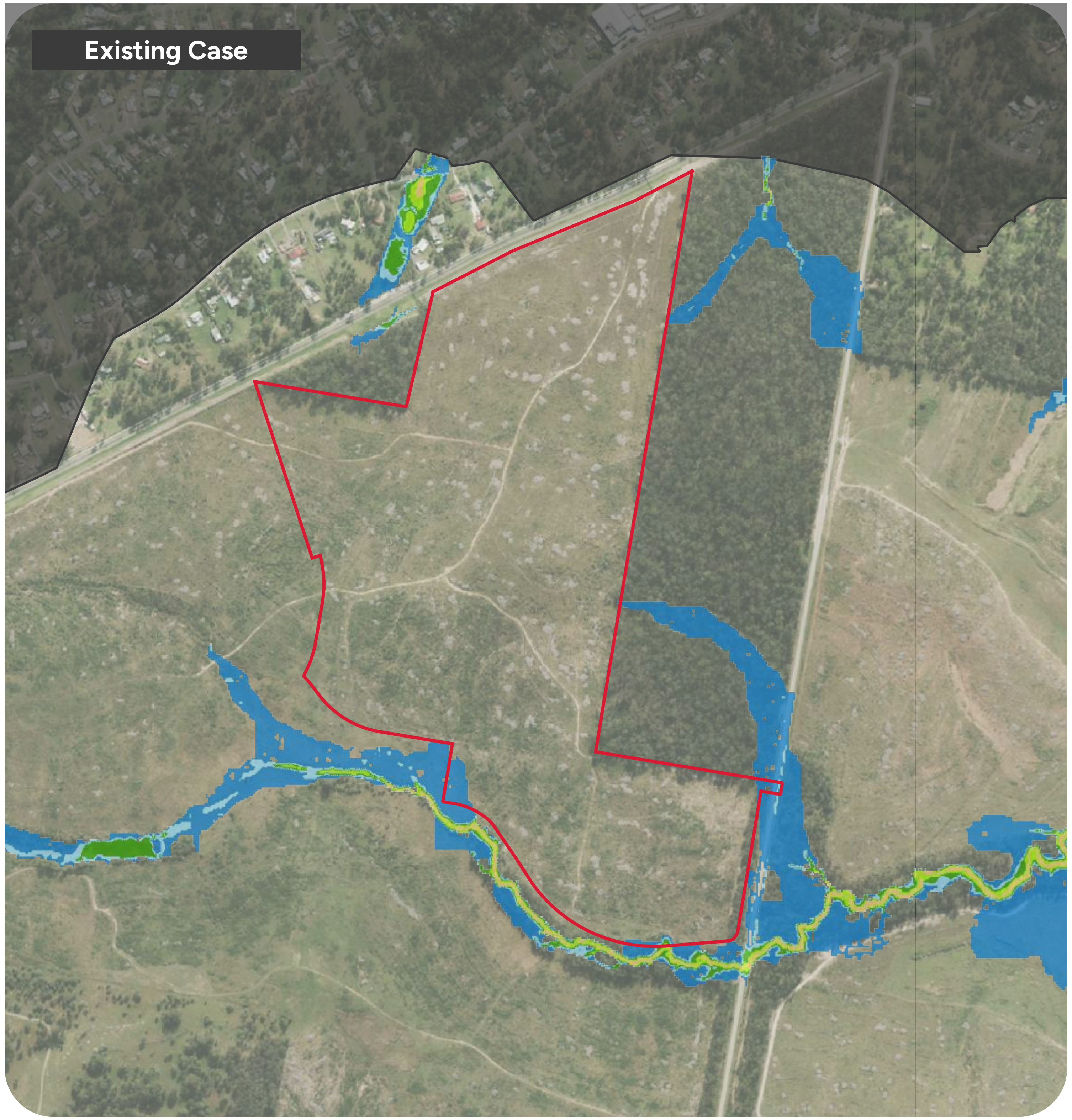
N

EPSG:28356
Scale 1:10000

0 100 300 m

Riverbend Precinct 1
(NL230370)

NORTHROP



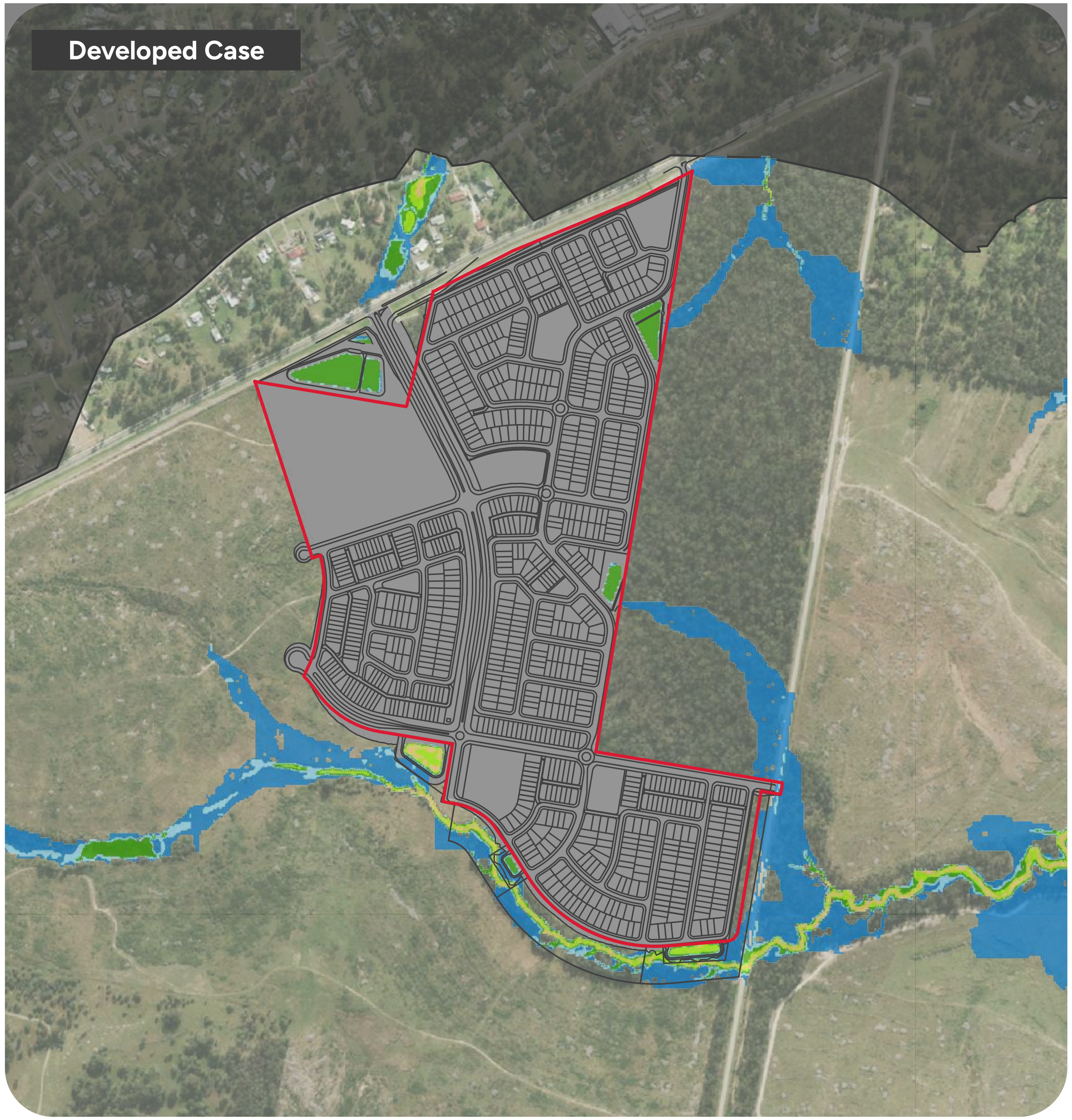


Figure C2-3

10% AEP
Local Catchment
Flood Hazard

Legend

- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Flood Hazard

- H1
- H2
- H3
- H4
- H5
- H6

EPSG:28356
Scale 1:10000
0 100 300 m

Riverbend Precinct 1
(NL230370)

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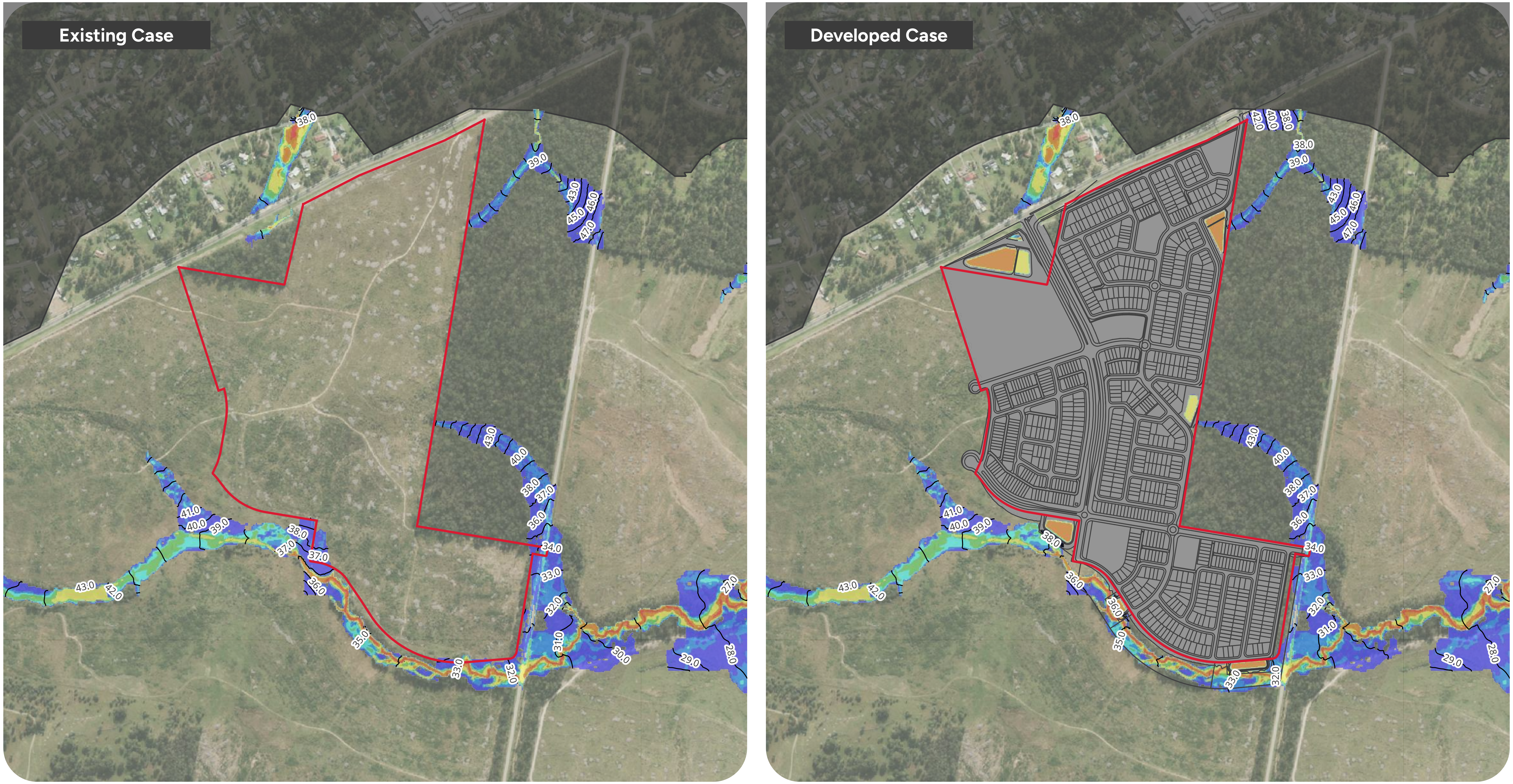

Figure C3-1

5% AEP
Local Catchment
Flood Depth and Elevation

Legend

- Contours (1M)
- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Flood Depth (m)

- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- Greater than 2.0

N

EPSG:28356
Scale 1:10000
0 100 300 m

Riverbend Precinct 1
(NL230370)

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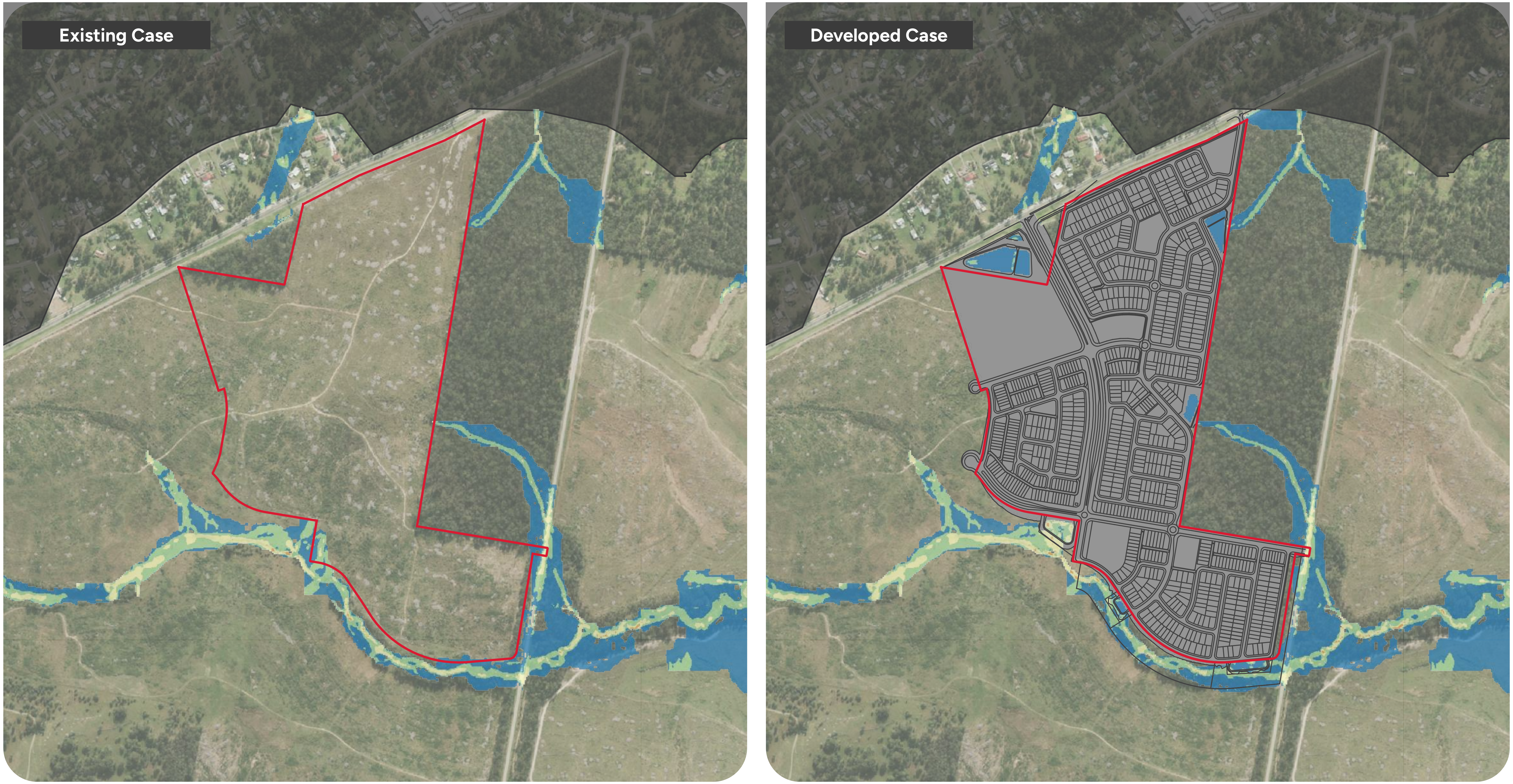

Figure C3-2

5% AEP
Local Catchment
Flood Velocity

Legend

- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Velocity (m/s)

- < 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- 4.0 - 6.0
- > 6.0

N

EPSG:28356
Scale 1:10000
0 100 300 m

Riverbend Precinct 1
(NL230370)

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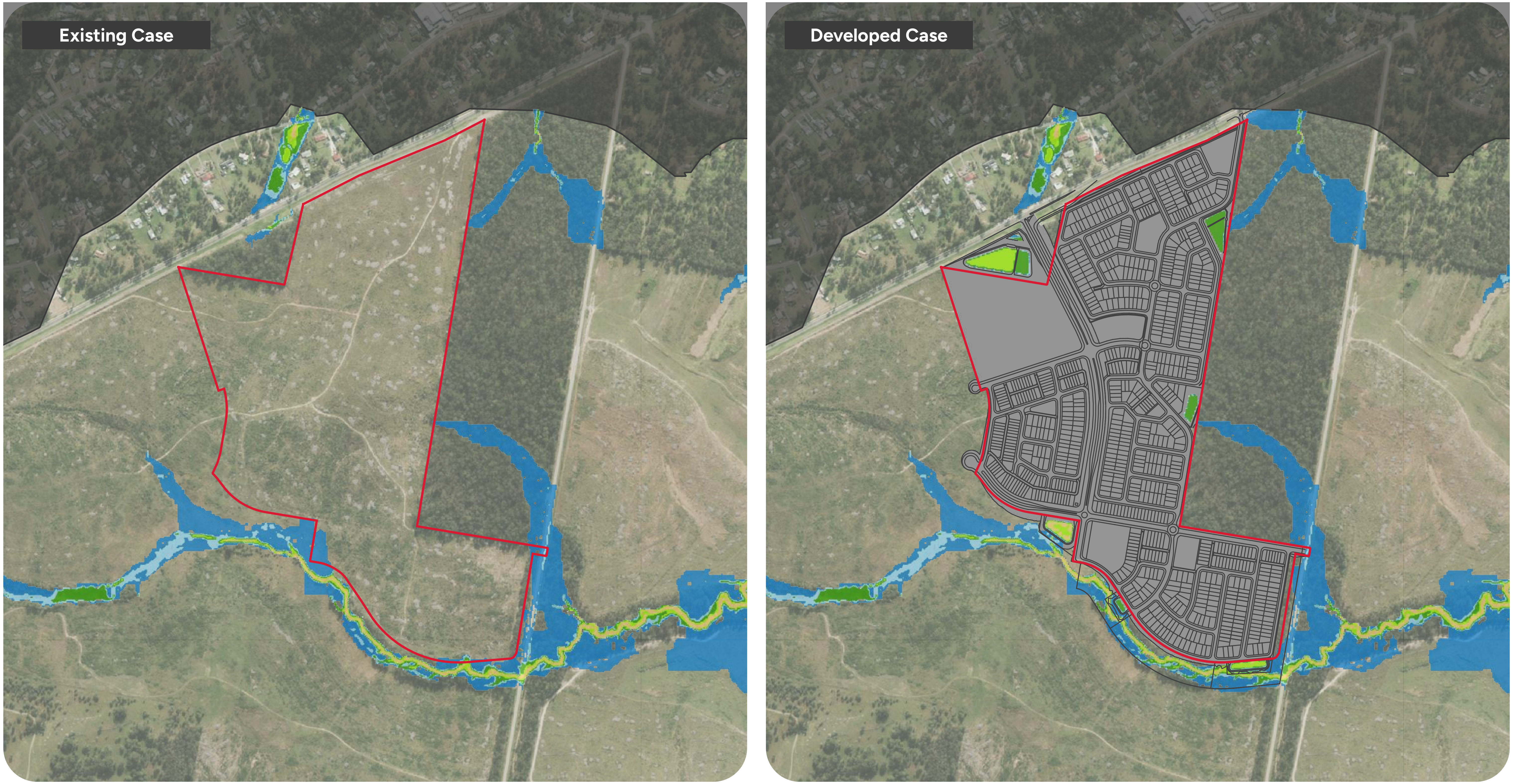

Figure C3-3

5% AEP
Local Catchment
Flood Hazard

Legend

- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Flood Hazard

- H1
- H2
- H3
- H4
- H5
- H6

EPSG:28356
Scale 1:10000

N

0 100 300 m

Riverbend Precinct 1
(NL230370)

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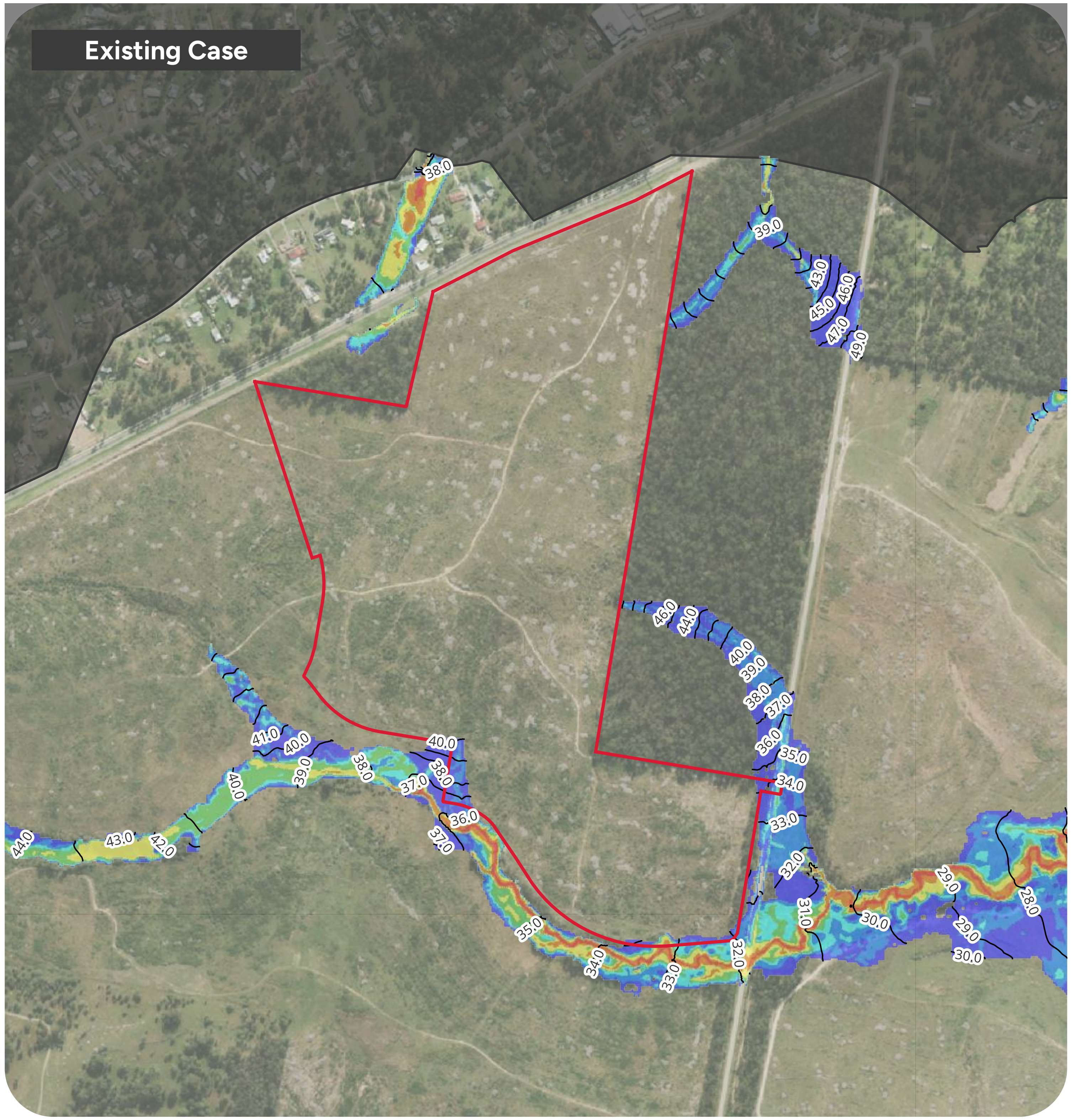


