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Marine Mammal Management Plan

LPC Channel Deepening Project: Stage 1

Lyttelton Port Company
Enviser Ref: 1006.MMMP
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lpc Lyttelton Port Company

Table of contents

Appendices

Foreword

This plan has been collated by Enviser Limited with technical input provided by the following:

- Deanna Clement, Marine Mammal Expert, Cawthron Institute
- Matt Pine, Underwater Acoustics and Marine Mammal Monitoring Expert, Styles Group Ltd
- Irena Dots, Environmental Engineer, Bosklais
- Paul Bartley, Works Manager, Boskalis

Abbreviations

CD: Chart Datum

LPC: Lyttelton Port Company

MMMP: Marine Mammal Management Plan (this plan)

TTS: Temporary Threshold Shift

MMO: Marine Mammal Observation/Observer

BHD: Back Hoe Dredge

CDP: Channel Deepening Project

TSHD: Trailer Suction Hopper Dredge

1 Introduction

1.1 Purpose of the MMMP

Lyttelton Port Company (LPC) is undertaking Stage 1 of the Channel Deepening Project to widen, deepen and lengthen its navigation channel to allow for larger vessels to access the Port at all tides. Dredging will also deepen and enlarge the ship-turning basin and some berth pockets, as well as deepen the seabed in Te Awaparahi Bay in advance of the proposed reclamation. The dredge spoil will be disposed of at an offshore disposal ground in Pegasus Bay, approximately 6 km from Godley Head.

The Marine Mammal Management Plan (MMMP) has been prepared to set out management responses in relation to marine mammals. The project area is within the Banks Peninsula Marine Mammal Sanctuary and provides habitat for the endangered Hector's Dolphin.

The purpose of this plan is to satisfy Condition 5 of the consent (CRC 172455/172522) by specifying the following:

- How the risk of vessel collisions with marine mammals will be minimised; and
- How the impacts from dredge noise on marine mammals will be reduced to the greatest extent practicable.

Additionally, this document assesses the risk of, and provides measures to minimise, the effects of entanglement in debris.

1.2 Scope of MMMP

Three species are identified as being present within the area of dredging and disposal:

- Hector's dolphin / upokohue (*Cephalorhynchus hectori hectori*);
- New Zealand fur seal *(Arctocephalus forsteri*); and
- Southern right whale (*Eubalaena australis*).

This MMMP describes the monitoring and mitigation measures that will be employed during the works to minimise effects on these species.

1.3 Roles and responsibilities

Table 1.1 summarises LPC's key project staff and contact details for each. The Project Director is ultimately responsible for implementing this MMMP.

It is the responsibility of LPC to ensure that the Contractor understands and can implement the requirements of this MMMP. The Contractor is responsible for training their staff and ensuring that they understand and are able to implement the requirements of the MMMP.

Table 1.1: Summary of key contacts, roles and responsibilities

Name	Role/Responsibility	Organisation	Contact details
Martin Watts	Project Director	LPC	martin.watts@lpc.co.nz 021 729 567

TBA	Project Manager	LPC	
Jared Pettersson	Project Environmental Adviser	LPC/Enviser Ltd	Jared.pettersson@lpc.co.nz 021 679 838
Paul Bartley	Dredge Contractor Works Manager	Boskalis	paul.bartley@boskalis.com
Irena Doets	Contractor Environmental Supervisor	Boskalis	Irena.doets@boskalis.com
Leonie Anderson	Water quality monitoring and real-time data analysis	Vision Environment	Leonie@visionenvironment.com.au
Dr Deanna Clement	Project Marine Mammal Specialist	Cawthron Institute	Deanna.clement@cawthron.org.nz
Dr Matt Pine	Project Underwater Noise Specialist (measurement)	Styles Group	matthew@stylesgroup.co.nz
Darran Humpheson	Project Underwater Noise Specialist (modelling)	AECOM	darran.humpheson@aecom.com

To ensure vessel crew are aware of the risks and controls to be implemented during the dredging, all vessel crew will attend the Marine Mammal Observation (MMO) toolbox talk, given by the Contractor's Environmental Supervisor, who will keep the attendance sheets in their records.

A marine mammal expert (Deanna Clement, Cawthron Institute) and Contractor's Environmental Supervisor will give training to relevant project personnel (i.e Master, designated observers etc), at the start of the project and whenever a new vessel starts to work for the project. Reminders and updated information will be provided in toolboxes throughout the project.

2 Environment and Project description

The following sections describe the environment of the project area, and the proposed works that will project will be undertaken in.

2.1 Environment

The environment of the project area is described in detail in the project's Environmental Management and Monitoring Plan (EMMP) (Tonkin & Taylor, 2016). Specific information about marine mammals that may be present in the project area is repeated (from the EMMP) below:

