

BEFORE THE ENVIRONMENTAL PROTECTION AUTHORITY

IN THE MATTER of the E x c l u s i v e Economic Zone and Continental Shelf (Environmental Effects) Act 2012 (the Act)

AND

IN THE MATTER of an Application under Section 38 of the Act for Marine Consent by Trans-Tasman Resources Limited (TTRL) in relation to the iron sand extraction and processing application (the Application)

JOINT STATEMENT OF EXPERTS IN THE FIELD OF

EFFECTS ON MARINE MAMMALS

Dated 3 March 2017

INTRODUCTION

1. Expert conferencing of the Effects on marine mammal experts took place in person and by video conferencing on Thursday, 16th February, 2017.
2. The conference was attended by:
 - a) Dr Simon Childerhouse
 - b) Prof Elisabeth Slooten
 - c) Dr Tony Chiffings (video link)
 - d) Dr Greg Barbara (video link)
 - e) Dr Alison MacDiarmid
 - f) Mr Anton van Helden

CODE OF CONDUCT

3. We confirm that we have read the Environment Court's Code of Conduct 2014 and agree to comply with it. We confirm that the issues addressed in this Joint Statement are within our area of expertise.

SCOPE OF STATEMENT

4. Prior to attending the conference, we each read the relevant parts of the Application, the evidence and independent reports prepared by the other expert(s) and circulated.
5. The issues discussed were the list of questions directed to Childerhouse and MacDiarmid relating to effects on marine mammals as specified on pages 9 to 11 of Minute 21 issued by the EPA. These questions are copied into Table 1.
6. In relation to each of these questions, following an initial response by either Childerhouse or MacDiarmid, we discussed points of agreement and disagreement and included these in Table 1.
7. In this Joint Statement, we report the outcome of our discussions in relation to each issue by reference to points of agreement and disagreement relating to facts, assumptions, uncertainties and expert opinions / conclusions. We have noted where each of us is relying on the opinion or advice of other experts. Where we are not agreed in relation to any issue, we have set out the nature and basis of that disagreement.
8. We have also considered the draft marine consent conditions proposed by the Applicant and have considered whether they are appropriate having regard to our opinions, should the Environmental Protection Authority grant the consents sought by the Applicant.

Not all participants were available for the entire conference and Prof Slooten and Mr van Helden were therefore not present in person for the latter parts of the conference discussion.

References

9. We have referred to the following documents in our discussions:

NIWA (2015) Report 17 Assessment of the scale of marine ecological effects of seabed mining in the South Taranaki Bight: Zooplankton, fish, kai moana, sea birds, and marine mammals. NIWA Client Report No: WLG2015-13

NIWA (2015) Report 4 Habitat models of southern right whales, Hector's dolphin, and killer whales in New Zealand. NIWA Client Report No: WLG2012-28

Signed:

a) Dr Simon Childerhouse (SC)

b) Prof Elisabeth Slooten (ES)

c) Dr Tony Chiffings (TC)

d) Dr Greg Barbara (GB)

e) Dr Alison MacDiarmid (AM)

f) Mr Anton van Helden (AVH)

Table 1. Questions, responses, and areas of agreement and disagreement with regard to effects on marine mammals.

