BEFORE THE ENVIRONMENTAL PROTECTION AUTHORITY
AT WELLINGTON

IN THE MATTER	of the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012
AND	
IN THE MATTER	of a decision-making committee appointed to hear a marine consent application by Trans Tasman Resources to undertake iron ore extraction and processing operations offshore in the South Taranaki Bight

---

EXPERT EVIDENCE OF BARRIE MALCOLM FORREST ON BEHALF OF TRANS TASMAN RESOURCES LIMITED

15 DECEMBER 2016

ATKINS | HOLM | MAJUREY

Mike Holm/Vicki Morrison-Shaw
PO Box 1585
Shortland Street
AUCKLAND 1140

Solicitor on the record	Mike Holm	Mike.Holm@ahmlaw.nz	(09) 304 0428
Contact solicitor	Vicki Morrison-Shaw	Vicki.Morrison-Shaw@ahmlaw.nz	(09) 304 0422

Contents

EXECUTIVE SUMMARY

1. International and domestic movements of vessels and equipment can lead to the inadvertent spread of marine non-indigenous species (NIS), via transport mechanisms such as hull biofouling, and ballast water discharge from ships. Some NIS have the potential to cause adverse impacts to the New Zealand marine environment and hence represent a biosecurity risk.

2. The proposed Trans-Tasman Resources Limited (TTR) iron sand extraction project in the South Taranaki Bight will involve deployments or ongoing movements of vessels and/or equipment from overseas, as well as domestic movements of support vessels to coastal ports. TTR also propose the occasional use of Admiralty Bay in the Marlborough Sounds to enable vessels to seek shelter from adverse weather.

3. In relation to vessels and equipment from international source regions, TTR will mitigate biosecurity risks by implementing management measures that meet or exceed stringent border standards for biofouling, ballast water and sediments. In particular:

   (a) TTR has proposed consent conditions to ensure that vessels or equipment being relocated to New Zealand for the project duration are subject, to the extent feasible, to biofouling management measures that exceed the requirements of border standards.

   (b) As export vessels visiting the project area (to load the processed iron sand) may discharge a relatively high volume of ballast water, TTR will charter vessels that have ship-board ballast water treatment or other approved ballast water management systems.

4. For domestic vessels, and for on-site equipment, TTR intend to ensure that effective controls are in place so that

operational activities pose a negligible risk for NIS spread to (or among) mainland localities. In this respect, a particular focus will be effective management of biofouling.

5. I was involved in discussions with aquaculture industry representatives in relation to biosecurity risk to Admiralty Bay and the wider aquaculture industry. To mitigate risk, TTR will not use Admiralty Bay for any maintenance or operational activities, including the discharge of ballast water. Together with effective management of biofouling, I consider that TTR operations will pose a negligible biosecurity risk to aquaculture.

6. In summary, potential biosecurity risks arising from the TTR proposal can be managed to a level that I consider acceptable in the context of other sources of biosecurity risk to New Zealand. Appropriate management measures are reflected in consent conditions proposed by TTR. Included in the conditions is the requirement that TTR develop a Biosecurity Management Plan (BMP) once operational details are finalised. The BMP provides for consultation with the Ministry for Primary Industries (MPI) and the aquaculture industry, to ensure that proposed mitigation measures are comprehensive and acceptable.

INTRODUCTION

Qualifications and experience

1. My full name is Barrie Malcolm Forrest. I am a Senior Marine Ecologist at Cawthron Institute, based in Nelson.

2. I have a PhD in Marine Biology (Victoria University of Wellington), a Master of Science with first class honours in Environmental Science and Zoology (University of Auckland), and a Bachelor of Science in Zoology (University of Canterbury).

3. My expertise broadly relates to the impacts of human activities on marine ecosystems. I have worked in the field of marine biosecurity since 1997. My principal role is to undertake research and consultancy regarding biosecurity risks from potentially harmful marine organisms and their transport pathways (e.g. vessel movements), and to develop tools and approaches for risk mitigation.

4. I have authored or co-authored more than 40 peer-reviewed publications in international journals or books, mainly concerning marine biosecurity. I have also authored or co-authored more than 100 consultancy reports regarding biosecurity and broader environmental issues. I have participated in various national and international workshops or Technical Advisory Groups on marine biosecurity, and have served as an expert witness on biosecurity and other matters for Regional Council, Environment Court and Environmental Protection Authority (EPA) hearings.

5. TTR have asked me to assess the marine biosecurity risks and management needs in relation to their proposal to extract and process iron sand from the South Taranaki Bight. In April 2016 I undertook a preliminary marine biosecurity assessment for TTR that focused on sources of risk to aquaculture in Marlborough, and considered mitigation needs. These

aspects were addressed by way of a letter to TTR (Forrest 2016a) and a subsequent meeting with aquaculture industry representatives. The evidence presented below is broader, in that it considers additional biosecurity issues (i.e. beyond aquaculture) that I did not address in my preliminary assessment.

Code of conduct

6. I confirm that I have read the Code of Conduct for Expert Witnesses as contained in the Environment Court Practice Note dated 1 December 2014. I agree to comply with this Code. This evidence is within my area of expertise, except where I state that I am relying upon the specified evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Abbreviations

7. In my evidence I use the following abbreviations:

- AHT – Anchor handling tug;
- BMP – Biosecurity Management Plan;
- BWM Convention - The International Convention for the Control and Management of Ships' Ballast Water and Sediments;
- CEV/s – Bulk carrier cape-size export vessels;
- CRMS – Craft risk management standard;
- EPA – Environmental Protection Authority;
- FSO – Floating, storage and offloading vessel;
- IHS – Import health standard;
- IMV – Integrated mining vessel;
- MNZ – Maritime New Zealand;
- MPI - Ministry for Primary Industries;
- NIS – Non-indigenous species; and
- TTR – Trans Tasman Resources Limited.

