Resource and Environmental Management Ltd

AWE Limited

Taranaki Basin Exploration Drilling Check-Shot Seismic Survey

Marine Mammal Impact Assessment

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List of Abbreviations

AEI	Areas of Ecological Importance
ACE	Annual Catch Entitlement
BOP	Blow Out Preventer
CMA	Coastal Marine Area
Code of Conduct	2012 Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations
COLREGS	International Regulations for the Prevention of Collisions at Sea 1972
DC	D'Urville Current
DOC	Department of Conservation
EEZ	Exclusive Economic Zone
EPA	Environmental Protection Authority
FMA	Fisheries Management Area
FPSO	Floating Production Storage and Offloading facility
IAGC	International Association of Geophysical Contractors
ISPPC	International Sewage Pollution Prevention Certificate
IUCN	International Union for Conservation of Nature
Kts	Knots – (Nautical miles per hour)
MARPOL	International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978
MfE	Ministry for the Environment
MMIA	Marine Mammal Impact Assessment
MMO	Marine Mammal Observer
MMS	Marine Mammal Sanctuary
MNZ	Maritime New Zealand
MPI	Ministry for Primary Industries
MSL	MetOcean Solutions Limited
NABIS	National Aquatic Biodiversity Information System
NIWA	National Institute of Water and Atmospheric Research
Nm	Nautical Mile
NZMEC	New Zealand Marine Environment Classification
NZP&M	New Zealand Petroleum and Minerals
PAM	Passive Acoustic Monitoring
PEPANZ	Petroleum Exploration and Production Association of New Zealand
PNA	Protected Natural Areas
PEP	Petroleum Exploration Permit
PMP	Petroleum Mining Permit

QMS	Quota Management System
REM	Resource and Environmental Management Limited
RMA	Resource Management Act 1991
SEL	Sound Exposure Level
SLIMPA	Sugar Loaf Island Marine Protected Area
SOPEP	Shipboard Oil Pollution Emergency Plan
TACC	Total Allowable Commercial Catch
WAUC	West Auckland Current
WC	Westland Current
WWF	Worldwide Fund for Nature

1 Introduction

1.1 Background

Resource and Environmental Management Limited (REM) has been engaged by AWE Limited (AWE) to prepare a Marine Mammal Impact Assessment (MMIA) for the check-shot seismic survey scheduled to be undertaken at their exploration well (Oi-1) within the Taranaki Basin. The well site is located north east of the Tui Floating Production Storage and Offloading (FPSO) facility, Umuroa, and within Petroleum Mining Permit (PMP) 38158 as shown in Figure 1 (hereafter the 'Survey Area').

Under the Transitional Provisions of the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 (EEZ Act), AWE submitted an Impact Assessment for their drilling activities to the Environmental Protection Authority (EPA) in accordance with s166 for planned petroleum activities within the EEZ. The impact assessment was accepted as complete by the EPA on 20 September 2013; allowing AWE to undertake their drilling activities prior to 28 June 2014 without the requirement of a marine consent.

The permitted activities regulations under the EEZ Act came into effect on 28 June 2013 and classifies seismic surveys as 'Permitted Activities' as long as they comply with the '2012 Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations' (Code of Conduct) (DOC, 2012).

AWE has adopted and will adhere to the Code of Conduct which came into effect on 1 August 2012 as a voluntary regime. The Code of Conduct was developed by the Department of Conservation (DOC) in consultation with a broad range of stakeholders in marine seismic survey operations in New Zealand (NZ). The Code of Conduct is currently being updated to account for some of the issues which were highlighted through its use by multiple operators before the Code of Conduct became a regulation under the EEZ Act. If the updated 2013 Code of Conduct becomes the new standard under the EEZ Act – Permitted Activities before the check-shot survey takes place, AWE will adhere to the updated 2013 Code of Conduct.

This MMIA has been prepared in accordance with the EEZ Act and the Code of Conduct (Appendix 1: Marine Mammal Impact Assessment) to assess and set out the management of any potential environmental impacts of the check-shot survey in the Survey Area with the purpose being to gain an understanding into:

1. Current key environmental sensitivities in relation to the seismic programme;
2. Potential environmental impacts on marine species and the surrounding environment; and
3. Measures to avoid or minimise any adverse impacts to the surrounding environment and marine mammals.

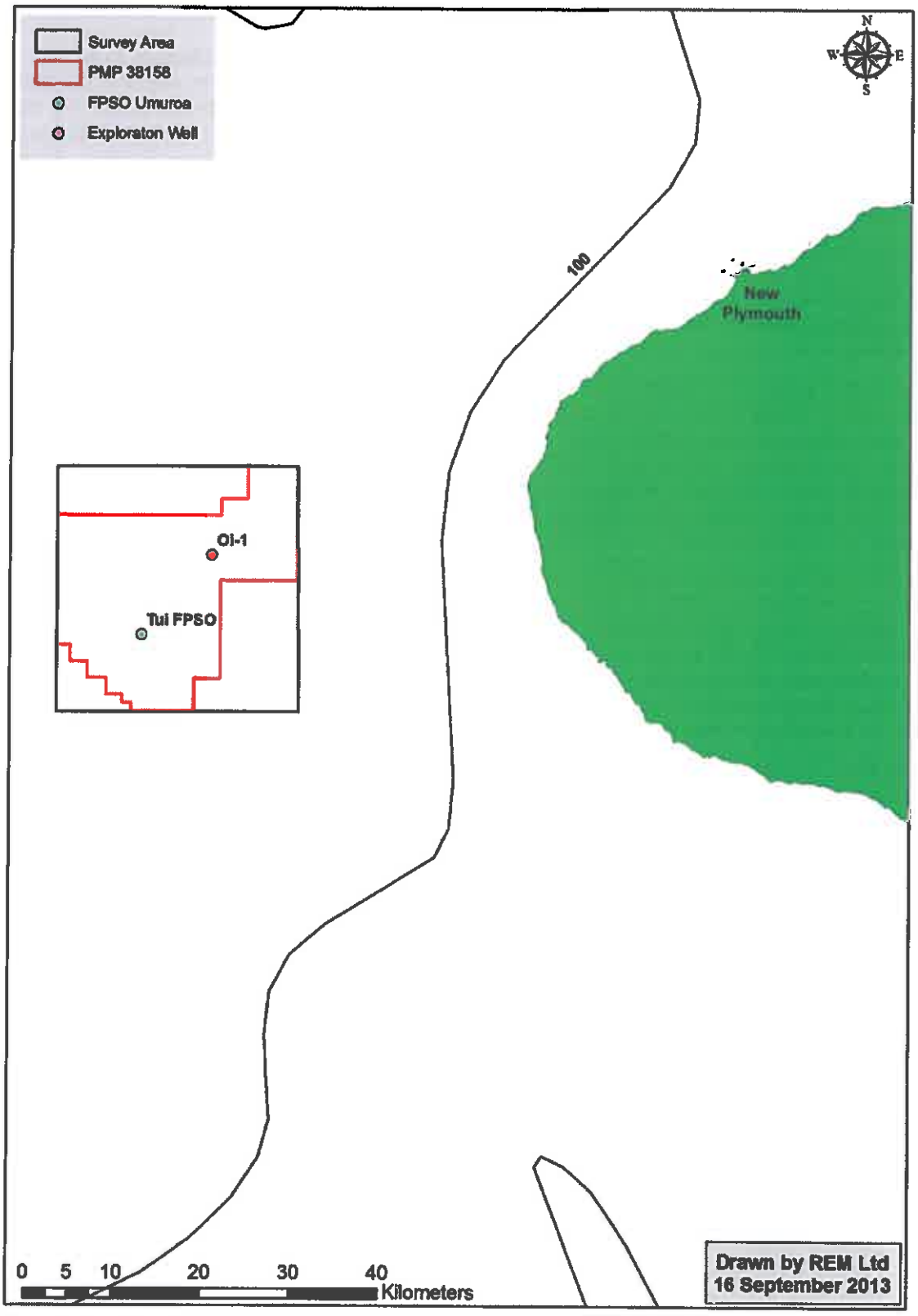

Figure 1: Location Map of the Survey Area

1.2 Drilling Programme

AWE will use the semi-submersible drilling rig (Kan Tan IV (KTIV)) (Figure 2) to drill the Oi-1 well which is located in a water depth of ~120 metres (m). The exploration drilling will consist of one well and the rig will be located on site for approximately 30 days. There is a possibility that AWE will side track the Oi-1 well, using the existing well bore to drill a secondary hole of to the side of the original well, but the wellhead/surface location will not be any different. Once the Oi-1 well is completed, it will be permanently abandoned.

Semi-submersible rigs provide stable platforms for drilling in the offshore oil and gas environment where they obtain their stability and buoyancy from ballasted, watertight pontoons located below the sea's surface and eight anchors which moor the rig onsite for the drilling period. The operating deck is located safely above the sea's surface, which ensures no waves can reach the deck, equipment or personnel.

The initial phase of drilling involves drilling the conductor, which supports the well head, permanent guide base and the subsea Blow out Preventer (BOP) stack. Above the BOP, a large diameter pipe (marine riser package), connects the BOP to the drilling rig above. After the surface casing and BOP are installed they are pressure tested to ensure integrity before the next phase of drilling is initiated. Steel casing down the well and the BOP are safety measures to control the flow of hydrocarbons when the well reaches the target zone and prevents any oil or gas seeping into the water.

As the drilling phase progresses, the well diameter is decreased at predetermined depths due to the physical limits of drilling at depth through different rock types, and is known as casing points. At each casing point the drill bit is removed and steel casing is inserted and cemented in place then pressure-tested to ensure the cement and casing are secure. The Oi-1 well will be drilled to a target depth vertically of approximately 3,855 m true vertical depth subsea (TVDSS). After the well is drilled to TVDSS a check-shot survey will be undertaken (see Section 1.3).

The AWE drilling campaign will consist of two wells, the Oi-1 and the Pateke-4H. The Pateke-4H well is a development well to further develop the existing Tui Field if successful. However, as it is a development well, no check-shot survey will be undertaken; where if successful, a permanent wellhead and subsea tree will be installed. AWE plan to drill in Q4 of 2013, and will utilise the KTIV, after OMV have drilled their first two wells, Manaia-2 and Matuku-1.

Figure 2: Kan Tan IV semi-submersible rig on heavy lift vessel in Admiralty Bay.

1.3 Check-shot Survey

A check-shot survey is a form of borehole seismic survey which measures the seismic travel time from an acoustic source released just below the sea surface to an acoustic receiver at a known depth within the borehole. Check-shot surveying is the only method to correlate sub-surface seismic data, which is recorded in Two-Way Travel time (TWT), and actual depth to geological intervals.

Irrespective of whether the Oi-1 well is assessed as a 'dry hole' or 'success case', a seismic check-shot wireline run will be carried out. There are two parts to the check-shot survey operation: an acoustic energy source deployed near the rig in the sea and a hydrophone lowered inside the wellbore. The package that is lowered down the borehole generally consists of a velocity sensitive hydrophone, amplifier circuits and a hydraulic anchoring system. The anchored hydrophone allows the tension of the cable to be released in order to eliminate the transmission of as much of the surface-generated noise as possible.

An air compressor will be present on the KTIV which will release a compressed air bubble from the two acoustic sources which will be deployed (typically from the rig's crane or work boat) 4 – 5 m below the sea surface (Figure 3).

AWE will use two 150 cubic inch (in^3) acoustic sources which will be fired three times successively at each level, 15 seconds apart at an operating pressure of 1800 psi and frequency of 10 Hz. It is envisaged that there will be a maximum of approximately 40 - 50 levels tested (every 100 m plus key horizons), however it could be much less, dependent upon geology. It will take approximately five minutes to move between levels and four hours to complete the job and will result in a maximum of ~150 shots being fired for the check-shot survey. Three depth station repeats will be tested as quality control as running in the wellbore to total depth. Prior to the actual check-shot survey commencing, the acoustic source will be tested 10 – 20 times over a one hour period.

Check-shot surveys differ from a vertical seismic profile in the number and density of receiver depths recorded; in a check-shot survey the hydrophone placement positions may vary widely and be irregularly placed within the wellbore, whereas a vertical seismic profile usually has numerous hydrophones positioned at closely and regularly spaced intervals in the wellbore.

Within the Code of Conduct the operational capacity of the acoustic source is the cumulative internal volume of all operational acoustic devices within an acoustic source array. In this case, two 150 in^3 acoustic sources will be used, resulting in an operational capacity of 300 in^3. This results in the check-shot survey being classified as a Level 2 marine seismic survey within the Code of Conduct, where the operational capacity is between 151 – 426 in^3. However, even though Passive Acoustic Monitoring (PAM) is an optional consideration under a Level 2 survey, AWE has opted to use PAM for the Oi-1 check-shot survey in order to mitigate any visibility/weather constraints which might be present during logging.

The requirements of a Level 2 marine seismic survey in the Code of Conduct are discussed further in Section 2.3.

As per the requirements within the 'Code of Conduct – Borehole Seismic Surveys', a soft start will be undertaken which involves the gradual increase of the acoustic source's power over a period of at least 20 minutes. The initial ramp-up procedures that will be followed for the AWE check-shots will involve:

- Start acoustic source at 500 psi firing with 60 second intervals for 5 minutes;
- Increase to 1,000 psi firing with 60 second intervals for 5 minutes;
- Increase to 1,500 psi firing with 30 second intervals for 5 minutes; and
- Increase to 1,800 psi firing with 30 second intervals for 5 minutes.

The Code of Conduct states that for check-shot surveys, activation of the acoustic source at least once within sequential 10 minute periods is regarded as continuous operation, so the soft start procedures do not need to be undertaken each time a different level is acquired, unless there are delays due to marine mammals within the relevant mitigation zones or operational delays. If there are operational delays to the check-shot survey, and it is likely that the 10 minute period may be exceeded, a single shot of the acoustic source will be fired, as this will release less noise into the environment than the 20 minutes of soft-start firing would, keeping the check-shot survey in continuous operation. However, this will only be done if there have been no sightings of marine mammals (other than NZ fur seals) in the area for the previous 30 minutes (i.e. the normal pre-start requirement).

Figure 3: Schematic representation of a check-shot survey

1.4 Objectives and General Approach

This MMIA forms part of the overall planning process for the Oi-1 seismic check-shot survey, which is being conducted in accordance with the Code of Conduct.

Under the EEZ Act – *Permitted Activities* Regulations, compliance with the Code of Conduct, including the preparation of a MMIA, is a requirement when carrying out seismic operations within the EEZ, and in this case will comply with the Level 2 seismic survey requirements, specifically the borehole seismic survey section.

AWE's exploration and development drilling programme Impact Assessment, Discharge Management Plan (DMP) and this MMIA for the check-shot survey also conform to the Craft Risk Management Standard (CRMS) for Vessel Biofouling, NZ Import Health Standard for Ballast Water from all Countries, Marine Mammals Protection Act 1978 and the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78).

1.5 Analysis of Alternatives

1.5.1 Introduction

This section of the MMIA outlines alternatives that were considered by AWE as part of the commissioning of the check-shot survey. The check-shot survey is being undertaken to

increase the subsurface resolution, confirm reservoir location and allow correlation with the conventional surface seismic data that was acquired through previous 3D seismic surveys; while operating to avoid adverse impacts on the environment to the fullest extent practicable.

1.5.2 Sound Source

A variety of seismic sources are available for marine applications, including Water Guns (20-1500 Hz), Air Gun (100 – 1500 Hz), Sparkers (50-4000 Hz), Boomers (300-3000 Hz), and Chirp Systems (500 Hz – 12kHz, 207 kHz, 4-24 kHz, 3.5 kHz, and 200 kHz). The greatest resolution of near surface structure is generally obtained from the higher frequency sources such as the Chirp systems, while the lower frequencies characterise structure at depth. For example, Chirp systems image only metres to tens of metres below the seafloor, whereas Air Guns image several kilometres below the sea floor.

AWE have opted for Air Guns as they are the only source to meet the geophysical objectives in the Taranaki Basin, whilst also minimising the potential acoustic disturbance to the local environment, including marine mammals. A dual sound source will be used, located at 5 m below the sea surface and suspended from the KTIV.

In summary, there is no alternative to the sound source to be able to achieve the sub surface data.

1.5.3 Airgun Barrel Volumes

It is proposed to use a cumulative 300 in^3 air gun configuration to undertake the check-shot survey, and to minimise the potential disturbance to the environment while still enabling the survey to be run effectively in terms of data acquisition.

As stated above, the full capacity of the gun array will be 300 in^3 while the operating pressure is 1800 psi.

1.5.4 Do Nothing Option

The check-shot survey forms part of AWE's exploration drilling programme which will be conducted in accordance with the requirements of PMP 38158 issued and regulated by New Zealand Petroleum and Minerals (NZP&M). PMP 38158 allows AWE to undertake mining operations relevant to the extraction, separation, treatment and processing of petroleum. The Tui Field has been in production since 2007 and the purpose of the Oi-1 well is to assess the potential for additional oil pools accessible from the Tui FPSO. The Oi-1 well location has been defined from 3D seismic acquisition and processing.

In order to further develop the existing Tui Field the drilling of the Oi-1 exploration well is required, and the seismic check-shot survey is the last stage of the drilling programme. Consequently, there is no 'do-nothing' option.

1.6 Sources of Information

A review of existing data and literature from national and international sources was the basis for the description of the existing environment and surrounding areas in Section 3. The following sources were used as a basis for the background information:

- Oceanographic, benthic habitats, communities and climatological information was obtained from data by Cawthron Institute (Cawthron), National Institute of Water and Atmospheric Research (NIWA) and MetOcean Solutions Limited (MSL); and
- Background biological information was obtained from numerous sources. The Ministry for Primary Industries (MPI); along with the National Aquatic Biodiversity Information System (NABIS) website which was used for part of the fisheries baseline information. Information on marine mammals, seabirds, and plankton was

obtained from DOC, various referenced articles, online sources and the Worldwide Fund for Nature (WWF).

A full list of references can be found in Section 6.

1.7 Consultation

AWE undertook extensive consultation with key local stakeholders in 2013 during the preparation of the Impact Assessment and DMP for the exploration and development drilling campaign. A consultation register from AWE's Impact Assessment and DMP process is included in Appendix 1, while a register of the stakeholders who were sent a consultation letter advising them of the proposed operations and drilling location is also included within Appendix 1. AWE is committed to continual consultation through the entire drilling programme with local stakeholders and iwi. DOC agreed that the consultation process in regards to AWE's drilling programme will suffice for the check-shot survey consultation, as this survey forms part of the overall drilling programme.

1.8 Limitations

Although information has been provided on the possible or likely fish, marine mammal and seabird species that might be found in the Survey Area, survey information on species numbers or seasonal or long-term variations is inherently difficult to obtain, as pelagic communities are generally highly mobile and transient.

In accordance with the agreed scope of work, this MMIA was prepared on the basis of existing information that could be readily obtained from relevant online and local sources. The conclusions and recommendations are therefore based on available published data from the consulted sources and expert review of these and other data. Baseline field studies were not completed by REM as part of this work.

1.9 Research

Research on the effects of seismic survey operations on marine species is being undertaken globally. The Code of Conduct does not anticipate NZ operators to duplicate international research; however it does state that it is essential for research to be carried out specifically to NZ species, habitats and conditions. Operators undertaking seismic surveys in NZ should use every opportunity possible to undertake research on gaps in the current knowledge and understanding of potential impacts (DOC, 2012).

At the conclusion of the check-shot survey, the Code of Conduct requires AWE to submit a Marine Mammal Observer (MMO) report to the Director-General, which includes all observational data from the survey. This can then be used for research by DOC or Universities to help build and expand on distributional and behavioural patterns of marine mammals and NZ fur seals around a seismic source.

The MMOs will be briefed to pay attention to the reactions and behaviour of NZ fur seals in close proximity to the KTIV.

In addition to the obligations under the DOC Seismic Code of Conduct, AWE is contributing to a Massey University study investigating the response of Pinnipeds in proximity to an active marine source. This study focusses on Pinnipeds observed by MMOs to be in a known sleeping position, and whether they are woken by the approaching seismic vessel. Interim results indicate that the proportion of Pinnipeds that awake as the vessel passes is the same, whether the seismic source is active or not.

2 Policy, Legal, and Administrative Framework

2.1 National Legislation

NZP&M manages the Crown's oil, gas, mineral and coal resources, known as the Crown Mineral Estate. NZP&M sits within the Ministry of Economic Development and replaced Crown Minerals in May 2011. NZP&M's role is to advise on policy, operational regulation and promote investment in the mineral estate.

National legislation applicable to the offshore oil & gas sector and relevant legislation in terms of environmental protection, maritime activities, biosecurity, industrial safety, and cultural and archaeological heritage is covered under a range of different legislation.

Variations do occur within the legal jurisdiction of the legislation, for example, the Resource Management (Marine Pollution) Regulations 1998 and the Biosecurity Act 1993 only apply within NZs territorial waters (12 Nm from the statutory baseline), the EEZ Act applies within the NZ EEZ, beyond 12 -200 Nm from shore, whereas the Marine Mammals Protection Act 1978 applies to NZ's 'fisheries waters', including inshore waters, territorial waters, and the EEZ.

For this MMIA of the upcoming Oi-1 check-shot survey, the relevant legislation which AWE will comply with is the EEZ Act and the Code of Conduct.

2.2 Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012

The EEZ Act was first introduced into the House on 24 August 2011, was enacted on 3 September 2012, and came into force on 28 June 2013, when the first regulations (Permitted Activities) were promulgated. The EEZ Act is considered as landmark legislation as it establishes the first comprehensive environmental consenting regime for activities in NZ's EEZ and Continental Shelf.

The purpose of the EEZ Act is to manage and protect the natural resources of the EEZ whilst concurrently enabling use of resources on or within the seabed and sub-surface. Before the EEZ Act was passed there was a wide gap in domestic legislations for the EEZ; where NZ has historically not being able to assess and regulate the environmental effects of many activities in the EEZ and Continental Shelf.

The EEZ Act allows the Minister for the Environment to classify activities with the EEZ and Continental Shelf, depending on a number of considerations outlined in s33 of the EEZ Act. These considerations include; environmental effects of the activity, the importance of protecting rare and vulnerable ecosystems and the economic benefit to NZ of the activity. The classifications for activities within the EEZ Act are either:

- **Permitted** – the activity can be undertaken provided the operator meets the conditions specified within the regulations. Seismic surveys, including check-shot surveys, fall within this classification and the conditions state that the person undertaking the activity must comply with the Code of Conduct;
- **Non-notified discretionary** – (this classification is currently under discussion in September 2013 through a Supplementary Order Paper to the Marine Legislation Bill) – where activities can be undertaken if applicants obtain a marine consent from the EPA, who may grant or decline consent and place conditions on the consent. The consent application is not publically notified and has statutory timeframes adding up to 60 working days in which the EPA must assess the consent application;

- **Discretionary** – activities may be undertaken if applicants obtain a marine consent from the EPA. The consent application will be notified, submissions will be invited and hearings will be held if requested by any party, including submitters. The process has a statutory timeframe of 140 working days in which the EPA must assess the consent application; and
- **Prohibited** – the activity may not be undertaken.

For completeness the requirements of s39 of the EEZ Act – Impact Assessment have been considered when preparing this MMIA.

2.3 2012 Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations

In February 2006 a set of guidelines were established by DOC for 'minimising the acoustic disturbance to marine mammals from seismic survey operations' in conjunction with PEPANZ. These were then further developed in collaboration with a broad, representative range of domestic and international stakeholders which formed the Code of Conduct. The Code of Conduct was developed to establish a comprehensive and ambitious regime to manage the potential impacts of seismic survey activities. It was initially implemented as a voluntary regime, however, under the EEZ Act – *Permitted Activities*, seismic surveys must now comply with the Code of Conduct.

The development of the Code of Conduct shows how industry and government can work together towards the shared goal of growing the contribution that the oil and gas industry makes to NZ in an environmentally responsible way (PEPANZ Foreword in DOC, 2012). The Code of Conduct aims to minimise potential impacts while still providing for normal seismic operations to continue (PEPANZ Foreword in DOC, 2012).

Under the Code of Conduct, AWE's check-shot seismic survey will fall under the classification of a Level 2 survey. The notification and requirements of the Code of Conduct have been adhered to and followed with the formulation of this MMIA. A letter was submitted to the Director-General of DOC on 29 August 2013, stating that AWE will adhere to the requirements within the Code of Conduct. Further to the notification requirements of the Code of Conduct, the Director-General will also be informed immediately about any instances of non-compliance with the Code of Conduct.

NZ fur seals are abundant and resident around all of the offshore installations (well head platforms, drilling platforms and FPSO's off the Taranaki coastline. They use parts of the installations for haul out areas and the marine life which establishes around these installations provides a food source to the NZ fur seals, where they remain on or near the installations for extended periods of time. The check-shot survey will commence following the completion of the Oi-1 well, where the rig is likely to have been on location for 30 days prior to commencing the check-shot survey. Therefore, given the Oi-1 well locations proximity to the existing installations (12 km northeast of Tui FPSO), it is highly likely NZ fur seals will be present around the KTIV when the check-shot survey is undertaken.

NZ fur seals are not listed as a 'Species of Concern' as defined in the Code of Conduct; however, as they are a marine mammal an issue potentially arises if NZ fur seals are within 200 m of the acoustic source prior to start up. Essentially the check-shot survey can only commence if all NZ fur seals are beyond the 200 m mitigation zone from the KTIV. With the knowledge that NZ fur seals are likely to be present around the KTIV, a discussion was held with DOC in regards to the additional costs the NZ fur seals could cause if they are within the mitigation zones resulting in significant delays to the drilling programme and rig schedule. NZ fur seals are a relatively common species with no significant threat at the wider population level.

DOC have acknowledged that check-shot surveys are significantly different to vessel-based marine seismic surveys, in that the airgun activity is limited to a single location, has a low acoustic source volume, and the shots are widely-spaced over a relatively short survey duration (~ four hours), essentially lowering the risk to marine mammals, as long as the appropriate monitoring of the mitigation zones and compliance with the Code of Conduct is undertaken.

DOC provided a further interpretation of the requirements of the Code of Conduct for NZ fur seals, given the facts detailed above; where the check-shot survey can proceed as long as a reasonable effort has been made to minimise the risk to NZ fur seals. Pre-start observations will give a good indication if NZ fur seals are continuously present within the 200 m mitigation zone or if they are entering and leaving the zone regularly. If they are entering and leaving regularly, every effort should be made to time the initial firing of the acoustic source when no NZ fur seals are present. However, if the NZ fur seals are always present, efforts should be made to fire the acoustic source when the seals are at the surface, rather than diving. NZ fur seals that are hauled out on the KTIV do not need to be considered in applying mitigation requirements, as they will be unaffected by the acoustic sources.

A Level 2 survey requires at least two qualified MMOs onboard for the duration of the survey, where:

- The qualified observers will be dedicated in that their roles during the period of seismic surveying on the vessel are strictly for the detection and data collection of marine mammal sightings and instructing crew on their requirements when a marine mammal is detected within the relevant mitigation zone; and
- At all times while the acoustic source is in the water (during daylight hours), at least one qualified MMO will maintain a watch for marine mammals.

When PAM is incorporated into a Level 2 survey, even though it is not a requirement, the additional minimum qualified observer requirements are:

- At all times there will be at least two qualified PAM operators on board the source vessel; and
- At all times while the acoustic source is in the water at least one qualified PAM operator will maintain a watch for marine mammals.

However, this requirement is based on the assumption that Level 2 surveys are typically of an extended duration; and in order for observers to maintain an appropriate focus, they need to have someone else to step in and give them a break. Given the short duration of the Oi-1 check-shot survey, where it is likely to be completed in four hours, DOC has allowed that only one MMO and one PAM operator are required for the acoustic source testing and check-shot survey. The MMO will be present on the KTIV, while the PAM operator will be on the support vessel circling the KTIV within a 1 km radius which will tow the PAM array to eliminate the noise fields emanating from the KTIV.

Pre-start observations will take place to the Level 2 survey requirements where the acoustic source can only be activated if it is within the operational area (Survey Area) and no marine mammals have been observed or detected in the respective mitigation zones. The acoustic source can only be activated during daylight hours unless:

- At least one qualified MMO has continuously made visual observations all around the source for the presence of marine mammals, from the bridge (or preferably an even higher vantage point) using both binoculars and the naked eye, and no marine mammals have been observed in the respective mitigation zones for at least 30 minutes; and
- If incorporated, passive acoustic monitoring for the presence of marine mammals has been carried out by a qualified PAM operator for at least 30 minutes before activation and no vocalising cetaceans have been detected in the respective mitigation zones.

AWE has elected to use PAM for the Oi-1 check-shot survey, where PAM operation will take place from the support vessel as detailed above and will ensure that there have been no vocalising cetaceans detected within the mitigation zones for at least 30 minutes.

The acoustic source cannot be activated during night-time hours or poor sighting conditions (visibility of 1.5 km or less or in a sea state of greater than or equal to Beaufort 4) unless:

- Passive acoustic monitoring for the presence of marine mammals has been carried out by a qualified PAM operator for at least 30 minutes before activation and no vocalising cetaceans have been detected in the relevant mitigation zones.

With PAM being operational for the Oi-1 check-shot survey, the Level 2 source (i.e. 300 in^3) may be activated and active surveys may proceed at night or during poor sighting conditions, according to the provisions of the Code of Conduct, following pre-start observations detailed above.

If during pre-start observations or while the acoustic source is activated (which includes soft starts), a qualified observer detects at least one cetacean with a calf within 1 km of the source, start up will be delayed or the source will be shut down and not be reactivated until:

- A qualified observer confirms the group has moved to a point that is more than 1 km from the source; or
- Despite continuous observation, 30 minutes has elapsed since the last detection of the group within 1 km of the source, and the mitigation zone remains clear.

If during pre-start observations or while the acoustic source is activated (which includes soft starts), a qualified observer detects a Species of Concern within 600 m of the source, start up will be delayed or the source will be shut down and not reactivated until:

- A qualified observer confirms the Species of Concern has moved to a point that is more than 600 m from the source; or
- Despite continuous observation, 30 minutes has elapsed since the last detection of a Species of Concern within 600 m of the source, and the mitigation zone remains clear.

If during pre-start observations prior to initiation of the acoustic source soft start, a qualified observer detects a marine mammal (other than NZ fur seal) within 200 m of the source, start up will be delayed until:

- A qualified observer confirms the marine mammal has moved to a point that is more than 200 m from the source; or
- Despite continuous observation, 30 minutes has elapsed since the last detection of a marine mammal within 200 m of the source, and the mitigation zone remains clear.

2.4 Marine Mammal Sanctuaries & Areas of Ecological Importance

In addition to the six gazetted Marine Mammal Sanctuaries (MMS) around NZ, DOC has also identified areas around NZ that are classified as Areas of Ecological Importance (AEI) for marine mammals based on information in the sightings and strandings database. In addition, technical input from marine mammal experts has been used to refine the AEI maps where data may be absent or incomplete. A map of these areas is shown in Figure 16. The check-shot survey at the Oi-1 well will be undertaken within the AEI.

3 Existing Environment

3.1 Physical Environment

3.1.1 Climate

NZ lies in the path of an irregular succession of anticyclones, which migrate eastwards every six to seven days. The centres of these anticyclones generally track across the North Island, with more northerly paths being followed in spring, and southerly paths in autumn and winter. Anticyclones are areas of descending air, and settled weather, with little or no rain, which may bring clear skies or low cloud and fog.

Between the anticyclones are troughs of low pressure, which move eastwards across NZ. Within these troughs, there are often cold fronts, orientated northwest to southeast, which produce one of the commonest types of weather sequence over the country: as the front approaches from the west, northwesterly winds become stronger and cloud increases, followed by a period of rain for several hours as the front passes over, and then a change to cold showery southwesterly winds.

