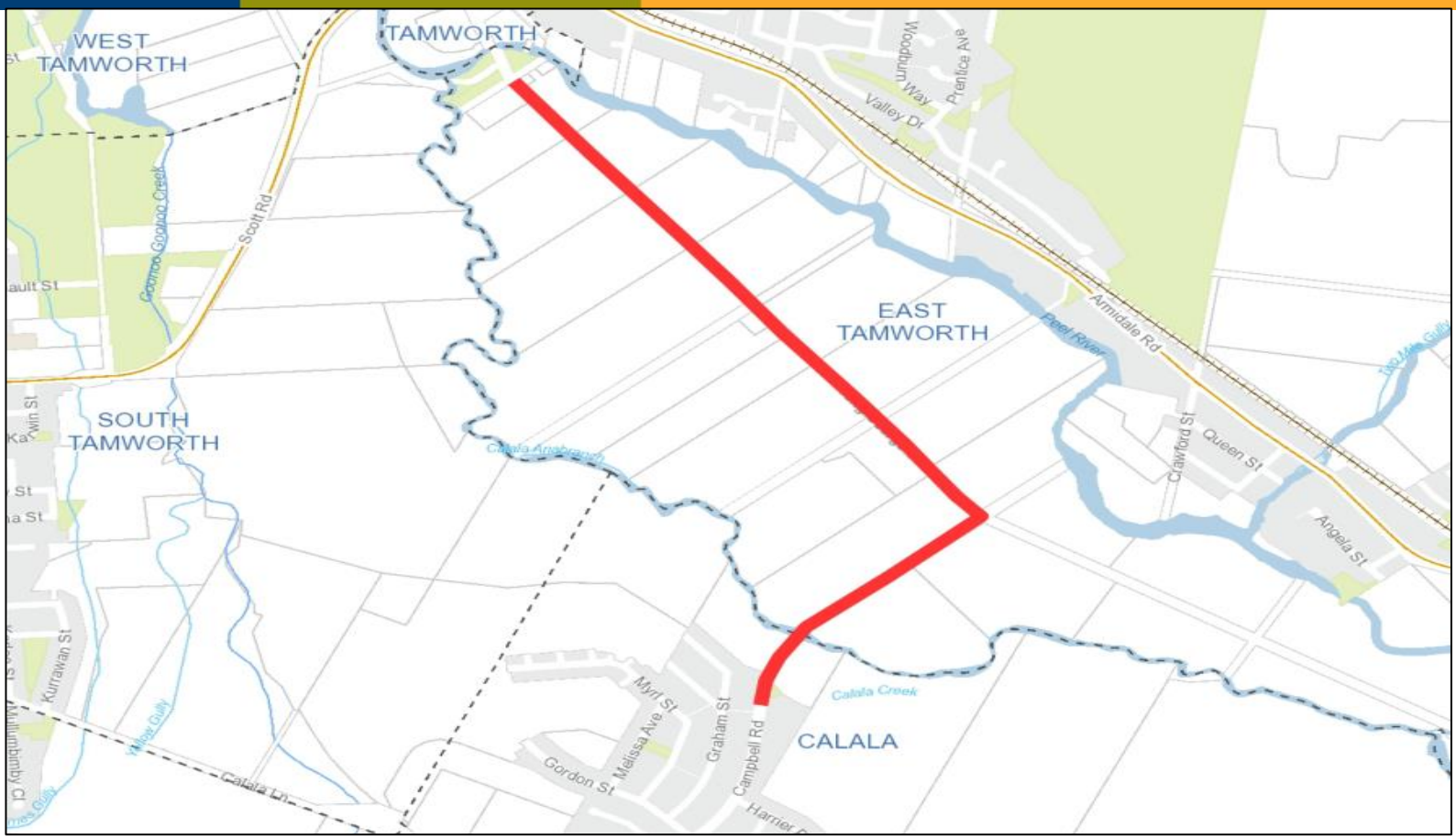

Preliminary Hydraulic Study

Calala to CBD Recreational Path Feasibility Study

DSJN1429 – Preliminary Hydraulic Study

Regional Services

Strategy, Assets and Design

Tamworth REGIONAL COUNCIL

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1 Introduction

1.1 Scope of the Study

Hydraulic analysis has been undertaken to determine the 1% Annual Exceedance Probability (AEP) and 0.05% AEP flood levels and velocities in Calala Creek at the Proposed Bridge and on King George V Avenue along the length of the proposed path. Hydrology of Peel River and Cockburn River was included in the Tamworth City-Wide Flooding Investigation prepared by Lyall and Associates (2019) and are considered reasonable for use for this study area to simulate the Citywide study results. Manning's Roughness coefficient 'n' was calibrated to achieve a reasonable average value for the floodplain. Flood Hydraulics were addressed using a 2D HEC-RAS model.

1.2 Location of the Site

The location of this study site is shown below in Figure 1. Proposed Bridge is approximately 3.6km south east of Tamworth CBD.

