

Date: 17.02.2025

Job Number: 1196-03-22

**Noel Becker,
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Email: Noel Becker noel.becker@waikaiagold.co.nz (letter sent as email)

CC: Bob Hall bobhall@xtra.co.nz

Dear Noel,

RE: RFI Discussion routing effects of overbank flow and effects of flood bank mitigation (REVISION A)

RJHall and Associates Ltd have undertaken additional modelling to address the question of the effects on routing that installation of flood protection banks may have on the Waikaka River, and downstream land parcels of the area of diversion.

A 2D flood model for three channel characteristics were computed as follows:

- 1.) Existing ground level no modification
- 2.) Installation of Diversion 1 – with no additional flood banks
- 3.) Installation of Diversion 1 – additional of flood banks

The analysis of the proposed flood bank layout was carried out by development of the flood model and providing an inflow hydrograph immediately below the Waikaka Road Bridge. A 20 year flood flow of 116m³/s was applied by inflow hydrograph to the upstream boundary of the model, hydrograph presented in Figure 1.

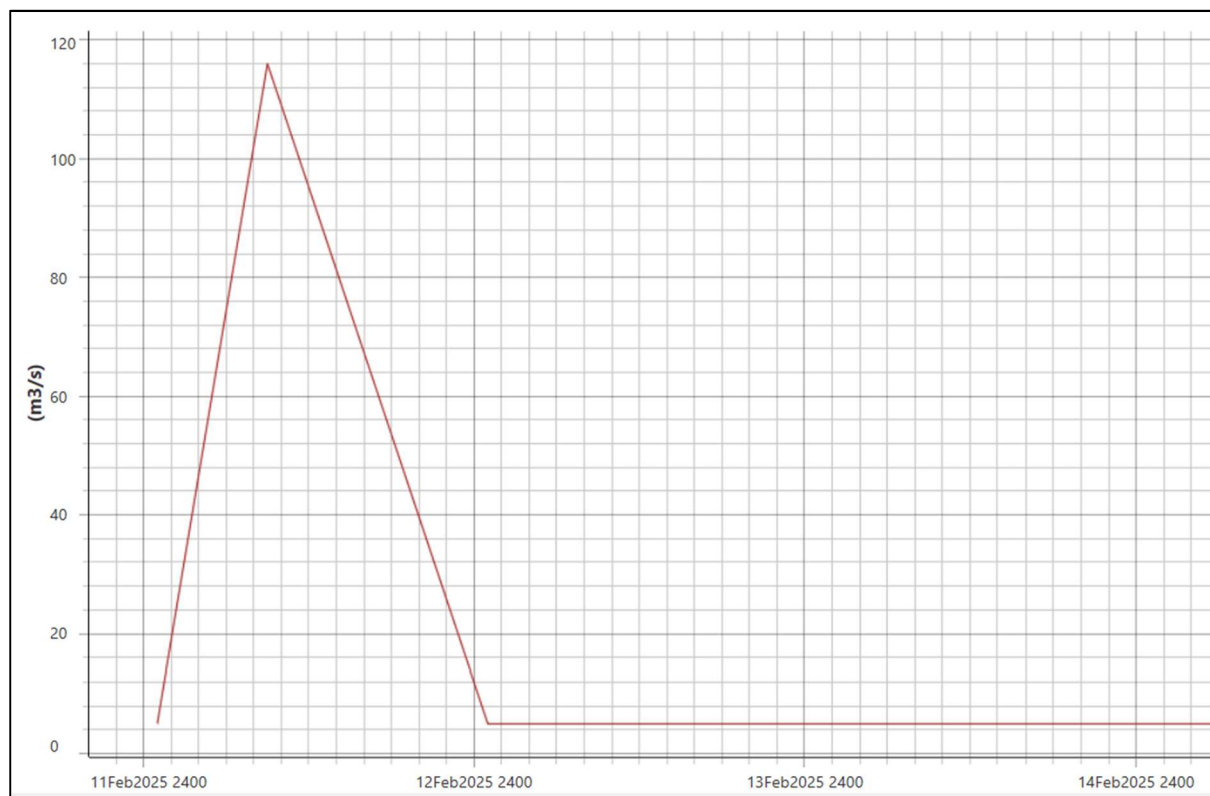


Figure 1 - Inflow Hydrograph

The DEM for each of the models were modified based on proposed bank levels, invert, and layouts for the proposed flood banks, and diversion 1. This was undertaken to assess the relative effective routing with the implementation of flood banks over the main reach of the Waikaka Stream. The predevelopment (existing channel) had no effective changes to the DEM, and channel and bank modifications were applied as presented in the consent proposal.

