Resource and Environmental Management Ltd

Shell Todd Oil Services Limited

Taranaki Basin Exploration Drilling, Vertical Seismic Profiling

Marine Mammal Impact Assessment

17 September 2014

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Table of Contents

List of Figures

List of Tables

List of Abbreviations

AEI	Areas of Ecological Importance
BOP	Blow Out Preventer
CNG	Compressed Natural Gas
The Code	2013 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
CRMS	Craft Risk Management Standard
DMP	Discharge Management Plan
DOC	Department of Conservation
EEZ	Exclusive Economic Zone
EEZ Act	Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012
EPA	Environmental Protection Authority
FMA	Fisheries Management Area
FPSO	Floating Production Storage and Offloading facility
IOPPC	International Oil Pollution Prevention Certificate
ISPPC	International Sewage Pollution Prevention Certificate
KTIV	Kan Tan IV
LPG	Liquefied Petroleum Gas
MARPOL	International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978
MMIA	Marine Mammal Impact Assessment
MMO	Marine Mammal Observer
MMS	Marine Mammal Sanctuary
MPI	Ministry for Primary Industries
MPR	Maritime Protection Rules
MSL	MetOcean Solutions Limited
NABIS	National Aquatic Biodiversity Information System
NIWA	National Institute of Water and Atmospheric Research
NZ	New Zealand
NZP&M	New Zealand Petroleum and Minerals
PAM	Passive Acoustic Monitoring
PEP	Petroleum Exploration Permit
PML	Petroleum Mining Licence
REM	Resource and Environmental Management
SEL	Sound Exposure Level
SLIMPA	Sugar Loaf Island Marine Protected Area

SOPEP	Shipboard Oil Pollution Emergency Plan
STOS	Shell Todd Oil Services
TVDSS	True Vertical Depth Subsea
VSP	Vertical Seismic Profile
WWF	Worldwide Fund for Nature

1 Non-Technical Summary

Shell Todd Oil Services Limited (STOS) propose to undertake two vertical seismic profile surveys (VSPs) at the Ruru-2 and Māui 8 exploration wells. The VSPs are being conducted to confirm reservoir location, increase data resolution, and allow the conventional seismic data (that was acquired through previous 3D marine seismic surveys) to be correlated for the two exploration wells. The Ruru-2 and Maui 8 well locations are approximately 40 km southwest of Cape Egmont in the offshore Taranaki Basin. The nearest major settlement is the coastal city of New Plymouth, approximately 80 km to the northeast.

The VSPs will be conducted from the semi-submersible drilling rig, the Kan Tan IV, following the completion of each exploration well. It is anticipated that the VSPs will commence in mid-2014 and that each survey will be completed within approximately 12 hours.

Both surveys will utilise two airguns with a total capacity of 500 in^3. The airguns will be deployed from the Kan Tan IV to a depth of 5 m, and will be fired 3 – 5 times (at 15 second intervals) with a hydrophone deployed down into the borehole recording the received sound. The hydrophone's depth is adjusted and the sequence is repeated with some 40 – 50 recording depths overall for each borehole. The Department of Conservation's 2013 Code of Conduct for minimising acoustic disturbance to marine mammals from seismic survey operations (the 'Code') defines three levels of marine seismic surveys based on acoustic source capacity. Based on this classification, both VSP surveys are considered to be 'Level 1' seismic surveys and require a Marine Mammal Impact Assessment (MMIA) to be approved by the Department of Conservation before the survey commences.

In assessing the potential impacts of the VSPs on marine mammals the following steps were undertaken:

- The identification of all potential environmental sensitivities which could be vulnerable to those activities identified;
- The identification of all potential environmental effects of the specific activities associated with the VSP surveys;
- The development of management actions to avoid, remedy or mitigate each potential effect; and
- An assessment of the significance of each potential environmental effect based on likelihood, magnitude, geographical scale, and mitigation actions.

An important part of the MMIA development is consultation with interested parties and technical experts, and in preparation for the drilling campaign, STOS consulted widely with a range of stakeholders and their concerns have been taken into account.

A thorough understanding of the existing environmental sensitivities in the offshore Taranaki region provides a fundamental basis of this MMIA. Environmental sensitivities include marine mammals, sea birds, fish species, benthic marine fauna and plankton. It is considered that six species of marine mammal that are classified as 'threatened' by the New Zealand Threat Classification Scheme (Baker et al. 2010) could be present; killer whales, bottlenose dolphins and southern right whales have a high probability of occurring in the vicinity of the VSP, whereas Bryde's whales, Hector's dolphins and Maui's dolphins have a low probability of being present. This likelihood assessment is based on life history characteristics, behaviour and previous sighting records. In addition to these threatened species, there is a high probability that other non-threatened species of marine mammals could also be utilising habitat in the vicinity, including a number of 'species of concern' as defined by the Code. In particular, New Zealand fur seals are expected to be present in relatively high densities around the KTIV and blue whales also have a high likelihood of being present in surrounding waters. The survey will not,

however, overlap spatially or temporally with any known critical habitat for marine mammals.

Numerous sea bird species are likely to be present in the survey area; however Gibson's albatross, Salvin's mollymawk, black-billed gulls, black-fronted terns, red billed gulls, pied shags, black petrels, flesh-footed shearwater and caspian terns have a Department of Conservation (DOC) threat listing of nationally vulnerable or greater so are of greatest significance. The most commonly caught commercial fish species in this area are jack mackerel and barracouta accounting for about 95% of the total catch in offshore Taranaki waters.

As part of this Marine Mammal Impact Assessment (MMIA), a range of potential effects on the environment have been assessed. To address these potential effects STOS will implement mitigation measures which aim to eliminate or minimise any negative environmental consequences as far as practicable.

The introduction of sound into the marine environment is considered to be the most significant potential impact from the Ruru-2 and Māui 8 VSPs. The primary mitigation tool to address this impact is compliance with the Code. STOS will adhere to the Code for the duration of the survey, with the exception of a small number of variances that have been developed in consultation with DOC and relate to the limited duration of each survey. The standard measures that will be employed include:

- The use of pre-start observations to detect marine mammals (both visually and acoustically) prior to the commencement of seismic operations;
- The delay of operations in the event that marine mammals (with the exception of NZ fur seals) are detected within the mitigation zones defined in the Code;
- The use of 'soft-starts' whereby the acoustic power is gradually increased over 20 – 40 minutes at the start of the survey to give any marine mammals the opportunity to leave the survey area before full power is reached; and
- The shut-down of the acoustic source if 'species of concern' enter the mitigation zones defined in the Code.

The agreed variances are:

- No sound transmission loss modelling will be required prior to the STOS VSPs;
- Only one trained and qualified Marine Mammal Observer (MMO) will be onboard the KTIV for the acoustic source testing and for the duration of the VSPs, and will maintain a watch for marine mammals while the acoustic source is in the water (during daylight hours);
- Passive Acoustic Monitoring (PAM) is to be operational at all times the seismic source is active, and the support vessel will be used as the PAM platform as the sound field emanating from the KTIV is unknown and could decrease the accuracy of acoustic detections. Therefore, the PAM hydrophone array will be towed from the support vessel, circling within a 1 km radius of the KTIV; and
- If NZ fur seals are entering and leaving the 200 m mitigation zone regularly, every effort will 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 will 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 active.

Other potential environmental effects (outside those directly relating to marine mammals and noise) are addressed by adherence to the Marine Mammal Protection Regulations 1994, the International Convention for the Prevention of Pollution From Ships 1978

(MARPOL), and the International Regulations for the Prevention of Collisions at Sea 1972 (COLREGS).

In summary, the environmental effects associated with the Ruru-2 and Māui 8 VSPs are considered to be negligible or minor. These determinations are largely driven by the limited timeframe over which the surveys will occur (c. 12 hours), and compliance with the Code which will reduce the risk of any potential environmental impacts.

2 Introduction

2.1 Background

Resource and Environmental Management Limited (REM) has been engaged by Shell Todd Oil Services Limited (STOS) and its joint venture partners to prepare a Marine Mammal Impact Assessment (MMIA) for the vertical seismic profiling (VSP) surveys scheduled to be undertaken at their exploration wells (Ruru-2 and Māui 8) within the Taranaki Basin. The Ruru-2 well site is located on the southeast boundary of the Māui Petroleum Mining Licence (PML) 381012, ~12 km from the two existing Māui platforms (A & B). Whereas, the Māui 8 well is located 6.7 km to the northwest of the Ruru-2 well; and is also located within PML 381012 as shown in Figure 1 (hereafter the 'Survey Area').

With regard to their drilling activities and under the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 (EEZ Act) STOS submitted a Marine Consent Application on 11 June 2014 to the Environmental Protection Authority (EPA) in accordance with s166 for planned petroleum activities within the Exclusive Economic Zone (EEZ). The application was accepted as complete by the EPA on 27 June 2014.

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 '2013 Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations' (the 'Code') (DOC, 2013).

STOS has adopted and will adhere to the Code which 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).

This MMIA has been prepared in accordance with the EEZ Act and the Code to assess and set out the management of any potential environmental impacts of the VSP surveys 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.

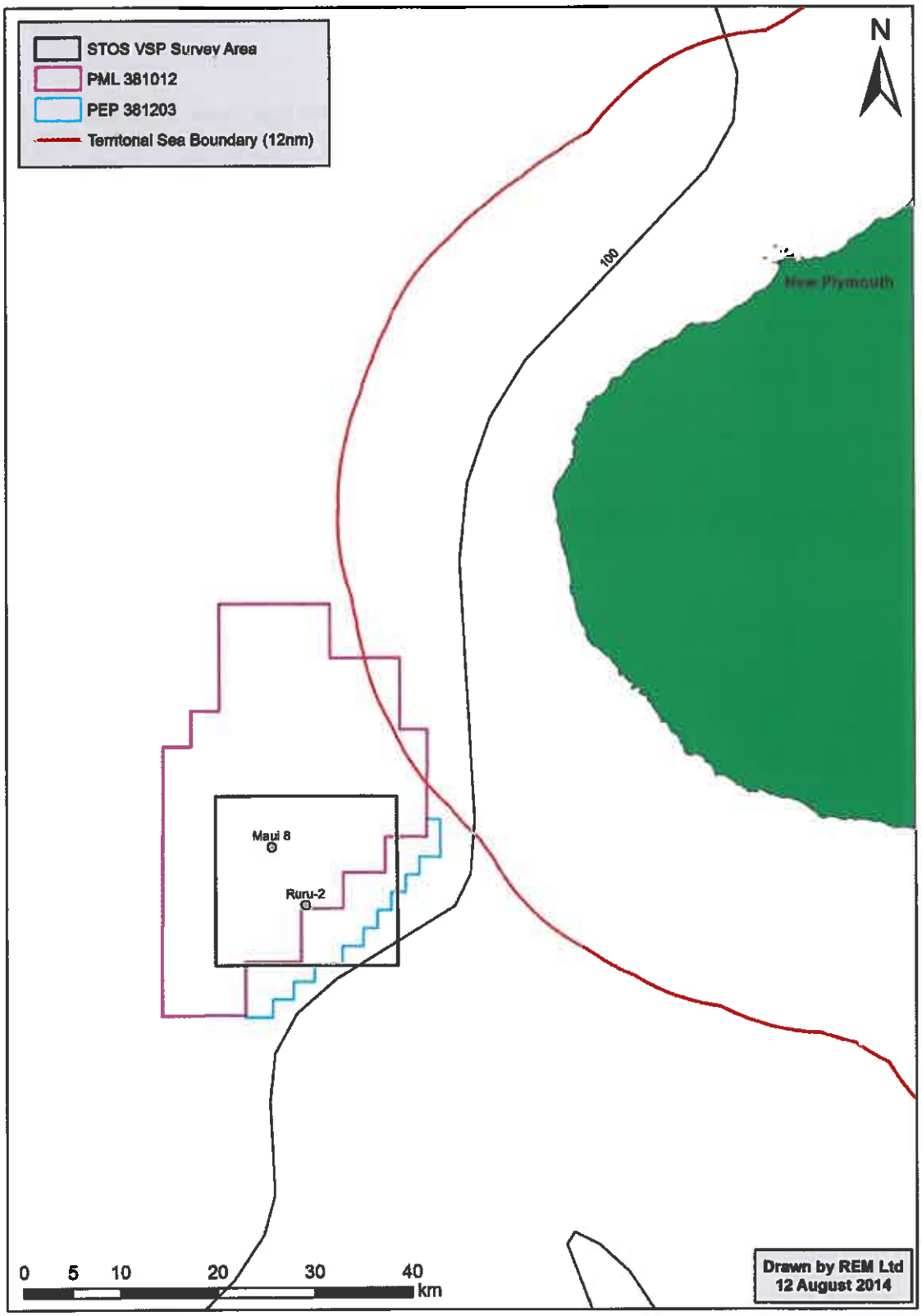

Figure 1: Location Map of the Survey Area

2.2 Drilling Programme

STOS will use the semi-submersible drilling rig Kan Tan IV (KTIV) (Figure 2) to drill the Ruru-2 and Māui 8 wells which are located in a water depth of ~108 m. The Ruru-2 exploration drilling will consist of one well and the rig will be located on site for approximately 50 days depending on downtime. The Māui 8 well will require a c. 35 day drilling programme to complete. If either well is successful and there is a showing of hydrocarbons, it is likely to be sidetracked from the 9 $^{5}/_{8}$" casing with an 8 ½" hole to target the C sands in Petroleum Exploration Permit (PEP) 381203. Once both wells are completed, they 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.