The South Taranaki Bight is directly exposed to intense weather systems from the Tasman Sea and is subject to high winds and seas. The strongest and most frequent winds and swells are generally from the west to southwest. Weather in the South Taranaki Bight has few climatic extremes, but can be extremely changeable. Winters are generally cooler and weather conditions are more unsettled than summer months.

In New Plymouth, summer daytime temperatures range from 19°C to 24°C but seldom exceed 30°C. Winters are relatively mild and are the most unsettled time of the year. Typically, winter daytime maximum temperatures range from 10°C to 14°C (NIWA, 2012). Table 1 outlines the mean monthly weather parameters at New Plymouth.

Table 1: Mean Monthly Weather Parameters at New Plymouth, Indicative for Survey Area

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	54	83	68	104	112	123	110	101	105	117	102	106
Humidity (%)	79	78	78	80	83	83	82	82	83	82	80	81
Temperature – average daytime (°C)	21	22	20	18	16	14	13	13	14	16	17	19
Temperature – average night time (°C)	14	14	13	11	10	8	7	7	8	10	10	13
Wind speed average (kts)	9	9	9	9	10	10	10	10	11	12	11	10
Wind speed – max (kts)	30	38	30	33	35	37	36	31	47	58	31	37

(Source: Weather2, 2013)

MSL produced a report in 2006, 'Tui Development Metocean Criteria – Environmental Statistics for Design' which is being used in this MMIA to provide further background information on the environmental conditions likely to be found at the Oi-1 well site. Site-specific metocean conditions were also produced as part of the 'Oil Spill Trajectory Modelling – Assessment of potential coastal impacts with simulation of surface release from proposed wells at Oi-1' (MSL, 2013).

3.1.2 Geological Setting

The Taranaki Basin occupies the site of late Mesozoic extension on the landward side of the Gondwana margin; covers an area of about 330,000 km^2 and is currently the only producing basin of oil and gas condensate in NZ. Jurassic and earliest Cretaceous Murihiku marine and non-marine rocks present in the Taranaki Basin are generally regarded as basement, but may also have been the earliest basin-fill. Taranaki Basin lies at the southern end of a rift that developed sub-parallel to the Tasman Sea rift, which now separates Australia and NZ. The structure of the basin has been controlled by movement along the Taranaki, Cape Egmont and Turi fault zones (Figure 4).

Exploration in Taranaki began in the early 1950s; over 400 onshore and offshore exploration and production wells have now been drilled (oil and gas fields shown in Figure 4). AWE have previously undertaken 3D seismic surveys within the Survey Area, where the proposed check-shot survey will increase the subsurface resolution, confirm reservoir location and allow correlation with the conventional surface seismic data to assess the structure, stratigraphy and properties beneath the sea floor following the drilling of the Oi-1 well.

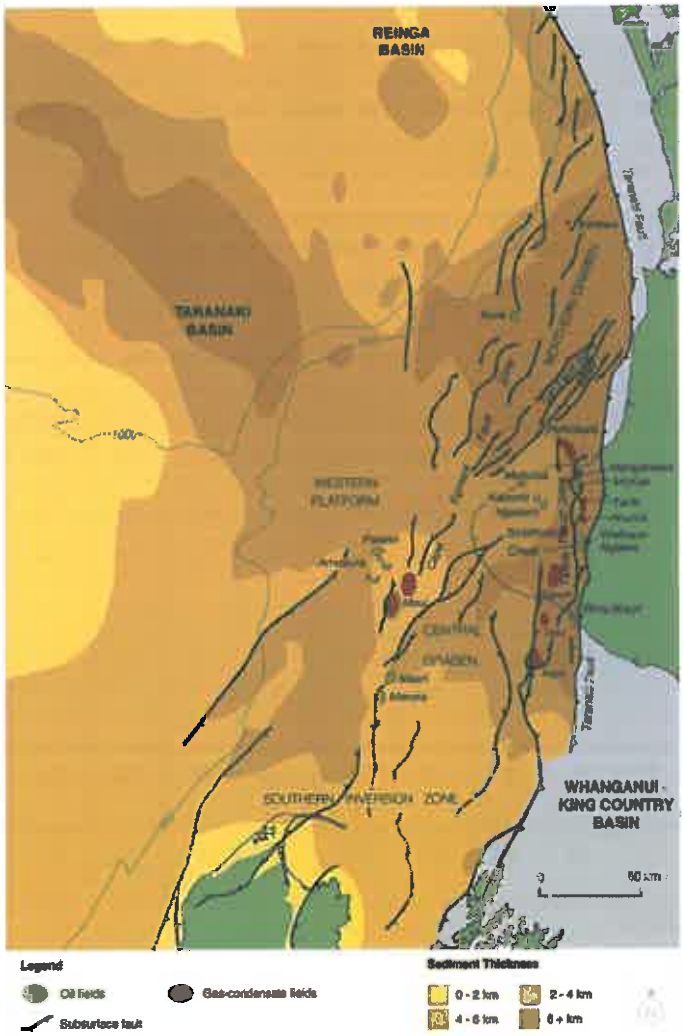

Figure 4: Taranaki Basin Map
(Source: NZP&M, 2012)

3.1.3 Oceanography

As part of the initial Tui Field development within PMP 38158 a metocean conditions report was prepared to form the environmental basis for the design of the Tui and adjacent fields. This data was prepared using regional data and on-site measurements to validate and calibrate the numerical models which were derived for wind, waves and currents.

Circulation in the Taranaki Basin is mainly influenced by tide, wind and regional circulation.

3.1.3.1 Wave Height

The Survey Area is located in a high energy wave climate due to its exposure to long period swells originating from the Southern Ocean, as well as locally generated seas (MSL, 2006). Most of the wave energy arrives from the west and southwest, although energetic southerly wave conditions can arrive within hours.

MSL (2006) used eight year hindcasting of the Tui field to characterise the ambient wave climate. The mean annual wave height at the Tui field is 2.86 m, where a strong seasonal wave climate trend was identified, with summer (January) being the least energetic (2.36 m) and winter (June) being the most energetic (3.23 m). It was also shown that wave heights greater than 2 m for durations of at least 24 hours occur for ~80% of the time (MSL, 2006). Storm activity is more frequent in the late winter period, however very large wave conditions can occur at any time of the year.

3.1.3.2 Wind Climate

Wind characteristics have been undertaken for the Oi-1 well (MSL, 2013) as well as for the Tui Field (MSL, 2006). The spatially varying wind field has been determined from an extract of a 33 year regional atmospheric hindcast constructed by MSL which was obtained by running the Weather Research and Forecasting model nested within the Climate Forecast System Reanalysis data set from NOAA. This wind data was then validated against numerous sites around NZ.

The predominant wind within the Survey Area is from the westerly sector, while the strongest winds derive from the southeast quarter Figure 5.

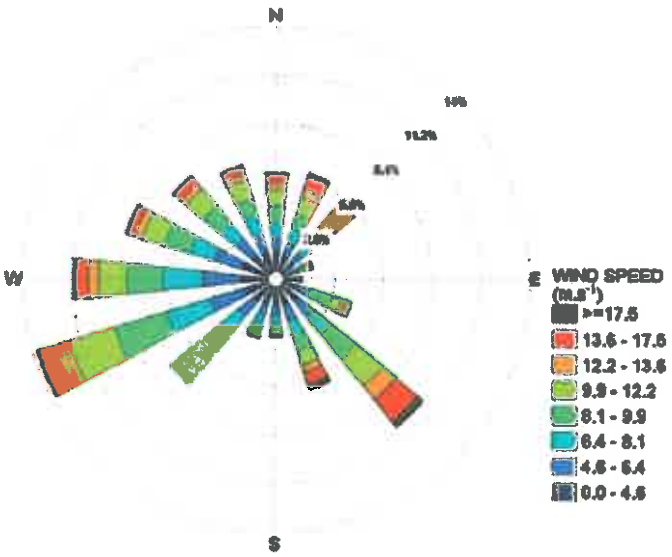

Figure 5: Annual Wind Rose for Oi-1 Well Site

3.1.3.3 Bathymetry

The broad Taranaki continental shelf has a 150 km wide opening to the Tasman Sea and forms the western approach to the constricted narrows of Cook Strait. The shelf area occupies approximately 30,000 km^2 and slopes gently towards the west with an overall gradient of less than 0.1° and locally less than 0.5° (Nodder, 1995).

The seabed has a gently sloping gradient through the Survey Area, where it slopes down to the west from ~120 m water depth on the eastern side to a depth of ~125 m on the western boundary (Figure 6), where the Oi-1 well is located in 120 m of water.

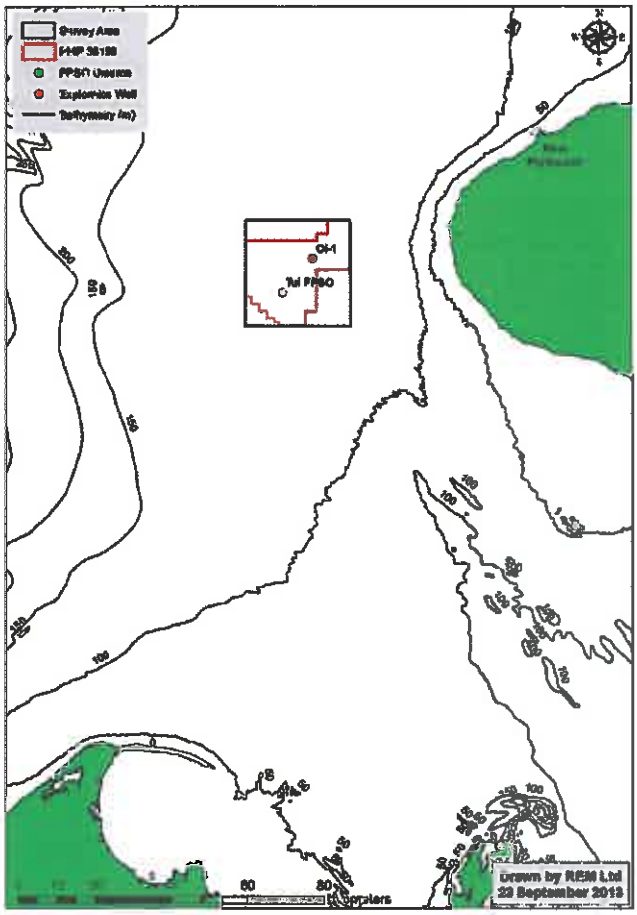

Figure 6: Bathymetry of the Survey Area

3.1.3.4 Currents

NZ sits in the eastward-forward southern branch of the South Pacific subtropical gyre. This gyre is driven by winds – the southeast trade winds to the north, and the Roaring Forties westerly winds to the south. Together these winds set up the anti-clockwise circulation within the gyre, which is then modified by the spin of the earth (Coriolis Effect).

Currents on the west coast of NZ are generally weaker and more variable than those along the east coast. The West Auckland Current (WAUC) flows southwards along the west coast of the North Island from North Cape to Raglan and is met by north-flowing currents in the North Taranaki Bight (Figure 7). These currents are both sub-tropical in origin with sea temperatures generally ranging from 13° to 22°.

The Westland Current (WC) flows in a northerly direction along the west coast of the South Island before merging with the D'Urville Current (DC) and moving into the South

Taranaki Bight. The DC sweeps into Cook Strait from the northwest, mixing with water from the Southland and East Cape currents before moving eastwards across Cook Strait. The DC is warm, saline and well stratified water from the Tasman Sea, pushed into Cook Strait by westerly and northerly winds.

The current regime around NZ is dominated by three main processes; wind-driven flows, low frequency flows and tidal currents. The net flows are a combination of all three of these processes, and can be further influenced by bathymetric effects.

The low-frequency currents offshore of the Taranaki headland exist as shelf (or coastal-trapped) waves that are associated with regional wind stresses and barometric pressure fluctuations (MSL, 2006). It has been observed that current variations in the offshore Taranaki waters are largely due to shelf waves, with a mixture of forcing mechanisms which include a coastal flux through Cook Strait and the regional and alongshore wind stress. As a result of these low frequency (and often oscillatory) currents being forced; receiving their energy from wind stress over a large region of the continental shelf, it is difficult to isolate their generation mechanisms using only local wind data (MSL, 2006).

Within the Survey Area it has been shown that tidal flows are not particularly strong, with the depth-averaged highest astronomical tidal current only being 0.18 m/s where the main axis of the tidal ellipse is orientated approximately north-south (MSL, 2006).

There are few direct measurements of currents around NZ, and long-term current measurements are even rarer. Tides around NZ are moderate compared to world standards, with a tidal range of 1 – 2 m and tidal currents which travel about 2 km/hr (~1 knot). The exception is Cook Strait where the tidal currents can be much stronger.

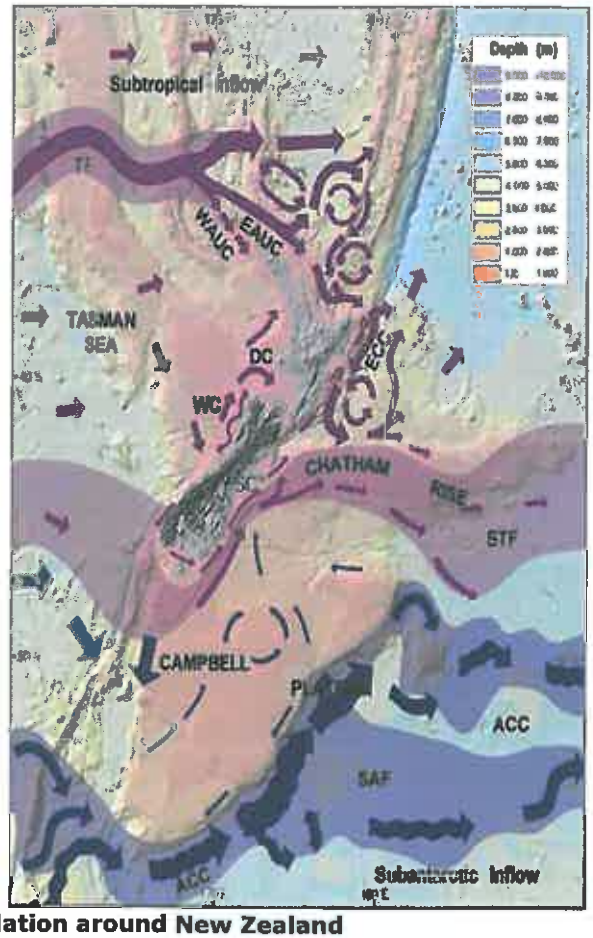

Figure 7: Ocean Circulation around New Zealand
(Source: The Encyclopaedia of New Zealand)

3.1.3.5 Water Column

During spring and summer months, thermal stratification of the water column occurs over a large portion of the Greater Cook Strait and the offshore Taranaki region. Solar heating of the upper water column causes this seasonal stratification, which typically extends down to the mid-water zone (i.e. 40 – 50 m) (MSL, 2006). During late autumn this stratification usually breaks down resulting in the water column becoming isothermal. Weather conditions dictate the range and form of stratification, where stormy weather in summer can quickly cause significant vertical mixing resulting in a breakdown of the thermal structure. Therefore, a well-defined thermocline is not always present (due to energetic nature of the environment), but may develop in settled periods of weather during the summer months.

Regionally, the temperature regime and water column properties is influenced by upwelling of cold, nutrient rich water, and the South Taranaki Bight is known to be affected by upwelling plumes originating from the Kahurangi Shoals, off Cape Farewell. This process is thought to be driven by bottom friction as the Westland Current flows past the Kahurangi Shoals (Bowman *et al.*, 1983), resulting in meanders and eddies (Figure 8), in the wake of the shoals and Farewell Spit (MSL, 2006). These features are most notable during spring tides, and typically propagate northwards towards the Taranaki headland. The rate of eddy propagation is highly variable, and speeds of up to 16 km/day have been measured (Viner & Wilkinson, 1987).

As these eddies propagate northwards, pulses of the upwelled water entrain phytoplankton, which proliferate in the nutrient rich water. These eddies gradually become nutrient-depleted and phytoplankton-rich (as the entrained phytoplankton proliferate and mature) as they reach the Taranaki region.

This high primary productivity subsequently affects the entire food chain within the western Cook Strait, including resident populations of blue whales at times. Episodic high concentrations of krill (*Nyctiphanes australis*) are often observed within the Maui Field and can also be expected in the Survey Area.

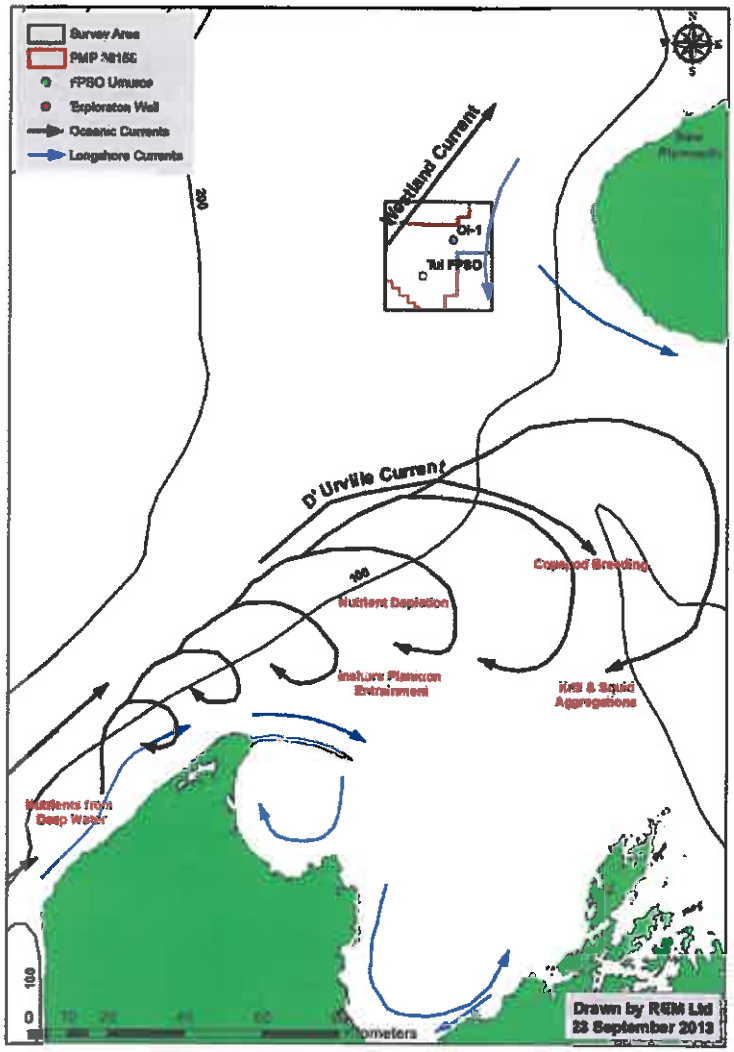

Figure 8: Schematic representation of the biological events consequent on the upwelling of cold, nutrient-rich water at Kahurangi Shoals

3.1.3.6 Water Temperature

MSL (2013) used satellite data from 2000 – 2009 to gain representative sea surface water temperatures within the Survey Area. Results showed the seasonal average temperatures over this period were:

- Summer – 17.75 – 17.82 °C
- Autumn – 17.53 – 17.59 °C
- Winter – 14.37 – 14.49 °C
- Spring – 14.49 – 14.57 °C

Regionally, the maximum seabed temperatures are typically observed to be 4.5 °C less than the surface summer waters, and most likely to occur as a result of mixing of the surface water layer into the lower levels (i.e. in persistent stormy weather) during breakdown of the thermocline (MSL, 2006).

The minimum seabed temperatures in offshore waters result from a complete breakdown of the thermocline during the winter months, where the minimum surface and seabed temperatures are assumed to be equivalent (MSL, 2006).

3.1.3.7 Sediments and Seafloor

The Taranaki basin is a Cretaceous and Tertiary sedimentary basin located along the western side of the North Island. Across the Taranaki shelf there is a grading from fine to medium sand to silt and muds further offshore with an increasing depth range. Waves and currents generated by prevailing southwest – westerly storms are probably the dominant sediment transport agents presently operating on the Taranaki coastline. The seabed in the Survey Area is mainly composed of silt, clay and fine sand fractions with no reef structures identified (Johnston & Forrest, 2012).

3.2 Biological Environment

3.2.1 New Zealand Marine Environmental Classification

NIWA were commissioned by Ministry for the Environment (MfE), MPI and DOC to develop an environmental classification covering NZ's Territorial Sea and EEZ which is known as the Marine Environment Classification (MEC). The purpose of this classification was to provide spatial frameworks for structured and systematic management by subdividing the geographic domain into units having similar environmental and biological character (NZMEC, 2005).

The MEC used physical and biological factors (depth, solar radiation, sea surface temperatures, orbital velocity (waves), tidal current, sediment type, seabed slope and seabed curvature) to classify and map marine areas that have a similar environmental character. From the classification, the marine environments around NZ can then be mapped to different levels of detail, depending on which environmental groups are selected.

The Survey Area falls within boundary classification group 60 representing the moderately shallow waters on the continental shelf (Figure 9), and is explained below (NZMEC, 2005).

- **Class 60**: occupies moderately shallow waters (mean = 112 m) on the continental shelf. It experiences moderate annular solar radiation and wintertime sea surface temperatures and has moderately high average chlorophyll-*a* concentrations. Some of the most commonly occurring fish species are jack mackerel, barracouta, red gurnard, john dory, spiny dogfish, snapper and sea perch, while arrow squid are also frequently caught in trawls. The most commonly represented benthic invertebrate families are Dentaliidae, Cardiidae, Carditidae, Nuculanidae, Amphiuridae, Pectinidae and Veneridae.

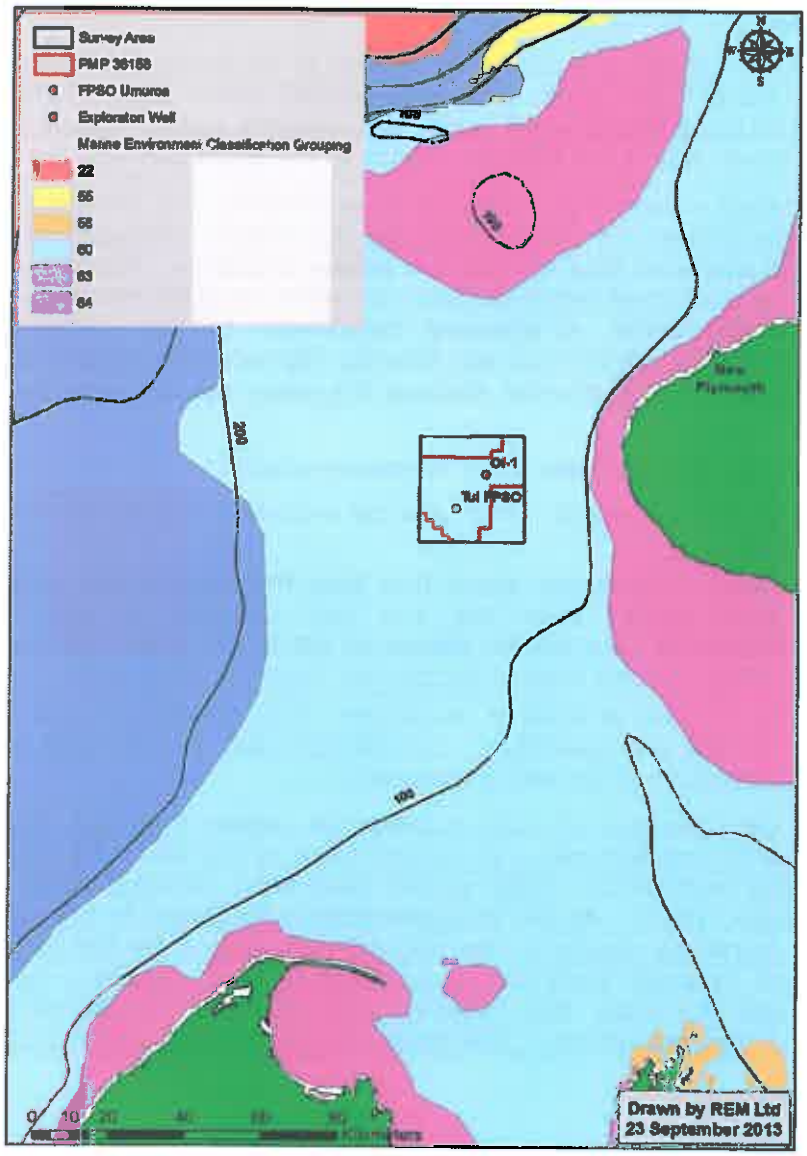

Figure 9: The NZMEC at the 20-Class Level.

3.2.2 Regional Coastal Environment

Around the Taranaki coastline, the northward flowing WC, DC and the southward flowing WAUC play important roles in determining the abundance of fish species (Figure 7). The level of plankton productivity, and therefore food available for fish, is dependent on the availability of nutrients which can be enhanced by vertical upwellings of currents and local freshwater inputs along the coastline.

Within the NZ Marine Fisheries Waters (EEZ and Territorial Sea) over 16,000 marine species have been identified. The sections below are a summary of the marine communities found within and surrounding the Survey Area.

The stretch of coastline inshore of the Survey Area is classified as an exposed coast which is commonly pounded by surf as a result of strong prevailing winds and sea. It consists of rocky shores interspersed with sandy beaches, steep cliffs, subtidal reefs, estuaries and small stream and river mouths which drain from the Taranaki ring plain. All of which provide a wide range of ecological habitats for native plant and animal species.

3.2.2.1 Plankton

The productivity of NZ waters is due to its location in the Pacific, its undersea landscape, ocean currents and climate. Warm subtropical surface waters along the North Island and west coast of the South Island meet colder sub-Antarctic surface waters which surround the rest of the South Island and offshore islands to the south and east (MPI, 2013a).

Plankton is a drifting organism (animals, plants or bacteria) that inhabits the pelagic zone of oceans or seas around the world. They are the primary producers of the ocean and provide a crucial source of food for fish and baleen cetaceans. Plankton travel with the ocean currents, and although some plankton can move vertically within the water column their horizontal distribution is primarily determined by the surrounding currents. Plankton abundance and distribution are strongly dependent on factors such as ambient nutrient concentrations, the physical state of the water column, and the abundance of other plankton.

Plankton can be divided into three broad functional groups:

- Bacterioplankton – bacteria which play an important role in nutrient cycles in the water column;
- Phytoplankton - microscopic plants that form the base of the marine food chain. They capture energy from the sun and nutrients in the water through photosynthesis and help sustain almost all life in the ocean; as they are primary producers which creates organic compounds from CO_2 dissolved in the water; and
- Zooplankton – small protists or metazoans (e.g. crustaceans and other animals) that feed on the phytoplankton. Zooplankton also includes the larval stages of larger animals such as fish and crustaceans.

During spring the upwelling of cold, nutrient-rich waters from the Kahurangi Shoals influence the water temperatures and nutrient input of the South Taranaki Bight as the water propagates northwards. Eddy speeds have been recorded at up to 16 km/day (Viner & Wilkinson, 1987). As the phytoplankton is entrained by the upwelling water, they begin to reproduce rapidly in the nutrient-rich water. By the time these eddies reach the South Taranaki Bight the phytoplankton have created a nutrient-depleted environment, and the water now contains high levels of chlorophyll-*a* which is an indicator for plankton productivity. This phase is cyclical during spring and summer.

3.2.3 Fish Species

Fish populations around the Survey Area are comprised of various demersal and pelagic species, most of which are widely distributed from north to south and from shallow water to beyond the shelf edge.

Over the summer months when warmer currents move down from further north, a number of pelagic species visit the Taranaki coastline following the abundance of food. The most common species are sunfish, flying fish, marlin, albacore, skipjack, mako sharks and blue sharks. The Survey Area does have these pelagic species present over the summer months; however at the scheduled time of the Oi-1 check-shot survey the waters will still be too cool for these pelagic species to be present.

The general distribution of fish species found along the coastline in relation to the Survey Area is shown in (Table 2).

Table 2: General Distribution of Fish Species along the Taranaki Coast

Water depth	Fish Species likely to be present
Pelagic	Albacore tuna, skip jack tuna, southern bluefin tuna, mako sharks, blue sharks, and possibly marlin.
Shallow to mid-shelf waters (depths of up to 200 m)	Snapper, trevally, kahawai, gurnard, blue warehou, blue cod, blue nose, john dory, hapuku, rig, school shark, spiny dogfish, blue mackerel, jack mackerel leather jacket, red cod, tarakihi and kingfish.
Coastal shelf region (depths of up to 500 m)	Elephant fish, school shark, giant stargazer, Gould's and Sloan's arrow squid, tarakihi, red cod, frost fish, silver dory, gem fish, barracouta, hapuku, spiny dogfish, red bait, rig and jack mackerel.

3.2.4 Recreational Fishing

The Taranaki coastline supports significant recreational fisheries for snapper, kingfish, hapuku/bass, trevally, kahawai, tarakihi and gurnard. More notably, warm currents over the summer bring billfish, tuna, sharks and other warm water pelagic species to this stretch of coast.

Even though more people are now using the marine environment for recreational fishing and with the ever improving technology for finding and catching fish with bigger faster boats; recreational fishers can access new and further fishing grounds. However, the stretch of water around the Survey Area is not fished often by recreational fishers, it is a long way from Port Taranaki and there is no reef structure nearby to concentrate fish numbers for fishers to target.

As part of the drilling programme, the Recreational Fishing Council and all the sport fishing and boating clubs along this stretch of coast have been contacted and provided with details of the drilling programme.

3.2.5 Customary Fishing and Cultural Environment

The Taranaki region is home to a number of iwi and hapu (Figure 10), who each have coastal areas that are of high cultural importance to them for collecting marine resources and protection of spiritual values. AWE's planned drilling programme falls within the rohe of the Taranaki iwi, where consultation has taken place prior to the drilling programme and will continue through the establishment of a relationship agreement between AWE and the Taranaki Iwi Trust.

Fishing and the gathering of kaimoana was, and remains today, a fundamental part of being Maori and living along the Taranaki coastline, as Maori hold a very strong relationship with the sea. For coastal hapu, kaimoana is vital to sustain the mauri (life force) of tangata whenua. Fisheries have provided a food source since the arrival of Maori on the North Island west coast region and the ability to provide hospitality to visitors.

Iwi value a number of marine species very highly, including snapper, kahawai, blue cod, flatfish, small sharks, grey mullet, sea urchin (kina), scallops, mussels, paua, pipi, toheroa, cockles and tuatua (MPI, 2013c).

Traditional management governing fishing practices within an area of significance to tangata whenua can be undertaken using the Fisheries (Kaimoana Customary Fishing) Regulations 1998. Customary rights provided for under these regulations allow tangata

whenua to establish management areas (mataitai reserves) where they can create bylaws to oversee fishing within these designated reserves and to create management plans for their overall area of interest.

If tangata whenua choose not to utilise the kaimoana customary fishing regulations they can still exercise their customary right through issue of a customary fishing permit under the Fisheries (Amateur Fishing) Regulations 1986.

Maori participate as part of customary, recreational and commercial fishing sectors in the North Island west coast region where rohe moana, mataitai and taiapure areas have been gazetted along sections of coast surrounding the Survey Area (Figure 11).

Under the Fisheries Act 1996 and Kaimoana Customary Fishing Regulations 1998, a rohe moana comprises of areas where Kaitiaki are appointed for the management of customary food gathering within the area/rohe. Definitions of the boundaries of rohe are contained within the relevant Fishers (Kaimoana Customary Fishing) Notices. While a Taiapure is a local management tool established within an area that has customarily been of special significance to an iwi or hapu as a source of food or for spiritual or cultural reasons. Mataitai reserves are also established under the Kaimoana Customary Fishing Regulations, which comprise of traditional fishing grounds established for the purpose of recognising and providing for customary management practices and food gathering.

