0.0 TECHNICAL MEMO – Turbidity and Coastal Processes

To:	Stacey Sharp & Blair Masefield, Beca (consultant planners)
From:	Dr Doug Treloar, Senior Principal Coastal Engineer, Stantec
Ref:	Northland Regional Council: APP.005055.38.01 Whangārei District Council: LU2200107
Date:	16 November 2023

1.0 STATEMENT OF QUALIFICATIONS AND EXPERIENCE

My name is Dr Philip Douglas Treloar. My qualifications and experience are as set out in my Coastal Processes memo dated 28 July 2023.

Through this process I have also reviewed the various coastal modelling reports and evidence statements and the proposed turbidity monitoring and reporting conditions. My qualifications and experience relevant to these matters include:

I have about 50 years of coastal engineering experience in Australia and the Pacific region, plus other areas. This experience began with physical modelling and included numerical modelling from about 1978, applying model systems developed by (then) Hydraulics Research Station, (HRS), Wallingford, DHI and Delft Hydraulics.

This modelling experience includes training sessions with DHI and Delft Hydraulics, plus many technical discussions with HRS during the Port Botany development programme. This modelling work has included wave climate, storm tide, current climate and morphological investigations – for example, the mouth of the Murray River in South Australia, the Gold Coast Seaway (Queensland), the Tuggerah Lakes Entrance and Port Botany developments (NSW).

This experience has included model set-up and calibration and application to investigations and design parameter preparation tasks in a range of physical environments.

I confirm that the statements made within this memorandum are within my area of expertise and that I am not aware of any material facts that might alter or detract from the opinions I express. Whilst acknowledging that this consenting process is not before the Environment Court, I have read and agree with the Code of Conduct for Expert Witnesses as set out in the Environment Court Consolidated Practice Note 2023. The opinions expressed in this memorandum are based on my qualifications and experience and are within my area of experience. Where I rely on the evidence or opinions of another, my statements will acknowledge that.

2.0 PURPOSE

The purpose of this supplementary memorandum is to respond to technical matters pertaining to coastal processes monitoring conditions, dredge turbidity management conditions and the adequacy of the coastal modelling that were raised during initial hearings proceedings.

This memorandum is to be read in conjunction with the initial coastal processes technical memorandum dated 28 July 2023 appended to the Council s42A Officers Report.

For the avoidance of doubt, the opinions and conclusions expressed in both above-referenced documents remain unchanged.

3.0 TECHNICAL RESPONSE TO MATTERS RAISED

3.1 Coastal Processes Monitoring Conditions

In my opinion, based on my experience with port development and beach renourishment projects, I believe that monitoring of shoreline movements within Marsden Cove, towards Mair Bank and on and around the proposed bird roost island (sandbank) should be a consent condition.

In terms of consent conditions proposed by Northport, I advise that I have participated in Teams workshops that have discussed and developed the consent conditions to be more relevant for this proposed development. My involvement has made them more specific, and I am satisfied that they are realistic and appropriate and support the changes to the NRC conditions for Shoreline and Bird Roost monitoring attached to the Addendum report.

3.2 Dredge Turbidity Conditions

It is my opinion that the methodology contained in the document entitled *“Turbidity Monitoring for the Northport Expansion Project”* (1 June 2023, Environmetrics Australia) and the following percentiles in terms of total hours over 30 days:

(i) Tier 1 : 80%,

(ii) Tier 2 : 95% and

(iii) Tier 3 Compliance Level : 99%

are reasonable and fit for the proposed purpose. In this procedure, duration is the maximum number of accumulated hours in a rolling 30-days period for which the Turbidity Intensity prescribed at a telemetered turbidity monitoring location in relation to turbidity trigger Tiers 1 and 2 or Tier 3 Compliance Levels may be exceeded without a management action being required.

The maximum number of hours for each Tier are as follow:

(i) Tier 1 : 144

(ii) Tier 2 : 36

(iii) Tier 3 : 7.2

I have proposed a number of limited changes to the proposed conditions in terms of reporting and monitoring locations and I support the changes to conditions in the Addendum report. These conditions include Northport ensuring that their monitoring stations function as agreed.

