12 December 2024
Job No: 1012397.1000

CCKV Maitai Dev Co Lp
PO Box 2284
Stoke
Nelson 7041

Attention: Tony Munnerley

Dear Tony

Proposed Gibbs and Jickells footbridges
Flooding assessment of effects

1 Introduction

In accordance with your request, we have carried out hydraulic modelling of proposed footbridges located alongside the existing Gibbs and Jickells Road Bridges. The new bridges are proposed as part of the transport connection required between the recently rezoned (PPC28) residential land in Kākā Valley and the Nelson CBD. The modelling is required to inform bridge deck level design and to assess potential flood effects on the surrounding area to support a resource consent application.

The proposed footbridge design and levels are conceptual only and are expected to be further refined in future design stages. This report has been provided under the conditions of our engagement, T+T ref: 1012397.1000, dated 1 November 2019.

2 Background

In early 2024, Tonkin & Taylor Ltd (T+T) was provided concept sketches for a footbridge option to the north of Jickells Bridge. We undertook a preliminary flood effects assessment for the proposed bridge in Section 6.5.4 of our Draft Stormwater Assessment Report (draft v2 dated 28 March 2024). While the proposed Jickells Footbridge location has not changed (downstream of existing Jickells Bridge), a second footbridge immediately upstream of the existing Gibbs Bridge is now also proposed. In addition, the Nelson City Council's (NCC) flood model of the Maitahi/Mahitahi River has been updated using calibration data captured during the August 2022 flood event. As a result, the work described in this report supersedes what was included in our draft stormwater assessment report.

The two proposed footbridges are proposed to support cycling and pedestrian traffic down Maitai Valley Road and provide crossing points for services across the Maitahi/Mahitahi River.

Concept footbridge details were developed by CDT Consultants Ltd and provided to T+T on 4 October 2024 (refer Appendix A). Based on these concept bridge designs, Davis Ogilvie (DO) developed preliminary bridge approach ramps, which were provided to T+T on 25 October and 22 November 2024.

The level of the underside of the existing bridge decks are outlined in Table 2.1 below. **All levels in this report are reported in terms of New Zealand Vertical Datum 2016 (NZVD2016).**

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Table 2.1: Underside of bridge deck assumptions

Insert heading	Reduced level (m)
Gibbs Bridge (existing road bridge)	18.10
Jickells Bridge (existing road bridge)	15.94

Note: Levels sourced from Davis Ogilvie survey reference 39470_304 & 39470_305, dated October 2023

3 Flood modelling

3.1 Modelling approach

Based on the proposed footbridge and approach designs provided to T+T, the existing Nelson City Council Maitahi/Mahitahi River stormwater model was modified to represent the footbridges and compared to the unmodified baseline model to determine whether there are any offsite effects.

The assessment was done using the most recent version of the NCC river flood model (MaiBkYk_v083). This model recalibration is currently nearing completion and will likely be adopted by NCC after being finalised and peer reviewed. We are satisfied that the recalibration is sufficiently advanced in the Kāka Stream area for the updated model to be appropriate for use for concept design of the proposed footbridges. Changes to the MaiBkYk_v083 model for design purposes are done under the Maitahi model used for modelling of the Kākā development.

3.2 Modelled scenarios

Modelling was completed for four different scenarios, as shown in Table 3.1 to test the impacts of the proposed footbridges.

Table 3.1: Model scenarios

Model name	Description	Purpose
MaiBkYk_v083	**Baseline** model. Represents the existing ground surface and bridges.	Used as a pre-development state for comparison.
Maitahi_v026	**Design** model for Jickells and Gibbs footbridges. The baseline model updated to include the proposed footbridges and approaches.	Compared with baseline to assess potential effects of proposed footbridges on flooding to adjacent property.
MaiBkYk_v083_ GibbsRaise	Baseline model, with Gibbs **B**ridge deck raised above peak flood levels	Represents a 'future' baseline scenario, if the existing Gibbs Bridge deck has been raised to achieve design freeboard. Used to understand the effect of removing the restriction that the current Gibbs Bridge places on flow.
Maitahi_v027	Design model for Jickells and Gibbs footbridges, with Gibbs Bridge raised above peak flood levels.	Used to assess the combined effects of proposed footbridges and removing the restriction that Gibbs Bridge places on flow.

Note: All models have been run for the 2090 RCP8.5M 1% AEP storm event

These scenarios were all assessed for the design storm event as defined in Section 5.4.6 of the Nelson Tasman Land Development Manual (NTLDM), i.e. the 2090 RCP8.5M 1% AEP storm event. The 12-hour event has been assessed as being the critical duration in this part of the Maitahi/Mahitahi River floodplain and has been used for the below modelling.

Modelling with the Gibbs Bridge raised has been undertaken to inform future discussion between CCKV and NCC.

The models outlined in this report do not include the CCKV development fill, but modelling has been done including the fill and the modelling results discussed are unchanged.

3.3 Model results

3.3.1 Baseline results

The baseline model (MaiBkYk_v083) models the 2090 RCP8.5M 1% AEP storm event representing the existing bridges and floodplain. The flood depths are shown in Figure 3.1.

