Before Gisborne District Council

Under	**t**he Resource Management Act 1991 (the **RMA**)
I**n the matter**	of applications by Gisborne District Council for resource consents to modify a stopbank at Te Karaka

Statement of evidence of Mark Hooker on behalf of Gisborne District Council

Flooding effects

14 September 2026

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1 Executive summary

1.1 I have provided evidence on the process used to select the preferred stopbank upgrade option for Te Karaka, the assessment of flooding effects undertaken through the Consequential Flood Risk Assessment (CFRA), concerns raised regarding future aggradation and bridge effects, and several matters raised in submissions and the Section 42A report.

1.2 The preferred stopbank alignment was selected through a structured optioneering process involving flood modelling, multi-criteria assessment and community engagement. Compared with raising the existing stopbank on its current alignment, the preferred retreated alignment was assessed as providing a better balance between reducing flood risk to Te Karaka township and limiting adverse flooding effects elsewhere.

1.3 Flood modelling played a central role in both the optioneering process and the subsequent CFRA. The CFRA assessed the difference in flooding effects between the existing and proposed stopbank arrangements across a range of flood events, including a Cyclone Gabrielle-sized flood, a design flood, and an overdesign flood.

1.4 The CFRA confirms that the stopbank proposal provides substantial flood protection benefits within Te Karaka township. At the same time, it identifies consequential flooding disbenefits for a number of properties and buildings outside the protected area. Assessment of those effects was the purpose of the CFRA and they have been quantified and reported.

1.5 While some land and buildings outside the protected area are expected to experience increased flooding effects in larger flood events, the overall scale of adverse effects is considerably smaller than the flood protection benefits achieved within the stopbanked area.

1.6 Submitters have raised legitimate concerns regarding future river aggradation and the potential for flood risk to worsen over time. In my opinion, flood risk is likely to increase under both the existing-stopbank and proposed-stopbank scenarios as aggradation continues. However, the information currently available does not demonstrate that the CFRA has materially underestimated the relative flooding effects of the stopbank proposal. A robust assessment of future aggradation impacts would require substantially more complex morphodynamic modelling and consideration of multiple future scenarios.

1.7 Submitters have also raised concerns regarding potential effects on the Rangatira Road and Kanakanaia Road bridges. The available assessment indicates that hydraulic loading and scour are likely to increase as a result of the stopbank proposal. Those effects may be significant, particularly for Kanakanaia Bridge, but the degree of risk and any need for structural strengthening cannot be determined without a detailed bridge assessment. With the proposed management measures, I do not expect the risk to life associated with bridge failure during major floods to increase.

1.8 Overall, I consider that the flooding effects of the proposal have been appropriately identified and assessed.

2 Introduction

2.1 My full name is Mark Christopher Hooker. I am currently employed as a Principal Water Engineer at Tonkin + Taylor (**T+T**).

2.2 I have been asked by Gisborne District Council to provide evidence in respect of its application for resource consents to modify the stopbanks around Te Karaka (the **Stopbank Proposal**).

3 Qualifications and experience

3.1 I hold the qualification of a BE (Hons) (Nat Res)[1] from the University of Canterbury and I am a Chartered Professional Engineer (CPEng).

3.2 I am a Principal Water Engineer at T+T, where I have worked since February 2023. Prior to this, I have had a range of consultancy and Regional Council experience, both around New Zealand and overseas, over a total career to date of 23 years.

3.3 My main areas of work are in flood risk management, river management and Three Waters infrastructure (this latter focussed mostly on stormwater but more recently also on drinking water).

3.4 Of particular relevance to the scope of this evidence are the six years (from 2013 to 2018) that I spent as Team Leader of Investigations, Strategy and Planning within the Flood Protection Department at Greater Wellington Regional Council. This role included:

(a) Scoping, directing and overseeing flood modelling work (both by team members and external consultants);

(b) Providing advice on flood risk to proposed developments (often to support Council regulatory staff), and reviewing the advice provided by team members;

(c) Oversight of the development or review of Floodplain Management Plans being carried out by my team, as well as my own technical tasks or technical review of work done within those projects;

(d) Various technical investigations or analyses (or review of work by others) in the general fields of flood risk management, river/erosion management, and gravel management;

(e) Involvement in the Council's flood warning system;

(f) Responsibility for budgets of (in a typical year) of approximately \$800,000 opex and \$500,000 capex.

[1] Natural Resources Engineering.

3.5 My current work in flood risk management mostly involves advising clients on optioneering approaches, supporting options development and leading or supporting designs from the concept stage. This has included the Te Karaka and East Coast flood resilience projects for GDC.

3.6 I have not personally carried out computational flood/stormwater modelling since around 2010, but during the time since have been involved in procuring, directing and overseeing flood modelling work, and reviewing the results for suitability. I am a frequent user and communicator of flood model results.

4 Code of conduct for expert witnesses

4.1 I confirm that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023 and that I agree to comply with it. I confirm that I have considered all the material facts that I am aware of that might alter or detract from the opinions that I express, and that this evidence is within my area of expertise, except where I state that I am relying on the evidence of another person.

5 Scope of evidence

5.1 In my evidence, I will address the following:

(a) the optioneering process which led to the selection of the preferred stopbank upgrade option;

(b) the use of flood modelling information to assess flooding impacts (the Consequential Flood Risk Assessment);

(c) concerns raised by submitters regarding future aggradation and risk to bridges;

(d) flooding effects relevant to issues raised in submissions; and

(e) responses to matters raised in the Section 42A report.

6 Involvement with the Stopbank Proposal

6.1 T+T became involved in the Te Karaka stopbank proposal through an engagement in February 2025 to support GDC with the **optioneering**. This included advising GDC on a suitable optioneering approach and providing support and technical input to help with the longlist – shortlist – preferred option process. T+T also documented the process in a report (“Te Karaka Flood Management Optioneering: Final Option Recommendation”, September 2025). My role in this work at various times was as technical contributor, report writer and reviewer.

6.2 As part of the optioneering work, T+T specialists also carried out various **geomorphic assessments**, reported in two documents:

(a) “High level Geomorphic Assessment: Te Karaka Flood Management Optioneering”, September 2025; and

(b) "Te Karaka Stopbank Upgrade: Berm Sediment Accretion Assessment", December 2025.

I was not involved significantly in the technical work or technical review. My opinion expressed later in response to matters raised by submitters is based on the appended letter by my colleague Prof. Ian Fuller.

6.3 To support the Assessment of Environmental Effects and the identification of flooding impacts on properties outside the area enclosed by the proposed stopbank, GDC engaged T+T to prepare a **"Consequential Flood Risk Assessment"** (CFRA). This was reported in "Te Karaka Consequential Flood Risk Assessment", April 2026. This work was complementary to the work done by Kyle Christensen, in that Mr Christensen's work focusses on the effects of flooding in financial terms and the CFRA focusses on the physical flooding effects. I contributed to the direction of the technical work, to report writing and review, but did not carry out the assessment myself.

6.4 T+T also provided information to support the work by Mr Christensen. This consisted of processing the flood model results provided by the flood modelling consultancy DHI into formats that he was able to use for his estimations (such as extracting flood results for various land parcels and building footprints).

6.5 GDC also engaged T+T to carry out a **high-level assessment of bed scour potential and flood loadings** on the Kanakanaia Road and Rangatira Road bridges. This work was done to gain an initial understanding of potential impacts on the bridges of the proposed stopbank works. The assessment did not include a detailed assessment of the structural capacity of the two bridges, i.e. their ability to resist the imposed loads, beyond a preliminary check of the bridge piles. The findings were summarised in Section 6 of the CFRA report. I was not involved significantly in the technical work or technical review. My opinion expressed later in response to matters raised by submitters is based on the appended letter by my colleague Oz Ben-Ezra.