My position also depends on agreement by the ecologists, (Dr Shane Kelly and Dr Drew Loehrer), that the likely turbidity levels described by MOS numerical modelling at the three presently nominated candidate monitoring locations are ecologically acceptable.

3.3 Adequacy of Coastal Modelling

Documents

As part my expert witness tasks, I have reviewed the following five reports prepared by Met-Ocean Solutions for Northport:

1. Morphodynamic Evolution Modelling for the Northport Environment – Numerical Modelling of the Sediment Dynamics at Northport – February, 2018
2. Hydrodynamic Modelling – Methodology, Validation and Simulations – April 2018
3. Hydrodynamic Modelling Update – Effects of Proposed Reclamation and Dredging Layout on Hydrodynamics – August 2022
4. Morphodynamic Modelling for the Northport Environment – Modelling Update, Predicted Morphological Response to Proposed Eastern Land Reclamation – August 2022
5. Dredge Plume Modelling – Dredging Sediment Plume Dispersion over Existing and Proposed Port Configurations – August 2022

Additionally, I have reviewed the Statements of Evidence prepared by Dr Brett James Beamsley and Professor Karin Bryan.

Comments

I understand that the three matters about which the hearing may benefit from my opinions are:

1. The adequacy of the numerical model calibration process that MOS have applied to their model systems – raised by Professor Bryan; and hence the reliability of MOS's modelling results near Marsden Point.
2. The likely effects of sea level rise, perhaps by 1m at circa 2100.
3. Model suitability to Northport's project.

MOS's report No 2. cited above does describe MOS's calibration processes that included both water level and current speed and direction calibration. The current data was recorded using an Acoustic Doppler Current Profiler (ADCP) that can measure current speed and direction at selected depth intervals. The instrument can be deployed on the seabed as a fixed instrument in a frame or mounted on a boat and moved with bottom tracking and GPS position keeping. The latter approach was adopted by MOS and both flood and ebb current data were recorded and used for model calibration – as well as the water level calibration.

Annexure A has been taken from MOS's report No 2. and describes the measured current and modelled data in terms of vectors – arrows that describe current direction and speed, the latter by the length of the arrows. Measured data is in blue and the modelled data is in red. There are both flood and ebb results. The fact that there is good agreement across and along the channel confirms that the model is reliable.

It is agreed that longer current records are used often, but they are generally at single points, or a few of them, and do not provide the same spatial model confidence.

MOS's report No. 1, cited above, does describe MOS's validation of the sediment transport and erosion/deposition processes near Marsden Point. Model validation was undertaken against reliable hydrographic survey differences that described the changes in the seabed levels near Marsden Point caused by the presence of the existing dredged seabed and the regional coastal processes – currents, waves, bed form and sediment characteristics. Their morphological modelling results are presented in their report Section 3.5 and their Table 3-3, which summarises their validation modelling results for the period 2016 to 2017, for which there was reliable seabed survey – see **Annexure B**.

The good outcome of the morphological modelling could only have been achieved if the hydrodynamics of the model were physically realistic, because without realistic currents and other data it would not be possible to achieve good morphological results. In this context, I say that good, albeit subjective, is a realistic assessment because the results of the morphological modelling presented in MOS's Table 3-3 are within 10% on a total volume change basis; noting that individual cells selected by MOS have larger differences. The overall character of the changes, with sediment moving seaward from Snake Bank is in agreement with observations.

On the basis of this overall outcome, I believe that MOS's model system is suited to the investigations undertaken by them for Northport's proposed port development. Moreover, in terms of investigating changes in current characteristics, these changes have been determined on a like-for-like basis – that is, the same physically realistic model has been used. Hence, any deficiencies would be the same for pre-development and post-development calculations.