The initial phase of drilling involves drilling the conductor, which supports the well head, permanent guide base and the subsea Blowout 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; these are 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 Ruru-2 well will be vertically drilled to a target depth of approximately 4,500 m true vertical depth subsea (TVDSS). The Māui 8 well will be drilled vertically to approximately 3,400 m TVDSS.

After the drilling of each well has been completed and TVDSS has been reached, a VSP survey will be undertaken. Only activities associated with the VSP surveys are assessed in this MMIA, as the drilling itself has been covered by a marine consent application. Information presented in this section (Section 2.2) is included solely to provide context for the VSPs.

STOS received the rig in early September. The first well will be drilled in September with the VSP expected to occur mid-October. The second well will be drilled in October/November with the VSP expected to occur late November.

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

2.3 Vertical Seismic Profiling

VSP 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.

Irrespective of whether the Ruru-2 and Māui-8 wells are assessed as a 'dry hole' or 'success case', a VSP will be carried out. There are two parts to the VSP 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 on the KTIV will release a compressed air bubble from the two acoustic sources which will be deployed (typically from the rig's crane) 4 – 5 m below the sea surface (Figure 3).

STOS will use two 250 in^3 acoustic sources which will be fired 3 - 5 times successively at each level, 15 seconds apart at an operating pressure of 1,800 psi and frequency of 2 - 250 Hz. It is envisaged that there will be a maximum of 50 depths tested (every 100 m plus key horizons); however, it could be much less, dependent upon geology, resulting in a maximum of ~250 shots being fired for each VSP. It will take approximately 5 - 10 minutes to move between levels and c. 10 hours to complete the data acquisition component of each VSP. Prior to the actual VSP commencing, the acoustic source will be tested 10 – 20 times over a 1 - 2 hour period. The most conservative estimate of maximum time between the first test shot and the last acquisition shot would be 18 hours. However without operational delays, the survey and testing is expected to be completed within 12 hours.

VSPs differ from check-shot surveys 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 with typically fewer depth positions, whereas a VSP usually has numerous hydrophones positioned at closely and regularly spaced intervals in the wellbore with many more depth positions for which data is collected.

Within the Code 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 250 in^3 acoustic sources will be used, resulting in an operational capacity of 500 in^3. This results in the VSPs being classified as a Level 1 marine seismic survey within the Code, where the operational capacity is > 427 in^3. The requirements of a Level 1 marine seismic survey in the Code are discussed further in Section 3.3.

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 and no longer than 40 minutes. The initial ramp-up procedures that will be followed for the STOS VSPs 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 states that for borehole surveys (such as VSPs), 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 VSP, 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 VSP 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). If the operational delay takes longer than 20 minutes to resolve then a full soft start will need to be undertaken before the survey continues.

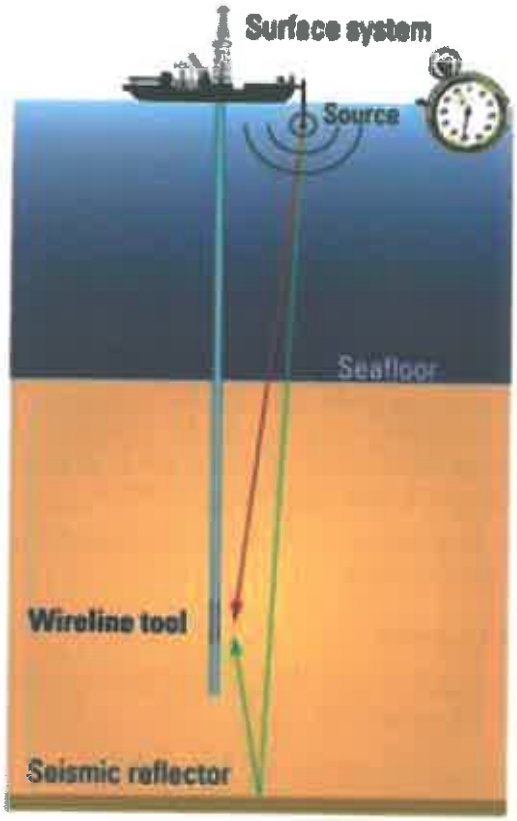

Figure 3: Schematic representation of a VSP survey

2.4 Objectives and General Approach

This MMIA forms part of the overall planning process for the Ruru-2 and Māui 8 seismic VSPs, which are being conducted in accordance with the Code.

Under the EEZ Act – *Permitted Activities* Regulations, compliance with the Code, 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 1 marine seismic survey requirements, specifically the borehole seismic survey section.

STOS's exploration drilling programme will also conform to the Marine Mammals Protection Act 1978 and the International Convention for the Prevention of Pollution From Ships 1978 (MARPOL).

2.5 Analysis of Alternatives

2.5.1 Introduction

This section of the MMIA outlines alternatives that were considered by STOS as part of the commissioning of the VSP. The VSP 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.

2.5.2 Sound Source

A variety of seismic sources are available for marine applications, including Water Guns (20-1500 Hz), Air Guns (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.

STOS have opted for airguns as they are the only source to meet the geophysical objectives, whilst also minimising the potential acoustic disturbance to the local environment, including marine mammals. A dual sound source will be used, located at 4 - 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 required resolution of sub surface data.

2.5.3 Airgun Barrel Volumes

It is proposed to use a cumulative 500 in^3 air gun configuration to undertake the VSP. The operating pressure will be 1,800 psi.

2.5.4 Do Nothing Option

The VSPs form part of STOS's exploration drilling programme which will be conducted in accordance with the requirements of PML 381012 issued and regulated by New Zealand Petroleum and Minerals (NZP&M). PML 381012 allows STOS to undertake mining operations relevant to the extraction, separation, treatment and processing of petroleum. The Māui Field has been in production since 1979 and the purpose of the Ruru-2 and Māui 8 wells is to assess the potential for any commercial accumulation of hydrocarbons.

In order to further progress investigations into the petroleum potential of the Māui field, and to ensure the Māui PML is optimally developed with the existing facilities before Māui End of Field Life, it is essential the drilling of the Ruru-2 and Māui 8 exploration wells is undertaken as soon as possible due to the long-time taken to develop any discovery. The VSPs are the last stage of the drilling programme. Consequently, there is no 'do-nothing' option.

2.6 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 4. 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, 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 7.

2.7 Consultation

STOS undertook extensive consultation with key local stakeholders and existing interests in 2013 during the preparation of the Impact Assessment and Discharge Management Plan (DMP) for the Ruru-2 and Māui 8 exploration drilling campaign. A consultation register from STOS's Impact Assessment and DMP process is included in Appendix 1. No written submissions were received during the consultation process. Consultation related correspondence is also included in Appendix 1.

STOS is committed to continual consultation with the local community (Māui Community Advisory Group) throughout the entire drilling programme as part of their ongoing Community Consultation Programme. The Māui Community Advisory Group includes iwi, Community Groups and other interested parties, and forms part of STOS's commitment to consultation for their operational and exploration activities.

Under the definition of existing interests within the EEZ Act, it is not regarded that Taranaki Iwi have existing interests within the Survey Area under the legislation. However, through consultation with STOS and the Taranaki Iwi Trust in regard to the Ruru-2 and Māui 8 drilling programme, it is believed that the Taranaki Iwi do have an existing interest within the offshore Taranaki coastline and the Survey Area through their exercise of mana whenua and mana moana. As a result STOS have undertaken an extensive consultation process and will continue ongoing discussions with the Taranaki Iwi Trust through the drilling programme, and beyond the completion of the drilling programme as part of their broader relationship.

2.8 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.

2.9 Research

Research on the effects of seismic survey operations on marine species is being undertaken globally. The Code 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 VSP, the Code requires STOS 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 the research community

to help build and expand on distributional and behavioural patterns of marine mammals around a seismic source.

3 Policy, Legal, and Administrative Framework

3.1 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 Business, Innovation and Employment 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 the upcoming Ruru-2 and Māui 8 VSPs, the relevant legislation which STOS will comply with is the EEZ Act and the associated Code as the wells are over 20 Nm from shore.

3.2 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 VSPs, fall within this classification and the conditions state that the person undertaking the activity must comply with the Code;
- **Non-notified discretionary** – 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, although the EPA has discretion to extend the timeframes by up to double;

- **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.

3.3 2013 Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations

The Code was developed to establish a comprehensive 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. The Code aims to minimise potential impacts while still providing for normal seismic operations to continue (DOC, 2012).

Under the Code, STOS's VSPs will fall under a Level 1 survey which features the most stringent requirements for marine mammal protection, and is the main focus of the Code on which this MMIA is based.

The notification and requirements of the Code have been adhered to and followed with the formulation of this MMIA. A letter was submitted to the Director-General of Conservation on 29 August 2013, informing of STOS's proposed survey and preparation of a MMIA as per the requirements of the EEZ Act.

STOS have contracted Blue Planet Marine to provide a single MMO and two PAM operators to oversee operations in relation to the Code for the Ruru-2 and Māui 8 VSPs. Details of the PAM specifications are provided in Appendix 2.

3.3.1 Level 1 Seismic Survey Requirements:

According to the Code the following operational protocols must be adhered to[1].

A Level 1 survey requires at least two qualified MMOs and two qualified[2] PAM operators onboard for the duration of the survey.

The minimum observer requirements for a Level 1 survey are that:

- The qualified observers will be dedicated in that their roles 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, at least one qualified MMO (during daylight hours) and one qualified PAM operator will maintain a watch for marine mammals.

Observations by qualified observers are also encouraged at all other times where practical and possible, however the maximum on-duty shift duration for MMOs and PAM operators must not exceed 12 hours in any 24-hour period.

If the PAM system has malfunctioned or become damaged, operations may continue for 20 minutes without PAM while the PAM operator diagnoses the issue. If the diagnosis indicates that the PAM gear must be repaired to solve the problem, operations may

[1] See Section 5.5.1 for proposed variances to the Code requirements for the Ruru-2 and Maui 8 VSP surveys
[2] Under the 3-year interim measure PAM operators for this VSP survey will be DOC approved.

continue for an additional 2 hours without PAM monitoring as long as all of the following conditions are met:

- It is daylight hours and the sea state is less than or equal to Beaufort 4;
- No marine mammals were detected solely by PAM in the relevant mitigation zones in the previous 2 hours;
- Two MMOs maintain watch at all times during operations when PAM is not operational;
- DOC is notified via email as soon as practicable with the time and location in which operations began without an active PAM system; and
- Operations with an active source, but without an active PAM system, do not exceed a cumulative total of 4 hours in any 24 hour period.

3.3.1.1 Pre-Start Observations:

The normal requirements for pre-start observations are as follows:

A Level 1 acoustic source can only be activated if it is within the specified operational area and no marine mammals have been observed or detected in the relevant mitigation zones.

The Level 1 source cannot 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 (other than fur seals) have been observed in the relevant mitigation zones for at least 30 minutes and no fur seals have been observed in the relevant mitigation zone for at least 10 minutes; and
- Passive acoustic monitoring for the presence of cetaceans 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.

The source cannot be activated during night-time hours or poor sighting conditions (visibility of 1.5 km or less or in a sea state 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
- The qualified observer has not detected vocalising cetaceans in the relevant mitigation zones.

In addition to the normal pre-start observation requirements outlined above, 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 either:

- MMOs have undertaken observations within 20 Nm of the planned start up position for at least the last two hours of good sighting conditions preceding proposed operations, and no marine mammals have been detected; or
- Where there have been less than 2 hours of good sighting conditions preceding proposed operations (within 20 Nm of the planned start up position), the source may be activated if:
  - PAM monitoring has been conducted for 2 hours immediately preceding proposed operations; and
  - Two MMOs have conducted visual monitoring in the 2 hours immediately preceding proposed operations; and
  - No Species of Concern have been sighted during visual monitoring or detected during acoustic monitoring in the relevant mitigation zones in the 2 hours immediately preceding proposed operations; and

- No fur seals have been sighted during visual monitoring in the relevant mitigation zone in the 10 minutes immediately preceding proposed operations; and
- No other marine mammals have been sighted during visual monitoring or detected during acoustic monitoring in the relevant mitigation zones in the 30 minutes immediately preceding proposed operations.

