Attachment 11

Draft Underwater Construction Management Plan

MARSHALL DAY Acoustics

BLEDISLOE & FERGUSSON WHARVES

DRAFT UNDERWATER CONSTRUCTION NOISE MANAGEMENT PLAN (UCNMP)

Rp 002 R01 20240240 | 4 February 2025

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1.0 INTRODUCTION

1.1 Overview

Port of Auckland Limited (PoAL) is seeking resource consent for the construction of a new wharf at the northern end of the Bledisloe Terminal and an extension to the Fergusson Terminal (the Project) under the Fast-track Approvals Act 2024. PoAL has engaged Marshall Day Acoustics (MDA) to prepare a construction noise assessment for the Resource Consent application[1].

This draft underwater construction noise management plan (UCNMP) supports the assessment by implementing the recommended underwater noise mitigation and management measures on site. This draft UNCMP meets the requirements of Conditions 29 – 31. It will be updated, if necessary, prior to being submitted for certification by Council.

This UCNMP sets out best practicable options (BPO) for underwater noise mitigation and management for the piling works. It shall be considered a 'living document' that is expanded and updated as the Project progresses and working conditions become clearer. It is intended to be the primary tool to inform the Project's management of underwater construction noise effects.

A glossary of terminology is included in Appendix A.

1.2 Scope

This UCNMP addresses underwater noise from the piling works associated with the Project. Impact and vibratory piling have the potential to generate high underwater noise levels, so a range of mitigation and management measures are required to address potential effects on marine fauna.

Other activities such as dredging using a backhoe excavator, vessel movements, drilling and land-based works are predicted to generate relatively minimal underwater noise. No specific mitigation or management measures are required for these activities, so they have not been addressed further in this UCNMP.

Airborne noise and vibration are not addressed in this UCNMP (or any management plan) because no specific mitigation or management is required to comply with the relevant limits and effects will be reasonable.

1.3 Updating this UCNMP

This UCNMP uses a precautionary approach based on current best practice. However, the field of underwater noise is a rapidly developing area, and best practice may change over the lifetime of the consent due to changes in piling methods, understanding of effects thresholds, or management methods.

The following triggers are appropriate for revisiting the management framework:

- A change in piling method, size or type of piles to be driven
- Revised TTS thresholds/weightings for the species of interest in the inner Waitematā Harbour
- Identification of new species of interest in the inner Waitematā Harbour (confirmation to be provided by a suitably qualified marine ecologist)
- The development of a best practice guide or similar document for management of underwater noise from piling. The document must be supported by the relevant regulatory agencies (e.g. Department of Conservation)

[1] 'Rp 001 r03 20240240 cmf (PoAL Bledisloe and Fergusson wharves - construction noise)', dated 4 February 2025

2.0 CONTACT DETAILS

Contact details for the relevant personal are included in Table 1.

The Project Manager is ultimately responsible for implementing this UCNMP.

Table 1: Contacts

Role	Name	Organisation	Phone	Email
Project Manager	TBC	TBC	TBC	TBC
Ecologist	Paul Kennedy	Kennedy Environmental	[redacted]	[redacted]
Acoustic Specialist	Ben Lawrence	Marshall Day Acoustics	[redacted]	[redacted]

3.0 THE PROJECT

3.1 Overview

PoAL is proposing to construct a new 330m long and 27.5m wide wharf to the northern end of the Bledisloe Terminal for roll on roll off (RORO) and large cruise ships and a 45m x 34m wide extension to the length of the existing Fergusson North Berth to accommodate larger container ships more efficiently.

3.2 Construction Methodology

A Beca memo provides detail on the indicative construction methodology[2].

The new wharf at Bledisloe North (BN) and extension at Fergusson North (FN) wharves are supported by five and six rows of piles respectively. The steel piles will be approximately 900mm in diameter, except the row at the top of the revetment which will be approximately 1200mm in diameter.

