

Resolution of Issues Raised by the Review of the Kawatiri Westport Flood Resilience Project Better Business Case

Summary

Te Uru Kahika, representing the Regional Councils and Unitary Authorities of New Zealand have been asked by West Coast Regional Council (WCRC) to assist the Buller Resilience Steering Group (the Steering Group) with the process for the release of Crown funding to improve Westport's flood resilience.

Correspondence from Ministers Robertson and McAnulty has only authorised release of Crown funding once they are satisfied the Westport proposal has been satisfactorily revised. Their expectations are that the revised proposal will:

- Rely less on universal long-term flood protection structures to mitigate flooding risks;
- Place greater emphasis on flexibility over the medium-to-long term;
- Create incentives to support a longer-term transition to relocate growth outside the flood zone; and
- Address the technical risks identified with the flood protection structures.

To that end Graeme Campbell (Wellington Regional Council), Peter Blackwood (Bay of Plenty Regional Council) and Mark Healey (WSP) were engaged by WCRC to assist with responding to the matters raised in the Ministers' correspondence. Terms of reference for our review group were developed by WCRC with the expectation that the review would be:

"To ensure that the technical issues and risks raised in the Tonkin + Taylor report are addressed and managed in the redesign of the structural flood protection components".

In addition, the WCRC expectation was that the peer review process would result in a report that will:

- Confirm that the concept design is sound; or
- To assist with the redesign process, particularly to help translate the technical issues/risks into the redesign whilst helping provide assurance to Ministers that the risks are clearly identified and managed.
- Recommend any changes to the concept design necessary to assure Ministers the concept is sound and able to be progressed to preliminary design; or
- Identify if further work is required and what work is to be undertaken to achieve this.

This report has been prepared to provide the outputs requested by WCRC and thereby achieve a quick release of funding for the next stages of the project. At this stage we have focused on addressing the technical risks identified with the flood protection structures. We have also gathered information and made comment on the other three matters raised by the Ministers.

The process followed to address the technical matters involved working with the designers and the reviewers of the protection infrastructure described in the Kawatiri / Westport Business Case, to ensure they had all the necessary information and to confirm when and how the issues raised could be addressed. This process enabled us to:

- Surface issues and opportunities.
- Achieve a greater understanding of the processes applied to reach the initial decisions.
- Develop an agreed approach going forward that will openly communicate and manage risk and its reduction in a staged manner aligned with future project phases.

Key conclusions of the work we have undertaken so far include:

- The Concept Design was sound for the development of a Business Case but will need further refinement in subsequent project phases before achieving final design status.
- Agreement has been reached that all 18 technical matters tabled in the Tonkin + Taylor review were either resolvable through the provision of additional information or can be addressed in subsequent project phases (mostly at Preliminary Design).
- None of the technical matters raised by Tonkin + Taylor should result in the withholding of funds and/or slow progression to the next phases.
- Government has allocated no funding for Carters Beach flood protection. These works have minimal effect on Buller Bridge flood levels. However, protection at Carters Beach is required mitigation for increased flood levels from protection measures proposed at Westport.
- During Preliminary Design some refinement of the flood mitigation strategies will be required including consideration of:
 - Differing climate change assumptions/allowances in some areas resulting in differing levels of protection.
 - More stringent and/or further integration of planning approaches to address the urban intensification that may arise from perceptions of improved flood risk mitigation.
 - Alternative protection approaches for some residential properties in Carters Beach.
 - Minimising the use of timber and/or concrete walls.
 - Potential use of temporary barriers on the lower reaches.
 - Refinement of the alignment of stopbanks and walls.
 - Staged implementation of all elements of the Business case including CDEM, Structural, Planning and cost management measures.
 - The significance of freeboard impacts on Buller Bridge, with options to mitigate it being explored with Waka Kotahi.
 - Co-ordination with the stormwater upgrades of Buller District Council, assisted through staged implementation of upstream protection works.
 - Geotechnical investigations and design.
- Consents and landowner agreements represent a risk to implementation of the project that may be managed through staged implementation, design, and the planning and consultation processes.
- A Risk Register needs to be developed to ensure all risks are managed as the project proceeds.
- Some refinement of other elements of the flood risk management strategies is required to ensure they are consistent with the PARA approach, and to ensure they cover all elements of the flood risk management approach.

The final bullet point (above) is the area where further work is required. This should be progressed by the Steering Group. The focus of this further work should be on addressing the first three issues raised in the Ministers' letter.

All elements of the Westport flood risk management strategy are interlinked and therefore need wider engagement to agree that an adjustment in one area is compensated for by other measures to ensure there is no gap in the whole flood risk management strategy.

In summary, we are confident that the Concept Design for the structural solutions described in the Business Case is sound and that the identified issues can be addressed through the refinement of the design in the Preliminary Design, consent and tender phase. To achieve this we are proposing, amongst other things, the development of a Risk Register that can be used to ensure all matters are addressed and that a staged approach to implementation should now proceed at pace.

1 Introduction

1.1 Purpose

The purpose of this report is to provide “assurance” to the responsible Ministers that the concept design, or components of that concept design, are sufficiently robust to enable work to be commissioned toward preliminary design, or in those limited circumstances where this assurance cannot be given, to define what that further work may look like.

We note the requested “assurance” needs, in the first instance, to be provided in the form of a revised proposal from the Steering Group to Government. This requirement is recorded in a letter from the Minister of Finance and Minister of Local Government dated 12 May 2023. The outputs from a review by a Technical Advisory Group are intended to provide information to the Steering Group to enable that revised proposal to be developed.

1.2 Terms of Reference

The terms of reference for the Technical Advisory Group (TAG) were prepared by Darryl Lew, CEO, West Coast Regional Council on behalf of the Steering Group (Refer Appendix 1).

The requested output of the review was a report to:

- Confirm that the concept design is sound; or
- To assist with the redesign process, particularly to help translate the technical issues/risks into the redesign whilst helping provide assurance to Ministers that the risks are clearly identified and managed; or
- Recommend any changes to the concept design necessary to assure Ministers the concept is sound and able to be progressed to preliminary design; or
- Identify if further work is required and what work is to be undertaken to achieve this.

