

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

Date 21 February 2025

1. My name is Jo Paterson. I am the Flood Risk Management Project Manager at Environment Southland. I have a Bachelor of Science degree in Geology, ten years' experience as a Geologist and seven years' experience in disaster resilience, natural hazard analysis and management.
2. I have been working in Natural Hazards analysis, mitigation and adaptation since 2018. I work a hybrid role for Environment Southland and for AF8 as a Senior Advisor.
3. I have been involved in the Environment Southland Submission on the proposed Gore District Plan.

Code of Conduct

4. 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. Having reviewed the submitters and further submitters relevant to this topic I advise there are no conflicts of interest that would impede me from providing independent advice to the Hearings Panel. 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.
5. I am authorised to give this evidence on Environment Southland's behalf to the Proposed District Plan (PDP) hearing commissioners (**Hearings Panel**).

Available Flood Modelling Recommended for the Gore District Plan

6. There are many coastal and fluvial modelling types and qualities available to support different needs in Southland that have been completed by various specialists for organisations with aligned or different needs. All flood models can be useful for district plan reviews along with experts, historic flood event insights and iwi knowledge. I recommend that the recent flood modelling completed on behalf of Environment Southland for the Mataura River floodplain be used to inform the PDP. This model includes the 2024 Tonkin + Taylor flood modelling and the 2024 Land River Sea flood modelling as well as knowledge of the flood events across the Mataura floodplain outside of these areas.
7. In early November 2024 Environment Southland shared Mid-Mataura 2D Hydraulic Flood & Flood Hazard Modelling Report and appended maps with Gore District Council via the General Manager Critical Services and the Property Group to support the PDP after completion in October 2024. This report is also available to the public, at the following link on the Environment Southland website: www.es.govt.nz/floodmodelling. I refer to this throughout the rest of my evidence as the Environment Southland Model.
8. Due to the differing scale and accuracy of flood modelling we grade and communicate the flood hazard modelling types into four tiers or levels, with the fourth tier being the highest quality modelling to support detailed engineering design. Applying this hierarchy when communicating flood modelling accuracy assists specialists and decision makers with how flood modelling is applied to flood risk mitigation and adaptation options such as planning provisions in the Gore District Plan.
9. I consider the Environment Southland Model (completed by Land River Sea) as the most accurate flood model available at approximately a tier/level 3. There are some refinements required to improve the data inputs as well as improving the number of scenarios to include climate change and a series of possible maximum credible event scenarios, but despite this it still forms the most accurate picture of flood hazard and risk in the Gore District and the current level of service for the Environment Southland flood scheme assets.
10. While we have not completed a detailed peer review or completed change detection analysis of the T&T flood model completed for Gore District Council in 2024, we estimate that it is a tier/level two model. My view on this point is due to the difference in modelling type and coarseness as well as additional input data that is included and refined in the Environment Southland Model, as well as the validation and calibration data inputs. This includes but is not limited to historical event calibration data

as well as improvements to the Digital Elevation Model in and around the flood scheme assets in Mataura and Gore. I believe the T&T model should be used to inform the PDP provisions outside of the area covered by the Environment Southland Model. For completeness, in my view both of these models present more accurate and detailed information on flood hazard risk than the maps currently included in the PDP.

Climate Change

11. As part of developing the Environment Southland Model completed by Land River Sea, we completed internal analysis into whether or not we could accurately model future climates such as what a 1% AEP or 2% AEP would look like on various projects over the next 100 years and beyond.
12. However, we have found that we need to improve our climate change rainfall and hydrology before completing this. Therefore we have not included climate change projections in our flood hazard scenarios as we are currently improving the climate change projections at a catchment scale. This work is a priority for us over 2025 and 2026 that is scheduled under the ES Flood Intelligence Work Programme that I manage.