The key works are as follows:

- Remove existing rocks, prepare toe trench and revetment slope with a long reach excavator and/or backhoe dredge
- Install new piles in two stages (i.e. piling at BN and FN will not occur at the same time):
    - Install temporary 2m diameter pile casings and remove rocks from inside with a clamshell bucket or similar (BN only)
    - Drive permanent 900mm or 1,200mm diameter piles within the casings with a vibratory hammer where practicable, and impact hammer where necessary
    - Drill out material from pile, install reinforcement cage in pile and fill with concrete
    - Break down the top of the pile for connection to the wharf deck structure
- Place rock armour with long reach excavator
- Place precast concrete beams and cast in-situ topping deck and rock revetment mattress

[2] BECA report 3237885-1057951712-12379, dated 20 Sep 2024

The commitment to prioritise the use of a vibro hammer minimises the airborne and underwater noise emissions. However, an impact hammer is sometimes required as a subsequent secondary driving method to reach sufficient embedment.

Construction could occur 24/7, except for vibro and impact piling, which would be limited to daylight hours only.

The following pile driving rates have been provided by POAL[3]:

- 1 – 2 piles installed per day for Bledisloe Wharf
- 2 – 3 piles installed per day for Fergusson Wharf

The following representative pile driving rates are based on similar projects on the Auckland waterfront and at other New Zealand ports to assess underwater noise:

- 30 minutes of vibro driving per pile
- 1,000 impact strikes per pile (contingency)
- The water depth in the piling areas range from 0 – 14m.

4.0 UNDERWATER NOISE CRITERIA

4.1 Conditions of Consent

The underwater noise conditions are reproduced below:

29. *The Consent Holder shall prepare an Underwater Construction Noise Management Plan ("UCNMP") in accordance with Conditions 6 – 9.*

    Advice note: The application documents contain a draft UCNMP which will be finalised in accordance with this condition of consent.

30. *The objective of the UCNMP is to:*

    a. *Manage the underwater noise effects of construction activities on marine mammals and penguins; and*

    b. *Confirm the predicted temporary threshold shift zones ("TTS") based on the selected piling methodology.*

31. *For certification purposes, the UCNMP shall, at a minimum:*

    a. *Detail the measures to manage underwater noise effects on marine mammals and penguins, including:*

        i. *Methods to reduce the noise at source by selecting pile driving equipment and methodologies that generate lower noise emissions.*

        ii. *The approach to scheduling of high noise works based on the ecologist's recommendations to manage pile driving during sensitive seasonal periods, and driving to daylight hours to aid marine mammal observers.*

        iii. *Methods to mitigate noise from piling works, including where necessary the use of bubble curtains, or other systems to reduce noise propagating into the water column.*

[3] Email from Alastair Kirk (POAL) to Paul Kennedy (ecologist) on 18 October 2024

iv. *Validation of the underwater noise levels and mitigation, including underwater noise measurements to validate the size of the predicted zones and review of the effectiveness of mitigation and management measures.*

v. *Marine mammal observation processes to identify marine mammal and penguin presence within the predicted TTS during piling, comprising visual monitoring from a static land-based observation point(s) 30 minutes prior to commencing all impact piling operations.*

vi. *Shut down procedures in the event that a marine mammal or penguin is detected within or approaching the TTS zones.*

4.2 Species of Interest

The following marine biota of interest were identified in the marine ecology assessment:

- Marine mammals including:
  - Orca, common dolphin and bottlenose dolphin (occasional visitors)
  - Fur seals (occasional visitors)
  - Leopard seals (occasional visitors)
- Little penguin/kororā (breeding/moulting typically July through March), closest known occupied burrow is 250m from the Fergusson Wharf extension

4.3 Marine Mammal Criteria

It is standard practice to use the *'Technical Guidance for Assessing the Effects on Anthropogenic Sound on Marine Mammal Hearing'* from the US Department of Commerce National Oceanic and Atmospheric Administration (NOAA) for underwater noise assessments in New Zealand. This document is referred to as the 'NOAA 2024 Guidelines'.

The NOAA 2024 Guidelines provide auditory injury thresholds and auditory weighting curves for all marine mammals identified in the ecology assessment. These thresholds and weightings are used in the underwater noise model to determine potential auditory injury zones in Section 5.2.

The temporary threshold shift (TTS) criteria for the species of interest are summarised in Table 2.

