MEMORANDUM

To	Nicole Basher, Northland Regional Council
From	Terence Kelly, Water Technology
Date	10 April 2025
Subject	Summary of 2024 updates to Raupo modelling
Our ref	M01V01_ModelUpdates.docx

This memorandum details changes that were made to the Raupo Drainage Scheme hydraulic model in 2024. The previous work (our project reference 22010005) applied a TUFLOW model to determine flood extents and hazard impacts under various tidal conditions. This is a supporting document to that report (ref '22010005_R01_V02_Kaipara'), reflecting amendments that were made as per instructions from Northland Regional Council and should be read alongside the original report.

1 INTRODUCTION

Hydraulic modelling was previously undertaken for the Northern Wairoa River in the Raupo region of the North Island. Initially for Northland Regional Council (NRC), the models were refined in partnership with Kaipara District Council and members of the Raupo Drainage Committee to better understand flood hazards across the Raupo region, particularly the township of Ruawai and surrounding farmland. This area is vulnerable to flooding, sitting near sea level on the eastern bank of the Wairoa River near Kaipara Harbour. A series of protective stopbanks, floodgates and pumps are used to manage both tidal impacts and stormwater runoff.

A TUFLOW model was developed to identify flood extents, depths, velocities and hazards for a range of both storm and tidal events including sea level rise scenarios.

Following the modelling, an upgraded flood gate structure on Canal G was planned and constructed. A low point in the modelled stopbanks was also identified. It was agreed with NRC to update the model to reflect these changes.

2 MODIFICATIONS TO HYDRAULIC MODEL

The TUFLOW model was adopted from the Raupo Drainage Scheme modelling. TUFLOW is a widely used software package suitable for the analysis of flooding. TUFLOW routes overland flow across a topographic surface (2D domain) to create flood extent, depth, velocity, and flood hazard outputs that can be used for planning, intelligence and emergency response.

Please refer to the draft *Raupo Drainage Scheme – Flood Hazard Impact Analysis* (Water Technology, April 2023) for additional details re: baseline methodology.

2.1 Canal G floodgate

Canal G, also known as the Awaroa River, is a small tributary of the Wairoa River and operates as a drainage canal. A floodgate roughly 2.5 km from the mouth of the river at Te Kowhai is used to allow stormwater out to sea when the tide is low, without permitting high-tidal waters into the canal.

Figure 2-1 Location of Canal G Floodgate

The TUFLOW model was updated in late 2023 based on design drawings (GWE Consulting Ltd 25 October 2023) of the floodgate, with changes to both dimensions and inverts. The surrounding terrain levels were also modified to design embankment heights as well as a bypass channel.

The model was revised in 2024 to reflect the following as-constructed dimensions:

- 4 concrete box culverts
  - Span of 3.7 m
  - Height of 2.0 m
  - Inverts of -1.20 m RL
  - Roughness coefficient of 0.012 (representative of smooth concrete)
  - Modelled as flap-gates (operating one-way)

2.2 Stopbank amendments

A gap in the southern stopbank was identified in October 2024, allowing tidal flows to enter near Whakatu Road as shown in Figure 2-2 and Figure 2-3. This gap was in the LiDAR used for the model from 2020 and was not captured by subsequent surveys, as this stopbank is outside of the Raupo Drainage area 9area of focus for the original study).

