Peer Review

Hydraulic design

Longford Cycle Bridge, Gore

Report prepared for:

Gore District Council

Report prepared by:

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Distribution:

Gore District Council

GeoSolve Limited (File)

May 2020

GeoSolve Ref: 200077

Revision	Issue Date	Purpose	Author	Reviewed
1	20/05/2020	Draft for client comment	HS	CEM
2	22/05/2020	Issue	HS	CEM

GEOTECHNICAL WATER RESOURCES PAVEMENTS

Table of Contents

1 Introduction 1

2 Hydrology - Design Flood Estimates 2

3 Hydraulics 3

3.1 Water Levels and Velocities 3

3.2 Debris loadings 3

3.3 Scour and erosion 3

4 Conclusions and Recommendations 4

5 Applicability 5

1 Introduction

In accordance with our Agreement dated 25 February 2020 we have undertaken an independent peer review of hydrological analysis and hydraulic design (the Design) by Riley Consultants for the proposed cycle/foot bridge at Longford, Gore.

The supplied documents covered by this review are:

a) Riley Consultants, 3 December 2019, PRELIMINARY GEOTECHNICAL AND HYDRAULIC INPUTS - LONGFORD SHARED PATH, GORE
b) Riley Consultants, 5 May 2020, GEOTECHNICAL AND HYDRAULIC INPUTS LONGFORD SHARED PATH, GORE

We note that document (a) is effectively updated, expanded, and superseded by (b); therefore our review will focus on relevant sections of (b). A preliminary hydraulic report by LandPro (August 2019), appended to the Riley reports, likewise has been superseded by the Riley modelling and reporting.

This is a high level peer review of Riley's methodology and results, with comparison against accepted good practice and expected range of outcomes. We have not checked Riley's arithmetical calculations nor undertaken our own modelling or numerical analysis.

The written material and imagery supplied has proved fully comprehensive and descriptive, and with other available information we have not found it necessary to visit the site for the purposes of this review.

2 Hydrology - Design Flood Estimates

The Designer has estimated design flood flows based on statistical flood frequency analysis of stream gauge recordings for the Mataura River at Gore, using annual maxima from 1960 to 2019. The recorder location is less than 1 km from the bridge site with no significant tributary inflows in the intervening reach, therefore the data analysis can be applied directly for this purpose.

Flood frequency estimates provided by Environment Southland (ES) have been referenced but were not directly adopted for design purposes.

Instead, Rileys undertook rigorous analysis utilising subsets of the annual flood maxima to explore the effects of climate variability, both past (Interdecadal Pacific Oscillation) and future (projected climate change). The resulting pre- climate change peak flow estimates for various ARIs, as adopted by Riley, are greater than or similar to the ES estimates. We note that flood frequency estimates are also provided by NIWA[1]; these are significantly lower than the ES estimates for greater ARIs. Hence the Riley pre- climate change flow estimates are generally conservative when compared to the ES and NIWA estimates.

Regarding the future climate change allowance, we consider the percentage increase in rainfall intensities may be compounded by increasing runoff coefficients, so the actual percentage increase in peak flood flows may be greater than that of rainfall intensities. Riley have not explicitly discussed this aspect, but we note their adopted future climate change factor of 15% is substantially greater than the average RCP 6.0 rainfall intensity increase of about 9% for the critical storm duration of approximately 40 hours. We consider that future climate change is appropriately factored into the design flow estimates.

The record event of February 2020 does not appear to be included in the Riley (or ES or NIWA) flood frequency analyses. This was a significant event, with a greater peak flow than the adopted 50-year ARI pre- climate change event, however it occurred after the various analyses were completed. We have discussed this point with the Designer who advises that the flow estimate for the Feb 2020 flood is not yet confirmed. We accept that the Riley analysis incorporates sufficient conservatisms that the derived flows provide a suitable basis for the bridge design.

We note that the SLS2 assessment is somewhat arbitrary because, while the bridge structure itself will remain operationally functional, its approaches will be inundated in this event (50 year ARI) and it will not be usable. However, the bridge can return to full functionality immediately upon subsidence of SLS2 event floodwaters provided the approaches are usable.

[1] New Zealand River Flood Statistics https://niwa.maps.arcgis.com/apps/webappviewer/index.html?id=933e8f24fe9140f99dfb57173087f27d

3 Hydraulics

The 2D modelling software utilised is considered the appropriate tool for estimating river main channel and floodplain parameters in this situation.

Riley's report demonstrates that the hydraulic model is based on accurate topography and has been developed and validated with a robust calibration / verification process. Flood event simulation has achieved good agreement with recorded events including the two major floods of 1978 and 2020. The resulting modelled parameters are within the range of expected values. This is considered to be a successful hydraulic modelling exercise, and suitable as a basis for associated design.

The floodplain in the bridge vicinity is protected by existing floodbanks on both river banks. For bridge design purposes, the model has been applied to simulate pre- and post- bridge conditions under a range of floodbank scenarios including the existing situation, floodbank failure during extreme flood, and potential future upgrading/raising of the floodbanks.

3.1 Water Levels and Velocities

As expected, given the robust hydraulic model utilised, design flood water levels and velocities are in line with known and expected parameters.

The modelled parameters are considered suitable to inform bridge design in accordance with the NZTA Bridge Manual.

3.2 Debris loadings

Freeboard above the maximum water level in the SLS2 event (50-year ARI flood, climate-adjusted) of 1.2 m is provided to the bridge soffit; this is in accordance with NZTA Bridge Manual specification where large woody debris such as entire trees may be expected in a major flood.

Modelled water depth and velocity information for the ULS event is provided to inform detailed design of the relevant structural elements, which will provide for derived debris pressure and impact loadings.

3.3 Scour and erosion

A range of standard methodologies has been applied to design a scour protection system where needed at vulnerable locations (abutments, approach embankments) as indicated by hydraulic modelling results. The adopted protection system involves a suitable combination of graded riprap, turf reinforcement mat (TRM), and selected vegetation as appropriate depending on expected local velocity and duration of flood water.

No scour protection is proposed for foundation piles, owing to embedment depth into competent rock.

4 Conclusions and Recommendations

- The major February 2020 event occurred too late to be incorporated in the flood frequency analysis. However otherwise the hydrological analysis is robust and conservative, and we consider the design flows to be appropriate.
- The design water levels and velocities are developed by robust hydraulic modelling, and are within the range of expected parameter values,
- Relevant parameters are provided to inform structural design for water and debris loadings,
- Proposed scour protection measures are suitable and appropriately specified.

5 Applicability

This report has been prepared for the benefit of Gore District Council with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

This has been a high level technical review of Riley's methodology and results, with comparison against accepted good practice and expected range of outcomes. We have not visited the site, nor undertaken our own analysis or modelling or checked Riley's numerical calculations.

Our peer review was undertaken to provide additional assurance to the Client as to the quality of the Design. The responsibility for the Design remains fully with Riley and our review does not constitute a means by which the Design responsibility can be passed on to GeoSolve.



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