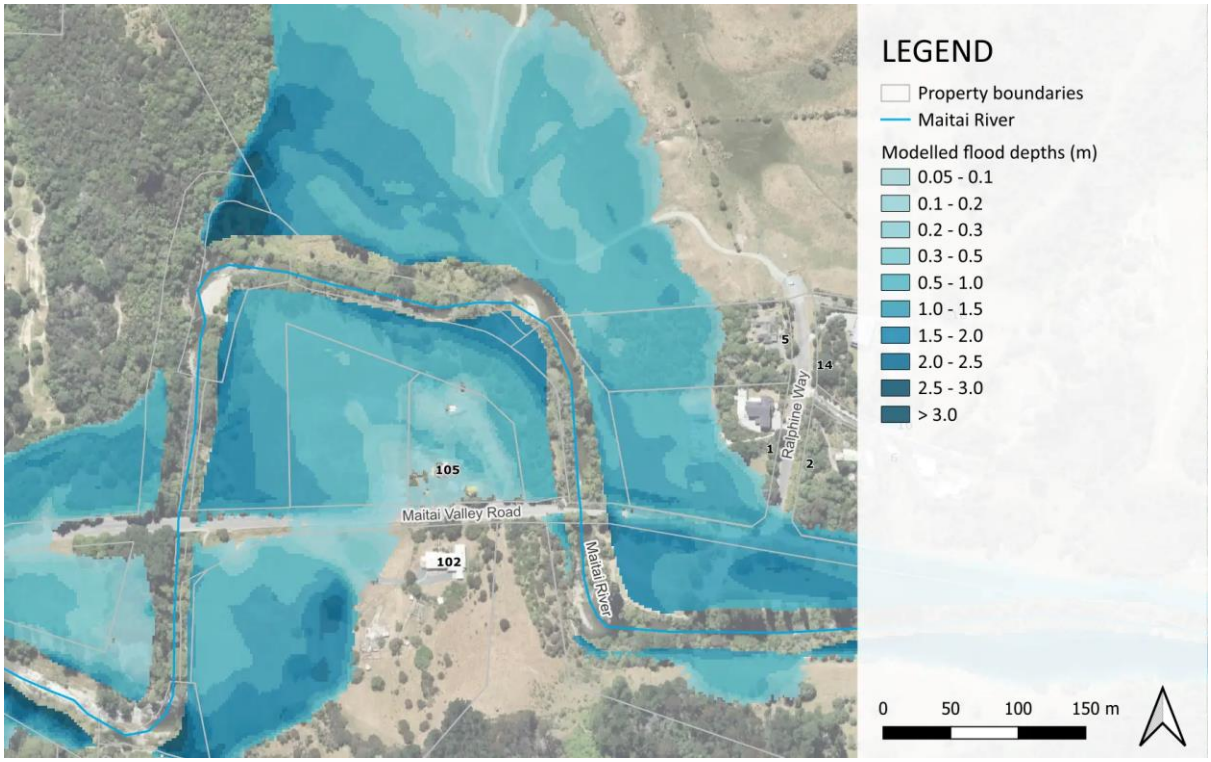

Figure 3.1: Modelled flood depths around Gibbs and Jickells Bridges in the 2090 RCP8.5M 1% AEP storm event. Model version MaiBikYk_v083.

The modelled flood levels from the baseline model were used to provide an initial recommendation for the level to be adopted for the **underside** of each of the proposed footbridges, which were incorporated into the concept footbridge design. These levels are summarised below:

Jickells Bridge

- The modelled flood level in the design flood event downstream of Jickells Bridge is RL 15.1 m.
- The preliminary level to be adopted for the **underside** of the footbridge deck downstream of Jickells Bridge (as per the NTLDM requirements) is 15.1 m + 0.6 m freeboard = minimum RL 15.7m. This compares with the underside level of the existing Jickells Bridge of RL 15.94 m (as provided by CDT). We recommend that the underside of the new bridge deck is set no lower than the underside of the existing bridge deck, i.e. minimum RL 15.94 m.

Gibbs Bridge

- The modelled flood level in design event upstream of Gibbs Bridge was RL 18.8 m.

- Given the existing level of the underside of Gibbs Bridge deck is RL 18.1 m, flood levels in the design event are expected to impact on the bridge deck. As a result, the existing bridge does not meet the current NTLDM level of service for freeboard. Furthermore, the modelled flood levels upstream of Gibbs Bridge are expected to be exacerbated by the restriction of flow from the current bridge deck, resulting in an increased bridge deck height for the proposed footbridge.
- The recommended level to be adopted for the underside of the footbridge deck upstream of Gibbs Bridge (as per the NTLDM requirements) is 18.8 m + 0.6 m freeboard = minimum RL 19.4 m. This compares with the underside level of the existing Gibbs Bridge of RL 18.1 m, i.e. setting the new bridge above the flood level behind the existing bridge means setting the underside of the new bridge significantly higher than the underside of the existing bridge.

3.3.2 Baseline results with Gibbs Bridge raised

Given that the flow restriction caused by the existing Gibbs Bridge deck results in higher upstream flood levels, an additional baseline scenario (MaiBkYk_v83_GibbsRaise). This scenario modelled the Gibbs Bridge deck as being raised clear of the flood level (no other changes to piers or channel cross section have been made), i.e. raising the level of the existing bridge to achieve the required level of service.

The purpose of this model scenario was to determine the sensitivity of the flow being restricted by the existing bridge deck on the upstream flood levels and subsequently the design footbridge deck levels. This also represents the scenario where improvements to the existing Gibbs Bridge to achieve level of service have been made prior to the 2090.

The difference in flood levels is shown in Figure 3.2.

