ATTACHMENT THIRTEEN
Assessment of Seabirds and Shorebirds Effects (NIWA)

McCALLUM BROS LTD
Established 1904

Sand extraction in Te Ākau Bream Bay

Potential effects on seabirds and shorebirds

Prepared for McCallum Bros Limited

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NIWA Conflict of Interest: NIWA, and other associated parties, have extensive and many tens of millions of dollars investment in major aquaculture facilities all relying on continuous access to 4 m^3 per sec of high quality seawater from offshore water intakes (3 intake, 3 outfall x 2.4 m diameter) in Te Ākau Bream Bay proximal to the proposed sand extraction area. Thus, NIWA may oppose the extraction.

Revision	Description	Date
Version 0.1	Draft in preparation/in review	31 July 2024
Version 0.2	Draft version sent to client	01 August 2024
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Note from author:

Confidentiality Statement

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Code of Conduct Reference for Application Material

Although this is not a hearing before the Environment Court, I record that I have read and agree to comply with the Environment Court's Code of Conduct for Expert Witnesses as specified in the Environment Court's Practice Note 2023 as relevant to preparation of a report for this Fast-track application. In particular, I confirm that this report is within my area of expertise, except where I state that I rely upon the evidence or reports of other expert witnesses lodged forming part of the project's application material. I have not omitted to consider any material facts known to me that might alter or detract from the opinions expressed.

Executive summary

This report was commissioned by McCallum Bros Limited to assess the potential effects on seabirds and shorebirds of proposed sand extraction from within an area at least 4.7 km offshore within Te Ākau Bream Bay, Northland.

The objectives of this assessment were to:

- Summarise the seabird and shorebird assemblage that is likely to occur in the vicinity of the proposed sand extraction area and along the shore adjacent to the proposed sand extraction area,
- Identify potential effects of sand extraction activity on seabirds and shorebirds, and
- Assess the likely impact of potential effects of sand extraction activity on seabirds and shorebirds.

A conservative total of 34 seabird taxa, of which five are classified as 'Threatened' under the New Zealand Threat Classification System (NZTCS: tara iti fairy tern *Sternula nereis davisae*, takahikare-raro New Zealand storm petrel *Fregetta maoriana*, taranui Caspian tern *Hydropogne caspia*, tākoketa black petrel *Procellaria Parkinson* and toroa grey-headed albatross *Thalassarche chrysostoma*), with a further 23 taxa classified as 'At Risk', were identified as likely to occur in the Te Ākau Bream Bay area. Overall, 82% of seabird taxa likely to occur in Te Ākau Bream Bay are classified as either 'Threatened' or 'At Risk'.

Additionally, 13 shorebird taxa, of which three are classified as 'Threatened' under the NZTCS (matuku-hūrepo Australasian bittern *Botaurus poiciloptilus*, ngutu pare wrybill *Anarhynchus frontalis* and tūturiwhatu northern New Zealand dotterel *Charadrius obscurus aquilonius*), with a further six classified as 'At Risk', were identified as likely to occur in Te Ākau Bream Bay.

Of particular conservation concern, tara iti fairy tern breeds at Waipū estuary, 5.6 km to the southwest of the proposed sand extraction area, with 1-2 breeding pairs at this site.

Seven potential effects of proposed sand extraction activity (loss of terrestrial breeding habitat, exclusion from marine habitat, changes to prey abundance/availability, interaction with the sand extraction vessel, fuel/oil spill, airborne noise and underwater noise) were assessed for all seabird and shorebird taxa using a consequence-likelihood-risk approach. Risk scores for all potential effects and for all taxa were classified as '**low**'. For tara iti fairy tern and for the potential effects of loss of terrestrial breeding habitat, interaction with the sand extraction vessel and fuel/oil spill the risk score was in the middle of the low category, due to the '**very low**' likelihood scores for these three potential effects. It is recommended that management plans (interaction with the sand extraction vessel and fuel/oil spill) be established or maintained.

1 Background

McCallum Bros Limited (MBL) is seeking resource consent to extract sand from an area within Te Ākau Bream Bay (also known as Whanga-a-Tamure), Northland. The proposed sand extraction area forms a rectangle extending approximately northwest to southeast, roughly parallel with the central Te Ākau Bream Bay shoreline, in water between approximately 20 and 30 m deep and at least 4.7 km offshore, this being the distance from shore to the point '5d' at the northwest corner of the proposed sand extraction area (Figure 1-1).

In short, sand extraction activities involve dredging and pumping of a sand slurry from the seabed to MBL's trailing-suction hopper dredge "*William Fraser*" travelling at 1.5-2.5 knots within the proposed sand extraction area. Sand extraction is proposed to take place predominantly during the day and to occur for a maximum of 3.5 hours per day. Two operating 'windows' are proposed: from April to September sand extraction is to occur between 12:00 and 18:00 hours, and from October to March sand extraction is to occur between 12:00 and 20:00 hours. Once the *William Fraser's* hopper is full of sand the vessel will return to MBL's Port of Auckland depot (or other destination port) for unloading.

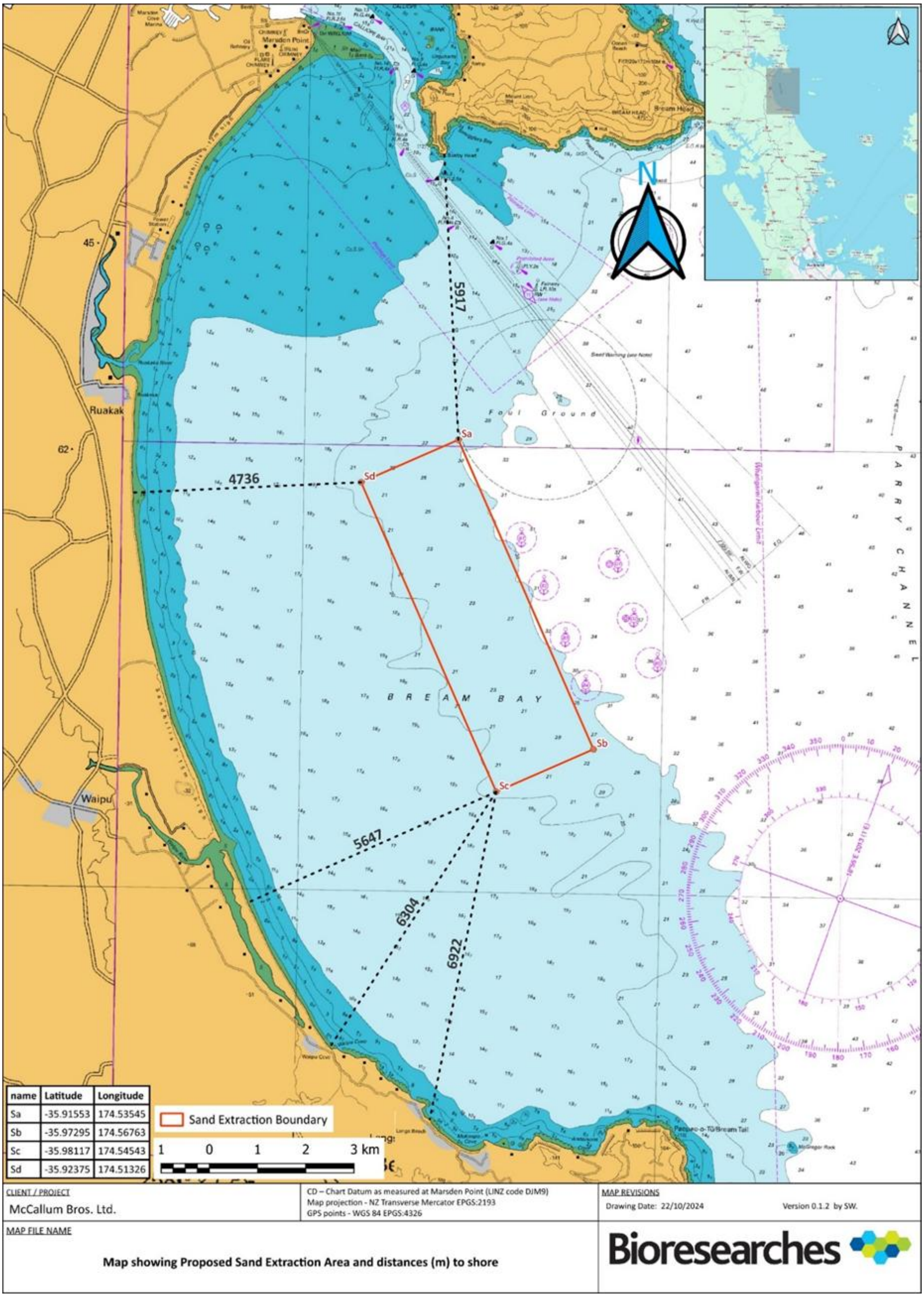

Figure 1-1: Map showing the location of the proposed sand extraction area (red rectangle) within Te Ākau Bream Bay. Black dotted lines indicate distances to shore in metres and the inset box places Te Ākau Bream Bay within a wider, regional context.

The objectives of this report are to:

- Summarise the seabird and shorebird assemblage that is likely to occur in the vicinity of the proposed sand extraction area and along the shore adjacent to the proposed sand extraction area,
- Identify potential effects of sand extraction activity on seabirds and shorebirds, and
- Assess the likely impact of potential effects of sand extraction activity on seabirds and shorebirds.

2 Seabirds and shorebirds in Te Ākau Bream Bay

2.1 Introduction

The northeast coast of Te Ika-a-Māui North Island supports a highly diverse avifauna. The entire coastal marine area from East Cape in the south to Manawatāwhi Three Kings Islands in the north constitutes 'The North East North Island' important area for seabirds (Forest & Bird 2014). Several islands, located relatively close to Te Ākau Bream Bay, have similarly been identified as important areas (islands) for seabirds: specifically, Tawhiti Rahi and Aorangi Poor Knights Islands, Taranga Hen Island, Marotere Chicken Islands, Mokohinau Islands, Te Hauturu-o-Toi Little Barrier Island and Aotea Great Barrier Island (Forest & Bird 2015), while Waipū estuary towards the south of Te Ākau Bream Bay has been identified as an important estuarine site for seabirds (Forest & Bird 2016).

Additionally, Northland Regional Council, through its Proposed Regional Plan[1] (PRP), has identified Ruakākā and Waipū estuaries and Whāngarei Harbour as significant ecological marine areas, along with the waters of Taranga Hen Island and Marotere Chicken Islands and Tawhiti Rahi and Aorangi Poor Knights Islands. Further, the PRP identifies the northern part of Te Ākau Bream Bay, including the proposed sand extraction area, as part of the Significant Marine Mammal and Seabird Area. Taranga Hen Island and Marotere Chicken Islands and Tawhiti Rahi and Aorangi Poor Knights Islands are also classified as significant bird areas in the PRP, primarily because of the seabird assemblages these island sites support[2]

The coastal fringe of Te Ākau Bream Bay similarly supports a diverse shorebird assemblage, with Waipū and Ruakākā estuaries specifically, and Te Ākau Bream Bay more generally, all identified as significant bird areas in the PRP.

2.2 Legislative framework

All indigenous (native) birds are fully protected under the Wildlife Act 1953 (Act). For seabirds, exceptions to full protection under the Act include those species listed under Schedule Three of the Act, which allows for species to be hunted or killed subject to the Minister's notification. For example, species covered by Schedule Three include two species of seabirds traditionally harvested by Māori (tītī sooty shearwater *Puffinus griseus* and ōi grey-faced petrel *Pterodroma macroptera gouldi*). Additionally, Schedule Five of the act identifies species that are not protected, which includes karoro black-backed gull *Larus dominicanus dominicanus*.