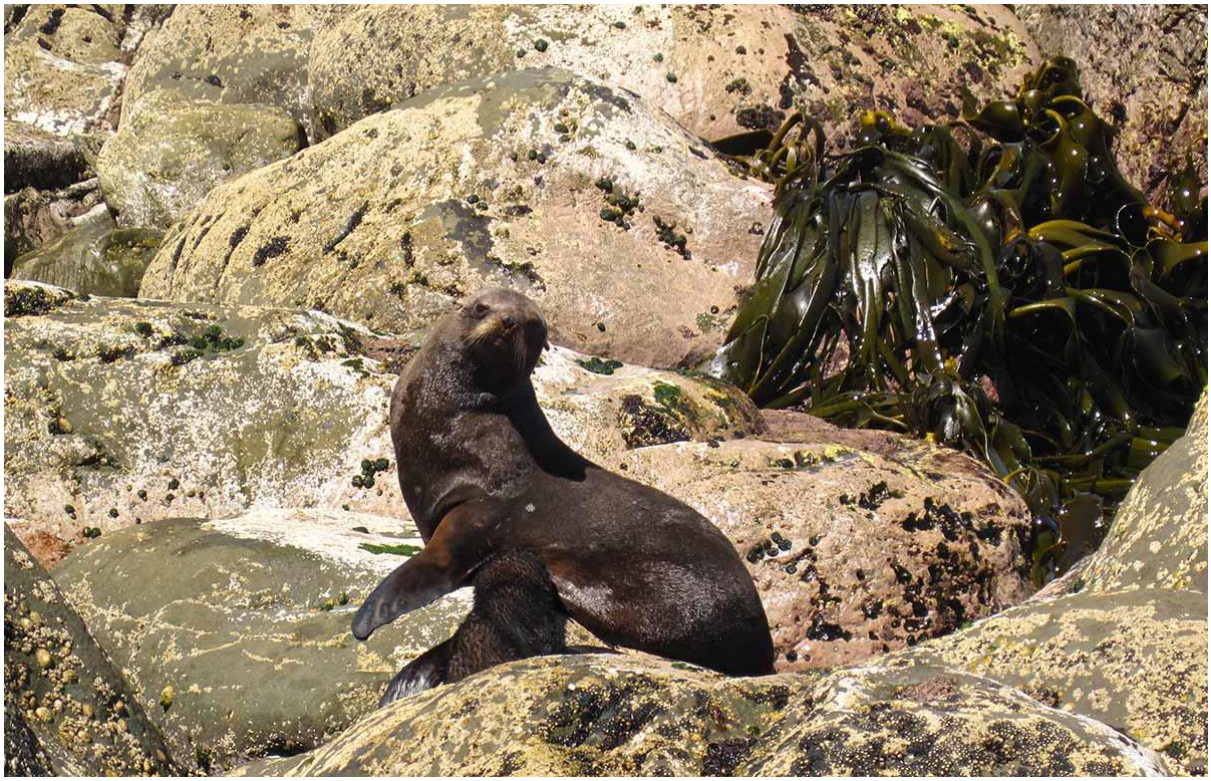
> *The footprint of the shipping channel extension and associated spoil disposal site are located within the boundaries of the Banks Peninsula Marine Mammal Sanctuary (BPMMS). The Sanctuary covers approximately 413,000 hectares and places restrictions on activities within its boundaries for the protection of marine mammals (in particular the endangered Hector's dolphin/upokohue).*

More than 25 cetacean (marine mammal) species have been sighted or stranded within the waters of Banks Peninsula. However, only the Hector's dolphin and New Zealand fur seal reside in the harbour year-round with the southern right whale often sighted offshore of Banks Peninsula.

Hector's dolphin/upokohue is endemic to New Zealand waters. Of the estimated 15,000 Hector's dolphins known to occur around the South Island, approximately 2,000–4,000 dolphins are found in the waters of Pegasus Bay year-round. The dolphins generally reside in the bays and harbours of Banks Peninsula in the summer and autumn months and move further offshore in the cooler months.

Photograph 2.1: Hectors Dolphin (WWF New Zealand)

Several New Zealand fur seal breeding colonies are located throughout the more eastern and southern bays of Banks Peninsula (more than 20 km away from Lyttelton Harbour/Whakaraupō and the offshore disposal ground). However, New Zealand fur seals often cover large distances away from their breeding grounds and thus are commonly seen within Lyttelton Harbour/Whakaraupō ,Port Levy/ Koukourārata and Pegasus Bay.



Photograph 2.2: New Zealand fur seal (DOC image[1])

Regular sightings of southern right whales occur each year off Banks Peninsula, in particular in the northern bays and along the Lyttelton Harbour coastline, as whales migrate back to their traditional wintering and calving grounds around New Zealand. At the current sighting rate, at least one or two southern right whales are expected to appear near Lyttelton Harbour / Whakaraupō each winter where they will remain for anywhere from a few days to several weeks (Cawthron, 2016).

[1]http://www.doc.govt.nz/nature/native-animals/marine-mammals/seals/nz-fur-seal/

Photograph 2.3: Southern Right Whale and calf

2.2 Description of the proposed works

2.2.1 Requirement for channel deepening

The CDP will deepen, enlarge and extend the main navigational channel and associated swing basin/berth pockets. Lyttelton Port (The Port) is currently New Zealand's third largest deep-water port and provides a vital link to international trade routes and a key role in the global transport network. However, the current channel does not have the draught to cope with the international trend for increasing vessel sizes. Deepening the channel will allow the Port to keep up with international trade demand which is a key facilitator of the regional and national economy. As part of the construction methodology, dredging will also be undertaken for sections of the footprint of the proposed Te Awaparahi Bay reclamation.

2.2.2 Location and extent of deepening works

The existing channel is 180m wide, 11.9m deep and approximately 6.5km in length. Stage 1 of the Channel Deepening Project will see the channel widened to 200m, increase in length to approximately 9km and increase in depth by approximately 2m. The swing basin is also being deepened and enlarged increasing the width from approximately 450m to 615m. This will involve the dredging of approximately 5 million cubic metres (m^3) of sediment. In addition, a further approximately 1 million $m^3$of material will be dredged to allow for:

- Deepening of the existing berth pockets at Cashin Quay;
- The creation of new pockets to serve the container terminal at Te Awaparahi Bay; and

- Removal of upper layers of sediment (to approximately -20 m CD[2]) within the proposed Stage 1 reclamation footprint at Te Awaparahi Bay as part of the reclamation construction methodology.

The navigation channel dredging and the reclamation dredging are separate projects and may be undertaken by different dredge contractors.

2.2.3 Dredging equipment and execution

Channel deepening will be primarily undertaken by a Trailer Suction Hopper Dredge (TSHD). TSHDs have a trailing suction pipe (or pipes) attached to a suction head that is capable of removing a lateral section of seabed. The seabed material is delivered into the hopper (hull) of the dredge. The spoil will then be disposed of to sea at the spoil disposal ground.

