

Ecotoxicology Joint Witness Statement

BEFORE THE ENVIRONMENTAL PROTECTION AUTHORITY

IN THE MATTER of the Exclusive 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 ECOTOXICOLOGY

Dated: 13 February 2017

INTRODUCTION

- a. Expert conferencing of the Ecotoxicology experts took place in person/ by telephone / or by videoconference on 13th February.
2. The conference was attended by the following experts:
 - a. Dr Mark James (in person)
 - b. Dr Ngaire Phillips (by teleconference)
 - c. Dr Tom Cresswell (by video conference)

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. In our conference we discussed the ecotoxicology issues relevant to the Application which arise within our field of expertise. Prior to attending the conference we each read the relevant parts of the Application, the evidence, independent reports prepared by the other expert(s) and circulated a summary of issues raised by Dr Cresswell (representing EPA).
5. The issues are:
 - a. Potential effects of higher heavy metal and nutrient and nutrient concentrations inshore (MJ only)
 - b. Relevance of Vopel 2014 reports and why not read? (MJ only)
 - c. Use of CORMIX, cautionary note and relevance to assessments (MJ only)
 - d. Why was area around EEZ boundary not sampled? (MJ only)
 - e. Uncertainty around variation in iron sand properties associated with depth and area sampled for ecotoxicity determinations (MJ only)

- f. Inclusion of analysis of metals attached to suspended sediments in monitoring programme
 - g. Water, sediment and suspended sediment monitoring to include mercury, antimony, silver and arsenic (also manganese and selenium?)
 - h. Details of biomonitoring/ecotoxicology plan, including choice of organisms for biomonitoring
 - i. Monitoring metals in discharge of resalinated water from the FSO vessel.
 - j. Undertaking chronic toxicity tests/bioaccumulation tests on locally relevant species for Ni and Cu.
6. In relation to each issue we discussed points of agreement and disagreement in relation to:
- a. Facts;
 - b. Assumptions;
 - c. Expert opinions / conclusions;
 - d. Areas of uncertainty or lack of information;
 - e. Conditions and monitoring
7. In this Joint Statement we report the outcome of our discussions in relation to each issue including points of agreement and disagreement relating to facts and assumptions, uncertainties or lack of knowledge, expert opinions / conclusions and monitoring. We have noted where each of us is relying on the opinion or advice of other experts. There are no areas that we were not in agreement in relation to any issue.
8. We have also considered the draft consent conditions and monitoring 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.

LIST OF ISSUES AND DISCUSSION

(List of specific questions for MJ and responses also attached at the back)

9. *Potential effects of higher heavy metal and nutrient and nutrient concentrations inshore (MJ30)*

The surf zone and clams were not specifically assessed as modelling predicted levels of metals would be negligible and effects undetectable by the time the plume reached the coast. It will also only reach the coast under certain wind and tide conditions. Inshore regions are areas of strong physical drivers and fine sediment is rapidly advected offshore, i.e. does not accumulate.

Based on typical nutrient levels in sediments and rapid mixing Larry Cahoon (in his evidence) estimated that the increase in nutrients will be negligible away from the ISR site and this would certainly apply to the inshore region. Therefore, algal blooms associated with operations are highly unlikely.

10. *Relevance of Vopel 2014 reports and why not read? (MJ31)*

The 2014 reports are evidence and supplementary evidence and basically summarise the report findings from 2013. Additional comments in the evidence that were not in the 2013 report are addressed below.

11. *Use of CORMIX and cautionary note and relevance (MJ31-33)*

There does not appear to be any mention in Vopel's 2013 report or evidence in 2014 that mentions CORMIX. Dilutions were mentioned in evidence based on modelling by Mark Hadfield which showed rapid dilution away from the discharge point.

12. *Why was area around EEZ boundary not sampled? (MJ34)*

The focus was on representative areas to be mined. Monitoring for baseline and ongoing programme includes a wider area, including nearshore and inside the EEZ boundary.

13. *Uncertainty around changes with depth and area covered (MJ35, 36)*

There will still be variation no matter how many samples are taken. It is not possible to sample everywhere. Baseline and ongoing monitoring will address this issue, and monitoring of the discharge, which was recommended by Vopel, will account for variability as the ISR moves to a different area.

14. *Recommend inclusion of dissolved metal monitoring, mercury, antimony, silver and arsenic (also manganese and selenium?) and metals in suspended sediments (from TC)*

The monitoring plan includes sampling just above the seabed (1 m), as well as collection of a sediment core. This is considered appropriate as the sites are focussed on the predicted plume, will provide long-term monitoring and address the issue of long-term exposure of sediments and biota on and in the seabed.

Metals in pore water as well as attached to particles are important as the latter are directly consumed and can bioaccumulate. It was agreed that both sources of contaminants should be analysed and be noted in the BEMP and EMMP, rather than just total recoverable metals. For particulate analyses the focus should be on the < 63 µm fraction.

