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Memorandum

To Meridian Energy Limited
Subject Manapōuri Lake Control Flow Improvement Project (MLCIP)- c s92 information
From Dr Martin Single - Coastal Geomorphologist
Date May 2024

MLCIP project effects on Bluecliffs

This memorandum provides context and comment on coastal erosion at Bluecliffs, Southland and addresses the request for further information by Environment Southland with regard to the Meridian Energy Limited (MEL) application for resource consents to construct a new channel to enable a permanent diversion of part of the flow of the Waiau Arm above the Manapouri Lake Control structure (the MLC Flow Improvement Project, or the MLCIP).

The section 92 request from Environment Southland, dated 13 May 2024, asked whether MEL considers that the effects of the altered flow in the Lower Waiau River from the operation of the MPS on coastal geomorphology at the Waiau River mouth, including effects of coastal erosion on the Bluecliffs community, are within the scope of the MLCIP applications.

I understand that these effects are not legally within scope of the application given that the consented flow regime is not being changed as a result of the MLCIP (see letter from Meridian dated 4 June 2024). However, for clarity I have been asked to consider what, if any, effect the consented flow regime is having on coastal geomorphology and coastal erosion at the Waiau river mouth.

Conclusion

I do not consider that flows in the Lower Waiau River, within the existing consented flow regime can cause any measurable effects on the river mouth behaviour or coastal erosion on the Bluecliffs community which are distinguishable from natural processes. It is my understanding that the MLCIP project purpose amongst other things is to provide a more reliable flushing flow regime to the Lower Waiau River to manage nuisance periphyton, and that the size and timing of such flows are well attenuated by the time they reach the coast. In my opinion this will not contribute to erosion at the coast.

Background & Analysis

92 request for information

The consent application for channel construction above the MLC does not contain an assessment of the effects of the proposal on the Bluecliffs community and surrounding coastal environment. From my reading of the application documents and AEE, the effects on flows in the Waiau River are within the

existing consented flow regime and are consistent with the flows considered and assessed in detail for the Manapouri Tailrace Amended Discharge (MTAD) project and presented at a hearing in August 2009. Based on Dr Mabin's evidence, the Decision of Consents Committee decision (July 2010) stated:

Sediment transport and the impact on the Te Waewae Lagoon and the coast were of concern to a number of parties, including the Beach Road Land Owners & Occupiers Association that believed their properties were under threat due to the existence of the MPS, and any additional changes that MTAD would bring. The Panel accepts that there have been changes to the shoreline and the lagoon in the vicinity of their properties but has preferred the evidence of Dr Mabin and Dr Hicks in regard to the reasons for the changes.

The historical aerial photos of the area pre-MLC clearly show a dynamic environment that went through a number of physical changes, mostly due to natural causes. While the construction of the MLC will have had some influence, the Panel accepts that natural events are likely to have been more significant. Geomorphological changes to the river will occur over a long timeframe and the Panel is satisfied that the impact of MTAD on this aspect will be minor. (p48 M289-0440)

I do not consider that the project will cause any measurable effects distinguishable from natural processes on the river mouth behaviour or coastal erosion on the Bluecliffs community.

My reasoning is based on the results of studies on comparable hāpua systems including and post-dating the 1994 work by Kirk and Shulmeister that investigated and described the lagoon system and coastal processes at the Waiau River mouth (see the reference list attached). These studies note the retreat of coastal cliffs backing hāpua, the erosional effects of the river currents, oceanic waves and waves propagated across the hāpua due to overtopping of the barrier beach or penetration through the river/hāpua outlet as part of the coastal geomorphological environment.

The changes recently observed at Bluecliffs, as described in the Tonkin and Taylor and PDP reports, fit the pattern of hāpua process dynamics and are also consistent with historical observations of "snapshots" of the river mouth condition described by observers from the 1850s through to the 1940s as presented by Day (1993) and in Mabin's 2009 MTAD evidence and technical report. There have been periods when the outlet of the river through the barrier beach has been opposite and to the west of Bluecliffs Beach Road, for example in 1851-2, 1900, 1912, 1934 and 1935, all prior to the MLC construction. The recent changes are not out of character with the long-term observations of coastal change, before and after the MPS and MLC.

Existing environment

The Waiau River historically and prior to the establishment of the Manapouri Power Scheme can be considered a "small" river geomorphologically as the flows and sediment supply to the coast are not enough to maintain a stable river mouth and to totally offset coastal erosion from wave processes. As a result of the lake fed catchment, and the hinterland that the Waiau River and catchment tributaries flow through, the river also has a greater sediment carrying capacity than the amount of sediment in the river.