1.3 About the Technical Advisory Group (TAG)

The TAG comprises two impartial and independent engineers who are members of the River Managers Group and who have significant combined expertise and experience in river engineering and floodplain management. The TAG members were Graeme Campbell and Peter Blackwood.

Graeme Campbell led the TAG. Graeme is a chartered professional Engineer specialising in Natural Hazards and River Management specifically. Graeme has 45 years of experience in the field of flood risk management. This experience has included working throughout New Zealand the Pacific and Asia. The last 15 years have been as the Manager of Greater Wellington Regional Council’s Flood Protection Department. In addition to this Graeme has been the convener of the New Zealand Regional Councils River Managers Special Interest group. This group draws together the River Managers from all Regional and Unitary Councils of New Zealand to support and share expertise in flood risk management.

Peter Blackwood is the Principal Technical Engineer for the Bay of Plenty Regional Council. Previously Peter was manager of river engineering teams at Manawatu-Whanganui Regional Council and Bay of Plenty (BOP) Regional Council for 21 years and Project Engineer for Greater Wellington Regional Council for 8 years. Peter has an honours degree in Civil Engineering and has 48 years of experience, principally in the field of flood risk management. Peter has completed investigations for the following rivers - Hutt Valley, Otaki, Manawatu, Oroua, Rangitikei, Akitio and the four major river schemes and others in



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the BOP. Peter designed the complex Lake Rotorua level control structure and has specialist coastal hazards design expertise.

Technical support to the TAG has been provided by Mark Healey. Mark has a Master of Engineering degree in River Engineering and is a Chartered Professional Engineer with 26 years of experience. He has worked at WSP in Greymouth for 23 years and holds the position of “Principal Engineer – Rivers”.

2 Background

2.1 Government Funding for Flood Protection

The principles for Central Government intervention in flood risk management are:

- Invest in effective risk reduction.
- Make risk management decisions at the level closest to the affected community.
- Provide effective outcomes for Māori.
- Intervene where there is national interest or benefit.
- Require beneficiaries of risk mitigation to pay.
- Ensure fairness and equity for communities, including across generations.

The Business Case for co-investment in Westport's resilience reflects the above principles. It has also used the government's PARA framework to help deliver sustainable outcomes:

- **Protect** – Reduce the extent and/or frequency of the hazard.
- **Avoid** – Ensure new development and property and vulnerable assets are not exposed to the hazard.
- **Retreat/Relocate** – Relocate existing people, property and assets from locations exposed to the hazard.
- **Accommodate** – Reduce the consequences of the hazard.

2.2 Westport Funding Application and DIA Review

The Kawatiri Westport Business Case, containing a co-investment proposal to Government to improve Westport's flood resilience, was submitted on 30 June 2022. The Department of Internal Affairs (DIA) completed an evaluation of the proposal to inform the Government's response. As part of the evaluation, the DIA commissioned Tonkin + Taylor (T+T) environmental and engineering consultants to undertake a technical review of the structural flood protection elements of the proposal.

The T+T Review raised questions regarding several technical proposals presented in the Business Case. These included:

- Heightened risk if walls are breached.
- Risk of increased flood levels at the Buller Bridge.
- Seismic risk and seepage concerns.

A total of \$15.6m has been allocated by Government for structural protection, in addition to the \$10.2m committed by the West Coast Regional Council. However, until Government can be assured of the soundness of the concept design for proposed structural protection at Westport, no funds will be released, apart from an initial \$300,000 which has been allocated to assist with the redesign work.

3 Issue Resolution Approach

3.1 Specific Tasks Undertaken

Work by the TAG commenced with a review of background documentation relating to the investigations and design of the proposed flood protection scheme. The documents reviewed included, but were not limited to:

- June 2022. “Westport Flood Mitigation, Engineering Report”. G&E Williams Consultants Ltd.
- 23 June 2022. “Buller River Flood Mitigation Options Assessment”. Land River Sea Consulting Ltd.
- 30 June 2022. “Co-Investment in Westport’s Resilience”. (The Business Case). Buller District Council, The West Coast Regional Council, Te Rūnanga o Ngāti Waewae.
- 29 June 2023. “DIA evaluation of the Westport flood resilience proposal incorporating a Tonkin+Taylor technical review”. Department of Internal Affairs.
- 4 July 2023. “Westport Flood Mitigation – T+T Review responses”. G & E Williams Consultants Ltd.
- 29 July 2023. “Response to DIA / T+T Technical Review of Buller Business Case”. Land River Sea Consulting Ltd.
- 2023. Email correspondence from Ministers Robertson and McAnulty.
- 29 August 2023. Additional breach modelling maps. Land River Sea Consulting.

This led into the site inspections and combined discussions as described below.

24 August: on-site inspection of key elements of the proposed scheme:

- TAG: Graeme Campbell, Mark Healey, (Peter Blackwood on 29 June)
- WCRC: Sam Scott, Paulette Birchfield, Brian Murphy

25 August: on-site discussion with T+T and DIA at Buller District Council Chambers:

- TAG: Graeme Campbell, Mark Healey
- T+T: David Bouma, Damian Velluppillai
- DIA: Paul Barker, Connor McElrich
- Resilient Westport Steering Group Chair: Mike Mendonca (who co-wrote the Business Case)

NB This discussion was followed by further discussion during a joint inspection of four sites (floating basin, Murphy property, Avery’s Culvert, Orowaiti Bridge).

29 August: meeting convened at Greater Wellington Regional Council offices to enable more detailed discussion about technical issues and the recommended path forward:

- WCRC: (via video link) Darryl Lew, Sam Scott
- TAG: Graeme Campbell, Peter Blackwood, Mark Healey
- DIA: Paul Barker,
- T+T: David Bouma, Damian Velluppillai
- Designers: Gary Williams, Matthew Gardner
- Business Case co-writer: John Hutchings

Work continued over the following weeks to compile this report and recommendations.

3.2 Process Constraints

There has been acknowledgement by all parties of the constraints that each were necessarily operating under during their involvement in the development and review of the Business Case.

