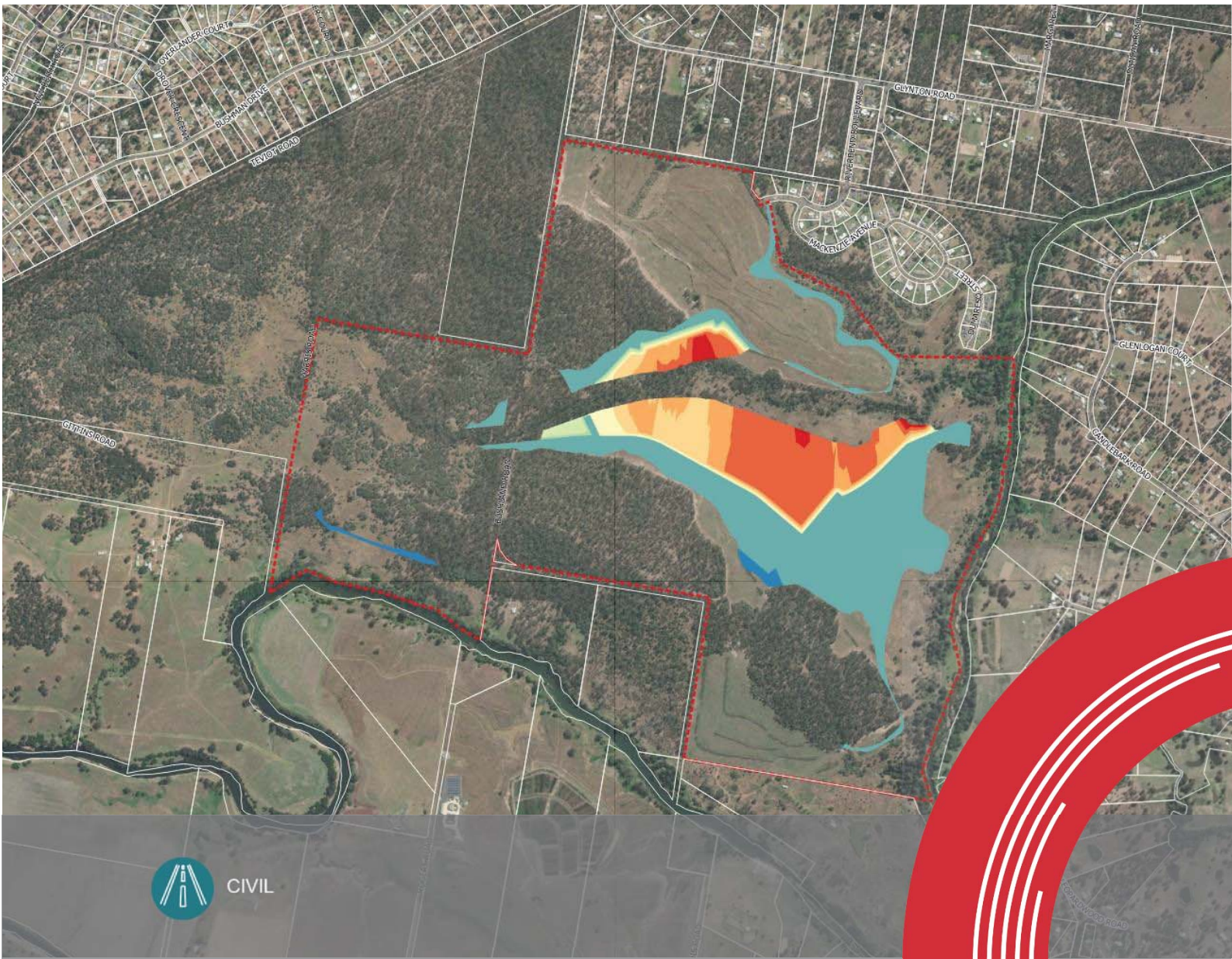




Flood Impact Assessment for Bulk Earthworks OPW

for

Riverbend, Jimboomba

for Celestino Pty Ltd

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Acronyms

2D	Two-Dimensional
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ARR	Australian Rainfall & Runoff
DTM	Digital Terrain Model
EDQ	Economic Development Queensland
FFL	Finished Floor Level
FHOC	Flood Hazard Overlay Code
FPL	Flood Planning Level
ha	Measure of area (hectares)
HPC	Heavy Parallelised Computation
GPU	Graphics Processing Unit
LCC	Logan City Council
LGA	Local Government Area
LiDAR	Light Detection and Ranging
m	Measure of length / height / distance (metres)
mm	Measure of length / height / distance (millimetres)
m/s	Measure of velocity (metres per second)
m ²	Measure of area (square meters)
m ³ /s	Measure of flow rate (cubic metres per second)
m AHD	Metres above Australian High Datum
PDA	Priority Development Area
RCP	Representative Concentration Pathway
TUFLOW	2D hydraulic modelling software

Introduction

Northrop Consulting Engineers Pty Ltd (Northrop) have been engaged by Celestino Pty Ltd to prepare a Flood Impact Assessment Report for proposed earthworks at their site in Riverbend, QLD.

The purpose of this report is to outline the expected flood behaviour for the site, review the potential flood impact created by the proposed earthworks, and review the development response with respect to the development requirements outlined by State Planning Policies (SPP) and Logan City Council (Council) policies.

Included herein is a:

- Methodology for our assessment.
- Description of the subject site and the proposed development.
- Outline of the hydraulic model parameters
- Overview of the existing and developed flood behaviour.
- Discussion of flood impact and compliance with Council's policies.

Methodology

Logan City Council (LCC) has provided a copy of the Logan and Albert Rivers Flood Study which was prepared by WRM Water and Environment (WRM) in 2021, herein referred to as the “Logan and Albert Rivers FS (WRM, 2021)”, for use on this project.

Using the Logan and Albert Rivers FS (WRM, 2021), the following approach has been adopted for our assessment:

- Desktop review of available information including detailed survey, design plans, aerial imagery, and LiDAR elevation data
- Setup 2D detailed site-specific and truncated version of the Logan and Albert Rivers FS (WRM, 2021) TUFLOW model provided by Council.
- Run the 50% AEP, 20% AEP, 10% AEP, 5% AEP, 1% AEP and 1% AEP Climate Change existing case events and reviews results.
- Amend the TUFLOW model to represent the proposed development and run and compare the results with the existing case.
- Assess the proposed development with respect to flood related planning requirements.

This report is to be read in conjunction with the following guidelines, reports and documents:

- Logan and Albert Rivers FS (WRM, 2021)
- Australian Rainfall and Runoff 2019 Guidelines
- State Planning Policy (SSP) – Natural Hazard, Risk and Resilience - Flood, Queensland Government 2017
- PDA guideline 15 - Protection from Flood and Storm Tide Inundation, EDQ 2015
- Logan Planning Scheme 2015 (Logan City Council, 2023)

Proposed Development

The proposed development consists of earthworks and the design surface is presented in **Figure 2** overleaf. The civil drawings are presented in **Appendix A** this report.

Model Parameters

The original TUFLOW model prepared as part of the Logan and Albert Rivers FS (WRM, 2021) has been used as the basis for the hydraulic modelling presented herein.

For the purposes of this analysis, the Logan and Albert Rivers FS (WRM, 2021) TUFLOW model extent was truncated to reduce model run-time. The updated model extent and boundary condition locations are shown in **Figure 3**. The truncated model extends from the site to approximately 14km to the downstream and approximately 13km to the upstream.