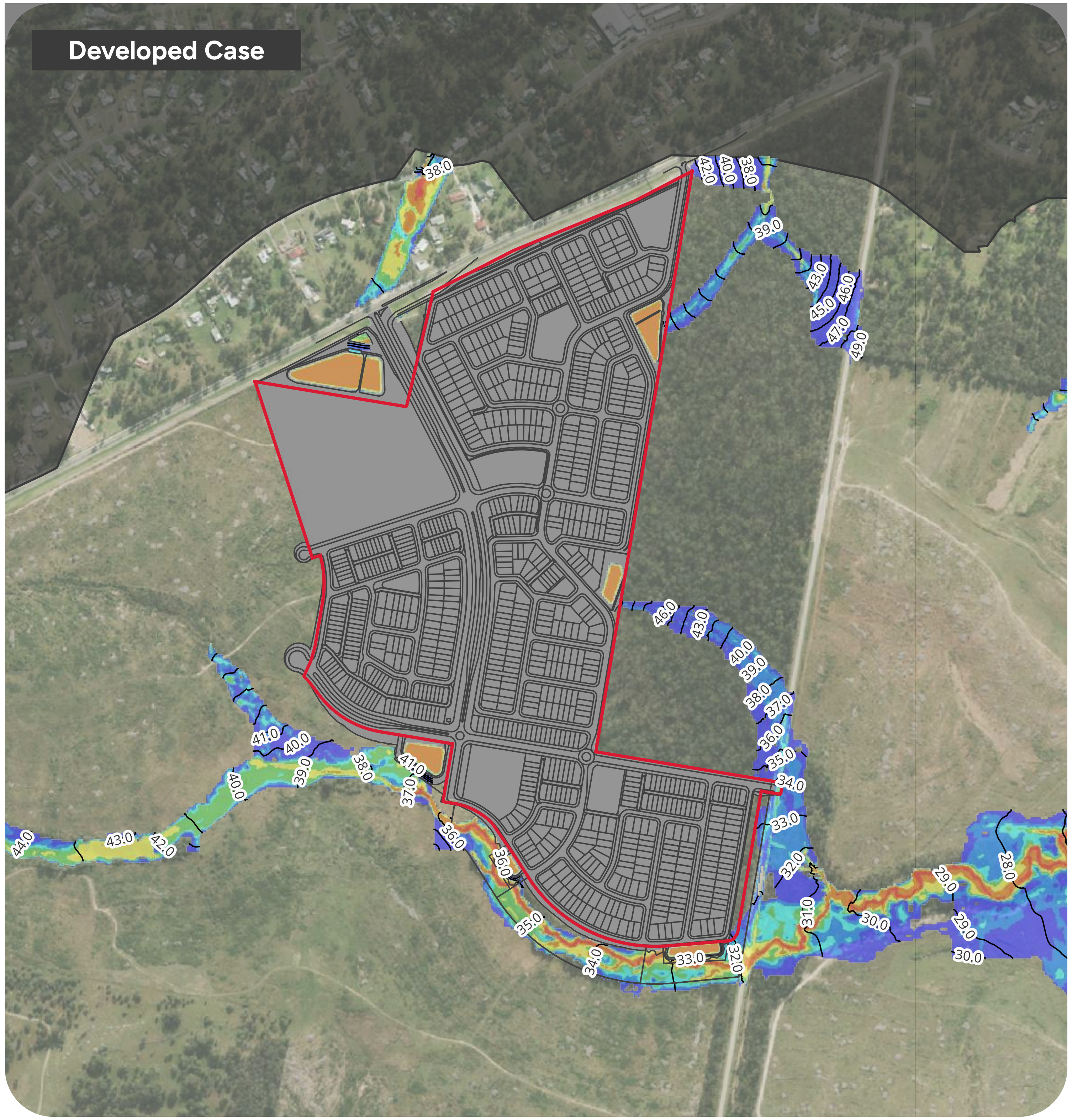


Figure C4-1

1% AEP
Local Catchment
Flood Depth and Elevation

Legend

- Contours (1M)
- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Flood Depth (m)

- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- Greater than 2.0

N

EPSG:28356
Scale 1:10000

0 100 300 m

Riverbend Precinct 1
(NL230370)

NORTHROP

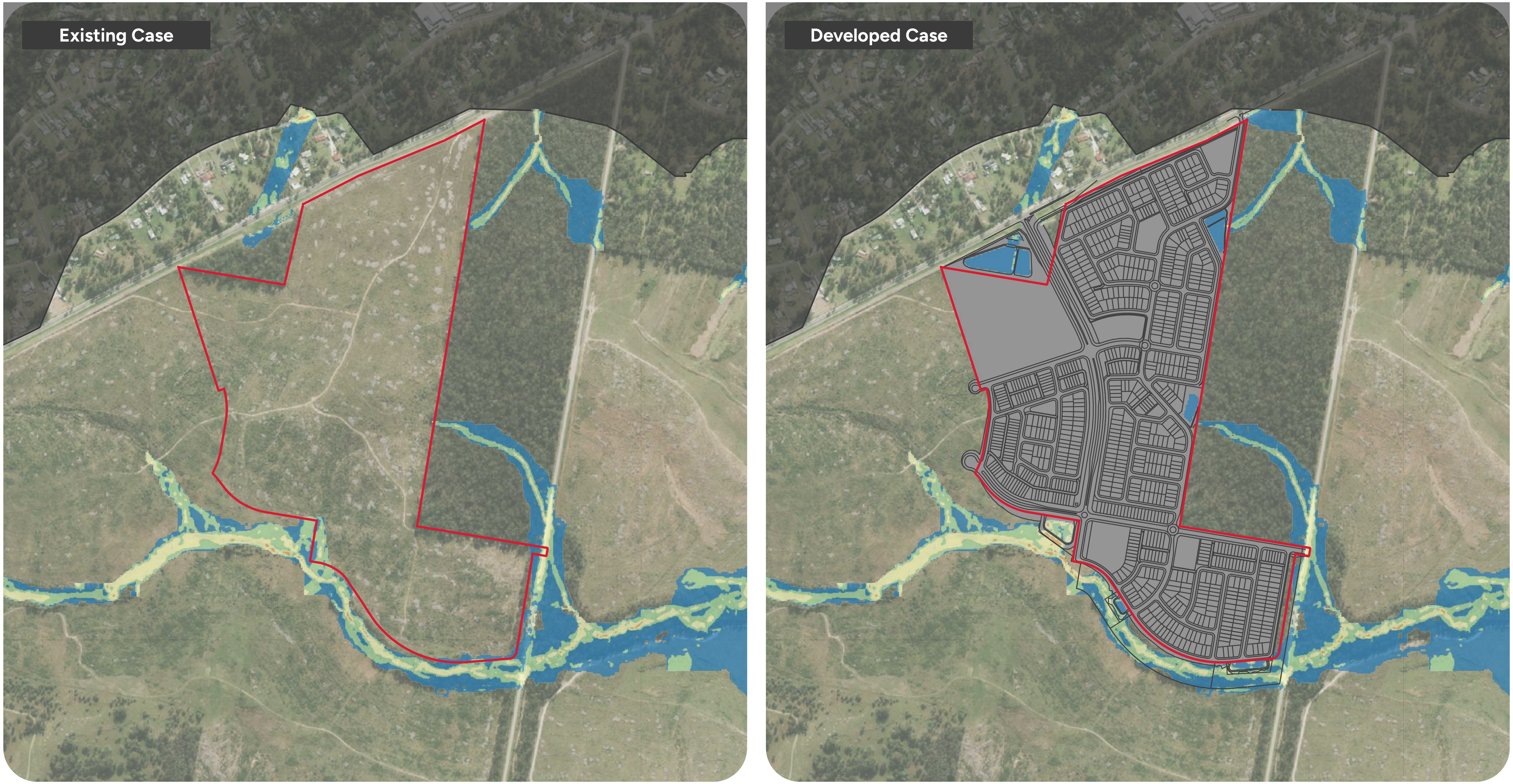


Figure C4-2

1% AEP
Local Catchment
Flood Velocity

Legend

- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

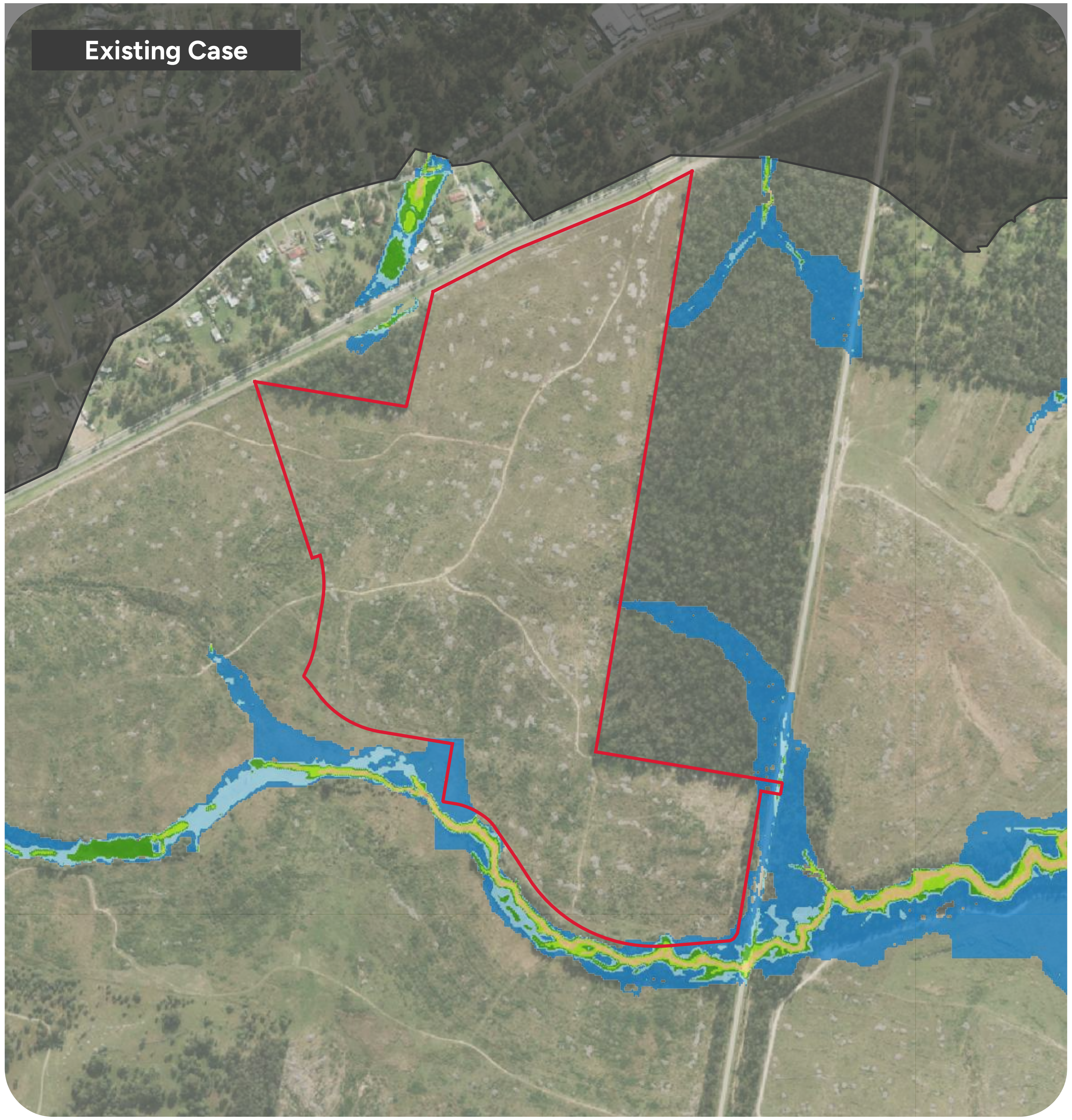
Velocity (m/s)