For the DIA reviewers of the Business Case this included a limited timeframe and background information, and an inability to discuss the design elements directly with designers due to confidentiality requirements around government budget processes.

In this context, the TAG consider that the reviewers made reasonable observations. Notwithstanding that, the constrained communication of information prior to and during the review process resulted in an incomplete understanding by T+T of some important technical detail and the context of the project. Insights from this process should be considered for future business case development requirements by Government.

3.3 Acknowledgements

The TAG would like to thank all participants in the review for their time and effort and their thoughtful and positive contributions.

Participants were highly engaged and actively participated, in an open and collaborative way, on how to best manage risk and achieve improved and sustainable flood risk resilience in Westport.

Technical discussion was robust. Searching questions were asked, considered responses were provided and good debate took place. This discussion led to an improved understanding of the risks and opportunities associated with the project.

4 Response to Technical Specific Issues

4.1 Technical Matters Resolved

Based on the in-depth discussions and the surfacing of information that was not initially available to the DIA technical reviewers (T+T) it has been determined that the Concept Design and associated cost estimation in the Business Case is sound but requires some refinement through the next phases of the project.

Agreement has been reached that all 18 technical matters raised in the review can be appropriately addressed with the provision of more information or by refining the Business Case and in the following phases of the project.

We have included in Appendix 2 a tabulated record of the 18 technical matters raised by T+T, key elements of discussion around them, and a summary of agreement on how they should be resolved. This record was compiled from the combined detailed technical discussion at the 29 August 2023 meeting in Wellington.

4.2 Issue Resolution and PARA Framework Balance

The need for an appropriate balance of PARA framework elements, staged as necessary, to ensure the long-term resilience of Westport was clearly desired and articulated by all parties involved in the joint discussions.

Similarly, the need to clearly understand, communicate and manage residual risk, was clearly understood and articulated by all parties.

We believe opportunities exist to achieve “PARA balance” and “residual risk” management goals. We consider the exploration and planned implementation of these matters is also rightly a component of Preliminary Design – the next phase of project development. They are also matters that require the attention of the Steering Group.

The need to consider the balance of PARA elements in subsequent phases is because each of the elements are dependent on each other. Hence if some structural options are adjusted so as not to provide a uniform level of protection, then the other PARA elements will need to be adjusted to compensate for this.

For example, a level of protection at the lower end of the town that does not allow for some elements of climate change will mean new development in this area will need to be strictly controlled. Equally, additional measures related to emergency management will need to be provided if there is a likelihood that flooding will be initiated from the downstream part of Westport. How these changes are properly balanced to provide flood risk mitigation for all levels of flooding will therefore only be able to be considered as a package developed as part of the next phase of the design.

4.3 Residual Risk and Complexity

A number of the issues raised are in relation to residual risk, its definition, management and understanding. What is clear is that Westport will have a higher level of security with the implementation of the BBC concept plan and there should be no doubt in the community's mind about this. What must also be understood is that there is always a risk of overtopping or failure of the structural flood protection measures and these need to be managed with other PARA framework measures. This risk of overtopping or failure will increase over time as climate change takes more effect and is why one of the primary

planning measures that will be needed is to ensure new development and intensification does not take place in areas that are affected but such failures. The structural measures proposed are intended to protect the existing development not new development. Over time existing residential development will also have to be relocated as the risk increases from more intense rainfall, sea level rise and potential river and coastal geomorphological changes, such as bed and berm aggradation, occur. A 30-year timeframe should be considered for this relocation.

Management of risk for this project is complex, as it comes from multiple sources and changes over time both naturally and in response to staged implementation of management measures. There are two key elements to be taken into account through this process. Firstly, the consideration of multiple hazards with different frequency of occurrence and consequence. Secondly, the appropriate relocation of new residential development over the next 30 years or so. This will therefore change the consequence of failure after that time and different risk tolerance levels will be able to be considered. This will change how consideration of matters such as sea level rise, increased rainfall, channel sedimentation and earthquake hazards are considered in the design refinement in subsequent phases.

4.4 Uniform Level of Protection

The TAG's view is that a universal level of protection to all areas would not be the best risk management approach. For example, some areas of the Floating Basin and the Orowaiti Lagoon would be better built without the additional RCP6.0 climate change allowance. This would provide the same 1% AEP level of protection as the rest of the scheme in the short-term but flag the limited lifetime of possible safe occupation of the area. This will encourage development in other more sustainably flood resilient areas and be one element in a toolset of measures to facilitate staged retreat. The resulting lower structural height of the wall will assist in reducing residual flooding risk behind the wall. It will also assist with cost-effective construction and consent-ability of this part of the scheme.

Another area for consideration will be Carters Beach. A refinement of design is required to not protect the whole area, including the airport, to the same level as Westport town because of the negative effects on flood levels at the Buller Bridge. However, this does not negate the opportunity to provide some protection to the beach settlement itself.

4.5 Project Risk Management

There are uncertainties associated with the proposal described in the Business Case, but these are not uncommon for this stage of project conception, and all are solvable.

Discussions between TAG members confirmed the need to adopt a project Risk Register. TAG members viewed this as an important tool for formally identifying and managing risks throughout the project. The development of a risk register also enables risks to be openly communicated and managed and for them to be reduced by applying a staged approach aligned with the project phases.

This process may be focused on managing technical risks. It could also be expanded to address wider issues as required.

A sample risk register format is provided in Appendix 3.