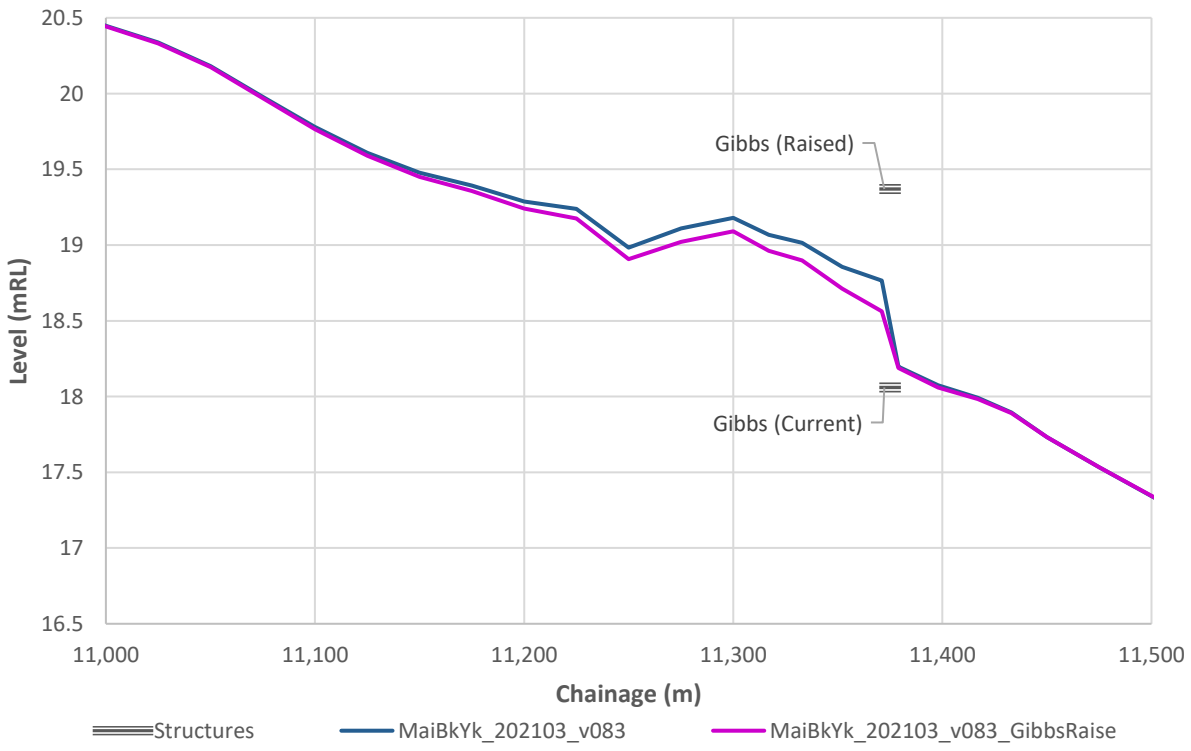

Figure 3.2: Modelled 1D flood levels through Gibbs Bridge for the 2090 RCP8.5M 1% AEP storm event

The model results show the following:

- The modelled flood levels upstream of the raised Gibbs Bridge in the 2090 RCP8.5M 1% AEP event is RL 18.6 m. This is 0.2 m lower than the flood level modelled without Gibbs Bridge raised of RL 18.8 m.
- With Gibbs Bridge raised, the recommended level to be adopted for the underside of the footbridge deck upstream of Gibbs Bridge (as per the NTLDM requirements) is 18.6 m + 0.6 m freeboard = minimum RL 19.2 m.
- The recommended level of RL 19.2 m does meet freeboard requirements for a present-day 1% AEP storm event, which has a modelled flood level of RL 18.2 m.
- The flood levels upstream of Gibbs Bridge are likely driven by a combination of a back water effect from the bend at Sunday hole and restrictions through the channel under the bridge (piers/abutments and channel capacity).

The recommended level for the underside of the footbridge deck based on this scenario has been adopted for the design model scenarios (i.e. an underside of bridge deck of RL 19.2 m).

3.3.3 Design scenario results

The design model (Maitahi_v026) models the 2090 RCP8.5M 1% AEP storm event including the preliminary footbridges, based on the following assumptions:

- Gibbs Footbridge included with an assumed underside of deck level of RL 19.2 m, and approach ramps (as provided by DO on 29 October 2024). The footbridge is located immediately upstream of the existing vehicular bridge.
- Jickells Footbridge with a bottom deck level of RL 15.94 m, and approach ramps (as provided by DO on 22 November 2024). The footbridge is located immediately downstream of the existing vehicular bridge.

The flood model results show the following results specific to the adopted bridge deck levels:

- The modelled flood levels upstream of Gibbs Bridge remain unchanged at RL 18.8 m, meaning the footbridge underside (at RL 19.2 m does not have the 0.6 m required freeboard (as per NTLDM requirements), but remains above the flood levels. This option would achieve freeboard if there was a future upgrade of the existing Gibbs Bridge to increase the deck height to meet current level of service (i.e. 0.6 m freeboard).
- The modelled flood levels downstream of Jickells Bridge also remained unchanged at RL 15.1 m. Based on the adopted underside of deck level of RL 15.94m, freeboard in excess of the NTLDM requirements can be achieved.

This model scenario has been compared to the baseline model version (i.e. with no additional footbridge and Gibbs Bridge at its current level) to determine the offsite flood effects of the proposed design (Figure 3.3 and Figure 3.4). Areas of increased flood depths are small and localised, as shown in the flood level difference plot below.