- < 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- 4.0 - 6.0
- > 6.0

N
EPSG:28356
Scale 1:10000
0 100 300 m

Riverbend Precinct 1
(NL230370)

NORTHROP



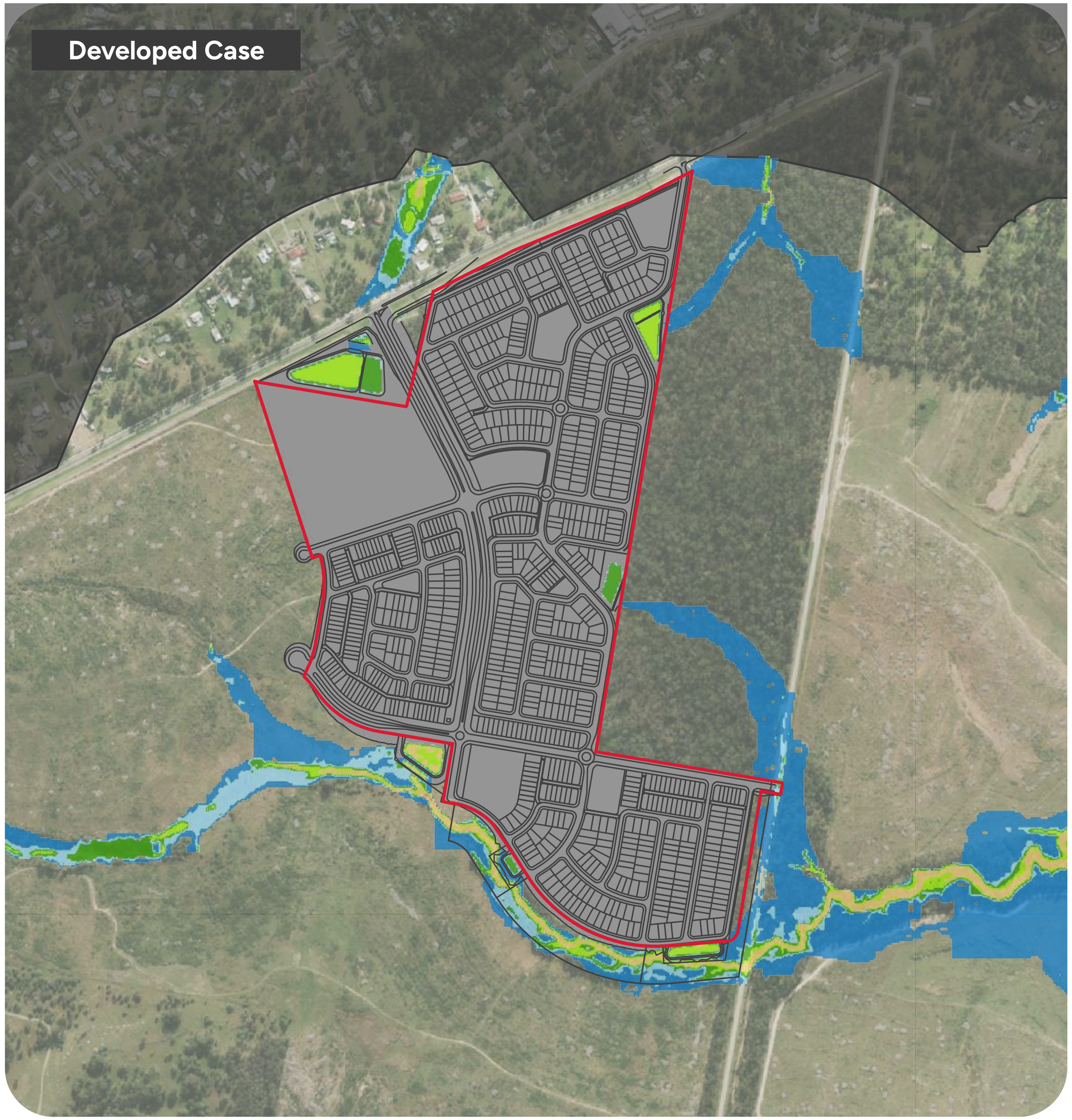


Figure C4-3

1% AEP
Local Catchment
Flood Hazard

Legend

- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Flood Hazard

- H1
- H2
- H3
- H4
- H5
- H6

N
EPSG:28356
Scale 1:10000
0 100 300 m

Riverbend Precinct 1
(NL230370)

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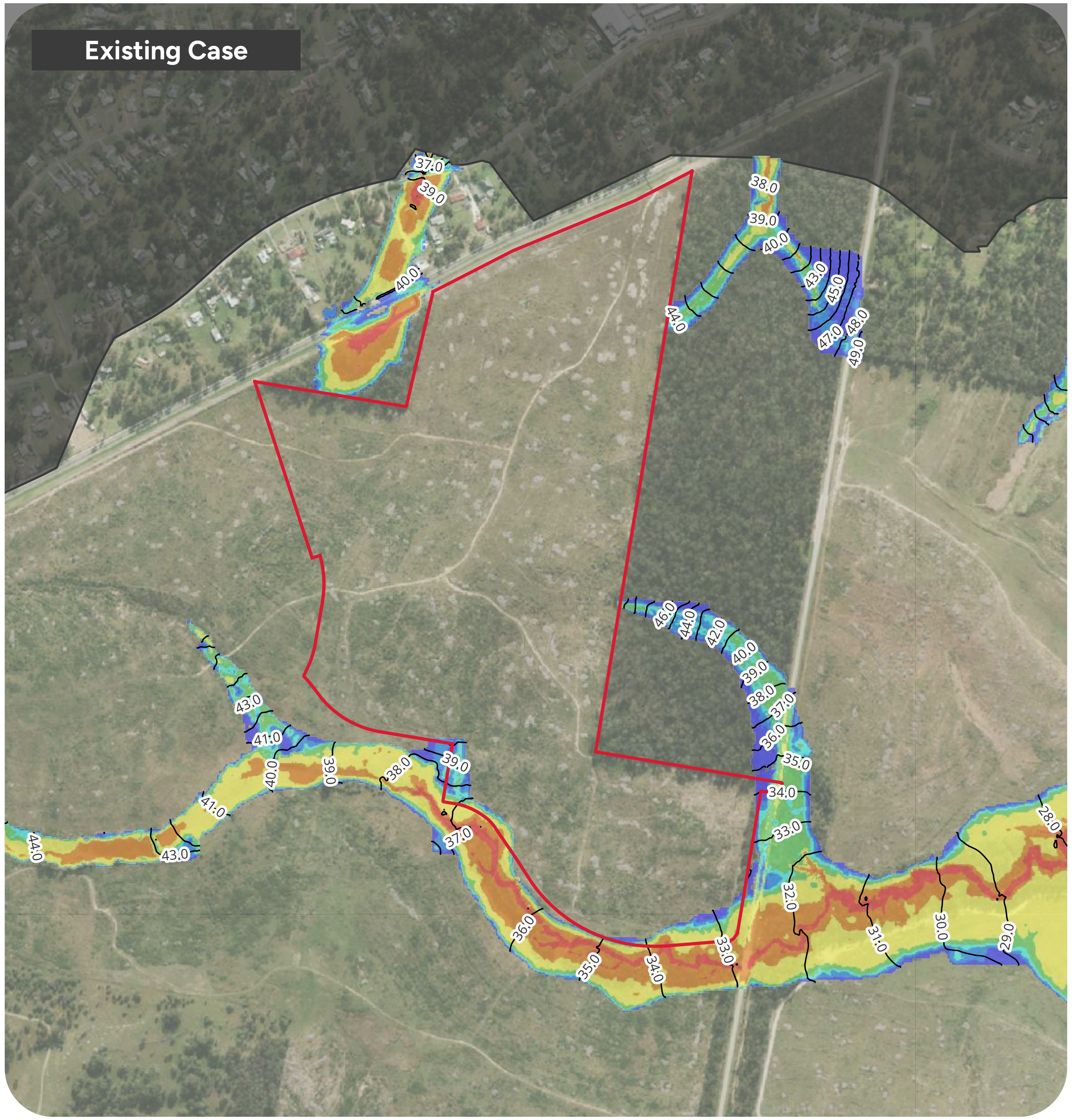

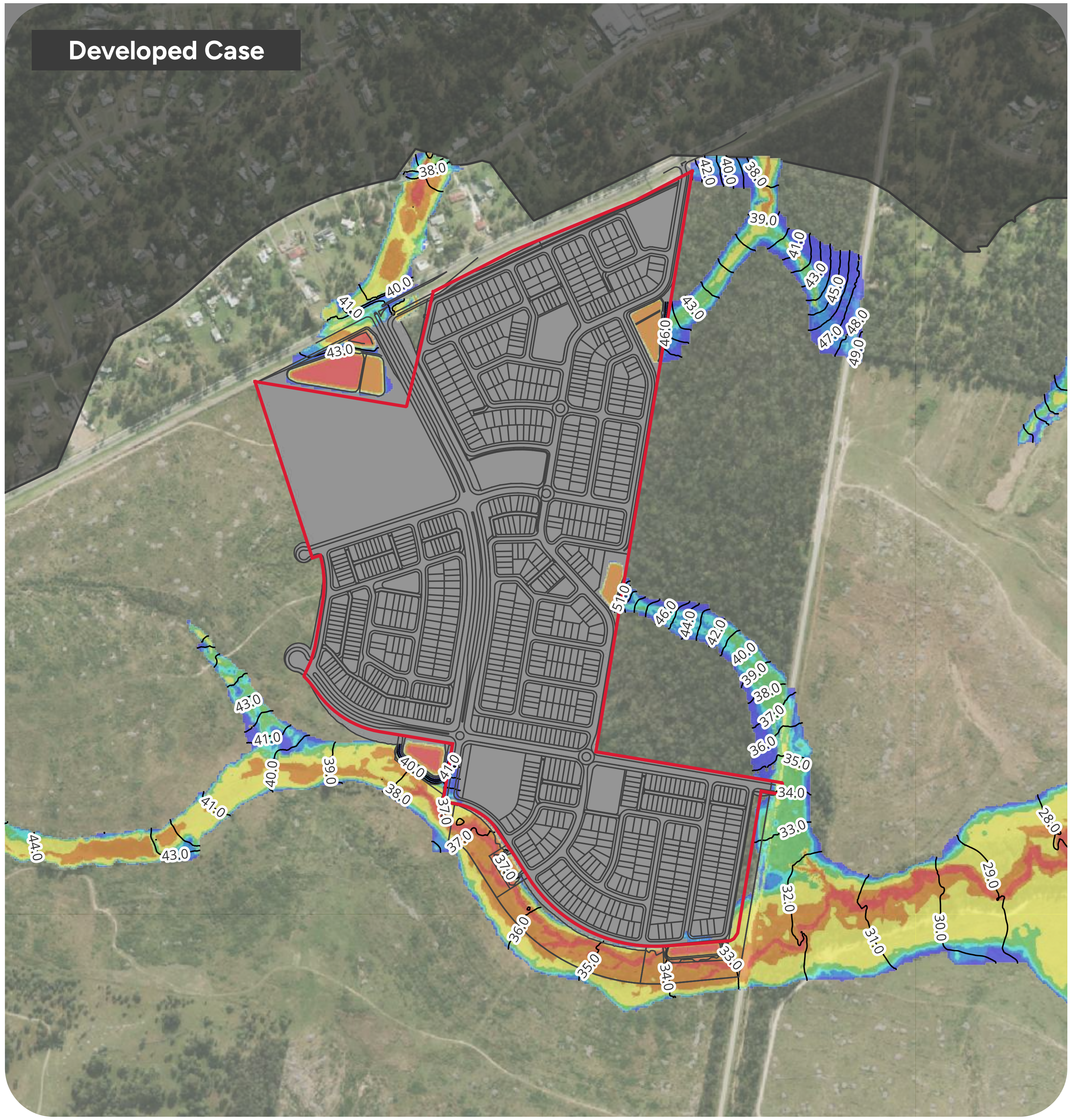

Figure C5-1

PMF
Local Catchment
Flood Depth and Elevation

Legend

- Contours (1M)
- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Flood Depth (m)

- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- Greater than 2.0

N

EPSG:28356
Scale 1:10000
0 100 300 m

Riverbend Precinct 1
(NL230370)

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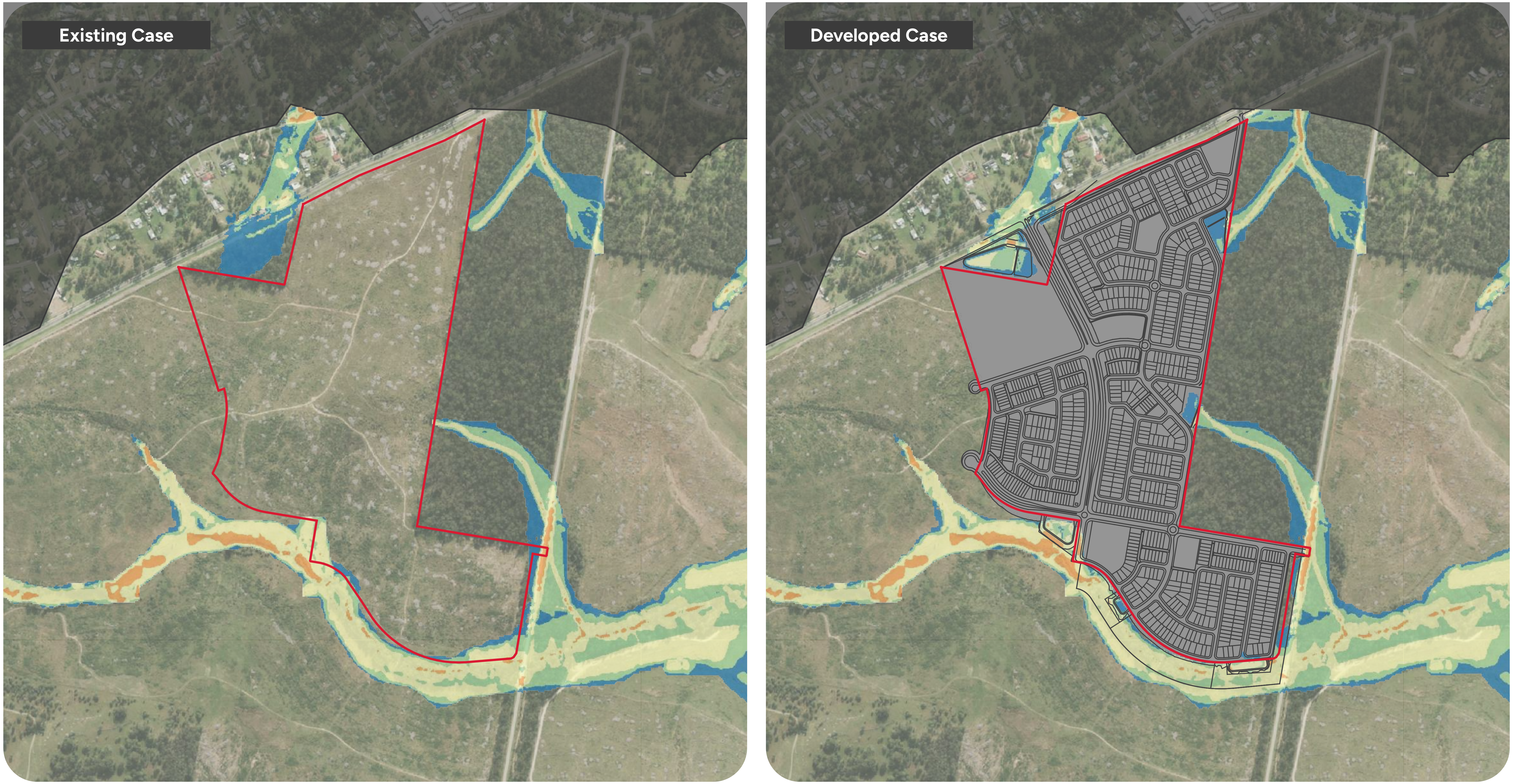

Figure C5-2

PMF
Local Catchment
Flood Velocity

Legend

- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Velocity (m/s)
- < 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- 4.0 - 6.0
- > 6.0

N
EPSG:28356
Scale 1:10000
0 100 300 m

Riverbend Precinct 1
(NL230370)

NORTHROP

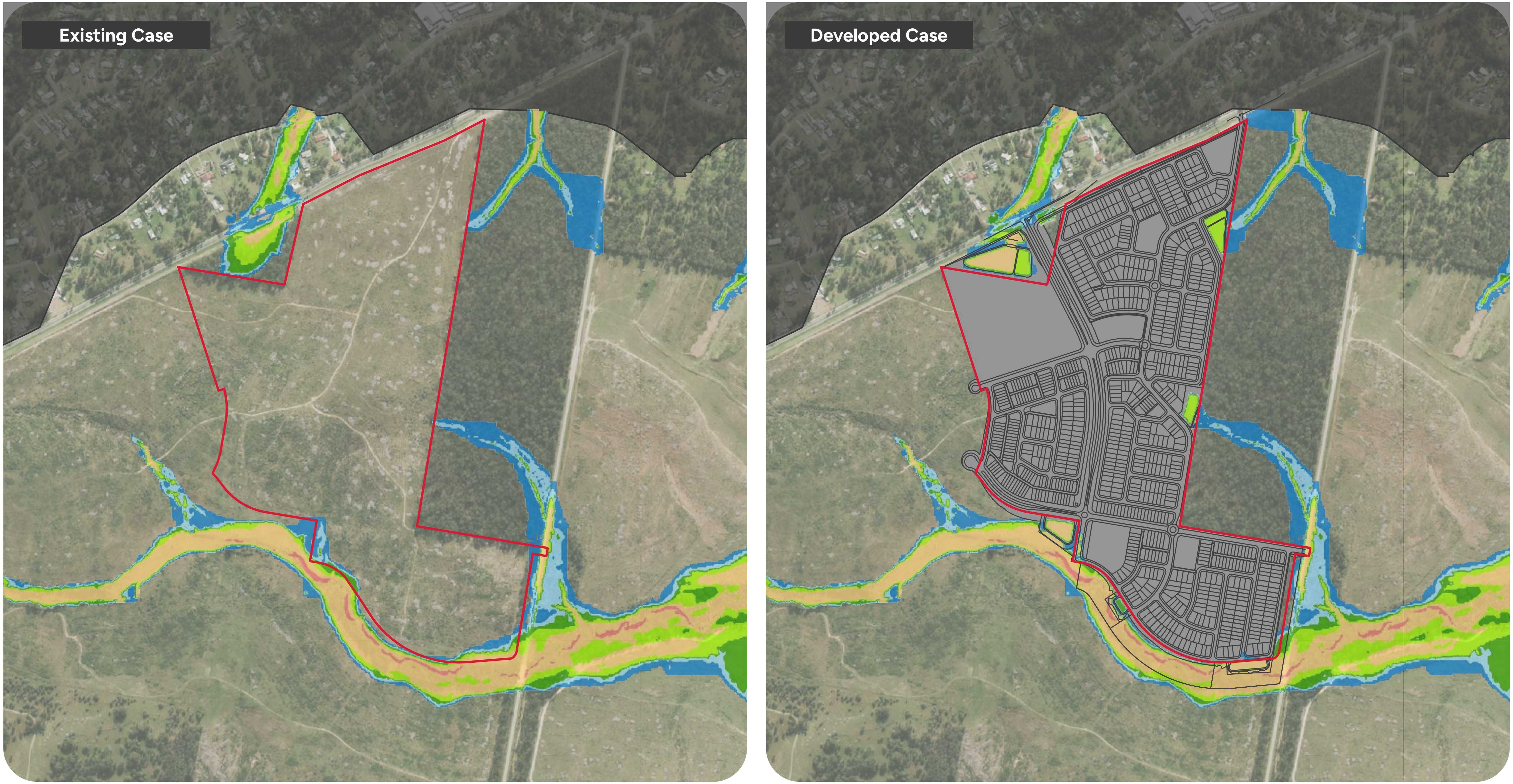

Figure C5-3

PMF
Local Catchment
Flood Hazard

Legend

- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Flood Hazard

- H1
- H2
- H3
- H4
- H5
- H6

N
EPSG:28356
Scale 1:10000
0 100 300 m

Riverbend Precinct 1
(NL230370)

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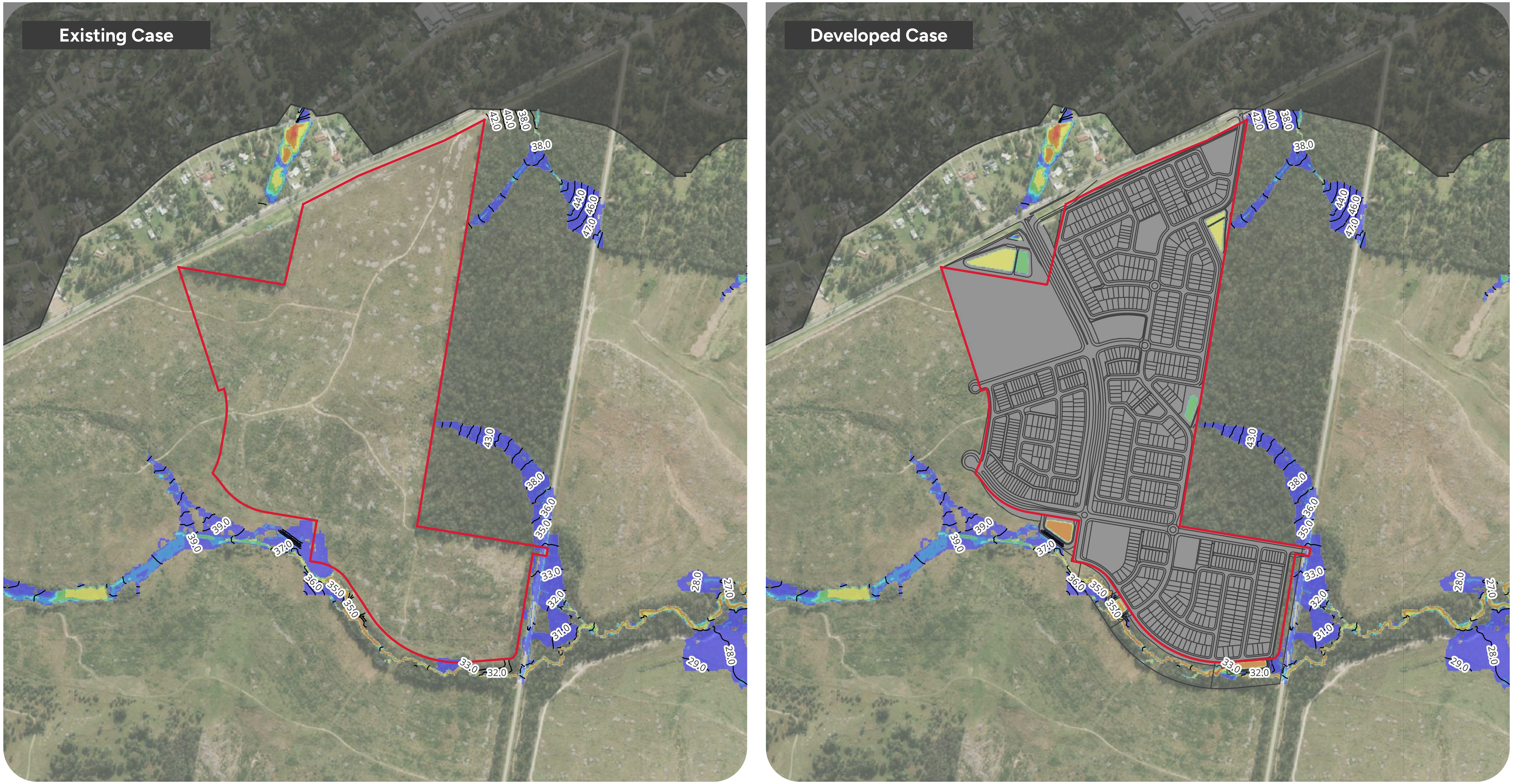