SCOPE OF EVIDENCE

8. My evidence addresses marine biosecurity risks from the TTR proposal, and covers the following:

   (a) Definition of marine biosecurity and the New Zealand context;

   (b) Sources and significance of marine biosecurity risk from the TTR proposal;

   (c) Proposed measures to mitigate marine biosecurity risk associated with the TTR proposal;

   (d) Response to submissions that raised issues relating to marine biosecurity;

   (e) Comment on TTR's proposed marine consent conditions; and

   (f) My conclusions regarding the impact of the TTR proposal with respect to marine biosecurity.

ASSESSMENT OF EFFECTS

Marine biosecurity context

9. Biosecurity is the exclusion, eradication or effective management of risks posed by pests and diseases to the economy, environment and human health (Biosecurity Council 2003). Marine biosecurity in New Zealand focuses on the risks posed by NIS. To date, almost 200 such species have been introduced and become established in New Zealand, mainly via unintentional transport with human activities (Kospartov et al. 2008). The primary 'pathways' for introduction are historic and ongoing arrivals of international vessels and equipment. These include merchant ships, cruise ships, barges, fishing boats and yachts, as well as towed structures such as drilling rigs. Similar types of craft, as well as

activities such as aquaculture, can subsequently exacerbate the spread of NIS within New Zealand (Dodgshun et al. 2007).

10. Only a small subset of the NIS introduced to New Zealand are recognised as potentially harmful, usually based on evidence of adverse effects from overseas source regions. The range of species includes aquatic pathogens and parasites that are a risk to industries like aquaculture, and various 'marine pests' such as species of seaweed, crab, sea star and 'sea squirt'. Such organisms can have a range of impacts on natural marine ecosystems and associated values, such as:

- Ecological effects on species or habitats, including on conservation values;
- Effects on commercial values such as aquaculture, and fishery resources of commercial, recreational or customary importance; and
- Effects on the natural character of coastal ecosystems.

11. The key mechanisms that enable the transport of NIS by vessels and other craft or equipment are biofouling, ballast water and sediments.

(a) **Biofouling** refers to marine plants and animals that are attached to submerged surfaces in the sea. Biofouling can occur on the exterior surfaces of vessel hulls, but tends to be less prevalent on vessels that are in active use and are well-maintained. Biofouling can also occur inside recesses such as pipework, 'sea chests', and other 'niche' areas. Approximately 87% of NIS accidentally introduced to New Zealand may have been transported here by biofouling (Kospartov et al. 2008). Non-indigenous biofouling organisms can themselves impact coastal ecosystems and associated values (see below), and some species may harbour agents of aquatic disease.

(b) **Ballast water** refers to water taken on board to aid in vessel stability and control. Export vessels arriving in New Zealand carrying ballast water will discharge some of that water to offset the added weight as they take on cargo. Ballast water and associated sediment can harbour a wide variety of marine organisms, in particular planktonic organisms or life-stages (e.g. the water-borne larvae of biofouling species). Although poorly understood, it is also recognised that ballast water has the potential to carry disease-causing micro-organisms (Drake et al. 2007).

(c) **Sediment** can occur in ballast water tanks, and on anchors, chains and other equipment. Although poorly understood as a transport mechanism, it is recognised that sediment originating from earlier destinations or deployment locations of vessels may contain a variety of marine organisms, and may thus represent a potential biosecurity risk if transferred elsewhere.

Potential sources of marine biosecurity risk from the TTR proposal

12. Sources of biosecurity risk arising from the TTR proposal can simplistically be conceptualised in relation to a 'chain of events' occurring in three main stages involving the transport and introduction of NIS from overseas, subsequent establishment in New Zealand, and secondary spread from the point of first introduction.

13. In relation to these stages, the potential sources of biosecurity risk from the TTR proposal are as follows:

(a) Movements of vessels and equipment from overseas. Overseas vessels and equipment are of particular interest given their potential to introduce new species and add incrementally to the biosecurity risk to New Zealand. In these respects the following is relevant:

i. Bulk carrier Cape-size Export Vessels (CEVs) will visit the environs of the South Taranaki Bight extraction area to load the processed iron sand concentrate for transport to export markets. TTR indicate up to 30 visits per year by such vessels are possible, with ports of origin most likely being in Asia.

ii. An Anchor Handling Tug (AHT), to be based in New Plymouth, will serve as an operational support vessel. The AHT will most likely be sourced initially from overseas.

iii. Specialist vessels and equipment sourced from overseas will remain on-site to recover, process and handle the iron sand sediment. These are an Integrated Mining Vessel (IMV; c. 345 m length); two remotely-operated seabed extraction crawlers launched from the IMV; and two Floating Storage and Offloading (FSO) vessels moored adjacent to the IMV. All of these five vessels will be 'new-builds' and transported to New Zealand dry. As such, the introduction of new NIS from overseas from these vessels does not need to be considered.

(b) Movements of vessels within New Zealand. Domestic vessel movements have the potential to spread NIS to New Zealand coastal areas. If unmanaged, such movements represent a far greater risk for the regional spread of NIS than is likely to occur via natural dispersal mechanisms (e.g. drift of planktonic life-stages with water currents). Directly at risk from unmanaged vessel movements are 'mainland' localities that project-related vessels visit. These are the ports of Taranaki, Nelson and Whanganui, and Admiralty Bay in the Marlborough Sounds. TTR propose using Admiralty Bay for vessel shelter during adverse weather events. In addition to the AHT, other vessels operated domestically by TTR include a Geotechnical Support Vessel (with associated drilling equipment) based in Whanganui, and a re-fuelling vessel that services the Taranaki Basin oil and gas industry.