Question #	Question	Response from Childerhouse or MacDiarmid	Areas of agreement and disagreement
SC1	<p>The focus for assessing potential impacts to marine mammals has been on cetaceans. However, of all marine mammals documented within the STB and PPA, New Zealand fur seals are the most frequently sighted species.</p> <p>Seals are an indicator species of the health of a fishery, and are also known to be opportunistic exploiters of human activities.</p> <p>Do you think it would be prudent to obtain baseline information about the numbers and health of seals in and around TTR's proposed operations to enable monitoring of any potential changes in their health?</p>	<ul style="list-style-type: none"> Childerhouse notes that it would be useful to have some additional information on seals, given that they are apparently occur in small numbers in the PPA, that the nearest haul out or breeding sites are >75km away, and that the nature of the mining operation means that there are unlikely to be any direct impacts on seals, this should be a low priority. 	<ul style="list-style-type: none"> All the experts agreed that fur seals are found in the PPA and that additional pre- and post-mining monitoring would be useful to investigate potential impacts.
SC2	<p>Why were no further marine mammal surveys undertaken?</p>	<ul style="list-style-type: none"> Childerhouse noted that he had not been asked by TTR to undertake any additional surveys and directed the question to TTR 	<ul style="list-style-type: none"> All the experts agreed that additional marine mammal surveys would have provided valuable information for the DMC on marine mammals in the area affected by noise and ecological impacts from the proposed mining operation.
SC3	<p>Do you accept that the information provided by TTR includes a population survey which is inadequate for the purpose, and some habitat modelling based on anecdotal information (Slooten para 13)? Do you accept that problems include the small size of the area covered and a lack of data on sighting probability? (Slooten para 13)</p>	<ul style="list-style-type: none"> Childerhouse noted that the aerial survey by Cawthorn for TTR was not designed to estimate abundance but rather to determine the presence/absence of marine mammals in the PPA and their spatial extent. Therefore, he believes that the Cawthorn survey met its stated purpose and was adequate for the purpose of identifying cetacean occurrence in the area. He agreed that the habitat modelling was based on the incidental sightings data from 	<ul style="list-style-type: none"> All the experts agreed that the modelling was based on incidental sightings data limited to DOC, Cawthorn and MPI datasets There was disagreement about the suitability of the existing survey and modelling in describing marine mammal fauna occurrence in the PPA and the wider area that would be affected by the proposed mining operation (e.g. through noise and ecological impacts). While MacDiarmid and Childerhouse thought they were sufficient, Slooten and van Helden said that there were severe

Question #	Question	Response from Childerhouse or MacDiarmid	Areas of agreement and disagreement
		<p>the public and ships officers, and sightings by MPI fisheries observers</p> <ul style="list-style-type: none"> • He noted that the aerial survey covered the entire PPA and also the waters inshore of the PPA. Obviously, the larger area that the survey covers, the more useful it is likely to be • Childerhouse agrees that there are no data on sighting probability however this survey was not designed to estimate abundance and therefore sighting probability was not required to meet the stated objective. However, it would have been a useful addition to aid in interpretation of the results. 	<p>deficiencies in their design that negated the value of their findings. Barbara agreed. It was noted that Torres also pointed out these deficiencies in her evidence. For example, sighting probability should have been estimated, regardless of whether the purpose of the survey was to estimate the number of individual marine mammals in the area (abundance) or the number of species (presence/absence). Slooten, van Helden and Barbara consider that because only two very common species (common dolphin and fur seal) were sighted, this indicates that the survey had a very low probability of seeing even relatively common marine mammal species. Childerhouse and MacDiarmid consider that despite the apparent limitations of the survey the fact that two smaller members of the marine mammal community were sighted suggests it is unlikely that larger fauna such as blue whales would have been missed along the survey lines, if present.</p> <ul style="list-style-type: none"> • Slooten, van Helden and Barbara consider that independent data, from other research projects (e.g. research by Torres), marine mammal observers on seismic surveys, the strandings record and other data show that a much larger number of marine mammal species use the area, as indicated in the evidence of all the marine mammal experts contributing to this process. They consider the Cawthorn survey was not adequate for concluding that species that were not seen were therefore absent from or present in low numbers in the survey area. • Childerhouse and MacDiarmid both accept the evidence of Torres about blue whale occurrence in the STB but have reservations about using