Table 2: Summary of NOAA 2024 Guidelines auditory injury thresholds[5]

NOAA species group	Species included	Impulsive criteria (impact piling)	Non-impulsive criteria (vibro piling)
High-frequency (HF) cetaceans	Orca, common dolphin, dusky dolphin, bottlenose dolphin	178 $SEL_{cum\ (HF)}$ 224 dB L_{peak}	181 dB $SEL_{cum\ (HF)}$
Phocid Pinnipeds (PW)	Leopard seals	168 $SEL_{cum\ (PW)}$ 217 dB L_{peak}	175 dB $SEL_{cum\ (PW)}$
Otariid Pinnipeds (OW)	Sea lions and fur seal	170 $SEL_{cum\ (OW)}$ 224 dB L_{peak}	179 dB $SEL_{cum\ (OW)}$

[5] SEL_{cum} thresholds are in $\mu Pa^2.s$ and L_{peak} thresholds are in µPa

4.4 Little penguin (kororā) criteria

There are currently no established thresholds for the onset of auditory injury for penguins. The thresholds and weightings for other carnivores in water (abbreviated as OCW) from Southall et al. (2019) have been used instead as a proxy due to the similarity in hearing sensitivity in the frequency band of underwater hearing for the two species groups. The thresholds are as follows:

- Non-impulsive noise: TTS: 199 dB $SEL_{cum\,(OCW)}$ re. 1 $\mu Pa^2.s$
- Impulsive noise: TTS: 188 dB $SEL_{cum\,(OCW)}$ re. 1 $\mu Pa^2.s$, 226 dB L_{peak} re. 1 µPa

5.0 PREDICTED UNDERWATER NOISE LEVELS

5.1 Noise Source Levels

The predicted underwater noise management zones are based on MDA's measurements of vibro driving and impact driving 1,000 mm steel piles in a water depth of 10m with a silt seafloor near the piling (comparable conditions to the Bledisloe and Fergusson Wharf berths).

The vibro hammer was an ICE 28RF and the impact hammer was a BSP HH357-9 hydraulic hammer with a 9 T weight and hammer cushion. Photos of the equipment are shown in Figure 1.

Figure 1: Vibro hammer (left) and impact hammer (right) source data used in the model

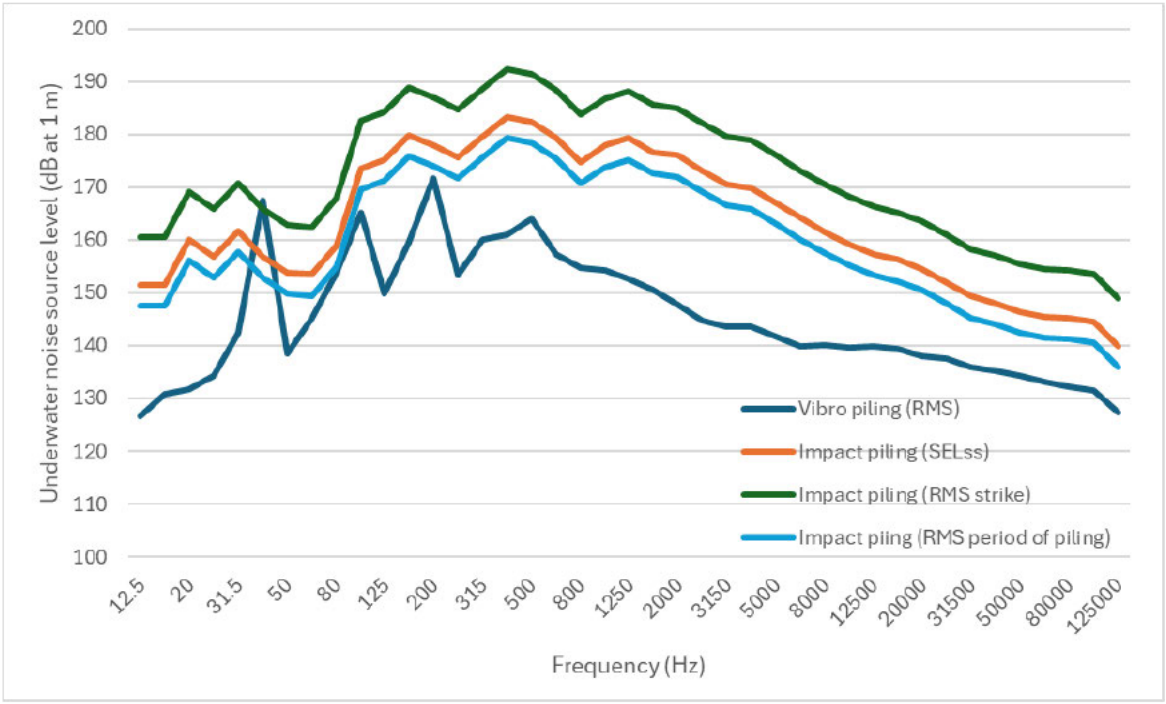
The predicted source levels are shown in Table 3 and the source spectra are presented in Figure 2.