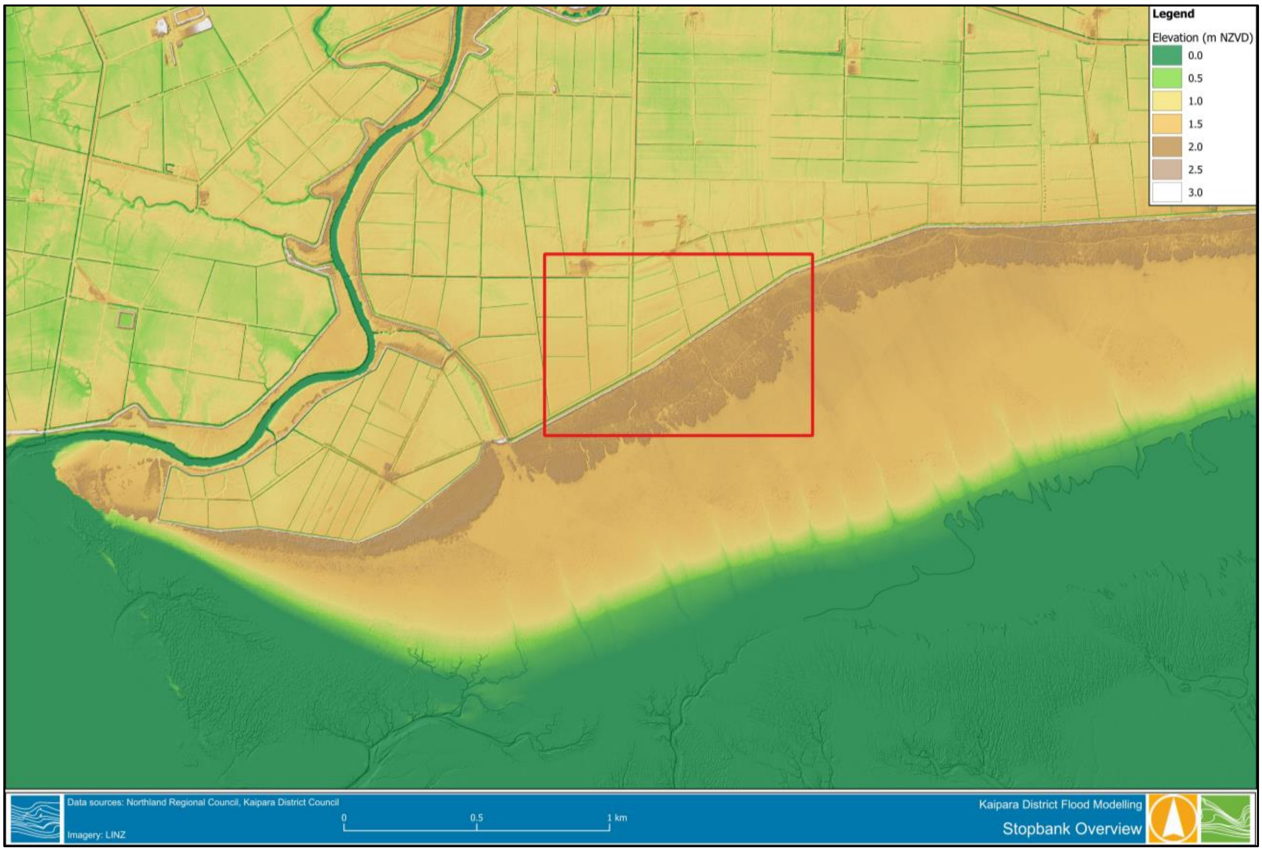

Figure 2-2 Stopbank location – with extent of Figure 2-3

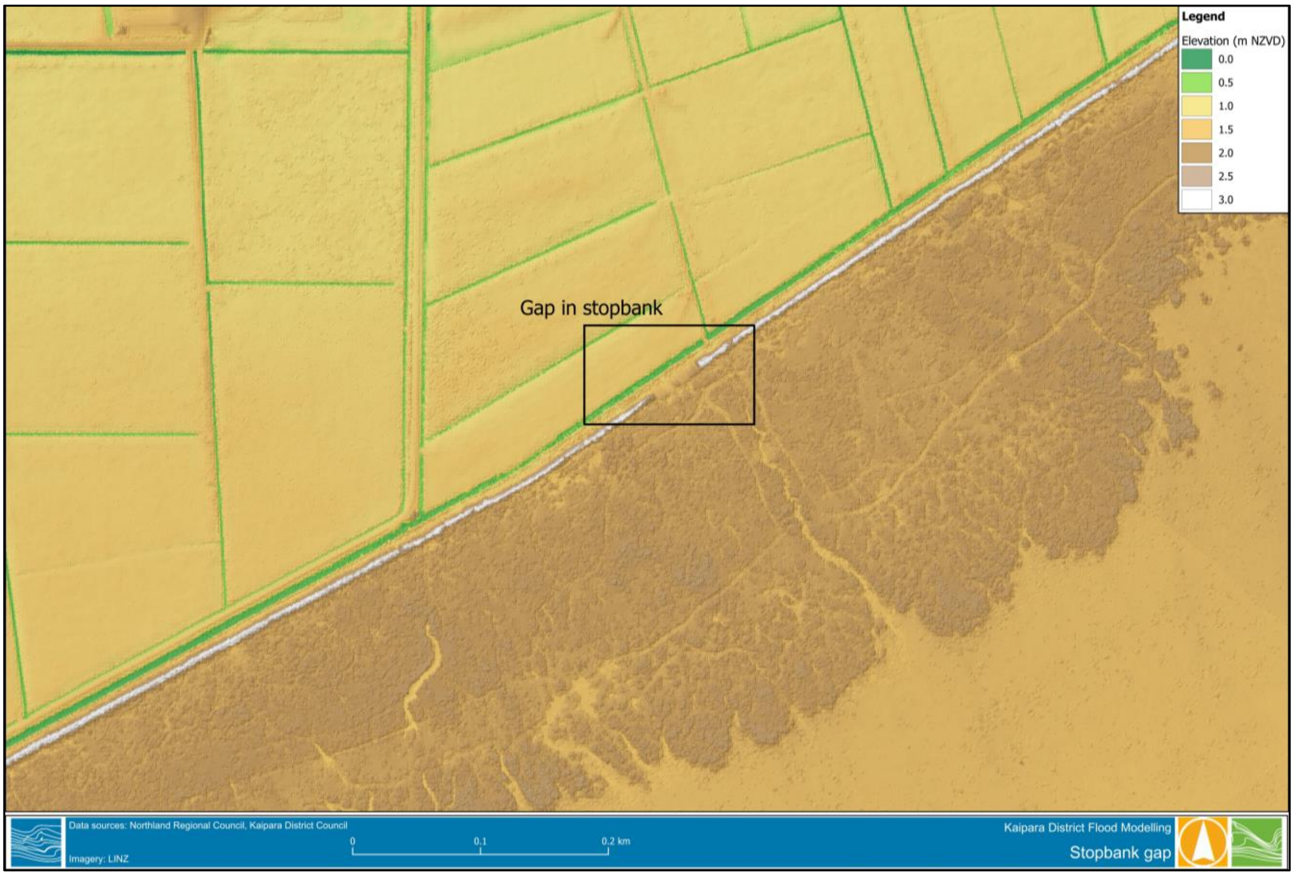

Figure 2-3 Identified gap in stopbank

The stopbank is enforced in the model with a 2d_zsh breakline. As part of the revision, this line was connected to completely close the gap with the adjacent crest levels, as shown in Figure 2-4.

