BEFORE THE FAST-TRACK EXPERT PANEL

IN THE MATTER of an application for approvals under section 42 of the Fast-track Approvals Act 2024 ("FTAA")

AND

IN THE MATTER of the application for approvals by Trans-Tasman Resources Limited for the Taranaki VTM Project, a project listed in Schedule 2 of the FTAA

JOINT STATEMENT OF EXPERT WITNESSES:

SEDIMENT DISTRIBUTION MODELLING

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13 November 2025

INTRODUCTION

1. Expert conferencing on the topic of sediment distribution modelling took place online via Microsoft Teams on 13 November 2025.

2. The conference was attended by the following experts:

   (a) Dr Mike Dearnaley ("MD") (Applicant);
   (b) Dr Charine Collins ("CC") (Applicant);
   (c) Dr Gregory Matthew Barbara ("GB") (Seafood NZ); and
   (d) Dr John Luick ("JL") (KASM and Greenpeace).

3. Dougal Greer ("DG") (KASM and Greenpeace) was unable to attend conferencing; however, DG circulated a written statement to the other experts prior to the conferencing (attached as **Appendix 1**).

4. Steve Mutch (ChanceryGreen) acted as facilitator.

5. Caitlin Todd (ChanceryGreen) assisted the experts to draft the JWS.

CODE OF CONDUCT

6. The experts confirm that they have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023 and agree to comply with it. The experts confirm that the issues addressed in this JWS are within their area of expertise, unless stated otherwise.

SCOPE OF STATEMENT

7. In Expert Panel Minute 19 (5 November 2025), the Panel directed experts in sediment distribution modelling to conference regarding identified questions, recording matters that are agreed or disagreed and any unresolved matters or uncertainties.

8. For any disagreement and identified uncertainty, the Panel has directed that the experts provide advice for experts relying on the suspended sediment plume or sediment deposition model outputs for their effects assessment to ensure they use and interpret the model outputs appropriately and are able to incorporate uncertainties into their assessment.

9. The scope of this statement is limited to sediment modelling distribution.

10. Appendix A of Panel Minute 19 formed the basis of an agenda for conferencing.

11. In this JWS, we report the outcome of our discussions in relation to each item (below), including by reference to points of agreement, disagreement, and unresolved matters or uncertainties. Where we are not agreed in relation to any issue, we have set out the nature and basis of that disagreement.

12. Regarding paragraph 8 above, CC and MD consider that the results as presented in the substantive application materials are suitable for use by other experts to inform their assessment. GB and JL's interpretation and uncertainty on the model outputs based on the reliance on the data are outlined in the paragraphs below.

QUESTIONS FROM THE PANEL

1. **What are the key areas of disagreement, if any, related to the adequacy of hydrodynamic modelling, suspended sediment (sediment plume) modelling, and sediment deposition modelling, including on modelling methods, assumptions, domain, parameters, calibration/validation, simulated scenarios, model output analysis and presentation, and interpretation?**

13. MD, GB and JL confirm that their views have not changed regarding the key areas of agreement and disagreement since the 23 February 2024 'Joint Witness Statement in the fields of Sediment Plume Modelling; and Effects on Benthic Ecology' ("**2024 JWS**") in relation to a previous 2023 application for the proposal.

14. MD reiterates, for context, that there are two different types of modelling used for the sediment plume modelling:

(a) Near-field modelling (undertaken by HR Wallingford) has been used to assist in defining the source terms to be used as input to the far-field modelling.

(b) Far-field modelling has been used to inform the environmental impact assessment in terms of changes in suspended sediment concentrations and sediment deposition within the South Taranaki Bight. The far-field model has been run for baseline conditions (no mining) and an original mining scenario and a further worst-case mining scenario.

15. MD and CC consider that the baseline far-field modelling credibly reproduces the time-varying gradients in suspended sediment concentrations from the coastal zone to the offshore area. MD and CC consider that the far-field modelling of the plume has clearly demonstrated that impacts on suspended sediment

concentration are generally insignificant compared to the variability in baseline conditions. MD and CC do not consider that a more refined calibration of the baseline suspended sediment concentrations in the nearshore would alter this conclusion.