Presented below is a summary of the modifications made to the original hydraulic model for the purposes of this investigation.

Hydraulic Model Updates

Modelled catchment inflows, within the extent of the truncated model remain unchanged when compared to those adopted by the Logan and Albert Rivers FS (WRM, 2021). Upstream inflow and downstream outlet head boundary level hydrographs were extracted from the original Logan and Albert Rivers FS (WRM, 2021) model for all events considered.

Ten metres model terrain grid size was adopted to simulate flow across the Logan River channel and floodplain. This is same as the ten-metre grid size adopted in the Logan and Albert Rivers FS (WRM, 2021). Similarly, the “10m Detailed” Council model roughness characteristics were adopted in the truncated model and presented in **Figure 4** below.

Legend

- Masterplan Stage
- Boundary
- Yarrahappini Gauge
- TUFLOW Model Extent
- Local Catchment Inflows
- U/S and D/S Boundaries

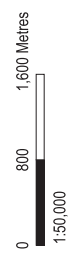
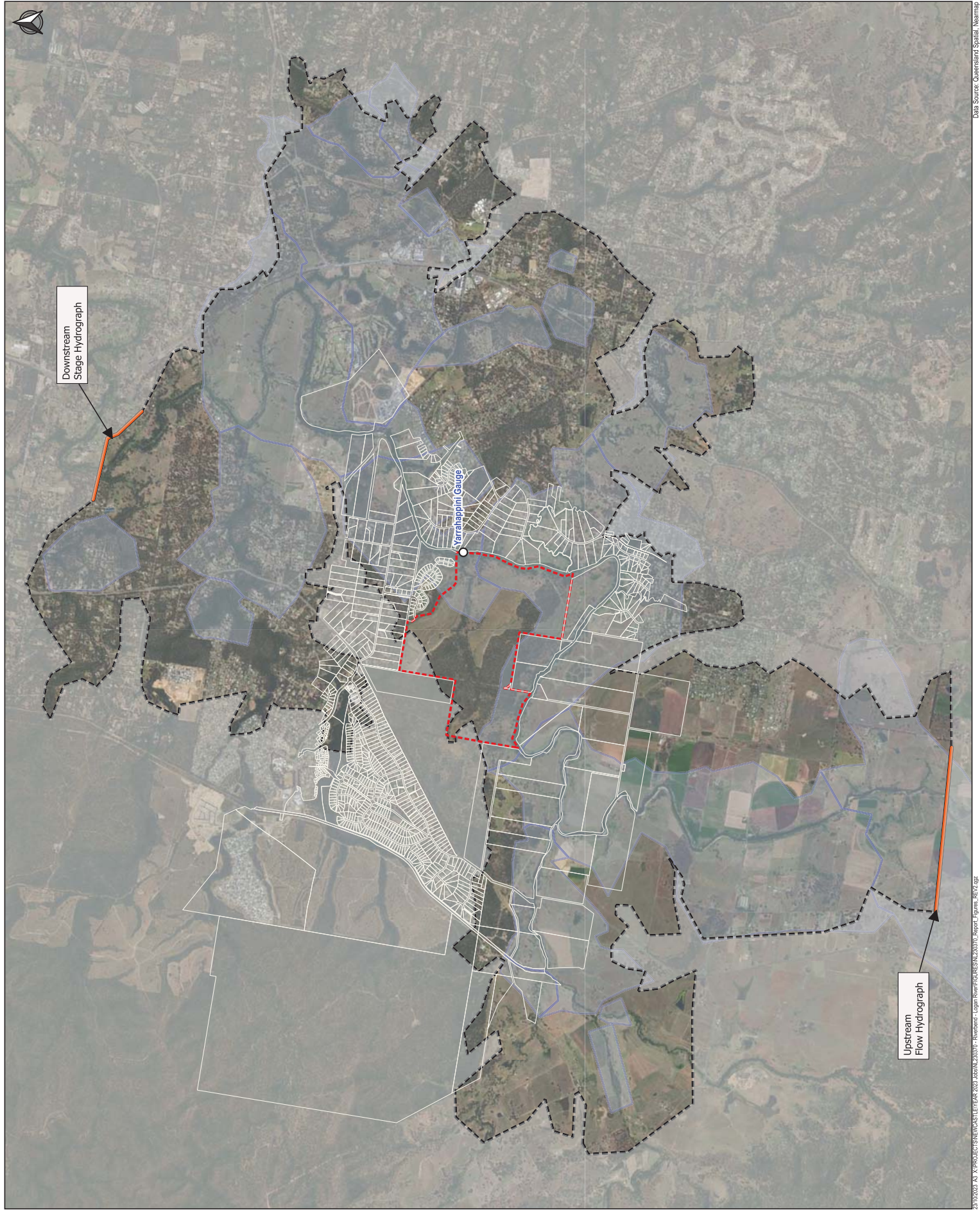
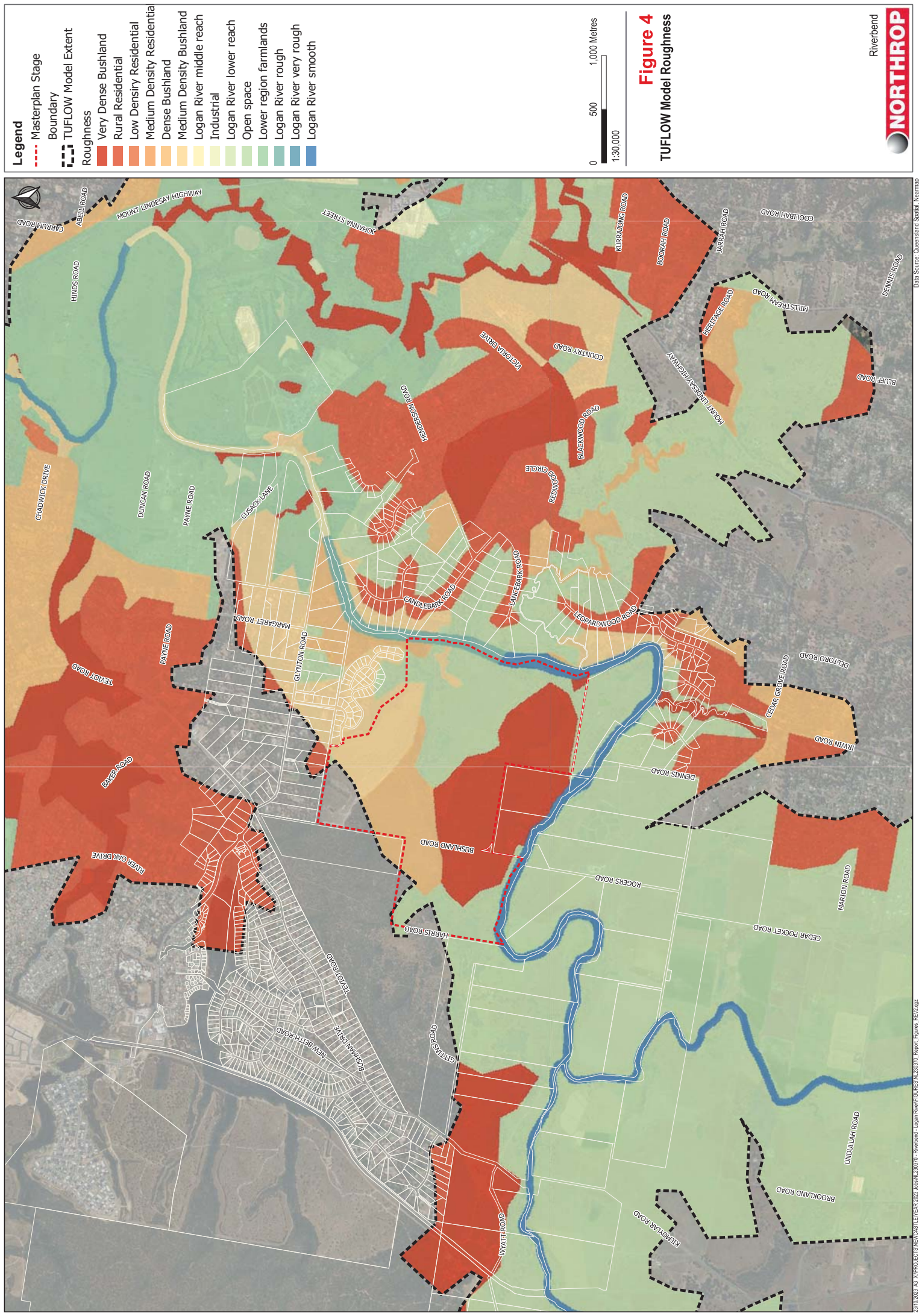