3.3.1.2 Delayed Starts & Shut-downs:

If, during pre-start observations or while a Level 1 acoustic source is activated (which includes soft starts), a qualified observer detects at least one cetacean with a calf within 1.5 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 1.5 km from the source; or
- Despite continuous observation, 30 minutes has elapsed since the last detection of the group within 1.5 km of the source, and the mitigation zone remains clear.

If during pre-start observations or while a Level 1 acoustic source is activated (which includes soft starts), a qualified observer detects a Species of Concern within 1 km 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 1 km from the source; or
- Despite continuous observation, 30 minutes has elapsed since the last detection of a Species of Concern within 1 km of the source, and the mitigation zone remains clear.

If during pre-start observations prior to initiation of a Level 1 acoustic source soft start, a qualified observer detects a marine mammal 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, 10 minutes has passed since the last detection of a New Zealand fur seal within 200 m of the source and 30 minutes has elapsed since the last detection of any other marine mammal within 200 m of the source, and the mitigation zone remains clear.

If all mammals detected within the relevant mitigation zones are observed moving beyond the respective areas, there will be no further delays to initiation of a soft start.

3.3.1.3 Soft Start Protocol:

Typically Level 1 acoustic sources will not be activated at any time except by soft start, unless the source is being reactivated after a single break in firing (not in response to a marine mammal observation within a mitigation zone) of less than 10 minutes immediately following normal operations at full power, and the qualified observers have not detected marine mammals in the relevant mitigation zones. This means a gradual increase of the source's power, starting with the lowest capacity gun, over a period of at least 20 minutes and no more than 40 minutes.

However, it is recognised that alternative acoustic source technologies may be used for VSPs, and that a soft start may not be possible in the same manner as a conventional marine seismic source array. Where possible, initial activation of the acoustic source must involve the gradual increase of the source's power over a period of at least 20 minutes and no more than 40 minutes, unless the source is being reactivated after a break in firing less than 10 minutes before that time. In the case of a VSP, activation of the acoustic source at least once within sequential 10 minute periods shall be regarded as continuous operation.

3.3.1.4 Consideration of the Code of Conduct in relation to NZ Fur Seals

NZ fur seals are abundant and resident around all of the offshore installations (well head platforms, drilling platforms and floating production, storage and offloading facilities) off the Taranaki coastline. They use the installations as haul out areas, and marine life which is attracted to the installations provides a ready food source for seals. The VSPs will commence following the completion of the wells, Ruru-2 first followed by Māui 8, where the rig is likely to have already been on location for 50 and 35 days respectively. Therefore, given both well locations proximity to the existing Māui A and Māui B platforms, it is highly likely NZ fur seals will be present around the KTIV when the VSPs are undertaken.

NZ fur seals are not listed as a 'Species of Concern' as defined in the Code; 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 VSP 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 regard 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 VSPs 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 (c. 12 hours). This essentially lowers the risk to marine mammals, as long as the appropriate monitoring of the mitigation zones and compliance with the Code is undertaken.

DOC provided a further interpretation of the requirements of the Code for NZ fur seals, given the facts detailed above; where the VSP 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 continuously present, efforts should be made to activate 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.

3.4 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 (Figure 4). The VSP at the Ruru-2 and Māui 8 wells will be undertaken within the AEI.

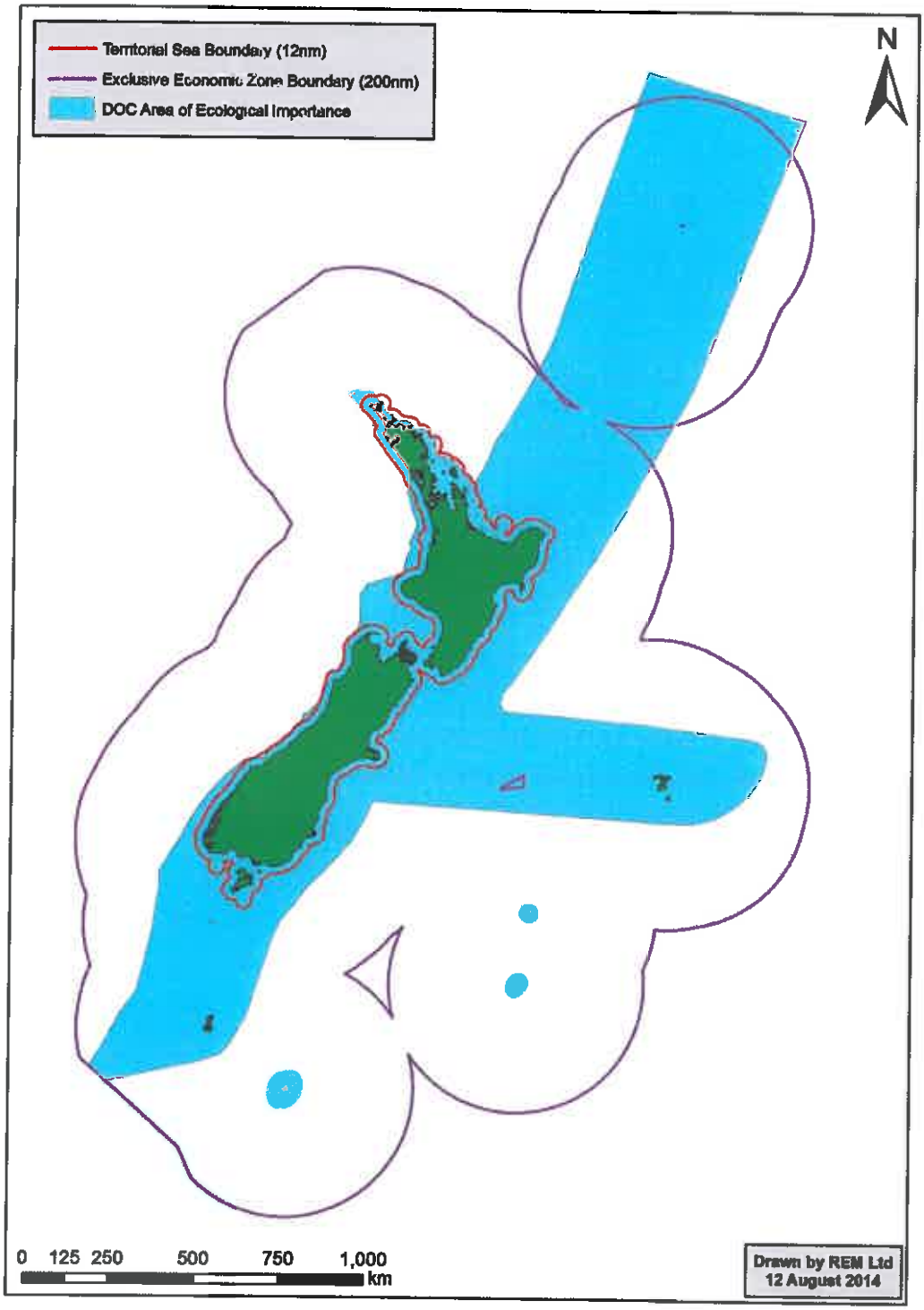

Figure 4: Areas of Ecological Importance

(redrawn from http://www.doc.govt.nz/Documents/conservation/marine-and-coastal/areas-of-ecological-importance.pdf)

4 Existing Environment

4.1 Physical Environment

4.1.1 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: as the front approaches from the west, north-westerly 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 south-westerly 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, 2013). Table 1 outlines the mean monthly weather parameters at New Plymouth.

Table 1: Mean Monthly Weather Parameters at New Plymouth

	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 summary report of the oceanographic and meteorological conditions at the Māui A and Māui B platforms (MSL, 2010a & 2010b). The purpose of these reports was to provide an up-to-date reference document to be used for a range of operational, planning and Health, Safety and Environmental scenarios. It is used in this MMIA to provide background information on the environmental conditions likely to be found at the Ruru-2 and Māui 8 prospects during the VSPs.

Site specific Metocean conditions were also produced as part of the 'Ruru-2 and Māui 8 Oil Spill Trajectory Modelling – Assessment of Potential Coastal Impacts' (MSL, 2012 & 2013).

4.1.2 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. The 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 5).

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 5). STOS have previously undertaken 3D seismic surveys within the Survey Area. The proposed VSP 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 Ruru-2 and Māui 8 wells.

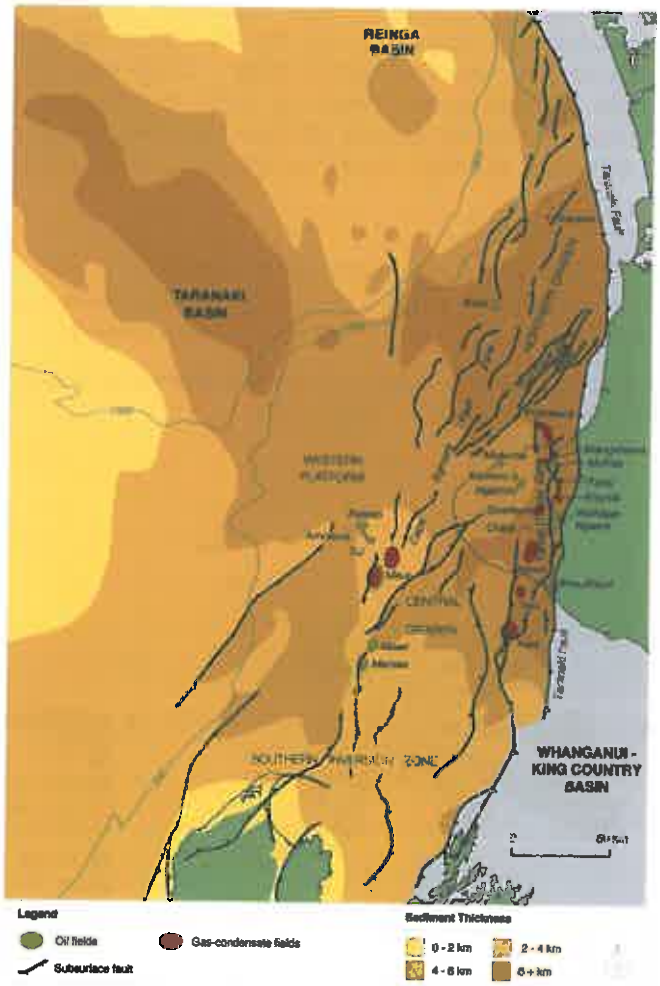

Figure 5: Taranaki Basin Map

(Source: NZP&M, 2012)

4.1.2.1 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 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, 2011; Johnston & Forrest, 2012; Johnston *et al.*, 2012).

4.1.3 Oceanography

4.1.3.1 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. Most of the wave energy arrives from the west and southwest, although energetic southerly wave conditions can arrive within hours when strong south-easterly winds are present.

MSL (2010a) undertook numerical hindcasting of the wave climate around central NZ, which spanned from 1998 to 2009 and was validated with wave buoy data from numerous locations around NZ, including the Maari, Pohokura and Kupe fields. The largest significant wave height over the period 1998 - 2009 was 10.88 m at Māui A and 10.81 m at Māui B with a mean wave height of 2.55 m and 2.54 m at the respective platform sites. The most energetic month off the Taranaki coastline appears to be in June (mean ~2.9 m) while the calmest month is January (mean ~2.15 m).

4.1.3.2 Wind Climate

From the MSL modelling at the Māui A and Māui B platforms (MSL, 2010a & 2010b), the windiest month is in June (9.92 $m.s^{-1}$ and 9.93 $m.s^{-1}$ respectively) while the month with the least wind is January (7.84 $m.s^{-1}$ and 7.89 $m.s^{-1}$ respectively).

The predominant wind at the Ruru-2 sites is from the westerly sector, while the strongest winds derive from the southeast quarter (Figure 6).

