BEFORE	Independent Commissioners appointed by Tasman District Council
IN THE MATTER	Of the Resource Management Act 1991
AND	
IN THE MATTER	Of an application by CJ Industries Ltd for land use consent RM200488 for gravel extraction and associated site rehabilitation and amenity planting and for land use consent RM200489 to establish and use vehicle access on an unformed legal road and erect associated signage

EVIDENCE OF SIMON JAMES AIKEN ON BEHALF OF CJ INDUSTRIES FLOODING

15 July 2022

1. INTRODUCTION

1.1 My full name is Simon James Aiken. I am a Senior Water Resources consultant at Tonkin & Taylor Ltd ("T+T"). I am the Team Leader for the Water Engineering Team in Nelson.

1.2 The applicant has applied for resource consents authorising the extraction of gravel, stockpiling of topsoil, and reinstatement of quarried land, with associated amenity planting, signage and access formation at 134 Peach Island Road, Motueka:

(a) RM200488 land use consent for gravel extraction and associated site rehabilitation and amenity planting, and

(b) RM200489 land use consent to establish and use vehicle access on an unformed legal road and erect associated signage.

1.3 My evidence addresses the flooding assessment of the activities for which consent is sought.

Qualifications and Experience

1.4 I have been employed as a Senior Water Resources Consultant at T+T since 2017. My previous experience (2011-2017) is as a Catchment Planner with the Stormwater Unit at Auckland Council and as a Hydrologist with Auckland University. I hold a Bachelor of Science (Environmental Science and Physical Geography) and a 1st Class Master of Science (Physical Geography) from the University of Auckland (2013).

1.5 My technical skills and experience directly relevant to my assessment include:

(a) Preparing Flood Hazard Models ("FHM") and interpretation of hydraulic model results.

(b) Assessment of engineering 'options' to manage effects of development and flooding.

(c) Assessment of hydrological changes because of land cover change, including the interpretation of the effects of climate change on flood records.

1.6 I have been to site and inspected the floodplain area, including existing vegetation and upstream and downstream reaches that is proposed for excavation.

Purpose and Scope of Evidence

1.7 The purpose of my evidence is to assess, on behalf of CJ Industries ("CJ's"), the impact of the proposed activity on floodplain hydraulics and offsite flooding-related effects (i.e., changes in water level and velocity). In particular, on the Peach Island stopbanks and to provide recommendations to avoid, remedy or mitigate any adverse effects on the environment.

Code of Conduct

1.8 I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2014 and I agree to comply with it. My evidence is within my area of expertise, however where I make statements on issues that are not in my area of expertise, I will state whose evidence I have relied upon. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in my evidence.

2. EXECUTIVE SUMMARY

2.1 The applicant is proposing to undertake gravel extraction on the floodplain of the Motueka River. The proposed works involve excavation of gravel from extraction (borrow) areas that are located a minimum of 20 m horizontal distance from the toe of the stopbank. The maximum depth of excavation is 5 m (likely less), the maximum width of excavation is 20 m and the maximum excavation length is 80 m. Only one stage will be active at any time. Excavation areas will be progressively backfilled with clean fill to ensure that the maximum plan area of the excavation pits open at any given time does not exceed these dimensions.

2.2 The applicant engaged T+T to assess the impact of the proposed activity on the adjacent Peach Island stopbanks, as well as any changes on upstream or downstream water levels or flood flow velocities for the 10 % and 1 % AEP design storm. T+T completed this assessment using a catchment wide hydraulic model which was prepared under contract for Tasman District Council.

2.3 The modelling results indicate that the greatest effect may be an almost indiscernible attenuation of flood flows, if the excavation was inundated during the operation of the borrow pit. Based on our assessment of modelled changes in flood depth, level and velocity there is no evidence to suggest this activity will worsen the existing flood hazard, impact natural drainage patterns or negatively impact the flood plain storage or conveyance capacity for the flood flow scenarios assessed.

3. EVIDENCE

Existing environment

3.1 The proposed gravel extraction site is located on the Motueka River floodplain area, adjacent to Peach Island, in the Tasman District. The adjacent channel is commonly referred to as 'the back channel'. The site is approximately 3 ha and is vegetated by grasses and infrequent small trees. The site is zoned Rural 1 under the Tasman Resource Management Plan ("TRMP").

The proposal

3.2 The Applicant proposes to undertake gravel extraction on the property in three stages, within an area of approximately 73,500 m^2, and over a 15-year period. No processing or crushing of gravel will occur on site.

3.3 The proposed works involve excavation of gravel from extraction (borrow) areas that are located a minimum of 20 m horizontal distance from the toe of the stopbank. The maximum depth of excavation is determined by groundwater depth but will not be more than 5 m. Excavation areas will be progressively backfilled with clean fill, to ensure that the maximum plan area of the excavation pits open at any given time does not exceed 1600 m^2.

