Before the Independent Hearing Panel
appointed by Environment Southland and
Gore District Council

Under	the Resource Management Act 1991
In the matter of	an application by Gore District Council for resource consent to establish the Longford Bridge across the Mataura River

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Statement of evidence in reply of Daniel Anthony Crocker

29 January 2021

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Introduction

1 My full name is Daniel Anthony Crocker.

2 I have prepared a statement of evidence dated 2 December 2020. My qualifications and experience are set out in that statement. I confirm that this supplementary evidence is also prepared in accordance with the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2014.

3 This evidence addresses:

(a) assessment of alternative alignments.

Preliminary Assessment of Alternative Alignments

4 During the Longford Bridge consent hearing held 16th and 17th December 2020 a number of alternative alignments to that submitted were discussed. These alternatives were called Option A (Rock Street), Option B (Denton Street), and Option C (Maitland Street) as shown in the figure below (this is Figure 1 of the evidence provided by Michael Pentecost).

Figure 1: Alternative Bridge Locations (Extract from M. Pentecost evidence)

5 Options have been assessed from a high-level perspective to consider likely span, cost, hydrological impact, and overall connectivity.

6 For the purposes of the assessment, the following is assumed:

(a) The hydraulic model developed for the preferred location is suitable for providing flood levels and flood velocities at the alternative sites;

(b) At the preferred location, the Mataura River main channel is approximately 60m wide with the bridge spanning 10m beyond the western river's edge to connect to the proposed embankment, and 20m past the eastern edge to connect the existing floodbank. Generally speaking, it is assumed that any span would need to project at least 10m beyond the main channel in both directions and thus the minimum span is estimated as main channel + 20m (but this is likely to increase dependent upon proximity of any connecting floodbank);

(c) Only single span options are considered at this stage consistent with the preferred location design approach. With further design, intermediate piers could be adopted which would help improve the economics, but it is recommended that these remain outside of the main river channel;

(d) The floodplain either side of the main river channel is generally consistent with the design at a level of circa 72.4mRL, but varies slightly across the options. This can be clarified by further survey if required;

(e) The eastern floodbank is generally consistent with the design at a level of circa 76.6mRL, albeit future raising is proposed that would increase this. This can be clarified by further survey if required;

(f) Bridge cost is assumed at $2.5M for a 90m long x 3m wide bridge carrying a cycleway and water infrastructure (but excluding the western approach embankment). This is approximated as a cost of $27,800 per m of bridge span;

(g) The western embankment cost is taken as $1.0M for a bank high enough to elevate the bridge to achieve normal NZTA flood design requirements. This also includes provision of adequate scour protection measures and pedestrian approach grades;

(h) It is assumed from a connectivity perspective that the majority of East Gore residents will be heading towards the town centre (or near to it) when using the bridge. This is in a south westerly direction with final destination south of the existing SH1 bridge;

(i) geotechnical conditions at the alternative sites are assumed consistent with the preferred location. This would need to be confirmed by detailed geotechnical investigation if any alternative is progressed further; and

(j) Cost increases considered are for the capital costs. They do not include any structural, hydrological, or geotechnical re-design costs.

7 Option A at Rock Street is approximately 500m south (downstream) of the proposed bridge and 140m north of the existing SH1 road bridge (refer figure 2 below). It is assumed to start at the end of the existing Rock Street and cross toward the floodbank to the west. Total length to connect from Rock Street to flood bank is 185m. The main channel width at this alignment is 85m.

Figure 2: Option A (Rock Street).

8 Key observations are as follows:

(a) The main river channel width at this location is 85m which is 25m wider than at the preferred location;

(b) The bridge would need to span River Terrace Road (between the Mataura River and Rock Street) to prevent closure of this road. This would add a further 30m to the span;

(c) The floodbank on the western side is 35m from the river's edge. It is still likely that an embankment similar to the proposed would be required in lieu of an increased span of 25m (35m minus the assumed 10m required to connect to an embankment) to connect straight to the floodbank. The embankment would also support the cable-stayed mast assumed required for such a large span. Refer comment (h) on associated hydrological impacts and comment (j) for a possible multi-span alternative;

