# Appendix 14

## Potential Effects on Marine Mammals

CAWTHRON

REPORT NO. 3652

# POTENTIAL EFFECTS OF THE PROPOSED NORTHPORT RECLAMATION ON MARINE MAMMALS IN THE WHANGĀREI HARBOUR REGION

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# EXECUTIVE SUMMARY


Northport Limited (NPL) is proposing to expand its facilities in Whangārei Harbour and increase the Port's capacity to support the regional economic growth of Northland and northern Auckland. NPL is seeking a package of consents to authorise a proposed reclamation development at the eastern end of the existing port. As part of the resource consent application process, NPL contracted the Cawthron Institute (Cawthron) to investigate potential effects of the proposal on local and regional marine mammal species. This report outlines and assesses the potential effects of the proposed reclamation extension on the relevant marine mammals.

Many of New Zealand's marine mammal species live or pass through the north-eastern coastal waters of the North Island. While a large portion of the proposed construction area around the existing Port cannot be considered undisturbed or optimal habitat for marine mammals, previous sighting data suggest several species regularly visit Whangārei Harbour and nearby Bream Bay waters. The species most likely to be present in the vicinity of the proposal are bottlenose and common dolphins, orca and Bryde's whales. Other species of interest include NZ fur seals, leopard seals, and southern right and humpback whales as they are more seasonal visitors to the wider Bream Bay area.

The direct effects of the proposed construction activities that are most relevant to marine mammal species in the Whangārei region are physical injury and / or habitat avoidance due to the associated increase in underwater noise production from pile-driving activities and possibly, the risk of entanglement. While these effects have the greatest potential consequences (i.e. injury or death of a marine mammal), the actual likelihood of them occurring has been assessed as low to moderate, and overall, the effects are deemed *less than minor* with proposed management actions. Indirect effects of construction activities on marine mammals may result from physical changes to the habitat itself that adversely affect the health of the local ecosystem and / or impinge on important prey resources. However, given the location and habitats associated with the proposal, any indirect effects of project activities are not expected to be adverse or detrimental for local or visiting marine mammals in the region.

To ensure that the most appropriate measures are in place to minimise any potential adverse effects, several best management practices (including source noise reduction options, shut down zones, and seasonal consideration of piling stages) are recommended. At the same time, the continuation of ongoing acoustic monitoring is recommended to verify *in situ* piling sound levels and ensures the effectiveness of the management measures employed. The development of a marine mammal management plan (MMMP) is also recommended prior to commencing operations.

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# 1. INTRODUCTION

Northport Limited (NPL) is embarking on a project to expand its existing facilities in Whangārei Harbour by increasing its freight storage and handling capacity to support the future freight needs of the upper North Island. NPL is seeking a package of consents to authorise this proposed development, which involves dredging of the existing swing basin, reclamation of areas east of the Port and the construction (including pile driving) of a wharf and associated structures (Figure 1).

These proposed reclamation activities will generate underwater noises that have the potential to affect marine mammals, species that rely heavily on underwater sounds for communication, orientation, predator avoidance and foraging. As Whangārei Harbour is visited by a variety of marine mammal species, NPL have contracted Cawthron Institute (Cawthron) to provide a technical assessment of the potential effects of these construction activities on marine mammals.

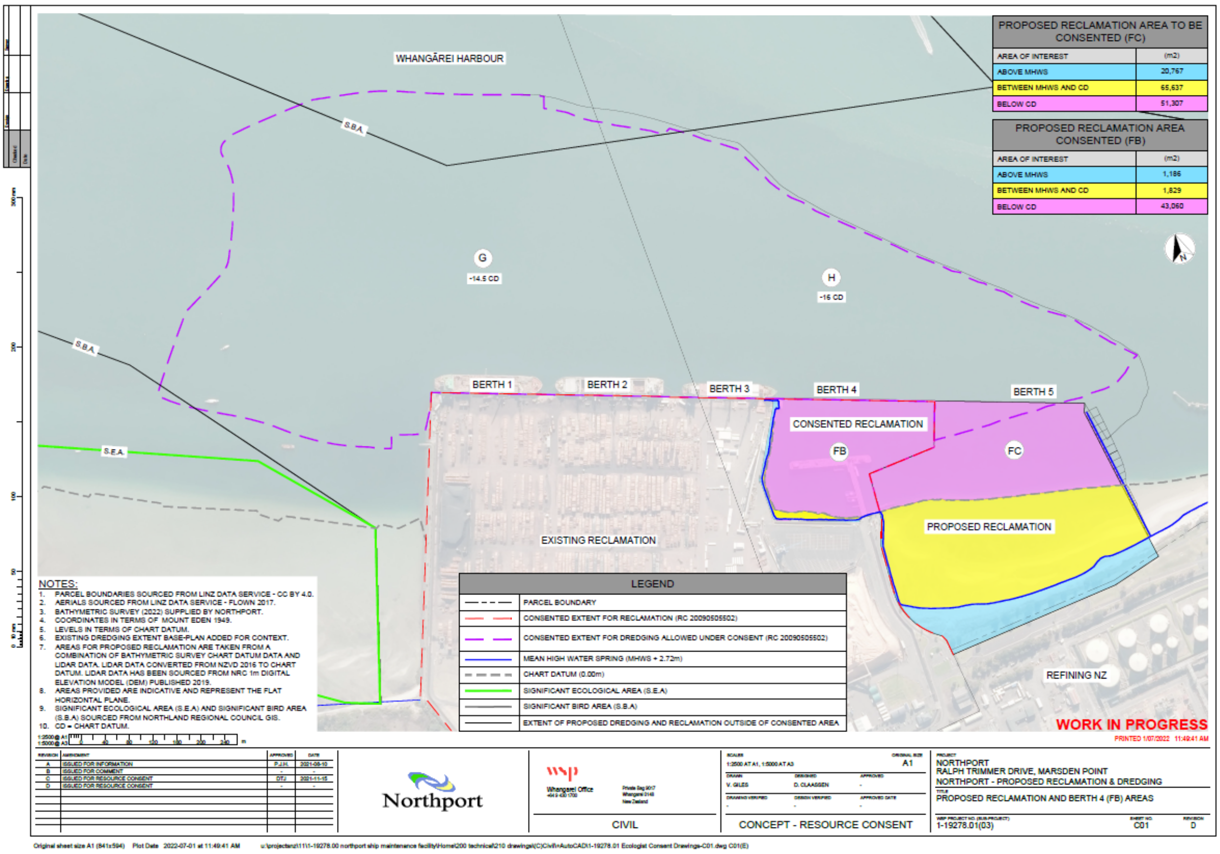



Figure 1. Layout of the proposed eastern reclamation construction components to Northport's current facilities. Source: WSP 2022.

## 1.1. Scope of assessment

This report provides an assessment of potential effects on marine mammals from the construction of the proposed reclamation. The report includes descriptions of the proposed reclamation activities and the existing environment from a marine mammal perspective. It focuses on following key assessment components:

1. Desktop review of the existing environment in terms of marine mammal species likely to be present in the general vicinity of the proposed activities,
2. Review of national and international literature on the effects of reclamation and construction activities on marine mammals,
3. Assessment of the overall risk of potential effects in terms of their scale, duration / persistence, likelihood and possible consequences, while taking into consideration findings from other project assessments being undertaken, and
4. Recommendations of possible management and monitoring actions to the extent required.

### *1.1.1. Assessment constraints*

The final design will be confirmed during the detailed design phase. Further detailed information can be found in Section 3 of the main resource consent application. For this reason, our assessment has been undertaken for all proposed methodologies and in particular, those activities that require careful management from a marine mammal perspective (i.e. all piling methods), if they are, in fact, utilised.

# 2. PROJECT OVERVIEW

The proposed reclamation project consists of an extension of NPL's existing eastern footprint, which will provide more land and additional wharf length.

The Proposal specifically includes:

- Reclamation within the Coastal Marine Area (CMA) and earthworks to the immediate east of the existing reclamation to expand Northport's footprint by approximately 13.7 hectares. This comprises 11.7 ha of reclamation within the CMA and 2 ha of earthworks outside the CMA.
- Capital and associated maintenance dredging to enlarge and deepen the existing swing basin and to enable construction of the new wharf.
- A 520-m-long wharf (including the consented, but not yet constructed 270-m-long Berth 4) constructed on the northern (seaward) face of the proposed reclamation.
- Sheet piling and rock revetment structures on the eastern edge of the proposed reclamation.
- Treatment of operational stormwater via the existing pond-based stormwater system.
- Port-related activities on the proposed expansion and wharves.
- Construction of a new tug jetty.
- Replacement of the existing floating pontoon, public access and public facilities.

The anticipated port-related activities include a container terminal, Coastguard, biosecurity, border control / customs and quarantine facilities, harbour control facilities plus supporting offices and workshops. In the future, as the number of containers handled by Northport increases, ship-to-shore gantry cranes will be added.

The construction period of the proposed reclamation area is estimated to take approximately 3.5 years (WSP 2022). The reclamation will involve approximately 9 months of dredging while the berth construction is estimated to take 2–2.5 years, of which approximately 24 months would have some pile-driving activity.

## 2.1. Marine construction components and methodology

The construction of the reclamation, wharf and associated structures is expected to include some or all of the following activities:

- Capital dredging, using a trailer suction hopper dredger (TSHD) and/or cutter suction dredger (CSD), to remove an anticipated volume of 1.7 million $m^3$ of dredge spoil.
- Reclamation, using the dredge spoil, and discharge of decant water.

- Construction dredging, using a backhoe dredger (BHD), to create the desired underwater profile and allow for construction of the batter slope.
- Excavation, placement of material and compaction.
- Construction work to construct seawalls and abutments (work above and below MHWS).
- Staging of construction equipment, including piling to create work platforms and install pile gates.
- Pile driving, using methods including vibro and top-driven impact hammers. This will involve cranes (shore based or mounted on jack-up barges), excavators and power packs (generators and hydraulic pumps).
- Placement of formwork, tying reinforcing steel and laying of ducts and pipework.
- Pouring of concrete for the port deck and discharge of concrete curing water.
- Construction of pavement surfaces.
- Installation of wharf furniture (bollards, electrical services, etc.).
- Installation of services and other infrastructure on the expansion area.

### 2.1.1. Land reclamation

It is anticipated the reclamation will be built using techniques used by NPL for previous reclamations. Broadly, sand and silts gathered from dredging are used to reclaim land behind a rock bunded wall, with some imported material (e.g. sand, rock and gravel) used where needed. The land construction sequence with the anticipated methodology is set out below:

- The rip-rap protected batter slope will be built as a bund along the eastern extent using land-based plant (i.e. excavators, trucks, etc.) from the shore and out to approximately mean low water springs. A temporary rock bund would then run westward to connect with the current Northport land.
- Once the rock bunded area is complete (and / or alternative measures such as silt curtains are installed), dredged material (as a slurry) will be pumped from the dredger and discharged into the reclamation area where the solids quickly settle out.
- A series of internal paddocks may be needed to settle out the finer-grained materials before residual sediments are discharged to the adjacent water. The discharge is expected to be via the existing stormwater discharge diffuser located under Berth 1.

### 2.1.2. Dredging methodology

Three dredging methods are available—two methods to dredge the bulk volume in the swing basin and another to dredge close to berth pockets and construction-related dredging. Capital dredging will be undertaken by either a cutter suction dredger (CSD) and / or a trailer-hopper suction dredger (THSD) to remove an anticipated volume of 1.7 million $m^3$ of dredge spoil. All other dredging will be undertaken using a backhoe dredge (BHD).

The duration of the dredging programme is dependent upon the equipment used but is expected to be in the order of approximately nine months.

### 2.1.3. Marine structures and methodology

To provide berthage for ships, several marine structures are proposed. The general nature and location of the structures are described in the application AEE. Structures will include:

- Revetment and seawalls – rock or concrete blocks with piles and / or combination of sheet piling and rock armour, and
- Wharves built using driven piles (steel or concrete) with a cast *in situ* reinforced concrete deck and / diaphragm walls.

Proposed pile-driving methods include both vibro (i.e. continuous) and top-driven impact hammer (i.e. intermittent) piling. Pile-driving activities will involve cranes (shore based or mounted on jack-up barges), excavators and power packs (generators and hydraulic pumps). Further detail of the proposed construction methodology is contained in the Concept Design Report (WSP 2022).

### 2.1.4. On-land container handling facilities

NPL anticipates the terminal to be developed with a gantry crane mode of operation, which allows for dense and high container stacking (compared with more traditional methods like use of straddle carriers) and enables future automation potential. This proposed design allows for the greatest physical bulk of cargo storage and represents an ‘upper bound’ effects envelope that could be expected for port activities.

# 3. DESCRIPTION OF THE EXISTING ENVIRONMENT

## 3.1. General approach

When considering potential implications of ports or other coastal developments on local marine mammals, the appropriate scale of consideration is not confined just to the scale of the proposal itself, but also needs to include the spatial scales relevant to the marine mammal species involved. For most marine mammals, normal home ranges can vary between tens to hundreds of kilometres or greater. As a result, the importance of the proposal area is placed in context of the species' New Zealand-wide and regional distributions. In this report, regional scale includes the coastal waters between the Bay of Islands and the Hauraki Gulf and is referred to as the 'area of interest' or AOI.

Clement and Elvines (2015) collated all available information on marine mammals that use Whangārei Harbour and the wider AOI waters to provide a comprehensive species overview. A list of these compiled information sources and maps are presented in Appendix 1. This report uses the same approach as the previous report and includes any new data that have since been reported. In addition, NPL collated opportunistic visual sightings between October 2019 and September 2021 (Appendix 2) on marine mammals within Whangārei Harbour. The goal was to establish a baseline of relative marine mammal occurrence within the harbour entrance area prior to any proposed development activities. An underwater acoustic programme (mooring locations shown in Figure 2) also collated information on underwater noise levels. More information on the acoustic programme is included in Pine (2022).

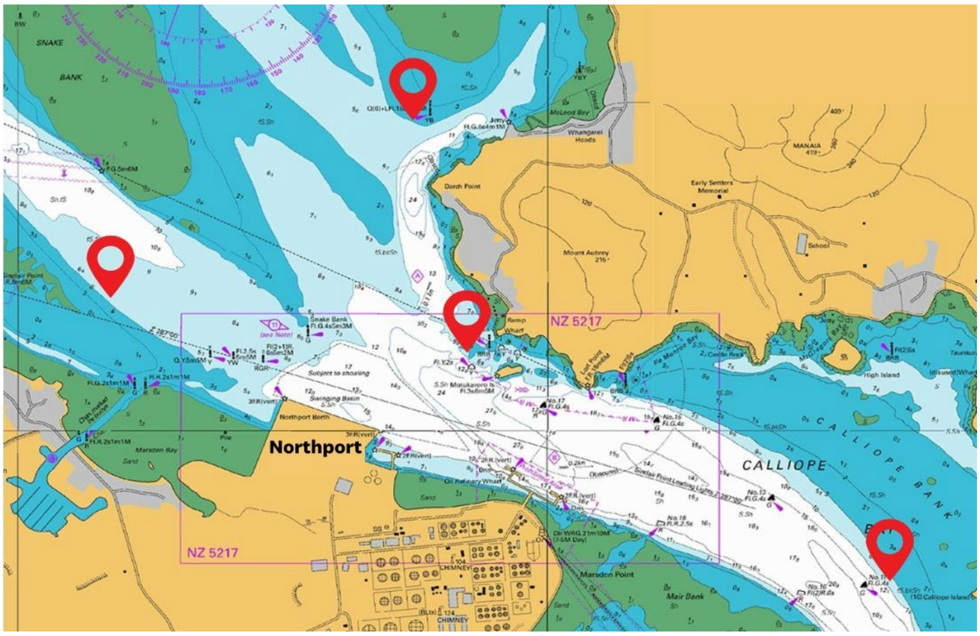



Figure 2. The deployment locations of the four underwater acoustic monitoring moorings (red squares) for marine mammals in relation to the relevant bays.

### *3.1.1. Data limitations*

It is important to note that most of the sighting records available are collected opportunistically from public sources (e.g. Department of Conservation (DOC) sighting and stranding databases) rather than systematically from research studies. Consequently, the number of sightings does not necessarily represent unique animals (i.e. the same animal may be reported by multiple members of the public or on separate days / in separate years) or their regular distribution patterns. As collection effort is not considered with opportunistic data, favourite fishing spots and tour boat tracks are likely to be over-represented, especially during periods of more favourable conditions (e.g. summer, daylight periods). For instance, the large number of sightings recorded around the Bay of Islands and Hauraki Gulf regions (Appendix 1) are most likely a reflection of the marine tour companies operating within these vicinities that offer marine mammal tours / swims and report their sightings to DOC.

Sighting (or the lack of sighting) records of pinnipeds were not considered a useful indicator for their occurrence patterns. Pinniped data tend to be either biased high, due to the animals' haul-out behaviour (i.e. leopard seals are aggressive and territorial), or biased low as their regular or expected occurrence goes unreported (i.e. NZ fur seals; McConnell 2020). Instead, the locations of known pinniped haul-out sites and breeding colonies are considered more informative. Cetacean stranding records are similar, in that they are a broad indicator of occurrence and supplemental to sighting records rather than evidence on their own (e.g. McConnell 2020). Records include animals that have stranded alive and then later died, or animals that have died at sea and washed ashore. The latter makes it more difficult to determine their normal distribution range as once dead, their final destination is dependent on current flows and tides.

### *3.1.2. Relevant species*

These data were used to determine what is currently known about the relevant species' occurrence, distribution and general behaviour within the AOI to evaluate those species most likely to be affected by the proposed project. For this assessment, more emphasis is placed on the presence and timing of an identified species in the Northland region. Overall, those species with multiple sightings and stranding reports were then included in Table 1 and divided into three general categories describing the current knowledge about their distribution patterns across the wider north-eastern coastal region (i.e. common, migrant or visitor).

The potential risks of the proposed construction activities to these more relevant species (discussed further in Section 4) were then assessed based on species' life history dynamics (e.g. species-specific sensitivities, conservation status, life span, main prey sources etc.) as surmised from New Zealand and international data sources[1].

## 3.2. General site description

A diverse range of New Zealand's marine mammal species live or pass through the North Island's upper and central eastern coastal waters (see Clement & Elvines 2015). At least 27 cetacean (whales, dolphins and porpoises) and two pinniped (seals and sea lions) species have been recorded along the north-eastern coastline of the North Island (Figure A1.1, Appendix 1). Figure 3 highlights sightings and / or strandings that have occurred around Whangārei Harbour and the Bream Bay area over the last several decades.

Due to its large size and natural deep water entrance channels, Whangārei Harbour has been a hub for both Māori and post-colonisation activities. Land reclamation and industrial development began in the early 1900s (e.g. Portland Cement works)[2]. By the 1960s, the oil refinery at Marsden Point was built. The current NPL site near the harbour entrance was constructed in the early 2000s and consisted of large-scale reclamation to reach the main channel. The entrance and main shipping channels currently experience heavy vessel traffic year-round by a variety of commercial and recreational vessels.

Despite these historical and ongoing disturbances, several marine mammal species still regularly visit harbour waters and frequent the wider region on a regular basis. In this regard, the Whangārei Harbour entrance represents a small (and conceivably less pristine) fraction of similar habitats available to support these various species that utilise the harbour and wider Bream Bay ecosystem.

### *3.2.1. Species of interest*

Several of the species highlighted in Figure 3 are known to be regular or seasonal visitors to the coastal regions surrounding AOI waters and are described further in Table 1 (Clement & Elvines 2015). Those species occurring more commonly along the Whangārei coastline, and therefore those with the greatest potential to be affected by the proposed project, are bottlenose dolphin (*Tursiops truncatus*), common dolphin (*Delphinus delphis*), orca (*Orcinus orca*), and Bryde's whale (*Balaenoptera edeni*).