Figure 10 shows approximate iwi land boundaries in the Taranaki region, while Figure 11 shows the coastal area where surrounding rohe moana, Mataitai and Taiapure are in place.

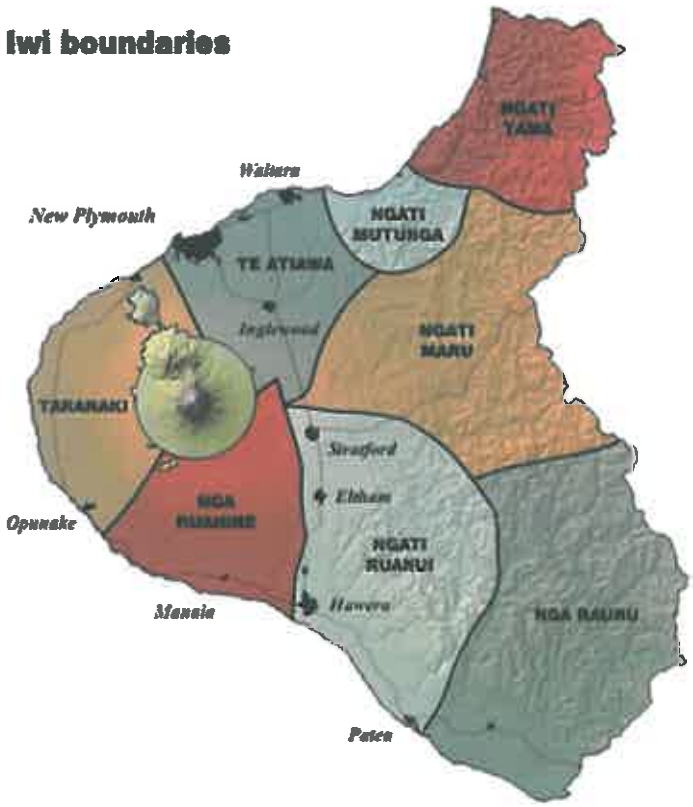

Figure 10: Taranaki Iwi Boundaries Location Map
(Source: www.trc.govt.nz)

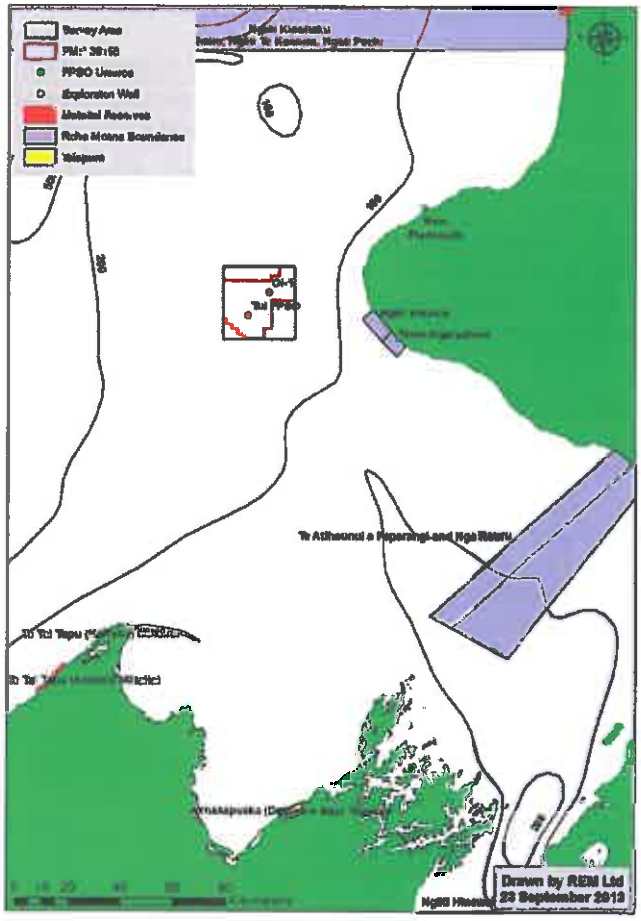

Figure 11: Culturally Important Areas

3.2.6 Threatened Marine Species

The NZ threat classification system was developed for species according to their risk of extinction and used criteria developed specifically for NZ conditions. The list was first released in October 2002, and then updated again in January 2007 (Townsend *et al.*, 2007) and then a cycle for 2008-2011 which was published in independent peer-reviewed scientific journals.

New Zealand has 444 threatened marine species under the NZ threat classification system list; this list includes 38 species of seaweeds (Hitchmough *et al.*, 2005), 33 of marine invertebrates (Freeman *et al.*, 2010), and 36 of NZs 109 species of seabirds (Miskelly *et al.*, 2008). There are 82 species of marine fish listed as being in gradual decline, sparse or range restricted; but there is no comprehensive dataset on the occurrence or distribution of these species within the Taranaki region. Additionally, eight of NZs 50 species of marine mammals are also threatened (Hitchmough *et al.*, 2005, Baker *et al.*, 2010).

Great White sharks and basking sharks are at risk of extinction and are classified as being in gradual decline. Great white sharks occur throughout Taranaki and are now fully protected in NZ waters under the Wildlife Act 1953 and are further protected on the high seas under the Fisheries Act where NZ flagged vessels are prohibited from taking these sharks beyond the 200 Nm EEZ. Other protected species in NZ waters include the whale shark, oceanic whitetip shark, deepwater nurse shark, manta ray and spiny-tailed devil ray.

3.2.7 Marine Mammals

New Zealand waters support a diverse community of marine mammals. There are 41 species of cetaceans (whales and dolphins) and nine species of pinnipeds (seals and sea lions) known to inhabit NZ waters (Suisted & Neale, 2004).

The NABIS database (MPI, 2013b) uses records and data from mammal sightings, strandings, literature reviews and DOC to identify the location of the marine mammals listed in Table 3 below. Marine mammal sightings around the Taranaki area have also been included in Table 3 which builds a comprehensive summary of marine mammals that may be encountered. These mammals are likely to be present or transitory in the vicinity of the Survey Area throughout the year. A basic summary of their ecology is summarised below.

It must be stressed that marine mammal sighting datasets consist of presence-only data, because absence data is not collected. Such presence-only data can restrict analysis of habitat preference and distributional trends because data was not collected with consistent observational effort across space and time. Therefore, the absence of sightings within some parts of the Survey Area does not indicate that marine mammals do not use that habitat, only that no sightings have been recorded there. Additionally, due to unbalanced sighting effort across the region, including increased observational effort due to seismic surveys and dedicated observations from the Maui production facilities, increased marine mammal sightings within a spatial area does not necessarily indicate increased use of that area relative to under-observed areas.

Table 3: Marine Mammals Likely to be Present around the Survey Area

Whales	Dolphin Family	Pinnipeds
Baleen Whales	Common dolphin (*Delphinus delphis*)	NZ fur seal (*Arctocephalus forsteri*)
Humpback whale (*Megaptera novaeangliae*)	Killer whale (*Orcinus orca*)	
Blue whale (*Balaenoptera musculus*)	Bottlenose dolphin (*Tursiops truncates*)	
Bryde's whale (*Balaenoptera edeni*)	Maui's dolphin (*Cephalorhynchus hectori maui*)	
Fin whale (*Balaenoptera physalus*)	Long-finned Pilot whale (*Globicephala macrorhynchus*) and Short-finned Pilot whales (*Globicephala macrorpynchus*)	
Minke whale (*Balaenoptera acutorostrata* & *B. bonaerensis*)	Hector's dolphin (*Cephalorhynchus hectori*)	
Sei whale (*Balaenoptera borealis*)	Dusky dolphin (*Lagenorhynchus obscurus*)	
Southern Right whale (*Eubalaena australis*)		
Toothed Whales		
Beaked whales (11 species identified in NZ waters)		
Sperm whale (*Physeter macrocephalus*)		

Eight marine mammal species have been identified within NZ waters that have been included in the NZ Threat Classification List (Baker *et al.*, 2010) as either *nationally critical, nationally endangered* or *range restricted* (Table 4). Of these listed species, five (Bryde's whale, killer whale, Hector's/Maui's dolphin, southern right whale, and bottlenose dolphin) have been identified that could be present within the Survey Area based on their life history characteristics, behaviour or previous sightings.

In 2012, NIWA were commissioned to do a modelling analysis of marine mammal distribution off Taranaki for OMV NZ Ltd with reference to their Matuku and Maari permit areas using sighting information from their seismic surveys as well as the DOC sighting database. This analysis took into account different environmental factors (water depth, sea surface temperature, chlorophyll-*a*) to describe habitat use characteristics (Torres, 2012). However, due to non-standardised observational effort used to collect these marine mammal sightings, the ability to draw firm conclusions about marine mammal distributions was limited. The data trends for each of the observations were interpreted ecologically and appropriate preliminary conclusions were made for each species.

Table 4: Marine Mammal Species Listed on the NZ Threat Classification List (DOC, 2009, Baker *et al.*, 2010)

Common and scientific name	NZ threat classification	Biology	Local distribution	Likely to occur within Survey Area
Bryde's whale *(Balaenoptera edeni)*	Nationally critical	Generally a coastal species but does live in the open ocean. Bryde's whales prefer temperate waters and are observed off the NZ coast generally north of the Bay of Plenty. This species of whale is believed to rarely venture beyond 40 degrees south.	Possibly encountered in the Survey Area	✓
Killer whale *(Orcinus orca)*	Nationally critical	Feeds on a variety of animals which include other marine mammals and fish species. They are believed to breed throughout the year and appear to migrate based on the availability of prey.	Largely unknown but tend to travel according to the availability of food. Killer whales are widely found in all oceans of the world although more dominant in cooler waters. Likely to occur in the Survey Area.	✓
Maui's dolphin *(Cephalorhynchus hectori maui)*	Nationally critical	World's smallest dolphin and found in inshore waters on the west coast of the North Island. Subspecies of Hector's dolphin	Generally live close to shore (within 4 nautical miles). Unlikely to occur in the Survey Area due to the area being south of their known distribution and their affinity for coastal areas. However, any observations will be recorded and DOC will be notified immediately as this could extend their offshore distribution.	x
Southern elephant seal *(Mirounga leonina)*	Nationally critical	They are the largest species of seal and feed on squid, cuttlefish and large fish. Generally only comes ashore in spring/summer on offshore islands and some mainland areas to breed and moult; otherwise lives mostly at sea. They have an inflatable proboscis (snout) which is most present in adult males which is meant to increase the bull elephant seals roar.	Primary range includes the Antipodes, Campbell, Auckland, Snares Islands and the surrounding Southern Ocean. Occasionally they are found on the mainland from Stewart Island to the Bay of Islands. Not likely to occur in the Survey Area.	x
Southern right whale *(Eubalaena australis)*	Nationally endangered	Present both offshore and inshore and their diet consist of krill, particularly copepods. Mate and calve during winter months in sheltered sub Antarctic harbours such as Auckland Islands and Campbell Island. Are baleen feeders and often travel well out to sea during feeding season; but they give birth in coastal areas (American Cetacean Society, 2010).	Likely to occur as a transient species in the Survey Area.	✓
Hector's dolphin *(Cephalorhynchus hectori)*	Nationally endangered	One of the smallest dolphin species (less than 1.5m long). Generally live inshore although have been sighted up to 18 Nm from the coast. Little known about migratory, reproductive, or feeding habits.	Patchily distributed around the South Island coast. On east coast live between Banks Peninsula and Te Waewae Bay and Porpoise Bay in the south. Has been found washed up in the Taranaki region at Kina Road beach. Two photographs of Hector's or Maui's dolphins have been taken off the Taranaki coast since 2007 and a Hector's or Maui's dolphin was caught in a commercial set net off Cape Egmont in 2012 although the species was not verified as the dolphin was disposed of without contacting DOC or MPI, otherwise it would have been requested to be brought ashore for verification. Three observations have been made in the offshore Taranaki waters (Torres, 2012). If any observations are made DOC will be notified immediately.	✓
NZ sea lion *(Phocarctos hookeri)*	Nationally critical	Feeds on fish, invertebrates, and occasionally birds or other seals. Breeding occurs in summer months with pupping occurring in December/January with the pups being weaned in July/August.	Known to forage along continental shelf breaks with primary range including the Auckland, Campbell, and Snares Islands. Small reproductive colony recently established on the Otago Peninsula. Unlikely to be encountered in the Survey Area.	x
Bottlenose dolphin *(Tursiops truncatus)*	Nationally endangered	Are found worldwide in temperate and tropical waters, generally north of 45 degrees south. Population density appears to be higher near shore. Resident bottlenose dolphins are found off the east coast of the North Island, the northern tip of the South Island, and in Doubtful Sound.	Possibly observed in the Survey Area.	✓

Each Spring most of the large whales living in the Southern Hemisphere undertake extensive migrations: from the Pacific Islands to the Antarctic Ocean to feed, and returning each Autumn-Winter back to the Pacific Islands for the breeding season (May – July) (DOC, 2007).

Figure 12 shows the distribution and migratory patterns of humpback, sperm, Bryde's and southern right whales around NZ throughout the year. The habitat range of the humpback whales includes the Survey Area. Additionally, the southern right whale may frequent the area on their migratory routes. It has to be noted that whilst the northwards migration routes are well known, the southwards routes are not so well known.

Figure 12: Whale Distribution in NZ Waters
(Source: Te Ara, 2013)

3.2.7.1 Humpback Whale

Humpback whales are a baleen whale and belong to the rorqual family; the head is broad and rounded when viewed from above but slim in profile, with a body shape which is quite round and unusually long pectoral fins. The top of the head and lower jaw on humpbacks have rounded bump-like knobs which each contain at least one stiff hair; its purpose is not known but is believed to help in detecting movement in nearby waters. In the summer months humpbacks feed in polar waters, while in the winter months they migrate north to tropical or sub-tropical waters, particularly around Tonga for mating and calving. Over the winter they fast and live off their fat reserves. Whaling in the southern hemisphere has reduced the population from ~120,000 animals to just 15,000 today but the population is currently recovering (Suisted & Neale, 2004).

The humpback whales winter migration route passes near the Survey Area between May and December; travelling from their summer feeding grounds in the Antarctic up the east coast of the South Island, through Cook Strait and continuing up the west coast of the North Island towards the tropics to their winter breeding grounds, particularly around Tonga (Shirihai, 2002).

Both northern and southern migrations are characterised by a gradual increase in the numbers of whales passing through NZ waters, with the highest number of whales observed during the middle of the season. During the migration of the humpbacks it has been observed that lactating females and yearlings are often seen early in the season, followed by immature whales, then mature males and females, while late spring the pregnant females migrate (Gibbs & Childerhouse, 2000). From the DOC database and previous observer reports, a number of humpback whales have been observed around the Taranaki coast, which reflects their migratory route as they travel north or south along the west coast of NZ. There have been 33 sightings of humpback whales reported around the coast of Taranaki, of which most have occurred during the August to December period (Torres, 2012). A number of these observations have been close to the New Plymouth Township but this could potentially reflect a bias in increased observational effort in this area.

No sightings of humpback whale have been observed within the Survey Area, but it is likely that the area is regularly used as a migratory pathway for Humpback whales (Torres, 2012).

3.2.7.2 Blue Whale

Blue whales are the largest animals to ever live; adults can reach up to 33 m long and weigh up to 150 tonnes (Croll *et al.*, 2005). They are long-lived, slow reproducing animals and it is estimated that fewer than 2,000 blue whales can be found in the southern hemisphere. During summer they travel to their feeding grounds in the Antarctic while in winter they spend their time in equatorial waters.

A number of blue whales have been sighted off the South Taranaki Bight and Cape Egmont. A large proportion of them have appeared to be clustered in the south Taranaki Bight which were observed during the seismic surveys which have occurred in the Petroleum Exploration Permit (PEP) areas over recent years. It is believed these whales are using the area of upwelling and high productivity for feeding and possibly breeding (Torres, 2012). These whales have also been observed during a marine seismic survey being conducted north of Farewell Spit in February/March 2013 feeding on krill. Despite blue whales being such large animals, they are fairly elusive and little is known about their distribution or habitat use patterns (Torres, 2012).

From the consultation process it appears there is a spring/early summer resident population that feeds and possibly breeds in the general area of the Survey Area, particularly in an area of upwelling and high productivity off Kahurangi Point (Torres, in prep) and Cape Egmont.

Blue whales have the highest prey demands of any predator where they consume up to two tonnes per day (Rice, 1978). Therefore, the presence of prey in large aggregations is important. Farewell Spit generates a cold water coastal upwelling system which extends north to the South Taranaki Bight which generates highly productive plumes of water. This enriched water enhances primary productivity creating large blooms of zooplankton such as the euphausiid (*Nyctiphanes australis*) which is likely to be the major food source to the blue whales in the area. The Taranaki Bight and Cook Strait areas have been shown to have the most extensive zooplankton biomass (exceeding 300 mg m^{-3}) of all the NZ coastal regions (Shirtcliffe *et al.*, 1990).

The euphausiid *Nyctiphanes australis* is a common species in this upwelling system, they are abundant downstream of this upwelling area, and are likely to be the major food source to the blue whales in this area. A relationship has been shown in the South

Australian Bight between upwelling centres, where euphausiid blooms correlate with high rates of blue whale sightings (Gill *et al.*, 2011). In Torres (2012) the relationship between blue whale sightings and chlorophyll-*a* concentrations indicated increased primary productivity during many of the sightings. Therefore it appears blue whales are using this stretch of water through the Cook Strait and the South Taranaki Bight as a foraging area on their migratory pathway.

There are two subspecies of blue whales in the Southern Hemisphere; Antarctic blue whales and pygmy blue whales which are difficult to distinguish between. There have been a few blue whale strandings around the Taranaki coastline, with a pygmy blue whale last washing up on Waiinu Beach in May 2011, confirming their use of the Taranaki waters.

With all the sightings to date in the South Taranaki Basin, blue whales could be observed in the Survey Area.

3.2.7.3 Bryde's Whale

Bryde's whales are the most common of the baleen whales around the NZ coast although are considered as a nationally critical threatened species. They prefer warmer waters (above 20 °C) so are generally only found in northern NZ (Hauraki Gulf area) (Suisted & Neale, 2004). They grow to 12 - 15 m in length with an average weight of 16 - 20 tonnes making them the second smallest of the NZ baleen whales. The Bryde's whale does differ to other baleen whales that eat krill in polar waters; the Bryde's will also feed on fish, such as pilchards, mackerel and mullet. Bryde's whales are only seen occasionally in Taranaki waters; one sighting in deep water in the South Taranaki Bight occurred during summer months. As a result, observation of Bryde's whales within the Survey Area is likely to be low but is possible.

3.2.7.4 Minke Whale

Minke whales are now believed to consist of two species: the common northern minke and the southern minke whale. The northern minke is confined to the northern hemisphere. However, a sub-species, the dwarf minke is also found in NZ. The Antarctic or southern minke whale is confined to the southern hemisphere, including NZ. These whales have been observed around the NZ coast, but are reported to be most common south of NZ, feeding in the Antarctic waters. However, observation records from DOC have reported Minke whales in the Taranaki area close to shore off Cape Egmont so could be encountered through the Survey Area.

3.2.7.5 Sei Whale

Sei whales are a medium sized baleen whale with an average length of 15 - 18 m and an average weight of 20 - 25 tonnes. They are a fast swimming whale and are among the fastest cetaceans; they have been recorded at speeds up to 50 km/h and have travelled up to 4,320 km in just ten days. In February/March the Sei whales migrate south to Antarctica feeding grounds and then return home to NZ waters between the South Island and Chatham Islands to calve. Observations have been made of these whales in the South Taranaki Bight with all three observations correlating to the summer months, so they could be encountered within the Survey Area during the check-shot survey.

3.2.7.6 Southern Right Whale

The southern right whale is a large bulky baleen whale species with a unique appearance. They can grow up to 15 - 18 m long and the lack of a dorsal fin makes them easy to identify. Their upper and lower jaw is highly curved, with their upper jaw often covered by 'callosities' (hardened patches of skin) that mainly occur around the facial area. These characteristic callosities are often made white by infestations of whale lice and the skin is also often infested with parasitic worms and barnacles making them easily

distinguishable. Southern right whales are slow moving where they swim at no more than 9 km/h, making them vulnerable to ship-strikes.

Southern right whales are the only baleen whales known to breed in NZ waters. Calving occurs in coastal waters during winter months while in summer they migrate to the Southern Ocean (sub-Antarctic Auckland and Campbell Islands) to feed. These whales migrate northwards through the Taranaki region typically between May and October, however they have been recorded at times outside this period in the past. This species is of particular concern as it is thought that there may only be approximately 30 animals left in the NZ mainland population (with only a small number of breeding females remaining). This species is classified as Nationally Endangered, due mainly to whaling that reduced the population from about 17,000 animals to 908 (Carroll *et al.*, 2011, Suisted & Neale 2004) and is currently a priority for DOC to collect sighting data and genetic samples where possible on this species.

When the southern right whales are either on their breeding grounds or migration paths they are frequently found in sheltered coastal waters. This is believed to allow for breeding, nursing calves and avoidance of predators (killer whales and sharks). It is still unknown whether there are two distinct populations of southern right whales around NZ; one in the Southern Ocean which has been making a slow population recovery and one around mainland NZ which is showing no increase in population size.

DOC observation and seismic survey records show four southern right whales have been observed around the Taranaki coastline, all of which over the winter period. Two of the sightings were relatively close to shore between New Plymouth and Okato, so there is the potential that these whales pass inshore of the Survey Area, but is unlikely to occur during the Oi-1 check-shot survey scheduled for Q4 2014. However, the survey will only be a short duration through this period.

3.2.7.7 Beaked Whale

Little is known about the distribution of beaked whales which is mainly due to limited sightings at sea. There are 11 species of beaked whales and it is difficult to identify specific habitat types and behaviours for the individual species; most of the data gathered on these species and in some cases the only proof they exist is from strandings along the coastline (WWF, 2013b). However, strandings of beaked whales along the coast between Wanganui and New Plymouth occur relatively frequently. The beaked whales are most commonly found in small groups in cool, temperate waters, with a preference for deep ocean waters or continental slope habitats down to about 300 m. Of the 11 species, several appear to be largely restricted to southern NZ waters (WWF, 2013b), which suggests these whales do not undertake an annual migration.

The Gray's beaked whale (*Mesoplodon grayi*) is the beaked whale stranded most often and is believed to be the most common beaked whale in the Taranaki region. From the relative frequency of strandings along the South Taranaki coast it is assumed that these animals are present year round in these waters. Population size of beaked whales is believed to be relatively low, and is typically a deep-water species. There is potential that these beaked whales may migrate through the Survey Area rather than reside there.

3.2.7.8 Sperm Whale

Sperm whales are globally distributed with all three known species of sperm whale (large, pygmy and dwarf) recorded in NZ waters. Sperm whales are the largest of the toothed whales; males can reach 18 m long and weigh between 32 - 45 tonnes while females are normally around half the weight and 2/3rds the length of the male.

The sperm whales have a very large brain which can weigh nearly 10 kg; heavier than that of any other animal. Sperm whales feed mainly on squid but are also known to take demersal fish (Torres, 2012), where they prefer to live in open ocean environments and areas on the seaward edge of the continental shelf or in the vicinity of deep canyons

where depths may reach 1,000 m (WWF, 2013a). At these depths the sperm whales rely heavily on acoustic senses for navigation and communication (Torres, 2012).

Kaikoura is home to the main resident population of sperm whales which includes both resident and transient individuals. Sperm whales migrate in summer toward the poles, although males more so than females. Females give birth to their calves between November and March in subtropical or tropical waters.

Sperm whales have previously been observed off the Taranaki coastline, generally during the summer months (Torres, 2012), with a sperm whale washing up in January 2013, 2 km west of the Patea mole, therefore it is assumed that sperm whales may be observed in the Survey Area. Under the International Union of Conservation of Nature (IUCN) they are currently listed as vulnerable.

3.2.7.8.1 Pygmy Sperm Whale

Pygmy sperm whales (*Kogia breviceps*) are small whales, not much larger than dolphins; they can grow to 3.5 m at maturity and weigh up to 400 kg. These whales are not often sighted at sea, where most knowledge of this species comes from the examination of stranded species. Pygmy sperm whales lack teeth in their upper jaw, but have 10 – 16 pairs of teeth in the lower jaw that fit into sockets in the upper jaw.

This species is very difficult to observe at sea given their timid behaviour, lack of a visible blow, and their low profile/appearance in the water. They are usually only detected in idea sea state (calm) and weather conditions (low wind speeds and little or no swells).

There have been a few pygmy sperm whales stranded ashore over recent years around the Wanganui and South Taranaki coastlines. The most recent of which was on Waiinu Beach in South Taranaki in May 2011. There was also a recent stranding of a pygmy sperm whale in the entrance of the Raglan Harbour in February 2013.

This indicates that these species are present in the general west coast area of the North Island. It is therefore assumed that pygmy sperm whales may be observed in the Survey Area.

3.2.7.9 Maui's Dolphin

Maui's dolphins are the world's smallest dolphin and are only found off the west coast of the northern half of the North Island (Maunganui Bluff in Northland to Oakura Beach, Taranaki in the south – although most of the sightings are between Manukau Harbour and Port Waikato (Figure 13)). However, there are some uncertainties relating to the southern and offshore distribution of Maui's dolphins.

Under the Marine Mammals Protection Act 1978 they are a protected species and are one of the world's rarest dolphins; classified as 'nationally critical' and 'critically endangered' by DOC and the IUCN. Maui's dolphins are recognised as a sub-species of the Hector's dolphin, they were once known as the North Island Hector's Dolphin but research showed that the North and South Island dolphins were genetically distinct from each other.

New research (Hamner *et al.*, 2012) has estimated the population abundance of Maui's dolphins to be 55 adults (with 95% confidence intervals that the population is between 48 and 69), which is significantly lower than the 2005 estimate (111 individuals with 95% confidence intervals of 48 – 252), although two different methodologies were used for the two estimates. The study by Hamner *et al.*, (2012), also found that two female Hector's dolphins from the west coast South Island population were within the Maui's population and is the first documented contact between these two subspecies, with the potential for interbreeding.

A MMS has been gazetted to protect the Maui's dolphin and covers 2,164 km of coastline (Figure 15). DOC is awaiting a decision from the Minister of Conservation on an extension of this sanctuary to Hawera. The government have also proposed to extend the set net fishing ban off the coast of Taranaki in an ongoing effort to protect the Maui's

dolphins and are undergoing consultation. The proposed Waitara set net fishing ban extension is from Pariokariwa Point to Waiwhakaiho River between 2 – 7 Nm offshore, covering an area of 350 km^2.

Maui's dolphins are susceptible to the effects of human-induced mortality due to the fact they (MPI, 2013d):

- Become sexually mature at a relatively late age (7 - 9 years);
- Are relatively short lived (20 years);
- Have a low reproduction rate (females have a single calf every 2-3 years);
- Favour shallow waters less than 100 m deep and have a localised inshore distribution (i.e. an overlap with many human activities); and
- Have a small population (and consequently may have few breeding females).

Maui's dolphins have a coastal distribution, generally in water less than 20 m deep where most of the sightings to date have been within 4 Nm of the coast (Figure 13), although Maui's dolphins have been sighted at 7 Nm offshore (Du Fresne, 2010). However, DOC advises that the 100 m depth contour more closely correlates with the offshore distribution of Maui's/Hector's dolphins based on their best available information and is the basis of the AEI being developed along the west coast of the North Island. The furthest offshore sighting of a Hector's/Maui's dolphin was been made from the Maui A platform in 115 m of water depth and 19 Nm from shore. However, this sighting must be treated with caution as it was a public sighting without photo/video evidence.

There are a number of surveys (Ferriera & Roberts, 2003; Slooten *et al.*, 2005; Webster & Edwards 2008) which have extended well to the south of Raglan, Kawhia and even the southern limit of the current closure area; and no Maui's dolphins have been observed during these surveys in the last ten years. This is believed to be due to two possible reasons; these areas are beyond the core range of Maui's dolphins, but are visited occasionally by the dolphins; or there are animals resident in these more southern areas, but surveys miss them because they are present in such low numbers (Du Fresne, 2010). However, there has been reports of a Hector's/Maui's dolphin in Port Taranaki in 2007, video footage of a Hector's/Maui's dolphin off the Waiongana Stream (north of New Plymouth) in December 2009, and a Hector's/Maui's dolphin caught in a set net in January 2012 near Cape Egmont suggesting that these species do visit this stretch of coastline.

The check-shot survey is being conducted 37 km offshore from Cape Egmont, so it is unlikely that a Maui's or Hector's dolphin would be observed. If a sighting of this dolphin was made and verified it would be highly significant as it may extend the known southern boundary of the northern subspecies.

If a Hector's/Maui's dolphin is observed during the check-shot survey, DOC will be notified immediately. Both National Office (Ian Angus, ( )) and the Taranaki Area Office (Callum Lilley or Bryan Williams who will mobilise a fixed wing plane and the DOC boat to try and gather a biopsy sample. The biopsy sample will be used to verify sub-species (Hector's or Maui's dolphin) using genetic (DNA) analysis to assist genetic modelling and helping to evaluate the population size.

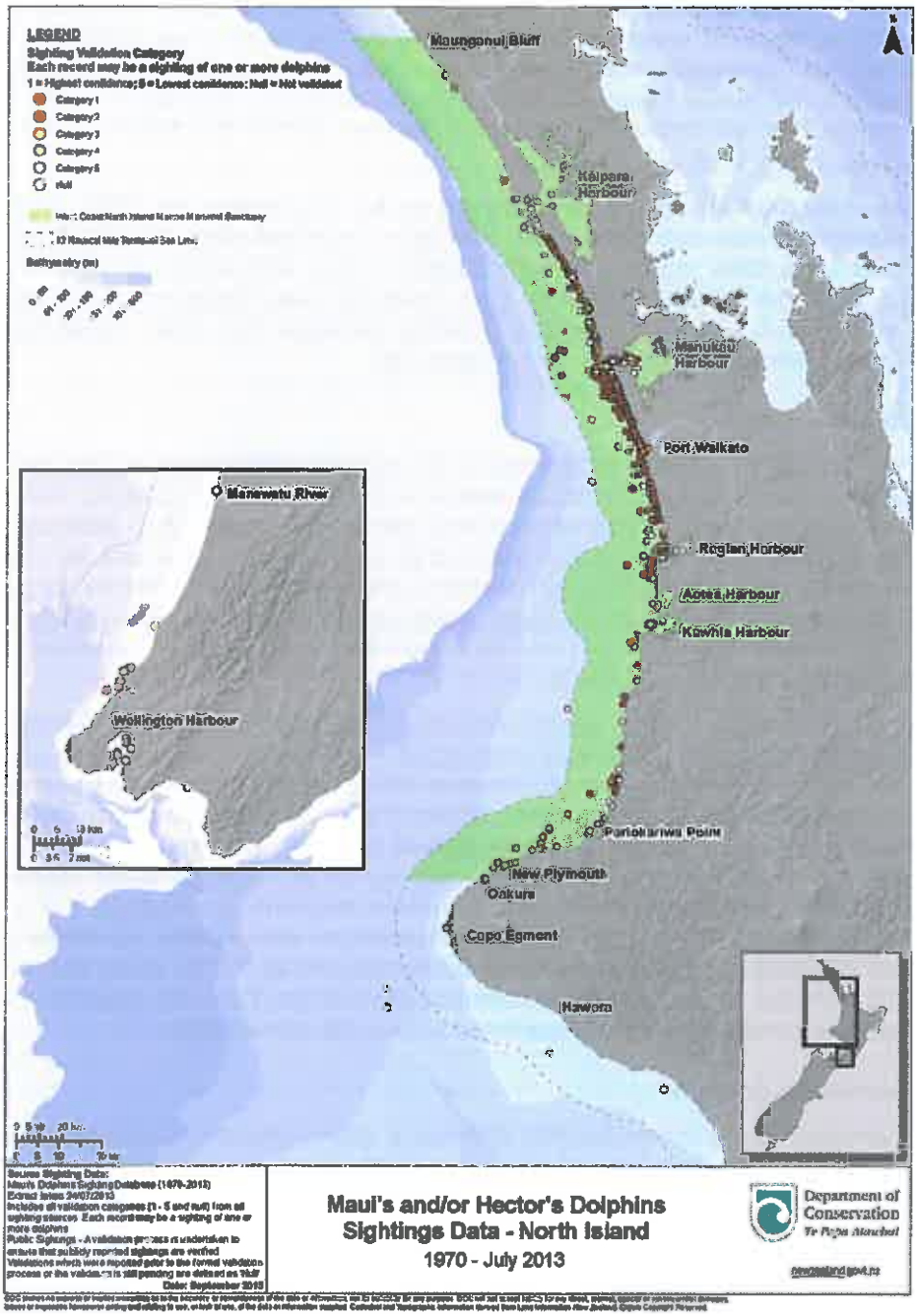

Figure 13: Maui's and/or Hector's Dolphin Sightings from 1970 - 2013.