[1] https://www.nrc.govt.nz/media/2yojfgax/proposed-regional-plan-february-2024.pdf
[2] https://www.nrc.govt.nz/your-council/about-us/council-projects/new-regional-plan/technical-reports/

The National Policy Statement for Indigenous Biodiversity[3] (NPSIB) aims to maintain indigenous biodiversity across Aotearoa New Zealand such that there is at least no overall loss in indegnous biodiversity. The NPSIB applies to all indigenous biodiversity in the terrestrial environment, but additionally makes provision for specified highly mobile fauna whether or not they use areas outside the terrestrial environment, including the coastal marine area. Appendix 2 of the NPSIB identifies specified highly mobile fauna, which includes several species of shorebirds, gulls, terns and kāruhiruhi pied shag *Phalacrocorax varius varius*. Many of these species occur within the environs of the proposed sand extraction area, including along the shore of Te Ākau Bream Bay to the east of the proposed sand extraction area (see Table 2-1).

2.2.1 Threat classification systems

This report includes sections that make reference to 'Threatened' or 'At Risk' species. These classifications are derived from the New Zealand Threat Classification System[4] (NZTCS: Townsend et al. 2008, Rolfe et al. 2022) or from the International Union for Conservation of Nature (IUCN) 'Red List' classification system[5]. Both systems aim to classify species on the basis of the likelihood of extinction, and the resulting classifications are often referred to as the 'conservation status' of a particular species. Further, both systems essentially assign higher conservation status to species with relatively small total populations, with populations that exhibit a declining trajectory and that occupy relatively small spatial extents. Therefore, species with small, declining populations that have limited areas of occupancy will have a higher conservation status than species with large, increasing populations that have large areas of occupancy. Both of these classification systems are of relevance to the New Zealand Coastal Policy Statement 2010[6] (NZCPS), and specifically to Policy 11 of the Statement, which deals with indigenous biological diversity (biodiversity) and its protection in the coastal environment (i.e., from the mean high water spring tide level to the 12 nm limit of the territorial sea). Policy 11 (a) notes that adverse effects of activities should be avoided on (i) 'indigenous taxa that are listed as threatened or at risk in the New Zealand Threat Classification System lists' and on (ii) 'taxa that are listed by the International Union for Conservation of Nature and Natural Resources as threatened'. 'Taxa' in this context usually equates to 'species' (plural), but in the New Zealand system can also include sub-species.

There are, however, some important differences between the two systems. The NZTCS considers species, and sub-species, at the scale of Aotearoa New Zealand, whereas the IUCN 'Red List' system considers species at a global scale. There are also differences in the number and type of categories used to classify taxa between the two systems. For wild populations of species (i.e. excluding species that are extinct in the wild, but which exist in captivity) that have been evaluated, the IUCN system assigns species to one of six categories: 'Data Deficient', 'Least Concern', 'Near Threatened' and three 'Threatened' categories, 'Vulnerable', 'Endangered' and 'Critically Endangered'. Excluding 'Data Deficient', the risk of extinction increases from 'Least Concern' through to 'Critically Endangered'. Figure 2-1 summarises the categories within the IUCN classification system.

[3] https://environment.govt.nz/assets/publications/biodiversity/National-Policy-Statement-for-Indigenous-Biodiversity.pdf
[4] https://nztcs.org.nz/
[5] https://www.iucnredlist.org/
[6] https://www.doc.govt.nz/Documents/conservation/marine-and-coastal/coastal-management/nz-coastal-policy-statement-2010.pdf

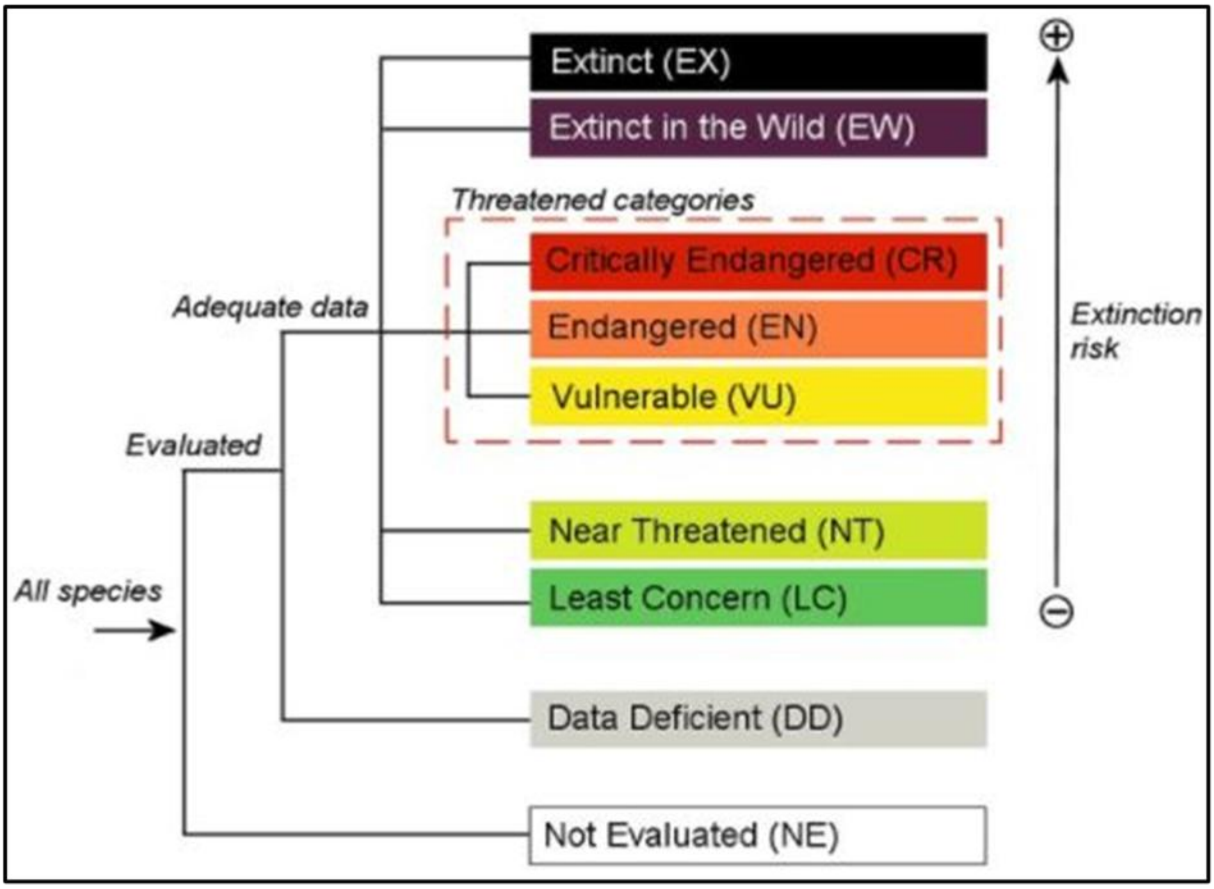

Figure 2-1: Schematic showing the IUCN 'Red List' categories. Further information can be found at the 'Red List' website[7].

The NZTCS has four 'Threatened' categories: 'Nationally Increasing', 'Nationally Vulnerable', 'Nationally Endangered', and 'Nationally Critical', again with increasing levels of risk of extinction. Additionally, and sitting below the 'Threatened' categories, the latest version of the NZTCS has three 'At Risk' categories: 'Recovering', 'Naturally Uncommon' and 'Declining'. The NZTCS also has a 'Data Deficient' category, a 'Not Threatened' category (which is analogous to the IUCN category 'Least Concern'), plus categories for non-resident native taxa of 'Migrant' and 'Vagrant', and a 'Coloniser' category, which includes taxa that would otherwise be considered 'Threatened' due to small population size, but which have arrived naturally to Aotearoa New Zealand and which have successfully reproduced in the wild since 1950 (Rolfe et al. 2022). Figure 2-2 shows the structure of the NZTCS.

[7] https://www.iucnredlist.org/

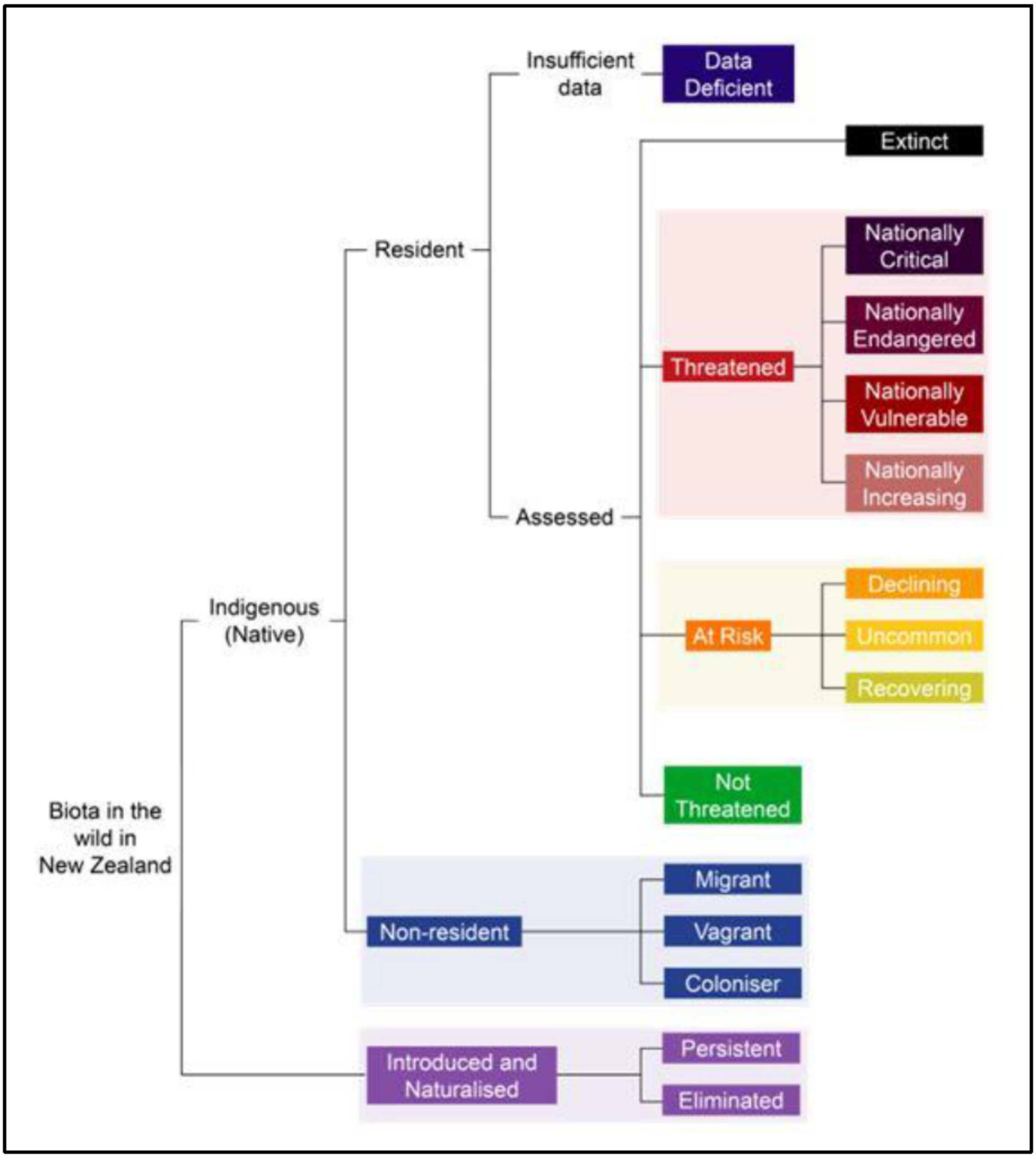

Figure 2-2: Structure of the New Zealand Threat Classification System. After Rolfe et al. (2022).

