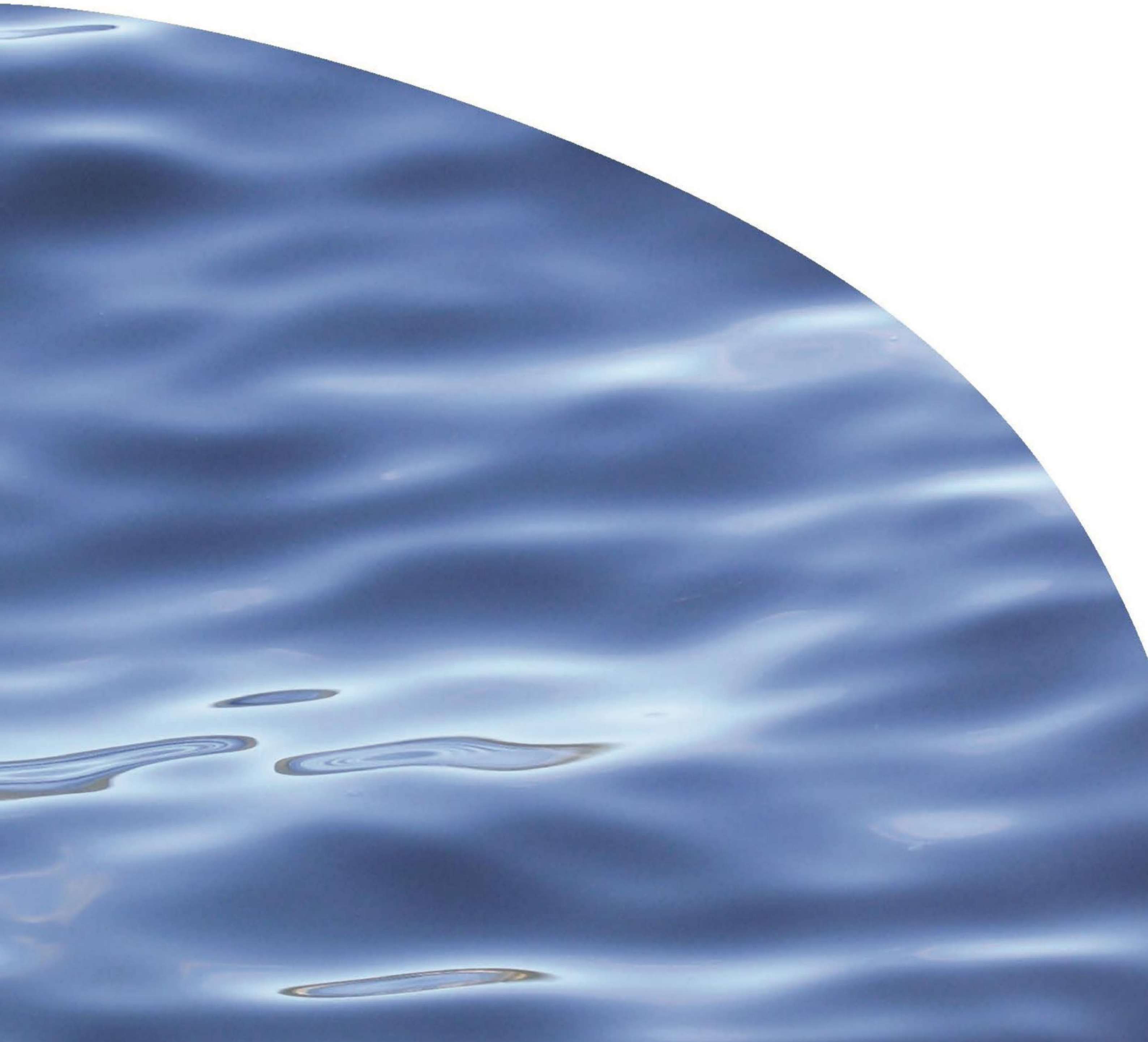
APPENDIX I

ASSESSMENT OF EFFECTS ON MARINE MAMMALS FROM PROPOSED CAPITAL DREDGING AND SPOIL DISPOSAL FOR NAPIER PORT

NAPIER PORT

REPORT NO. 2907

ASSESSMENT OF EFFECTS ON MARINE MAMMALS FROM PROPOSED CAPITAL DREDGING AND SPOIL DISPOSAL FOR THE PORT OF NAPIER



ASSESSMENT OF EFFECTS ON MARINE MAMMALS FROM PROPOSED CAPITAL DREDGING AND SPOIL DISPOSAL FOR THE PORT OF NAPIER

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EXECUTIVE SUMMARY

Port of Napier Limited (PONL) is proposing to deepen its existing approach channel to the Port and to establish a new berth (No.6 Berth) to accommodate deeper draft vessels. This work will involve the capital dredging of approximately 3.2 million cubic metres of benthic sediments from the existing navigation channel, swing basins and berth area of the Port. The associated disposal of dredge spoil is proposed to occur within a new disposal area located approximately 3.3 km south-east of Pania Reef and 4 km offshore in water depths of 20-23 m. PONL has contracted the Cawthron Institute to investigate and report on the potential effects of dredging, spoil disposal and construction activities on local and regional marine mammal species.

Out of the 25 marine mammal species that have been sighted, or recorded stranded within Hawke Bay waters, only four species regularly or seasonally frequent the inshore waters of the bay. These species include New Zealand fur seals, common dolphins and orca as well as southern right whales, which potentially use these waters as winter nursery habitats. Other species considered include offshore, deep-water species, such as pygmy sperm whales, as they are considered acoustically more sensitive relative to marine mammal species with more inshore ranges. Hawke Bay coastal waters are not considered ecologically significant habitats for the species discussed, but instead represent a small proportion of similar habitats available throughout nearby regions. A qualified exception is made for the southern right whales and their temporary use of these waters as potential winter nursery habitats.

The direct effects of dredging and construction activities considered most relevant to marine mammal species in the Hawke Bay region include: potential vessel strikes, increased underwater noise production (particularly pile driving) and possibly the risk of entanglement. While these effects have the greatest potential consequences (i.e. injury or death), their actual likelihoods were considered *low* and overall effects deemed *de minimis* with recommended mitigation actions. Indirect effects of dredging and disposal 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. Given the location and habitats associated with the dredging proposal, the review of possible indirect effects to the ecosystem focused on: quality of spoil sediments, ecological effects to benthos and associated fish assemblages, and the effects of resultant turbidity plumes. Overall, indirect effects from project activities are not expected to be significant or have any longer-term adverse consequences for local or visiting marine mammals in the region.

An informative monitoring programme is proposed that involves recording visual sightings of marine mammals from the project vessels during dredging, disposal and pile-driving activities. Such a programme will report on the actual effects of dredging and pile driving on New Zealand marine mammals while also assessing the effectiveness of the mitigation measures employed.

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1. INTRODUCTION

1.1. Description of proposal

Port of Napier Limited (PONL) is in the process of applying for resource consent to deepen its existing approach channel to the Port and establish a new berth (No.6 Berth) on the northern face of the main Port reclamation, which will accept the deeper draft vessels (Figure 1).

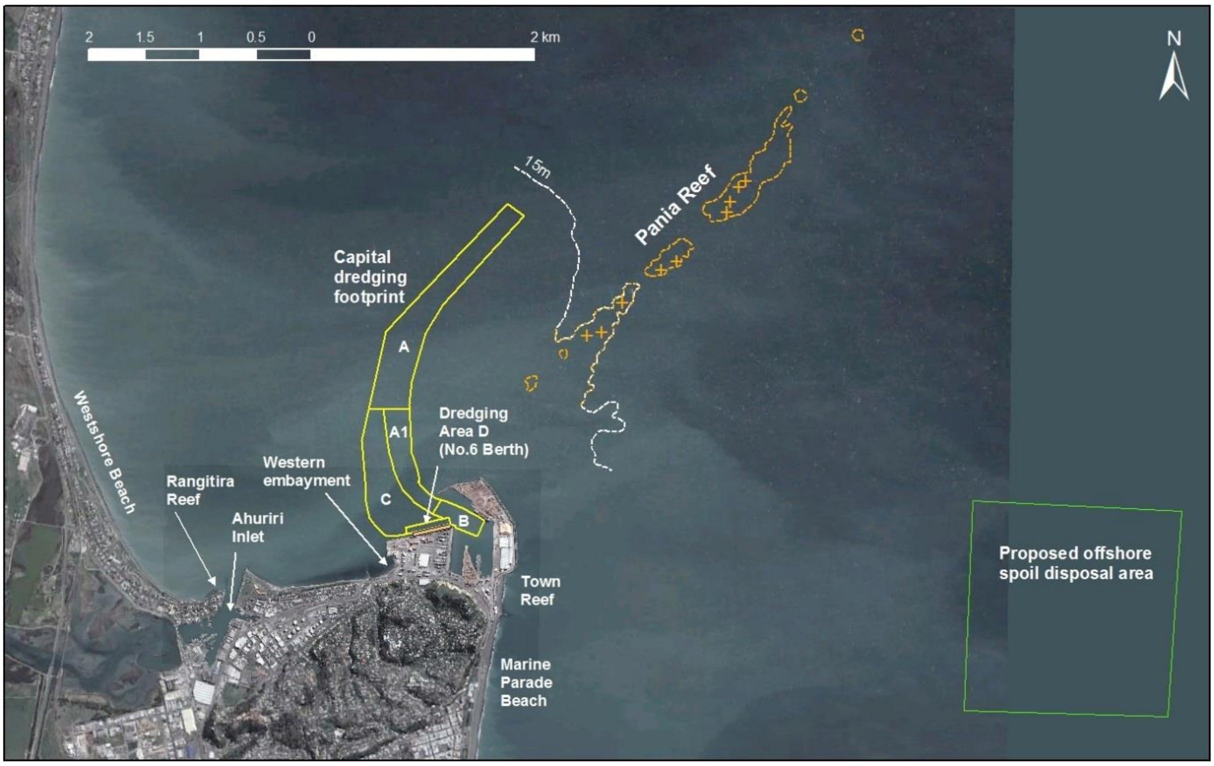

Figure 1. Composite aerial photograph of Port of Napier, showing the scale and layout of the proposed project elements.