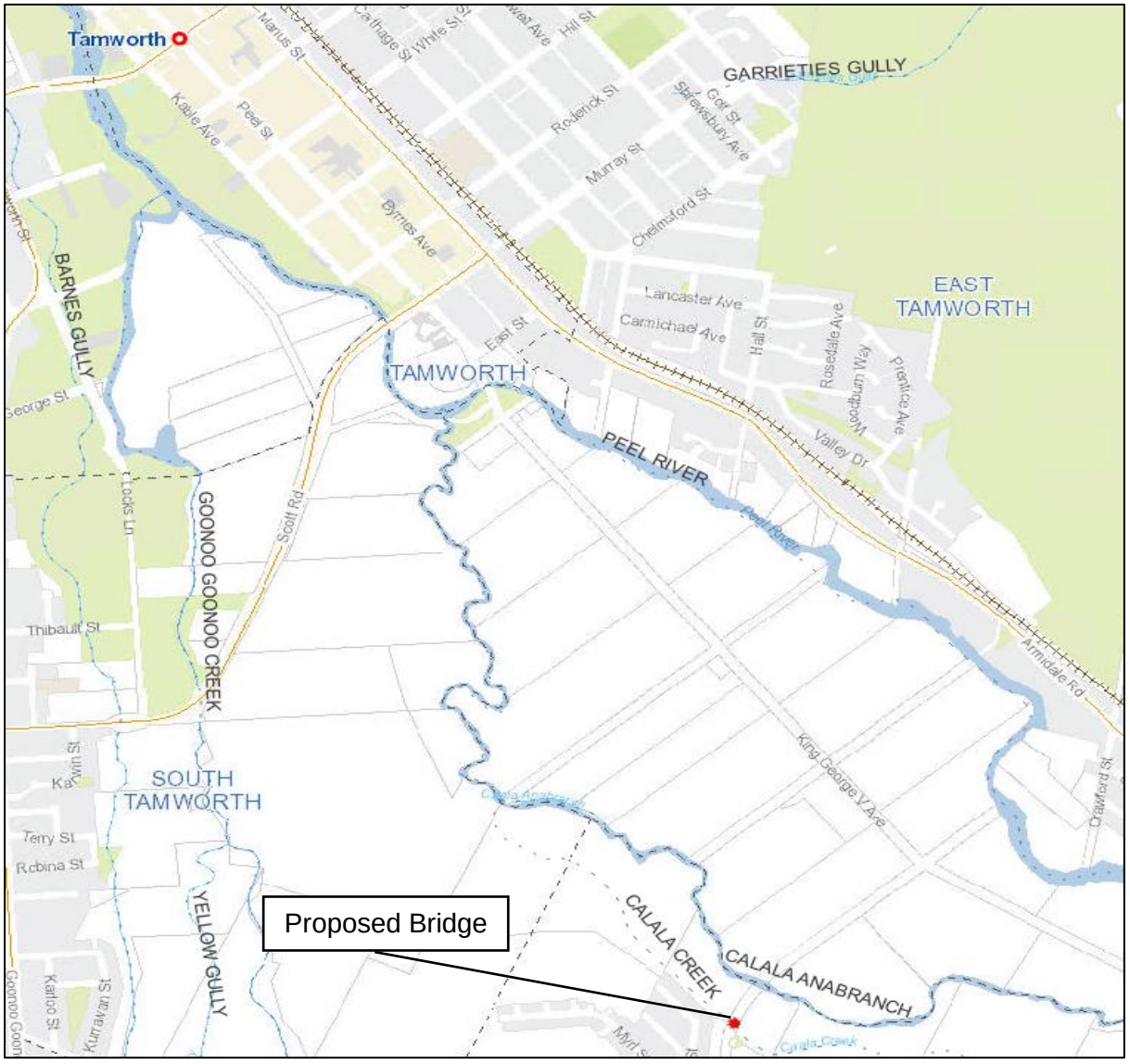

Figure 1 - Site Locality

2 Hydrology

Hydrology was adopted directly from the Tamworth City-Wide Flooding Investigation.

3 Model Inputs

3.1 Storm Hydrograph

The hydraulic model was assessed using the following hydrograph (Figure 2) for the 1% AEP event for Cockburn and Peel River. The 1% AEP input hydrograph data is provided within Appendix A – **Storm Hydrograph Data**.