6.6 T+T prepared technical responses to the consent authority's Section 92 requests, including:

(a) more explanations of the geomorphic and river-dynamic effects;

(b) recommending that the geomorphic assessment and berm accretion assessment be provided with the Section 92 response, as these had not been submitted with the consent application;

(c) clarifying the flood model assessment extent and outputs;

(d) providing additional depth and velocity maps;

(e) a minor correction to how the maximum values were described in the CFRA; and

(f) responding on the design and overdesign flood assessments.

6.7 As well as my technical contributions to the above work, I have been T+T's Project Manager across all work streams.

6.8 The above assessments were all submitted as part of either the AEE or the Section 92 response so I will only summarise relevant key information and findings in my evidence below.

6.9 Various meetings and site visits by the individual T+T staff are described in the reports listed above, although these technical assessments were largely desktop-based. I visited the area myself on 8 September to familiarise myself with the setting first-hand and in particular some of the concerns raised by submitters.

6.10 T+T has also been engaged (as of May 2026) in the role of designer for the stopbank proposal, through to detailed design and tendering. I am not involved in this work in a technical role but rather as Project Director.

7 Flood modelling

7.1 Flood modelling and mapping are discussed in the reports and in my evidence, so it is worth being clear what is meant. Computational flood modelling is a process of taking river flows and/or rainfall (hydrology) and using computer simulation to analyse how this water will flow in the river and on the floodplain (hydraulic modelling).

7.2 In the case of the two-dimensional Te Karaka Waipaoa River model, these flows are being represented on a mesh of cells across the river and surrounding areas. This concept is well-established and widely used in flood management investigations and design. Flood maps (of water level, depth, velocity or various other parameters) can be produced from the model results.

7.3 DHI has calibrated the modelled flood results against observed past results, based on available data.

7.4 Flood modelling is a particularly valuable tool for making comparisons, for example:

(a) comparing the effects of different stopbank alignments; or

(b) a “before” and “after” analysis of stopbank impacts.

as was done during the optioneering and CFRA work. Some of the uncertainties associated with input data limitations or assumptions will tend to “cancel out” when comparing different scenarios side-by-side.

7.5 For this project, T+T was not involved in the flood modelling or its peer review, beyond briefing DHI on stopbank scenarios to model during the optioneering phase. T+T made use of model results produced by DHI for both the optioneering process and CFRA assessment, and we checked the results themselves for suitability before using them.

7.6 T+T was not involved in the hydrology, derivation of design flows or the assigning of AEP/return periods to those flows.

8 **Optioneering process**

8.1 The process of optioneering involves narrowing down from a (potentially) wide range of options down to a preferred option which can then be taken forward to more detailed design. In the case of the stopbank proposal, this followed a structured longlist – shortlist – preferred option process. Concepts are typically refined and developed with more detail at each stage, or with more information to support decisions, as was the case here.

8.2 GDC and DHI had already developed and modelled an initial longlist before T+T became involved. T+T considered that work, recommended the final longlist of six options, facilitated the optioneering process and helped develop/refine the four shortlisted options. Key tasks included:

(a) facilitating the longlist-to-shortlist and shortlist-to-preferred-option multi-criteria analysis (MCA) workshops;

(b) preparing flood modelling scenario briefs and liaising with DHI;

(c) optioneering-level stopbank concepts and refinement of alignments;

(d) mapping and processing of DHI's modelling results; and

(e) material supporting GDC's consultation and Council decision-making, including a report on the optioneering process.

8.3 The MCA process that was adopted for the longlist to shortlist, and shortlist to preferred option recommendations, was designed to provide a transparent and consistent framework to guide decision-making. The MCA criteria used were aligned with those applied in other catchments across Tairāwhiti as part of GDC's broader flood resilience programme.

8.4 The MCA criteria were:

(a) Delivery (feasibility/practicality and consentability);

(b) Stakeholder/mana whenua/community views;

(c) Sustainability;

(d) Environment; and

(e) Flood risk reduction/flood benefit.

8.5 The four shortlisted options that were considered in the second MCA workshop are shown in Figure 1, below.

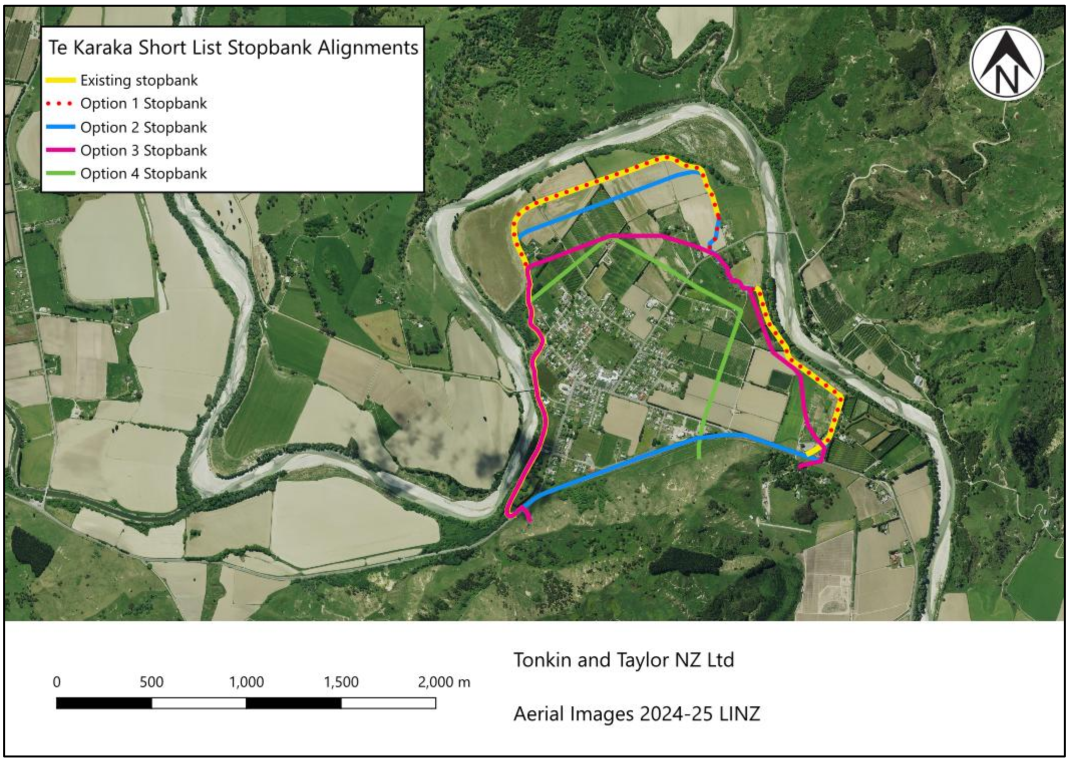

Figure 1. The four shortlisted options

8.6 These were assessed by members of the GDC project team supported by T+T expertise/assessments and the flood mapping results from DHI. At the shortlist to preferred option stage, stakeholder/mana whenua/community views were not scored by GDC officers directly but rather a draft preferred option recommendation was taken by GDC to the community for feedback.