The Fairway Channel, or main approach channel, along with the outer and inner swing basin will undergo capital dredging from its current consented maximum of 12.5 metres (m) to take it to a final depth of 14.5 m. It is understood that the capital dredging will be carried out over up to five stages, with deepening at 0.5 m increments. Dredging work will be undertaken by a combination of back-hoe (BHD) and trailer suction hopper (TSHD) dredgers. The total volume of dredged materials (spoil) is estimated to be around 3.2 million m^3. It is proposed that this material will be transferred to a proposed new spoil ground some 4 km offshore from Marine Parade Beach in approximately 20–23 m water depth (Figure 1).

The proposal also includes the construction of a new 350 m long and 34 m wide wharf along the northern end of the existing Port reclamation to handle the larger vessels. The structure will comprise a 700 mm thick concrete deck supported on piles laid out on a 6.5 m grid spacing. The wharf will be built from the edge of the existing reclamation. Pile casings will be driven into bedrock using a large hydraulic hammer.

1.2. Scope of assessment

PONL has contracted the Cawthron Institute (Cawthron) to investigate any possible environmental effects of the proposal on local and regional marine mammal species. The primary objective of this investigation was to provide a desktop assessment of potential effects on marine mammals by the proposed capital dredging of the approach channel to Port of Napier, as well as the necessary disposal of dredge spoil and berth construction activities. Specifically, this assessment of effects incorporates the following components in the first part of the report:

- a summary of the existing environment in terms of those marine mammal species most susceptible to any effects of the proposal
- an evaluation of resident and transient marine mammal populations utilising and / or influenced by the wider Hawke Bay coastal ecosystem.

The second part of the report comprehensively assesses the actual and potential effects of the proposal on the relevant marine mammal species, with possible mitigation options, and is intended to support the final resource consent application. It specifically:

- reviews the national and international literature on the effects of dredging and disposal activities on marine mammals, specifically addressing direct and indirect effects
- places any potential impacts in context of the actual project area and environment, based on other relevant assessment of effects reports (e.g. underwater noise, ecology, spoil disposal modelling)
- categorises any resulting effects in terms of their possible scale, duration/persistence, likelihood and possible consequences
- discusses possible mitigation options and monitoring conditions based on the final risk assessment of any potential effects.

2. DESCRIPTION OF EXISTING ENVIRONMENT

2.1. General species summary

More than half of all the cetacean (whales, dolphins and porpoises) and pinniped (seals and sea lions) species known to exist worldwide live or migrate through New Zealand waters. At least 25 of these species have been sighted or have stranded within Hawke Bay waters (Figure 2). However, detailed information on abundance, distribution and critical habitats is available only for a limited number of New Zealand's marine mammals, despite recent advances in survey techniques. To date, little to no marine mammal research has occurred within Hawke Bay waters specifically.

Hence, in the absence of any long-term and spatially-explicit research on marine mammals in this region, species information and sighting data were collated from opportunistic sightings and stranding databases (e.g. Department of Conservation (DOC) seismic database, public sightings, tourism reports, fisheries observers etc.). This information was used to evaluate those species most likely to be affected by the proposed project and to determine what is currently known about any possible seasonal or distribution trends within the general area. The potential risks to marine mammal species associated with various anthropogenic (human-made) activities can still be assessed in the absence of adequate population information using instead species' life-history dynamics (e.g. species-specific sensitivities, conservation listing, main prey sources) gathered within New Zealand (e.g. local and national databases, New Zealand Threat Classification System, NABIS) and internationally (e.g. peer-reviewed journals, IUCN Red List of Threatened Species).

When considering potential implications of coastal developments on local marine mammals, the importance of Hawke Bay waters needs to be considered in the context of the species' regional and New Zealand-wide distributions, given that most species' normal ranges extend across hundreds to thousands of kilometres. For instance, while humpback whales may be considered only seasonal migrants through Hawke Bay waters, this particular stretch of water may provide an important corridor that this species uses to travel to key habitats in more northern waters. Hence, Figure 2 highlights the various marine mammal species found to frequent the general south-eastern coastal regions of Hawke's Bay, Manawatu-Wanganui, and Wellington councils.

Sightings occurred throughout inshore and offshore regions, but were generally more frequent north of Mahia Peninsula and within deeper waters associated with the continental shelf break (c. 150 m isobaths). As expected, strandings of dead (or live) animals were spread along the coastline itself, and over 80% occurred mainly within Hawke Bay alone (Figure 2). Historically, Mahia Peninsula (particularly Opoutama Beach) and Napier are known as natural stranding hotspots for marine mammals due to the influence of local currents (Brabyn 1990).

It is important to note that each reported sighting does not necessarily represent unique animals (i.e. the same group of animals may be reported by several different members of the public at different times). Consequently, the number of sightings in Figure 2 does not necessarily reflect the actual abundance of these species within these regions. In addition, the location and the time of year that most opportunistic sightings are recorded may reflect a closer proximity to larger towns or harbours and where the majority of coastal activities (e.g. tour boats, recreational fishing, diving etc.) tend to occur.

A list of the most prevalent species found to reside or regularly visit the coastal waters of Hawke Bay, and in particular the Napier region, is presented in Table 1. These species have been defined into three main categories that describe their distribution trends within this particular region. Note that the distribution and frequency inferences for lesser-studied species, discussed below, are expected to change with time and more scientific information.

1. Resident—a species that lives (either remaining to feed and/or breed) within Hawke Bay and surrounding waters either permanently (year-round) or for regular time periods (seasonally)
2. Migrant—a species that regularly travels through parts of Hawke Bay and surrounding waters, remaining for only short or temporary time periods that may be predictable seasonally
3. Visitor—a species that may wander into Hawke Bay and surrounding waters intermittently, depending on the Bay's proximity to the species' normal distribution range; visits may occur seasonally, infrequently or rarely.

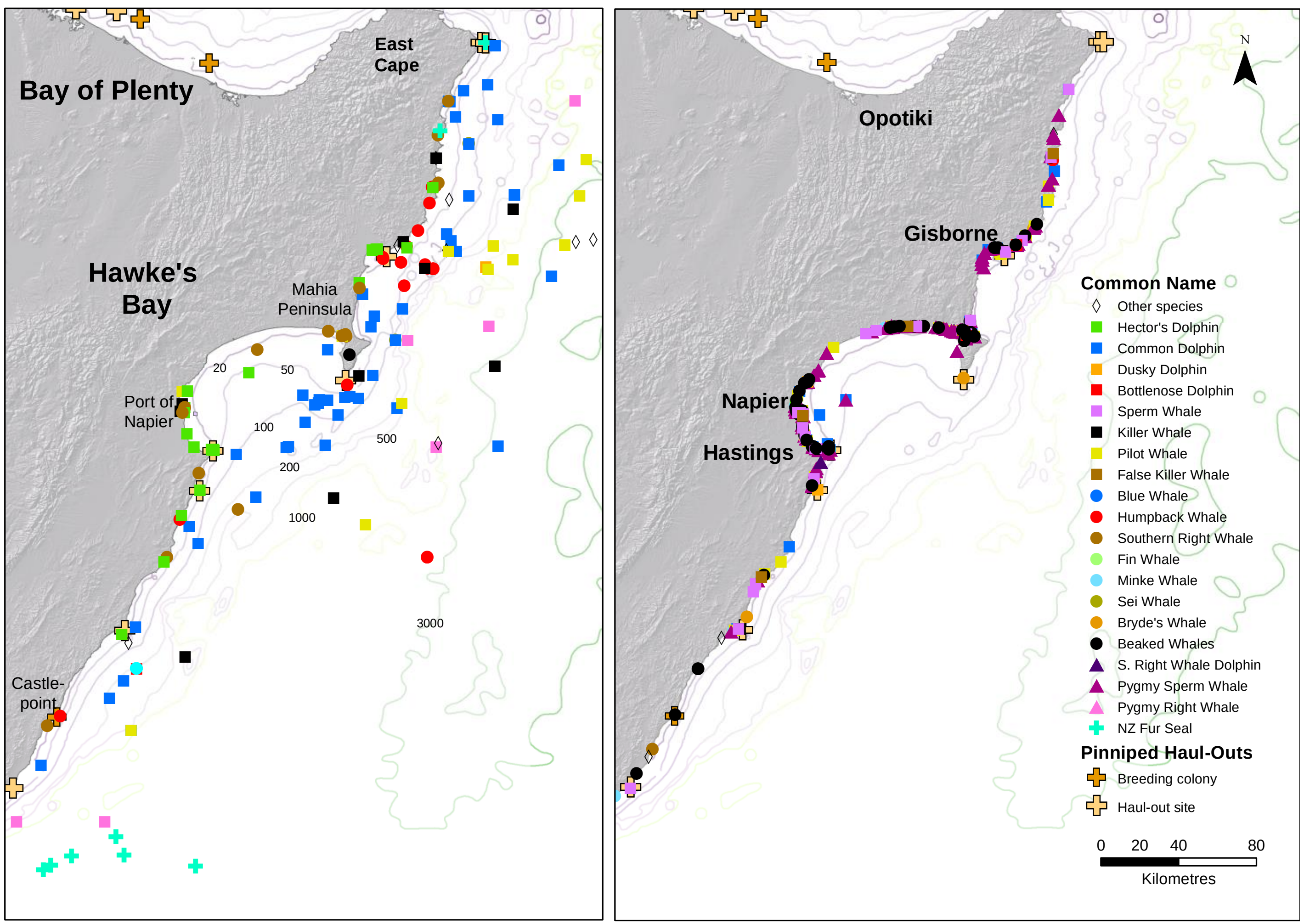

Figure 2. A summary of research and opportunistic sightings (left) and strandings (right) of marine mammals prevalent in Hawke Bay regional coastal waters (DOC databases: seismic, public, tourism reports, fisheries observers etc.).