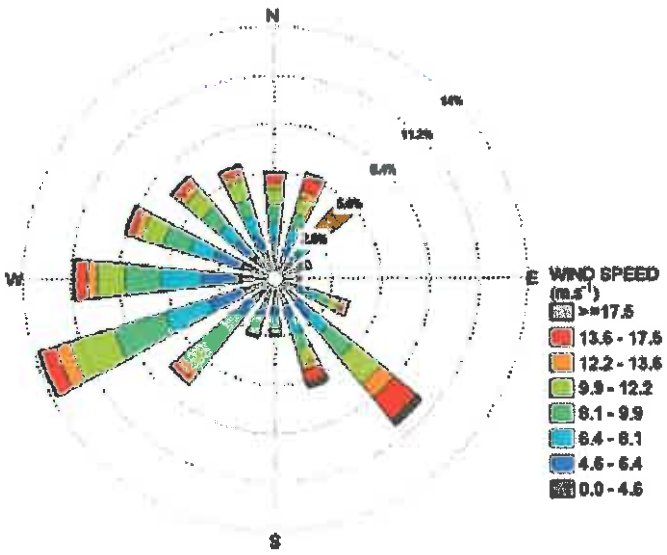

Figure 6: Annual Wind Rose for Māui A platform

4.1.3.3 Bathymetry

The broad Taranaki continental shelf has a 150 km wide opening to the Tasman Sea and forms the western approach to 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 ~105 m water depth on the eastern side to a depth of ~125 m on the western boundary (Figure 7). The Ruru-2 and Māui 8 wells are located in 108 m of water.

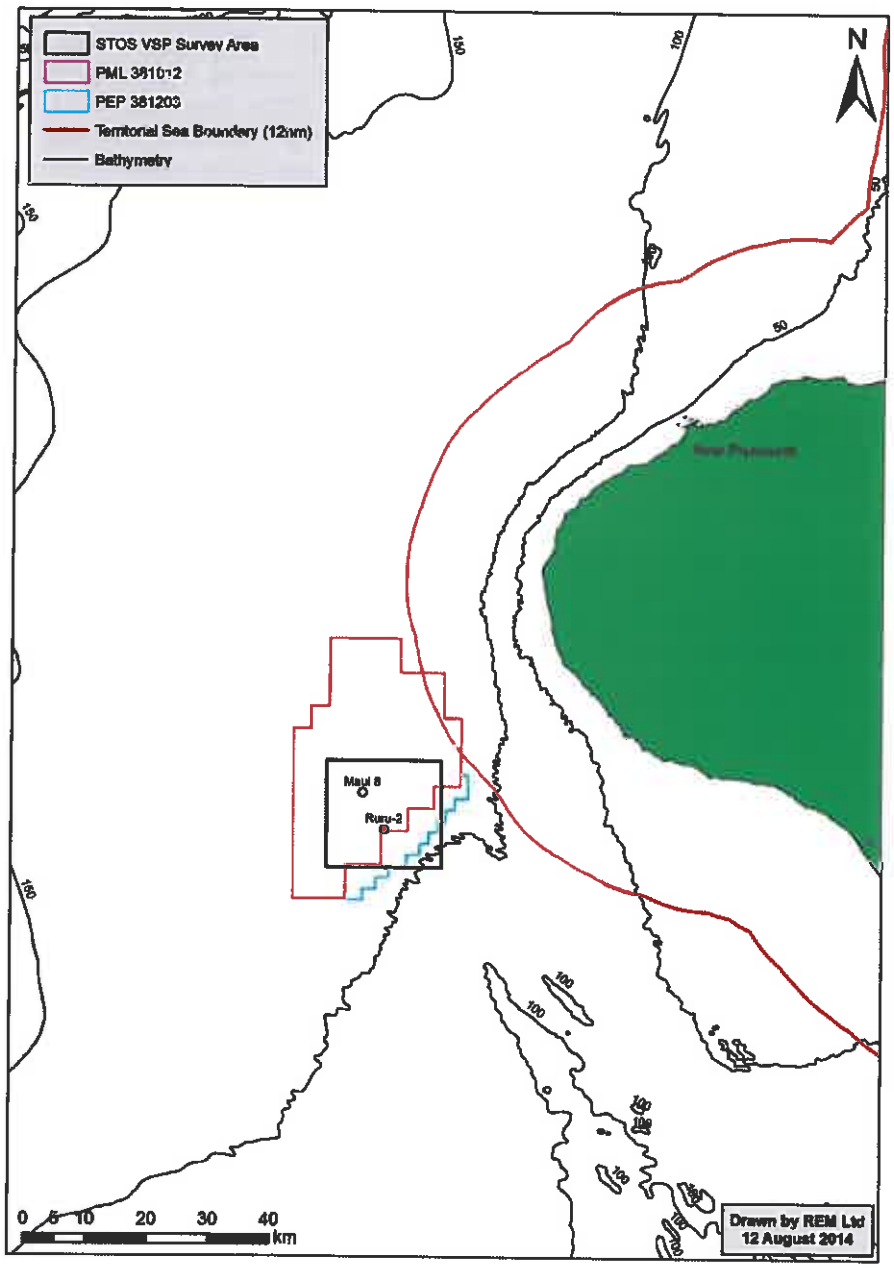

Figure 7: Bathymetry of the Survey Area

4.1.3.4 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 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 8). These currents are both sub-tropical in origin with sea temperatures generally ranging from 13° to 22°.

The Westland Current flows in a northerly direction along the west coast of the South Island before merging with the D'Urville Current and moving into the South Taranaki Bight. The D'Urville Current sweeps into Cook Strait from the northwest, mixing with water from the Southland and East Cape currents before moving eastwards across Cook Strait. The D'Urville Current 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.

At the Ruru-2 well location, MSL undertook a 10 year hindcast to show seasonal current regimes at the site. Results showed that there was a predominance of northerly-directed currents with very little seasonal variation. At 10 m below the sea surface hindcast current speeds averaged 0.81 $m.s^{-1}$, responding to strong and persistent regional wind stress. The maximum value at mid water level was 0.70 ms^{-1} and the maximum value at 10 m above the seabed was 0.57 ms^{-1} (MSL, 2010a and 2010b).

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/hour (~1 knot). The exception is Cook Strait where the tidal currents can be much stronger.

Figure 8: Ocean Circulation around New Zealand

(Source: The Encyclopaedia of New Zealand)

4.1.3.5 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. This seasonal stratification is a result of the solar heating of the upper water column. During late autumn this stratification usually breaks down due to the turbulent mixing of the water column and less solar radiation, resulting in the water column becoming isothermal. The degree of stratification is strongly influenced by weather conditions, where rough weather in summer can quickly cause vertical mixing resulting in a breakdown of the thermal stratification; hence, a well-defined thermocline in summer is not always present.

Regionally, the temperature regime and water column properties are 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 9), which are shed off the tip of Cape Farewell. 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 influences a trophic cascade within western Cook Strait and the South Taranaki Bight. Here, blue whales (Section 4.2.6) at times exploit episodic high concentrations of krill (*Nyctiphanes australis*) (Section 4.2.4).

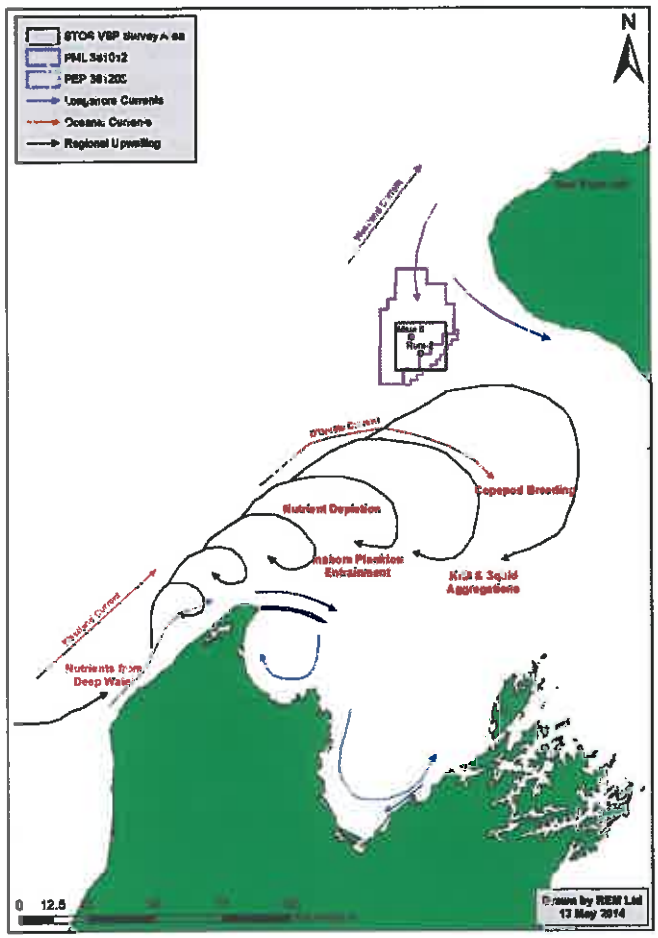

Figure 9: Biological events consequent on the Kahurangi Shoals upwelling

(Source: Adapted from Bowman *et al.*, 1982)

4.1.3.6 Water Temperature

MSL (2012) used satellite data from 1998 – 2008 to gain representative sea surface water temperatures within the Survey Area. Results showed the seasonal average temperatures over this period were:

- Summer – 17.3 °C;
- Autumn – 16.85 °C;
- Winter – 13.63 °C; and
- Spring – 13.72 °C.

4.2 Marine Ecosystems

4.2.1 Overview

NZ is home to approximately 16,000 marine species, 444 of which are listed as threatened according to the NZ threat classification system. This system classifies all threatened and potentially threatened species that breed in New Zealand waters based on population size, range of the species and population trends. The NZ Threat Classification Database can be accessed via the following link:

http://www.doc.govt.nz/publications/conservation/nz-threat-classification-system/nz-threat-classification-system-lists-2012-14/

The database 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 NZ's 50 species of marine mammals are also classified as threatened (Hitchmough *et al.*, 2005, Baker *et al.*, 2010).

New Zealand Marine Environmental Classification

NIWA were commissioned by Ministry for the Environment, MPI and DOC to develop an environmental classification covering NZ's Territorial Sea and EEZ which is known as the Marine Environment Classification. 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 Marine Environment Classification 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 classification system is accessible via the following link:

https://www.mfe.govt.nz/publications/ser/marine-environment-classification-jun05/

The Survey Area falls within classification group 60 representing the moderately shallow waters on the continental shelf (Figure 10), 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 tusk shells (Dentaliidae), cockles (Cardiidae), clams (Carditidae, Veneridae andNuculanidae), brittle stars (Amphiuridae) and scallops (Pectinidae).

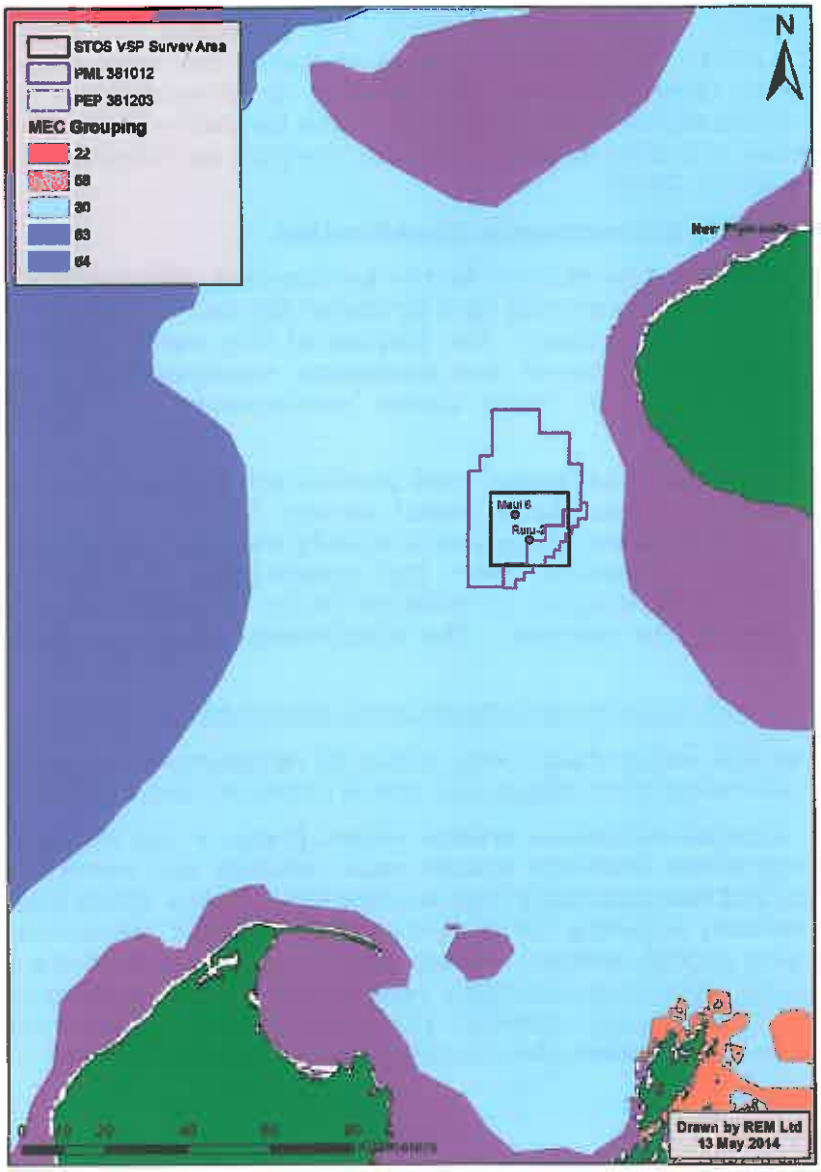

Figure 10: The Marine Environmental Classification at the 20-Class Level.

