

**BEFORE COMMISSIONERS APPOINTED BY THE CANTERBURY
REGIONAL COUNCIL**

UNDER the Resource Management Act 1991

IN THE MATTER applications for resource consents by Lyttelton Port
Company for capital and maintenance dredging

TABLED AT HEARING

Application:

Date: *2 May 2017*

**SUMMARY AND RESPONSE EVIDENCE OF DANIEL WILLIAM PRITCHARD
FOR TE HAPŪ O NGĀTI WHEKE, TE RŪNANGA O KOUKOURĀRATA,
NGĀI TAHU SEAFOOD, AND TE RŪNANGA O NGĀI TAHU**

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INTRODUCTION / BACKGROUND

- 1 Kia ora koutou. My name is Daniel William Pritchard.
- 2 I provided evidence in support of the submission by Ngāi Tahu, dated 4 April 2017.
- 3 At a high level, my evidence in chief had four key parts:
 - (a) The relationship between technical and scientific advice and mahinga kai;
 - (b) Ngāi Tahu engagement with the Technical Advisory Group (TAG);
 - (c) Integration of expert advice with respect to mahinga kai; and
 - (d) Ongoing Ngāi Tahu engagement on technical issues related to adaptive management
- 4 I will provide a summary of each of these points in turn, along with comments about issues raised or resolved since my evidence in chief was submitted.

RELATIONSHIP BETWEEN TECHNICAL AND SCIENTIFIC ADVICE AND MAHINGA KAI

- 5 Overall, the purpose of this part of my evidence was to provide the panel with the details of my background and role throughout this process (and prior to it).
- 6 I explained that my strengths are interdisciplinary coastal marine research with a background in marine ecology and hydrodynamic modelling.
- 7 Technical and scientific knowledge is not a prerequisite to understand or to practice mahinga kai – but some consider that this knowledge can support contemporary expressions of it. My role with Te Rūnanga o Ngāi Tahu is to support Ngāi Tahu Tangata Tiaki/Kaitiaki in these technical and scientific matters.
- 8 In my evidence, I explained that I ascribe to the view, that the technical advice provided by experts engaged by Ngāi Tahu and the experience, observations and mātauranga offered by Ngāi Tahu

cultural experts represent parallel knowledge systems. In my opinion and experience, each lends strength to the other.

- 9 In my evidence in chief I highlighted some specific examples, including:
 - (a) Examples of rubbish, putatively from the Cashin Quay reclamation accumulating on the beaches of Rāpaki; and
 - (b) Observations of the trajectory of ecological change over timescales that are otherwise difficult to measure.
- 10 I consider that the evidence of these Ngāi Tahu cultural witnesses demonstrates that loss of mahinga kai risks not just disruption of knowledge transfer but opportunities to teach complex ecological principles, even if they are not characterised by them as such.

NGĀI TAHU ENGAGEMENT WITH THE TECHNICAL ADVISORY GROUP

- 11 The TAG was formed by LPC in September 2015. I was nominated as the Te Rūnanga o Ngāi Tahu representative and I have attended all 19 TAG meetings.
- 12 I found the TAG to have been a constructive and positive process, and I consider it to have been useful during the pre-consent phase of this project.
- 13 However, in some key areas, the TAG process has not been able to 'solve' important technical issues. In my opinion these represented fundamental limitations with the LPC application. Specifically, these areas are:
 - (a) Flaws in the hydrodynamic modelling, especially within Whakaraupō / Lyttelton Harbour; and
 - (b) The uncertainty (including, within the LPC team) regarding the integration of monitoring and trigger levels within the Environmental Management and Monitoring Plan (hereafter, EMMP).
- 14 These issues are detailed in my evidence in chief. In summary, I will address each of them in turn.