The effect of routing of the reach was assessed by reviewing the time series hydrograph at a downstream cross section profile presented in Figure 2 to Figure 4. The time series outflow are presented in Figure 5.

It is noted that some routing of the input flow occurs in all scenarios with the 116 cumec flood peak reduced to 112.6cumecs. It is assumed that the routed 3.4 cumecs could be added to the hydrograph to offset the base channel routing (to make a true 20 year peak flow) but in general the scale of the flow is within the order of the 20 year flood, and it is opined that the model adequately represents the effects of routing pre and post construction, and meets the intended purpose of the model development.

Review of the effects of overbank flow during this level of flooding, indicates a 3.4% change between the unmodified channel (some minor overbank flow rates), and the developed diversion 1 with flood mitigation banks, this represents the effects of wider flood berm routing.

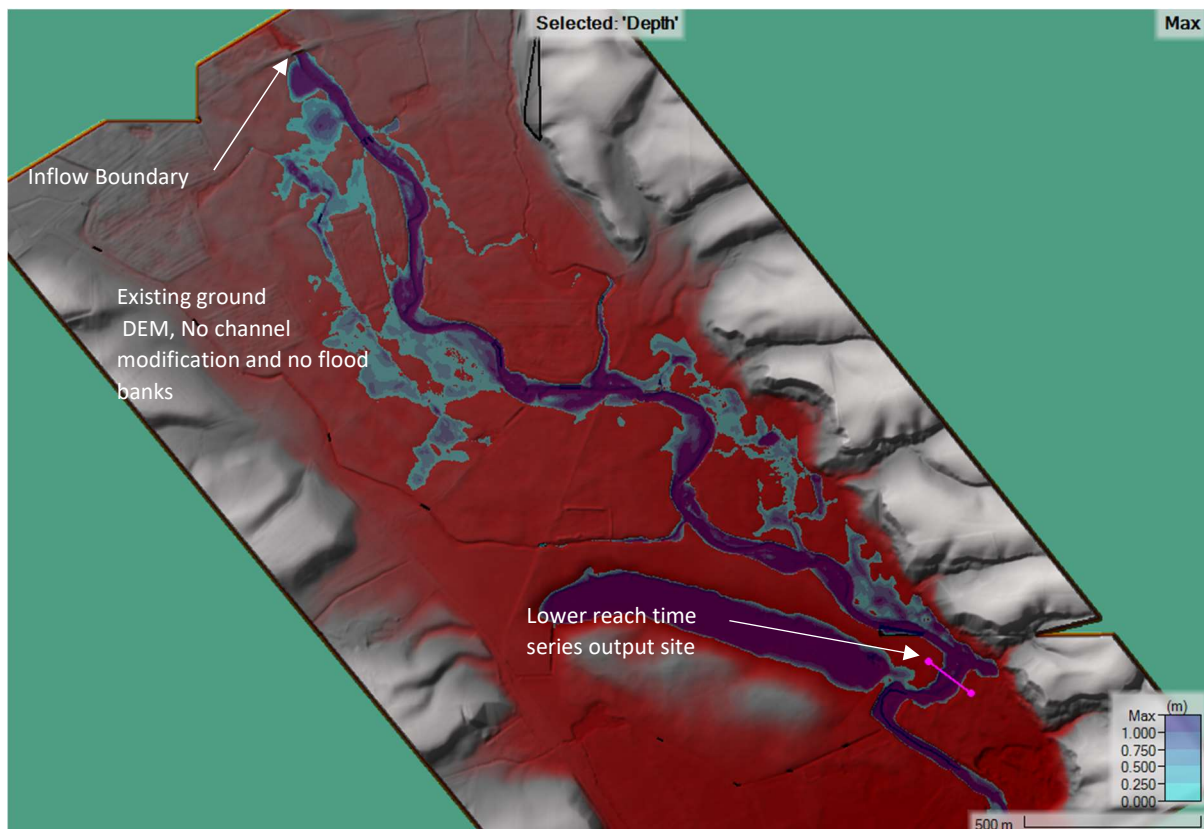


Figure 2 - 2D Model – Existing Bed - Max Depth Q20 (116m³s)

