Environmental Protection Authority
Te Mana Rauhī Taiao

EPA Key Issues Report

Trans-Tasman Resources Limited offshore iron sand extraction and processing project – application for marine consents and marine discharge consents

September 2016

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List of abbreviations

AES	Aquatic Environmental Sciences Limited
BEMP	Baseline Environmental Monitoring Plan
CEV	Cape-sized export vessel
CMA	Coastal marine area
CVA	Cultural Values Assessment
DMC	Decision-making Committee
EEZ	Exclusive economic zone
EEZ Act	Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012
EMMP	Environmental Monitoring and Management Plan
EPA	Environmental Protection Authority
FSO	Floating storage and off-loading vessel
HRW	HR Wallingford Limited
IA	Impact assessment
IMV	Integrated mining vessel
I-O	Input-output
ISQG	Interim sediment quality guidelines
MMR	Marine management regime
MPB	Microphytobenthos
NIWA	National Institute of Water and Atmospheric Research
NM	Nautical mile
ROMS	Regional Ocean Modelling System
SMD	Sediment model domain
SSC	Suspended sediment concentration
STB	South Taranaki Bight
TTRL	Trans-Tasman Resources Limited

1. Introduction

1. My name is Rob Lieffering. I am a Technical Advisor to the Environmental Protection Authority (EPA) and was engaged in June 2016 to prepare this Key Issues Report.

2. I hold the degrees of PhD, MSc (Hons), and BSc, all in Earth Sciences. I currently work for MWH New Zealand Limited as a Senior Environmental Consultant and also work privately as an independent hearings commissioner (under the Resource Management Act 1991). My previous work experience includes holding the position of Consents Manager at Northland Regional Council and also Tasman District Council. In 2014 I worked for the EPA (on contract) as the decision support writer for two marine consent applications associated with offshore exploratory drilling in the Taranaki Basin.

3. I have read Trans-Tasman Resources Limited's (TTRL) application forms, the impact assessment (IA) and its appendices, the supporting technical documents including un-redacted versions of the material covered by section 158 (Protection of sensitive information) of the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 (EEZ Act), and the EPA's technical expert reviews.

1.1. Background

4. On 23 August 2016 TTRL lodged an application for marine consents and marine discharge consents for various activities associated with a proposal to extract and process iron sand offshore within the area covered by Minerals Mining Permit (MMP) #55581, which is located within the South Taranaki Bight (STB).

5. As outlined in Section 1.1 (page 1) of TTRL's IA, in 2013 TTRL applied to the EPA for marine consents to extract and process iron sand from the same area but the applications were refused.

6. It is acknowledged that TTRL applied for marine consents for a similar proposal in 2013 and was declined. The current application must be considered on its own merits based on the information and evidence provided by TTRL, submitters, and any other person who is asked to present evidence. I note that TTRL's IA for the current application includes numerous references to the previous DMC decision and also Statements of Evidence or Joint Statements that relate to the earlier application (usually as footnotes in the IA). TTRL has verbally advised the EPA that these references are provided only to provide context and it has not provided copies of the documents referenced in that manner. At this point, the referenced documents do not form part of the application because they have not been provided by TTRL and therefore the DMC cannot take them into account during its consideration of the application. However, it is acknowledged that these documents may be put to the DMC for consideration later in the process.

1.2. Purpose and scope of this key issues report

7. This Key Issues Report identifies what I consider to be the 'key' issues associated with the proposal that the DMC will need to carefully consider as part of its decision making process.

8. While the issues which I discuss in this Key Issues Report are those that I consider to be 'key', there are many other issues and effects associated with the proposal and the fact that I do not discuss them in this report should not be construed or interpreted to mean that those other matters are irrelevant. On the contrary, the other matters, which are covered in TTRL's IA and supporting documents, are still matters that the DMC may make findings on when it considers the application and makes its decision.

9. This Key Issues Report deliberately does not provide my own assessment of the effects of the application or a conclusion/recommendation on whether the application should be granted or refused.

10. This Key Issues Report is intended to provide a 'roadmap' for the DMC in terms of relevant considerations for the key issues and guidance on where to find relevant information on these issues within the application documents. To assist the DMC, at the start of each key issue section I list the relevant section(s) of the IA, and also the relevant technical report(s)[1] which TTRL has submitted in support of the IA, including the section 158 sensitive information reports[2]. Any relevant report prepared by the EPA's technical experts are also listed. Some of the sections include questions which I consider the DMC should consider when assessing the application.

11. This Key Issues Report has been prepared in advance of the close of submissions and it is important to note that additional information on these key issues may well be provided in submissions, evidence, and during the hearing. These may either identify effects or issues that have not been considered at this point of time in this report or they may provide important information on the key issues discussed in this report.

12. This Key Issues Report includes discussion on where the EPA's technical experts or EPA staff have raised issues regarding certain parts of TTRL's application documents. These may be in the form of recommendations or highlighting of information gaps. The DMC will need to decide whether it has the '*best available information*' in respect of such matters. Sections 61(1)(b) and 87E of the EEZ Act (Information principles) requires the DMC to base its decision on the best available information which is defined as meaning '*the best available information that, in the particular circumstances, is available without unreasonable cost, effort, or time*'. It will be up to the DMC to decide whether it needs to pursue the matters raised in this Key Issues Report with respect to best available information. If the DMC considers it requires further information then it will need to decide how and when it will obtain the information. Equally, it is open to the DMC to determine that it has the best available information it requires and to take any particular matter no further.

[1] I have used the report number and naming convention for these technical reports as shown in the Table of Contents of Volumes 1 to 4 of the supporting 'Reports Referenced in SOUTH TARANAKI BIGHT OFFSHORE IRON SAND EXTRACTION AND PROCESSING PROJECT, IMPACT ASSESSMENT.
[2] I have provided the full name of the 158 sensitive information technical reports.

2. The application

2.1. EEZ Act Restrictions

13. This section will briefly describe TTRL's project (generally adopting TTRL's description) including the activities it has applied for marine consents and marine discharge consents.

14. TTRL has applied for marine consents to undertake the activities listed in Table 1 (this being based on the project elements listed Table 1.2 of the IA) which are restricted by section 20 of the EEZ Act.

Table 1. Section 20 EEZ Act activities (Marine Consents)

Section of EEZ Act	EEZ Act restriction	TTRL's description of activity
20(2)(a)	The construction, placement, alteration, extension, removal, or demolition of a structure on or under the seabed	• The placement, movement and removal of the Integrated Mining Vessel ("IMV") anchor and the geotechnical support vessel anchor, including the anchor spread, on or under the seabed. • The placement, movement and removal of the crawler on or under the seabed. • The placement, movement and removal of the grade control drilling equipment on or under the seabed. • The placement, movement and retrieval of moored environmental monitoring equipment on or under the seabed.
20(2)(d)	The removal non-living natural material from the seabed or subsoil	• The removal of sediment from the seabed and subsoil using the crawler and by grade control drilling. • The taking of sediment and benthic grab samples from the seabed and subsoil associated with environmental monitoring.
20(2)(e)	The disturbance of the seabed or subsoil in a manner that is likely to have an adverse effect on the seabed or subsoil	• The disturbance of the seabed and subsoil associated with the placement, movement and removal of the IMV anchor and the geotechnical support vessel anchor, including the anchor spread. • The disturbance of the seabed and subsoil associated with seabed material extraction via the crawler, through re-deposition of de-ored sediments, and from grade control drilling.

		• The disturbance of the seabed and subsoil associated with the placement, deployment, retrieval and mooring of environmental monitoring equipment. • The disturbance of the seabed and subsoil associated with the taking of sediment and benthic samples associated with environmental monitoring.
20(2)(f)	The deposit of any thing or organism, in, on, or under the seabed	• The re-deposition of de-ored sediments in, on or under the seabed. • The deposition of small amounts of marine organisms and solids in, on or under the seabed as a result of vessel maintenance, hull cleaning (biofouling).
20(2)(g)	The destruction, damage, or disturbance of the seabed or subsoil in a manner that is likely to have an adverse effect on marine species or their habitat	• The disturbance and damage of the seabed and subsoil as a result of the placement, movement and removal of the IMV anchor, and the geotechnical support vessel anchor on the seabed. • The disturbance and damage of the seabed and subsoil as a result of seabed material extraction via the crawler, the re-deposition of de-ored sediments, and the grade control drilling. The disturbance and damage of the seabed and subsoil as a result of the placement, deployment, retrieval and mooring of environmental monitoring equipment. The disturbance and damage of the seabed and subsoil as a result of the taking of sediment and benthic samples associated with environmental monitoring.
20(4)(a)	The construction, mooring or anchoring long-term, placement, alteration, extension, removal, or demolition of a structure or part of a structure in the waters of the Exclusive Economic Zone (EEZ)	• The anchoring of the IMV in the water column above the seabed, and the associated placement, movement and removal of the IMV anchor in the water column above the seabed. • The placement, movement and removal of the crawler in the water column above the seabed. • The placement, movement and removal of the grade control drilling equipment in the water column above the seabed. The placement, deployment, retrieval

		and mooring of environmental monitoring equipment in the water column above the seabed.
20(4)(b)	The causing of vibrations (other than vibrations caused by the normal operation of a ship) in manner that is likely to have an adverse effect on marine life	• Vibration (noise) caused by the IMV and crawler during iron sand extraction activities.

15. TTRL has also applied for marine discharge consents for the discharges of sediment listed in Table 2 which are restricted by sections 20B and 20C of the EEZ Act.