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			strandings data to inform cetacean use of the PPA or adjacent waters as dead or dying individuals on the seashore may originate from over a very wide area.
SC4	In para 3 you say “If noise levels of the dredge are comparable to those of shipping as the literature suggests “	<ul style="list-style-type: none"> • This question appears to be incomplete • As stated in Childerhouse’s primary evidence, he believes that the likely noise levels from the operation are comparable to shipping noise. 	<ul style="list-style-type: none"> • All the experts agreed that the noise levels and frequencies from the proposed mining operation are currently unknown and that relevant data need to be gathered from other marine mining operations (e.g. recordings of de Beers mining operation, using modern, broadband equipment). • All the experts agreed that <ul style="list-style-type: none"> a. Information on background intensities and frequencies of underwater noise at the mining area should be obtained by TTR over a period of a least 1 year before mining starts. It was noted that NIWA is collecting broadband underwater noise information from the STB and analysis of these data would help to define existing background noise levels and therefore cumulative noise impacts. b. The lack of information on the noise signatures (frequency and intensity) of individual operational components and the resultant operational noise profiles at various stages of operations has not been adequately described at this time. • There was disagreement about whether the sound produced from the TTR operation would or would not be comparable to shipping noise.
SC5	In para 10 you say that you have not undertaken any field studies in relation to this proposal. Why not?	<ul style="list-style-type: none"> • Childerhouse was not asked to undertake any field studies by TTR. The baseline survey was undertaken by Martin Cawthorn Associates and Childerhouse was only asked to review it by TTR and directed the question to TTR. 	<ul style="list-style-type: none"> • All the experts agreed that additional marine mammal surveys would have provided valuable information for the DMC on marine mammals in the area affected by noise and ecological impacts from the proposed mining operation.

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SC6	<p>Do you accept that noise produced by the mining operations may directly disrupt blue whale foraging, cause blue whales to move out of important feeding areas, interfere with blue whale communication causing loss of feeding or mating opportunities, cause changes in vocal behaviour patterns with subsequent energetic consequences, and induce increased physiological stress that compromises blue whale health? (Torres para 9)</p>	<ul style="list-style-type: none"> • Childerhouse does not agree with this very broad statement. • In his primary evidence, he undertakes an assessment of potential noise impacts (e.g. Table 2) and conclude that behavioural, rather than physiological effects (e.g. Temporary or Permanent Threshold Shift in hearing) are likely to be of more concern for blue whales. Overall, while the risk of behavioural disturbance is low to moderate, this effect will only be evident in the area immediately around (e.g. ~2km) the operation • Childerhouse also noted that if TTR Condition 12 was accepted, then there is unlikely to be any impacts on blues whales outside the immediate operational area. 	<ul style="list-style-type: none"> • There was disagreement on this issue as there was a range of views on the likely impacts from noise. • The experts agreed that one of the potential impacts of the proposed mining operation is displacement of blue whales and other species from areas that may be important for feeding, breeding or other critical activities. • Van Helden and Slooten summarised data from research on the behavioural and other impacts of noise on whales and dolphins. It is noted that Torres also included relevant research in her evidence.
SC7	<p>Do you accept that the expected sediment plume from the mining operations may impact the distribution and availability of <i>N. Australis</i> (krill), thus reducing the foraging ability and efficiency of blue whales (Torres para 9)?</p>	<ul style="list-style-type: none"> • Childerhouse noted that he was not an expert on krill and sediment plumes and referred to the information provided in MacDiarmid et al. (2015b) which reported that there should be negligible effects of mining 50 Mt per annum according to standard evaluation criteria. This is principally because the scale of the mined area and the areas of elevated suspended sediment concentrations are small compared to the area used by the populations of these species. Consequently, they are likely to be displaced from, or experience a decrease in prey abundance or availability over a very small part of their distribution. Furthermore, marine mammals are highly mobile and have ample opportunity to avoid the discharge plume. 	<ul style="list-style-type: none"> • All the experts agreed that it isn't known if the area impacted by the sediment plume is a preferential area for marine mammal foraging and therefore it would be useful to investigate this. • There wasn't agreement on the likely impact on krill and therefore blue whale foraging from the expected sediment plume. MacDiarmid and Barbara did not think there would be significant impacts on krill abundance due to the plume.