Hydrodynamic Modelling

- 15 My evidence in chief provided some background to the discussion had at the TAG before LPC lodged their application (September 2016) and with LPC (and ECan) directly since then.
- 16 Hydrodynamic modelling was discussed throughout the TAG process. From the first meeting, there was an understanding that this modelling would be an important tool available early on in the process to inform the TAG when developing the EMMP. In reality, it has been a topic that, with input from the TAG, has 'evolved' alongside parallel discussions about the EMMP (and associated trigger values).
- 17 Apart from methods to include the non-tidal component of the seiche velocities, the TAG did not discuss other key processes in the harbour model, including resuspension of sediment, and interaction with wind and waves. Although I had some concerns about these aspects of the modelling, they were not confirmed until Ngāi Tahu engaged Mr John Oldman in October 2016 to assist with preparing the Ngāi Tahu submission to the publicly notified LPC application. I have read and agree with Mr Oldman's evidence and I have seen a draft of his rebuttal evidence.
- 18 The timeline in my evidence in chief is provided to give the panel some context to the development of modelling within Whakaraupō / Lyttelton Harbour. The process started with a very simple (tide only) model (from the Lyttelton Port Recovery Plan process) and then the LPC and MetOcean team 'bolted on' additional processes as time went on.
- 19 Mr Oldman and I both consider that the existing models are too simplistic for Whakaraupō / Lyttelton Harbour. My concern is that we have now run out of time to 'bolt on' what is needed unless the hearing is adjourned for a period of time.
- 20 As it stands today, models within Whakaraupō / Lyttelton Harbour do not include wind, waves, resuspension or a moving dredger. Mr Oldman has provided a demonstration model which shows that in combination these things are important¹. I agree with Mr Oldman that the important issue is that these things be considered in combination.

¹ See, for example, Figure 1 vs Figure 4 in Mr Oldman's evidence in chief.

In response, Dr Beamsley has taken these processes in isolation and appears to consider that by accepting some further assumptions, we need not include them. I do not agree with that approach. It is clear to me that the modelling process has ‘missed a step’. The key question for me is: Does including these key processes in combination in a simulation of Whakaraupō / Lyttelton Harbour make a difference, or not? Mr Oldman has presented evidence that it does. However, Dr Beamsley does not agree.

21 But are these things really needed? Putting aside the evidence of Mr Oldman for a moment, I cannot reconcile observations from Whakaraupō / Lyttelton Harbour and some other aspects of the LPC application with a plume model that does not include wind, waves and resuspension. Specifically:

- (a) Monitoring data collected so far (and presented to this hearing by Ms Andersen on Tuesday 2 May) show that surface turbidity is “driven by wind”².
 - (b) The real-time monitoring network described by Ms Anderson relies on plumes to (at some point and to some degree) “mix up” into the water column where they can be measured by equipment at the surface³.
 - (c) Mr Sneddon describes a near bottom turbidity layer which reduces visibility to “near zero” at sites in the outer harbour⁴. He considers that this is due to surge (*i.e.* swell waves).
 - (d) The rubbish collected on the beaches around Rāpaki by Dr Gillies has been attributed by him and other Tangata Tiaki/Kaitiaki as being sourced from the recent reclamation to the east of Cashin Quay.
- 22 All of these things should be impossible if the plume model presented by Dr Beamsley provides a possible description of the physical processes operating in Whakaraupō / Lyttelton Harbour.

² Summary presentation to commissioners, Ms Leonie Andersen, Tuesday May 2 2017, slide 18

³ Summary presentation to commissioners (slide 12 and subsequent discussions with commissioners), Ms Leonie Andersen, Tuesday May 2 2017. See also paragraph 46, summary evidence of Mr Jared Pettersson.

⁴ Discussions with commissioners Wednesday 3 May, 2017

- 23 In my view, these concerns are not just disagreements between experts on minor technical points. As I detailed in my evidence and summarise here later, the overly simplistic nature of the LPC models has practical implications for both the assessment of effects and the way the dredging operation can be managed. At this point, there remains a fundamental disagreement between Dr Beamsley on the one hand and Mr Oldman and I on the other about the minimum set of physical processes which best practice requires to be included in the hydrodynamic model.
- 24 I agree with Mr Oldman, that if Dr Beamsley were to now accept the inclusion of those processes in combination, and consequently undertook the remodelling exercise that Ngāi Tahu considers is needed, that this would not be a particularly arduous or time-consuming task for Dr Beamsley.

Uncertainty in the EMMP

- 25 The second main area where the TAG was unable to agree workable solutions was regarding some aspects of the EMMP.

Regarding the real time monitoring

- 26 An ongoing concern from Ngāi Tahu TAG members and manawhenua has been the placement of the real-time monitoring buoys. In my evidence, I highlighted two key issues.
- 27 The first is that benthic or mid-water plumes would remain undetected with the real-time monitoring buoys deployed by LPC.
- 28 I accept evidence presented by Ms Andersen for LPC that Whakaraupō / Lyttelton Harbour does not exhibit stratification driven by differences in temperature or salinity⁵.
- 29 But there can be no doubt that benthic sediment plumes do exist from time to time. Depending on wind and wave conditions, recently deposited sediment will be resuspended to varying degrees (see 21(c), above).