Table 1. The residency patterns of marine mammal species known to frequent Hawke Bay and nearby waters along with potential species-specific effects from dredging activities. Species conservation threat status is listed for both the New Zealand system (NZTCS; Baker et al. 2016) and international IUCN system (ver 3.1).

Common name	Species name	NZ threat classification (NZTCS) (status and ranking)		IUCN red listing	Residency category in Hawke Bay	Potential effects of dredging activities (Todd et al. 2015) *
RESIDENTS						
NZ fur seal	*Arctocephalus forsteri*	NZ native & resident, evaluated	Not Threatened	Least Concern	Seasonal to Year-Round Resident	Habitat alterations, increased turbidity & changes to prey availability, masking, incidental capture or injury, avoidance to increased shipping traffic
Common dolphin	*Delphinus delphis/capensis*	NZ native & resident, evaluated	Not Threatened	Least Concern	Seasonal to Year-Round Resident	Habitat alterations & changes to prey distribution
Orca (killer whale)	*Orcinus orca*	NZ native & resident, threatened	Nationally Critical	Data Deficient	Seasonal to Infrequent Visitor	Increased boat traffic, masking, alterations to prey availability, habitat avoidance or behaviour alterations
Pygmy sperm whale	*Kogia breviceps*	NZ native & resident, evaluated	Not Threatened	Data Deficient	Potential Offshore Resident	Changes to cephalopod availability or distribution & increased shipping traffic
Long-finned pilot whale	*Globicephala melas*	NZ native & resident, evaluated	Not Threatened	Data Deficient	Potential Offshore Semi-Resident	Increased shipping traffic & chance of collisions & changes to prey availability
Beaked whales	Ziphiidae species	NZ native & resident, not evaluated	Data Deficient to Not Threatened	Data Deficient to Least Concern	Potential Offshore Resident to Rare Visitor	Change to behavioural (surfacing, feeding) patterns, avoidance & increased shipping traffic
MIGRANTS						
Southern right whale	*Eubalaena australis*	NZ native & resident, evaluated, threatened	Nationally Vulnerable	Least Concern	Seasonal Migrant	Collision with a dredging vessel, habitat avoidance, behavioural changes & masking
Humpback whale (oceanic pop. only)	*Megaptera novaeangliae*	NZ native, evaluated	Migrant	Endangered	Seasonal Migrant	Movement away from habitat, noise pollution, habitat degradation, behavioural alterations, masking of conspecifics at close range (< 1 km), alterations to migration routes & avoidance
Sperm whale	*Physeter macrocephalus*	NZ native, evaluated	Not Threatened	Vulnerable	Potential Offshore Migrant	Increased shipping traffic (Broker and Ilangakoon, 2008), changes to cephalopod availability or distribution

Table 1 (continued).

Common name	Species name	NZ threat classification		IUCN red listing	Residency category in Hawke Bay	Potential effects of dredging activities (Todd et al. 2015) *
VISITORS						
Bottlenose dolphin	*Tursiops truncatus*	NZ native & resident, evaluated	Nationally Endangered	Least Concern	Irregular to Rare Visitor	Altered feeding patterns, increased shipping traffic & potential disturbance to the nursing areas
Hector's dolphin	*Cephalorhynchus hectori hectori*	NZ native & resident, evaluated, threatened	Nationally Endangered	Endangered	Irregular to Rare Visitor	Disturbance from increased shipping traffic & noise levels, destruction & alteration of habitat

* Proposed effects by Todd et al. (2015) are highly dependent on the location, the scale and context of the project (e.g. equipment used, duration, spoil volumes) as well as species.

2.2. Species specific summary

At least four of the species highlighted in Figure 2 and Table 1 regularly or seasonally transit through Hawke Bay and nearby coastal waters (Clement 2010), and are therefore the most likely to be affected by the proposed project. These more common species include NZ fur seals (*Arctocephalus forsteri*), common dolphins (*Delphinus delphis/capensis*), orca (killer whales or *Orcinus orca*) and southern right whales (*Eubalaena australis*). A short summary of these and other relevant species is given below.

The only species commonly sighted at the southern end of Hawke Bay in the vicinity of the proposal area is the NZ fur seal. Known fur seal haul-out sites are located off and to the south of Cape Kidnappers as well as Mahia Peninsula (Figure 2). Haul-out sites are rocky shore regions where fur seals tend to regularly come ashore and rest, particularly over the colder winter months[1]. While fur seals are considered non-migratory, they easily and repeatedly cover large distances and will not remain at any one location year-round (e.g. Goldsworthy & Gales 2008). Due to the close proximity of the continental shelf to these haul-out sites, fur seals most likely are travelling out to these more open-ocean waters to feed rather than relying solely on the inshore fish species within Hawke Bay waters (e.g. Goldsworthy & Gales 2008).

Dense sightings of common dolphins have been reported from East Cape south to Castlepoint (Figure 2, Clement 2010); mostly associated with the continental shelf break (c. 150 m depth contour), although this species has been anecdotally sighted throughout most of the bay. They are generally more prevalent in summer and autumn, but occasionally seen throughout winter months, making them likely year-round residents of the general Hawke Bay region. Based on observations and diet analyses, these dolphins are thought to undertake short-term movements between daytime feeding areas within inshore waters and night feeding in offshore, shelf waters (e.g. Neumann & Orams 2005; Meynier et al*.* 2008). Little is known about their actual population sizes or movements between various east coast locations (Stockin et al*.* 2008a).

Orca and southern right whales are less frequent but more seasonal within Hawke Bay waters (Figure 2, Clement 2010). Orca are regularly sighted along most of the east coast of the North Island, as this area appears to be an important region for both the North Island and the North-South Islands sub-populations (Visser 2000). They seem to mainly visit Hawke Bay waters over early winter and late spring/summer months, although occasional sightings of orca were reported in other seasons as well. In New Zealand, orca most commonly forage on rays (Visser 1999a), which may account for their tendency to frequent fairly shallow waters (Hupman et al*.* 2014), as

[1] Limited numbers of fur seals are known to periodically rest on the end of the Port of Napier main breakwater.

well as pelagic and reef fish (Visser 2000) and other marine mammals (Visser 1999b; Visser et al. 2010).

As seasonal ‘migrants’, southern right whales regularly travel to and through the inshore waters of Hawke Bay each winter and spring as part of their traditional wintering grounds (Table 1). The North Island’s eastern coastal waters between Napier and Mt Maunganui (Patenaude 2003) and the Northland region (Carroll et al. 2014) are considered important nursery habitats with 40–50% of all cow/calf pairs observed along these areas. Cow/calf pairs sighted within the East Cape/Hawke Bay region mainly occur between August and November, with some pairs remaining within nearshore waters for up to four weeks (Patenaude 2003). Their tendency to remain within shallow, inshore surface waters while migrating, and their natural curiosity, places them at greater risk of interactions with human activities than other whale species.

Potential deep-water residents of Hawke Bay waters include pygmy sperm whales, pilot whales, and several species of beaked whales (DOC databases; Baker 2001; Brabyn 1990). However, as they mainly occupy offshore waters (along and /or past the edge of the continental shelf), less is known about their regular or seasonal movement patterns. It is important to note that some deep-water species are now thought to be more acoustically sensitive than other, more inshore marine mammal species (Cox et al. 2006).

Pygmy sperm whales are the most frequently reported cetaceans to strand in New Zealand waters (e.g. Brabyn 1990). This species mostly strands around the North Island, with the majority of strandings occurring in Hawke Bay (Figure 2). These animals are generally thought to prefer deeper, shelf waters as evident by a diet centered on oceanic and mesopelagic cephalopods (squid and octopus; Beatson 2007). Strandings of pygmy sperm whales occur year-round in this region with more reported over the summer and autumn months. It has been hypothesised that the Hawke Bay offshore waters may be an important calving and/or nursery habitat for this species as a large portion of strandings reported here are pregnant females or females with a calf (Beatson 2007).

Fairly large groups of pilot whales are sighted year-round in more offshore Hawke Bay waters (around 10–50 n mi.) as well as regions to the north and south (Figure 2). It is assumed this species feeds along nearby continental shelf waters based on sighting observations and their cephalopod-based diet (Beatson et al. 2007; Beatson & O’Shea 2009). Migrations are not well documented and pilot whales are thought to be generally nomadic. Both Hawke Bay sighting and stranding data may support an inshore movement during summer and autumn, and then offshore again over the winter and spring. Overseas evidence suggests most groups of pilot whales likely follow prey trends (Carwardine 1995).

