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LATROBE FLOOD MANAGEMENT

Frogmore Lane causeway removal hydraulic benefits

ENTURA-1E4A7D
7 January 2022

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Document information

Title	Latrobe flood management
	Frogmore Lane causeway removal hydraulic benefits
Client organisation	Latrobe Council

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1. Introduction

The township of Latrobe is located in the Mersey River's flood plains and has a history of being flooded, most recently in 2016. Latrobe Council have engaged Entura to undertake modelling and design of works to protect the town from a similar flood, including a 1:100 Annual Exceedance Probability (AEP) flood in Kings Creek. During the consultation for this design there has been questions raised from the community about the potential flood protection benefits of removing the Frogmore Lane causeway that crosses the valley at Latrobe.

The causeway across the valley is a raised earth embankment, broken by three suspended bridge deck sections (Figure 1.1). A typical causeway cross section, based on a LIDAR derived ground shape, is shown in Figure 2.1. The approximate length of causeway is 390 m of the total 745 m valley crossing between the Frogmore property and Latrobe, the balance is suspended bridge deck.

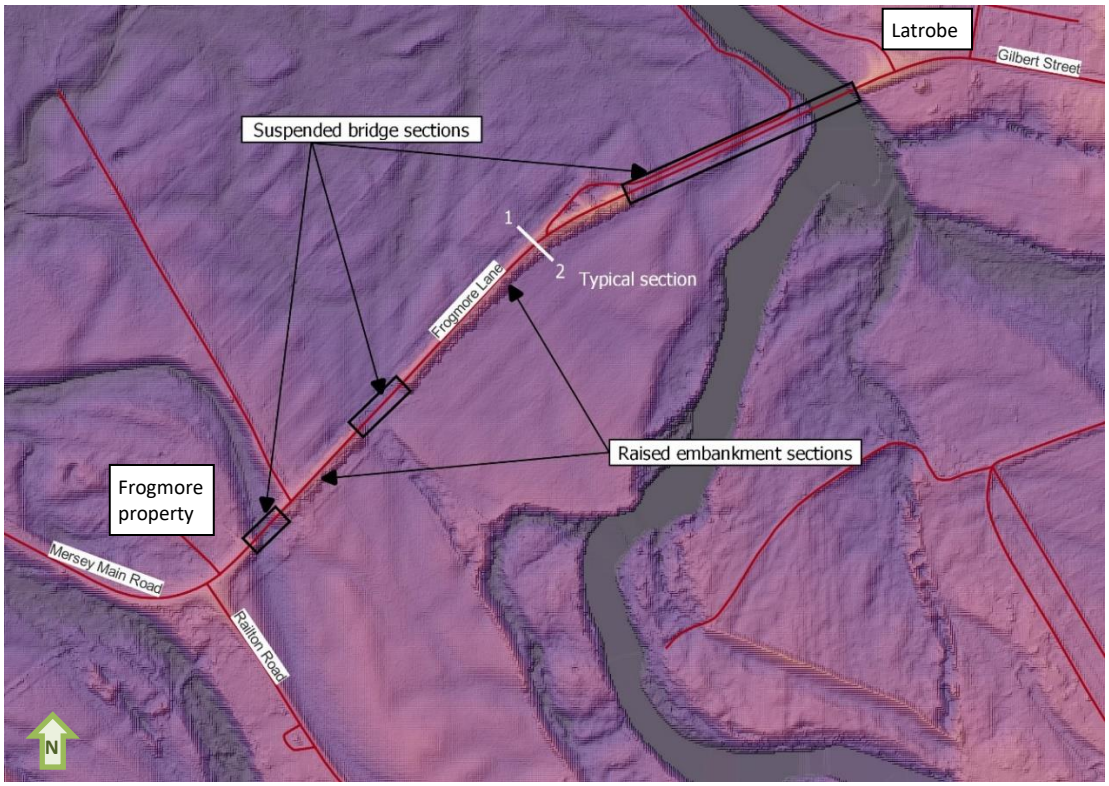


Figure 1.1: Mersey River bridge and causeway

This report was developed in response to the community questions. It aims to quantify the potential hydraulic benefits of removal of this obvious constriction to flow. The report doesn't include assessment of direct costs of removal or the indirect costs of traffic changes from these works to maintain a similar level of service for this roadway.

Modelling without the existing road causeway in place produces the lowest flood risk to the Latrobe township that can be achieved by works along the existing Frogmore Lane alignment. A road link on this alignment is likely to remain, and could potentially be achieved by a new road on the valley floor or an elevated multi span bridge across the valley; with both scenarios expecting to providing less

benefit than the modelling undertaken for this report. Additional modelling of a lowered road and/or extended bridge would only be undertaken if the initial modelling with the causeway removed proved to be clearly beneficial in reducing the flood risk to Latrobe.

2. Methodology

An existing hydraulic model, used for the design of the proposed Latrobe levee system, was modified to undertake this assessment. The shape and elevations for the Mersey Valley and causeway are described by the gridded LIDAR sourced from Geoscience Australia and the Tasmanian Government on the ELVIS Spatial Database. No detailed survey has been undertaken for this assessment, but the LIDAR data has a suitable accuracy for this level of assessment.

To remove the causeway a plane was drawn between the levels on the upstream and downstream side of the causeway, effectively removing the causeway to be flush with the surrounding land. A typical section in Figure 2.1 shows this change.