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		<ul style="list-style-type: none"> This issue is also covered by MacDiarmid in her response to questions AM28 and AM29 below 	
SC8	Do you accept that the STB is an important habitat and foraging area for blue whales?	<ul style="list-style-type: none"> Yes. Childerhouse agreed that some parts of the STB are an important habitat and foraging area for blue whales. 	<ul style="list-style-type: none"> All the experts agreed with this statement.
SC9	Do you accept that Blue whales have extreme energy demands, and each disturbance to their feeding opportunities and success rate can impact their viability and reproductive capacity. Added noise, habitat impacts, prey disturbance and vessel density in the STB by the mining operation would add physiological and behavioural consequences and burdens to blue whales already living within an impacted and compromised ecosystem? (Torres para 9)	<ul style="list-style-type: none"> Childerhouse doesn't agree that blue whales have extreme energy demands but rather that they have energy demands consistent with normal biological process such as growth and reproduction. They do require large amounts of krill to eat but are highly adapted to efficiently find, catch, and consume large amounts of krill to meet these needs. He agrees that any disturbance to foraging efficiency could result in negative impacts for blue whales and that any increase in cumulative impacts needs to be carefully considered. However, for the reasons provided above for question SC7 the impact of the proposed mining operations on foraging opportunities and thus on energy supplies and reproductive capacity is likely to be negligible. Childerhouse noted that the STB ecosystem is certainly already impacted by a number of human activities. The degree to which it is compromised is unclear. 	<ul style="list-style-type: none"> All the experts agreed that any new activity has the potential to have an effect on a species or population. However, an impact has to be significant before it will have negative effect on that species or population. Several individual impacts which are insignificant on their own, may add up to a significant cumulative impact. All the experts agreed that Antarctic blue whales are endangered and pygmy blue whales are classed as data deficient by the IUCN and therefore require careful consideration of effects. If the mining operation impacts a relatively small part of their habitat/foraging area, then any effect may be acceptable. However, if the mining operation impacts a large proportion or important area of their habitat/foraging range, then it is likely to lead to significant impacts.
SC10	Do you accept that with every increase in anthropogenic activity in the STB region, the risk of vessel strike of a blue whale increases? (Torres para. 33)	<ul style="list-style-type: none"> Yes Childerhouse agrees in that adding even one additional vessel will increase the risk of vessel strike. However, the additional amount of expected vessel traffic from the TTR operation is negligible compared with existing traffic levels transiting the region. 	<ul style="list-style-type: none"> All the experts agreed that as vessel speed increases, the risk of vessel strike to marine mammals increases and therefore vessel speed should be reduced wherever possible. For example, modelling has demonstrated that if vessel speed is