8.7 The outcome of this process, following GDC engagement with the community at a hui on 24 June 2025, was a modified version of shortlist Option 3 as the preferred option. Amongst the shortlisted options, this represented the stopbank alignment that was second-closest in to Te Karaka (i.e., a retreat from the existing stopbank alignment in many places, but not as close-in as Option 4).

8.8 In a broad sense, the key factors supporting the selection of a retreated alignment for the stopbank in comparison to raising the stopbank on its existing or a similar alignment were:

(a) Smaller increase in flood levels for upstream landowners and those on the opposite side of the river;

(b) The retreated stopbanks would require a lower crest height above ground level, thereby reducing the potential consequences associated with stopbank failure;

(c) Less risk to the stopbank from river bank erosion, or less need to invest resources in protecting from this erosion in the future;

(d) Less risk to the bridges; and

(e) A greater floodplain area on which sedimentation can occur in moderate floods, potentially prolonging the useful life of the stopbank. There are concerns that continuing aggradation could mean that stopbanks close to the river may lose their capacity faster than those further retreated;

although there is uncertainty in how this might balance against an increased tendency for sediment deposition on the greater floodplain area of a retreated stopbank, the direction of the geomorphic trends is for aggradation within this reach.

8.9 Community feedback (via hui and online submissions) and from Te Aitanga a Māhaki representatives was in favour of Option 3.

9 Consequential Flood Risk Assessment

9.1 T+T was engaged by GDC to carry out a CFRA, that is, an assessment of the adverse flooding effects (disbenefits) of the stopbank proposal for locations outside of its intended 'benefit area'.

9.2 The assessment used outputs from the DHI flood model of the Waipoua River at Te Karaka. The model was used to evaluate 'pre-upgrade' and 'post-upgrade'[2] cases across three event scenarios:

(a) a Cyclone Gabrielle-sized event (estimated at approximately a 40-year or 2.5% Annual Exceedance Probability – AEP – event);

(b) a 5,625 m^3/s design event (approximately a 100-year or 1% AEP event, under present-day climate); and

(c) an over-design event (approximately a 500-year or 0.2% AEP flood event, with climate change). This event, at 14,869 m^3/s, is nearly three times the design flow.

9.3 Maximum flood **depths**, flood **velocities** and **'flood hazard'** classes from the flood model were assessed and reported on against:

(a) Land area;

(b) buildings;

(c) roads; and

(d) residential dwellings affected by flooding.

9.4 Flood 'hazard' in this context is a measure of the risk to life posed by floodwaters, typically combining flood depth and velocity. The Water NZ "National Stormwater Modelling Guide" (April 2024) recommends a particular approach developed by the Australian Emergency Management Institute that reflects risk to people, buildings and vehicles. These hazard classes H1 to H6 are shown on Figure 2 below.

[2] Based on the geometric design provided by Civil Project Solutions

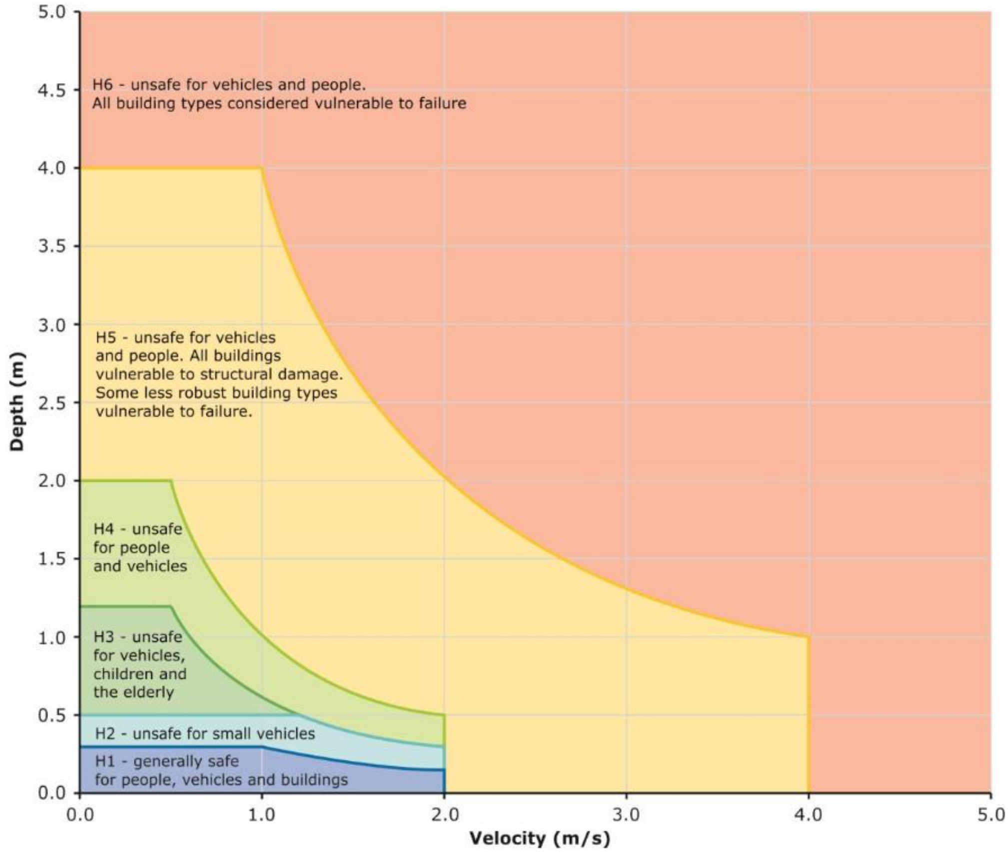

Figure 2. Hazard classes H1 to H6.[3]

9.5 The existing and proposed stopbank alignments considered in the CFRA are shown in Figure 3, below.

[3] Figure 5-5 of Smith et. al., 2014. “Flood hazard”. WRL Technical Report 2014/07. UNSW, Australia.

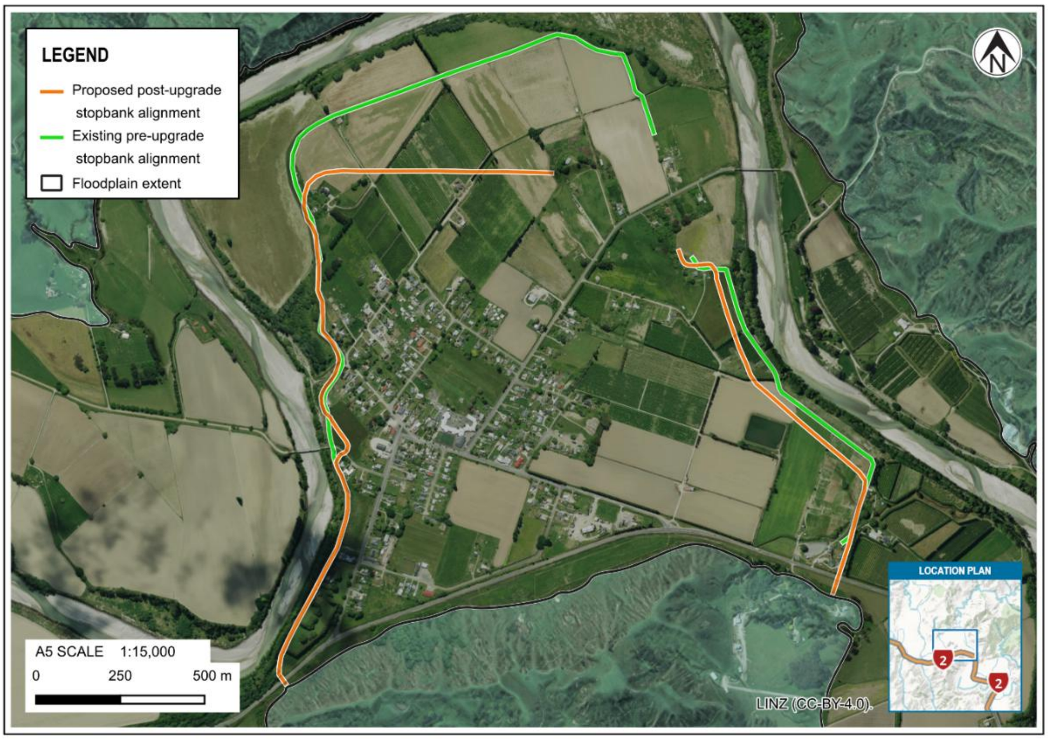

Figure 3. Existing and proposed stopbank alignments (Figure 1.1 from the CFRA)