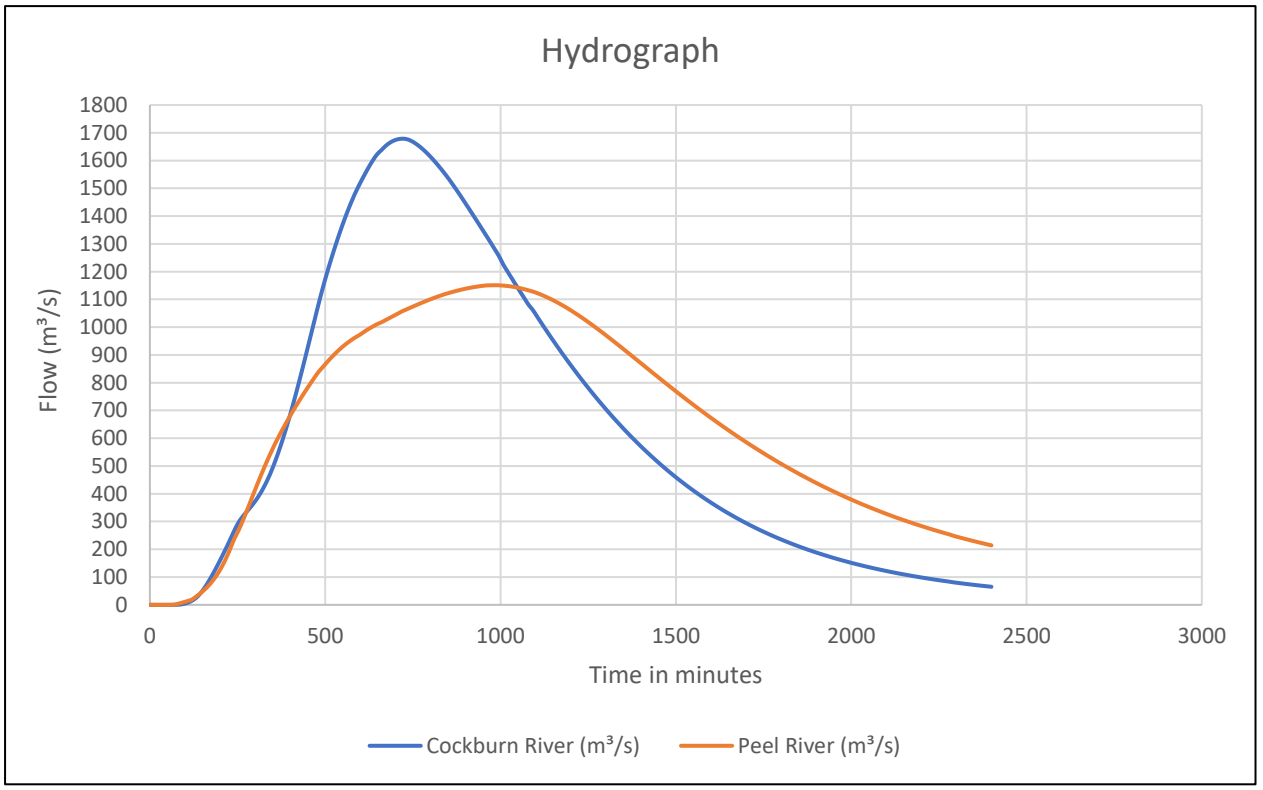

Figure 2 - Storm Hydrograph for 1% and 0.05% AEP Events

The indicative 0.05% AEP flows for both the Cockburn and Peel River were also calculated by doubling the flow values for the 1% AEP Hydrograph. Table 1 below includes the peak flows for each of the design event AEPs.

Table 1 – Peak Flows for 2%, 1% and 0.05% AEP Events

	$Q_{1\%}$	$Q_{0.05\%}$
Cockburn River Peak Flow	1679 m³/s	3358 m³/s
Peel River Peak Flow	1151 m³/s	2302 m³/s

3.2 Upstream and Downstream Boundary

The floodplain hydraulics were modelled to approximately 3km upstream and 2km downstream of the bridge to limit the effect of the downstream boundary condition on the study. A flow hydrograph was applied to the upstream boundary condition (BC) with a 0.1% slope for distributing flow along BC line. A normal depth boundary condition was applied to the downstream boundary with a friction slope of 0.08%.

3.3 Manning's n

Manning's Roughness coefficient 'n' was calibrated to achieve a reasonable average value for the floodplain study area compared to the citywide flood study results. The adopted manning's n value of **0.0475** was used for the 2D HEC-RAS model.

The values adopted are similar to the values used in the Tamworth City Wide Study as shown in the Table 2 below – Table 4.4 from the City-Wide Flooding Investigation.

Table 2 – Calibrated Hydraulic Roughness Values (Lyall and Associates 2019)

Surface Treatment	Manning's n Value	
	Historic Flood Events	Design Flood Events
Concrete surfaces (including piped elements)	0.015	0.015
Asphalt or concrete road surface	0.02	0.02
Creek and river bed	0.03	0.045
Lightly vegetated creek bed	**0.04**	**0.05**
Overbank areas, floodplain, including grass and lawns	**0.045**	**0.045**
Macrophytes	0.06	0.06
Heavily vegetated creek bank, trees/shrubs	0.05	0.08
Allotments (between buildings)	0.1	0.1
Buildings	10	10

3.4 Elevation Model

A 2D HEC-RAS model was developed using the TRC 0.5m LIDAR DEM. A 10m cell size was applied to the whole model, adjacent to break lines at the top of bank, existing contour banks and road centre line; as shown below Figure 3.