In terms of the effects of sea level rise at this site and within Whangārei Harbour, without having a thorough understanding of the overall tidal hydraulics of the system, I would say that there would likely be no discernible change in the net sediment transport characteristics of this waterway. Any changes would be very slow and occur over a time-scale of a about century, based on my experience at the following sites:

- Port Botany (Sydney, NSW) – dredged shipping channel, no changes in tidal structure, changes at shorelines caused by wave climate changes - high conveyance waterway

- Swansea Channel (entrance to Lake Macquarie, NSW) – major changes since late 19th century, caused by entrance training walls - low conveyance waterway with a small tidal range in the lake
- Lake Illawarra (NSW) – ongoing changes in tidal range and sediment transport - very low conveyance waterway with a small tidal range in the lake

Whilst none of these examples relates directly to sea level rise, they indicate that there would likely be only small changes in a high conveyance waterway such as Whangārei Harbour, provided that there were no major changes in waterway cross-sectional shape at a higher sea level.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

Overall, in consideration of the above, I remain of the opinion that, subject to agreed conditions, the actual and potential adverse effects of the proposal on coastal processes will be adequately managed.

Memo prepared by:	Dr Philip Douglas Treloar, Senior Principal Coastal Engineering, Stantec
Date:	16 November, 2023
Memo reviewed and approved for release by:	Blair Masefield, Technical Director, Beca Limited
	On behalf of the Whangārei District Council and Northland Regional Council
Date:	16 November 2023

Annexure A

MOS Hydrodynamics Calibration

Figure 2.9 Modelled (SELFE) and measured velocity comparisons within Zone A (Figure 2.4) for the peak ebb (upper) and flood (lower) tidal stages.