The North Island's east coast appears to be one of three hotspots for beaked whale strandings. At least eight species of beaked whales are known to strand between Bay of Plenty and Hawke Bay waters (Figure 2). The strong prevalence of strandings from late spring to autumn suggests a general inshore movement towards coastal waters for some species over summer months. In general it is thought that beaked whales occur largely in deep waters, often associated near ocean trenches where they are thought to feed mainly on cephalopods (e.g. Baker 1999; Taylor et al. 2008).

Other species that tend to be seen or strand in Hawke Bay waters less frequently are considered seasonal migrants or visitors. Humpback and sperm whales regularly occur off the North Island's east coast during both their northern and southern migrations with at least 1–2 animals reported in offshore waters between Bay of Plenty and Hawke Bay annually. Humpback whales are thought to be more prevalent within the Hawke Bay region during their winter migration (June and July) as they move north up the length of the country. Sperm whales appear to migrate through these offshore regions during summer and autumn months. Almost half of all sperm whale strandings have occurred along these same coastlines with multiple strandings centred on Mahia Peninsula. These species tend to migrate further off the coast, associating more with the continental slope and as such are rarely observed within enclosed waters such as Hawke Bay.

Two visiting species (Hector's and bottlenose dolphins) are particularly noteworthy given that both are considered *nationally endangered* according to DOC's threat classification system (Baker et al. 2016). Hector's dolphin is the only dolphin species found solely within New Zealand waters. Irregular sightings of this species since the 1970s suggest individuals or small groups may still visit south-eastern coastal waters (including Hawke Bay) over summer months on occasion (Figure 2). Hawke Bay waters may also represent the southern limit of visiting bottlenose dolphins (*Tursiops truncatus*) from more northern regions (e.g. Bay of Plenty and Hauraki Gulf). Only infrequent visits of small groups or single animals of this species have been observed, generally over summer and autumn, to Hawke Bay and more southern waters (Figure 2).

Based on the available data, and in reference to both Section 6(c) of the Resource Management Act (RMA)[2] and Policy 11 of the New Zealand Coastal Policy Statement (NZCPS), there is no evidence indicating that any of these species have home ranges restricted solely to Hawke Bay waters or that these waters are considered ecologically more significant in terms of feeding, resting or breeding habitats for any particular species relative to other regions along the North Island's south-eastern and central coastlines. Instead, Hawke Bay waters represent only a small portion of similar habitats available to support these marine mammals, which generally range

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

throughout the larger coastal regions between Bay of Plenty and East Cape to the north and Cape Palliser to the south (Clement 2010). The exceptions are southern right whales, given their use of Hawke Bay waters as potential winter nursery habitats, and to a much lesser extent, some offshore species (e.g. pygmy sperm whales) given their acoustic sensitivities.

3. ASSESSMENT OF ACTUAL AND POTENTIAL EFFECTS

Despite the frequent use of dredges in most ports, harbours and coastal development projects, little research has focused specifically on the effects of dredging operations on marine mammals (see review by Todd et al*.* 2015 and references therein). The most consequential interactions between marine mammals and coastal development usually result from a direct overlap between the spatial location of the development and important habitats of the species (i.e*.* feeding or nursing grounds). The direct effects of such overlap range from physical interactions with the animals (e.g*.* vessel strikes or entanglements) to avoidance or even abandonment of the area by the species due to the general increase in activity (e.g*.* noise or traffic). Indirect effects 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. The following section describes the direct and indirect effects that dredging can have on marine mammals based on available (predominantly overseas) studies while relying on a wider range of research focused on coastal development and marine mammals in general.

3.1. Direct effects

The act of breaking and/or removing bottom substrate in itself is not expected to directly affect any marine mammals known to frequent Hawke Bay waters. Instead, the associated increase in vessel activity, resulting production of underwater sound and physical activities within the general port region are the more likely circumstances in which marine mammals will be affected.

3.1.1. Vessel strikes

The proposed capital dredging of the No.6 Berth, swing basin and channel will involve the removal of approximately 3.2 million m^3 of spoil by a combination of trailer suction hopper dredge (TSHD) and back-hoe dredge (BHD). This material will be taken to the new 346 ha disposal area located approximately 3.3 km south-east of Pania Reef and 4 km offshore in water depths of 20–23 m (see Figure 1). Based on the types of dredge vessel likely to be used, this removal will involve around 2,000 return trips of a 1,840 m^3 TSHD travelling at up to 9 knots and around 3,000 return trips using split-hopper barges (associated with back-hoe dredging) travelling at about 5 knots.

A recent worldwide review of dredging effects by Todd et al*.* (2015) suggests that the risk of collision between dredges and marine mammals will be minimal if the activity avoids critical habitats and seasons when the species of concern may be distracted (e.g*.* feeding or resting) or have calves present. To date, most reported incidences of vessel strikes have been with mysticete (baleen) whales.

Baleen whales

Vessel strikes are a well-known source of injury and mortality for several species of baleen whales around the world. A review of vessel strikes worldwide by Laist et al. (2001) found that the whales more commonly struck by vessels were: fin whales (*Balaenoptera physalus*), right whales (*Eubalaena glacialis* and *E. australis*), humpback whales, sperm whales, and gray whales (*Eschrichtius robustus*). In New Zealand waters, at least four baleen whale species have been found wrapped around the bows of container ships entering Ports of Auckland (Stone & Yoshinaga 2000; Constantine et al. 2015) and one species across the bow of a car carrier entering Lyttelton Harbour (L. Allum, Department of Conservation, pers. comm. 2009). These species include: Bryde's whale (*Balaenoptera edeni*), blue whale (*Balaenoptera musculus*), sei whale (*Balaenoptera borealis*), minke whale (*Balaenoptera acutorostrata*) and fin whale.

The likelihood of vessel strike depends on a number of factors including vessel type, speed, location and the species and behaviour of marine mammals (Van Waerebeek et al. 2007). While all types and sizes of vessels have hit whales, the most severe collisions (e.g. fatal injury or mortality) occurred with large (i.e. > 80 m) and fast moving ships (i.e. > 14 kn or > 26 km/h; Laist et al. 2001; Jensen & Silber 2004). However, the size of the vessel appears to be less significant than its speed. The greatest increase in both the risk of 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). This might explain why dredges, which generally have maximum transit speeds of 12–16 knots (Brunn et al. 2005), have only been involved in one out of the 134 worldwide collision cases (in which the vessel type was known) reported between 1975 and 2002. A 110 m dredge operating in South Africa struck a southern right whale cow / calf pair that surfaced directly in front of it while underway, and the calf was subsequently killed (Jensen & Silber 2004). Younger, less experienced animals (calves and sub-adults) were found to be more at risk of collision with vessels compared to adult whales (Lammers et al. 2013).

Based on this evidence, the likelihood of a vessel strike (injury or mortality) associated with the capital dredging and berth construction of Port of Napier is considered *low* for migrating baleen whale species (see Table 2). This conclusion is based on these factors:

Spatial and temporal factors

- dredge vessel traffic will be restricted to within a small localised spatial area within Hawke Bay waters (i.e. ≤ 5 km distance between channel/berth area and disposal sites)
- low probability of the dredging vessel encountering a migrating whale as currently only 1 or 2 individual whales are sighted within inshore Hawke Bay waters each year while the majority pass by the Bay in deeper waters, further offshore (> 20 km)

- Whales occur seasonally with sightings restricted mainly to winter months and some spring months; most only remain for a few days while southern right whales may stay for a few weeks.

Known collision factors

- low probability of dredge vessel striking a migrating whale as the dredging vessel will be relatively stationary while dredging and speed of transit to the disposal site (approximately 5 kn for barges or 9 kn for TSHD) should be slow enough for any whales to avoid the vessel or to be detected and avoided if necessary
- Hawke Bay waters are not considered to be particularly significant for migrating whales in terms of feeding, resting or breeding habitats; the exception being some southern right whale cow/calf pairs potentially using more inshore areas as nursery habitats between August and November.

Odontocetes and pinnipeds

In general, most odontocete ('toothed' whales or dolphins) and pinniped (seals or sea lions) species demonstrate few avoidance behaviours around most ships and boats. In fact some species regularly tolerate heavy vessel traffic while others often approach the vessels themselves (Richardson 1995). However, Todd et al. (2015) noted that certain age groups (i.e. calves and juveniles) and individuals engaged in particular behaviours, and therefore less focused on vessel movements, may be more susceptible to vessel strike. For instance, in Akaroa Harbour (Banks Peninsula) newborn Hector's dolphin calves are thought to be potentially vulnerable to small, high-speed vessels (Stone & Yoshinaga 2000). Regardless, it should be noted that odontocete and pinniped reactions to vessels can vary greatly between species, populations and even individual animals.

Based on the research to date, the likelihood for any vessel strikes (i.e. injury or mortality) due to an increase in dredging traffic in Hawke Bay waters is also considered *low* for any resident or visiting odontocete or pinniped species (Table 2). This conclusion is based on:

Spatial and temporal factors

- dredge vessel traffic will be restricted to within a small localised spatial area within Hawke Bay waters (i.e. ≤ 5 km distance between channel/berth area and disposal sites
- the species known to frequent Hawke Bay are in regular contact with all types and speeds of commercial (including tourism) and recreational vessels throughout their entire distributional range.