Figure 3
Truncated Site-Specific
Model Setup





Flood Behaviour

Validation with the Council's model

Modelled maximum water elevations during the existing scenario were compared with the flood modelling results from the Logan and Albert Rivers FS (WRM, 2021). The results at Yarrahappini Gauge are presented in the below **Table 1**.

Table 1 – Maximum Water Elevations at Yarrahappini Gauge

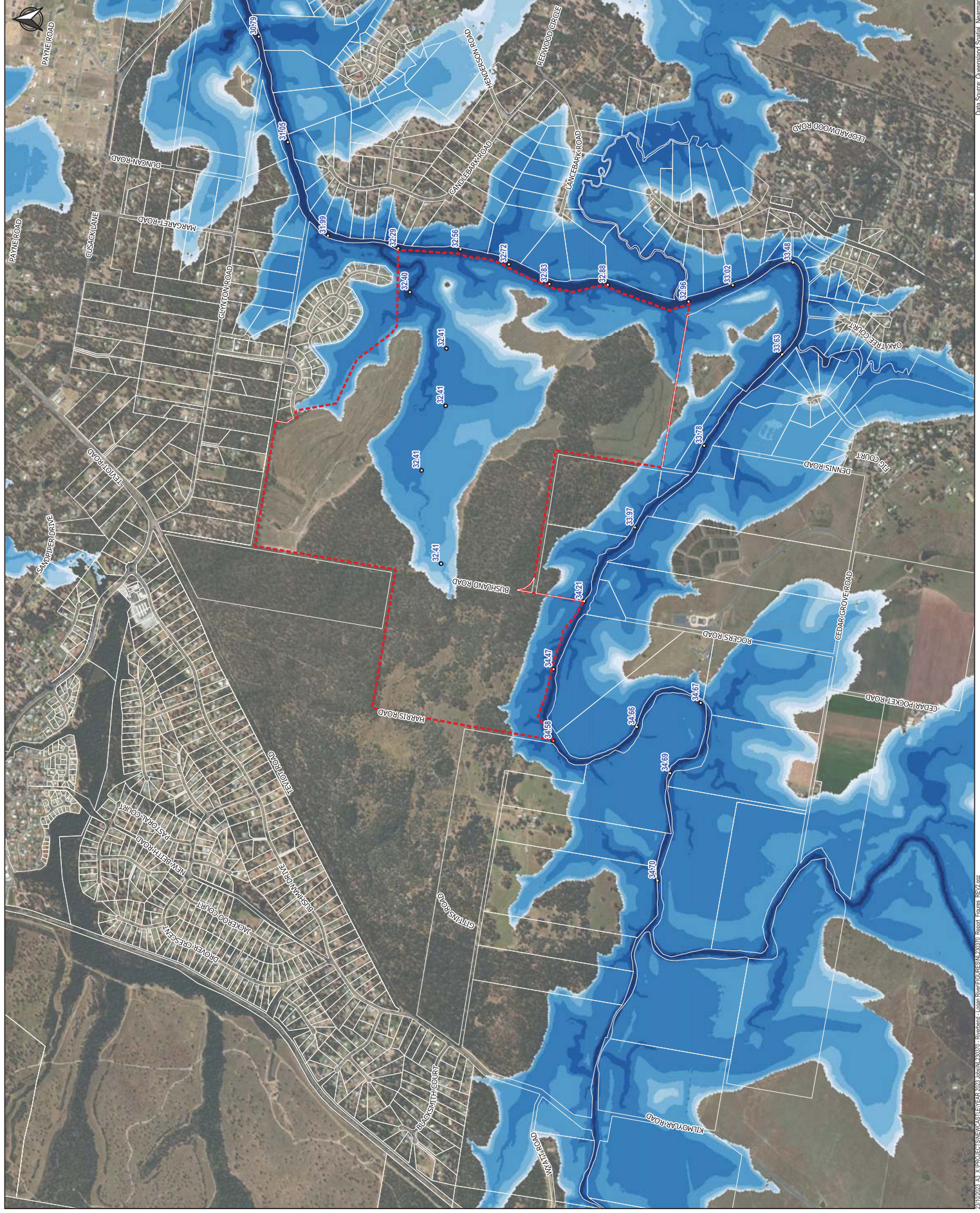
Design Flood Event	Council "Fast" Model 20m grid (m AHD)	Council "Detailed" Model 10m grid (m AHD)	Northrop Site-Specific Model 10m grid (m AHD)
1% AEP Climate Change RCP 6.5	32.82	32.89	32.89
1% AEP Climate Change RCP 4.5	32.75	32.80	32.80
1% AEP	32.31	32.37	32.37
2% AEP	31.25	31.30	31.28
5% AEP	29.86	29.90	29.87
10% AEP	27.82	27.73	27.74
20% AEP	25.32	24.93	24.98
50% AEP	21.65	20.99	20.98