The TSHD is appropriate for the predominantly soft sediments found in the Lyttelton Harbour seabed. However, other types of dredges may need to be used, for example if areas of more consolidated sediment are found, or space constraints prevent the use of a TSHD. In these instances, a grab dredge or backhoe dredge may be required. It is anticipated that a backhoe or grab dredge may be needed for the following parts of the dredging:

- Portions of, or all of the reclamation related dredging;
- Portions of the berth pocket deepening; and
- Some of the detailed areas of the swing basin, i.e. corners.

To provide final levelling and assist in dredging tight corners, a sweeping spread will be deployed. This will include a sweep vessel (tug or similar) and a sweep bar or plough which is dragged across the sea floor.

2.2.4 Timeframes

This stage of channel deepening will commence in mid 2018 and is anticipated to take approximately 3-6 months to complete.

The reclamation dredging will commence in the 3rd or 4th quarter of 2018 and is anticipated to take approximately 3-12 months to complete (depending on the method).

At least one more stage of dredging will be required in order to provide vessels with a draught of up to 14.5 m access to the Port, should this be required by LPC.

A formal review of the performance of this MMMP will be undertaken upon completion of Stage 1 and updates to monitoring frequencies, locations and other matters made as necessary prior to the commencement of Stage Two of the CDP (refer to Section 7.6 for further details).

2.3 Regulatory requirements

The management of effects on marine mammals is subject to the provisions of the Resource Management Act 1991, New Zealand Coastal Policy Statement and Regional Coastal Environment Plan for the Canterbury Region. These are implemented through the resource consent conditions.

[2] Chart Datum

This MMMP is a requirement of the consent conditions for the following resource consents granted to LPC (the Consent Holder) by the Canterbury Regional Council (the Consent Authority).

- CRC172455 – A Coastal Permit, under section 12 of the Resource Management Act 1991, to:
  - dredge (disturb) seabed material for the purposes of deepening, extending and widening a shipping (navigation) channel that includes a ship-turning basing, and berth pockets;
  - dredge (disturb) seabed material for the purposes of the construction of a reclamation in Te Awaparahi Bay; and
  - deposit seabed material (from the above activities) on the seabed.
- CRC172522 – A Discharge Permit, under sections 15, 15A and 15B of the Resource Management Act 1991, to:
  - discharge contaminants (seabed material and water) into water associated with channel deepening dredging as described in CRC172455;
  - discharge (dump) dredge material from a ship into water at the disposal ground as described in CRC172455; and
  - discharge contaminants (seabed material and water) from a ship into water associated with channel deepening as described in CRC172455.

For the purposes of this report, CRC172455 and CRC172522 are collectively referred to as "the Consents".

Performance standards aren't specified in the consent conditions, but there is a requirement for this Plan to, among other things:

- set detailed guidelines for the dredge and attendant vessel including speed limits around mammals;
- describe the methods to characterise underwater noise to determine effects on marine mammal hearing; and
- describe the measures to maintain the vessel, including all dredging equipment, to reduce underwater noise.

This plan provides a framework for compliance with these resource consents related to the marine mammal monitoring and management and should be read in conjunction with the resource consent conditions.

3 Environmental risk assessment

In accordance with Condition 5 of the Consents, the MMMP needs to evaluate the following potential risks to marine mammals associated with the dredging and disposal activities:

- Vessel strikes
- Underwater noise

The following sections evaluate these risks.

3.1 Vessel strikes

Baleen whales have had the most reported incidents of vessel strikes, however the risk of collision is minimal if the activity avoids critical habitats and seasons (eg resting, feeding, breeding) (Todd et al. 2015).

The risk of a vessel strike (injury or mortality) is assessed as LOW[3] for the following reasons:

- Only 1-3 individual whales are sighted within or near Lyttelton Harbour / Whakaraupō each year, mostly in winter months, and remain only for a few days up to a few weeks;
- Lyttelton Harbour / Whakaraupō is not considered to be an important feeding, resting or breeding area for marine mammals;
- The dredge vessel will be slow moving (1-3 knts) while dredging and normal operating speed while travelling (10-15knts) should be slow enough for marine mammals to be detected and avoided;
- Species that regularly visit the area are in contact with all types and speeds of commercial and recreational vessels and are used to avoiding these vessels;
- The dredge will only represent a small and temporary increase in vessel traffic in the area; and
- There are no reported incidents of marine mammal strike by a dredge vessel in Lyttelton Harbour / Whakaraupō despite over 100-years of ongoing dredging activity.

3.2 Underwater noise

Dredging activities will involve a very minor increase in vessel traffic and mechanical activities that may alter the amount and character of underwater sound in the project area. The noise from dredging will vary with the type and size of dredge vessel, the stage of the dredging process, the type of sediment and the background sound conditions.

Marine mammals use sounds for communication, orientation, foraging and predator avoidance. An increase in underwater noise can impact marine mammals, resulting in avoidance of noisy areas, behavioural changes, auditory masking or physical injury.

The risk of underwater noise from dredge operations impacting on marine mammals is assessed as LOW for the following reasons[4]:

- Dolphins generally communicate at high frequency ranges and are less sensitive to the low-frequency sounds produced by dredging activities;
- While baleen whales communicate at frequencies that overlap with dredging activities, dredge noise would be detectable by whales up to at least several kilometres outside the harbour, allowing them to avoid the area;

[4] Clement D 2016. Assessment of effects on marine mammals from Lyttelton Port Company channel deepening project. Prepared for Lyttelton Port of Christchurch. Cawthron Report No. 2869.