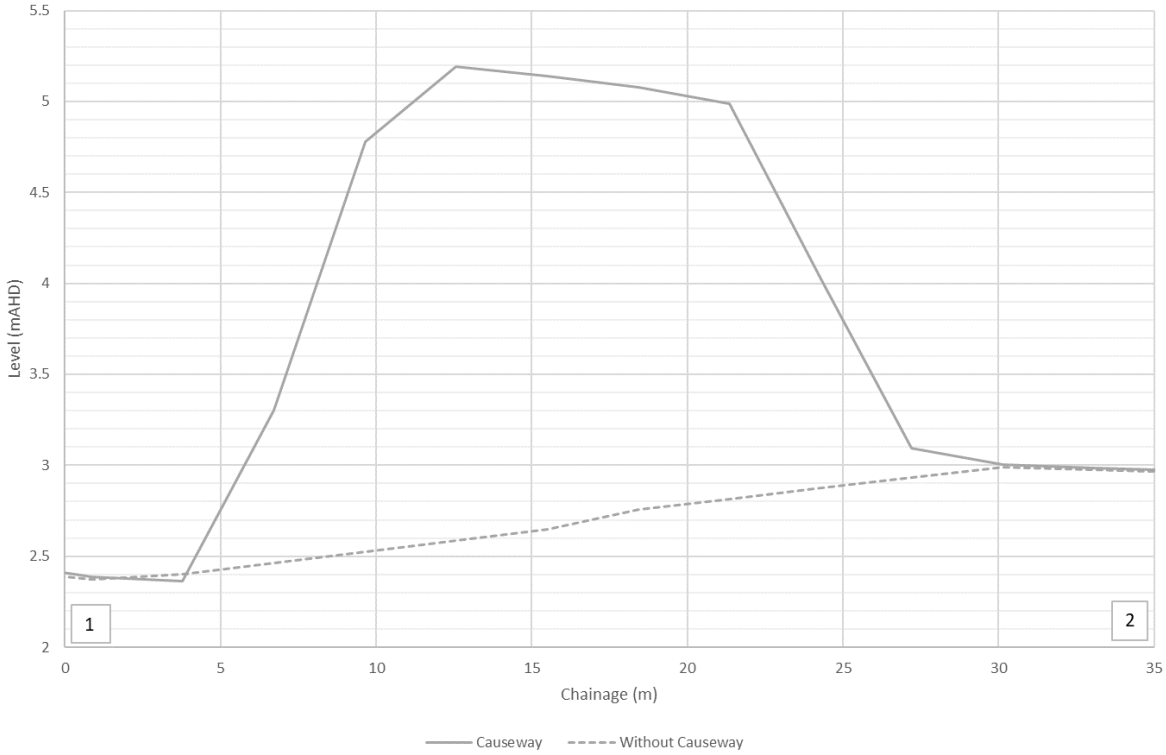


Figure 2.1: Causeway typical cross section (location per Figure 1.1)
Note: 1 indicates downstream; 2 indicates upstream

Four scenarios with and without the existing causeway were modelled for the Latrobe township and nearby valley for the 2016 flood with:

1. No levees with causeway
2. No levees without causeway
3. Proposed levee with causeway
4. Proposed levee without causeway

To make the assessment, the hydraulic model was set up with the geometry of the scenario and run with a fixed upstream water level and downstream water level until the model reached equilibrium. This steady state approach is suitable for looking at the peak hydraulic impact of the change in water levels and is similar to how the levee heights for the proposed town flood defence were assessed. The software used is called TUFLOW-HPC, which is a two dimensional, depth average model commonly used for flood modelling around the world.

The extent of the model domain (where the model calculations were made), is shown in Figure 2.2. The downstream tailwater was set at 3.5 m AHD which was used for the previous modelling. A sensitivity check was undertaken with a 2.5 m AHD level, which had minimal impact on flood behaviour upstream of the causeway. The upstream water level of 6.1 m AHD has been previously calibrated to reproduce the observed 2016 flood levels around the edges of the township. This level is beyond the influence of the existing causeway or its absence.

The size of the model calculation grid was chosen at 2 m x 2 m square, meaning the model calculates water level and velocity every 2 m. The maximum values of water depth and velocity in each grid cell were captured during the model simulations and used to prepare maps. Differences between model scenarios were calculated to assess the impacts of causeway removal with or without the proposed Latrobe flood defence levees in place.