Note that the most recent NZTCS assessment of birds (Robertson et al. 2021) occurred when the NZTCS included a fourth 'At Risk' category – 'Relict', which occupied a position between 'At Risk – Recovering' and 'At Risk – Naturally Uncommon': see Townsend et al. (2008) for further details. Essentially, 'At Risk – Relict' taxa were those that had undergone a documented decline within the last 1,000 years such that they now occupy less than 10% of their former range.Taxa classified as 'At Risk – Relict' by Robertson et al. (2021) have been retained in this report.

2.3 Sources of information

For seabirds there has been only one systematic and structured at-sea survey of seabird occurrence within Te Ākau Bream Bay, including the proposed sand extraction area. Seabird occurrence was recorded from a series of vessel-based transects across Te Ākau Bream Bay from December 2022 to March 2024 (Brough et al. 2024). Additionally, several further information sources were used to enable the compilation of a list of seabird taxa that could be expected to occur within Te Ākau Bream Bay, and by extension the proposed sand extraction area. These sources include published journal papers and reports, unpublished ('grey') literature and online databases, particularly the eBird online database[8] of bird sightings but also information available from the New Zealand Birds Online website[9] on seabird breeding sites. It has been assumed that seabird taxa with breeding sites relatively close to Te Ākau Bream Bay will occur within the bay. Similarly, the information sources noted here were explored in order to compile a list of shorebird taxa that would be likely to occur along the coastal fringe of Te Ākau Bream Bay.

2.4 Species likely to occur in Te Ākau Bream Bay

Table 2-1 lists species of seabirds and shorebirds that are known to, or which are likely to, occur in Te Ākau Bream Bay. It should be noted that the list of taxa in Table 2-1 is conservative and additional species, not listed in Table 2-1, could occur in the Te Ākau Bream Bay area from time to time. No account has been made of temporal variation in the occurrence of taxa noted in Table 2-1. However, for some taxa that migrate out of Aotearoa New Zealand following breeding, occurrence in the area of interest will be strongly seasonal. For example, tītī sooty shearwaters migrate to the northern Pacific Ocean for the austral winter (Shaffer et al. 2006), from approximately June to September, during which time occurrence locally is highly unlikely. Further examples of seasonality of occurrence for seabirds in Te Ākau Bream Bay are provided in Brough et al. (2024). Additionally, for seabirds, no attempt has been made to quantify the 'importance' of the proposed sand extraction area specifically, or the Te Ākau Bream Bay area more generally, either in absolute terms or relative to other areas. It should be noted that Brough et al. (2024) produced maps of probabilities of occurrence for a number of seabird species within Te Ākau Bream Bay, based on species distribution modelling, that show clear, species-specific spatio-temporal patterns of occurrence. However, given the relatively large distributions of the seabird species likely to occur in Te Ākau Bream Bay (Table 2-1), probably extending well beyond the area surveyed by Brough et al. (2024) for even the most sedentary species, assigning 'importance' to any specific area (such as the proposed sand extraction area, for example) within Te Ākau Bream Bay becomes challenging.

2.4.1 Seabirds

Table 2-1 lists 34 seabird taxa, of which five are classified as 'Threatened' under the NZTCS (tara iti fairy tern *Sternula nereis davisae*, takahikare-raro New Zealand storm petrel *Fregetta maoriana*, taranui Caspian tern *Hydropogne caspia*, tākoketa black petrel *Procellaria parkinsoni* and toroa grey-headed albatross *Thalassarche chrysostoma*) with a further 23 taxa classified as 'At Risk' (82% of seabird taxa listed in Table 2-1 are classified as either 'Threatened' or 'At Risk').

[8] https://ebird.org/home
[9] https://www.nzbirdsonline.org.nz/

Table 2-1: Summary information on the conservation status and relative abundance of seabirds and shorebirds that are likely to occur in the Te Ākau Bream Bay area. Taxonomy (scientific name) and NZTCS conservation status follow Robertson et al. (2021). Taxa are ranked according to NZTCS conservation status, and then alphabetically by scientific name. IUCN Red List classifications were obtained from the IUCN Red List of Threatened Species website[10] (accessed July 2024). Relative abundance scores follow Townsend et al. (2008), whereby a score of 1 = < 250 mature individuals (defined as an individual capable of reproduction and here calculated as double the best estimate of number of annual breeding pairs for each taxon), 2 = 250-1,000, 3 = 1,000-5,000, 4 = 5,000-20,000, 5 = 20,000-100,000 and 6 = > 100,000 mature individuals. Abundance scores are based on information available on the New Zealand Birds Online website[11] and the New Zealand Threat Classification System website[12] (both accessed July 2024) and are provided for those taxa that breed in Aotearoa New Zealand. The list of seabirds and shorebirds included here is based primarily on information provided by Beauchamp & Parrish (2007), Forest & Bird (2014), Frost (2017), Gaskin & Rayner (2017), Taylor (2000a, b), Robertson et al. (2021), Bull (2022a, 2022b) and Brough et al. (2024), or available at the New Zealand eBird website[13], and references cited within these sources. 'a' superscript to common names: Brough et al. (2024) identified 'Cape pigeon' and 'Buller's albatross' in the Te Ākau Bream Bay area, but based on proximity to breeding sites the sub-species 'Snares Cape petrel' and 'northern Buller's albatross', both recognised by Robertson et al. (2021), have been included here. 'hmf' superscript to common names: taxa specified as 'highly mobile fauna' by the NPSIB. Te Ākau Bream Bay area here includes the terrestrial coastal environment.

Common Name	Scientific Name	NZTCS Conservation Status	IUCN Red List Classification	Relative Abundance
Seabirds				
Tara iti New Zealand fairy tern[hmf]	*Sternula nereis davisae*	Threatened – Nationally Critical	Vulnerable	1
Takahikare-raro New Zealand storm petrel	*Fregetta maoriana*	Threatened – Nationally Vulnerable	Critically Endangered	2
Taranui Caspian tern[hmf]	*Hydropogne caspia*	Threatened – Nationally Vulnerable	Least Concern	3
Tākoketa Black petrel	*Procellaria parkinsoni*	Threatened – Nationally Vulnerable	Vulnerable	3
Toroa Grey-headed albatross	*Thalassarche chrysostoma*	Threatened – Nationally Vulnerable	Endangered	4
Kororā Northern little penguin	*Eudyptula minor iredalei*	At Risk - Declining	Least Concern	4
Tarāpuka Black-billed gull[hmf]	*Larus bulleri*	At Risk - Declining	Near Threatened	5
Tarāpunga Red-billed gull[hmf]	*Larus novaehollandiae scopulinus*	At Risk - Declining	Least Concern	5
Rako Buller's shearwater	*Puffinus bulleri*	At Risk - Declining	Vulnerable	6
Tītī Sooty shearwater	*Puffinus griseus*	At Risk - Declining	Near Threatened	6
Tara White-fronted tern[hmf]	*Sterna striata striata*	At Risk - Declining	Near Threatened	5

[10] http://www.iucnredlist.org/
[11] http://nzbirdsonline.org/
[12] https://nztcs.org.nz/
[13] http://ebird.org/content/newzealand/

Common Name	Scientific Name	NZTCS Conservation Status	IUCN Red List Classification	Relative Abundance
Toroa White-capped albatross	*Thalassarche cauta steadi*	At Risk - Declining	Near Threatened	6
Pāngurunguru Northern giant petrel	*Macronectes halli*	At Risk – Recovering	Least Concern	3
Kāruhiruhi Pied shag[hmf]	*Phalacrocorax varius varius*	At Risk – Recovering	Least Concern	3
Pycroft's petrel	*Pterodroma pycrofti*	At Risk - Recovering	Vulnerable	4
Totorore North Island little shearwater	*Puffinus assimilis haurakiensis*	At Risk - Recovering	Least Concern	4
Tītī wainui Fairy prion	*Pachyptila turtur*	At Risk - Relict	Least Concern	6
Takahikare White-faced storm petrel	*Pelagodroma marina maoriana*	At Risk - Relict	Least Concern	6
Kuaka Northern diving petrel	*Pelecanoides urinatrix urinatrix*	At Risk - Relict	Least Concern	6
Māpunga Black shag	*Phalacrocorax carbo novaehollandiae*	At Risk - Relict	Least Concern	3
Kawaupaka Little shag	*Phalacrocorax melanoleucos brevirostris*	At Risk - Relict	Least Concern	4
Grey noddy	*Procelsterna cerulea albivitta*	At Risk - Relict	Least Concern	5
Tītī Cook's petrel	*Pterodroma cookii*	At Risk - Relict	Vulnerable	6
Toanui Flesh-footed shearwater	*Puffinus carneipes*	At Risk - Relict	Near Threatened	4
Pakahā Fluttering shearwater	*Puffinus gavia*	At Risk - Relict	Least Concern	5
Karetai hurukoko Snares Cape petrel[a]	*Daption capense australe*	At Risk – Naturally Uncommon	Least Concern	4
Kawau tūī Little black shag	*Phalacrocorax sulcirostris*	At Risk – Naturally Uncommon	Least Concern	3
Toroa Northern Buller's albatross[a]	*Thalassarche bulleri platei*	At Risk – Naturally Uncommon	Near Threatened	5
Karoro Southern black-backed gull	*Larus dominicanus*	Not Threatened	Least Concern	6
Tākapu Australasian gannet	*Morus serrator*	Not Threatened	Least Concern	5
Ōi Grey-faced petrel	*Pterodroma macroptera gouldi*	Not Threatened	Least Concern	6
Karetai kapa mangu Black-winged petrel	*Pterodroma nigripennis*	Not Threatened	Least Concern	6

Common Name	Scientific Name	NZTCS Conservation Status	IUCN Red List Classification	Relative Abundance
Arctic skua	*Stercorarius parasiticus*	Migrant	Endangered	
Toroa Black-browed albatross	*Thalassarche melanophris*	Coloniser	Least Concern	2
Shorebirds				
Matuku-hūrepo Australasian bittern[hmf]	*Botaurus poiciloptilus*	Threatened – Nationally Critical	Vulnerable	2
Ngutu pare Wrybill[hmf]	*Anarhynchus frontalis*	Threatened – Nationally Increasing	Vulnerable	3
Tūturiwhatu Northern New Zealand dotterel[hmf]	*Charadrius obscurus aquilonius*	Threatened – Nationally Increasing	Least Concern	3
Huahou Red knot[hmf]	*Calidris canutus rogersi*	At Risk - Declining	Near Threatened	
Pohowera Banded dotterel[hmf]	*Charadrius bicinctus bicinctus*	At Risk - Declining	Near Threatened	4
Tōrea South Island pied oystercatcher[hmf]	*Haematopus finschi*	At Risk - Declining	Least Concern	5
Kuaka Eastern bar-tailed godwit[hmf]	*Limosa lapponica baueri*	At Risk - Declining	Near Threatened	
Tōrea pango Variable oystercatcher[hmf]	*Haematopus unicolor*	At Risk - Recovering	Least Concern	4
Kōtuku ngutupapa Royal spoonbill	*Platalea regia*	At Risk – Naturally Uncommon	Least Concern	3
Poaka Pied stilt	*Himantopus himantopus leucocephalus*	Not Threatened	Least Concern	5
Spur-winged plover	*Vanellus miles novaehollandiae*	Not Threatened	Least Concern	6
Turnstone	*Arenaria interpres*	Migrant	Near Threatened	
Kuriri Pacific golden plover	*Pluvialis fulva*	Migrant	Least Concern	

The seabird taxa listed in Table 2-1 fall very broadly into two groups. Firstly, one group of species could be described as coastal (generally occupying the coastal 'strip' out to perhaps 20-25 km from shore): this group would include gulls, terns, shags, kororā northern little penguin *Eudyptula minor iredalei*, Arctic skua *Stercorarius parasiticus* and tākapu Australasian gannet *Morus serrator*, although species within this group are certainly capable of venturing further offshore (e.g., Poupart et al. 2017). This first group comprises species that tend to be active diurnally and which roost ashore at night. The second group comprises generally offshore, pelagic species and is made up of mostly procellariiformes (albatrosses, petrels, storm petrels and shearwaters). Again, while species in this group tend to spend most of their time far from land when at sea, many can be seen well inshore on occasion, and when breeding will return to breeding sites, often islands relatively close to shore, to incubate eggs or feed chicks. In contrast to the first group, many species in this second group are active nocturnally as well as diurnally (e.g., Mackley et al. 2010, 2011).