16. As stated in his 2024 rebuttal evidence relating to DG's evidence, MD accepts that it would be possible to come up with alternative assumptions for a more severe worst-case modelling scenario, but MD does not see the value in so-doing to inform the far-field impact assessment. In MD's view, such an assessment would be unrealistic given the discharge conditions. MD further illustrated this in his presentation to the EPA Hearing on 14th March 2024. MD also made the point that in his opinion, given the evidence from the laboratory testing and the near-field modelling, it was not strictly necessary to have undertaken the worst-case modelling. MD considers that the scale of the effect of using different source terms on the mid to far-field could have been inferred from the existing results.

17. MD and CC state that model results from the simulations were stored at 12-hour intervals which means that any further interrogation of the existing model results can only be done at this frequency. MD and CC understand that the time series of model predictions at fixed points presented originally would have been extracted at hourly intervals from the model as it was run.

18. As stated in his 2024 rebuttal evidence relating to JL's evidence, MD considers that the far-field modelling can be considered conservative in that the settling velocity of classes of material remains constant over time in the model.

19. CC and MD note the concerns that the sediment distribution modelling is considered to be out-of-date as it was all carried out more than five years ago. CC and MD can confirm that there has been no recent update of the far-field sediment modelling. CC and MD state that the model simulations have not been updated because there has been no new information relating to the character and properties of the sediment (background and mining sources) that will have a significant impact on the sediment plume modelling. New products are available for atmospheric forcing and lateral boundary conditions but without an in-depth assessment of these products there is no certainty that the different products will have a significant impact on the sediment plume modelling. Therefore, CC and MD consider that, to date, there has been no tangible justification for updating the sediment plume modelling.

20. CC and MD note the concerns that the model domain and model resolution used for the sediment plume modelling is considered to be inadequate. CC and MD state that the 1 km South Taranaki Bight domain was designed to capture the area of greatest potential effect – namely, the region around the mining site where suspended concentrations and deposition rates would be highest. CC and MD state that the limited spatial extent of the model domain was a deliberate and necessary decision, as the suspended-sediment simulations were computationally intensive and a balance had to be struck between spatial coverage and resolution.

21. In terms of model resolution, CC and MD note there are concerns that the model resolution is too coarse to capture the effects of pits and mounds on the local and regional currents. CC and MD state that the focus of the model was on the regional circulation and sediment transport pathways across the South Taranaki Bight, and the model was not designed to resolve the effects of pits and mounds on the local and regional currents. CC and MD consider that resolution-sensitivity tests demonstrate that suspended sediment concentrations more than 2–3 km from the source are not sensitive to grid resolution. CC and MD consider that this indicates that far-field sediment dispersion and accumulation – the primary focus of TTR's assessment – are robust to the resolution used. CC and MD noted that it was also stated in the Joint Statement of Experts in the field of sediment plume modelling (dated 25 March 2014) that "*while being coarser than ideal to simulate accurately the variability and near-field behaviour, [the model grid] represent a reasonable balance between the competing demands of spatial-grid resolution and computing power requirements*".

22. CC and MD note the concerns that the model simulation only spanned a period of two years which is considered to be too short to resolve long-term climate dynamics and also does not account for climate change. CC and MD state that the propose of the sediment plume modelling was not to resolve long-term climate variability but rather to adequately capture the natural variability of currents, waves, and sediment dynamics within the South Taranaki Bight. In addition, CC and MD note that, to simulate the sediment dynamics under climate change requires a different modelling approach to the one used.

23. GB considers it is best practice to run models for hydrodynamic marine discharges for at least 10 years and consider the effects of climate change in long term modelling, and this is routinely required in other jurisdictions.

24. CC and MD note the concern that the model validation and calibration are considered inadequate. CC and MD state that the model was validated and calibrated using the best available data from a range of sources (e.g. in situ and satellite derived).

25. Regarding points of disagreement, GB's position has not changed since the 2024 JWS. See paragraphs 29-31, 33-34, and 36 of the 2024 JWS regarding the uncertainties around the parameters for wave period, percentage of ultra-fines, settlement rate/based on flocculation calculations using laboratory tests. Regarding storage of the modelled data every 12 hours, GB considers that future models should store data at least hourly.

