

**Environment Southland Flood Modelling evidence relating to
submission 85
on Proposed Gore District Plan
Prepared by Matthew Gardner**

Date 21 February 2025

1. My full name is Mathew James Gardner.
2. I practice as a consulting engineer specialising in water resources engineering. I am the managing director of Land River Sea Consulting Limited, a Christchurch based engineering consultancy that specialises in flood modelling, geomorphology, river engineering and flood risk management.
3. I hold the degree of Bachelor of Engineering (Hons) in Natural Resources Engineering from the University of Canterbury. I am a Chartered Professional Engineer (CMEngNZ, CPEng). I am also a member of the Engineering New Zealand (EngNZ) Rivers Group (a technical subgroup of EngNZ), the New Zealand Hydrological Society and Water New Zealand (the New Zealand Water and Wastes association).
4. I have been working as a professional engineer in the field of water resources engineering, river modelling and floodplain management since early 2006. Included in this experience is 4 years with Wellington Regional Council where I was employed in the Flood Protection Department. I have further experience on a range of river flood, sediment transport and urban drainage modelling/engineering projects working for URS New Zealand Ltd as well as with River Edge Consulting Limited.

Expert Witness Code of Conduct

5. I confirm that I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2023 and that I have complied with it when preparing this evidence. The opinions expressed in this evidence are based on my qualifications and experience and are within my area of expertise. Where I have relied on the evidence or opinions of another my evidence will acknowledge that position.
6. I am authorised to give this evidence on Environment Southland's behalf to the Proposed District Plan (PDP) hearing commissioners ("Hearings Panel").

Purpose of evidence

7. The purpose of this evidence is to provide an overview of the Environment Southland Flood Model (**Model**) prepared to inform future flood management in Gore and Mataura townships. It outlines the information use, process followed and the findings.

Summary of the Modelling Methodology in the Mataura Modelling Report

8. Land River Sea Consulting was commissioned by Environment Southland to build a 2D flood model of the Mataura River.
9. The purpose of this Model is to allow a better understanding of the current level of service that the Mataura protection scheme provides for the Gore and Mataura townships, to investigate the impact of potential stopbank breaches and to investigate the impact of potential upgrades to the scheme.

The Environment Southland Model

10. The Model has been based on the following:

Data Inputs & Preparation

11. To build the most accurate Digital Elevation Model (**DEM**) possible we used a series of datasets.
12. Some of this information is publicly available and some of the information was such as the crest level surveys was collected specifically for the Model.
13. The LiDAR Data used was as follows:
 - Bathymetric LiDAR (Landpro 2022) for riverbed elevation.
 - Terrestrial LiDAR (PGF 2020/21) for floodplain elevations.
14. Crest Level Surveys to establish the heights of flood banks and bridge elevation surveys were conducted in November 2022.
15. Hydrological data relied on included:
 - Flow inputs primarily from Mataura River at Gore station as provided by the Environment Southland hydrology team.
 - Historical flood records used for calibration.
 - Peak flow adjustments based on Environment Southland hydrology assessments.
16. Information and data relating to historic events was used to calibrate the model. This including analysis of flood records, photos, videos and receiving anecdotal information.

Model Construction

17. The model is a flexible mesh-based 2D hydraulic model, built in the industry standard MIKE software which is developed by DHI (Danish Hydraulic Institute).
18. The Model was divided into two sections: Gore (upstream) and Mataura (downstream) and used the flow data from Gore is used as input for the Mataura model.
19. Key hydraulic features which will impact on the nature of the flooding
 - Flood banks and road crests elevations enforced based on ground survey, or extracted from the LiDAR.
 - Bridges (Gore and Mataura) represented with modified roughness values to account for flow constriction.
 - Floodplain resistance (Manning's 'n') applied based on detailed land use classification based on manual and automated classification techniques.

Calibration & Validation

20. The primary calibration event was the February 2020 flood which was the biggest flood on record at the time. Independent validation was also carried out using the 1999 Mataura River flood debris survey information.
21. Debris levels, satellite imagery, building assessment information and field surveys used for both calibration and validation.

22. The model has calibrated well overall, however due to limitations in the 2D modelling software, there is increased uncertainty for flood levels through the narrow Mataura Gorge area, where the water is very turbulent and flowing at very high speeds. The results outside of this area including through the Mataura residential and rural areas are considered reliable.

Model Scenarios & Analysis

23. We simulated a 2% AEP (50-year ARI) and 1% AEP (100-year ARI) flood scenarios of the Mataura River for this initial model build of the Mataura floodplain.
24. Nine breach scenarios were tested to evaluate flood consequences of the flood protection scheme failures. Locations of these were selected by Environment Southland, Gore District Council and Land River Sea Consulting staff.
25. The model has been used to investigate the impacts of:
- Effect of raising the Boundary Creek stopbank.
 - Impact of deepening and widening the channel under Gore bridges.

Model Results & Recommendations

26. The existing flood protection scheme fails at 1% AEP events, leading to significant risk in Gore and Mataura. The primary cause of flooding in Gore is due to a lack of capacity under the railway bridge at Gore.
27. Whilst the Boundary Creek stopbank has been recently raised, it is still likely to overtop in a 1%AEP event, causing significant flooding to the main Mataura township. The true left stopbanks are also likely to overtop.
28. Breach scenarios show extensive flooding, emphasising the need for stopbank maintenance and evacuation planning.
29. Full details of the results, conclusions and recommendations can be found in the model build report.

Peer Review

30. The hydrological inputs were formally peer reviewed by NIWA and found to be appropriate.
31. The hydraulic modelling was formally peer reviewed by Philip Wallace from River Edge Consulting and has also been found to be fit for the purpose outlined in the report.