The overall levels rely on the assumed piling rates detailed in Section 3.2. This shall be verified through underwater noise monitoring (Section 6.5).

Table 3: Source levels used for underwater noise predictions (unweighted)

Parameter	Calculated source level
Impact piling	
SEL (single strike)	191 dB SEL re 1 µPa².s
SEL (cumulative 24 hour) – 2,000 strikes per day for Bledisloe Wharf	224 dB SEL re 1 µPa².s
SEL (cumulative 24 hour) – 3,000 strikes per day for Fergusson Wharf	226 dB SEL re 1 µPa².s
RMS (pile strike)	200 dB RMS re. 1 µPa
RMS (period of piling)	187 dB RMS re. 1 µPa
Peak	222 dB RMS re. 1 µPa
Vibro piling	
SEL (cumulative 24 hour) – 60 minutes for Bledisloe Wharf	211 dB SEL re 1 µPa².s
SEL (cumulative 24 hour) – 90 minutes per day for Fergusson Wharf	213 dB SEL re 1 µPa².s
RMS (period of piling)	175 dB RMS re. 1 µPa

Figure 2: Underwater piling noise spectra



5.2 Predicted zones

The following scenarios have been modelled:

1. Vibro piling in the middle of the Bledisloe Wharf extension
2. Impact piling in the middle of the Bledisloe Wharf (with and without a bubble curtain)
3. Vibro piling at the eastern end of Fergusson Wharf
4. Impact piling at the eastern end Fergusson Wharf (with and without a bubble curtain)

The vibro piling results are dominated by low frequency noise. Bubble curtains have not been included for this methodology because the mitigation benefit at low frequencies is small (refer Section 6.3).

Table 4 overleaf presents the predicted TTS zones.

It should be noted that the water depth at the piling location will vary from 0 – 14m. The predicted zones are based on the seaward row of piles (i.e. those in the deepest water). In general, piling in shallower water depths will result in lower underwater noise levels in the harbour depending on the specific ground conditions at the piling location. However, the reduction is predicted to be small based on indicative modelling, so it is recommended that the zones in the following sections are used for all piling works in water as a conservative approach.

The predicted zones shall be verified with underwater noise monitoring (see Section 6.5).

Table 4: Predicted TTS zones

	Predicted zones (m)		
Species group	Impact pile driving (hammer cushion)	Impact pile driving (hammer cushion and bubble curtain)	Vibro pile driving
Bledisloe Wharf			
High-frequency cetaceans	435m	< 200m	Below criteria
Otariid pinnipeds	1,460m	445m	< 200m
Phocid pinnipeds	1,645m	585m	< 200m
Little penguin	205m	< 200m	Below criteria
Fergusson Wharf			
High-frequency cetaceans	600m	< 200m	Below criteria
Otariid pinnipeds	1,960m	655m	< 200m
Phocid pinnipeds	2,350m	825m	< 200m
Little penguin	270m	< 200m	Below criteria

6.0 MITIGATION AND MANAGEMENT

It is standard practice to implement a range of underwater noise mitigation and management measures on marine projects where there is the potential to impact marine fauna.

Current best practice measures include:

1. Reducing the noise at source by selecting pile driving equipment and methodologies that generate lower noise emissions
2. Scheduling high noise works based on the ecologist's recommendations to avoid pile driving during sensitive seasonal periods, and driving during daylight hours to aid marine mammal observers
3. Mitigating noise from the piling using bubble curtains, cofferdams and similar systems to reduce noise propagating into the water column
4. Stopping/postponing works when marine fauna is present using marine mammal observers, and/or use of acoustic detectors and similar technologies to identify marine mammals in the marine mammal observation zone
5. Validating the underwater noise levels and mitigation by carrying out underwater noise measurements to verify the size of the predicted zones and review the effectiveness of mitigation and management measures.