26. GB raises new concerns over the inclusion of the desalination plant freshwater processing of ore, which introduces uncertainties regarding water chemistry and flocculation if freshwater is used in the processing compared to the laboratory tests using seawater conducted by Vopel, et al. 2013.[1] GB considers that the fate of the brine discharge from the processing is also unaccounted for.

27. JL agrees with GB's statements above at paragraphs 25 and 26.

2. Is the information used to inform the model development and the modelling outputs presented by the Applicant the best available information? If not, what would best available information or the best available modelling approach be? What approximate effort and resources would be required to achieve model results that would represent best available information?

28. MD and CC note that, in the time since the modelling was undertaken, computer processing power has been updated, and it would now be practical to undertake longer and/or higher resolution simulations than those previously undertaken. However, MD and CC do not consider that such simulations would materially change the assessment in the far-field.

29. All participating experts agree that there are different products available to use for atmospheric forcing and lateral boundary conditions, but these have their own biases, and a detailed assessment would be required before applying these to any model.

[1] Vopel K, Robertson J and Wilson PS 2013 Iron sand extraction in South Taranaki Bight" Effects on seawater trace metal concentrations. Auckland University of Technology, Institute for Applied Ecology New Zealand. Client Report TTRL 2013 (Report 41 of the Substantive Application).

30. CC and MD consider that the data used to determine the sediment classes and their characteristics in the far-field modelling were the best available at the time and to CC and MD's knowledge are still the only data available to inform this. Similarly, the data used to validate and calibrate the far-field model are the best and only available data of its kind to date. MD and CC consider that current best practice has been adopted in the modelling studies. In MD and CCs' experience this is still a relatively unusual step to adopt in plume dispersion modelling.

31. GB considers that the data used is a subset of the core samples collected by the Applicant and without scrutinising that data, GB has reservations that the most suitable data was provided to the modellers. GB considers that the better practice would have been for the modellers to have access to all the data and then determine what sediment parameters are applied. GB considers that the Operational Sediment Plume Model must incorporate the data from the Grade Control Drilling across the entire site and exclude defined areas that will be excluded from mining.

32. GB raised that the applicant has now included the use of a desalination plant and freshwater aboard the Integrated Mining Vessel ("IMV") as part of their application but provided no information on the fate of the brine discharge and the potential impacts. While not directly related to the sediment plume, GB considers this an additional impact.

3. What are the uncertainties associated with the model results presented by the Applicant, if any, and how do these uncertainties affect confidence in predicted suspended sediment concentrations and sediment deposition rates at different distances from the proposed mining area?

33. CC and MD consider that all model predictions have uncertainties, and this is hard to quantify.

34. CC and MD consider that compared to satellite data and in-situ point measurements of suspended sediment concentrations (SSC), the modelled background SSC may be biased high by a factor of up to two within a kilometre or two from the shore. CC and MD consider that the most likely source of this uncertainty is the SSC from rivers for which data was only available for a single river and the concentrations for all other rivers were estimated based on the assumption that SSC is directly proportional to flow. Despite this bias in the near-

shore background SSC, CC and MD consider the conclusions from the sediment plume modelling to be robust.

35. CC and MD consider that there are only scattered measurements of existing SSC against which to verify and calibrate the model. In addition, all participating experts note there are no measurements at all of the SSC due to the proposed mining activities, and these can only be obtained once mining activities have commenced.

36. GB agrees with DG (refer to DG's response to this question at **Appendix 1**) regarding inputs from the rivers and the fact that the model relies on sediment coming from the rivers. GB agrees with DG that anthropogenic sources increase sediment coming from the rivers, which is significantly higher due to erosion from land use practices, and that this overshadows the effects that the mining plume may be having on sensitive habitats (including reef features that may have not yet been discovered).

37. MD and CC note that, for the original scenario, a single source term was used that assumed an ultra-fines content of 1.6%. MD and CC further note that the average ultra fines content from the available sample data is 0.8%.

38. MD and CC state that the original far-field modelling is based on a scenario where, on average, twice as much ultra fine material is present than is indicated by the sampling.

39. MD and CC state that, in the far-field modelling, the ultra-fine material has been distributed into four classes characterised by different settling velocities.