Terrain Model

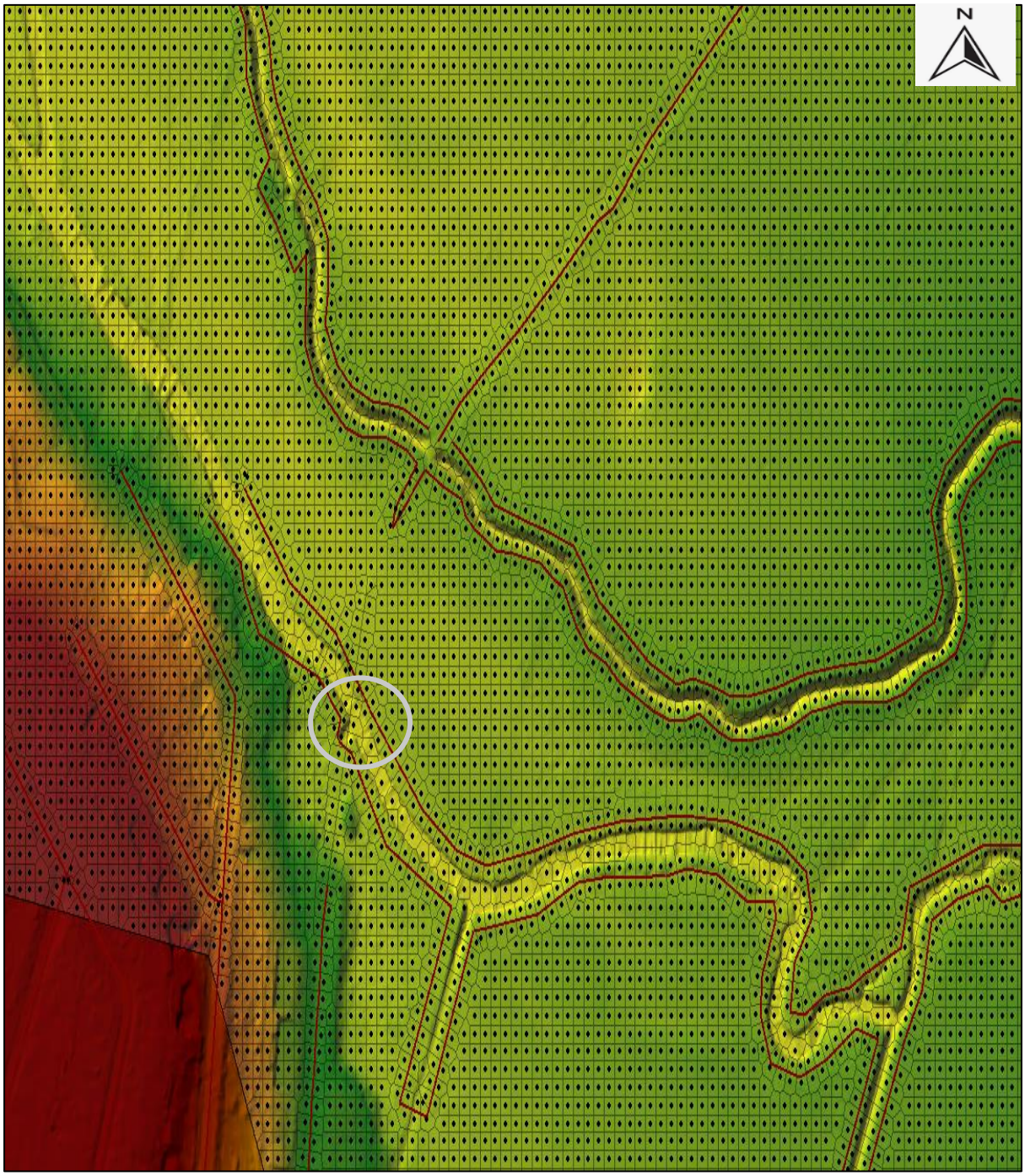

Figure 3 - HEC-RAS 2D Model near Proposed Bridge

3.5 Model Geometry

The proposed bridge has been modelled with the following geometric design:

- Bridge Deck has been modelled at a Reduced Level (RL) of **383.3m**
- Pylons/Towers have been assumed to have negligible impact on the flood levels and thus has not been modelled
- Bridge approaches has been assumed to have a 10H:1V slope
- Single span proposed bridge has the following geometry:
    - Superstructure depth assumed to be 1m
    - Balustrade Depth assumed to be 1m
- Figure 4 is a snippet of the bridge deck and roadway embankment geometry

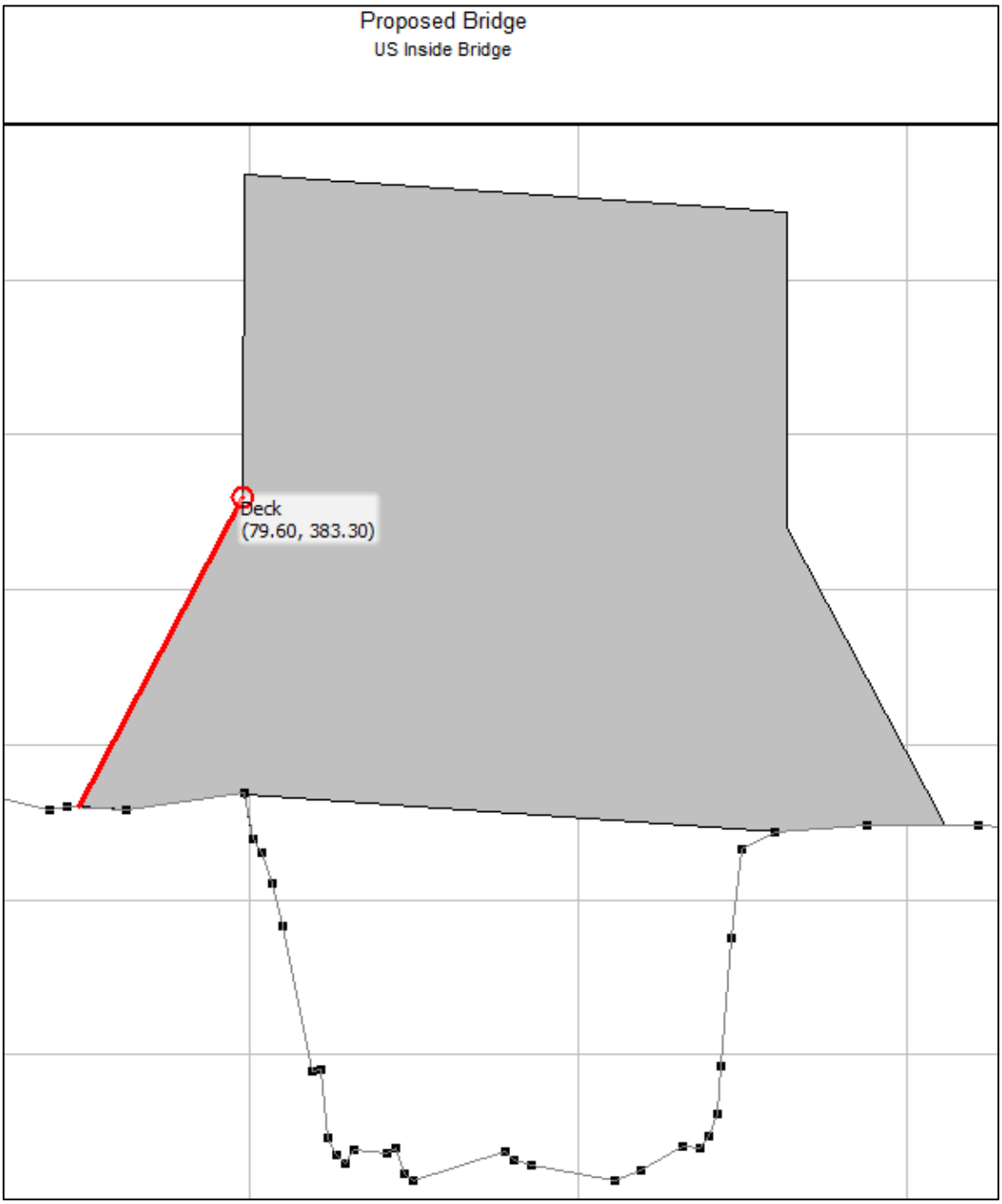

Figure 4 - Bridge Deck and Road Embankment as modelled in HEC-RAS

- Figure 5 provides the Deck/Roadway Station and Elevation values as used in HEC-RAS