Tara iti fairy tern

Of the seabird taxa included in Table 2-1, tara iti fairy tern is arguably Aotearoa New Zealand's rarest and most threatened seabird taxon, confined when breeding to sites north of Tāmaki Makaurau Auckland. The subspecies of tara iti fairy tern in Aotearoa New Zealand is an endemic subspecies and breeds regularly at only four Te Ika-a-Māui North Island sites: Papakanui Spit (South Head, Kaipara Harbour), Mangawhai and Waipū estuaries, and at Pākiri River mouth, towards the south of the Mangawhai-Pākiri embayment (Pulham & Wilson 2013). Since 2012, tara iti fairy terns have also occasionally nested at the Te Arai Stream mouth (Pulham & Wilson 2013) and Te Arai Stream mouth is additionally well-known as a post-breeding flocking site for tara iti fairy terns (Preddey & Pulham 2017).

Ismar et al. (2014), citing Department of Conservation (DoC) internal reports, reported an annual average of nine breeding pairs across all sites between 2008-2009 and 2011-2012. Ferreira et al. (2005) estimated a total population of between 30-35 individuals from 2000-2002, whereas Hansen (2006) suggested the overall population numbered 35-40 individuals, a similar total to that noted by Pulham & Wilson (2013). These relatively low population estimates, with approximately 8-11 breeding pairs annually, are reflected in the relative abundance score of '1' (less than 250 mature individuals) for this taxon in Table 2-1, and are consistent with more recent population estimates[14,15]

Waipū estuary, which is over 5 km to the southwest of the proposed sand extraction area, supports 1-2 breeding pairs of tara iti fairy tern.

Brough et al. (2024) did not report sighting tara iti fairy tern from any of the vessel-based observational surveys across Te Ākau Bream Bay.

2.4.2 Shorebirds

The shoreline to the west of the proposed sand extraction area supports breeding or regularly occurring populations of shorebirds: typically, but not exclusively, wading birds (waders), which generally feed in the inter-tidal zone, and some of which breed along the coastal fringe (e.g., pohowera banded dotterel *Charadrius bicinctus bicinctus*, tūturiwhatu northern New Zealand dotterel *Charadrius obscurus aquilonius* and tōrea pango variable oystercatcher *Haematopus unicolor*.

[14] https://www.fairytern.org.nz/
[15] https://www.doc.govt.nz/nature/native-animals/birds/birds-a-z/nz-fairy-tern-tara-iti/

Table 2-1 lists 13 shorebird taxa, of which three are classified as 'Threatened' under the NZTCS (matuku-hūrepo Australasian bittern *Botaurus poiciloptilus*, ngutu pare wrybill *Anarhynchus frontalis* and tūturiwhatu northern New Zealand dotterel), with a further six classified as 'At Risk'.

Shorebirds, as their name suggests, primarily occupy the coastal fringe, including when foraging in inter-tidal areas at low tide. Shorebirds rarely occur at sea and are usually encountered flying over open water when travelling between feeding and roosting sites around high tide or when embarking upon larger-scale migratory movements either within Aotearoa New Zealand or when transiting internationally.

3 Potential effects of sand extraction at Te Ākau Bream Bay on seabirds and shorebirds

3.1 Loss of terrestrial breeding habitat

For sand extraction operations to affect seabirds and shorebirds breeding in upper beach habitat, removal of sand would need to generate detrimental physical effects along the shoreline running approximately parallel with the proposed sand extraction area, more than 4 km offshore. For example, if sand extraction resulted in undermining of the shoreline with loss of shoreline habitat, nesting birds that use the upper beach as breeding habitat could be adversely affected. This potential effect is likely to be less impactful for shorebirds included in Table 2-1 that breed further away from the coast, for example matuku-hūrepo Australasian bittern, and for non-breeding birds that are less spatially constrained compared to breeding birds.

It is worth noting that tara iti fairy tern nest in upper shore habitats, above the extreme high-water mark (Pulham & Wilson 2013) and would be susceptible to any loss of breeding habitat. Given the strong philopatry exhibited by seabirds, loss of breeding habitat could effectively mean the removal of affected breeding pairs from the breeding population. It follows that the loss of even a single breeding pair of tara iti fairy terns, given the relatively small overall breeding population in Aotearoa New Zealand (see section 2.4.1) could have a measurable and significant adverse effect on the population.

It is my understanding that the proposed sand extraction area is to be located beyond the depth of closure, that is the most landward depth seaward of which there is no significant change in bottom elevation and no significant net sediment transport between the nearshore and the offshore. In assessing the effects of proposed sand extraction on coastal processes, Beetham (2025) concluded that sand extraction at the site proposed is not expected to directly or indirectly influence the beach and dune environment and that the effect of sand extraction on coastal morphology would be **negligible**. Therefore, and on this basis, it follows that the proposed sand extraction will have a **negligible** effect on the upper shore breeding habitats of birds.

3.2 Exclusion from at-sea habitat

It is possible that some seabird taxa will be excluded from the proposed sand extraction area through the presence of the extraction vessel, potentially removing access to preferred habitat, or preventing seabirds from foraging efficiently within the extraction area. This would be a significant issue if the proposed extraction area was relatively important for a particular species, either because a seabird relied on prey that was only available at that site or if the area was a significant proportion of the foraging range of a particular seabird. I am unaware of any scientific evidence in support of either of these two scenarios. All species of seabirds that occur in the Te Ākau Bream Bay area exhibit relatively large distributions and have the potential to forage over relatively large areas. For example, tītī Cook's petrel *Pterodroma cookii*, a relatively abundant and commonly-observed seabird off the northeast coast of Te Ika-a-Māui North Island, and in Te Ākau Bream Bay more specifically (Brough et al. 2024), has been shown to forage in the Tasman Sea and far to the southeast of Te Ika-a-Māui North Island (Rayner et al. 2008, 2010) and so it would seem reasonable to conclude that even complete exclusion from the proposed extraction area would have a **negligible** effect on this species. I think it is highly likely that a similar conclusion could be drawn for other species of seabirds.

3.3 Reduced prey abundance or prey availability

3.3.1 Prey abundance

The proposed sand extraction activity could potentially affect seabird prey abundance in the sand extraction area in a number of ways. It is possible that the vessel and/or the William Fraser's draghead (which would remove sand from the seabed to be pumped up to the vessel) could cause direct mortality of seabird prey. While possible, I think this is very unlikely, since seabird prey (typically, fish, cephalopods, crustaceans or some combination of these) tend to be pelagic (rather than benthic) and are highly mobile, being able to move away from extraction activity. Mobile prey could be temporarily displaced from the area being extracted but would be available for capture at some other location.

Alternatively, sand extraction activities could affect seabird prey abundance by reducing primary productivity at the base of the food chain. This reduction in productivity could propagate up the food chain resulting in lower abundances of higher trophic level (seabird) prey. This effect could operate through increased levels of turbidity in the water column as unwanted dredged material is returned to the sea from the sand extraction vessel. Primary productivity relies, in part, upon sunlight penetrating the upper reaches of the ocean, and so turbid waters tend to be less productive than those relatively free from suspended solid material. I think this scenario is unlikely to have a measureable effect on seabird prey abundance for the following reasons. The sand that is proposed to be dredged in Te Ākau Bream Bay is similar in character to that dredged further south in the Mangawhai-Pākiri embayment (SLR 2025), and material returned to the water column from sand extraction activity will have largely settled out within a few hundred metres and within a few minutes from the point and time of discharge (Jacobs 2020, SLR 2025). Water quality work undertaken on material returned from the sand extraction vessel in the Mangawhai-Pākiri embayment showed that along one transect total suspended solids fell to ambient levels within 250 m from the point of discharge over a timeframe of less than five minutes. Generally, total suspended solids and turbidity values in the plume were at or very close to ambient levels within 1-2 km and approximately 26 minutes after discharge (Jacobs 2020). Once the proposed sand extraction activity ends (noting also that, 1. sand extraction will occur for a maximum of 3.5 hours per day and, 2. for a maximum of 11% of the time over a year, because sand extraction will not occur every day), water conditions return to ambient relatively quickly. On this basis, I think itreasonable to conclude that the overall impact on primary production within the proposed extraction area will be **less than minor to negligible**.

Northeastern Aotearoa New Zealand continental shelf waters are a relatively high primary biomass area (Murphy et al. 2001). In this region, seasonal wind-driven upwelling occurs in spring (September–November) and early summer (December), when episodic along-shelf wind-stress from the northwest drives surface water offshore, transporting cool, low salinity, nitrate rich waters from depth to the surface (Zeldis 2004, Zeldis et al. 2004, Gall & Zeldis 2011). Later in summer (February), upon relaxation of winds favourable for upwelling, shoreward intrusions of East Auckland Current surface water cross the shelf, infusing the region with warm, high salinity, low nitrate water (Sharples, 1997, Zeldis 2004, Zeldis et al. 2004). The timing and extent of upwelling and downwelling events determine the availability of nitrate for primary biomass and 'new' production (Zeldis 2004), and affect the composition of the phytoplankton community (Chang et al. 2003). These climatically driven mechanisms are the main drivers of primary productivity across northeastern shelf waters, and it seems reasonable to conclude that the proposed sand extraction activity would have a **negligible** effect on these processes and, therefore, on seabird prey abundance through primary productivity.

3.3.2 Prey availability

The proposed extraction of sand will result in an increase in suspended solid material and turbidity in the water column as oversized material is discharged back into the sea. Increased turbidity in the water column below the extraction vessel, and extending away from the vessel, resulting from this unwanted dredged material, has the potential to reduce the foraging efficiency (prey would be less available) in diving seabirds that capture prey from the water column (e.g., penguins and shags).

However, as noted above (section 3.3.1) elevated turbidity levels fall back to ambient conditions relatively quickly and within a short distance of the point of sediment discharge from the extraction vessel. Given the relatively short time and spatial scales for sediment plume characteristics to return to ambient, and noting that seabird taxa tend to have very large ranges relative to the proposed sand extraction area generally, and the sediment plume area specifically (section 3.2), it would seem reasonable to conclude that even in the unlikely scenario where complete exclusion from the proposed extraction area occurred, as a result of increased turbidity in the plume area, it would have a **negligible** effect on seabirds.