(d) Ground levels on the Rock Street side are approximately 8m higher than the preferred design's eastern landing and is elevated well above the floodbank level. This option could therefore add significant complexities when striving to fit a code compliant accessible pathway gradient of 1V:14H. Given the space constraints between the edge of River Terrace Road and the end of Rock Street, the design is likely to require landing as early as possible e.g. within 10m of the road edge and then utilizing some form of winding pathway and/or ramp system up the remaining 25m of existing bank. This is likely to be detrimental to safe and direct access and add further cost. For assessment purposes a straight-line bridging cost from the edge of River Terrace Road to Rock Street is adopted for simplicity. The higher cost of bridging over the 25m straight line length is expected to be consistent with a much longer winding pathway/ramp of circa 110m and associated balustrades and earthworks costs needed to resolve the vertical alignment issues (refer Figure 3 below). Further survey and concept design could clarify this matter if required;

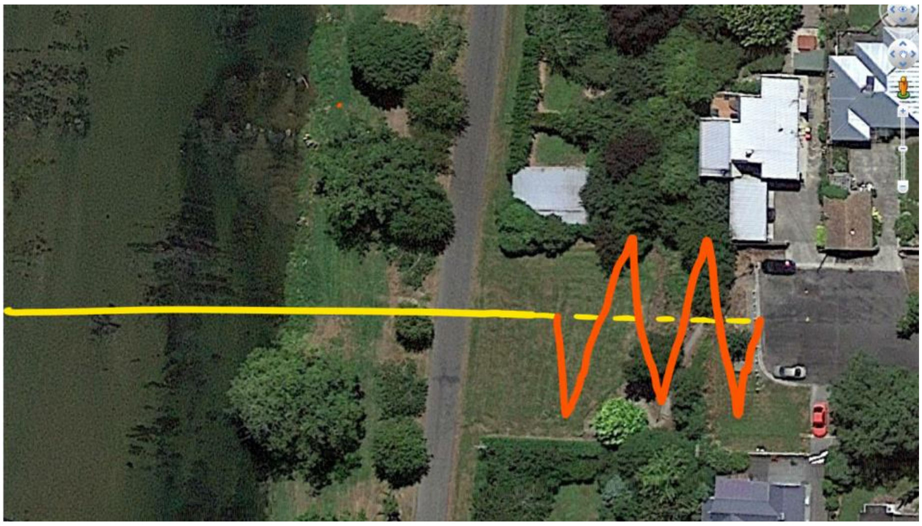

Figure 3: Option A Rock Street Connection: Yellow = assumed for pricing assessment purposes, Orange = likely zig-zag footpath style for an "accessible" gradient tie into Rock Street.

(e) The span required is estimated to be in the order of 10m (on the western side) + 85m (over the water) + 30m (over River Terrace Road) + 35m (to connect to Rock Street) = 160m. It is assumed that only one embankment on the west is required as the ground elevation is higher than the ULS flood on the eastern side;

(f) A 160m long bridge with a western embankment is likely to add $1.95M to the current project cost;

(g) A single span of 160m is an order of magnitude more complex than a 90m span and it is likely that an intermediate pier will be essential in order for the design to meet wind and pedestrian vibration best practice. This pier is likely to be needed on the river side of River Terrace Road (between river and road). This will create more barriers to the river water passage which is very critical during flood events at this location;

(h) The total floodplain width at this location is estimated at circa 185m which is significantly narrower than the 405m at the preferred location. From discussions with Eli Maynard (Hydrologist), the impact of having a smaller channel width from hydrological perspective is as follows:

(i) constructing an embankment here will have a larger impact on reducing the channels capacity in flood thereby increasing flood potential. Initial estimates are that the flow area will be reduced by around 10% which is more than double the effect at the at the preferred location (around 5%);

(ii) average flow depths and velocities are greater, increasing debris forces and scour potential, and the need for more robust scour protection measures (i.e. larger diameter riprap); and

(iii) the proximity of Option A to the SH1 and railway bridges means that the effects mentioned above are more significant because the natural river system has already been affected by the cumulative effects of two other bridges;

(i) Mr Maynard has confirmed that, unless the bridge is designed to fully span the river, hydrological effects at this option will be more severe than any of the other options considered;

(j) Although recognizing the constraints/issues noted in (f), (h), and (i) above, it is considered unfeasible/uneconomic to design an NZTA Bridge Manual compliant footbridge with a clear span of 185m. A multi-span structure with a span configuration working west to east of 35m + 85m + 65m is likely to be more appropriate. However, it should be noted that this still has a main span of 85m and would require a large above structure support system such as a cable stay mast or arch to achieve such spans. Said support system would still need to be lifted above the flooding and adequately protected meaning a substantial pier(s) and/or embankment causing an obstruction in the flood plain is still unavoidable;