40. GB maintains the same uncertainties as pointed out in paragraphs 25-26 above. For improvements to the model, GB recommends inclusion of more representative sediment classes as stated in paragraph 31 above. GB supports DG's recommendation for improvements in parameterisation. GB raised that the current near-field model assumes an average pit depth of 5m and doesn't include the creation of the mound at the beginning of each pit, whereas mining operations could go down to 11m and create said mounds. GB considers that the model should include worst-case scenarios for the shallower and the deepest lanes (11m). GB also refers to paragraph 32 above of this statement regarding brine discharge impacts.

41. JL considers that the Operational Sediment Plume Model should incorporate a settling velocity sub-model so that it takes account of interactions and flocculation. GB agrees with JL.

42. All participating experts consider that the far-field model is suitable for informing potential impacts at distances greater than 3km from the mining activity. All participating experts consider that, closer to the mining activity, it does not have sufficient resolution to represent the detail of the release from the IMV and the effect of mounds and pits on the entrainment of fine slow settling material into the ambient currents.

43. MD and CC consider that it is possible to inform assessment of potential impact in the near-field (within 3km of the mining activity) using the results of the near-field modelling. MD and CC state that the near-field modelling has been run for scenarios of linearly increasing current speeds and fixed wave activity.

44. MD and CC consider that the near-field modelling demonstrates that nearly all fine material with settling velocities of 1mm/s (90%) or 10mm/s (100%) (about half the material discharged from the IMV) will remain on the seabed in a mound or in the mining lane. MD and CC note that some of the fine material settling at 0.1mm/s will be entrained out of the mining lane by current action in combination with wave action (20-50%) and nearly all (95%) of the slowest settling fraction (0.01mm/s) will be entrained. MD and CC consider that the nature of this release will depend upon where in the pit the IMV is discharging material back to the seabed, the tidal conditions and wave action and the depth of the mining face.

45. In reality, MD and CC consider that, even if all the material being mined were of exactly the same fines and mineral content, there would still be a variation in time and space of the quantity of the fines leaving the mining area to be dispersed into the STB. MD and CC state that this variation is not taken into account in the far-field modelling; instead, the average fines content leaving the mining area is expected to be at the upper end of the variability leading to a conservative approach for the far-field modelling.

46. MD and CC consider that within 3km of the mining activity there will be variations in the suspended sediment concentrations and associated sediment deposition that will be influenced by these assumptions.

4. **What parameters were used to define the worst-case modelling scenario, and in what sense does this scenario represent a "worst case" (e.g., maximum spatial extent, maximum concentration, maximum ecological impact)? Do experts agree on what the worst-case scenario represents and whether it appropriately characterises potential worst-case environmental impact?**

47. MD states that in the worst-case modelling, six different source terms were used, representing the scenarios when mining of a new lane was initiated with the creation of a 300m long mound at the start of a lane prior to subsequent discharge of material onto the mined seabed of the lane. MD states that two proportions of ultra fine sediments were considered in this scenario: 2.25% occurring for 300m of the mining lane and then 1.6% for the following 600m. MD states that the effect of having wave heights greater or less than 2.5m (Hs) was included with 50% of the fines settling at 0.1mm/s being entrained from the mining lane during periods of larger waves. CC agrees with MD.

48. GB's position has not changed since the 2024 JWS, that the model does not represent the worst-case scenario due to the uncertainties, as explained in earlier sections of this statement. See paragraphs 24-38 and 40-41 of the 2024 JWS for GB's position.

49. JL has concerns that the effects of flocculation on light penetration in the far-field model that would affect the optical model (relating to effects on primary productivity) have not been taken into account. GB agrees with JL.

5. **Do experts consider that the sediment plume and deposition modelling provides an adequate and reliable basis for assessing environmental effects?**

50. MD and CC are of the view that the outputs from these investigations provide a suitable basis for the related assessments of far-field dispersion, and the environmental effects of sediment dispersion.

51. GB does not consider that the sediment plume and deposition modelling provides an adequate and reliable basis for assessing environmental effects for the reasons outlined in paragraph 55 below.

52. JL considers that there are some omissions in the far-field modelling that limit its usefulness. Some sub-grid scale processes (e.g. turbulence and flocculation) are not captured.

If not:

a. What are the critical information gaps or methodological limitations?

53. MD and CC consider that, to assess the potential for impact on any sensitive receptors in the near-field (<3km), a higher resolution model would be required that represents the detail of the mounds and mining lanes and the location at which fine material is dispersing away from the mining operation which will be impacted by the current occurring and the relative position of the IMV over the mining lane.