3.2.7.10 Hector's Dolphins

Hector's dolphins are also only found in NZ and grow to 1.2 – 1.5 m in length making them one of the smallest cetaceans in the world. Their life cycles are very similar to the Maui's dolphins described above. They are endemic to NZ and have a patchy distribution around most of the South Island. The centres of distribution are on the west coast between Farewell Spit and Haast and on the east coast around Banks Peninsula; although there is a population around the top of the south from Farewell Spit to Cloudy Bay.

Over the last 40 years their numbers have declined rapidly - in the 1970s their population was believed to be about 29,000 whereas today there are around 8,000 remaining. Hector's dolphins live in three geographically distinct groups around the

South Island. It is estimated about 90 dolphins live on the south coast of the South Island, 2,600 on the east coast and about 5,400 on the west coast (MPI 2013e). They are classified as 'nationally endangered' by DOC. However, their numbers have increased within the Banks Peninsula MMS and are routinely reported in and around the Marlborough Sounds, as well as individuals observed within the Maui's dolphin area in north Taranaki (Hamner *et al.*, 2012).

Set nets used in coastal waters are believed to be responsible for 75% of the known Hector's dolphin's deaths but many more may go unreported (MPI, 2013d; Project Jonah, 2013). Hector's dolphins prefer shallow, coastal waters with water depths of less than 100 m but a Hector's/Maui's dolphin (not verified) was observed from the Maui A platform, where they may be possibly moving between the west coast/Marlborough Sounds and near-shore Taranaki waters (Figure 13).

3.2.7.11 Common Dolphin

The common dolphin in NZ waters belongs to the species now known as the short-beaked common dolphin. They are easily recognisable by their pattern of colours; from purplish-black to dark grey on top to white and creamy tan on the underside. Although dolphins generally tend to remain within a few kilometres of the coast, they are far ranging and distributed around NZ. In the Bay of Islands a study was conducted by Constantine & Baker (1997) which showed that the mean water depth of sightings for common dolphins was 80 m and ranged from 6 to 141 m. Although they are the most abundant dolphin in the world, globally they are in decline.

They feed on a variety of prey which includes surface schooling fish (anchovies) and small mid-water fish (jack mackerel) and squid. This is supported by a study which surveyed the gut contents of common dolphins of by-caught or stranded animals around NZ, including 10 from the northern and southern Taranaki Bights, and found their diet to consist of a diverse range of fish and cephalopod species, with the prevalent prey being arrow squid, jack mackerel and anchovies (Meynier *et al.*, 2008). Killer whales are the principal predators of common dolphins. Common dolphins grow up to 1.7 – 2.4 m in length and can weigh 70 – 110 kg. The maximum age of the common dolphin is estimated at 22 years with sexual maturity being reached at 7 - 12 years for males and 6 - 7 years for females. This species is common around the Taranaki coastline, especially over the summer period and will be observed within the Survey Area.

3.2.7.12 Bottlenose Dolphin

Bottlenose dolphins are a larger dolphin that has a wide variation in size globally, ranging from 2.4 – 4 m in length and 250 - 650 kg in weight. The NZ bottlenose can reach 4 m in length. Bottlenose dolphins are widely distributed through the world in cold temperate and tropical seas, with NZ being their southernmost point of their range.

There are three main coastal populations of bottlenose dolphins in NZ; around 450 live along the northeast coast of Northland, around 60 live in Fiordland and there is a population living in the Marlborough Sounds to Westport region. Genetic analyses have shown that these three populations are differentiated with regard to DNA diversity, indicating little or no gene flow between the populations (Baker *et al.*, 2010). There is a sub-population of offshore bottlenose dolphins that tend to travel more widely and in larger groups.

In the latest threat classification list, bottlenose dolphins were uplisted from 'Range Restricted' to 'Nationally Endangered' based on new evidence of low abundance and concern over potential decline in two populations with known ranges.

The DOC marine mammal database shows that bottlenose dolphins have been observed within the Taranaki coastal region off Cape Egmont. Any observation through the Survey Area would likely be the offshore bottlenose dolphins.

3.2.7.13 Dusky Dolphin

Dusky dolphins are found in coastal waters in the Southern Hemisphere; they are slightly smaller than common dolphins where they can grow to 2 m in length, 50 – 90 kg in weight and are characterised by having virtually no beak. They prefer cool, upwelling waters and mainly live in inshore waters but can be found out to the outer continental shelf. Within NZ they are most abundant from East Cape down to Kaikoura and are the second most numerous species of dolphin around NZ. The NZ population of dusky dolphins is believed to be in the order of 12,000 to 20,000 individuals and are not regarded as threatened (Markowitz *et al.*, 2004). There are no defined seasonal migrations but they are known to make offshore seasonal and diurnal movements. During late spring and summer it has been shown that dusky dolphins will spend the mornings inshore resting and socialising then by late afternoon move between 6 and 15 km offshore. Over winter dusky dolphins will generally spend more time in deeper water.

Dusky dolphins consume a variety of fish (e.g. anchovies) and squid species as part of their diet and often form large groups for their feeding activities. Cooperative foraging in large groups is often used for feeding. Admiralty Bay in the top of the Marlborough Sounds is regularly used by 200 - 300 dolphins as a winter foraging habitat.

It was shown in Torres (2012) that dusky dolphins have been observed in both shallow and deep waters off Cape Egmont suggesting they may use the Taranaki coastal area on occasions and possibly in the Survey Area.

3.2.7.14 Killer Whale

Killer whales are classified as a nationally critical threatened species in NZ waters (Suisted & Neale, 2004), they are the largest living members of the dolphin family where males can grow up to 6 – 8 m long and weigh in excess of 6 tonnes. They have the second heaviest brains among marine mammals. Within NZ waters there are believed to be two killer whale populations; one inshore and one offshore although this has not been verified. These whales are commonly inshore during the summer fur seal breeding season. However, the Survey Area is far enough offshore that there are no seal colonies located nearby which could aggregate these dolphins. However, seals will frequently use the offshore area to forage for food and are present at most of the offshore Taranaki platforms and FPSO's. Other prey species consist of fish, sharks and rays. The entire NZ killer whale population is small (mean = 119 ± 24 SE) with broad distribution patterns around both North and South Islands (Visser, 2000). Killer whales frequent the Taranaki region but typically exhibit a coastal distribution in this area and no sightings of killer whales have been recorded within the Survey Area (Torres, 2012).

3.2.7.15 Pilot Whale

Two species of pilot whales exist in NZ waters; long-finned pilot whales and short-finned pilot whales, and are a member of the dolphin family. Short-finned pilot whales prefer the warmer waters but their ranges do overlap. Both species are listed as data deficient by the IUCN.

For the long finned pilot whales, males are much larger than the females, which can measure up to 6.1 m long and weigh up to 3 tonnes. Pilot whales prefer coastal waters along the continental shelf breaks and in areas of sharp topographic relief (WWF, 2013c). Long finned pilot whales are migratory and prefer cold and more temperate waters where they feed on fish and squid in off-shore deeper waters.

Pilot whales are notorious for stranding on beaches and Farewell Spit has a number of strandings each year. Pilot whales frequent deep water for feeding which may account for the difficulties they experience when they encounter unfamiliar shallow water. They are very social, family animals and may travel in groups of over 100 animals.

Strandings of pilot whales occur throughout the coastlines of NZ, where peaks in standing events seem to occur during spring and summer months (O'Callaghan, 2001).

It was originally thought that family relationships among pilot whales led to the strandings due to their 'care-giving' behaviour; where the stranding of one or a few whales, because of sickness or disorientation, triggers a chain reaction in which healthy individuals are drawn into the shallows in an effort to support their family members (Oremus *et al.*, 2013). However, the study by Oremus *et al.* (2013) using genetic data from stranded whales in NZ and Tasmania showed that the stranded groups are not necessarily members of one extended family, and many stranded calves were found with no mother in evidence.

The stranding of pilot whales along Farewell Spit has been a regular occurrence throughout NZ's recorded history; recent strandings have included 86 individuals in February 2011, 65 individuals in November 2011, 25 individuals in January 2012, another 99 individuals in January 2012 and 28 individuals in November 2012. Pilot whales are common visitors to the Taranaki waters during the summer months and are likely to be observed in the Survey Area.

3.2.8 Pinnipeds

The NZ fur seal is the most common pinniped in NZ waters and are found throughout the country. Population estimates are in the order of 50,000 to 60,000 but this is believed to be an underestimate. Most sightings of fur seals have been inshore, in water depths of less than 100 m, however fur seals have been observed in the offshore Taranaki waters (Torres, 2012). They are known to forage along continental shelf breaks up to 200 km offshore but are generally distributed inshore.

NZ fur seals can hold their breath for 10 – 12 minutes, enabling very deep dives (~200 m) to feed on fish (small mid water fish, conger eels, barracouta, jack mackerel and hoki), squid and octopus; which is further aided by the adaptation of being able to slow their heart rate down to about one-tenth of its normal rate to help conserve oxygen (WWF, 2013d).

NZ fur seals are present year round in offshore Taranaki waters. They have a continual presence at the offshore Taranaki platforms and FPSO's in the Taranaki Basin, which act as artificial reefs and attract large schools of fish, and the seals spend time hauled out on the platform and associated structures. There are several breeding colonies and haul-out areas of the NZ fur seal in the central NZ area, particularly the Sugar Loaf Island Marine Protected Area (SLIMPA). The breeding season is from mid-November to mid-January. At the breeding colonies adult males arrive first from late October, followed by females in late November. Pups are generally born in January and weaned in July/August when females return to sea. It is highly likely that NZ fur seals will be observed within the Survey Area.

3.2.9 Marine Reptiles

There are seven species of marine reptiles known to occur off the coast of NZ: the loggerhead turtle (*Caretta caretta)*, the green turtle (*Chelonia mydas)*, the hawksbill turtle (*Eretmochelys imbricate)*, the olive Ridley turtle (*Lepidochelys olivacea)*, the leatherback turtle (*Dermochelys coriacea*) the yellow-bellied sea snake (*Pelamis platurus)*, and the banded sea snake (*Laticauda colubrine)*. Apart from the leatherback sea turtle, marine reptiles are generally found in warm temperate waters and as a result most of NZ's marine reptiles are found off the northeast coast of the North Island in the warmer water (WWF, 2013e).

Marine reptiles do occasionally visit the Taranaki coastline, although mainly during summer months when the warmer currents push down the western side of NZ. Leatherback turtles and yellow bellied sea snakes have been observed within Taranaki waters (DOC, 2013a). However, they are only rarely seen in Taranaki and if any marine reptiles are observed they will be recorded by the MMO and will add to the knowledge of the distribution of marine reptiles around NZ. A study undertaken by McCauley *et al.*,

(2000) exposed captive sea turtles to an approaching single air gun. The results indicated that the turtles displayed a general alarm response at an estimated 2 km range from an operating seismic vessel with avoidance behaviour estimated at 1 km.

3.2.10 Seabirds

NZ is often considered to be the seabird capital of the world due to the diversity of seabirds in NZ waters. There are 86 species of sea birds found in the marine waters off NZ which include albatrosses, cormorants and shags, fulmars, petrels, prions, shearwaters, terns, gulls, penguins, and skuas (DOC, 2013b). The greatest variety of albatrosses and petrels in the world are found within NZ waters, with NZ considered as an important breeding ground.

Information on seabirds within the Taranaki area was obtained from DOC records and the NABIS database which is based on records of birds washed up dead on beaches in the region and from sightings by people passing through the area on boats. Some might only be present as individuals while others could be flocks of thousands (e.g. fairy prions). Species identified that could possibly be in the Survey Area include:

- Albatross, including the wandering, southern royal, northern royal, light-mantled sooty, antipodean, Campbell, Gibson's, grey headed, Wandering, Chatham and white capped;
- Mollymawks, including the Salvin's, Black-browed and Buller's;
- Shearwaters, such as short-tailed, little, Buller's, flesh-footed, sooty, Hutton's, common-diving, and fluttering;
- Petrels, including black, common diving, grey, grey-faced, Kermadec, northern giant, Westland, New Zealand storm, Giant (Nelly), Cape, Mottled, and white-headed;
- Terns, including Caspian, white, and the white-fronted;
- Penguins including northern little blue, and blue; and
- Other seabirds such as south polar skua, black-backed gull, red-billed gull, black-billed gull, cape pigeon, masked booby, fairy prion and the Australasian gannet.

Many of these species have been identified to be at risk. In summary, the bird species which could be in the Survey Area and are most at risk from a conservation perspective are:

- Eastern rockhopper penguin – which has experienced an estimated 70% decline in population over the last ten years (not within Survey Area);
- Kermadec white-faced petrel – which has an estimated remaining population of only 250 birds and one known breeding location (not within Survey Area);
- Black-fronted tern and black-billed gull – which have both experienced significant population decline over recent years;
- Northern Royal Albatross – which has only two breeding locations in NZ – Taiaroa Head in Dunedin and Chatham Islands; and
- Hutton's shearwater – which has a very restricted breeding range (not within Survey Area).

From the NZ Threat Classification List for birds, a summary of the birds that has been identified as likely to be in the Survey Area at some stage during the year from the NABIS website, DOC records and Miskelly *et al.*, (2008) are shown in Table 5.

Table 5: Seabirds in the NZ Threatened Species Classification

Common Name	Further details and Qualifiers
Nationally critical	
Eastern rockhopper penguin	>70% decline over 10 years or 3 generations. Deterioration thought to be linked with decrease in ocean productivity possibly as a result of global warming. The species is also threatened overseas, and is identified as Vulnerable under the IUCN Red list.
Kermadec white-faced storm petrel	<250 individuals, island endemic, one location, note breeding areas are not within the Survey Area.
Nationally endangered	
Black-fronted tern	50 - 70% population decline, data poor. Identified as Endangered in the IUCN Red List.
Black-billed gull	Decline thought to be associated with changes to land-use.
King shag	250 - 1000 individuals, population stable.
Nationally vulnerable	
Gibson's albatross	5,000 – 20,000 individuals, 30-70% population decline, island endemic, range restricted.
Fiordland crested penguin	1,000 – 5,000 individuals, 10-50% population decline, sparse
Caspian tern	1,000 – 5,000 individuals, stable, secure overseas
Red-billed gull	20,000 – 100,000 individuals, 50-70% population decline
Pied shag	1,000 – 5,000 individuals, 10-50% population decline,
Black petrel	1,000 – 5,000 individuals, stable, range restricted
Declining	
Light-mantled sooty albatross	20,000 – 100,000 individuals, 10 - 50% population decline, data poor, range restricted, Near Threatened under IUCN Red List.
White-chinned petrel	>100,000 individuals, 10 - 70% population, ranged restricted, threatened overseas, Vulnerable under IUCN red list.
Grey petrel	20,000 – 100,000 individuals, 10 - 50% population decline, secure overseas, Near Threatened under IUCN Red List
Flesh-footed shearwater	20,000 – 100,000 individuals, 10 - 50% population decline, ranged restricted, threatened overseas, and declining under IUCN red list.
Sooty shearwater	>100,000 individuals, 10 - 70% population, secure overseas, Near Threatened under IUCN Red List
Hutton's shearwater	>100,000 individuals, 10 - 70% population, one location. It is listed as Endangered under the IUCN Red List.
White-fronted tern	20,000 – 100,000 individuals, 10 - 50% population decline, data poor
Northern little blue penguin	5,000 - 20,000 individuals,10 - 30% population decline, data poor, extreme fluctuations

Sea birds that feed by plunge diving (i.e. Australasian Gannet) or that rest on the sea surface and dive for food (i.e. sooty shearwater) have the potential to be affected by underwater noise from seismic surveys. Potential impacts of seismic pulses to seabirds could include physiological injury, behavioural avoidance of seismic survey areas and indirect impacts due to effects on prey.

Diving seabirds are all highly mobile and are likely to flee from sound sources. The potential for physiological impact of seismic noise on diving bird species is considered to be of high intensity for 3D marine seismic surveys, specifically in close proximity to the sound source, however, given the survey duration (i.e. short term) and the low volume of the acoustic source used for the check-shot survey, the potential effects are reduced.

Avoidance behaviour of the birds, if at all, would only last for as long as the check-shot survey continues, There is a high probability that the Australasian Gannet may be

present during the Oi-1 check-shot survey if the pelagic baitfish that these birds feed on are present within the Survey Area, however, the likelihood of seabirds diving close to the rig to capture prey at the same time the acoustic source is being fired is considered to be very unlikely and as a result the potential effects on seabirds (both diving and non-diving) would be *negligible*.

Gannets (*Morrus serrator*) are large black and white birds with a yellow head. They hunt for fish by diving from a height into the sea to pursue their prey underwater. With this hunting method the gannets have evolved some adaptations which allow them to do this:

- They have no external nostrils;
- They have air sacs in their face and chest under their skin which act like bubble wrap, cushioning their impact with the water; and
- Their eyes are positioned far enough forward on their face to give them binocular vision so that they can judge distances accurately.

Gannets can dive from a height of 30 m and can reach speeds of 145 km/h as they strike the water which allows them to dive to depths of about 40 m to catch fish. They generally follow the large schools of bait fish which are chased by the pelagic fish that visit the north Taranaki waters during the summer months, and as a result may be observed within the Survey Area.

3.2.10.1 Breeding Colonies

There are five species of birds that have known breeding colonies in the surrounding areas of the Survey Area, all of which are in the NZ Threatened Species Classification (Figure 14). These species are listed below with their classifications, if any and further details are given in Table 5.

- The NZ King shag – Nationally endangered given their few remaining breeding pairs;
- The flesh footed shearwater at SLIMPA – declining;
- The sooty shearwater at SLIMPA – declining;
- The grey-faced petrel – not threatened; and
- The Caspian tern – nationally vulnerable (though secure overseas).

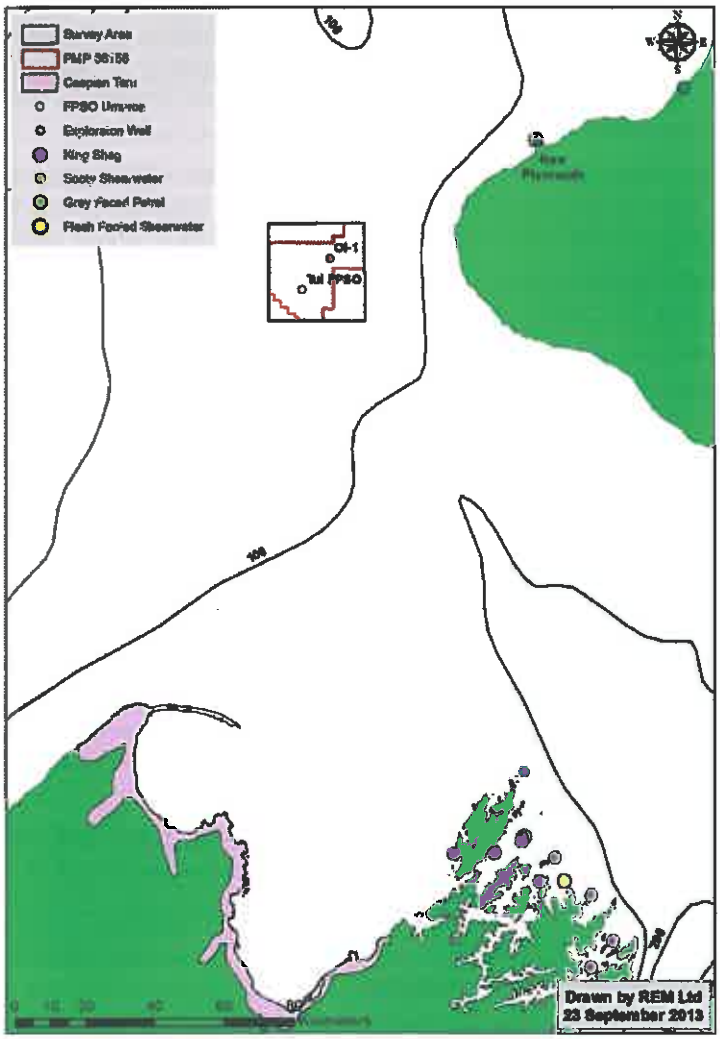

Figure 14: Breeding Colonies of Seabirds in Areas Surrounding the Survey Area

3.2.11 Protected Natural Areas in the Vicinity of the Survey Area

Protected Natural Area's (PNA) are locations that receive protection due to their recognised natural ecological values, and are put in place for biodiversity conservation.

The closest PNA to the Survey Area is the Tapuae Marine Reserve (Figure 15). The Tapuae Marine Reserve covers 1,404 ha and has a diverse range of habitats from canyons to boulder fields which provide a safe haven and nursery for a wealth of underwater life (DOC, 2013c). It adjoins SLIMPA, and extends south of New Plymouth to Tapuae Stream and has a contrast of environments within the reserve. In the northwest there are islands, remnants of an ancient volcano with caves, canyons, boulder fields, while in the south-western part of the reserve is less sheltered and is a classic example of the wild Taranaki Coast (DOC, 2013c). Within the reserve, the waters contain a diverse range of fish, invertebrate and algal species. Tapuae reserve is an important breeding and haul out site for NZ fur seals. Within this area other marine mammals have also been observed such as common dolphins, pilot whales, orca, humpback whales and southern right whales.

The Survey Area is located 33 km southwest of the southern boundary of the West Coast North Island MMS, which extends from Maunganui Bluff in Northland to Oakura Beach in the south and was established in 2008 for the protection of the Maui's dolphins. The MMS

offshore boundary extends from mean high water springs to the 12 Nm territorial sea limit, giving a total area of 1,200,086 hectares and covers 2,164 km of coastline.

DOC have also classified an area of coastline as Areas of Ecological Importance (Figure 16), which was established due to the presence of Maui's/Hector's dolphins in the area. Under the Code of Conduct, when seismic surveys are operating within these areas of ecological importance, additional measures to avoid, remedy or mitigate adverse effects are required to minimise any effects to marine mammals. However, given the scale, duration and nature of the Oi-1 check-shot survey scheduled, other than complying with the Level 2 requirements of the Code of Conduct, no additional mitigation measures are required.

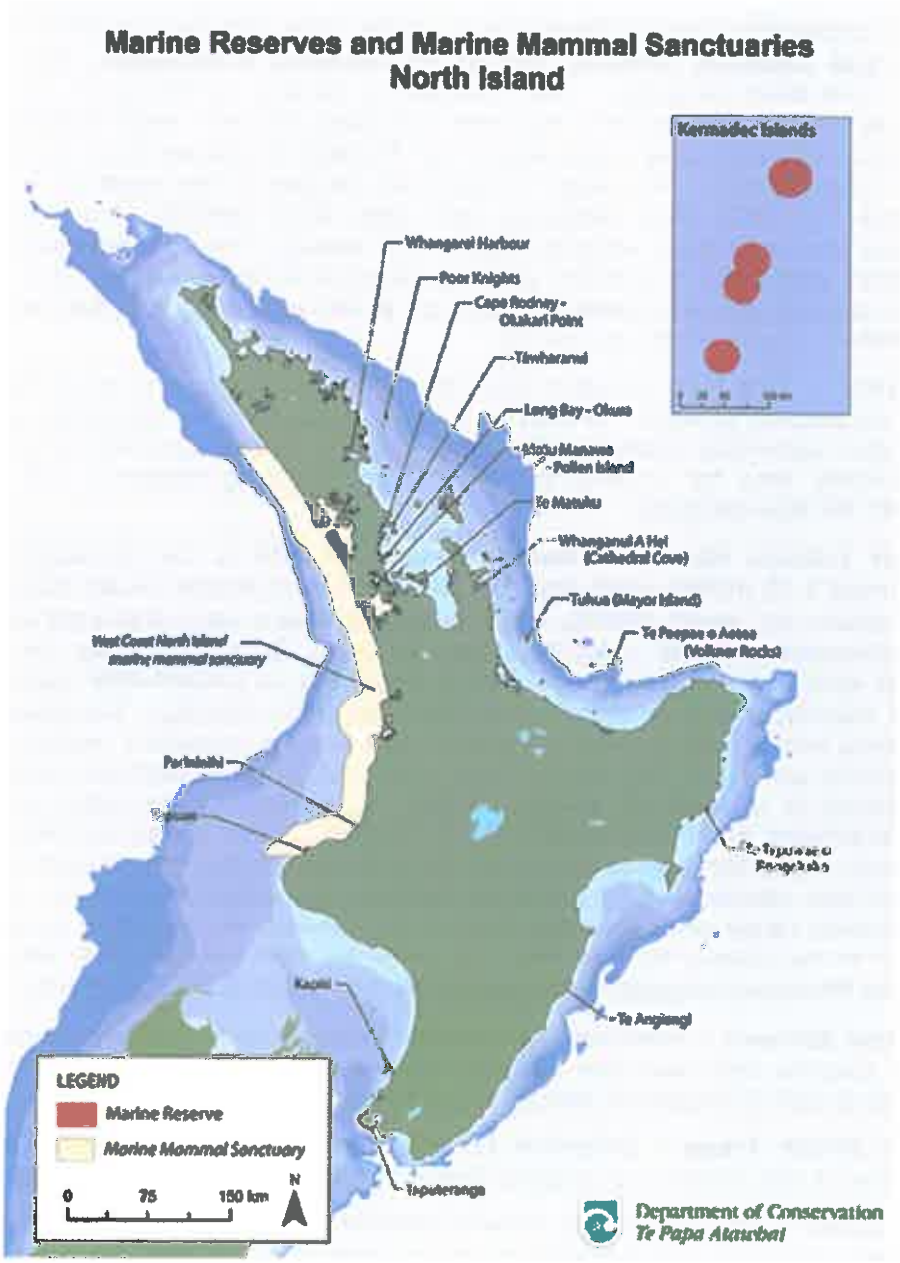

Figure 15: North Island Marine Reserves and Marine Mammal Sanctuary

3.2.12 Taranaki Areas of Significant Conservation Value

Within the Taranaki Regional Coastal Plan (1997) there are several areas within the coastal marine area which have significant conservation values and there are policies in place to protect them from any adverse effects of use or development. These areas and their outstanding coastal values are listed below (TRC 1997) and are identified in Figure 16. The Survey Area is located offshore from these significant areas, but they have been discussed here for completeness.

Pariokariwa Point to Waihi Stream – This section of coastline contains a diverse range of nationally and locally significant features. The area includes fur seal haul-out and seabird roosting areas on Opourapa Island, offshore reefs containing abundant marine life, outstanding natural landscape at White Cliffs and its associated walkway, a shipwreck, and important breeding habitat for fluttering shearwaters, the grey-faced petrel and little blue penguins. The Mohakatino Estuary to the north is considered nationally significant. The estuary supports whitebait, flounder and shellfish, and the adjacent sand flats and wetland are habitat for threatened species such as Australasian bittern and Caspian tern. The large Tongaporutu Estuary to the south is an important nesting area for little blue penguins and grey-faced petrels. The rare variable oystercatcher has also been recorded there. The estuary includes whitebait spawning habitat and an abundance of shellfish with high species diversity. A large reef, supporting a range of marine life and sponges, extends 8 km offshore. The natural landscape includes offshore stacks, cliffs, and caves.

Mimi Estuary – This area includes tidal mudflats, saltmarsh and sand dune habitat which are uncommon in north Taranaki. It provides habitat for migratory and wading birds, whitebait spawning habitat in the upper estuary, feeding grounds for snapper and trevally, nursery area for juvenile marine species including flounder, and a periodic breeding site for blue penguins.

Sugar Loaf Islands Marine Protected Area – SLIMPA is the remnants of an old volcano formed 1.75 million years ago that has since been eroded away leaving a group of low sea stacks and seven islands, which provide a unique semi-sheltered environment along an otherwise exposed coastline (DOC, 2013d). SLIMPA includes the foreshore, seabed and water, and encompasses islands protected as conservation park land (the three inner islands) and a sanctuary area (the four outer islands). The islands are the oldest exposed volcanic formations in Taranaki and provide important nesting habitat for 27,000 seabirds per year. The islands have a diverse range of subtidal marine habitats providing home to at least 89 species of fish, 33 species of encrusting sponges, 28 species of bryozoans and 9 nudibranchs (DOC, 2013d). There are 19 species of seabirds found on and around the islands and about 10,000 seabirds nest there each year. They are predator-free islands and NZ fur seals use them as breeding grounds. The islands include a diverse range of underwater habitats and marine life including several species that appear to be unique to the area. SLIMPA are the only offshore islands in the Taranaki and Manawatu regions, where access to the islands is by permit only.

Whenuakura Estuary – Relatively unmodified estuary which provides habitat for the threatened Caspian tern and rare variable oystercatcher. The estuary is a route for migratory birds and an important whitebait spawning habitat.

North and South Traps – Extensive *Ecklonia radiata* kelp forests with diverse and abundant marine life, which is an unusual feature on an otherwise sandy coast.

Waverley Beach – An outstanding natural landscape with eroding stacks, caverns and tunnels, which produces unique landforms at land/sea interface, and blowholes.

Waitotara Estuary – An unmodified representative estuary, it is adjacent to an existing conservation area which is the habitat of threatened birds (Australian bittern, NZ shoveller and black swan). Is a stopover for migratory wading birds and international

migrant birds. Sub-fossil totara stumps are present in the estuary and it is an important whitebait spawning area.

Waiinu Reef – The area has limestone rock outcrops from mean high water springs (MHWS) to 500 m offshore. The hard rock platforms contain many well-preserved fossils and an abundance of marine life.