Known collision factors

- the low probability of dredge vessel striking an individual odontocete or pinniped given the vessel will be relatively stationary while dredging. Speed of transit to the disposal site should be slow enough for any marine mammals to avoid the vessel or to be detected and avoided if necessary

- while these species have a general attraction to or curiosity for boats, most dolphin species safely approach and/or bow-ride with numerous vessels, while fur seals often respond neutrally to boats when in the water (although they may bow-ride occasionally)
- Hawke Bay is not considered unique or important feeding, resting or nursery habitats for any residential or visiting species. However, some species may have calves present within these waters over summer and autumn months.

Table 2. Summary of actual and potential effects on marine mammal species from the proposed No.6 Berth Project (* with mitigation measures). TTS = temporary auditory threshold shift. PTS = permanent auditory threshold shift.

Potential environmental effects	Spatial scale of effect	Persistence / duration of effect	Consequence	Likelihood of effect	Overall risk level
Marine mammal / vessel strike due to increased vessel activity	**Medium to Large:** Limited vessel movements between the port and disposal site up to 5 km away	**Short to Persistent:** Whales will only be present in the area for a few days to weeks; Campaign 1 expected to last up to 9 mo (mainly BHD). Other campaigns ≤ 10 wks (BHD & TSHD)	**Population Level:** death or injury of endangered or threatened species **Individual Level:** death or injury of non-threatened species	**Low**	**De Minimis ***
Behavioural and / or physical responses to underwater sound from: **- dredge / disposal activities**	**Small to Large:** Dependent on sounds produced; behavioural / masking responses predicted at large distances (several kms), potential TTS only within close proximity (< 10 m)	**Short to Persistent:** dependent on species' presence in area; Campaign 1 expected to last ≤ 9 mo (BHD). Other campaigns ≤ 10 wks (BHD & TSHD)	**Individual to Regional Level:** Individuals may avoid, approach dredging activities or hearing effects; possible acoustic masking between conspecifics (regional)	**Low -** TTS, masking **to Moderate -** behavioural	**De Minimis**
- pile-driving activities	**Small to Large:** Behavioural / masking responses predicted at large distances (2.25 km), potential hearing injury/impairment with close proximity	**Moderate:** Wharf construction completed over ≥ 20 weeks	**Individual to Regional Level**: Individual avoidance or hearing injury/impairment (TTS/PTS), possible acoustic masking between conspecifics (regional)	**Low –** PTS, TTS to **High** - masking, behavioural	**Nil –** TTS / PTS **to De Minimis –**, behavioural, masking *****
Marine mammal entanglement in operational gear and / or debris	**Small to Medium** Limited to immediate waters around operating dredge vessels	**Short to Persistent** Mainly while dredge vessel is operating; Campaign 1 expected to last up to 9 mo (mainly BHD). Other campaigns ≤ 10 wks (BHD & TSHD).	**Population Level:** death or injury of endangered or threatened species **Individual Level:** death or injury of non-threatened species	**Low**	**De Minimis ***
Contaminant effects on marine mammals from dredge sediments and/or spoil	**Medium to Large** Limited to immediate waters and habitats adjacent to dredge and disposal sites (< 3 km).	**Short to Persistent** Dependent on level of contamination in sediments	**Individual Level:** Limited potential for any individual to consume more than few prey species exposed to dredging sediments	**Not Applicable to Low**	**Nil to De Minimis**
Marine mammal habitat / prey disturbance and increased turbidity due to dredging / disposal activities	**Medium to Large** Limited to immediate waters and habitats adjacent to dredge and disposal sites (< 3 km)	**Short to Persistent** Re-colonisation will begin during on-going activities and recovery within disposal site only after disturbance has ceased	**Individual Level:** Possible avoidance of disturbed area, some individuals may approach disposal site(s) for foraging	**Not Applicable to Low**	**Nil to De Minimis**

Ranking of terms used in table:

- Spatial scale of effect: Small (tens of metres), Medium (hundreds of metres), Large (> 1 km)
- Duration of effect: Short (days to weeks), Moderate (weeks to months), Persistent (years or more)
- Consequence: Population, Regional, Individual
- Likelihood of effect: Not Applicable (NA), Low (< 25%), Moderate (25–75%), High (> 75%)
- Significance of effect: Nil (no effects at all), De Minimis (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 mitigated)

3.1.2. Underwater noise

The proposed capital dredging, as well as spoil disposal and berth construction activities, will involve an increase in vessel traffic and mechanical activities that will generally increase the amount of anthropogenic underwater sound produced in the area (e.g*.* CEDA 2011; WODA 2013). Materially increasing underwater noise is always a concern in regards to marine mammals. Noise has the potential to adversely affect both cetacean and pinniped species since they rely heavily on underwater sounds for communication, orientation, predator avoidance and foraging. However, only a few studies have specifically examined the effects of dredging noise on marine mammals or attempted to tease apart these effects from other, often coincident, construction sources. Potential effects associated with underwater noise from dredging and construction activities will be dependent on the types and levels of noise produced, with possible impacts ranging from short-term avoidance, behavioural changes and acoustic masking to physical injury resulting from auditory damage (see Todd et al*.* 2015 and references therein).

Dredge noise

Generally, the noises produced from dredging activities are continuous, broad-band sounds mostly below 1 kHz (Todd et al*.* 2015). Dredges produce relatively lower sound levels than a powerful ship: 124–188 dB re 1 µPa rms at 1 m versus 180-190 dB re 1 µPa rms at 1 m, respectively[3] (OSPAR 2009; Todd et al*.* 2015). However, the two differ in that a dredge may be actively operating within one general area for longer periods of time (weeks or months) while a ship rarely remains in the same area for long (minutes or hours). The associated noise characteristics of dredging activities can also vary depending on the type of dredge, operational stage, and ambient (environmental background) conditions.

Underwater noise reviews by CEDA (2011) and WODA (2013) found that trailer-suction hopper dredges (TSHD) and back-hoe dredges (BHD), the two types considered for this proposal, produce mostly low frequency, omni-directional sounds between 100-500 Hz. However, their bandwidths could fluctuate as low as 20 Hz and as high as 20 kHz. The exact ranges are dependent on the sediment extraction process and the types of sediment being extracted, with coarser gravel causing greater sound levels.

Understanding ambient underwater sound levels is important in assessing the potential scale and impact of additional underwater noises as these background noises, along with the physical environment, will influence the propagation and detection of any introduced sounds. The ambient background underwater sound levels for the Port of Napier were recorded over the period 7–12 July 2016 by

[3] The term ‘dB re1 µPa at 1 m’ represents the sound pressure level at one metre distance from the source. RMS = root mean square or mean squared pressure and rms levels are often used for long duration or continuous noise sources instead of ‘peak’ levels. The averaged square pressure is measured across some defined time window that encompasses the call signal.

Marshall Day (2017). Ambient levels averaging 117–123 dB re 1 µPa rms were established. It was noted that the underwater noise environment was generally typical of a coastal harbour environment, with wave noise, vessel movements and port activity being the principal noise sources (Marshall Day 2017).

Baleen whales

The lower frequency vocalisation ranges of southern right whales suggest their best hearing capabilities are at least between 50 Hz and 2 kHz (Parks & Tyack 2005) and 20 Hz to 12 kHz for humpbacks (McCauley & Cato 2003), while the functional hearing of baleen whales in general is thought to be between 7 Hz and 22 kHz (Southall et al. 2007). These frequency ranges directly overlap with most anthropogenic underwater noise, including dredging activities as discussed above, meaning baleen whales are the species most susceptible to any dredge noise effects (e.g. Clark et al. 2009).

As evidenced by overseas studies, the likelihood of any migrating baleen whales being able to detect or hear underwater noise produced by dredging activity is *moderate* (25–75%; Table 2), depending on their proximity to the Port. Marshall Day (2017) note that dredging source levels will be similar to the majority of vessels currently travelling to and from the Port. As such any effects are expected to be transitory and non-injurious with the strongest responses resulting in short-term masking of some whales' communication calls and possibly temporary avoidance of the immediate area by whales with calves during their migration (e.g. Todd et al 2015). This conclusion is based on:

Spatial and temporal factors

- mainly lower-frequency noise expected to be generated by dredging vessels and activities that would be detectable by whales up to at least several kilometres, if not more
- only a few whales occur within Hawke Bay waters each year, mainly in winter and some spring months and remaining for only a few days, while southern right whales may stay for a few weeks. Most whales pass by in deeper, more offshore waters past the 100 m depth contour (> 20 km from the Port; see Figure 2, Clement 2010)
- whale species known to frequent Hawke Bay waters are regularly exposed to similar types and levels of underwater noise from commercial and recreational vessels throughout their entire distributional range
- given that most dredging will take place in open water, animals may travel past the vessel while dredging is underway in the Bay. However, no individuals are expected to approach and remain in close enough proximity to the vessel (i.e. < 10 m) long enough for any adverse exposure effects to occur.

Known acoustic factors

- dredging sound levels are not expected to exceed any permanent injury threshold criteria, while whales' short-term visits (i.e. days to weeks) ensure that the likelihood of any other exposure effects (i.e. temporary auditory threshold shift or TTS) will be *low* to *not applicable*.