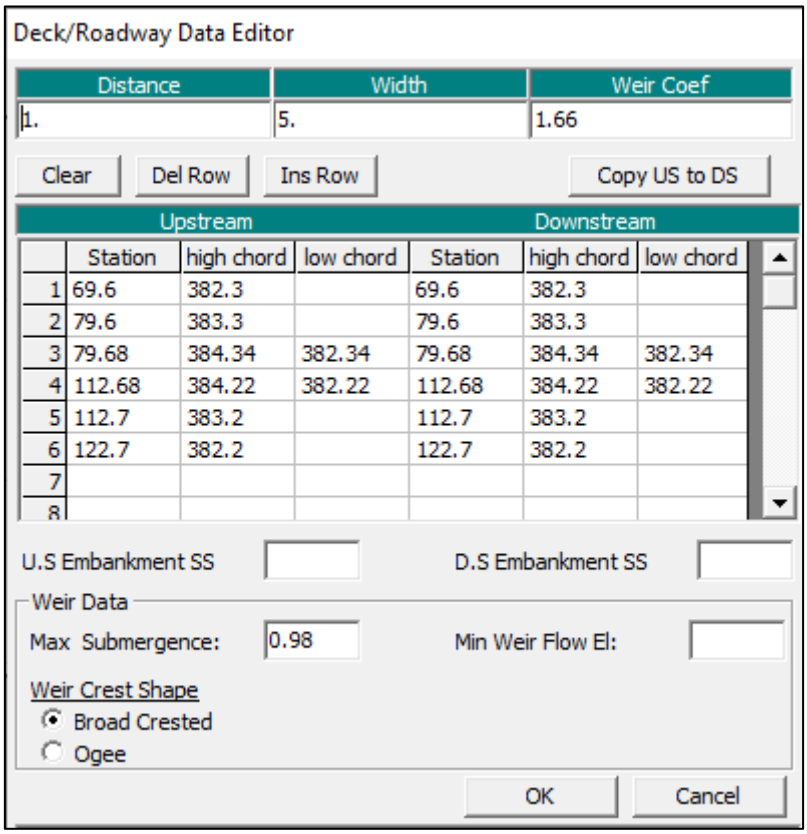

Figure 5 - Deck/Roadway Data Editor

4 Results

4.1 Bridge Modelling

Table 3 shows the **approximate unfactored** peak values of the flood depth and flood velocity at the centre line (CL) of the modelled bridge, for the Bridge opening and the Bridge Abutment/Embankment. See Figure 6 and Figure 7 in Appendix B – Flood Maps for the "1% AEP Flood Depth and Flood Water Surface Contours" in the Existing Conditions and with the inclusion of the Proposed Bridge.

Table 3 – Peak Depth and Velocity values at the Modelled Bridge CL

		$Q_{1\%}$	$Q_{0.05\%}$
Bridge Opening	**Modelled Peak Depth (m)**	3.33 (384.27m AHD)	4.27 (385.21m AHD)
	Modelled Peak Velocity (m/s)	2.16	2.43
Abutment/Embankment	**Modelled Peak Depth (m)**	2.0 (384.21m AHD)	2.95 (385.14m AHD)
	Modelled Peak Velocity (m/s)	1.6	2.0

4.2 Flood Immunity Modelling

A range of flood event probabilities were modelled to determine the flood immunity of the shared recreational path. A 35% AEP (2.32 years Annual Recurrence Interval (ARI)) flood event in the Cockburn and Peel River would make the path inaccessible at King George V Avenue near Paradise Bridge. See Figure 8 in Appendix B – Flood Maps for the Flood Depth Map.

4.3 Proposed Recreational Path

Figure 9 and Figure 10 in Appendix B – Flood Maps shows the Flood Depth and Flood Velocity maps in a 1% AEP event for the entire Proposed Recreational Path.

King George V Avenue: Flood Depth varies from 0.5m to 2m and Flood Velocity varies from 0.75m/s to 1.8m/s.

Campbell Road: Flood Depth varies from 0.01m to 3.33m and Flood Velocity varies from 0.2m/s to 2.16m/s with the maximum values observed at or near the proposed bridge location.

5 Discussion on results:

The inclusion of the proposed bridge in the model has not caused adverse flood impact on the surrounding properties, see Figure 11**Error! Reference source not found.** in Appendix B – Flood Maps for the afflux map. There is negligible change in the extent of flooding with the inclusion of the proposed bridge and insignificant change in the flooding depth as follows:

- There is a decrease in the flooding depth in the downstream vicinity of the proposed bridge in the range of **0 to ~30mm;**
- There is an increase in the flooding depth in the upstream vicinity of the proposed bridge in the range of **0 to ~30mm** which is within the floodplain.

Given the negligible change in extent of flooding and insignificant change in flood depth caused by the proposed bridge, it is acceptable for the project to proceed to the detailed design stage.

Updated bridge modelling and a detailed hydraulic study need to be performed to include the specific bridge geometry and design details at the detailed design stage.