(c) In addition to biosecurity risk from vessel or equipment movements, the potential for NIS to establish in the vicinity of the sand extraction operations also needs to be considered, with key potential issues being as follows:

i. On-site sand extraction vessels/equipment may provide a 'reservoir' for the accumulation of NIS initially introduced by vessel or equipment movements. In particular, on-site vessels/equipment will provide surfaces for the accumulation of biofouling organisms. The accumulation of such organisms may provide a population for subsequent spread to the wider environment (i.e. by vessel-mediated or natural mechanisms of spread).

ii. The natural environment of the sand extraction area may provide suitable habitats for NIS, and operational activities that lead to seabed disturbance (both extraction and waste disposal) may facilitate the establishment of certain opportunistic species.

14. My evidence below considers the marine biosecurity risks associated with vessel and equipment movements with respect to biofouling, ballast water and sediment. I also describe the measures that TTR will adopt to negate or reduce that risk to an acceptable level. I then specifically consider issues for Admiralty Bay and domestic ports associated with TTR operations, followed by an assessment of the potential for NIS to establish in habitats in the vicinity of the sand extraction operations.

15. I focus on conceptualising and describing potential sources of risk and their significance, especially with respect to key potential mechanisms of NIS spread. Given that it is difficult to eliminate marine NIS once established in New Zealand, managing the activities that introduce such species or contribute to their spread is the most practical and effective mitigation approach. Hence, throughout my evidence I highlight the importance of ensuring that there are effective biosecurity practices in place for all project-related vessel or equipment movements.

Biofouling risk and mitigation for international vessel movements

16. The relocation of the AHT to New Zealand, and the estimated 30 annual CEV visits, represent a low level of vessel activity in the broader national context (Inglis et al. 2010; Inglis et al. 2012). For example, around 850 foreign ships visited New Zealand in 2014-2015 making over 2,300 visits and 6,200 port calls (MNZ 2015). While the majority of traffic reflects merchant ship visits, additional arrivals include other

vessel types such as cruise ships, yachts, fishing boats and barges.

17. Based on vessel activity, the biofouling risk from TTR vessels is relatively low. Nonetheless, it is appropriate to consider requirements and opportunities for minimising risk. From May 2018, it will be mandatory for vessels arriving in New Zealand territorial waters to meet border standards developed by MPI, which are outlined in a craft risk management standard (CRMS) for biofouling (CRMS 2014). Even though the iron sand extraction area is outside territorial waters, international vessels may seek shelter in territorial waters. As such, application of the CRMS is relevant for risk mitigation.

18. The CRMS requires that vessels arrive with a 'clean hull', which is defined in relation to two thresholds of allowable macrofouling (i.e. visible fouling). The threshold relevant to the CEV and AHT is that for 'long stay' vessels, which are defined in the CRMS as:

> *'… those vessels intending to remain in New Zealand for 21 days or longer, or those vessels intending to visit areas other than those designated under section 37 of the Biosecurity Act 1993 (the Act) as 'Places of First Arrival'.*

19. Even though a CEV may visit for less than 21 days, neither the sand extraction area nor Admiralty Bay are designated Places of First Arrival[1]. As such, the 'long stay' biofouling threshold will apply to the CEV. That threshold restricts allowable biofouling on all hull surfaces to a 'slime layer' and goose barnacles. The CRMS outlines four options that can be taken to meet the standard or demonstrate an equivalent level of risk mitigation. Provided the CEV meets the long stay standard or can demonstrate equivalence, marine

---

[1] Places of First Arrival are primarily New Zealand's main ports, as listed here: https://www.mpi.govt.nz/importing/border-clearance/places-of-first-arrival/.

biosecurity risk from biofouling will be Negligible due to the relatively short turnaround time of the vessels.

20. In the case of the AHT, meeting the long stay standard means the vessel will represent a very low level of risk relative to the broader context described in paragraph 16. Nonetheless, residual risk from the AHT needs to be considered, given that this vessel will periodically visit mainland locations. For example, even if the AHT has no visible macrofouling (other than goose barnacles), the slime layer may contain microscopic life-stages of macrofouling species. Such life-stages have the capacity to survive transport on vessel hulls, with a long duration deployment providing an opportunity for surviving life-stages to grow and reproduce (Schimanski 2015). To minimise risk from the AHT to the extent practical, TTR intend to identify and implement, where feasible, specific measures that exceed the requirements of the CRMS (e.g. ensuring the vessel is newly cleaned and/or antifouled immediately prior to departure for New Zealand).

21. The various approaches that TTR intends to adopt to ensure that all international vessels meet or exceed CRMS requirements are described in proposed marine consent conditions 74 and 75. These include development of vessel-specific Biofouling Management Plans, and maintenance of Biofouling Record Books that detail all inspections and biofouling management measures undertaken. These approaches are consistent with 'best practice' advocated by the International Maritime Organisation (IMO) in the 2011 'Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species' (IMO 2011).

Ballast water discharge

22. The primary source of ballast water risk from the TTR proposal arises due to CEV visits. These vessels will arrive carrying ballast water, and will discharge some of that ballast as the processed iron sand is loaded. The risk of such discharges depends on factors such as the origin of the ballast water, discharge volume and frequency, the viability and amount of organisms discharged, and discharge location.