Table 2. Section 20B and section 20C EEZ Act activities (Marine Discharge Consents)

Section of EEZ Act	EEZ Act restriction	Component of activity
20B(1)	No person may discharge a harmful substance from a structure or from a submarine pipeline into the sea or into or onto the seabed of the exclusive economic zone.	• The release of seabed material (sediments) as a result of the seabed disturbance during grade control drilling activities. • The release of disturbed seabed material (sediments) as a result of the seabed disturbance during the crawler extraction operations. • The release of seabed material (sediments) as a result of taking of sediment and benthic samples associated with environmental monitoring.
20C(1)(a)	No person may discharge a harmful substance (if the discharge is a mining discharge) from a ship into the sea or into or onto the seabed of the exclusive economic zone or above the continental shelf beyond the outer limits of the exclusive economic zone.	• De-ored sediments and any associated contaminants discharged back to the water column from the IMV.

2.2. TTRL's proposal

16. TTRL proposes to extract up to 50 million tonnes of seabed and subsoil material per year targeting the recovery of iron sand which makes up approximately 10% of the volume, with the remaining de-ored sediments (45 million tonnes per year) being re-deposited on the seabed within the previously excavated area.

17. The entire project area occupies an area of 65.76 km^2, located between 22 and 36 km off the south Taranaki coast, in water depths of between 20 and 42 m (the project area is shown in Figure 1). TTRL proposes to extract seabed and subsoil material from an average area of 5 km^2 per year with maximum depth of excavation being 11 m below the existing seabed.

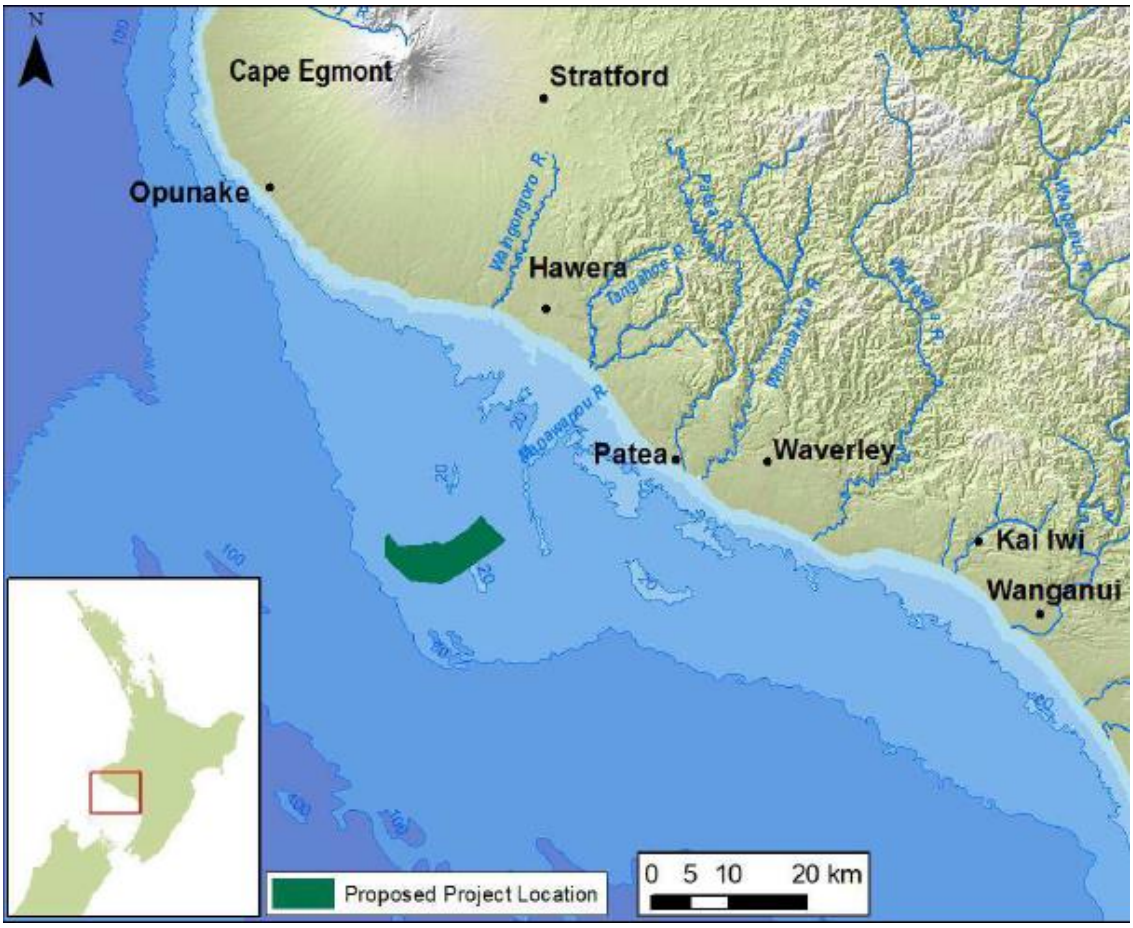

Figure 1. Location of project area

18. The proposed extraction methodology consists of two phases: 1) grade control drilling and planning; and 2) extraction of sediments for processing and iron ore recovery.

19. Grade control drilling involves closely spaced seabed sampling to further define the extent of the extraction area as well as further characterisation of the sediments prior to extraction occurring. A reverse circulation drilling rig will be lowered to the seabed and will collect representative samples at 1

m intervals to a depth of 11 m. The drilling rig will be launched and retrieved from a geotechnical support vessel that will be anchored to the seabed via two anchors.

20. Sediment extraction will be undertaken using a remote controlled subsea 'crawler' which will mobilise the sediment using seawater jets and then pump the sediment (as a slurry) to an integrated mining vessel (IMV) which follows the crawler over a planned grid. The IMV, which will have an overall length of 345 m and draught of 12 m, will periodically be repositioned which will involve moving its anchors. For context I note that Interislander ferries are in the order of 180 m long.

21. Sediment will be processed on the IMV through separation of iron ore using gravity, milling (comminution), and magnetic separation processes. The de-ored sediment will be returned to the seabed as a slurry at a depth of approximately 4 m above the seabed via a disposal pipe.

22. The processed iron ore concentrate will be transferred from the IMV to a floating storage and off-loading vessel (FSO vessel) via a floating slurry line (using desalinated seawater as a transport medium). The iron ore, having been rinsed with the desalinated transport water, will then be de-watered on the FSO using hyperbaric disc filtration with the clean resalinated water from the filter system being discharged into the sea via an outfall pipe located 1 m below the water surface near the bow of the FSO vessel.

23. The FSO will periodically transfer the dewatered iron ore to a bulk carrier export vessel (referred to as a cape-sized export vessel, or CEV) via belt conveyors. This transfer will take place at least 2 km from the IMV.

24. The activities that TTRL has described in its IA include those associated with the extraction of the sediments, the re-deposition of de-ored sediments, and ancillary activities such as vessel maintenance, fuel storage/handling, port/harbour usage, vessel sheltering during rough weather, and environmental monitoring.

3. Statutory considerations

25. TTRL's application seeks marine consents for activities restricted by section 20 and marine discharge consents for activities restricted by sections 20B and 20C of the EEZ Act. These activities are presented in Tables 1 and 2 of this report, respectively.

26. While TTRL has applied for both marine consents and marine discharge consents, for the purposes of this report the term 'consent' and/or 'the application' is used to cover both. This is not inconsistent with the definition of 'marine consent' or 'consent' in section 4 (Interpretation) of the EEZ Act which includes both marine and marine discharge consents. Further, TTRL's application and IA has been prepared in a holistic matter as the activities for which marine consents and marine discharge consents are sought are inextricably linked.

27. The EEZ Act prescribes the decision making function of the DMC. Section 10 of the EEZ Act sets out the purpose of the Act. In order to achieve the EEZ Act's purpose when determining TTRL's application, section 10 directs the DMC to take into account the decision-making criteria in sections 59, 60, and section 87D, and to apply the information principles outlined in sections 61 and 87E of the EEZ Act. The relevant sections are provided in Appendix 1.

28. The decision-making criteria in section 87D apply to the application for marine discharge consents and these are essentially the matters outlined in sections 59 and 60 (which apply to the application for marine consents) with one exception. Section 87D directs the DMC to specifically exclude the matters described in section 59(2)(c) from its considerations. Instead, the DMC is directed to take into account *the effects on human health of the discharge of harmful substances* rather than *the effects on human health that may arise from effects on the environment.*

29. The information principles in section 87E also apply specifically to the application for marine discharge consents and these are essentially the same as those outlined in section 61 (which apply to the application for marine consent) with one exception. Section 87E does not include the principle outlined in section 61(3) which requires the EPA to first consider whether taking an adaptive management approach would allow the activity to be undertaken if the EPA is considering a decision to refuse the application. The DMC will need to turn its mind to the difference in wording and the implications for its consideration of TTRL's application.

4. Key issues

4.1. Introduction

30. After reviewing the application documents, I consider there are six 'key' issues associated with the proposal, namely:

    a. The discharges of sediment including its off-site dispersion – referred to as the 'sediment plume' – and the various direct and indirect effects of this sediment;

    b. The proposed environmental triggers/limits and the adaptive management approach;

    c. The physical seabed and subsoil disturbance effects as a result of the extraction and structures (anchor placement and removal);

    d. Effects on Māori existing interests;

    e. The exclusionary effects in and around the project area;

    f. The economic benefits to New Zealand.

31. These key issues are discussed in the following sections.

4.2. The sediment plume

4.2.1. Introduction

32. I consider that the discharge of sediment is a key issue associated with the proposed activities. Some of the sediment discharged will disperse away from the project area, this being referred to as the 'sediment plume', and there are several direct and indirect effects associated with the sediment plume.

33. TTRL has identified the following sources of sediment which have the potential to contribute to the sediment plume (these being the activities for which marine discharge consents have been sought):

    a. The release of seabed material (sediments) as a result of the seabed disturbance during grade control drilling activities;

    b. The release of disturbed seabed material (sediments) as a result of the seabed disturbance during the crawler extraction operations;

    c. The release of seabed material (sediments) as a result of taking of sediment and benthic samples associated with environmental monitoring; and

    d. De-ored sediments and any associated contaminants discharged back to the water column from the IMV.