4.2.2 Coastline Ecosystems

Around the Taranaki coastline, the northward flowing Westland Current, D'Urville Current and the southward flowing West Auckland Current play important roles in determining the abundance of fish species (Figure 9). 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 Taranaki 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 high energy coast as a result of strong prevailing winds. It consists of rocky shores interspersed with sandy beaches, steep cliffs, subtidal reefs, estuaries and small stream and river mouths.

4.2.3 Protected Areas in the Vicinity of the Survey Area

Protected Areas are locations that receive protection due to their recognised natural ecological values, and are typically established for biodiversity conservation.

The closest protected area to the Survey Area is the West Coast North Island Marine Mammal Sanctuary (Figure 11). The Survey Area is located 52 km south of the southern boundary of the sanctuary, 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.

Tapuae Marine Reserve is the second closest protected area (Figure 11). 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 the Sugar Loaf Islands Marine Protected Area (SLIMPA) in the north, and extends south of New Plymouth to Tapuae Stream. A contrast of environments can be found within the reserve. In the northwest there are islands, remnants of an ancient volcano with caves, canyons, and boulder fields, while 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.

DOC have also classified an area of coastline as an AEI (Figure 4), which was established due to the presence of Maui's/Hector's dolphins in the area. Under the Code, 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 Ruru-2 and Māui 8 VSPs scheduled, other than complying with the Level 1 requirements of the Code, no additional mitigation measures are required.

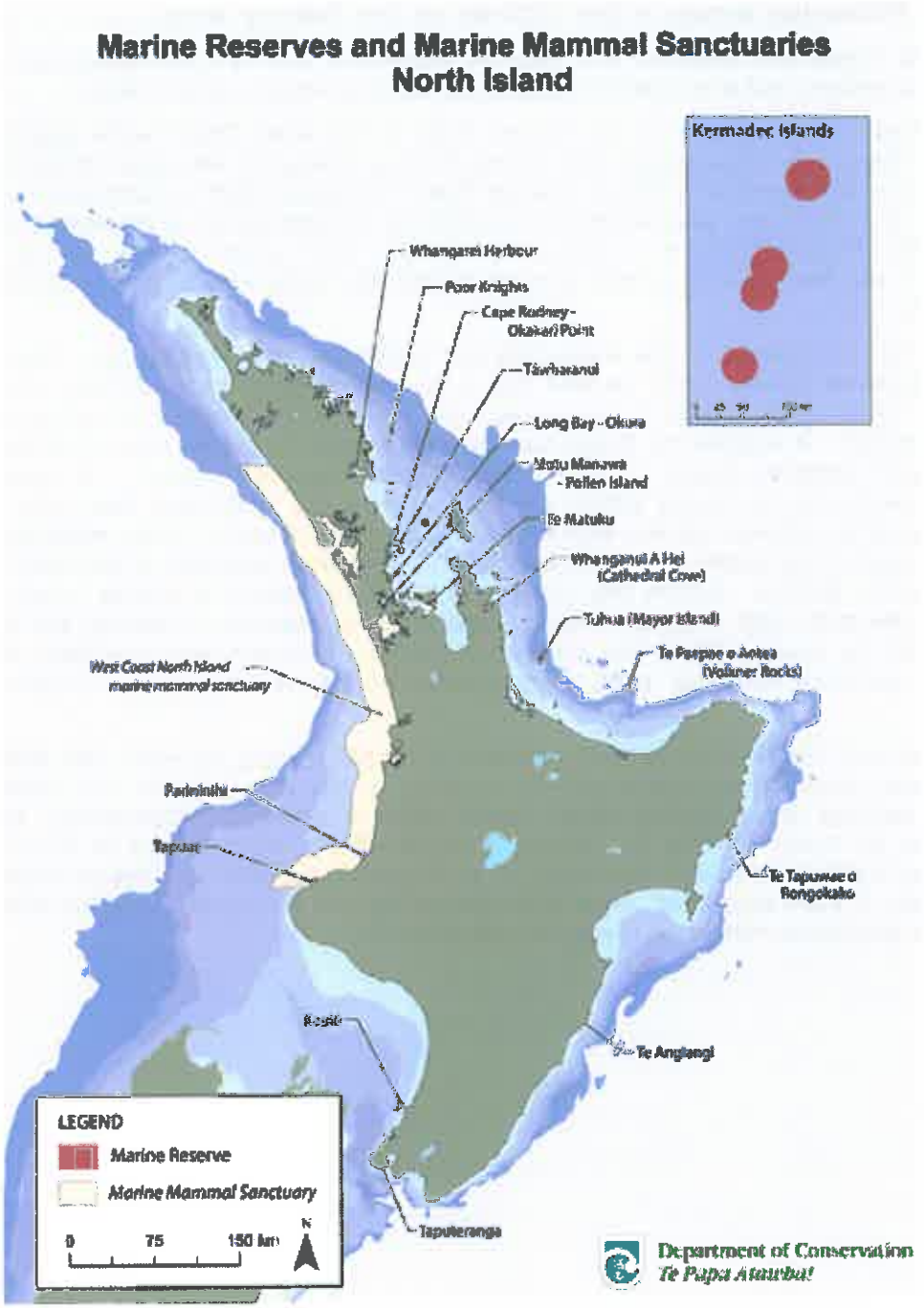

Figure 11: North Island Marine Reserves and Marine Mammal Sanctuary

(Source: www.doc.govt.nz)

4.2.3.1 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 12. 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 wetlands are habitat for threatened species such as Australasian bitterns and Caspian terns. 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 mudflat, 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 areas for juvenile marine species including flounder, and a periodic breeding site for blue penguins.

Sugar Loaf Islands Marine Protected Area (SLIMPA) – 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. This provides 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. 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. The islands within 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, tunnels, and blowholes, which produces unique landforms at land/sea interface.

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 to 500 m offshore. The hard rock platforms contain many well-preserved fossils and an abundance of marine life.

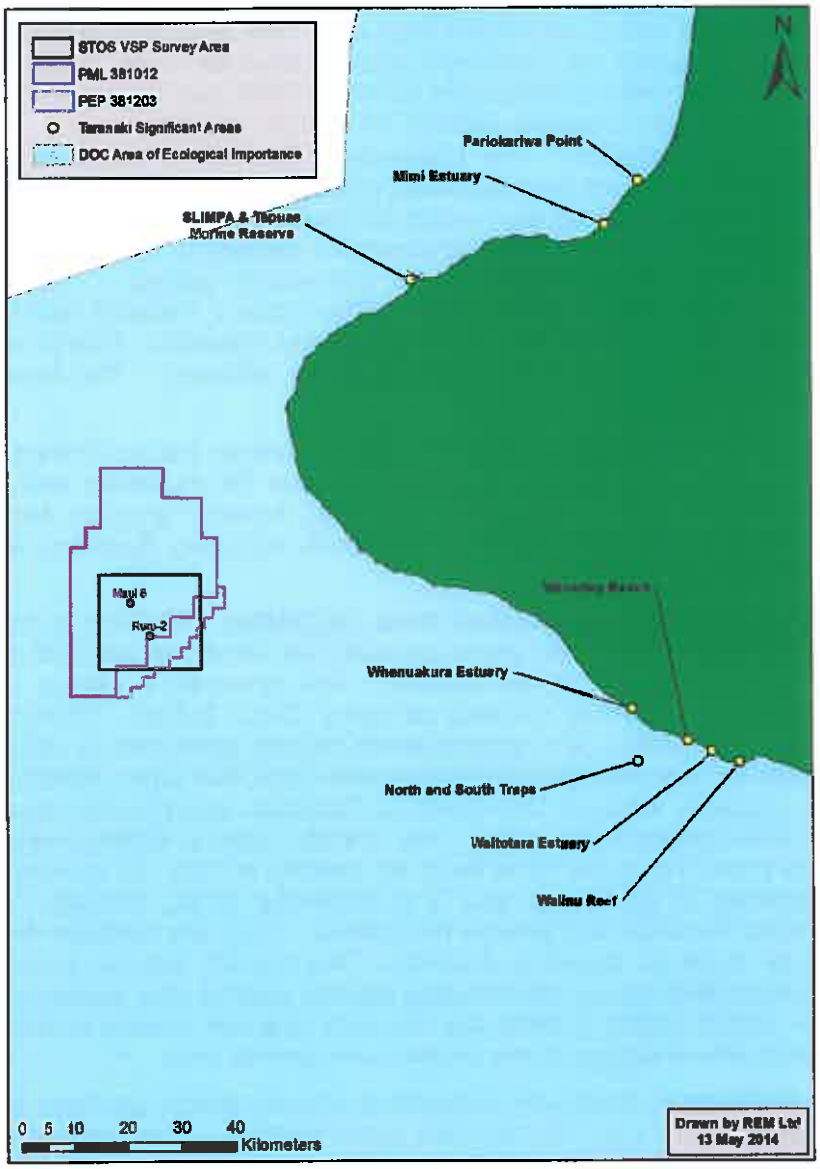

Figure 12: Areas of Significant Conservation Value and Ecological Importance

4.2.4 Plankton

The primary biological productivity of oceanic waters is typically influenced by latitude, undersea landscape, ocean currents and climate. In the case of New Zealand, 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;
- 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. 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.

4.2.5 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 tuna, skipjack tuna, 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 Ruru-2 and Māui 8 VSPs the waters will 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.

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 fish shark and ray species which could be present in the area include the whale shark, oceanic whitetip shark, deepwater nurse shark, manta ray and spiny-tailed devil ray.

4.2.6 Deep Sea Corals

A rich and diverse range of corals are recorded in NZ waters from the intertidal region out to depths of c. 5,000 m (Consalvey *et al.*, 2006). Within the phylum Cnidaria, all corals belong to the class of Anthozoa or hydrozoa. These typically long-lived organisms exist either as individuals or in colonies, and form external skeletons which provide habitat for other organisms. Of the protected marine invertebrate species, the deep sea corals are the most relevant to this VSP project.

Within NZ's EEZ, black coral and stylasterid hydrocoral (also known as red coral) are protected under the Wildlife Act 1953. The NABIS database provides a distribution map for black corals only and indicates that a discrete patch of coral is located to the southeast of the permit area[3] and more extensive black coral habitat is found along the continental shelf break to the northeast (Figure 13). Within NZ waters there have been 58 species of black coral identified, and although their depth and geographical distributions have not been analysed in detail, it appears most tend to live in deep water on seamounts or other hard substrate in depths ranging from 200 to 1,000 m deep.

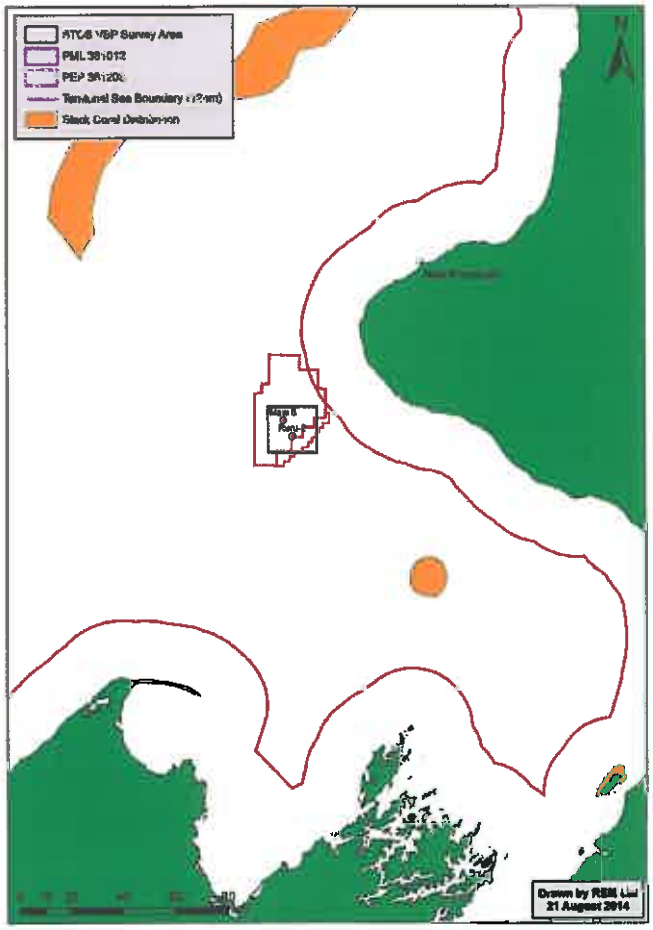

Figure 13: Black coral distribution relative to the survey area

[3] The Taranaki Bight record of black coral is based upon fisheries observer data which was collected in December 2009 while the vessel was trawling for jack mackerel (at 40.15667, 174.075). This was a one-off record, and black coral has not subsequently been reported for this area (NABIS, 2012).