3.4 Interaction with the sand extraction vessel

Seabirds can be attracted to, and disorientated by, ships' lights (and indeed other artificially illuminated human structures at sea) at night. It is well known that some seabirds collide with ships and rigs at sea having become attracted to relatively intense, artificial lights, sometimes resulting in injury and death, but this tends to be a problem in poor visibility, with lights directed upwards or outwards and when the light source (vessel) is relatively close to seabird breeding colonies (for example, Black 2005). This potential effect is more likely to impact those seabird species that are active at night. In Aotearoa New Zealand nocturnally-active species include members of the seabird order Procellariiformes (the albatrosses, petrels, shearwaters and storm petrels), while gulls, terns and shags tend to be diurnal and roost ashore at night. Over 50 species of petrels and shearwaters are negatively impacted by artificial nocturnal lighting (Rodríguez et al. 2017).

Vessels operating at night would necessitate the use of artificial lighting, to both operate safely and for navigation purposes. Several mitigation measures can be employed to minimise the risk of seabird collision, these include: the use of minimal deck lighting (other than that required for safe operations and navigation), which should be directed downwards (as opposed to outwards or upwards from the vessel) and shielded wherever possible to reduce light spill, lights should be of the lowest intensity as appropriate for operations and safety and screens or blinds should cover port holes and windows to prevent light spill (see Black 2005). The Ministry for Primary Industries has recently developed a set of mitigation standards to minimise seabird strike with commercial fishing vessels, including the measures noted here (MPI 2023), which should serve as a template for mitigation and management of this potential effect with the *William Fraser*. MPI (2023) also recommended a light management plan should be developed for the different operations of the vessel that describes the practices and actions that would ensure mitigation standards are met. The effect of artificial nocturnal lighting on seabirds is an area of active research: recent work exploring the effects of light intensity and light colour (wavelength) found that more intense white light attracted more seabirds than amber or red lights (Goad et al. 2023).

However, MBL's proposal is for the sand extraction vessel to operate during the daytime, with two operating 'windows' between 12:00 and 18:00 hours and between 12:00 and 20:00 hours from April to September and from October to March, respectively. Whilst these operating windows and hours will, for the majority, occur during daylight, there will be a relatively small number of days when sunset occurs before the 18:00 or 20:00 cut-offs for sand extraction operations. Assuming that sufficient natural light is available immediately following sunset, there will still be some days when the time of the end of civil twilight (i.e., the period from sunset to when the centre of the sun is six degrees below the horizon and when artificial light may not be required) occurs before the 18:00 and 20:00 cut-offs. However, the time from the end of civil twilight to the operating cut-offs will be relatively short: maximums of approximately 15 minutes and 17 minutes for the April to September and October to March periods, respectively (timings of sunset and of civil twilight obtained from the 'timeanddate' website[16]).

If the standard mitigation measures noted above and identified by MPI (2023) are employed by the sand extraction vessel within a light management plan framework, and given the relatively few occasions when artificial nocturnal lighting would be required, then it would be reasonable to conclude that the effect of nocturnal lighting on the extraction vessel on seabirds will be **minor**. Furthermore, it is my understanding that no incidents of seabird strike have been recorded by vessels extracting sand at night from the Mangawhai-Pākiri embayment to the south of the proposed sand extraction area in Te Ākau Bream Bay.

3.5 Loss of fuel or oil from the extraction vessel

Spilt fuel or oil could potentially affect seabirds at sea if they were to come into contact with such spills. The primary direct impacts on seabirds include external effects, such as the contamination of feathers reducing insulation properties and flight efficiency, and internal toxic effects, which would occur if spilled material was ingested. The detrimental effects of such a spill would be dependent upon, amongst other variables, the scale and magnitude of the spill, the response to the spill, the movement of the spilt material following the spill (which will be dependent upon weather and sea conditions at the time), and the time of year the spill occurred. Species that are likely to be more at risk from a fuel spill include those that spend a relatively large amount of time on the sea surface or those which dive to capture prey underwater. These would include kororā northern little penguin, kuaka northern diving petrel *Pelecanoides urinatrix urinatrix* and all shag species. However, even species of seabird that spend relatively more time flying than those mentioned above could potentially be affected by a spill.

For shorebirds, or nesting seabirds, to be impacted by a spill, lost fuel or oil would need to reach the adjacent shoreline to the sand extraction area, which in turn would depend upon the type of fuel or oil lost (diesel, for example, is relatively volatile and would degrade and be lost to the atmosphere relatively rapidly once released to the sea), the volume of fuel or oil released and the prevailing weather conditions at the time of the release. An offshore wind, for example, at the time of release would result in relatively less fuel or oil reaching the shoreline. Furthermore, the time of year at

[16] https://www.timeanddate.com

which a loss of fuel or oil occurred would also influence whether shorebirds were impacted. A substantial loss of fuel or oil that reached the shore and was transported by wave action relatively high up the shoreline would be more likely to have a detrimental effect during the summer months when birds are breeding. It is possible that under such a scenario, nests containing eggs could be coated with fuel or oil. However, there would likely be sufficient time to position physical barriers to prevent fuel or oil from the sand extraction area from reaching nest sites that would be located towards the upper reaches of the beach. Additionally, there is evidence to suggest that even in relatively large fuel or oil-loss events, nearby shorebirds tend not to be impacted. For example, following the grounding of the vessel Rena on Astrolabe Reef off Tauranga in 2011, in which approximately 350 tonnes of heavy fuel oil were released to the marine environment, all 1364 oiled birds collected from Te Moana-a-Toi Bay of Plenty beaches were seabirds, predominantly kuaka northern diving petrels and pakahā fluttering shearwaters *Puffinus gavia* (Miskelly et al. 2012).

However, the likelihood of a relatively significant loss of fuel or oil into the marine environment and for this to reach the shoreline, is relatively small. For such a loss to occur the *William Fraser* would need to suffer a catastrophic structural failure or be involved in a substantial impact from another vessel, both of which are relatively unlikely. Further, the *William Fraser* operates according to Maritime New Zealand regulations in keeping with all commercial vessels, and MBL is proposing a specific oil spill management plan as part of its conditions of consent. MBL has reduced the risk of any oil discharge to the marine environment further by having an electric sand pump in the dredge vessel's pipework, rather than a hydraulic pump, thus removing the risk of hydraulic oil leaks into the environment. Given the very low likelihood of a loss of fuel or oil from the extraction vessel, I think the overall effect on seabirds and shorebirds will be **less than minor**.

3.6 Noise

The sand extraction vessel will generate both airborne and underwater noise, which have the potential to disturb or cause more impactful effects for both seabirds and shorebirds (airborne noise only). In considering the potential effects of airborne and underwater noise I have referred to the reports of Styles (2025) and of Pine (2025), respectively.

3.6.1 Airborne noise

Generally, the effects of disturbance resulting from airborne noise can be significant at times when birds are spatially constrained. For example, birds have to spend time at a nest site when breeding and many species spend extended periods of time resting, often at a preferred roost site.

Disturbance at these times can result in breeding failure or increased energy expenditure. At other times, birds tend to be less constrained in where they occur, and so the potential for noise disturbance at a specific location within a species' range is reduced.

Among seabirds, it is widely accepted that shags, in general, are particularly susceptible to human disturbance. For example, reduced foraging activity in European shags *Phalacrocorax aristotelis* has been linked to increased boat traffic (Velando & Munilla 2011), and human disturbance at nesting sites is likely limiting population recovery in some double-crested cormorant *Phalacrocorax auritus* populations in western North America (Adkins et al. 2014). Studies of anthropogenic noise on American oystercatchers *Haematopus palliatus* and Brandt's cormorants *Phalacrocorax penicillatus* showed that distant aircraft noise had minimal effect, but that nearby anthropogenic noise resulted in birds spending less time on their nests and decreased survival of fledglings (Borneman et al. 2016, Buxton et al. 2017). In Aotearoa New Zealand, the DoC has proposed buffer zones of 1000 m and 500 m around kawau pāteketeke New Zealand king shag *Leucocarbo carunculatus* breeding sites, and roosting sites, respectively (Davidson et al. 1995), in order to minimise disturbance in this particularly disturbance-prone species (Butler 2003, Fisher & Boren 2012).

With respect to the proposed extraction of sand, disturbance through airborne noise from routine operations is likely to have a **negligible to non-existent** disturbance effect on both seabirds and shorebirds. The nearest breeding sites are located along the Te Ākau Bream Bay coast at least 4.7 km away from the proposed sand extraction area, with Taranga Hen Island and Marotere Chicken Islands more than 10 km away to the east. Styles (2025) determined that the airborne operating noise from the sand extraction vessel reaching the shoreline of Te Ākau Bream Bay would be less than 15 dB under favourable conditions. This noise level would be inaudible or barely audible in birds occupying the upper shore (e.g., Mooney et al. 2020, Smith et al. 2023). The presence of the sand extraction vessel, and the associated airborne noise from that vessel, is very unlikely to have any detrimental disturbance effect on birds at the locations noted above given the distances involved, even less so for seabirds breeding at more distant locations.

3.6.2 Underwater noise

Whilst it is unknown how, or even if, seabirds utilise underwater noise (Smith et al. 2023), there is a growing number of studies that have shown seabirds are able to detect noise while underwater, including two species known to, or likely to, occur in Te Ākau Bream Bay, kororā northern little penguin *Eudyptula minor iredalei* and māpunga black shag *Phalacrocorax carbo novaehollandiae* (Hansen et al. 2020, Larsen et al. 2020, Sørensen et al. 2020, Wei & Erbe 2024). Relatively extreme responses to noise were observed in African penguins *Spheniscus demersus*, which avoided areas affected by relatively loud noise during seismic surveys (Pichegru et al. 2017), and an increase in underwater noise resulting from vessel traffic was implicated in the concomitant decline of an African penguin population at Algoa Bay, South Africa (Pichegru et al. 2022).

For the majority of seabirds utilising Te Ākau Bream Bay information on sound reception and hearing while underwater is lacking. However, for the assessment of the effects of underwater noise from the sand extraction vessel it has been assumed that all seabird species capable of diving in order to capture prey (kororā northern little penguin, kuaka northern diving petrel, shags and shearwaters) can detect underwater noise.

Pine (2025) estimated that noise from the sand extraction vessel would be audible to kororā northern little penguin approximately 5.9 km away, but that small behavioural responses would be unlikely to occur beyond approximately 200 m from the vessel. Given the highly mobile nature of kororā northern little penguin and other diving seabirds, I think it is likely that the predominant response to underwater noise generated by the extraction vessel will be to move away, but such a response would be temporary and of **less than minor** consequence for seabirds affected.

4 Assessment of potential effects on seabirds and shorebirds

4.1 Potential effects considered

Each of the potential negative effects described above (section 3) has been considered for each seabird taxon identified in Table 2-1.

For each effect, a 'worst-case' approach has been adopted. The effects considered translate to the following potential outcomes affecting seabirds and shorebirds.

4.1.1 Loss of terrestrial breeding habitat

The effect considered here is the physical loss of beach material, extending to above extreme high tide levels to include the upper beach, which constitutes a breeding habitat for a number of shorebirds and seabirds, such that breeding by affected taxa is not possible. It has been assumed that affected breeding birds do not continue to breed at some other location outside Te Ākau Bream Bay and would effectively be 'lost' from the breeding population. It follows that those taxa that do not breed along the coast of Te Ākau Bream Bay will suffer **negligible to non-existent** consequences of this effect.

4.1.2 Exclusion from habitat

The potential effect here is complete exclusion from the proposed sand extraction area, including the water column, during sand extraction operations. While sand extraction would not occur over the entire proposed sand extraction area at any given time (sand extraction would occur for a maximum of 3.5 hours per day (and up to a maximum of 11% of time over a year), a conservative approach has been adopted such that birds are assumed to be excluded over the entire area. It is further assumed that taxa are able to access the proposed sand extraction area during times when extraction is not occurring (over 89% of time over a year). Essentially, this effect as described here would result in seabirds being unable to capture prey from within the sand extraction area and they would have to search for and capture food elsewhere.