34. Of these, it is the discharge of de-ored sediments which is the greatest contributor to the sediment plume. The EPA's technical experts (AECOM) on benthic ecology have noted that section 2.3.6 of the IA (page 26) refers to the discharge from the hyperbaric pressure filter aboard the FSO vessel as '*clean resalinated water*', however they note that discharges from this filter may be a further source of fine sediments, depending upon the maximum size of sediment particles that can pass through the filter. If this discharge contains sediment then marine discharge consent will be required to authorise its discharge into the sea.

35. The reason why the discharge of sediment is considered a key issue is because there are a number of direct and indirect potential effects on the environment associated with the sediment within the plume, including:

    a. Impacts on physiological processes including clogging of respiratory surfaces and feeding structures and processes for animal biota;

    b. Smothering of benthic habitats and communities from sediment deposition;

    c. Avoidance of sediment plumes by fish, birds, and mammals;

    d. Reduced primary production in the water column and on the seabed or reefs through reduced light availability as a result of increased suspended sediment concentrations;

    e. Reduced prey and prey detection for fish, birds, and mammals; and

    f. Release of contaminants (nutrients and toxic compounds).

36. These sediment effects, in turn, have the potential to result in adverse effects on existing interests, including:

    a. Māori with statutory acknowledgments near the project area;

    b. Māori who have had settlements under the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992;

    c. Recreational users;

    d. Tourism operators; and

    e. Commercial fishers.

37. The following sections discuss the matters relating to the sediment plume.

4.2.2. The sediment plume model

Relevant section(s) of IA:	4.4.2 (page 82)
Relevant TTRL technical report(s):	Section 158 Report – HR Wallingford – Source terms and sediment properties for plume dispersion modelling – October 2015 Section 158 Report – NIWA – Sediment Plume Modelling – October 2015 Report 20 – Aquatic Environmental Sciences (AES) – Trans-Tasman Resources Ltd Consent Application: Ecological Assessments – January 2016
Relevant EPA technical expert report(s):	GHD – Review of sediment mobilisation and transport (06/09/2016)

38. A number of the proposed activities will result in the generation of suspended sediment within the water column of the project area and some of this sediment will be transported away from the project area by sea currents and winds, including landward of the EEZ boundary into the coastal marine area (CMA).

39. TTRL's assessment of effects beyond the project area is almost entirely dependent on the accuracy of the sediment transport model used by NIWA. Therefore, the DMC needs to have confidence that the model and its outputs provide a reliable basis for an assessment of effects.

40. The key consideration in respect of the sediment modelling is whether the mining derived sediment inputs, in particular the discharge rates, particle size distribution, settlement and re-suspension behaviour are appropriate and accurately reflect TTRL's proposed sediment discharges.

41. NIWA has modelled the dispersion of the sediment beyond the project area using Regional Ocean Modelling System (ROMS). Key inputs into the sediment transport model include background sediments (river and sea derived) and mining derived sediments – the former dictates what the

'background' (or no mining) suspended sediment concentrations (SSC) are and the latter dictating the effects of the mining activities on changes in SSC. Behaviour parameters (e.g. particle size distributions, flocculation and settlement rates, and re-suspension rates) for these sediments also influence the results of the model.

42. The outputs of this modelling provide predictions on the magnitude of increases in SSC within the water column (increases in near surface and near bottom concentrations have been predicted) and also increases in sediment deposition rates (spatially and temporally) as a result of the proposed activities.

43. TTRL engaged HR Wallingford (HRW) to conduct laboratory tests on three sediment samples from the STB to better understand the behaviour of the de-ored sediment once they are discharged. HRW also undertook 3D and a 1D modelling of 'near field' and 'near bed' processes and the results were used to assess trapping and burial of various sediment settlement fractions. This work has culminated in refining the settling velocity of the finest sediment fraction, refinement of the erosive forces required to re-suspend this fraction once it had settled, and the 'trapping' of the finest fraction within the pit following discharge of the sediment. The full results are provided in HRW (2015) and contains a set of final recommended 'source terms' in Table 8.1 of that report (being discharge rates for different sediment settlement velocities) that were used as the key inputs in the NIWA sediment plume model which were used to predict effects of the sediment discharges.

44. The NIWA sediment plume modelling uses two types of sediment input: 1) 'underflow', which is the de-ored sediment; and 2) 'overflow', which is the discharge from the hydro-cyclone, being a discharge of mostly fine sediment with a large flow of water. Section 2.3.5 (page 25) of the IA confirms that both of these discharges will be combined before being released from the deposition pipe. The combined sediment stream is represented in the model by two different mechanisms: 1) the 'suspended source'; and 2) the 'patch source'. Details are presented in section 2.9 (page 26) of the NIWA sediment plume modelling report.

45. The EPA's technical experts (GHD) on sediment plume modelling have reviewed TTRL's IA and sediment plume modelling. They conclude that, although the accuracy of the methods utilised are limited by the methodology themselves (e.g. tests undertaken in a laboratory and not in the natural environment) and the number of test repeats (e.g. number of sediment samples tested), the differences observed are small and the estimate of sediment source rates is reasonable and can be considered a 'best estimate'. However, GHD note that the accuracy and reliability of the predicted suspended sediment source (being a critical input into the model) is dependent on predicted discharge rates of the overflow and underflow. These predicted discharge rates have been provided by TTRL and are dependent on the design dredging and grinding circuit and technology process design. The accuracy or otherwise of these estimates could not be verified by GHD.

46. GHD also note that the sediment plume modelling study only considers the discharge of de-ored sediment and not the other three sediment sources for which marine discharge consents are sought

(outlined in paragraph 33 of this report). GHD state that the sediment generated by grade control drilling and monitoring sample collection are expected to be minimal and that, although generation of the sediment plume from the crawler was not considered in the model, sediment release at the crawler head is expected to be much less significant than the discharge of de-ored sediment and hence it may not be necessary to include this source in the model. However, GHD states that this assumes that the operation of the crawler will be undertaken in a way to minimise the release of sediment at the crawler head in particular should clay lenses be encountered. The DMC will need to be satisfied that all the sediment likely to be generated by the activities has been adequately accounted for in the inputs of the sediment plume modelling.

4.2.3. Outputs of the sediment plume modelling

47. Sediment modelling results are presented in terms of statistical maps of SSC (near surface and near bottom) as well as sediment deposition maps. Two scenarios have been modelled, one (Location A) where mining occurs at a location closest to the Taranaki coastline (just seaward of the EEZ/CMA boundary) and one (Location B) where mining occurs near the outer edge of the project area.

48. The sediment plume is predicted to travel in an east-southeast direction from the project area. While the mining activity will take place within the EEZ, the sediment plume is predicted to be present primarily within the CMA administered by the Taranaki Regional Council, with the plume's distal parts being within the CMA administered by the Horizons Regional Council.

49. Section 4.4.2.3 (page 85) of the IA presents the results of the sediment plume modelling in respect of predicted effects of the mining on SSC, this information being a summary of the detailed information provided in section 5 (page 47) of the NIWA sediment plume modelling report, which is also summarised in section 5 (page 19) of the AES (2016) report. GHD consider that the results are a reasonable estimate of the predicted SSC. However, GHD notes that the description of the durations of the potential SSC due to the mining at selected receptors is not presented.

50. GHD notes that section 4.4.2.3 (page 85) of the IA presents 'net differences' (predicted increases) in median and 99th percentile SSC at three points (2 km, 8 km, and 20 km) from the project area but that these outputs are not presented in the NIWA sediment plume modelling report. The actual geographical location of the three points are also not presented. The relevance of the information in section 4.4.2.3 (page 85) of the IA is unclear.

51. Section 4.4.2.4 (page 88) of the IA summaries the predicted effects of the mining activities on sediment deposition. Section 5 (page 47) of the NIWA sediment plume modelling report provides significantly more detail including maps. GHD has reviewed this information and, while they raise a number of issues regarding how the background sedimentation is modelled, they conclude that because the results show that the increase in sedimentation is small and significantly less than the background sedimentation the predicted sedimentation is unlikely to affect the study conclusions.

4.2.4. Optical model

Relevant section(s) of IA:	4.4.3 (page 89)
Relevant TTRL technical report(s):	Section 158 Report – NIWA – Optical Effects of Proposed Iron Sand Mining in the South Taranaki Bight Region – September 2015 Report 20 - Aquatic Environmental Sciences (AES) - Trans-Tasman Resources Ltd Consent Application: Ecological Assessments – January 2016
Relevant EPA technical expert report(s):	GHD - Review of sediment mobilisation and transport (06/09/2016) DHI - Lodgement Review of Effects on Plankton, Fish and Marine Mammals – September 2016

52. TTRL engaged NIWA to apply an optical model to the results of a sediment plume model to predict potential effects on the optical properties of the water column – reductions of which can affect visual feeders and light attenuation for primary producers within the water column and on the seabed. The effects of reduced light attenuation on primary production within the STB has been assessed using the outputs of the optical modelling.

53. Section 4.4.3 (page 89) of the IA summarises the optical modelling and the outputs, with this summary being based on various parts of section 5 (page 19) of the AES (2016) report which in turn summarises the detailed information contained in the NIWA optical modelling report.

54. GHD has reviewed the NIWA optical modelling report which presents the model used to predict optical effects. They conclude that a high level of detail is presented in the report. The overall impact of the proposed activities has been assessed over the whole sediment model domain (SMD) and at two selected sites (the Graham Banks and the Traps, these having recreational and ecological values with areas of hard substrate and macroalgae). GHD notes that while this provides a 'global' picture of impacts (and the two selected sites), it does not address potential impacts at other specific geographic areas of concern.

55. GHD also notes that the number of days where light is reduced is estimated but no indication is given as to whether there is any pattern to these days. For example, are they all contiguous or is it two days per month? Such information may be useful in assessing the potential impacts of the plume on primary production.