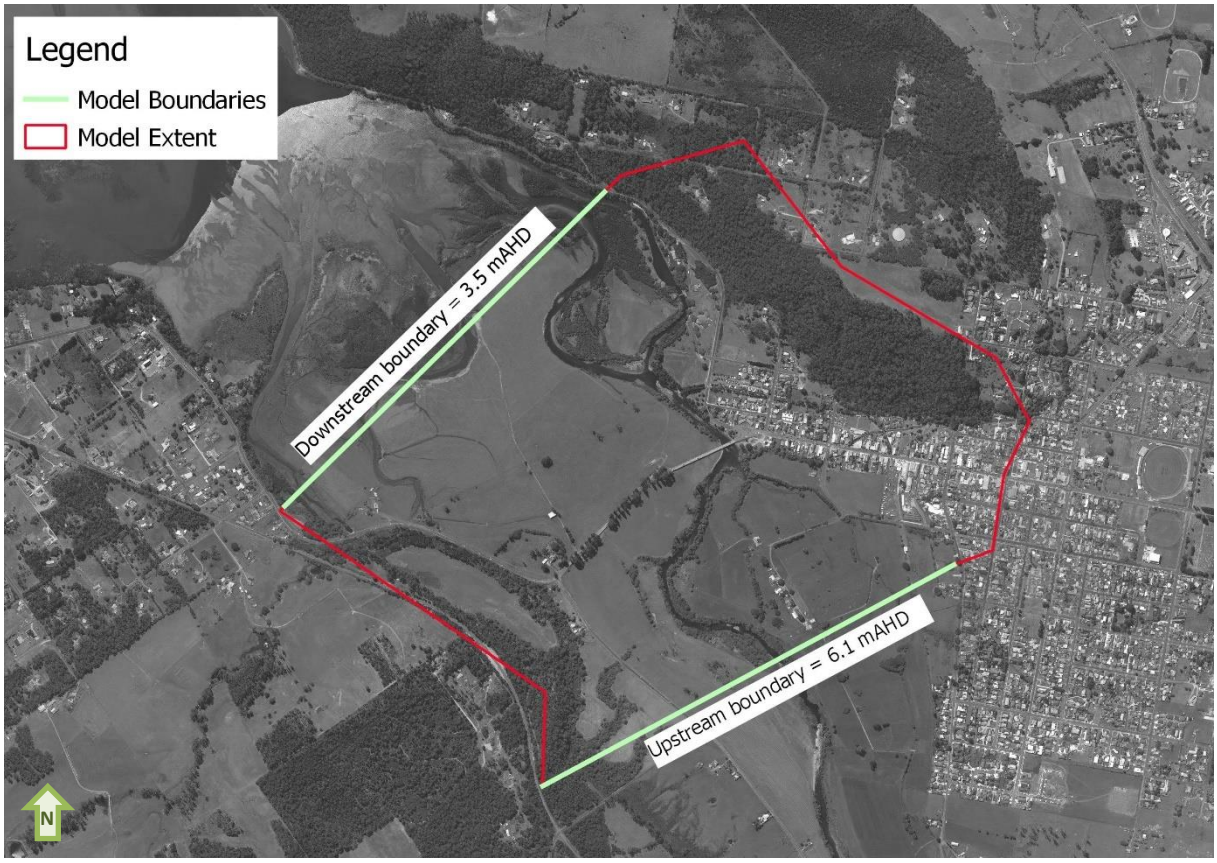


Figure 2.2: TUFLOW-HPC model extent and boundaries

3. Results

Maps depicting the Mersey River flooding for each of the scenarios described in Section 2 are provided in Appendix A. Maps of the impact on flood depth with the removal of the causeway are provided in Appendix B.

Figure 3.1 depicts a longitudinal section of flood levels adjacent to the proposed Latrobe levee for the four modelled scenarios. The section is from north of Axemans Hall of Fame on River Road to the intersection of Cotton Street and Weld Street.