3.4 The acoustic engineer has recommended a 3 m high bund between the extraction areas and 131 Peach Island Road, as shown in the blue line in the image below (from Figure 1 in Mr Hegley's evidence):

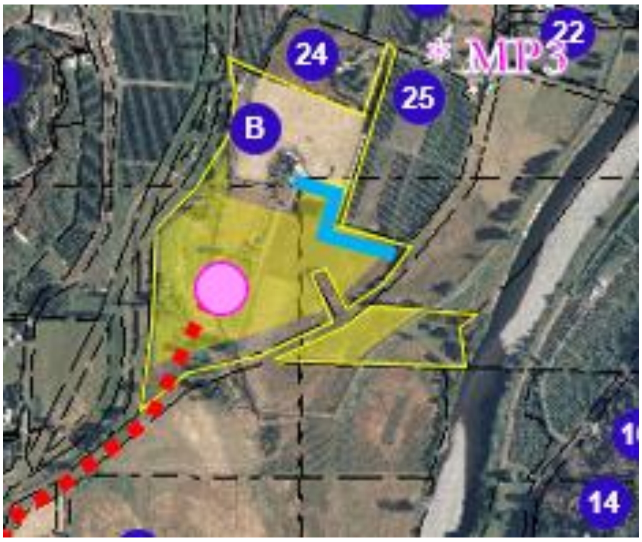

Figure 1: Location of acoustic bund recommended by Mr Hegley.

3.5 Temporary topsoil is proposed to be stockpiled close to the Stage 1 extraction areas (outside the stopbanks).

3.6 Those aspects of the proposal were not assessed in my report as they were not under consideration at that time, but I have assessed them as part of my evidence.

Flood model and context

3.7 In 2018 T+T was engaged by TDC to commence a flood study of the Motueka River, the main objective of which was to determine appropriate and cost-effective flood mitigation measures for areas potentially affected by flooding from an outbreak of the Motueka River, Riwaka River, Little Sydney Stream and Brooklyn Stream systems.

3.8 Included in that engagement was the development of a hydrological and hydraulic model to undertake simulation of design events of 1 %, 2 % and 10 % Annual Exceedance Probability ("AEP") rainfall for present day climate with different storm durations.

3.9 The process for the hydrological and hydraulic model calibration is detailed in T+T Report "Motueka, Brooklyn and Riwaka TUFLOW Flood Model Build"**.** The hydrological model was calibrated against flow gauge data, and closely matches observed flow data. The roughness value for the Motueka Riverbed in the hydraulic model was calibrated using data collected from the 1983 event, as described in the 1994 "Motueka Flood Hazards" report. The T+T Flood Model Build report should be read alongside this evidence.

3.10 Following the 17 July 2021 storm event T+T was engaged by TDC to 'run' that storm event through the existing Motueka River TUFLOW model. A comparison was undertaken between modelled flood levels and extents and surveyed flood debris levels. less than 0.1 m difference was observed for the Peach Island Motueka Western Branch, commonly referred to as the "back channel". Further the modelling had indicated overtopping into Peach Island at the main access bridge, which happened in the event.

3.11 In summary, as part of my assessment of the proposed activity I have reviewed relevant information related to the T+T TUFLOW model and consider it an appropriate tool for understanding the effects on floodplain hydraulics and implications for stop bank stability.

Potential effects on the environment

3.12 T+T was engaged by CJ's to provide advice on the implications of gravel extraction at Peach Island, Motueka for flooding. As a part of providing that advice, I assessed the flood hazard as a result of the proposed activity. The extent of my assessment included the Peach Island stopbanks, immediate adjacent channel and floodplain areas upstream and downstream of the proposed extraction (borrow) areas. It was focused on the Stage 1 area because Stages 2 and 3 are located behind the stopbanks and so are protected from all but the most extreme flood events.[1] It assessed flooding across this extent for the Stage 1 area for the 1 and 10 % AEP storm event.

3.13 The report setting out my advice (T+T report Ref: 1015514.0000, dated 16 December 2021, titled "Peach Island Gravel Extraction ("T+T report")) was provided to Tasman District Council ("TDC") as part of CJ's response to Council's request for further information.

3.14 The methodology used for my assessment, results, and my conclusions are set out in the T+T report, and that report should be read alongside this evidence. It is important to note that I consider the scenarios assessed in the T+T report a conservative representation of the proposed activity. This is because a significantly larger excavation footprint was modelled, in practice this area is likely to be significantly smaller.

3.15 My conclusions as set out in the T+T report were:[2]

> "The modelling results indicate that the greatest effect may be an almost indiscernible attenuation of flood flows if the excavation [within the Stage 1 area] was inundated during the operation of the borrow pit. The mechanism for this minor reduction is that excavation of the floodplain and removal of material will increase floodplain storage volume, resulting in a very minor reduction of flood flows (flood levels). Based on my assessment of modelled changes in flood depth, level and velocity there is no evidence to suggest this activity will worsen existing flood hazard, impact natural drainage patterns during our modelled flood flow scenarios or negatively impact the flood plain storage or conveyance capacity. Based on the modelled flows there is no indication that upstream or downstream

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[1] T+T report section 2.1
[2] T+T report section 3.13

changes in water level or velocity are either extensive or significant. Following the excavation of material, the borrow pits will be backfilled to a similar level as the existing and therefore will act in a similar hydraulic manner to the pre-excavation floodplain."

3.16 From my analysis there is no indication that the proposed acoustic bund will impact any overland flowpaths or displace any floodplain storage, noting that the bund is also located inside the protection of the stopbanks.

Matters raised in submissions

Flood Records

3.17 Various submitters have raised concerns about discrepancies between reported return periods (or annual exceedance probabilities - AEP). In my experience it is necessary to understand the year the original annual exceedance probability was reported as the estimate of AEPs change over time as the flow gauging record length increases and more data becomes available.