Figure C6-1

63% AEP
Local Catchment
Flood Depth and Elevation

Legend

- Contours (1M)
- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

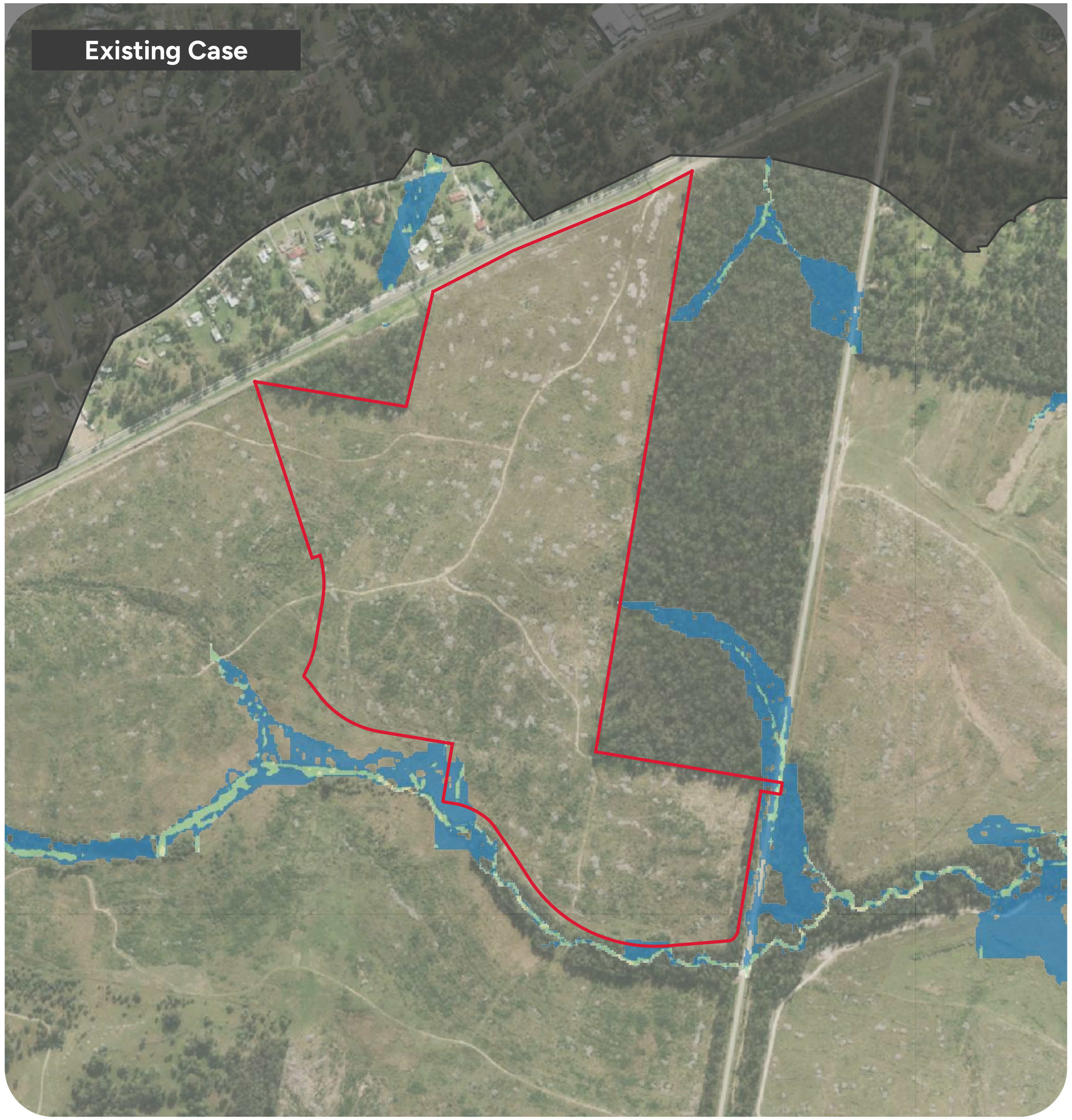
Flood Depth (m)

- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- Greater than 2.0

N
EPSG:28356
Scale 1:10000
0 100 300 m

Riverbend Precinct 1
(NL230370)

NORTHROP



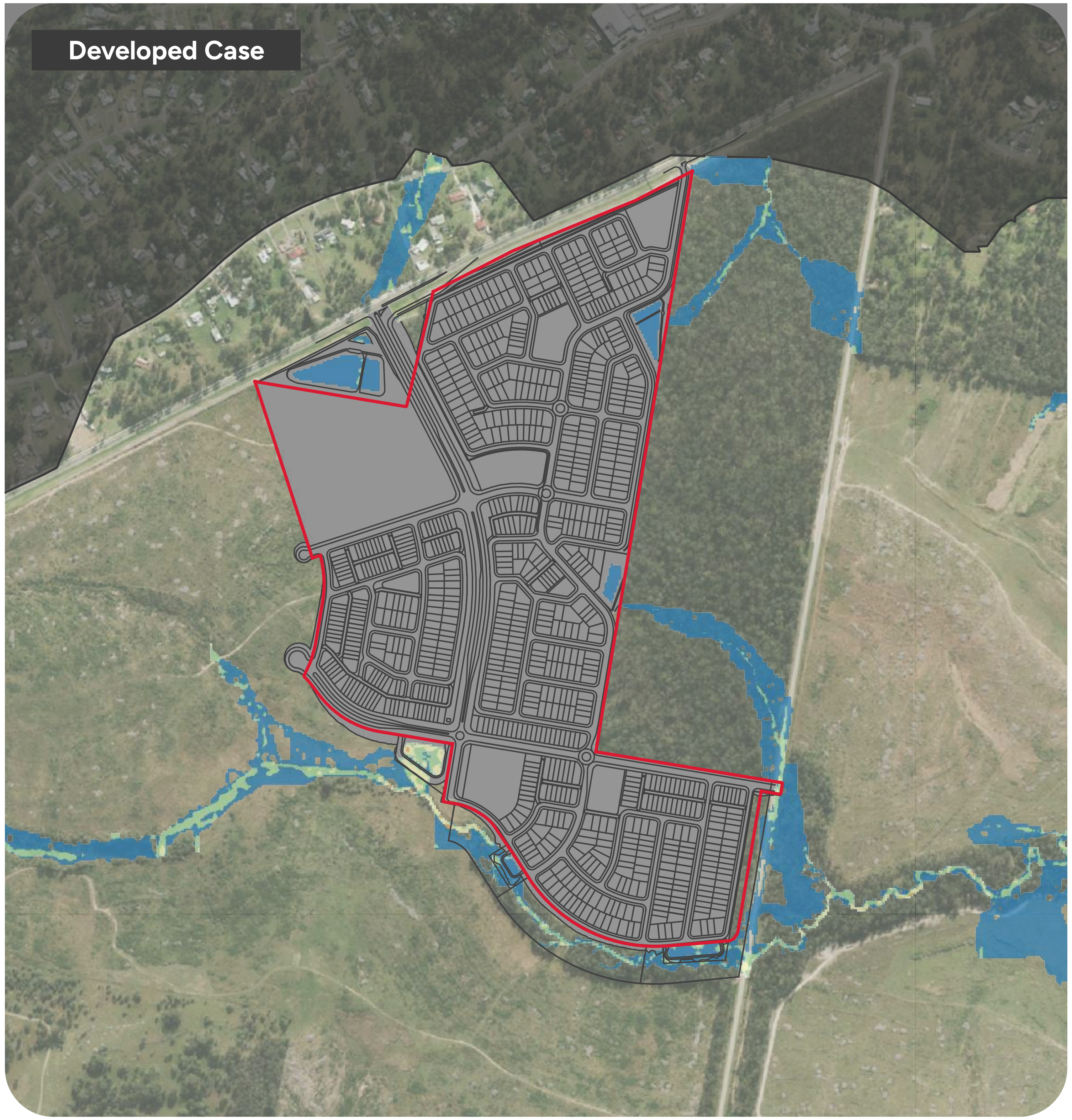


Figure C6-2

63% AEP
Local Catchment
Flood Velocity

Legend

- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Velocity (m/s)

- < 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- 4.0 - 6.0
- > 6.0

N

EPSG:28356
Scale 1:10000
0 100 300 m

Riverbend Precinct 1
(NL230370)

NORTHROP

Legend

- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Elevation Difference (m)

- <= -0.50
- -0.50 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.02
- 0.02 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.40
- > 0.40

Wet/Dry Comparison

- was wet now dry
- was dry now wet

20% AEP
Pre to Post Comparison
Flood Elevation Difference

Figure C7-1

Riverbend Precinct 1
(NL230370)

NORTHROP

Legend

- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Elevation Difference (m)

- <= -0.50
- -0.50 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.02
- 0.02 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.40
- > 0.40

Wet/Dry Comparison

- was wet now dry
- was dry now wet

10% AEP
Pre to Post Comparison
Flood Elevation Difference

Figure C7-2

Riverbend Precinct 1
(NL230370)

NORTHROP

1/4/2026 \\192.168.5.11\ncl-nas5\FLOODING\PROJECTS\NEWCASTLE\YEAR 2023 Jobs\NL230370 - Riverbend - Logan River\PRECINCT 1\QGIS\260225 Updated Layout\Precinct1_DEV07_Figures.qgz

Legend

- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Elevation Difference (m)

- <= -0.50
- -0.50 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.02
- 0.02 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.40
- > 0.40

Wet/Dry Comparison

- was wet now dry
- was dry now wet

5% AEP
Pre to Post Comparison
Flood Elevation Difference

Figure C7-3

Riverbend Precinct 1
(NL230370)

NORTHROP

1/4/2026 \\192.168.5.11\ncl-nas5\FLOODING\PROJECTS\NEWCASTLE\YEAR 2023 Jobs\NL230370 - Riverbend - Logan River\PRECINCT 1\QGIS\260225 Updated Layout\Precinct1_DEV07_Figures.qgz

Legend

- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Elevation Difference (m)

- <= -0.50
- -0.50 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01 - 0.01
- 0.01 - 0.02
- 0.02 - 0.03
- 0.03 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.40
- > 0.40

Wet/Dry Comparison

- was wet now dry
- was dry now wet

1% AEP
Pre to Post Comparison
Flood Elevation Difference

Figure C7-4

Riverbend Precinct 1
(NL230370)

NORTHROP

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Legend

- Development Layout
- Precinct 1 Stage Boundary
- Tuflow Extent

Velocity Difference (m/s)

- <= -0.50
- -0.50 - -0.10
- -0.10 - -0.05
- -0.05 - -0.03
- -0.03 - -0.02
- -0.02 - -0.01
- -0.01- 0.01
- 0.01 - 0.02
- 0.02 - 0.03
- 0.03 - 0.5
- 0.05 - 0.10
- 0.10 - 0.50
- >0.50