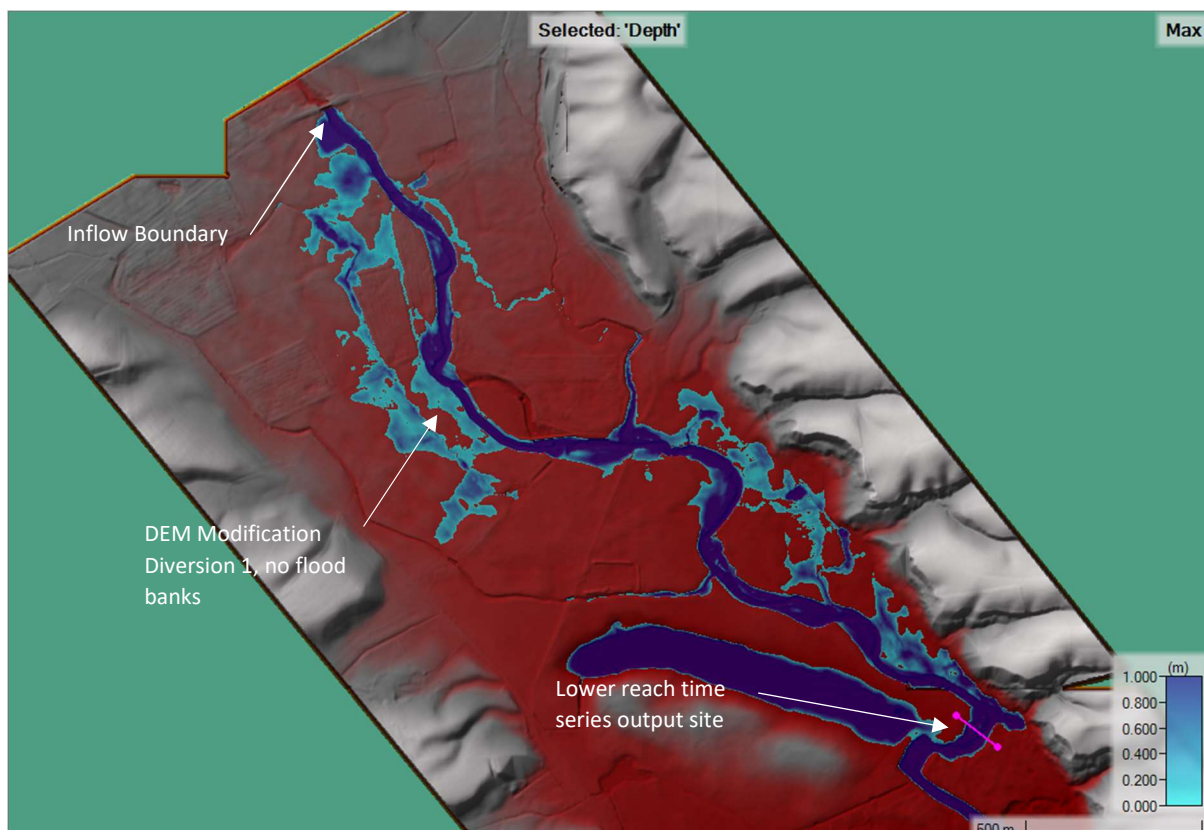


Figure 3 - 2D Model - Diversion 1 - No Flood Banks - Max Depth Q20 (116m³s)

