BEFORE INDEPENDENT HEARING COMMISSIONERS

AT WHANGĀREI

I MUA NGĀ KAIKŌMIHANA WHAKAWĀ MOTUHAKE

KI WHANGĀREI

IN THE MATTER	**of the Resource Management Act 1991**
AND	
IN THE MATTER	**of the hearing of submissions on applications by the Northport Ltd – Port Expansion project at Marsden Point**

STATEMENT OF PRIMARY EVIDENCE OF PROFESSOR KARIN BRYAN ON BEHALF OF PATUHARAKEKE TE IWI TRUST BOARD

COASTAL PROCESSES AND HYDRODYNAMICS

18 SEPTEMBER 2023

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CHAMBERS

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1. EXECUTIVE SUMMARY

1.1 Numerical hydrodynamic and sediment transport modelling has been conducted using state of the art numerical modelling software. The set up of the model follows best practice. The numerical models have not been well-calibrated or verified with in-situ data. The models focus on the region around the entrance.

1.2 The applicant, Northport Ltd, argues that the changes to tidal hydrodynamics and sediment transport processes around the entrance are minor. This conclusion is based entirely on the results of numerical modelling which has not been well calibrated or verified with in-situ current and suspended sediment measurements. Without calibration or verification, I cannot be confident that the effects are minor. Calibration and verification current data should be collected for a minimum of a month. Suspended sediment measurements should be collected for longer than a month to capture episodic events that normally dominate suspended sediment timeseries in these environments.

1.3 The balance between ebbing and flooding currents and the effects of spatial variations to bedshear stress are very sensitive to the parameters used in the modelling. Minor inaccuracies in these can have larger implications to modelling output. Without sound calibration and verification data, I cannot be confident that the effects are minor.

1.4 The modelling is focused on the entrance of the harbour, but does not check whether effects are minor over the wider harbour. Understanding effect on wider Harbour residence times and flushing is important to assessing wider ecological effects. It also does not check whether effects would be minor when sea level rises. Given the permanent nature of the reclamation and the virtual certainty of sea level rise, I believe that it would be best practice for these matters to be assessed.

2. INTRODUCTION

2.1 My name is Professor Karin Bryan, PhD UToronto, FRSNZ.

2.2 I have 26 years of experience post PhD working in Aotearoa New Zealand. I have published 167 scientific papers, the majority of which are on coastal and estuarine processes and of which at least 90 are in international quartile 1 ranked journals. I have completed 21 commissioned research reports for clients in New Zealand and Internationally. I am a Fulbright Alumini and Fellow of the Royal Society of New Zealand. I have worked extensively in barrier-enclosed estuaries in the Bay of Plenty and the Coromandel, in similar environments to Whangarei Harbour. I have also provided advice and underpinning research to the Port of Tauranga maintenance and capital dredging research programmes.

2.3 Patuharekeke Te Iwi Trust board approached me in November 2022 and asked me to provide advice and expert evidence on the applicant's proposal.

Code of Conduct

2.4 Although this is a Council hearing, I have read the Environment Court's Code of Conduct in the Court's Practice Note 2023 and agree to comply with it. My qualifications as an expert are set out above. I confirm that the issues addressed in this statement of evidence are within my area of expertise.

Material reviewed

2.5 I have read the:

- NRC Application Documents: Appendix 10 Coastal Processes Assessment written by Tonkin Taylor Ltd
- NRC Application Documents: Appendix 9 Hydrodynamic and Morphodynamic modelling reports

- Response to request for Information-s92: Attachment 13 Hydrodynamic and Morphodynamic Modelling Reports
- TT Coastal Processes Supplementary Memo (22 May 2023)
- S42A Staff Report Appendix C1 Coastal Processes
- S42A Staff Report Appendix C13 Hydrodynamic, Morphology and Sediment Transport Modelling

Scope of Evidence

2.6 My evidence will address the hydrodynamic and sediment transport modelling and the coastal processes report to the extent that hydrodynamic and sediment transport modelling underpin coastal processes.

2.7 Where appropriate and relevant, my evidence will reference and rely on the evidence of Dr Christo Rautenbach (NIWA), whose opinion I agree with.

3. INSUFFICIENT HYDRODYNAMIC OBSERVATIONS

3.1 I agree with the technical review of Dr Christo Rautenbach in that insufficient hydrodynamic observations have been collected to support the numerical modelling.

3.2 In addition, the coastal process assessment (and a number of other assessments) are based partially on the numerical modelling results, and there also rely on in sufficient in situ measurements. Apart from the lack of calibration and verification data, the numerical modelling has been undertaken following best practice using state-of-the-art models.

4. EFFECTS OF PROPOSED RECLAMATION AND TIDAL HYDRODYNAMICS

4.1 The applicant has provided evidence that the effects of the proposed reclamation are minor. I agree that the effects on the wave climate are

minor given the natural variations that occur in the ebb-tidal delta region of the entrance where waves are one of the main driving forces.

4.2 The applicant argues that the changes to tidal hydrodynamics and sediment transport processes around the entrance are also minor. This conclusion is based entirely on the results of numerical modelling which has not been well calibrated or verified with in-situ current measurements.

4.3 The only current data provided is a ship-mounted acoustic doppler survey (ADCP) which appears to be collected over a single incoming and outgoing tide, and over a single track. The currents around the complex entrance geometry likely to be spatially and temporarily varying and standard practice is to collect observations of currents at multiple locations over a spring-neap cycle (at least 14 days, and ideally more than a month).