9.6 Detailed results were provided in the CFRA report and its appendices, in both table and map format. Six additional maps were also provided in the Section 92 response. Changes in flood levels, velocities and hazard classes were tabulated in the main report for affected residential properties. I will not attempt to cover all this detail in my evidence but will instead summarise the more important results.

Flood extent changes

9.7 Table 1 below summarises the difference in flood extent for the three flood events assessed.

Table 1. Flood extent changes resulting from the stopbank proposal (Table 3.1 of the CFRA)

Event	Difference in flooded areas		
	Newly flooded	No longer flooded	Still flooded
Design event	10 ha	161 ha	2,092 ha
Cyclone Gabrielle flows	2 ha	153 ha	2,046 ha
Over-design event	6 ha	~ 0 ha	2,433 ha

9.8 The land no longer flooded is largely within the 'benefit area' of the township, and some small margins of lower floodwaters in the reach downstream of the township.

9.9 In the design event and Cyclone Gabrielle-sized flood, the area of newly flooded land is small in comparison to the area no longer flooded.

Flood depth changes - land

9.10 The largest increase in peak flood depths in all three events occurs immediately adjacent to the stopbank, especially around the apex of the Te Karaka bend (see Figure 3.1), and up the Waihora River. Downstream from Te Karaka, there is a reduction in peak flood depths in the Gabrielle and design events, especially around Matawai Rd/State Highway 2 about Takipū Marae. Figure 4, below, shows the distribution of these differences in the vicinity of the township in the design event.

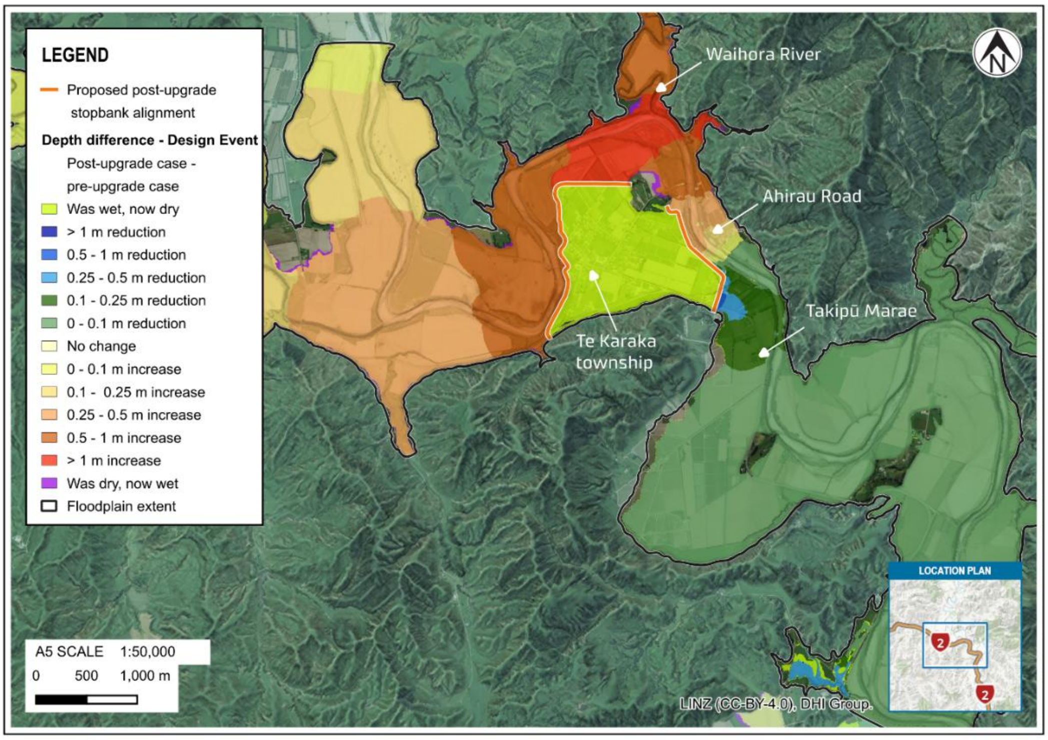

Figure 4. Depth difference in the design event (Figure 3.1 from CFRA)

9.11 Table 2, below, summarises the difference in flood depth across the three modelled flood events, in terms of land area.

Table 2. Summary of flood depth change by land area (Table 3.2 of the CFRA)

Post-upgrade case – difference to pre-upgrade case	**Event**		
	Design event (5,625 m³/s)	**Cyclone Gabrielle flows (4,200 m³/s)**	**Over-design event (14,869 m³/s)**
> 1 m reduction	0 ha	0 ha	0 ha
0.5 - 1 m reduction	1 ha	1 ha	1 ha
0.25 - 0.5 m reduction	14 ha	4 ha	14 ha
0.1 - 0.25 m reduction	48 ha	23 ha	13 ha
0 - 0.1 m reduction	931 ha	592 ha	372 ha
Any reduction (total)	**994 ha**	**620 ha**	**401 ha**
No change (within 0.001 m)	**44 ha**	**212 ha**	**34 ha**
0 - 0.1 m increase	283 ha	1,066 ha	988 ha
0.1 - 0.25 m increase	189 ha	30 ha	278 ha
0.25 - 0.5 m increase	296 ha	74 ha	551 ha
0.5 - 1 m increase	215 ha	37 ha	181 ha
> 1 m increase	69 ha	8 ha	1 ha
Any increase (total)	**1,053 ha**	**1,214 ha**	**1,998 ha**

9.12 These flood depth changes, as noted in the CFRA report, are only for areas of land that are flooded in both the pre- and post- upgrade scenarios. They do not include the areas no longer flooded or newly flooded, shown in Table 1.

9.13 This information shows that for the **design event**, the area of increased flood depth (generally in the township-adjacent reach and upstream) is roughly equal to the area of reduced flood depth. However, the depth of increase (evenly spread across bands from 0 to 1 m increase) is larger than the decrease (generally < 0.1 m depth reduction). Again, I note that this is only for the less intensively developed land outside of the benefit area (the benefit area generally receives a large depth reduction).

9.14 In a **Cyclone Gabrielle-sized event**, the area with an increased flood depth is more than the area with a reduced flood depth. The increased depth in this case is mostly less than 0.1 m.

9.15 In an **overdesign event**, a much greater area of land experiences much deeper flooding. Generally, the increase is greater than the corresponding flood depth reduction in areas where a reduction occurs.

Flood hazard changes – land

9.16 In the **design event**, including in the pre-upgrade case, much of the assessed Waipaoa River floodplain experiences a peak hazard of H6 (the highest category), with lower hazard at the margins of the floodplain or in elevated areas, regardless of the stopbank proposal. Increases in hazard due to the proposed upgrade (shown in yellow, with a small area of orange on Figure 5) are relatively small in extent.