Other species of interest include those that may be less frequent visitors but that are more vulnerable to anthropogenic (human-made) impacts due to their current

[1] Peer-reviewed journals, New Zealand Threat Classification System - NZTCS, National Aquatic Biodiversity Information System – NABIS (www.nabis.govt.nz/), International Union for Conservation of Nature (IUCN) Red List of Threatened Species (https://www.iucnredlist.org/).

[2] A. H. McLintock, originally published in 1966. Te Ara - the Encyclopedia of New Zealand URL: http://www.TeAra.govt.nz/en/1966/whangarei-harbour (accessed 29 Mar 2021).

conservation status (e.g. southern right whales are *at risk–recovering*) or are of special significance to tangata whenua[3] (Clement & Elvines 2015). A short summary of these marine mammal species is provided in Table 1 along with more detailed information on their abundance, distribution and any known life-history characteristics in AOI waters. Further species' information is available in Appendix 1 of Clement and Elvines (2015).

Most sightings near or within Whangārei Harbour are of bottlenose or common dolphins (Figure 3). An inshore population of **bottlenose dolphins** is known to range between Doubtless Bay to the north and Tauranga to the south (Constantine 2002). This Northland population[4] shows varying degrees of site fidelity along this region, but are found mainly near to the Bay of Islands (Hartel et al. 2014) and Great Barrier Island (Dwyer et al. 2014). Sightings near Whangārei occurred mainly over spring and early summer months. A continuing decline in the number of individuals visiting the Bay of Islands (Constantine 2002; Tezanos-Pinto et al*.* 2013; Peters & Stockin 2016) has led to the recent proposal for a Bay of Islands marine mammal sanctuary[5]. The decline may be due to high calf mortality (Tezanos-Pinto et al*.* 2014), vessel disturbance (Constantine et al. 2003; Peters & Stockin 2016) and / or emigration to other areas within this region (Dwyer et al*.* 2014). This species is listed as *nationally endangered* by the New Zealand Threat Classification System (Baker et al*.* 2019) meaning they are potentially more vulnerable to disturbance or changes within their distribution range.

As the most numerous of the dolphin species inhabiting New Zealand waters, several localised populations of **common dolphins** are found year-round off the east coast of the North Island from the Bay of Islands to the Bay of Plenty (Constantine & Baker 1997; Neumann et al. 2002). This species has been observed mainly in deeper waters of the AOI (> 30 m) and in a variety of group sizes (3–300 animals). Several studies have suggested that the Hauraki Gulf region may be an important nursing and / or foraging area for this species (Stockin et al*.* 2008; Dwyer et al. 2016), where they are more prevalent within inshore waters over winter and spring months (Stockin et al. 2008). This species is listed as *not threatened* (NZTCS – Baker et al. 2019), however, little is known about their actual population sizes and movements between these locations.

**Orca** are frequently sighted along the coastline between the Bay of Islands and Hauraki Gulf (Visser 2000). They have been observed year-round but are thought to be more common in AOI waters during late winter and early spring (Visser 1999,

[3] Whangārei Heads was previously known as 'Whangārei Te Rerenga Paraoa', which translates as 'Whangārei, the gathering place of whales'.
[4] One of three known coastal populations of bottlenose dolphins around New Zealand. Other genetically distinct populations are found around the Marlborough Sounds and Fiordland with a possible fourth population around Otago and Stewart Island (Brough et al. 2015).
[5] https://www.doc.govt.nz/news/media-releases/2021-media-releases/consultation-opens-on-proposed-bay-of-islands-marine-mammal-sanctuary/.

2000, 2007; Hupman et al. 2014; DOC sighting database). The orca that occur within Northland waters appear to be generalist feeders, opportunistically foraging on a variety of prey species. Visser (1999) reports on 22 observations of benthic foraging behaviour made between September 1994 and September 1996 from across the Northland region: Bay of Islands (n = 9), Whangārei Harbour (n = 5), Kawau Channel (n = 1), Gulf Harbour (n = 3) and Auckland Harbour (n = 4)[6]. While these habitats are described as containing substantial mud / sand flats and an estuarine 'component', Visser (2000) also notes observations of orca feeding on rays along the sandy beaches of Ocean Beach (just north of Whangārei Head) and Ruakaka Beach to the south. Overall, it appears that orca generally meander up and down the Northland coastline taking advantage of those habitats where rays may be more common as well as the habitats of other prey types.

Based on the sighting data and the timing of individual re-sightings from various Visser publications, orca do not spend a large amount of time in any one location. For instance, they most likely move in and out of Whangārei Harbour over the course of several hours and may perhaps re-visit on subsequent days or are not seen again for several months. Visser (2007) suggests that the tendency by orca to forage in and around enclosed harbours makes this species more susceptible to harbour developments. Orca are currently listed as *nationally critical* by the New Zealand Threat Classification System (Baker et al. 2019) based on their natural low abundance.

**Bryde's whales** are the most reported whale species in the AOI, particularly over late spring and summer months, passing through Whangārei offshore waters as they travel between Bay of Islands and Hauraki Gulf 'hotspots' (DOC sighting database). This species does not undertake long seasonal migrations like humpback or other whales and is thought to seasonally migrate along the north-eastern coast of the North Island to and from the subtropics (Gaskin 1972; Baker 1999). Their more offshore tendencies also mean that this species is unlikely to move into a harbour or bay like some other whale species (e.g. southern right or humpback whale). A small, residential population of Bryde's whales is found year-round within the Hauraki Gulf region (Wiseman 2008; Dwyer et al. 2016). Here, their natural tendency to remain just below the surface of the water most of the time (91%) and their spatial overlap with the main shipping channels of Auckland makes them highly vulnerable to ship strikes (Constantine et al. 2015). This species is listed as *nationally critical* in New Zealand

[6] The proposed Northland Regional Plan states *Essentially the threatened Orca and bottlenose dolphins visit all our estuaries, including the small ones and quite shallow tidal areas. …... Whangarei Harbour especially is a hotspot for Orca feeding forays*. (Kerr 2016b, p. 2). Visser's 1999 and 2007 publications are based on the same dataset as her PhD thesis (2000). She refers in her 2007 update to "Preliminary analysis of the post-1997 data…". However, we cannot find any official publication or even 'grey' literature in which the results of any additional orca sightings collected after 1997 are displayed or discussed. Without more information, I have had to assume that the statement about five important feeding grounds for orca (relative to other areas along the northeastern coastline) are based only on the 22 observations listed in Visser (1999).

waters (Baker et al. 2019) due to low abundance and the high proportion of mortalities due to ship strikes (Constantine et al. 2015).

**New Zealand fur seals** are considered year-round residents in lower North Island waters with established breeding colonies in Bay of Plenty and several known haul-out sites around Coromandel Peninsula. Regular sightings of adults and pups are now common in the Hauraki Gulf region with frequent sightings around the Hen and Chickens Islands as well as the occasional visiting seal within the Whangārei region as this species appears to be expanding northward (DOC sighting database). Fur seals are considered non-migratory but are known to easily and repeatedly cover large distances to find food. Some adults will travel out to open waters over winter while younger animals focus over shallower continental shelf waters. More public sightings of seals hauled out on land often occur over the late winter / spring months when pups depart from colonies and are exploring new areas.

**Leopard seals**, although mainly occurring around the Antarctic pack ice, will disperse northwards over the colder autumn and winter months (e.g. Hückstädt 2015) when individuals are occasionally observed in New Zealand waters. Leopard seals prey on a variety of species (e.g. krill, penguins, birds, fish, seals), eating their prey where it is taken. There are several reports of solitary animals observed within Whangārei Harbour as well as various haul-out sites and marinas between Auckland and Northland (Hupman et al. 2020). However, the number of reported sightings is likely biased high (i.e. a very small number of individuals are reported multiple times) given the novelty of seeing this species and with an active reporting programme underway. An individual leopard seal, *Owha*, was sighted visiting within Marsden Cove marina mainly over the autumn months between 2018–2020; (K. Hupman, LeopardSeals.org, unpublished data). Due to their aggressive nature, precautions need to be taken when working in the water near this species.

Several baleen whale species migrate through Northland waters from early winter (May) to the late spring months (November). Most whale species begin their northern migrations in late autumn or winter; humpbacks travel from May to August and southern right whales from July to September. **Southern right whales** can be slow migrators, especially cow / calf pairs, with a tendency to remain in shallow protected bays and coastal waters when calving. They can be observed with newborn calves from August onwards, particularly around the Northland region (Carroll et al. 2014). Approximately 40–50% of all cow / calf pairs are observed between Northland and Hawke’s Bay waters (Carroll et al. 2014) and may remain within nearshore waters for up to four weeks (Patenaude 2003). Southern right whales are considered *at risk - recovering* by the NZTCS (Baker et al. 2019), as their preference for shallow, protected bays and coastal waters (particularly for calving) overlaps with numerous anthropogenic activities in New Zealand’s waters.

More frequent sightings of **humpback whales** along the eastern coastline of the North Island are generally reported during their returning south-bound migration (e.g. Meissner 2015). Humpbacks begin returning with their newborn calves in later September, passing through Northland waters until late November / December. While humpbacks tend to travel more directly between headlands, they can occasionally briefly enter nearby harbours and bays. The Oceania sub-population of humpbacks (including New Zealand) is considered *endangered* by the IUCN due to their slower recovery rate from whaling impacts (Childerhouse et al. 2008).

Potential offshore species observed within AOI waters include **pilot whales, sperm whales**, **false killer whales,** and **blue whales.** Despite few sighting data, the strong prevalence of whale strandings from late spring to autumn suggests a general inshore movement within Northland waters for some of these species (particularly pilot whales) over summer months. Other offshore species that strand frequently along north-eastern coastlines include several species of **beaked whales** (including Grey's beaked whales) and **pygmy sperm whales** (DOC databases; Baker 2001; Zaeschmar et al. 2014; Brabyn 1990).

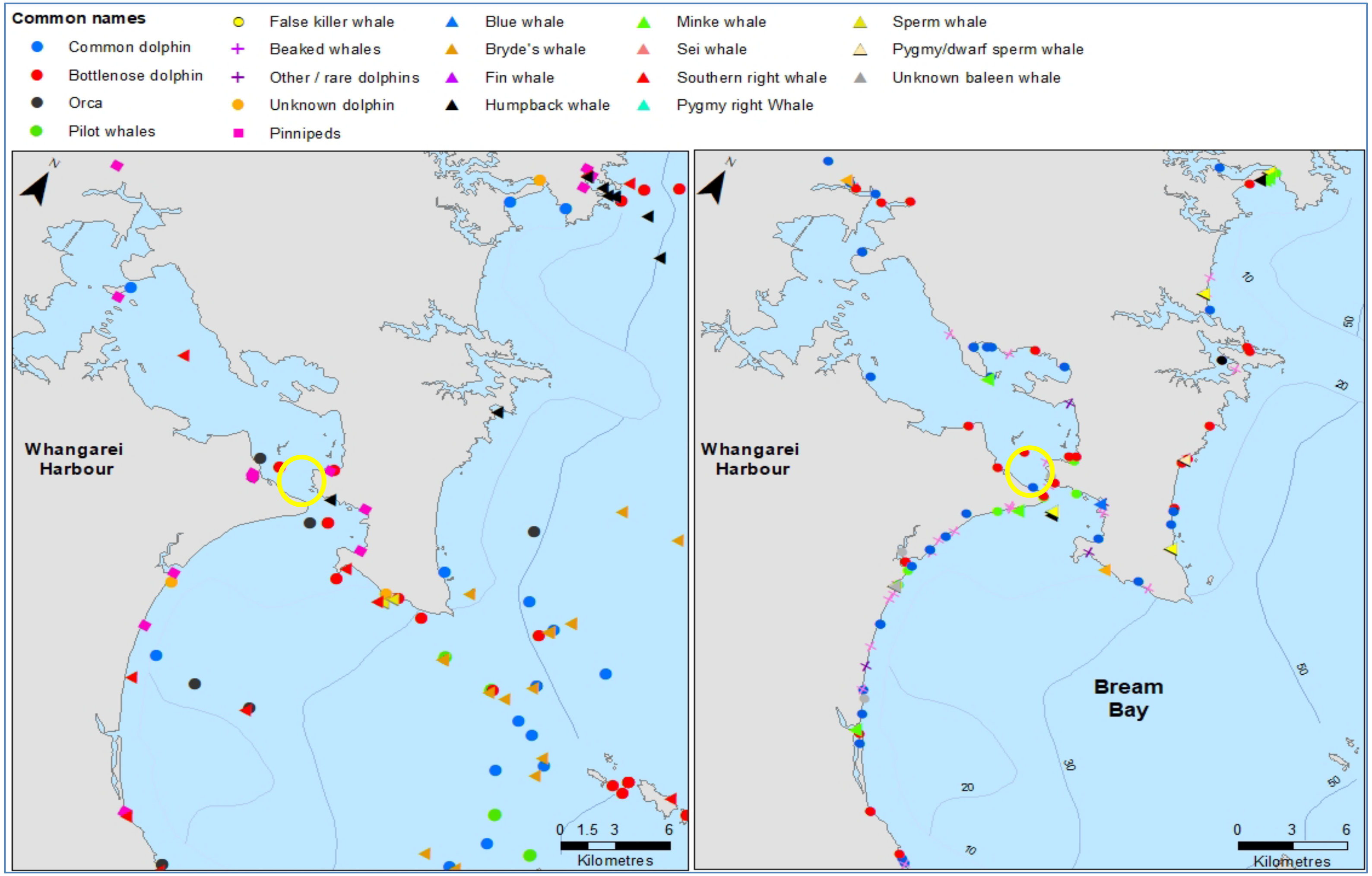



Figure 3. The distribution of Department of Conservation (DOC) reported sightings (1978–July 2020) on the left and strandings (1869–2019) on the right near Whangārei Harbour / headlands and the wider Bream Bay area. The yellow circles indicate Northport's location and the extent of underwater acoustic monitoring locations. See Appendix 1 for species' distribution across the wider Area of Interest.

Table 1. Distribution patterns of the more common marine mammal species to frequent Whangārei and nearby waters. Species' conservation threat status is listed for the New Zealand system (NZTCS – Baker et al. 2019) and internationally (IUCN system, ver 3.1). Modified from Clement and Elvines (2015).

| Common name | Species name | NZ Threat Classification System | IUCN Listing | Residency category in Northland | Patterns of Seasonality (relative to proposal area) |
|---|---|---|---|---|---|
| Bottlenose dolphin | *Tursiops truncatus* | Nationally Endangered | Least Concern | Common Seasonal to Year-Round | Resident sub-population to north in Bay of Islands that ranges between Doubtless Bay, Great Barrier Island and Tauranga. Occasional visits to Whangārei / Bream Bay, perhaps more over summer months. Generalist feeders. Currently in decline. |
| Common dolphin | *Delphinus delphis* (including *D. capensis)* | Not Threatened | Least Concern | Common Seasonal to Year-Round | Common throughout north-eastern waters year-round. Feed on schooling or more pelagic fish species. Generally observed in deeper waters off Whangārei / Bream Bay with occasional inshore sighting. |
| NZ fur seal | *Arctocephalus forsteri* | Not Threatened | Least Concern | Common Seasonal to Year-Round | Present year-round with multiple haul-out sites in the Hauraki Gulf and regular sightings off the Hen & Chickens Islands and Bay of Islands. More susceptible to human effects in breeding colonies. Feed mainly over shelf waters. |
| Leopard seal | *Hydrurga leptonyx* | Naturally uncommon | Least Concern | Seasonal to Semi-Common | Solitary animals occasionally observed within Whangārei Harbour (e.g. Marsden Cove Marina) as well as various haul-out sites and marinas between Auckland and Northland. |
| Orca (killer whale) | *Orcinus orca* | Nationally Critical | Data Deficient | Seasonal to Semi-Common | Frequent north-eastern waters year-round, more common in late winter / early spring. Forage in harbours, estuaries and coastal areas on rays, fish and other marine mammal species. Overseas populations noted for heavy pollutant loads due to high trophic level. |
| Bryde's whale | *Balaenoptera edeni* | Nationally Critical | Least Concern | Seasonal to Semi-Common | Commonly observed whale species in north-eastern waters year-round. Feed on small schooling fish and sometimes krill. Regularly move through Bream Bay, travelling between Bay of Islands and Hauraki Gulf. |
| Southern right whale | *Eubalaena australis* | At Risk - Recovering | Least Concern | Seasonal Migrant | Frequent more inshore, shallow regions of Northland during seasonal migration periods, particularly with new-born calves. Once present, they can remain in the Northland region for several days to weeks. Most often seen between August and November. |
| Humpback whale (Oceania) | *Megaptera novaeangliae* | Migrant | Endangered | Seasonal Migrant | Pass by Whangārei / Bream Bay on both north and south migrations but more prevalent and closer to shore on southern return migration when with calves (mainly Oct to late Dec). |
| Pilot whale | *Globicephala melas* | Not Threatened | Least Concern | Offshore Semi-Common | While a more offshore species, inshore sightings occur mainly over summer months. Forages off shelf waters. Known for frequent and mass strandings in Bream Bay and surrounding waters. |
| Sperm whale | *Physeter macrocephalus* | Data deficient | Vulnerable | Offshore Visitor | Increased sightings along the north-eastern coasts, mainly over summer and autumn months. |

### 3.2.2. Species summary

When considering the potential implications of coastal developments on local marine mammal populations, our review considers the available species data in reference to the following:

- Section 6(c) of the Resource Management Act 1991 (RMA) [7]
- Policy 11 of the New Zealand Coastal Policy Statement (NZCPS)
- Policy 4.4.1 of the Regional Policy Statement for Northland
- Method 9.2.5.2 of Northland's Regional Coastal Plan (RCP)[8]
- relevant maps and provisions in the Regional Plan for Northland (NRP, see Appendix 3).

Against this context, there is no evidence indicating that any of these species have home ranges restricted *solely* to Whangārei Harbour and nearby Bream Bay waters. Several whale species have known migration routes through the region. However, harbour waters are not considered part of any important migration corridors, as most animals generally pass further offshore (more than 5 km) with only a few individuals found near or within the harbour entrance each year. Hence, based on current knowledge, the proposal area is not considered ecologically more significant in terms of feeding, resting or breeding habitats for any marine mammal species relative to other regions along the north-eastern coastline (see species' overviews in Clement and Elvines (2015)). But as highlighted in Table 1, these waters do periodically support threatened or endangered species, such as bottlenose dolphins, orca, Bryde's whales, and southern right whales. These species are relevant in regard to Policy 11(a) of the NZCPS, which refers to avoiding adverse effects on nationally and / or internationally recognised threatened species.

[7] Section 6(c) - the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna.

[8] Appendix 9 - The Council has used the following criteria to determine those areas of important conservation value identified in the Plan as Marine 1 Management Areas. 5 – Marine Mammals and Birds Area including or near any: (a) marine mammal breeding or haul-out site.

# 4. ASSESSMENT OF EFFECTS

As described in the Project Overview (Section 2), the proposed reclamation will involve temporary activities that will generally disturb the marine environment and increase the amount of construction noise (both airborne and underwater) produced in lower harbour areas (Figure 4). Interactions between marine mammals and coastal developments usually result from an overlap between the spatial location of the physical development and important habitats of the species. However, recent studies into the effects of anthropogenic (human-made) underwater noise associated with such activities are demonstrating that this overlap is spatially larger and the effects wider-ranging than previously thought. Anthropogenic underwater noise is now recognised as a concern by several industries and regulatory agencies around the world (e.g. OSPAR 2009; DPTI 2012; WODA 2013; ACCOBAMS 2013; NOAA 2018).