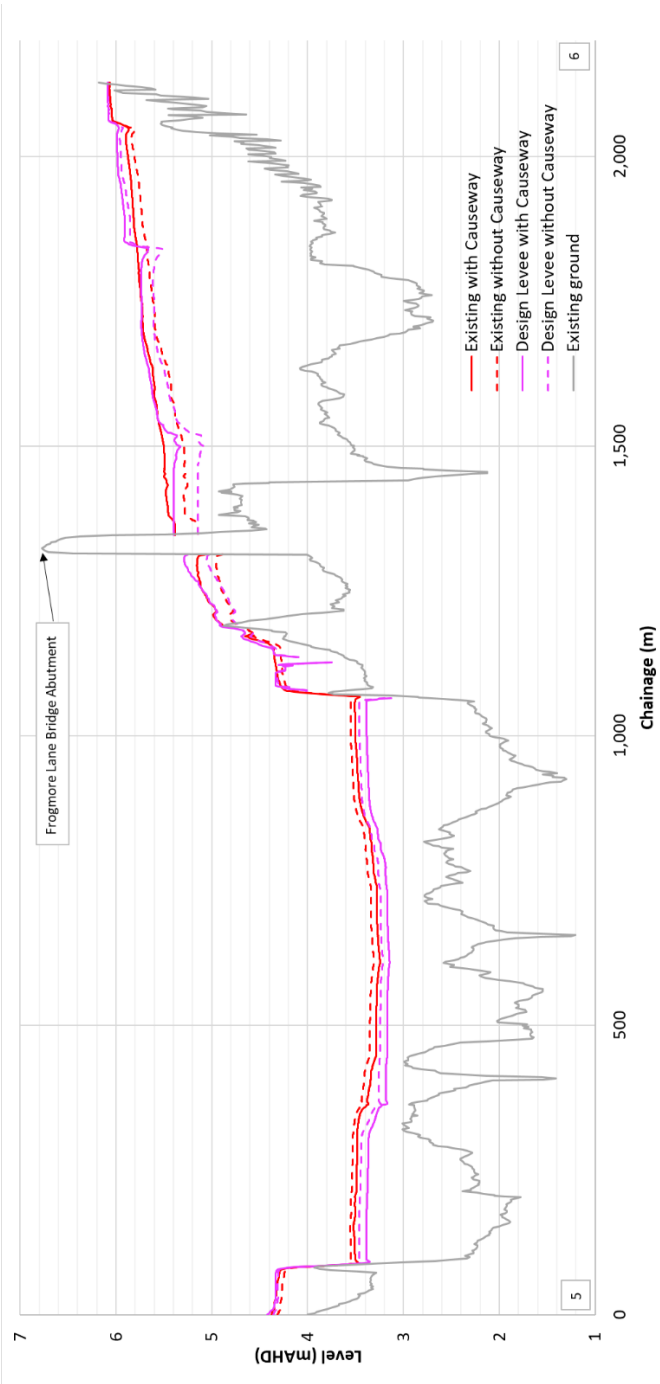


Figure 3.1: Levee longitudinal section with flood levels

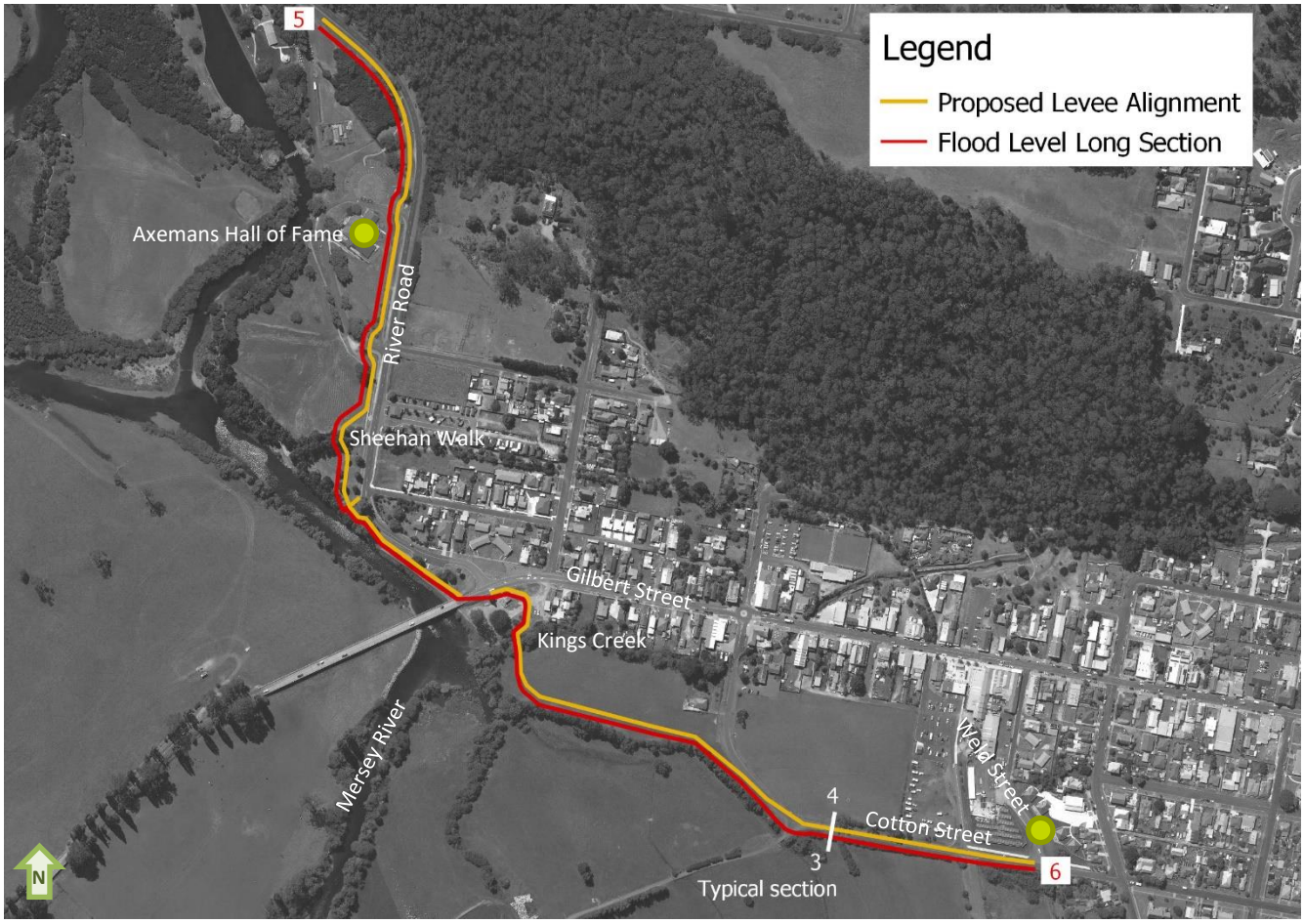


Figure 3.2: Levee Longitudinal and cross sections

4. Discussion

The question to be addressed from this analysis was whether the removal of the causeway could reduce or eliminate the need for the proposed Latrobe levee. The impact of the causeway removal on water levels varies across the flood plain. Close to where the causeway is located there are larger changes than further away from its removal. In general, for the 2016 flood a complete removal of the causeway (without considering any replacement bridge) results in the following key impacts:

- A general reduction on water levels upstream of causeway, and immediately upstream of the causeway at centre of valley the water levels are reduced 930 mm.
- Near the proposed levees (Figure 3.1), water levels are reduced up to 250 mm near Kings Creek and reducing to 0 mm to the east near Weld Street. A typical section just west of Weld Street shows a 100 mm reduction (Figure 4.1).
- A general increase in water levels immediately downstream of causeway. Along River Road near the Axemans Hall of Fame there is a 70 mm increase in water level.
- Adjacent to the west end of Sheean Walk there is a reduction in flood depth of up to 140 mm.