(k) Assuming a similar cost per metre length for the 185m long multi-span version (but excluding an embankment), the overall price increase would become $1.6M. I note this is a reduction from the $1.95M estimate discussed for a single span design in comment (f) above but that a lot of uncertainty and risk remains until a workable solution is developed to deal with vertical alignment and flood issues;

(l) Overall, it is deemed likely that Option A will add somewhere in the order of $1.8M (depending upon the final configuration) to the current capital cost; and

(m) From an East-West cycleway connectivity perspective this option would appear consistent with the preferred location for connecting East and West Gore. In fact, this alignment is potentially more desirable given the majority of East Gore residents would not need to unnecessarily head northward to the bridge when aiming for the main Gore township in the South (refer Figure 4)

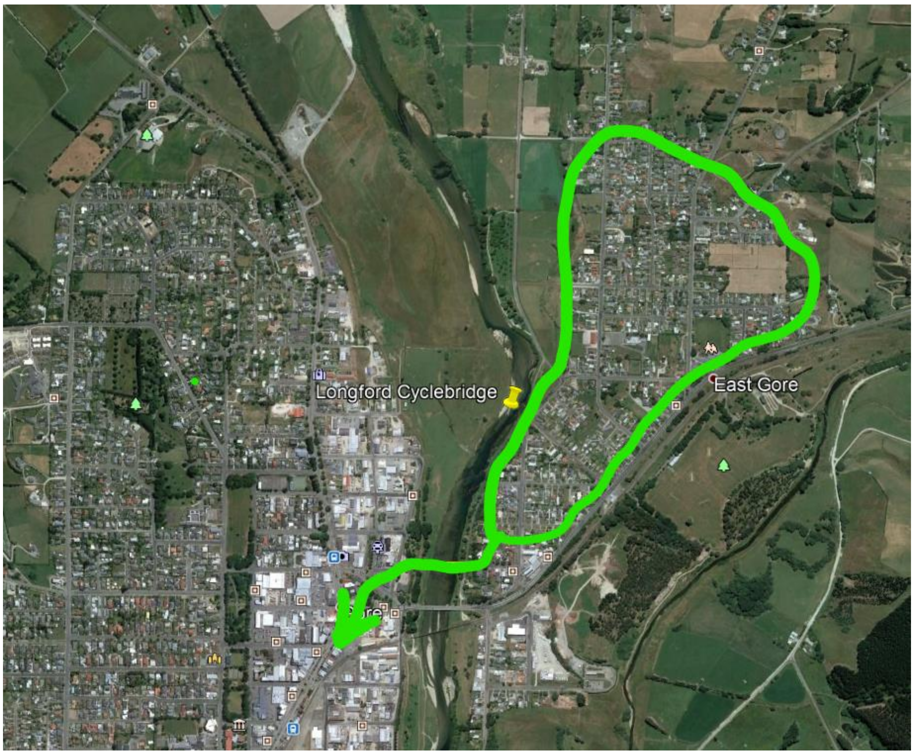

Figure 4: Option A (Rock Street) East Gore to Central Gore connectivity. Green = no unnecessary movement northward when travelling towards town centre.

9 Option B at Denton Street is approximately 250m upstream of the preferred location (refer Figure 5 below). The river is contained within a 580m wide floodplain (floodbank to floodbank), with the eastern floodbank around 120m away across Woolwhich Street and the western 390m near Denton

Street. Therefore, it is assumed than two embankments, both similar to the western embankment of the preferred location will be required