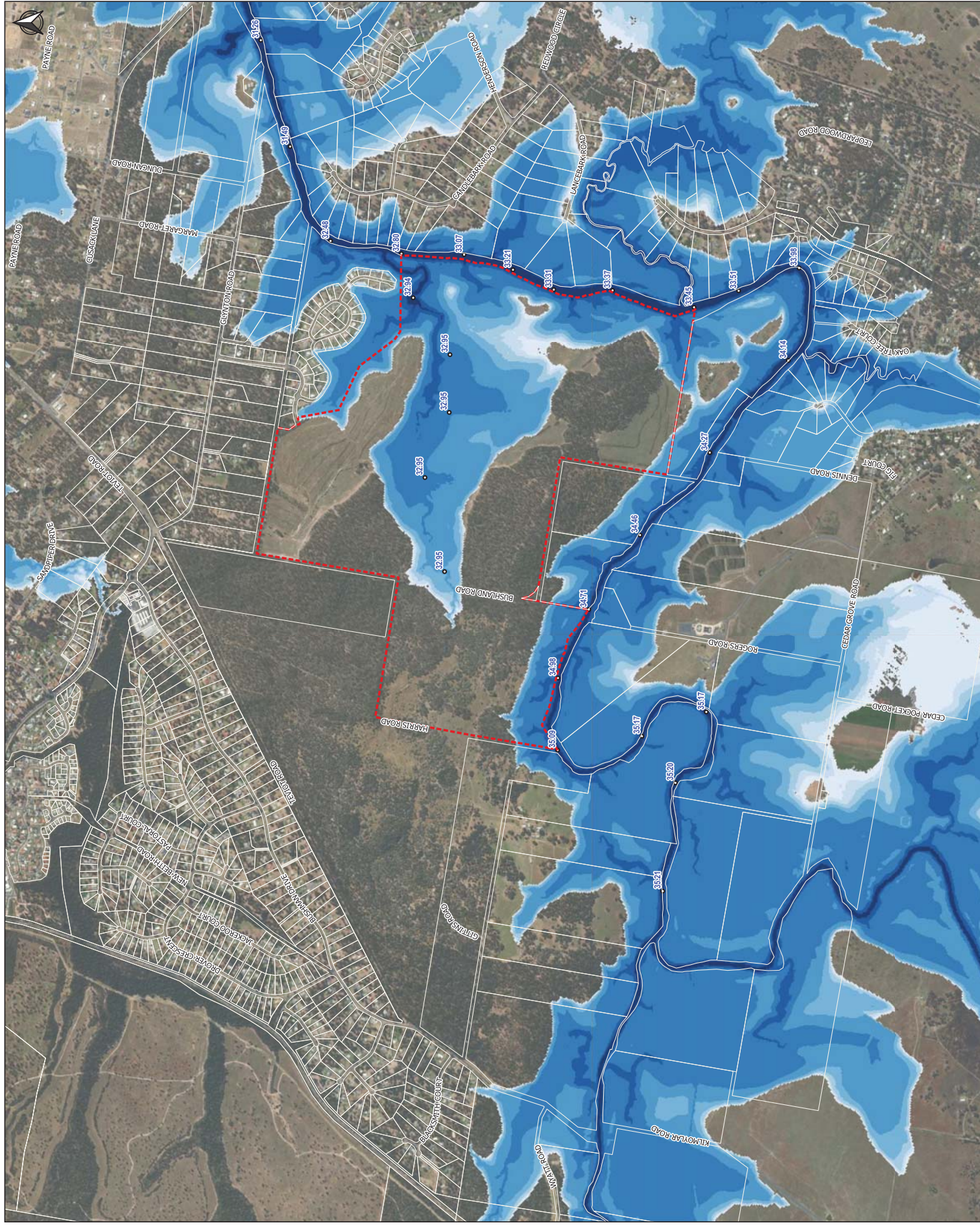
Spatial distribution of water elevation comparison between Council's model and the local truncated model for the 1% AEP and 1% AEP Climate Change RCP 6.5 flood events are presented in **Figures 5** and **6** below.

Modelling indicates the Northrop modelled flood elevations are consistent with the design event modelled elevations and considered suitable for the purposes of the flood impact assessment.

Existing Case

The existing case flood depth and elevation for the 1% AEP, 1% AEP Climate Change RCP 6.5 and 10% AEP flood events are presented in below **Figures B1**, **B2** and **B3** respectively.





Legend

- Masterplan Stage
- Boundary
- Existing Lots
- Spot Water Level (mAHD)

Depth (m)

- <= 0.02
- 0.02 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 5.00
- 5.00 - 10.00
- 10.00 - 15.00
- > 15.00

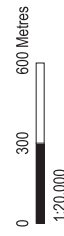
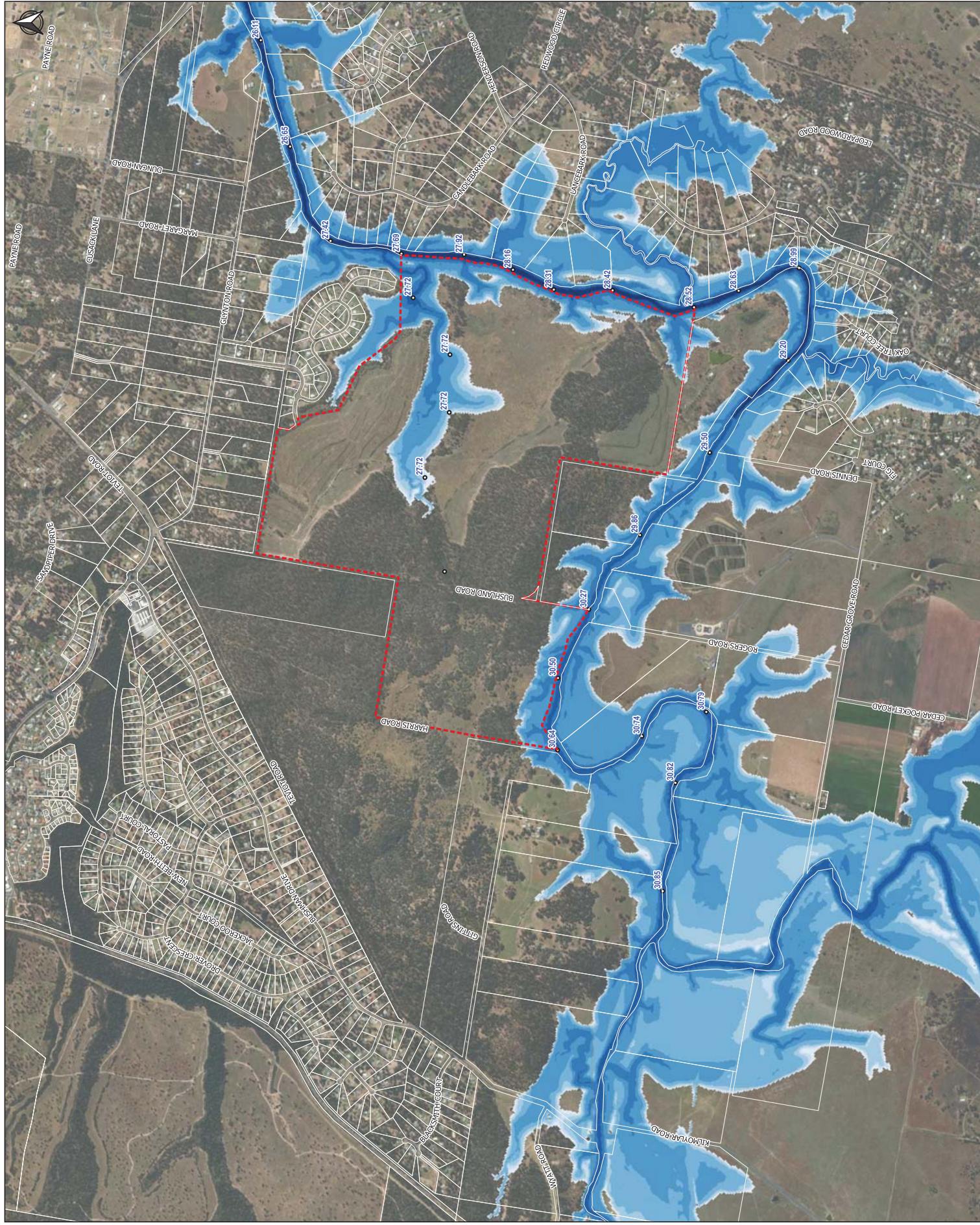


Figure B2
1% AEP Flood Depth
and Elevation
Climate Change RCP 6.5
Scenario
Existing Conditions

Riverbend





Legend

- Masterplan Stage
- Boundary
- Existing Lots
- Spot Water Level (mAHD)

Depth (m)

<= 0.02
0.02 - 0.25
0.25 - 0.50
0.50 - 1.00
1.00 - 2.00
2.00 - 5.00
5.00 - 10.00
10.00 - 15.00
> 15.00