- The largest reduction in flood depth within the township of Latrobe from removing the causeway is in the vicinity of lower Gilbert Street where flood depths are modelled to be up to 215 mm lower without the causeway.

The spatial variability of the changes can be rationalised as:

- There is an existing bridge opening near the township, which flows reasonably freely, so the impacts of the causeway removal are lower near the town
- The existing (high) level difference across the causeway and higher velocity through bridges, is changed with the causeway removal to a reduced level difference, reduced velocity and larger cross section. Note this trade off does not represent a directly proportional increase in flow rate at the causeway embankment cross section
- The largest changes in water levels in the middle of the valley are where there is the longest section of causeway
- With the overall increase in capacity of the river, there is a small increase in water level downstream.

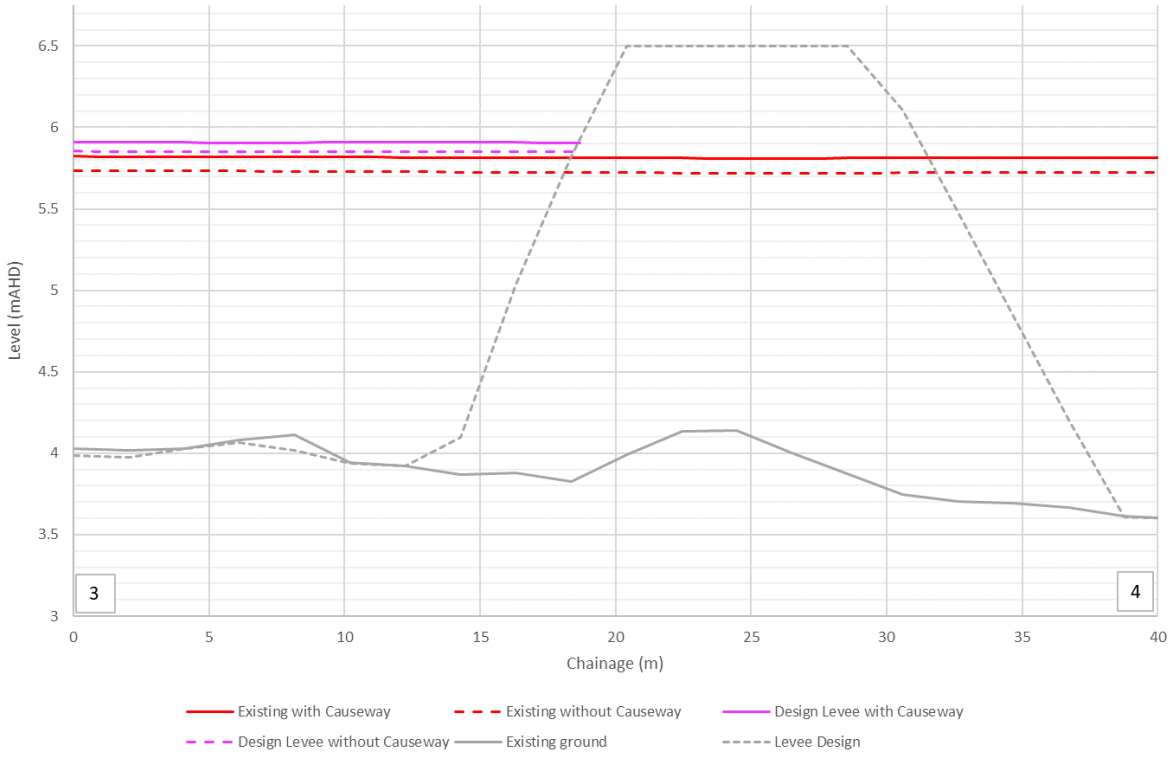


Figure 4.1: Proposed levee cross section (with flooding) on Cotton Street