56. The EPA's technical experts (DHI) on plankton (an important driver of primary production), fish, and mammals have also reviewed TTRL's IA and supporting reports and conclude that the determination of the optical impacts is very well executed.

4.2.5. Effects of suspended and deposited sediment

Relevant section(s) of IA:	4.6 (page 104)
Relevant TTRL technical report(s):	Report 1 – NIWA – South Taranaki Bight Factual Baseline Environmental Report – November 2015 including four Appendices Report 16 – NIWA – Effects on Primary Production of proposed Iron Sand Mining in the South Taranaki Bight – October 2015 Report 20 – Aquatic Environmental Sciences (AES) – Trans-Tasman Resources Ltd Consent Application: Ecological Assessments – January 2016
Relevant EPA technical expert report(s):	DHI – Lodgement Review of Effects on Plankton, Fish and Marine Mammals – September 2016 AECOM – Review of benthic ecology – 5 September 2016

57. Figure 4.10 (page 109) of the IA (reproduced below as Figure 2) provides a summary of the various effects of suspended and deposited sediment.

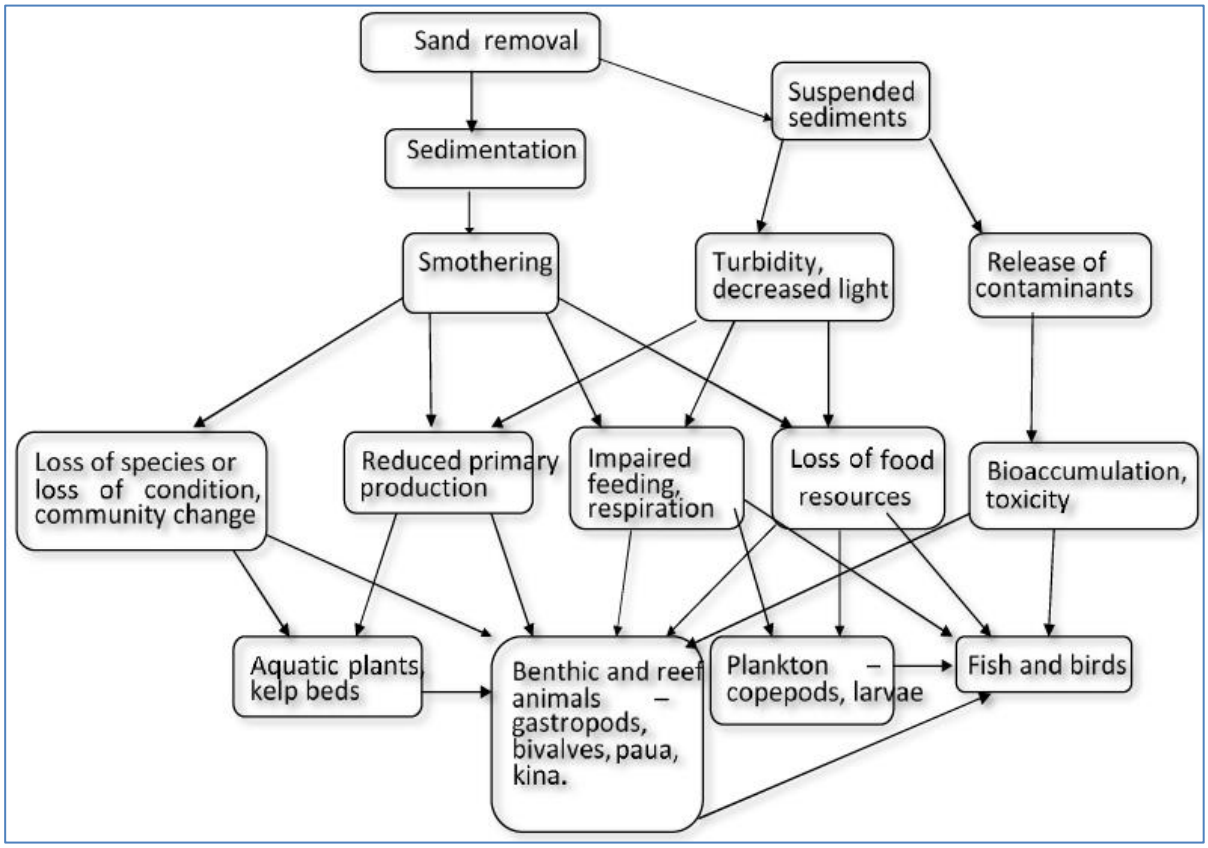

Figure 2. Summary of effects of suspended and deposited sediment

58. Of the effects outlined in Figure 2, it is the potential reduction in primary production, which forms the base of the food chain which is a key issue associated with the discharges of sediment as reductions in primary production can result in adverse effects further up the food chain. Primary production occurs in oceans primarily by algae through photosynthesis and occurs both within the water column by phytoplankton and on the seabed by macroalgae (seaweed) and microphytobenthos (MPB).

59. The NIWA baseline environment report includes an assessment of the existing primary production within the STB. It concludes that primary and secondary pelagic productivity is relatively high in the STB region compared to other similar coastal regions but this does not appear to be translated into dense or diverse benthic macrofaunal communities. NIWA consider that this may be to be due to the high energy environment of the area.

60. TTRL has assessed the likely effects of its mining activity on primary production by using the outputs of the sediment plume model and optical model. Details of this assessment are summarised in section 4.6.3 (page 108) of the IA, section 6 (page 30) of the AES (2016) report, and detailed assessments are presented in the NIWA report on primary production effects.

61. The NIWA primary production effects report estimates likely changes in both water column and benthic (seabed) primary production (marcroalgae and MPB are assessed separately). These estimates are almost exclusively based on literature values from outside of the SMD, as no useful local information is available. That report also notes that the accuracy and reliability of the effects on primary production are dependent on the performances of the sediment transport and optical models. This therefore means that for the DMC to be able to rely on NIWA's assessments on the effects of the activity on primary production it must also be confident that the two models provide reliable and accurate assessments of the dispersion of the sediment plume – that is, the sediment plume model and its assumptions and inputs.

62. NIWA's prediction on the impacts on primary production was assessed at the scale of the entire SMD (13,300 km^2), over a one year period, using an empirical approach to estimate the reduction in primary production averaged over the SMD area. The report includes specific discussion on likely local effects on macroalgae on Graham Bank and at the Traps, being areas that have high recreational and ecological values with areas of hard substrate and macroalgae.

63. Water column (phytoplankton) primary production averaged over the SMD is estimated to be reduced by between 0.8-1% as a result of the mining and the IA states (page 110) that these effects will be '*essentially indistinguishable*' because of natural variability.

64. The EPA's technical experts (DHI) on plankton have reviewed TTRL's IA and supporting reports. DHI considers that the determination of the optical impacts is very well executed but the final assessment of the impacts on primary production is relatively simple.

65. DHI did not review the sediment transport model *per se* but they did raise a number of questions regarding the modelling because its outputs have been used to assess effects on primary production. DHI notes that modelling domain boundaries are normally defined well away from the specific areas of

interest within the model domain so boundary effects do not interfere with the subsequent analysis. DHI notes that Figure 2-3 (page 18) of the NIWA sediment plume modelling report shows that there is a strong likelihood of hydrodynamic gradients, and therefore dispersion boundaries, within the SMD. This is reflected in the modelling results of projected sediment plume dispersion and transport. DHI state that it would be normal practise to assess the extent of impacts within the context of such boundaries and gradients and not across the entire SMD. DHI is of the view that expressing impacts as an average over the SMD may not be appropriate in this case and that TTRL needs to demonstrate why it has assumed the SMD is a suitable area over which to average results.

66. Section 3.2.3 (page 16) of the NIWA primary production effects report states that primary production by macroalgae is likely to be small relative to water column primary production because of the small area of hard substrate at the scale of the SMD. However, the report notes that despite the sparse distribution of suitable substrate for macroalgae, their importance as substrate and habitat for many organisms may be disproportionately important relative to their overall productivity, at least locally.

67. The NIWA primary production effects report states (page 16) that mining impacts can be expected to significantly impact on growth of any macroalgae on Graham Bank, however total elimination is unlikely. The Traps is located further away and is known to support macroalgae and the NIWA report states (page 16) that some reduction in macroalgal growth and coverage may occur here.

68. In terms of effects on primary production of MPB, the area most likely to be affected is to the east of the project area (the Patea Banks) where, according to NIWA, the dominant benthic primary producer is likely to be MPB. Averaged over the SMD the reduced primary production of MPB is predicted to be between 13-19%. The NIWA primary production effects report notes (page 20) that the ability to quantitatively predict effects on MPB primary production is limited by the absence of useful information on primary producer dynamics and photosynthesis rate (P) – light effluence (E) curves (P-E curves).

69. EPA's experts (AECOM) on benthic ecology state that predicting the potential extent of impact upon primary production is hampered by the lack of knowledge on the distribution of MPB. Unlike the distribution of macroalgae, which can be reasonably inferred from the distribution of rock substrates in the region, the predicted distribution of MPB is based primarily upon the nature of substrates upon which it has been recorded elsewhere. Despite this uncertainty, AECOM considers that the model outputs indicate that the areas within which localised significant reductions in benthic primary production may occur are small relative to the area of similar benthic habitat present in the broader STB region. AECOM consider that, if the model outputs can be verified as sufficiently accurate, it is reasonable to conclude that the risk of significant impacts upon regional benthic primary production is low.

70. The NIWA primary production report (summarised in Table 3-5 on page 25) 'best estimate' prediction of reduction in the total primary production (i.e. the water column primary production plus benthic primary production by macroalgae and MPB) averaged over the SMD is 1.9% (lower and upper limits of likely

reduction being 1.6-2.2%) when mining occurs at Location A and 1.4% (lower and upper limits of likely reduction being 1.2-1.7%) when mining occurs at Location B.