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			<p>reduced to 10 knots, this will significantly reduce both the risk and mortality rate of vessel strike.</p> <ul style="list-style-type: none"> • All the experts agreed that consideration should be given to including vessel strike issues in the EMMP.
SC11	<p>Do you accept that the conservation status and cumulative impacts for Māui dolphin are of serious concern? (Slooten para. 18.1)</p> <p>Do you accept that there is still considerable overlap between Māui dolphins and fisheries in the area, which is likely to be exacerbated by the mining and the sediment plume resulting from the mining. (Slooten 18.1)</p>	<ul style="list-style-type: none"> • Yes – Childerhouse agrees that cumulative impacts are of significant concern for Māui dolphins. • He also agrees that there is significant overlap between fisheries and Māui dolphins across most of their range but believe that the inshore waters of the STB are at the limit of the southern range of Māui dolphin and that Māui dolphins are present in extremely low numbers (e.g. Currey et al. (2012) reported that Māui dolphin density was less than 0.0005 Māui dolphin per square nautical mile inshore of the proposed mining area). 	<ul style="list-style-type: none"> • All the experts agreed that the STB is an important area linking Māui and Hector's dolphin habitat. • All the experts agreed that any additional impact on Māui dolphins will be unsustainable and therefore should be avoided. • There was no agreement on the density and likely abundance of Māui dolphins in the STB. • There is a very high level of uncertainty about Māui dolphin distribution, due to the very low population size of Māui dolphins and therefore it would be extremely difficult to robustly describe their distribution.
SC12	<p>Do you accept that a detailed assessment of the conservation implications of the proposed mining, including cumulative impacts, will be essential in order to provide the DMC with enough information to make a science-based appraisal of the potential impacts of the proposed mining on marine mammals, in particular for Māui dolphins which are already at an extremely high risk of extinction (Slooten 18.1)</p>	<ul style="list-style-type: none"> • Yes – Childerhouse agreed that it is important to carefully consider cumulative impacts of any activity, especially for species at high risk of extinction. • He believed that there is sufficient information available presently to make a science based assessment of the scale of the impact of the proposed operations on marine mammals, including Māui dolphins. 	<ul style="list-style-type: none"> • All the experts agreed that it is important to carefully consider cumulative impacts of any activity, especially for species at high risk of extinction. • There was no agreement about whether there is sufficient information available presently to make a science based assessment of the scale of the impact of the proposed operations on marine mammals, including Māui dolphins.
SC13	<p>Do you accept that TTR have failed to provide either measurements of the noise made by the proposed mining operation (ships, generator and dredge to be used) or measurements of the background “ambient” noise off Taranaki? (Slooten para. 15)</p>	<ul style="list-style-type: none"> • Yes – Childerhouse agrees that there are no actual measurements of the noise likely to be produced from the mining operation nor of ambient noise for the proposed PPA. 	<ul style="list-style-type: none"> • All the experts agreed that there are no actual measurements of the noise likely to be produced from the mining operation nor of baseline ambient noise for the proposed PPA.

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SC14	Why did TTR perform no actual assessment of the ambient noise levels at the mining site? (Torres para 37) rather only of Lyttelton Port for only 15 minutes? Do you accept that the Lyttelton recorded sound is surprisingly high (Slooten para. 15.8)?	<ul style="list-style-type: none"> Childerhouse noted that he had not been asked by TTR to undertake ambient noise measurements but that he understood that Hegley had attempted it at the PPA and directed the question to TTR. 	<ul style="list-style-type: none"> All the experts agreed that there is no relevance of acoustic data collected from Lyttelton Harbour to the PPA.
SC15	Do you accept that ambient ocean noise is highly site specific, as well as variable temporally? (Torres para 37, Slooten para 15.7))	<ul style="list-style-type: none"> Yes - Childerhouse agrees. 	<ul style="list-style-type: none"> All the experts agreed that ambient ocean noise varies substantially from location to location and from time to time .
SC16	Do you accept that there is no information on local sound propagation conditions that will impact the distance sound will travel (because these local conditions were never measured) (Torres para 42) And do you accept that sound propagation depends strongly on underwater topography, benthic substrate and water temperature (Slooten para. 15.7)	<ul style="list-style-type: none"> Yes - Childerhouse agrees. 	<ul style="list-style-type: none"> All the experts agreed with this statement.
SC17	Do you accept that each sound increase contributes to the behavioural and physical consequences to ocean animals, including blue whales (Torres para 49)?	<ul style="list-style-type: none"> Childerhouse noted that not all increases in sound will necessarily lead to an impact on marine mammals. Only those increases that lead to overall levels of noise passing a certain threshold will have a significant effect. This applies to both single and cumulative effects. 	<ul style="list-style-type: none"> All the experts agreed that increases in sound contribute to behavioural and physical consequences for marine mammals, including blue whales, and to the overall cumulative effects of human activities on these species.
SC18	<p>You have not estimated sound levels and frequencies at various distances have you?</p> <p>And do you accept without this information and without marine mammal surveys, you are unable to predict effects on specific marine mammal species at different distances?</p>	<ul style="list-style-type: none"> Childerhouse undertook analysis of estimated sound levels at various distances from the source in Table 2 of my primary evidence. I did not undertake an analysis of the frequency spectra by distance but instead took the conservative approach and assumed that the broadband level was the same for all frequencies (e.g. non-weighting of frequency species impacts). 	<ul style="list-style-type: none"> All the experts agreed that some species (e.g. beaked whales, porpoises) have a higher sensitivity to anthropogenic noise than others and so these species should be considered separately. There was disagreement on the likely impact of noise on marine mammals. Van Helden and Slooten reported on recent literature showing harbour porpoise responding to noise up to 50 km from the source of the noise,

