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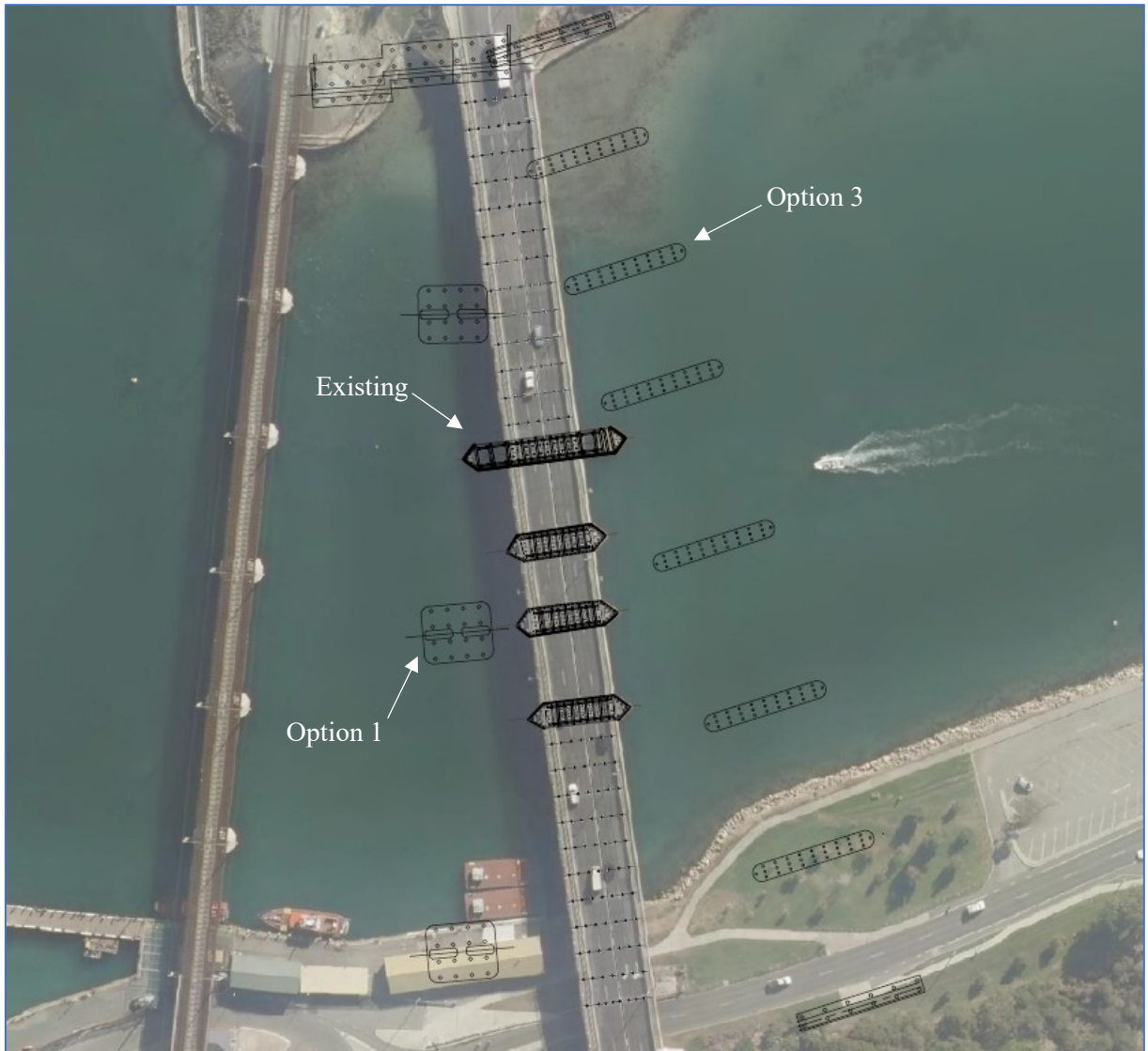
Dear Nicholas

## **SWAN RIVER CROSSINGS – BACKWATER FLOODING ASSESSMENT**

Coastal Engineers M P Rogers & Associated Pty Ltd (MRA) were engaged by the Fremantle Bridges Alliance to undertake a desktop review of the potential impacts of the Option 1 Fremantle Traffic Bridge (FTB) alignment on backwater flooding. This has been undertaken utilising previous modelling results completed by MRA (2021) for the existing and Option 3 FTB alignments. Numerical modelling specific for Option 1 has not been completed at this stage and will be required to confirm the initial outcomes of the assessment summarised herein.