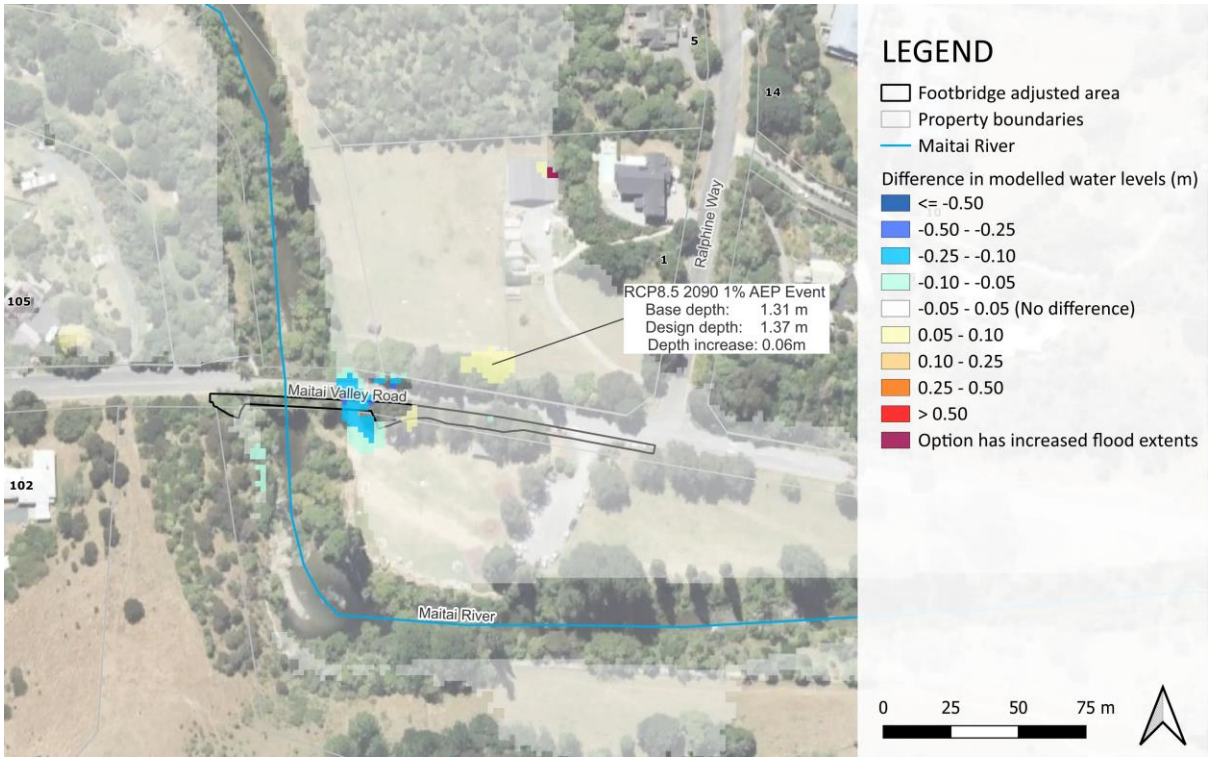

Figure 3.3: Differences in modelled flood levels for the proposed Gibbs Footbridge (Maitahi_v026 MINUS MaiBkYk_v083)

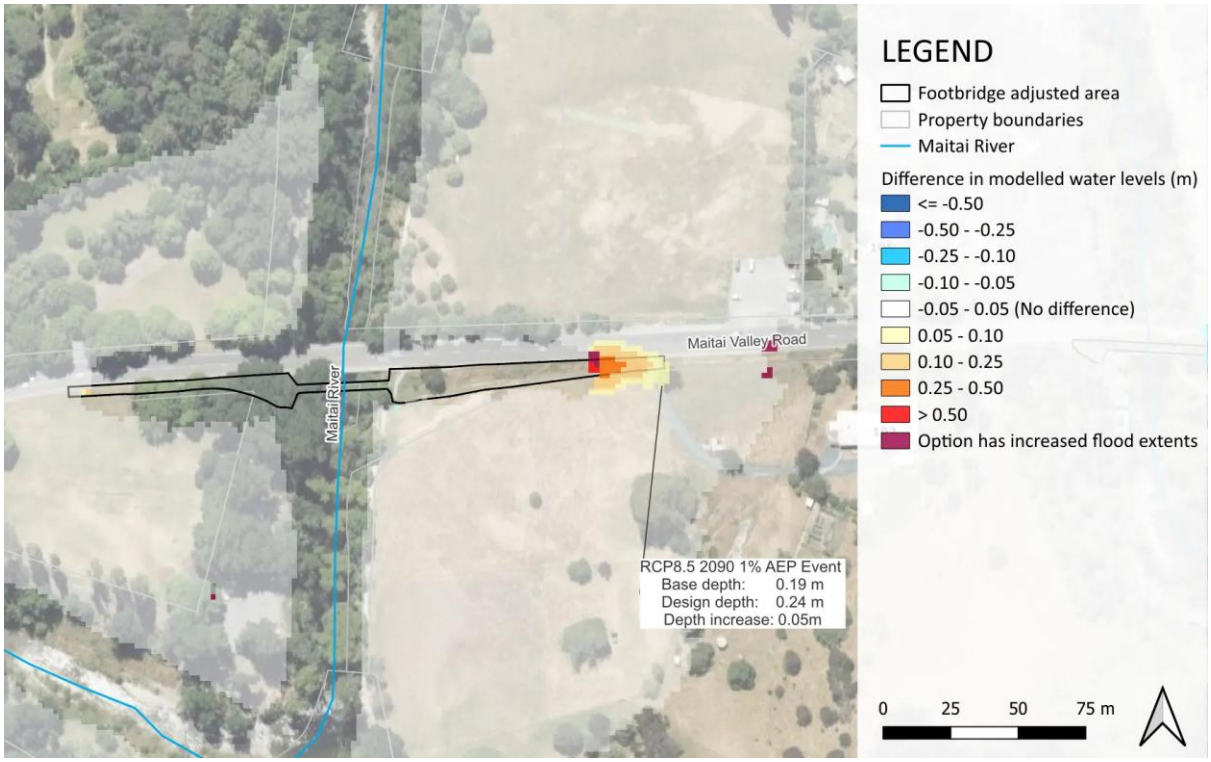

Figure 3.4: Differences in modelled flood levels for the proposed Jickells Footbridge (Maitahi_v026 MINUS MaiBkYk_v083)

The flood model results show:

- Up to 60 mm increase in flood depths by Gibbs Bridge in the neighbouring private property (1 Ralphine Way), as labelled. This increase is in an undeveloped area of private property that is already affected by flooding to significant depth.
- Up to 600 mm increase in flood depths around the eastern extent of the Jickells Footbridge approach ramp. This is caused by flow being forced over the raised ground level from the proposed ramp. Outside of the raised area, there is a 50 mm increase in flood depths, as labelled.
- Outside of these areas, depth changes were less than the model confidence limits of 50 mm.

3.3.4 Design scenario results with Gibbs Bridge raised

The design scenario, including both proposed footbridges and approach ramps, has also been modelled with Gibbs Bridge being raised outside of the design flood level for the 2090 RCP8.5M 1% AEP storm event.

The flood model results show the following results specific to the adopted bridge deck levels

- The modelled flood levels upstream of Gibbs Bridge remain are RL 18.6 m, meaning the footbridge underside (at RL 19.2 m) does achieve the 0.6 m required freeboard (as per NTLDM requirements).
- The modelled flood levels downstream of Jickells Bridge also remained unchanged at RL 15.1 m. Based on the adopted underside of deck level of RL 15.94 m, freeboard in excess of the NTLDM requirements can be achieved.