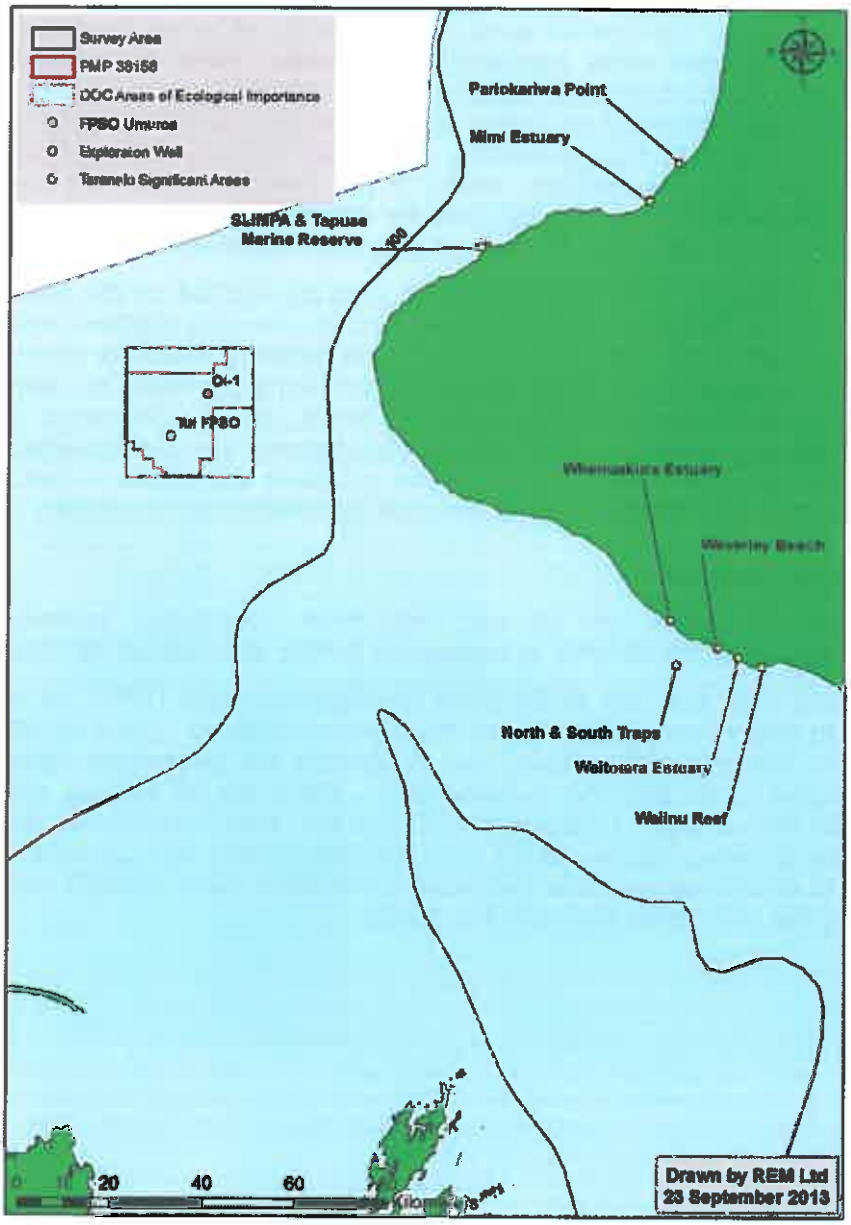

Figure 16: Areas of Significant Conservation Value as defined in the Taranaki Regional Coastal Plan and DOC Area of Ecological Importance

3.3 Anthropogenic Environment

This section focuses on the users of the surrounding environments; with particular emphasis on shipping, commercial fishing, oil and gas industry, tourism and research.

3.3.1 Ports and Harbours

NZ has thirteen major commercial ports and harbours, of which there are three main types; major ports, river ports and breakwater ports. Ports are not only important gateways for freight, transport and trading both nationally and internationally but they can have a general conservation value due to the abundance of eelgrass, mudflats, mangroves and salt marshes, providing extensive habitats for a diverse range of migratory birdlife, fish and shellfish. Many of the harbours within NZ have numerous arms and embayment's which may be used for swimming, boating or fishing. Local iwi also hold harbours and estuaries as areas of particular significance to them.

Port Taranaki, northeast of the Survey Area is centrally located on the west coast of the North Island and is the only deep water seaport on the NZs western seaboard with a maximum port draft of 12.5 m. It is a modern port, offering nine fully serviced berths for a wide variety of cargoes and a full range of providoring, stevedoring, ship agency and government border protection services (Port Taranaki, 2013). The cargo going through the port is generally related to the farming, engineering and petrochemical industries. Additionally the port is a servicing base for sea transport and related industries since the beginnings of the major offshore and onshore oil exploration in the 1960s.

3.3.2 Fishing Industry

Fishing within NZ waters can be split into three categories: commercial fishing; recreational fishing; and traditional or customary fishing as practiced by Maori.

NZ waters have been split into 10 Fisheries Management Areas (FMA), as seen in Figure 17, in order to better manage the Quota Management System (QMS) by MPI. The QMS is the primary fisheries management tool to provide for commercial utilisation of the fisheries resource while ensuring sustainability. There are 96 species within the QMS which have an Annual Catch Entitlement (ACE) which takes into account the commercial catch from the previous season, along with the recreational and customary catch. The ACE is used to determine the Total Available Commercial Catch (TACC) each year which is split among the companies that own the quota.

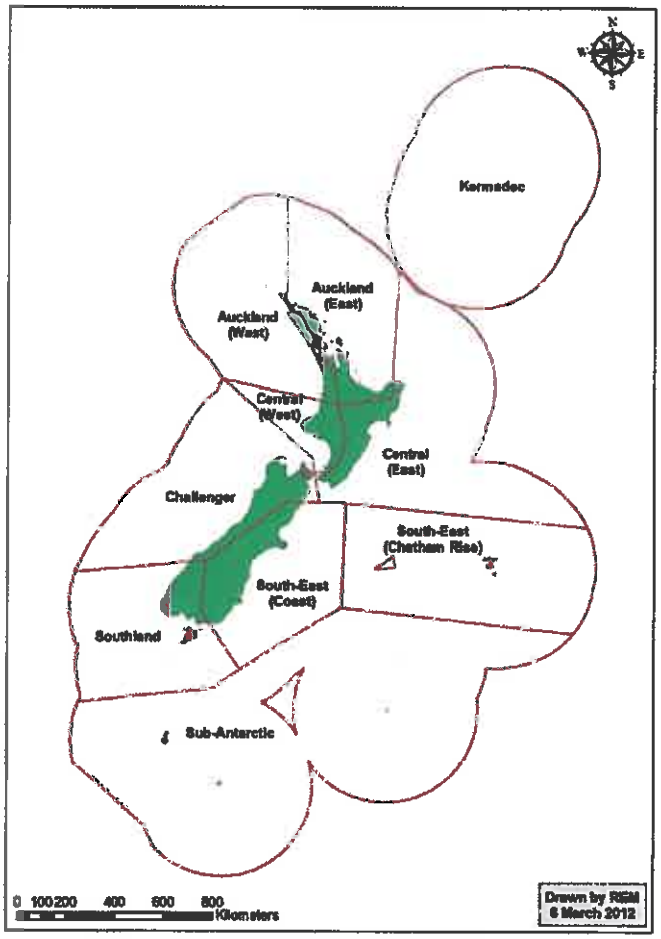

Figure 17: Fisheries Management Areas

Commercial fishing activities are the most intensely monitored fishing activities within NZ. The calculated asset value of NZs commercial fish resource in 2009 was $4.017 billion which is a 47% increase from 1996 (Statistics NZ, 2013). The top 20 species of fish contributed 91% of the value of NZ's commercial fish resource, with hoki contributing 20% alone.

Consultation with the Deepwater Group was conducted after the deep water jack mackerel fishery was identified as being within the Survey Area.

MPI undertook a fisheries assessment for the Survey Area from 1 October 2007 to 30 September 2012 within FMA 8 (Central (West)) (Figure 17). The assessment area is shown in Figure 18.

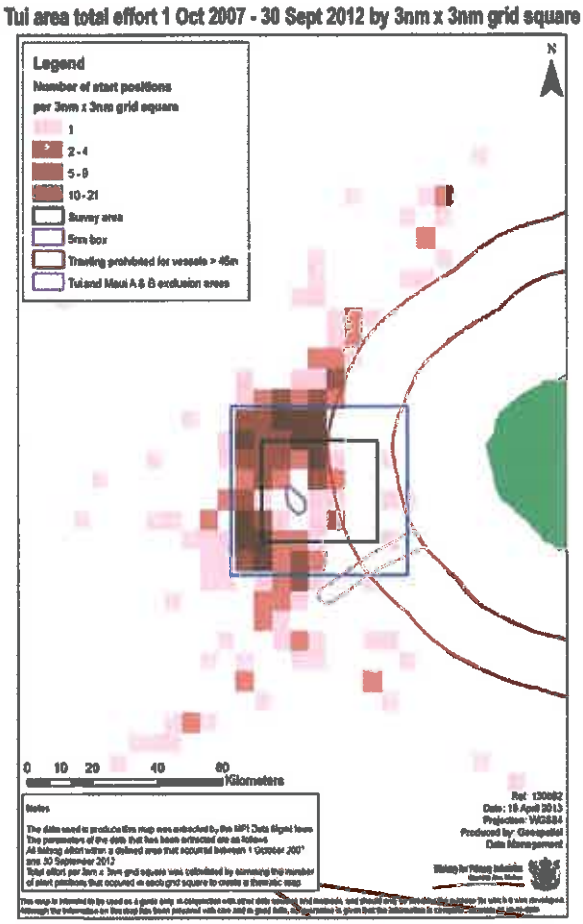

Figure 18: Fishing Effort around Survey Area from October 2007 – September 2012
(Source: MPI)

Five years' worth of fishing data was used in this assessment (1 October 2007 to 30 September 2012) from completed catch effort returns from commercial fishers. Data was included in the assessment if the fishing event started, ended or passed through the Survey Area, where the total catch was 2,712 tonnes. The majority of the total catch was jack mackerel (90%). Bycatch species from the jack mackerel fishery within the Survey Area include barracouta, frostfish and redbait.

Trawling is the most commonly used fishing method in the Survey Area which has been shown to peak in effort during December/January and then again during June/July. The least amount of fishing effort occurs during the months of February through to May. The jack mackerel trawl fleet mainly consists of 6 - 7 foreign charter vessels to NZ operators and these operators have been advised of the Survey Area and period that the drilling programme and check-shot survey will be undertaken.

As well as notification provided to all users of the marine environment, a Notice to Mariners will be issued and will be broadcast over maritime radio, notifying the presence and location of the KTIV.

The KTIV and associated support vessels will apply all the appropriate navigational lighting and day-shapes to abide with the International COLREGS. Likewise, if all vessels in the area are abiding to the International COLREGS there should be no close calls or damage of any fishing gear, or the KTIV.

3.3.3 Oil and Gas Activity

Taranaki is the centre of NZ's oil, gas and petrochemical industry and is very important to NZ's economy. Taranaki produces all of NZ's hydrocarbon products (i.e. crude oil, condensate, naphtha, natural gas, liquefied petroleum gas (LPG) and compressed natural gas (CNG)) and petrochemical products (e.g. methanol and urea). Exploration and production activities in Taranaki have occurred for more than 30 years, with an increase of activity within last decade. Producing offshore fields include: Maari, Maui, Kupe, Pohokura, and Tui. Figure 19 shows the current extent of offshore oil and gas exploration and production within the Taranaki Basin area. Seismic operations have been commonplace off the Taranaki coastline since the 1950s with hundreds of thousands of kilometres acquired, as well as check-shot and vertical seismic profiling, and there have been no recorded incidents or harm to marine mammals as a result of these surveys.

Figure 19: Taranaki Oil and Gas Fields
(Source: http://www.teara.govt.nz/en/map/8934/taranaki-oil-and-gas-fields)

3.3.4 Tourism Industry

Various tourism companies operate on land or near the coastline in the Taranaki region. However, on-water based tourism is not a large industry around the Survey Area due to the exposed coastline resulting in often rough seas and distance offshore.

3.3.5 Other Uses

No specific information is available on other users of the ocean near or within the Survey Area; however, maritime shipping, recreation and navy vessels have the potential to traverse the Survey Area during the Oi-1 check-shot survey, although they will be

required to remain at least 500 m away from the KTIV due to a non-interference zone being in place.

3.3.6 Research

Various organisations conduct research within or near the Survey Area. DOC, NIWA, MPI, and research institutions conduct research and monitoring at the various marine reserves and parks along the coastlines inshore of the Survey Area. Surveys and studies are also extensively being done within the West Coast North Island MMS due to the recent publicity of Maui's dolphins and their low population estimate and the resulting restrictions in place due to these latest population estimates.

The check-shot survey will also contribute to the knowledge of marine mammals and mega fauna in the area as a dedicated MMO will be on board the KTIV for the duration of the source testing and check-shot survey.

4 Potential Environmental Effects and Mitigation Measures

4.1 Introduction and Methodology

This chapter considers all of the likely environmental effects of the Oi-1 check-shot survey, including the planned and unplanned activities. The main steps used in the assessment can be summarised as follows:

- Identification of the activities of the proposed check-shot survey that might result in potential environmental impacts and impacts on marine mammals;
- Identification of the key potential environmental sensitivities vulnerable to those activities identified;
- Detailed description of each identified potential environmental effect, including the factors which AWE will undertake to control and mitigate each potential effect; and
- Determining the significance of the potential environmental effects identified, taking into account the proposed control and mitigation measures. This assessment considers the likelihood and magnitude of the potential environmental impact including its geographical scale (site, local and region) and its duration in relation to the sensitivity of the key environmental receptors.

The scale of the environmental effects has been classified into four categories specifically for the check-shot survey, which is based on the mitigation zones within the Code of Conduct for a Level 2 seismic survey, and is outlined below in Table 6.

Table 6: Categories of Potential Environmental Effects to Marine Mammals and the Environment

Negligible Effect
There are no significant effects predicted to occur to the environment, or the impact is of small enough magnitude that it does not require further consideration. Marine mammals beyond 1,000 m from the sound source will be unaffected which is based on the Level 2 mitigation zone for marine mammals classified as Species of Concern with calves present. No recovery is required from exposure to the sound source and no specific mitigation measures are required.
Minor Effect
The negative environmental effect, if any, disappears within one hour after cessation of activity. Marine mammals between 1,000 m and 600 m from the sound source may show some behavioural disturbance, which relates to the distance between the two Level 2 mitigation zones within the Code of Conduct. No mitigation measures are necessary for the return to the original situation or behaviour.
Moderate Effect
The environmental effect requires some time to disappear after cessation of the activity. For marine mammals this impact is likely to occur between 600 m to 200 m from the sound source which relates to the Level 2 mitigation zones for Species of Concern with calves and other marine mammals within the Code of Conduct. Behavioural effects may be seen, and physical effects could occur, but are presumed to be temporary. No mitigation measures other than best management practices are required to return to the original situation.
Severe Effect
The environmental effect requires the implementation of mitigation measures, and with these measures, the return to the original situation requires a relatively long period of time. For marine mammals this impact is likely to occur when they are within 200 m of the seismic source, which is based on the marine mammal mitigation zone within the Code of Conduct. Within 200 m there could be behavioural or physical effects. If the animal was close enough to have physical trauma inflicted, it is likely to take longer than 24 hours to recover.

4.2 Sources of Effects

The first step of the assessment process is to identify potential sources of environmental effects. These sources can vary from accidental events, such as accidental discharges, to routine operations in relation to the check-shot survey, including the source sound or the physical presence of the vessels.

Table 7 outlines the planned and unplanned components of the Oi-1 check-shot survey that have the potential to result in environmental effects. The following sections will then outline the potential effects of these activities, and the mechanisms AWE propose to utilise to ensure these effects are avoided, remedied or mitigated.

Table 7: Check-shot Survey Activities and Potential Environmental Effects

Planned Activities
Physical presence of the KTIV and support vessels (Section 4.3.1) • Interference with local fishing activity (Section 4.3.1.1); • Interaction or interference with marine traffic (Section 4.3.1.2); • Interference and/or damage to marine archaeology, cultural heritage, or submarine infrastructure (Section 4.3.1.3); • Indirect effects, such as changes in the abundance or behaviour of fish species targeted by established fisheries (Section 4.3.1.4); • Change in marine bird behaviour (Section 4.3.1.5); • Introduction of marine pests (Section 4.3.1.6); and • Interaction or interference of the KTIV with marine mammals (Section 4.3.1.7).
Source sound emissions (Section 4.3.2) • Physiological effects on marine fauna from exposure to sound or associated pressure effects (Section 4.3.2.1); • Behaviour disturbance leading to behavioural changes or displacement (Section 4.3.2.2); • Disruption to feeding, mating, breeding or nursery activities of marine organisms (Section 4.3.2.3); • Interference with the use of acoustic communication signals, or naturally-produced cues used by marine animals (Section 4.3.2.4); and • Indirect effects, such as changes in the abundance or behaviour of prey (Section 4.3.2.5).
Solid and liquid wastes generated on the KTIV and support vessels (Section 4.3.3) • Generation of sewage and greywater (Section 4.3.3.1); • Generation of galley waste and garbage (Section 4.3.3.2); and • Generation of oily waters (Section 4.3.3.3).
Unplanned Activities
Impacts of Unplanned Activities and mitigation measures (Section 4.4)
Fuel/oil spill from vessels (Section 4.4.1)
Vessel collision or sinking (Section 4.4.2)

4.3 Effects of Planned Activities and Proposed Mitigation Measures

4.3.1 Physical Presence of the KTIV and Support Vessels

The physical presence of the KTIV, along with the support vessel, has the potential to interfere with the following activities within the Survey Area in the subheadings below.

4.3.1.1 Interference with local fishing activity

Disturbance to the offshore fishing activities could occur due to the physical presence of the KTIV and potential exclusion of fishing vessels within a 500 m radius non-interference zone around the KTIV, which could cause temporary loss or reduction of access to fishing grounds.

Surrounding the Survey Area the deepwater mackerel trawlers use the area (Section 3.3.2) and have been notified of the drilling programme taking place, and are also aware of the hydrocarbon production facilities and exploration activities within this offshore Taranaki Basin. The KTIV and support vessel will comply with the COLREGS, and the support vessel will implement the 500 m non-interference zone around the KTIV. Each well location is on a flat featureless seabed (Johnston & Forrest, 2012), so there are no locations where fish are known to aggregate and that fishers target more than other areas. A notice to mariners will be broadcast daily on maritime radio so all fishing vessels will be aware of the KTIV's location and can plan the excluded area into any daily fishing activities. As a result of these measures in place, the relatively small area of excluded space and the short check-shot survey duration at each well location, the effects from the Oi-1 check-shot survey on the fishing activities is believed to be ***negligible***.

4.3.1.2 Interaction or interference with marine traffic

Adherence to the COLREGS by the KTIV, support vessels and all maritime traffic will essentially mitigate any potential risks of collision. The location of each of the exploration and appraisal wells and area covered by the KTIV's anchor pattern is not within a known navigation channel; therefore ships can navigate freely around the KTIV. A Notice to Mariners will be issued on VHF radio for the duration of the drilling programme. The Survey Area is also within the Taranaki offshore precautionary area promulgated by the International Maritime Organisation, which was established to ensure the safety of both vessels and offshore installations around Taranaki. The support vessel will also act as a warning vessel to any ship in the vicinity of the KTIV which may approach inside the 500 m non-interference zone and will ensure the potential risks of collision are minimised as far as practicable. The potential for disturbance to commercial vessels or private vessels will be ***negligible***.

4.3.1.3 Interference with and/or damage to marine archaeology, cultural heritage or submarine infrastructure

There are no archaeological sites, sites of historic significance or submarine infrastructure identified within the footprint of the exploration drill sites. Most of the areas of cultural importance are on the shallow reefs and coastline inshore of the Survey Area. Therefore, it is considered that the potential interference with and/or damage to marine archaeology, cultural heritage or submarine infrastructure is ***negligible***.

4.3.1.4 Indirect effects, such as changes in the abundance or behaviour of fish species targeted by established fisheries

Overseas reports and studies have noted that seismic data acquisition can alter the behavioural patterns of certain fish species, causing them to dive deep and away from the sound source or tightening up of their school structure (McCauley *et al.*, 2000). However, this effect is generally noted for shallow waters in areas of hard bottom. There is anecdotal information that the tuna are harder to catch, both commercially and recreationally out of Taranaki from previous seismic surveys which have been conducted over the summer months. However, during the WesternGeco marine seismic survey on the *Western Monarch*, which commenced in January 2013 there was no effects observed on the gamefish species (tuna and marlin); in fact it was one of the best fishing seasons for a number of years in and around their Survey Area.

The Oi-1 check-shot survey will only run for a short duration (~ four hours), and any potential effect in the Survey Area on fish species is considered to be ***negligible*** in relation to the commercial fish species most commonly targeted (i.e. jack mackerel and barracouta).

4.3.1.5 Change in marine bird behaviour

There is the potential, either positive or negative, for sea birds to interact with the KTIV and/or the support vessel. A positive interaction would include the KTIV and vessels providing loafing or perching opportunities that would not otherwise be available to birds on the open ocean. This interaction is known to occur on slow moving vessels and offshore installations. Whereas negative interactions could include injury to birds through a collision with the KTIV and/or vessels or becoming entangled in any of the rigging.

Research has shown that artificial lighting can cause disorientation in seabirds, mainly fledglings and novice flyers, particularly when it occurs near shore (Telfer *et al.*, 1987). The mechanisms through which seabirds are attracted to artificially lit vessels are poorly understood. Seabirds are thought to navigate by starlight over the ocean, and in some cases artificial lights may interfere with their ability to navigate by stars (Black, 2005; Guynup, 2003). There is also a chance that fish and other forager species are attracted to lights which would then in turn attract seabirds due to the foraging opportunities around the rig and vessels (Black, 2005).

Collisions or entanglements during the day would be unlikely as most seabirds are agile flyers with keen eyesight, and would be able to avoid collisions with the KTIV and support vessel. However, the risk would be greater at night as they may become disoriented or unable to identify the rigging in flight.

Information from a number of exploration drilling programmes undertaken in the offshore Taranaki area as well as from the Maui A and B platforms, which have been operating since 1978 and 1992 respectively, there is no evidence of any potential adverse effects on seabirds. The short term duration of the exploration and appraisal drilling programme (approximately 30 – 40 days for each well, and the check-shot survey duration of approximately four hours) will also reduce the potential for any long-term interference with seabird navigation.

At the Tui FPSO, the only birds to have been observed landing on the facility are sparrows, swallows and finches which are believed to have been brought out by the workboats and Offtake Tankers visiting the FPSO. No collisions or deaths of birds have been observed since the Tui FPSO has been onsite.

The most common bird that has been observed landing on the Maui platforms are pigeons, which are exhausted and use the platform to rest (Bruce Colgan, STOS, *pers. comm.*). DOC Taranaki Area Office reports that one bird is delivered to them every three or four years from manned offshore installations, all of which have been alive. The birds have not been entangled in rigging but attracted to the lights and then disorientated, whereupon they get into the machinery spaces and get oil on their feathers. The birds were transported back to land via helicopter and sent to Massey University to have the light oiling removed from their feathers. All birds were then released into the wild from a boat off New Plymouth. Birds that have been delivered to DOC have included blue petrels, fairy prion and diving petrels.

It is likely that the KTIV and support vessel may provide resting opportunities for birds on railings, antennas, or other similar structures over the relatively short period the KTIV is on location, but from previous experience at Taranaki offshore installations, collisions or entanglements are rare. Therefore, it is considered that the proposed check-shot survey would have ***negligible*** adverse effects on seabirds.

4.3.1.6 Introduction of marine pests

The primary mechanisms that have the potential to cause the inadvertent introduction and spread of marine pest species to NZ waters are; ballast water discharges, sea chests and hull fouling. Infected bilge water and sediments in the bottom of ballast water tanks

on vessels which travel internationally also provide a potential source of exotic organisms to NZ.

The introduction of foreign marine organisms to NZ does not necessarily result in the introduction of marine pests, as water temperature, depth and other environmental factors may prevent their establishment. However, if the organisms can survive and establish in NZ waters, this may result in catastrophic consequences for native species as well as threaten marine farming and fishing industries.

Pursuant to s22 of the Biosecurity Act 1993, MPI issued the *Import Health Standard for Importing Ballast Water from all Countries* in June 2005. This standard was developed to limit the potential for the introduction and spread of marine pests into NZ territorial seas. This standard applies to ballast water loaded within the territorial waters of a county other than NZ, and intended for discharge in NZ waters.

MPI also issued the *Draft CRMS for Vessel Biofouling* in accordance with Section 22 of the Biosecurity Act 1993. This standard specifies the requirements to be met for the effective management of risks associated with biofouling on the submerged parts of vessels arriving in NZ from international waters. This requires any vessel arriving into NZ to be 'clean' which is defined as no visible aquatic organisms on the hull, including niche areas (propellers, rudder shafts, bow thrusters, sea chests and dry-docking support strips), except as a slime layer.

The CRMS for biofouling was released in 2013 as a voluntary standard and is expected to come into force in 2017, to allow vessels enough time to make any required changes to their current hull management regimes. Up until 2017 these requirements will be voluntary but MPI are actively encouraging vessels to improve hull management and become compliant as early as practical. The KTIV was in dry dock in Singapore undergoing maintenance prior to departing for NZ waters, where it was mechanically cleaned and inspected; resulting in compliance with the CRMS for biofouling and MPI gave approval for the KTIV to enter NZ waters in August 2013.

Therefore, the potential for the KTIV to introduce marine pests as a result of biofouling is ***negligible***.

4.3.1.7 Interaction or interference of the KTIV with marine mammals

As outlined in Table 4, two marine mammals classified as nationally critical (bryde's whale and killer whale) and three as nationally endangered (southern right whale, Hector's dolphin and bottlenose dolphin) may be present in part of or in close proximity to the Survey Area during the proposed Oi-1 check-shot survey.

Adverse effects of seismic surveys have not been unequivocally demonstrated in NZ, but concerns have been raised by researchers in other international cases and it is presumed the same potential exists here in NZ. Most mammals seem to use avoidance mechanisms and stay clear of any operations where noise is produced (Hammond *et al.*, 2002), whereas other species are attracted to the facilities. NZ fur seals are attracted to offshore structures, as they can provide a food source and haul out area for the seals.

In order to further reduce the probability of interaction with marine mammals the check-shot survey will operate in accordance with the Code of Conduct as outlined in Section 4.5.

These mitigation measures will also be employed to reduce the impacts associated with source sound emission on marine mammals' acoustic communication as detailed in Section 4.3.2.4. As a result of these mitigation measures and compliance with the Code of Conduct, it is believed that the impacts on marine mammals as a result of this survey would be ***negligible***.

4.3.2 Source Sound Emissions

The acoustic source used for seismic data acquisition is generated using arrays of air guns, that produce sound at about 250-270 dB at frequencies generally lower than 1 KHz (usually lower than 200 Hz) and directed downwards towards the sea floor. In the case of the Oi-1 check-shot survey the sound will be ~193 dB and a frequency of 10 Hz will be used.

The low-frequency signals created during seismic survey events propagate efficiently in the water, with little loss due to attenuation (i.e. due to absorption and scattering). Within a few metres of an airgun array, in deeper waters, spherical spreading loss (the reduction in intensity caused by the spreading of waves into an ever increasing space) results in a loss of around 6 dB per doubling of distance. However, attenuation depends on propagation conditions. In good propagation conditions, the signal may be above the background level for more than 100 km; in poor propagation conditions it may reach background level within a few tens of kilometres (McCauley, 1994).

Sound waves travel until they meet an object or they are dissipated by normal decay of the signal. Nevertheless, the intensity of sound waves decays exponentially, and although low level signals travel for long distances, the higher amplitude waves lose much of their energy very close to the airgun source. Typically, most emitted energy is low frequency, between 0.01 to 0.3 kHz, but pulses also contain some higher frequency energy up to 0.5 to 1 kHz. However, the latter components are weak when compared to the low frequency emissions (Richardson *et al.*, 1995). The low frequency component of the sound spectrum attenuates slowly, but high frequency sound attenuates rapidly to levels similar to those produced from natural sources. The rate of change in sound level from a seismic airgun is relatively rapid, and it may be this factor, as much as any, which contributes to observed effects on marine organisms.

Environmental issues relating to seismic surveys are focused on the potential effects on marine mammals and other fauna from the sound waves associated with the seismic energy source. The pulses associated with seismic surveys produce a steep-fronted detonation wave which is transformed into a high-intensity pressure wave (shock wave with an outward flow of energy in the form of water movement). There is an instantaneous rise in maximum pressure followed by an exponential pressure decrease and drop in energy.

The exposure time to the airgun signal will be determined by the firing sequence and the sound level of interest. Large mobile fauna such as marine mammals have been routinely observed to stay away from the airgun source at the higher sound levels, thereby reducing their exposure times. However, observations of fish congregating in the lights of a working seismic vessel have been made, suggesting that they are not adversely affected by the operating seismic source. Furthermore, low level acoustic sources (e.g. mitigation guns or during soft start) have been observed to attract some species of marine mammal (e.g. killer whales), and are thus not considered to adversely affect those species. The proposed Oi-1 check-shot survey would be considered as a mid-level acoustic source.

There is potential for seismic survey operations to have an adverse effect on marine mammals; mostly in regards to the larger cetacean species although there are also a few smaller species for which there is a serious conservation concern. The Code of Conduct classifies the Species of Concern as those listed in Schedule 2 of the Code of Conduct and includes all NZ cetacean species except common dolphin, dusky dolphins and NZ fur seal (DOC, 2012).

In the Code of Conduct, it is acknowledged that operations in some areas could be significantly impacted by shutdowns to protect NZ fur seals when complying with the mitigation zones, a relatively common species with no significant threat at the wider population level.

Previous seismic surveys around NZ have generally shown that during the summer months (November-March) NZ fur seals dominate sightings. The seals are generally feeding in the coastal waters of NZ and are known to live around the platforms and FPSO facilities in the South Taranaki Basin. This issue was raised as part of consultation with DOC who acknowledged that special consideration is warranted with respect to the Code of Conduct requirements for NZ fur seals, as the seals are likely to use the KTIV as a haul out and remain on or near the rig for extended periods of time.

Check-shot surveys are significantly different to vessel-based 2D or 3D marine seismic surveys, where the acoustic source is limited to a single location, and the shots are spaced over relatively short survey duration (~ four hours). The Oi-1 check-shot survey will have a low source volume (2 x 150 in^3) with a maximum of 150 shots fired at an operating capacity of 1800 psi. Most 3D seismic survey programmes tend to run for 20 – 30 days continuously with the acoustic source fired every ~10 seconds, so in comparison to the number of shots fired for the Oi-1 check-shot survey (~150), the same total of shots, although at a lower volume and operating capacity, would be completed in 25 minutes. Therefore, if the check-shot survey is undertaken to the requirements of the Code of Conduct, it is believed there will be a ***negligible*** risk to marine mammals.

In light of this, DOC is willing to let check-shot survey operations commence as long as a reasonable effort has been made to minimise the risk to NZ fur seals. If observations during the pre-start procedures indicate that NZ fur seals are entering and leaving the 200 m mitigation zone, then every effort should be made to time the firing of the initial acoustic source when no NZ fur seals are present within the mitigation zone. However, if the NZ fur seals are continuously present, every effort should be made to fire the acoustic source when the NZ fur seals are at the surface, rather than diving. NZ fur seals which have hauled out on the KTIV do not need to be considered when applying mitigation requirements, as they will presumably be unaffected by the acoustic source.

The presence of a dedicated MMO onboard the KTIV during the Oi-1 check-shot survey may help increase the understanding of effects or lack thereof to NZ fur seals through observational data.

4.3.2.1 Physiological effects on marine fauna from exposure noise or associated pressure effects

The sound intensities required to produce physiological effects are largely unknown for most marine animals, and what is known is based on a limited number of experiments. To cause immediate serious physiological damage, sound levels need to be very high (Richardson *et al.*, 1995). High sound levels are found only close to the acoustic source, and hence the area where damage may occur is limited to close proximity to the source.

Most free-swimming animals have been observed to practice avoidance manoeuvres well before they get within the range at which negative effects may occur; pre-start observations and soft-start procedures will be routinely employed to ensure this area is clear of potentially sensitive fauna prior to the check-shot activities commencing. There is a general lack of conclusive data on the physiological effects of sound on marine mammals because protected species (including most cetaceans) cannot be sacrificed for physical examinations, and their large size is generally prohibitive of captive studies.

Animals which do not flee the area of an acoustic source because of behavioural or physical constraints could be at risk of physiological effects. Such animals include plankton, fish eggs and some sessile (i.e. non-mobile) organisms such as marine benthos and some species of fish.