The following sections include specific requirements on the above measures.

The requirements are consistent with best practice for near shore piling projects, and based on MDA's experience on comparable projects in Australia and New Zealand.

6.1 Best practice piling methodology

The construction methodology (summarised in Section 3.2) already includes a commitment to prioritise the use of a vibro hammer to minimise the airborne and underwater noise emissions.

However, an impact hammer is sometimes required as a subsequent secondary driving method to reach sufficient embedment. Impact pile driving is therefore included as a contingency method. Impact hammers will have mechanisms to dampen noise levels (e.g. hammer cushions/dollies) if used.

The noise modelling assumes a hammer cushion or dolly will be incorporated into the impact piling rig to avoid steel on steel contact. Most modern hydraulic impact hammers have some form of cushion built in, although the primary purpose is generally to prevent damage and prolong the life of the hammer, they also provide effective noise mitigation.

6.2 Scheduling

Piling works shall only be carried out between sunrise and sunset to enable sufficient light for visual observation for the presence of marine mammals and penguins.

Additional scheduling may be required if new sensitive marine fauna is identified close to the piling works (e.g. an occupied kororā burrow). Advice shall be sought from the Marine Ecologist to determine suitable days and times for the works to be carried out.

6.3 Bubble curtains

6.3.1 Requirements

A single bubble curtain shall be used for impact piling.

The performance of the bubble curtain is highly dependent on an effective installation. The following shall be confirmed prior to the commencement of impact piling:

- The bubble curtain is weighted down to the seabed (not floating) and not obstructed
- The bubbles are consistent across the length of the tubing. Note that higher pressures may be required if the tubing is on sloped ground (more pressure is required to produce bubbles in deeper water compared with shallow water)
- A method is available to purge water from the tubing
- The tubing creates a consistent barrier between the piling and harbour (typically a horse-shoe shape)

The bubble curtain performance shall be verified through underwater noise monitoring, and the results compared to the data in Figure 3 to determine its effectiveness.