A preliminary list of risks that may be considered for formal management include:

- General

- Cost, Programme, Quality.
- Funding.
- Technical
 - Construction costs and estimates.
 - Level of design detail.
 - Stopbanks vs walls cost, performance, resilience, constructability, location.
 - Temporary barriers
 - Geotechnical assessment: ground conditions, seepage, stability, completion reports.
 - Seismic stability / liquefaction hazard / multi-hazard resilience.
 - Climate change: flood magnitude and frequency and rising sea and ground water levels.
 - WCRC/BDC co-ordination (and funding) of stormwater upgrades.
 - Pumping requirements.
 - Carters Beach flood resilience.
 - Tsunami and storm surge wave run-up risk.
 - Feasibility / desirability of Lagoon wall lift.
 - Adoption of mixed design standards and how PARA framework is balanced to cover this.
 - Residual risk understanding and communication to stakeholders.
 - Floodplain intensification increasing residual risk.
 - Implementation sequencing to avoid increased residual risk.
 - Co-ordination with Waka Kotahi over Buller and Orowaiti bridges waterway maintenance, hydraulic assessments, replacement programme and options assessment.
- Environmental
 - Flood impacts, ecological impacts, landscape (views in particular), social.
- Safety
 - Health and Safety.
 - Safety in Design.
- Planning & Consents
 - Landowner agreements.
 - Designations / consents.
 - Consent-ability of stopbanks and flood walls.
 - Effectiveness of planning and building controls at preventing infill and putting more focus on avoid / accommodate (building consent / raised floor levels). TPP (Te Tai o Poutini Plan) etc.
 - Consideration of alternatives (long to short list of options).
- Emergency Management
 - Ongoing flood preparedness and community awareness and engagement.
 - Specific response planning for over-design and breach scenarios.
 - Recovery funding (maintenance, disaster fund, insurance).
 - Advance warning systems.

- Operational
 - Ongoing monitoring and analysis (bed levels, river mouth position, etc.), and inspection and maintenance, funding and execution.

4.6 Implementation Sequencing

The sequencing of the implementation of all elements of the proposal will be critical to the effective achievement of the goal of a more resilient Westport community. Overflows from the Buller River present the highest risk to the community and should be addressed first through the construction of stopbanks at the upstream end of the town. However, implementing all the remaining structural elements has been raised as then risking the undertaking of the other BBC initiatives. The Risk Register should be able to be used to guide the sequencing of implementation to avoid this potential risk. This will ensure that the appropriate measures are prioritised first.

4.7 Carters Beach Flood Protection

The review by the team has clarified some matters around the reasons for the Carters Beach works within the Business Case and their impacts on flood levels.

Protection of the beach settlement at Carters Beach does not have any significant adverse impact on flooding in Westport. The works are proposed as mitigation of the effects of protecting Westport which push water from the Westport town side across to Carters Beach. It was the addition of further stopbanking to include the Airport that has a backwater effect up to the Buller Bridge, resulting in an increase in peak flood levels of approximately 100mm.

The Crown has not made any provision for flood protection of Carters Beach. This represents a consenting risk for the proposed flood protection for Westport. This issue needs to be addressed through a refinement of the design of potential protection works for the beach community at Carters and then in more detail in preliminary design.

NB Funding for the whole project may come from sources other than the Crown. Funds from these other sources may be able to be used for this element of the project.

4.8 Use of Timber Walls

Timber walls have been proposed in a number of locations around the Orowaiti Lagoon where space is limited. Such walls have been used successfully in similar situations around New Zealand. Timber walls are however not as resilient as an earth embankment, more expensive to construct and maintain and their use should therefore be reduced to a minimum.

Use of timber walls will require managed conversations with the respective landowners. For example, some areas on the Orowaiti Lagoon are shown to have extensive lengths of timber wall whereas there are only short locations where the development has encroached right up to the Lagoon. Getting the right balance between accommodating this constraint and ensuring resilience is maximised will be critical.

4.9 Temporary Barriers

The use of temporary barriers on the lower reaches of the Orowaiti and Buller rivers should be given consideration during the Preliminary Design phase.

Temporary flood barriers are only put in place when large events are expected. The use of temporary barriers should be limited in scale due to the additional personnel burden they introduce, and the risk of not being able to effectively install them in time, during a flood event. Consequently, such barriers should only be considered in areas that permanent structures are difficult or undesirable to construct. A further key determinant is assessing the advance warning for locations where temporary barriers may be desired.

Temporary flood barriers can be utilised as a both a cost-effective method and at the same time mitigate landowner concerns about serviceability during normal times. They are not commonly used in NZ because of speed of onset of flooding but may have applicability in areas more affected by sea surge such as exists by the floating basin and some parts of the Orowaiti Lagoon.

Temporary barriers could be used to provide additional protection on top of existing or new structural protection measures. They could also be used to minimise adverse effects of permanent structures. In either case they could be used to temporarily reduce risk in an area whilst retreat or relocate measures are implemented.

An example of where such measures may be considered is the retaining wall at the Floating Basin. Implementation of a temporary barrier in this location may offset any difficulty in constructing a full height permanent structure and may be appropriate given the primarily coastal derived nature of the flood risk in this location.

4.10 Over Design and Breach Events

The preliminary design must include the development of over design and breach scenarios for the inclusion in an emergency management response. Part of this work will be to identify which sections of bank are likely to overtop first and have the greatest consequences if a failure occurs.

5 Broader Matter Raised in Ministers Correspondence

5.1 Business Case Concept Design

In a New Zealand Civil Engineering context in general, and in a Flood Protection scheme design context in particular, the refinement of designs and cost estimates tends to adhere to a phased approach as follows:

- 1 Project Establishment
- 2 Concept Design
- 3 Preliminary Design
- 4 Developed Design (in some cases)
- 5 Detailed Design
- 6 Procurement (Tendering)
- 7 Implementation (Construction)
- 8 Post Completion (As-built/review)

We view the Business Case as being a well-considered part of step 2 “Concept Design”.

5.2 Next Phases of Design

Over the last decade and longer, a considerable amount of work has been put into design options for Westport flood mitigation. This provided the base for the Concept Design described in the Business Case.

The next step in the preferred approach is Preliminary Design. This is a pivotal phase and is a vital means of fully achieving the benefits from the Westport Flood Protection project. The workstreams to be put in place as part of this “Preliminary Design” phase are:

- Areas to be protected by the project.
- Final design alignments.
- Final design standard of each compartment.
- Stopbank and floodwall geotechnical investigations and design.
- Tangata whenua advice.
- Environmental assessment and mitigation.
- Landowner agreements.
- Cost estimates.
- Resource consents/designations.
- Identification and communication of residual risk.
- Consideration of how PARA fits and works alongside the protection elements.