The following sections describe the potential effects that the proposed reclamation might have on marine mammals. These are based on available studies (predominantly overseas) of development activities and marine mammals, while relying on a wider range of research on marine mammals near coastal development, along with information from other assessment reports.

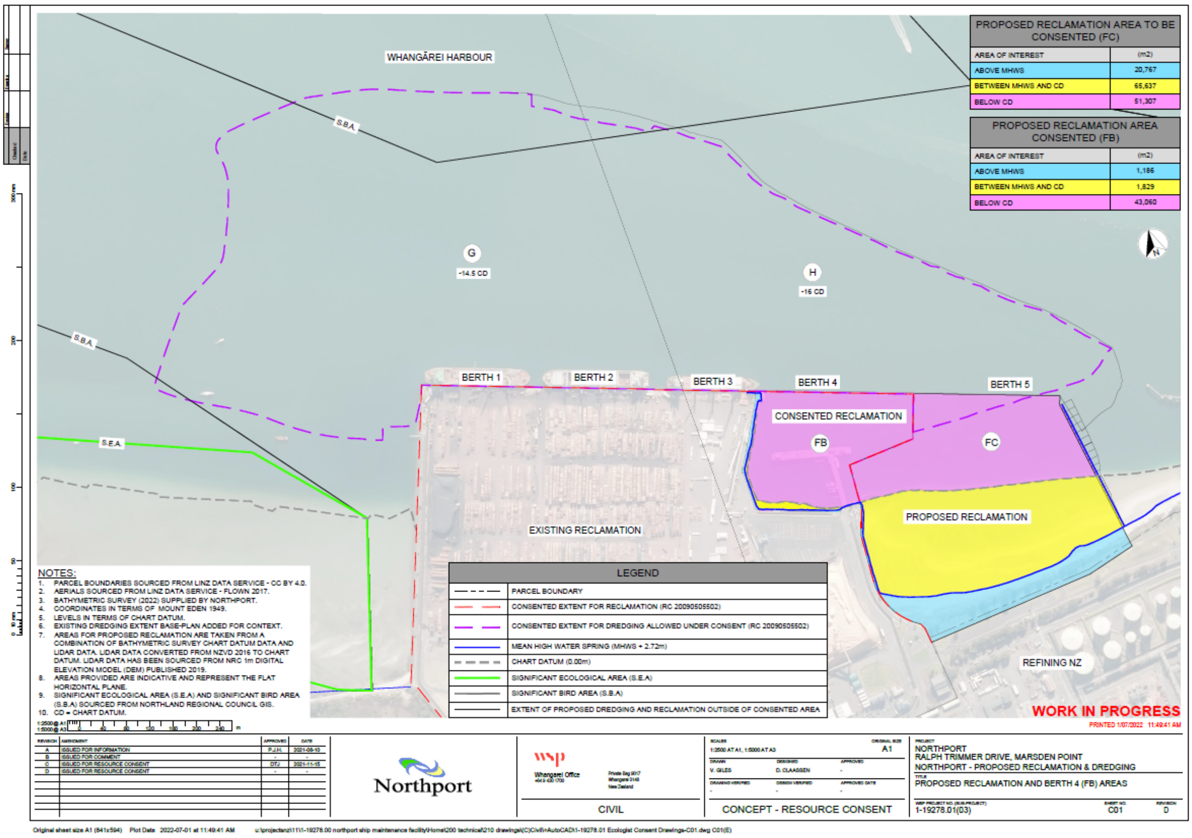



Figure 4. Indicative plan for the proposed reclamation project showing the proposed areas of reclamation (yellow / purple) and dredging (outlined in purple). Provided by WSP (2022).

## 4.1. General construction noise

Increasing underwater noise can affect marine mammals as they rely heavily on underwater sounds for communication, orientation, predator avoidance and foraging. Nowacek et al. (2007) noted that underwater noises can elicit three types of responses in marine mammals: behavioural (e.g. changes in surfacing or diving patterns), acoustic (e.g. changes in type or timing of vocalisations) and physiological injury (e.g. auditory threshold shifts and stress). These types of responses and the theoretical zones in which they occur are discussed in more detail in Appendix 4.

Reclamation and construction of the rock seawalls will involve the movement and disposal of large quantities of rock, sand and gravel material, placed individually in the case of large boulders or end-tipped from land. The level of disturbance and underwater noise that these demolition and seawall construction activities will produce are generally expected to be several orders of magnitude less compared to those from pile-driving and dredging activities. As such, underwater noise propagation modelling has been undertaken for selected pile-driving and dredging activities only (Pine 2022).

Due to the localised scale along the shoreline / wharf and the intermittent (hours), as well as shorter-term duration for most of these activities, the underwater noise produced by any general construction activities (excluding piling and dredging activities) has the potential to disturb individual animals visiting the immediate port vicinity only temporarily. The strongest response to this disturbance could be temporary avoidance of Whangārei entrance waters while the activities are occurring, but more likely, directed movement away from the immediate vicinity until the activities have stopped.

This assessment is based on the following factors:

- the proposed reclamation sites are not unique or rare habitat for any marine mammal species in terms of feeding, resting and / or breeding activities,
- most underwater noises generated from these activities are expected to be within the lower frequency ranges and intermittent in duration, similar to the underwater noise produced by existing commercial vessels visiting the Port, and
- relevant environmental factors of the proposed site (e.g. intertidal / shallow depths and soft mud) may, to some degree, naturally dampen any underwater noise production.

At the commencement of any construction activities, noise validation will be completed and the MMMP updated to ensure all noise management actions (i.e. size of shut down zones) are appropriate.

## 4.2. Pile-driving noise

### *4.2.1. Background*

Pile driving has been recognised as one of the noisiest of all construction sounds (e.g. Madsen et al. 2006) and has been identified as the most intense underwater noise that will be produced by the proposed reclamation project (Pine 2022). Pile driving generates a very high source level as broadband impulses (i.e. sound pulses across a wide range of frequencies) and has a high potential to disrupt marine mammal hearing and behaviour up to many kilometres away (Madsen et al. 2006). In closer proximity, these impulses could induce acute stress and cause hearing impairment (i.e. temporary or permanent threshold shifts, e.g. Tougaard et al. 2003, 2005; Madsen et al. 2006; Bailey et al. 2010; Brandt et al. 2016; Dähne et al. 2017). In humans, the onset of a temporary threshold shift (TTS) is often described as the muffled effect your hearing might have after a loud concert; the longer the exposure time, the longer this temporary effect lasts. A permanent threshold shift (PTS) results in alteration of hearing function leading to physical damage and irreversible hearing loss. PTS can occur suddenly through trauma (i.e. intense impulses) or develop gradually over time from a less intense noise source.

Behavioural disturbance of marine mammals from underwater noise has been well-studied overseas. However, results tend to be highly variable between species and among individual animals, as well as being context-specific (e.g. different reactions while feeding from when communicating), making them less predictable. Duration of exposure may also be an important factor (Southall et al. 2007; Bailey et al. 2010). Behavioural responses can vary from lower or minor level changes in swimming direction / speed, breathing or vocalisation rates to more moderate level responses (e.g. extensive changes in swimming or cessation of vocalisations) to complete abandonment or avoidance of impacted waters (Southall et al. 2007). Acoustic disturbance can also involve the 'masking' of certain communication or echolocation signals. For instance, members of the same species may find it more difficult to communicate across particular frequencies or at certain sound levels while near an anthropogenic noise source.

The only study in New Zealand to investigate how pile-driving noise may affect marine mammals was a study of local Hector's dolphin distribution in Lyttelton Harbour (Leunissen 2017). As expected, pile-driving noise was detectable by recorders above Lyttelton Harbour's already noisy background (i.e. ambient) levels over areas greater than 16.3 km$^2$. Similar to overseas research into the behavioural reactions of marine mammals to piling noise (e.g. Tougaard et al. 2003, 2005; Bailey et al. 2010), Leunissen and Dawson (2018) observed short-term movements by Hector's dolphins away from piling activity, with animals returning to the area once the activity finished.

The effect of pile driving on pinnipeds is less straightforward, with reported reactions ranging from little to no response from ringed seals (*Phoca hispida*: Blackwell et al. 2004) to significantly fewer harbour seals (*Phoca vitulina*) observed in haul-out areas located 10 km from pile-driving activities (Edrén et al. 2004). However, the authors noted that changes in haul-out numbers were short term as the general abundance of seals showed no decrease over the whole construction period. As pinnipeds also spend significant amounts of time out of the water and hauled out on shore, in-air sound levels also need to be considered, although the in-air hearing of both otariid (e.g. fur seals) and phocids (e.g. leopard seals) are substantially less sensitive than in water (e.g. Southall et al. 2007).

### *4.2.2. Proposed piling works*

The new wharf of the eastern extension will take the form of an open-piled structure with a cast concrete deck. The piles supporting the deck will be open-ended, tubular steel piles up to 914 mm in diameter driven to depths of approximately 50 m. Several driving methods have been proposed including vibro-hammer (continuous noise production) and traditional hydraulic impact hammer (impulsive noise) piling techniques from both barge and land-based platforms.

Tubular steel piles will be installed using a pile gate that consecutively pitches (lifting and placing the pile in the pile guide), sets (vibro-hammering piles into position), welds (new sections on to previously driven sections) and drives several piles in the same gate. Overall, the average installation time for each pile is estimated to take 10–12 hours, approximately 4 hours of which will involve driving using vibro and hammering methods using a 14-pile gate (WSP 2022).

The construction of the berth wharves is expected to take approximately 2 to 2.5 years of which pile installation is estimated to occur for varying durations throughout. It is assumed that no concurrent vibro and hydraulic hammering will take place at the same time over the course of the day and that pile driving will only take place during daylight hours.

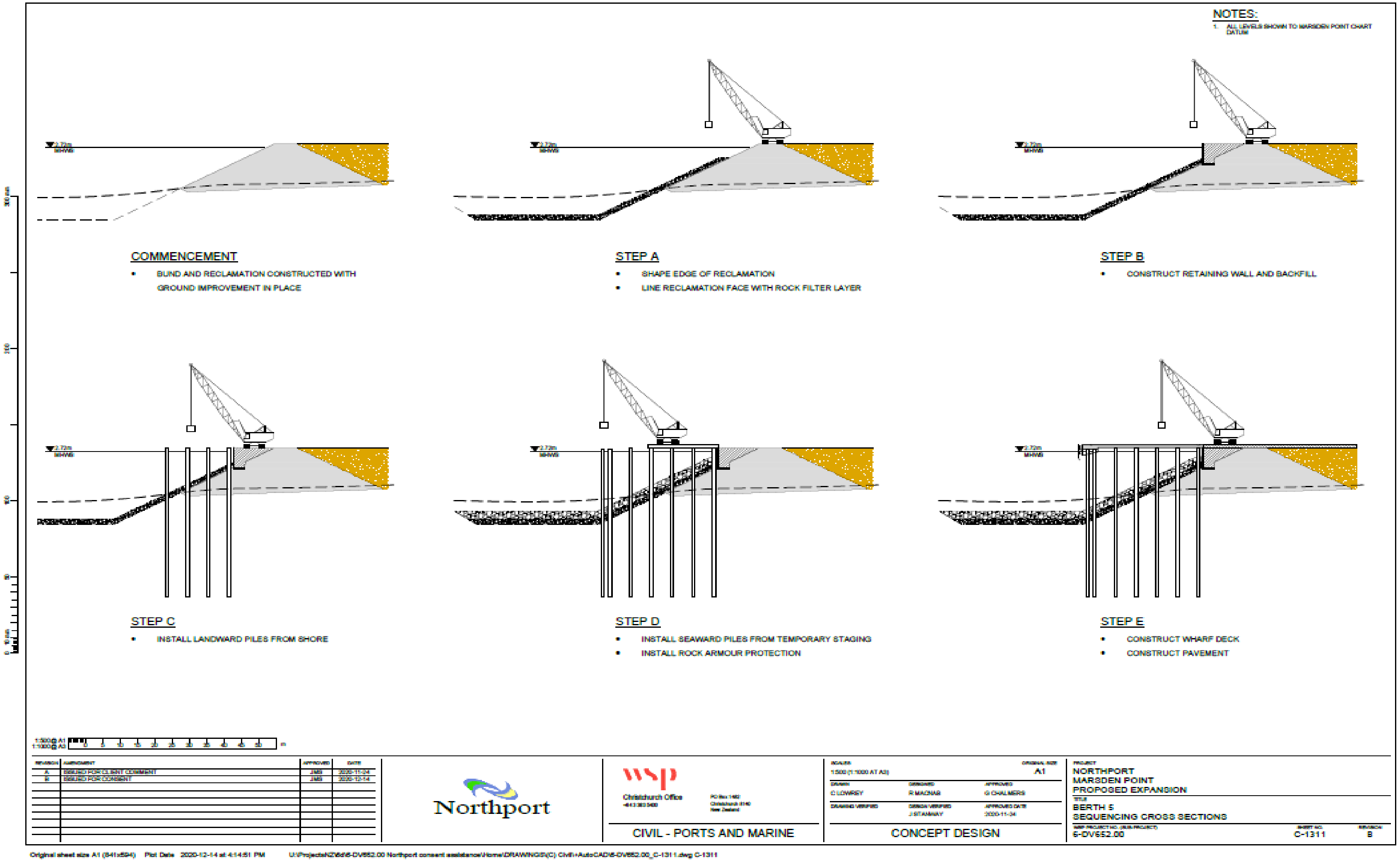



Figure 5. Schematic drawings of the various steps proposed to build the proposed reclamation's new wharf / berth frontage (WSP 2022).

### Potential physical effects

Pine (2022) developed an underwater noise propagation model to estimate the potential noise levels generated by the proposed construction works. This propagation model incorporated data on local bathymetry, water temperature, tidal flow and sediment type, all of which affect how noise travels through water. With this framework, acoustic models were then built for the largest proposed steel piles (i.e. 914 mm) at the location with the most potential impact on marine life (i.e. eastern reclamation area) in order to predict the 'worst-case' distance ranges of piling-generated noise.

There are currently no national or standard guidelines for pile-driving activities within New Zealand waters. To determine at what distance predicted noise levels could cause any physical impairment or injury (i.e. PTS or TTS) to local species, Pine (2022) used previously established functional hearing groups to distinguish between different marine mammal species (Table 2) and the relevant underwater acoustic thresholds defined by the USA National Oceanic and Atmospheric Administration (NOAA) *Revision to Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing* (Version 2.0-2018; Table 3). For this proposal, the acoustic thresholds are based on the species most likely to visit the wider Whangārei and Bream Bay area (Table 1): low-frequency (LF) hearing group (including baleen whales), mid-frequency (MF) hearing group (including toothed species such as bottlenose dolphins, common dolphins, orca, and beaked whales), and both phocid (PW) and otariid (OW) seals (in water; Table 2). These thresholds are M-weighted, meaning they are weighted based on the functional hearing ranges over which the hearing group is most sensitive and then considers the frequencies over which most sound energy might be concentrated for a particular sound source (i.e. pile-driving strikes; Table 3).

Table 2. Summary of the generalised functional hearing ranges defining the different marine mammal hearing sensitivity groups used by the USA National Oceanic and Atmospheric Administration (NOAA) agency. Source: NOAA 2018.

| Hearing Group | Generalised Hearing Range |
|---|---|
| Low-frequency cetaceans (LF)<br>baleen whales | 7 Hz to 35 kHz |
| Mid-frequency cetaceans (MF)<br>toothed dolphins / whales, beaked whales | 150 Hz to 160 kHz |
| Phocid pinnipeds underwater (PW)<br>true seals and leopard seals | 50 Hz to 86 kHz |
| Otariid pinnipeds underwater (OW)<br>sea lions and fur seals | 60 Hz to 39 kHz |

Table 3. Underwater acoustic thresholds for the onset of TTS and PTS from impulse (i.e. pile driving) and non-impulse (e.g. dredging or vibro piling) noise sources proposed by NOAA (2018) and listed by the relevant functional hearing groups of marine mammals. Note that the *SEL* criteria are cumulative over a 24-hr period and M-weighted. As there are no current behavioural thresholds, dose-response curves or low / moderate response levels were used (see Pine (2022) for more details).

| **Functional Hearing Group** | **Non-Impulsive Thresholds** | | | **Impulse Thresholds** | | |
|---|---|---|---|---|---|---|
| | TTS (*SEL*) | PTS (*SEL*) | Behaviour Levels* | TTS (*SEL*) | PTS (*SEL*) | Behaviour Levels** |
| **LF** | 179 | 199 | Dose-response curves (variable by species) | 168 | 183 | Low 140 |
| **MF** | 178 | 198 | | 170 | 185 | |
| **PW** | 181 | 201 | | 170 | 185 | Moderate 160 |
| **OW** | 199 | 219 | | 188 | 203 | |

* Non-impulsive noise methods proposed by Joy et al. (2019).
** Proposed by NOAA (2018) and modified from Southall et al. (2007) to include both low and moderate behavioural responses that are applicable to all species rather than by functional groups.

The underwater sound measurement methods and the modelling approach undertaken by Pine (2022) are appropriate and similar to approaches taken for other marine development projects undertaken around New Zealand[9]. These results provide a basis for my assessment and any recommended mitigation or management measures.

Subject to *in situ* validation of noise levels, the table and figures displayed below represent the *predicted worst-case* sound levels from impact driving methods in which cumulative PTS ($PTS_{cum}$) and TTS ($TTS_{cum}$) were estimated for the largest proposed piles[10]. Vibro-piling methods are not included here as source levels from this method were assessed by Pine (2022) to be lower than impact driving, based on the expected durations of piling as per the proposed schedule. Given the distance estimates in Table 4, impact pile driving could cause the onset of TTS in dolphins, orca or fur seals when animals are within the immediate vicinity of the construction site (100–200 m; Figure 6) but PTS is possible only when an animal is within 26 m or less.

Any visiting baleen whales or leopard seals will experience the onset of TTS at greater distances, either when they enter the harbour or if already present, as they

[9] Refining New Zealand Ltd –Deepening and Alignment project, Lyttelton Port Company Ltd – Capital Dredging and Cruise Berth Development projects; Port Marlborough Ltd – Waitohi Ferry Precinct Redevelopment project.
[10] These modelling scenarios assume similar impact driving rates to recently completed piling work in Lyttelton Harbour; an average of 1700 strikes on 914 mm piles over 24 hr period with a BSP HH16-1.2 Hammer with 7130kN capacity (M. Pine, pers. comm.).

approach the harbour entrance from inner regions (Figure 6). For baleen whales, this level of noise may result in a general avoidance of harbour waters while pile driving is underway and hearing injury (PTS) is possible if a whale is within 500 m of the noise source. Leopard seals are still expected to enter the harbour while piling activity occurs[11] but their movements into some inner regions of the harbour may be affected depending on the piling location. A leopard seal may experience the onset of PTS if they approach to within 150 m of the noise source.

[11] *Owha* continued to remain within Westhaven Marina during recent construction work in the marina with no known noise mitigation protocols in place (K. Hupman, 2021, pers.comm.).