3.18 For example, the largest flood recorded since flow gauging began in 1969 (53 years ago) was the 1983 flood event, which was estimated at about a 1 in 70-year return (1.45 % AEP) period at the time. Reanalysis of that record using gauge data available to 2020 suggests this was around a 0.8 % AEP (1 in 120) year return period event.

3.19 Considering the length of record (53 years) available and recent 2020 reanalysis of that record I consider the AEPs modelled as acceptable for an assessment of effects for a resource consent.

Floodplain Hydraulics and Stopbank Stability

3.20 Various submitters[3] have raised concerns about the proposed activity and the associated impact on floodplain hydraulics and stability of the Peach Island stopbanks. From these submissions it is not clear if the concerns are related to geotechnical stability of the stopbanks, either as a result of the excavations or from an unspecified flood related mechanism. In all matters related to geotechnical stability I defer to Mr Dave Averill.

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[3] TDC assigned number 01, 39, 17, 42 and 100.

3.21 Regarding stability from a flood related mechanism, the modelling results indicate that the greatest affect may be an almost indiscernible attenuation of flood flows during the 1 % and 10 % AEP design storm if the Stage 1 excavation area was inundated during the operation of the borrow pit. If the Stage 1 area was inundated after excavation and reinstatement of the floodplain flood flows would be substantially the same as before the activity took place. Based on our assessment of modelled changes in flood depth, level and velocity there is no evidence to suggest this activity will worsen the existing flood hazard, impact natural drainage patterns or negatively impact the flood plain storage or conveyance capacity for the flood flow scenarios assessed. Considering the above, it is difficult to envisage how the proposed activity, undertaken in accordance with the conditions of consent, would affect the stability of the stopbanks.

3.22 Provided the gravel extraction operates as currently proposed and in accordance with the conditions of consent it is unlikely that the activity will generate adverse effects on floodplain flood function.

3.23 In summary there has been no additional information provided to me that would change my conclusions in my original report

Response to Dr Michael Harvey

3.24 In general, most submitters raised generic queries related to flooding and flood risk which I have addressed above or are addressed by the analysis in the T+T report. However, Dr Michael Harvey raised a series of more technical queries and I explicitly respond to these below.

3.25 **Issue:** "Additional coincident flows in the floodway from significant local west bank tributaries are probably not included in the model"

(a) This statement is incorrect. The hydraulic model includes coincident flows from the west bank tributaries. The extent of the model was schematised to include the urban areas of Motueka and Riwaka and surrounding floodplains. Flows from six upstream catchments are assessed through lumped catchment hydrology and introduced to the model as point sources at the hydraulic model boundary. The model extent and location of these six inflows is shown in Figure 2 below.

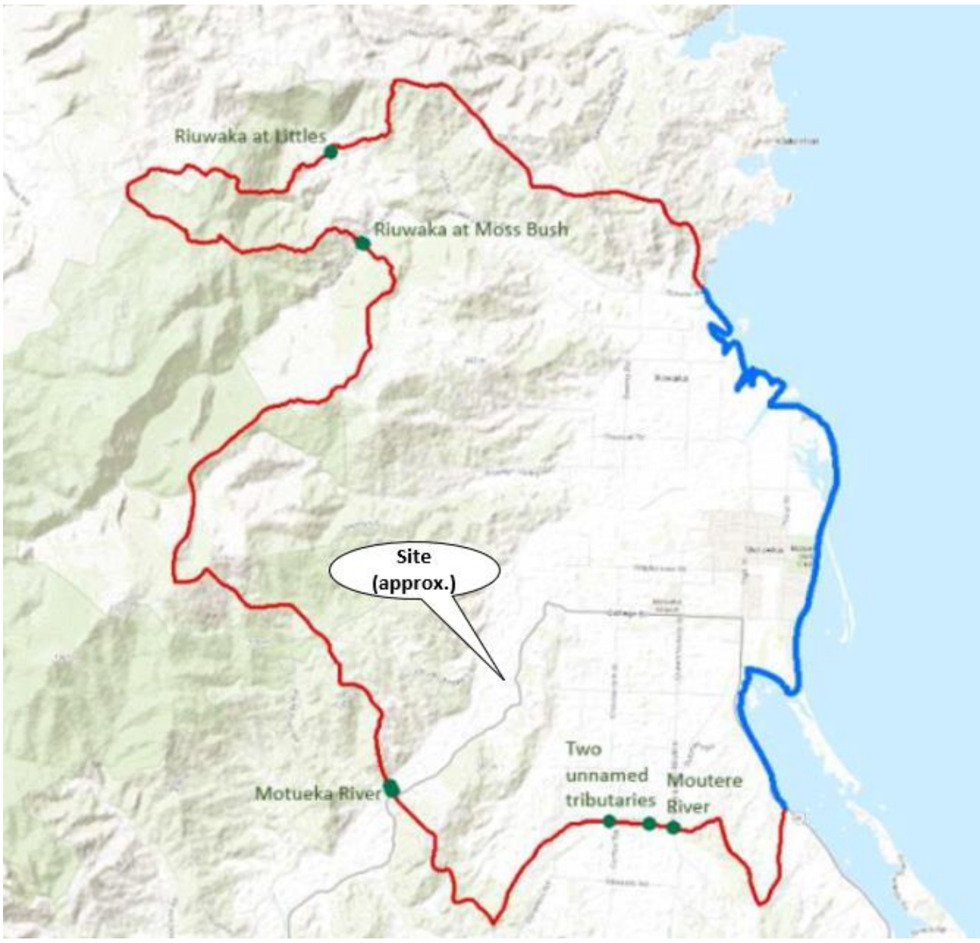
(b) 

Figure 2: Motueka and Riuwaka 2D model extent (in red). Labelled parts of the extent polygon show lumped catchment inflow locations (in green) and downstream boundary location (in blue).