Flood Hazard

13. All Environment Southland flood hazard modelling methodology is based on the Australian Institute for Disaster Resilience (AIDR) 2017, Guideline 7-3 Flood Hazard (<https://knowledge.aidr.org.au/media/3518/adr-guideline-7-3.pdf>). This is detailed in the Environment Southland Flood Modelling report.
14. Both the models available in this area (the Environment Southland Model and the Tonkin and Taylor Model) have applied this methodology as there is no New Zealand standard currently available.
15. Further background technical information supporting the advice in this guide can be found in the report:
Smith GP, Davey EK and Cox RJ 2014, Flood hazard, Technical report 2014/07, Water Research Laboratory, University of New South Wales, Sydney.
<https://knowledge.aidr.org.au/media/2334/wrl-flood-hazard-technical-report-september-2014.pdf>
16. This guideline provides technical advice and a methodology for the the quantification of flood hazard to support the general guidance on best practice in flood risk management. This methodology involves the assessment of flood hazard risks into different hazard categories, based on the risk they present to both people, vehicles and buildings. This is assessed through consideration of both the depth and velocity of modelled floodwaters, to better understand the potential impact of floodwaters.
17. Understanding flood behaviour during the timeframe leading into the peak flood and the waning flood (not just flood extent) is essential for making informed decisions on managing flood risk. The Environment Southland Model enables us to do this while also understanding the hazard it poses to people, vehicles and buildings with the flood hazard categorisation. This includes the range of possible flood scenarios and the interaction of flooding with the landscape and infrastructure, which can result in varying degrees of flood hazard.
18. Flood hazard modelling and the categories created show the variation of hazardous conditions for people, vehicles and buildings within a floodplain. This modelling can be used to inform Emergency Management, land use planning, longer term strategic and development scale land use planning as well as planning for future flood scheme levels of service. We can then model flood risk management options and their change to the flood risk profile in an area within the model.
19. In my view, categorisation using the AIDR guidance of flood hazard risk is the appropriate categorisation to use in both models. In my experience the flood hazard categories can be used to delineate areas with different planning rules applied. An example of where this has been applied is the Te Tai o Poutini Plan and the Westport 2100 mitigation and adaptation master planning process.

20. The degree of flood hazard posed to people, buildings, infrastructure and the environment is influenced by the flood extent, depth, velocity but also the rate of rise of flooding (how quickly the water is rising), isolation and access to help. In some areas the flood extent may be broad but the flood hazard is in Hazard Category 1 due to the depth and velocity posing a low flood hazard to people and infrastructure. In comparison, an area with low depth but high velocity will have a higher flood hazard category because it may cause a higher impact from the flood on people and infrastructure. For these reasons the flood hazard modelling and mapping inputs are integral to supporting land use planning.
21. As detailed in the AIDR Flood Hazard Guidance the effective warning time available to respond to a flood event, the rate of rise of floodwaters, the time of day a flood occurs, and isolation from safety by floodwaters and impassable terrain are all factors that may increase the potential for people to be exposed to hazardous flood situations. These factors are important considerations that influence the vulnerability of communities, the environment and critical infrastructure to flooding and are important considerations in managing flood risk. The PDP needs to consider this for current and future flood hazards and flood protection schemes, including for planning for further development.
22. Flood scheme asset breach scenarios or overtopping can cause high velocities and therefore higher flood hazards. While flood protection assets aim to protect people, the environment, and infrastructure if there is a flood event greater than the level of service of the flood scheme asset or there is debris or impact to the asset creating vulnerability, then the flood hazard can be high, flooding can occur quickly with little to no warning and can also cause isolation of people and critical community and response facilities. This change in flood hazard is demonstrated in the breach scenario modelling completed in the Environment Southland model. These locations simulate what can happen - however the location of a breach can occur anywhere in the scheme depending on many factors relating to the flood and asset capability at the time of a flood.
23. I recommend that consideration of proximity to flood protection assets is considered in the PDP so that future critical community and response facilities such as health, education, and response agencies are not built within close proximity to a flood scheme asset such as a stopbank or dam, and that the breach scenario hazard modelling should be considered to inform this.

References:

Australian Institute for Disaster Resilience (AIDR) 2017, Guideline 7-3 Flood Hazard

<https://knowledge.aidr.org.au/media/3518/adr-guideline-7-3.pdf>

Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (AIDR 2017) <https://knowledge.aidr.org.au/media/3521/adr-handbook-7.pdf>

Australian Institute for Disaster Resilience (AIDR) 2017, Guideline 7-2 Flood Emergency Response Classification of the Floodplain, Melbourne. <https://knowledge.aidr.org.au/media/3515/adr-guideline-7-2.pdf>

Smith GP, Davey EK and Cox RJ 2014, Flood hazard, Technical report 2014/07, Water Research Laboratory, University of New South Wales, Sydney. <https://knowledge.aidr.org.au/media/2334/wrl-flood-hazard-technical-report-september-2014.pdf>