6 Appendix A – Storm Hydrograph Data

Table 4 –Hydrograph Data for 1% AEP Event for Cockburn River

Time Increment (Hour)	1% Flows (m^3/s)
0	0
1	0
2	14.9097
3	111.939
4	265.533
5	372.854
6	526.357
7	777.11
8	1078.18
9	1334.8
10	1519.87
11	1637.29
12	1678.69
13	1638.91
14	1554.4
15	1445.9
16	1328.15
17	1200.29
18	1080.58
19	970.472
20	863.569
21	765.701
22	676.654
23	596.176
24	523.947
25	459.551
26	402.481
27	352.157
28	307.964
29	269.281
30	235.503
31	206.063
32	180.437
33	158.149
34	138.772
35	121.927
36	107.281
37	94.5387
38	83.4459
39	73.42
40	65.0335

Table 5 –Hydrograph Data for 1% AEP Event for Peel River

Time Increment (Hour)	1% Flows (m^3/s)
0	0
1	0
2	19.2225
3	88.134
4	236.018
5	414.325
6	587.766
7	722.962
8	837.344
9	918.781
10	973.666
11	1017.34
12	1057.51
13	1090.27
14	1118.49
15	1138.42
16	1150.28
17	1148.16
18	1132.41
19	1103.18
20	1060.88
21	1009.28
22	951.663
23	890.976
24	829.559
25	769.119
26	710.792
27	655.261
28	602.888

Time Increment (Hour)	1% Flows (m^3/s)
29	553.821
30	508.09
31	465.668
32	426.507
33	390.54
34	357.663
35	327.726
36	300.541
37	275.888
38	253.536
39	232.482
40	214.122

7 Appendix B – Flood Maps

Figure 6 – Existing Conditions 1% AEP Flood Contours (m AHD)

Figure 7 – Proposed Conditions 1% AEP Flood Contours (m AHD)

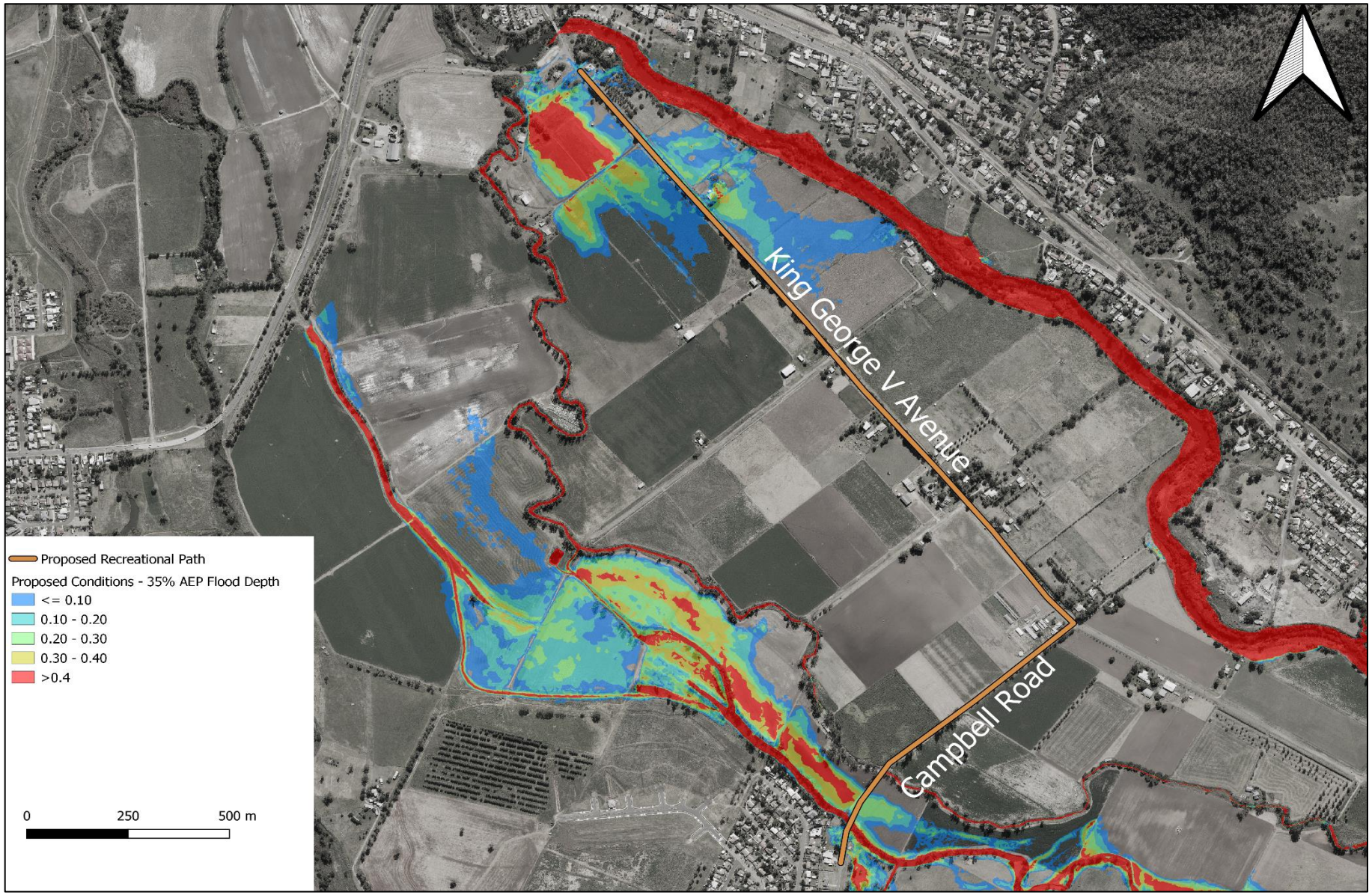

Figure 8 – Proposed Conditions 35% AEP Flood Depth (m)