3.21 **Issue:** "Climate change projections indicate that the probability of occurrence will increase" note.

(a) I acknowledge that climate change and its related impacts on the occurrence of extreme weather events and on rainfall distribution(s) are likely to alter the frequency at which various river flood flows occur.

(b) The proposed activity has been assessed to not worsen the existing situation with regards to floodplain hydraulics or flood risk for both the 1% and 10% AEP design storm. This would remain the case, even if the frequency of these events increased. Therefore, if the floodplain (i.e. Stage 1) was to become inundated more frequently as a result of climate change, this would be an operational issue to be managed by CJ's and through appropriate conditions of consent. It should not be considered as an adverse effect as a result of the activity.

3.26 Dr Harvey raised a series of linked concerns. These are summarised and responded to below:

(a) **Floodplain scour Issue:** "No analysis of floodplain scour was conducted when results of the hydraulic modelling showed reduced flow depths and increased velocities immediately upstream of the south pit (i.e. increased shear stress). Presentation of the results as changes between existing and proposed conditions does not provide absolute values of depth or velocity with which either critical velocity or shear stress can be assessed for what are clearly sandy soils (Landvision, Ltd, May 2021 report). Velocities in excess of 0.6 m/s are likely to cause erosion of bare sandy soils and it appears that velocities of 0.7-0.8 m/s are predicted during the 100-yr ARI event (T&T, p.5)"

(i) The original T+T report did not present absolute values in our discussion of floodplain hydraulics or scour. To address this query, I have extracted time varying (Figure 4 and Figure 5) plots of velocity from the hydraulic model at several locations on the floodplain areas adjacent to the modelled borrow pits. These plots compare velocity between the pre (i.e. existing topography) and post development case (i.e. 5 m deep borrow pit). For reference the location of the extracted data points is shown in Figure 3 below.

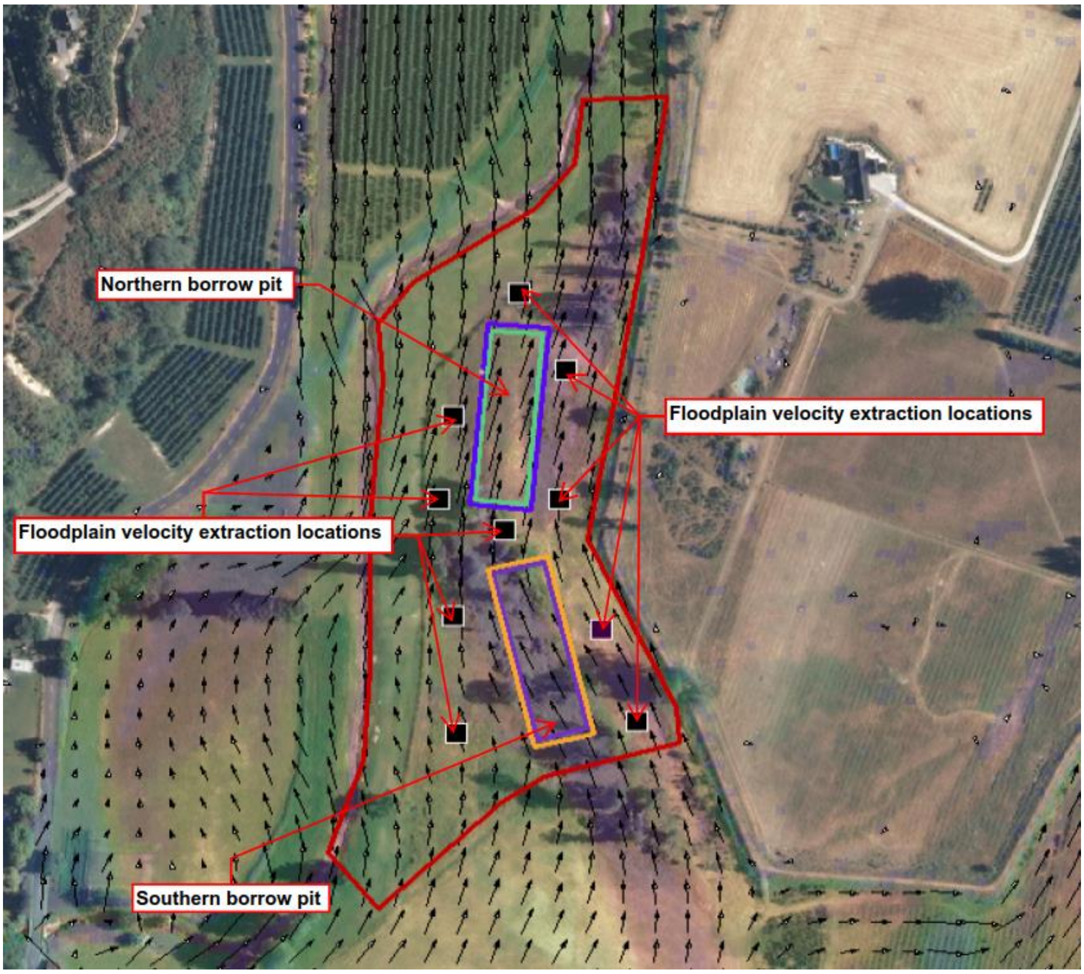


Figure 3: Location of velocity plots shown in Figures 4 and 5.