23. I estimate that the 30 CEV visits could discharge in total between 1.7 and 5.4 million tonnes of ballast water to the project area annually. The lower estimate is based on a typical Cape-size bulk carrier being 150,000 DWT (dead-weight tonnes), with the upper estimate recognising that the largest vessels may be up to 400,000 DWT. Both estimates assume that the ballast water capacity for this vessel type ranges from 30 and 45% of the DWT (David 2015).

24. Historic MPI data for the period 2000-2008 indicate that an average of 6.5 million tonnes of ballast water of foreign origin was discharged annually to mainland New Zealand ports. However, for several ports there has been a 3 to 4-fold increase in vessel visits over the last decade, and a noticeable increase from 2014 to 2015. Accordingly, present-day ballast water discharge to mainland New Zealand ports is likely to be substantially greater than indicated by the 2000-2008 data. In addition to the mainland ports, a high volume of ballast water discharge also occurs as part of the Taharoa Iron Sand mining operation on the west coast of the North Island. Data acquired from MPI indicate an annual ballast water discharge from that operation of c. 1.5 million tonnes in the 12 month period up to October 2016.

25. In terms of TTR ballast water discharge, several factors are likely to mitigate risk. These include:

(a) The survivorship and viability of many ballast water organisms is likely to be greatly reduced during transport to New Zealand by:

i. Lengthy voyage durations in the case of ships arriving from Asia (c. 10 days' voyage duration);

ii. Voyages that cross different latitudes and climatic zones (e.g. temperate to equatorial); and

iii. Differences in environmental conditions between source and recipient regions (i.e. northern hemisphere, Asian ports vs southern hemisphere temperate offshore waters).

For example, the majority of ballast water organisms die at an exponential rate during the first three to five days in a ballast tank due to unfavourable conditions; including darkness, oxygen reduction, limited food resources and varying temperatures (Gollasch et al. 2000, Olenin et al. 2000, Zaiko et al. 2015). Particularly harsh conditions develop in ballast tanks during inter-oceanic, cross-latitudinal ship voyages when several climatic zones are traversed (Gollasch et al. 2015, Zaiko et al. 2015).

(b) Reduced retention and establishment success of propagules (e.g. aquatic animal larvae) in the exposed offshore waters and natural seabed habitats of the South Taranaki Bight; for example, due to physical dispersion and dilution processes, or lack of suitable habitat. A recent risk assessment involving 29 international biofouling experts highlighted the prevailing view that open and exposed marine environments are significantly less vulnerable to NIS incursions than relatively sheltered port environments (Barry et al. 2015).

26. Ballast water risk will be further reduced by management measures that will be implemented under New Zealand's border standards. Ballast water discharge to New Zealand's territorial waters is presently managed by an Import Health Standard (IHS) developed under the Biosecurity Act 1993 (IHS 2015). The IHS provides several options for managing risk, with mitigation to date being based on mid-ocean ballast water exchange while vessels are *en route* to New Zealand. This procedure involves flushing oceanic water into ballast tanks to displace the potentially higher-risk coastal ballast water from the port of origin. Although this method is not completely effective (e.g. the performance standard is based on 95% volumetric exchange) it has been accepted internationally as best practice for ballast water management for more than 20 years.

27. The most recent development in ballast water management has been the ratification of The International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention), which will enter into force on 8 September 2017. The BWM Convention will result in the IHS being revoked. Ballast Water Management in New Zealand will be administered by Maritime New Zealand (MNZ) under Marine Protection Rules (Part 300: Ballast Water Management) that give effect to the BWM Convention.

28. Among other things, the BWM Convention and related MNZ rules will require that international ships manage their ballast water and sediments to certain standards, according to a vessel-specific Ballast Water Management Plan. It is expected that most vessels will need to install an approved on-board system to treat ballast water to eliminate potentially harmful organisms. However, it is likely that ballast

water treatment will be phased in over a period of time; meaning that ballast water exchange to prescribed standards will continue to be used as a mitigation tool.

29. TTR have proposed a consent condition that will require all chartered international vessels that carry ballast water to have an approved ship-board ballast water treatment system in accordance with the BWM Convention. For any vessels that do not have such a system, TTR's proposed conditions state that the vessel cannot be used unless it is demonstrated that it complies with additional ballast water management options set out in the IHS or any subsequent version. In my view, this condition provides an acceptable approach to managing the issue at this time, given that few ships in the world currently have ship-board ballast water treatment systems. I comment below on the changes I recommend to the conditions to cover the coming into force of MNZ rules.

Sediment

30. The spread of marine species via sediment transfer is recognised as a potential mechanism (Casas-Monroy et al. 2011), but the exact nature and magnitude of risk is poorly understood. The release of sediment from international vessels is currently managed in New Zealand via the ballast water IHS discussed above. In the future, the discharge of sediment associated with ballast water will be mitigated by the Marine Protection Rules (referred to above), and the associated requirement for a vessel-specific Ballast Water Management Plan.

31. In terms of other potential sources of sediment, I note that the main equipment associated with project operations will be new-build (IMV, crawlers, etc). As such, the potential for transfer of sediment-associated organisms is not a relevant consideration. However, large anchors will be used to moor

the IMV and other vessels at the extraction site, and there is potential for associated equipment (e.g. wires, chains, mooring blocks) to have sediment present. Once project operational details are finalised, these types of potential risk mechanisms will be addressed via the BMP under proposed condition 75. Potential mitigation measures outlined in that condition include appropriate cleaning of equipment transferred from overseas, or acquisition of equipment (e.g. IMV anchors) from within New Zealand where feasible.