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		<ul style="list-style-type: none"> As noted in Childerhouse’s primary evidence, there are very few species-specific thresholds for noise impacts available and therefore I followed the approach of Southall et al. (2007) who assessed impact by group for low, medium and high frequency cetaceans rather than for specific species as the data is simply not available for 95% of species. Table 2 of Childerhouse’s primary evidence provides estimates of received sound levels at increasing distances from the source and an assessment of the likely impact on marine mammals at that distance based on published criteria for threshold based on Southall et al. (2007). 	<p>data on stress levels in cetaceans due to noise and other impacts of noise on marine mammals.</p> <ul style="list-style-type: none"> All the experts agreed that the lack of information on the intensity and frequency range of the noise from the proposed mining operation means it is not possible to determine the likely impacts on marine mammals, including physical and behavioural effects.
SC19	<p>Do you accept that the plume will cause impacts on ecosystem productivity through reduced light penetration and subsequent change to the zooplankton community, including <i>Nyctiphanes australis</i> (krill), the target prey item of blue whales in the region? (Torres para 51)</p> <p>And do you accept that that with increased sediment in the water column dense patches of <i>N. australis</i> – needed by blue whales to survive – may be less numerous, more difficult to detect, and occur in unusual areas that reduce availability to whales (Torres para 51)?</p>	<ul style="list-style-type: none"> Childerhouse noted that he was not an expert on krill and sediment plumes and referred to the information provided in MacDiarmid et al. (2015b) which is summarised above under question SC7. Krill have been found throughout the STB and its distribution is likely to be highly variable within seasons and among years. For this reason, it is reasonable to assume the foraging area for blue whales includes the whole of the STB. On this basis, MacDiarmid et al. (2015) concluded that the area of the STB occupied by the plume that may affect krill and therefore blue whales was negligible. This issue is also covered by MacDiarmid in her response to questions AM28 and AM29 below 	<ul style="list-style-type: none"> All the experts agreed that the sediment plume is likely to have ecological impacts, some of which will affect marine mammals using the area. There was no agreement on the impact of the sediment plume on blue whale foraging.
SC20	Do you accept that there is an important biomass of <i>N. australis</i> in the STB with an unknown distribution (spatially or	<ul style="list-style-type: none"> Childerhouse noted that he was not an expert on krill and sediment plumes and referred to the information provided in 	<ul style="list-style-type: none"> All the experts agreed that impacts on the foraging area of blue whales should be avoided.