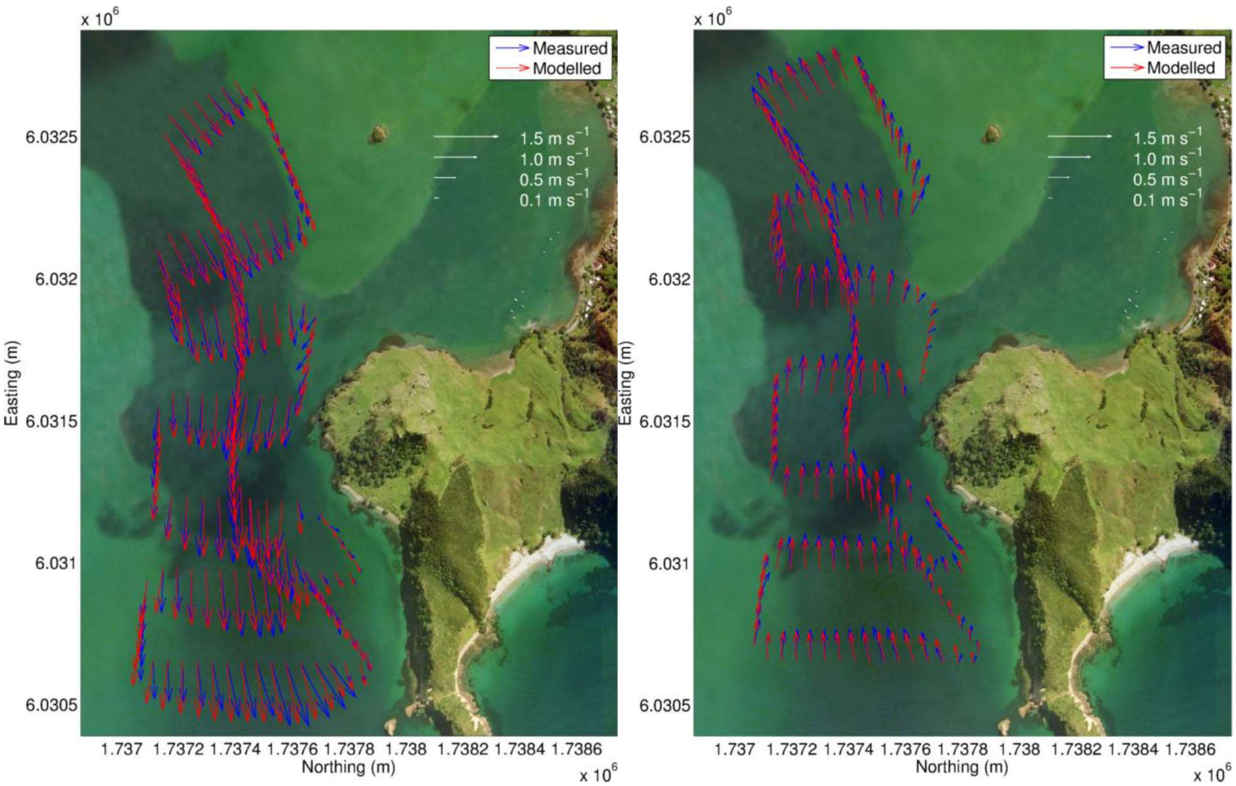

Figure 2.10 Modelled (SELFE) and measured velocity comparisons within Zone B (Figure 2.4) for the peak ebb (left) and flood (right) tidal stages.

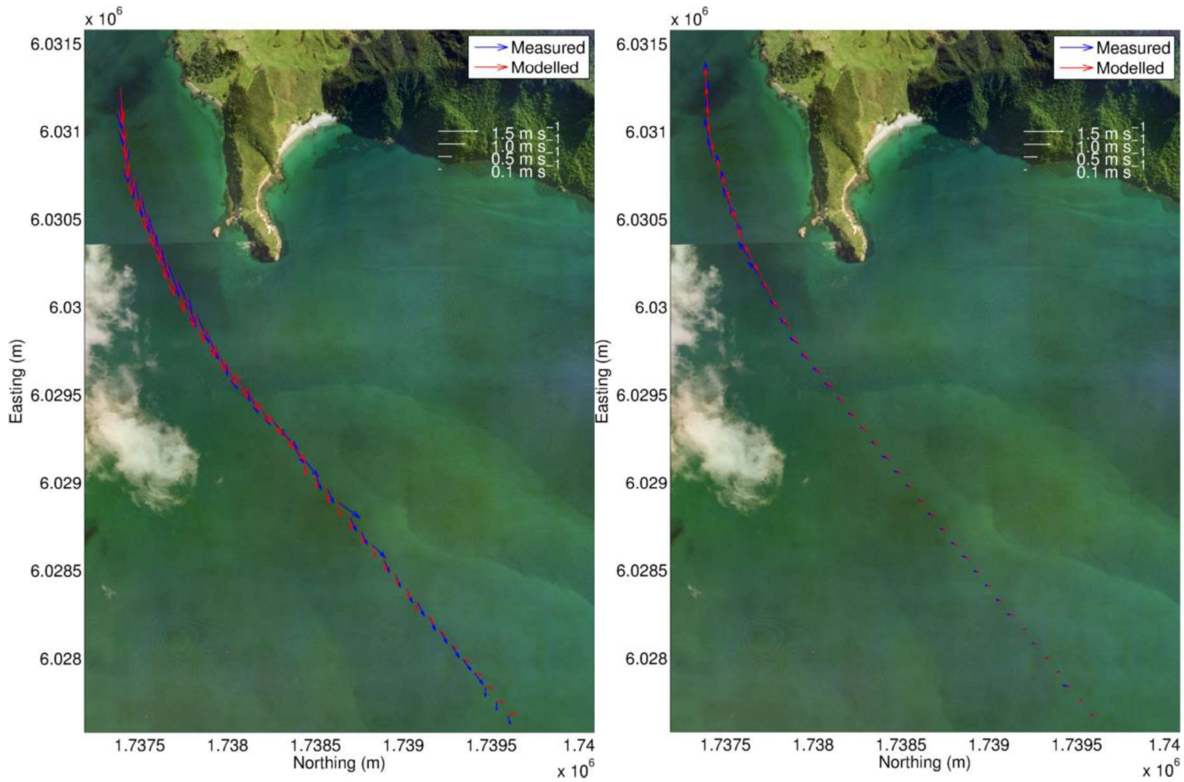

Figure 2.11 Modelled (SELFE) and measured velocity comparisons within Zone C (Figure 2.4) for the peak ebb (left) and flood (right) tidal stages.