(i) Each plot within Figures 4 and 5 shows four time-series plots for velocity (i.e. changes in velocity over a time at location). The red line shows the velocity for the existing topography and the blue line shows the velocity with the activity and its extraction (borrow) pits in place. Each plot shows data extracted from different locations (shown as black boxes on Figure 3) on the floodplain. Figure 4 relates to the southern extraction (borrow) pit in Figure 3. I have repeated this query for the modelled northern borrow pit in Figure 5.

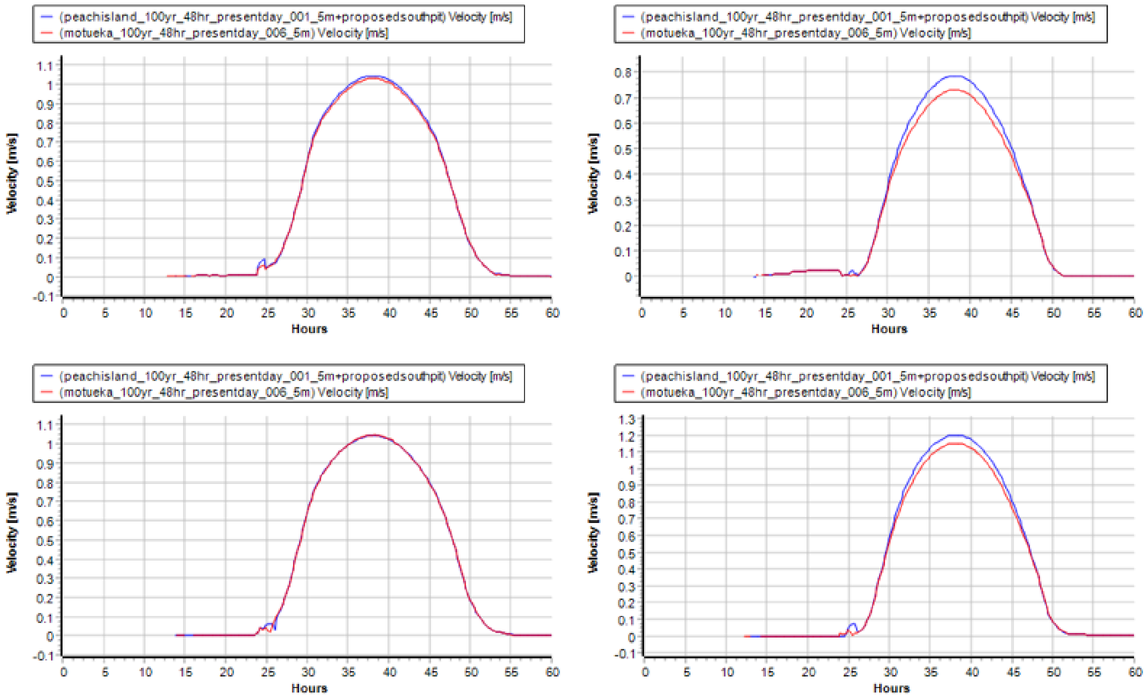


Figure 4: Time-series plot of velocity from four locations in the north of the site and in proximity to the modelled southern borrow pit.