5.2.1 *Areas Addressed Under the Project*

The Government funding covers the flood protection to Westport as well as other PARA ancillary actions. These ancillary actions include the need to establish a robust flood forecasting system, coastal wave recording buoy and the development of the criteria to guide expenditure of a limited amount of funding for individual/group mitigation or retreat/relocate. (NB we note that the Government funding does not include assisting with the cost of direct flood protection to the Snodgrass area or Carters Beach).

In this regard Section 5.1 of the Buller Flood Mitigation Options Assessment advises “model results show that by not providing protection to Snodgrass, flooding will be no worse than it

currently is. However, for a 1% AEP, future climate (RCP6.0) scenario, flood levels are actually reduced". This is due to the project works reducing overflows from the Buller to the Orowaiti.

The benefits of providing strategic flood protection to Carters Beach should be considered further. This will require identification of houses currently at risk and the additional number and depth of those impacted by the Westport Town protection works. There may be individual/group options here, or even incorporation of the option identified in the options assessment – maybe with or without the airport flood mitigation. Storm surge wave runup (SWRU) threats and mitigation should also be considered.

Detailed modelling to assess the potential impacts of the Town stopbank is required. This will enable final decisions to be taken – as part of the Preliminary Design phase, about the potential impacts from possible flood mitigation works at Carters Beach.

5.2.2 Final Design Alignments

The key points here are to:

- 1 Put the stopbanks and floodwalls in a secure and sound place; and
- 2 Optimise the flow of water down the Orowaiti River; and
- 3 Consider how to minimise the impacts on flood levels and freeboard at the Buller Bridge.

The first point is addressed by keeping stopbanks at least 50 metres, but ideally 80m, from the Buller River banks. This will reduce erosion pressures and increase seepage path lengths. The addition of berm plantings would also help to reduce berm velocities and increase the resilience of the stopbanks. The first point will also be addressed by adopting the “preferred inland alignment” described in a report prepared by Gary Williams after the Business Case was submitted to Government.

In the Orowaiti Estuary area it is not practicable to achieve a good setback of the protection structures from the Estuary at every location (given the location of existing infrastructure and houses that would need to be moved to facilitate a reasonable setback). However, erosive pressures will be less, but wave-lap erosion may need mitigation. In some areas, such as the Avery initial project, the stopbank will be set back from the estuary edge – through the reserve area. This provides a (narrow) berm on the estuary side, and planting here would have both recreational and wave runup benefits. This is the most exposed length for wave runup.

Another important factor is, as far as practical, to harmonise the stopbank alignments to minimise direct erosive forces.

The above points can easily be addressed as part of the “Preliminary Design” phase of the project.

The second point may be addressed by a combination of the proposed planting of Organs Island (to reduce overflows) and the making of final decisions about the preferred alignment of the upstream / inland end of the ring bank.

In making these final decisions we recommend the design and alignment be conceived to strive for the optimal balance of flood flows in Buller and Orowaiti rivers. The approach may be to reasonably minimise flows travelling through to the Orowaiti River, whilst maintaining a good strategic balance between flows there and in the Buller River. Noting that flood levels in the Orowaiti River are more sensitive to flow changes, but blocking of these entirely will impact flood levels at the Buller Bridge and Carters Beach. Figure 4-3 of

the Design Report prepared by Gary Williams entitled “Alternative alignment (Townbank)” may be a good starting point.

The third point requires detailed modelling to assess impacts from the Town Stopbank and whether there are also impacts from possible flood mitigation works at Carters Beach. The latter impact appears to be small, but nevertheless also requires assessment and confirmation of any options pursued there. The impacts on flood levels from the Town Stopbank must be assessed, conclusions made on their significance and investigations undertaken to identify mitigatory mechanisms.

A first step in further investigations into effects on the Buller Bridge should be to validate modelling assumptions and undertake sensitivity testing. Liaison and alignment with the Waka Kotahi bridging team may be useful in this process. Notwithstanding that, we note that there are several options available that may improve waterway capacity at the bridge crossing that do not require structural modification to the bridge itself.

We are very clear in our minds that the prime purpose of the stopbanks is to mitigate risks to existing housing and the CBD. Construction of the stopbanks should not be used as an enabler to allow new undesirable subdivision of areas within the stopbanks. This is a very important point that needs clear communication to the developer forum.

The TPPP will need to provide measures to achieve this objective and will require careful stewardship through the process to ensure they remain and are effective. Hence the recommendation that the provisions of the proposed NPS on Natural Hazards and or the special regulatory powers of the Minister for the Environment could be used to achieve this. We would also recommend that the development of the staged implementation is done in a way that reflects the importance of this component of the business case, ahead of some of the other options, including structural measures

5.2.3 *Final Design Standard*

The overall design standard proposed within the Business Case is protection from the 1% AEP (1 in 100 year) flood under a RCP6.0 (2080-2100) scenario with 600mm freeboard. This freeboard component is entirely appropriate for the flood level design estimate imprecision, construction tolerances, and natural phenomenon (such as waves, debris, aggradations, channel transition, and bend effects) not explicitly included in the calculations (Section 1.2.2 NZS4404:2010).

For a river of the nature of the Buller, the imprecision component has been found to be around 300mm for a 1% AEP.

Other factors are principally waves in this case, as no aggradation has been found in the lower Buller River from recorded surveys. This freeboard can be reviewed if detailed design information supports a different number, but it is likely it is appropriate.

There has been some debate on whether freeboard and/or climate change should be included in the Orowaiti Estuary flood protection. There are concerns about sending false signals about sustainability of flood protection in this location and the impact of flood structures on landowner visibility of the lagoon area.

Both are valid viewpoints, and the Resilient Westport Steering Group will need to resolve what to include. The TAG recommended revisiting these design standards as part of the preliminary design.

5.2.4 *Geotechnical Design of Stopbanks and Floodwalls*

A geotechnical assessment of the stability of flood mitigation works is an essential component of the design for any proposed flood mitigation works. The design standard to be considered requires careful determination. Regardless of the final stopbank height agreed however design case studies should include geotechnical performance in the 1% AEP under RCP6.0 and extreme event scenarios, for all stopbanks and floodwalls built.