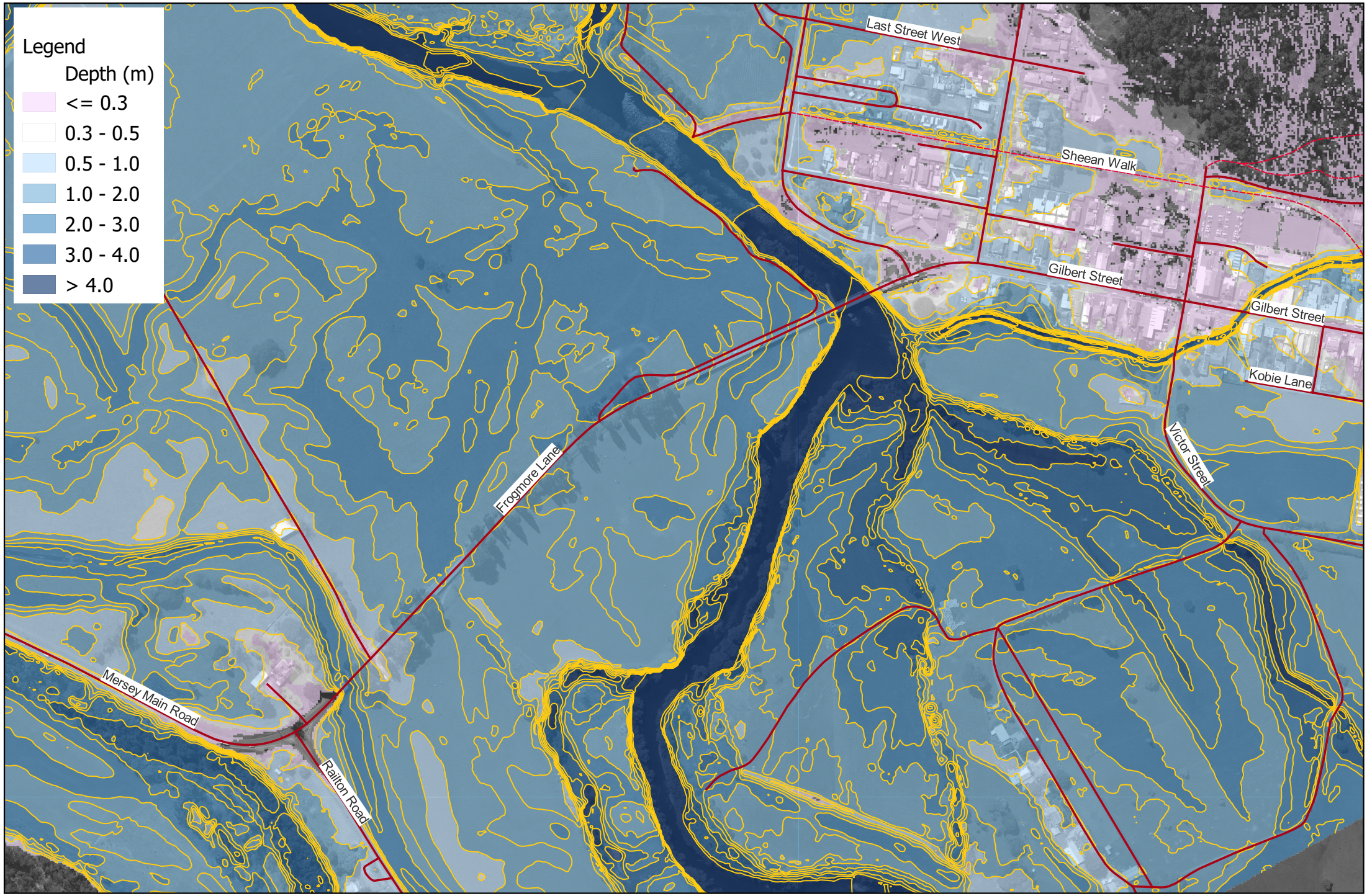
5. Conclusion

The removal of the whole Frogmore Lane causeway, without the impacts of rebuilding a new suspended bridge would:

- Reduce flood waters near the town by approximately 200 mm
- Along the proposed levee this could potentially reduce the height of the levee by up to 250 mm in areas near Kings Creek, reducing upstream to no change closer to Weld Street
- Along River Road there would need to be an increase in the levee of approximately 70 mm.

In the context of a proposed levee, which is generally 1 m to 3 m in height, it's expected the removal of the Frogmore Lane causeway would mean a revised levee design is overall slightly smaller than the current proposal. While the proposed levee has not been redesigned with the revised water levels due to the causeway removal, it's clear a levee similar to the current proposal would still be required even with the removal of the causeway. Therefore, there is no clear hydraulic benefit for the causeway removal on Latrobe's current levee proposal.