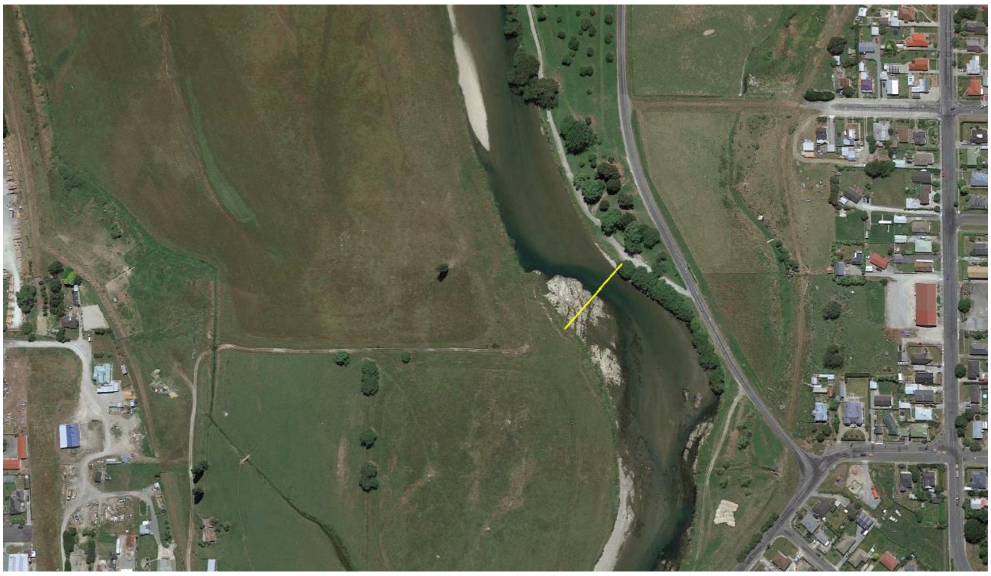

Figure 5: Option B (Denton Street).

10 Key observations are as follows:

(a) The main river channel at this location is at least 70m wide which is 10m wider than at the preferred location;

(b) By adopting an approach embankment on both sides of the river the required span is estimated to be in the order of 10m (on the western side) + 70m (over the water) + 10m (on the eastern side) = 90m;

(c) Span is unaffected when compared to the preferred location and therefore it is assumed the same bridge design would remain appropriate (to be confirmed by detailed review);

(d) The addition of the eastern embankment would add approximately $1.0M to the current project cost;

(e) The total flood plain width at this location is estimated at circa 580m which is significantly larger than the 405m in the preferred location. Hydrological assessment will need to confirm this, but early analysis provided to me by Mr Maynard suggests that accommodating the extra approach embankment could be achieved with around a 7% reduction in the flow area. This is more of an effect compared to the preferred location, but less than Option A;

(f) From an East-West cycleway connectivity perspective this option would appear to be less desirable when compared with the preferred alignment for connecting East and West Gore. Residents in the bottom half of East Gore would need to travel 300m further northward to cross the bridge before heading back 300m south toward the town centre (when compared to the preferred alignment);

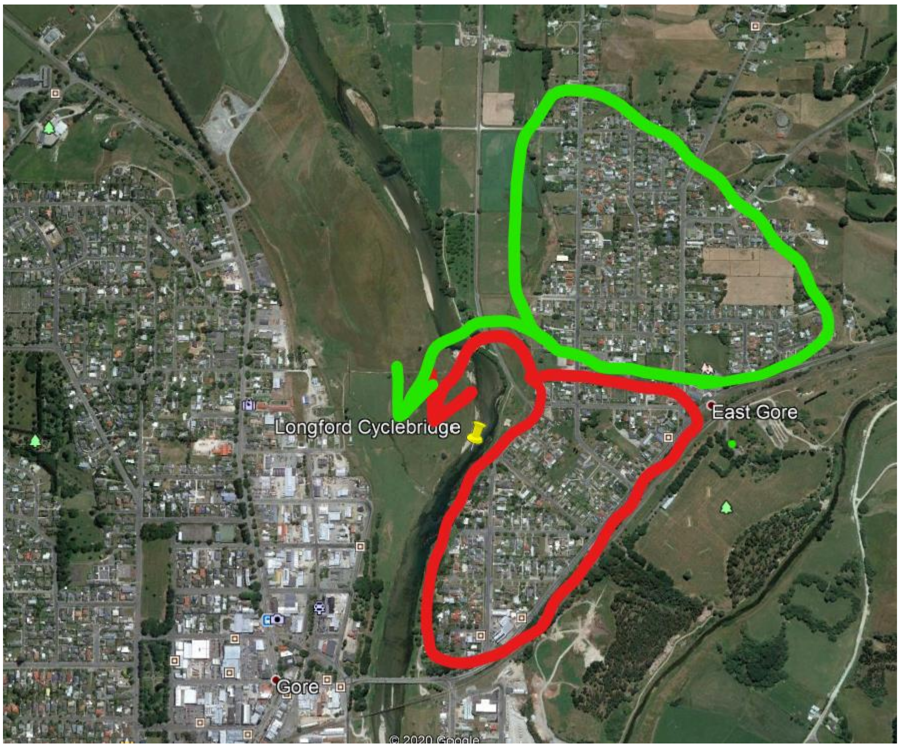

Figure 6: Option B (Denton Street) East Gore to Central Gore connectivity. Green = no unnecessary movement northward when travelling towards town centre, Red = unnecessary movement northward when travelling towards town centre.