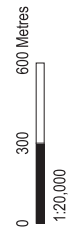
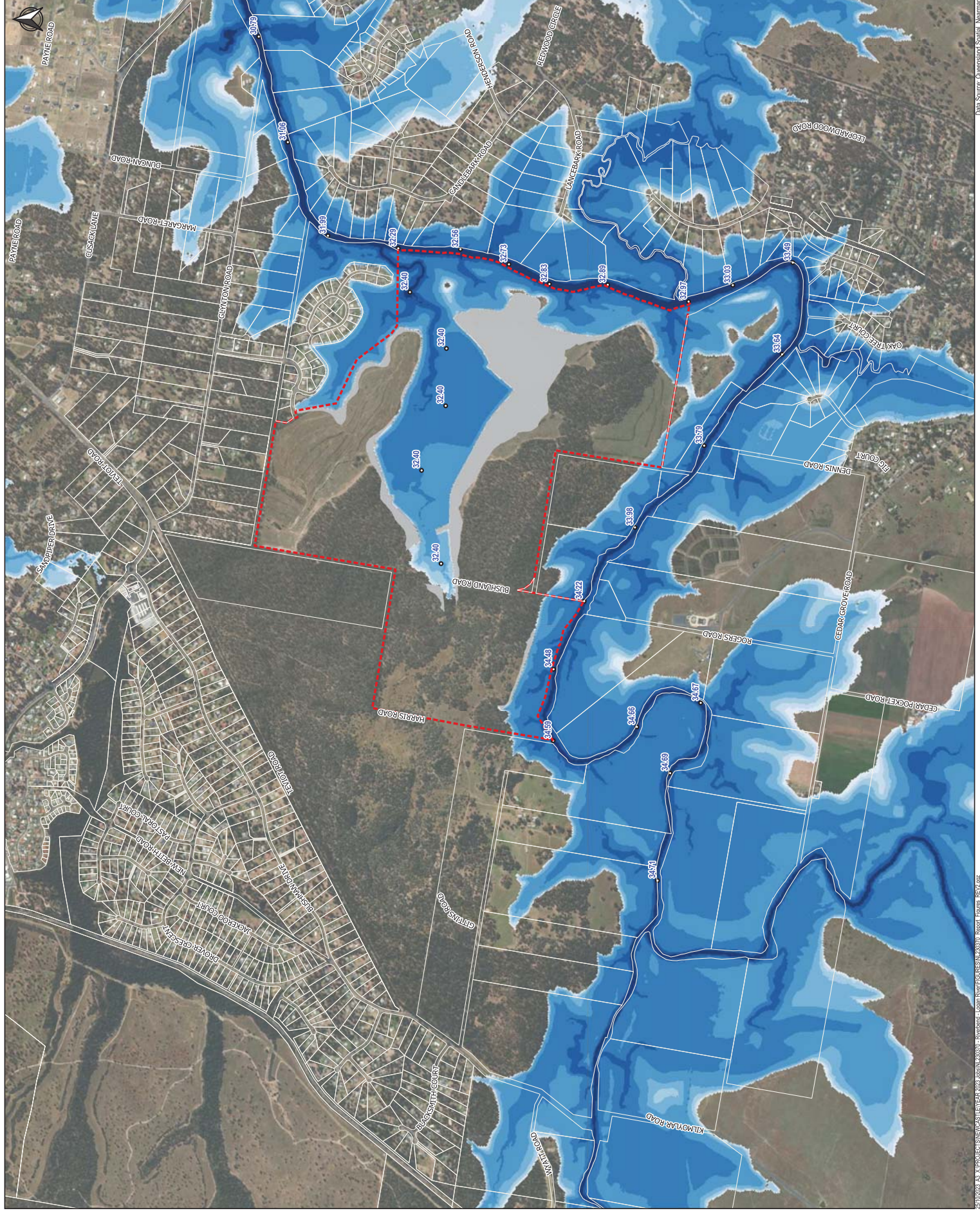


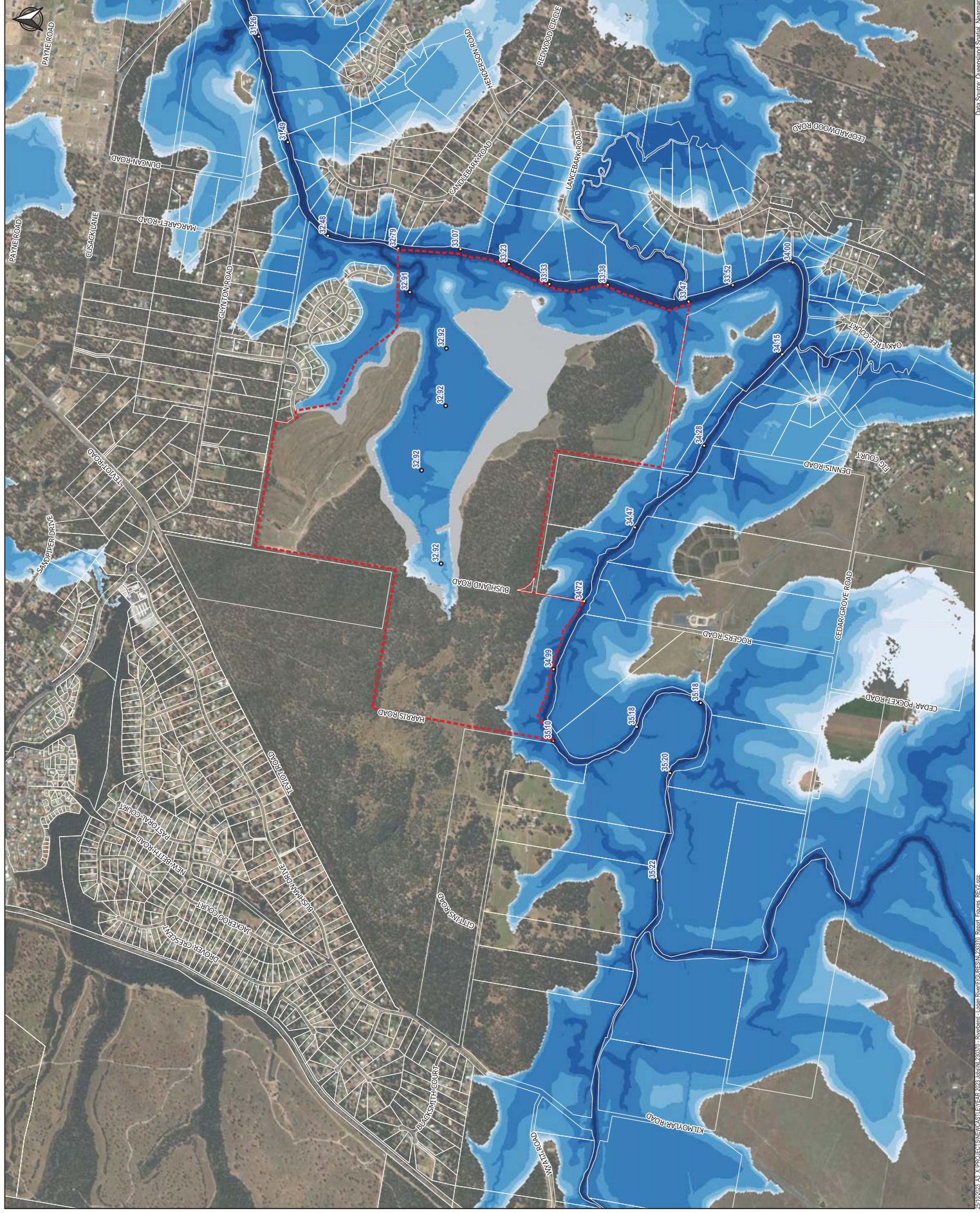
Figure B3
10% AEP Flood Depth
and Elevation
Existing Conditions