4.1.3 Reduced prey abundance or prey availability

This potential effect considers a reduction in prey abundance or availability within the proposed sand extraction area during the hours of sand extraction operations, such that seabirds feed elsewhere. This potential effect assumes that when sand extraction is not occurring, suspended solid concentrations and turbidity levels in the sand extraction area are at background levels and seabird prey may have returned to the extraction area and be available to seabirds. In this scenario, the effect is analogous to exclusion from the sand extraction area (section 4.1.2).

4.1.4 Interaction with the sand extraction vessel

The effect of an individual seabird becoming disorientated by artificial nocturnal lighting on the sand extraction vessel during operations that may extend into relatively brief periods of darkness at specific times during the year (see section 3.4), and striking the vessel structure resulting in death has been considered as the worst-case outcome. This potential effect has been considered for all taxa identified in Table 2-1, noting that an interaction with the sand extraction vessel will be more likely for those taxa that are active at night.

4.1.5 Loss of fuel or oil from the extraction vessel

This potential effect considers an individual bird becoming acutely contaminated through fuel or oil ingestion, or through coating of the plumage, resulting in death, from an accidental loss of fuel or oil from the sand extraction vessel.

4.1.6 Airborne noise

This effect considers the behavioural response of birds to airborne noise generated by the extraction vessel during operations. Given that birds ashore will be barely able to detect the noise from the vessel (see section 3.6.1), any effect will be minor and will likely manifest as birds being aware of the vessel. It is unlikely that the noise levels would result in any other response. For birds either on the sea surface or flying over the proposed extraction area, noise levels may be sufficient to provoke relatively inconsequential movement away from the vessel.

4.1.7 Underwater noise

As noted above (section 3.6.2), underwater noise is very likely to be detectable over a scale of a few kilometres, but relatively minor behavioural responses, including moving away from the operating extraction vessel, would be possible within a few hundred metres. The effect being considered here, therefore, is that of moving away from the operating vessel, analogous to the 'exclusion from habitat' effect (section 4.1.2).

4.2 Risk assessment process

Having identified the suite of potential effects (section 3) and impacts (section 4.1) that could affect seabirds and shorebirds as a result of the proposal to extract sand from Te Ākau Bream Bay, the assessment process comprises three steps.

Firstly, the consequence or magnitude of each effect on each seabird or shorebird species is defined. Consequence is scored on a six-point scale from 0 (zero) to 5 using a standardised set of consequence descriptions, ranging from negligible (0) to catastrophic (5). Consequence descriptions are presented in Table 4-1 and have been adapted from those used by Fletcher (2005) and later by MacDiarmid et al. (2011, 2015, 2016), the latter in work assessing risk to elements of the marine environment in Aotearoa New Zealand. Here each potential effect is assessed in terms of the likely impact on shorebird and seabird populations. Additionally, Table 4-1 presents indicative recovery period descriptors for each level of consequence. Compared to many other groups of birds, including shorebirds, seabird life histories are characterised by deferred maturity, relatively low annual productivity, relatively high adult survival rates and relatively high longevity, characteristics that infer relatively slow rates of population growth and extended timeframes for recovery from population perturbations. Consequently, recovery times included in Table 4-1 are relatively long, and in the order of several decades for the most impactful consequences. Also included in Table 4-1 are the equivalent Resource Management Act terminologies for magnitude of effect, aligned to the consequence levels used in this assessment.

Table 4-1: Consequence levels of potential effects impacting seabirds and shorebirds. Summary descriptions of the six consequence levels on seabird populations together with likely recovery periods. Adapted from Fletcher (2005). Terms in parentheses below each consequence descriptor are the equivalent terms used in the Resource management Act.

Consequence level	Population impact	Recovery period
0 – Negligible (Negligible)	Interactions may be occurring but unlikely to be ecologically significant (<1% changes in abundance) or be detectable at the scale of the population	No recovery time required
1 – Minor (Low)	Possibly detectable with 1-5% change in population size and no detectable impact on dynamics of specific populations	Relatively rapid recovery would occur if activity stopped: > 6 months to 2 years
2 – Moderate (Moderate)	Measurable with 6-20% change to the population without there being a major change in function	Recovery in 3-10 years if activity stopped
3 – Major (High)	Populations substantially altered (21-50%) and some function missing	Recovery occurs in 1-3 decades if activity stopped
4 – Severe (Very High)	Populations seriously impacted (51-90%) with local extinctions of vulnerable species likely if impact continues. Different population dynamics now occur	Recovery period 4-6 decades if activity stopped
5 – Catastrophic (Very High)	Populations drastically reduced (91% or greater) with local extinctions of species imminent/immediate. Total collapse of ecosystem processes	Long term recovery to former levels will be greater than 6 decades or never, even if activity stopped

Secondly, the likelihood of a particular effect occurring was assessed and scored on a six-point scale, again using a set of standardised descriptions, ranging from 1 (remote), with a 0-5% likelihood of occurrence, to 6 (likely), with a 96-100% likelihood of occurrence. Likelihood descriptions are presented in Table 4-2.

Table 4-2: Likelihood levels of potential effects occurring. Levels and descriptions for each likelihood category. Adapted from Fletcher (2005).

Likelihood level	Descriptor	Likelihood
1	Remote	Negligible likelihood of occurrence: 0-5%
2	Rare	Possible but not likely to occur: 6-20%
3	Unlikely	Moderately likely to occur: 21-50%
4	Possible	Significant chance to occur: 51-80%
5	Occasional	Very likely to occur: 81-95%
6	Likely	Almost certain to occur: 96-100%

Thirdly, using the tables of defined levels and scores of consequences (Table 4-1) and likelihoods (Table 4-2), risk scores were calculated as the product (multiplication) of consequence and likelihood. Risk scores can range from a minimum of 0 (zero) to a maximum of 30 (Table 4-3).

Table 4-3: Risk levels and categories.

Risk Level	Risk Score Range	Risk score derivation	
		Consequence level	Likelihood level
Low	0-6	0 – negligible	1-6 (remote to likely)
		1 – minor	1-6 (remote to likely)
		2 – moderate	1-3 (remote, rare or unlikely)
		3 – major	1-2 (remote or rare)
		4 – severe	1 (remote)
		5 – catastrophic	1 (remote)
Moderate	8-12	2 – moderate	4-6 (possible, occasional or likely)
		3 – major	3-4 (unlikely or possible)
		4 – severe	2-3 (rare or unlikely)
		5 – catastrophic	2 (rare)
High	15-20	3 – major	5-6 (occasional or likely)
		4 – severe	4-5 (possible or occasional)
		5 – catastrophic	3-4 (unlikely or possible)
Extreme	24-30	4 – severe	6 (likely)
		5 – catastrophic	5-6 (occasional or likely)

The risk categories and scores presented here (Table 4-3) follow those adopted by MacDiarmid et al. (2011). Risk scores of 0-6 are classified as ‘low’ and arise from the lowest two levels of consequence (negligible and minor) at all levels of likelihood, from moderate level of consequence at unlikely or lower levels of likelihood, from major level of consequence at remote or rare levels of likelihood or from severe and catastrophic levels of consequence at remote level of likelihood. At the upper end of risk scores, values of 24 or greater are classified as ‘extreme’. This level of risk is only achieved from consequences that are severe or catastrophic at the two highest levels of likelihood, occasional or likely. Between these two extreme risk categories, risk scores of 8-12 are classified as ‘moderate’ and risk scores of 15-20 are classified as ‘high’ (Table 4-3).

Categorising risk scores into four groups (‘low’, ‘moderate’, ‘high’ and ‘extreme’: Table 4-3) is somewhat subjective, but this approach nevertheless provides a framework for identifying potential effects that would be considered unacceptable (‘extreme’) and for which management and mitigation may never result in a lowering of risk. Risk scores falling in the ‘moderate’ or ‘high’ categories could indicate potential effects that would require an increasing level of management and mitigation in order to move the risk score to a lower category. For risk scores falling in the ‘low’ category, potential effects could be viewed as acceptable, requiring no action or maintaining action currently in place.

Table 4-4: Results of the risk assessment process for all 47 seabird and shorebird taxa and seven potentially negative effects of the proposal. Taxa are listed in the same order as in Table 2-1. For each potential effect the risk score is the product of the consequence score and the likelihood score - see Table 4-1, Table 4-2 and Table 4-3 for details.

Species	Loss of terrestrial breeding habitat			Exclusion from at-sea habitat			Changes to prey abundance / availability			Interaction with the sand extraction vessel			Fuel / oil spill			Airborne noise			Underwater noise		
	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk
Seabirds																					
Tara iti New Zealand fairy tern	3	1	3	0	2	0	0	1	0	3	1	3	3	1	3	0	1	0	0	1	0
Takahikare-raro New Zealand storm petrel	0	1	0	0	2	0	0	1	0	1	2	2	1	1	1	0	1	0	0	1	0
Taranui Caspian tern	1	1	1	0	2	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0
Tākoketa Black petrel	0	1	0	0	2	0	0	1	0	1	2	2	1	1	1	0	1	0	0	1	0
Toroa Grey-headed albatross	0	1	0	0	2	0	0	1	0	1	2	2	1	1	1	0	1	0	0	1	0
Kororā Northern little penguin	1	1	1	0	2	0	0	1	0	1	1	1	1	2	2	0	1	0	0	3	0
Tarāpuka Black-billed gull	0	1	0	0	2	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0
Tarāpunga Red-billed gull	1	1	1	0	2	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0
Rako Buller's shearwater	0	1	0	0	2	0	0	1	0	1	2	2	1	1	1	0	1	0	0	3	0
Tītī Sooty shearwater	0	1	0	0	2	0	0	1	0	1	2	2	1	1	1	0	1	0	0	3	0

Species	Loss of terrestrial breeding habitat			Exclusion from at-sea habitat			Changes to prey abundance / availability			Interaction with the sand extraction vessel			Fuel / oil spill			Airborne noise			Underwater noise		
	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk
Tara White-fronted tern	1	1	1	0	2	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0
Toroa White-capped albatross	0	1	0	0	2	0	0	1	0	1	2	2	1	1	1	0	1	0	0	1	0
Pāngurunguru Northern giant petrel	0	1	0	0	2	0	0	1	0	1	2	2	1	1	1	0	1	0	0	1	0
Kāruhiruhi Pied shag	0	1	0	0	2	0	0	1	0	1	1	1	1	2	2	0	1	0	0	3	0
Pycroft’s petrel	0	1	0	0	2	0	0	1	0	1	2	2	1	1	1	0	1	0	0	1	0
Totorore North Island little shearwater	0	1	0	0	2	0	0	1	0	1	2	2	1	1	1	0	1	0	0	3	0
Tītī wainui Fairy prion	0	1	0	0	2	0	0	1	0	1	2	2	1	1	1	0	1	0	0	1	0
Takahikare White-faced storm petrel	0	1	0	0	2	0	0	1	0	1	2	2	1	1	1	0	1	0	0	1	0
Kuaka Northern diving petrel	0	1	0	0	2	0	0	1	0	1	2	2	1	2	2	0	1	0	0	3	0
Māpunga Black shag	0	1	0	0	2	0	0	1	0	1	1	1	1	2	2	0	1	0	0	3	0
Kawaupaka Little shag	0	1	0	0	2	0	0	1	0	1	1	1	1	2	2	0	1	0	0	3	0
Grey noddy	0	1	0	0	2	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0
Tītī Cook’s petrel	0	1	0	0	2	0	0	1	0	1	2	2	1	1	1	0	1	0	0	1	0
Toanui Flesh-footed shearwater	0	1	0	0	2	0	0	1	0	1	2	2	1	1	1	0	1	0	0	3	0