Table 4. Estimated distance ranges of **impact pile-driving**[12] generated noise for potential hearing effects (TTS, PTS), behavioural impacts[13] and listening space reduction (i.e. masking) of the four modelled hearing groups in Pine (2022). Distances equate to the maximum distance estimated from sound propagation models developed for the consent area by Pine (2022). LF = Low Frequency group, MF = Mid-Frequency group, PW = Phocid Pinniped group in water and OW = Otariid Pinniped group in water. NA = Not applicable as sound levels too low.

| ***Threshold Criteria*** | **LF** (baleen whales) | **MF** (orca, other delphinids) | **PW** (leopard seal) | **OW** (fur seal) |
|---|---|---|---|---|
| | Max Distance (m) * | Max Distance (m) * | Max Distance (m) * | Max Distance (m) ** |
| PTS (permanent threshold shift) # | 475 | 26 | 145 | NA |
| TTS (temporary threshold shift) # | 1348 | 183 | 765 | 111 |
| 140 dB Low Behavioural Threshold | 2047 | | | |
| 160 dB Moderate Behavioural Threshold | 969 | | | |

| | **Percent reduction** | **LF** (baleen whales) | **MF** (orca, other delphinids) | **PW** (leopard seal) | **OW** (fur seal) |
|---|---|---|---|---|---|
| | | Max Distance (m) * | Max Distance (m) * | Max Distance (m) * | Max Distance (m) ** |
| Listening Space Reduction (Masking) | 0% | 2851 | 2782–2828 | 2914 | 2841 |
| | 25% | 1983 | 2040–2204 | 2430 | 2232 |
| | 50% | 1065 | 1279–1295 | 1397 | 1334 |
| | 75% | 171 | 330–402 | 693 | 619 |

* Where available, these were based on the relevant species audiogram data (Pine 2022). Masking result for whales were calculated based on fin whale audiograms.

** Range based on northern fur seal audiogram data in the absence of NZ fur seal audiogram.

[12] Vibro-piling methods are not included as noise levels were assessed by Pine (2022) to be lower than impact driving based on the expected durations of piling as per the proposed schedule.

[13] The probability of a behavioural response occurring at varying distances from a piling source was not able to be calculated through the dose-response method that Pine (2022) used to calculate behavioural risk for dredging (e.g. continuous noise). See Pine (2022) for more details.

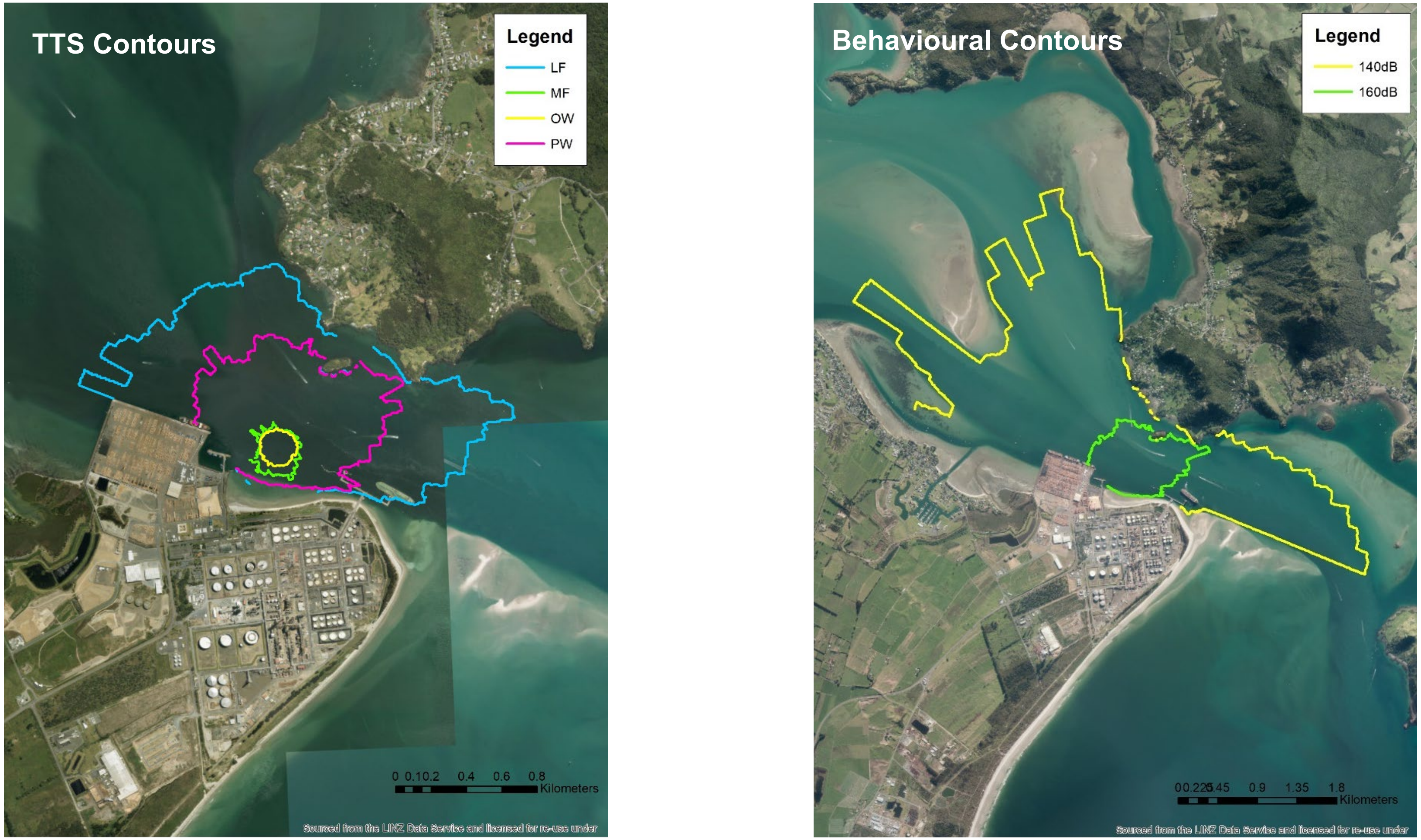



Figure 6. The predicted spatial ranges of the different functional hearing groups for the onset of temporary threshold shift (TTS; left) and the onset of behavioural responses (right) from **percussive impact piling** at the eastern edge of the wharf area. LF = Low Frequency group, MF = Mid-Frequency group, PW = Phocid Pinniped group in water and OW = Otariid Pinniped group in water. NOTE—These diagrams show sound contours from a pile source within the eastern reclamation area as this location was deemed the 'worst-case scenario' in terms of potential impact on visiting marine mammals (Pine 2022).

### Potential displacement or behavioural effects

Appropriate sound level thresholds for behavioural disturbance are currently being assessed and revised overseas (NOAA 2016). In the interim, and based on overseas studies, Pine (2022) used the two-tiered approach of Southall et al. (2007)[14]. This approach notes that lower behavioural responses to impulse noise can occur at sound levels as low as 140 $dB_{rms}$ re 1µPa with more moderate responses at sound levels of 160 $dB_{rms}$ re 1µPa for all species (Table 3). Based on these two-tiered unweighted thresholds, the distance ranges for potential low and moderate level behavioural effects were conservatively estimated for all species (Table 4, Figure 6).

As discussed earlier, behavioural responses are expected to be contextual and situation dependent. While these behavioural thresholds are much lower than the noise levels generated by most commercial and recreational vessels (i.e. OSPAR 2009; Todd et al. 2015), animals are expected to respond more adversely to intermittent and unexpected noise than more consistent or regular intervals of noise. By way of analogy, a fire alarm will startle people nearby when it goes off unexpectedly. However, if a person approaches a fire alarm from a distance that has been sounding prior to their arrival, their response is more modest, and they may even approach or pass by the building as they habituate to the noise of the alarm. This is why management measures such as soft start or ramping up are used by piling operators to avoid sudden or unexpected full-force piling noise.

As Figure 6 demonstrates, the potential behavioural responses from impact driving are expected to be confined spatially within inner Whangārei Harbour waters and the entrance. Any animal attempting to enter the harbour underwater will likely exhibit at least lower-level behavioural responses while piling is underway. By way of context, *Owha*, the visiting leopard seal, is expected to be able to continue to use any existing haul-out sites in the harbour and / or nearby marinas throughout the proposed construction period[15] as in-air piling sound levels are expected to be much lower than in-water levels, and seals often swim with their heads out of water when near human activity (D. Clement, pers. obs.).

Pine (2022) also calculated distances from piling activity where the associated noise levels might interfere or prevent an animal from hearing some natural acoustic signals, also known as acoustic masking (e.g. members of the same species trying to communicate across particular frequencies / levels while in proximity of the operating pile driver). The estimated reductions in an animal's listening space (e.g. volume of ocean around an individual) or when acoustic masking might occur as it approaches a pile-driving source are listed in Table 4 and illustrated in Appendix 5. For all dolphin and whale species, the greatest reduction to their listening space (> 75%) would be

[14] Southall et al.'s (2007) approach was instrumental in formulating the basis of the NOAA (2018) underwater noise threshold levels.

[15] *Owha* continued to remain within Westhaven Marina in Auckland during recent construction work in the marina with no known noise mitigation protocols in place (K. Hupman, 2021, pers. comm.).

limited to within a 400 m radius from the piling source when in operation, and out to 700 m for pinnipeds (Table 4).

Overall, the sound modelling of Pine (2022) suggests that for most species (with the exception of visiting baleen whales and leopard seals), pile-driving noise without any mitigation has the potential to cause temporary hearing impairment (TTS) and / or injury (PTS) only within close proximity of the piling source (Table 5). While the potential for both TTS and PTS is greater for visiting baleen whales and leopard seals, very few of these individuals visit these waters in any one year (i.e. 1–3 animals) and these species tend to have a stronger seasonal presence (e.g. winter migrations for whales, autumn visits by leopard seals). Hence, the likelihood of any TTS or PTS effects occurring is considered *low* for all species (Table 5).

Instead, pile-driving noise will most likely elicit varying levels of non-detrimental acoustic masking and / or short-term behavioural responses at variable distances of a few hundred metres up to 2 km from the source, depending on the species and even individual animals (e.g. lone male vs mother / calf). With recommended management actions, which are described below, including the establishment of marine mammal shut down zones and soft start / ramping up procedures, any residual effects of PTS / TTS and behavioural responses are expected to be *nil* to *less than minor* (Table 5). The relevant factors that underlie this assessment are listed below and discussed further in Section 5.1.

*Spatial and temporal factors*

- Underwater noise produced from the proposed pile-driving activities will occur in several staged blocks, potentially intermittent over the course of two and more years.
- The proposed pile-driving system, with vibro-hammering and welding cycles, limits traditional impact hammering during any one day. The currently proposed piling schedule estimates the driving of 1 to 4 piles per day, and all piling activity taking place during daylight hours only.
- Previous visual and current underwater acoustic monitoring confirm that several species visit Whangārei Harbour waters with some more seasonal in their occurrences.
- Whangārei Harbour is not currently considered unique or ecologically important feeding, resting or nursery habitats for any marine mammal species relative to similar habitats within eastern coastal waters of the North Island.

*Known acoustic factors*

- Shut down zone management is able to avoid any $PTS_{cum}$ or $TTS_{cum}$ effects by ceasing all piling activity if and when species enter the designated zone.

- Management options, such as soft starts and ramping up procedures, will help reduce more moderate behavioural responses by avoiding sudden or unexpected full-force piling noise.
- The semi-enclosed nature of the harbour entrance limits effects to mainly entrance and harbour waters. Hence, underwater noise effects are unlikely to apply for any other visiting dolphins, pinniped or migrating whales outside the harbour entrance or within Bream Bay.
- Different sources of underwater noises are not necessarily additive or cumulative. The ‘loudest’ noise (i.e. pile driving) will mask other noises generated nearby by other construction activities (e.g. dredging). The MMMP and / or consent conditions proposed by NPL will, however, need to provide against two similar pile drivers operating at the same time, because under such an operational scenario it is possible that PTS or TTS thresholds will be reached over a shorter exposure period (less than 24-hours).
- Current evidence that these species continue to use port and harbour waters as well as the wider Whangārei Harbour / Bream Bay area, despite a wide range of pile-driving activities associated with previous NPL (and third party) construction projects.

Table 5. Summary of potential effects on relevant marine mammal species from the proposed NPL proposed reclamation extension. TTS = temporary auditory threshold shift. PTS = permanent auditory threshold shift. MMMP = Marine Mammal Management Plan

| Potential environmental effects | Spatial scale of effect on marine mammals | Persistence / duration of effect for marine mammals | Consequences for marine mammals | Likelihood of effect | Significance Level of Effect (without proposed management approaches) | Proposed management approaches / effects analysis | Significance Level of Residual Effect (with proposed management approaches) |
|---|---|---|---|---|---|---|---|
| **Behavioural and / or physical responses to:**<br>• **General construction activities** | **Small to Large**<br>- dependent on final method / sounds produced<br>- behavioural responses (BR) predicted at larger distances | **Short to Persistent**<br>- construction expected to be completed within 2–3 years<br>- various activities will produce more or less noise | **Individual Level**<br>- individuals may avoid or approach activities | **NA / Low**<br>- TTS<br>- masking<br>- behavioural | **Nil to Negligible** | • Localised, intermittent activity of short durations but continuing for months and / or years<br>• Relevant environmental factors (may naturally help dampen underwater noise production)<br>• *In situ* measurements of underwater noise levels from construction activities and adjust mitigation if necessary (MMMP) | **Nil to Negligible** |
| • **Pile-driving activities:**<br>**Physical injury (TTS / PTS)** | **Small to Large**<br>- PTS and TTS vary with species, up to 1.3 km | **Short to Persistent**<br>- dependent on exposure, damage and recovery periods between events, eastern construction over 2–3 years | **Individual to Regional Level**<br>- hearing impairment or injury of endangered individual (i.e. breeding female) to potential attraction of juvenile animals | **Low**<br>- PTS<br>- TTS | **Less than Minor to More than Minor**<br>- PTS<br>- TTS | • BPO used in method selection (MMMP)<br>• Regular maintenance and upkeep of piling equipment (MMMP)<br>• Explore reducing noise at source developments<br>• Reduce unexpected noise by using ramping up and / or soft starts (MMMP)<br>• *In situ* verification of underwater noise levels from piling activities and adjust mitigation if necessary (MMMP) | **Nil to Negligible**<br>- PTS<br>- TTS |
| **Displacement effects (Behavioural / masking)** | **Large**<br>- behavioural responses (BR) / masking over 1–2 km | **Short to Persistent**<br>- dependent on exposure and recovery periods between events; eastern construction over 2–3 years | **Individual to Regional Level**<br>- abandonment or avoidance by particular age groups (e.g. mother / calves) or individuals<br>- possible acoustic masking between conspecifics only within harbour waters | **Moderate**<br>- behavioural avoidance / attraction<br>- masking | **Less than Minor to Minor** | • Establishment of shut down zones in which piling activities will cease if an animal enters (MMMP)<br>• Daylight hours operations only (MMMP)<br>• Intermittent piling (1–4 piles per day)<br>• Very low probability of whale presence near proposal area<br>• Proactive staging may prevent piling activities over successive seasons (i.e. 2 consecutive winter seasons) (MMMP) | **Negligible to Less than Minor**<br>- behavioural<br>- masking |
| • **Dredging activities** | **Small to Medium**<br>- behavioural / masking responses predicted at < 600 m<br>- potential TTS only when next to dredger (< 1 m) | **Short to Persistent**<br>- possibly intermittent over weeks / months<br>- eastern construction over a few months | **Individual Level**<br>- individuals may avoid or approach dredge activities, individuals subject to potential behavioural responses and acoustic masking when within close proximity | **NA**<br>- PTS / TTS<br>**Low to Moderate**<br>- behavioural<br>- masking | **Nil to Less than Minor** | • Regular maintenance and proper upkeep of all dredging equipment and the vessel / platform (MMMP)<br>• *In situ* verification of underwater noise levels from dredging activities and adjust mitigation if necessary (MMMP)<br>• Localised activity of short durations (hours to months)<br>• Very low probability of whale presence near proposal area | **Nil to Less than Minor** |
| **Marine mammal / vessel collision risk** | **Large**<br>- daily ship movements between ports and along the north-eastern coastline | **Short to Persistent**<br>- daily transits through region limited duration but for length of consent,<br>- animals only present in region for a day to weeks | **Individual to Population Level**<br>- death or injury of endangered or threatened species vs death of non-threatened dolphin or pinniped | **Low** | **Less than Minor to More than Minor** | • Very low probability of whale encounter (other than Bryde's whales mainly in Gulf waters)<br>• Adoption of boating behaviour guidelines (MMMP)<br>• Support / encourage expansion and uptake of the Hauraki Gulf transit protocol for shipping that include speed limits and crew member on watch while transiting through destinated waters in daylight hours | **Negligible to Less than Minor** |
| **Marine mammal entanglement in operational gear and / or debris** | **Small to Medium**<br>- limited to immediate waters around construction sites | **Short to Persistent**<br>- construction expected to be completed within 2–3 years<br>-different activities have variable risk | **Individual to Population Level**<br>- death or injury of endangered or threatened species vs death of non-threatened dolphin or pinniped | **NA to Low** | **Nil to Less than Minor** | • Avoid loose rope, lines, nets or other debris (MMMP)<br>• Compliance with NZ Maritime Rules Part 180 (MMMP)<br>• Regular maintenance / inspection of properly tensioned silt curtains or other sediment containment gear (MMMP) | **Nil to Negligible** |
| **Marine mammal habitat loss and / or prey disturbance** | **Medium to Large**<br>- complete loss of reclaimed habitat; disturbance limited to immediate waters and habitats adjacent to construction sites | **Short to Persistent**<br>- re-colonisation of most habitats (except reclaimed areas) will begin after disturbance has ceased, boat scour persistent for wharf lifetime | **Individual Level**<br>- individuals may avoid or approach activities | **NA to Low** | **Nil to Negligible** | • Previous or ongoing disturbance to nearby seabed from associated Port activities<br>• No unique feeding habitats in the proposed areas | **Nil to Negligible** |

Definition of terms used in table:

- Spatial scale of effect: Small (tens of metres), Medium (hundreds of metres), Large (> 1 km)
- Persistence of effect: Short (days to weeks), Moderate (weeks to months), Persistent (years or more)
- Consequence: Individual, Regional, Population level
- Likelihood of effect: Not Applicable (NA), Low (< 25%), Moderate (25–75%), High (> 75%)
- Significance level: Nil (no effects at all), Negligible (effect too small to be discernible or of concern), Less than Minor (discernible effect but too small to affect others), Minor (noticeable but will not cause any significant adverse effects), More than Minor (noticeable that may cause adverse impact but could be mitigated), Significant (noticeable and will have serious adverse impact but could be potential for mitigation).

## 4.3. Dredging noise

Despite the frequent use of dredges in most port, harbour and coastal development projects, little research has focused specifically on the effects of dredging operations on marine mammals. However, the act of breaking and / or removing bottom substrate in itself is not expected to directly affect any marine mammals known to frequent Whangārei Harbour. Instead, the associated increases in the production of underwater sound and physical disturbance within the harbour are the more likely circumstances in which marine mammals will be affected. Noises produced from dredging activities differ from pile driving in that they are non-impulsive, generally continuous, broadband sounds that tend to occur at frequencies mostly below 1 kHz (Todd et al. 2015).

The proposal currently anticipates that three types of dredge platforms; a trailer suction hopper dredger (TSHD), cutter suction (CSD) and backhoe (BHD or excavator type) dredger, will likely be used from both land and floating barges. A large portion of the seabed directly affected by the proposed dredging has already been dredged previously, been modified by the presence of artificial structures and / or been subjected to direct disturbance from propeller wash from large vessels (Figure 7). Hence, any indirect flow-on effects from disturbing this habitat, and thus potential prey resources, are unlikely and are discussed further in Section 4.6.