⁵ Ms Leonie Andersen, Evidence in chief, Paragraph 53, 28 March 2017

30 I accept Ms Andersen's statement that it is not practicable to monitor the dynamics of this benthic plume directly. However, limitations with the modelling (including the application of a 2D model in the harbour) mean that we cannot explore the dynamics of this benthic plume using these tools either. Beyond revising the modelling as Ngāi Tahu suggests, this leaves us with very few options, other than to accept that the dynamics of this plume are currently 'unknown' and remain so if (or when) capital dredging begins.

31 The second issue with the placement of the real-time monitoring buoys is the spatial layout of monitoring sites. This placement has been underpinned in part by the results of the hydrodynamic modelling. Specifically, as detailed by Ms Andersen the monitoring network was placed to detect what the modelling predicted to be extraordinarily rare events⁶ and provide an early warning of plumes. In my opinion, evidence presented by Mr Oldman calls into doubt the reliability of these predictions and therefore these placements.

32 The main problem is that if the monitoring buoys are constantly within the footprint of the dredging plume, then they cease to be an early warning of unexpected conditions (as the network was designed). LPC have argued that if this is the case, then the triggers will be tripped. This is the way it should be and LPC say they will respond if this happens⁷. LPC also say these responses will be sufficient to prevent any effects on the sensitive receiving environments that these buoys were intended to protect. However, no tools will be available to predict or understand what is happening beyond the real-time monitoring stations themselves. If we can resolve the issues with the hydrodynamic modelling, then this would provide a way to explore putative management options and provide guidance should any particular station (or number of stations) be 'triggered'. LPC say that the risk sits with them and not the environment in this situation. I think that this is overly simplistic. Without reliable modelling to support the 'adapt' step of this adaptive management plan, I consider that the risk sits with *both* LPC *and* the environment.

⁶ As detailed in rebuttal evidence from Mr Pettersson (paragraph 55), except for one of the spoil ground sites (SG2b) the predictions from the model are zero dredging-related suspended sediment at all monitoring sites.

⁷ Four potential responses are listed in paragraph 18.3 of summary evidence of Mr Jared Pettersson.

Regarding the statistical methods

- 33 As detailed in my evidence in chief, I agree with Dr Fox and the s42A Officers report that the statistical methods proposed for this project are appropriate and can generate appropriate trigger values.
- 34 However, I raised a number of concerns about how this would work in practice. Some of these concerns have now been resolved. Specifically:
- (a) In my evidence in chief I expressed a concern that the proposed method for converting modelled concentrations of sediment (mg/L) to the same units as that produced by the monitoring equipment (NTU). In rebuttal evidence (paragraph 23), Dr Fox makes it clear that a 'no intercept' model will be used. This effectively deals with my concern.
 - (b) Also, in my evidence in chief I expressed concerns about how the trigger values would interface with consent conditions and how this could generate a number of unintended loopholes (paragraphs 99 – 107 of my evidence in chief). In my view, the evolution of the method described in rebuttal evidence from Dr Fox (summarised in paragraph 30 and 31 of rebuttal evidence) prevents the specific concerns I raised.
- 35 However, some concerns remain or have, themselves, evolved alongside the additional information provided by LPC.
- 36 When the LPC application was lodged with ECan, it came as a surprise to Ngāi Tahu representatives on the TAG and manawhenua that LPC was proposing to add modelled concentrations of sediment to the background data to create the trigger values. Before lodgement of the consent application, Ngāi Tahu was under the impression that LPC would use triggers based on background and not background plus modelling. As stated in my evidence in chief, the rationale for including modelled concentrations in the trigger values should acknowledge that expert ecologists have deemed it safe to do so. Notwithstanding any disagreements between ecologists about the utility of this, if the modelling is revised as Ngāi Tahu suggests, then a reassessment of effects will be required.

- 37 When I wrote my evidence, the application did not describe how the simulations of suspended sediment for the purposes of trigger setting would be conducted. I had assumed that this work was yet to be done and methods would be forthcoming via the TAG or some similar processes. However, discussions during these hearings have clarified that this work has already been done⁸. In my opinion, it is essential that LPC provide further details about how exactly this has been carried out.
- 38 For example: What specific period of time has been simulated and extracted? Is the offshore hindcast presented as an average of the ten year period? How are short term (e.g. 28-day harbour simulations) 'scaled up' to 1-year? How can discrete release points be rationalised with the use of a moving dredger? Have concentrations been extracted from the surface layer or have depth-averaged numbers been used? Given that there are at least two plume models in use, which model is being used for which sites? What combination of model parameters and assumptions (or setups, generally) have been used? These are all important issues that need to be understood when setting the trigger levels. Without this it is, in my opinion, impossible to know if the trigger values will provide the level of protection for the environment that is intended.
- 39 A clear methods document could address these and similar questions. It would, in my view, help all parties understand what information is being used for the trigger setting process beyond the existing limited description in the conditions⁹.
- 40 Finally, in my evidence in chief, I discussed the application of a statistical model that may include the combined effects of wind, waves and tides for the purposes for distinguishing between natural or dredging related turbidity events. In rebuttal evidence (paragraph 32), Dr Fox makes it clear that this will not be done for this project. For me this is a concern. I was originally supportive of what appeared to be