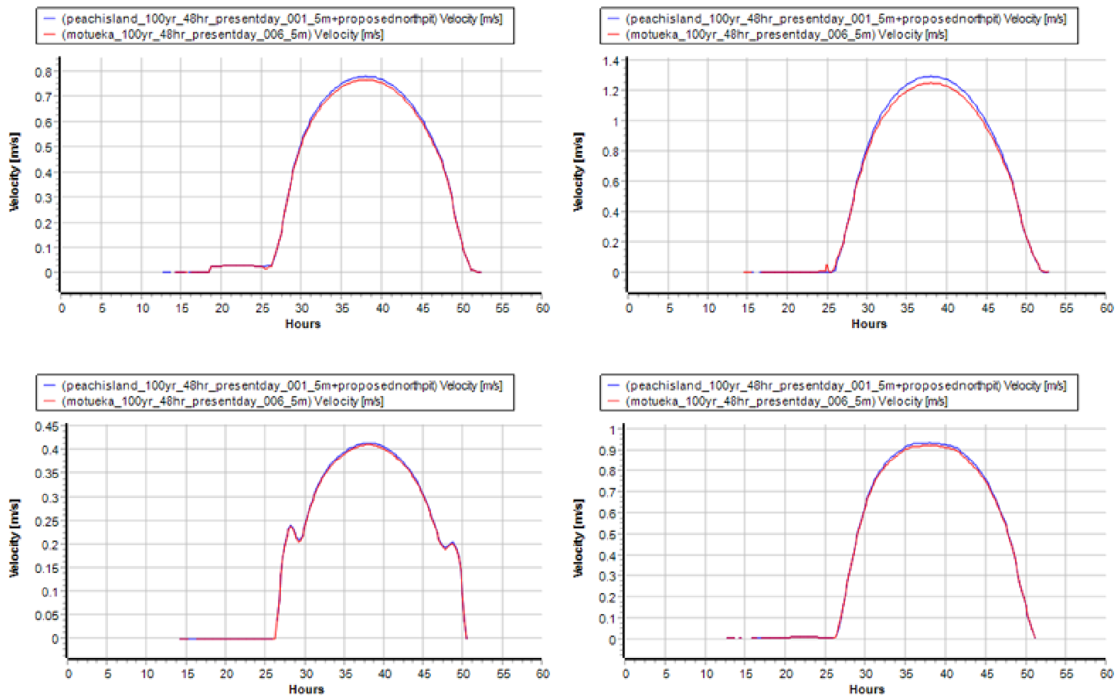


Figure 5: Time-series plot of velocity from four locations in the south of the site and in proximity to the modelled northern borrow pit.

(ii) These plots illustrate negligible change in both absolute velocity values and the temporal flow pattern between the existing (pre) and post development scenarios across the wider floodplain and hence negligible change in shear stress and erosion effects

(b) **Borrow Pit Velocity**

Issue: Dr Harvey noted that the T+T report reported flow velocities in the order of 0.7-0.8 m/s.[4] He considered this to be an issue.

This number relates to velocities only to the south of the southern borrow pit. It is the peak relative (not absolute) change in velocity at any one time across the entirety of flood duration and is related to acceleration of flood flows into the borrow pit at the 25 hr time step, as the borrow pit fills with water. This can be seen in Figure 6.

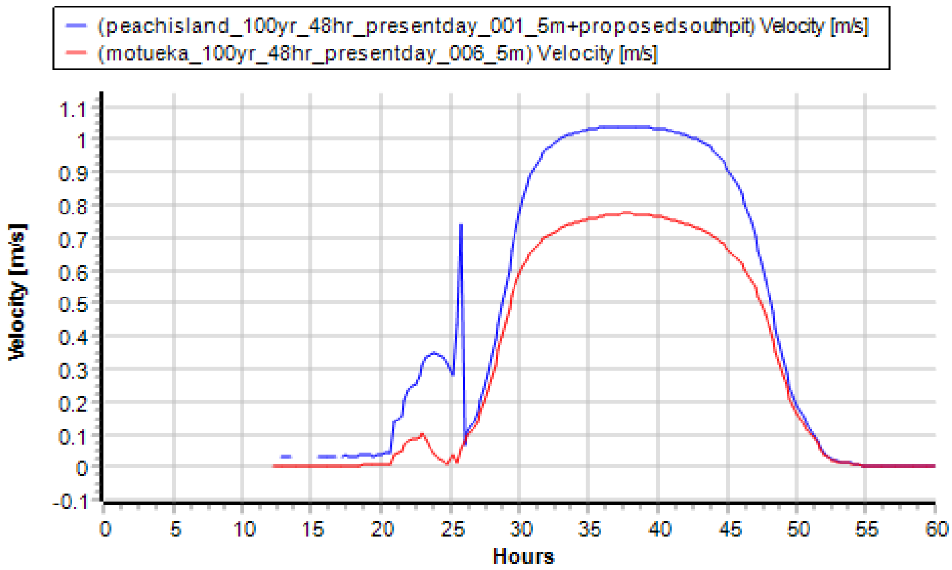


Figure 6: Time-series plot of velocity for model cell immediately adjacent to the modelled proposed borrow pits. The plots show the velocity on the vertical axis over time on the horizontal access over the 1% 48-hour design storm.

This increase is for a short period of time compared with the overall flood duration. While there is an increase of velocity 0.2 – 0.3 m/s for the remainder of the event. This is an average flow velocity over the full depth of the water, in reality the velocity at the base will be lower. The increase in velocity is temporary until the excavation is full and velocities return to normal.