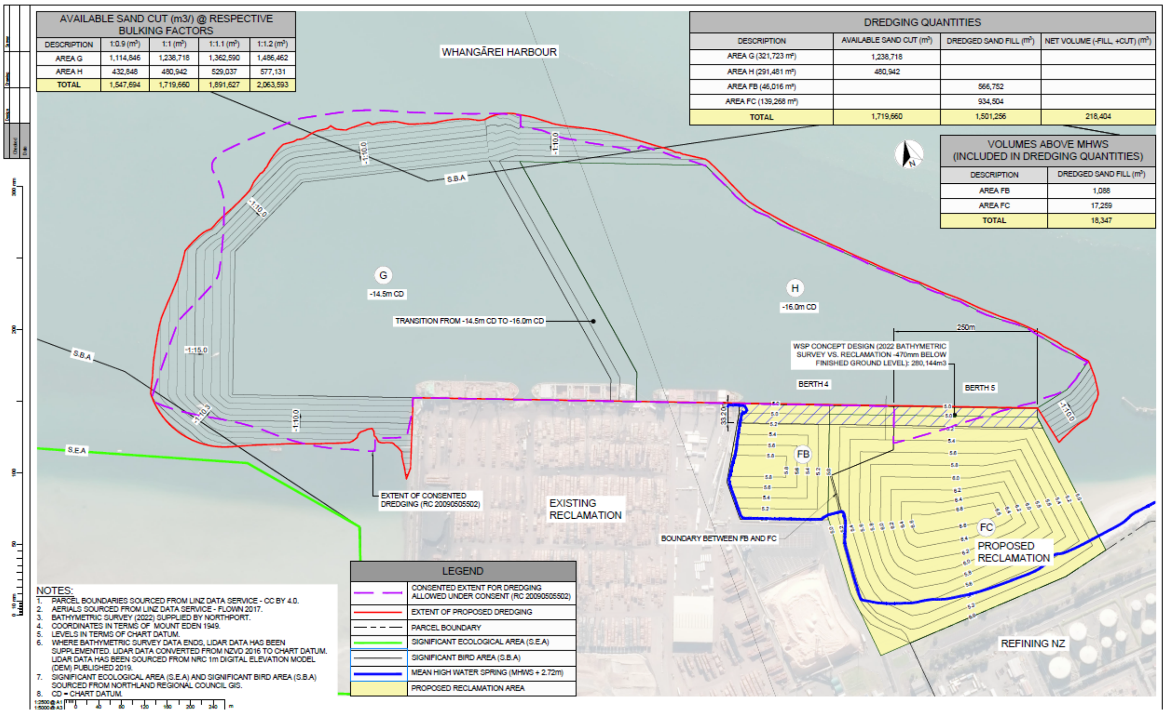



Figure 7. A schematic drawing of the extent and locations of consented dredging campaigns (purple hashed line) and the proposed dredging areas (outlined in red) for the proposed reclamation works.

Dredge-related sound levels will be dependent on the specific vessel(s) selected to undertake the proposed works, as well as the type of seabed materials to be broken and / or removed. International underwater noise reviews CEDA (2011) and WODA (2013) noted that CSD and TSHD generate most sound energy below 2.5 kHz and 500 Hz, respectively, with variable intensities of sound dependent on the hardness of materials removed (Figure 8). BHD produce mostly low frequency, omni-directional sounds with bandwidths that can fluctuate as low as 20 Hz and as high as 20 kHz, depending on the different operating stages (Figure 8; WODA (2013) and references therein).

Pine (2022) has estimated that underwater sound levels generated from the proposed reclamation dredging work could range between 164 and 179 dB *re* 1 µPa @ 1 m[16], based on actual noise measurements for similar dredge platforms in the published literature (see Pine 2022 – appendix D). These source levels are lower than those from a large moving ship, which can be between 180–190 dB *re* 1 µPa rms @ 1 m (i.e. OSPAR 2009; Todd et al. 2015) and are expected to represent the 'worst-case' scenario for dredging noise.

Pine (2022) used these estimated source levels to spatially model the propagation of dredge-generated noise and predict the potential extent of any potential hearing threshold shifts, behavioural responses, and auditory masking ranges for local marine mammals. Similar to pile driving, the hearing thresholds are based on NOAA's (2018) recommended levels for non-impulsive sounds (Table 3). Behavioural response and auditory masking ranges are based on a continuous noise approach known as dose-response curves (Joy et al. 2019). This approach estimates the probability of a response occurring at different noise levels (i.e. distances from the source) and can be species-specific where data are available. Further details about this approach can be found in Pine (2022).

No permanent hearing impairments (PTS) are predicted for any marine mammals and the onset of any hearing injuries, or TTS, is estimated to occur only if an animal is within one metre or less of the operating dredge, regardless of dredge type or location (Table 6; Pine 2022). Underwater noises generated from the disposal of dredged material within the reclamation areas will be significantly lower than dredge noise, and further dampened by any temporary and permanent seawall structures.

As Table 6 and Table 7 demonstrate, the probability of a behavioural response (either low or moderate) or acoustic masking occurring will increase as an individual animal gets closer to the dredge vessel. Pine (2022) has estimated that the initial onset distance for any low level behavioural responses to dredging noise will only occur when animals are within 1.6 km or less of the dredging location, regardless of method

[16] The term 'dB *re* 1 µPa @ 1 m' represents the sound pressure level that has been back calculated to a standardised distance of one metre distance from the source and is often known as source level.

(Table 6, Figure 9). These predicted distance ranges decrease for any potentially moderate level behavioural responses to within 600 m or less from the dredger. Any short-term auditory masking effects (also termed a reduction in an animal's listening space) between two individuals of the same species are predicted to occur within distances similar or less to behavioural responses (Table 7, Figure 10).

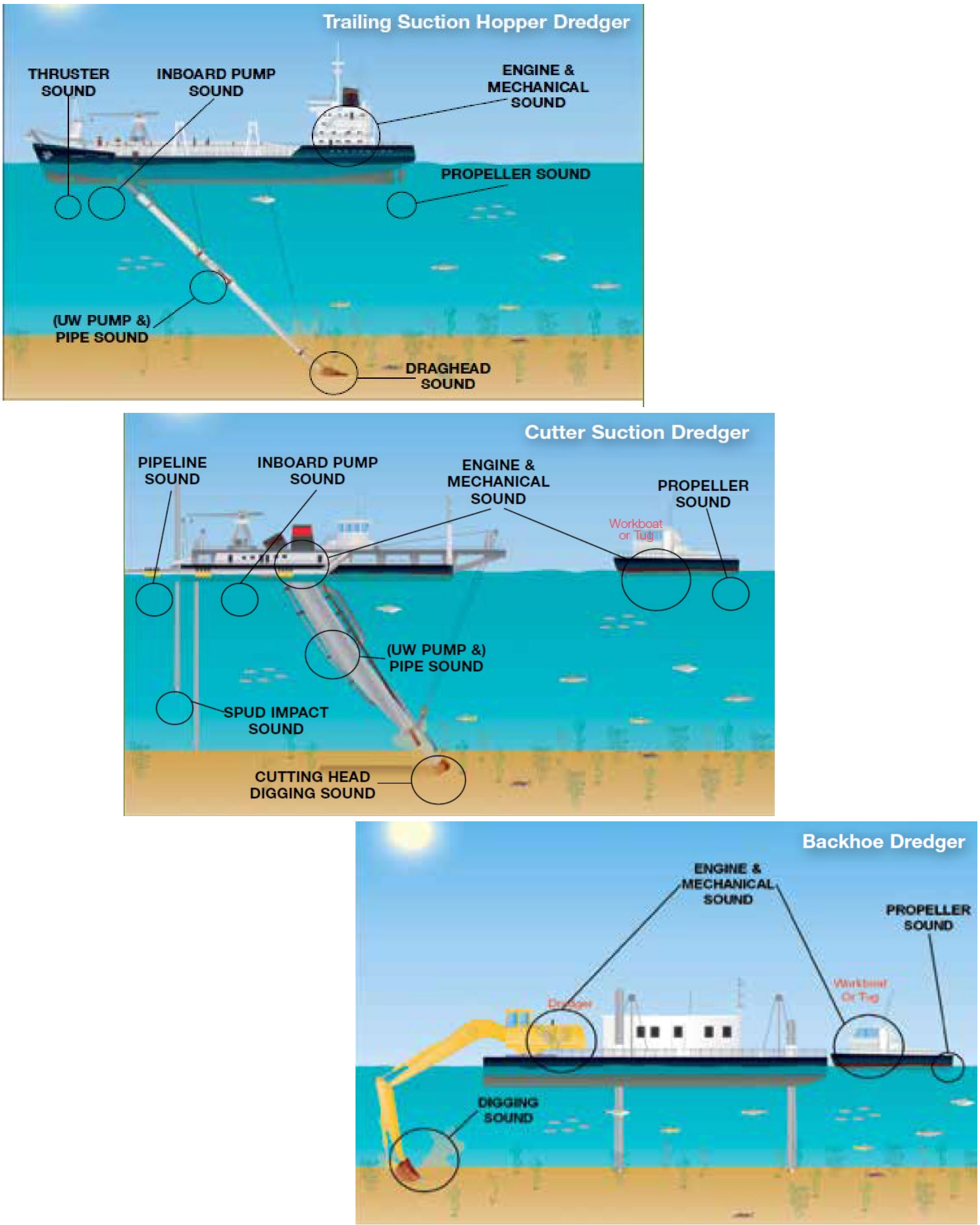



Figure 8. Schematic drawings indicating the main sound generating sources for the proposed dredging methods: trailer-suction hopper dredger (top), cutter suction dredger (middle) and backhoe dredger (bottom). Modified from CEDA (2011).

Table 6. Summary of the estimated cumulative PTS, TTS and behavioural zones for the different marine mammal hearing group categories for dredging methods from Pine (2022). LF = Low Frequency group, MF = Mid-Frequency group, OW = Otariid Pinniped group, and PW = Phocid Pinniped group. NA = species data not available to calculate.

| | | **Cutter-Suction Dredge** | | | | **Trailer-Suction Hopper Dredge** | | | | **Backhoe Dredge** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **LF** (baleen whale) | **MF** (orca, other delphinid) | **PW** (leopard seal) | **OW** (fur seal) | **LF** (baleen whale) | **MF** (orca, other delphinid) | **PW** (leopard seal) | **OW** (fur seal) | **LF** (baleen whale) | **MF** (orca, other delphinid) | **PW** (leopard seal) | **OW** (fur seal) |
| | **Chance of impact occurrence*** | Max Distance (m) | Max Distance (m) | Max Distance (m) | Max Distance (m) | Max Distance (m) | Max Distance (m) | Max Distance (m) | Max Distance (m) | Max Distance (m) | Max Distance (m) | Max Distance (m) | Max Distance (m) |
| **PTS** (permanent threshold shift) | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **TTS** (temporary threshold shift) | | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| **Low Behavioural Response #** | **0%** | 621 | 422 | | | 1635 | 935 | | | 608 | 368 | | |
| | **25%** | 577 | 290 | 505 | 505 | 1202 | 544 | 1033 | 1033 | 514 | 263 | 377 | 377 |
| | **50%** | 503 | 202 | | | 1055 | 451 | | | 468 | 185 | | |
| | **75%** | 425 | 168 | | | 884 | 327 | | | 398 | 178 | | |
| **Moderate Behavioural Response ^** | **0%** | NA | 293 | | | NA | 585 | | | NA | 259 | | |
| | **25%** | NA | 138 | 197 | 197 | NA | 324 | 461 | 461 | NA | 135 | 202 | 202 |
| | **50%** | NA | 90 | | | NA | 245 | | | NA | 93 | | |
| | **75%** | NA | 58 | | | NA | 171 | | | NA | 57 | | |

* Where available, these were based on the relevant species audiogram data (Pine 2022).

\# For whales, the received level at which there was 50% risk of a low behavioural response occurring was set at 120 dB re 1 μPa (based on bowhead whale behavioural responses to continuous noise – Southall et al. 2007) and for MF species, 129.5 dB re 1 μPa was used (based on orca behavioural data – Joy et al. 2019).

^ There are no data available to inform received level for moderate behavioural effects for whales. MF species were based on killer whale data (Joy et al. 2019) with a 50% risk of a moderate behavioural response occurring at 137.2 dB re 1 μPa.

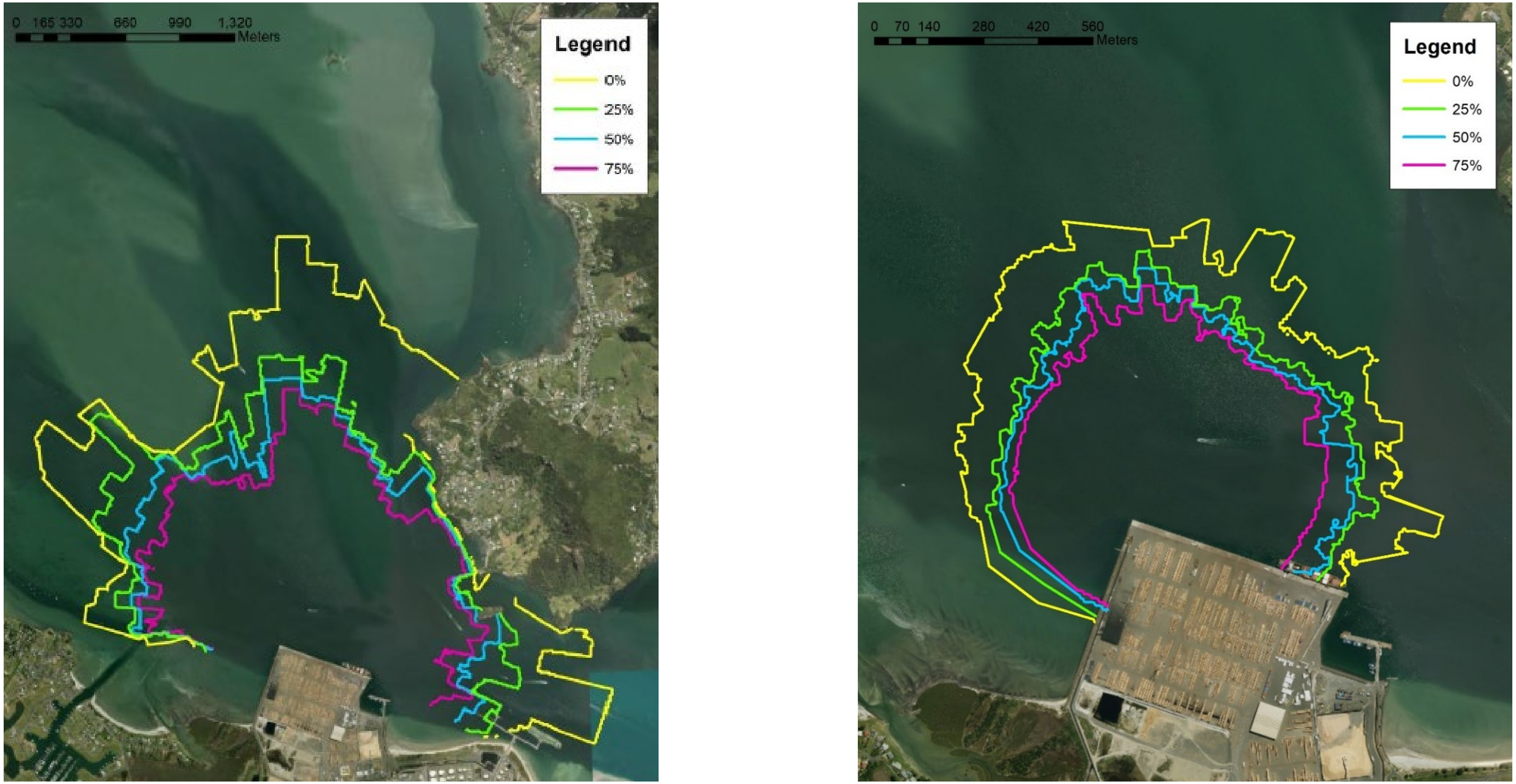


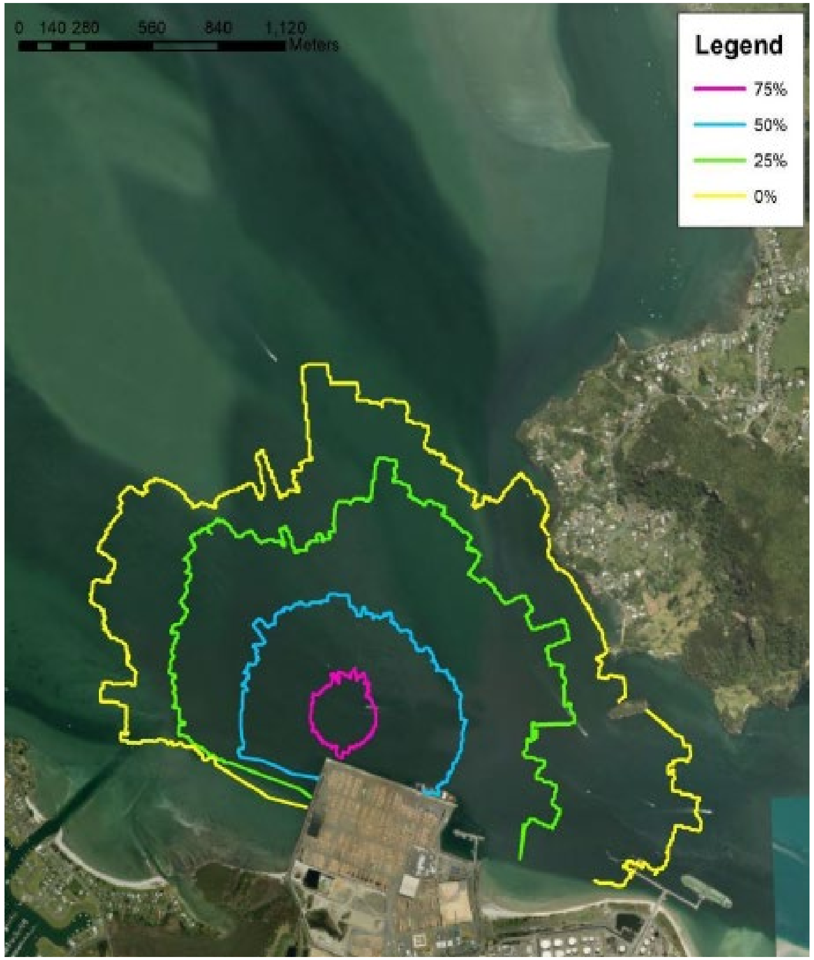

Figure 9. Examples of the likelihood of dredging noise from a trailer-suction hopper dredger (left) and a cutter-suction dredger (right) eliciting low **behavioural responses from baleen whales** during dredging within the proposed dredge area. The pink contour represents the distance in which there is a 75% chance of a visiting whale exhibiting low behavioural responses to dredge noise while the yellow contour is the distance in which no low behavioural effects are expected to occur beyond. See Table 6 for actual distances.