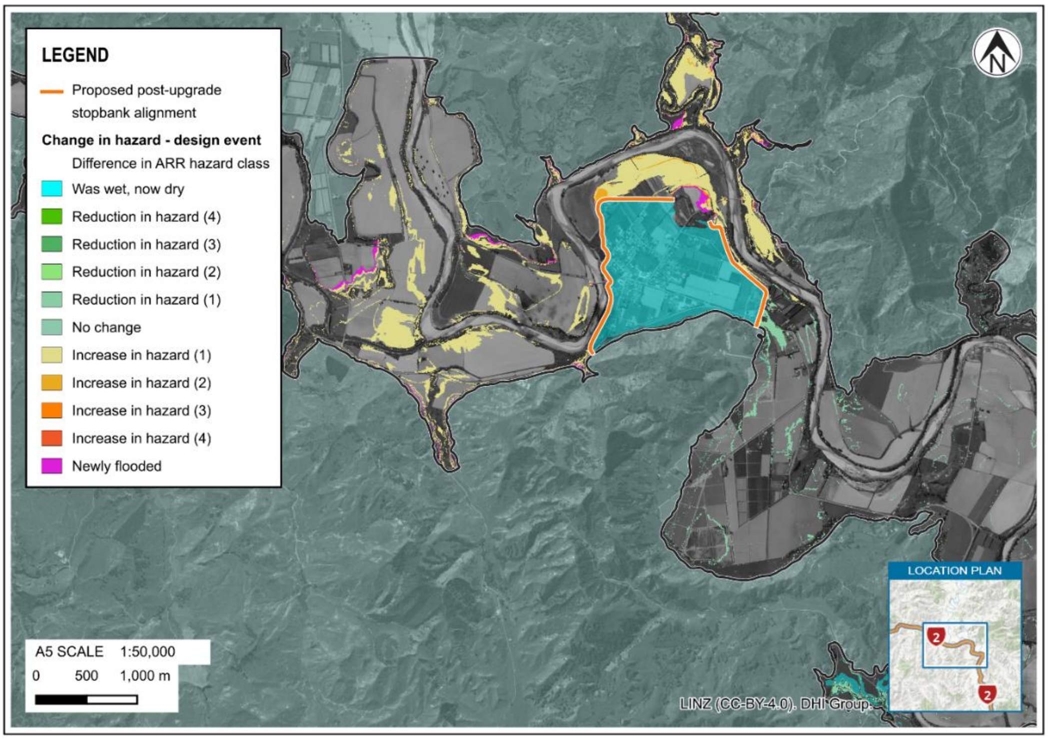

Figure 5. Change in peak hazard in the design event (Figure 3.4 from the CFRA)

9.17 In total, 157 ha of land has an increase in hazard, with the majority of this being areas which were subject to H5 hazard becoming subject to H6 hazard in the post-upgrade case, and areas which were dry in the pre-upgrade becoming subject to flooding in the post-upgrade case. A total of 210 ha of land has a decrease in hazard, largely within the ‘benefit area’ at Te Karaka township which has reduced flood risk in the post-upgrade case.

9.18 Changes in the hazard class for a **Cyclone Gabrielle-sized event** and the **overdesign event** (as shown in Figures 9 and 10 in the appendices of the CFRA report respectively) are more limited than in the design event. This is because:

(a) The impacts in a Cyclone Gabrielle-sized event in terms of “pushing water around” are smaller, and

(b) In the overdesign event, much more of the flooded area is subject to the highest classes anyway, so the relative impact of the proposed stopbank is smaller.

Adverse flooding effects - buildings

9.19 Across all modelled events, an adverse flooding effect to a building in the CFRA was defined as an increase in the flood hazard classification, or a localised flood depth increase of at least 50 mm, when comparing the post-upgrade case to the pre-upgrade case.

9.20 In the **design event**, 23 individual buildings are subject to an adverse flooding effect. Of these, six are identified as residential dwellings.

9.21 In a **Cyclone Gabrielle-sized event**, 11 buildings are subject to an adverse flooding effect. Of these, three are identified as residential dwellings.

9.22 In the **overdesign event**, 67 individual buildings are subject to an increased flooding effect. Of these, 15[4] are residential dwellings.

9.23 For comparison, 215 buildings within the benefit area are no longer within the design flood extent.

9.24 Finally, the CFRA Tables 5.1 to 5.15 contained a small error, in that velocity and hazard results were referred to as “mean peak velocity/hazard” instead of “maximum peak velocity/hazard”. This was addressed in the Section 92 response. For clarity, as some submitters also raised this as a concern: peak flood depth, peak water level, maximum velocity and maximum hazard results were assessed at each building, not event-mean results.

9.25 The stopbank alignment assessed in the CFRA differs very slightly from the alignment that was ultimately notified as part of the consent application process. The alignment and location/dimension of borrow pits has continued to change incrementally throughout the detailed design process, which is to be anticipated. From my understanding of the changes, I consider that these are unlikely to have a major impact on the flood hydraulics and therefore on assessed flood impacts. However, a consent condition is proposed that would require this to be reassessed based on the detailed design.

10 Submitter Concerns

10.1 I will respond to some common themes raised by submitters, before responding individually to several specific points.

Distribution of benefits and disbenefits

10.2 Submitters raised concerns about the distribution of benefits and disbenefits. Some submitters felt that a stopbank upgrade on the existing alignment would be more appropriate.

10.3 As acknowledged in the consent application and specifically in the CFRA, the stopbank proposal protects the township of Te Karaka but imposes disbenefits on other properties in terms of flooding effects. In some cases, flooding will be more extensive or deeper in a larger flood. In other areas that will now lie on the river side of the retreated stopbank, land that was previously behind the stopbank will now be exposed to more frequent flooding (of approximately a 5-year ARI/20% AEP frequency, for land close to the river, based on GDC staff observations on past flooding)

10.4 Structural responses to flood risk (e.g. stopbanks) inevitably involve “pushing water around”, speeding it up or holding it back. Given that the volumes of water in this case are large, this can’t be done without causing effects.

10.5 Benefits and disbenefits have been quantified through the CFRA process as well as Mr Christensen’s work, and the optioneering process has delivered a stopbank alignment that lies close to the township itself and therefore “pushes water around” less than raising the stopbank on its existing alignment would have. As noted earlier in my evidence, raising the stopbank on its existing

[4] Increased from the 14 homes reported in the CFRA, to include 76 Whatatutu Road (which I address later in my evidence)

alignment would constrain flows more, causing greater flooding impacts in the vicinity of the stopbank and upstream.

Use of aggradation scenarios in the CFRA

10.6 Submitters also raised concerns that the CFRA was not based on a future aggradation[5] scenario.

10.7 As I am not an expert in fluvial geomorphology, I sought input from my colleague Prof. Ian Fuller, who was involved in the previous geomorphic assessment work. He prepared a short letter report expanding on this aspect, which is appended to my evidence and on which I've relied in responding to this topic. Through my involvement in the project and my engineering expertise I am able to speak to what these results mean.

10.8 Several submitters assert that flooding will be worse on their properties in the future because of aggradation, which is likely correct. However, it doesn't necessarily follow that the CFRA has underestimated the impacts of the stopbank proposal. In the context of assessing the effects of the stopbank proposal, it is not the absolute flooding effects we should be interested in but rather the difference due to the stopbank proposal (i.e. comparison between existing stopbank and proposed upgrade), which is what the CFRA has sought to assess. Flooding will also worsen over time in the 'existing stopbank' case.