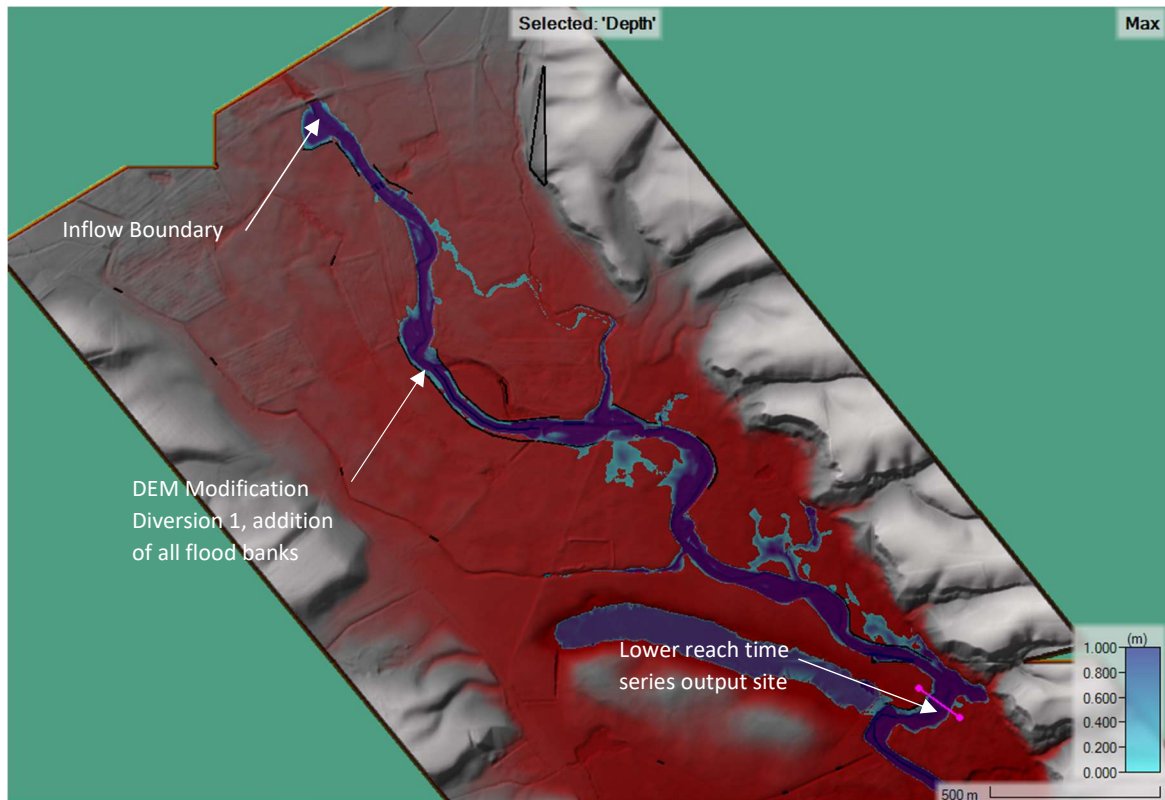


Figure 4 - 2D Model - Diversion 1 and Flood Banks - Max Depth Q20 (116m³s)