Table 7. Summary of the estimated distances at which the percentage of an animal's listening space may be reduced (also known as acoustic masking) in the different marine mammal hearing group categories for all dredging methods from Pine (2022). LF = Low Frequency group, MF = Mid-Frequency group, OW = Otariid Pinniped group, and PW = Phocid Pinniped group. NC = source too low to calculate an effect.

| | | **Cutter-Suction Dredge** | | | | **Trailer Suction Hopper Dredge** | | | | **Backhoe Dredge** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **LF *** (baleen whales) | **MF** (orca, other delphinid) | **PW** (leopard seal) | **OW **** (fur seal) | **LF *** (baleen whales) | **MF** (orca, other delphinid) | **PW** (leopard seal) | **OW **** (fur seal) | **LF *** (baleen whales) | **MF** (orca, other delphinid) | **PW** (leopard seal) | **OW **** (fur seal) |
| | **Percent Reduction** | Max Distance (m) | Max Distance (m) | Max Distance (m) | Max Distance (m) | Max Distance (m) | Max Distance (m) | Max Distance (m) | Max Distance (m) | Max Distance (m) | Max Distance (m) | Max Distance (m) | Max Distance (m) |
| **Listening Space (Masking)** | **0%** | 415 | 398–403 | 578 | 434 | 1081 | 1027–1055 | 1190 | 1102 | 334 | 304–308 | 591 | 343 |
| | **25%** | 260 | 236–251 | 327 | 263 | 537 | 650–657 | 828 | 758 | 161 | 146–148 | 236 | 172 |
| | **50%** | 24 | 34–41 | 191 | 70 | 259 | 308–333 | 420 | 395 | NC | NC | NC | NC |
| | **75%** | NC | NC | NC | NC | 31 | 34–36 | 134 | 78 | NC | NC | NC | NC |

* Masking result for whales were calculated based on fin whale audiograms.

** Masking range based on northern fur seal audiogram data in the absence of NZ fur seal audiogram.



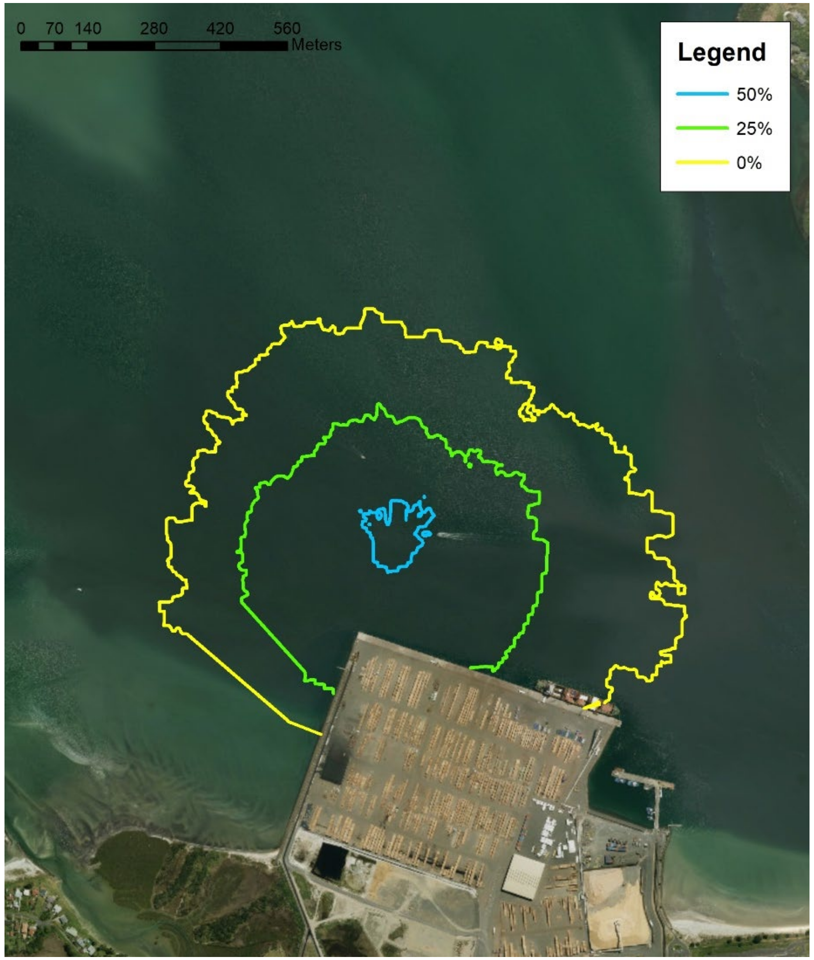




Figure 10. Examples of the likelihood of dredging noise from a trailer-suction hopper dredger (TSHD) (left) and a cutter-suction dredger (CSD) (right) **reducing the listening space** (LSR) or causing acoustic masking in a **leopard seal** during dredging within the dredge area. NOTE – models suggest that this species' listening space will not be reduced (e.g. acoustical masked) by more than 50% with a CSD. See Table 7 for actual distances.

Based on the modelled results by Pine (2022), any effects from dredging-generated underwater noises will likely be transitory and non-injurious. Effects will be predominantly limited to the momentary masking of some noise signals and a range of potential behavioural responses to within a kilometre or less of the dredging location, depending on the species. The likelihood of any hearing injury effects (TTS or PTS) occurring is considered *not applicable* (Table 5). The most relevant factors contributing to this assessment are summarised below:

*Spatial and temporal factors*

- Relatively intermittent and limited duration increases in underwater noise from dredging activities over the 9 months of dredging across the duration of the proposed reclamation project.
- Most whale, dolphin and pinniped species known to frequent Whangārei and wider Bream Bay waters are currently exposed to similar types and levels of underwater noise from commercial and recreational vessels transiting along the North Island's eastern coastline.
- Only a few migrating whales are sighted within the wider Bream Bay area for a limited period each year with most restricted mainly to winter months and some spring months and generally in deeper, more offshore waters (e.g. further than 5 to 10 nm).
- The proposed reclamation area is not considered unique or particularly important feeding, resting or nursery habitats for any residential or visiting species based on current knowledge.
- It is important to note that as dredged material will be used for reclamation (and will not be required to be barged for disposal elsewhere), the potential for any boat strike of local marine mammals from the proposed dredge platforms is *nil to negligible*.

*Known acoustic factors*

- Mainly lower-frequency, continuous noise generated by proposed dredge vessels and activities. Dredge sound levels are not expected to exceed PTS at all or TTS criteria at greater than one metre from dredge.
- Dredge sound levels are expected to be quieter than most large commercial vessels. Similar to other vessels, a range of potential behavioural and masking responses are possible, but the risk for most species is greatest (> 75%) only if an animal remains in close proximity to the dredge for an extended period.
- Underwater noise levels are not necessarily additive or cumulative. The 'loudest' noise (e.g. commercial vessels) can often cover up other noises generated nearby.

## 4.4. Vessel strike

As noted in the previous section, the potential for any boat strike of local marine mammals from the proposed dredge platforms is *nil* to *negligible*. Yet, increasing NPL's capabilities and / or capacity means that more large commercial ships will be expected to visit the port, Whangārei Harbour and the wider area each year. While the transiting of commercial ships to and from NPL does not require resource consent, this section addresses the potential concerns of tangata whenua and the public in regard to possible collision risks with local marine mammals.

In New Zealand waters, vessel strikes are often associated with large fast vessels, such as container or carrier ships, and baleen whales. Between 1996 and 2014, 17 Bryde's whale deaths within the Hauraki Gulf have been attributed to vessel strike and the speeds at which commercial ships pass through the area (Constantine et al. 2015). Numerous reviews have found that the likelihood of vessel strike also depends on operational factors including vessel type, speed, and location (Van Waerebeek et al. 2007). Although all types and sizes of vessels have hit whales, the most severe collisions (e.g. fatal injury or mortality) occurred with large (> 80 m) ships, and yet, the size of the vessel appears to be less significant than its speed (Laist et al. 2001; Jensen & Silber 2004). The greatest increase in both the risk of a collision and the likelihood that it will result in severe injury or death occurs at speeds over 11 knots (Vanderlaan & Taggart 2007; Gende et al. 2011).

In regard to potential increases in shipping, NPL is expecting that additional commercial ship traffic will be from other New Zealand destinations (i.e. Ports of Auckland) rather than any new or additional container ships coming from overseas. At the moment, most south-bound container ships pass around the Hen and Chicken Islands and travel towards the Ports of Auckland via the Jellicoe Channel. Little would change in terms of shipping volumes in this scenario other than a proportion would turn and enter Whangārei Harbour rather than continuing south.

Alternatively, north-bound ships would likely either transit through the Hauraki Gulf or around Great Barrier Island before heading towards Whangārei Heads. These ships will constitute an increase in the shipping traffic moving through Bream Bay waters than has occurred to date. It is important to note that NPL is currently supporting an initiative to extend the Hauraki Gulf Transit Protocol for Commercial Shipping up to the Poor Knights (Sea Change – The Hauraki Gulf Marine Spatial Plan). This protocol was instigated in 2013 to protect the endangered Bryde's whales by voluntarily limiting speed for all commercial ships travelling within the Gulf to 10 knots and designating a crew member to watch for any signs of whales during daylight hours.[17]

[17] https://www.poal.co.nz/ops-information/Documents/POAL_Whale_2014.pdf.

In this case, the species considered most vulnerable to any potential vessel collisions include Bryde's, humpback and southern right whales and to a lesser extent, bottlenose dolphins and orca given their current endangered species status rather than proneness for vessel strike. Despite this potential increase in north-bound vessel traffic due to the proposed port projects, the likelihood of a vessel strike (injury or mortality) associated with the port's extension proposals is assessed as *low* for migrating baleen whales, odontocete and pinniped species (Table 5). This conclusion is based on the relevant factors as summarised below:

*Spatial and temporal factors*

- Low probability of port-related commercial ships encountering a migrating whale within Whangārei Harbour and the wider Bream Bay region as currently only 1–3 individual whales are sighted within these waters each year.
- The majority of migrating whales currently pass by Hen (Taranga) and Chicken Islands in deeper, more offshore waters (e.g. further than 5 to 10 nm) where they are likely encountering the same south-bound ships currently travelling to Ports of Auckland and that may be diverted into NPL in the future.
- Most whales occur in the area for a limited period each year; mainly in the winter months and some spring months, and most only remain for a day up to a week.
- Most odontocete and pinniped species known to frequent Whangārei waters are in regular contact with all types and speeds of commercial and recreational vessels throughout their entire distributional range with few to no reported ship strikes.

*Known collision factors*

- Vessel traffic is expected to increase mainly from the south as more commercial ships may be diverted further north and likely travelling through Mangawhai / Bream Bay coastal waters.
- Any expansion of the Hauraki Gulf Transit Protocol into and behind Whangārei waters provides the best chance of significantly reducing fatal injuries and mortalities of baleen whales due to vessel collisions in this region. Implementation of the protocol (i.e. reducing average speed to 10 knots) has been estimated to reduce the probability of a lethal ship strike from 51% to 16% (Riekkola 2013) in the Hauraki Gulf.
- Most dolphin species have a general attraction to boats and safely approach and / or bowride with numerous vessels. Fur seals often respond neutrally to boats when in the water (although they may bowride occasionally).
- With the exception of Bryde's whales, whale species do not normally feed while migrating past New Zealand's north-eastern coastline to and from their northern tropical breeding and southern sub-Antarctic / Antarctic feeding sites.
- Whangārei Harbour and Bream Bay are not considered unique or important feeding, resting or nursery habitats for any visiting species, hence individuals are less likely to be 'distracted' by such activities, and are thus less vulnerable to collision risk.

## 4.5. Operational loss and possible entanglements

Potentially harmful operational by-products from coastal development activities can include such items as lost ropes, support buoys, nets, bags and plastics (e.g. Weeber & Gibbs 1998). These items are often collectively known as marine debris (Laist et al. 1999). As most marine materials are now manufactured from a range of plastics, they often tend to float and persist rather than degrading quickly as is generally the case with materials made from natural fibre (Laist et al. 1999).

An additional hazard associated with marine debris and construction activities for marine mammals is the possibility of entanglement (Laist et al. 1999). Whales, dolphins and pinnipeds are often attracted to floating debris with a potential risk of becoming entangled in floating lines and netting (e.g. Suisted & Neale 2004; Groom & Coughran 2012). Loose, thin lines (e.g. lines used to tie up boats, floats and other equipment) and nets (such as silt curtains) can pose an entanglement risk, especially when nets, ropes and lines are lost or discarded.

Construction associated debris generation can generally be prevented in well-maintained coastal projects with proper waste management programmes in place (e.g. secure onboard storage of lines, nets, and waste) in order to comply with the NZ Maritime Rules Part 180. There has been no known entanglement of a marine mammal in silt curtains within New Zealand or overseas. Curtains are often solid material or fabric that produce a noticeable acoustic footprint. Properly tensioned and maintained hanging silt curtains generally have plenty of spaces between the seabed and material for animals to manoeuvre under and around with few opportunities for entanglement. Fully enclosed standing silt curtains, when regularly inspected, provide no openings in which marine mammals might enter the contained area. In such cases, any subsequent effects to marine mammals are expected to be *nil to negligible* (Table 5).

## 4.6. Ecological effects of habitat and prey species

The potential ecological effects from any loss of existing intertidal, subtidal, and benthic biota and loss or alteration of the habitats within the immediate region of the proposed activities are discussed in detail in the ecological assessment (Kelly 2021). While the report acknowledges that ecological effects associated with the permanent loss of approximately 6.2 ha of intertidal and 5.5 ha of subtidal habitats to reclamation is significant at the project footprint scale, it also notes that extensive habitats of similar biotic composition are found nearby and throughout the lower harbour. Similarly, the effects of dredging are expected to be temporary and potentially reversible given the types of exposed seabed and depending on the need for future maintenance dredging (MetOcean 2022).

The limited effect (both spatially and temporally) that the proposed construction activities are expected to have on local habitats and associated prey resources means that there is unlikely to be any long-term flow-on effects to local marine mammals (see Table 5). This conclusion is based on the following factors:

- A relatively small percentage habitat loss to reclamation within the port area relative to similar intertidal and subtidal habitats found in the wider lower harbour.
- Dredged habitat is expected to recover or new habitat colonised relatively rapidly after construction is complete.
- Dredged sediments are expected to be relatively clean and uncontaminated while any turbidity effects from dredging are predicted to be confined to a limited region around construction sites (MetOcean 2022). Any affected fauna are expected to fully recover as demonstrated by the results of previous dredge monitoring.
- A large proportion of subtidal areas within the proposed construction area is already modified environment due to previous dredging campaign.
- Short-term displacement of prey resources as a result of the small spatial scale of disturbance with no effect on species recruitment.
- Home ranges of local marine mammal species are large and overlap with similar types of habitats in other parts of the harbour and along most other coastal bay regions.

## 4.7. Cumulative impacts

It is important to note that those marine mammals passing through Whangārei and the wider Bream Bay region are exposed to a variety of other anthropogenic activities that generate underwater noise including large-scale commercial shipping and recreational boating as well as commercial fishing vessels (e.g. fishing dredges and trawls). The underwater noise model (Pine 2022) is based on actual measurements of the current ambient (i.e. background) noise that incorporates these additional aspects of the existing harbour environment. As discussed throughout this report, underwater noise generated by different activities within proximity of each other and the wider harbour are not usually additive. This means that the louder source merely covers up the other sources rather than all sources adding together to make the environment twice as noisy. This effect is particularly true for activities that make different types of noise (i.e. pulses vs continuous) or generate noise in different frequencies ranges.

In the case of this proposal, if pile driving and dredging (or similar underwater noise generating activity) are taking place in the vicinity of the proposal site at the same time, the louder pulses of piling will be heard over the top of the more constant low frequency noise of the dredger each time the hammer falls. However, as specifically modelled (Pine 2022), there is no additive effects in noise from the two noise sources, and therefore cumulative noise effects are not expected.

Other consented, but unimplemented, marine development projects within the lower harbour region include the Channel Infrastructure Channel Deepening Project and the construction of NPL’s Berth 4. With respect to these we note:

- In the unlikely case of the Channel Infrastructure consents being implemented, I understand that NPL is to commit to ceasing (or not commencing) the dredging component of this application to avoid concurrent dredging operations.
- Given the proposed staged approach to construction of NPL's Berth 4 and Berth 5, it is more likely that any increases in underwater noise levels will be variable and intermittent (e.g. undertaken in blocks of time over weeks or months) rather than consecutive. For instance, reclaimed land will need to settle and compact for a period of time before seawalls or wharves can be built.

# 5. EFFECTS MANAGEMENT

Overall, the residual effect of any impacts from the proposal on local and visiting marine mammals is considered to be *less than minor* to *nil* (Table 5). This assessment is based on the consideration of the types of effects, their spatial scales and durations, and relevant species' information. It also takes into consideration existing operational aspects, as well as natural avoidance factors, that currently help mitigate adverse effects on marine mammals. Yet the scale of the construction activities, expected noise levels, and extended timeline (more than 2.5 years) of the proposal necessitate implementing appropriate management measures in relation to marine mammals (see Table 8). These measures will avoid adverse effects on threatened or at-risk taxa, and avoid, remedy or mitigate any other adverse effects. A more detailed discussion of the management measures, and how they will operate, is contained in the section below.

To ensure that the most appropriate measures are in place, a draft marine mammal management plan (MMMP) was developed by the Port in consultation with marine mammal and underwater acoustic experts. This draft plan outlines in detail the procedures necessary to reduce or manage the effects of underwater noise, as well as other effects referred to in Table 8, while giving effect to any consent conditions to ensure the intended performance standards are being met by the MMMP's methods and procedures. Importantly, the MMMP establishes appropriate reviewing and reporting timelines for management actions and any implemented mitigation procedures to ensure their effectiveness during operations. The final MMMP should be reviewed and consulted on with DOC before commencing operations.

## 5.1. Management measures

The draft MMMP requires the consent holder to identify and adopt accepted best practices to minimise the adverse effects on the environment of underwater noise emissions. Consistent with the draft MMMP, the key recommended management measures and actions are as follows:

- Verification of the *in situ* noise levels produced from pile-driving activities by measuring the associated underwater noises of these activities as soon as practicable once the project has begun. Results will be reviewed against the same parameters used for acoustic modelling by Pine (2022) and any necessary adjustments made to mitigation actions (e.g. revised marine mammal observation zones).
- Reduction of noise levels at the source – several operational considerations may help reduce the source level of underwater noise produced by piling driving activities:

- The preferred method for minimising underwater noise in the first instance would be the use of vibro driving whenever possible, due to a continuous and generally lower level of sound generated using this technique compared to intense, discrete pulses of impact driving. However, full consideration must be given to other environmental factors such as substrate type and duration implications (i.e. BPO).
- Consider any recent developments in reducing noise at the source including but not limited to bottom-driven piles, air balloons inflated within open piles to reduce ringing and / or bubble curtain technology.
- The smallest possible pile size should be used that meets the specific operational need as the smaller the pile, generally the lower the noise level, subject to different piling methodologies.
- The use of a 'soft start' or 'ramping up' procedures, in which pile-driving energy is gradually increased to normal operating levels, is recommended as it gives nearby animals (i.e. close to or just outside the marine mammal observation zone or MMOZ) an opportunity to move away from the area before sound levels increase to an extent that may cause discomfort or injury (i.e. TTS). This process is also expected to help mediate more moderate and some low behavioural responses from nearby animals, giving them a chance to habituate to the pulses of sound over time before increasing the noise level.
- A sacrificial, non-metallic hammer cushion cap (or dolly) is often used with impact piling work in New Zealand (see Appendix 6). This cushion is made of wood (preferred), nylon or polymer plastic and sits between the hammer and the top of the pile where it is used to reduce wear. MDA (2020) have recorded appreciable reductions in both underwater noise and airborne noise levels by dampening the impact of the hammer with this method.
- Modifying the pile strike by changing the contact time of the hammer should theoretically reduce the noise generated by the impact through a reduction in the amplitude of the pile vibration. Saleem (2011) considers this the best short-term option for effective sound mitigation as a slight modification in hammer settings. However, this modification needs to be tested in the context of this proposal and will likely need to be used in combination with other proposed actions to result in any significant reduction.