A Mersey River Flood Maps



FLOOD DEPTH
NO LEVEES AND WITHOUT CAUSEWAY
2016 FLOOD

0 75 150 m

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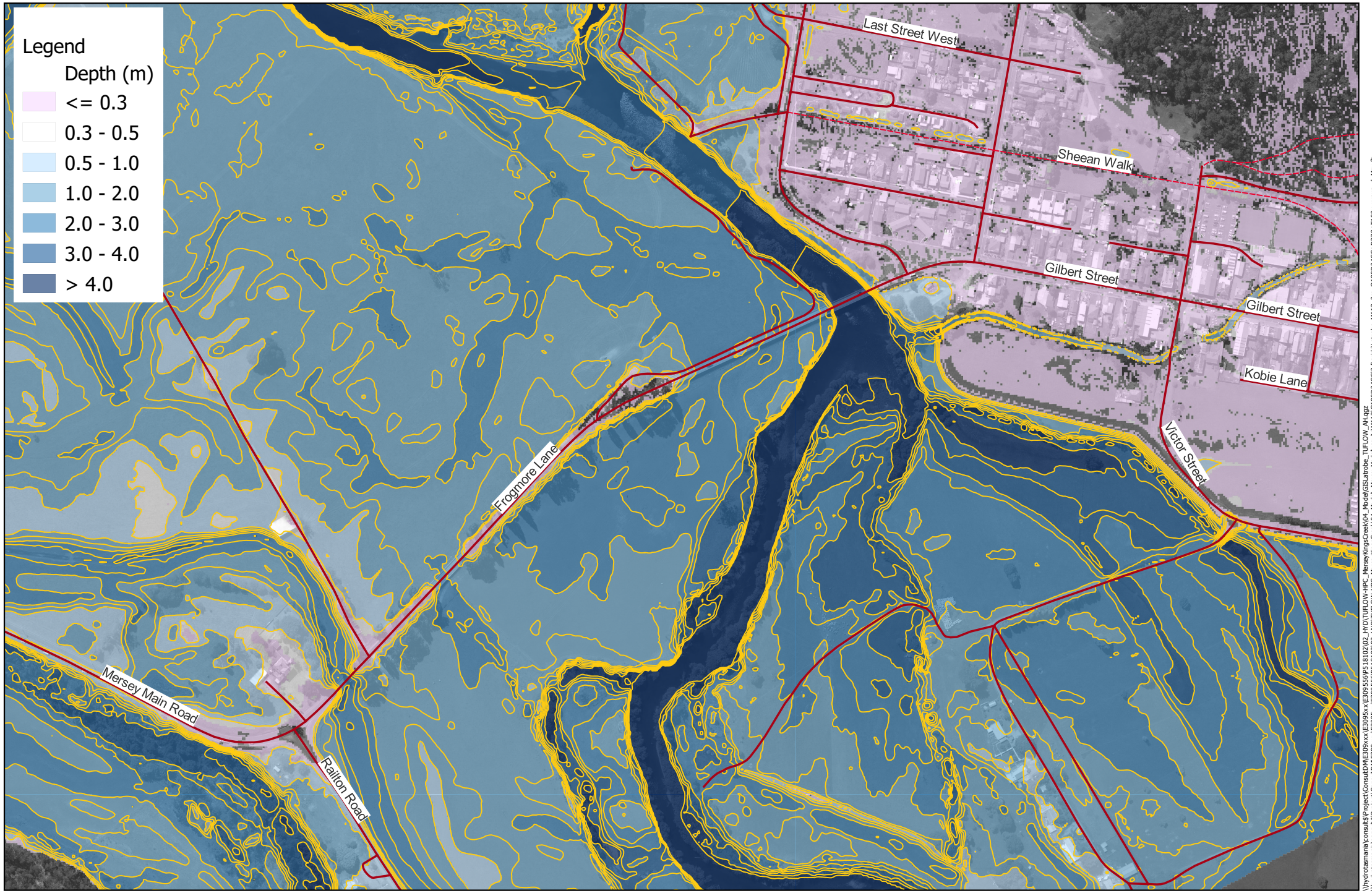

FLOOD DEPTH
DESIGN LEVEES WITH CAUSEWAY
2016 FLOOD

0 75 150 m

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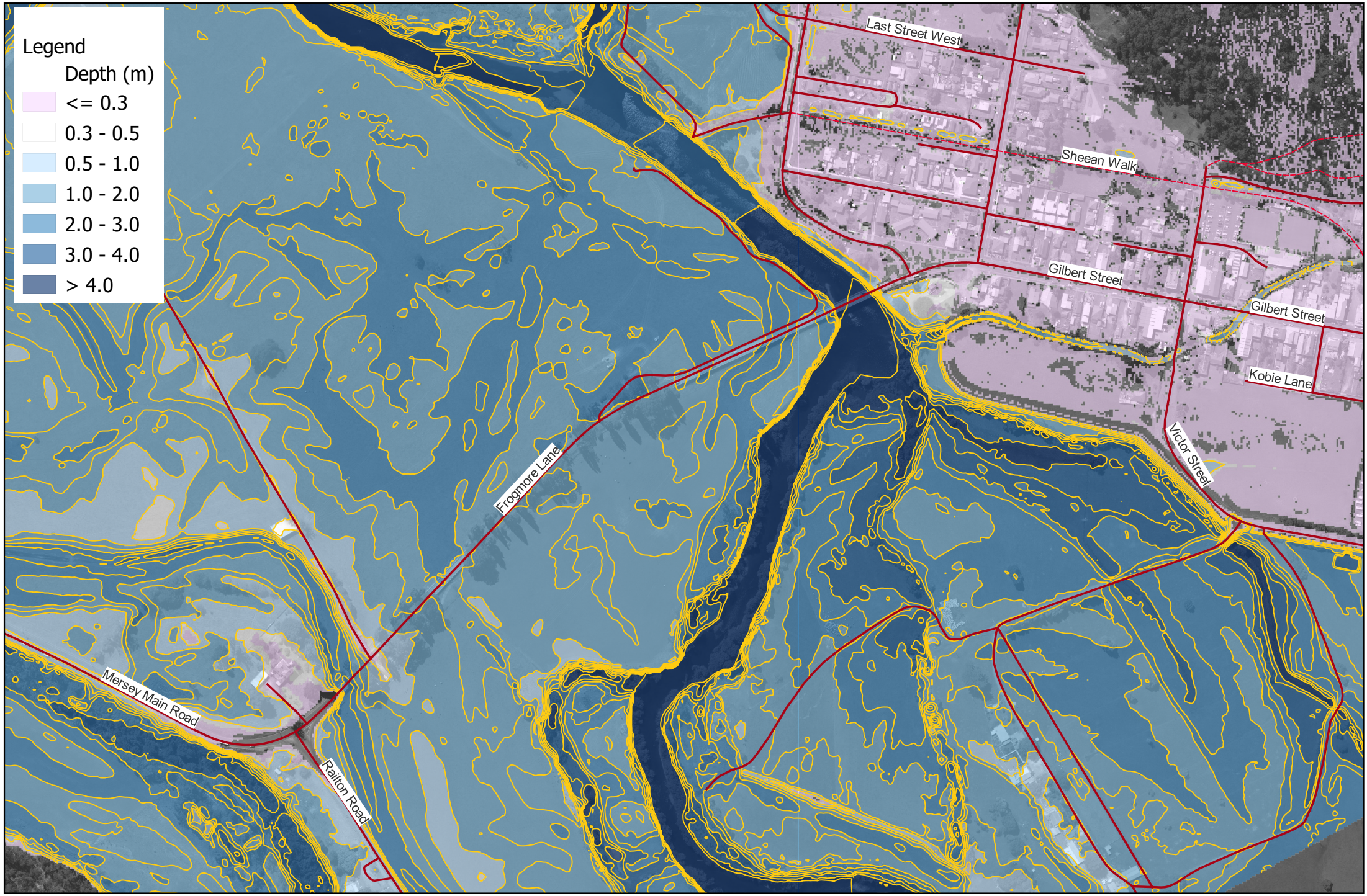