It was agreed that the list of metals analysed by Vopel was appropriate. While it was considered that other metals such as mercury, antimony, silver and arsenic are likely to be at low levels these should be included in at least the BEMP as they are included in ANZECC recommendations with guideline values but have not been measured to date. There was some discussion around selenium and manganese and it is recommended that these be included in the BEMP for characterisation.

It was also recommended that sediment samples be analysed for acid volatile sulphides (AVS) as undertaken by Vopel rather than total free sulphides, as AVS provides a more direct indication of bioavailability potential than total free sulphides when compared against simultaneously extractable metals (SEM; dilute acid extractable).

15. *Details of biomonitoring/ecotoxicology plan, including choice of organisms for biomonitoring (from TC)*

There was some discussion on the difference between biomonitoring and ecotoxicity testing. The ANZECC guidelines are based on a tiered approach whereby if testing shows a risk that species will not be protected then ecotoxicity tests should be performed. It was considered that laboratory tests with relevant species, including larval and adult life stages and lethal and sub-lethal endpoints,

exposed to metals from dilute-acid extraction and local sand ground to its smallest size during ISR, is the best way to assess ecotoxicity. We recommend that ecotoxicity tests be conducted during the baseline period and then if concentrations of dilute-acid extractable metals or dissolved metals (<0.45 µm filtered) exceed the 95% protection level of the ANZECC/ARMCANZ sediment and water quality guidelines respectively at sites further than 1 km from the ISR site (to take into account dilution and mixing) and are above background levels.

Bioaccumulation on the other hand is where organisms such as shellfish accumulate metals over time, thereby potentially presenting a risk to human health via consumption. Monitoring for potential bioaccumulation is best done in-situ. Rebuttal evidence of Dan Govier notes that this is now part of the monitoring programme but the experts agreed that it should use relevant local species and be limited to key sites (1 km for the edge of the ISR and a site at the Traps). Because the plume modelling indicates the chance of metals brought to the surface (at concentrations higher than at present), reaching the coast is negligible, if at all, then this should be conducted at a few key sites during the baseline and then in the plume every 2 years and be focussed on bioaccumulation of the same suite of metals as for the dissolved and particulate analyses. We recommend that analysis of biomarkers representative of sub-lethal effects to the shellfish also be undertaken as part of this biomonitoring.

16. *Monitoring metals in discharge of resalinated water from the FSO vessel.*
(From TC)

The addition of monitoring the discharge for key metals was proposed by Vopel in his evidence to the first hearing and is considered appropriate. This will address variability as the ISR moves to a new area as well as characterisation of what is discharged and in what form (dissolved vs attached to particles). It is recommended that samples also be taken from the resalinated water to characterise the discharge and confirm that there are no metals at levels of concern in this source. This only needs to be undertaken every 6 months.

17. Undertaking chronic toxicity tests/bioaccumulation tests on locally relevant species for Ni and Cu (*NP evidence and from TC*)

It is recommended that one-off chronic ecotoxicity tests with locally-relevant species at early life stages be undertaken to determine their sensitivity to dissolved and particulate nickel and copper. This would address the potential long term effects of these metals on sensitive life stages.

FACTS

18. We agreed on all facts set out earlier in response to issues and questions raised.

ASSUMPTIONS

19. We agree on all the assumptions used in the above discussion in relation to the issues/questions. In addition we all agree that dilution and mixing will rapidly dilute concentrations below trigger levels and will not impact on the nearshore environment but may impact on the small area immediately near the ISR operations and for a small distance downstream. The issue of changes in the concentrations of nickel and copper background concentrations due to sustained operations can be addressed through the BEMP and EMMP which will monitor these concentrations (in dissolved and particulate form) to confirm predictions of low risk.

EXPERT OPINION/CONCLUSIONS

20. In our opinion the issues around ecotoxicology are important to the application, because even though the evidence indicates that most metals are at similar concentrations at the surface of bed sediments as they are at depth, Ni and Cr concentrations were found to increase with depth and thus mining operations could expose biota to higher concentrations than those currently present in surface waters. In addition, the process of crushing and extracting the iron ore will reduce the sediment grain size and elutriate tests indicate that Cu and Ni concentrations increase with smaller grain size; thus both dissolved and small particulate concentrations of metals may represent a potential risk.

21. In our opinion the additional metals to be monitored and the approach to analyses will not change the conclusions that risks will be negligible once sufficient dilution occurs but it is important to confirm these assumptions.
22. Monitoring of the discharge and sediments and water just above the seabed downstream of mining activities will be important to confirm that, beyond the immediate plume area, concentrations will not result in increased risk of ecotoxic effects to biota.