This model scenario has been compared to the baseline model version (i.e. with no additional footbridge and Gibbs bridge at its current level) to determine the flood effects of the proposed design combined with raising Gibbs Bridge deck to remove the restriction on flow. (Figure 3.5 and Figure 3.6). Areas of increased flood depths are small and localised, as shown in the flood level difference plot below.

- The modelled flood levels upstream of Gibbs Bridge are reduced to RL 18.6 m, meaning the footbridge underside (at RL 19.2 m) does have the 0.6 m required freeboard (as per NTLDM requirements).

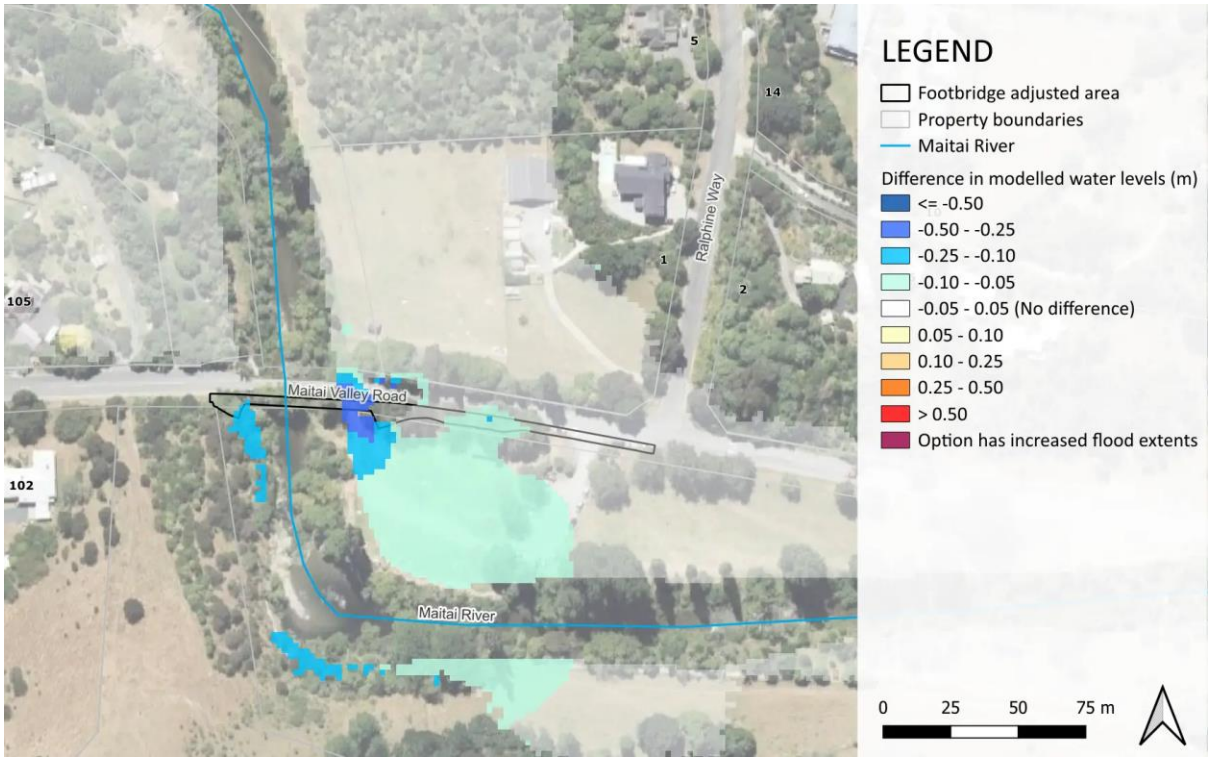

Figure 3.5: Differences in modelled flood levels for the proposed Gibbs Footbridge (Maitahi_v027 MINUS MaiBkYk_v083)