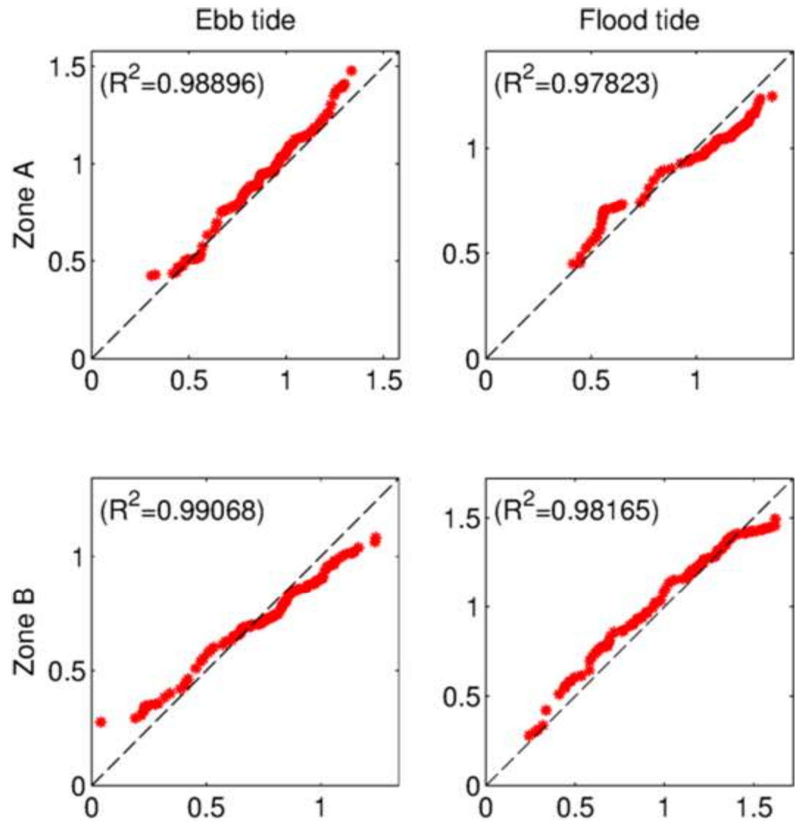

Figure 2.12 Quantile – Quantile plots of the measured and modelled (SELFE) peak tidal ebb and flood current speed (m/s) along the vessel tracks within zones A and B for both peak ebb and flood stages. The root mean squared errors corresponding to the different distributions are presented in the top-left corner of each plot.

Annexure B

MOS Sedimentation Calibration

3.5. Predicted sediment dynamics

Calibration of the Delft3D morphological model for the period 2016-2017 was undertaken by comparing model predicted annual morphological changes to those observed (see Figure 3.11).

Qualitatively, model results show a good agreement spatially with the measured morphological changes, with the model capturing the migration of Snake Bank into the swinging basin and the succession of erosion and accretion along the southern margin of bank (see Figure 3.11). The high degree of stability observed elsewhere in the channel was relatively well reproduced in the predictions, as is the strong activity over the deep area adjacent to Motukaroro Island

Quantitatively, the accretion of sand from the tip of Snake Bank into the swinging basin by bedload transport is somewhat under-estimated. It is likely that a lack of resolution in the model grid resulted in decreasing bed slope gradients which influenced greatly the bedload component of the sediment transport. Irrespective, within the order of magnitude errors expected for hydrographic surveys, the model showed a good capability in predicting realistic volumetric infilling rates within Areas 1 to 3; +8,128 m^3 and +3,658 m^3 respectively (Table 3.3). Within Area 2, the morphological model predicted a similar order of magnitude in the total bed erosion to that observed (i.e. 2500 m^3 and 1,600 m^3 respectively, Table 3.3).

The successful validation of the morphological model indicates that the modelling approach is applicable for examining both the existing morphological evolution and the response of the system to the proposed dredging and reclamations.