4.4 Figure 2.12 of the MetOcean solutions report shows the ADCP data compared against the modelling output. Note that the strongest currents are most important because these are the currents that have the ability to suspend and transport sediment most effectively. In addition, as stated in the Coastal Processes report by Tonkin & Taylor, which I agree with, sediment fluxes at the entrances of these kinds of estuaries are dependant on the balance (i.e. the difference) between the ebb and flooding currents. Based on Figure 2.12, I think the harbour is more ebb-dominant (or more exporting) than the numerical model shows. If the y-axis represents observations and the x-axis model, the difference between the ebb-dominance shown in the model and that shown in the data is about 17cm/s. That is of a similar size or greater then the size of the modelled changes to currents caused by the proposed reclamation. This means the current differences caused by the reclamation could be double in size).

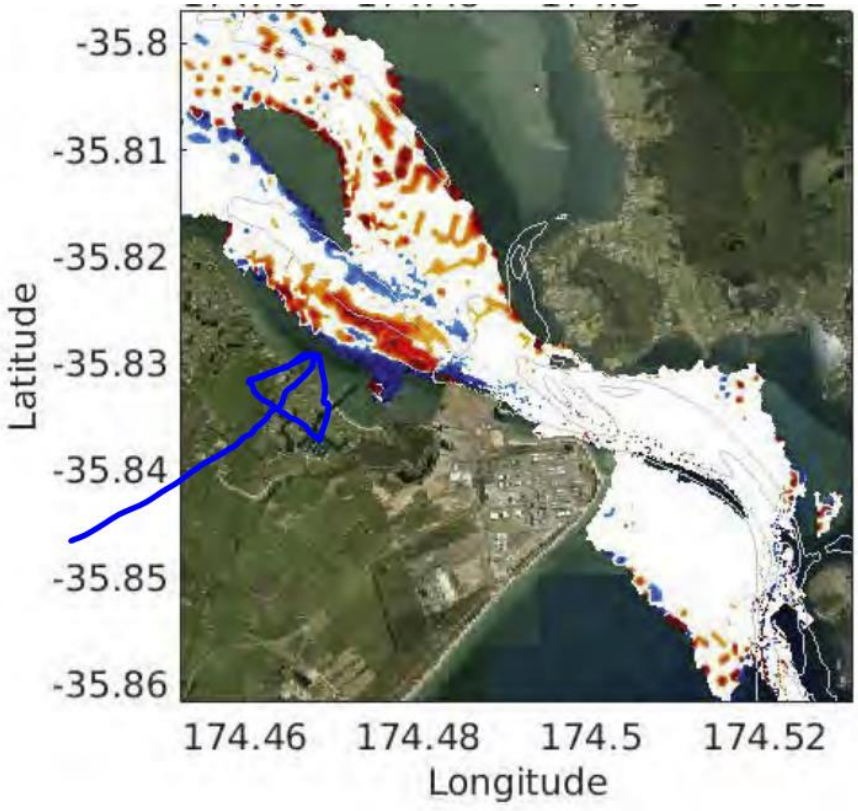
If the currents and bed shear stresses are larger than modelled, then the effects of the reclaimation might not be minor as stated. In addition, if the difference between ebb and flood currents is different than modelled, then sediment might not accumulate in the same way as modelled. The difference between ebb and flood currents is a component of the residual circulation

of the harbour, which determines ecological connectivity and flushing of the harbour. Therefore, the balance of ebbing and flooding currents is not well produced by the model, then the implications to the ecology would be unsure.

4.5 Changes to the ebb-flood dominance can determine whether sediment is stored in the estuary or not. Sediment stored in an estuary can cause adverse effects to shellfish populations and can fuel the expansion of mangrove areas. Alternatively, sediments can provide a buffer against the effects of sea level rise, by allowing fringing marsh/wetland areas to maintain their elevation relative to sea level rise. There is no modelling provided on the effects to the upper reaches of the harbour, or to understand changes that might be caused by predicted sea level rise (although the coastal processes report does highlight that sea level rise might be important in this estuary). The modelling is entirely focused on the immediate entrance area.

4.6 I am also concerned about the way that bedshear stress has been assessed in the numerical modelling. Figure 3.23 and 2.24 show the amount of time that the bedshear stress exceeds the value needed to entrain a grain size of 200 μm. If stability of Snake bank and McDonald bank are important, then a grain size that is appropriate for sediments on these banks should be used rather than 200μm. Figure 3-5 of the Appendix 10 Coastal Processes Assessment indicates that the observed sediment grain sizes of the lower harbour range from a median of 40 μm to 240 μm Therefore using a more appropriate grainsize might change the critical bed shear stress values used and make the sediment more mobile than predicted by the modelling.

4.7 I am also concerned with the level of changes that occur along the mangroved shoreline west of the proposed reclamation. The modelling suggests that this area will become increasingly less energetic which might indicate retention and accumulation of fine sediments, which could have flow on ecological effects in that area.



5. SUMMARY OF KEY CONCERNS WITH PROJECT

5.1 The numerical modelling is not well validated or calibrated. Without this validation or calibration, the accuracy of numerical modelling scenarios cannot be sure, and therefore it is not possible to say with any confidence the the effects of the proposed reclamation are minor. Other reports rely on numerical modelling, and so the lack of confidence would also influence the conclusions of these other reports.

5.2 A monitoring plan prior to any reclaimation, which includes spatially-resolved current measurements and suspended sediment measurements (along with the proposed bathymetric surveys), would ensure that the implications to coastal processes in the wider estuary could be assessed (beyond the sandy areas around the entrance).

5.3 Residence times and flushing times are a useful way to understand the effect on wider water quality in the estuary (as highlighted in the NIWA peer-review). Hydrodynamic measurements would need to be collected for more than a spring-neap cycle (preferably a month).

5.4 Suspended sediment measurements tend to be dominated by episodic rare events, and therefore should need a longer montoring period to establish baselines.

Professor Karin Bryan
18 September 2023