71. DHI is of the view that a model of primary production that includes phytoplankton and MPB production should be used. DHI considers that coupling such a primary production model with the optical model, which in turn is based on the hydrodynamic/sediment model, would enable TTRL to address the impacts on primary production within the STB and at environmentally sensitive areas (ESAs) in greater detail. The DMC will need to decide if the information provided by TTRL is the best available information in respect of the potential effects of the sediment discharges on primary production.

72. Although impacts on primary productivity at the SMD scale are predicted to be minor, a key consideration for the DMC is the significance of localised decreases in primary production and whether any decreases may have long-term flow on effects for communities present in the affected areas, and the wider ecosystem. In determining the significance of any potential effects, the DMC may need to consider:

    a. whether reductions in primary productivity within localised areas have the potential to affect communities of ecological significance, including habitats of threatened species, or rare and vulnerable ecosystems; and

    b. the permanence and significance of any localised reductions in primary production over the time scale of the proposed mining activities.

4.3. Environmental triggers and the adaptive management approach

Relevant section(s) of IA:	5.5.3 (page 211) 7.7 (page 270)
Relevant TTRL technical report(s):	Report 16 – NIWA – Effects on Primary Production of proposed Iron Sand Mining in the South Taranaki Bight – October 2015 Report 20 – Aquatic Environmental Sciences (AES) - Trans-Tasman Resources Ltd Consent Application: Ecological Assessments – January 2016
Relevant EPA technical expert report(s):	DHI – Lodgement Review of Effects on Plankton, Fish and Marine Mammals – September 2016 AECOM – Review of benthic ecology – 5 September 2016

73. Once mining commences, TTRL proposes to use the results of monitoring of SSC and sediment quality at seven locations within the STB to prompt a management response to ensure adverse effects are

avoided, remedied, or mitigated. This is a form of 'adaptive management approach', a term which is defined in section 64(2) of the EEZ Act and which the DMC may incorporate into any marine consent granted for the activities.

74. Further, when considering the marine consents section 61(3) (Information principles) of the EEZ Act states that, if the DMC is favouring caution and environmental protection and considering refusing consent, it must first consider whether taking an adaptive management approach would allow the activity to be undertaken.

75. In respect of TTRL's proposed adaptive management approach, the DMC will need to be satisfied that: 1) the environmental triggers have been appropriately set/developed (including location); 2) the proposed management responses will adequately avoid or mitigate adverse effects; and 3) significant long term environmental degradation will not occur if/when mining ceases.

76. TTRL has used the outputs of the sediment plume model to develop environmental management triggers in relation to SSC at selected sites. The model has been used to determine the variability of the naturally occurring ('background') SSC in surface and bottom layers of the water column at ten sites within the STB, these being outlined in Table 5.4 (page 211) of the IA.

77. TTRL has proposed the use of 'response' and 'compliance' limits, being the 80th and 95th percentile background SSC respectively, for seven sites as outlined in Schedule 2 (page 30 of Attachment 1 of the IA) of the proposed conditions. The SSC response and compliance limits will be reviewed and, if necessary, amended before mining commences based on the results of the two year baseline monitoring programme. I note that TTRL proposes to measure SSC continuously via optical turbidity sensors.

78. If the SSC exceeds a response limit (but not the compliance limit) then TTRL would review the data to and collect additional samples to determine whether the exceedance is a result of the mining activities. If the additional sampling again shows an exceedance of the response limit (but not the compliance limit) then TTRL proposes to instigate an operational response to ensure no further exceedances occur – details of possible operational responses are listed in section 5.5.3.3 (page 213) of the IA.

79. If the SSC exceeds the compliance limit and the exceedance is due to the mining activity then TTRL proposes to cease mining activities and no resumption of mining activities would occur until TTRL has satisfied the EPA that compliance is able to be achieved.

80. The same approach is proposed in respect of sediment quality but TTRL proposes to use the interim sediment quality guidelines (ISQG) 'low' and 'high' concentrations from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality released in 2000 (ANZECC/ARMCANZ, 2000) as the response and compliance limits respectively.

81. There are a number of issues that the DMC should consider in relation to TTRL's proposed adaptive management approach:

    a. Are the seven selected sites appropriately located?

b. Are 80th and 95th percentile SSC limits appropriate for the purpose of preventing unacceptable effects at the seven selected sites and elsewhere within in STB?

c. Is measuring turbidity appropriate as a surrogate for SSC?

d. Are the thresholds proposed measureable and is TTRL able to respond to any exceedances within an appropriate timeframe?

82. AECOM recommend that the monitoring locations should be reviewed and, if necessary, changed during the two year baseline monitoring period if it becomes apparent that some locations are not appropriate (or that new locations are more appropriate) for monitoring, rather than waiting until the end of the baseline monitoring period.

83. Section 5.5.3 (page 211) of the IA states that the SSC limits have been determined based on the ecological monitoring assessment by AES as outlined in a report referenced as 'AES (2016b)', which stated in footnote 126 on page 189, as being a report by 'James, M.R., MacDiarmid, A., 2016. "Trans-Tasman Resource Ltd consent application: Ecological Monitoring" February, 2016. 13 pp'. That report is not included in the Technical Reports (Volumes 1-4) which support the IA. The DMC will need to satisfy itself that the 80th and 95th percentile SSC limits provide sufficient protection for the values that exist at the monitoring sites.

84. In assessing operational SSC data against the response and compliance limits, AECOM recommends that TTRL (in consultation with the TRG) devises a response trigger mechanism that takes account of the frequency and duration of exceedances, rather than just intensity. Otherwise there will be a risk that frequent management responses are triggered by short-duration spikes in SSC that may be of minimal significance to benthic ecological receptors. Another related matter which the DMC needs to consider is that the proposed conditions could allow the mining activities to result in long-term elevated SSC, say at just below the 80th percentile response limit, and this may result in unanticipated environmental effects, especially at sensitive sites. If this 'discharge SSC up to' response limit occurred for long periods then there could be an upward shift in the SSC statistics post-mining (i.e. the post-mining median would be greater than pre-mining). The DMC will need to be satisfied that this will not result in unacceptable effects on values at the monitoring sites.

85. DHI also recommends the setting of evaluation criteria as 'exposure over time' be adopted (i.e. the area affected by a specified concentration or intensity for specified periods of time).

86. AECOM recommend that response and compliance limits also be derived in relation to subtidal and intertidal reef communities (including macroalgae and kaimoana). If measurable changes (attributable to the extraction activities) are occurring in respect of the abundance or diversity of these communities, yet the response or compliance limits for SSC are not being exceeded, then this may indicate that these limits are set at inappropriately high levels. This is a relevant matter for the DMC to consider and decide on.

87. The DMC should also consider whether monitoring turbidity will provide a suitable surrogate for the proposed response and compliance SSC limits. Note 2 below Schedule 2 (which lists the proposed response and compliance limits) of the proposed conditions contained in the IA (page 30 of Attachment 1 of the IA) states that turbidity may be used as a proxy for SSC. Turbidity is a relative measure of the scattering of light caused by suspended particles in the water. Thus, a greater amount of suspended particles in the water results in higher measured turbidity levels. However, turbidity can also be influenced by suspended particles other than inorganic sediment (e.g. organic matter, algal cells). It is therefore possible to have high turbidity without high suspended sediments concentrations. Turbidity is also influenced by the physical and optical properties of the suspended particles (e.g. particle size, shape, mineral composition) and the amount of dissolved colour (e.g. organic matter). SSC, however, is a direct measure of the mass of sediments suspended in a water sample.

88. The DMC also needs to consider whether the adequacy of the proposed monitoring regime for detecting exceedances of management triggers, and the efficacy and efficiency of the adaptive response regime outlined in the proposed conditions, are appropriate. TTRL proposes to undertake synoptic surveys and collect water samples on a fortnightly basis for the purpose of monitoring compliance with the response and compliance SSC limits. Such an approach could result in the exceedance of a SSC limit for up to 13 days continuously prior to measurements being taken. Alternatively, exceedances that occur during the interim period may not be detected at all, although the proposed permanently moored monitoring stations may overcome this problem. The key issue for consideration is whether the lag in TTRL's response time to exceedances of environmental triggers poses an unacceptable environmental risk.

89. As discussed in paragraph 77 of this report, if there is an exceedance of the 'response' limit (the 80th percentile SSC or ISQG-low concentrations) then TTRL proposes to undertake additional sampling and investigations to determine if the exceedance has been due to the mining operations, and if this is shown to be the case then operational changes are to be made and further testing undertaken. The process and timeframes which TTRL proposes, which are outlined in proposed condition 5 in Attachment 1 of the IA, could potentially result in extended periods when the response limit is exceeded. The DMC will need to be satisfied that prolonged periods of exceedances of the response limit will not result in unacceptable effects.

90. The DMC will also need to be confident that no long-term unacceptable environmental degradation occur if/when mining stops. The information provided in section 4.3 (page 26) of the NIWA effects on primary production report suggests that suspended sediment will gradually be flushed out of the STB and that this would take, at most, a few months. The report states (page 26) that phytoplankton and MPB are expected to respond very quickly to changes in clarity and would recover to pre-mining levels within a few weeks or months of the cessation of mining. Section 4.4 (page 54) of the AES (2016) presents additional information on environmental recovery.