4.2.7 Marine Mammals

NZ waters support a diverse community of marine mammals. There are forty-one 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, 2013d) uses mammal sightings, strandings, literature reviews and DOC data to provide accounts of marine mammal distributions within the NZ EEZ. Using information contained in NABIS and recent DOC stranding and sighting data, a list of marine mammals which may be present in the area has been compiled (Table 3).

The marine mammal datasets used here contain opportunistic presence-only data, and it is important to recognise that observer effort is not consistent across space and time.

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

Species	NZ Threat Status (Baker *et al.* 2010)	Listed as a 'Species of Concern' in the Code
*Humpback whale (*Megaptera novaeangliae*)	Migrant	Yes
*Blue whale (*Balaenoptera musculus and B. musculus brevicauda*)	Migrant	Yes
*Bryde's whale (*Balaenoptera edeni*)	Nationally Critical	Yes
*Fin whale (*Balaenoptera physalus*)	Migrant	Yes
*Minke whale (*Balaenoptera acutorostrata* & *B. bonaerensis*)	Not Threatened	Yes
Sei whale (*Balaenoptera borealis*)	Migrant	Yes
Southern Right whale (*Eubalaena australis*)	Nationally Endangered	Yes
*Beaked whales (13 species identified in NZ waters)	Data Deficient	Yes
*Sperm whale (*Physeter macrocephalus*)	Not Threatened	Yes
*Common dolphin (*Delphinus delphis*)	Not Threatened	No
*Killer whale (*Orcinus orca*)	Nationally Critical	Yes
*Bottlenose dolphin (*Tursiops truncatus*)	Nationally Endangered	Yes
*Maui's dolphin (*Cephalorhynchus hectori maui*)	Nationally Critical	Yes
*Long-finned Pilot whale (*Globicephala melas*)	Not Threatened	Yes
*Short-finned Pilot whales (*Globicephala macrorpynchus*)	Migrant	Yes
*Hector's dolphin (*Cephalorhynchus hectori*)	Nationally Endangered	Yes
*Dusky dolphin (*Lagenorhynchus obscurus*)	Not Threatened	No
*False killer whales (*Pseudorca crassidens*)	Not Threatened	Yes
*Striped dolphin (*Stenella coeruleoalba*)	Vagrant	No
*Pygmy sperm whale (*Kogia Breviceps*)	Data Deficient	Yes
*Pygmy right whale (*Caperea marginata*)	Data Deficient	Yes
* NZ fur seal (*Arctophoca australis forsteri*)	Not Threatened	No

Those species marked with an asterix have also been recorded stranding in Taranaki from 1960 – 2013. (Source NABIS species distribution data and DOC stranding records).

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, six (Bryde's whale, killer whale, Hector's dolphin, Maui's dolphin, southern right whale, and bottlenose dolphin) could be present within the Survey Area based on their life history characteristics, behaviour or previous sightings.

Table 4: A summary of New Zealand's threatened marine mammal species

Common and scientific name	NZ threat classification (Baker *et al* 2010)	Biology	Local distribution	Likely to occur within 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. Killer whales are widely found in all oceans of the world although more dominant in cooler waters. Likely to occur in the Survey Area.	✓
Bryde's whale *(Balaenoptera edeni)*	Nationally critical	Generally a coastal species but does frequent 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.	Low probability of being encountered in the Survey Area	✓ (low)
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	A coastal dwelling dolphin which is typically found inside the 100 m isobaths and within 7.5 km from the shore Unlikely to occur in the Survey Area on account of 1) the majority of sightings for this species occur between Raglan Harbour and Manukau Harbour, and 2) their affinity for coastal areas. However, any observations will be recorded and DOC will be notified immediately as this could extend their offshore distribution.	✓ (low)
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. Highly unlikely to occur in the Survey Area.	*
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.	*
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.	✓
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.	✓
Hector's dolphin *(Cephalorhynchus hectori 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.	✓ (low)

4.2.7.1 Whale migration routes

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 return each Autumn-Winter back to the Pacific Islands for the breeding season (May – July) (DOC, 2007).

Figure 14 shows the distribution and migratory patterns of humpback, sperm, Bryde's and southern right whales around NZ throughout the year. These species are each discussed individually below. It has to be noted that whilst the northwards migration routes are well known, the southwards routes are not so well known.

Figure 14: Whale Distribution in NZ Waters

(Source: Te Ara, 2013)

4.2.7.2 Humpback Whale

In the summer months humpbacks feed in Antarctic waters, while in the winter months they migrate north to tropical or sub-tropical waters, particularly around Tonga (Shirihai, 2002) for mating and calving. Both females and males are sexually mature at around five years old. Whaling in the southern hemisphere has reduced the population from ~120,000 animals to just 15,000; however, the population is now believed to be recovering (Suisted & Neale, 2004).

The winter migration north occurs between May and December, whereby this species travels up the east coast of the South Island, through Cook Strait before continuing up the west coast of the North Island. The southern migration in spring is along the west coast of the South Island.

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. Lactating females and yearlings are often seen early in the season, followed by immature whales, then mature males and females, with pregnant females being the last cohort to travel (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.

One sighting of a humpback whale has 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).

It is possible that humpback whales may be observed during the VSPs. The survey timing means that whales on their northward migration will possibly pass through the Survey Area.

4.2.7.3 Blue Whale

Blue whales are the largest living animals, with adults reaching lengths of 33 m (Croll *et al.*, 2005). They are long-lived, slow reproducing animals and it is estimated that fewer than 2,000 blue whales are present in the southern hemisphere. During summer they are typically found at feeding grounds in the Antarctic, and in winter they are present in equatorial waters.

Blue whales have the highest prey demands of any predator consuming 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 generating highly productive plumes of water. This enriched water enhances primary productivity creating large blooms of zooplankton such as the euphausiid (*Nyctiphanes australis*). 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). Torres (2012) described the relationship between blue whale sightings and chlorophyll-*a* concentrations and indicated increased primary productivity during many of the whale sightings. Therefore, it is likely that blue whales are using Cook Strait and the South Taranaki Bight as a foraging area on their migratory pathway.

A number of blue whales have been sighted off the South Taranaki Bight and Cape Egmont. Most sightings are from the South Taranaki Bight and reflect increased observational efforts associated with past seismic surveys. These whales have also been observed during a marine seismic survey being conducted north of Farewell Spit in

February/March 2013. Despite blue whales being such large animals, they are fairly elusive and little is known about their distribution or habitat use patterns (Torres, 2012).

Information garnered during the consultation process indicate that a spring/early summer resident population feeds and possibly breeds in the Taranaki Basin, particularly in an area of upwelling and high productivity off Kahurangi Point (Torres, 2013) and Cape Egmont.

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 washing up on Waiinu Beach in May 2011 and more recently (4 July 2014) a blue whale washing up dead at Tapuae Beach.

Blue whales could certainly be observed in the Survey Area during the Ruru-2 and Māui 8 VSPs.

4.2.7.4 Bryde's Whale

Bryde's whales are nationally critical, but are the most frequently encountered baleen whale around NZ mainly on account of their coastal distribution in populated areas. They prefer warmer waters (above 20°C) so are generally only found in northern NZ (particularly the Hauraki Gulf area) (Suisted & Neale, 2004). They grow to 12 - 15 m in length making them the second smallest of the NZ baleen whales. The Bryde's whale differs to other baleen whales that eat krill in polar waters; Bryde's whales 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 unlikely, but possible.

4.2.7.5 Minke Whale

Minke whales are comprised of two species: the common northern minke and the southern minke. The northern minke is confined to the northern hemisphere. The Antarctic or southern minke whale is confined to the southern hemisphere, including NZ. A sub-species, the dwarf minke is also found in NZ. These whales have been observed around the NZ coast, but are reported to be most common south of NZ, feeding in Antarctic waters. However, DOC sighting records indicate minke whales have been observed in the Taranaki area close to shore off Cape Egmont. Therefore, it is possible that this species could be encountered in the Survey Area.

4.2.7.6 Sei Whale

Sei whales are a medium sized baleen whale with an average length of 15 - 18 m. They are a fast swimming whale and have been recorded at speeds up to 50 km/h. 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 VSPs.

4.2.7.7 Fin whale

Fin whales are similar in size, appearance and behaviour to Sei and Bryde's whales. Fin whales reach lengths of 24 m (Baker 1999) and are rarely seen in New Zealand coastal waters (Dawson 1985), however, they have stranded before on the Taranaki coast so there is a low possibility that they could be present in the Survey Area.

4.2.7.8 Southern Right Whale

The southern right whale reaches 18 m in length and lacks a dorsal fin. 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. Southern right whales are slow moving, swimming 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. This species is classified as Nationally Endangered, due mainly to their reduced population size (whaling accounted for a reduction from c. 17,000 animals to just 908 today; Carroll *et al.*, 2011, Suisted & Neale 2004). Recent genetic findings from DOC have shown that southern right whales around mainland NZ are part of the sub-Antarctic population, which is believed to be undergoing a range expansion (DOC, 2013a).

When southern right whales are either on their breeding grounds or migration paths they are frequently found in sheltered coastal waters. Historical whaling records suggest that summer feeding grounds are present off the Chatham Rise (Patenaude, 2003), although most sightings of southern right whales in recent years around the NZ mainland have occurred during the winter months.

Many sightings of southern right whales have been made around the Taranaki coastline, in recent years, the majority of which are inshore and during the winter months. There is a possibility that this species could be present in the Survey Area, although previous sightings indicate that most would be expected to pass inshore of the Survey Area.

4.2.7.9 Pygmy right whale

This southern hemisphere dwelling whale is the smallest of the baleen whales, growing to only 6.4 m in length (Baker 1999). The majority of knowledge of this species is from stranded specimens as sightings at sea are rare. This species has stranded before on the Taranaki coast so there is a low possibility that they could be present in the Survey Area.

4.2.7.10 Beaked Whale

There are many species of beaked whales, each of which is believed to have a low population, and each of which are typically deep water species. Beaked whales are typically elusive at sea so very few sightings of live animals have been reported. For some species, stranding data is the only indication of their presence in NZ waters (WWF, 2013b). Beaked whales are most commonly found in small groups in cool, temperate waters, with a preference for deep ocean waters or continental slope habitats. Several species 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 along the Taranaki coastline and is therefore thought to be the most common beaked whale in the region. From the relative frequency of strandings along the Taranaki coast it is assumed that these animals are present year round in these waters, hence could be present in the survey area during VSP operations.

4.2.7.11 Sperm Whale

Sperm whales are globally distributed and are relatively common in NZ waters. Sperm whales are the largest of the toothed whales; males can reach 18 m in length with females typically 2/3rds this length.

Sperm whales feed on squid and fish and live in open ocean environments or areas on the seaward edge of the continental shelf in the vicinity of deep productive canyons (WWF, 2013a). Sperm whales rely heavily on acoustic senses for navigation and communication.

Kaikoura is home to the main resident population of sperm whales in NZ; however, groups of non-resident sperm whales are not uncommon elsewhere. There are around 85 sperm whales (mostly male) present around Kaikoura at any one time (Richter *et al.*, 1996). Off Kaikoura, whale distribution is strongly related to bathymetry. This is particularly the case in summer, when almost all sightings are made in Kaikoura Canyon waters deeper than 1,000 m (Richter *et al.*, 1996).

Sperm whales have previously been observed off the Taranaki coastline, generally during the summer months (Torres, 2012). A dead sperm whale washed ashore in January 2013, 2 km west of the Patea mole and a number of other sperm whale strandings have been recorded along the south Taranaki, Wanganui, Kapiti, Golden Bay and Farewell Spit coastlines. Therefore, it is possible that sperm whales may be present in the Survey Area.

4.2.7.12 Pygmy Sperm Whale

Pygmy sperm whales are small whales, growing to only 3.5 m at maturity. They are difficult to observe at sea on account of their size, timid behaviour, lack of a visible blow, and their low profile in the water.

A small number of pygmy sperm whales have stranded in 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. Therefore, it is assumed that pygmy sperm whales may be observed in the Survey Area.

4.2.7.13 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 with males growing up to 8 m. Within NZ waters there are several morphological forms (Taylor *et al.* 2013) which have been provisionally designated as Types A – D (Baker *et al.* 2010). The majority of killer whale sightings in New Zealand coastal waters are believed to be Type A, with Types B – D occurring mostly in Antarctic waters.