Odontocetes and pinnipeds

Odontocetes (e.g. orca and dolphins) generally communicate at higher frequency ranges than baleen whales and have the capability to echolocate (produce biological sonar) for navigation and hunting. While most dolphins' functional hearing range is estimated to be quite large, and they can likely detect low-frequency sounds, their sensitivity significantly decreases at frequencies below 1–2 kHz (Au 2000; Southall et al*.* 2007). Pinnipeds' hearing ranges are thought to vary more widely (otariid pinnipeds e.g. NZ fur seal; 60 Hz–39 kHz; NOAA 2016), including some ultrasonic frequencies, and can be quite sensitive to frequencies below 1 kHz (based on grey and harbour seals; Thomsen et al*.* 2009).

While more detailed research is needed in terms of individual species' sensitivity to low-frequency sound, the physiological differences in these species' hearing (relative to baleen whales) may help minimise any direct hearing effects caused by a general increase in lower frequency noise production. It also may explain the continued presence of several dolphin (e.g*.* common, bottlenose) and pinniped species in ports, harbours, and coastal regions with extremely high shipping and development activities world-wide. For example, a study of NZ fur seals in Western Australia reported no disturbance reactions to dredging taking place close to haul-out sites (Todd et al*.* 2015 and references therein).

The noise from dredging and disposal operations is expected to have a *de minimis effect* on local or visiting odontocete and pinniped species (see Table 2). If any effects do occur, they are expected to result from the increase in activity as much as from underwater noise, which may lead to temporary avoidance or even attraction to the activity area. This conclusion is based on:

Spatial and temporal factors

- relatively temporary increase in underwater noise due to capital dredging activities relative to shipping traffic and the current level of maintenance dredging activities
- most odontocete and pinniped species known to frequent Hawke Bay waters are currently exposed to similar types and levels of underwater noise from commercial and recreational vessels throughout their entire distributional range
- NZ fur seals continued year-round occupancy of nearby haul-out sites and occasional presence on the Port breakwater structure despite on-going maintenance dredging taking place over the last several decades.

Known acoustic factors

- dredge sound levels are not expected to exceed any permanent injury threshold criteria (Marshall Day 2017)

- extreme close proximity to the dredge vessel necessary for any other exposure effects (i.e. TTS) to occur, combined with visiting marine mammals' short-term visits to the area (i.e. dolphins—hours to days; and NZ fur seals—days to weeks), ensure that the likelihood of such effects will be *low* to *not applicable*
- differences in functional frequencies ranges between species' hearing sensitivities and the lower frequency sounds produced by dredge activities
- Hawke Bay waters are not considered unique or particularly important feeding, resting or nursery habitats for any residential or visiting odontocete species.

Pile-driving noise

Pile driving has been found to be one of the 'noisiest' of all construction sounds as it generates a very high source level as broadband impulses of underwater sound. A review by Madsen et al. (2006) found that pile driving had the highest potential to disrupt marine mammal behaviour at many kilometres distance, and is an activity that could theoretically induce hearing impairment (i.e. permanent auditory threshold shift or PTS) at closer ranges.

Bailey et al. (2010) measured actual pile-driving sounds off northeast Scotland at various distances ranging from 100 m to 80 km away from the source to determine potential impacts on marine mammals in the vicinity. The authors found any possible hearing injury or impairment (TTS or PTS) was only possible within 100 m or less from the source and dependent on exposure duration. Within 2 km of the source, they recorded peak sound energy between 100 Hz to 2 kHz and this tended to decrease with distance. The authors suggested, in that case, noise levels would more likely affect low to mid-frequency marine mammals (baleen whales to bottlenose dolphins).

To date, no known published studies have focused on the reactions of baleen whales to pile-driving activities and very few have observed cetaceans other than harbour porpoises. Based on their *in situ* measurements, Bailey et al. (2010) predicted that pile-driving sounds have the potential to elicit disturbance behaviours in minke whales and bottlenose dolphins within 40 and 50 km from the source, respectively.

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.

High-frequency cetaceans (e.g. Hector's dolphins) and more acoustically-sensitive animals (e.g. pygmy sperm whales) will detect pile-driving sounds at similar distances to low and mid-frequency cetaceans. However, as greater energy was generally found in the lower frequencies, Bailey et al. (2010) predicted strong avoidance behaviours occurring only within 20 km of the source for these species. Tougaard et al. (2003) noted that harbour porpoises (the cetacean species most analogous to the hearing and sonar producing capabilities of Hector's dolphin) in Danish waters showed a strong negative response to pile driving with all porpoises leaving the area, up to 15 km away, when the driving began and later returning once the activity finished.

The proposed berth construction activities will involve the driving of approximately 275 steel pile casings over a time period spanning months. Marshall Day (2017) used 3D underwater noise modelling software to establish spatial envelopes for sound levels from the piling operation for the Port of Napier coastal area. From these modelling outputs, specific zones of influence for PTS were then generated using the NOAA (2016) *Guidelines for Assessing the Effects on Anthropogenic Sound on Marine Mammal Hearing*. While pile driving has the potential to injure the hearing of any marine mammals within close range, the distances provided by Marshall Day (2017) for PTS from cumulative 24-hour exposure are between 20–580 m. As PTS sound levels will largely be confined to within the Port itself, and given the limited number of animals observed within the general region of the Port, there will be no more than a *low* risk in this instance of any injury exposure effects (see Table 2).

Appropriate sound level thresholds for significant behavioural disturbance are currently being re-analysed (NOAA 2016). In the interim, the behavioural harassment threshold for impulse sounds (such as pile driving) is given as 160 dB re 1 μPa (see Marshall Day 2017). Applying this to the acoustic modelling results, Marshall Day (2017) concluded that as the pile-driving activity is semi-confined with the Port itself, any potential behavioural responses by marine mammals will be limited to distances of only 2.25 km from the source (see Table 2). The principal response of relevant species to this activity is likely to be abandonment and / or avoidance of the general Port area while piling driving is underway. The relevant factors contributing to this conclusion are very similar to those listed above for dredging effects. Any additional factors specific to pile driving are summarised below:

Spatial and temporal factors

- any underwater noise produced from the proposed pile driving will be intermittent over the course of at least a year and localised to the surrounding Port area and nearby waters (approximately 2.25 km).

Known acoustic factors

- a small estimated spatial zone for the onset of TTS or PTS to occur (< 600 m), confined mainly within the Port itself (Marshall Day 2017), ensures that the likelihood of exposure effects will be *low* to *not applicable* with mitigation (for more details see Section 4.1),
- the estimated spatial area for any significant behavioural responses (approximately 2.25 km) is considered relatively small and unlikely to affect most visiting odontocetes or any whales migrating offshore

- no significant behavioural responses by fur seals are expected to any airborne noises from pile driving given the distance to haul-out locations (Marshall Day 2017).

Marshall Day (2017) has provided recommendations for several mitigation measures to ensure that any potential pile-driving effects are minimised. These are further discussed in Section 4.1.

3.1.3. Operational loss and possible entanglements

Potentially harmful operational by-products of any type of coastal development can include such items as lost ropes, support buoys, bags and plastics (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).

The major hazard associated with marine debris from coastal development projects to 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 pose the greatest entanglement risk (e.g. lines used to tie up boats, floats and other equipment, and especially lost ropes and lines). However, the nature of dredge operating activities and equipment involved means the likelihood of entanglement in marine debris from capital and/or maintenance dredging and disposal is *low* (Table 2). Any subsequent effects on marine mammals will be *de minimis* in well-maintained coastal development projects with proper waste management programmes in place.

3.2. Indirect effects

Coastal dredging and associated spoil disposal within any established ecosystem will result in some change to that system. However, the nature and extent of such change will be dependent on many variables, including the scale of dredging. Currently there is little to no research on how ecosystem changes due to dredging activities might indirectly affect marine mammals. While most cetaceans are generalist feeders and flexible in their feeding habits, some species have been known to dramatically alter their distribution patterns in response to even small changes in prey availability (e.g. bottlenose dolphins: Bearzi et al. 2004) and / or ecosystem dynamics (e.g. North Atlantic right whales: Baumgartner et al. 2007). The following section focuses on potential indirect effects that dredging and / or spoil disposal activities could have on the ecosystem as a whole, and more specifically on the abundance, distribution and / or health of marine mammal prey resources.

3.2.1. Quality of dredge spoil

Despite evidence of detectable concentrations of several known contaminants in a large number of global and New Zealand species (e.g. Evans 2003; Fossi & Marsili 2003; Stockin et al. 2007, 2010), predicting the possible consequences of marine mammal exposure to contaminants is difficult due to the lack of available information around most species' distribution ranges, individual sensitivities to pollutants and exposure to non-point sources of pollutants (Jones 1998).

Contaminants and bacteria adsorb to marine sediments, which can lead to their accumulation and bioturbation over time. Dredging re-suspends these sediments and potentially results in these contaminants becoming bioavailable to potential prey species. Health risks to local marine mammals may derive from direct (floating debris or particulates trapped in surface microlayers) or indirect pathways (consumption of contaminants through exposed prey species). The level of exposure to contaminants will depend on the contaminant status and chemical characteristics of the spoil sediments, the subsequent uptake by relevant prey species, and the feeding habits and range of local marine mammal species.

Todd et al. (2015) noted that risks are greatest to marine mammals only when dredging *contaminated* sediments (i.e. not all sediments have significant contaminant loading). In the case of the No.6 Berth Project, contaminants associated with the capital dredge spoil have not been identified as a significant risk for the ecology of Hawke Bay or the benthic area of the proposed spoil grounds (Sneddon et al. 2017).