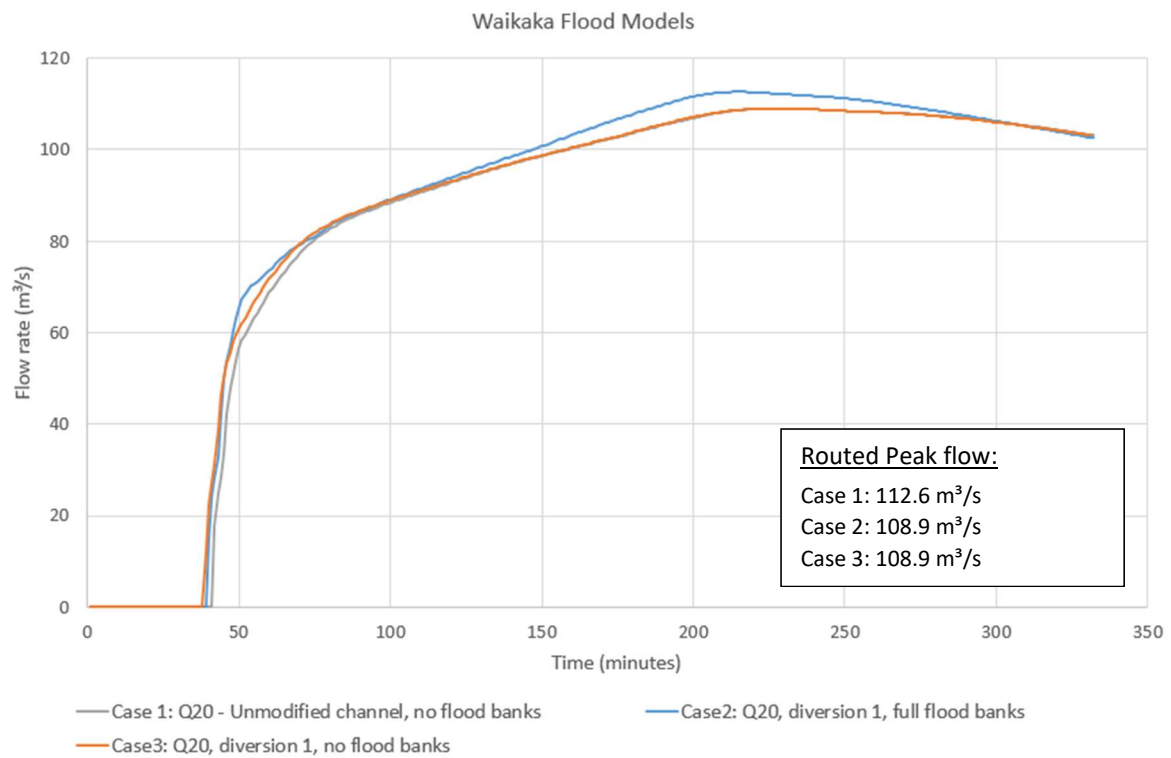


Figure 5 – Downstream cross section time series

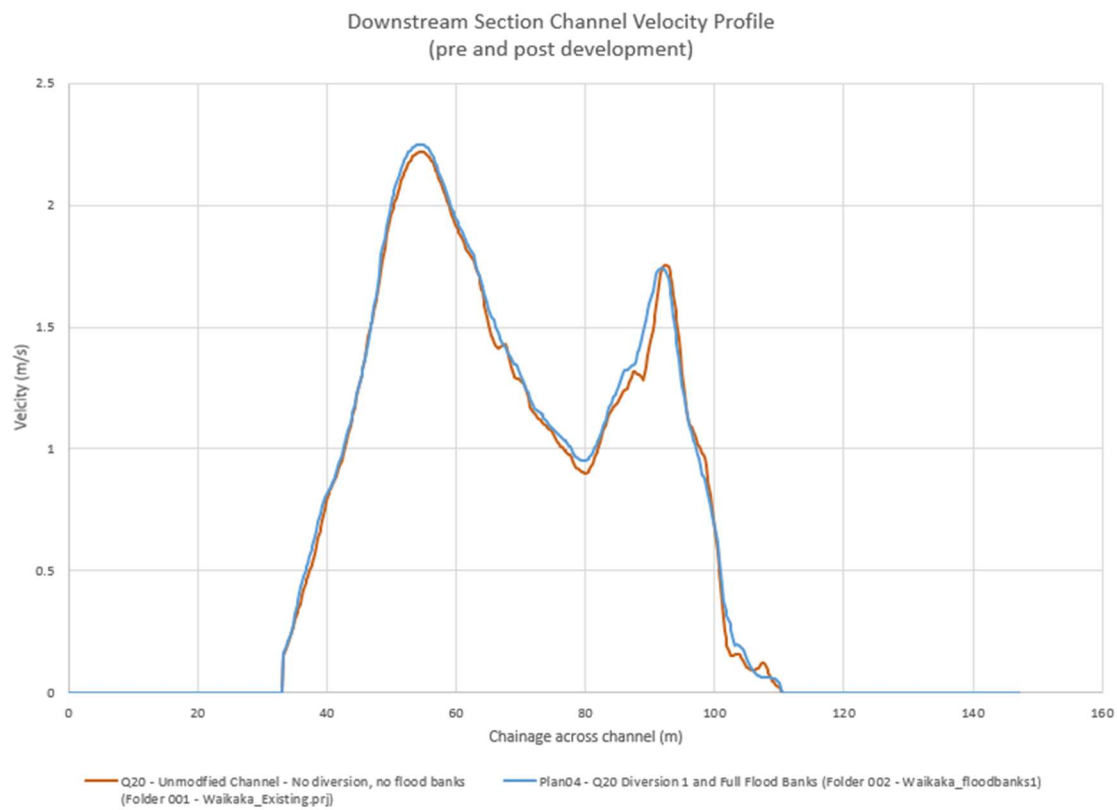


Figure 6 – Comparison of Pre and Post Flood banks velocity profile at downstream cross section