Exposure to elevated sound can lead to what is known as threshold shift in hearing, or elevation of lower limit of auditory sensitivity, in fish and mammals. In most cases this is believed to be temporary only, colloquially known as the 'rock concert effect', that is a temporary loss of a degree of hearing following exposure to loud sound. It is generally believed that exposure to extremely loud noise, or multiple or prolonged exposure to

loud sound could cause a permanent threshold shift, but the details of when this would occur, in terms of levels and frequencies of sound and exposure times, are not known. For the proposed Oi-1 check-shot survey, which has a low source volume (2 x 150 in^3) over a relatively short duration (~ four hours) with shots spaced out (groups of three, 15 seconds apart, every five minutes), there is unlikely to be any threshold shift in hearing for fish species.

Studies with beluga whales and species of dolphin have shown that temporary threshold shift did not occur until sound levels were in the order of 225-230 dB, and for a seismic survey, this would be a few tens of metres at most from the sound source (OGP/ International Association of Geophysical Contractors (IAGC) position paper). The use of the Code of Conduct for the protection of marine mammals from sound is specifically designed to ensure that marine mammals are nowhere as near to the gun array as this.

Therefore, it is considered that sound effects on marine mammals and other marine fauna from the Oi-1 check-shot survey is likely to be ***minor***, provided the provisions of the Code of Conduct are adhered to.

4.3.2.2 Behavioural disturbance leading to behavioural changes or displacement

Behavioural responses to seismic surveys, including fright, avoidance, and changes in vocal behaviour have been observed in *Mysticetes* (baleen whales) in particular, which 'operate' at lower sound frequencies (moans at 10 - 25 Hz recorded). *Odontocetes* (toothed whales and dolphins) are less likely to be detrimentally affected, as they 'operate' at sound frequencies far higher than those generated by air guns (> 5 kHz). See Section 4.3.2.4 below.

Observations of the effects of sound from offshore seismic surveys on whales indicate that seismic survey sound may cause changes in localised movements and behaviours in cetaceans; in general swimming away from the source, but on occasion's rapid swimming at the surface, and breaching (McCauley *et al.*, 1998; McCauley *et al.*, 2003). However, seismic survey sound does not appear to cause changes in the regional migration patterns of cetaceans (McCauley *et al.*, 2003). The sound level proposed for the Oi-1 check-shot survey is considerably lower than most marine seismic surveys and would have ***negligible*** effects on any behavioural changes of cetaceans.

A captive exposure study on pink snapper demonstrated minor behavioural responses to air gun signals ranging from startle to alarm responses (McCauley *et al.*, 2003). This study also suggested that fish numbers decrease with habituation, and that fish may actively avoid active seismic surveys in the wild. Reef fish are also expected to move away from the sound source as shown in the McCauley *et al.* (2003) study; however, the Survey Area is a relatively flat muddy seabed in deep water (~120 m). Given the relatively short duration of this project (~ four hours) and the likelihood that most pelagic fish would either avoid or move away from the sound source, the proposed check-shot survey would likely have ***negligible*** effects on fish behaviour and limited to the duration of the survey.

4.3.2.3 Disruption to feeding, mating, breeding or nursery activities of marine organisms

For those species that will potentially be present within the Survey Area as identified within this MMIA, there are expected to be no significant effects related to disturbance of feeding activities or potentially displacement of habitat. It is believed that species in close proximity to the KTIV would move away from the sound source when it is activated. However, there is anecdotal evidence from other seismic operations that there is the potential for NZ fur seals to be attracted to the vessel/acoustic source, although NZ fur seals are likely to be present already around the KTIV.

The check-shot survey would likely have ***negligible*** effects on the basic life histories of marine organisms encountered within or adjacent to the Survey Area due to the short

survey duration (~ four hours) and once the sound source has dissipated there will be no further effects on marine species.

4.3.2.4 Interference with the use of acoustic communication signals, or naturally-produced cues used by marine animals

The most studied, and best understood, examples of acoustic communication in the marine environment are cetacean vocalisations. Cetaceans emit sound for the purposes of communication and navigation. The ability to perceive biologically important sounds is critical to marine mammals, and acoustic disturbance through human generated noise has the potential to interfere with their natural functions (Di Iorio & Clark, 2009). Seismic surveys could have significant impacts on cetacean's ability to use these signals if the sounds associated were in the same frequency range as the sounds generated by the cetaceans, and interfered with or obscured signals in areas that are biologically significant to cetaceans (Richardson *et al.*, 1995).

Table 8 summarises the known frequencies of echolocation and communication calls for selected species of toothed whales and dolphins whose vocal range is known. These species could be present in the Survey Area at the time of the survey. The table illustrates that the known spectrum of echolocation signals are at much higher frequencies (6 - 130 kHz) than the check-shot seismic source (0.01 kHz). The range of frequencies used by cetaceans for communication is generally lower than the range of frequencies used for echolocation, so the greatest potential for interference would occur at the highest end of the seismic spectrum and the lowest end of whales' and dolphins' communication spectrum.

Table 8: Frequencies of Cetacean Communication and Echolocation Vocalisations

Species	Communication Call Frequency Range (kHz)	Echolocation Frequency Range (kHz)
Bottlenose dolphin	0.8 - 24	110 - 130
Common dolphin	0.2 - 16	23 - 67
Killer whale	0.5 - 25	12 - 25
Long-finned pilot whale	1 - 18	6 - 117
Sperm whale	0.1 - 30	2 - 30
Blue whale	0.01 – 0.4	0.01 – 0.4

(Source: Richardson *et al.*, 1995)

The lowest frequencies of some toothed whales communication calls partially overlap with the high end of seismic airguns' operational range. However, most acoustic energy emitted from airguns during deep-water surveys is between 0.01 – 0.3 kHz, well below the lower frequency limits of most toothed whales. Of the species listed in Table 8, the blue whale vocalises at a sufficiently low frequency (0.01 - 0.4 kHz) similar to the frequencies emitted during check-shot seismic surveys.

The study undertaken by Di Iorio & Clark (2009) investigated whether blue whales changed their vocal behaviour during a seismic survey that deployed a low-medium power technology (sparker). In summary it was found that blue whales called consistently more on seismic exploration days than on non-exploration days as well as during periods within a day when the sparker was operating. This increase was observed for the discrete, audible calls that are emitted during social encounters and feeding (Di Iorio & Clark, 2009) and also consistent with Melcon *et al.*, 2012. It is believed that by the blue whale increasing its rate of calling; it increases the probability that its signal will be successfully received by conspecifics. The survey location within Di Iorio & Clark (2009) was crossed by a busy shipping lane where vessel noise was regularly present,

and it was concluded that shipping noise did not account for any changes in the acoustic behaviour.

The mean sound pressure that was imposed on the blue whales in the Di Iorio & Clark (2009) study is assumed to be relatively low (131 dB re 1µPa (30 – 500 Hz)) with a mean sound exposure level (SEL) of 114 dB re 1µPa^{2}s. These were the levels that the blue whales would change their calling behaviour in response to the low-medium power technology that is presumed to have minor environmental impact (Duchesne *et al.*, 2007).

From the literature reviewed it is believed that the check-shot survey may have a ***minor*** effect on marine organism's use of naturally-produced acoustic signals if they are close to the Oi-1 well location.

4.3.2.5 Indirect effects, such as changes in the abundance or behaviour of prey

During the late spring and summer check-shot survey period, the nutrient rich water will start to move down from further north and bring with it an abundance of bait fish which pelagic predators and sea birds predate, resulting in warmer waters within the Survey Area. For the pelagic predators which hunt bait fish within the Survey Area, their prey may alter its behaviour or distribution as a result of the check-shot survey, namely avoiding areas of higher sound levels. However, these predatory species, if present, would simply adjust their behaviour and distribution to react to new patterns of prey location and availability, if they are indeed present during the survey and thus preserving their ability to forage. However, the Oi-1 check-shot survey will only be for a short duration, and is likely to have ***negligible*** effects on the abundance or distribution of prey.

4.3.3 Solid and Liquid Wastes Generated on the KTIV & Support Vessels

AWE's drilling programme and check-shot survey has the potential to affect the marine environment through inappropriate management of sewage, galley waste, garbage and oily water on the KTIV and support vessel while at sea.

However, AWE will operate a comprehensive Waste Management Plan for the KTIV as per the maritime garbage rules (Marine Protection Rule (MPR) Part 170 & Part 200, and MARPOL, specifically Annex IV & V) which cover all procedures on how wastes are managed offshore and onshore. A garbage record book is also kept of all discharges.

4.3.3.1 Generation of sewage and greywater

The liquid wastes from the KTIV include sewage and wastewater from toilets, washrooms, the galley and the laundry. An estimate of sewage volumes generated per day from the KTIV is in the order of 10 m^3 of treated domestic wastewater.

The KTIV has an on-board sewage treatment plant which results in a discharge to sea which meets NZ Resource Management Act 1991 (RMA) requirements for such discharges (there are in fact no requirements for the Survey Area, only for within the CMA).

Given the remoteness of the Oi-1 drilling location and no known sensitive habitats nearby (Johnston *et al.*, 2012; Johnston & Forrest, 2012) and the high level of treatment, the environmental effects arising from sewage discharges is anticipated to be ***negligible***.

The KTIV and support vessels have an approved International Sewage Pollution Prevention Certificate (ISPPC) as per the regulations of MARPOL Annex IV.

4.3.3.2 Generation of galley waste and garbage

Only biodegradable galley waste, mainly food scraps, will be discharged to the sea in accordance with international standards and the relevant MPR's, namely comminuted (as a minimum). Comminuted waste can be discharged beyond 3 Nm from the shore and

these discharges will rapidly dilute to non-detectable levels in the offshore marine environment.

Food waste is required under MPR Part 200 to be comminuted or ground such that the material can pass through a screen with an opening of a screen no greater than 25 mm and not to be contaminated by any other garbage type; therefore the environmental effects are considered to be ***negligible***.

Other solid and non-biodegradable liquid wastes will be retained aboard for subsequent disposal to managed facilities ashore.

MARPOL Annex V and MPR Part 200 stipulations will be followed. Records will be kept which will detail the quantity, type and approved disposal route of all wastes generated. All records on waste disposal will be available for official inspection. All wastes, including hazardous waste returned to shore will be disposed of in strict adherence to local waste management requirements, with all chain of custody records retained by AWE. Due to these operating procedures in place the impact on the environment from the presence of the KTIV and the check-shot survey occurring will be ***negligible***. Table 9 summarises garbage disposal restrictions.

Table 9: Waste Streams under MARPOL Annex V Classification

Garbage Type	Appropriate Disposal Route
Plastic – including synthetic ropes, fishing nets, packaging materials and plastic bags	Should be compacted and stored onboard for transfer to shore for disposal at an appropriate disposal facility.
Paper, rags, glass, metal, crockery and similar refuse	Should be stored onboard until disposal in a controlled facility onshore is possible.
Maintenance and operational waste: rags, oil soaks, used oil, batteries	Should be stored onboard until disposal in a controlled facility onshore is possible.
Food waste	If biodegradable, then can be comminuted and discharged offshore, as required under MPR's (Beyond 3 Nm if comminuted, otherwise 12 Nm).
Sewage	Should be treated by the ship's sewage treatment facility in accordance with international best practice for offshore waters.

4.3.3.3 Generation of oily waters

Rain and process waters may become contaminated with hydrocarbons and other chemicals from the following operations:

- The migration of rainwater through external onboard oil-containing equipment;
- Wastewater from wash-down, maintenance and cleaning of the KTIV;
- Wastewater and oily mixtures that drain from onboard equipment and machinery spaces, e.g. compressor blow-down, cooling water, pump seals etc.; and
- Minor leaks and spills, in particular in areas storing oil and other chemicals.

The KTIV has designated containment zones in all locations where oil and chemical products are used or stored. Any discharges of water from the vessel (other than production water) cannot contain more than the 15 ppm of oil, as required by MPR Part 200. This includes contaminated deck water and water from machinery spaces.

Equipment to treat oil containing wastewater and contaminated deck water to 15 ppm is present on the KTIV (MARPOL 73/78). Both the support vessels and KTIV hold an

International Oil Pollution Prevention Certificate (IOPPC) which certifies that the MARPOL standards can be met.

Therefore, it is expected that the environmental effect of the discharge of any oily water into the sea; if in compliance with the 15 ppm concentration limit, will have a ***negligible*** effect.

4.4 Impacts of Unplanned Activities and Mitigation Measures

Unplanned activities, including fuel/oil spills and vessel collision are rare during marine seismic operations. However, marine operations do pose a small potential risk of accidental contamination and hence this assessment has been conducted to cover their possible occurrence.

4.4.1 Fuel/Oil Spill from Vessels

The potential for a fuel/oil spill from the KTIV and support vessels while undertaking the drilling programme and associated check-shot survey could be due to:

- Leaking equipment storage containers;
- Accidental releases from containers;
- Hull/fuel tank failure due to collisions/sinking; and
- Accidental spill during a refuelling operation.

A hull/fuel tank failure would have the largest potential for an environmental effect. The other potential spills are often entirely contained on the vessel and if they do reach the sea they are generally only in small volumes.

The KTIV and support vessels involved in the drilling programme and check-shot survey have an approved and certified Shipboard Oil Pollution Emergency Plan (SOPEP) and IOPPC as per MARPOL 73/78 and the MPR Part 130A and 123A respectively. These will be kept onboard for the duration of the drilling programme.

The typical volume of fuel oil (diesel), likely to be held onboard the KTIV (when the tanks are full) is ~1,400 m^3, while the support vessels typically have a fuel capacity of 1,700 m^3. The average daily consumption of the KTIV is in the order of 14 m^3 which would give a maximum drilling capacity of 100 days; however, the tanks will not be left to run low, where the fuel tanks onboard the rigs will generally be topped up every 2 – 3 weeks from the support vessels. For the Oi-1 exploration well there will be no flowing of hydrocarbons, only the logging via check-shot survey, so there is no risk of a spill from normal operations with all the operational procedures, technology, monitoring and measures to avoid, remedy or mitigate adverse effects in place.

The worst-case scenario would be the partial or complete loss of one of the support vessels fuel tanks (~ 1,700 m^3) following a collision. However, this size of spill would only occur as a result of complete failure of the vessel's fuel containment system or catastrophic hull integrity failure. This is considered to be highly unlikely due to the high-tech navigational systems on board and compliance with the COLREGS.

Refuelling operations generally take about 2 – 3 hours to complete. The KTIV has detailed refuelling protocols and procedures in place designed to prevent any incidents occurring. Spills caused by fuel handling mishaps are rare, because of tried-and-true monitoring and management systems and procedures for such activities. But because of the number of times fuel is handled at sea and the volumes involved, this is one of the more common sources of spills, albeit minor. Causes include hose rupture, coupling failures and tank overflow.

Fuelling is carried out using standard industry practices and several standard safety procedures will be implemented to minimise the risk of an accidental spill. These can include:

- Fuelling operations are undertaken only in suitable weather conditions;
- Use of wire-reinforced hoses; and
- Transfer hoses are fitted with 'dry break' couplings.

If assistance is required due to the size or nature of a spill, this will be managed as a Tier 3 national marine oil spill response by MNZ, with backup from Taranaki Regional Council. The local Regional On-Scene Commander is located in New Plymouth at the Taranaki Regional Council.

Spills of a significant quantity of hazardous substances as a result of any of the events outlined above are not considered likely due to the stringent safety, environmental and maritime requirements that will be implemented during the drilling programme and check-shot survey. Volumes, storage locations and material safety data sheets for all fuels and hazardous substances are included in the DMP. Therefore, it is considered that the environmental risks associated with this type of event are ***negligible***.

4.4.2 Vessel Collision or Sinking

The most significant environmental effect associated with a vessel collision or sinking is associated with the vessel making contact with the sea floor, and the on-board hazardous substances, specifically the oil and lubricants. However, this is very unlikely as the KTIV will have been on location for the duration of the drilling period (~ 30 days) before the check-shot survey is undertaken, and the risks associated around the KTIV are mitigated through the presence of a support vessel at all times during the drilling programme and check-shot survey. The International COLREGS will be followed at all times and users of the marine environment will be aware of the KTIV's location due to a number of measures. Therefore, it is considered the potential impacts from vessel collision or sinking is ***negligible***.

4.5 Mitigation Measures

AWE will adhere to the mitigation measures stipulated in the Code of Conduct under the Level 2 classification for the Oi-1 check-shot survey to minimise any adverse effect to marine mammals resulting from the check-shot seismic survey operation (DOC, 2012). Also as per the requirements of the Code of Conduct, the Director-General will be informed immediately about any instances of non-compliance with the Code of Conduct and the mitigation measures identified below.

4.5.1 2012 Code of Conduct Mitigation Measures

AWE will implement the mitigation measures identified within the Code of Conduct, with some slight variances which have been approved by DOC, due to the nature of check-shot surveys compared to conventional marine seismic surveys, i.e. a lower sound source volume, short survey duration (~ four hours) and being undertaken at a single location. The full operating procedures that AWE will follow; in compliance with the Code of Conduct will be included in the Marine Mammal Mitigation Plan (MMMP) (Appendix 2). A summary of these operating procedures and mitigation measures are listed below and further detailed in the MMMP:

- One trained and qualified MMO will be onboard the KTIV for the acoustic source testing and for the duration of the check-shot survey and will maintain a watch for marine mammals while the acoustic source is in the water (during daylight hours);
- AWE have elected to use PAM for the Level 2 Oi-1 check-shot survey, therefore, one trained and qualified PAM operator will be onboard a support vessel for the duration of the survey, where PAM is to be operational at all times the seismic

source is active. The support vessel will be used as the sound field emanating from the KTIV is unknown and could decrease the accuracy of the PAM system. Therefore, the PAM hydrophone array will be towed from the support vessel, circling within a 1 km radius of the KTIV;

- During daylight hours the acoustic source can only be activated if it is within the specified operational area (Survey Area - Figure 1), and no marine mammals have been observed or detected in the respective mitigation zones. The source cannot be activated during daylight hours unless:
    - One MMO has continuously made visual observations all around the source for the presence of marine mammals, from the bridge (or preferably an even higher vantage point) using both binoculars and the naked eye, and no marine mammals have been observed in the respective mitigation zones for at least 30 minutes; and
    - Passive acoustic monitoring for the presence of marine mammals has been carried out by a qualified PAM operator for at least 30 minutes before activation and no vocalising cetaceans have been detected in the respective mitigation zones.
- With PAM being operational for the Oi-1check-shot survey, the acoustic source may be activated and active surveys may proceed at night or during poor sighting conditions, according to the provisions of the Code of Conduct, following pre-start observations;
- If during pre-start observations or while the acoustic source is activated, a qualified observer detects at least one Species of Concern with a calf within 1 km of the source, start up will be delayed or the source will be shut down and not be reactivated until:
    - A qualified observer confirms the group has moved to a point that is more than 1 km from the source; or
    - Despite continuous observation, 30 minutes has elapsed since the last detection of the group within 1 km of the source, and the mitigation zone remains clear.
- If during pre-start observations or while the acoustic source is activated, a qualified observer detects a Species of Concern within 600 m of the source, start up will be delayed or the source will be shut down and not reactivated until:
    - A qualified observer confirms the Species of Concern has moved to a point that is more than 600 m from the source; or
    - Despite continuous observation, 30 minutes has elapsed since the last detection of a Species of Concern within 600 m of the source, and the mitigation zone remains clear.
- If during pre-start observations prior to initiation of the Level 2 acoustic source soft start, a qualified observer detects a marine mammal (other than NZ fur seal) within 200 m of the source, start up will be delayed until:
    - A qualified observer confirms the marine mammal has moved to a point that is more than 200 m from the source; or
    - Despite continuous observation, 30 minutes has elapsed since the last detection of a marine mammal within 200 m of the source, and the mitigation zone remains clear.
- As discussed with DOC as part of the pre-survey and MMIA planning, if NZ fur seals are entering and leaving the 200 m mitigation zone regularly, every effort should be made to fire the initial acoustic source when no NZ fur seals are present within the mitigation zone. However, if seals are always present within the mitigation zone, every effort should be made to fire the acoustic source when the seals are at the surface, rather than diving. Any seals which are hauled out on the KTIV do not need to be considered in applying mitigation requirements, as they will presumably

be unaffected by the acoustic source. All seal observations will be recorded, with particular attention paid to their behaviour when the acoustic source is fired;

- If there are delays to the check-shot survey operation, and it is likely that the 10 minute sequential firing period may be exceeded, a single shot of the acoustic source will be fired to keep the check-shot survey in continuous operation (Section 1.3). However, this will only be undertaken if there have been no sightings of marine mammals (other than NZ fur seals) in the area for the previous 30 minutes (i.e. the normal pre-start requirements); and
- A written trip report will be submitted to the Director-General of DOC at the earliest opportunity but no longer than 60 days after completion of the check-shot survey.

4.6 Cumulative Effects

Cumulative effects on the marine environment may arise over time or in combination with other effects. Currently the Taranaki offshore environment is used for fishing, shipping and hydrocarbon production and exploration, which will continue during and after the Oi-1 check-shot survey. As discussed in Section 4.3.2.4 in the study undertaken by Di Iorio & Clark (2009), their seismic survey area overlapped with a busy shipping lane where vessel noise was regularly present. From the study it was concluded shipping noise did not account for any changes in the acoustic behaviour of blue whales. As a result, the inclusion of shipping noise from passing shipping traffic has not been considered as part of this cumulative effects assessment.

Directionality of the array and bathymetry of the surrounding area play an important part in attenuation of the sound source; upslope propagation results in more rapid attenuation and lower sound levels than downslope propagation and the highest level of sound is predicted to occur in the cross-survey line direction. For the Oi-1 well location, it is a relatively flat, featureless soft seabed, which has a higher absorption capacity of the sound waves and the propagation of sound is likely to be uniform from the acoustic source.

The cumulative effects of a seismic survey involve many variables and although there is the potential for this to occur, it is difficult to accurately assess these effects. However, the Oi-1 check-shot survey will only occur for a very short duration and at a low source volume.

The AWE check-shot survey will be following the Code of Conduct to mitigate any effects on marine mammals, and will shut down or delay starting if marine mammals are within the relevant mitigation zones. Given it is believed that only the AWE check-shot survey will be operating during AWE's drilling programme, the potential cumulative impacts on marine mammals or the environment from the proposed Oi-1 check-shot survey will be ***negligible***.

4.7 Summary of Environmental Effects and Mitigation Measures

Table 10 summarises the project activities, associated effects, and impact mechanisms identified in this assessment.

Table 10: Check-shot Survey Activities and Associated Effects

Aspect or Source	Potential Effect	Probability of Occurrence or Exposure	Proposed Monitoring or Mitigation Measures	Residual Outcome or Effect
Planned Activities				
Physical presence of KTIV and support vessels.	Interference with local fishing activity.	Low.	Short duration of check-shot survey (~ four hours). Compliance with COLREGS. Presence of support vessel at all times. Notice to Mariners will be issued. 500 m non-interference zone.	Negligible.
	Interaction or interference with marine traffic.	Very low considering the mitigation measures in place.		Negligible.
	Interference and/or damage to marine archaeology, cultural heritage or submarine infrastructure.	Unlikely considering the distance of Survey Area offshore.	Best Practice.	Negligible.
	Indirect effects on fisheries resulting from displacement of targeted species.	Low.	Short duration of check-shot survey (~ four hours).	Negligible.
	Change in marine bird behaviour.	Likely. KTIV may provide resting opportunities for birds. Collisions or entanglements are unlikely during daylight, but could occur after dark.	No mitigation options available. Blue Planet Marine observers will record any seabird strikes that are witnessed.	Negligible.
	Introduction of marine pests.	Low.	Biosecurity clearance was gained before KTIV entered NZ. Compliance with CRMS. Antifouling systems in place. Regular maintenance undertaken.	Negligible.
	Interaction or interference of the KTIV with marine mammals.	Low.	Compliance with the Code of Conduct and mitigation zones. One MMO onboard the KTIV and one PAM operator will be onboard the support vessel observing for mammals while the acoustic source is active. Short duration of check-shot survey (~ four hours). Low source volume.	Negligible.
Source sound emissions.	Physiological effects on marine fauna from exposure to sound or associated pressure effects.	Low.	Compliance with the Code of Conduct. Presence of one trained MMO on the KTIV and one trained PAM operator onboard the support vessel to provide complete observation coverage while acoustic source is active. Pre-start observations. Soft start procedures. Delay start/shut down procedures. Short duration of check-shot survey (~ four hours).	Minor.
	Behavioural disturbance leading to behavioural changes or displacement.	Low.		Negligible.
	Disruption to feeding, mating, breeding or nursery activities of marine organisms.	Low.		Negligible.
	Interference with the use of acoustic communication signals, or naturally produced cues used by marine animals.	Low.		Minor.
	Indirect effects, such as changes in the abundance or behaviour of prey.	Low.		Negligible.
Solid and liquid wastes generated on the KTIV	Generation of sewage and greywater.	Will occur.	Only biodegradable waste will be discharged. Discharges will dilute to non-detectable levels.	Negligible.

Aspect or Source	Potential Effect	Probability of Occurrence or Exposure	Proposed Monitoring or Mitigation Measures	Residual Outcome or Effect
and support vessels.			Adherence to MARPOL Annex IV. Approved ISPPC. Onboard sewage treatment plant.	
	Generation of galley waste and garbage.	Will occur.	Waste management plan. Only biodegradable and comminuted waste will be discharged. Adherence to MARPOL Annex V.	Negligible.
	Generation of oily waters.	Will occur.	Bilge water treatment system to meet the international standard of 15 ppm before any discharge occurs. Approved IOPPC.	Negligible.
Unplanned Activities (including accidental events)				
Fuel/oil spill from vessels.	Water impact. Coastal impact.	Low due to mitigation measures.	SOPEPs and IOPPC in place. High level of environmental standards/plans developed and adhered too.	Negligible.
Vessel collision or sinking.	Water impact. Coastal impact.	Extremely unlikely.	Short duration of check-shot survey (~ four hours). Compliance with COLREGS. Presence of support vessel. Notice to Mariners will be issued and broadcast on Maritime Radio. Thorough consultation all users of this environment have been advised of the drilling operations.	Negligible.

5 Conclusion

Check-shot surveys are considered routine activities within the oil and gas sector following the drilling of a well to increase the subsurface resolution, confirm reservoir location and allow correlation with the conventional surface seismic data that has been acquired through previous 3D seismic surveys. As highlighted previously, AWE will comply with the Code of Conduct which is now a requirement under the EEZ Act – Permitted Activities.

NZ and particularly Taranaki has had a history of significant seismic data acquisition operations with no associated environmental issues reported to date by independent observers. The Oi-1 check-shot survey is at a lot lower scale to a conventional 2D or 3D marine seismic survey; where the check-shot will only occur for a short duration (~ four hours), has a low source volume (150 in^3), and there is likely to be a maximum of 150 shots fired at an operating capacity of 1800 psi. Most marine seismic survey programmes tend to run for 20 – 30 days continuously with the acoustic source fired every ~10 seconds, so in comparison to the number of shots fired for the Oi-1 check-shot survey (~150), the same total of shots fired would be completed in 25 minutes.

The potential effects and mitigation measures which AWE will implement to minimise any environmental effect on the surrounding areas or on marine mammals have been discussed throughout this MMIA. In summary from the information provided in this MMIA and the mitigation and management of the Oi-1 check-shot survey, the environmental and marine mammal effects associated with the check-shot survey is considered to be ***negligible***.

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Appendices

This report contains the following appendices.

Number	Title
1	Consultation Register with Key Stakeholders
2	Marine Mammal Mitigation Plan for Oi-1 Check-shot Survey

APPENDIX 1

Consultation Register with Key Stakeholders

Department /Organisation	Date	Type/Purpose/Result of Consultation
MfE & EPA	2013	Discussed drilling campaign including timing of activities
Taranaki Iwi Trust	25/03/2013	Discussed drilling campaign including timing of activities
Port Taranaki	19/04/2013	Discussed drilling campaign including timing of activities
Taranaki Regional Council	22/04/2013	Discussed drilling campaign including timing of activities
Taranaki Iwi Trust	22/04/2013	Discussed drilling campaign including timing of activities
Ngati Mahanga	15/05/2013	Discussed drilling campaign including timing of activities
Maritime New Zealand	11/07/2013	Discussed drilling campaign and DMP

- - Cape Egmont Boat and Fishing Club;
- - Civil Aviation Authority;
- – Coastguard;
- Ian Angus - Department of Conservation;
- Callum Lilley - Department of Conservation;
- Department of Labour;
- Egmont Seafoods;
- – Helicopters New Zealand;
- Land Information New Zealand;
- - National MP;
- - Maritime New Zealand;
- Maritime New Zealand;
- - Maritime New Zealand;
- Maritime New Zealand;
- Maritime New Zealand;
- - Maritime New Zealand;
- - Ministry for Primary Industries;
- – Environment Protection Authority;
- - Ministry of Economic Development;
- - New Plymouth District Council;
- New Plymouth District Council;
- - Nga Mahanga (Puniho Pa);
- - New Plymouth Fishing Club;
- - Okato Coastal School;
- - Port Taranaki;
- - Port Taranaki;
- - PTMS;
- - St Johns;
- – STOS;

- – Swire;
- Taranaki Iwi Trust;
- – Te Atiawa Iwi Authority;
- – Ngaa Hapu o Ngaruahine Iwi Inc;
- - Taranaki Regional Council;
- - Taranaki Regional Council;
- - Taranaki Regional Council;
- e - Venture Taranaki;
- - Maritime New Zealand;
- - Maritime New Zealand;
- eepwater Group;
- - Taranaki Commercial Fishing Federation;
- Seafood New Zealand;
- Fisheries Inshore New Zealand;
- Southern Inshore Fisheries, Challenger Finfish Management Company;
- Horizons Regional Council;
- Greater Wellington Regional Council;
- – Tasman District Council;
- Nelson City Council; and
- en – Marlborough District Council.

APPENDIX 2

Marine Mammal Mitigation Plan for Oi-1 Check-shot Survey

Marine Mammal Mitigation Plan:

AWE Limited Taranaki Basin Exploration Drilling Check-shot Seismic Survey

BPM-13-AWE-Check-Shot_Survey_MMMP-Level-2 v1.1

24/10/2013

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Title: Marine Mammal Mitigation Plan: AWE Limited Taranaki Basin Exploration Drilling Check-shot Seismic Survey

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1. Introduction

This document has been developed by Blue Planet Marine (BPM) for AWE Limited (AWE) to meet the requirements for a Marine Mammal Mitigation Plan (MMMP) for the check shot seismic survey to be undertaken at their exploration well (Oi-1) within the Taranaki Basin. The well site is located north east of the Tui Floating Production Storage and Offloading (FPSO) facility, Umuroa, and within Petroleum Mining Permit (PMP) 38158 as shown in **Error! Reference source not found.** (hereafter referred to as the 'Survey Area').

This document outlines the procedures to be followed by observers and crew in order to guide Survey operations. It should be read in conjunction with the *2012 Code of Conduct for Minimising Disturbance to Marine Mammals from Seismic Survey Operations* (the Code) and the AWE Marine Mammal Impact Assessment (MMIA) developed specifically for this survey. The Code of Conduct is currently being updated to account for some operational matters that were highlighted through its use by multiple operators before the Code of Conduct became a regulation under the EEZ Act (refer Survey MMIA for further detail). If the updated 2013 Code of Conduct becomes the new standard under the EEZ Act – Permitted Activities before the check-shot survey takes place, AWE will adhere to the updated 2013 Code of Conduct.