Todd et al. (2015) further concluded that, even in those cases where contaminated sediments were dredged, exposure of marine mammals was still spatially restricted. In Hawke Bay, local or visiting marine mammals are generalist feeders that potentially range and forage throughout the entire bay, in waters further offshore and along other eastern coastline regions. Hence, individual animals would not be expected to forage regularly or frequently on individual prey fish exposed to dredge spoil or sediments resuspended by project activities.

The absence of a significant source of contamination and the limited potential for exposure means that the likelihood for bioaccumulation and/or biomagnification in local marine mammal species from the resuspension and dispersal of any contaminants in dredge sediments were assessed as *low* to *not applicable,* and the overall effects as *nil* to *de minimis*. This conclusion is based on the following factors:

- reported low contaminant levels in dredged sediments (Sneddon et al. 2017)
- rapid settlement of dredged sediments resulting in limited spatial exposure to individual prey species (Advisian 2017)
- generalist diet and roving nature of local marine mammals is expected to limit contact with any prey species exposed to dredge spoil and resuspended sediments.

3.2.2. Ecological effects on habitat and prey species

Benthic disturbance and habitat loss

Dredging activities are expected to directly affect local food webs to some degree. However, the duration and extent of such changes will vary temporally and are dependent upon the benthic species impacted and the scale of the dredging activity. As a result, a dredging effects review (Todd et al. 2015) concluded that only minor changes (i.e. positive and negative) in the prey resources of local marine mammal are likely to occur in response to most dredging activities, thus limiting further flow-on effects to marine mammals themselves.

The capital dredging of the new channel extension is expected to cause direct loss of benthic biota within the dredging footprint and may result in a small but permanent alteration in the habitat of areas, which are thereafter subject to ongoing maintenance dredging (Sneddon et al. 2017). However, it was concluded that the 60 ha of previously undredged seabed is too small relative to similar habitat in the wider area to significantly affect the functioning of Hawke Bay coastal ecosystems. Once capital dredging and berth construction is completed, it is likely that recolonisation of a range of benthic species will occur between periodic maintenance dredging (Sneddon et al. 2017). This situation is similar to the present benthic dynamics in the existing channel.

Sneddon et al. (2017) similarly concluded that, while smothering of benthic communities will occur within the 346 ha of proposed spoil ground area, this impact will be incremental and intermittent across the project time-frame, allowing for recovery to occur between dredging campaigns. Spoil disposal is furthermore very unlikely to bring about the complete loss of biota within the spoil grounds since the process of recovery will commence between successive deposition events. The naturally dispersive nature of the offshore sediment environment and the dominant taxa within the benthic community are conducive to such rapid recovery.

Sneddon et al. (2017) reported no features of special ecological importance for fish species in the areas that will be directly affected by project activities. Species that utilise the proposed dredging and spoil disposal areas are expected to temporarily avoid the immediate vicinity during phases of direct physical disturbance and due to associated temporary loss of existing food sources. However, it was concluded that the benthic areas involved are too small for such effects to result in any significant impacts on stocks of any inshore fish species at the population level.

It was concluded that the benthic ecological effects of dredging activities will be limited in their spatial extent, displacing only a small portion of individual fish temporarily from sites of direct disturbance; hence short- or long-term flow-on effects to local marine mammal are assessed as being *nil* to *de minimis*. This conclusion was based on:

- alteration and/or temporary loss through dredging of a relatively very small percentage of benthic habitat within Hawke Bay inshore waters, which is expected to recover between subsequent periodic maintenance dredging
- benthic smothering effects confined to a limited region around the spoil disposal site, and affected communities expected to recover rapidly (time-scale of months)
- only temporary and localised avoidance of capital dredging and / or spoil disposal sites by fish (representing marine mammal prey species) with minimal effect on species populations or recruitment
- no evidence that project sites serve as unique and / or rare habitat for any marine mammal species in terms of feeding activities
- overall home ranges of local marine mammal species are large and overlap with similar types of habitats in other parts of the Bay and along other eastern coastline regions.

Turbidity plumes

Turbidity plumes are generated from the re-suspension of sediments at the dredging site and any marine location where dredged spoil sediments are later deposited. There is potential for such plumes to be additive to existing turbidity levels, or become entrained in local gyres and eddies. High turbidity levels and the propagation of any sediment plumes created by dredging and / or disposal activities may affect communities within or adjacent to work sites (e.g. Sneddon et al*.* 2017).

However, marine mammals are known to inhabit fairly turbid environments worldwide and especially within New Zealand. While they generally have very good vision, it does not appear to be the sense they rely upon most for foraging. Instead, odontocetes mainly depend on echolocation systems for underwater navigation and searching for food. Even baleen whales, which do not have the ability to echolocate, regularly forage in dark, benthic environments, stirring up sediments to find prey. Thus, turbidity plumes are more likely to affect marine mammals indirectly via their prey resources rather than directly. Previous research on plumes suggests that any impacts on local food organisms should be short term and limited in scale, and therefore, no substantial flow-on effects to local marine mammals are expected (e.g. Todd et al*.* 2015 and references therein).

Hydrodynamic modelling by Advisian (2017) has indicated that the sand fraction (estimated between 73% and 83% of dredged material) will settle onto the seabed very close to the source of disturbance. The plumes from spoil disposal are predicted to significantly exceed, in extent, those from dredging. However, suspended sediment concentrations (SSC) within spoil disposal plumes are expected to be less than 30 mg/L above background around 2–3 km of the source activity for 98% of the time during dredging. Ambient turbidity in inshore Hawke Bay waters is generated from significant riverine inputs and natural wave resuspension (Sneddon et al*.* 2017), but also appears to be dependent on wind speed more generally (Ellison 1995). As such, most finfish species frequenting these waters are already acclimated to highly variable and occasionally elevated levels of turbidity (up to 80 mg/L at Pania Reef; Sneddon et al. 2017). Hence they are expected to tolerate the turbidity plumes generated from project activities in all but directly adjacent areas (tens to low hundreds of metres). Therefore, any ecological effects of dredging activities will be limited in their spatial extent and are likely to displace only a small proportion of individual fish temporarily from disturbance sites or areas affected by high strength plumes.

Overall, any indirect effects from turbidity plumes associated with dredging activities are not expected to have any adverse or long-term flow-on effects to local marine mammals in the region and therefore these effects are assessed as being *nil* to *de minimis*. This assessment is based on the following factors:

- turbidity plumes resulting from dredging or disposal activities are expected to settle out relatively quickly and are not expected to adversely affect benthic habitats beyond hundreds of meters from the source
- regular exposure to highly turbid waters already occurs for local marine mammal species and their prey
- unlikely that whales would avoid or be affected by any localised turbidity plumes as they regular migrate through New Zealand’s highly turbidity coastal waters each year.

4. MITIGATION AND MONITORING

4.1. Mitigation

Sections of Policy 11 of the New Zealand Coastal Policy Statement relevant to the potential effects to marine mammals from the proposal are:

(a) avoid adverse effects of activities on:

(i) indigenous taxa that are listed as threatened or at risk in the New Zealand Threat Classification System (NZTCS) lists;

(ii) taxa that are listed by the International Union for Conservation of Nature and Natural Resources (IUCN)

(b) avoid significant adverse effects and avoid, remedy or mitigate other adverse effects of activities on:

(ii) habitats in the coastal environment that are important during the vulnerable life stages of indigenous species;

(iv) habitats, including areas and routes, important to migratory species.

In relation to 11(a), species' status under the NZTCS and IUCN systems are listed in Table 1 and were considered when assessing the consequence of potential effects on the relevant species (in particular, orca and southern right whales). In regards to 11(b), Hawke Bay waters are not considered to be of particular ecological significance in terms of feeding, resting or breeding habitats, as these waters represent only a small fraction of similar habitats available along nearby coastal regions used by these species (Clement 2010 and Section 2.2). The exception is southern right whales, in which a few mother/calf pairs are thought to use Hawke Bay as a temporary nursery area over late winter and some spring months. If the recommended mitigation plans, as discussed further below, are followed any potential adverse effects to threatened marine mammals species or their habitats from the proposal will be *de minimis*.

Overall, the likelihood of any potential impacts from dredging and construction activities affecting local and visiting marine mammals is assessed as *low* when considering the types of effects, their spatial scales and durations, and relevant species' information. However, given that some of the possible consequences of rare events (i.e. vessel collision, pile-driving effects or entanglement) could have population level effects (i.e. injury or death of an endangered or threatened animal), several best management practices (BMPs) are recommended as mitigation actions in relation to marine mammals and the proposed activities in the Port of Napier (Table 2 and Table 3).

To ensure that the most appropriate measures are in place, it is also suggested that a marine wildlife management plan (MWMP) be completed in consultation with DOC prior to commencing operations. This plan should outline in detail the procedures referred to in Table 3, determine timelines for any on-going monitoring (see Section 4.2) and / or any implemented mitigation procedures that will need to be reviewed for effectiveness during operations (e.g. Appendix 1). Together, industry and DOC can use this information to further understand any actual effects on marine mammals due to proposed dredging and construction activities, and if necessary, help reduce the risk of similar incidences with any future maintenance dredging.

In regards to vessel strike, researchers have found that, when given a chance, most marine mammal species will exhibit avoidance behaviours when approached by vessels moving at speed, by a vessel producing rapidly changing noises and / or when a vessel directly approached an animal (Richardson 1995). Yet, despite a *low* probability of the dredge vessel both encountering and striking a marine mammal within the Hawke Bay region, the risk is not zero. The use of simple and commonsense boating behaviour guidelines around marine mammals by the dredge vessel, particularly around baleen whales and any calves, are expected to further reduce any risk of collision to as near to zero as possible (see Appendix 1 for further details). In addition, it is recommend that real-time / recent sighting information is obtained from DOC in order to anticipate and mitigate potential interactions with any whale species (particularly southern right whales) sighted in and near the project area.