Species	Loss of terrestrial breeding habitat			Exclusion from at-sea habitat			Changes to prey abundance / availability			Interaction with the sand extraction vessel			Fuel / oil spill			Airborne noise			Underwater noise		
	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk
Pakahā Fluttering shearwater	0	1	0	0	2	0	0	1	0	1	2	2	1	1	1	0	1	0	0	3	0
Karetai hurukoko Snares Cape petrel	0	1	0	0	2	0	0	1	0	1	2	2	1	1	1	0	1	0	0	1	0
Kawau tūī Little black shag	0	1	0	0	2	0	0	1	0	1	1	1	1	2	2	0	1	0	0	3	0
Toroa Northern Buller's albatross	0	1	0	0	2	0	0	1	0	1	2	2	1	1	1	0	1	0	0	1	0
Karoro Southern black-backed gull	0	1	0	0	2	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0
Tākapu Australasian gannet	0	1	0	0	2	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0
Ōi Grey-faced petrel	0	1	0	0	2	0	0	1	0	1	2	2	1	1	1	0	1	0	0	1	0
Karetai kapa mangu Black-winged petrel	0	1	0	0	2	0	0	1	0	1	2	2	1	1	1	0	1	0	0	1	0
Arctic skua	0	1	0	0	2	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0
Toroa Black-browed albatross	0	1	0	0	2	0	0	1	0	1	2	2	1	1	1	0	1	0	0	1	0
Shorebirds																					
Matuku-hūrepo Australasian bittern	2	1	2	0	1	0	0	1	0	2	1	2	2	1	2	0	1	0	0	1	0

Species	Loss of terrestrial breeding habitat			Exclusion from at-sea habitat			Changes to prey abundance / availability			Interaction with the sand extraction vessel			Fuel / oil spill			Airborne noise			Underwater noise		
	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk	Consequence	Likelihood	Risk
Ngutu pare Wrybill	1	1	1	0	1	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0
Tūturiwhatu Northern New Zealand dotterel	1	1	1	0	1	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0
Huahou Red knot	1	1	1	0	1	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0
Pohowera Banded dotterel	1	1	1	0	1	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0
Tōrea South Island pied oystercatcher	1	1	1	0	1	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0
Kuaka Eastern bar-tailed godwit	1	1	1	0	1	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0
Tōrea pango Variable oystercatcher	1	1	1	0	1	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0
Kōtuku ngutupapa Royal spoonbill	1	1	1	0	1	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0
Poaka Pied stilt	1	1	1	0	1	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0
Spur-winged plover	1	1	1	0	1	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0
Turnstone	1	1	1	0	1	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0
Kuriri Pacific golden plover	1	1	1	0	1	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0

4.3 Results of the risk assessment process

For all potential effects and impacts, and for all taxa considered, risk scores fell within the 'low' risk level, with risk scores ranging from 0 (zero) to 3 (Table 4-4): for all potential effects, impacts on all taxa will be **less than minor** and often **negligible**. These low risk scores largely reflect low consequence scores: for example, consequence scores were 0 (zero), negligible consequence, for all taxa for the potential effects of habitat exclusion from, and of reduced prey abundance or availability in, the proposed sand extraction area, and likewise for the effects of airborne and underwater noise.

For tara iti fairy tern, and for the potential effects of loss of terrestrial breeding habitat, interaction with the sand extraction vessel and fuel/oil spill, risk scores were in the middle of the 'low' risk level (risk scores of 3 for each of these potential effects: Table 4-4). For all of these potential effects, the outcome effectively removed a bird from the population, either through being unable to breed (loss of terrestrial breeding habitat) or through mortality (interaction with the sand extraction vessel and fuel/oil spill). Because the overall population of tara iti fairy tern is critically small, the loss of a breeding bird would have 'major' consequences (consequence score of 3: Table 4-1 and Table 4-4). That the overall risk scores for these three potential effects were only 3 reflects the very low likelihood scores (scores of 1, negligible likelihood of occurrence, with a 0-5% chance of occurrence: Table 4-2) in each case. In the case of loss of terrestrial breeding habitat, the likelihood score is based on the proposed sand extraction area being sited beyond the depth of closure and that sand extraction will, therefore, have a **negligible** effect on beach morphology and on the upper shore breeding habitats of birds, including tara iti fairy tern.

Similarly, for the potential effects of interaction with the sand extraction vessel and fuel/oil spill, the likelihood score of 1 for tara iti fairy tern seems reasonable. In over 70 years of extraction at Pākiri, MBL have never had an interaction event with tara iti fairy tern while extracting sand, and substantial loss of fuel or oils from a vessel is a demonstrably rare occurrence. Further, the proposed extraction site is approximately 5.6 km offshore from the nearest tara iti fairy tern breeding site at Waipū. It is likely that tara iti fairy tern forages predominantly in estuarine and nearshore environments (Ismar et al. 2014), well within (shoreward of) the 5.6 km distance, but it is possible that birds venture offshore from time to time. Habitat use, the extent to which tara iti fairy terns utilise specific foraging zones and distributions of foraging trip distances remain to be fully quantified, but the 'low' risk of interaction with the sand extraction vessel, operating for the most part during daylight hours, reflects in part the distance from shore to the proposed sand extraction area.

In order to maintain these low likelihood scores the sand extraction vessel should follow the recommendation of MPI (2023) that a light management plan be developed for the different operations of the vessel, which describe the practices and actions that would ensure mitigation standards are met for nocturnal light, and should operate to the proposed oil spill management plan.

As noted above, should consent be granted for the proposed sand extraction area, my recommendation would be that this included a condition that the sand extraction vessel developed a (nocturnal) light management plan, following the guidelines set out by MPI (2023). Such a plan would detail mitigation measures to be employed to reduce the risk of seabird collision with the sand extraction vessel on those relatively infrequent occasions when operating at night. Measures would include, but not be limited to, reducing artificial nocturnal lighting to the minimum required for safe operation and for navigational purposes, directing lights downwards with shielding to prevent as much light spill outwards from the vessel as practicable, reducing the intensity of lights as much as practicable and covering windows and port holes wherever reasonably practicable to prevent light spill. Additionally, vessel crew should maintain a log of all seabird interactions, including both fatal and non-fatal interactions, recording time and date of interactions, species involved (if possible, photographs should be taken of the bird) and outcome. Such a log should be submitted to the DoC annually.

5 Summary

For all seabirds and shorebirds, and for all potential effects assessed, the risk posed by the proposed sand extraction in Te Ākau Bay Bream Bay is **low** and impacts on seabirds and shorebirds will be **less than minor**, and for some potential effects **negligible**. However, for tara iti fary tern, a taxon with a critically small population and very high conservation concern, the low risk of loss of terrestrial breeding habitat is based upon the proposed sand extraction area being outside the depth of closure and that extraction of sand will have a negligible effect on beach morphology and stability. Similarly, the **low** risk of tara iti interacting with the sand extraction vessel, or of being impacted by a fuel/oil spill from the sand extraction vessel, is based on the low likelihood of these two effects occurring. If this proposal is successful, the sand extraction vessel should operate under a light management plan when operating at night.

It is my opinion that the proposal, including its various management plans, to extract sand from Te Ākau Bream Bay will not result in any adverse effects on seabirds and shorebirds, and will, therefore, satisfy Policy 11 of the NZCPS[17] and additionally the objectives and policies of the Regional Policy Statement[18] (for example, Objective 2.4 and Policy 4.4.1) and of the PRP[19] (for example, D.2.18 and F.1.3). The proposal is also not contrary to the NPSIB in respect to those birds listed as highly mobile fauna in Appendix 2 of the NPSIB.

[17] https://web.archive.org/web/20240510065726/https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/coastal-management/nz-coastal-policy-statement-2010.pdf
[18] https://www.nrc.govt.nz/media/clxj0ndy/regionalpolicystatementfornorthlandmay2016updatedmay2018.pdf
[19] https://www.nrc.govt.nz/media/2yojfgax/proposed-regional-plan-february-2024.pdf

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7 References

Adkins, J.Y., Roby, D.D., Lyons, D.E., Courtot, K.N., Collis, K., Carter, H.R., Shuford, W.D., Capitolo, P.J. (2014) Recent population size, trends and limiting factors for the double-crested cormorant in western North America. *Journal of Wildlife Management,* 78: 1131-1142.

Beauchamp, A.J., Parrish, G.R. (2007) Wader (Charadriiformes) and royal spoonbill (*Platalea regia*) use of roosts in Whangarei harbour and Ruakaka estuary, Northland, 1973-2000. *Notornis*, 54: 83-91.

Beetham, E. (2025) Te Ākau Bream Bay sand extraction: coastal process effects assessment. Report prepared by Tonkin & Taylor Ltd. for McCallum Bros Ltd.

Black, A. (2005) Light induced seabird mortality on vessels operating in the Southern Ocean: incidents and mitigation measures. *Antarctic Science,* 17: 67-68.

Borneman, T.E., Rose, E.T., Simons, T.R. (2016) Off-road vehicles affect nestling behaviour and reproductive success of American oystercatchers *Haematopus palliatus*. *Ibis*, 158: 261-278.

Brough, T., Kereopa, H., Zaeschmar, J., Leunissen, E., Shirkey, T. (2024) Baseline surveys of marine megafauna in Te Ākau / Bream Bay to support kaitiakitanga. *NIWA Client Report* 2024202HN. A collaboration between Patuharekeke, Far Out Ocean Research and the National Institute of Water and Atmospheric Research.

Bull, L. (2022a) Northport eastern expansion. Coastal avifauna assessment. Report prepared by Boffa Miskell Limited for Northport Limited.

Bull, L. (2022b) Northport eastern expansion. Additional winter 2022 avifauna data analysis. Report prepared by Boffa Miskell Limited for Northport Limited.

Butler, D.J. (2003) Possible impacts of marine farming of mussels (*Perna canaliculus*) on king shags (*Leucocarbo carunculatus*). *DOC Science Internal* Series, 111. Department of Conservation, Wellington.

Buxton, R.T., Galvan, R., McKenna, M.F., White, C.L., Seher, V. (2017) Visitor noise at a nesting colony alters the behavior of a coastal seabird. *Marine Ecology Progress Series*, 570: 233-246.

Chang, F.H., Zeldis, J., Gall, M., Hall, J. (2003) Seasonal and spatial variation of phytoplankton assemblages, biomass and cell size from spring to summer across the north-eastern New Zealand continental shelf. *Journal of Plankton Research,* 25: 737–758.

Davidson, R.J., Courtney, S.P., Millar, I.R., Brown, D.A., Deans, N.A., Clerke, P.R., Dix, J.C., Lawless, P.F., Mavor, S.J., McRae, S.M. (1995) Ecologically important marine, freshwater, island and mainland areas from Cape Soucis to Ure River, Marlborough, New Zealand: recommendations for protection. *Occasional Publication,* No. 16. Department of Conservation, Nelson.

Ferreira, S.M., Hansen, K.M., Parrish, G.R., Pierce, R.J., Pulham, G.A., Taylor, S. (2005) Conservation of the endangered New Zealand fairy tern. *Biological Conservation,* 125: 345-354.

Fisher, P.R., Boren, L.J. (2012) New Zealand king shag (*Leucocarbo carunculatus*) foraging distribution and use of mussel farms in Admiralty Bay, Marlborough Sounds. *Notornis,* 59: 105-115.

Fletcher, W.J. (2005) The application of qualitative risk assessment methodology to prioritize issues for fisheries management. *ICES Journal of Marine Science,* 62: 1576-1587.

Forest & Bird (2014) Important areas for New Zealand seabirds: sites at sea, seaward extensions, pelagic areas. The Royal Forest and Bird Protection Society of New Zealand, Wellington.