54. CC and MD consider that direct measurements of the SSC from more of the rivers would be useful in improving the modelled background SSC.

55. GB agrees with paragraphs 53 and 54 above, and considers that the critical model gaps and recommended actions are as follows:

Modelling Gap	Recommended Action
Incorrect wave period for near-field model (7s vs 13s)	Re-parameterise with updated swell data
Poor calibration vs observed SSC	Recalibrate using full dataset including storm spikes provided by DG
12-hour peaks	Store hourly outputs and maxima
Limited sediment sampling for representative variability across the mining area	Expand sampling across mining area
No climate change scenarios	Include interannual variability (El Nino and La Nina), storm projections, and integrate updated global climate change models
No reef mapping integration	Update ecological overlays with latest habitat data to inform the seabed morphology in the model

56. JL considers there may be a gap in the representation of turbulence in the far-field model that could be rectified with existing Acoustic Doppler Current Profiler (“ADCP”) data collected by the Applicant for the proposed mining site.

b. **Could these gaps or limitations be addressed in through consent conditions? If so, what conditions would be required (provide a high-level description)?**

57. MD and CC consider that proposed marine consent condition 4 relating to extraction and discharge rates and the ultra-fines content of the material to be mined will contribute to managing potential impact.

58. MD and CC consider that the additional proposal by TTR to not commence any mining for the first five years within 3km of the coastal marine area ("CMA") boundary will enable verification of the Operational Sediment Plume Model to be achieved prior to mining taking place where there is any risk of potential impact on sensitive receptors which are located within a few kilometres of the mining operation. MD and CC note there is also a proposed addition to the conditions at proposed marine consent condition 48 to require multi beam swath mapping to identify all reef (i.e. sensitive) habitat within 3km of the mining area, pre-commencement.

59. CC and MD consider that measurements of the near-field and far-field SSC once the proposed mining has commenced will be crucial for validating and calibrating any additional sediment plume modelling.

60. GB refers to paragraph 56, as well as GB's recommended actions contained in the table above at paragraph 55. While GB's preference would be to re-run the model, GB considers that, as a minimum, the recommended actions need to be included in the conditions. GB also considers, as outlined at paragraph 40 above, the model should include worst-case scenarios for the shallower and the deepest lanes (11m). JL agrees with GB.

61. GB considers that ecological trigger levels need to be identified using the principles of the ANZG 2018[2] to inform the mitigation management which may be considered in other expert conferencing. Without ecological triggers, GB considers that the model cannot reliably inform operational decisions. The integration of a brine discharge model is recommended by GB, and the effects on chemical interactions of the freshwater washing and brine on bioavailability of metals (Cu and Ni). JL agrees with GB.

62. GB considers that proposed marine consent condition 5(c) should be amended to provide that, in the initial 2-year period of operation, the Applicant be required

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2 https://www.waterquality.gov.au/anz-guidelines

to report at least quarterly and compare against the pre-commencement monitoring, to determine if effects are above those predicted as part of the model validation. JL agrees with GB.

63. GB considers that, within other approval processes for new marine discharge projects, that monitoring is more intense for the first 2-5 years and once it is demonstrated that effects are no more than what was predicted, the regulator may agree that monitoring can be scaled back.

6. Is the development of an Operational Sediment Plume Model as proposed in proposed consent condition 52 suitable and feasible for predicting the sediment transportation processes in the South Taranaki Bight and informing during the mining operation and informing operational decisions as described in the proposed conditions?

64. All participating experts consider that an Operational Sediment Plume Model will provide a tool for predicting total suspended sediment concentrations in the South Taranaki Bight. All participating experts consider it is reasonable to develop such a model over the pre-commencement period. All participating experts consider that initially the Operational Sediment Plume Model will be compared against measurements of suspended sediment concentrations without any mining activity.

65. All participating experts consider that the Operational Sediment Plume Model will need to have suitable resolution in the near-field to ensure that the detail of mounds, mining lanes and pits can be included once mining commences.

66. All participating experts consider that the Operational Sediment Plume Model will further benefit from the collection of monitoring data relating to the suspended sediment plume collected after mining commences. All participating experts consider this will require near-field surveillance monitoring of the sediment plume. All participating experts consider this observational data will be relevant for verifying potential impacts in the near-field.