Although no underwater noise guidelines exist for either dredging or pile-driving activities within New Zealand, several overseas regulators provide excellent context and guidance on appropriate noise thresholds and mitigation measures for avoiding adverse noise effects on marine mammals (e.g. US-NOAA 2016, Australia-DPTI 2012). The 'NOAA Guidelines', as discussed in detail in Marshall Day's (2017) report, provide functional hearing specific sound threshold criteria for sound levels likely to cause injury (i.e. TTS and PTS; NOAA 2016) or significant behavioural responses (NOAA 2011) in marine mammals.

Given the above guidelines and lack of any publically available *in situ* noise level data for dredge and construction activities in New Zealand waters, I concur with Marshall Day's recommendation that a construction noise management plan be completed prior to commencing any proposed operations. The aims of this plan should be to *identify practicable noise mitigation measures and … minimise adverse noise effects on marine animals and fauna* (Marshall Day 2017). The key mitigation actions are briefly described below with some additional considerations:

- Verification of the actual noise levels produced from dredging and pile-driving activities by measuring the associated underwater noises of these activities as soon as practical once the project has begun. Results will be reviewed with the same parameters used for acoustic modelling by Marshall Day (2017).

- The preferred methods for minimising underwater noise in the first instance would be the selection of the smallest practical dredge vessel and vibro-driving, due to the lower level of sound produced using this technique compared to impact-driving. However, full consideration must be given to other environmental factors such as substrate type and duration implications.
- Soft-start / ramp-up procedures in which the pile driving slowly increases the energy of the emitted sound giving any animals in the area time to move a safe distance away (Marshall Day 2017).
- Established safety zone that involves a dedicated observer scanning a defined radius of the water's surface and coastal shoreline around the construction area for the presence of fur seals, dolphins or whales prior to commencement of pile-driving activities. If present, ramp-up procedures for pile driving should only commence once they have moved out of the zone or cease if animals enter the zone. The size of the zone will be dependent on the technique used for pile driving (vibro-driving vs impact-driving) and any mitigation devices used, such as plastic or plywood dolly/cushion head (Marshall Day 2017).

Table 3. Proposed mitigation goals and practices to mitigate or minimise the risk of any adverse effects of dredging and construction activities on marine mammals in Hawke Bay.

Potential effects	Mitigation goal	Best Management Practice	Reporting / monitoring
Marine mammal / vessel strike due to increased vessel activity	1. Minimise the risk of dredge or construction vessel collisions with any marine mammal and aim for zero mortality	1a. Adoption of best boating guidelines for marine mammals, including speed limits, to further reduce any chances of mortality from vessel strikes (see Appendix 1). 1b. Consider establishing a designated observer on the vessel and maintain a watch for marine mammals during any dredging and disposal activities over daylight hours. 1c. Liaison with the Department of Conservation (DOC) over the project period for real-time / recent sighting information, in order to anticipate and mitigate potential interactions with any whale species (but particularly southern right whales) sighted in and near the project area.	• Record and report the type and frequency of any marine mammal sighted before, during or after transiting to or from the disposal site. • Record all vessel strike incidents or near incidents regardless of outcome (e.g. injury or mortality). • 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.
Behavioural and / or physical responses to underwater sound from dredging / disposal and pile-driving activities	2. Minimise the avoidance (attraction) or potential for injury of marine mammals to dredging and construction activities	2a. Establish a construction noise management plan (as part of the MWMP) that considers; <u>Dredging Activities</u> 2b. Regular maintenance and proper up-keep of all dredging equipment and the vessel (e.g. lubrication and repair of winches, generators). <u>Pile-Driving Activities</u> 2c. Establish designated safety zone and trained marine mammal observers on site to maintain a watch before, during and post any pile-driving activities (during daylight hours only). 2d. Adoption of soft-start procedures and choose plant/techniques on the basis of minimisation of underwater noise levels (e.g. vibro-driving preferred over impact-driving).	• Measure actual underwater noise levels from dredging and pile-driving activities, and adjust any modelling results and monitoring zones based on these data, if necessary. • Record and report the type and frequency of any marine mammal sighted before, during or after pile-driving activities. Include behavioural data if possible. • Project sightings from 1b and 2c should be reported to DOC for input to database.
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). 3b. Ensure that all dredging, support vessels and other project activities have waste management plans in place before the commencement of works.	• Record all entanglement incidents or near incidents regardless of outcome (e.g. injury or mortality). • 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.

4.2. Recommended monitoring

Given the general lack of marine mammals' presence in project waters and that the overall effects of this proposal are assessed as *de minimis*, no systematic marine mammal surveys are recommended. In this case, it would be more realistic to implement an informative monitoring programme focused on simple and answerable questions related to specific aspects of the dredging and pile driving rather than attempting to assess cause-effect relationships, which is not warranted or practical[4]. In this regard, monitoring is not intended to statistically assess the impact of dredging or pile driving on local marine mammal populations in relation to pre-determined indicators or thresholds. Instead, the monitoring programme has been designed to help validate any potential assumptions of the AEE and further fine-tune mitigation options.

Informative monitoring questions should include:

- What are marine mammal behavioural reactions to the presence of dredging vessels during active versus non-active operations? For example, if present prior to dredging start-up, do animals immediately leave at start up?
- What are marine mammal behavioural reactions to spoil disposal? For example, if present prior to disposal, do animals immediately leave once disposal begins? If so, what is the mean time it takes them to return (if at all)?
- Are marine mammals visiting/passing through the dredging or spoil disposal area in between deposition events?
- What are the actual noise levels and frequencies produced from dredging/disposal and pile-driving activities within the Port and at the disposal site?
- How many delayed starts or shutdowns occurred due to marine mammal presence (and what species were these) during a single daylight period during pile-driving activities?

Informative monitoring should involve the collection of visual sighting data from dredging and construction support vessels within the project area during daylight hours. A well-kept database can help confirm the presence (or absence) of any marine mammal species during dredging and construction activities. Another advantage of such a programme is that it will allow for the effectiveness of any mitigation measures put in place to be revisited and amended, if necessary, while project operations are underway. Such information is crucial towards continuing to investigate and develop appropriate mitigation measures in the context of this proposal.

[4] There are inherent problems associated with implementing comprehensive monitoring programmes for marine mammals around cause-effect relationships. This is due to the animals' mobility and flexible behaviour, highly variable population dynamics, and low sample sizes, with the manifestation of impacts from dredging likely to be very small relative to other stressors (and consequently lost in the 'noise' of background variability). As such, even with an established baseline dataset and a high level of long-term effort, it would be highly unlikely that any statistically valid conclusion could be reached in terms of a dredging effect on the population.

5. CONCLUSIONS

The purpose of this assessment of effects report was to describe the existing environment in terms of the local and visiting marine mammals that utilise and / or are influenced by the Hawke Bay ecosystem. In particular, information on the various species was reviewed for any life-history dynamics that make the animals more vulnerable to dredging or construction activities or where proposal sites may overlap with ecologically significant feeding, resting or breeding habitats (which include prey resources). This in turn, enabled the potential effects associated with the dredging, spoil disposal and construction components on marine mammals to be assessed in the context of the proposal.

The marine mammals most likely affected by the proposal include the few species that frequent the inshore waters of Hawke Bay year-round or on a semi-regular basis. These species include NZ fur seals, common dolphins, orca and southern right whales. However, these coastal waters are not considered ecologically significant habitats for these species. Instead Hawke Bay waters represent only a small fraction of similar habitats available to these marine mammals throughout nearby coastal regions. A qualified exception is made for the southern right whales and their temporary use of these waters as potential winter nursery habitats.

In light of the potential direct and indirect effects highlighted in this report, the overall risk of significant adverse effects on these species arising from the proposed No.6 Berth Project was assessed as *de minimis* when considered with the recommended mitigation actions. These conclusions were based in part on information from other consultant reports on the expected levels of underwater noise due to dredging and construction activities (Marshall Day 2017), concentrations of contaminants in dredging materials (Sneddon et al. 2017), expected effects on local benthos and fish populations (Sneddon et al. 2017), and modelled and predicted turbidity plume dynamics (Advisian 2017).

Informative monitoring is recommended and involves the recording of visual sightings of marine mammals from dedicated observers on the project vessels during dredging, disposal and pile-driving activities. Given the *low* likelihood and *de minimis* effects of the proposal, this monitoring plan is based on collection of information to improve understanding of how marine mammals respond to these activities, rather than testing of specific predictions of effect. Such a programme will serve the dual purpose of collecting important data on the actual effects of dredging and pile driving on New Zealand marine mammals while assessing the effectiveness of any mitigation measures put in place. These measures can then be amended, if necessary, while operations are underway or for later maintenance dredging projects.

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7. APPENDICES

Appendix 1. Guidelines for boating around marine mammals.

The overall risk of a vessel strike between dredging vessels and marine mammals is low. In the unlikely case that a vessel should encounter a marine mammal while working, the following 'best practice' boating behaviours used worldwide around marine mammals should further reduce any chances of collision.

General

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 southern right and humpback 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.

Small to medium whales and dolphins —– such as common 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) approach 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.