UNCERTAINTIES

22. We agree that there is enough information to make a valid assessment of potential risks for the metals analysed.
23. We agree that there are some aspects of metal contaminants which would benefit from further characterisation of the natural levels and the discharge during operation. While we do not expect these to affect our current assessment of the potential risk to aquatic biota, it is important that monitoring provide confirmation that this is the case.
24. The following matters relating to uncertainty are not agreed: No disagreement
25. We agree that addressing the following matters through monitoring would assist in confirming the assessment of ecotoxicity potential:
 - a. Additional metals analysed as part of BEMP;
 - b. Including soluble and particulate metals in the assessment;
 - c. Including monitoring of the discharge in the sampling as part of the EMMP; and
 - d. Undertaking toxicity tests of Cu and Ni to determine the sensitivity of early stages of locally relevant aquatic species.

MATTERS FOR THE DMC'S CONSIDERATION

CONDITIONS AND MONITORING

27. We agree that the following conditions/monitoring which are within our area of expertise would likely be both practicable and cost effective:
- a. Analyses to include metals in the dissolved and suspended particulate fractions, as well as in deposited sediments;
 - b. Monitoring to include characterisation of the discharge as the ISR every 6 months;
 - c. Toxicity monitoring using relevant biota during baseline and subsequently if levels exceed the ANZECC guidelines;
 - d. Biomonitoring for bioaccumulation at key sites every 2 years
 - e. One-off determination of the sensitivity to Cu and Ni of early-stage locally relevant aquatic species during baseline phase.
28. We do not agree that the following conditions within our area of expertise would likely be both practicable and cost effective: Not applicable

REFERENCES

29. We have referred to the following documents in our discussions:
- Evidence of Dr Mark James, Dr Ngaire Phillips and rebuttal evidence of Mr Dan Govier for this hearing
 - Vopel, K.; Robertson, J.; Wilson, P.S. (2013). Iron sand extraction in South Taranaki Bight: effects on trace metal contents of sediment and seawater. AUT Client Report: TTRL20138. Report prepared for Trans-Tasman Resources Ltd.
 - Evidence of Dr Kay Vopel presented to first hearing and supplementary evidence (2014)

Handwritten signatures of Mark James, Ngaire Phillips, and Kay Vopel.

Approved questions on ecotoxicology and responses - Mark James (MJ)
Note all are answered

Fisheries submitters

MJ30

In her evidence, Dr MacDiarmid at paragraph [93], relating to marine effects and benthic ecology, states: "These levels of deposition are highly unlikely to clog the respiratory or feeding surfaces of benthic organisms. Organism growth and movement is sufficient to ensure that smothering will not occur at these rates of deposition over the lifetime of the operations. The NIWA modelling indicates that mining derived sediments suspended in the water column or deposited on the seafloor surf are highly unlikely to affect surf clams along the Manawatu coast or aquaculture areas in the Marlborough Sounds."

Did your analysis consider the sensitivity of surf clams to algal blooms and heavy metal concentrations?

The surf zone and clams were not specifically assessed as modelling predicted levels of metals would be negligible and undetectable by the time the plume reached the coast. It will also only reach the coast under certain wind and tide conditions. Inshore regions are areas of strong physical drivers and fine sediment is rapidly advected offshore, i.e does not accumulate.

Based on typical nutrient levels in sediments and rapid mixing Larry Cahoon estimated that the increase in nutrients will be negligible away from the ISR site and this would certainly apply to the inshore region. Therefore algal blooms associated with operations are unlikely.

Karen Pratt

MJ31

Points 95-98 of your report only discuss Vopel 2013 - why did you not read Vopel March 2014 and February 2014 as these contain important data?

The 2014 reports are evidence and summarise the report findings from 2013. Additional comments in the evidence that were not in the 2013 report are addressed below.

MJ32

Why have you not raised the issue that Vopel gave a cautionary note that the CORMIX modelling for dilution modelling was done at 20metres (which is not representative of the height of outflow)

There does not appear to be any mention in Vopel's 2013 report or evidence in 2014 that mentions CORMIX. Dilutions were mentioned in evidence based on modelling by Mark Hadfield which showed rapid dilution away from the discharge point. Mark did not use CORMIX modelling.

MJ33

Why did you not raise the cautionary note by Vopel that the Cormix modelling was not exhaustive and may not have covered the worst case?

As above

MJ34

Why has the area close to the EEZ border, approx. 23m, had no heavy metal samples taken? (Three sampling sites Christina (38–43 m water depth); two sites Diana (32–37 m water depth)).

The focus was on representative areas to be mined. Monitoring for baseline and the ongoing monitoring programme includes a wider area, including near the EEZ border.

MJ35

Vopel (Feb 2014) has an important context note, that is missing from your commentary – why? “I note, however, that uncertainty remains in regard to variations in iron sand properties across the entire TTR mining area and any changes in these properties at depth below seafloor greater than five meters.”

There can still be variation no matter how many samples are collected. It is not practical or possible to sample everywhere. Baseline and ongoing monitoring will address this question and monitoring of the discharge will account for variability as the ISR moves to a different area.

J36

From the table below you can see that not all samples were taken to 5m – why? And is this statistically sound?

Sample depth does vary but this is not uncommon with sampling these environments which is very difficult to achieve a consistent depth profile with any sediment core/sampling technique. The process undertaken is considered statistically and methodologically sound.