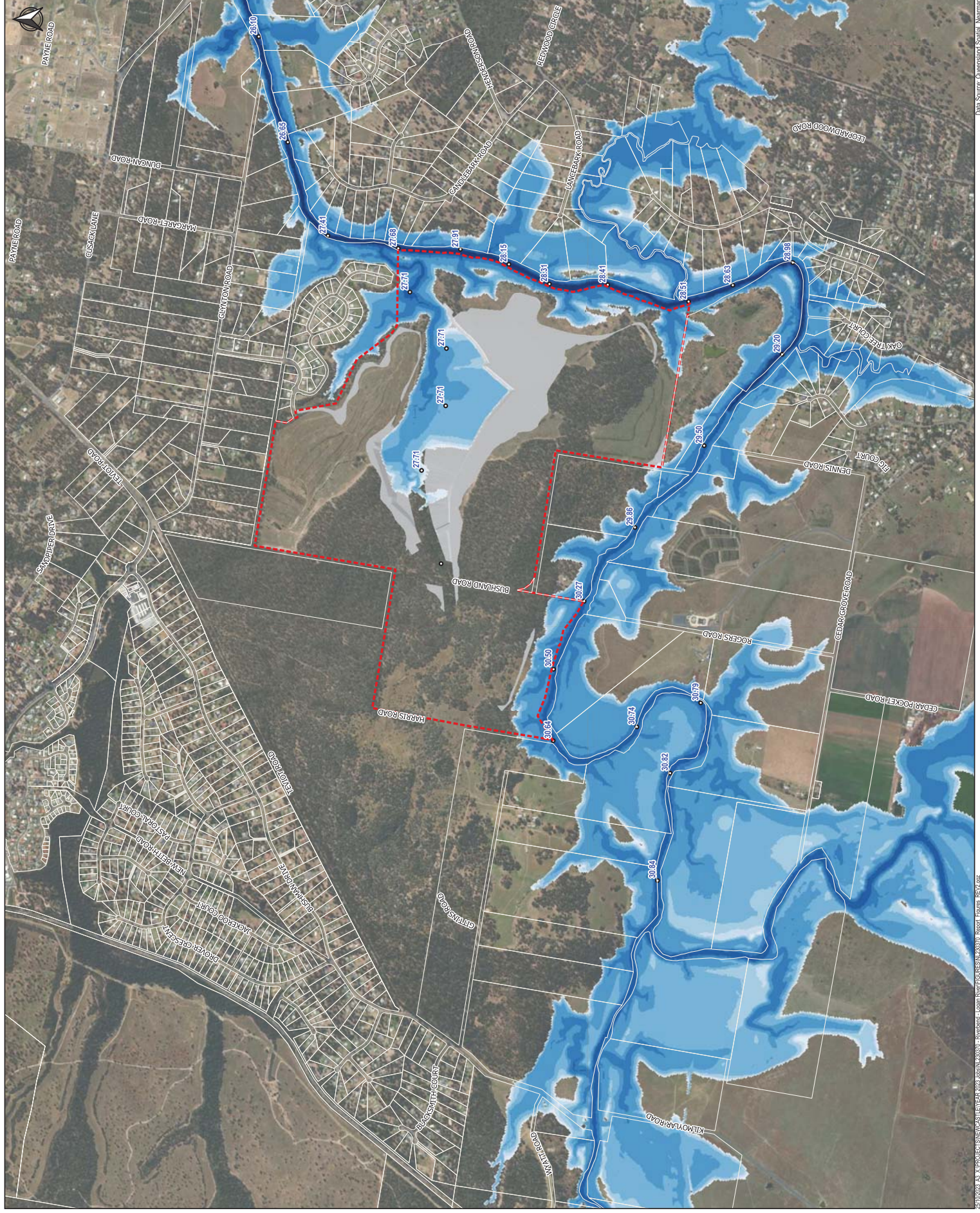
Developed Case and Flood Effects

The developed case flood depth and elevation for the 1% AEP, 1% AEP Climate Change RCP 6.5 and 10% AEP flood events are presented in below **Figures C1, C2** and **C3** respectively.

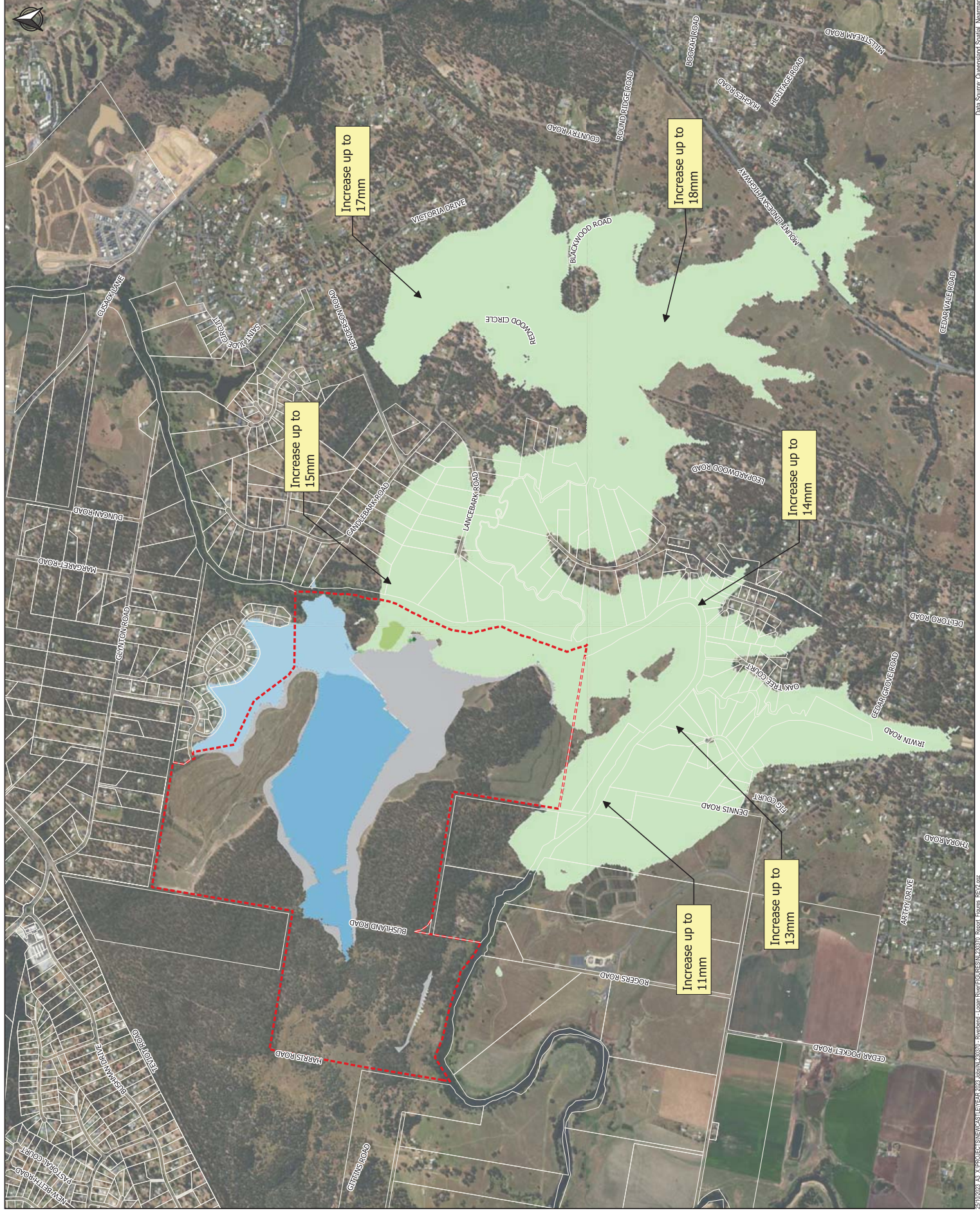
The proposed earthworks encroach on the Logan River floodplain, and this results in a minor localised increase of 20mm within the subject site boundary and less than 10mm in adjoining properties in the 1% AEP event. An increase of approximately up to 19mm is observed on the site and in the vicinity of the site in the 1% AEP climate change sensitivity scenario. Impacts in the 10% AEP are less than 10mm. These impacts are presented in **Figures D1, D2**, and **D3** overleaf.