Type A killer whales are commonly seen inshore during the summer fur seal breeding season and are thought to opportunistically feed on seals. The closet fur seal breeding location to the survey area is at the Sugar Loaf Islands (Miller and Williams 2003); however, seals frequently use the offshore Taranaki platforms and Floating Production Storage and Offloading facility's (FPSO) as haul-out locations. The entire NZ killer whale population is small (mean = 119 ± 24 SE) with a wide ranging distribution 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). However, it is possible that this species will be encountered during the VSPs.

4.2.7.14 False Killer Whales

This species grows to over 5 m in length and is often seen in very large pods of several hundred animals (Baker, 1999). They are an extremely vocal species (Dawson, 1985) implying that intraspecific acoustic communication is important. False killer whales are commonly seen in deep, warm/temperate oceanic waters and will often bowride alongside vessels (Dawson, 1985).

This species is present from the stranding record in Taranaki, so could be observed during the VSPs.

4.2.7.15 Pilot Whale

Two species of pilot whales exist in NZ waters; long-finned pilot whales and short-finned pilot whales. Pilot whales are a member of the dolphin family. Short-finned pilot whales prefer warmer waters but their ranges do overlap. Both species are listed as Data Deficient by the International Union for Conservation of Nature.

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 have been recorded in all coastal regions of NZ, where peaks in standing events seem to occur during spring and summer months (O'Callaghan, 2001). 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, 28 individuals in November 2012, and a total of 113 individuals in January 2014 (over multiple days and locations). Pilot whales are common visitors to Taranaki waters during the summer months and are likely to be observed in the Survey Area.

4.2.7.16 South Island Hector's Dolphin

South Island Hector's dolphins are endemic to NZ and grow to 1.2 – 1.5 m in length making them one of the smallest cetaceans in the world. They have a patchy distribution around the entire South Island. Three geographically distinct groups are present 1) on the West Coast of the South Island (summer abundance c. 5,400 dolphins; Slooten *et al.* 2004); 2) on the east coast of the South Island with highest densities around Banks Peninsula (summer abundance c. 9,100 dolphins; Clement and Mackenzie, 2014); and 3) on the south coast of South Island (c. autumn abundance c. 630 dolphins; Clement *et al.* 2011).

Since the 1970s their numbers have declined from an estimated 29,000 to around 15,000 today. They are classified as 'Nationally Endangered' by DOC. However, their numbers have increased within the Banks Peninsula Marine Mammal Sanctuary and they are routinely reported in and around the Marlborough Sounds. A recent genetic study has documented two female South Island Hector's dolphins off the West Coast of the North Island (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, 2013e and Project Jonah, 2013). Hector's dolphins prefer shallow, coastal waters with water depths of less than 100 m; therefore, they are not likely to occur in the vicinity of the surveys. However, as there have been Hector's dolphins identified along the west coast of the North Island it is possible that a Hector's dolphin could be sighted in the survey area. See section below on Maui's dolphins, the North Island subspecies, which are more relevant to the VSPs.

4.2.7.17 Maui's Dolphin

Maui's dolphins are recognised as a sub-species of the Hector's dolphin, with the Maui's dolphin being genetically extinct from the South Island Hector's dolphin. 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 International Union for Conservation of Nature respectively.

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 15). However, there are some uncertainties relating to the southern and offshore distribution of Maui's dolphins.

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 15), 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 made from the Māui A platform in 115 m of water depth and 19 Nm from shore by a member of the public with no associated photographic 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. However; these areas are beyond the core range of Maui's dolphins so, if present, dolphin density here is likely to be very low making detection extremely difficult (Du Fresne, 2010). Despite these survey results, there have 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.

Hamner *et al.* (2012) estimated the population size of Maui's dolphins to be 55 adults (with 95% confidence intervals: 48 - 69), which is significantly lower than the 2005 estimate of 111 individuals (with 95% confidence intervals of 48 – 252), although two different methodologies were used for the two estimates therefore these results are not directly comparable. 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 dolphin population and is the first documented contact between these two subspecies, with the potential for interbreeding.

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).

A MMS, covering 2,164 km of coastline is in place to protect the Maui's dolphin and the government has recently extended the set net fishing ban off the coast of Taranaki (Figure 16).

The VSPs are being conducted ~40 km offshore from Cape Egmont, so it is unlikely that a Maui's (or Hector's dolphin) would be observed. If a sighting was made and verified it would be highly significant.

If a Hector's/Maui's dolphin is observed during the VSP, DOC will be notified immediately via both National Office (Ian Angus, 027 704 8369) and the Taranaki Area Office (Callum Lilley 027 206 5842 or Bryan Williams 027 704 8369); with the intention to mobilise a

fixed wing plane and/or the DOC work boat to verify the sighting and where possible collect a genetic sample.

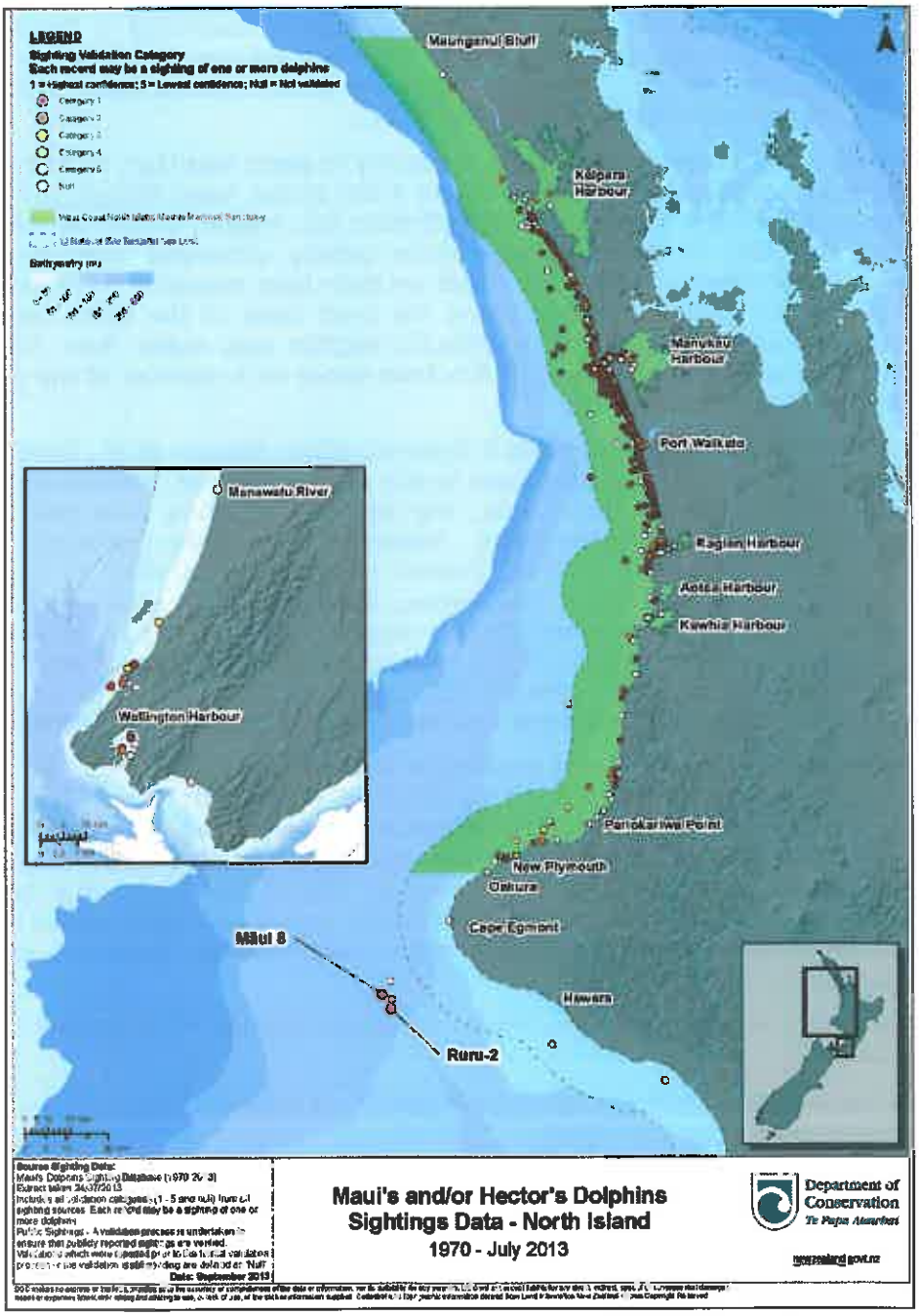

Figure 15: Maui's and/or Hector's Dolphin Sightings from 1970 - 2013.

(Source: www.doc.govt.nz)

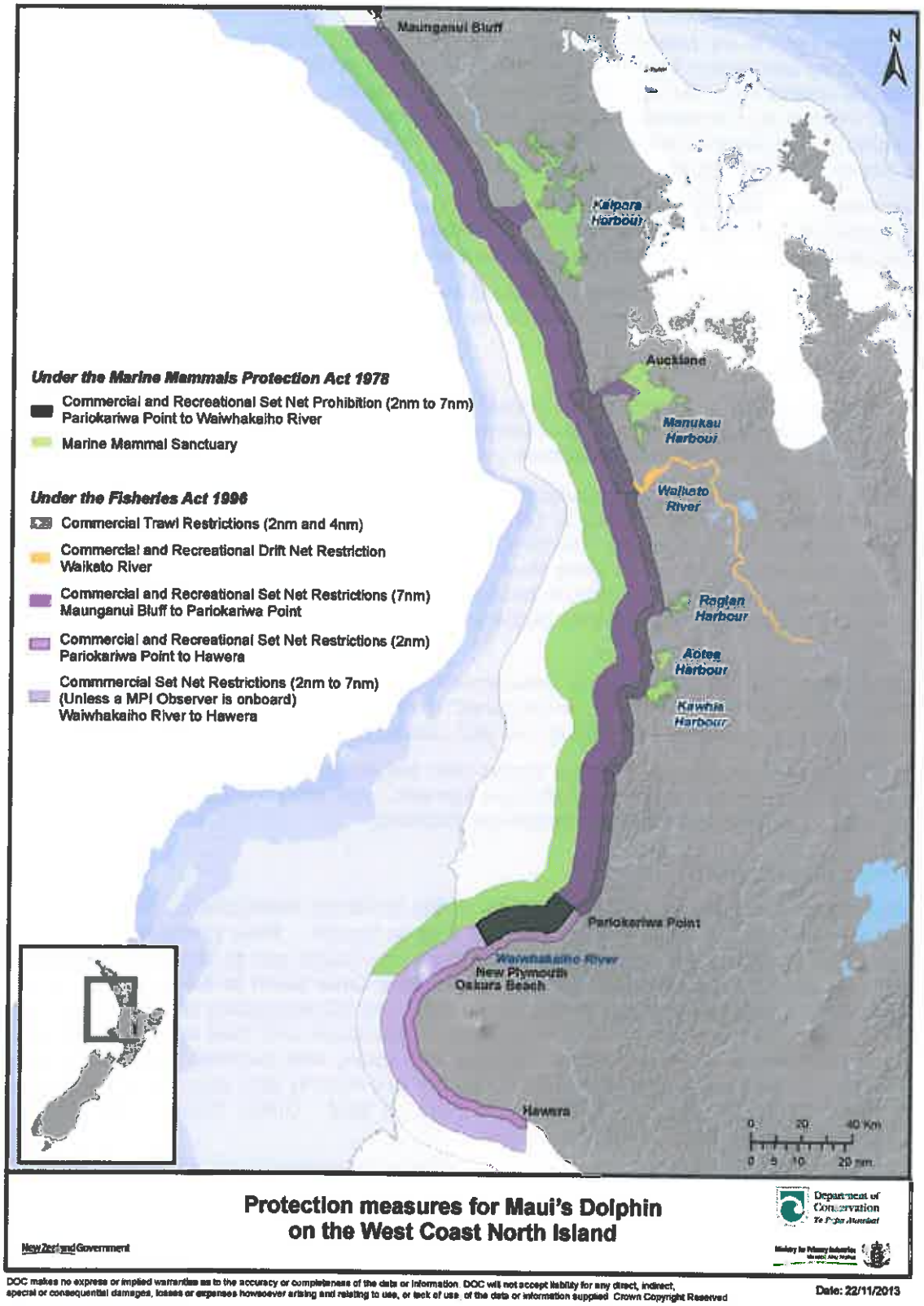

Figure 16: Maui's Dolphin Protection Measures

(Source: www.doc.govt.nz)

4.2.7.18 Common Dolphin

Common dolphins are easily recognisable by their pattern of colours; from purplish-black to dark grey on top to white and creamy tan on the underside. This species typically has a coastal distribution, but is found throughout NZ waters. A study was conducted in the Bay of Islands 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), small mid-water fish (jack mackerel) and squid (Meynier *et al.*, 2008). Killer whales are the principal predators of common dolphins. Common dolphins grow to 12.4 m in length.