The geotechnical design cases to be considered must be in accord with the highest standards of geotechnical design practice in New Zealand. This must be carried out by a qualified CPEng geotechnical engineer. Design cases that may be considered as part of the project are:

- Stability of embankment or wall and foundation for various load cases, including:
 - Sliding or overturning failures.
 - Slope stability and slumping failures of stopbanks.
 - Piping failures from seepage in or under flood mitigation structures.
 - Rapid drawdown – though this seems unlikely in the slow recession of the Buller, but will especially need consideration in the Orowaiti works.
 - Impacts of scouring from overflows.
- Stability of structure and foundations under seismic load cases - including consideration of potential for instability, settlement, lateral spread effects.

In regard to the impact of scouring from overflows, we recommend serious consideration be given to determining initial overflow points for any over design floods as part of the Preliminary Design phase. Geotechnical advice will necessarily be a key part of this consideration.

The geotechnical examination must be based on an appropriate level of borehole investigations and shallow, open pits, and the testing of sub-surface materials. This must be representative of the subsurface materials along all parts of the design alignments.

It is noted that the geotechnical design of stopbanks is not completed until the footprint of the stopbank is opened up and sub-surface material, such as in a key, have been determined along the full length. Changes to the design during construction should be expected.

One option for consideration in the Preliminary Design phase is the use of flattened stopbank batters and reinforced ground cover.

Consideration should be given to having Geotechnical Completion reports prepared on the structural elements of the project. The intent of these reports would be to ensure that geotechnical test results and design and construction advice have been appropriately carried through to those phases of the project. This documentation will also form a useful resource for any future structural works.

5.2.5 *Tangata Whenua Advice*

The advice of Ngāti Waewae is again key to achieving a sound flood risk mitigation approach for Westport. Their advice goes beyond advice on wāhi tapu and other sites. Their corporate history and flood observations is a key input into resolving the final design. We note their advice was sought and considered as part of the Business Case. They should be invited to also participate in decisions to be taken when the Preliminary Design phase is completed.

5.2.6 *Environmental Assessment and Mitigation*

All the standard environmental impacts must be assessed by qualified professionals. This includes, but is not limited to, flood impacts, ecological impacts, landscape (views in particular), social impacts. These are all standard matters. However, a key matter to address is the impact on flooding elsewhere – particularly at Carters Beach.

5.2.7 *Remaining Important Matters*

The remaining matters raised in the T+T review are also able to be addressed as part of the Preliminary Design phase. We do not elaborate further on them. They include:

- Landowner agreements.
- Cost estimates.
- Resource consents/designations.
- Identification and communication of residual risk.
- Matters raised about the integration of structural flood risk mitigation measures with other elements of the PARA framework are matters to be addressed by the Steering Group as they are beyond the technical review brief of the TAG.

5.3 Stormwater Upgrade Facilitation

Buller District Council stormwater upgrades need to be funded and construction needs to be well-coordinated with that of the proposed flood protection scheme to ensure optimum delivery and functioning of the flood protection system. These stormwater upgrades need to be designed to an appropriate capacity with climate change provisions for both increasing rainfall intensity and rising ground water levels in mind.

5.4 Planning Controls and Retreat/Relocate Incentives

The Government's Natural and Built Environment Act 2023 provides a key new set of tools to assist with the mitigation of flood risk. In the interim, the draft National Policy Statement on natural hazard decision-making is particularly relevant, with public engagement planned from 18 September to 13 November 2023. It is important that planning controls and retreat/relocate incentives are soundly secured as part of the holistic flood mitigation strategy.

5.5 Release of Funds

Release of the balance of the allocated funding will enable the structural elements of the project to progress into the Preliminary Design phase. During this time more detailed investigations and assessments should be undertaken to provide greater clarity about the right balance of flood risk management methods under the PARA framework.

6 Conclusions

Key conclusions of the work we have undertaken so far include:

- The Concept Design was sound for the development of a Business Case but will need further refinement in subsequent project phases before achieving final design status.
- Agreement has been reached that all 18 technical matters tabled in the Tonkin + Taylor review were either resolvable through the provision of additional information or can be addressed in subsequent project phases (mostly at Preliminary Design).
- None of the technical matters raised by Tonkin + Taylor should result in the withholding of funds and/or slow progression to the next phases.
- Government has allocated no funding for Carters Beach flood protection. These works have minimal effect on Buller Bridge flood levels. However, protection at Carters Beach is required mitigation for increased flood levels from protection measures proposed at Westport.
- During Preliminary Design some refinement of the flood mitigation strategies will be required including consideration of:
 - Differing climate change assumptions/allowances in some areas resulting in differing levels of protection.
 - More stringent and/or further integration of planning approaches to address the urban intensification that may arise from perceptions of improved flood risk mitigation.
 - Alternative protection approaches for some residential properties in Carters Beach.
 - Minimising the use of timber and/or concrete walls.
 - Potential use of temporary barriers on the lower reaches.
 - Refinement of the alignment of stopbanks and walls
 - Staged implementation of all elements of the Business case including CDEM, Structural, Planning and cost management measures
 - The significance of freeboard impacts on Buller Bridge, with options to mitigate it being explored with Waka Kotahi
 - Co-ordination with the stormwater upgrades of Buller District Council, assisted through staged implementation of upstream protection works
 - Geotechnical investigations and design.
- Consents and landowner agreements represent a risk to implementation of the project that may be managed through staged implementation, design, and the planning and consultation processes.
- A Risk Register needs to be developed to ensure all risks are managed as the project proceeds.
- Some refinement of other elements of the flood risk management strategies is required to ensure they are consistent with the PARA approach, and to ensure they cover all elements of the flood risk management approach.

The final bullet point (above) is the area where further work is required. This should be progressed by the Steering Group. The focus of this further work should be on addressing the first three issues raised in the Ministers' letter.

All elements of the Westport flood risk management strategy are interlinked and therefore need wider engagement to agree that an adjustment in one area is compensated for by other measures to ensure there is no gap in the whole flood risk management strategy.

7 Recommendations

As a result of the work undertaken by the TAG to date we recommend that the Kawatiri Westport flood Resilience Project Business Case proceed to the next stage of preliminary design and that WCRC put into place a process to consider the refinements to the Better Business Case detailed in section 6 Conclusions of this report.