FLOOD DEPTH
DESIGN LEVEES WITHOUT CAUSEWAY
2016 FLOOD

0 75 150 m

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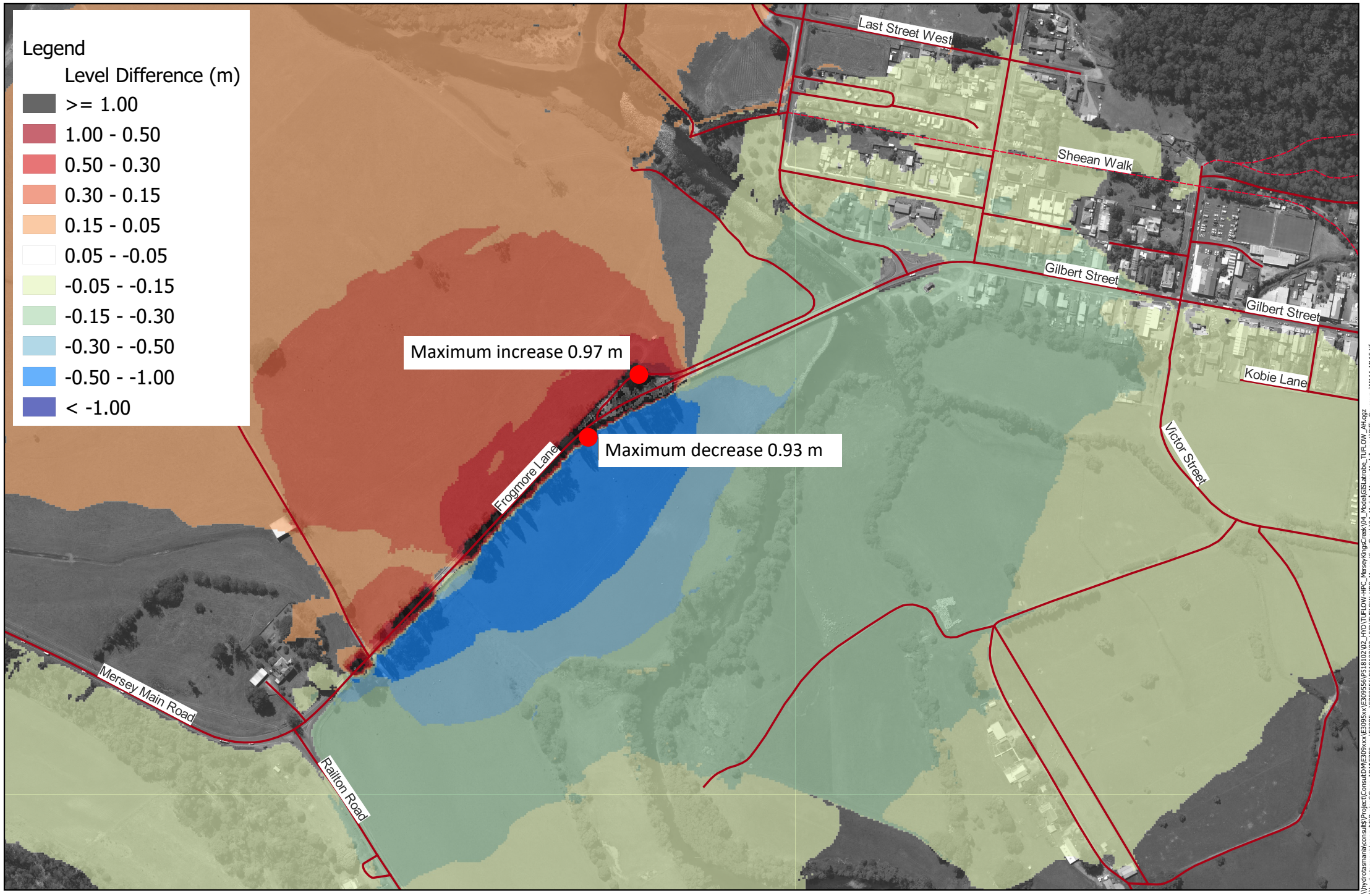
B Flood Impact Maps



EXISTING (NO LEVEE) DIFFERENCE
WITHOUT CAUSEWAY MINUS WITH CAUSEWAY
2016 FLOOD

0 75 150 m

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DESIGN (WITH LEVEE) DIFFERENCE
WITHOUT CAUSEWAY MINUS WITH CAUSEWAY
2016 FLOOD

0 75 150 m

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