- Dredge sound level ranges are not expected to exceed injury threshold criteria for either Hector's dolphin or whales[5]; however, *in situ* validation of the actual noise levels is necessary;
- Environmental factors, such as soft mud substrates, shallow depths and high sediment load, act to dampen underwater noise production; and
- Previous and current exposure to similar types and levels of dredging noise within Lyttelton Harbour / Whakaraupō has not resulted in any lasting avoidance behaviours (i.e. these species continue to regularly visit the harbour) or led to any known vessel strikes through acoustic masking.

3.3 Marine debris and entanglement

Marine debris from coastal developments may include lost ropes, support buoys, bags and plastics. These objects tend to float and do not degrade quickly. Marine mammals are attracted to floating debris and risk becoming entangled, particularly in floating lines and netting.

The risk of entanglement from dredge operation is assessed as LOW for the following reasons:

- The dredge operation does not involve high-risk materials such as fine lines and netting;
- Dredge operating activities do not involve debris being placed in the water; and
- Proper waste management programmes will be in place.

4 Control measures

Despite the low risk rating, measures are still required to manage the risks of dredging activities on marine mammals. These measures are summarised in Table 4.1 and described in more detail in the following sections.

Specific measures to control the impacts of underwater noise on marine mammals cannot be finalised until the noise of the dredge vessel is determined. Underwater noise will be measured while the vessel is operating in full dredge cycle as soon as practical after the dredging has begun. Using these measurements, spatial acoustic modelling will be verified by the Underwater Noise Specialist. The Marine Mammal Specialist will then recommend control measures, which will be finalised by the Project Manager in consultation with the Contractor and Department of Conservation staff.

[5] NOAA (2011 and 2016) thresholds for Hectors dolphins (high frequency cetacean, the threshold for behavioural change is estimated at 120 dB re.1mPa rms, Temporary Threshold Shift (TTS) at 153 dB re.1mPa^2/s SEL_{cum} and for Permanent Threshold Shift (PTS) 173 dB re.1mPa^2/s SEL_{cum} weighted). For low-frequency animals like southern right whales, NOAA (2016) thresholds are 120 dB re.1mPa rms for behavioural change, 179 dB re.1mPa^2/s SEL_{cum} for TTS, and 199 dB re.1mPa^2/s SEL_{cum} weighted for PTS.

Table 4-1 Control measures

Type of work	Marine mammal risk	Control
Dredging works	LOW	• Regular maintenance of all dredging equipment and vessel to reduce noise and vibration, including maintaining and lubricating rotating parts as required • If noise levels are found to be high and TTS could manifest, the dredge shall cease or sufficiently reduce noise making activities (i.e. sediment extraction) if a marine mammal comes within (TBA following noise measurement m) of an active dredge vessel and until the animal has left the pre-determined 'shut-down' zone. • Crew member(s) will be trained as designated marine mammal observer and will be present on the vessel at all times the dredge is operating during daylight hours. • Avoid loose ropes over the side of the vessel and minimise loss of debris from the vessel.
Travel to / from dredging and disposal grounds	LOW	• Crew member(s) will be trained as designated marine mammal observer and will be present on the vessel at all times the dredge is operating during daylight hours. • Detailed guidelines for operating the vessel, including speed and direction controls following sighting of a whale, or being made aware of a whale being present in the area. • Liaise with the Department of Conservation on whale sightings, particularly southern right whale. • In case of a fatal marine mammal incident, immediately notify DOC.
Disposal of dredge spoil	LOW	• A trained and designated marine mammal observer will be present on the vessel at all times the dredge is operating during daylight hours. • Avoid loose ropes over the side of the vessel and avoid loss of debris from the vessel. • Liaise with the Department of Conservation on whale sightings, particularly southern right whale.

4.1 Vessel strike

Slow moving marine mammals that regularly swim at the water surface, may be impacted by vessels movements. The Southern Right Whale is at the most risk (albeit very low) as it is the species most likely to be within nearby waters over winter months. Dolphins are far less likely to get struck by a vessel, but attention needs to be paid regardless, especially to Hector's dolphin. Noting that Hector's dolphins are inquisitive mammals and they will approach the vessel and interact with it, i.e. bow ride.

During all phases of the Project, the general principle guiding vessel operations will be to avoid, as far as practicable, any interaction with marine mammals. To achieve this, a number of operational control procedures for vessels shall be implemented.

4.1.1 Designated Observer

As many of the control measures are triggered by the sighting of a marine mammal, a key part of the control measures is having a suitably trained Designated Observer on board during daylight hours. The Designated Observer(s) will be, trained by a suitably qualified Marine Mammal expert, with additional guidance from LPC's Environmental Adviser and the Contractor's Environmental Manager.

Training will include:

- Types of marine mammals likely to be present in the area and how to identify them
- Search and scanning protocol and methods to be used
- Marine mammal behaviours
- Requirements of the relevant consent conditions
- Measures to be taken if marine mammals sighted
- Reporting requirements
- Health and safety requirements specific to undertaking the observations

Photograph 4.1: Marine mammal observation

Marine mammal sightings will be logged and reported according to the schedule in Section 7.

4.1.2 Vessel interaction with mammals

The Marine Mammals Protection Regulations 1992 list the conditions governing behaviour around marine mammals. All seals, sea lions, dolphins and whales are protected under the Marine Mammals Protection Act 1978. It's an offence to harass, disturb, injure or kill marine mammals. Vessels in the vicinity of a cetacean or cetaceans will (with the exception of emergency situations) adhere to the following Department of Conservation (DOC) general guidelines.