⁸ Discussions with commissioners and Dr Beamsley and Ms Appleyard in these hearings on Tuesday 2 May 2017

⁹ Revised consent condition 9.2 (2017-05-05). "*The Intensity (I) for each telemetered turbidity monitoring location is calculated using the time series data of baseline turbidity required by condition 8.3 to which has been added the dredging-related total suspended solids (TSS) predicted from the hydrodynamic model provided in support of the application.*"

multiple lines of evidence to determine if a turbidity event is attributable to natural or dredging-related events. It is now clear that these multiple lines of evidence will not exist. LPC have revised the conditions to make it clear that they intend to invoke this clause only in response to an "extraordinary event"¹⁰. However, I consider that the detail of how this is to be defined is still lacking.

- 41 Although several of the concerns I set out in my evidence in chief have been resolved, I remain of the view that, despite best efforts, I am not sure that I have identified all of the potential pitfalls in technical aspects of the draft EMMP. This is especially true given that some important technical details have only been provided recently through this hearing process. I support Ms Rickards statements (for Ngāi Tahu) that there needs to be further clarity of referencing documents. Once this has been resolved and all relevant information is at hand, then it should be possible to review the EMMP again to ensure it functions as intended, but currently this is not possible.

INTEGRATION OF EXPERT ADVICE WITH RESPECT TO MAHINGA KAI

- 42 In the third main section of my evidence I attempted to draw together the various arguments presented by experts engaged by Ngāi Tahu. I find very little disagreement with LPC experts regarding this section of my evidence.
- 43 In my view, protection of key mahinga kai species implies protection of the habitats that support them. This naturally requires integration of interdisciplinary research, local knowledge and mātauranga.
- 44 In my view, having regard to the evidence of Mr Oldman, Dr Stephenson, Dr Hepburn and Dr Marsden, the primary concern with respect to mahinga kai stems from the fundamental flaws in the modelling presented in the LPC application and what appears to be a lack of understanding of sediment and physical processes within Whakaraupō / Lyttelton Harbour and Pegasus Bay, generally.
- 45 As the primary predictive component of this application, hydrodynamic modelling forms the foundation of the assessment of effects, has

¹⁰ Summary and rebuttle evidence of Mr Pettersson, paragraph 76.

guided the placement of monitoring locations and is (under the current proposal) tied explicitly to the setting of trigger levels. Process-based hydrodynamic modelling is one of the few quantitative tools available to establish before the activity begins if the activity can be undertaken without adverse effects on mahinga kai and to direct the dredging in a way that can minimise the spread of any plumes during operation.

46 The lack of a predicted effect on ecological communities is contingent on plumes not reaching sensitive receptor sites¹¹. This is a reasonable predication. However, based on the above comments, I do not consider that it is currently possible to adequately understand the probability that sediment will reach these sites. Therefore, I believe it is hard for any expert to reasonably assess the potential impacts of this proposal.

47 In my opinion LPC has not provided all the information we require to know with any degree of certainty if the large (by New Zealand standards) capital dredging phase (or phases) can be managed without irreversible change to the ecology and associated values of Whakaraupō / Lyttelton Harbour, Koukourāta / Port Levy and Southern Pegasus Bay.

ONGOING NGĀI TAHU ENGAGEMENT ON TECHNICAL ISSUES RELATED TO ADAPTIVE MANAGEMENT

48 In the final section of my evidence I discussed the form of any ongoing engagement with LPC on technical matters through something like the TAG. The purpose of this was to make clear to the panel that just the existence of the TAG, or something like it, would not necessarily guarantee that these remaining technical issues can be solved. I see no particular disagreement from LPC expert witnesses on the challenges or effort required to 'make the TAG work'.

¹¹ As described in the evidence of Ross Sneddon and confirmed during these hearings on Thursday 4 May 2017.

FURTHER RESPONSES TO LPC EXPERT WITNESSES REBUTTAL

Ross Sneddon

- 49 Regarding changes in community structure other than local extinction (**paragraph 42**). I agree. There are a range of more subtle effects which may occur, including changes in dominance. But this does not change the substance of my point that if the characteristics of the community change, so do the values associated with it.