### **Background**

The three bridge alignments considered in the assessment include the existing FTB, Option 1 and Option 3. The Option 1 alignment was provided to MRA by WSP in early August 2021 (pers. comm. Andrew Whiteside 5/8/21). The Option 3 alignment was used in MRA's previous modelling (2020 & 2021) and is located to the east of the existing FTB. The three bridge alignments and the indicative location of the pile caps and piles for each are presented in the figure below.

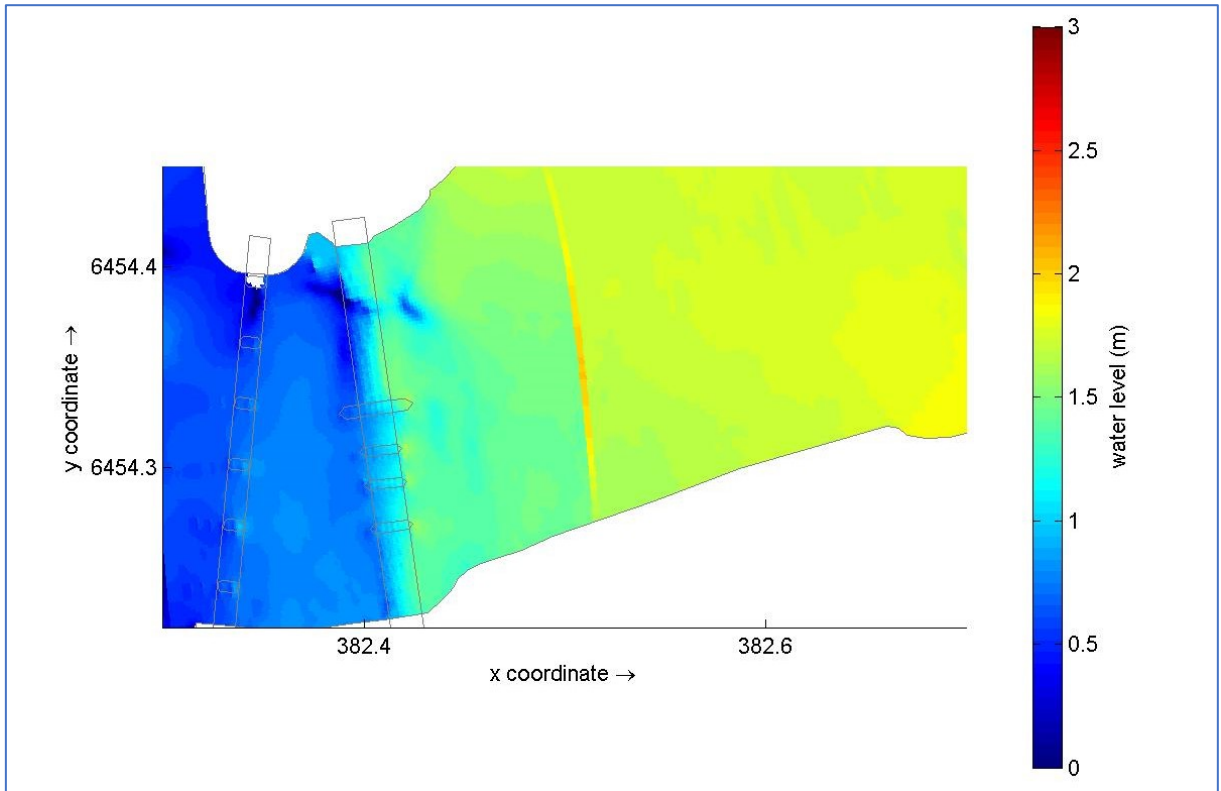


**Figure 1 FTB Alignments**

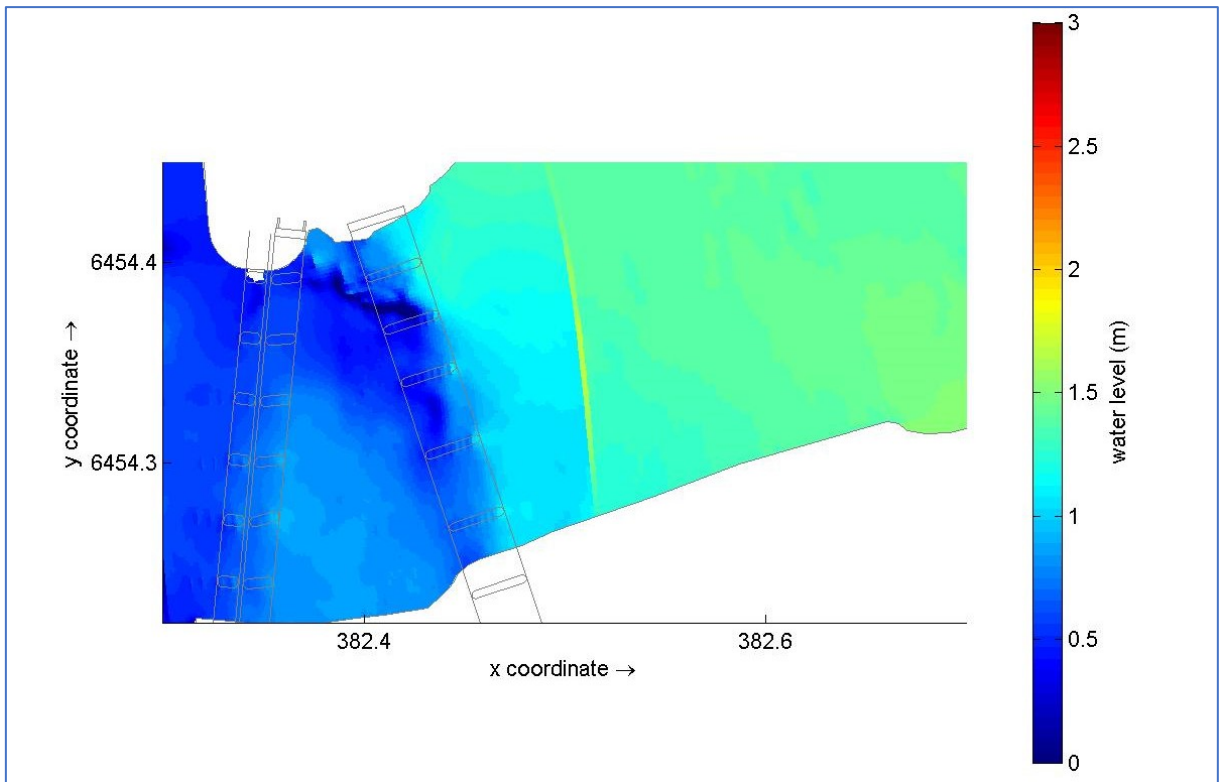
### Previous Modelling

As part of MRA's initial hydrodynamic modelling, backwater flooding was assessed under the existing FTB configuration and the Option 3 FTB configuration during the 10 year and 2000 year ARI riverine discharge flood events. It was found that the impacts of backwater flooding during the 10 year ARI riverine flood event were quite small, for both the existing in Option 3 alignments.

Modelling of the 2000 year ARI riverine flood indicated that the impacts of backwater flooding were significant under the existing configuration and slightly reduced under the Option 3 alignment as shown in Figures 2 and 3 below. Water levels upstream of the bridges under the existing configuration peaked at approximately +1.8 mAHD, whilst water levels upstream of the bridges under the Option 3 configuration peaked at approximately +1.5 mAHD. These results indicated that the Option 3 FTB would have reduced backwater flooding during the 2000 year ARI event, compared to the existing bridge. This is because the Option 3 alignment is supported by a different pile and pier arrangement which reduces the constriction of flow in the area.