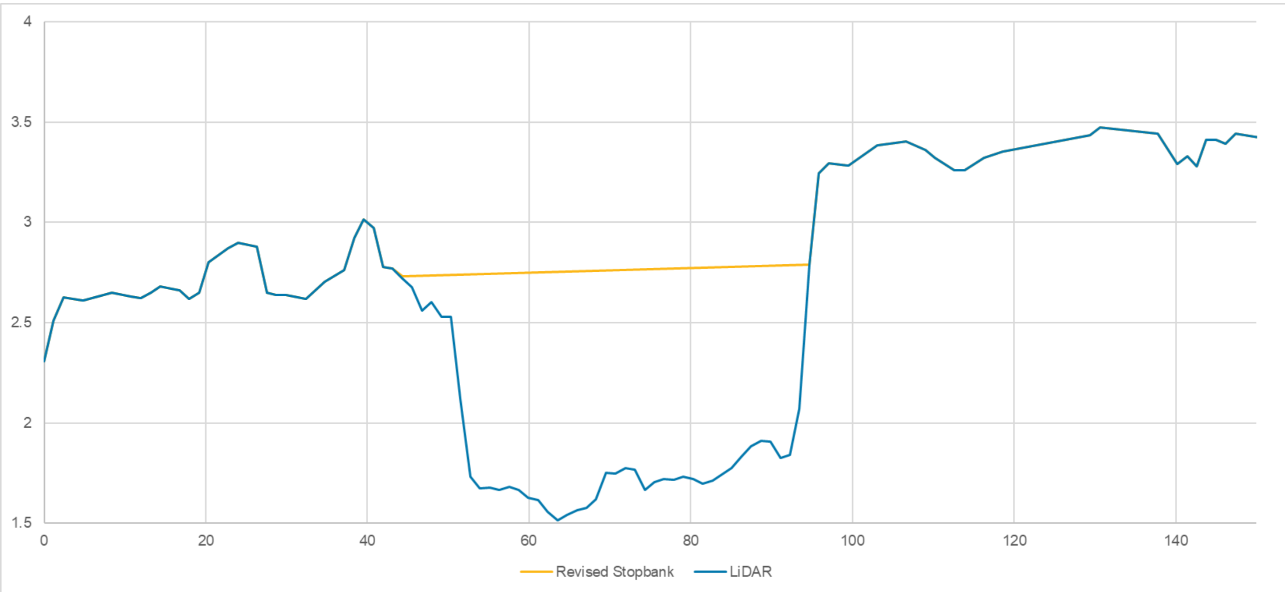

Figure 2-4 Cross-section along stopbank at area of identified gap

Following updates, the model was re-run for the following scenarios:

- Design Storms, each for 1 hour, 6 hour, 12 hour and 24 hour duration:
  - 10% AEP with MHWS Tidal Boundary
  - 2% AEP with MHWS Tidal Boundary
  - 1% AEP with MHWS Tidal Boundary
  - 1% AEP + Climate Change (2081-2100 RCP 8.5) with MHWS + 0.6 m Sea Level Rise Tidal Boundary
  - 1% AEP + Climate Change (2081-2100 RCP 8.5) with MHWS + 1.2 m Sea Level Rise Tidal Boundary
- Coastal Hazard Scenarios (no rainfall applied):
  - No storm, 1% AEP Tidal Surge (CFHZ0)
  - No storm, 2% AEP Tidal Surge + 0.6 m Sea Level Rise (CFHZ1)
  - No Storm, 1% AEP Tidal Surge + 1.2 m Sea Level Rise (CFHZ2)
  - No Storm, 1% AEP Tidal Surge + 1.66 m Sea Level Rise (CFHZ3)

3 RESULTS AND CONCLUSION

Modelled flow was inspected at both the amended Flood Gate and section of stopbank and determined to be behaving suitably. Tidal flow no longer enters the farmland behind the stopbank in the MHWS or 1% AEP Tidal Surge scenarios (as shown in Figure 3-1).

Figure 3-2 shows flood extent for he G-Canal Floodgate, showing flood behaviour in the area comparable to the original modelled design scenario, noting the asset size was slightly modified during construction.

Model results were post-processed with the same method and format as previous modelling and provided to NRC as gridded GIS data.