67. All participating experts consider that the Operational Sediment Plume Model will need to have carefully considered which products to use for atmospheric forcing and lateral boundary conditions and there will also need to be careful consideration of the model resolution to resolve the interaction between the near-field and specific locations in the far-field processes.

68. GB considers that the Operational Sediment Plume Model concept as outlined appears acceptable but lacks some of the details referred to in previous paragraphs 40, 55-56, and 61-63, and consideration of the effects of resuspension of sediments from crawler tracks in the near-field model.

SIGNATURES OF EXPERTS

Dr Mike Dearnaley	Dr Charine Collins
Dr Gregory Barbara	Dr John Luick

APPENDIX 1: DOUGAL GREER'S WRITTEN STATEMENT

Questions to address:

1. **What are the key areas of disagreement, if any, related to the adequacy of hydrodynamic modelling, suspended sediment (sediment plume) modelling, and sediment deposition modelling, including on modelling methods, assumptions, domain, parameters, calibration/validation, simulated scenarios, model output analysis and presentation, and interpretation?**

While the plume modelling tools used by TTR are broadly appropriate, I hold serious concerns about incorrect model parameterisation, calibration and interpretation of results. In my opinion, and for reasons outlined below, these deficiencies mean the current modelling may significantly underestimate the spatial extent, magnitude, and variability of the sediment plume that would be generated by the proposed mining activities. The areas of uncertainty are as follows

Wave period

A central issue is the incorrect wave period input used in the near-field modelling. The near-field modelling determines how much sediment settles back into the mining pit and how much is released into the wider environment as a passive plume, which then feeds into the far-field model. The model prepared by HR Wallingford used a 7-second wave period, representing short crested, locally generated wind waves. Based on my knowledge of this coastline and analysis of long-term data at this site, a more appropriate typical peak wave period is approximately 13 seconds (See my most recent evidence, Figure 3), reflecting long-period swells generated in the Southern Ocean. The regularity of these higher period swells is part of the reason why this coastline is internationally recognised as a surf destination. If the typical wave period were 7 seconds, the quality of the surf here would be very low. A 13-second wave penetrates much deeper into the water column than a 7-second period wave. For typical wave heights, a 13 s wave would resuspend sediment on the seabed and stop suspended sediment from settling, whereas the effects of a 7-second wave are more confined to the surface layers and does not resuspend seabed sediment unless the waves were very large. This error is highly significant because using a 7-second wave period will grossly underestimate the amount of fine sediment leaving the mining pit, resulting in far-field modelling that fails to predict the true magnitude of the plume.

Far-field Calibration

The far-field model calibration raises further concerns. The model was calibrated by comparing predicted suspended sediment concentrations (SSC) with observed data.

At times, the observed SSC was five to ten times higher than the model predictions, particularly during storm-driven spikes (see Figure 1). These high 'spikes' or 'peaks' define the 99th percentile plots, which are used for understanding environmental impacts. If the model fails to capture these events, the 99th percentile outputs become unreliable.