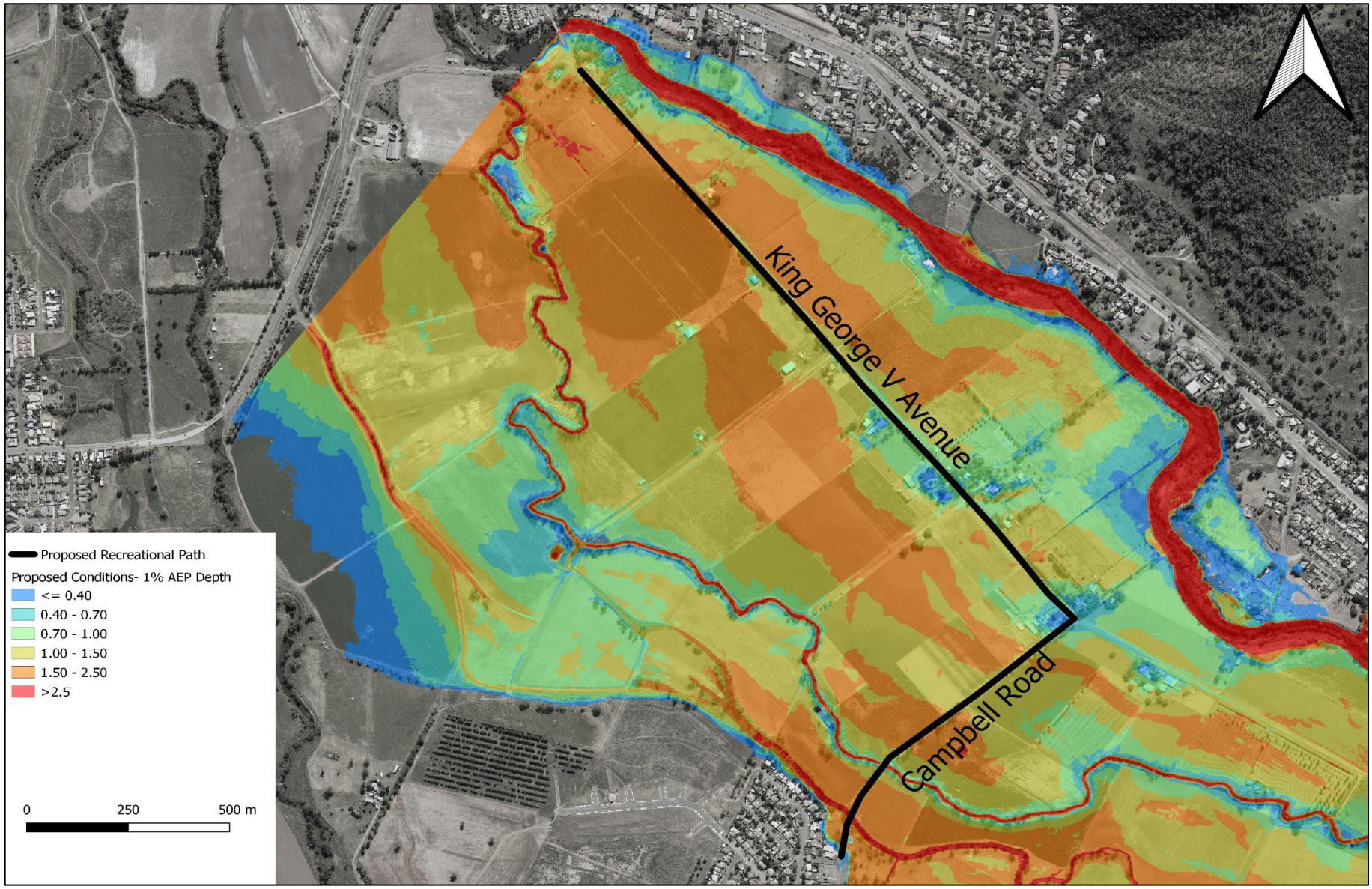

Figure 9 – Proposed Conditions 1% AEP Flood Depth (m)