10.9 As Prof. Fuller notes, ideally the assessment of flooding effects would include future impacts with consideration of aggradation, given the aggrading trend in the Waipaoa River which will contribute to a worsening of flood risk over time.

10.10 This would require consideration of a range of geomorphic/hydrological future scenarios for both the existing stopbank and proposed upgrade cases, as the outcomes of modelling depend on assumptions about both the sediment load/processes and also the flood events that occur over time. As Prof. Fuller notes, these contain considerable uncertainties. The results of such a study, while likely useful for understanding future trajectories and for floodplain management planning, would be likely to give rise to a range of possible outcomes rather than a single number.

10.11 Development of the morphological model required to predict the evolution of the river in order to carry out this assessment, along with the likely associated field data collection and effort required to calibrate it, would be a considerable and time-consuming project.

10.12 A + 1 m river bed level (not berm) scenario was modelled at the optioneering stage for shortlist options 1 to 4, as a broad test to understand their relative sensitivity to river bed level increases and to inform the options assessment. The results from this earlier sensitivity test are not especially relevant to the assessment of effects of the proposed stopbank upgrade because they do not include an 'existing stopbank' scenario to compare against. Those scenarios also included assumptions about berm lowering/borrow pits which reflected thinking

[5] Technically, sediment buildup on the berms is called 'accretion' and this word has also been used in T+T's reports. Here, for simplicity, I have used 'aggradation' to mean sediment buildup in both the channel and berms/floodplain.

in the optioneering stage, but differ significantly from the design ultimately submitted with the consent application.

10.13 Development of meaningful scenarios reflecting the complex interplay of stopbank retreat, channel and berm dynamics takes us back into the realm of morphodynamic modelling as described in Prof. Fuller's letter.

Risk to bridges

10.14 The increased risk to the Rangatira Road and Kanakanaia Road bridges, resulting from the stopbank proposal, was raised by a number of submitters. I am not a structural engineer, so I sought input from my colleague Oz Ben-Ezra, who prepared a short letter report on the potential effects of the stopbank proposal on the Kanakanaia Road and Rangatira Road bridges in the 5,625 m^3/s design flood event. That report builds on the high-level load assessment previously summarised in the CFRA and is appended to my evidence. No additional analysis was carried out at this stage. I fully rely on Mr Ben Ezra's assessment in addressing the additional risks to the bridge structures and their structural capacity. Through my involvement in the project and my engineering expertise I am able to speak to what these results mean.

10.15 The assessment considered how the stopbank proposal would affect flood levels, flow velocities, hydraulic loads and scour at the two bridges during the 5,625 m^3/s design flood event. The analysis found that the stopbank proposal would increase hydraulic loading on both structures.

10.16 The assessment also considered scour effects. Estimated scour depth increases by up to approximately 0.8 m at Kanakanaia Bridge and 0.7 m at Rangatira Bridge, representing around 10% of the total calculated scour depth. The additional scour further increases bending demand on the piles.

10.17 Importantly, the assessment was a preliminary investigation rather than a detailed bridge assessment. Only very limited capacity checks were undertaken and the structural capacity of all bridge elements was not assessed. Nevertheless, the assessment concluded that the Kanakanaia Bridge is of particular concern, with the preliminary checks indicating that the bridge columns are likely to have inadequate capacity under both existing and proposed design flood conditions. In contrast, the Rangatira Bridge pier wall assessed appears to have adequate capacity for the design loading considered, although the report notes that other elements such as the piles or pile cap may ultimately prove to be more critical.

10.18 A more detailed structural assessment would be required to determine overall bridge capacity, the degree of risk, and whether strengthening works would be recommended to meet NZTA Bridge Manual standards. For example, it may be that some elements are designed for seismic loads in excess of the hydraulic loads, in which case the additional hydraulic loads may turn out to be less critical.

10.19 The key point from Mr Ben-Ezra's letter is that the bridge assessment identifies a potentially significant consequence of the increased flood levels associated with the stopbank proposal. T+T's work concludes that the increase in risk cannot be quantified without further investigation. If the increase in risk to the bridge structures were to be mitigated, this would likely involve at least some structural strengthening works.

10.20 For context, it is important to keep in mind that increased flood pressure on the bridges will only occur in flood events of sufficient magnitude to overwhelm the existing stopbanks. There will be no significant change to the scour or loads experienced at the bridges in any small to moderate floods that would have been within the capacity of the existing stopbank. This is because the quantity of water passing under the bridges is effectively unchanged in the pre- and post-upgrade scenarios.

10.21 I have also been requested to comment on the NPS-NH[6] risk matrix as it applies to the bridges. This risk matrix is awkward to apply to bridges and seems primarily intended to apply to the land on which an activity occurs. Furthermore, it does not consider the criticality or vulnerability of assets.

10.22 Mr Exeter discusses this in his planning evidence. We have agreed that the NPS-NH would be most defensibly applied to risk to life for users of the bridges.

10.23 On balance, with both bridges having survived an approximately 40-year flood event (Cyclone Gabrielle) but at least one of the bridges being assessed to have inadequate capacity for the approximately 100-year ARI design event, the 'likelihood level' for bridge failure on the NPS-NH risk matrix is likely to sit in the 'possible' or 'unlikely' categories. Combined with a 'major' or 'catastrophic' consequence due to the risk to life in that case, it is reasonable to say that the current risk to life caused by flood loads on the bridges is 'medium' to 'high'.

10.24 With proposed mitigation in the form of an updated emergency management plan and pre-emptive bridge closures, the risk category of 'medium' to 'high' is not likely to increase despite the increased risk of bridge failure; the risk to life could potentially even be reduced compared to the current situation.

Response to submission from Burgess Family Trust (submission #7)

10.25 Flooding effects were assessed to the property at 2416 Matawai Road as described in the CFRA, including the buildings at the property. The submitters consider that their property will be subject to worsened flood risk as a result of the stopbank proposal. Their property was identified in the CFRA as experiencing a disbenefit in a Cyclone Gabrielle-sized event.

10.26 The CFRA results indicate that the property at 2416 Matawai Road experiences a reduction in flood depth under all three modelled scenarios. This also applies to the dwelling on the property. The relevant values are as shown in Table 3, below:

[6] National Policy Statement on Natural Hazards

Table 3. Summary of effects at the dwelling at 2416 Matawai Road

Parameter	Cyclone Gabrielle flows		Design flows		Overdesign	
	Pre-upgrade	Post-upgrade	Pre-upgrade	Post-upgrade	Pre-upgrade	Post-upgrade
Water level (mRL)	39.18	38.97	40.33	39.98	44.20	44.18
Velocity (m/s)	0.65	1.08	0.87	1.46	1.95	2.09
Hazard class	H3	H4	H5	H5	H6	H6

10.27 Flood level (and therefore depth) decreases in the post-upgrade case for each flow scenario. Flood velocity rises in each case despite the reduction in water level; this is a result of the flood dynamics, with larger amounts of water being held back upstream of Te Karaka and the reduced flows not backing up as much on the submitters' land. This increase in velocity leads to the increase in hazard class noted for the Cyclone Gabrielle-sized event.

10.28 All of the estimated flood levels are higher than the stated floor level of 38.58 mRL, so the dwelling would be expected to flood in all of the events assessed (regardless of the proposed stopbank upgrade).