Jared Pettersson

- 50 Regarding a 1-year minimum baseline period (**paragraph 38 – 40**). I acknowledge and appreciate the revision to the conditions to reflect that the baseline should be “at least one year” to better reflect the discussion at the TAG and the wording of the draft EMMP. This resolves this issue by allowing for baseline monitoring to continue if possible.
- 51 Regarding sub surface monitoring (**paragraph 41 – 44**). I acknowledge that the monitoring programme relies on reliable provision of real time data. I further acknowledge Ms Andersen’s experience in this matter. Nevertheless, as detailed above (paragraph 21) I still cannot reconcile the reliance of surface monitoring buoy’s with assumptions in the modelling that only allow plumes to travel downwards after release and can never resuspended. Further (again, as detailed above, paragraph 21), I cannot reconcile Ms Andersen’s evidence (see her summary presentation, slide 18) that surface turbidity in the harbour is “driven by wind” with the exclusion of wind and resuspension in the sediment plume model. Therefore, I consider that this issue is not resolved.
- 52 Regarding a relationship between benthic and surface measurements (**paragraph 45 – 49**). I am not convinced by the argument that higher and more variable data from benthic stations necessarily preclude (in and of itself) the use of direct benthic measurements for detecting changes due to dredging. Nor do I follow the logic that a specific ecological benthic trigger is needed to justify benthic monitoring because LPC are proposing exactly this approach using with the surface data.

- 53 Despite this, I accept Ms Andersen's experience and her evidence that there are data reliability and other logistical constraints on deploying benthic loggers which may make this impractical for this project. This is the only compelling reason I can see not to pursue real-time benthic data collection. I appreciate that extra depth profile monitoring has been undertaken and proposed for the beginning of the dredge campaign (as suggested by the TAG) and that benthic logging equipment has been deployed, even despite concerns about data reliability. However, this does not change the substance of my concern (detailed above, paragraph 30) that the real-time dynamics of this plume are largely unknown in most places of Whakaraupō / Lyttelton Harbour, Koukourārata / Port Levy and Southern Pegasus Bay, generally. Ms Andersen has assured us that there is a relationship between benthic and surface turbidity, but issues with data quality preclude the establishment of a robust mathematical relationship between surface and benthic time series. Because of limitations in monitoring and modelling these unknowns will remain after the dredging begins.
- 54 Regarding "background plus dredge" (**paragraph 51 – 55**). I do not disagree with using a "background plus dredge" approach as long as the model predictions are truly conservative with respect to environmental effects and those environmental effects have been properly considered (and agreed to) by expert ecologists. I agree with Mr Pettersson (paragraph 55) that this remains a moot point. In this sense, I question the necessity of such a detailed rebuttal from Dr Fox and Mr Pettersson on this matter. If the LPC model is correct then this activity can (in nearly every case) be managed within the envelope (or the 'IFD fingerprint') of measured background data only. If the modelling is 'done' then LPC should already be able to tell precisely where and under what conditions they are able to dredge without exceeding percentiles of background only. That, however, is not the case.
- 55 Regarding plume extents and monitoring locations (**paragraph 56 – 59**). The problem is, we do not agree at this stage on what the likely plume extents will be and therefore it is too early to determine if there are enough monitoring stations. While I can agree that the network used here is the best in New Zealand this does not logically follow that

it is sufficient for this project. The number and placement of buoys in Whakaraupō / Lyttelton Harbour certainly seems reasonable based on the results presented by LPC. If the modelling is revised as Ngāi Tahu suggests, then a reassessment using an assessment of event based plumes should be carried out to confirm this.

- 56 Regarding expert ecological opinion (**paragraph 60 – 65**). I don't believe there is any disagreement here. Rather, we seem to agree that the same modelling that is used for the trigger process, should be used for the assessment of effects. If the modelling is revised as Ngāi Tahu suggests then a reassessment of effects will be required.

- 57 Regarding implementation of adaptive management (**paragraph 66 – 73**). There was a major concern in my evidence in chief and I appreciate the clarity provided by Mr Pettersson. As detailed above, the evolved m-IFD method proposed by Dr Fox addresses my specific concerns and Mr Pettersson's comments in these paragraphs reassure me that the LPC team will implement it as designed.

- 58 Regarding attribution to natural causes and dredge vs natural turbidity (**paragraph 74 – 77**). I appreciate the clarity provided by Mr Pettersson on this matter and I support the changes to define an "extraordinary event". However, as outlined above (paragraph 40) I am concerned that a statistical model will not be used in this project. This means the project will not benefit from multiple lines of evidence to determine when an "extraordinary event" begins and ends.

Daniel Pritchard

5 May 2017