- Establishment of shut down zones around the construction area to minimise any risk of hearing impairment (i.e. TTS) to marine mammals from pile-driving activities only[18]. The presence of any marine mammals within these zones would require the cessation of pile driving, with recommencement or continuation not to occur until the animal leaves the pre-determined zone. The final size of these

[18] Shut down zones for dredging activities are not considered necessary based on predicted noise levels and relative to other similar and relevant dredging consents, i.e. Refining New Zealand's deepening and realignment of Whangārei Harbour channel entrance. Any significant differences in actual dredging noise levels may necessitate reconsideration of a shut down zone option.

zone(s) will be confirmed once construction methodologies are confirmed and *in situ* sound levels are verified.

- Based on the worst-case modelling scenarios for 914-mm piles, it is recommended that two zones be established: 1) a main marine mammal observation zone (MMOZ) that goes out to 200 m from the source and that will protect bottlenose and common dolphins, orca and fur seals (species that visit harbour waters throughout the year), and 2) an extended zone (EMMOZ) of approximately 800 m[19] for baleen whales and leopard seals.
- MMOZ – Monitoring of the MMOZ will involve at least one dedicated, experienced marine mammal observer (MMO) maintaining an effective lookout station at an elevated, fixed platform near the piling site. The MMO will be continuously scanning for the presence of marine mammals prior to, during and following any pile-driving activities (which will take place during daylight hours only):
    - To minimise the risk to any species already present in the harbour (i.e. swimming into Harbour regions overnight prior to piling starting in the morning), a pre-start scan should be undertaken by at least two MMOs first thing in the morning (and after any extended breaks in piling greater than one hour) for at least 30 minutes prior to piling commencing. If any animal(s) are present in or near to the MMOZ prior to pile driving commencing, operations will be suspended until the animal(s) has relocated out of the MMOZ.
    - All efforts should be made by MMOs to regularly scan areas further out from the designated MMOZ for any unexpected sighting of baleen whales or a leopard seal. If any sightings of these species are observed outside the MMOZ, piling should be halted as animals are likely to be within the zone for TTS, and the EMMOZ implemented instead. If more than two unexpected sightings of these species are made by the MMO outside the MMOZ, this situation will trigger a review of the MMMP and the MMOZ criteria with consideration given to potentially using the larger EMMOZ as the main shut down zone.
- EMMOZ – It is anticipated that this zone will be only used between July and September when baleen whales are in the region or when a leopard seal has been sighted near Whangārei (e.g. over the winter months and autumn months, respectively).
    - Based on communication with DOC and social media (see next point), the larger EMMOZ will be temporarily enacted after the first sighting of a whale or leopard seal in the wider Whangārei region (i.e. Bream Bay to Tutukaka). The EMMOZ will continue to be monitored for at least 48 hrs or

[19] The EMMOZ in this case is a compromise between the potential extent of any TTS effects for visiting baleen whales and a leopard seal and the spatial extent at which MMOs can reliably detect and identify these species.

until further sightings have been confirmed. After 48 hrs, with no further confirmed whale or leopard seal sightings, the MMOZ shutdown zone will be reinstated.

- Monitoring the larger EMMOZ will require at least two dedicated MMOs (one near the piling source and another at the 800 m boundary and / or near the harbour entrance). The Port will need to consider and assess whether more remote technologies (e.g. drones, real-time hydrophones, camera systems) may offer better or more comprehensive monitoring over part(s) of the EMMOZ, in combination with the dedicated MMO(s).
- The recommended monitoring method for the EMMOZ would involve at least one MMO stationed from an elevated viewpoint over the entrance channel (approximately 800 m across) watching for any marine mammals entering or leaving the harbour. Piling work would cease when an animal approached and / or passed through the entrance[20], depending on species. Activity would recommence once animals had moved out of the designated EMMOZ.
- It is assumed that MMOs will be able to adequately distinguish baleen whale and leopard seals from the other species while monitoring the EMMOZ and activate the different shutdown zones accordingly. If this is not possible, the EMMOZ will serve as the shutdown distance for all species until the whale or leopard seal has not been sighted in the Whangārei area for at least 48 hrs.

- A central contact point should be established with DOC to obtain up-to-date regional sighting information for the duration of the project, particularly in regard to nearby visiting baleen whales or leopard seal sighting. With this information, the MMO can anticipate and verify the potential presence or absence of these, and any other species sighted in or near the project area. The MMO should also monitor news and social media for any information about marine mammals reported in the wider AOI regions. Any reports of baleen whales or a leopard seal being present could potentially lead to additional MMO resources moving onto standby for deployment for the larger EMMOZ.
- A similar contact should be established with Marsden Cove marina staff, Westhaven Marina (in Auckland) and other nearby marinas (e.g. Tutukaka Marina) as well as LeopardSeals.org in order to receive sightings updates of the leopard seal, *Owha*, in the marina throughout the duration of the project. Due to leopard seals' aggressive natures, several precautions need to be considered if contractors have any staff working in or near the water when this animal may be present. In addition, the marine mammal observer can better anticipate the seal's possible movements near and through the project area and MMOZ / EMMOZ.

[20] The best location would be an elevated tower or crane on Refining New Zealand's property near their jetty. MMOs are expected to continuously scan with the naked eye, binoculars or spotting scope for any signs (e.g. dorsal fin, footprint watermarks, splashes, blows) of marine mammal presence.

- Ideally, and if practical, the various piling stages of the project should be timed so that most of the piling work does not occur over successive seasons, e.g. back-to-back winters. As noted in Section 3.2.1, the use of the AOI is seasonal for some marine mammal species (e.g. baleen whales) and successive interactions of this type may affect an animal's decision to return to these waters in the near future.

## 5.2. Monitoring recommendations

The continued presence (or absence) of the relevant marine mammal species within the harbour and / or near the construction site by MMOs can be used to confirm the effectiveness of management actions. In addition, it is recommended that underwater acoustic monitoring continues at the established baseline stations (see Pine 2022) across Whangārei Harbour while pile-driving and dredging activities are underway. This informative monitoring can help assist in both verifying actual sound levels while determining the potential presence of any behavioural effect(s) and at what sound level(s) they may be occurring. These results can then help determine the efficacy of implemented management actions for further monitoring throughout the reclamation project.

Table 8. Proposed management goals and practices to reduce or avoid the risk of any adverse effects of construction activities on marine mammals in Whangārei Harbour. DOC = Department of Conservation, NRC = Northland Regional Council. BPO = best practical option.

| Potential effects | Management goal | Best Management Practice | Reporting / monitoring |
|---|---|---|---|
| Physical and / or behavioural responses to underwater sound from construction activities | 1. Avoid acoustic injury and minimise disturbance to marine mammals | 1a. Use BPO to minimise underwater noise effects.<br>1b. Establish a marine mammal management plan (MMMP) for:<br>Dredging activities<br>1c. Regular maintenance, proper up-keep of all dredging equipment and vessels (e.g. lubrication and repair of winches, generators).<br>Pile-driving activities<br>1d. Adopt soft-start / ramping up procedures and choose plant / techniques on the basis of BPO.<br>1e. Designated shut down zones with dedicated, experienced marine mammal observer(s) to maintain a watch before, during and after any pile-driving activities (during daylight hours only).<br>1f. Minimise the spreading of piling stages over successive seasons. | • Measure actual underwater noise levels from pile driving, dredging and other construction activities and adjust / implement any mitigation actions based on these data, if necessary.<br>• Record and report the type and frequency of any marine mammal sightings (i.e. visual and acoustic) and interactions before, during and after pile-driving activities (including absences and effort), in a standardised format. Annual records provided to DOC and NRC and made publicly available (e.g. web). Include behavioural data if possible.<br>• Any project sightings should be reported to DOC for input to their national database. |
| Marine mammal / vessel strike due to increased vessel activity | 2. Minimise the risk of vessel collisions with any marine mammal and aim for zero injury / mortality | 2a. Encourage port-related ships to adopt best boating guidelines for marine mammals (see Appendix 7).<br>2b. Formally support and establish a similar protocol to the Hauraki Gulf Transit Protocol for Commercial Shipping that includes speed limits, crew watches and reporting of sightings to reduce any chances of mortality from vessel strikes. | • Consistent with the Hauraki Gulf's voluntary shipping protocol, NPL will maintain records of all reported vessel strike incidents or near incidents regardless of outcome.<br>• In case of a fatal marine mammal incident, carcass(es) recovered (if possible) and given to DOC, and further steps taken in consultation with DOC to reduce the risk of future incidences. Tangata Whenua notified. |
| Marine mammal entanglement in operational gear and / or debris | 3. Minimise entanglement and aim for zero mortality | 3a. Avoid loose rope and / or nets (i.e. keep all ropes and nets taut). All deck lines should be tied up when not in use or under some degree of tension.<br>3b. Regular maintenance / inspection of properly tensioned silt curtains or other sediment containment gear.<br>3c. Ensure that all support vessels and other project activities have waste management plans in place.<br>3d. Record all entanglement incidents or near incidents regardless of outcome (e.g. injury or mortality). | • Nothing required, self-checking with up-to-date records available.<br>• In case of a fatal marine mammal incident, carcass(es) recovered and given to DOC, and further steps taken in consultation with DOC to reduce the risk of future incidences. Tangata Whenua notified. |

# 6. SUMMARY

The purpose of this report is to describe the existing environment in terms of the local and visiting marine mammals that utilise Whangārei Harbour and the wider Bream Bay area and assess the potential effects of the proposed NPL dredging and reclamation activities. The species of marine mammals identified as being potentially affected by the project include bottlenose dolphins, common dolphins, and orca, and occasional visitors such as NZ fur seals, leopard seals and Bryde's, southern right and humpback whales.

Although all dredging and construction activities were considered, pile driving was identified as the main activity that could adversely affect marine mammals in the vicinity through high underwater noise levels. These conclusions are based in part on information from other consultant reports including the expected levels of underwater noise due to dredging and pile-driving activities (Pine 2022), concentrations of contaminants in dredging materials and expected effects on local benthos and prey communities (Kelly 2021), and modelled turbidity plume and hydrodynamics (MetOcean 2022).

Preliminary underwater acoustic modelling work undertaken within the proposed reclamation sites suggests pile-driving noise is expected to be detectable within the entrance and lower harbour waters, depending on the piling location. Given the potential for temporary hearing impairment near the piling source for endangered species, such as bottlenose dolphins and orca, and at further distances for visiting baleen whale species (e.g. Bryde's whale), actions are necessary to avoid these effects. With appropriate actions in place, piling and dredging activities are expected to only elicit short-term, non-injurious behavioural responses with the potential for momentary masking of some acoustic signals from visiting marine mammals while in close proximity to construction activities.

The further development of the draft marine mammal management plan by marine mammal and underwater acoustic experts in consultation with DOC is recommended to ensure that the most appropriate measures are in place to minimise any potential adverse effects prior to commencing operations. Informative monitoring is recommended and based around a combination of recording visual sightings of marine mammals (from dedicated marine mammal observers) with the continuation of simultaneous passive underwater acoustic monitoring.

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# 8. APPENDICES

Appendix 1. Sources of marine mammal data and information

Only broad-scale, regional information is available for most marine mammals using the general Whangārei Harbour / Bream Bay region. Multiple and finer-scale studies have been undertaken in both the Bay of Islands to the north and in the wider Hauraki Gulf region to the south. The studies and databases used to make summaries and assessments of the marine mammal species discussed in this report are listed below:

- DOC opportunistic database and stranding record database
- Marine mammal tourism data in the Bay of Islands and Hauraki Gulf region
- National Aquatic Biodiversity Information System (NABIS)
- Scientific research through University of Auckland:
    - R Constantine – various studies in Bay of Islands, Bryde's whales in the Hauraki Gulf, and humpback whales around New Zealand
    - G Tezanos-Pinto – research on bottlenose dolphins in Bay of Islands, and Bryde's whales in Hauraki Gulf
    - E Carroll – various studies on southern right whales
- Scientific research through Massey University at Albany:
    - K Stockin –various studies on common / bottlenose dolphins and Bryde's whales in the Hauraki Gulf
    - N Wiseman – studies on Bryde's whales in Hauraki Gulf
    - S Dwyer – various papers on cetaceans in the Hauraki Gulf and Great Barrier Island
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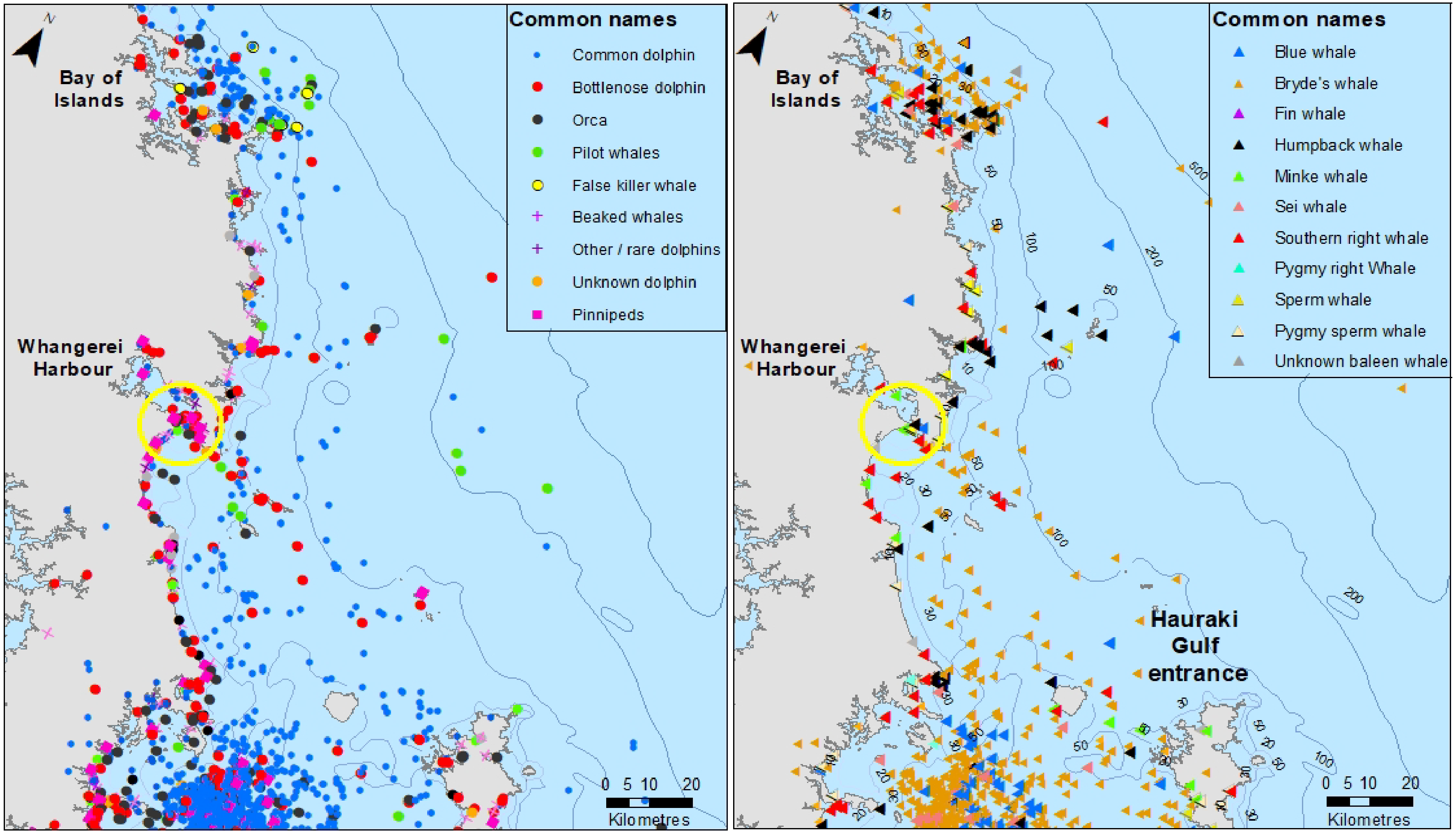


Figure A1.1 The distribution of Department of Conservation (DOC) reported sightings (1978–July 2020) and strandings (1869–2019) between Bay of Islands and the northern entrance of the Hauraki Gulf. Toothed whales and dolphins plus pinnipeds (seals) are shown in the left image and whale species in the right image. The yellow circles indicate Whangārei Harbour entrance and NPL's general location.

Appendix 2. Reported occurrences of marine mammals in the Whangārei coastal region and harbour collected by NPL staff since October 2019.

| Date: | Whales | Dolphins | Seals | Report | Comments |
|---|---|---|---|---|---|
| 16/10/2019 | | | I Fur seal | PSC | @1015 |
| 17/11/2019 | | Pod of six unknown | | Patu | |
| 20/12/2019 | Pilot Whales | | | Pilot | Pod of 4 x Pilot Whales Vicinity Buoy 11 |
| 11/01/2020 | | pod of 4 unknown | | PSC | |
| 25/05/2020 | | pod of 20 unknown species | | GB | |
| 26/05/2020 | | pod of 20 unknown species | | GB | |
| 27/05/2020 | | pod of 20 unknown species | | GB | |
| 29/05/2020 | Humpback whales | | | GB / IV | in harbour - confirmed by IV |
| 13/06/2020 | | pod unknown number | | GB | |
| 14/06/2020 | | pod unknown number | | GB | |
| 21/06/2020 | Orca | | | Pilot | Sighting Channel By No.11 |
| 21/06/2020 | Orca | | | GB | Ingrid to supply her tracking details; feeding in Marina Entrance (1500) |
| 21/06/2020 | Orca | | | PSC | |
| 26/06/2020 | | Pod of approx 20 | | GB | |
| 27/06/2020 | Humpback Whales | | | Public | off tutukaka headiug north; https://www.nzherald.co.nz/northern-advocate/news/article.cfm?c_id=1503450&objectid=12344669 |
| 28/06/2020 | Pilot Whales | | | Public | Passage Island |
| 24/08/2020 | | Small Pod 8-10 | | GB | Small pod including playful juveniles |
| 27/08/2020 | Orca | | | JS | sighted 0800 in Marine Reserve. 0830, seen heading west towards limestone island. Small pod (4) with two small juvinilles. Large male, possibly Funky Monkey |
| 21/09/2020 | Orca | | | GB | Reported at OTP by I Visser. Not varified by camera. Estimated small pod of 4. |
| 24/09/2020 | | Medium sized pod 10 - 15 | | GB | following Tug & Barge as it was transiting past the port heading for the entrance 1300hrs |
| 27/09/2020 | Orca | | | JS | Time1742. Images saved to X Drive; seen off berth 2 - possibly 2 animals. |
| 6/10/2020 | | bottlenose dolphins | | JS | 7 to 8 dolphins; at No. 14 heading out |
| 6/10/2020 | Orca | | | IV | Small Pod 5-6 heading into harbour |

| Date: | Whales | Dolphins | Seals | Report | Comments |
|---|---|---|---|---|---|
| 26/01/2021 | Gray's beaked whale | | | Public | 4 whales stranded on Ruakākā Beach; 3 returned and one died; https://www.nzherald.co.nz/northern-advocate/news/three-whales-swam-back-one-died-on-northland-beach/DAF7VIGD6PDGJZNLEJFOVQJM7M/ |
| 16/06/2021 | Humpback whales | | | GB | 2 to 3 whales reported to Port by Ingrid Visser; Commercial shipping were alerted by VHF, as well as direct contact with Northport's Pilots as shipping movements were underway at the time of the notification. transited from Passage Island west past the Port and towards Parua Bay, observered for over an hour |
| 27/08/2021 | | Pod of Dolphins | | JM - CEO | Looked to be a large pod, heading west past the port approx 3pm |
| 7/09/2021 | Orca | | | | Two Orca see heading east from tug jetty area to RNZ jetties 10:41am |
| 9/09/2021 | Humback whales | | | GB / KA | 2 x whales; seen between Passage Island and the port and refinery |
| 10/09/2021 | | Pod of Dolphins | | GB | Pod of approx 12 dolphins seen moving west, very close to berth edge, 1 ship in at B2 |
| 16/09/2021 | Orca | | | JM - CEO | 1815hrs - 2 x Orca in the Waikaraka channel |

Appendix 3. Marine Mammals and the Regional Plan for Northland.