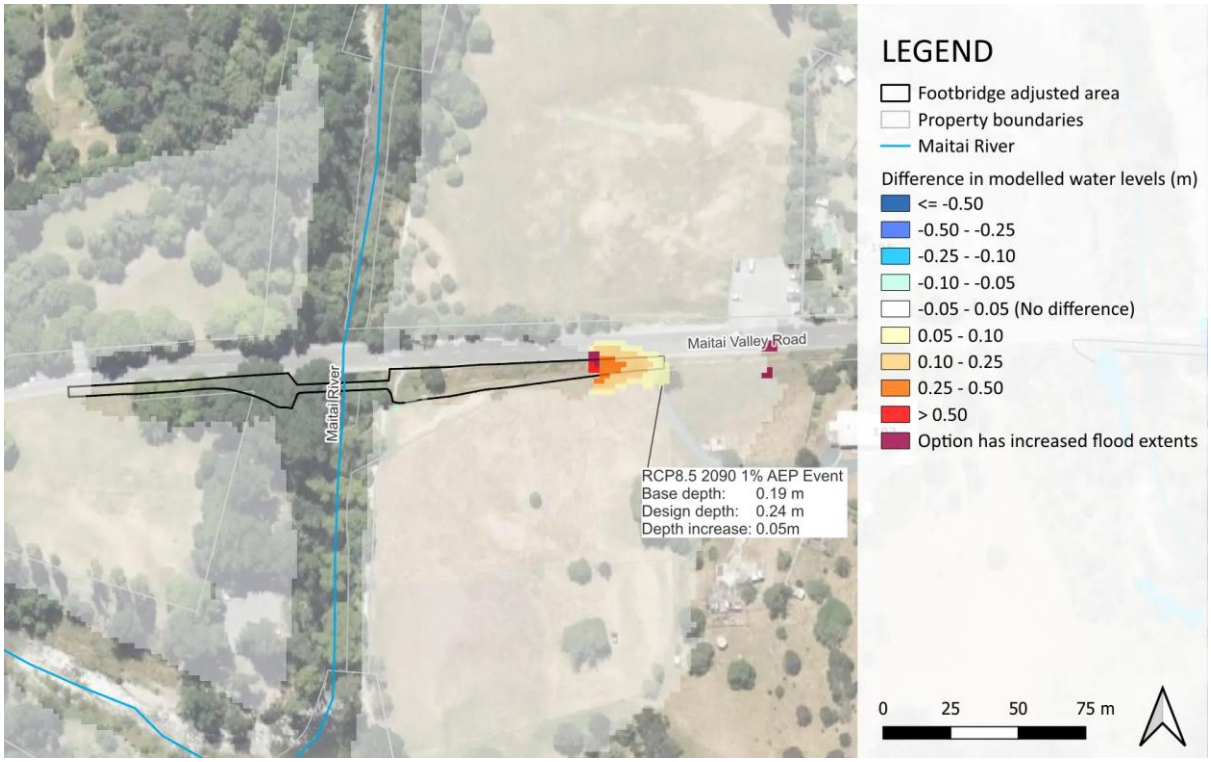

Figure 3.6: Differences in modelled flood levels for the proposed Jickells Footbridge (Maitahi_v027 MINUS MaiBkYk_v083)

The flood model results show:

- 50 to 75 mm decrease in flood depths upstream of Gibbs Bridge.
- Up to 600 mm increase in flood depths around Jickells Footbridge. This is caused by flow being forced over the increased ground level from the eastern approach ramp. Outside of the raised area, there is a 50 mm increase in flood depths, as labelled.
- Outside of these areas, depth changes were less than the model confidence limits of 50 mm.

4 Conclusions

A number of scenarios have been run to determine appropriate bridge deck underside levels to achieve the level of service as per the NTLDM, and to assess effects on flooding of the proposed bridges and approach ramps.

Jickells Bridge

- The proposed footbridge downstream of Jickells Bridge achieves the required freeboard in the design event when adopting a bridge deck underside level equivalent to the existing bridge (RL 15.94 m).

Gibbs Bridge

- The existing Gibbs Bridge deck is impacted by the top flood level in the design event. As a result of this flow obstruction there is a subsequent increase in flood levels upstream of the bridge. Modelling indicated that removing this obstruction through raising the existing Gibbs Bridge deck would reduce upstream flood levels by approximately 200 mm at the peak of the 2090 RCP8.5M 1% AEP event. An underside of bridge deck level based on the scenario where the existing bridge has been raised to achieve current level of service by the 2090 modelling horizon was adopted (RL 19.2 m). If this is not acceptable to NCC, a higher underside of bridge deck would need to be adopted (RL 19.4 m).
- Based on the existing Gibbs Bridge level, the proposed footbridge upstream of Gibbs Bridge does not achieve the 600 mm required freeboard (as per NTLDM requirements) but remains above the flood levels in the design event (2090 RCP8.5 1% AEP). The proposed footbridge does achieve the required freeboard for a present-day 1% AEP event. This option would achieve NTLDM freeboard requirements if there was a future upgrade of the existing Gibbs bridge to increase the deck height to meet current level of service (i.e. 0.6 m freeboard).

Flood level difference maps were produced to estimate the offsite effects on flood levels of the two footbridges. These maps show:

- Up to 60 mm increase in flood depths by Gibbs Bridge in the neighbouring private property (1 Ralphine Way). This increase is in an undeveloped area already significantly impacted by flooding. The incremental effects of the proposed bridge are considered less than minor.
- Some modifications to flood levels around the proposed access ramps.
- Outside of these areas, depth changes were less than the model confidence limits of 50 mm.

5 Applicability

This report has been prepared for the exclusive use of our client CCKV Maitai Dev Co Lp, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an application for resource consent and that Nelson City Council as the consenting authority will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd

Report prepared by:

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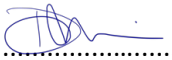
Chris Gray
Water Resources Engineer

Authorised for Tonkin & Taylor Ltd by:



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Damian Velluppillai
Project Director

Reviewed by Byron Munro, Water Resources Engineer

12-Dec-24
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Appendix A Concept footbridge details

river flow direction

wingwall or gabian baskets

New Bridge

boundary

BH required

end of bridge from survey

1985 tbc

Existing Bridge

pier CL from drawings

end of bridge from drawings

existing wingwall

Nelson end

37900

match existing deck level with existing footpath (this section needs to be updated)

16.15

15.83

Q100 flood level 15.10

RCP8.5M 1% AEP (Q_{100}) flood level as required by NTLDM

ø800 piers to line up with existing bridge piers

ø1050 piles, depth to be confirmed following Geotechnical investigation

existing bridge shown dotted – based on Sanders and Lane Consulting Engineering drawings supplied by NCC

1 S1–02

Note~General

- All dimensions shall be verified on site prior to any shop drawings or the commencement of any work.
- This drawing shall be read in conjunction with the Architectural drawings.
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3	UPDATED FLOOD LEVEL	15.10.24
2	CO–ORDINATION	04.10.24
1	CONCEPTUAL DESIGN	07.12.23

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Structural and Civil Design
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Structural Drawings