Discussion

Flood Storage

A balance in flood storage has been achieved within the current flood hazard overlay extent. This is reflected in the civil drawings presented in **Appendix A**.

Finished Fill Pad Levels

Whilst the flood impact assessment has been undertaken based on a site-specific model and primarily based on the current 1% AEP, minimum fill pad levels have been selected on the base Logan and Albert Rivers FS (WRM, 2021) 1% AEP plus climate change RCP 6.5 scenario (as supplied by Council).

Flood Impacts

Increases less than 10mm have been determined off-site in the 1% AEP, and we do not believe this is a significant impact.

State Planning Policy Compliance

The proposed development is located within Greater Flagstone Priority Development Area (PDA) and endorsed by State Government and administrated by Economic Development Queensland (EDQ). EDQ is responsible for development assessment and compliance relating to any development within the PDA.

An assessment of compliance of the proposed development in respect to the EDQ requirements (outlined in *Table 1* of EDQ Guideline 15) is summarised in **Table 4**, overleaf.

Council Requirements and Assessment

The proposed development has been assessed with respect to the Council's Flood Hazard Overlay Codes. Responses are summarised in **Table 5**, overleaf.

Table 4 – EDQ Compliance Assessment

	EDQ Standards	Response
Defined Flood Event (DFE)	1. The DFE adopted by the relevant Council for the area, or 2. Where 1 is not available, the DFE adopted by the Council for a similar area, or 3. Where 2 is not available, the 1% AEP flood.	LCC DFE of 1% AEP was adopted for the impact assessment.
Habitable Floor Level (or “freeboard”)	1. The habitable floor level or freeboard adopted by the relevant Council for the area, or 2. Where 1 is not available, the habitable floor level or freeboard adopted by the Council for a similar area, or 3. Where 2 is not available, 300 mm above the DFE adopted for the area.	LCC freeboard of 500mm over the DFE was adopted.
Development Assessment Criteria	1. Where the Minister for State Development, Infrastructure and Planning has endorsed the Council planning scheme as adequately reflecting the SPP, the relevant provisions in the planning scheme, or 2. Where the Minister for State Development, Infrastructure and Planning has not endorsed the Council planning scheme as adequately reflecting the SPP, the performance criteria set out in the Draft SPP mandatory requirements: flooding hazard section 4, and, for the specified community infrastructure, the recommended flood levels in Table 1 of the Draft SPP mandatory requirements: flooding hazard	Development was assessed against the LCC planning scheme FHOC criteria.

Table 5 – LCC FHO Compliance Assessment

Performance outcomes		Acceptable outcomes	Response
For accepted development (subject to requirements) and assessable development			
Risk to people and premises			
PO1 A building floor level of a habitable room has adequate allowance for the hydraulic gradient above the main floodway.		AO1 A building has a finished habitable floor level a minimum of 500mm above the defined flood event.	Not applicable. No building works proposed.
PO2 Development must not increase the level of risk of injury to life or risk of damage to property or adversely affect flood evacuation procedures.		AO2 Development: a. does not result in any of the following: i. an increase in the number of people at risk from flooding up to and including the defined flood event; or ii. an increase in the number of people that need evacuation up to and including the defined flood event; or iii. an increase in the number of premises or infrastructure at risk from flooding up to and including the defined flood event; or iv. existing flood warning times being reduced for flood events up to and including the defined flood event; or v. an adverse impact on the ability of traffic to use evacuation routes or unreasonably increase traffic volumes on evacuation routes; or b. is located entirely within a development envelope area approved by an earlier development approval.	The proposed earthworks have less than 10mm impact in the DFE flood levels off-site. The application does not seek approval for an increase in population within the DFE.

Performance outcomes		Acceptable outcomes	Response
For assessable development			
PO3 Development provides a development envelope area that is: a. above the flood level during the defined flood event; b. of an area and dimensions to accommodate the activities associated with the intended use.		AO3 Development provides a development envelope area above the flood level during the defined flood event with a minimum size and dimension specified in Table 8.2.5.3.2 - Development envelope area.	Not applicable. Application is for earthworks only.
PO4 Public safety and the environment are not adversely affected by floodwater by: a. locating a Medium impact industry or High impact industry to be able to function safely during and immediately after flood events; b. safely storing hazardous materials.		AO4 Development: a. for a Medium impact industry or High impact industry is above the flood level specified in column 2 of Table 8.2.5.3.3 - Minimum flood levels; b. involving the storage, sale or use of hazardous materials is located above the flood level during the defined flood event.	Not applicable. Application is for earthworks only.
PO5 A car park other than a Parking station is only located below the flood level during the defined flood event where there is no increase in risk to: a. pedestrian and vehicular safety; b. a building or other structure. Note - Section 4.1 - Guidelines for satisfying flood hazard overlay code in Planning scheme policy 5 - Infrastructure provides guidance to achieve this outcome.		AO5 No acceptable outcome provided.	Not applicable. Application is for earthworks only.
PO6 Development for any of the uses identified in column 1 of Table 8.2.5.3.3 - Minimum flood levels, are able to function effectively during and immediately after flood events. Note - Compliance with this performance outcome is to be demonstrated by a flood study		AO6 Development for any of the uses identified in column 1 of Table 8.2.5.3.3 - Minimum flood levels is located above the flood level specified in column 2 of Table 8.2.5.3.3 - Minimum flood levels.	Not applicable. Application is for earthworks only.