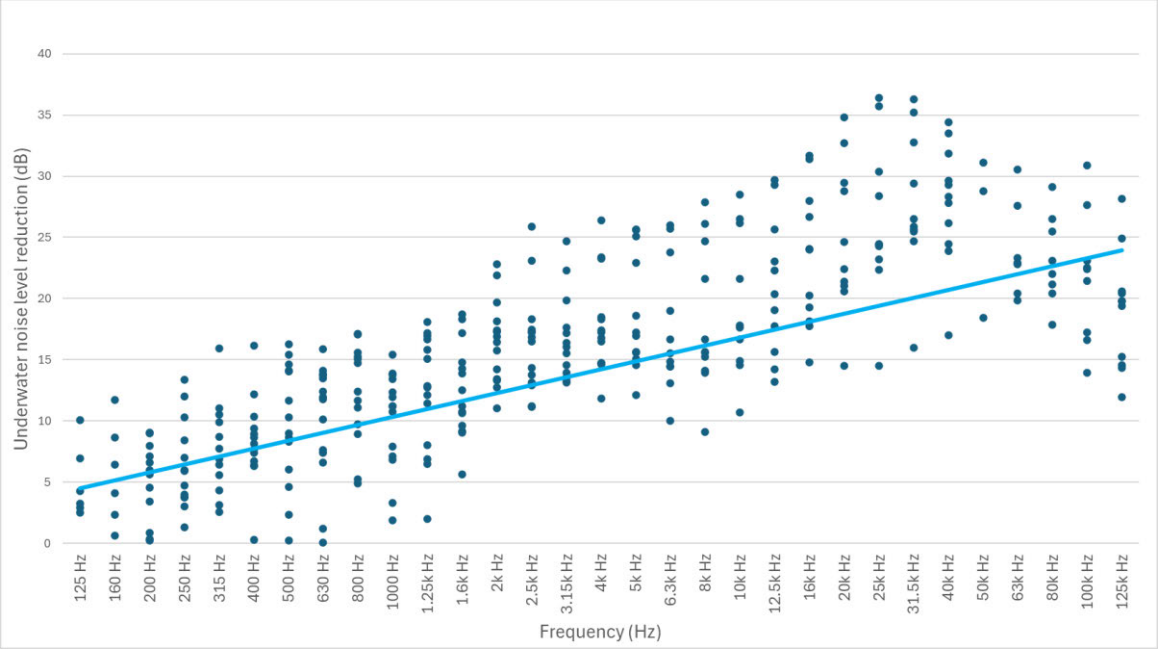
6.3.2 Expected Performance

MDA have measured a range of single and double bubble curtain systems in shallow water marine environments comparable to this project. This database includes 15 single bubble curtain and 4 double bubble curtain configurations across 5 separate projects. Most projects used proprietary Bubble Tubing from Canadian Pond. The bubble curtains were installed on the sea floor at separations ranging from 1 – 10m from the piles being driven.

The database of 15 single bubble curtain measurements has been used to obtain a representative typical bubble curtain performance estimate.

Figure 3 shows the spread of data and the line of best fit. The line of best fit has been used to calculate the PTS and TTS zones with inclusion of a bubble curtain (see Section 5.2).

Figure 3: Single bubble curtain measurement results (dark blue) and line of best fit (light blue)



6.4 Marine Mammal Observers (MMO)

The marine mammal observation zone (MMOZ) is an area identified by the marine ecologist that must be clear of marine mammals or penguins during piling. This area is based on the predicted TTS zones as per standard practice (refer to Table 4).

Visual observation of this zone to identify marine mammals' or penguins' presence during piling minimises the risk of TTS. The following list sets out the required process on site.

- **MMO**: at least one dedicated MMO shall be on continuous watch from an elevated position near the pile-driving rig. The aim of the observers is to ensure that any marine mammals or penguins entering the wider project area are promptly identified and appropriate mitigation action is undertaken if necessary. The MMO will be familiar with the standard operating procedures, keep a record of all sightings, delayed start-up, or enforced shut-downs due to presence of marine mammals and penguins.
- **Pre-start procedure**: the MMOZ shall be visually monitored by the MMO for at least 30 minutes before the commencement of the soft start procedure. Observations should be made from an elevated viewing platform near the piling rig or a better vantage point if possible.
- **Soft start procedure (impact piling)**: Soft start procedures shall commence once 30 minutes of pre-start observations have been completed and no marine mammals or penguins have been seen within the MMOZ. Once the soft start procedure is cleared to proceed, the piling impact energy is gradually increased. The soft start procedure may alert marine mammals or penguins to the presence of the piling rig and enable animals to move away.
- **Shut-down procedure**: the piling activity should be stopped immediately If a marine mammal or penguin is sighted within or about to enter the shut-down zone.