- Record any sightings on the Marine Mammal Observation Log Sheet as described in section 6.1.1;
- Approach whales and dolphins from behind and to the side as shown in Figure 4.1 and Figure 4.2;
- Do not circle them, obstruct their path or cut through any group;

- Keep at least 100 m from whales (or 200 m from any large whale mother and calf or calves) and 50 m from dolphins and pinnipeds;
- Do not encourage bow riding by cetaceans. Should any cetacean(s) commence bow riding in front of a vessel, the vessel master will not change course or speed suddenly;
- Ensure that you travel no faster than idle or 'no wake' speed within 300 m of any marine mammal;
- Idle slowly away. Speed may be gradually increased to out-distance dolphins and should not exceed 10 knots within 300 m of any dolphin, and

When operating a stationary or slow-moving dredge (e.g. back-hoe dredge), a 500m safety zone will be enforced around the dredging unit. If marine mammals are observed within the 500m 'safety zone' around the operational dredging unit, any non-essential movement of auxiliary vessels will be prohibited. The speed of any vessels already moving within the safety zone shall be reduced to no wake speed, and avoid the path of the sighted animal(s), until the animals have moved away.

It should be noted, that in confined waters, such as areas within breakwaters, there may be occasions where it may not be possible for vessels to maintain the approach angles or distances without compromising the safety of the vessel and its crew. If such situations should arise, all efforts will be made to minimise vessel interactions with, or disturbance to, cetaceans.

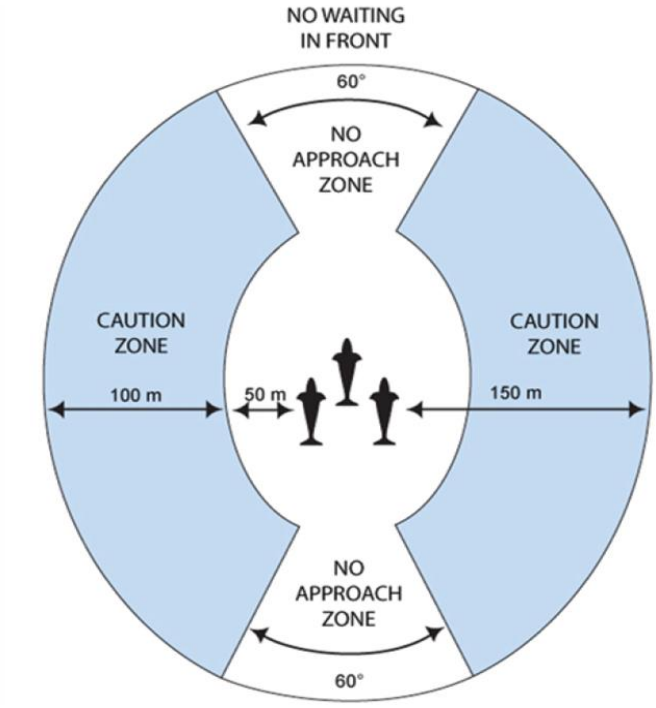


Figure 1: Interaction restrictions for marine vessels encountering smaller marine megafauna, such as dolphins and seals

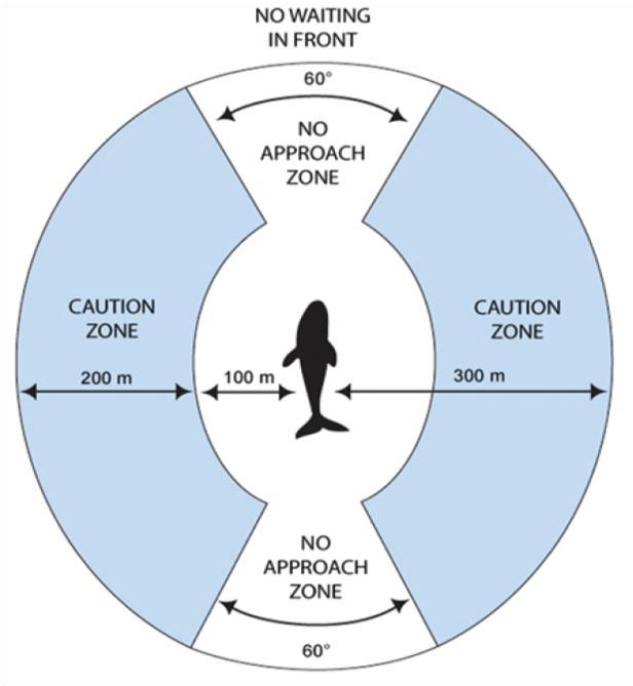


Figure 4.2: Interaction restrictions for marine vessels encountering large marine mega fauna, such as whales

The following sections describe in detail the controls to minimise the risk of vessel strike for the different dredging activities occurring in the Project:

4.1.2.1 Trailing Suction Hopper Dredge dredging in the channel

During dredging, the TSHD moves at speeds of 1-3 knots. The TSHD also has one or two suction pipes down in the water and drag heads on the seabed. These two factors make manoeuvring difficult, but the risk of colliding with a large cetacean at these speeds is low. The following guidelines apply:

- When a large cetacean is seen within 300m from the dredge, stay on course until the cetacean has moved away, and
- If the cetacean is still within 300m when the dredging process has finished, determine whether it is safe to lift the drag head(s) and suction pipe(s) out of the water. Then determine the best direction to safely and slowly move away from the cetacean. Do not increase speed until the cetacean is at least 300m away.

4.1.2.2 Trailing Suction Hopper Dredge sailing to and from offshore disposal areas

During this activity, the dredge sails at a speed of 10-14 knots with a maximum speed limit of 15 knts, depending on whether the hopper is loaded or not. Because of the sailing speed, the following interaction guidelines apply:

- 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, and
  - Maintain or resume normal operating speeds once well way from animals.
- 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, and
  - Once the whale has been re-sighted away from the vessel, slowly increase speed back to normal operation levels.
- 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, and
  - 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, and
  - Maintain or resume normal operating speeds once well way from animals (> 500 m).

4.1.2.3 Trailing Suction Hopper Dredge disposing at the offshore ground

Disposal activities are done at low speeds (1-3 knots). Should a large cetacean be present in the disposal ground, the same guidelines apply as described for dredging in the channel above.