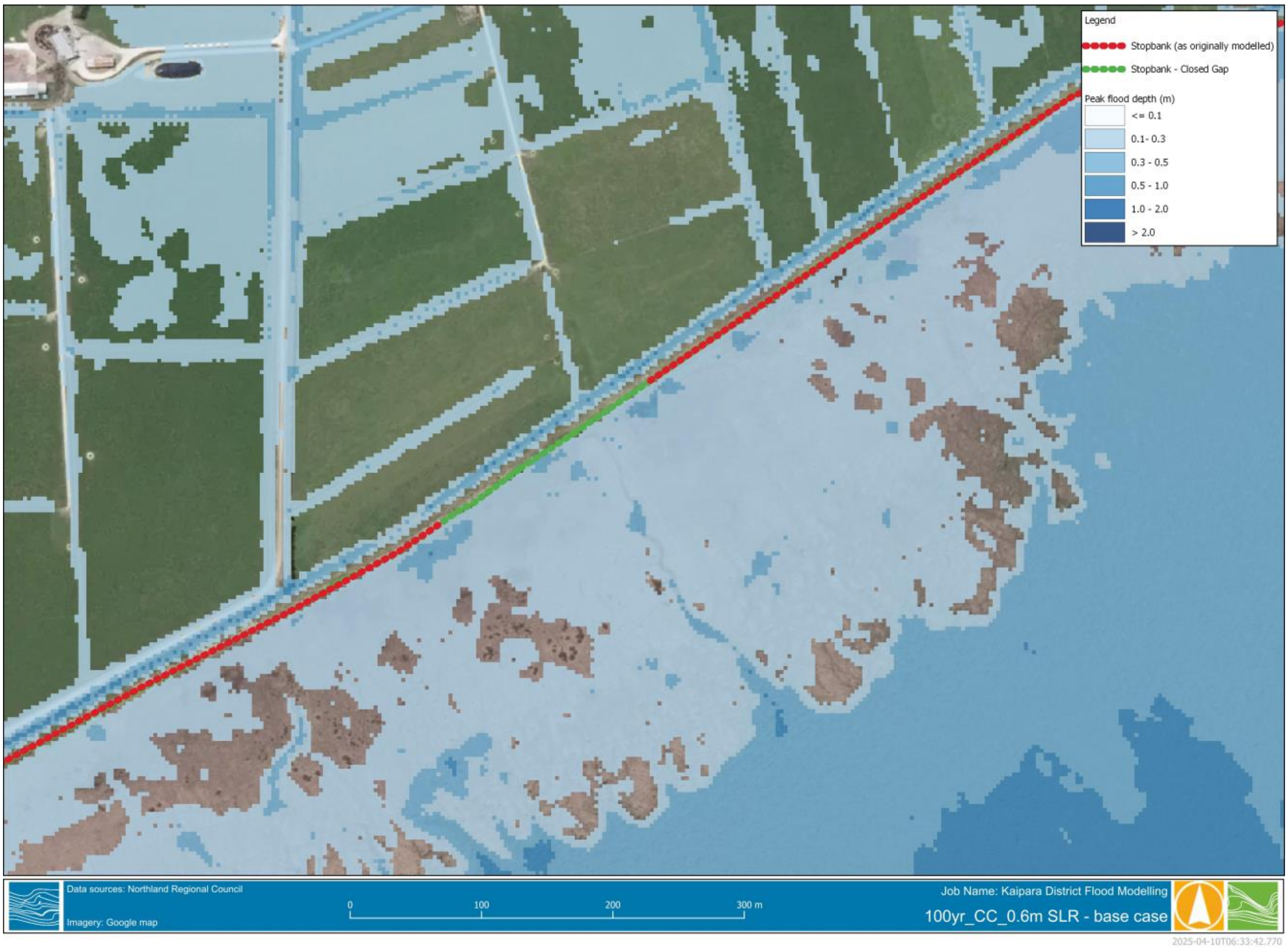

Figure 3-1 Stopbank – Flood Extent and Depths (100-year + 0.6 m Sea Level Rise Tidal Boundary)