The river mouth system is a result of the relative energies of the river and the high-energy coastal system of Te Waewae Bay. The river mouth comprises a lagoon system fronting an eroding cliffed shore and enclosed by a long, narrow barrier beach.

The waterbody to the true left of the river channel is relatively stable in form but fluctuates in size and volume depending on terrestrial fluvial inputs and episodic wave overtopping barrier beach. To the true

right of the river channel, the water body changes in form and volume in response to variations in the river flow volume and the oceanic wave environment and sediment transport along the barrier beach.

These changes are typical of a hāpua process environment resulting from a complex balance of marine, fluvial and lagoonal process factors. The shore of Te Waewae Bay is also subject to measured downward vertical land movement and sea level rise¹ and is projected to be exposed to increased wave storminess and flood events due to climate change.² There has been observed long-term variability in the position of the Waiau River outlet channel through the barrier beach as recorded by Day (1993) and shown in the PDP review of the Tonkin and Taylor report (March 2024). The observed locations of the outlet of the river through the barrier beach include being directly seaward of the river channel and varying positions to the west, seaward of Bluecliffs Beach Road and less often, to the east of the river channel. These types of changes to the hāpua and outlet channel position pre-date the MPS and other catchment changes and are consistent with observations of long-term variability for hāpua systems on the Canterbury coast.

Models derived from Canterbury rivers show that the interaction and significance of river floods, periods of low flows, oceanic storms and combinations of fluvial and oceanic events result in variations to the hāpua process environment, the outlet position, the barrier beach geomorphology and erosion of the land backing the hāpua waterbody over time.

Geomorphic monitoring of the channel of the lower Waiau River and the lagoon and beach at the Waiau River mouth carried out by URS and AECOM in 2009 and 2017 as part of conditions in *Appendix 1* to the 1996 Manapouri Power Scheme (MPS) operational resource consents and in *Appendix A* to the 2010 Manapouri Amended Tailrace Discharge (MTAD) resource consents confirms the dynamic nature of the Te Waewae Bay shoreline resulting from the range of high-energy coastal processes, including sediment transport along the barrier and over the barrier into the lagoon and hāpua waterbody, and occasional floods down the Waiau River delivering “pulses” of sediment to the coast (URS 2011; AECOM 2018). The 2018 AECOM report concludes that changes measured between 2009 and 2017 showed no evidence of the flow regulation through MLC having a detectable effect on shoreline behaviour at the coast.

Recent erosion of the shore along Bluecliffs Beach Road (in 2023 and early 2024) fits into long-term snapshots of outlet position, hāpua behaviour and coastal change, and is consistent with historical behaviour and erosion of the landward shore of the hāpua of the Ashburton, Hurunui and Waitaki Rivers.

MLC project effects

The hāpua dynamics are not well related to the mean flow in the river, but are driven by extremes of river flow and in wave action at the coast. The projected changes to the reliability of passing flushing flows from the MLCIP are unlikely to result in significant effects on the river mouth and hāpua dynamics. In my opinion, the Lower Waiau River consented flow regime does not have an effect on the coastal and hāpua processes at the Waiau River mouth and Te Waewae Bay shoreline that is distinguishable from the natural changes and processes of this system.

¹ NZ SeaRise Project <https://www.searise.nz/maps-2>

² (Ministry for the Environment 2018, *Climate Change Projections for New Zealand: Atmosphere Projections Based on Simulations from the IPCC Fifth Assessment, 2nd Edition*; Albuquerque, J.; Antolínez, J.A.A.; Méndez, F.J.; Coco, G. 2022, On the projected changes in New Zealand’s wave climate and its main drivers *New Zealand Journal of Marine and Freshwater Research*).

From my understanding of the MLCIP, the project purpose amongst other things is to provide a more reliable flushing flow regime to the Lower Waiau River to assist in the management of nuisance periphyton. The size (< 160 cumec peak) and timing (during summer months) of such flows are well attenuated into the base flow by the time they reach the coast and in their own right could not in my opinion contribute to erosion at the coast.

My Background to the MPS and the Waiau River

I am familiar with the Manapōuri Power Scheme (MPS) and previous consent applications relevant to Waiau River flows and potential effects, having provided technical information for MEL for the MTAD consent process (2006 to 2009) and for lakeshore management of Lakes Manapōuri and Te Anau (from 1987 to present day). My coastal geomorphology and process background includes extensive study on the shore type and hāpua river mouth forms as found at Bluecliffs. I have supervised studies on these river mouth types in the Canterbury and West Coast regions. I am familiar with research carried out at Bluecliffs (Kirk and Schulmeister 1994 Geomorphic processes and coastal change in the lagoon system, Lower Waiau River, Southland) and at the Hurunui, Rakaia, Ashburton, Opihi and Waitaki River mouths and smaller hāpua such as the Waikoriri Lagoon, Westland.