[4] See T+T report section 3.1.2

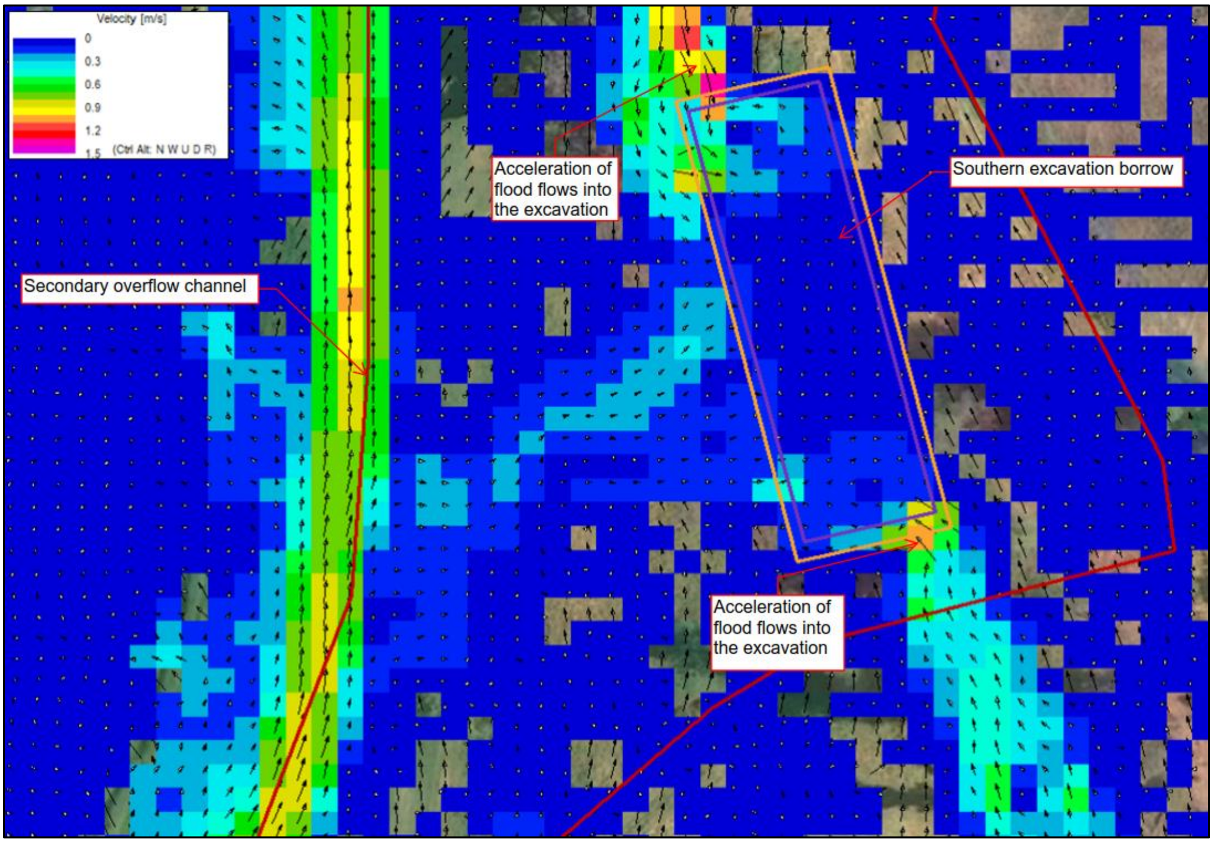


Figure 7: Example of flood flows accelerating into the excavation borrow at the~25hr timestep

As demonstrated in Figures 2 and 3 this increase in velocity is not representative of changes to velocity across the wider floodplain, which is negligible.

(c) **Issue:** "There was no analysis conducted of headcut potential for either of the pits modelled"

(i) A headcut is best described as erosional feature that lowers the channel bed level. No specific analysis on headcut potential was presented in the T+T report. Headcuts occur in the direction of the flow vector. Based on my assessment of inundation of the floodplain the most likely direction of any headcut is in a western direction towards the overflow channel or directly upstream. In both cases away from the Peach Island stopbank (see Figure 5).

(d) **Other Floodplain Features**

Issue: "Because noise berms and topsoil stockpiles were not included in the modelled scenarios, their erosion potential has not been assessed"

(i) CJs has indicated there will be no permanent or fixed earthen structures on the floodplain. Therefore, the effects of these have not been assessed.

(ii) Only the topsoil to be used for that day's restoration of Stage 1 will be stored outside the stopbanks. I support a condition that if heavy rain is forecast, any unused soil will be moved inside the stopbanks.

Matters raised in s 42A report

3.27 The issue raised in the s 42A report that I have not already addressed is the potential impacts of flooding from Stages 2 and 3 if the stopbank overtopped. This issue was raised in light of submissions that that a 1 % AEP event had a 15 % chance of occurring and that was not insignificant' over the term of the consent.

(a) I acknowledge that over the 15-year period for which consent is sought there is a 15 % probability that the 1 % AEP event may occur.

(b) The starting point is that in any weather event, the stopbanks at the site provide a degree of protection for the stage 2 and stage 3 excavations.

(c) The stopbank will overtop in events greater than exceed the design standard, regardless of the proposed activity.

(d) Modelling of the 1 % AEP flow event does not show overtopping of the stop bank around the site (Figure 8).

(e) Regardless, the proposed activity has been shown to not fundamentally change the performance of the floodplain, increase the risk of overtopping or failure of the stopbanks. Therefore, I consider the assessment of effects on the stopbank overtopping during an event that exceeds the design criteria is not necessary.