4.4. Physical disturbance effects

Relevant section(s) of IA:	3.3.5 (page 41) 4.6.3.1 (page 108)
Relevant TTRL technical report(s):	Report 3 – NIWA – Benthic Flora and Fauna of the Patea Shoals Region, South Taranaki Bight – November 2015 Report 20 – Aquatic Environmental Sciences (AES) - Trans-Tasman Resources Ltd Consent Application: Ecological Assessments – January 2016
Relevant EPA technical expert report(s):	AECOM – Review of benthic ecology – 5 September 2016

91. In terms of physical disturbance of the seabed and subsoil, TTRL propose to excavate up to 11 m depth of seabed material over an area of around 5 km^2 per year using a crawler. Up to 50 million tonnes of seabed and subsoil material year is proposed to be extracted, of which around 45 million tonnes will be re-deposited to the seabed. While other activities will also disturb the seabed (such as placement and removal of anchors, grade control drilling, and environmental sampling) it is the disturbance by the crawler and the re-deposition of de-ored sediments which constitutes the most significant disturbance of the seabed and subsoil associated with the project.

92. Section 3.3.5 (page 41) of the IA summaries the nature of the sediments (habitat) present over the project area and section 3.4.2 (page 46) describes the offshore benthic ecology. The NIWA benthic flora and fauna report states (page 118) that the sampling undertaken identifies that there is no evidence that the project area is unique with respect to benthic epifauna or infauna.

93. The disturbance of the seabed and subsoil will alter the habitat and will also result in destruction of benthic biota.

94. The proposed activities are certain to initially change the nature of the seafloor habitat as it will selectively remove a fraction of the seafloor sediments. The sediments returned to the seafloor will be different in both chemical and physical composition to those that were extracted. AECOM consider that these physical changes may result in a different suite of species initially colonising the mined areas than were present pre-mining. The STB is a highly dynamic environment and it would be expected that, over time, sediments from the areas adjacent to the mined areas would progressively spread across the mined areas. The functionality of the seafloor habitats for benthic communities would therefore return to the pre-mining condition, which would enable the progressive re-establishment of the benthic communities present prior to the commencement of mining.

95. Section 4.6.3.1 (page 108) of the IA confirms that the excavation will result in the physical removal of all sessile and sedentary taxa as well as relatively immobile taxa. Some of the hard-bodied organisms will be screened out at the intake point but soft bodied organisms will be destroyed.

96. The mortality of benthic biota is certain to occur within the mining area as it is unlikely (with perhaps a few exceptions) that benthic biota would survive the processing of the sediment on the IMV. However, AECOM consider that the benthic biota within the area to be mined is well represented across the broader STB region. A similar suite of benthic biota would eventually become established once mining activity ceased. The same species may not necessarily recruit immediately into the area; a succession of species may progressively recruit into the area until a similar suite of species is present. Hence, while there will almost certainly be reductions in primary and secondary productivity within the benthic communities at the onset of mining, AECOM consider it likely that these will be temporary and reversible, and productivity will progressively recover in mined areas as the operation moves into subsequent areas.

97. The two community types that will suffer the most significant direct effect are the rippled sands habitat and the wormfield communities present in the mining area. However, these communities occur across the STB and are likely to recover after mining moves to adjacent blocks. This is a relevant consideration under section 59(2)(d) of the EEZ Act which requires the DMC to take into account the importance of protecting the biological diversity and integrity of marine species, ecosystems, and processes.

98. Assessing the magnitude of the disturbance effects is scale dependent, both spatially and temporally. In terms of the immediate area of disturbance the effects on biota and habitat will be significant (or severe using the terms used in Table 4.8, page 107, of the IA) as the habitat will be completely altered and most, if not all, the fauna will be destroyed. However, at the scale of the broader STB, or the area of similar habitat within the STB, the effects would be negligible. Section 4.6.3.1 (page 108) of the IA estimates that 1,860 km^2 of the STB falls between 20-40 m water depth and the physical disruption of the proposed mining would affect 0.3% of this area per year.

99. In terms of the temporal scale of effects, the habitat and benthic biota are expected to recover over time. However, AECOM state there are insufficient data available for the STB region to be able to reliably predict a likely timeframe within which this recovery could occur. Despite this, whilst the adverse effects at a local scale will be significant immediately following the mining activities, over time the scale of effects will reduce to such a degree as to be considered negligible as recovery to pre-mining conditions progresses. Given the uncertainty in the rate of recovery, I note that if physical disturbance effects were evident over the entire project area (65.76 km^2) after the completion of the mining activities, then this total represents approximately 3.5% of the 1,860 km^2 of the STB which falls between 20-40 m water depth.

4.5. Effects on Māori existing interests

Relevant section(s) of IA:	3.11.8-3.11.10 (commencing on page 68) 4.11 (page 142)
Relevant TTRL technical report(s):	Report 41 – Tahu Potiki – Cultural Values Assessment and Analysis – August 2016 Appendix 4.6: TTR – Sand Mining – Patea Matauranga Māori and Customary Fisheries Analysis Te Tai Hauauru Fish Forum
Relevant EPA technical expert report(s):	None[3]

100. The term 'existing interest' is defined in section 4 (Interpretation) of the EEZ Act and while there are many interests that fall into the various parts of this definition, there are four parts of this definition where Māori can have an existing interest. These are by way of: 1) customary fishing (being a lawfully established existing activity); 2) settlement of a historical claim under the Treaty of Waitangi Act 1975; 3) settlement of a contemporary claim under the Treaty of Waitangi as provided for by an Act, including the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992; and 4) a protected customary right or customary marine title recognised under the Marine and Coastal Area (Takutai Moana) Act 2011.

101. Section 3.11.10 (page 70) of the IA presents information on customary fishing and identifies three iwi (Nga Ruahine, Ngati Ruanui, and Ngaa Rauru) as having an existing interest in this regard. The IA concludes (page 70) that the project '*will not result in any effects on the existing customary fishing interests*'.

102. Section 4.11.3 (page 147) of the IA summarises the report prepared by the Te Tai Hauauru Fisheries Forum (the Forum Report), which was established through the development of Fisheries Management Area 8 (FMA 8). The Forum Report identifies 27 sites of significance with regard to customary fisheries and concludes that some of these will potentially be affected by the project. The Forum Report includes a number of recommendations, including conditions which would require monitoring of culturally important sites. The IA notes (page 148) that Ngati Ruanui has confirmed that it does not endorse the Forum Report or its findings.

103. Section 3.11.8 (page 68) of the IA outlines Māori interests as they relate to the settlement of a historical claim under the Treaty of Waitangi Act 1975 (listed in Table 3.7, page 69, of the IA) and notes that no such settlements exist within the EEZ but the sediment plume will migrate into the CMA where Māori have statutory acknowledgements. However, the IA concludes (page 70) that due to the separation distance between the project area and the areas of interest and statutory acknowledgment areas, there

[3] I note that Ngā Kaihautū Tikanga Taiao has been requested by the DMC to prepare a report which will provide a high level Māori perspective on the potential impacts of TTRL's application. This report is due to be completed by 9 November 2016.

will '*typically be no effect on the 'existing interests' of these groups*'. The DMC should test this conclusion with Māori.

104. Statutory acknowledgements provide evidence of the cultural, spiritual, historical, and traditional association of the respective Māori group with certain specified areas. The DMC will need to consider whether or not the activities, in particular the sediment plume and its direct and indirect effects, will have adverse impacts on the statutory acknowledgements within the CMA and if so, the extent of those effects.

105. Section 4.11.2 (page 143) of the IA summarises the assessment of cultural values prepared for TTRL by Mr Tahu Potiki (the Cultural Values Assessment, or CVA). The CVA focusses on Ngati Ruanui's cultural values. However, I note that Ngati Ruanui did not prepare the CVA report on which this section of the IA is based. It should also be noted that Māori other than Ngati Ruanui may also have cultural values and associations within the STB but the IA does not specifically assess the effects of the proposed activities on these.

106. The DMC will need to satisfy itself that the CVA adequately represents the views of Ngati Ruanui given that the report has not been provided or endorsed by Ngati Ruanui. This is a key consideration before the DMC can move on to assess the magnitude and significance of the effects of the proposal on existing interests held by Māori, including Ngati Ruanui as discussed above. Māori with existing interests that may be affected by the proposed activities will be notified of the application. Any submissions that they lodge may provide the DMC with useful information to determine such effects.

4.6. Exclusionary effects

Relevant section(s) of IA:	4.15.1 (page 162) 4.15.1.11 and 4.15.1.12 (commencing on page 168)
Relevant TTRL technical report(s):	Report 25 – Fathom – Assessment of Potential Impacts on Commercial Fishing – November 2015
Relevant EPA technical expert report(s):	None

107. TTRL proposes to implement a 1 nautical mile (NM) operational buffer from the centre of the IMV which will incorporate the IMV itself, the crawler, anchors, and FSO, equating to an exclusion area of 10.8 km^2. This forms the extent of the physical exclusion zone and will be a dynamic buffer which moves approximately every ten days when the anchor moorings are moved. In addition, smaller exclusion areas may also be established around vessel transfer areas where they do not occur in the active extraction area.

108. Sections 4.15.1.11 (page 168) and 4.15.4.3 (page 175) of the IA states that the exclusion buffer will still allow commercial fishing and other marine traffic to occur in the remainder of the project area.

109. The effects of the proposed exclusion on commercial fishing is assessed in section 4.15.1 (page 162) of the IA, noting that this assessment not only considers the physical exclusionary effects but also the effects of the sediment plume on commercial fishing.

110. Section 4.15.1.12 (page 169) of the IA assesses the cumulative effects of the proposed exclusion zone when considered together with other exclusion zones in the STB (e.g. those associated with oil production and the Maui's Dolphin Threat Management Plan). The IA states (page 169) that even a minimal amount of displacement may be considered significant by the affected fishers due to the history of spatial exclusions in the STB.

111. The DMC will need to assess the magnitude and significance of the exclusionary effects of the proposal, including the cumulative effects. The persons with existing interests that may be affected by the exclusionary effects will be notified of the application and any submissions that they lodge may provide the DMC with useful information to determine the magnitude and significance of these effects.