Wet/Dry Comparison

- was wet now dry
- was dry now wet

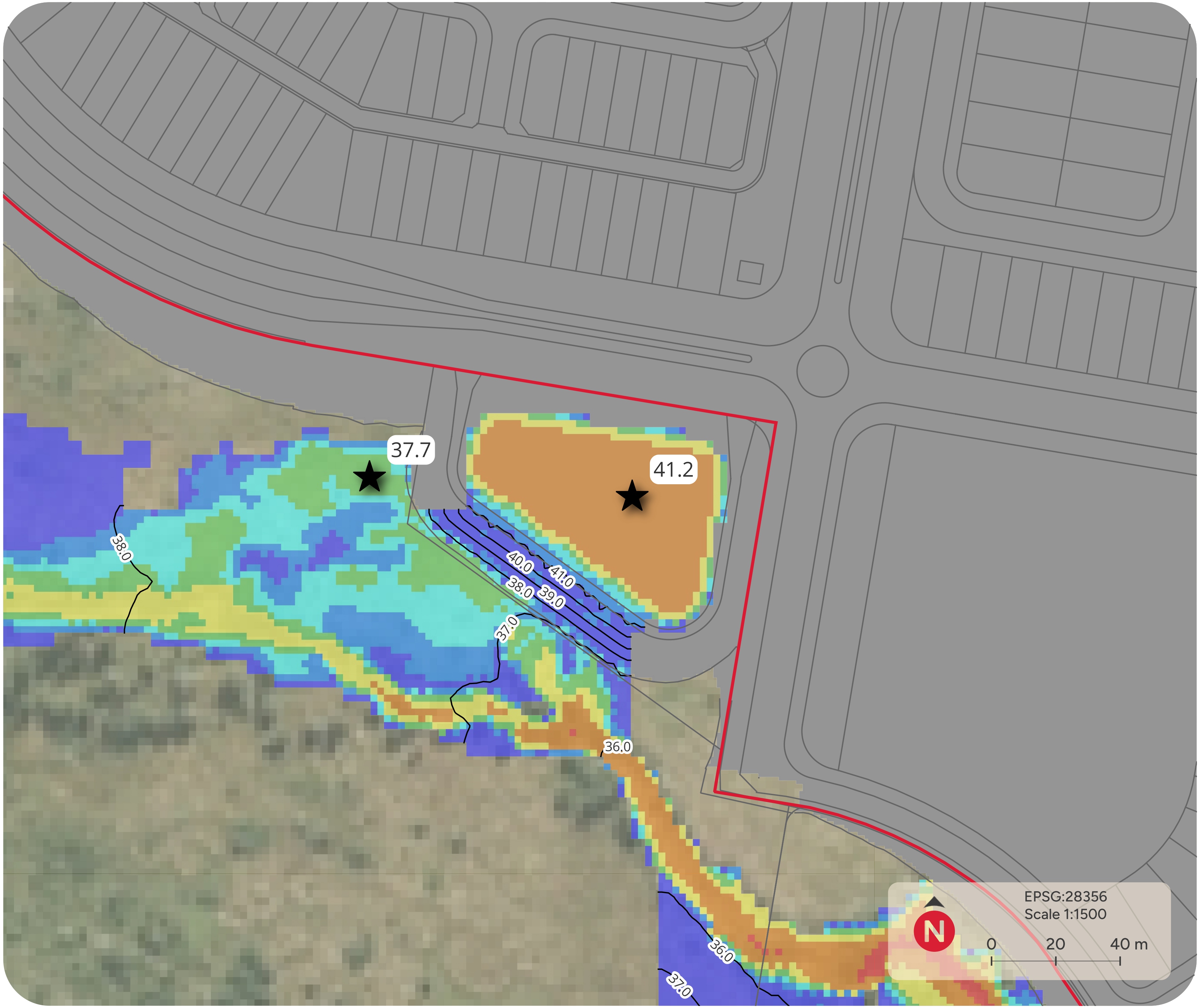
63% AEP
Pre to Post Comparison
Flood Velocity Difference

Figure C8-1

Riverbend Precinct 1
(NL230370)

NORTHROP

1/4/2026 \\192.168.5.11\ncl-nas5\FLOODING\PROJECTS\NEWCASTLE\YEAR 2023 Jobs\NL230370 - Riverbend - Logan River\PRECINCT 1\QGIS\260225 Updated Layout\Precinct1_DEV07_Figures.qgz



Legend

- Precinct 1 Stage Boundary
- Contours (1M)
- Elevation Level (m AHD)

Flood Depth (m)

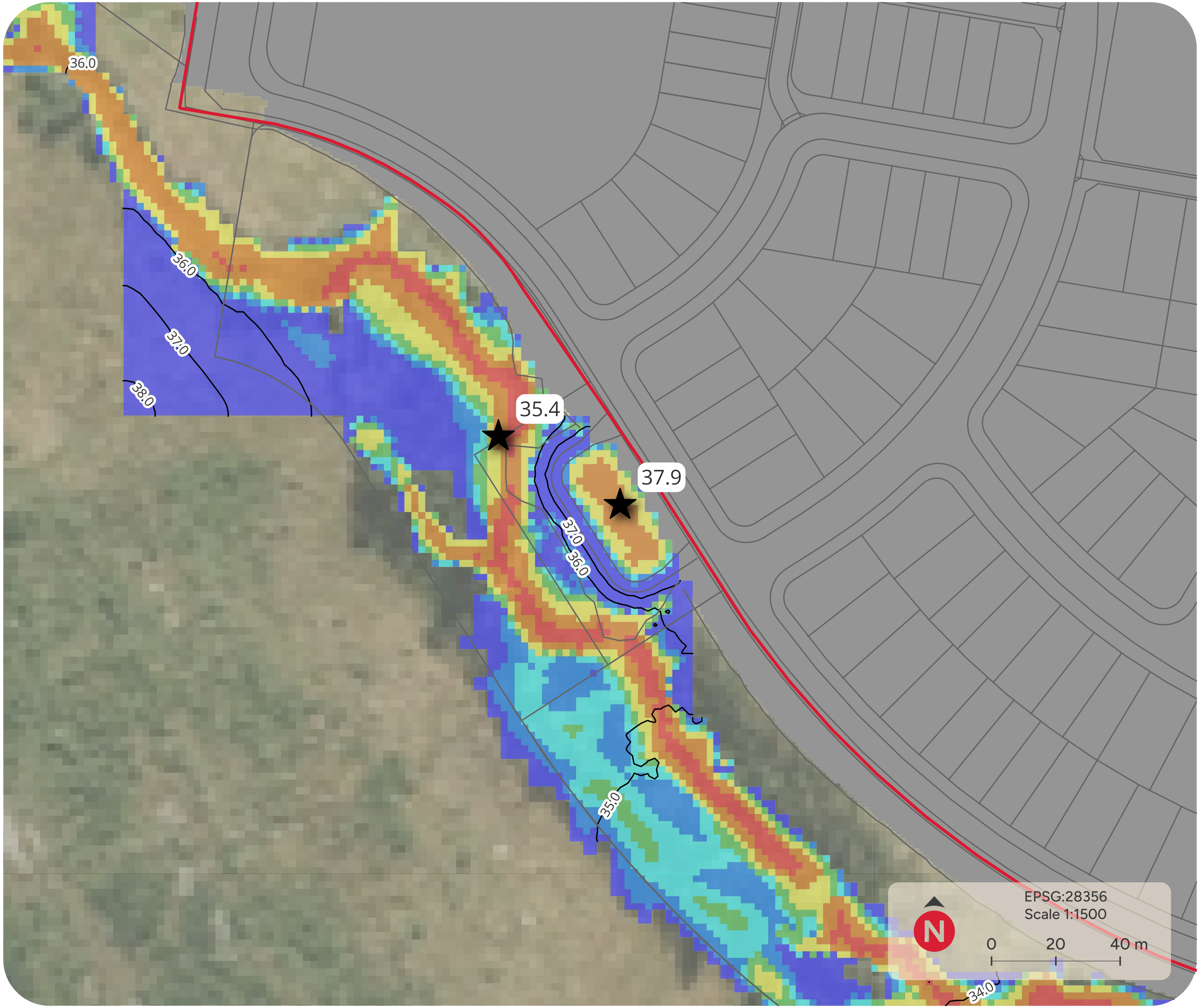
- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- Greater than 2.0

5% AEP
Basin WQ8
Flood Depth and Elevation

Figure D3-1

Riverbend Precinct 1
(NL230370)

NORTHROP



Legend

- Precinct 1 Stage Boundary
- Contours (1M)
- Elevation Level (m AHD)

Flood Depth (m)

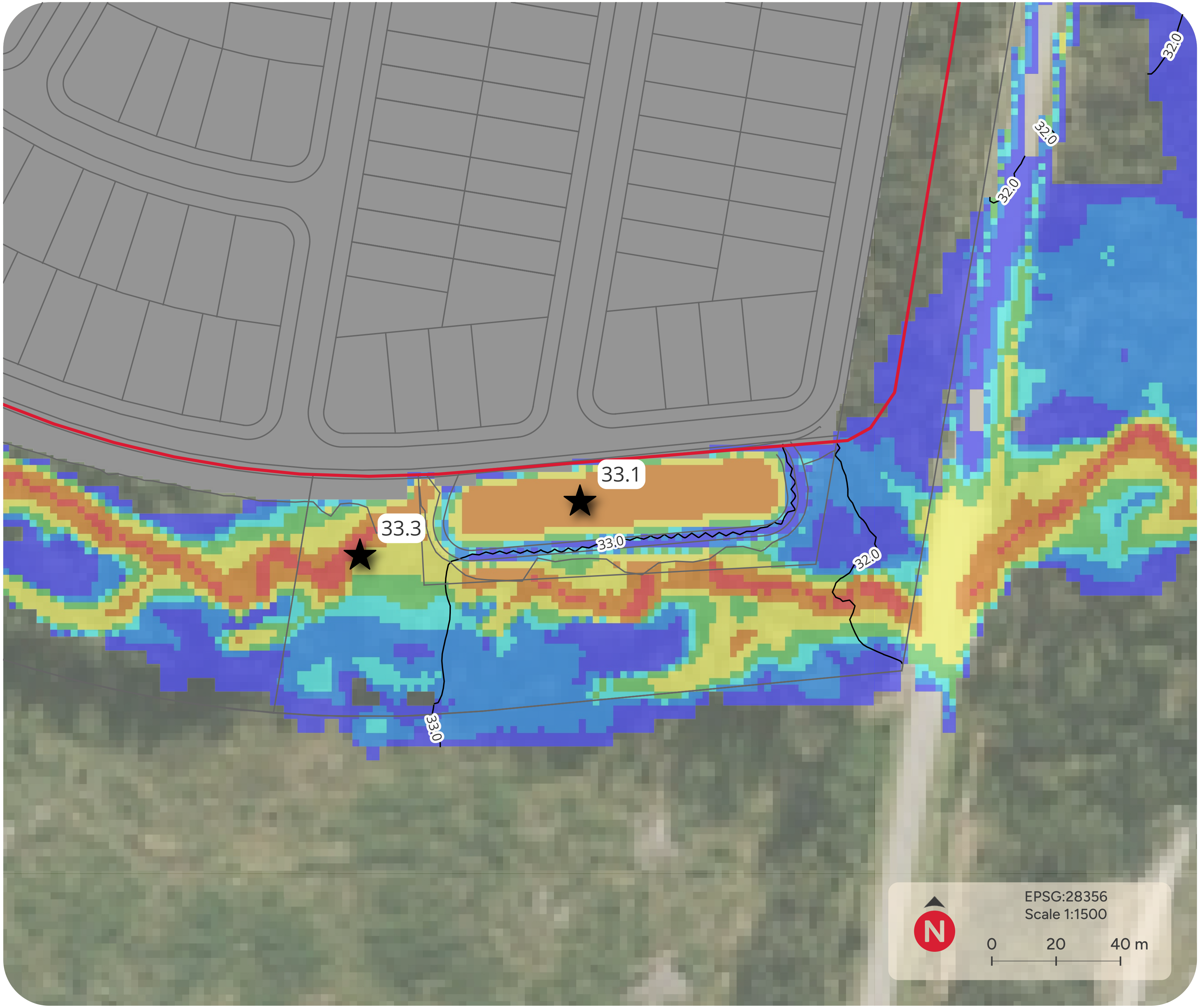
- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- Greater than 2.0

5% AEP
Basin WQ11
Flood Depth and Elevation

Figure D3-2

Riverbend Precinct 1
(NL230370)

NORTHROP



Legend

- Precinct 1 Stage Boundary
- Contours (1M)
- Elevation Level (m AHD)

Flood Depth (m)