CCKV MAITAI DEV CO LP

JICKELLS BRIDGE
Long Section (looking downstream) & Plan

Scales:	A1–Full size at A3 A3–1:100
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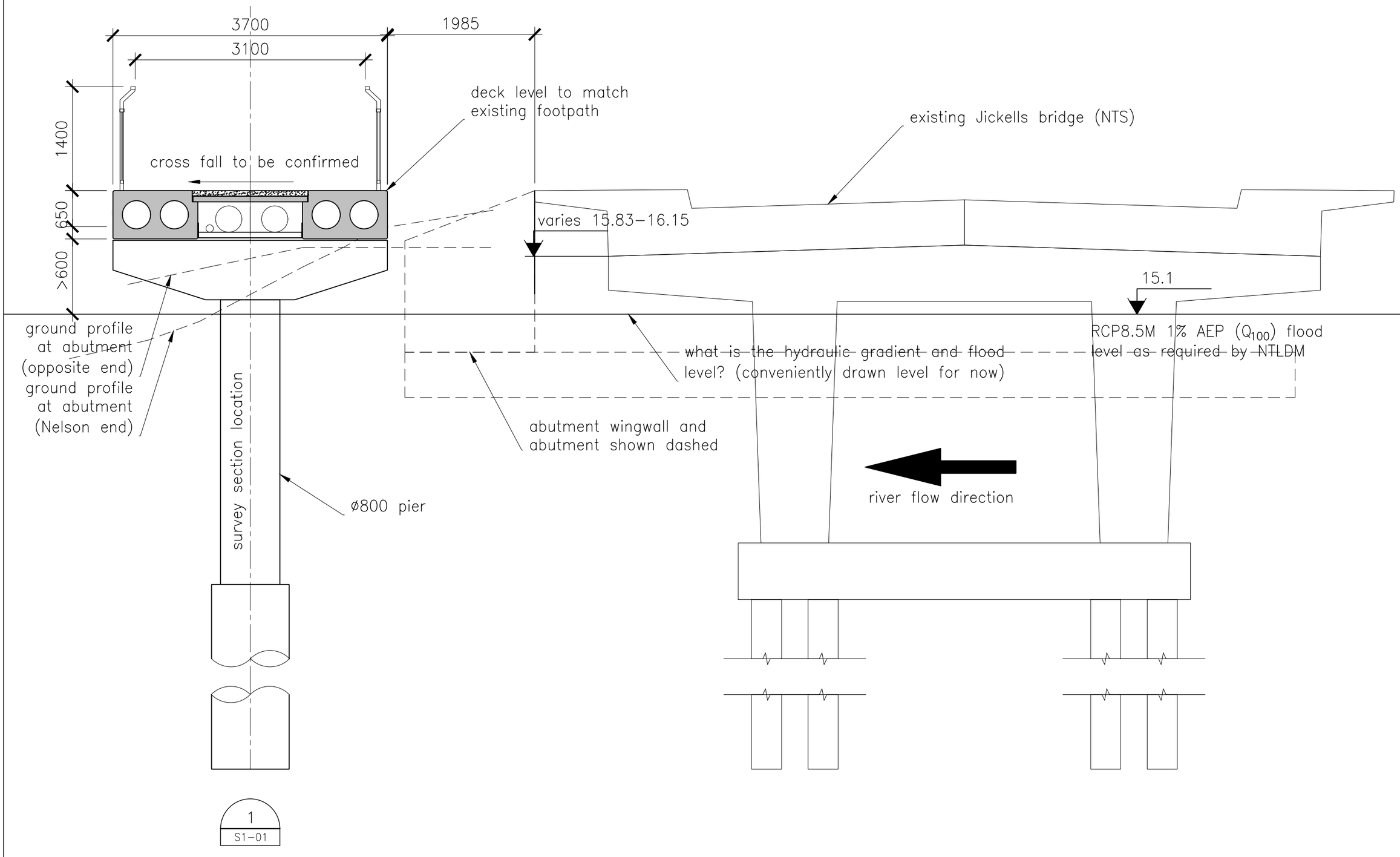

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Structural Drawings

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JICKELLS BRIDGE
Cross Section

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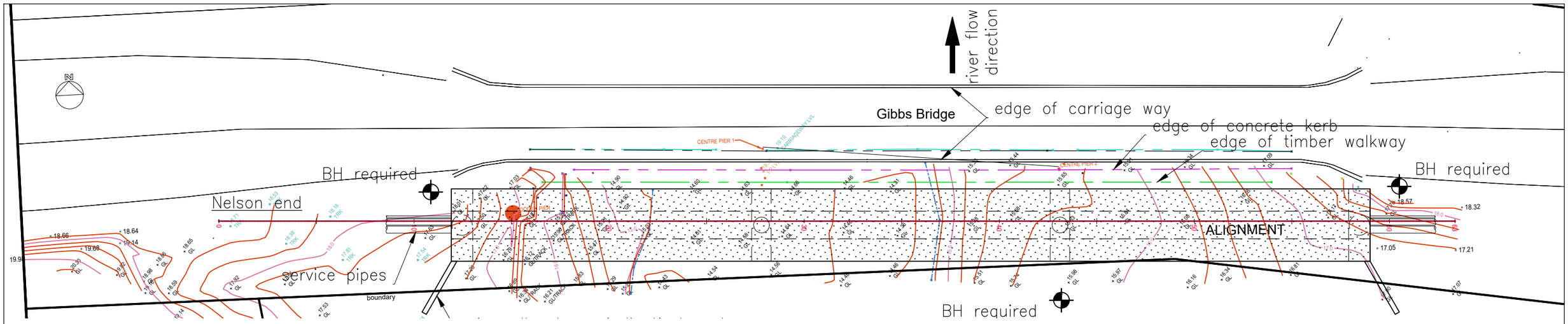