4.7. Economic benefits

Relevant section(s) of IA:	4.2 (page 73)
Relevant TTRL technical report(s):	Report 40 – Martin Jenkins Ltd – Economic Impact Analysis of the Offshore Iron Sands Project – October 2015 Section 158 Report – Martin Jenkins Ltd – Additional Economic Information provided to the EPA on 28 January 2016
Relevant EPA technical expert report(s):	GHD – Post-Lodgement Report Review of economic effects – 5 September 2016

112. The economic benefit to New Zealand of allowing the application is one of the matters which the DMC must take into account under section 59 of the EEZ Act.

113. Section 4.2 (page 73) of the IA assesses the economic effects of the project at three levels: 1) locally (South Taranaki and Whanganui); 2) regionally (Taranaki and Whanganui regions); and 3) nationally (New Zealand).

114. TTRL has applied an Input Output (I-O) multiplier analysis approach, which it states is an internationally recognised method of identifying the economic effects that defined expenditure has on a specified area in terms of the gross domestic product (GDP) and employment. Expenditure has been based on TTRL's operations budget and where that expenditure is likely to be incurred.

115. The EPA's experts (GHD) on economic effects consider that, given some inherent weakness in the I-O methodology used by TTRL when applied at the national level, it is likely that the suggested economic impacts in the IA may be slightly overstated. However, GHD do acknowledge that the use of an I-O

modelling methodology is considered to be best available practice given the intent and scope of the Jenkins (2015) report on which the IA is based without incurring additional expense for likely marginal gains.

116. GHD does not accept the 'precise' forecast of economic impacts suggested in the IA because it is based on two key variables which are either not transparent, or not cross-referenced to other relevant analyses – these being TTRL's underlying labour costs for the project (no details have been provided as to the build-up of the total labour cost) and the use of specific regional economic multipliers. GHD state that a rapid research of public-domain information shows that there currently appears to be no specific economic multipliers existing for the project region and TTRL has relied on commissioned multiplier data. Furthermore, GHD notes that there is no discussion in the IA or the Jenkins (2015) report of the economic multipliers being cross-referenced to similar analyses carried out for other projects or the wider New Zealand economy.

117. GHD notes that although the project suggests positive economic impacts, its impact on the overall New Zealand economy is likely to be minimal.

118. The term 'economic benefit' is not defined in the EEZ Act so it is unclear whether it is only the positive economic factors that are to be considered, also referred to as the 'gross' economic impacts/benefits, or whether costs need to also be factored and the 'net' economic impact/benefit is to be considered.

119. Section 4.2.3.5 (page 78) of the IA discusses the potential costs of the project in terms of potential impacts on existing interests that may be adversely affected by the project, in particular tourism and fishing interests. The IA concludes that these effects are extremely difficult to determine or quantify and therefore placing any monetary value on these effects is also difficult. Despite this, the IA concludes (page 79) that '*when considering the balance of economic effects of the project, the positive economic effects are significantly greater than any other effects*'.

120. GHD notes that without any visibility on the monetisation (valuation) of any potential economic 'dis-benefits' (costs) from any negative impacts, the suggested economic benefits of the project to New Zealand can only be viewed as 'gross' estimates with the 'net' economic impact to New Zealand likely to be less than the 'gross' values suggested in the IA. However, GHD are of the view that the quantum of the difference between 'gross' and 'net' economic impact is still likely to result in a positive net economic impact (i.e. a benefit) for the New Zealand economy, but with a low degree of risk present as to this not occurring provided the project is able to operate at or above commercial break-even levels.

121. One matter that the DMC needs to be particularly conscious of is not 'double counting' any 'costs' associated with the environmental effects. Consideration of environmental effects are clearly provided for in sections 59(2)(a) and (b) of the EEZ Act (as well as to a more specific extent in other subsections of section 59). It is therefore not appropriate to also account for them by subtracting environmental costs from economic benefits. However, non-environmental economic costs (other than those which might arise from quantifying environmental costs directly but perhaps including costs indirectly arising

as a result of environmental effects) may still be a relevant factor to consider in terms of calculating the overall (net) economic benefit of the activity.

122. The DMC may receive further information on the economic impacts of the project on tourism, fishing interests, or other persons through submissions. Any such economic information will need to be reviewed and the DMC will then need to reassess what the net economic impact of the project on the New Zealand economy will be.

5. Conditions and management plans

123. The DMC is required to take into account the extent to which imposing conditions might avoid, remedy or mitigate the adverse effects of TTRL's activities. TTRL has provided with its application a draft conditions framework, a draft Baseline Environmental Management and Monitoring Plan (BEMP), and a draft Environmental Management and Monitoring Plan (EMMP)[4]. The conditions proposed and the draft plans provide the basis for the environmental management of TTRL's operation.

124. Section 63 of the EEZ Act enables the DMC to grant a marine consent on any condition that it considers appropriate, provided the condition deals with adverse effects on the environment or existing interests. It should be noted that sections 63(3) and 63(4) prohibit the imposition of conditions which are inconsistent with the EEZ Act (or any regulations) or a condition to deal with an effect if the condition would conflict with a measure required in relation to the activity by another marine management regime (MMR) of the Health and Safety in Employment Act (the latter having been replaced by the Health and Safety at Work Act 2015).

125. I note that under section 87F(4) of the EEZ Act, if the DMC grants the application for marine discharge consent, it may issue the consent subject to conditions under section 63, '*but not under section 63(2)(b)*'. Section 63(2)(b) allows conditions to be imposed on marine consents '*that together amount or contribute to an adaptive management approach*'. The impact of section 87F(4) on the ability to impose conditions on the marine discharge consents will need further consideration by the DMC.

126. In addition to the conditions which the DMC may impose (should consent be granted), other conditions volunteered by TTRL, including those that may be outside those that the DMC can fairly impose, may also be imposed and become enforceable. Such conditions are often referred to as '*Augier*' conditions.

127. I note that EPA staff have previously provided comments on TTRL's proposed conditions during pre-lodgement. However it should be noted that this does not necessarily mean that EPA staff endorse or support the conditions. EPA staff may recommend additional conditions, or changes to those put forward by TTRL. If the DMC considers it would be useful, the most appropriate means for the EPA to provide comment on TTRL's conditions or its condition framework is for the DMC to request this. This report could also provide technical input to ensure conditions are clear, certain and enforceable.

[4] The BEMP and EMMP are contained in the Appendicies to the IA

6. Summary

128. TTRL has applied for marine consents and marine discharge consents associated with a proposal to extract and process iron sand offshore within the STB.

129. After having read TTRL's application, the IA and its appendices, the supporting technical documents including the un-redacted version of the section 158 sensitive information, and the EPA's technical expert reviews, I consider that the six key issues associated with the proposed activities are:

    a. The discharges of sediment including its off-site dispersion – referred to as the 'sediment plume' – and the various direct and indirect effects of this sediment;

    b. The proposed environmental triggers/limits and the adaptive management approach;

    c. The physical seabed and subsoil disturbance effects as a result of the extraction and structures (anchor placement and removal);

    d. Effects on Māori existing interests;

    e. The exclusionary effects in and around the project area; and

    f. The economic benefits to New Zealand.

130. Table 3 below summaries these six key issues and identifies the matters that the DMC should consider and which may also form the basis of further information that the DMC may decide it needs to ensure that it has the best available information to make a decision on the application.

Table 3. Summary of Key Issues and Relevant DMC Considerations/Questions and Possible Further Information Needs

	Key Issue	Summary	Relevant DMC Considerations/Questions and Possible Further Information Needs
1.	Discharges of sediment including its off-site dispersion – referred to as the 'sediment plume'	• Many direct and indirect effects including smothering, clogging, reduced visibility, reduced primary production, and release of contaminants. • Effects of sediment, in turn, have the potential to result in adverse effects on existing interests including Māori, recreational users, tourism, and commercial fishers. • Assessment of many of the effects of sediment discharges rely on the outputs of the NIWA sediment plume modelling. • Critical inputs into the NIWA sediment plume model are the 'source terms' – these have been derived from recent laboratory testing by HRW on post-processing sediment samples. • Accuracy of the discharge rates provided by TTRL are dependent on the design dredging and grinding circuit and technology process design. These have not been able to be verified by EPA experts (GHD). • Only the de-ored sediment discharge has been included in the model, not the sediment discharges from the crawler, grade control drilling, or environmental sampling.	• Have all the sediment sources likely to be generated by the activities (especially the crawler) been adequately accounted for as inputs in the NIWA sediment plume modelling? • Do the sediment 'source terms' appropriately and accurately reflect TTRL's proposed discharges of sediments? • What are the relevance of the 'net differences' (predicted increases) in median and 99th percentile SSC at the three locations discussed in section 4.4.2.3 of the IA? • What pattern exists in terms of the predicted number of days where light is predicted to be reduced – are they all contiguous or spread out and does this affect the primary production effects assessment? • Is it appropriate to rely on literature values from outside the STB to predict the effects on primary production or should these effects, especially at ecologically sensitive sites, be assessed using a primary production model? • Has TTRL demonstrated that the assumed SMD is a suitable area over which to average predicted results for optical and primary production effects given the strong likelihood of hydrodynamic gradients within the SMD?