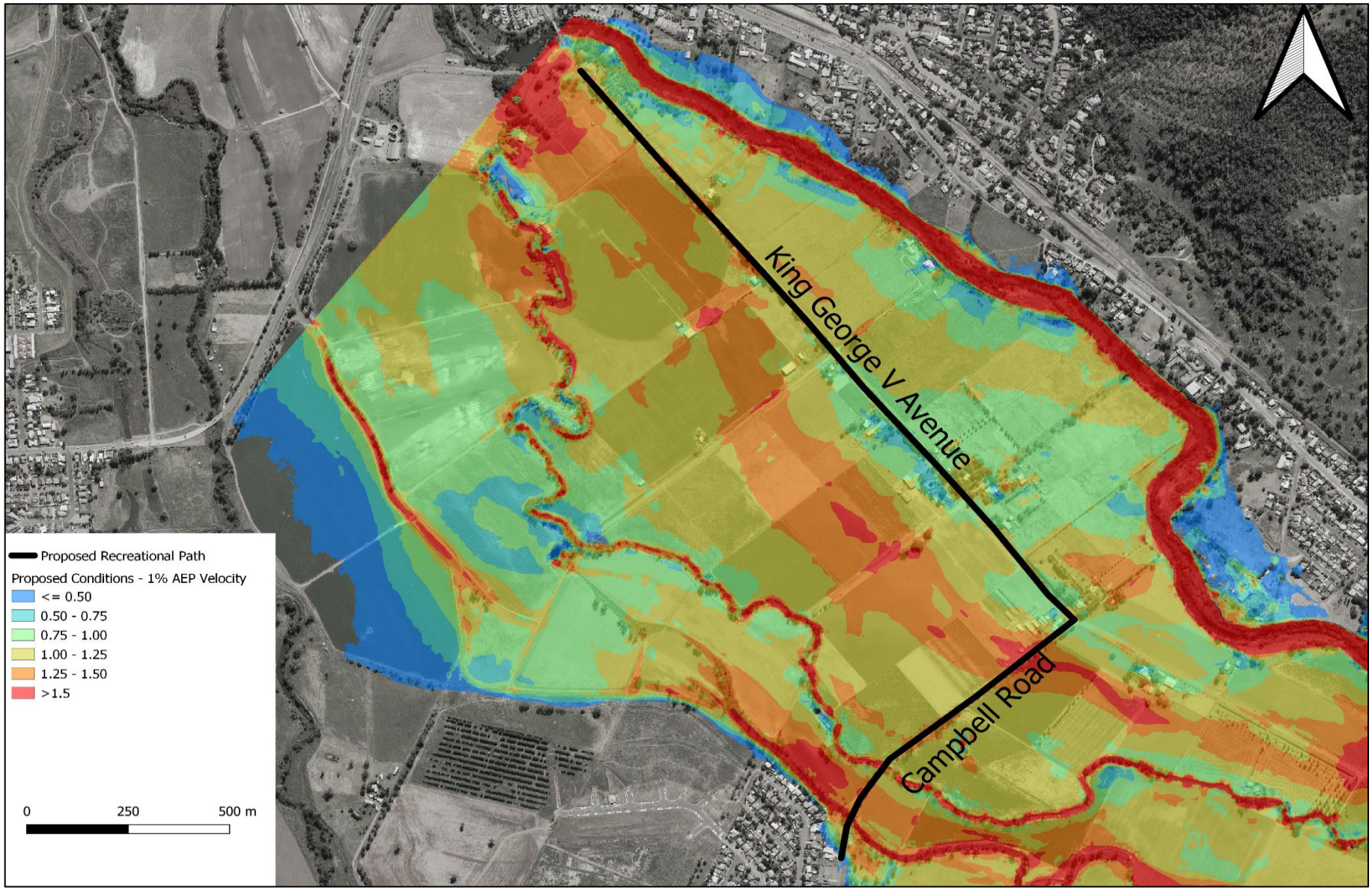

Figure 10 – Proposed Conditions 1% AEP Flood Velocity (m/s)

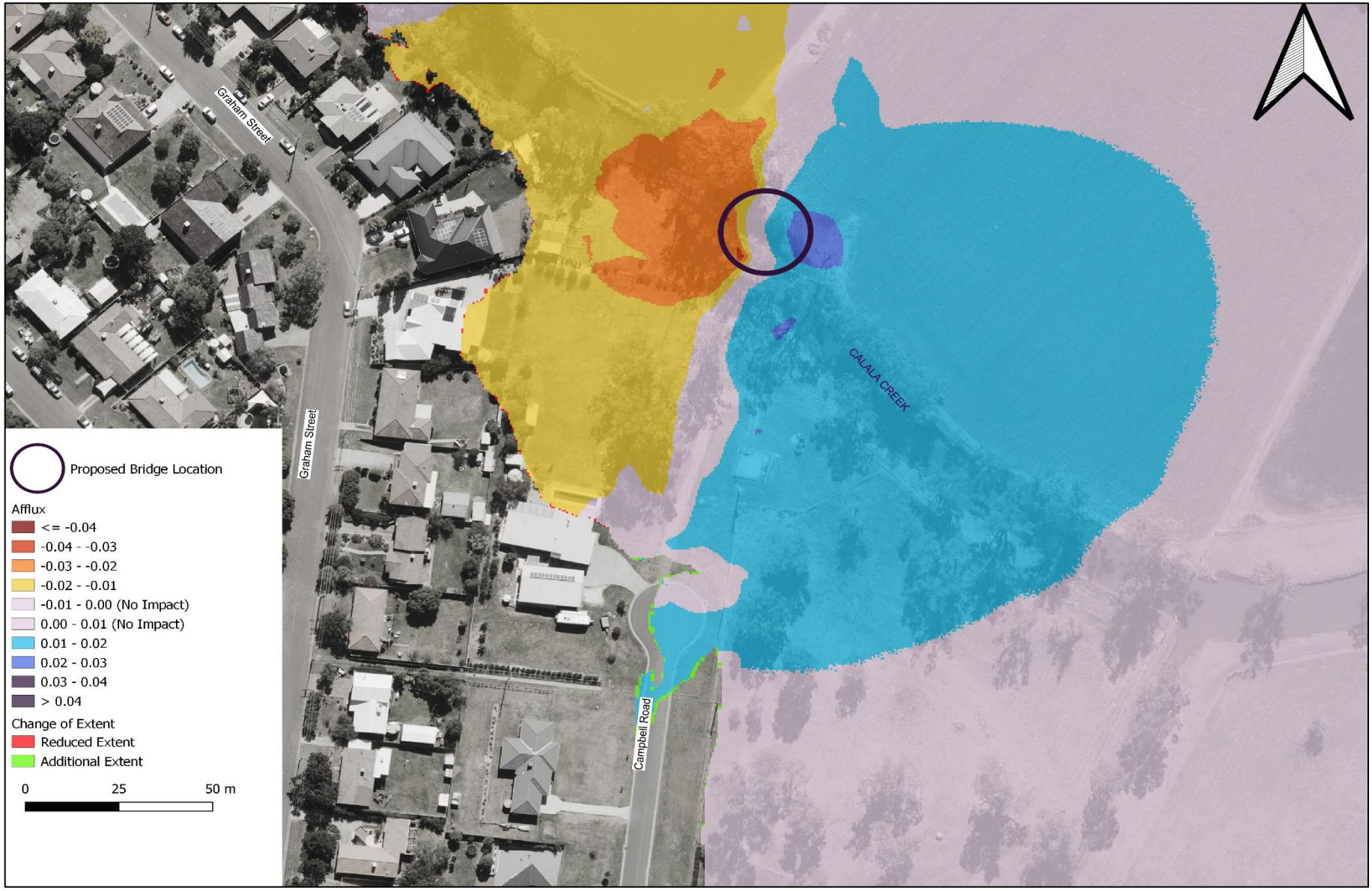

Figure 11 – Flood Afflux 1% AEP (m)

END OF REPORT

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