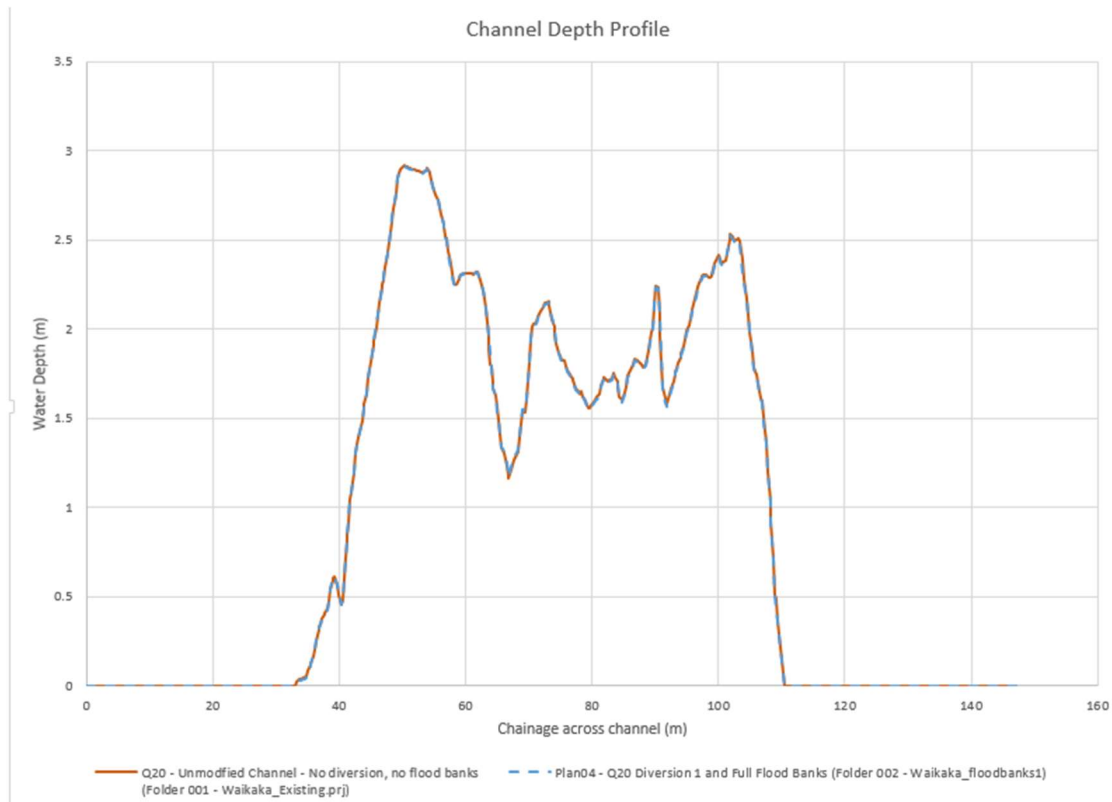


Figure 7 – Comparison of Pre and Post Flood banks depth profile at downstream cross section

It is concluded from the flood model review that the effect of installation of flood banks has a very limited effect on routing during the diversions. It is noted that the application of diversion 1 without the flood banks was found to have no measurable effects on flood routing c.f. the unmodified channel case. This can also be seen in the depth and velocity profiles for the pre and post scenario (Figure 6 and Figure 7). It is observed that there is effectively no change to the depth and very limited change to the velocity profile.

The overall routing effect altered the modelled flow by 3.7 cumecs (3.4 percent), which is thought to represent a less than measurable effect downstream of the site, and will have a less than minor effect downstream parties.

If there are further queries please don't hesitate to get in contact.

Regards,



Cameron Hall

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and Civil Engineer,
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