Based on the available species data, I do not consider the coastal waters of Whangārei Harbour and Bream Bay to be ecologically significant habitat for any marine mammal species. Instead, this area represents only a small fraction of similar habitats available along the North Island's north-eastern coast that several species of marine mammal regularly utilise and migrate past on a regular basis.

I realise that this assessment of habitat is contrary to the "Significant Marine Mammals and Seabird Area" maps realised as part of the Regional Plan for Northland (NRP). In my opinion, the ecological assessment criteria in Kerr (2016 - Appendix 5), as applied, are not appropriate for marine mammals. The mismatch of this ecosystem approach for marine mammals is also discussed by the authors of the maps, specifically noting that, *Marine ecosystems are hard to characterise in terms of spatial boundaries with the proposed criteria system. They are made up of many overlapping ecosystems, functions and connections working across a full range of spatial scales. A small estuary has benthic communities and algal communities that work on scales of 10-1000 $m^2$ and at the same time can be of prime importance to a range of coastal fish and marine mammals which are part of an ecosystem that is 1000s $km^2$*. (Kerr 2016a, p.6). The authors go on to say that *Consideration of marine mammal values in this process provided another set of unique challenges for both Northland estuaries and coastal waters*. (Kerr 2016, p.11).

The final approach by the authors was to prepare a separate worksheet that describes marine mammal values over the whole coastal area (Kerr 2016, p.12). This approach has led to the entire Northland Coastal Management area now being labelled as 'Significant Marine Mammals and Seabird Area'.

In my opinion, none of these current assessment systems deal particularly well with marine mammals. The reasons for my view are that marine mammals are long-lived (i.e. 20-90 years), generally have large home ranges (10s to 100s of kilometres) that are highly variable from year to year, and can use several areas for the same or differing aspects of their life dynamics (e.g. feeding, breeding, resting, migrating). In addition, the distribution of marine mammals in New Zealand waters is currently changing in relation to climate change effects and will continue to do so into the future.

This broad-scale application of 'significance' diminishes any areas that may be important or significant to marine mammal species and others. I am concerned that the marine mammal maps inclusion will suggest to the public, and any commercial interests, that the maps are based on the best and most up-to-date information on the marine mammals that live and visit the waters of Northland. This assumption is not true in my opinion.

Appendix 4. Theoretical zones of auditory influence and sound threshold criteria.

Theoretical 'zones of auditory influence', originally proposed by Richardson (1995), are mainly based around the distance between the source and receiver, and the idea that underwater sound intensity, and its potential impact, decreases with increasing distance. These zones include detection, behavioural responses, auditory masking and possible auditory injury (Figure A4.1).

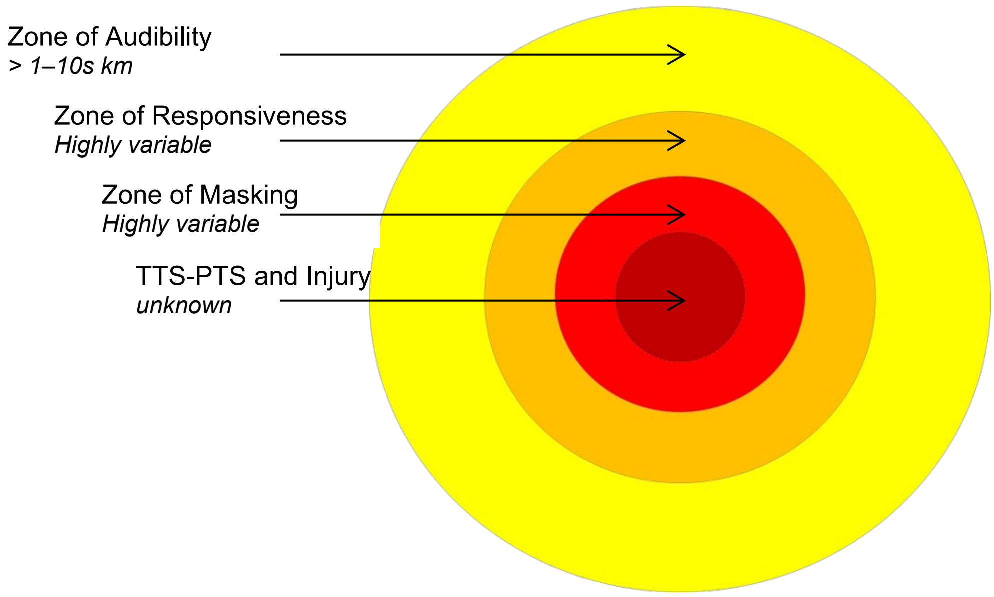


Figure A4.1 Schematic of the theoretical zones of auditory influence based on Richardson et al. (1995).

Southall et al. (2007) used a number of studies that examined the potential onset of temporary auditory threshold shifts (TTS; in humans this is often described as the muffled effect your hearing might have after a loud concert) and more permanent threshold shifts (PTS) in captive marine mammals and extrapolated these to set some initial thresholds for assessing potential auditory damage. More recently, the USA National Oceanic and Atmospheric Administration (NOAA) has reviewed and suggested functional hearing specific sound thresholds for the sound levels likely to cause injury (NOAA 2018) or behavioural responses (NOAA 2011). The sound levels at which significant behavioural disturbance for marine mammals can occur are still under discussion.

# Appendix 5. Listening space reduction plots for the different functional hearing groups

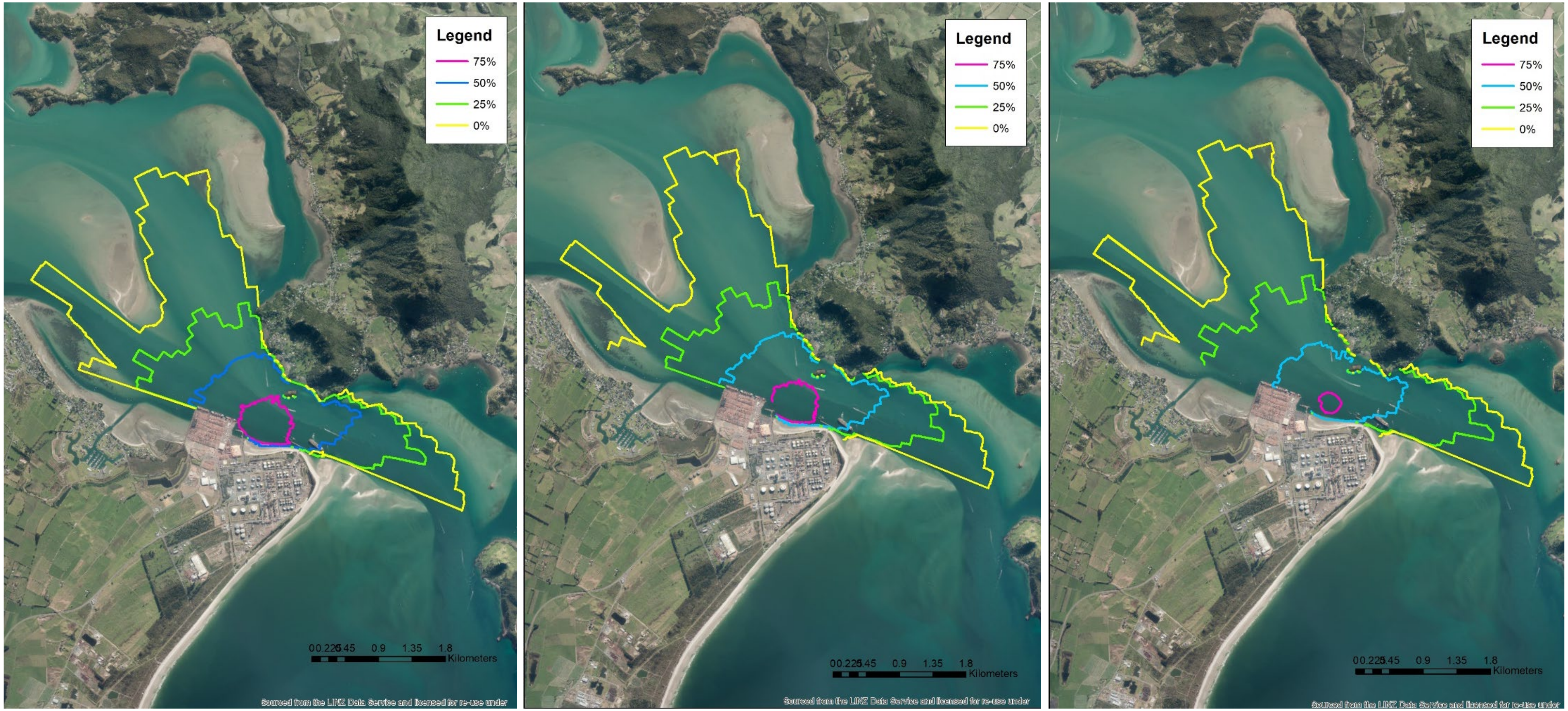


Figure A5.1 Distance contour plots of the predicted **reduced listening space risk** (as a percent) from **percussive impact piling** within the proposed reclamation area for mid-frequency animals (e.g. bottlenose dolphins) on the left, orca (in centre) and low frequency animals (e.g. baleen whales) on the right. For instance, the pink contour signifies the area around pile-driving activities where an animal's listening space has reduced to 75% its unimpacted extent due to acoustic masking effects (Pine 2022).

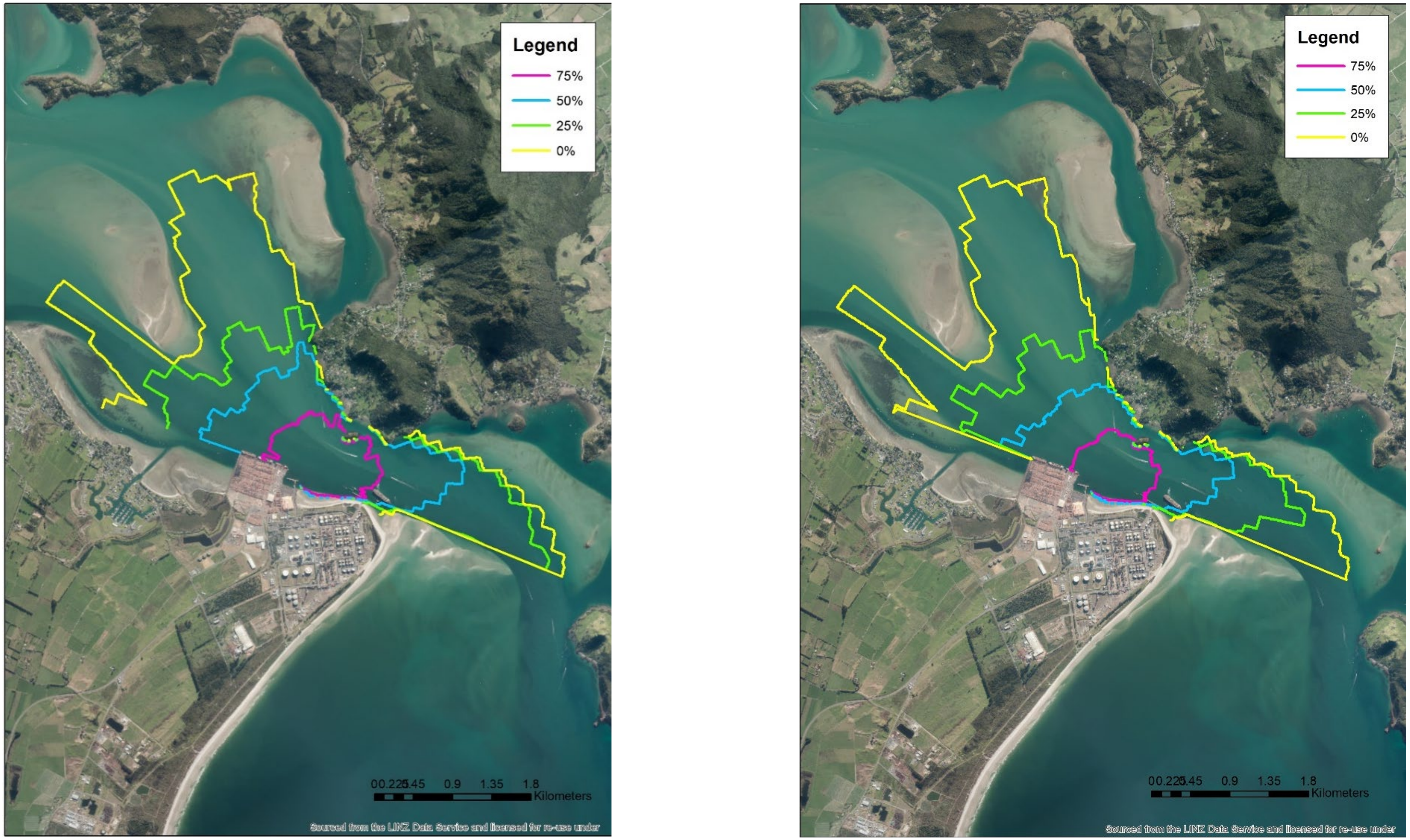


Figure A5.2 Distance contour plots of the predicted levels of **reduced listening space risk** (as a percent) from **percussive impact piling** for phocid animals in water (e.g. leopard seals swimming under water) on the left and otariid animals (e.g. fur seals swimming under water) on the right. For instance, the pink contour signifies the area around pile-driving activities where an animal's listening space has reduced to 75% of its unimpacted extent due to acoustic masking effects (Pine 2022).

Appendix 6. Hammer cushions.

A known mitigation measure to help reduce noise levels generated from hydraulic impact piling hammers is the use of a hammer cushion, cap or dolly (Figure A6.1). MDA (2020) regularly recommend this method as several New Zealand piling contractors already use this technique to reduce the wear on hammer equipment. MDA (2020) note that wooden cushions provide the greatest reduction in noise level while polymer cushions noticeably less effective and with nylon cushions the least effective.

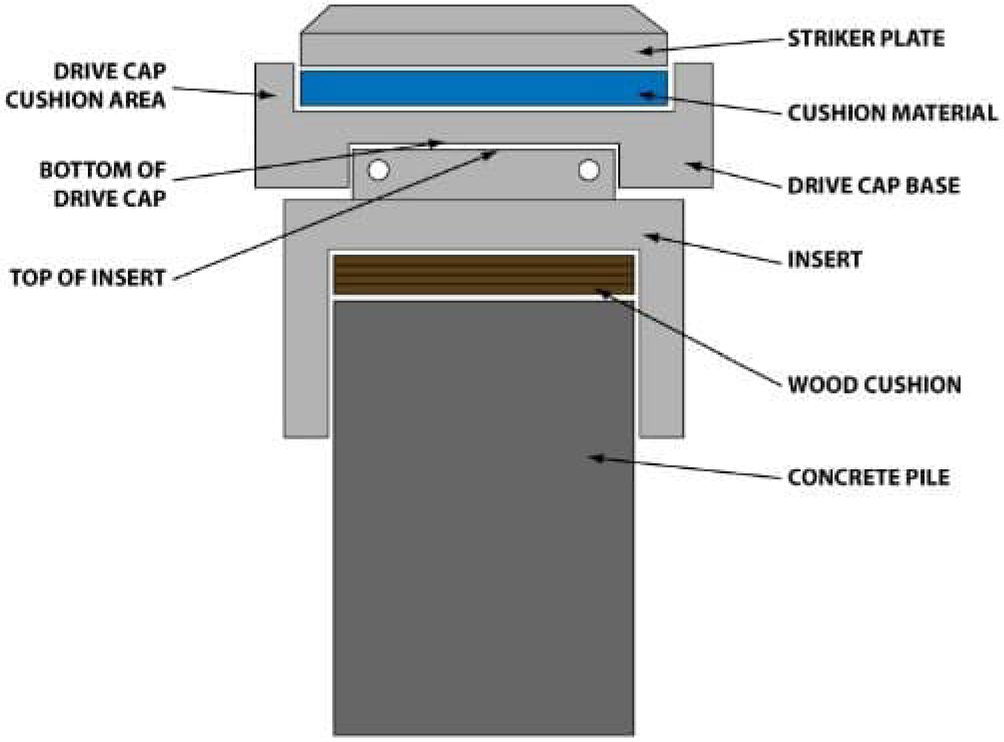


Figure A6.1 A wooden, polymer or nylon cushion placed between hammer and pile can reduce the noise generated with impact piles from impulsive signals. Image: https://theconstructor.org/geotechnical/pile-driving-equipment-types-uses/17605/

# Appendix 7. Best boating behaviour guidelines around marine mammals

In the unlikely case that a vessel should encounter a marine mammal while working, implementing the following 'best practice' boating behaviours These guidelines are based on those recommended by DOC (and with regard to the Marine Mammal Protection Regulations of 1992) with some extra precautions to reduce any chance of collision. Above all else, the skippers will do their best to operate their vessels so as not to disrupt the normal movements or behaviour of any marine mammal in line with the Marine Mammal Protection Regulations of 1992.

## General practice

If a whale or dolphin is sighted, but not directly in the path of the vessel:

- Keep boat speed constant and / or slow down while maintaining current direction
- Avoid any abrupt or erratic changes in direction
- Maintain or resume normal operating speeds once well way from animals.

## Large baleen whales—such as Bryde's or southern right whales

If a whale is sighted directly in the path of the vessel:

- If the whale is far enough ahead of the vessel (e.g. > 500 m) and can be avoided, slow to 'no-wake' if necessary and maintain a straight course away from the immediate sighting area (where practicable)
- If the whale is too close to the vessel and cannot be avoided, immediately place the engine in neutral and allow the boat to drift to one side of the sighting area where practicable (do not assume the whale will move out of the way)
- Avoid any abrupt or erratic changes in direction while at speed
- Once the whale has been re-sighted away from the vessel, slowly increase speed back to normal operation levels.

If a cow / calf pair is sighted within 500 m of an underway vessel:

- Gradually slow boat while maintaining a course away from the immediate sighting area (where practicable)
- Allow the pair to pass
- Once the pair has been re-sighted away from the vessel (> 500 m), slowly increase speed back to normal operation levels
- Avoid any abrupt or erratic changes in direction while at speed.

If a whale and / or cow / calf pair approaches a stationary vessel:

- Keep the engine in neutral, and allow the animal to pass

- Maintain or resume normal operating speeds once well way from animals (> 500 m).

**Small to medium whales and dolphins —— such as bottlenose dolphin or orca**

If a dolphin(s) is sighted directly in the path of the vessel:

- Keep boat speed constant and / or slow down while maintaining a course slightly to one side of the group, do not drive through the middle of a pod
- Avoid any abrupt or erratic changes in direction
- Maintain or resume normal operating speeds once well way from animals.

If a dolphin(s) approaches an underway vessel to bow-ride or ride the stern wave:

- Keep boat speed constant and / or slow down while maintaining course
- Avoid any abrupt or erratic changes in direction
- Do not drive through the middle of a pod
- Maintain or resume normal operating speeds once well way from animals (> 500 m).