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Appendices

Appendix 1: Terms of Reference

Appendix 2: Business Case Technical Review Issue Resolution

Appendix 3: Sample Project Risk Register

Appendix 4: Correspondence from Ministers Robertson and McAnulty



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Appendix 1: Terms of Reference



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Appendix 2: Business Case Technical Review Issue Resolution

The following table forms a record of the resolution of the 18 technical issues, as agreed at the 29 August 2023 combined meeting in Wellington.

Item	Description	Discussion	Resolution
1	The BBC is clear that it is not possible to eliminate flood risk and that the proposed Protect measures present residual risk. However, there is currently insufficient information in the BBC and supporting documents to enable the community and other stakeholders to understand the nature and scale of consequences and impacts associated with that residual risk . This information is necessary to understand the measures that may be required to manage and mitigate those risks, and in turn, to set appropriate expectations about the time the protections measures could or should “buy”.	Important to communicate residual risk. This has been done in many reports and presentations to the community to date. Risk graphing by G Williams also noted. NIWA risk-scape in BBC report showed extent of damage under various scenarios. Additional breach modelling runs provided before and described at this meeting. Important to determine which bank sections have the greater consequences of failure.	Additional breach modelling and analysis and communication to be provided to stakeholders (decision makers and community) at the conclusion of the Preliminary Design phase.
2	Conceptually, the main component of the Protect proposal, a ring bund around urban Westport, functions as “bathtub”. For smaller (more frequent) flood events it should provide protection by keeping the water out if properly designed and constructed. However, failure of the wall during a large flood event would result in the town being rapidly inundated with water. This exacerbates the residual risk to life and property for the larger events above the “do nothing” scenario. There is not a precedent for this type of design in NZ .	Extensive NZ precedent for ring banking described. Breach modelling undertaken has helped to articulate the actual scale of the risk being less than what might be expected. The importance of emergency response planning and preparation. That ERP will consider various breach scenarios and be designed to mitigate this risk. The need to consider consequences of failure of different sections of stopbank/wall and use more conservative design approaches where consequences are greater - an important component of mitigating this risk.	During Preliminary Design phase: Undertaking and communicating to stakeholders breach modelling and residual risks as above. ERP to consider various breach scenarios and be designed to mitigate this risk. More conservative design approaches to be considered where consequences are greater. Explore risk balancing options under PARA framework. Address and seek commitment to BDC stormwater upgrades and intensification management methods.

		<p>The residual risk of further development / intensification needs to be managed. Reference to importance of government's Natural and Built Environment Act 2023 being a key element. Similarly, stormwater upgrades need to be funded and undertaken at same time to ensure proper functioning of the flood protection system.</p>	
3	<p>No breach modelling analysis has been completed to demonstrate the consequences of failure.</p>	<p>As per Item 2 above. Additional breach modelling information was provided by Land River Sea (M Gardner) prior to TAG meeting.</p>	<p>During Preliminary Design phase as per Item 2 above.</p>
4	<p>Bathymetry changes because of existing geomorphological processes and accelerated by climate change, are not accounted for in the LRS model and these changes would likely raise water levels in the Buller and Orowaiti during floods.</p>	<p>Previous investigations have looked at changing riverbed levels in the Buller River and Orowaiti Rivers. Need to consider longer-term trends vs short-term changes. Discussed option to make provision for maintenance dredging. G Williams noted that this had been investigated and shown to make no difference to flood levels. M Gardner noted that in detailed design sensitivity testing on bed levels would be undertaken to help set freeboard. Bed level monitoring is a key element - needs to be ongoing. Ongoing northward migration of Orowaiti River mouth and sea level rise means long term trend will be continued aggradation of the Orowaiti riverbed. This will also lead to a trend of increasing groundwater levels, and reductions in</p>	<p>Consider the implications of these various items again in Preliminary Design phase. Include further consideration of the practicalities, risks and benefits of trying to design the protection element of the PARA framework for climate change when the other elements of PARA are focussed on retreating.</p>

		performance of stormwater drainage systems. Consensus that it does not make sense to design the scheme for RCP 6.5 river flows and sea levels.	
5	The Protect scheme will increase peak flood levels at the Buller Bridge by 600 mm, reducing the free board beneath the bridge to less than 200 mm , significantly increasing the risk of a bridge blockage and overtopping of the Westport flood defences upstream of the Buller Bridge. This would have significant implications for evacuation planning as the bridge is the only route out of town for a large flood event (based on the assumption that for an event that would block the Buller Bridge the Orowaiti Bridge is also likely to be blocked / damaged).	Effects vary with increasing design flows and whether airport (not Carters Beach) protection in place or not. Westport floodwalls are the key driver of freeboard loss. But Westport flood protection is also the key driver for works. Various possible mechanisms available to reduce risk at bridge crossings, including modification of available waterway area. Overflow is likely to occur toward lower area south of the bridge no matter what. Bed load management will not assist – details were included in BBC. Bridge modelling should be reviewed to ensure it is not over-conservative. Modelling should also explore effectiveness of mitigation options. Consideration should be given to modelling improved waterway scenarios for Orowaiti River bridge to help inform Waka Kotahi medium to longer term bridge replacement options.	Consider further at Preliminary Design phase. Including review of bridge modelling and debris risk mitigation options.
6	Design standards for an encirclement option need to be much higher than what is presented in the BBC, as the consequences of failure are much higher than for non-encirclement options (namely, increased potential for loss of life in the case of	Similar to items 1 and 2. Agreed that encirclement option only provides a defined level of resilience against flood risks – this needs to be communicated to the community. It does not imply a need to build	During Preliminary Design : Explore rebalancing of upstream downstream design standard and/or other mitigation measures, including mandated intensification control and emergency preparedness.