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	<p>seasonally), yet the studies that do exist show increasing abundance toward the proposed mining site, and therefore, habitat disturbance that impacts prey availability for blue whales in this area should be considered and avoided? (Torres para 53)</p>	<p>MacDiarmid et al. (2015b) which is summarised above under question SC7.</p> <ul style="list-style-type: none"> Childerhouse agrees that impacts in the foraging area of blue whales should be avoided wherever possible. 	
SC21	<p>Do you accept that in conclusion, “it is naive to think that a 35 year mining project within the STB region will not impact this population of blue whales, through elevated noise within their frequency range, habitat displacement, vessel impacts, and prey disturbance.” (Torres para 58).</p> <p>And do you accept that the absence of credible, scientifically robust data on background noise and the noise produced by the mining operation mean that it is not possible to determine the impact of the noise from the proposed mining operation on marine mammals, nor to develop conditions relating to noise (Slooten 15.9)</p>	<ul style="list-style-type: none"> Childerhouse does not believe that there will be any significant impact on blue whales from any of these issues for the following reasons: <ul style="list-style-type: none"> TTR condition 12 will limit noise from the operation to levels that minimise any impact on blue whales While the possibility of habitat displacement exists, if it occurs it is likely to only be around the immediate area (e.g. within 2km) of the operational activity which represents only a very small part of the total foraging area of blue whales in the region, and There is unlikely to be significant prey disturbance, and if it does occur, it is likely to only be around the immediate area (e.g. within 2km) of the operational activity which represents only a very small part of the total foraging area of blue whales in the region. He noted that information on noise and ambient levels are not required for an assessment of impact as Condition 12 sets a maximum allowable level of noise from the operation. Therefore, the operation must comply with this condition and no louder noise will be permitted. The noise level 	<ul style="list-style-type: none"> All the experts agreed that the proposed number of acoustic recorders inside and outside the PPA was insufficient to provide baseline information on the range of species potentially present in the area. Data from a more extensive array of acoustic recorders would be extremely valuable to the DMC in their decisions on whether to approve or decline the application for resource consent. The experts did not agree on whether Condition 12 would be an effective mitigation tool. Problems with condition 12 were discussed, including: The threshold level is arbitrary and very high. The method proposed for monitoring noise is inadequate. The sighting probability of marine mammal observers is typically very low which means that some (unknown number of) marine mammals would be exposed to levels between 135 and 188 dB. There was disagreement on the likelihood and nature of impact from noise for the operation. van Helden, Slooten and Barbara noted that a consent that calls for an agreed level is problematic. The level set at 135 dB and considered “conservative” by Childerhouse, is not conservative by international standards. The level was set by expert conferencing at the previous application by TTR for this consent. There is considerable new

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		<p>specified in Condition 12 has been set to minimise impacts on marine mammals based on published international studies (e.g. Southall et al. (2007).</p>	<p>information and papers on such levels and the responses of marine mammals to anthropogenic noise. An independent conferencing by marine mammal acousticians would be helpful to provide the DMC with an up to date understanding of these impacts. As it stands the 135 dB is over a ten-fold increase on levels used by NOAA at 120dB. There are also considerable issues with how and where the sound would be measured. There are multiple noise sources and so there is difficulty in determining where the sound should be measured. The current proposal of condition 12 calls for a measurement at a nominal 10m depth rather than maximum over depth that could only be derived from full spectrum modelling.</p>
AM27	<p>In paragraph 107 (d) on Māui’s dolphins you are relying on modelling, correct? Not on surveys? Why were no surveys undertaken? Does your conclusion stand that “mining 50 Mt per annum is likely to have negligible effects on this species” if one Māui’s dolphin is killed or displaced or reproduction is affected by mining?</p>	<ul style="list-style-type: none"> • Yes, Childerhouse agrees that the assessment relies on modelling the distribution of Hector’s and Māui dolphins based on incidental sightings by the public, ships officers and MPI observer sightings. • He noted that a survey by Martin Cawthorn Associates Ltd (2013) was undertaken. • MacDiarmid stated her understanding that Māui is a sub-species (i.e. very closely related to southern populations called Hector’s dolphin). If a single Māui dolphin was killed through displacement or changes in the availability of abundance of prey, then her assessment of risk to this population would increase. However, given the available information about Māui distribution and its use of turbid water the likelihood of a death from the mining activities is very unlikely. 	<ul style="list-style-type: none"> • All the experts agreed that it will be very difficult to ascribe ultimate cause of death from a dead beach cast marine mammal and so the occurrence of a dead marine mammal near the mining area may not provide much insight into causation. Nonetheless, all the experts agreed that every dead marine mammal should be formally autopsied to provide possible indications of cause of death, tissue samples taken for genetic and ecotoxicological analysis, and analysis of sound reception capability. • All the experts agreed that any additional impact on Māui dolphins will be unsustainable and therefore should be avoided. The likelihood of impact on Māuidolphins is very poorly known. This is partly because it is very difficult to determine the number of Māui dolphins using the area that would be affected by the proposed mining operation, and partly because the potential impacts of the proposed mining operation are very poorly known