10.29 I am unable to provide detailed evidence on the effects of inundation and scour on the applicants' orchard, as I'm not an expert on the effects of flooding on productive land. I would, however, note that an increase in velocity alone is not the sole determinant of land damage. The shear stress experienced by the soil is also very strongly linked with the depth of the floodwaters, as moving water with greater depth applies far more force to the soil. Faster flowing water also has less potential to deposit fine sediment, which may have a bearing on the amount of damage from silt deposition.

Response to submissions from J Moran (submission #6) and D Moran (submission #64)

10.30 The property at 88 Rangatira Road (see Figure 6) consists of land at a lower level closer to the river, and higher ground on a terrace further to the west, on which the house and a cluster of farm buildings are located. The impacts on this land are shown in the maps in the appendices of the CFRA, which I will not reproduce here in full. Figure 6 shows the impacts of the stopbank proposal on flood depth in the **design event**.

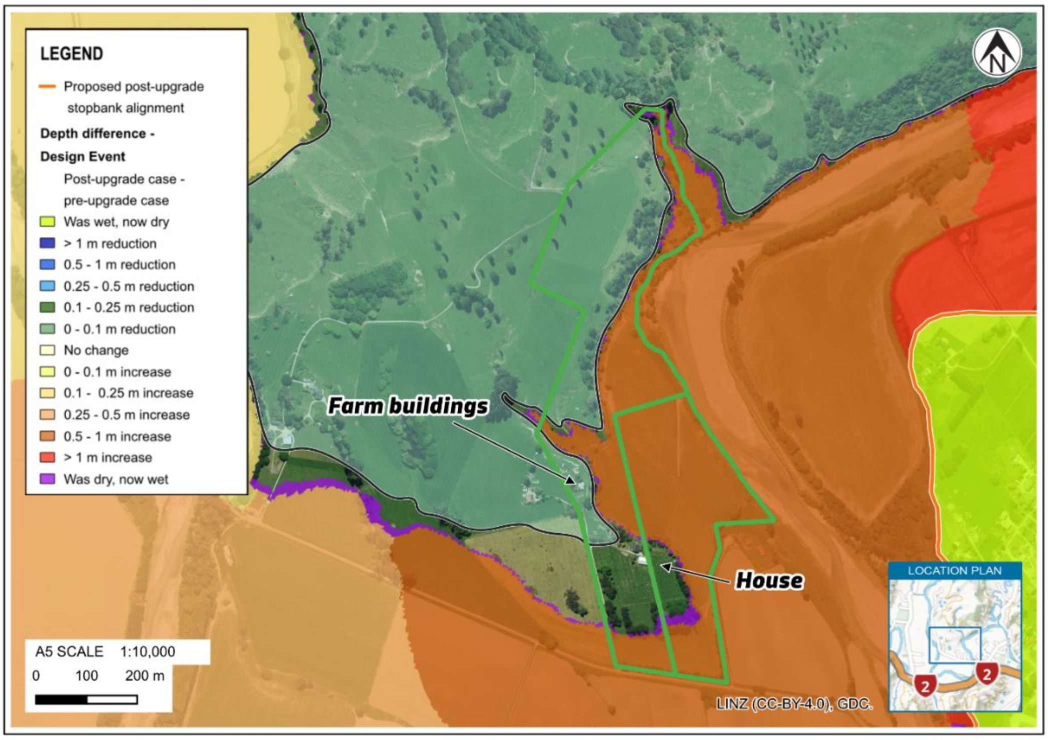

Figure 6. Depth increases in the design event, property outlined in green.

10.31 The modelled results indicate that lower land close to the river will be flooded to a greater depth, but that the terrace on which the dwelling is located constrains the flooding so that no additional land will be flooded in the design event beyond small fringes on the terrace edge. This pattern is the same in the **Cyclone Gabrielle-sized** scenario.

10.32 In the **overdesign event**, the cluster of farm buildings is modelled to be unaffected by flooding but the house sits on an area of land that would be "newly flooded" by the stopbank proposal due to water flowing over the inside of the bend.

10.33 In terms of velocity, a strip of land immediately adjacent to the river land lies in a band on the maps which is subject to increases in the range of 0.1 to 0.25 m/s in the **design event**. In the **overdesign event**, the area affected also includes the southern portion of the property, where the house stands, and velocity increases include some areas subject to the 0.25 to 0.5 m/s band. Modelling indicates negligible changes in the **Cyclone Gabrielle-sized event**.

10.34 The above increases result in small portions of the property experiencing an increase of one hazard class in the **Cyclone Gabrielle** and **design flow** scenarios. In the **overdesign event**, the area near the house experiences an increase of two hazard classes (to H3).

10.35 Details of changes in flood level and hazard class at the dwelling (which only floods in the overdesign event) are included in Table 4.4 of the CFRA. I can provide the following additional information:

(a) The peak flood depth in the overdesign event, post-stopbank upgrade would be 0.27 m.

(b) The peak velocity in the overdesign event, post-stopbank upgrade would be 0.7 m/s.

Response to submission from Coates Family Trust (submission #76)

10.36 The dwelling at 76 Whatatutu Road was inadvertently omitted from the reporting tables, despite being identified and assessed, due to its having been incorrectly associated with the two removed houses at 62/62a Whatatutu Road. It is not modelled to flood in the **Cyclone Gabrielle** or **design events**, regardless of the stopbank proposal.

10.37 It is modelled to flood in the **overdesign event** in both the existing case and with the proposed stopbank. The changes in modelled flooding at the house due to the stopbank proposal are:

(a) Water level increases from 49.05 mRL to 49.43 mRL (approximate depth increase from 2.34 m to 2.72 m);

(b) The peak velocity barely changes, from 0.75 m/s to 0.74 m/s; and

(c) The hazard class remains unchanged at H5.

10.38 The submitter has requested a full assessment of the flooding effects for a detailed list of farm assets. Only impacts on parcels and buildings were assessed for the purposes of the CFRA. The change in depth, velocity and hazard class was mapped and is shown in Appendices B, C and D, respectively, of the CFRA.

10.39 The land in question lies in the band "0.25 m to 0.5 m increase" for the **design event** flood depth. This result is the same for the **overdesign event**.

10.40 Changes in velocity in the **design** and **overdesign events** are small (in the band +/- up to 0.25 m/s) and areas of increase are balanced out by areas of reduction.

10.41 In a **Cyclone Gabrielle-sized event**, the expected increase at this property lies in the 0 to 0.1 m range, and generally at the smaller end of this range.

10.42 Significant parts of the property experience an increase of one hazard class in the **design event**, as shown on Figure 7, below. Changes in the **overdesign event** are smaller. Changes to hazard class in the **Cyclone Gabrielle scenario** are negligible.

Figure 7. Change in hazard class in the design event at 48, 62/62a and 76 Whatatutu Road

10.43 The following map and tables summarise the effects on all buildings identified on the subject parcels owned by the submitter.

Figure 8. Buildings at 48, 62/62a, and 76 Whatatutu Road (with ID numbers)

10.44 I have highlighted the one building (ID 4652588) for which an increase in hazard class occurs, this in the design event only. I have not confirmed whether this building in fact has been removed along with the house at 62 Whatatutu road. The submitter's evidence seems to state that the only building still remaining at 62/62a Whatatutu Road is "a two-bay pole shed and two tanks remaining at 62a", which would be Building ID 5343339.