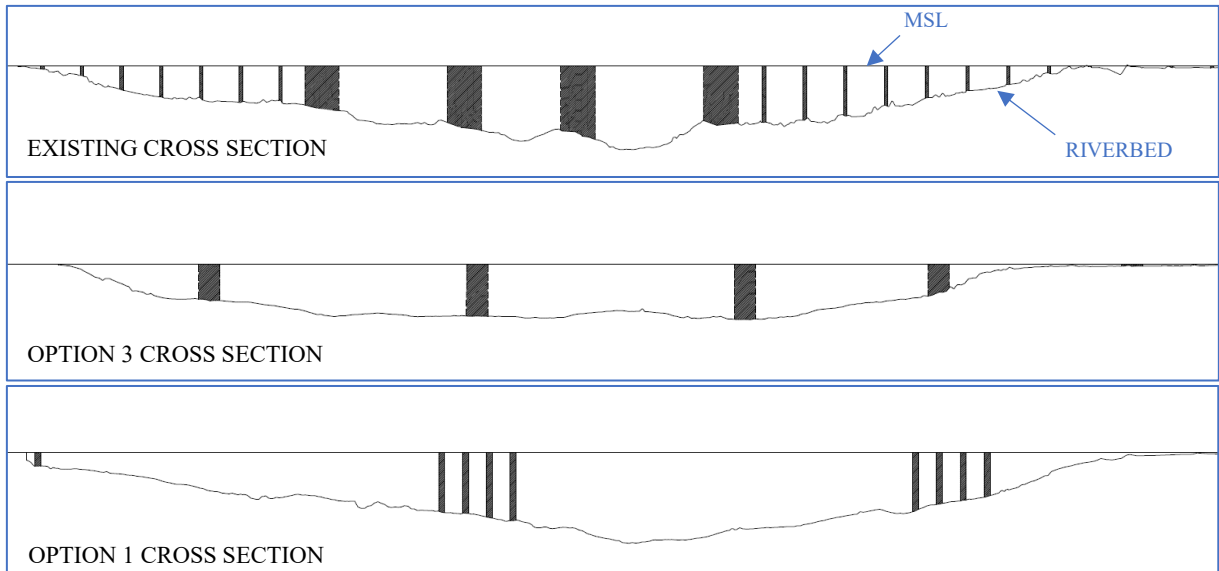
**Figure 2 2000 yr ARI Flood Event Peak Water Level – Existing Structures**



**Figure 3 2000 yr ARI Flood Event Peak Water Level – Option 3**

## Backwater Flooding Assessment

To assess the effect of the Option 1 FTB alignment on backwater flooding, it was necessary to compare the existing, Option 1 and Option 3 cross sectional areas. The figures below show the cross sections for each alignment option below mean sea level. The bathymetry was taken from Innovative Corrosion Management’s December 2020 hydrographic survey.



**Figure 4 FTB Alignment Cross Sections**

The cross sections above were then used to determine the total cross-sectional area, the area blocked by piles and the percentage of area blocked by the piles for each alignment. A limitation of the assessment is that closely spaced piles, represented as solid structures in this calculation do have a degree of porosity which must be neglected. Numerical modelling allows consideration of these factors. The results of the high-level assessment are presented in the table below.