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			(e.g. lack of relevant data on noise, uncertainty about impacts from sedimentation). Even if it could be established that the number of Māui dolphins in the area affected by mining were low, this would still result in a situation of low probability of impact but very serious consequences of any impact that does occur. Potential mining impacts (e.g. direct impacts such as noise and ship strike or indirect impacts such as displacement or ecological impacts) could push the Critically Endangered Māui dolphin beyond the point of no return.
AM28	In paragraph 107 (a) you discuss blue whales. Do you accept Dr Torres findings that the STB is an important habitat and foraging area for blue whales? (Torres para 9)	<ul style="list-style-type: none"> • Yes, MacDiarmid cites Torres in MacDiarmid et al. (2015). 	<ul style="list-style-type: none"> • All the experts agreed that the STB is an important habitat and foraging area for blue whales and note their previous agreement for question SC8.
AM29	Do you accept that the mining may affect <i>Nyctiphanes australis</i> (krill) and therefore blue whales? (Torres para 9)	<ul style="list-style-type: none"> • This issue is also addressed in question SC7 and SC9 above. • MacDiarmid noted that krill have been found throughout the STB and its distribution is likely to be highly variable within seasons and among years. For this reason, it is reasonable to assume the foraging area for blue whales includes the whole of the STB. On this basis, MacDiarmid et al (2015) concluded that the area of the STB occupied by the plume that may affect krill and therefore blue whales was negligible. 	<ul style="list-style-type: none"> • There was disagreement on the impact of the plume on blue whale foraging.
AM30	Is your finding of negligible impacts affected if one blue whale was known to forage in the “in the vicinity of the proposed mining areas”?	<ul style="list-style-type: none"> • MacDiarmid’s assessment assumed that blue whales forage over the whole of the STB, including the PPA, thus my assessment would not alter if a single blue whale was observed to forage in the area affected by mining. The natural variability in the availability of krill in the area is known and expected and is likely 	<ul style="list-style-type: none"> • There was no agreement with the statement that the availability of krill in the area is likely to have a bigger impact on where blue whales forage than the impact of the proposed mining. • All the experts agreed that the potential impacts of the mining (including noise and sedimentation) would affect a much larger area than the PPA.

Question #	Question	Response from Childerhouse or MacDiarmid	Areas of agreement and disagreement
		<p>to have a much bigger impact on where blue whales forage than the impact of the proposed mining.</p>	
AM31	<p>At paragraph 108 f you discuss cumulative impacts. Do you accept that noise can be a cumulative impact? Why did you not measure it?</p>	<ul style="list-style-type: none"> • Yes - MacDiarmid agrees noise can be an impact. • She noted that NIWA was not commissioned by TTR to undertake assessments of underwater noise. This question is best addressed to TTR. 	<ul style="list-style-type: none"> • All the experts agreed that noise can be an impact on its own and by contributing to the cumulative impact
AM32	<p>How about other disruption by ship activities? You do not discuss ocean acidification. Can this be a cumulative impact?</p>	<ul style="list-style-type: none"> • MacDiarmid noted that the likelihood of vessel strikes can be mitigated by reductions in vessels speeds. • For vessel noise see responses by Dr Childerhouse above. • MacDiarmid noted other possible vessel activities that could cause disruption to marine mammals (e.g. rubbish, discharges, oil spills) are addressed by other TTR witnesses. • MacDiarmid discusses the potential impacts of ocean acidification and cumulative impacts in paragraphs 108-110 of my evidence. 	<ul style="list-style-type: none"> • All the experts agreed that the effects of the proposed mining operation should be evaluated in terms of how they add to cumulative impacts already affecting marine mammals in the area (including noise and ship strikes from existing shipping, fishing and other existing impacts).