4.2 Controls to minimise effects of underwater noise

Condition 5.3.5 requires that the underwater noise produced by the dredge during dredging is characterised. The purpose of characterising the noise is to ascertain the potential for the noise to cause TTS in marine mammals and put in place appropriate measures to, as far as practicable, reduce this potential effect. Acoustic monitoring shall be undertaken at the earliest possible date once the dredge vessels has arrived to confirm that the actual noise levels associated with dredging activities are as expected (Cawthron 2016).

4.2.1 Method to characterise the noise

In order to characterise the noise underwater noise, measurements of the underwater noise shall be taken during the following operational conditions/production cycles:

- During the sediment extraction phase (for all dredge types), from when the bucket/drag-head/cutter-head enters the water and sediment is being loaded into the hopper/barge, and
- During disposal of sediment.

The methodology for collecting the underwater noise measurements shall include:

- Measurements taken during good weather conditions (Beaufort scale 0-3) to minimise natural noise sources (waves etc);
- Use of LPC's existing passive acoustic recorders (CPODs) already deployed at various locations in the harbour to collect co-incident data on mammal presence. These devices log the number of dolphin click detections, but do not record the signal's waveform (i.e. audible sound files, digitalised as .WAV files). As such, general noise is not recorded;
- Soundtrap HF autonomous recorders will be used to continuously record all sounds from these same fixed locations, using the following method:
  - Installation of the recorders on the existing moorings that house the CPOD devices;
  - Moorings will be selected to capture the noise at various locations in the harbour and at varying distances from the dredge;
  - The recorders will be attached to the line in a way which prevents noise contamination from the mooring or the connection to the mooring;
  - Recordings shall be collected for a duration of approximately 2 months (2-4 weeks prior to dredging and 2-4 weeks during the startup of dredging), and
  - Noise emissions from the vessel during loaded/unloaded transit to the disposal ground can be assessed and monitored from the Soundtrap moorings and AIS data from the area during dredging.
- Additional mobile noise measurements will be collected, also using Soundtrap HF recorders. This will be achieved by:
  - Deploying a recorder (s) from a small vessel with a tether to reduce noise contamination from the vessel;
  - Measure sound at multiple locations around the dredge (i.e. multiple bearings), multiple distances (log based, i.e. 50 m, 100 m, 200 m, 500 m, 1000 m) and at two depths for each location; 1-2m and 5m or mid depth in shallow water locations;
  - Recordings should be of a duration that allows for at least three representative production cycles to be sampled in good weather over the same day, and
  - RMS parameters will be measured to compare with the TTS criteria for ground-truthing and development of underwater noise propagation models.

To evaluate the effectiveness of potential noise reduction controls, the effect of the following controls shall also be evaluate during the noise measurement programme:

- Ceasing/reducing the pumping rate;
- Lifting the drag-head off the seafloor but continuing to pump;
- Ceasing dredging and lifting drag-head off the seafloor, and
- Reduction in propulsion effort

The results will be reviewed to determine the distance that TTS effects could occur, and if necessary, effectiveness of contingency measures considered to reduce any effects. Actual implemented controls will be dependent on the underwater noise levels recorded and efficacy of the controls.

4.2.2 Measures to reduce potential TTS effects

Foremost, all dredging equipment and vessels will be regularly maintained with proper upkeep (e.g. lubrication and repair of winches, generators) to reduce the production of underwater noise (see Section 4.3)).

An observer will be on board the dredge vessel during daylight hours over the duration of capital dredging. The observer will be on watch whenever dredging or disposal activities are underway (including transiting). The observer has three general duties; (1) to record marine mammal sighting data, (2)to help avoid, as far as practicable, any interaction with marine mammals, and (3) if deemed necessary, to enforce noise control measures when marine mammals are, during dredging or disposal activities, within a pre-determined exclusion zone based on *in situ* noise measurements (see Section 4.2.2).

If a marine mammal comes within a pre-determined radius of an active dredge vessel (i.e. undertaking sediment extraction), the noise controls shall be instigated by the designated observer to reduce the risk of TTS onset. The controls could include:

- Ceasing/reducing the pumping rate;
- Lifting the drag-head off the seafloor but continuing to pump;
- Ceasing dredging and lifting drag-head off the seafloor;
- Reduction in propulsion effort, and
- Cessation of ongoing removal (BHD)

Once the mammal has left the pre-determined radius, operations can be resumed. Details of any shut down event should be captured on an incident reporting form (see Appendix A).

The on-board observer will communicate to the Dredge Master when a marine mammal is within the shut down zone of the dredge vessel. The Dredge Master will then implement the control. Once the marine mammals has left the pre-determined radius, the observer will advise the Dredge Master that normal operations can be resumed.

4.3 Vessel maintenance to minimise underwater noise

Condition 5.3.6 requires details of the measures to maintain the vessel, including all dredging equipment, in order to reduce underwater noise. Correct and regular maintenance of the vessel and its systems will minimise the amount of underwater noise produced. During the works, regular maintenance will take place on all equipment. The purpose of the maintenance is to ensure proper and efficient operation of the dredger and to minimise potential effects on the environment (i.e. underwater noise and possible leakage of hazardous substances).

Boskalis vessels and equipment follow the Boskalis Fleet Management System (FMS), which is based on the International Safety Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM-code). All main vessels and equipment of Boskalis are managed centrally by Fleet Management Dredging (FM). To keep track of repair, maintenance and stock of each vessel in the fleet Boskalis uses IBM Maximo Asset Management software. Required intervals of routine inspections, repairs and refits are shown in the system. This also helps plan necessary quantity of assets to stock on the vessels before they leave the port.