**Table 1 Cross Section Analysis**

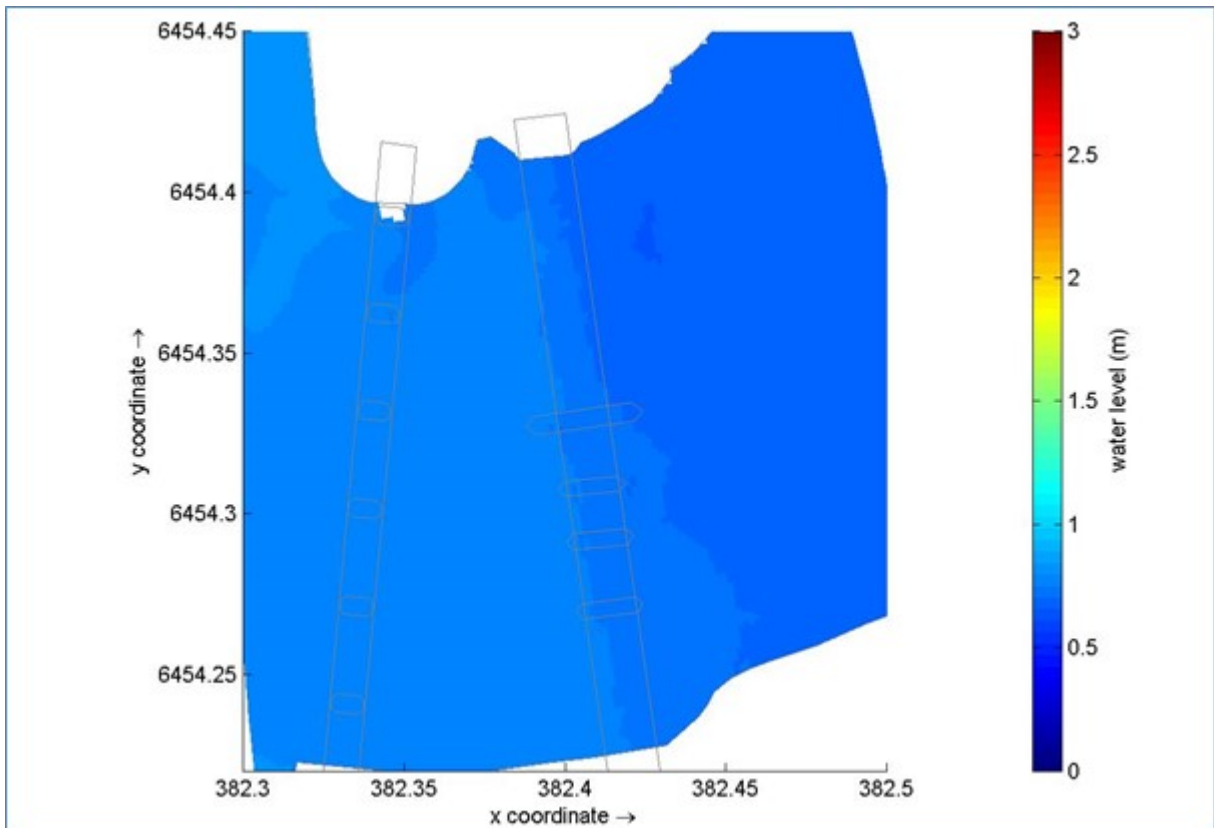
Bridge Alignment	Total Cross Sectional Area (m <sup>2</sup> )	Area Blocked by Piles (m <sup>2</sup> )	Percentage of Area Blocked by Piles (%)
Existing	1,060	212	20
Option 3	782	73	9
Option 1	1,298	64	5

The analysis indicates that the Option 1 alignment will have the largest cross-sectional area for the river to flow through and will have the smallest area and percentage of area blocked by piles. This suggests that during flood events that cause backwater flooding, the pier configuration of the Option 1 alignment would have reduced constriction of flow in the area compared to the other alignments. It is therefore expected that there is a low risk of exacerbated backwater flooding for the Option 1 alignment compared to the existing and Option 3 alignments.

### Construction Phase

MRA has also been asked to consider the effects of backwater flooding during the construction phase of the project. During the construction phase it is likely there would be a temporary period where the existing and new bridges will be in place simultaneously. This case will likely only be for a period of months and therefore it is appropriate to consider a reduced severity event for the assessment on

backwater flooding. During the 10-year ARI riverine flood event under the existing bridge alignment, the difference in peak water level upstream and downstream of the bridge is approximately 0.2 m as shown in Figure 5. This suggests that the impacts of backwater flooding during these lower ARI events is small.



**Figure 5 10 yr ARI Flood Event Peak Water Level – Existing Structures**

It is expected that with the Option 1 alignment also in place, there will be an increase in the constriction of flow around the bridges, which may slightly exacerbate backwater flooding. However, as shown in Figure 5, the impacts of backwater flooding are small for the types of events that need to be considered for construction phase. Hence, the exacerbation on backwater flooding due to the simultaneous presence of the bridges is also likely to be small.

### Summary

The proposed Option 1 alignment for the FTB would result in reduced flow constriction around the bridge piles compared to the existing and Option 3 alignments. It is therefore expected that there is a low risk of exacerbated backwater flooding for the Option 1 alignment compared to the existing and Option 3 alignments. This assessment has not included any numerical modelling specific to Option 1 and further modelling will be required to confirm the outcomes of this assessment.

If you have any queries regarding the information contained herein or would like to discuss any aspect at all please feel free to contact the undersigned.

Yours sincerely

for and on behalf of  
m p rogers & associates pl

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