Table 4. Flood effects on buildings at 48, 62/62a and 76 Whatatutu Road - Design Event

Building ID	Design Event – Post-upgrade case compared to pre-upgrade case					
	Depth (m)		Velocity (m/s)		Hazard (class)	
	Pre-	Post-	Pre-	Post-	Pre-	Post-
4652142	-	-	-	-	-	-
4652595	-	-	-	-	-	-
4652598	-	-	-	-	-	-
5343339	1.37	1.68	0.37	0.35	4	4
4652588	1.64	1.95	0.28	0.27	4	5
5343271	1.28	1.59	0.25	0.32	4	4
4652144	1.31	1.61	0.10	0.14	4	4
4652591	1.82	2.12	0.10	0.14	5	5

Table 5. Flood effects on buildings at 48, 62/62a and 76 Whatatutu Road - Cyclone Gabrielle-sized event

Building ID	Gabrielle Event – Post-upgrade case compared to pre-upgrade case					
	Depth (m)		Velocity (m/s)		Hazard (class)	
	Pre-	Post-	Pre-	Post-	Pre-	Post-
4652142	-	-	-	-	-	-
4652595	-	-	-	-	-	-
4652598	-	-	-	-	-	-
5343339	0.74	0.75	0.27	0.27	3	3
4652588	1.00	1.01	0.23	0.23	4	4
5343271	0.65	0.65	0.06	0.07	3	3
4652144	0.67	0.68	0.03	0.03	3	3
4652591	1.18	1.19	0.07	0.07	4	4

Table 6. Flood effects on buildings at 48, 62/62a and 76 Whatatutu Road - Overdesign Event

Building ID	Overdesign Event – Post-upgrade case compared to pre-upgrade case					
	Depth (m)		Velocity (m/s)		Hazard (class)	
	Pre-	Post-	Pre-	Post-	Pre-	Post-
4652142	2.34	2.72	0.75	0.74	5	5
4652595	1.85	2.23	0.45	0.47	5	5
4652598	2.17	2.56	0.79	0.78	5	5
5343339	4.32	4.71	0.68	0.67	6	6
4652588	4.58	4.97	0.56	0.55	6	6
5343271	4.24	4.63	0.96	0.92	6	6
4652144	4.26	4.66	0.63	0.63	6	6
4652591	4.77	5.16	0.64	0.64	6	6

Response to submission from Neta Worsley and others (submission #67)

10.45 The submitter is concerned that flooding will be worsened at Takipū Marae by the stopbank proposal. However, the flood model results assessed in the CFRA show a flooding benefit at this location.

10.46 Effects at the marae are detailed in Section 5.2.2 of the CFRA. In summary, the depth at the marae building is proposed to be reduced significantly in a **Cyclone Gabrielle-sized event** and in the **design event** (-140 mm and -120 mm respectively) and only increase slightly (+20 mm) in the **overdesign event**. Flood velocities decrease slightly or remain the same. The hazard class remains the same except in the **Cyclone Gabrielle scenario**, in which it reduces from H4 to H3 as a result of the proposed stopbank.

11 Response to section 42A report

Liquefaction and landslide risk to the proposed stopbank

11.1 Section 6.7 of the section 42A report notes that an assessment of liquefaction and landslip risk in line with the NPS-NH risk matrix is to be provided in evidence. I address this here.

11.2 As part of the detailed design of the proposed stopbank upgrade (post lodgement of the consent application) additional ground investigations and geotechnical assessment has been carried out by T+T. I have sought input from T+T's geotechnical engineers in commenting on the NPS-NH hazard category.

11.3 They advise that as the land is flat, the stopbank is not considered to be subject to landslip hazards.

11.4 In terms of liquefaction/seismic hazard: all stopbanks are subject to a degree of hazard and should be checked, and repaired if necessary, following a large earthquake. However, the consequence of a stopbank being damaged is minor unless the damage is significant and it coincides with a large flood. The "joint probability" of a large flood occurring within a very short time after the earthquake (so that there is no time to repair the stopbank) is unlikely.

11.5 The stopbank has been assessed to be generally subject to up to 14 to 36 mm settlement in a 500-year earthquake. This amount of settlement is negligible.

11.6 One area of the stopbank, close to the river, has been identified as potentially being subject to a greater risk of liquefaction damage, based on the most conservative interpretation of the site investigation data. Under the conservative assumptions, this area of the stopbank could be subject to more significant settlement/damage, potentially 'catastrophic' in terms of the NPS-NH risk matrix if it were to lead to a flooding catastrophe. However, as noted above, the likelihood of such damage coinciding with a large flood is very low.

11.7 I consider the seismic/liquefaction risk should therefore be assessed at low to medium in terms of the NPS-NH risk matrix.

Identification of affected properties

11.8 Confirmation that all affected properties have been identified was requested in the S42a report. I can confirm that the Consequential FRA identified all affected properties (parcel and/or buildings) as described in that report based on existing rating/building databases and the DHI flood modelling results.

11.9 Residential buildings were identified manually through use of high-resolution aerial photos, and Google Street View data (where available). This was checked by GDC officers based on their local knowledge. For example, the two houses at 62 Whatatutu Road which were still shown in the aerial photo were manually removed from the data.

11.10 As described earlier in my evidence, the dwelling at 76 Whatatutu Road was inadvertently omitted from the reporting.

Risk to the Puha Substation

11.11 As noted in the S42a report, the Puha Substation is modelled to experience a slight flood disbenefit in the overdesign event (flooding of approximately 9 cm, compared to no flooding in the pre-upgrade case).

11.12 For clarity, it is worth stating that the substation is modelled to experience no flooding in the Cyclone Gabrielle-size or design events, regardless of the stopbank proposal.

12 Conclusion

12.1 The preferred stopbank alignment was selected through a structured optioneering process involving flood modelling, MCA assessment and community input, and reflects a balance between protecting Te Karaka and minimising adverse effects elsewhere.

12.2 Relative to upgrading the stopbank on its existing alignment, the preferred option is expected to result in smaller increases in upstream and opposite-bank flooding effects while also reducing the stopbank's exposure to erosion and providing greater flexibility in an aggrading river environment.

12.3 The CFRA provides a robust assessment of the flooding effects of the proposed stopbank upgrade through comparison of existing and proposed scenarios using calibrated flood modelling across a range of flood events.

12.4 The assessment confirms that while the proposal produces clear flood protection benefits for Te Karaka township, it also creates flooding disbenefits for some properties outside the protected area. Those effects have been quantified and reported through the CFRA.

12.5 The proposal substantially reduces flooding exposure within the stopbanked benefit area, including removal of a large number of buildings from the design-event flood extent, while adverse effects outside the benefit area are generally limited to a relatively small number of buildings.

12.6 Concerns regarding future aggradation are valid and flood risk is likely to increase over time under both the existing-stopbank and proposed-stopbank scenarios. However, the available information does not demonstrate that the CFRA has materially underestimated the *relative effects* of the proposed stopbank upgrade compared with the existing situation. Assessment of future flooding effects under aggradation would require a substantially more complex morphodynamic assessment involving multiple future scenarios and significant uncertainty.

12.7 The available bridge assessment indicates that the proposed stopbank upgrade is likely to increase hydraulic loading and scour effects at the Rangatira Road and Kanakanaia Road bridges in the design flood event. These effects may be significant, particularly at Kanakanaia Bridge, but the magnitude of the risk and any requirement for strengthening cannot be determined without further structural assessment. With the proposed mitigation measures, the risk to life posed by increased flood loads on these bridges in large floods is not expected to increase.

Mark Christopher Hooker

14 September 2026

Attached: letter from Ian fuller
Attached: letter from Oz Ben-Ezra