Specific attention is made to 'Critical Equipment', which is defined as equipment that is vital for the safety of the Fleet and its crew. FM-430 'Critical Equipment' describes the control, preventive maintenance, purchasing and logistics of these Critical Equipment. For each vessel a general criticality assessment matrix is made for each equipment based on seven parameters:

1. Class
2. Environmental
3. Risk failure start-up
4. Risk failure in operation
5. Effect on production
6. Complexity
7. Cost re-install/change-out

Scores per parameter are based on Table 4.3:

Analyse - Critical value of equipment					
Definition		Score = 1	Score = 2	Score = 3	Score = 4
Class	Is the equipment under Class?	N			Y
Environmental	What is the impact of the failure of the equipment on the environment?	N	Moderate	Considerable	Extremely
Risk failure start up	Are there safety risks for the installation/personnel when the equipment fails to start	N	Low	High	Extremely high
Risk failure in operation	Are there safety risks for the installation/personnel when the equipment fails during operation	N	Low	High	Extremely high
Effect on production	What is the influence of the equipment on the production ?	N	Moderate reduction of production	Considerable reduction of production	Stop of production
Complexity	How complex is the installation?	Simple	Moderate complex	Considerable complex	Extremely complex
Cost re-install / change-out	How high are the costs of repair/ replacement in case the installation fails?	Minor	Moderate	Considerable	Extremely high

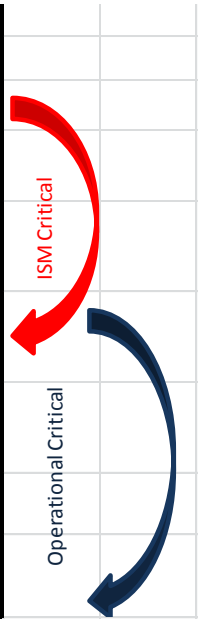


Table 4.3 Maintenance scoring table

For all equipment, a critical value is calculated:

- Based on the 4 first parameters, all equipment with a critical value above 80% is considered as ISM critical;
- Based on the 4 last parameters, all equipment with a critical value above 50% is considered as Operational critical, and
- Based on all 7 parameters, all equipment with a critical value below 50% is considered as non-critical.

For all ISM Critical Equipment, a Preventive Maintenance Schedule has to be implemented to increase the reliability of the equipment. This schedule includes planned maintenance, corrective maintenance and a planned testing and inspection regime. For Operational Critical Equipment, the Preventive Maintenance scheme is based on regular inspections, experience and wear & tear.

Defining the criticality of each equipment on board the vessel allows assessment of the critical equipment of each vessel and the required maintenance to be programmed. The critical value of the equipment is displayed in Maximo and all maintenance activities on Critical Equipment is registered in Maximo. In case of failures of Critical Equipment, the Captain shall directly inform the Fleet Management Team. The Fleet Management Team and the Captain shall jointly and as soon as possible initiate the necessary mitigating actions to limit the risks involved.

As an example, equipment for the TSHD Fairway assessed as ISM critical (critical value above 80%) are:.: CO_2 system, Foam Fire Fighting System, Water Mist Installation, Engine, Rudder, Propulsion, Thruster, Oil Pollution Prevention, Pilot ladder, Radar and Magnetic Compass.

5 Department of Conservation liaison procedures

A two-way liaison with the Department of Conservation shall be established for exchange of marine mammal (southern right whale, humpback whale and orca) sighting data throughout the capital dredging project.

The Department of Conservation shall be contacted regularly weekly over the project period to obtain real-time/recent sighting information. Information will be shared with the designated observer on-board the dredge vessel. This will allow project vessels to anticipate and mitigate potential interactions with any whale species sighted in and near the project area.

In addition, LPC shall collate and, on a weekly basis, share any opportunistic or on-board observer sighting data (Section 6) with DOC.

Contact persons and contact details

Contact person (DOC): Rachel Brown, 0275417691, rabrown@doc.govt.nz

Contact person (LPC): Jared Pettersson, 021 679 838, jared.pettersson@lpc.co.nz

5.1 Incident reporting (vessel strike or entanglement)

Incidents involving the injury or mortality of a marine mammal shall be reported to the Department of Conservation's contact person as soon as is practicable but not more than six hours. In the case of a fatality, Tangata Whenua's representative shall also be notified within 24 hours of the incident occurring.

Incident details shall include as much information as possible relating to incident (e.g. date, time, weather conditions [visibility, sea state, etc], vessel location, speed, activity, etc). Any details of the marine mammal (e.g. species, group size) and its behaviour before, during and after the incident shall also be recorded. If practicable, video or photos could be taken. Information will be used to inform how future incidences could be avoided.

Any incident that results in marine mammal injury or fatality will be documented using the incident reporting form (Section 5.1.1 below).

Contact persons and contact details

Department of Conservation: Rachel Brown, 0275417691, rabrown@doc.govt.nz

Te Hapu o Ngāti Wheke: Andrew Scott, 0221610893, andrew.scott@ngaitahu.iwi.nz

Te Rūnanga o Koukourārata: Marion Crofts, 03 3398 308, koukourarata@ngaitahu.iwi.nz

5.1.1 Incident reporting form

Project vessels shall record any incidents in which a marine mammal physically contacts any project gear with this plan using the incident reporting form in Appendix A. Incident reporting forms will be shared with DOC and Tangata Whenua within 24 hours of the incident occurring.

6 Monitoring and reporting

Monitoring and reporting measures will allow the LPC Project Manager and Contractor to adjust mitigation where necessary to manage the low risk of impacts on marine mammals. Monitoring and reporting requirements are set out in the following sections.

6.1 Monitoring

The monitoring of marine mammals focuses on monitoring any behaviour responses of marine mammals to dredging operations using visual observations by the designated observer on the dredging vessel and passive acoustic detections of Hector's dolphins presence around the harbour, dredge vessel and disposal area. Combining this monitoring data will determine marine mammal (primarily Hector's dolphin) behavioural responses to the dredge activity (including noise) and enable mitigation to be improved where appropriate.