	failure of the wall during a large flood event).	higher walls. Intensification of floodplain and emergency preparedness need to be actively managed. Further communication required to community about role of embankment as a community “flood risk mitigation” rather than as a “protection tool”.	Consideration of more conservative design approach for high consequence sections to minimise failure to be included in preliminary and detailed design as an important risk mitigation tool.
7	No geotechnical investigations have been undertaken, which is a significant gap when trying to understand the feasibility and cost of the proposed designs. This is acknowledged in the BBC.	Some earlier boreholes were drilled for the concrete walls near the Buller River side of Westport. Recent Geotech investigation work for the initial projects has/is being undertaken by Davis Ogilvie to guidelines provided by Gary Williams.	Undertake additional necessary work in Preliminary Design .
8	There is a mismatch between the heights for the stopbanks / floodwalls used in the LRS modelling and what is presented in the BBC. This has implications for design assumptions and cost calculations.	Misinterpretation clarified (due to limited information provided to reviewers). Mismatch was a consequence of the Steering Group overriding the recommendation of technical group. However, all designs, quantities and costings in business case updated to reflect change, so no error or additional cost risk. Higher walls bring stability, constructability and consent-ability challenges. Raises issue of what are the standards being adopted for the scheme. Climate change allowed for everywhere, but this doesn't mean same level or type of protection is required.	During Preliminary Design : Review constructability and consent-ability and flood risk mitigation methodology, particularly in the Orowaiti Lagoon area. Consider reversion to the originally recommended standard at Orowaiti to rebalance risk.
9	Very limited information is provided about the design , and concept sketches only have been provided for the	Focus was on providing sufficient design detail to support a reasonable cost	Provide additional detail in Preliminary Design . Also review and update

	embankments and timber floodwalls.	estimate. More detail appropriate in next phase.	cost estimates after Preliminary Design.
10	No design details or conceptual sketches are provided for the concrete sections of the wall.	As above, focus was on providing sufficient design detail to support a reasonable cost estimate. It is noted though that Davis Ogilvie provided cost information on the timber walls. Costs for the concrete walls was provided by WCRC (from earlier such works). More detail appropriate in next phase.	Provide additional detail in Preliminary Design .
11	Timber floodwalls have not been used for rivers the size of the Buller or Orowaiti rivers.	Reviewers accepted that statement is not correct. Timber floodwalls are not proposed for the Buller River part of the system. They have been used in similar situations in NZ. It was noted that gravel stopbanks would be used in preference to walls everywhere this was possible (likely more than shown) due to their lower cost and greater resilience.	Further review, particularly of height and linear extent to be undertaken in Preliminary Design .
12	Seepage path length beneath the proposed walls and embankments is substantially less than industry guidelines such as the Bay of Plenty Regional Council guidelines for stopbank design.	Agreed that seepage analysis / path part of next stage.	Explore in more detail at Preliminary Design following geotechnical investigations.
13	Construction assumptions result in an under estimation of costs.	Some misunderstanding resulting from changes in wall height. Construction methodology changes resulting from increased wall height were allowed for in the costing. Costs have been calculated using up to date (2021) unit-rates with suitable rate and quantity margins	Project costs to be reviewed as project evolves and scope and staging adjusted as necessary. Next review at Preliminary Design .

		<p>at each step. There is little that can be done about short-term fluctuations in construction costs. Any changes not able to be accommodated in the allowed contingencies will need to be absorbed by council and/or offset by value engineering / scheme design modifications and/or staging. Some staging and phasing has been looked at previously.</p>	
14	<p>Changes in groundwater levels overtime have not been accounted for. This is acknowledged in the BBC, but still needs to be addressed.</p>	<p>Noted. Areas affected need to be managed by other means as sea level rise is realised. Also noted that Aqualinc have been commissioned to do a ground water model for BDC. This may be useful for an assessment of climate change impacts on ground water levels. Long-term sea-level rise will affect ground water levels. Pumping investments should recognise this – and be committed to early on.</p>	<p>Consider additional information and alternative risk management measures in Preliminary Design.</p>
15	<p>The Protect proposals are not resilient to seismic events and the proposal is not “multi-hazard resilient”.</p>	<p>No “affordable” structure is possible if AF8 earthquake occurs. Noted that if liquefaction occurs that damages flood protection structures it is likely that houses will be similarly adversely affected and there may be nothing to provide protection to. If liquefaction drops ground level, then a wider flooding problem may also then exist. There is no point in having over-designed banks. It was noted that an ability to respond rapidly to a seismic event was key to</p>	<p>Issues and solutions to be explored further in Preliminary Design.</p>

		managing the risk from the next flood. Having a maintenance fund and reserves that can be called upon to commence work rapidly means that risks from awaiting insurance pay-out is greatly mitigated. Results of Geotech investigations will assist assessments.	
16	Timber floodwalls will not be readily adaptable and repairable as suggested in the BBC.	Timber walls are as repairable / adaptable as any other construction method – and in some instances may lend themselves to adaptation more than other structural options. Noted that timber and concrete walls have similar issues.	Consider further in Preliminary Design .
17	The assessment of low consenting risk for most of the works depends on assumptions that need to be tested and confirmed. The assessment does advise that further investigation will be needed to determine consent needs (and consent-ability) in areas near the coast and where works in the riverbed/wetland areas are proposed.	Good advice was provided to the technical group about “consent-ability”, but this will not be proven until final design and the proposition is fully tested via public processes. Wall height at Orowaiti Lagoon could be a consenting risk. Landowner agreements are key. No government funding of Carters Beach protection could be a consenting risk for Westport flood protection, as has an impact on Carters Beach. Wall behind Carters Beach could present a Tsunami risk. These issues need to be explored and resolved.	Progress resolution during Preliminary Design and Consenting phases

18	<p>The seven “protect” options considered prior to the selection of the current proposal presented in the BBC are different iterations of the same conceptual design (full encirclement of Westport). The proposal has not considered a wider spectrum of protect options (such as partial / targeted protection).</p>	<p>Not all options presented in Business Case. Previous options included cut to sea, partial options, river management options, just right bank (doesn't fix coastal flooding), Snodgrass options (cuts, causeways, buy-outs), etc. These are described in the appendix to the BBC report. Likely need to pull-forward this previous work on alternatives to support consenting. There would be value in preparing a long list to short list of options.</p>	<p>Consider further in Preliminary Design and Consenting phases</p>
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Appendix 3: Sample Project Risk Register



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Appendix 4: Correspondence from Ministers Robertson and McAnulty