Considerations for New Zealand ports visited by TTR vessels and use of Admiralty Bay for sheltering

32. The biosecurity risk associated with TTR vessels that operate domestically and visit ports such as Nelson, Taranaki and Whanganui is likely to be very low. Whanganui is expected to be the base for the Geotechnical Support Vessel only, which is likely to be built new in New Zealand. Nelson and Taranaki already receive significant volumes of international and domestic vessel traffic. Any additional activity from TTR operations (e.g. visits by the AHT vessel) is likely to be a minor component of the overall risk profile.

33. Nonetheless, implementation of best management practices for domestic vessels will provide an additional level of assurance that biosecurity risk is being minimised to the extent feasible and practical. In the event that a new-to-New Zealand NIS established in the vicinity of the sand extraction operation, the most effective way to reduce risk to mainland localities is to ensure that domestic vessel activities represent a negligible risk as a subsequent pathway for spread. Appropriate practices to address domestic vessel risk are reflected in proposed consent condition 75. Particularly relevant for domestic vessels are practices for hull biofouling management, as ballast water is not expected to be relevant. The biofouling management approach proposed in condition 75 is consistent with the IMO (2011)

biofouling guidelines referred to in paragraph 21, and surpass accepted current practices for domestic vessel management.

34. In relation to Admiralty Bay, TTR recognise the high economic value of aquaculture in Marlborough and the wider top of the South Island, as well as existing industry experiences of adverse impacts from NIS. As such, proposed consent conditions 77 and 78 will allow TTR vessels to enter Admiralty Bay only for shelter during severe weather or for safety reasons. This need is expected to arise only infrequently. TTR will not use Admiralty Bay for any maintenance activities or operational activities, including the discharge of ballast water.

35. Together with effective management of biofouling and other potential mechanisms (e.g. sediments), I consider that TTR operations will pose a negligible biosecurity risk to Admiralty Bay and the wider aquaculture industry. Moreover, the TTR risk is likely to be very low by comparison with pre-existing risks from other sources. These sources include international vessels such as log ships, cruise ships and barges arriving in regional ports (Port Nelson, Picton and Shakespeare Bay) and transfers of NIS directly into the Marlborough Sounds by biofouling on recreational vessels (Forrest 2016b).

Potential for harmful species to establish in the sand extraction area and subsequently spread

36. I reiterate that the best way to minimise the risk of potentially harmful species establishing in the sand extraction area, or further spreading, is to implement good biosecurity management practices (as reflected in the proposed consent conditions) to ensure that project vessels and equipment are 'clean'. Nonetheless, in the event that operational activities lead to the unintentional transport of NIS to the project area, the likelihood that any such species

will subsequently establish a viable population and spread to the wider region needs to be considered.

37. The natural habitats of the project environs consist primarily of soft-sediments, although the Impact Assessment report (on p. 47-48) describes habitats in the wider area (e.g. shell hash) that may support biofouling and mobile seabed-dwelling organisms. As such, there exist a range of natural habitats potentially suitable for any organisms introduced by biofouling, ballast water and sediments. Similarly, mechanisms such as ballast water have the potential to transport species that inhabit the water column. Additionally, natural or project-related disturbance could be an exacerbating factor that facilitates the establishment of certain species. Hence, the possibility of introduced species establishing in natural habitats of the sand extraction area cannot be disregarded, but the likelihood of this eventuality in an open marine environment is low for reasons such as noted in paragraph 25(b).

38. In addition to natural habitats, the artificial infrastructure deployed in the project area (especially the IMV and FSO structures) provides a potential habitat for biofouling organisms. Existing studies of nearby oil and gas platforms show that a wide range of biofouling organisms can inhabit offshore structures (Forrest & Zaiko 2016). To mitigate this situation, TTR propose to use marine growth prevention systems, including a long-service antifouling coating on the IMV, to minimise biofouling accumulation. While this will mitigate risk to some extent, long-term antifouling efficacy is likely to be reduced by the fact that the vessels are relatively stationary.

39. In the Appendices to the Impact Assessment, TTR describe a range of additional operational measures that they plan to implement to minimise biosecurity risk to the wider

environment from sand extraction operations and related activities. These measures include: *in situ* infrastructure surveillance to detect potentially harmful species; cleaning to minimise fouling accumulation (e.g. in-water cleaning of the IMV); inspections of associated vessels (e.g. AHT and Geotechnical Support Vessel) for potentially harmful species; surveillance for potentially harmful species in nearshore habitats; and containment/ eradication plans at affected locations in the event of a wider incursion.

40. These management approaches have different levels of feasibility, efficacy, risk and cost, as follows:

(a) New Zealand experience shows that managing biofouling on large offshore structures is very difficult; for example, due to limited safe diving windows imposed by sea conditions (Hopkins & Forrest 2010; Forrest & Zaiko 2016).

(b) Related to the previous point, in-water cleaning to mitigate biofouling risk may itself lead to risks relating to the dislodgment of potentially harmful organisms and the release of antifouling contaminants (e.g. copper). In recognition of such risks, Anti-fouling and In-water Cleaning Guidelines have been developed by Australia and New Zealand (COA 2013). Related investigations have considered circumstances in which in-water cleaning (e.g. with or without waste capture) is expected to represent an acceptable level of risk from both a biosecurity and contaminant perspective (Morrisey *et al.* 2013). In the event that in-water cleaning (e.g. of the IMV) is considered feasible and is undertaken by TTR, the specific requirements for acceptable cleaning methods should be developed as part of the BMP proposed under condition 75.

(c) Experience in New Zealand and internationally is that effective NIS surveillance is difficult, and eradication of established organisms is very expensive and seldom successful, especially in the case of incursions to natural habitats (Forrest 2007; Hunt et al. 2009; Hopkins et al. 2011; Forrest & Hopkins 2013). I consider that the wave-exposed nature of the coastal environments of the South Taranaki Bight would make effective incursion response even more difficult than indicated by previous experience.