Forest & Bird (2015) Important areas for New Zealand seabirds: sites on land, coastal sites and islands. The Royal Forest and Bird Protection Society of New Zealand, Wellington.

Forest & Bird (2016) Important areas for New Zealand seabirds: sites on land, rivers, estuaries, coastal lagoons and harbours. The Royal Forest and Bird Protection Society of New Zealand, Wellington

Frost, P.G.H. (2017) Population status and trends of selected seabirds in northern New Zealand. Report prepared by Science Support Service for the Department of Conservation.

Gall, M., Zeldis, J. (2011) Phytoplankton biomass and primary production responses to physico-chemical forcing across the northeastern New Zealand continental shelf. *Continental Shelf Research*, 31: 1799-1810.

Gaskin, C.P., Rayner, M.J. (2017) Seabirds of the Hauraki Gulf. Natural history, research and conservation. Report prepared for the Hauraki Gulf forum.

Goad, D., Middlemiss, K., Cieraad, E., Duke, K., Bell, H., Le Lec, Marc., Le Lec, Marissa., Fischer, J., Taylor, G. (2023) Light mitigation: reducing vessel interactions with seabirds. MIT2022-06 final report prepared for the Conservation Services Programme, Department of Conservation.

Hansen, K. (2006) New Zealand fairy tern (*Sterna nereis davisae*) recovery plan, 2005-15. *Threatened Species Recovery Plan,* 57. Department of Conservation, Wellington.

Hansen, K.A., Hernandez, A., Mooney, T.A., Rasmussen, M.H., Sørensen, K., Wahlberg, M. (2020) The common murre (*Uria aalge*), an auk seabird, reacts to underwater sound. *Journal of the Acoustic Society of America*, 147: 4069-4074.

Ismar, S.M.H., Trnski, T., Beauchamp, T., Bury, S.J., Wilson, D., Kannemeyer, R., Bellingham, M., Baird, K. (2014) Foraging ecology and choice of feeding habitat in the New Zealand fairy tern *Sterna nereis davisae*. *Bird Conservation International*, 24: 72-87.

Jacobs (2020) Pakiri sand extraction consent application – water quality technical report. Report number IZ111900-NP-RPT-003, V2. Prepared for McCallum Brothers Limited.

Larsen, O.N., Wahlberg, M., Christensen-Dalsgaard, J. (2020) Amphibious hearing in a diving bird, the great cormorant (*Phalacrocorax carbo sinensis*). *Journal of Experimental Biology*, 223: 217265.

MacDiarmid, A., Baird, S.J., Clark, M., Goetz, K., Hickey, C., Mills, S., O'Driscoll, R., Pinkerton, M., Thompson, D. (2016) Marine ecological risk assessment of the cumulative impact of Electron rocket launches. *NIWA Client Report* 2016059WN. Prepared for the Ministry for the Environment.

MacDiarmid, A., Beaumont, J., Bostock, H., Bowden, D., Clark, M., Hadfield, M., Heath, P., Lamarche, G., Nodder, S., Orpin, A., Stevens, C., Thompson, D., Torres, L., Wysoczanski, R. (2011) Expert risk assessment of activities in the New Zealand Exclusive Economic Zone and extended continental shelf. *NIWA Client Report* WLG2011-39. Prepared for the Ministry for the Environment.

MacDiarmid, A., Wysoczanski, R., Clark, M., Goetz, K., Hadfield, M., Neil, H., Pallentin, A., Pinkerton, M., Thompson, D., Tracey, D. (2015) Environmental risk assessment of discharges of sediment during exploration for seabed minerals: polymetallic nodules, placer gold and polymetallic crusts. *NIWA Client Report* WLG2015-42. Prepared for the Ministry for the Environment.

Mackley, E.K., Phillips, R.A., Silk, J.R.D., Wakefield, E.D., Afanasyev, V., Fox, J.W., Furness, R.W. (2010) Free as a bird? Activity patterns of albatrosses during the nonbreeding period. *Marine Ecology Progress Series,* 406: 291–303.

Mackley, E.K., Phillips, R.A., Silk, J.R.D., Wakefield, E.D., Afanasyev, V., Furness, R.W. (2011) At-sea activity patterns of breeding and nonbreeding white-chinned petrels *Procellaria aequinoctialis* from South Georgia. *Marine Biology,* 158: 429-438.

Miskelly, C., Baylis, S., Tennyson, A., Waugh, S., Bartle, S., Hunter, S., Gartrell, B., Morgan, K. (2012) Impacts of the Rena oil spill on New Zealand seabirds. *Te Papa Science Poster*, No. 2.

Mooney, T.A., Smith, A., Larsen, O.N., Hansen, K.A., Rasmussen, M. (2020) A field study of auditory sensitivity of the Atlantic puffin, *Fratercula arctica*. *Journal of Experimental Biology*, 223: jeb228270.

MPI (2023) Mitigation standards to reduce light-induced vessel strikes of seabirds with New Zealand commercial fishing vessels. Ministry for Primary Industries, Wellington.

Murphy, R.J., Pinkerton, M.H., Richardson, K.M., Bradford-Grieve, J.M., Boyd, P.W. (2001) Phytoplankton distributions around New Zealand derived from SeaWiFS remotely-sensed ocean colour data. *New Zealand Journal of Marine and Freshwater Research*, 35: 343–362.

Pichegru, L., Nyengera, R., McInnes, A.M., Pistorius, P. (2017) Avoidance of seismic survey activities by penguins. *Scientific Reports*, 7: 16305.

Pichegru, L., Vibert, L., Thiebault, A., Charrier, I., Stander, N., Ludynia, K., Lewis, M., Carpenter-Kling, T., McInnes, A. (2022) Maritime traffic trends around the southern tip of Africa – did marine noise pollution contribute to the local penguins' collapse? *Science of the Total Environment,* 849: 157878.

Pine, M. (2025) Assessment of underwater noise levels: proposed sand extraction Te Ākau Bream Bay. Report prepared by Styles group for McCallum Brothers Limited.

Poupart, T.A., Waugh, S.M., Bost, C., Bost, C.A., Dennis, T., Lane, R., Rogers, K., Sugishita, J., Taylor, G.A., Wilson, K.J., Zhang, J.J., Arnould, J.P.Y. (2017) Variability in the foraging range of *Eudyptula minor* across breeding sites in central New Zealand. *New Zealand Journal of Zoology,* 44: 225-244.\

Pulham, G., Wilson, D. (2013) [updated 2017] Fairy tern. In: Miskelly, C.M. (ed.) *New Zealand Birds Online* www.nzbirdsonline.org.nz

Preddey, J.M., Pulham, G.A. (2017) Observations of New Zealand fairy tern (*Sterna nereis davisae*) foraging at Te Arai dune lakes, New Zealand. *Notornis,* 64: 87-92.

Rayner, M.J., Hartill, B.W., Hauber, M.E., Phillips, R.A. (2010) Central place foraging by breeding Cook's petrel *Pterodroma cookii*: foraging duration reflects range, diet and chick meal mass. *Marine Biology,* 157: 2187–2194.

Rayner, M.J., Hauber, M.E., Clout, M.N., Seldon, D.S., Van Dijken, S., Bury, S., Phillips, R.A. (2008) Foraging ecology of the Cook's petrel *Pterodroma cookii* during the austral breeding season: a comparison of its two populations. *Marine Ecology Progress Series*, 370: 271-284.

Robertson, H.A., Baird, K.A., Elliott, G.P., Hitchmough, R.A., McArthur, N.J., Makan, T.D., Miskelly, C.M., O'Donnell, C.F.J., Sagar, P.M., Scofield, R.P., Taylor, G.A., Michel, P. (2021) Conservation status of birds in Aotearoa New Zealand, 2021. New Zealand Threat Classification Series, 36. Department of Conservation, Wellington.

Rodriguez, A., Holmes, N.D., Ryan, P.G., Wilson, K.J., Faulquier, L., Murillo, Y., Raine, A.F., Penniman, J.F., Neves, V., Rodriguez, B., Negro, J.J., Chiaradia, A., Dann, P., Anderson, T., Metzger, B., Shirai, M., Deppe, L., Wheeler, J., Hodum, P., Gouveia, C., Carmo, V., Carreira, G.P., Delgado-Alburqueque, L., Guerra-Correa, C., Couzi, F.X., Travers, M., Le Corre, M. (2017) Seabird mortality induced by land-based artificial lights. *Conservation Biology,* 31: 986-1001.

Rolfe, J., Hitchmough, R., Michel, P., Makan, T., Cooper, J.A., de Lange, P.J., Townsend, A.J., Miskelly, C.M., Molloy, J. (2022) New Zealand Threat Classification System manual 2022, Part 1: assessments. Department of Conservation, Wellington.

Shaffer, S.A., Tremblay, Y., Weimerskirch, H., Scott, D., Thompson, D.R., Sagar, P.M., Moller, H., Taylor, G.A., Foley, D.G., Block, B.A., Costa, D.P. (2006) Migratory shearwaters integrate oceanic resources across the Pacific Ocean in an endless summer. *Proceedings of the National Academy of Sciences,* 103: 12799-12802.

Sharples, J. (1997) Cross-shelf intrusion of subtropical water into the coastal zone of northeast New Zealand. *Continental Shelf Research*, 17: 835–857.

SLR (2025) Te Ākau Bream Bay sand extraction: water quality assessment of environmental effects. Report prepared by SLR Consulting New Zealand for McCallum Group.

Smith, A.B., Fischer-McMorrow, I., Kolbeinsson, Y., Rasmussen, M., Shero, M.R., McElwaine, J.N., Jones, O.R., Mooney, T.A (2023) Sensitive aerial hearing within a noisy nesting soundscape in a deep-diving seabird, the common murre *Uria aalge*. *Marine Ecology Progress Series*, 714: 87-104.

Sørensen, K., Neumann, C., Dähne, M., Hansen, K.A., Wahlberg, M. (2020) Gentoo penguins (*Pygoscelis papua*) react to underwater sounds. *Royal Society of Open Science*, 7: 191988.

Styles, J. (2024) Assessment of airborne noise effects. Sand extraction Bream Bay. Report prepared by Styles group for McCallum Brothers Limited.

Taylor, G.A. (2000a) Action plan for seabird conservation in New Zealand. Part A: threatened seabirds. Threatened Species Occasional Publication, No. 16, Department of Conservation, Wellington.

Taylor, G.A. (2000b) Action plan for seabird conservation in New Zealand. Part B: Non-threatened seabirds. Threatened Species Occasional Publication, No. 17, Department of Conservation, Wellington.

Townsend, A.J., de Lange, P.J., Duffy, C.A.J., Miskelly, C.M., Molloy, J., Norton, D.A. (2008) New Zealand Threat Classification System manual. Department of Conservation, Wellington.

Velando, A., Munilla, I. (2011) Disturbance to a foraging seabird by sea-based tourism: implications for reserve management in marine protected areas. *Biological Conservation*, 144: 1167-1174.

Wei, C., Erbe, C. (2024). Sound reception and hearing capabilities in the little penguin (*Eudyptula minor*): first predicted in-air and underwater audiograms. *Royal Society of Open Science*, 11: 240593.

Zeldis, J.R. (2004) New and remineralised nutrient supply and ecosystem metabolism on the northeastern New Zealand continental shelf. *Continental Shelf Research*, 24: 563–581.

Zeldis, J.R., Walters, R.A., Greig, M.J.N., Image, K. (2004) Circulation over the northeastern New Zealand continental slope, shelf and adjacent Hauraki Gulf during spring and summer. *Continental Shelf Research*, 24: 543–561.