2. The AWE Taranaki Basin Exploration Drilling Check-shot Seismic Survey

The Taranaki Basin Exploration Drilling Check-shot Seismic Survey comprises one well site within the Taranaki Basin, which is located in a water depth of ~120m (Figure 1). The exploration drilling will consist of one well and the rig will be located on site for approximately 30 days. There is a possibility that AWE will side track the Oi-1 well, using the existing well bore to drill a secondary hole off to the side of the original well, but the wellhead/surface location will remain the same. The drilling is expected to be completed within 30 days. Readers are directed to the MMIA for further technical detail on Drilling and Check-shot Surveys.

The Check-shot Seismic Survey (CSS) will be conducted by the semi-submersible drilling rig *Kan Tan IV* (KTIV) (Figure 2). Aside from rig mobilisation, positioning and drilling activities, the CSS is expected to take approximately four hours, with a period of source testing prior to commencement of the survey. The acoustic source will be removed from the water after source testing until the check-shot survey commences.

AWE will use two 150 cubic inch (in^3) acoustic sources which will be fired three times successively at each level, 15 seconds apart at an operating pressure of 1800 psi and frequency of 10 Hz. It is envisaged that there will be a maximum of approximately 40 - 50 levels tested (every 100 m plus key horizons), however it could be much less, dependent upon geology. It will take approximately five minutes to move between levels and four hours to complete the job and will result in a maximum of ~150 shots being fired for the check-shot survey. Prior to the actual check-shot survey commencing, the acoustic source will be tested 10 – 20 times over a one hour period.

Given the volume of the airguns being used, the CSS is classified as a Level 2 marine seismic survey under the *2012 Code of Conduct for Minimising Disturbance to Marine Mammals from Seismic Survey Operations* (the Code). Therefore, mitigation procedures set out in this MMMP will adhere to the Level 2 survey requirements therein.

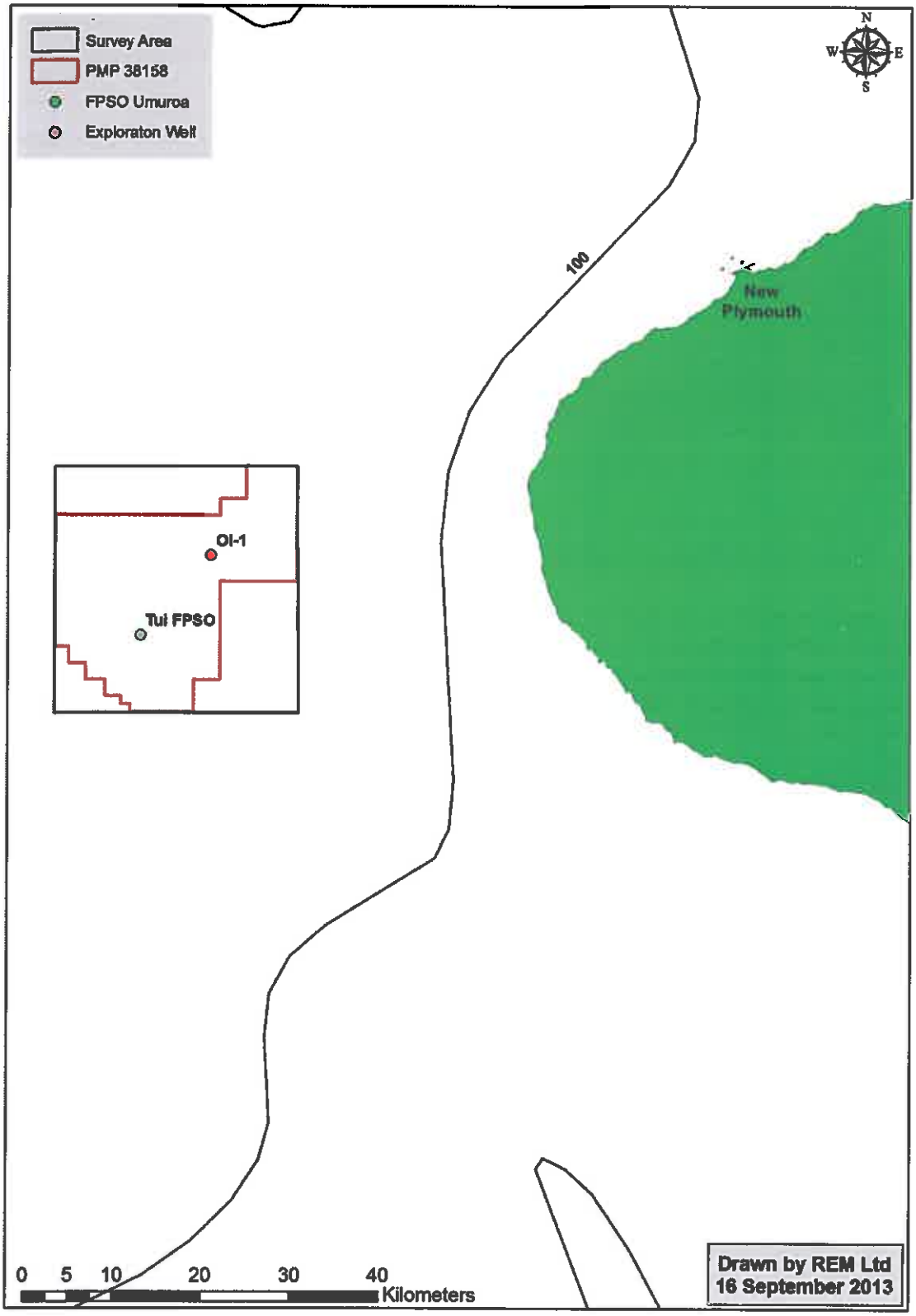


Figure 1: Location of the Check-shot Seismic Survey Area.

Figure 2: Kan Tan IV semi-submersible rig on vessel prior to mobilisation to the survey location.

3. Record Keeping and Reporting

The observers (MMOs and PAM operators) are responsible for maintaining records of all marine mammal sightings/detections and mitigation measures taken throughout each survey period. Observers are also required to monitor and record seismic operations, the power output of the acoustic source while in operation, observer effort and sighting conditions. These and other requirements are detailed in Appendix 2 of the Code.

Please review Appendix 2 of the Code carefully. Note that you are required to record the power levels (and timing) of at least one random soft start per survey[1]

All data must be recorded in a standardised Department of Conservation (DOC) Reporting Form. Datasheets are available from www.doc.govt.nz/notifications and are in Excel format. With regard to these forms please note the following advice from DOC:

- There is no drop down menu item for check-shot surveys so outline the survey type in the notes section;
- Always save the forms in MS Excel 2003 version, with macros enabled;
- Do not attempt to use the forms on a Macintosh device; and
- Do not cut/paste within the document (copy/paste should be okay, but cutting and pasting causes problems with formulas and validation).

It is recommended that observers test the functionality of the datasheets prior to mobilisation and become familiar with their use. In particular, note that macros must be enabled

All raw datasheets shall be submitted directly to the Director-General (refer Appendix 5 of the Code for postal and email addresses) within 14 days of a completed MMO/PAM operator rotation or end of the survey.

[1] Note: Items in blue boxes are recommendations or further explanations from BPM and/or DOC.

There are a number of situations that require immediate notification to DOC. These are listed in Table 1, in Section 6.

It is recommended that observers provide the client with a daily summary detailing marine mammal sightings, mitigation measures taken and instances of non-compliances.

The Team leader is responsible for compiling an end of survey summary report based on the data collected throughout the survey. The contents of this report are summarised in Appendix 2 of the Code.

3.1 Contact details for the Department of Conservation

During this Survey, the first point of contact within DOC is Ian Angu[illegible] or [illegible]). If a response is required urgently then telephone but in all other circumstances use email.[2]

3.1.1 Communication Protocol

The communication protocol to be followed for reporting to DOC will be as follows:

For general reporting of non-urgent issues to DOC the communication protocol to be followed is:

- MMO Team Leader to contact BPM Project Manager ashore (Simon Childerhouse);
- BPM to contact AWE (Stuart Duff);
- AWE to contact REM (Dan Govier); and
- REM to contact DOC (Ian Angus or other).

For **urgent communications**, the MMO Team Leader can contact DOC directly either by email or by phone under the following conditions:

- Team Leader must first seek permission from the Offshore Installation Manager (OIM) and the Client Reps (and keep them informed);
- The BPM Project Manager and onshore AWE exploration manager (Stuart Duff) must be kept informed;
- If the contact is by email, then the Team Leader should consider making a phone call advising DOC of the situation; and
- All direct contacts to DOC via email must be followed up by a phone call to DOC and AWE at the earliest opportunity to ensure the message has been received.

4. Mitigation Measures Required Under the Code

This CSS is classified as a Level 2 survey under the Code. Within the operational area, the marine mammal impact mitigation required under the Code can be divided into three principal components:

1) The use of dedicated observers (i.e. MMOs and PAM operators);
2) The mitigation measures to be applied; and
3) The mitigation actions to be implemented, should a marine mammal be detected.

It should be noted that AWE has some dispensations from DOC to follow mitigation measures that have been amended from those in the Code as approved in the MMIA. Accordingly, the mitigation

[2] Email advice from Mr Tara Ross-Watt, DOC Senior Adviser - International and Marine; 19 December 2012.

measures reported here reflect those in the MMIA rather than the Code. When there has been an approved dispensation, it is identified here.

4.1 Dedicated Observers (MMOs and PAM operators)

A Level 2 survey requires at least two qualified MMOs on board for the duration of the survey. For Level 2 surveys, at least one qualified MMO is required to maintain a watch for marine mammals, at all times the acoustic source is in the water (during daylight hours). In addition, although PAM is designated as an optional consideration for Level 2 surveys, AWE have chosen to include it and therefore the Code requires that two experienced PAM operators are on board the support vessel. In this scenario, at least one qualified PAM operator is required to undertake acoustic monitoring for marine mammals at all times the acoustic source is in the water. However, given the short duration of the survey, where it is likely to be completed in four hours, DOC has allowed that only one MMO and one PAM operator are required for the acoustic source testing and check-shot survey (refer Survey MMIA).

PAM is to be operational at all times when the seismic source is active and during pre-start procedures. The sound field emanating from the KTIV is unknown and could decrease the accuracy of the PAM readings. Therefore, the PAM hydrophone array will be towed from the support vessel, circling within approximately 1 km radius of the KTIV.

The MMO will be present on the KTIV, while the PAM operator will be on the support vessel. Communications between the two observers will be facilitated by way of handheld radio in the first instance, and shop phone or VHF as a backup alternative.

The training and experience of the observers will meet the requirements stipulated in Section 3.4 of the Code (i.e. BPM will provide one qualified MMO under the Code and a PAM operator approved by DOC under interim guidelines). Both the MMO (during daylight hours) and the PAM operator will be on watch at all times while the acoustic source is in the water in the operational area and for pre start procedures. Observers may stand down from active observational duties when the acoustic source is inactive for extended periods.

The primary role of the observers is to detect and identify marine mammals and guide the crew through any mitigation procedures that may be required. This requires clear lines of communication and that all personnel understand their roles and responsibilities with respect to mitigation.

It is recommended that:

- The observers hold briefings with key personnel prior to the commencement of seismic operations; and
- The observers provide posters detailing mitigation procedures and communications protocols and display these in the instrument room, at the PAM station and on the Bridge (refer Addenda 2 and Addenda 3 of this document).

4.1.1 Safety drills

Attendance at a safety drill at least once during each rotation is typically mandatory (e.g. the rig and vessel HSE plans will specify the number). Although not specified in the Code, safety of personnel takes priority over mitigation. Safety drills may be conducted when the acoustic source is active. In this case however, given that only one MMO and one PAM operator will be stationed on the KTIV and support vessel respectively, it will not be possible for the MMO or PAM operator to attend the safety drill if the acoustic source is active and/or in the water. At other times (e.g. when the acoustic source is inactive or not in the water), the MMO and PAM operator will endeavour to attend drills as required. In all cases, observers must comply with the mandatory safety code of the vessel.

4.1.2 PAM not operational

Section 4.2.1 of the Code states for Level 2 surveys:

"Where PAM is incorporated, the additional minimum qualified observer requirements are:

- *At all times while the acoustic source is in the water, at least one qualified PAM operator will maintain a watch for marine mammals."*

The definition of PAM in the Code states that there will be full system redundancy. BPM has provided full redundancy for this survey by providing two full sets of PAM equipment including a second backup PAM hydrophone cable. However, there may be periods when PAM is not operational.

To repair and/or replace a non-operational set of PAM gear takes on average approximately two to two and half hours to trouble shoot, identify the source of the issue and/or replace the hydrophone or any other components as required and have PAM operational again. Therefore, given:

- the short length of the CSS (e.g. approximately four hours);
- the fact that the source for CSS is only Level 2; and
- that PAM is not a requirement for Level 2 surveys;

if PAM becomes non-operational while the source is active, normal operations may continue in the absence of PAM while repairs are conducted. However, this exception cannot be used during pre-start and soft start procedures (i.e. if PAM fails during these periods, the source must be shut down until PAM is repaired and re-deployed).

4.2 Mitigation procedures

During the CSS, AWE will adhere to the mitigation measures stipulated in the Code of Conduct under the Level 2 classification, with the voluntary inclusion of PAM. There will be some variances to these measures due to the nature of check-shot surveys compared to conventional marine seismic surveys (i.e. a lower acoustic volume undertaken in a single location with a considerably shorter survey duration of ~4 hours). These variances to the mitigation measures have been approved by DOC (refer section 4.1).

The proponent will observe the following mitigation practices:

4.2.1 Operational area

Under the Code, an operational area must be designated outside of which the acoustic source will not be activated. This includes testing of the acoustic source and soft starts. For this survey, the operational area is defined in the MMIA.

4.2.2 Sighting conditions

Good sighting conditions means in daylight hours, during visibility of more than 1.5 km, and in a sea state of less than or equal to Beaufort 3.

Poor sighting conditions means either at night, or during daylight visibility of 1.5 km or less, or in a sea state of greater than or equal to Beaufort 4.

4.2.3 Pre-start observations

Prior to activating the acoustic source the MMO and the PAM operator must have had sufficient time to conduct 30 minutes of pre-start observations. (Note: the Code requires observations to be maintained at all times while the acoustic source is in the water whether it is on or off)

Beaufort 3

- Gentle breeze: 7–10 kts
- Wave height: 0.5–1 m
- Large wavelets. Crests begin to break; scattered whitecaps.

BEAUFORT FORCE 3
WIND SPEED: 7-10 KNOTS

SEA: WAVE HEIGHT .6-1M (2-3FT), LARGE WAVELETS, CRESTS BEGIN TO BREAK, ANY FOAM HAS GLASSY APPEARANCE, SCATTERED WHITECAPS

Beaufort 4

- Moderate breeze: 11-16 kts
- Wave height: 1–2 m
- Small waves with breaking crests. Fairly frequent whitecaps.

BEAUFORT FORCE 4
WIND SPEED: 11-16 KNOTS

SEA: WAVE HEIGHT 1-1.5M (3.5-5FT), SMALL WAVES BECOMING LONGER, FAIRLY FREQUENT WHITE HORSES

It is recommended that the MMO and PAM operator are notified at least 45 minutes prior to activation of the source to ensure that the 30 min of pre-start observations can be conducted.

When arriving at the survey location for the first time, the initial activation of the acoustic source must not be undertaken at night or during poor sighting conditions unless:

- PAM has been conducted for at least 30 minutes before activation and no vocalising cetaceans have been detected in the relevant mitigation zones.

The source cannot be activated during daylight hours unless:

- The MMO has continuously made visual observations all around the source for the presence of marine mammals, from the bridge or higher vantage point, using both binoculars and the naked eye, and no marine mammals (except NZ fur seals; refer section 4.5.3) have been observed in the respective mitigation zones for at least 30 minutes; and
- PAM has been conducted for at least 30 minutes before activation and no vocalising cetaceans have been detected in the respective mitigation zones.

The source cannot be activated during night-time hours or poor sighting conditions unless:

- PAM has been conducted for at least 30 minutes before activation and no vocalising cetaceans have been detected in the respective mitigation zones.

Note: If a marine mammal is observed to move into a relevant mitigation zone during pre-start observations and then observed to move out again there is no requirement to delay soft start (providing that at least 30 minutes of pre-start observations have been completed). The important criterion is that there are no marine mammals inside the relevant mitigation zones when the acoustic source is activated at the beginning of soft start and that at least 30 minutes of pre-start observations had been undertaken immediately prior.

4.2.4 Soft starts

The soft start procedure will be followed every time the source is activated. That is: the gradual increase of the source's power to the operational power requirement over a period of at least 20 minutes and no more than 40 minutes, starting with the lowest power gun in the array. The Survey MMIA describes the soft start procedures to be conducted for each CSS will aim to follow:

- Start acoustic source at 500 psi firing with 60 second intervals for 5 minutes;
- Increase to 1,000 psi firing with 60 second intervals for 5 minutes;
- Increase to 1,500 psi firing with 30 second intervals for 5 minutes; and
- Increase to 1,800 psi firing with 30 second intervals for 5 minutes.

The soft start procedure will also be applied to testing of the acoustic array unless the maximum combined source capacity being tested is equal to, or less than, 150 in^3. If the combined maximum source capacity does not exceed 150 in^3 then soft start procedures are not required and testing may commence following pre-start observations.

Soft starts will also be scheduled so as to minimise the interval between reaching full power and commencing data acquisition.

The only exception to the requirement to use the soft start procedure when the acoustic source is activated is when there has been a single break in firing of less than 10 minutes immediately following normal operations at full power (see Section 3.8.10 of the Code).

Explanatory note from MMIA: "If there are delays to the check-shot survey, and it is likely that the 10 minute sequential firing period may be exceeded, a single shot of the acoustic source will be fired to keep the check-shot survey in continuous operation. However, this will only be undertaken if there have been no sightings of marine mammals (other than NZ fur seals) in the area for the previous 30 minutes (i.e. the normal pre-start requirements)."

Note: for this CSS, at least one random sample of a soft-start should be recorded in the standard form and submitted to DOC for every rotation (see Appendix 2 of the Code).

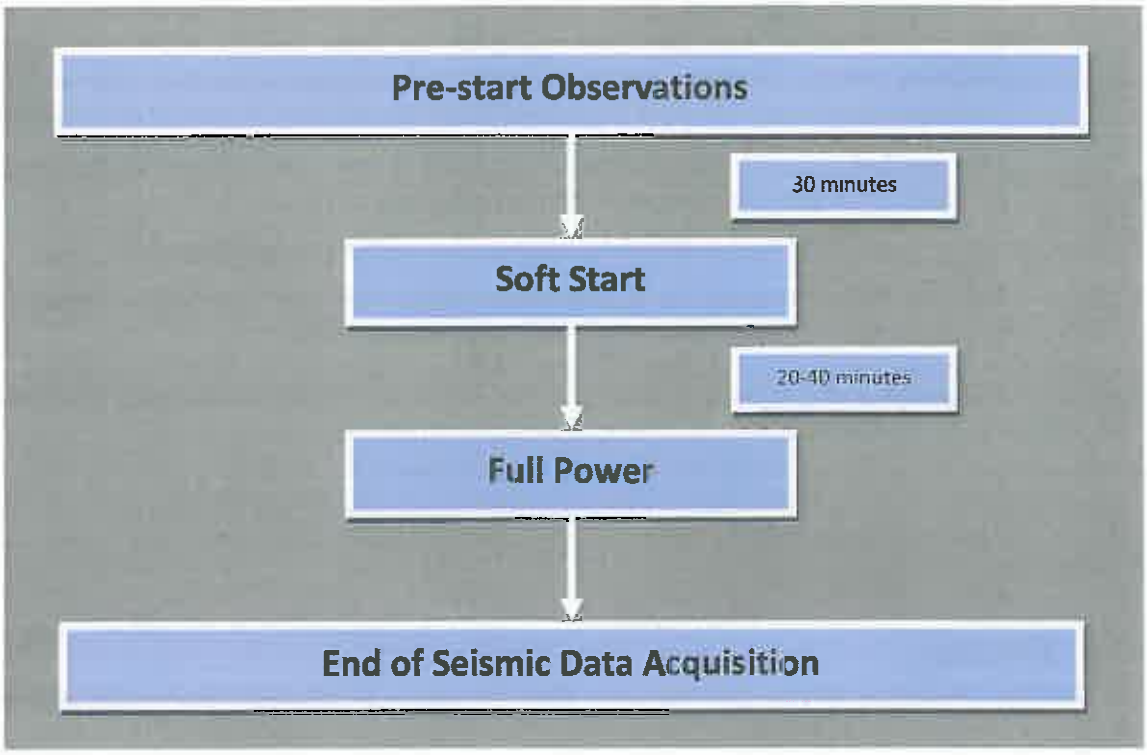


Figure 3: Seismic operations mitigation procedure.

4.3 Species of Concern (SOC)

The full list of SOC as defined by the Code is shown in Addenda 1 below.

4.4 Mitigation zones

The Code stipulates three mitigation zones for Level 2 marine seismic surveys (refer Figure 4):

1) 1.0 km from the centre of the acoustic source for SOC **with** calves;
2) 600 m from the centre of the acoustic source for SOC **without** calves; and
3) 200 m from the centre of the acoustic source for all other marine mammals (**with the exception of fur seals**[3]).

[3] After discussions with DOC during the development of the Survey MMIA, mitigation procedures in respect of NZ fur seals have been amended (refer section 4.5.3 for further details).

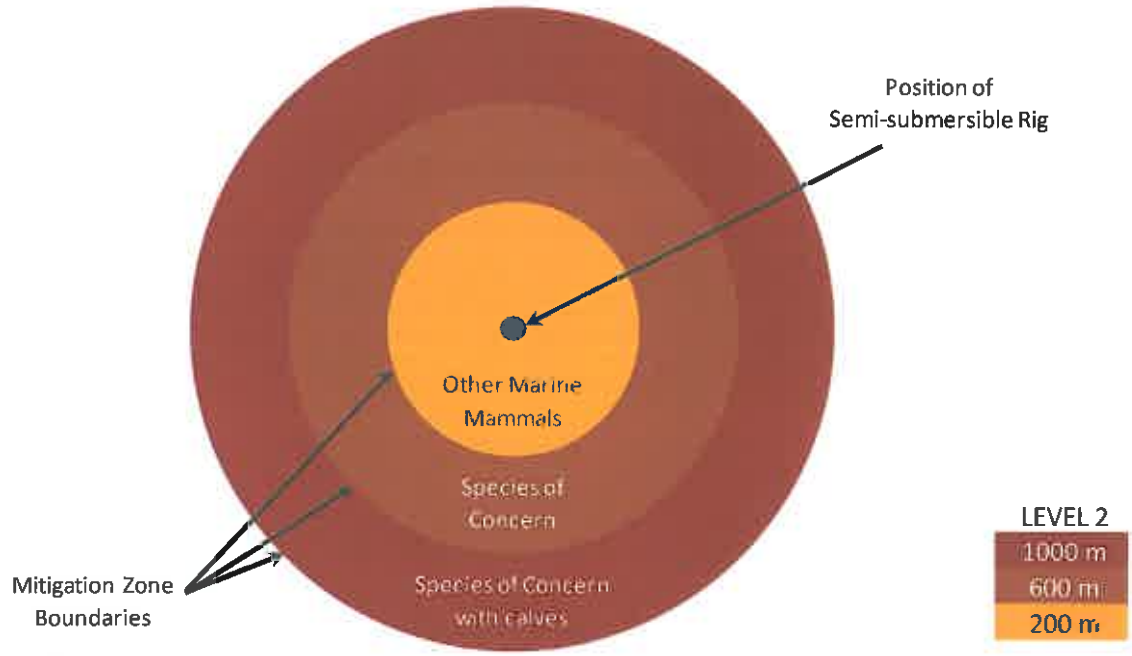


Figure 4: Mitigation zones.

4.4.1 PAM and calves

PAM cannot distinguish calves from adults, the Code therefore requires the proponent to apply the precautionary principle and the 1.0 km rule to cetacean SOC detected by PAM where:

1) The survey is an area where calves of cetacean SOC are expected to be present; and/or
2) Calves of cetacean SOC have been observed previously during the survey.

However, if the MMO can confirm, *in good sighting conditions*, no calves are present then the 600 m rule should be applied.

4.5 Mitigation actions

In the event that marine mammals are detected by the observer within the designated mitigation zones of **1.0 km, 600 m** and **200 m**, the observer will either delay the start of operations or shut down the source. These mitigation actions will apply to:

4.5.1 Species of Concern with calves

If during pre-start observations or when the acoustic source is active (including soft starts) the observer (MMO or PAM operator) detects at least one SOC cetacean with a calf within 1.0 km of the source, start up will be delayed, or the source will be shut down and not reactivated until:

1) The observer confirms the group has moved to a point that is more than 1.0 km from the source; or
2) Despite continuous observation, 30 minutes has elapsed since the last detection of the group within 1.0 km of the source, and the mitigation zone remains clear.

In regard to SOC cetaceans with a calf, note that the requirements above apply to the entire group containing that calf. An explanatory note from DOC[4]: " *Yes, whole group has to be seen to move beyond zone, or not be seen for 30 mins*", and "*The intent of this provision is that since a group of marine mammals containing one calf has potential to contain more (and at distance it may be hard to follow movement of the cow/calf pair), the same precaution should apply to all the individuals*".

It is recommended that due to the range limitations of PAM, all acoustic detections of cetaceans using ultra high frequency vocalisations (e.g. Maui's or Hector's dolphins) trigger an immediate shutdown of an active survey or delay the start of operations unless the MMO can visually confirm that vocalisations do not emanate from a SOC. This is because the maximum effective detection range of ultra-high frequency vocalisations from the PAM equipment under these general operational conditions (i.e. background noise levels) is in the order of 300-400 m.

It is also recommended that observers monitor the area immediately beyond the 1.0 km mitigation zone and if SOC are approaching this zone then notify the seismic operator that a shutdown may be required.

4.5.2 Species of Concern without calves

If during pre-start observations or when the acoustic source is active (including soft starts) the observer (MMO or PAM operator) detects a SOC (without calves) within 600 m of the source, start up will be delayed, or the source will be shut down and not reactivated until:

1) The observer confirms the SOC has moved to a point that is more than 600 m from the source; or
2) Despite continuous observation, 30 minutes has elapsed since the last detection of the SOC within 600 m of the source, and the mitigation zone remains clear.

It is recommended that due to the range limitations of PAM, all acoustic detections of cetaceans using ultra high frequency vocalisations (e.g. Maui's or Hector's dolphins) trigger an immediate shutdown of an active survey or delay the start of operations unless a MMO confirms that vocalisations do not emanate from a SOC. This is because the maximum effective detection range of ultra-high frequency vocalisations from the PAM equipment under these general operational conditions (i.e. background noise levels) is in the order of 300-400 m.

4.5.3 Other Marine Mammals

If, during pre-start observations the observer detects a marine mammal (excluding NZ fur seals; see below for details on the variance of this rule for NZ fur seals) within 200 m of the source, soft start will be delayed until:

1) The observer confirms the marine mammal has moved to a point that is more than 200 m from the source; or
2) Despite continuous observation, 30 minutes has elapsed since the last detection of a marine mammal within 200 m of the source, and the mitigation zone remains clear.

Note: The presence of "Other Marine Mammals" within 200 m of the source will not result in a shutdown if the source is active, it can only result in a delay to start up of the source.

After discussions during the development of the MMIA for this project, NZ fur seal mitigation procedures have been amended to reflect that:

[4] Email from Mr Tara Ross-Watt, DOC Senior Adviser - International and Marine; 17 December 2012

1) NZ fur seals are not listed as a 'Species of Concern' within the Code of Conduct for this project;
2) NZ fur seals are a relatively common species with no significant threat at the wider population level;
3) NZ fur seals are abundant and resident around all of the offshore installations (e.g. well head platforms, drilling platforms and Floating Production Storage and Offloading facilities) off the Taranaki coastline;
4) They use parts of the installations as haul out areas and the marine life which establishes around these installations provides a food source to the NZ fur seals, where they remain on or near the installations for extended periods of time;
5) Given the well locations proximity to the existing installations, it is highly likely NZ fur seals will be present around the KTIV when the check-shots will be undertaken;
6) If the 200 m pre-start mitigation zone and 30 minute observation period are strictly adhered to for NZ fur seals then delays and additional costs to the drilling programme and rig schedule could occur; and
7) The airgun activity during check-shot surveys are limited to a single location, has a low acoustic source volume, and the shots are widely-spaced over a relatively short survey duration (~ four hours), essentially lowers the risk to marine mammals (including NZ fur seals).

Consequently, the MMIA approved by DOC specifies that mitigation requirements for fur seals may be amended during the check-shot survey as follows: delay to soft start procedures will not be required for NZ fur seals. However, the check-shot survey may proceed provided:

1) If NZ fur seals are entering and leaving the 200 m mitigation zone regularly, every effort should be made to begin the soft start when no NZ fur seals are present within the mitigation zone;
2) In the event that NZ fur seals are always present within the mitigation zone, every effort should be made to fire the acoustic source when the seals are at the surface, rather than diving; and
3) Any seals which are hauled out on the KTIV do not need to be considered in applying mitigation requirements, as they will presumably be unaffected by the acoustic source.

The MMOs should pay particular attention to the reactions and behaviour of NZ fur seals in close proximity to the KTIV (i.e. where practicable and where it does not interfere with mitigation, observers should record the behaviour of fur seals that are in close proximity to the acoustic source, with particular attention paid to their behaviour when the acoustic source is fired). The aim is to build knowledge of the effects of seismic noise on the behaviour of this species.

4.5.4 Mitigation Posters and Summary

Refer to Addenda 2 of this MMMP for posters detailing mitigation action procedures, and Addenda 4 for a summary table of these.

5. Further Mitigation Measures

The following additional mitigation measures will be implemented during this survey and are over and above those identified in the Code. They have been agreed by DOC following discussions between AWE and DOC.

1) **Autopsy of any stranded marine mammals during the survey**

Should any marine mammal be found dead inshore of the operational area during the same period as the CSS, AWE will engage Massey University researchers to conduct necropsies to look for auditory or pressure-related injuries.

2) **Notification of any Maui's dolphin sightings**

DOC will be immediately notified of any Maui's dolphin sightings so that if observed, DOC can mobilise a fixed wing plane for verification and/or a vessel to obtain a biopsy sample to aid further research of the population.

3) **MMOs to maintain observations when outside the operational area**

Allowing for the management of fatigue and effective watch-keeping, an MMO will be on watch while in transit outside of the survey area.

Explanatory note from MMIA: "the observers will be mobilised to the KTIV via helicopter, and while no dedicated observations will take place during this passage out to the KTIV, DOC encourage the observers to keep their eye out for anything interesting while in flight".

6. Notifications to DOC

A written report will be submitted to the Director-General of DOC at the earliest opportunity, but no longer than 60 days after completion of the CSS. Sightings forms must be submitted to DOC at the completion the CSS.

If a situation arises that requires a more direct line of communication from the Observers to DOC; the MMO Team Leader is to first seek permission from the Offshore Installation Manager. The following table summarises the situations when DOC (in effect, the Director General) should be notified immediately. During this Survey, the first point of contact within DOC is Ian Angus (. . or). If a response is required urgently then telephone, but in all other circumstances use email. For any Maui's/Hector's dolphin sighting also contact Callum Lilley from the Taranaki office of DOC on n the instance of a Maui's/Hector's dolphin sighting please contact DOC directly (after notifying the Offshore Installation Manager) rather than following the communication protocol below.

Table 1: Events that require the immediate notification to DOC (i.e. communication protocols outlined in section 3.1.1 are overruled).