6.1.1 Visual monitoring

During dredging, transit and disposal, the trained crew member on the dredge must visually monitor the area around the dredge, with particular attention placed ahead of the dredger.

Each vessel has a Marine Mammal Observation log sheet on board. When a marine mammal is sighted this will be reported on the log sheet.

- What species of marine mammal is sighted?
- What date and time is the marine mammal sighted?
- At what stage of dredging operations is the marine mammal sighted (e.g. start-up dredging, dredging, travel to/from disposal site, disposal)?
- At what approximate distance is the marine mammal visible?
- Heading and distance from the vessel.
- Direction in which the animal is travelling.
- If the marine mammal is present while the dredge operation changes, what is its reaction (e.g. does it immediately leave, does it leave and return, does it stay)?
- Short description of the animal(s) and their behaviour.
- Mitigation action taken, if any.
- Observer name and position.

A record sheet for Marine Mammal Observers is included as Appendix B.

6.1.2 Noise monitoring

Passive underwater acoustic monitoring within the proposal area will occur before, during and after dredging and disposal activities. Four CPODs (passive acoustic monitoring devices) are installed to gather seasonal data on Hector's dolphin presence and frequency within the harbour, dredging and disposal areas. These devices have gathered over one year of baseline data prior to any dredging activity and will remain for the duration of the dredging project and for a period of 4 months after the capital dredging has ceased.

The resulting data will be used (in conjunction with the visual monitoring data) to verify the predicted visitation/presence of marine mammals (as described in the AEE), to determine use of the project area by marine mammals during active dredging operations and to determine the continued presence, or return, of marine mammals in the project area following the completion of capital dredging.

6.2 Reporting

The following table sets out the reporting frequency.

Table 5-1 Reporting requirements

Information	Timeframe
Marine mammal observation sheets must be provided to the LPC Project Manager	Weekly
Providing marine mammal observation sheets and any monitoring data to DOC	At the end of each month of operation
Marine mammal entanglement or collision incidents or near incidents to DOC	Within 6 hours of occurrence
Behavioural and noise monitoring data collated and reported to LPC Project Manager and DOC	As per conditions of the consent, provide relevant monitoring reports to DOC within 2 weeks of providing to Environment Canterbury
Meetings between LPC Project Manager and DOC staff to discuss monitoring results	Every two months during dredging and on completion of behavioural and noise monitoring report
Vessel maintenance register must be completed by the Contractor and provided to LPC Project Manager	Weekly
All data in Dredging Stage Completion Report	Within 1 year of completing a stage

7 Updating the MMMP

To maintain relevance, this Plan must be reviewed at the following times and amended where necessary:

- Upon completion of the dredge vessel noise monitoring and spatial acoustic modelling;
- Following collation and reporting of the behavioural and noise monitoring data and before a subsequent dredging stage;
- Following any marine mammal entanglement incident or near incident;
- At the completion of each dredging stage, and
- If the size/capacity of the TSHD changes during the project.

If the MMMP is altered due to the above review, an amended copy must be provided to the Canterbury Regional Council in accordance with the consent conditions.

8 References

Cawthron. (2016). *Assessment of Effects on Marine Mammals from Capital Dredging in Lyttelton Harbour.* Christchurch.

Todd VL, Todd IB, Gardiner JC, Morrin EC, MacPherson NA, DiMarzio NA, Thomsen F 2015. *A review of impacts of marine dredging activities on marine mammals.* ICES Journal of Marine Science: Journal du Conseil 72(2): 328-340.

Tonkin & Taylor, 2016. *Channel Deepening Project: Draft Environmental Monitoring and Management Plan*. Prepared for Lyttelton Port Company.

9 Applicability

Enviser Ltd has prepared this report for Lyttelton Port Company and Contractors delivering the Channel Deepening Project in accordance with the agreed scope. No other party may rely on this report, or any conclusions or opinions within it, for any purpose without the express written permission of Enviser Ltd.

The opinions and conclusions within this report are based on the information that was viewed during preparation of the report.

Prepared for Enviser Ltd by:

Jared Pettersson
Director
CPEng, CMEngNZ, IntPE

Reviewed for Enviser Ltd by:

Bianca Sullivan
Director

Marine Mammal Expert

Dr Deanna Clement
Marine Mammal Ecologist
Cawthron Institute

Underwater Noise Specialist

Dr Matt Pine
Styles Group Limited

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Appendix A: Incident Reporting Form

INCIDENT REPORTING FORM (Draft – final likely to be electronic)

Date	Time	Incident Location on Vessel (description; port, bow, propeller,..)	Vessel Position		Vessel type, activity, and speed at time of incident and any subsequent responses*	Species ¥	No. of animals involved	Animal(s) activity before incident and after #	Description of any injury or mortality	Observer/ reporter	Additional comments (e.g. weather and sea conditions)
			Latitude (northing	Longitude (easting)							

* TSHD, CSD, BHD; in transit, dredging, discharging spoil, etc

¥ Using a species guide such as IFAW and AHP (2005).

Feeding, resting, travelling, socialising, breaching, bowriding etc (e.g. see IFAW and AHP (2005]).

Appendix B: Marine Mammal Observers Record Sheet

Channel Deepening Project

Marine Mammal Observations: Record Sheet

NB Draft – Final likely to be electronic

Marine Mammal Observer	
Position	
Date and time of observation	
Location	
Weather and sea state	

What species of marine mammal was sighted	
At what stage of dredging operations was the marine mammal sighted (e.g. start-up dredging, dredging, travel to/from disposal site, disposal	
Speed of vessel	
At what approximate distance is the marine mammal visible	
Bearing (in degrees) and distance from the vessel	
Direction in which the animal is travelling	
If the marine mammal is present while the dredge operation changes, what is its reaction (eg does it immediately leave, does it leave and return, does it stay)?	
Short description of the animal(s) and their behaviour	
Mitigation action taken, if any	