41. Accordingly, while TTR are proposing to undertake a broad range of measures, the primary mitigation focus will be to ensure that all vessels and equipment associated with the operation represent a negligible risk for the introduction and spread of biofouling and potential NIS (as discussed above).

42. It needs to be kept in mind that the possibility of new species' incursions to New Zealand, and their subsequent domestic spread, is an ongoing risk that arises from numerous vessel movements and other human activities. This is particularly the case where human activities connect sheltered coastal environments (e.g. port-to-port movements), as such localities typically provide a range of suitable habitats for NIS to establish. Nonetheless, the conditions proposed by TTR recognise that a potential risk exists, and set out the biosecurity management measures proposed to mitigate this risk.

RESPONSE TO EPA REPORT AND SUBMISSIONS

43. The EPA Key Issues report did not identify any issues relating to marine biosecurity.

44. Three of the submissions raised generic concerns regarding biosecurity risk from the proposal, on issues that have largely been addressed in my evidence above. Two additional submissions were made on matters not considered above.

Generic concerns raised in submission

45. I respond collectively to the generic concerns raised in three submissions as follows:

(a) The submission of Chris Cresswell recognised that '*ballast water may contain exotic organisms…*' and that this water may originate from Asia.

(b) Malibu Hamilton (on behalf of Te Ngaru Roa ā Maui) notes that '*TNRM raise the issue of biosecurity risks from bilge water and vessels sea chests as potential for adverse effects. There is the potential to impact on taonga species of tangata whenua along with impacts to mahinga kai and customary fisheries. The applicant has not developed any emergency plans for unplanned events. TNRM raise the issues above on potential adverse effects from vessels and while they may be seen to be effects of low probability, they are potential effects that have a high potential impact and could become significant to major*'.

(c) John Edgar (on behalf of the Waitakere Ranges Protection Society) notes that '*There could be significant biosecurity risks associated with ships and equipment coming into the area from outside the EEZ. It is vital that these risks are assessed and, if the project was to proceed, proper mitigations established to avoid establishment of any introduced marine species*'.

46. In considering these submissions, it is important to recognise that very few of the many marine NIS introduced to New Zealand (or in fact globally) have led to significant adverse impacts (e.g. impacts that are high magnitude, widespread or persistent in the long term). On the other hand, I acknowledge that the likelihood of biosecurity events

occurring and leading to adverse consequences is difficult to predict with a high degree of certainty.

47. Accordingly, my evidence has focused on understanding the potential sources of risk from proposed TTR operations; and describing the steps that TTR will take to mitigate those risks, even where they have been judged to be low or even negligible. In most instances, these steps exceed both the minimum requirements of New Zealand's international border standards, and accepted practices for domestic vessel management. In my view, there is nothing more that TTR can feasibly do to further reduce risk.

48. It is also important to recognise that mitigation in a marine biosecurity context is typically about identifying practical measures that reduce and minimise risk. In situations where vessels move among locations it is seldom feasible for risk to be completely negated; hence, some level of residual risk will almost invariably remain. My conclusion that TTR biosecurity risks can be managed to an acceptable level is made in the context of the many ongoing other sources of biosecurity risk that have the potential to lead to the introduction of potentially harmful organisms to New Zealand, or their subsequent domestic spread.

Specific additional issues raised in submission of A P Smith Fishing Consultancy Ltd

49. Biosecurity concerns are raised on p. 8 of this submission. A P Smith Fishing Consultancy Ltd (AP Smith) noted that the fishing industry is currently engaging with the Department of Conservation (DOC) on increased biosecurity measures for vessels that travel to areas of significance in New Zealand. This submitter is concerned that vessels associated with the TTR operation may not be required to comply to a similar standard, and that: '*New Zealand vessels could in some instances be held to a higher standard than the foreign*

vessels that may be operating throughout the mining period'.

50. This submitter is most likely referring to a proposed biofouling standard developed by DOC for vessels visiting with 1 km of the Kermadec and Sub-Antartic Islands. The proposed standard requires that vessels meet the equivalent of the CRMS long stay standard (i.e. slime layer and goose barnacles) that I described in paragraphs 23-25. The same standard has been proposed by Environment Southland for vessels visiting Fiordland.

51. Under the proposed DOC regime, vessels in active service will need to be inspected at intervals of c. 3 – 6 months to determine whether they pass or fail against the standard. Vessels that fail must be cleaned to meet the standard, or take the option of demonstrating equivalence through a prescribed risk assessment process.

52. With respect to TTR operations, vessels arriving from overseas will be required to meet the same standard as vessels managed under the DOC regime, with special additional risk reduction considerations for vessels/equipment deployed for the long-term (as reflected in proposed consent condition 75c).

53. With respect to all TTR vessels operating domestically, the intent of proposed condition 75b is to ensure that vessel movements pose a negligible risk of spreading potentially harmful biofouling species. To achieve this outcome the condition requires adoption of international best practices in accordance with IMO (2011) guidelines, which address all hull areas, including higher-risk recessed niche areas such as sea chests.

54. As per condition 75(b)(iv), all TTR vessels will be required to maintain a Biofouling Record Book to demonstrate that they

are following IMO (2011) best practice. A copy of the Biofouling Record Book must be provided annually to the EPA and aquaculture industry (as per condition 76).

55. AP Smith is correct that the TTR regime is less stringent than that proposed by DOC for the Kermadec and Sub-Antartic Islands insofar as there are no mandated biofouling inspections to determine compliance with a prescribed standard (as occurs in the DOC regime). For the Kermadec and Sub-Antarctic Islands, this level of management is reasonable given: (i) the outstanding conservation value of the islands, and (ii) the small number of vessels that operate in their environs (meaning that vessel-mediated biosecurity risk can be managed effectively).