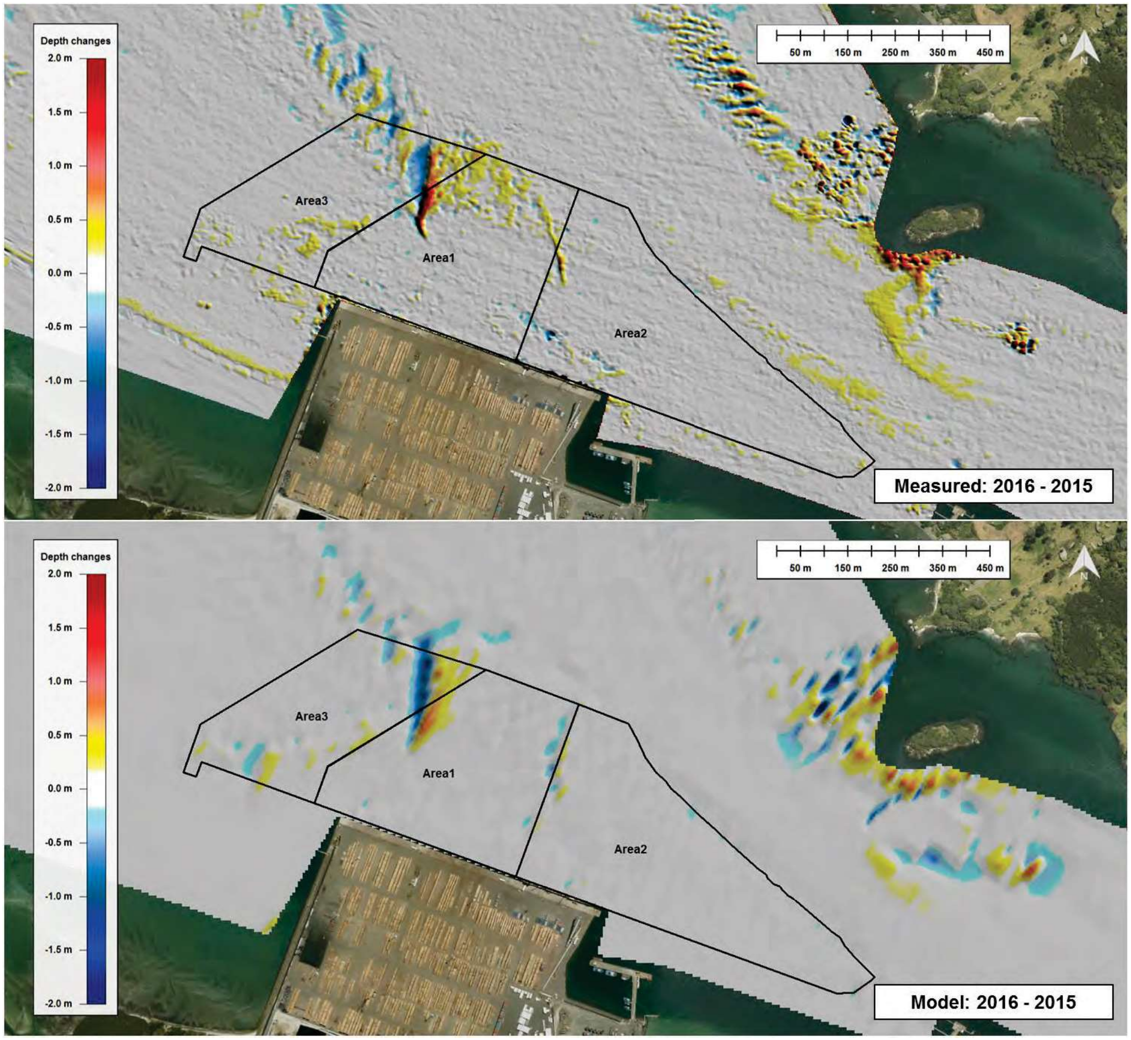

Figure 3.11 Measured (top) and model (bottom) depth change after one year from 2016 to 2017.

Table 3.3 Volumetric change from 2016 to 2017 estimated using model outputs and bathymetric survey data.

Area	Volumetric change between 2016 and 2017 [$m^3.yr^{-1}$]	
	Measurements	**Model**
Area 1	+6,260	+8,128
Area 2	-1,597	-2,489
Area 3	+3,973	+3,658