(g) I note that Mr Maynard has commented that the floodplain elevation at the preferred location is around RL 72.5m. By comparison, Option B is much more variable with Woolwich St at around RL 72m grading to the east, and the right floodplain at around RL 73m. This means that the eastern side (Woolwich St) would be inundated more frequently limiting access to the bridge. At the preferred location the eastern side is coincident with the floodbank (RL 77.5m). Existing contour drains on the western (right) floodplain for both the preferred location and Option B enable the floodplain to be drained following a flood. This issue is also addressed in the evidence in reply of Mr Standring.

11 Option C at Maitland Street is approximately 900m upstream of the proposed bridge (refer Figure 7 below). The floodbanks either side are approximately 400m away from the main river channel edge and thus it is assumed that an embankment similar to the western embankment of the

preferred design will be required on both sides of the river. The current hydraulic model does not extend this far upstream due to the limited survey information. A survey would therefore be required. Total river width at this alignment is about 80m.

Figure 7: Option C (Maitland Street).

12 Key observations are as follows:

(a) The main river channel at this location is 80m wide which is 20m wider than at the preferred location;

(b) By adopting an approach embankment on both sides of the river the required span is estimated to be in the order of 10m (on the western side) + 80m (over the water) + 10m (on the eastern side) = 100m;

(c) Span is slightly longer (circa 10%) than that of the preferred location. Overall a similar design will be appropriate albeit loads, wind dynamics, pedestrian dynamics, etc. would need to be re-run to confirm any structural increase in member sizes to accommodate the increased span;

(d) The addition of the eastern embankment and 10m increase in length is likely to add $1.3M to the current project capital cost;

(e) The total floodplain width at this location is estimated at circa 900m which is significantly larger than the 405m in the preferred alignment. Detailed hydrological assessment will need to confirm this, but an early assessment provided to me by Mr Maynard suggests that accommodating the extra approach embankment could be achieved with minor hydrological effects similar to the preferred location. On a hydrological basis, Option C is preferred to Option A and B;

(f) From an East-West cycleway connectivity perspective this option would appear to be very poor when compared with the preferred location for connecting East and West Gore. All residents in the southern region of East Gore (south of Oxford Street) would need to travel at least 850m northward to cross the bridge before heading back 850m south toward the town centre when compared to the preferred location (refer Figure 8 below);

Figure 8: Option C (Maitland Street) East Gore to Central Gore connectivity. Red = unnecessary movement northward when travelling towards town centre.

(g) Mr Peter Standring has commented on effects on continuity of access to the bridge at this location as a result of flood events in his evidence in reply.

Conclusion

13 In summary, all discussed alternatives are feasible but will add at least \$1.0M to the current budget (≥30%).

14 From a technical perspective, Option B is the most consistent with the proposed design having the same span. In essence the same bridge with a re-arranged eastern landing (to accommodate a new embankment) would

be appropriate and would result in the least amount of re-design. We note however that this still incurs +$1M extra cost and adds 600m to the typical journey of South East Gore residents when travelling into town. A geotechnical investigation would be required at the site, and the design confirmed. The project Hydrologist has confirmed the likelihood that the eastern side (Woolwich St) will be inaccessible more often than the preferred site due to flood inundation.

15 The only option to add connectivity benefit that might warrant further consideration is Option A. However, since Option A is heavily handicapped by the significantly narrower flood cross section, it will create further risks to the water passage during flood events and may not be consented. Moreover, the need to cross River Terrace Road and tie into a highly elevated Rock Street, this option is in the order of $1.8M more expensive (albeit with the greatest pricing uncertainty/risk of all the options). Progressing this option is likely to require a further 50% in capital funding. In my opinion this is unlikely to represent best value for Council and associated ratepayers given the availability of more cost-effective options.

16 In summary I believe in reviewing the alternatives, that the proposed option represents the best value outcomes when trying to strike a good balance between span, cost, flood risk, and connectivity.

Dated this 29th day of January 2021

Dan Crocker