56. In the case of TTR operations, the biosecurity risk to high value places like the Marlborough Sounds is relatively minor in that it is a very small increment to considerable pre-existing sources of regional risk (see paragraph 41). Moreover, there is currently no national biofouling management regime for vessels in general, and only limited development of biofouling management approaches regionally. In this context, I consider that the associated level of management effort reflected in consent conditions for TTR strikes a reasonable balance between risk reduction and practicality.

Specific additional issues raised in submission of Karen Pratt

57. Karen Pratt's submission points relating to marine biosecurity primarily reflect concerns regarding biofouling management, as follows:

    (a) P. 52 of the submission: with reference to proposed condition 74 (which describes measures to be undertaken to ensure that vessels and equipment moved to New Zealand from overseas are 'clean') the submitter's concerns relate to '*…environmental* *impacts from processes/ products used for reducing marine pests*'.

(b) P. 27 and p. 618 – 624 of the submission: the concerns of the submitter relate to the '*…environmental risks from in-water cleaning*'.

58. In relation to the concern in 63(a), I note that condition 74 is referring to measures that would typically be applied pre-border (i.e. in the port of origin) so that border clearance is readily obtained from MPI. My experience with project-related vessel/equipment movements to New Zealand is that biofouling mitigation measures, and verification inspections with respect to CRMS requirements, are conducted in overseas ports of origin (e.g. Forrest & Hopkins 2009; Hopkins & Forrest 2014). In the unlikely event that cleaning to meet the CRMS standard was required on arrival, the CRMS allows 24 hours for the cleaning to be undertaken. Any such cleaning would not be carried out in the project area, as the CRMS requires that it is conducted in a facility or by a system approved by MPI. As yet, MPI have not listed any approved treatments; however, with the CRMS due to become mandatory in 2018, I expect that approved treatments will gradually be developed.

59. In relation to the concern in 63(b) regarding in-water cleaning (e.g. ongoing cleaning of the IMV), the scenarios that lead to risk from both a biosecurity and contaminant perspective involve a complexity of factors that are accounted for in the guidance documents referred to in paragraph 46(b). The most appropriate way to address risk in accordance with this existing guidance will depend on specific operational details. As such, this issue should be addressed as part of the BMP developed by TTR.

CONDITIONS

60. As noted throughout my evidence, TTR have proposed consent conditions that address the range of marine biosecurity risks identified. These include provisions that exceed the requirements of New Zealand border standards, and surpass accepted practices for domestic vessel management.

61. I consider that these conditions are sufficiently comprehensive to adequately mitigate biosecurity risk from TTR operations, and to ensure a low level of risk compared with other sources to New Zealand (e.g. international vessel movements direct to ports). In particular, I support the development of a BMP as proposed in condition 75. This provides a means to ensure that all relevant risks are identified once project details are finalised. The BMP also provides for consultation with MPI and the aquaculture industry, to ensure that the proposed mitigation measures are comprehensive and acceptable.

62. Some minor editing is needed to tighten up the conditions as follows:

    (a) Condition 73 relating to ballast water: The IHS for ballast water will be revoked when the BWM Convention comes into force in September 2017 (see paragraph 27). Hence, I suggest the text in Condition 73 that relates to the IHS and states '….*or any subsequent version thereof*' is amended to read '…*or any replacement rule or standard, including the Maritime New Zealand Marine Protection Rules (Part 300: Ballast Water Management)*'.

    (b) Incorrect cross-referencing in conditions 74, 75 and 76:

i. In condition 74(b), the correct cross-reference to the Biosecurity Management Plan should refer to condition 75; and

ii. In condition 75, the cross-reference to conditions 72 and 73, should be to 73 and 74.

iii. In condition 76, the reference to the Biofouling Record Book should be to condition 75(b)(iv) not 75(a)(iv) as written.

CONCLUSIONS

63. The potential biosecurity risks arising from the TTR proposal are either: inherently low compared to existing and on-going risk processes, or can be adequately mitigated by the range of measures that are reflected in proposed consent conditions.

64. Included in the conditions is the requirement to develop a BMP to ensure that all risks are identified once operational details are finalised, and are mitigated to the extent feasible and practical. The BMP provides for consultation with MPI and the aquaculture industry to ensure that the proposed mitigation measures are comprehensive and acceptable.

Barrie Malcolm Forrest

15 December 2016

APPENDIX 1 - REFERENCES CITED

Barry SC, Caley P, Liu S, Paini DR, Carey J, Clark G 2015. Development of an expert-based model for improved biofouling risk assessment. CSIRO, Australia. 47 p.

Biosecurity Council 2003. Tiakina Aotearoa Protect New Zealand: The Biosecurity Strategy for New Zealand. August 2003, 63 p. Available at: http://www.biosecurity.govt.nz/files/biosec/sys/strategy/biosecurity-strategy.pdf.

Casas-Monroy O, Roy S, Rochon A 2011. Ballast sediment-mediated transport of non-indigenous species of dinoflagellates on the East Coast of Canada. Aquatic Invasions 6(3): 231-248.

COA 2013. Anti-fouling and in-water cleaning guidelines. Commonwealth of Australia, June 2013. 26 p.

CRMS 2014. Craft Risk Management Standard: Biofouling on vessels arriving to New Zealand. Ministry for Primary Industries, Wellington, New Zealand, 15 May 2014. 8 p. Available at: http://www.mpi.govt.nz/document-vault/11668.