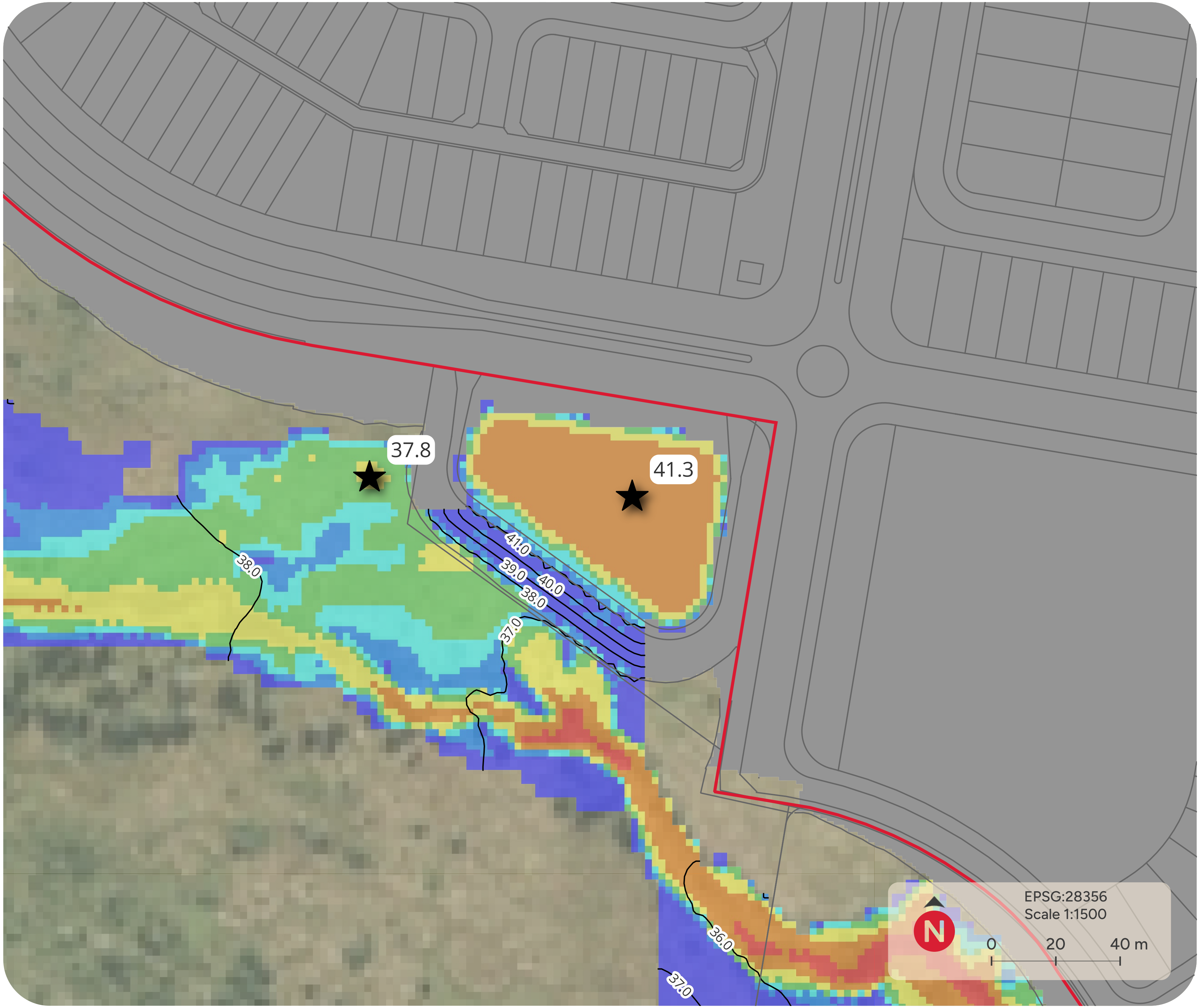
- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- Greater than 2.0

5% AEP
Basin WQ15
Flood Depth and Elevation

Figure D3-3

Riverbend Precinct 1
(NL230370)

NORTHROP



Legend

Precinct 1 Stage Boundary
Contours (1m)
Elevation Level (m AHD)

Flood Depth (m)

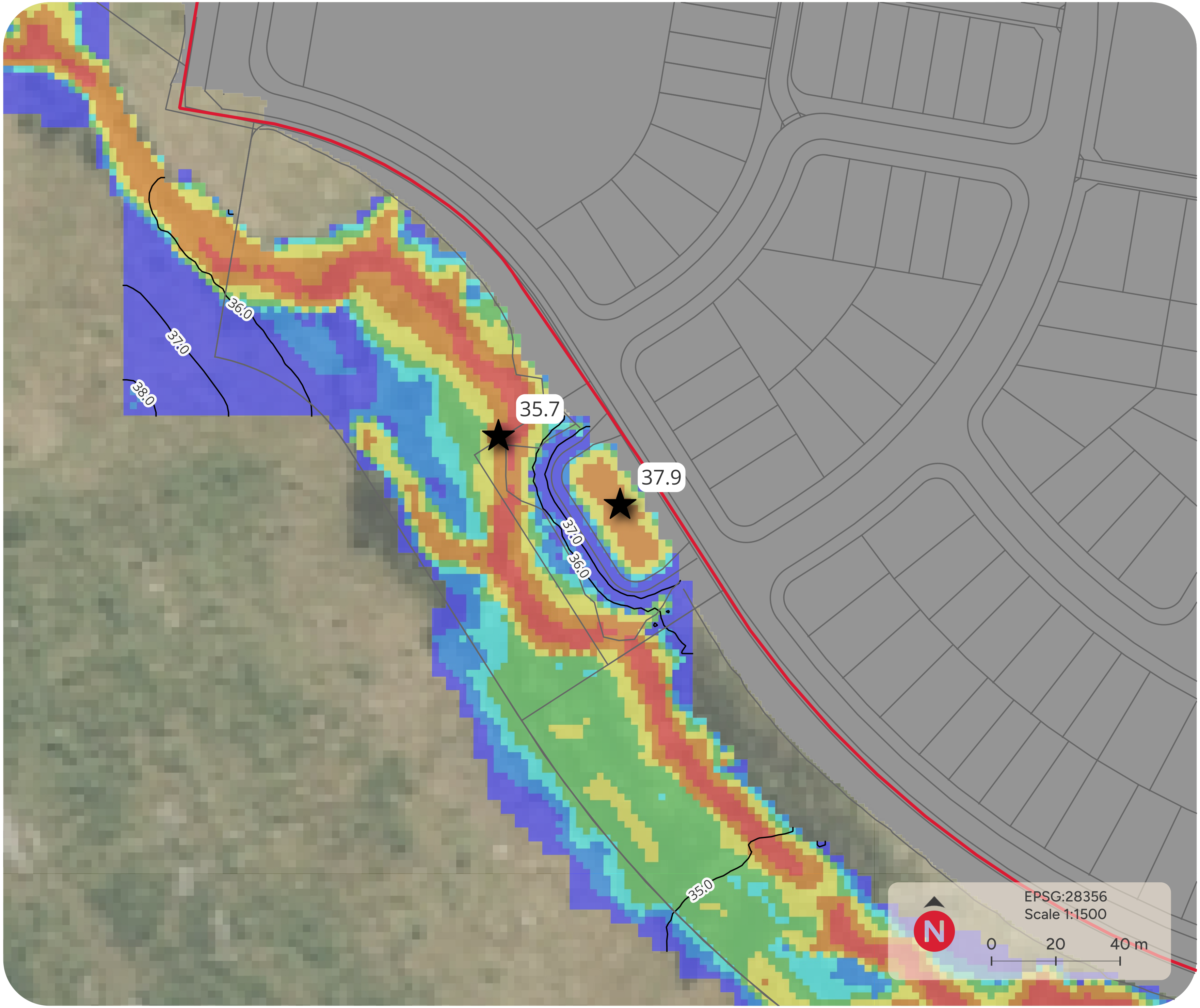
- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- Greater than 2.0

1% AEP Basin WQ8 Flood Depth and Elevation

Figure D4-1

Riverbend Precinct 1
(NL230370)

NORTHROP



Legend

Precinct 1 Stage Boundary
Contours (1m)
Elevation Level (m AHD)

Flood Depth (m)

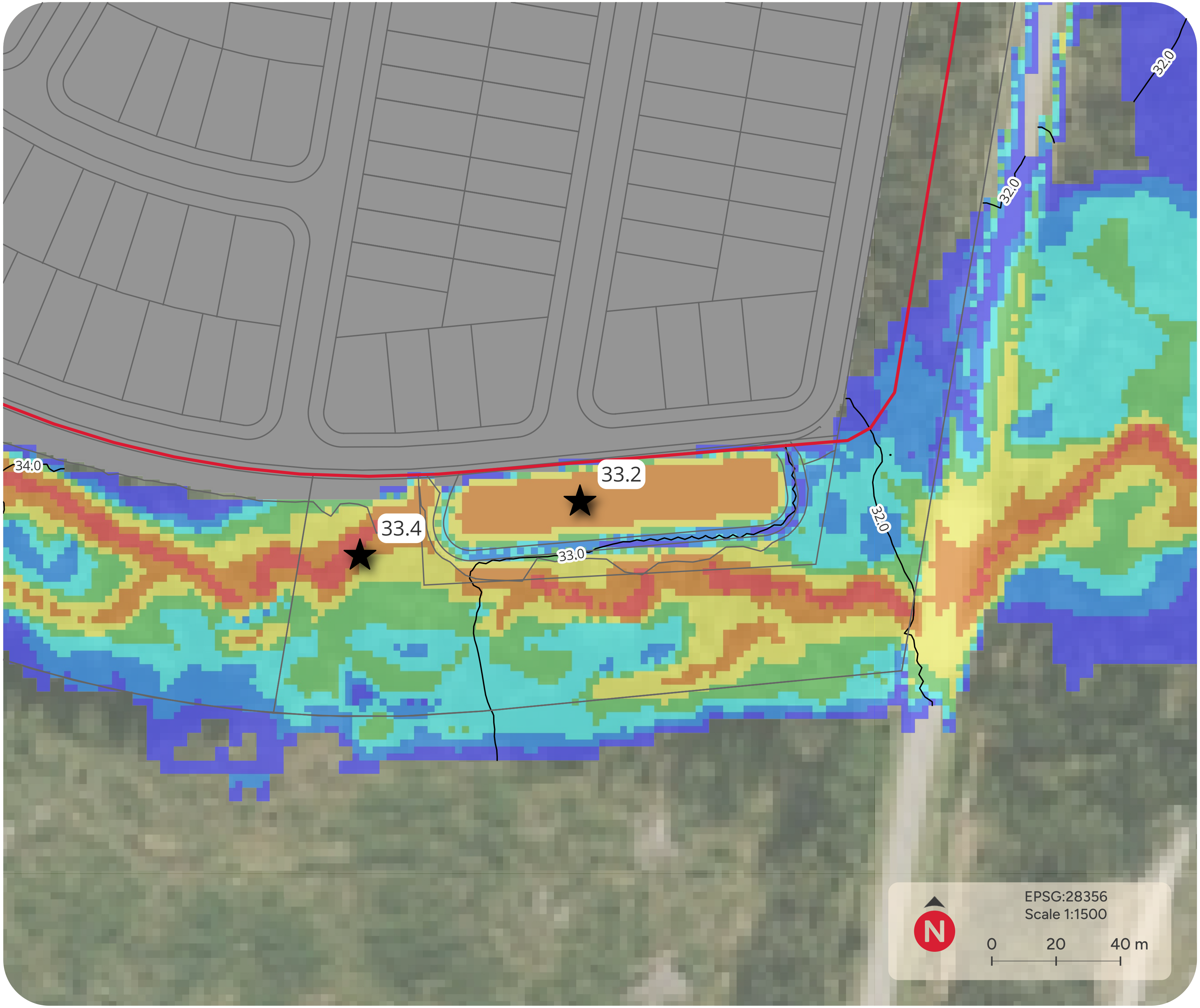
- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- Greater than 2.0

1% AEP
Basin WQ11
Flood Depth and Elevation

Figure D4-2

Riverbend Precinct 1
(NL230370)

NORTHROP



Legend

- Precinct 1 Stage Boundary
- Contours (1m)
- ★ Elevation Level (m AHD)

Flood Depth (m)

- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- Greater than 2.0

1% AEP Basin WQ15 Flood Depth and Elevation

Figure D4-3

Riverbend Precinct 1 (NL230370)

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