	Key Issue	Summary	Relevant DMC Considerations/Questions and Possible Further Information Needs
2.	Proposed environmental triggers/limits and the adaptive management approach	• Response and compliance limits for SSC and sediment quality are proposed for seven sites – this is a form of adaptive management. • The 80th and 95th percentile SSC are proposed for the response and compliance limits, respectively. • Response and compliance limits will be based on existing and baseline monitoring data for SSC. • If the response limit is exceeded (but not the compliance limit) and is shown to be as a result of mining then additional monitoring and operational changes will be made. • If the compliance limit is exceeded and is shown to be as a result of mining then mining ceases. • Turbidity monitoring may be used as a proxy for SSC.	• Are the seven selected compliance sites appropriately located – are there other sensitive or representative sites that should be included (e.g. subtidal and intertidal reef communities)? • Are the proposed response and compliance limits and the proposed management approach appropriate for preventing unacceptable adverse effects at the seven sites and elsewhere in the STB? • Should the limits be based on 'exposure over time' (frequency and duration) in addition to intensity? • Is measuring turbidity appropriate as a proxy for SSC? • Are the limits proposed measureable and is TTRL able to respond to any exceedances within an appropriate timeframe?
3.	Physical seabed and subsoil disturbance effects	• Around 5 km^2 of seabed, up to 11 m depth, will be disturbed per year. • No evidence that the project area is unique in respect of habitats and benthic biota. • The nature of existing habitat will change – particle size distribution and sediment chemistry will be different after de-ored sediments are re-deposited.	• Will the benthic communities recover to pre-mining levels? • What timeframe will recovery occur over?

	Key Issue	Summary	Relevant DMC Considerations/Questions and Possible Further Information Needs
		• Mortality of benthic biota is certain to occur within the mining area. • Recovery will occur over time, however the timeframes over which recovery will occur are uncertain. • Magnitude of effects is scale dependent, both spatially and temporally. Significant effects will occur within the extraction area (local scale), however they will be negligible at STB scale. Likewise, effects will be significant immediately following excavation but negligible following the recovery period.	
4.	Effects on Māori existing interests	• Māori existing interests include customary fishing, settlement of Treaty of Waitangi historical claims, and settlement of contemporary claims under the Treaty. • Te Tai Hauauru Forum Report identifies 27 sites of significance within the CMA with regard to customary fisheries. • Three settlements, which include statutory acknowledgements, exist within the CMA. • A CVA has been prepared which focusses on Ngati Ruanui's cultural values – however the CVA has not been prepared or endorsed by Ngati Ruanui.	• Does the CVA adequately represent the views of Ngati Ruanui given that the report has not been provided or endorsed by Ngati Ruanui? • Are there other Māori existing interests that may be adversely affected by the proposal? • What is the magnitude and significance of the effects of the proposed activities on Māori existing interests?

	Key Issue	Summary	Relevant DMC Considerations/Questions and Possible Further Information Needs
		• Māori other than Ngati Ruanui may also have cultural values and associations within the STB	
5.	Exclusionary effects in and around the project area	• A 1 NM operational buffer around the IMV is proposed, which equates to an exclusionary area of 10.8 km^2. • The operational buffer will be dynamic as the IMV moves. The buffer will move approximately every 10 days. • Fishing and other marine traffic will still be allowed in the remainder of the project area. • Other exclusion areas existing within the STB (e.g. those associated with oil production) and cumulative effects need to be considered.	• What is the significance of the exclusionary effects, including cumulative effects, on existing interests?
6.	Economic benefits to New Zealand	• Economic benefits have been calculated at a local, regional, and national level. • Input-Output (I-O) multiplier analysis has been used to calculate benefits. • Economic costs have not been calculated as these are considered by TTRL to be too difficult to determine or quantify. • It is important not to 'double count' any 'costs' associated with environmental effects as these are already taken into account under other parts of section 59 of the EEZ Act.	• Have the estimates of economic benefits been appropriately assessed? • Can the economic 'costs' (excluding environmental costs) be determined and quantified? • What will the net economic benefit of the proposal be to the New Zealand economy?

Key Issue	Summary	Relevant DMC Considerations/Questions and Possible Further Information Needs
	• Overall TTRL have determined that the positive economic effects are considered to be significantly greater than the other effects.	

29 September 2016

Rob Lieffering – Technical Advisor **Date**

Appendix 1 Statutory provisions

10 Purpose

(1)The purpose of this Act is -

(a) to promote the sustainable management of the natural resources of the exclusive economic zone and the continental shelf; and
(b) in relation to the exclusive economic zone, the continental shelf, and the waters above the continental shelf beyond the outer limits of the exclusive economic zone, to protect the environment from pollution by regulating or prohibiting the discharge of harmful substances and the dumping or incineration of waste or other matter.

*(2) In this Act, **sustainable management** means managing the use, development, and protection of natural resources in a way, or at a rate, that enables people to provide for their economic well-being while—*

(a) sustaining the potential of natural resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and
(b) safeguarding the life-supporting capacity of the environment; and
(c) avoiding, remedying, or mitigating any adverse effects of activities on the environment

(3) In order to achieve the purpose, decision-makers must—

(a) take into account decision-making criteria specified in relation to particular decisions; and
(b) apply the information principles to the development of regulations and the consideration of applications for marine consent

59 Environmental Protection Authority's consideration of application

(1) This section and sections 60 and 61 apply when the Environmental Protection Authority is considering an application for a marine consent and submissions on the application.

(2) The EPA must take into account—

(a) any effects on the environment or existing interests of allowing the activity, including—
(i) cumulative effects; and
(ii) effects that may occur in New Zealand or in the waters above or beyond the continental shelf beyond the outer limits of the exclusive economic zone; and
(b) the effects on the environment or existing interests of other activities undertaken in the area covered by the application or in its vicinity, including—
(i) the effects of activities that are not regulated under this Act; and
(ii) effects that may occur in New Zealand or in the waters above or beyond the continental shelf beyond the outer limits of the exclusive economic zone; and
(c) the effects on human health that may arise from effects on the environment; and

(d) the importance of protecting the biological diversity and integrity of marine species, ecosystems, and processes; and
(e) the importance of protecting rare and vulnerable ecosystems and the habitats of threatened species; and
(f) the economic benefit to New Zealand of allowing the application; and
(g) the efficient use and development of natural resources; and
(h) the nature and effect of other marine management regimes; and
(i) best practice in relation to an industry or activity; and
(j) the extent to which imposing conditions under section 63 might avoid, remedy, or mitigate the adverse effects of the activity; and
(k) relevant regulations; and
(l) any other applicable law; and
(m) any other matter the EPA considers relevant and reasonably necessary to determine the application.

(3) The EPA must have regard to—

(a) any submissions made and evidence given in relation to the application; and
(b) any advice, reports, or information it has sought and received in relation to the application; and
(c) any advice received from the Māori Advisory Committee.

(4) When considering an application affected by section 74, the EPA must also have regard to the value of the investment in the activity of the existing consent holder.

(5) Despite subsection (3), the EPA must not have regard to—

(a) trade competition or the effects of trade competition; or
(b) the effects on climate change of discharging greenhouse gases into the air; or
(c) any effects on a person's existing interest if the person has given written approval to the proposed activity.

(6) Subsection (5)(c) does not apply if the person has given written approval but the person withdraws the approval by giving written notice to the EPA—

(a) before the date of the hearing, if there is one; or
(b) if there is no hearing, before the EPA decides the application.

60 Matters to be considered in deciding extent of adverse effects on existing interests

In considering the effects of an activity on existing interests under section 59(2)(a), the Environmental Protection Authority must have regard to—

(a) the area that the activity would have in common with the existing interest; and
(b) the degree to which both the activity and the existing interest must be carried out to the exclusion of other activities; and
(c) whether the existing interest can be exercised only in the area to which the application relates; and

(d) any other relevant matter.

61 Information principles

(1) When considering an application for a marine consent, the Environmental Protection Authority must—

(a) make full use of its powers to request information from the applicant, obtain advice, and commission a review or a report; and
(b) base decisions on the best available information; and
(c) take into account any uncertainty or inadequacy in the information available.

(2) If, in relation to making a decision under this Act, the information available is uncertain or inadequate, the EPA must favour caution and environmental protection.

(3) If favouring caution and environmental protection means that an activity is likely to be refused, the EPA must first consider whether taking an adaptive management approach would allow the activity to be undertaken.

(4) Subsection (3) does not limit section 63 or 64.

*(5) In this section, **best available information** means the best information that, in the particular circumstances, is available without unreasonable cost, effort, or time.*

87D Environmental Protection Authority's consideration of application

(1) This section and sections 87E and 87F apply when the Environmental Protection Authority is considering an application for a marine discharge consent or a marine dumping consent and submissions on the application.

(2) The EPA must take into account,—

(a) in relation to the discharge of harmful substances,—
(i) the matters described in section 59(2), except paragraph (c); and
(ii) the effects on human health of the discharge of harmful substances if consent is granted

87E Information principles relating to discharges and dumping

(1) When considering an application for a marine dumping consent or a marine discharge consent, the Environmental Protection Authority must—
(a) make full use of its powers to request information from the applicant, obtain advice, and commission a review or a report; and
(b) base decisions on the best available information; and
(c) take into account any uncertainty or inadequacy in the information available.

(2) If, in relation to making a decision on the application, the information available is uncertain or inadequate, the EPA must favour caution and environmental protection.

*(3) In this section, **best available information** means the best information that, in the particular circumstances, is available without unreasonable cost, effort, or time.*

87F Decision on application for marine discharge consent or marine dumping consent

(1) After complying with sections 87D and 87E, the Environmental Protection Authority may—

(a) grant an application for a marine discharge consent or a marine dumping consent, in whole or in part, and issue a consent; or

(b) refuse the application.

(2) However, the EPA must refuse an application for a marine dumping consent if—

(a) the EPA considers that the waste or other matter may be reused, recycled, or treated without—

(i) adverse effects on human health or the environment that are more than minor; or

(ii) imposing costs on the applicant that are unreasonable in the circumstances; or

(b) the waste or other matter is identified in such a way that it is not possible to assess the potential effects of dumping the waste or other matter on human health or the environment; or

(c) the EPA considers that dumping the waste or other matter is not the best approach to the disposal of the waste or other matter in the circumstances.

(3) To avoid doubt, the EPA may refuse an application for a marine discharge consent or a marine dumping consent if the EPA considers that it does not have adequate information to determine the application.

(4) If the EPA grants the application, it may issue the consent subject to conditions under section 63, but not under section 63(2)(b).