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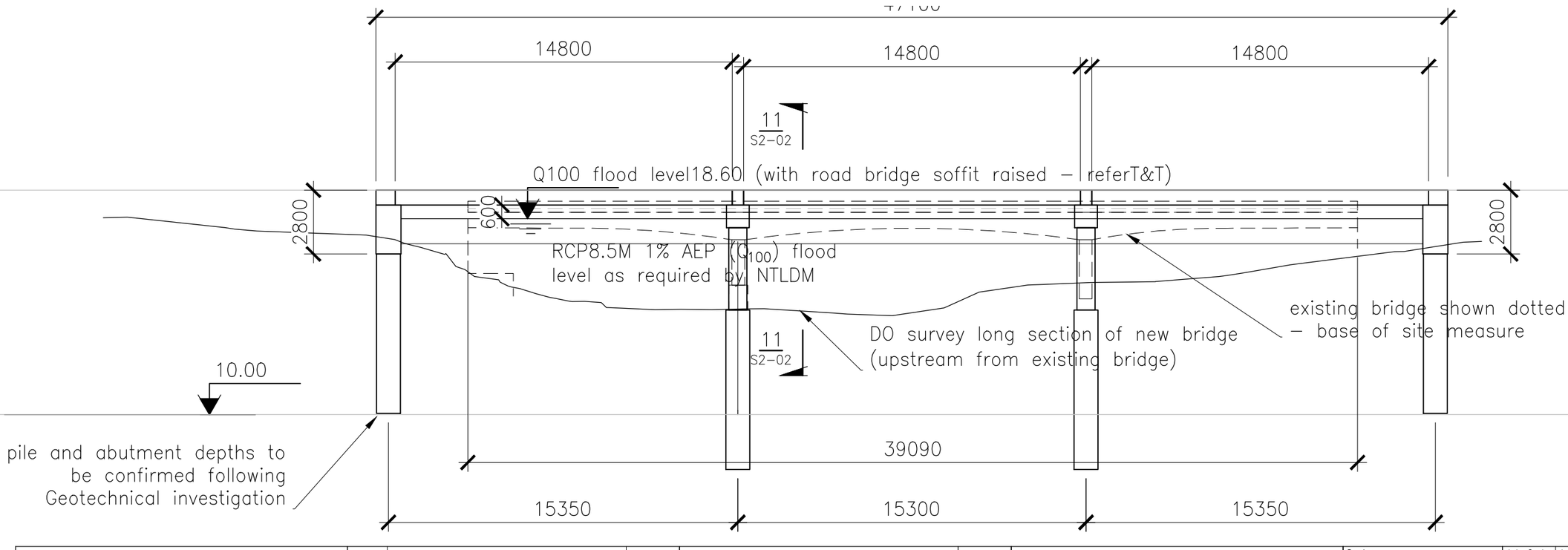

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Structural Drawings

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GIBBS BRIDGE
Long Section (looking downstream)
& Plan

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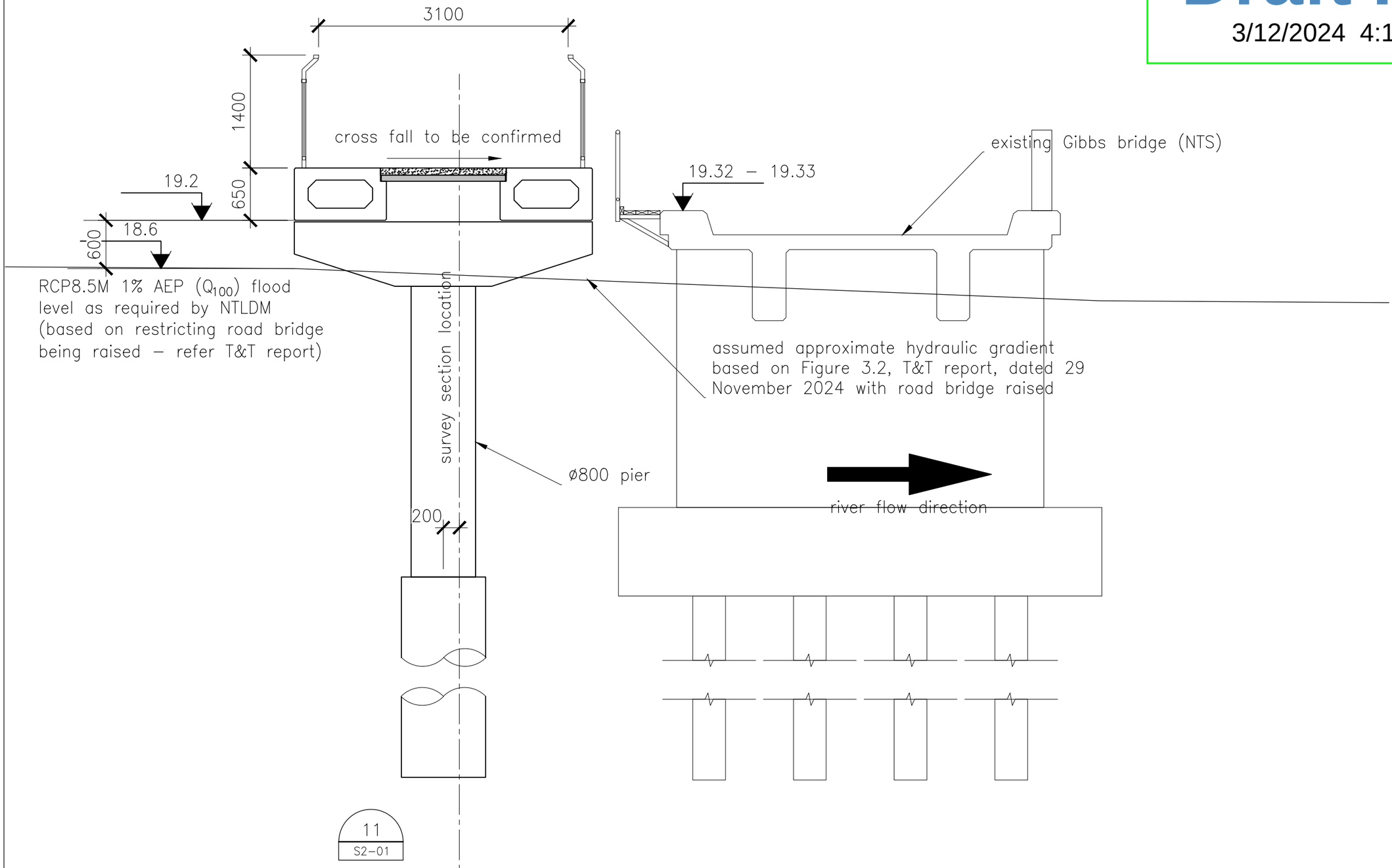

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GIBBS BRIDGE
Cross Section

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