David M 2015. Vessels and ballast water. In: David M, Gollasch S (eds.) Global maritime transport and ballast water management. Invading Nature – Springer Series in Invasion Ecology 8, pp. 13-34.

Dodgshun TJ, Taylor MD, Forrest BM 2007. Human-mediated pathways of spread for nonindigenous marine species in New Zealand. DOC Research & Development Series 266, Department of Conservation, Wellington, New Zealand. 44 p. plus appendices.

Drake LA, Doblin MA, Dobbs FC 2007. Potential microbial bioinvasions via ships' ballast water, sediment, and biofilm. Marine Pollution Bulletin 55(7-9): 333-341.

Forrest B 2016a. Preliminary biosecurity assessment for Trans-Tasman Resources Ltd Iron Sand Mining Proposal. Draft letter to TTR, dated 19 April 2014. 12 p.

Forrest B 2016b. Regional recreational vessel hull fouling survey and boater questionnaire. Top of the South Marine Biosecurity Partnership, Technical Report 2016/01. 27 p.

Forrest BM, Hopkins GA 2009. Assessment of Marine Biosecurity Risks from Exploratory Drilling at the Tuatara Site. Cawthron Report No. 1632. 42 p.

Forrest B, Zaiko A 2016. Marine biosecurity risks from offshore Māui facilities. Prepared for Shell Todd Oil Services Ltd. Cawthron Report No. 2812. 70 p.

Forrest BM 2007. Managing risks from invasive marine species: is post-border management feasible? Unpublished PhD thesis, Victoria University of Wellington, Wellington, New Zealand.

Forrest BM, Hopkins GA 2013. Population control to mitigate the spread of marine pests: insights from management of the Asian kelp *Undaria pinnatifida* and colonial ascidian *Didemnum vexillum*. Management of Biological Invasions 4(4): 317-326.

Gollasch S, Lenz J, Dammer M, Andres HG 2000. Survival of tropical ballast water organisms during a cruise from the Indian Ocean to the North Sea. Journal of Plankton Research 22: 923-937.

Gollasch S, Minchin D, David M 2015. The transfer of harmful aquatic organisms and pathogens with ballast water and their impacts. In: David M, Gollasch S (eds.) Global maritime transport and ballast water management. Invading Nature – Springer Series in Invasion Ecology 8, pp. 35-58.

Hopkins GA, Forrest BM 2010. Challenges associated with pre-border management of biofouling on oil rigs. Marine Pollution Bulletin 60: 1924-1929.

Hopkins G, Forrest B 2014. Post-mitigation Biosecurity Inspection of the Jack-up Rig ENSCO 107: February 2014, Singapore. Prepared for OMV New Zealand Ltd. Cawthron Report No. 2478. 8 p.

Hopkins GA, Forrest BM, Jiang W, Gardner JPA 2011. Successful eradication of a non-indigenous marine bivalve from a subtidal soft-sediment environment. Journal of Applied Ecology 48(2): 424-431.

Hunt L, Chadderton L, Stuart M, Cooper S, Carruthers M 2009. Results of an attempt to control and eradicate *Undaria pinnatifida* in Southland, New Zealand, April 1997 - November 2004. Department of Conservation, Invercargill, New Zealand. 48 p.

IHS 2015. Import health standard: ballast water from all countries. Ministry for Primary Industries, 16 December 2015. 8 p. Available at: https://mpi.govt.nz/document-vault/1167.

IMO 2011. 2011 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species. International Maritime Organisation, Annex 26 Resolution MEPC.207(62), adopted on 15 July 2011. 24 p.

Inglis G, Floerl O, Woods C 2012. Scenarios of vessel biofouling risk and their management. MAF Technical Paper No: 2012/07. A report prepared for MAF Research Project RFP11832. 117p. plus appendices.

Inglis GJ, Floerl O, Ahyong S, Cox S, Unwin M, Ponder-Sutton A, Seaward K, Kospartov M, Read G, Gordon D, Hosie A, Nelson W, d'Archino R, Bell A, Kluza D 2010. The biosecurity risks associated with biofouling on international vessels arriving in New Zealand: summary of the patterns and predictors of fouling. Biosecurity New Zealand Technical Paper No: 2008. A report prepared for MAF Biosecurity New Zealand Policy and Risk Directorate Project FP0811321 No. 182.

Kospartov M, Inglis G, Seaward K, van den Brink A, D'Archino R, Ahyong S 2008. Non-indigenous and cryptogenic marine species in New Zealand - current state of knowledge: Interim report. NIWA Research Report prepared for MAFBNZ Project BNZ10740. 25 p + tables + appendices.

MNZ 2015. Maritime New Zealand Annual Report 2014/2015. Available at: www.maritimenz.govt.nz/about/annual-reports/documents/MNZ-annual-report-2014-2015.pdf

Morrisey D, Gadd J, Page M, Floerl O, Woods C, Lewis J, Bell A, Georgiades E 2013. In-water cleaning of vessels: biosecurity and chemical contamination risks. MPI Technical Paper No: 2013/11, Ministry of Primary Industries, Wellington, New Zealand. 265 pp.

Olenin S, Gollasch S, Jonushas S, Rimkute I 2000. En-route investigations of plankton in ballast water on a ships´ voyage from the Baltic Sea to the open Atlantic coast of Europe. International Review of Hydrobiology 85: 577-596.

Schimanski K 2015. The importance of selective filters on vessel biofouling invasion processes. PhD thesis. University of Canterbury.

Zaiko A, Martinez JL, Schmidt-Petersen J, Ribicic D, Samuloviene A, Garcia-Vazquez E 2015. Metabarcoding approach for the ballast water surveillance - an advantageous solution or an awkward challenge? Marine Pollution Bulletin 92: 25-34.