In providing comment on the hāpua and river mouth processes at Bluecliffs, I have read the submissions relating to the MEL MLCIP project. I have also read the recent reports prepared for the Southland District Council by Tonkin and Taylor (Bluecliffs Beach Road Papatotara, Preliminary hazard and geotechnical assessment - October 2023, letter dated 8 February 2024) and Pattle Delamore Partners (Waiau River mouth opening, memorandum dated 25 March 2024). I have also refamiliarised myself with the report to the Waiau River Working Party by Delwyn Day (1993 Historical review of the Waiau River and coastal area), and the statements of evidence of Dr Mark Mabin and Dr Murray Hicks with regard to the geomorphology and river sediment transport (respectively) of the Waiau River and Te Waewae Bay shore presented at the hearing for resource consents for the MTAD in August 2009. I have also re-read the comments relating to submissions by the Bluecliffs Beach Landowners Group in the MTAD consent decision. I have also read the AECOM report on changes in the Lower Waiau River between 2009 and 2017 (Lower Waiau River geomorphic monitoring 2009/ 2016/2017, May 2018) to provide insight as to sediment supply changes in the Waiau River.

Although I have looked at air photographs of the Waiau River mouth area from the 1940s through to 2023, I have not carried out a detailed assessment of “snapshots” of change in the mouth, lagoon and outlet configuration.

Hāpua and river mouth process references:

Hicks, D.M.; Baynes, E.R.C.; Measures, R.; Stecca, G.; Tunncliffe, J.; Friedrich, H. 2021 Morphodynamic research challenges for braided river environments: Lessons from the iconic case of New Zealand. *Earth Surface Processes and Landforms* 46, 188-204

Measures, R. 2020. *HapuaModel*. GitHub Repository, <https://github.com/RegMeasures/HapuaModel>

Measures, R.J.; Hart, D.E.; Cochrane, T.A.; Hicks, D.M. 2020 Processes controlling river-mouth lagoon dynamics on high-energy mixed sand and gravel coasts. *Marine Geology* 420: 106082

McSweeney, S.L.; Hart, D.E.; Todd, D.J.; Kennedy, D.M. 2016 Changes in the Frequency and Duration of Closures of the Opihi Hapua Following Construction of the Opuha Dam. *Journal of Coastal Research* 75: 88–92.

Hume, T.; Gerbeaux, P.; Hart, D.; Kettles, H.; Neale, D. 2016 *A classification of New Zealand's coastal hydrosystems*. National Institute of Water & Atmospheric Research Ltd, Prepared for Ministry of the Environment.

Hart, D.E. 2009 Morphodynamics of non-estuarine rivermouth lagoons on high-energy coasts. *Journal of Coastal Research* 56: 1355–1359

Paterson, A.; Hume, T.; Healy, T. 2001 River mouth morphodynamics on a mixed sand-gravel coast. *Journal of Coastal Research* (Special Issue 34): 288–294.

Kirk, R.; Lauder, G. 1994 *Guidelines for managing lagoon mouth closure on significant coastal/wetland lagoon systems - coastal processes investigation*. Wellington: Department of Conservation

Kirk, R.; Shulmeister, J. 1994 *Geomorphic processes and coastal change in the lagoon system, Lower Waiau River, Southland*. Coastal Research Group, Department of Geography, University of Canterbury, May 1994: 77p

Other reports referenced:

NIWA 2023 *Manapouri Lake Control Flow Improvement Project - Assessment of environmental effects: Freshwater Ecology* Report prepared for Meridian Energy Limited, December 2023, 92p

URS New Zealand Limited 2011 *Lower Waiau River cross section surveys 1992 - 2009* Report to Meridian Energy Ltd, 19 August 2011, 95p

AECOM New Zealand Limited 2018 *Lower Waiau River geomorphic monitoring 2016/17* Report to Meridian Energy Ltd, 30-May-2018, 140p

NZ SeaRise Project <https://www.searise.nz/maps-2> (accessed 23 May 2024)

Ministry for the Environment 2018, *Climate Change Projections for New Zealand: Atmosphere Projections Based on Simulations from the IPCC Fifth Assessment, 2nd Edition*

Albuquerque, J.; Antolínez, J.A.A.; Méndez, F.J.; Coco, G. 2022, On the projected changes in New Zealand's wave climate and its main drivers *New Zealand Journal of Marine and Freshwater Research* Published online: 03 November 2022: <https://doi.org/10.1080/00288330.2022.2135116>