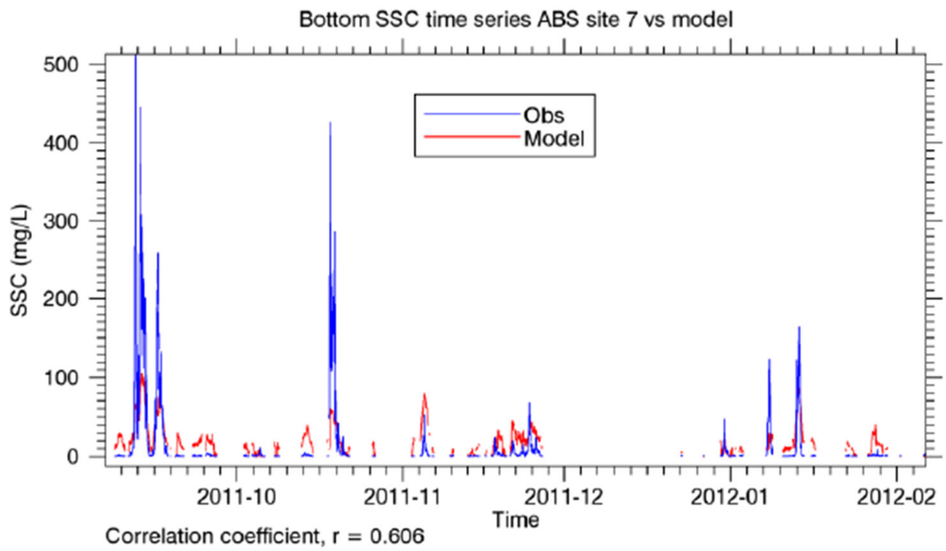

Figure 1: Comparison of modelled and measured data shows that the model underpredicts SSC by 5 – 10 fold in some cases. These 'spikes' define the high percentile model results.

Model Post-Processing

Model outputs were generated as 12-hour averages, which will have smoothed out peaks in SSC which arise due to tidal excursions over a 12-hour period. This will lead to further underestimation of SSC values particularly for higher percentiles. Model output should be stored at least as hourly averages or hourly maxima to provide a reasonable estimation of higher percentile SSC values

Fine Sediment Samples

The laboratory analysis of sediment characteristics was based on only three samples. These were used to calculate the erosion threshold and settling rates used in the near-field and far-field modelling. The mining area is very large (approximately half the size of Hamilton City) and it would be expected that sediment characteristics would vary considerably throughout the proposed mining region

Upper limit of fines for processing

An upper limit of 2.25% ultra-fines was imposed on material that would be mined. This was applied based on TTRL's assertion that they would not consider mining material with a higher ultra-fines content than this for a "period of weeks to 1 month". This infers that material with higher than 2.25% of ultra fine material would be mined for significant periods of time. Over shorter periods of time (< 1-

month), it is not clear how long a higher level of ultra-fines would be mined for. This has clear implications for the source term in the modelling

Background Sediment Levels

The model compares the mining plume only to existing “background” sediment levels. The Taranaki coast is highly impacted and these background levels already include substantial anthropogenic inputs from river systems caused by land use practices in the catchment. Failing to separate natural and anthropogenic sources masks the true cumulative effects of the proposed activity. It effectively portrays the mining plume as relatively minor because the baseline is already heavily impacted. Best practice would be to explicitly identify and account for existing human inputs and consider how land use may change over time. This has not been done here.

Hypersaline discharge

The latest application refers to a large “peak daily production of 30,000 m3 of desalinated seawater”. The application also states that “The discharged brine will be returned to the sea via the submerged tailings pipe.” It is not clear what the volume of the water is, nor do we know the salinity of it. The above text insinuates that the discharged plume will be dense and will be released into the pit. If this is the case, this dense hypersaline plume (typical salinities for desalination discharge is between 50 to 70 psu) will remain on the seabed and likely fill the pit with hypersaline water. It would likely ultimately overflow the pit and spread along the sea floor (depending on the volume/flux of release). Without detailed modelling, it is unclear how far this plume will spread nor what the ecological impacts of this plume will be. The effects of this hypersaline plume could be widespread, but no detail or in-depth analysis is presented as to the expected effects of this plume. Usually a desalination plant with this kind of production rate would require a consent and EOI for that activity alone. In this application the activity is only briefly mentioned.

Characterisation of Longterm Oceanographic Variability and Climate Change

The far-field sediment transport modelling uses modelled hydrodynamics and waves to drive the advection, settling and resuspension of both background and mining derived sediments for a period of approximately 2 years. This is expected to be representative of likely conditions; however, additional interannual variability is expected over the course of the mining operation (for example El Nino versus La Nina years) and this is not accounted for in the modelling.

The modelling also fails to investigate the expected effects of climate change. Assessment of climate change impacts is now standard in large marine projects. Climate change could alter storm frequency, wave heights, and currents, potentially increasing sediment resuspension and transport altering dispersion patterns. Without considering these factors, the longterm predictions lack essential context.

Newly discovered habitats

Since the original modelling was undertaken, recent surveys have identified many new reef habitats (Morrison (2022).*This report demonstrates that subtidal reefs are in fact common on Pātea Bank, with many more awaiting discovery by multibeam sonar mapping.* The results of the plume modelling was not reanalysed and re-examined by ecologists and peer reviewed by independent ecologists for these new areas. Note however, that it will not be possible for the numerical modellers to provide information for all reefs in the area since many remain undiscovered.