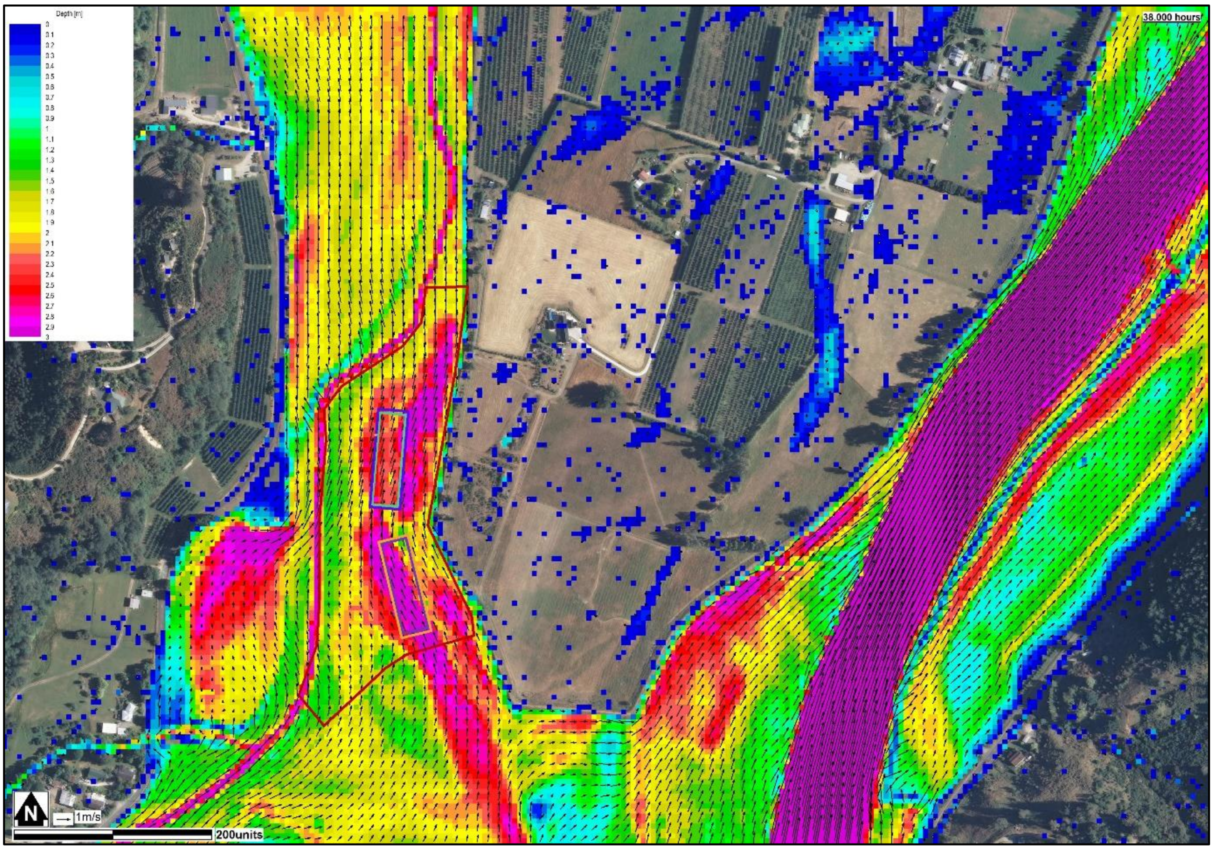


Figure 8: Peak flood levels during the 1% AEP (existing design storm).

Recommendations to avoid, remedy, or mitigate effects

3.28 As part of my evidence, I have assessed the planting plan (dated July 6th) and the hydraulic model 'roughness' values and am satisfied that it will not further increase the flood risk, provided planting occurs parallel to flood flows and that the final plant selection maximises smaller flaxes and sedges that can 'fold away' during large flood flows. This is consistent with the advice of the TDC's river engineer.

3.29 In particular I support the following draft conditions of consent:

(a) Stockpiles shall not be located on berm land. This does not include the topsoil (needed for that day's rehabilitation) from Stage 1 excavations.

(b) The excavation shall occur in strips aligned parallel to the general direction of flood flow across the berm land. No individual strip shall be wider than 30 m.

(c) The consent holder shall maintain the site in a clean and tidy manner. Redundant machinery and equipment not required for the operation of the quarry shall be removed from site. If heavy rain is forecast, heavy machinery shall be moved inside the stopbank.

Consistency with policy direction

3.30 For flooding and stopbank stability effects, relevant provisions are found in Chapter 5 Site amenity effects Chapter 12 Land disturbance, and then primarily in Chapter 12 Natural hazards of the TRMP. The key directions for the purposes of assessing the actual and potential effects of the proposal are:

(a) *Manage areas subject to natural hazards, including flooding, to avoid or mitigate development depending on the level of risk.*

(b) *Development should be resilient to natural hazard risk.*

(c) *Prevent damage to or interference with the functioning of major overland flood flow paths.*

(d) *Avoid damage to flood control structures.*

(e) *Use hazard management strategies as a tool for managing effects.*

3.31 In response:

(a) Based on the description of the proposed activity there is no indication that peak runoff rates or volumes will change significantly or alter the existing flood hazard.

(b) The activity has described has a minor development footprint. In the event of flooding vehicles and other machinery can be relocated, based on this I consider the activity resilient to natural hazard risk.

(c) There are no major overland flowpaths present on the site to be managed.

(d) Based on my assessment there is no indication that this activity will damage flood control structures.

(e) The conditions of consent include suitable site-specific responses (i.e., relocation of machinery should a flood warning be issued) to manage the effects of flooding.

4. CONCLUSION

4.1 The applicant engaged T+T to assess the impact of the proposed activity on the adjacent Peach Island stopbanks as well as any changes on upstream or downstream water levels or flood flow velocities for the 10 % and 1 % AEP design storm. T+T completed this assessment using a catchment wide hydraulic model which was prepared under contract for Tasman District Council.

4.2 The modelling results indicate that the greatest effect may be an almost indiscernible attenuation of flood flows if the excavation was inundated during the operation of the borrow pit. Based on our assessment of modelled changes in flood depth, level and velocity there is no evidence to suggest this activity will worsen the existing flood hazard, impact natural drainage patterns or negatively impact the flood plain storage or conveyance capacity for the flood flow scenarios assessed.

4.3 As a result of the s 42A Report and public submissions there has been no additional information provided to me that would change my conclusions in my original report and that I am satisfied the activity meets the policy direct set out in the TRMP.