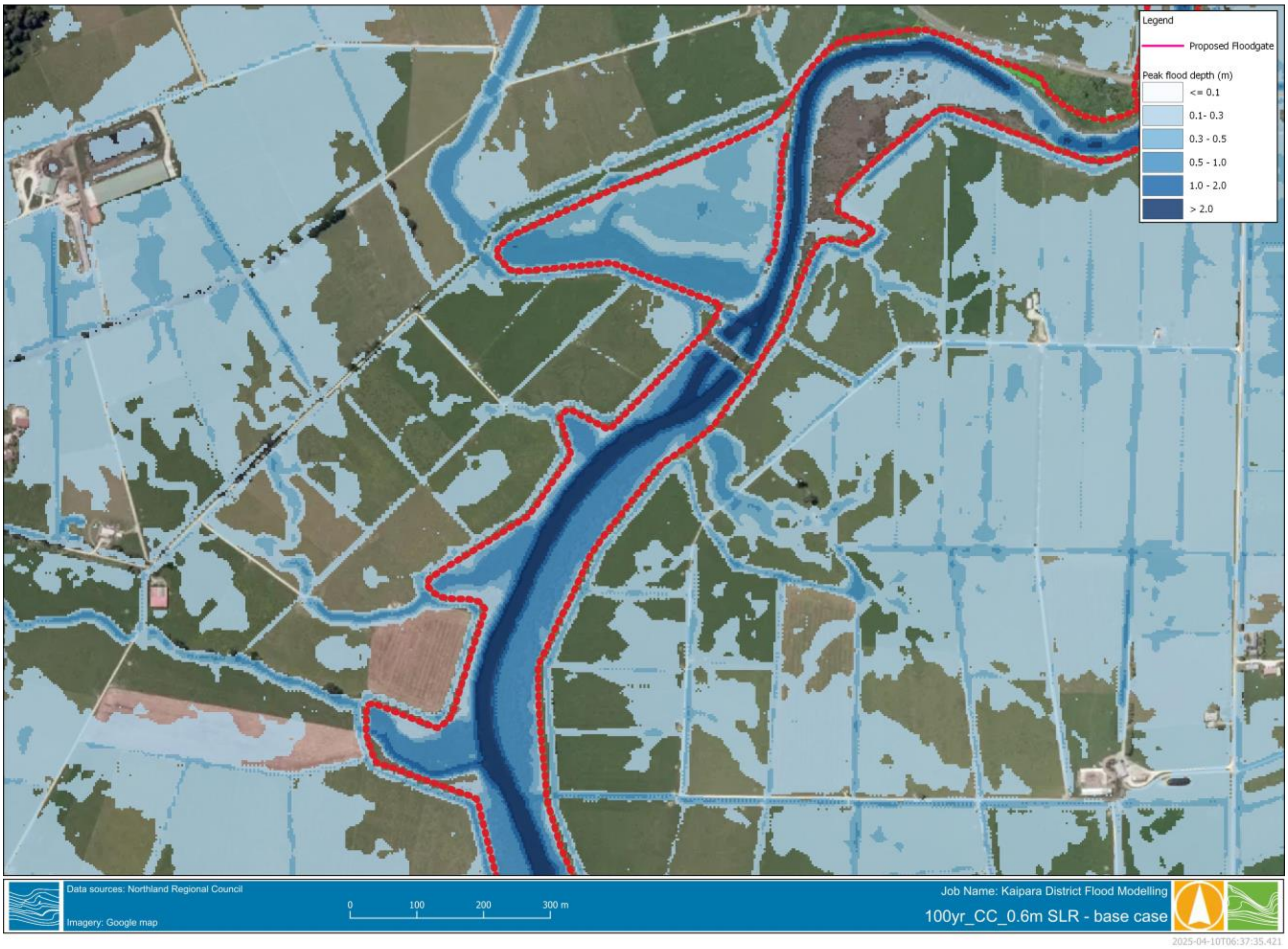

Figure 3-2 G-Canal Floodgate – Flood Extent and Depths (100-year + 0.6 m Sea Level Rise Tidal Boundary)