Conditions

I have reviewed the conditions proposed to manage suspended sediment concentrations as part of the Fast Track application. Unlike similar large-scale dredging projects, there is no clear, standalone trigger value methodology report that explains how compliance thresholds were selected and justified. Instead, these matters are embedded in the conditions, such as Schedule 3, which I found ambiguous and unclear. In my view, this is a missing step in the application and undermines confidence in the effectiveness of the proposed monitoring and management regime.

2. Is the information used to inform the model development and the modelling outputs presented by the Applicant the best available information? If not, what would best available information or the best available modelling approach be? What approximate effort and resources would be required to achieve model results that would represent best available information?

As highlighted in the issues above, the modelling approach has serious deficiencies in the parameterisation, calibration, post-processing and scope. This modelling was developed in 2017 but in the intervening eight years no apparent attempt has been made to update the model despite these deficiencies being pointed out on multiple occasions.

The best approach would be to redo the modelling using a more modern approach and addressing the current deficiencies listed above. This would require:

- Reparametrising the model, revisiting the calibration and rerunning it for longer periods of time.
- Saving output hourly instead of 12-hourly.
- Model runs would also be required to consider the projected effects of climate change.
- More clarity would be required around the upper limit of fines that would be mined.
- Ecologists would need to confirm that there is sufficient information about reefs in the area to provide an adequate assessment of environmental effects.
- The desalination process is only mentioned briefly but it would appear that a modelling study would be required to determine the adverse effects of the

3. What are the uncertainties associated with the model results presented by the Applicant, if any, and how do these uncertainties affect confidence in predicted suspended sediment concentrations and sediment deposition rates at different distances from the proposed mining area?

As described above, the uncertainties are:

- Poor model parameterisation
- Poor model calibration
- Incorrect post-processing of results.
- Insufficient model run length
- No consideration of climate change
- Lack of treatment of high productivity locations.

The cumulative effect of these deficiencies is a lack of conservatism and lack of confidence in the model results. I do not believe that the modelling in its current form is fit for purpose.

4. What parameters were used to define the worst-case modelling scenario, and in what sense does this scenario represent a "worst case" (e.g., maximum spatial extent, maximum concentration, maximum ecological impact)? Do experts agree on what the worst-case scenario represents and whether it appropriately characterises potential worst-case environmental impact?

The second 2017 JWS included agreement from the experts that '*SSC contour plots and median and 99th percentile plots should be generated for shorter periods of* *time corresponding to the periods of highest release.'* However, this analysis was not included in the worst-case scenario reporting and consequently the model results do not show how the periods of higher release affect median and 99th percentile SSC during those periods.

As discussed above, it is also not clear what a worst-case scenario is in terms of mining of fines. The application is not clear on how long the mining operation would mine an area of high fines content.

The poor model parameterisation, calibration and post-processing leads to a lack of conservatism and a lack of confidence in model performance. Consequently, I don not believe that this can be considered a worst-case scenario

5. Do experts consider that the sediment plume and deposition modelling provides an adequate and reliable basis for assessing environmental effects? If not:

a. What are the critical information gaps or methodological limitations?

As above the deficiencies are as follows:

- Poor model parameterisations
- Poor model calibration
- Incorrect post-processing of results.
- Insufficient model run length
- No consideration of climate change
- Lack of treatment of high productivity locations.

b. Could these gaps or limitations be addressed in through consent conditions? If so, what conditions would be required (provide a high-level description)?

No. These deficiencies would need to be addressed through remodelling of the plume dispersion.

6. Is the development of an Operational Sediment Plume Model as proposed in proposed consent condition 52 suitable and feasible for predicting the sediment transportation processes in the South Taranaki Bight and informing during the mining operation and informing operational decisions as described in the proposed conditions?

The operational model needs to be developed in such a way that it provides a useful diagnostic tool. While this high level description of the model seems appropriate, an unusual aspect of this application is that no dedicated study has been undertaken to establish trigger values. Such a study would be standard practice in (for example) a dredging study. It is difficult to assess the utility of the modelling since no information has been provided on how the results will be applied in practice. Conditions 30 and 32 relate to environmental effects but are high level in nature.