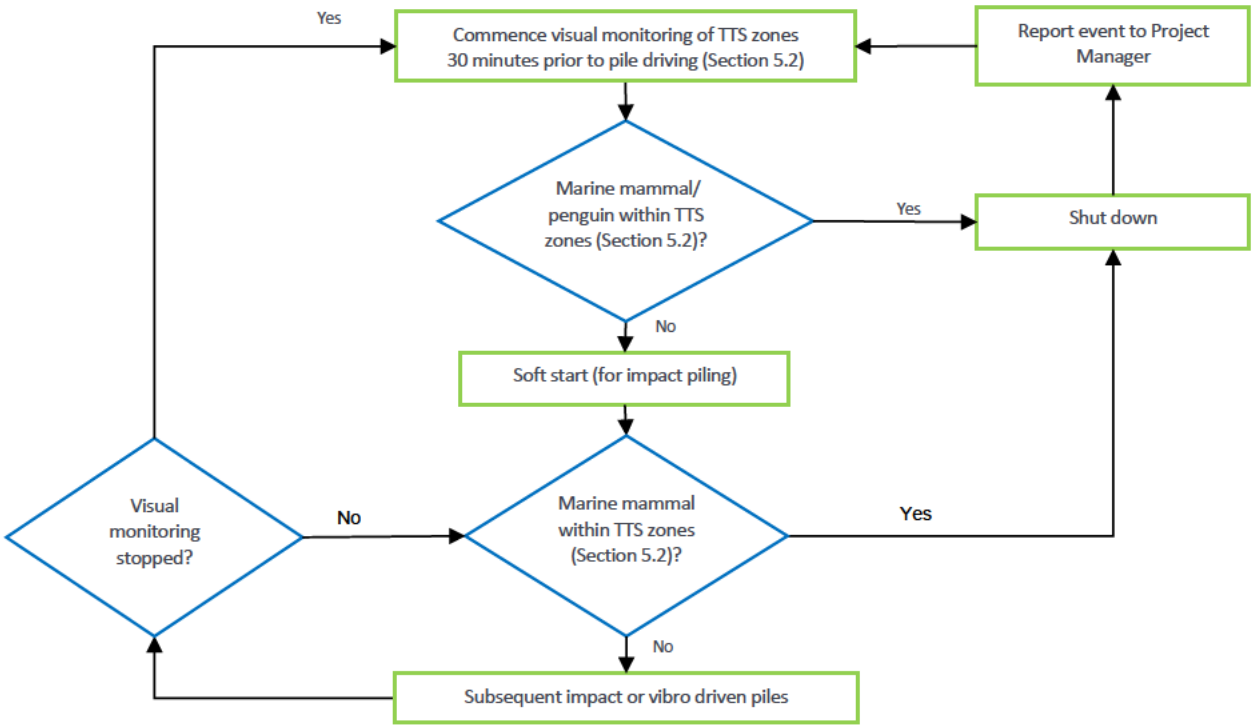
The MMO shall:

- Hold an observer qualification that is recognised by DOC, or
- Be trained to the satisfaction of an MMO who holds an observer qualification that is recognised by DOC

Figure 4 illustrates the observation process on site.

A survey sheet with photos and descriptions of the species of interest and the corresponding MMOZ will be provided to the MMOs.

Figure 4: Underwater noise monitoring flowchart



6.5 Underwater Noise Monitoring

Underwater construction noise levels shall be monitored:

- During impact and vibro driving steel piles:
  - At least once during piling in shallow water. The purpose of these measurements is to determine whether a bubble curtain is required for shallow water piling. This includes pile rows A – C for BN and A – D for FN.
  - At least once during piling in deeper water. These measurements will identify the largest zones. This includes pile rows D – E for BN and E – F for FN.
- By the Acoustic Specialist (Table 1)
- For a representative duration

The results will be used to update Section 5.2 as appropriate and reported to Council within 2 weeks.

APPENDIX A GLOSSARY OF TERMINOLOGY

Noise	A sound that is unwanted by, or distracting to, the receiver.
dB	Decibel (dB) is the unit of sound level. Expressed as a logarithmic ratio of sound pressure (P) relative to a reference pressure (Pr), where dB = 20 x log(P/Pr).
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) to more closely approximate the frequency bias of the human ear. A-weighting is used in airborne acoustics.
$L_{Aeq\ (t)}$	The equivalent continuous (time-averaged) A-weighted sound level commonly referred to as the average level. The suffix (t) represents the period, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{AFmax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
NZS 6803:1999	New Zealand Standard NZS 6803: 1999 "Acoustics - Construction Noise"
Underwater noise	A sound that is unwanted by, or distracting to, the receiver underwater.
L_{peak}	The peak instantaneous pressure level (un-weighted).
RMS	Root Mean Square (RMS) is the equivalent continuous (time-averaged) sound level commonly referred to as the average level (period matches the event duration).
SEL	Sound exposure level (SEL) is the total sound energy of an event, normalised to an average sound level over one second. It is the time-integrated, sound-pressure-squared level. SEL is typically used to compare transient sound events having different time durations, pressure levels and temporal characteristics.
SEL_{cum}	The SEL_{cum} is the 'cumulative' sound energy of all events in a 24 hour period, normalised to an average sound level over one second.
TTS	Temporary Threshold Shift (TTS) is the temporary loss of hearing caused by sound exposure. The duration of TTS varies depending on the nature of the stimulus, but there is generally recovery of full hearing over time.
PTS	Permanent Threshold Shift (PTS) is the permanent loss of hearing caused by acoustic trauma. PTS results in irreversible damage to the sensory hair cells of the ear.