Performance outcomes	Acceptable outcomes	Response
report prepared in accordance with section 2.5.1 of Planning scheme policy 5 - Infrastructure Note - Section 4.1 - Guidelines for satisfying flood hazard overlay of Planning scheme policy 5 - Infrastructure provides guidance to achieve this outcome.		
Flood storage and discharge capacity		
PO7 An existing floodway is protected and maintained to ensure there are no losses of conveyance capacity of waterways and storage so as not to adversely affect other premises, infrastructure and the environment. Note - Compliance with this performance outcome is to be demonstrated by a flood study report prepared in accordance with section 2.5.1 of Planning scheme policy 5 - Infrastructure Note - Section 4.1 - Guidelines for satisfying flood hazard overlay of Planning scheme policy 5 - Infrastructure provides guidance to achieve this outcome.	AO7 No acceptable outcome provided.	No earthworks are proposed within the main river channel in the DFE. There is an insignificant increase in the DFE less than 10mm. We do not believe this constitutes an adverse impact on adjoining properties. There is no net loss in flood storage within the LCC FHOC extents.
PO8 The natural conveyance of flood waters and natural overland flow paths are protected and maintained without adversely affecting adjoining premises. Note - Section 4.1 - Guidelines for satisfying flood hazard overlay of Planning scheme policy 5 - Infrastructure provides guidance to achieve this outcome.	AO8 No acceptable outcome provided.	The earthworks design provides free draining of the fill pad and is located away from the main river channel and tributaries through the site.
PO9 Development (or development in combination with other development) for all flood events up to	AO9 No acceptable outcome provided.	Consideration has been given to Section 2.5.1 of Planning Scheme Policy 5 – Infrastructure in preparation of this document. The 10% AEP, 1%

Performance outcomes	Acceptable outcomes	Response
and including the defined flood event does not do any of the following: a. cause or have the potential to cause damage; or b. cause ponding of flood water; or c. adversely affect the flood discharge capacity of the floodplain; or d. decrease the flood resilience of properties and infrastructure; or e. cause a cumulative increase in flood levels external to the premises. Note - Compliance with this performance outcome is to be demonstrated by a flood study report prepared in accordance with section 2.5.1 of Planning scheme policy 5 - Infrastructure Note - Section 4.1 - Guidelines for satisfying flood hazard overlay of Planning scheme policy 5 - Infrastructure provides guidance to achieve this outcome.		AEP, and a 1% AEP plus Climate Change RCP 6.5 sensitivity has been considered to capture the range of flood events.
PO10 Any loss of floodplain storage is compensated with compensatory storage or excavation that: a. is of equal volume, creating a balance of cut to fill; b. is free draining; c. is located within the premises; d. does not adversely affect the hydraulic conveyance capacity of the flood channel or floodplain; e. is provided to the corresponding flood level; f. is landscaped to provide visual amenity and erosion control; g. is solely for the purpose of compensatory storage. Note - Compliance with this performance outcome is to be demonstrated by a flood study	AO10 No acceptable outcome provided.	A balance of cut to fill have been provided – refer to the Civil Drawings in Appendix A.

Performance outcomes	Acceptable outcomes	Response
report prepared in accordance with section 2.5.1 of Planning scheme policy 5 - Infrastructure Note - Section 4.1 - Guidelines for satisfying flood hazard overlay of Planning scheme policy 5 - Infrastructure provides guidance to achieve this outcome.		
PO11 Development does not adversely change the following flood characteristics for all flood events up to and including the defined flood event: a. peak flow; b. flow of any part of the flood before the peak; c. flood flow velocity; d. level of flooding; e. flood time to peak. Note - Compliance with this performance outcome is to be demonstrated by a flood study report prepared in accordance with section 2.5.1 of Planning scheme policy 5 - Infrastructure Note - Section 4.1 - Guidelines for satisfying flood hazard overlay of Planning scheme policy 5 - Infrastructure provides guidance to achieve this outcome.	AO11 No acceptable outcome provided.	There is less than 10mm difference in the 10% AEP event. This indicates the flood characteristics have been approximately matched. Similarly, there are less than 10mm increases in the vicinity of the site in the 1% AEP. We do not believe this is an adverse impact. Furthermore, the application is for earthworks only and with no change in impervious fraction, we do not believe there will be any change in flood volume or peak flow before the flood peak.
PO12 A stormwater quality improvement device is located to retain existing flood plain storage capacity and ensure functionality of the stormwater quality improvement device.	AO12 A stormwater quality improvement high flow outlet device is located: a. above the five percent AEP flood event caused by local flooding; above the two percent AEP flood event caused by regional flooding.	Not applicable. Application is for earthworks only.
PO13 A stormwater quantity management device is located to retain existing flood plain storage capacity and ensure functionality of the stormwater quantity management device.	AO13 A stormwater quantity management high flow outlet device is located above the two percent AEP flood event.	Not applicable. Application is for earthworks only.

Performance outcomes		Acceptable outcomes	Response
Filling and excavation			
PO14 Filling and excavation is carried out above the flood level of the 10 percent AEP event to protect in stream and banks of a waterway and wetland. Note - Section 4.1 - Guidelines for satisfying flood hazard overlay code in Planning scheme policy 5 - Infrastructure provides guidance to achieve this outcome.	AO14.1 Earthworks are limited to areas where: a. flooding is predominately due to backflow; b. the peak depth average velocity is less than the maximum permissible velocity for considerable bare earth channels (typically 0.5m/sec) in accordance with Table 9.0.5.3 of the Queensland Urban Drainage Manual; c. the cut/fill batter is not steeper than 1V:4H and the exposed earth surface is landscaped with erosion resistant vegetation cover.	Earthworks have been carried out below the 10% AEP on the basis this area is predominately backflow, and there are measures proposed to stabilise and rehabilitate the disturbed areas.	
	AO14.2 A filling and excavation plan is provided in accordance with section 2.2.2 of Planning scheme policy 5 - Infrastructure.		
Access			
PO15 Development provides vehicular access to a road network that is sufficient to enable safe access and egress. Note - Section 4.1 - Guidelines for satisfying flood hazard overlay code in Planning scheme policy 5 - Infrastructure provides guidance to achieve this outcome.	AO15 Development provides vehicular access to a road that is: a. above the flood level during the defined flood event; or b. below the flood level during the defined flood event where the road: i. has a low flood hazard; ii. remains trafficable until another road access to the development becomes trafficable; iii. directly connects to a road that is above the defined flood event that provides access to the road network.	Not applicable. Application for earthworks only.	
PO16 Development provides an access area to a building or fill area on which a building is to be constructed where the access is located on land	AO16 Development provides access to a building or fill area that has:	Not applicable. Application for earthworks only.	

Performance outcomes	Acceptable outcomes	Response
classified as a low flood hazard in the defined flood event.	a. a maximum depth of inundation of 300 mm during all flood events up to and including the defined flood event; b. a maximum distance of inundation of 200 metres during all flood events up to and including the defined flood event; c. a depth multiplied velocity product of less than or equal to 0.4m²/s. Note - Velocity in flood waters is measured as the average velocity over a column of water.	

Conclusions

A Flood Impact Assessment has been prepared for the proposed earthworks Riverbend QLD.

It was concluded that the proposed earthworks are not expected to create a significant adverse impact to the existing flood behaviour on the subject site and on the properties surrounding the subject site in the defined flood event.

Furthermore, we believe the proposed development generally complies with Council's flood related development controls.

We commend our findings to EDQ for their review.



Angus Brien

Principal | Group Manager | Senior Flood Engineer
BE(Civil) NER CPEng RPEQ 23583

On behalf of Northrop Consulting Engineers Pty Ltd

Limitation statement

Northrop Consulting Engineers Pty Ltd (Northrop) has been retained to prepare this report based on specific instructions, scope of work and purpose pursuant to a contract with its client. It has been prepared in accordance with the usual care and thoroughness of the consulting profession for the use by Celestino Pty Ltd. The report is based on generally accepted practices and standards applicable to the scope of work at the time it was prepared. No other warranty, express or implied, is made as to the professional advice included in this report.

Except where expressly permitted in writing or required by law, no third party may use or rely on this report unless otherwise agreed in writing by Northrop.

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The report was prepared on the dates shown and is based on the conditions and information received at the time of preparation.

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Document Register

Rev	Status	Prepared	Approved	Date
A	For Approval	RB	GB	1 September 2023
B	For Approval	GB	GB	5 September 2023
C	For Approval	RB	GB	25 October 2023

Appendix A – Civil Drawings