Situation	Comments
Any instances of non-compliance with the Code	This is a standard requirement under the Code
The PAM system becomes non-operational	This refers to when both primary and backup systems are non-operational
Any confirmed sighting of Maui's/Hector's dolphin	This applies to both in transit and in the operational area

Addenda 1: Species of Concern as defined in the Code

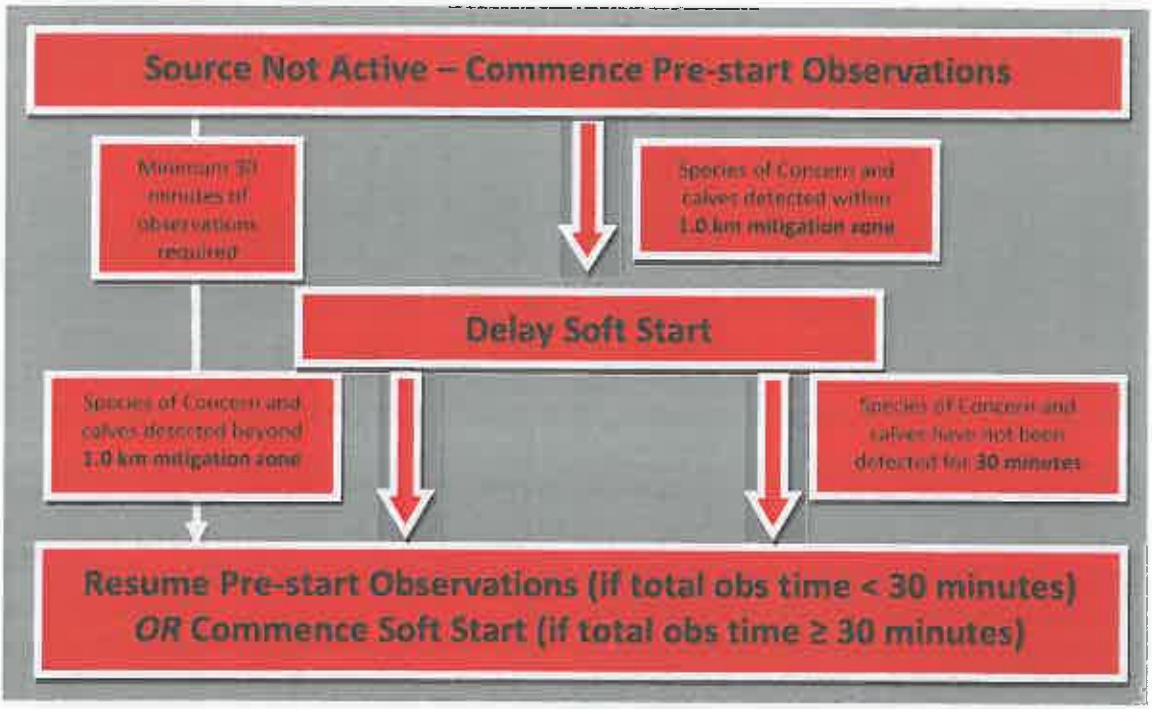
Common name	Latin name
Andrew's beaked whale	*Mesoplodon bowdoini*
Antarctic minke whale	*Balaenoptera bonarensis*
Arnoux's beaked whale	*Berardius arnuxii*
Blainville's beaked whale	*Mesoplodon densirostris*
Blue whale	*Balaenoptera musculus*
Bottlenose dolphin	*Tursiops truncatus*
Bryde's whale	*Balaenoptera edeni*
Cuvier's beaked whale	*Ziphius cavirostris*
Dwarf Minke whale	*Balaenoptera acutorostrata subsp.*
Dwarf sperm whale	*Kogia simus*
False killer whale	*Pseudorca crassidens*
Fin whale	*Balaenoptera physalus*
Ginkgo-toothed whale	*Mesoplodon ginkgodens*
Gray's beaked whale	*Mesoplodon grayi*
Hector's beaked whale	*Mesoplodon hectori*
Hector's dolphin	*Cephalorhynchus hectori*
Humpback whale	*Megaptera novaeangliae*
Killer whale	*Orcinus orca*
Long-finned pilot whale	*Globicephala melas*
Maui's dolphin	*Cephalorhynchus hectori maui*
Melon-headed whale	*Peponocephala electra*
New Zealand sea lion	*Phocarctos hookeri*
Pygmy/Peruvian beaked whale	*Mesoplodon peruvianus*
Pygmy blue whale	*Balaenoptera musculus brevicauda*
Pygmy killer whale	*Feresa attenuata*
Pygmy right whale	*Caperea marginata*
Pygmy sperm whale	*Kogia breviceps*
Sei whale	*Balaenoptera borealis*
Shepherd's beaked whale	*Tasmacetus shepherdi*
Short-finned pilot whale	*Globicephala macrorhynchus*

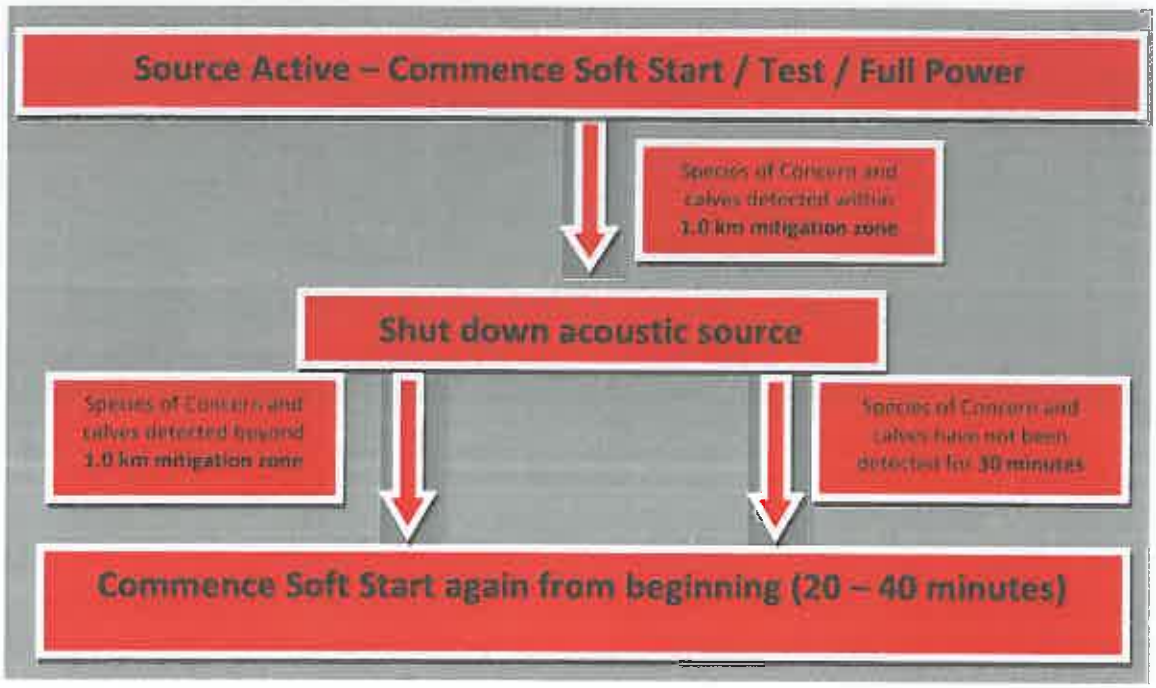
Southern Bottlenose whale	*Hyperoodon planifrons*
Southern right whale	*Eubalaena australis*
Southern right whale dolphin	*Lissodelphis peronii*
Sperm whale	*Physeter macrocephalus*
Strap-toothed whale	*Mesoplodon layardii*
True's beaked whale	*Mesoplodon mirus*

Addenda 2: Mitigation Procedures – Good Sighting Conditions (poster format)

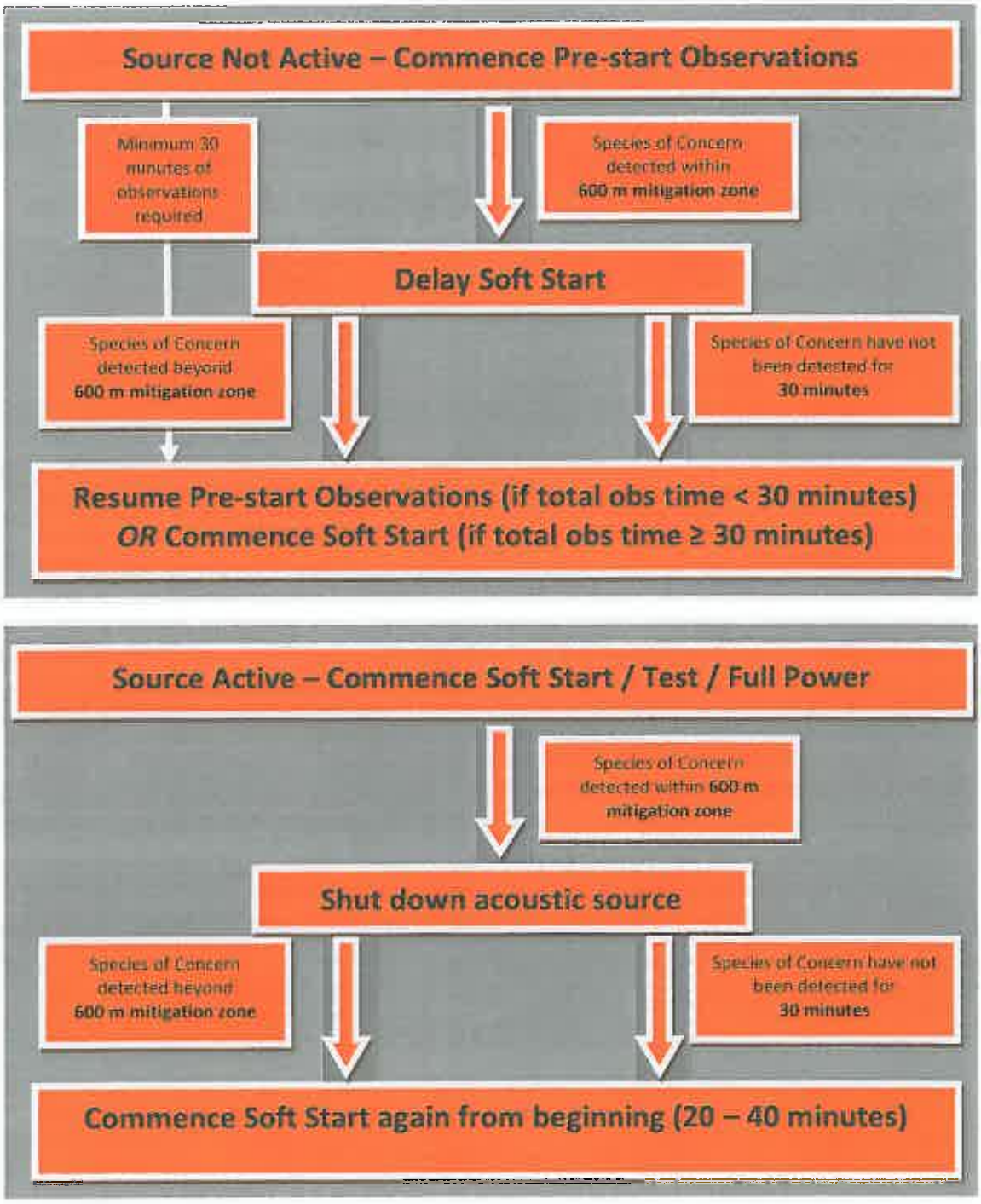
The following posters depict mitigation procedures. It is recommended they be posted in the instrument room, the PAM station and on the bridge. Operational flowcharts are also found in Appendix 4 of the Code.

Species of Concern with Calves within 1.0 km of Acoustic Source



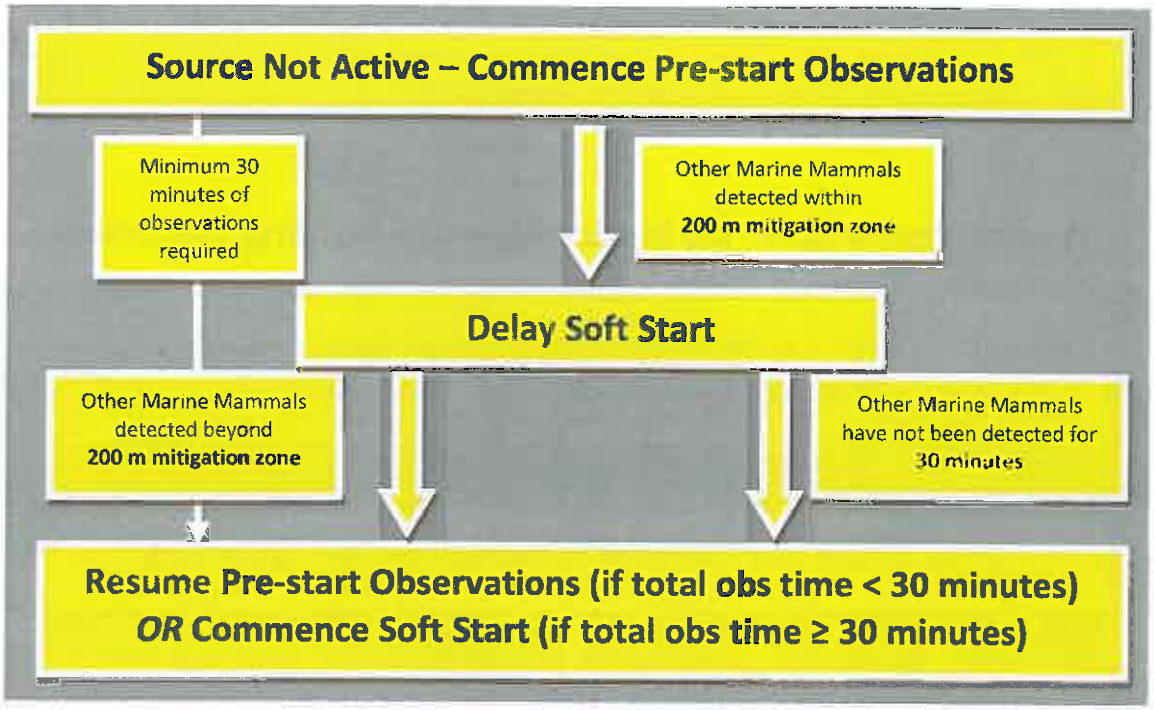


Species of Concern (no Calves) within 600 m of Acoustic Source



Other Marine Mammals within 200 m of Acoustic Source

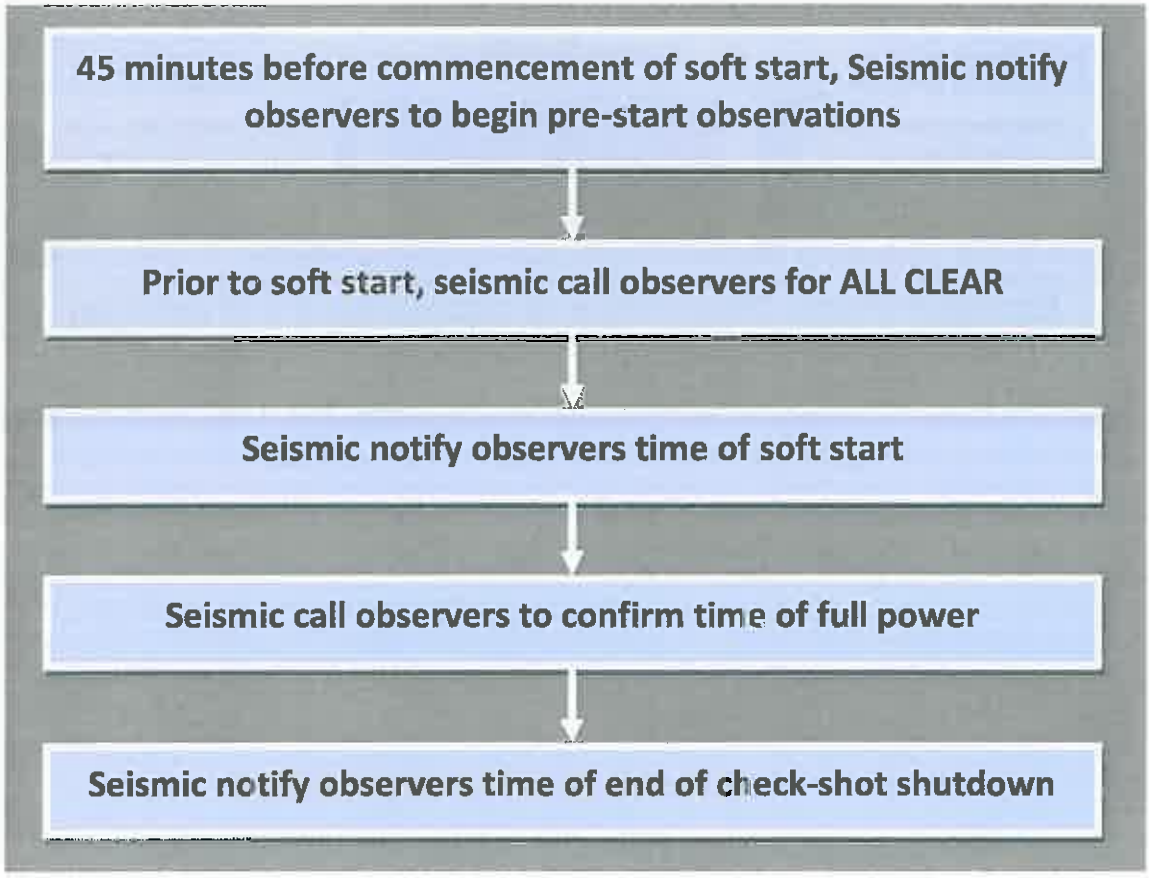
(excluding fur seals)



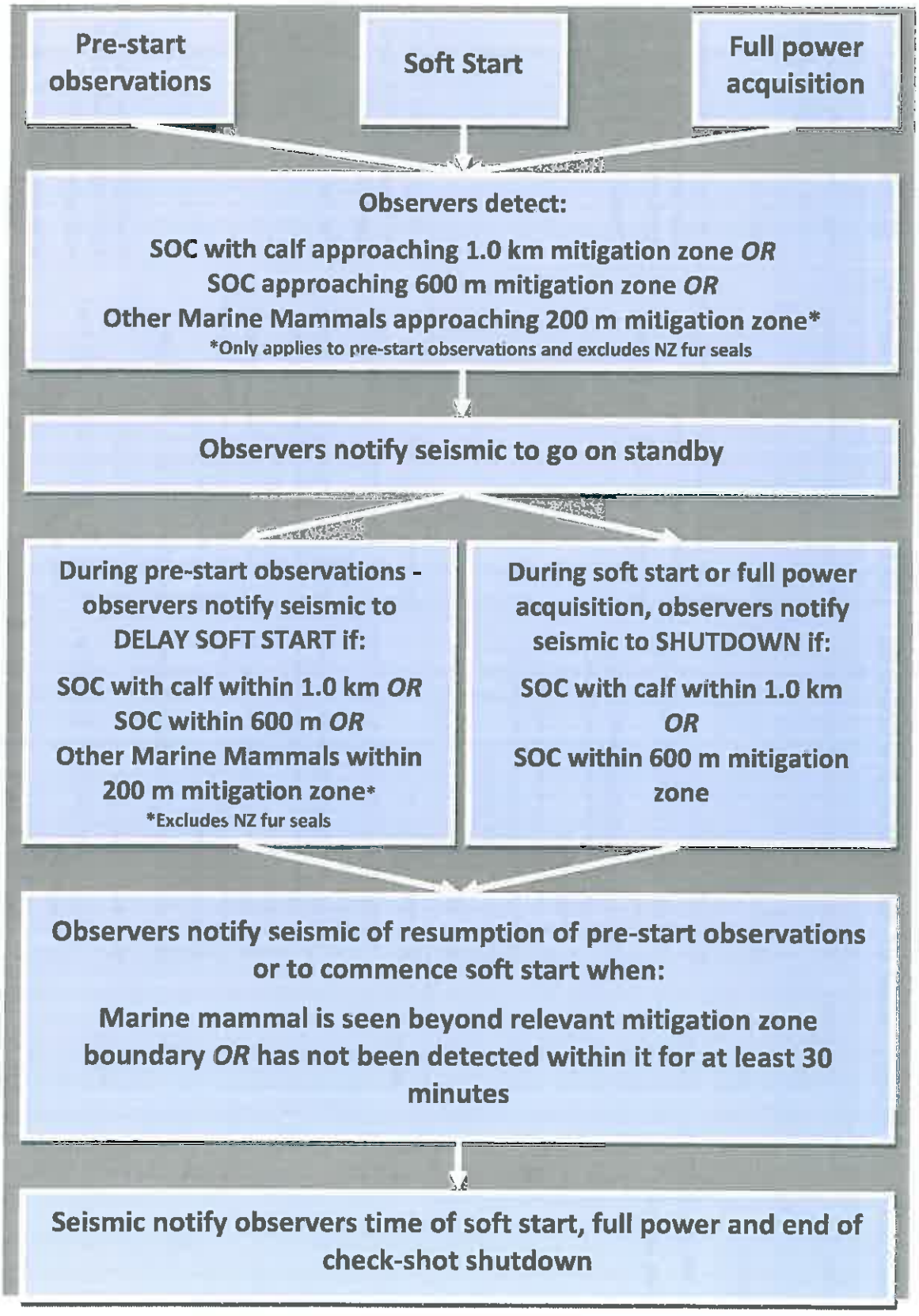
Addenda 3: Recommended Communication Protocols (poster format)

Note: Seismic control room (or equivalent for a check shot survey) to immediately notify observers (MMO and PAM) of any changes in the status of seismic guns

Normal Operations - No Marine Mammal Sighting/Detection



Delayed Soft Start or Shutdown – Marine Mammal Sighting/Detection



Addenda 4: Summary table of mitigation procedures – Level 2 check-shot survey – good sighting conditions

Activity	Mitigation Zone	SOC with Calves sighted/detected	SOC (no Calves) sighted/detected	Other Marine Mammals (excluding fur seals) sighted/detected
In transit	N/A	Record sighting	Record sighting	Record sighting
Acoustic source testing (source active)	**1.0 km**	Shut down source until: • Group moved more than 1.0 km from source; or • Group not seen/heard within 1.0 km of source for 30 minutes and zone remains clear. Then, resume or commence soft start (if maximum test volume >150 in^3); no 20 minute minimum required. Refer also Notes 1), 3), 4) and 5) below.	Inform Seismic Control room of sighting / detection and to standby. Refer also Notes 1), 3), and 5) below.	No mitigation action required. Observe marine mammals and record movement/response. Refer also Notes 1), 3), and 5) below.
	600 m	Shut down source until: • Group moved more than 1.0 km from source; or • Group not seen/heard within 1.0 km of source for 30 minutes and zone remains clear. Then, resume or commence soft start (if maximum test volume >150 in^3); no 20 minute minimum required. Refer also Notes 1), 3), 4) and 5) below.	Shut down source until: • SOC moved more than 600 m from source; or • SOC not seen/heard within 600 m of source for 30 minutes and zone remains clear. Then, resume or commence soft start (if maximum test volume >150 in^3); no 20 minute minimum required. Refer also Notes 1), 3), and 5) below.	No mitigation action required. Observe marine mammals and record movement/response. Refer also Notes 1), 3), and 5) below.
	200 m	Shut down source until: • Group moved more than 1.0 km from source; or	Shut down source until: • SOC moved more than 600 m from source; or	No mitigation action required. Observe marine mammals and record movement/response. Refer also Notes 1), 3), and 5) below.

Activity	Mitigation Zone	SOC with Calves sighted/detected	SOC (no Calves) sighted/detected	Other Marine Mammals (excluding fur seals) sighted/detected
		• Group not seen/heard within 1.0 km of source for 30 minutes and zone remains clear. Then, resume or commence soft start (if maximum test volume >150 in^3); no 20 minute minimum required. Refer also Notes 1), 3), 4) and 5) below.	• SOC not seen/heard within 600 m of source for 30 minutes and zone remains clear. Then, resume or commence soft start (if maximum test volume >150 in^3); no 20 minute minimum required. Refer also Notes 1), 3), and 5) below.	
New location		Prior to data acquisition at a new location, the following mitigation measures for SOC with Calves apply: • Pre-start observations; • Soft start; and • Full-power operation. Refer Notes 1) and 2) below.	Prior to data acquisition on a new line, the following mitigation measures for SOC (no Calves) apply: • Pre-start observations; • Soft start; and • Full-power operation. Refer Notes 1) and 2) below.	Prior to data acquisition, the following mitigation measures for Other Marine Mammals apply: • Pre-start observations. Refer Notes 1) and 2) below.
Pre-start observations (source not active)	**1.0 km**	Delay soft start until • Group moved more than 1.0 km from source, or • Group not seen/heard within 1.0 km of source for 30 minutes and zone remains clear. Then, resume pre-start observations or commence soft start. Refer also Notes 1), 4) and 5) below.	Inform Seismic Control room of sighting / detection and to standby. Refer also Notes 1) and 5) below.	Inform Seismic Control room of sighting / detection and potential need to standby. Refer also Notes 1) and 5) below.
	600 m	Delay soft start until • Group moved more than 1.0 km from source, or	Delay soft start until • SOC moved more than 600 m from source, or	Inform Seismic Control room of sighting / detection and potential need to standby. Refer also Notes 1) and 5) below.

Activity	Mitigation Zone	SOC with Calves sighted/detected	SOC (no Calves) sighted/detected	Other Marine Mammals (excluding fur seals) sighted/detected
		• Group not seen/heard within 1.0 km of source for 30 minutes and zone remains clear. Then, resume pre-start observations or commence soft start. Refer also Notes 1), 4) and 5) below.	• SOC not seen/heard within 600 m of source for 30 minutes and zone remains clear. Then, resume pre-start observations or commence soft start. Refer also Notes 1) and 5) below.	
	200 m	Delay soft start until: • Group moved more than 1.0 km from source, or • Group not seen/heard within 1.0 km of source for 30 minutes and zone remains clear. Then, resume pre-start observations or commence soft start. Refer also Notes 1), 4) and 5) below.	Delay soft start until: • SOC moved more than 600 m from source, or • SOC not seen/heard within 600 m of source for 30 minutes and zone remains clear. Then, resume pre-start observations or commence soft start. Refer also Notes 1) and 5) below.	Delay soft start until: • Marine mammal moved more than 200 m from source, or • Marine mammal not seen/heard within 200 m of source for 30 minutes and zone remains clear. Then, resume pre-start observations or commence soft start. Refer also Notes 1), 5) and 6) below.
Soft-start **(source active)**	**1.0 km**	Shut down source until: • Group moved more than 1.0 km from source; or • Group not seen/heard within 1.0 km of source for 30 minutes and zone remains clear. Then, resume or commence soft start for 20- 40 minutes (total). Refer also Notes 1), 4) and 5) below.	Inform Seismic Control room of sighting / detection and to standby. Refer also Notes 1), 4) and 5) below.	No mitigation action required. Observe marine mammals and record movement/response.
	600 m	Shut down source until: • Group moved more than 1.0 km from source; or	Shut down source until: • SOC moved more than 600 m from source; or	No mitigation action required. Observe marine mammals and record movement/response.

Activity	Mitigation Zone	SOC with Calves sighted/detected	SOC (no Calves) sighted/detected	Other Marine Mammals (excluding fur seals) sighted/detected
		• Group not seen/heard within 1.0 km of source for 30 minutes and zone remains clear. Then, resume or commence soft start for 20- 40 minutes (total). Refer also Notes 1), 4) and 5) below.	• SOC not seen/heard within 600 m of source for 30 minutes and zone remains clear. Then, resume or commence soft start for 20- 40 minutes (total). Refer also Notes 1), 4) and 5) below.	
	200 m	Shut down source until: • Group moved more than 1.0 km from source; or • Group not seen/heard within 1.0 km of source for 30 minutes and zone remains clear. Then, resume or commence soft start for 20- 40 minutes (total). Refer also Notes 1), 4) and 5) below.	Shut down source until: • SOC moved more than 1 km from source; or • SOC not seen/heard within 1 km of source for 30 minutes and zone remains clear. Then, resume or commence soft start for 20- 40 minutes (total). Refer also Notes 1), 4) and 5) below.	No mitigation action required. Observe marine mammals and record movement/response.
Full-power operation (source active)	**1.0 km**	Shut down source until: • Group moved more than 1.0 km from source; or • Group not seen/heard within 1.0 km of source for 30 minutes and zone remains clear. Then, resume soft start for 20- 40 minutes (total). Refer also Notes 4) and 5) below.	Inform Seismic Control room of sighting / detection and to standby. Refer also Notes 4) and 5) below.	No mitigation action required. Observe marine mammals and record movement/response.
	600 m	Shut down source until: • Group moved more than 1.0 km from source; or	Shut down source until: • SOC moved more than 600 m from source; or	No mitigation action required. Observe marine mammals and record movement/response.

Activity	Mitigation Zone	SOC with Calves sighted/detected	SOC (no Calves) sighted/detected	Other Marine Mammals (excluding fur seals) sighted/detected
		• Group not seen/heard within 1.0 km of source for 30 minutes and zone remains clear Then, resume or commence soft start for 20- 40 minutes (total) Refer also Notes 4) and 5) below	• SOC not seen/heard within 600 m of source for 30 minutes and zone remains clear Then, resume or commence soft start for 20- 40 minutes (total) Refer also Notes 4) and 5) below	
	200 m	Shut down source until • Group moved more than 1.0 km from source, or • Group not seen/heard within 1.0 km of source for 30 minutes and zone remains clear Then, resume or commence soft start for 20- 40 minutes (total) Refer also Notes 4) and 5) below	Shut down source until • SOC moved more than 600 m from source, or • SOC not seen/heard within 600 m of source for 30 minutes and zone remains clear Then, resume or commence soft start for 20- 40 minutes (total) Refer also Notes 4) and 5) below	No mitigation action required. Observe marine mammals and record movement/response

NOTES

Night operations or poor sighting conditions

1) The source cannot be activated during night-time hours or poor sighting conditions unless: Passive Acoustic Monitoring for the presence of marine mammals has been carried out by a PAM operator for at least 30 minutes before activation, and the PAM operator has not detected vocalising cetaceans in the relevant mitigation zones.

2) When arriving at a new location in the survey programme for the first time, the initial acoustic source activation must not be undertaken at night or during poor sighting conditions unless Passive Acoustic Monitoring for the presence of marine mammals has been carried out by a qualified PAM operator for at least 30 minutes before activation, and the qualified observer has not detected vocalising cetaceans in the relevant mitigation zones.

Acoustic source testing

3) Acoustic source testing: Level 2 seismic source tests with a maximum combined source capacity of <2.49 litres or 150 cubic inches do not require soft start procedures, and can be undertaken following relevant pre-start observations.

SOC with Calves

4) It should be noted that consistent with a precautionary approach, if operating in an area where calves are expected to be present or have been observed during the survey, that vocalising cetacean detections by PAM should be assumed to be emanating from a cow/calf pair. In this case the more stringent mitigation zone provisions should be applied, unless determined otherwise by the MMO during good sighting conditions.

PAM

5) Due to the limited detection range of current PAM technology for ultra-high frequency cetaceans (<300 m), any such bioacoustic detections will require an immediate shutdown of an active survey or will delay the start of operations, regardless of signal strength or whether distance or bearing from the acoustic source has been determined. Shutdown of an activated acoustic source will not be required if visual observations by a qualified MMO confirm that the acoustic detection was of a species falling into the category of 'Other Marine Mammals'.

Marine Mammals

6) After discussions with DOC during the development of the MMIA, mitigation procedures in respect of NZ fur seals have been amended (refer section 4.5.3). Consequently, delay to soft start procedures will not be required for NZ fur seals. However, effort should be made to begin the soft start when no NZ fur seals are present within the mitigation zone; and every effort should be made to fire the acoustic source when the seals are at the surface. In addition, the MMOs should pay particular attention to the reactions and behaviour of NZ fur seals in close proximity to the KTIV, with particular attention paid to their behaviour when the acoustic source is fired.