This species is common around the Taranaki coastline, especially over the summer period and is likely to be observed within the Survey Area.

4.2.7.19 Bottlenose Dolphin

Bottlenose dolphins are among the largest dolphins, ranging from 2.4 – 4 m in length. Bottlenose dolphins are widely distributed through the world in cold temperate and tropical seas, with NZ representing their southernmost range.

There are three main coastal populations of bottlenose dolphins in NZ; c. 450 live along the northeast coast of Northland, c. 60 live in Fiordland and there is another population present from the Marlborough Sounds to Westport. These populations are genetically distinct, 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. The offshore bottlenose dolphins could be encountered during the surveys.

In the latest threat classification assessment, bottlenose dolphins were moved from 'Range Restricted' to 'Nationally Endangered' based on new evidence of low abundance and concern over potential decline in two well described populations.

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.

4.2.7.20 Dusky Dolphin

Dusky dolphins are found in coastal waters in the Southern Hemisphere; they are slightly smaller than common dolphins growing to 2 m in length. 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 in NZ. The NZ population of dusky dolphins is believed to be in the order of 12,000 to 20,000 individuals and they are not regarded as threatened (Markowitz *et al.*, 2004). 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 to feed. Dusky dolphins will generally spend more time in deeper water in winter.

Dusky dolphins consume a variety of pelagic fish and squid species as part of their diet and often feed in very large groups.

Torres (2012) reported one sighting of a dusky dolphin close to the Survey Area which indicates they may be present during the VSPs.

4.2.7.21 Striped Dolphin

This species is similar, but larger than the common dolphin, reaching lengths of 3.4 m (Baker, 1999). This species typically inhabits warmer oceanic waters north of New Zealand and is rarely seen in NZ coastal waters (Dawson, 1985). However, this species

has stranded on Taranaki coastlines in the past and for completeness is included here. This species is unlikely to be seen in the Survey Area.

4.2.8 Pinnipeds

4.2.8.1 New Zealand fur seal

The NZ fur seal is the most common seal in NZ waters and is found throughout the country. Conservative population estimates are believed to be in the order of 50,000 to 60,000.

They are known to forage along continental shelf breaks up to 200 km offshore where they dive for fish (small mid water fish, conger eels, barracouta, jack mackerel and hoki), squid and octopus (as summarised in Baird, 2011).

NZ fur seals are present year round in offshore Taranaki waters. They have a continual presence at the offshore Taranaki oil production platforms, including the Maui Platforms which are located close to the survey area. These platforms act as artificial reefs and attract large schools of fish, which in turn attract seals. Seals also haul-out on platforms and other infrastructure. This attraction to offshore infrastructure increases the likelihood of fur seal presence in the Survey Area.

The closet fur seal breeding location to the survey area is at Sugar Loaf Islands (Miller and Williams, 2003). 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.

4.2.9 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.

4.2.10 Seabirds

Due to the diversity of seabirds in NZ waters, NZ is often considered to be the seabird capital of the world. 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, 2013c). 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, Ministry of Fisheries records, the NABIS database and the Taranaki Regional Oil Spill Contingency Plan. Table 5 summarises the information from these data sources into an indicative list of the seabirds which could be present in the Survey Area. Note that some species might only be present as individuals while others could be present in flocks of thousands (e.g. fairy prions).

Table 5: Seabird species which could be present in Taranaki

Species	NZ Threat Status (Robertson *et al.* 2013)
Gibson's albatross (*Diomedea antipodensis gibsoni)*	Nationally critical
Salvin's mollymawk (*Thalassarche salvini)*	Nationally critical
Black-billed gull (*Larus bulleri*)	Nationally critical
Black-fronted tern (*Chlidonias albostriatus)*	Nationally endangered
*Red billed gull (*Larus novaehollandiae scopulinus*)	Nationally vulnerable
Pied shag (*Phalacrocorax varius varius*)	Nationally vulnerable
Black petrel (*Procellaria parkinsoni)*	Nationally vulnerable
*Flesh-footed shearwater (*Puffinus carneipes)*	Nationally vulnerable
*Caspian tern (*Hydroprogne caspia)*	Nationally vulnerable
NZ white capped mollymawk (*Thalassarche cauta steadi)*	Declining
*Northern little blue penguin (*Eudyptula minor iredalei*)	Declining
White-chinned petrel (*Procellaria aequinoctialis)*	Declining
*Sooty shearwater (*Puffinus griseus)*	Declining
White-fronted tern (*Sterna striata striata*)	Declining
*Northern diving petrel (*Pelecanoides urinatrix urinatrix)*	Relict
Fluttering shearwater (*Puffinus gavia)*	Relict
*Fairy prion (*Pachyptila turtur)*	Relict
Northern royal albatross (*Diomedea epomophora Sanfordi)*	Naturally uncommon
Southern royal albatross (*Diomedea epomophora epomophora)*	Naturally uncommon
Campbell Island mollymawk (*Thalassarche impavida)*	Naturally uncommon
Chatham Island mollymawk (*Thalassarche eremita)*	Naturally uncommon
Northern giant petrel (Macronectes halli)	Naturally uncommon
Black shag (*Phalacrocorax carbo novaehollandiae)*	Naturally uncommon
Little black shag (*Phalacrocorax sulcirostris)*	Naturally uncommon
Westland Petrel (*Procellaria westlandica)*	Naturally uncommon
Buller's shearwater (*Puffinus bulleri*)	Naturally uncommon
Brown skua (*Catharacta antarctica lonnbergi)*	Naturally uncommon
White winged black tern (*Chlidonias leucopterus*)	Migrant
Wandering/Snowy albatross (*Diomedea exulans)*	Migrant
Southern giant petrel (*Macronectes giganteus)*	Migrant
Cape pigeon (*Daption capense capense)*	Migrant
Eastern little tern (*Sternula albifrons sinensis)*	Migrant
Black browed mollymawk (*Thalassarche melanophris*)	Coloniser
*Southern black-backed gull (*Larus dominicanus dominicanus)*	Not threatened
*Australasian gannet (*Morus serrator)*	Not threatened
Little shag (*Phalacrocorax melanoleucos brevirostris)*	Not threatened
*Grey faced petrel (*Pterodroma macroptera gouldi)*	Not threatened

** indicates a breeding presence in the wider Survey Area vicinity (see Figure 17)*

4.2.10.1 Breeding Colonies

There are thirteen species of seabirds that breed in the wider vicinity of the Survey Area, (Figure 17).

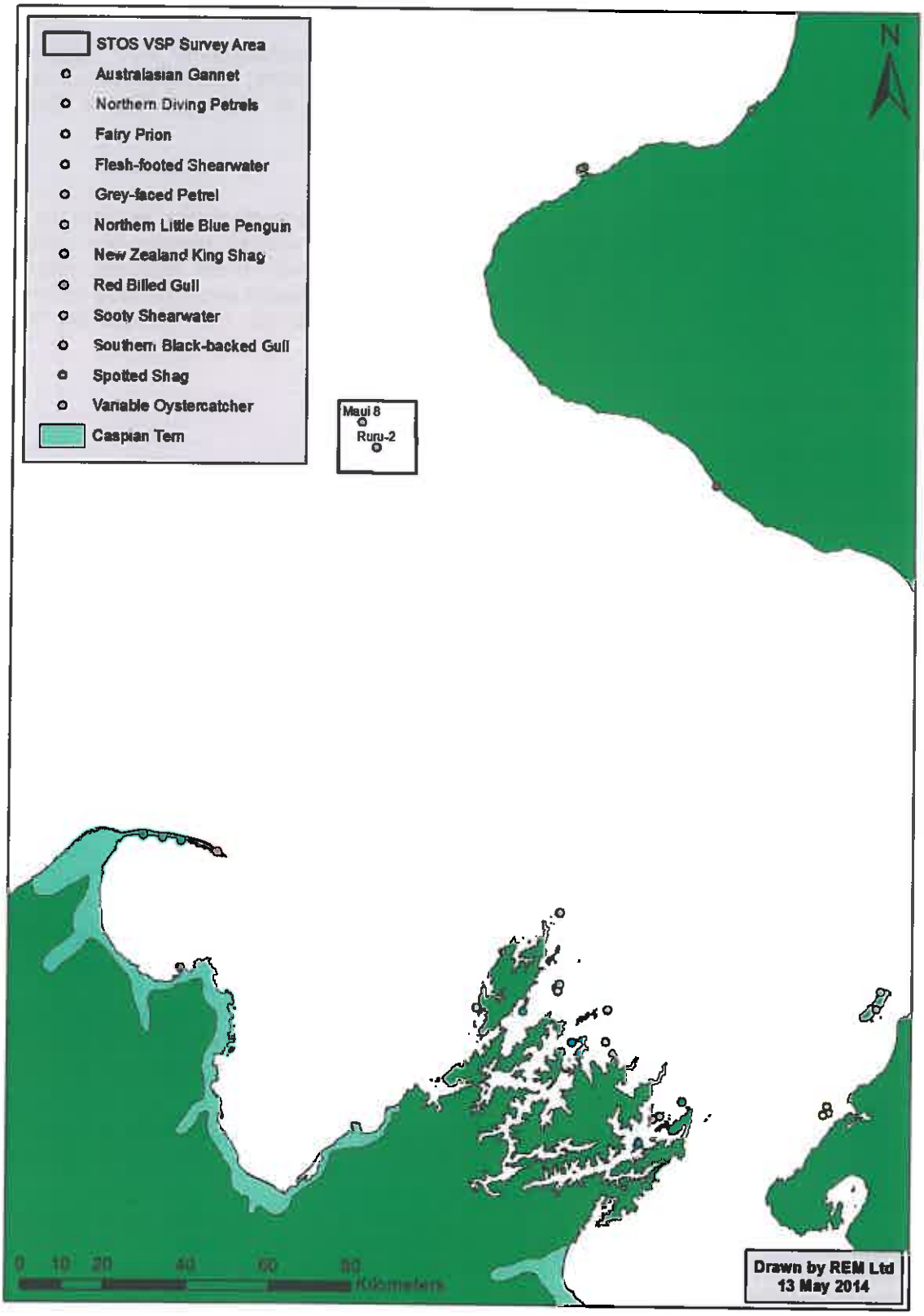

Figure 17: Breeding Colonies of Seabirds in Areas Surrounding the Survey Area

(Data source: primarily NABIS, with updates from various Regional Coastal Plans)

4.3 Existing Interests

This section focuses on the users of the surrounding environments; with particular emphasis on shipping, commercial fishing, oil and gas industry, tourism and research. STOS are continuing to consult with the local community on this Ruru-2 and Māui 8 drilling programme.

4.3.1 Cultural Values

STOS understands that there are a range of cultural considerations relating to its offshore activities and is working with the Taranaki Iwi Trust to identify any cultural impacts associated with these activities and ways in which these impacts may be addressed. Taranaki iwi exercise mana whenua and mana moana over the area in which the VSPs will occur and STOS engage in ongoing discussions with the Taranaki Iwi Trust as part of a broader relationship.

4.3.2 Fishing Values

4.3.2.1 Commercial Fisheries

NZ waters have been split into 10 Fisheries Management Areas (FMA) (Figure 18). The Quota Management System is the primary fisheries management tool to provide for commercial utilisation of the fisheries resource while ensuring sustainability.

MPI undertook a fisheries assessment for the Survey Area from 1 October 2006 to 30 September 2011 within FMAs 7 and 8 (Challenger and Central (West)) (Figure 18). The assessment area is shown in Figure 19.

Five years' worth of fishing data was used in this assessment (1 October 2006 to 30 September 2011) 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 17,818 tonnes. The vast majority of the total catch was jack mackerel and barracouta (74.4% and 20.4% respectively). The remainder of the top five species caught (including barracouta, frostfish, blue mackerel and redbait) was from target jack mackerel trawls so it is largely only a bycatch fishery.

As jack mackerel and barracouta made up nearly 95% of the total landings within and surrounding the Survey Area for this assessment, MPI only considered these two dominant species in order to investigate what time of year they are targeted. The catch peaks of the jack mackerel fishery occurred during October, December, January and June. The least amount of fishing effort occurs during the months of March through to May.

Consultation with the Deepwater Group was conducted in response to the deep water jack mackerel fishery occurring within the Survey Area, and the jack mackerel trawl fleet have been advised of the Survey Area and period that the drilling programme and VSPs 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 to all the appropriate navigational lighting and day-shapes to abide with the International Regulations for the Prevention of Collisions at Sea 1972 (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.

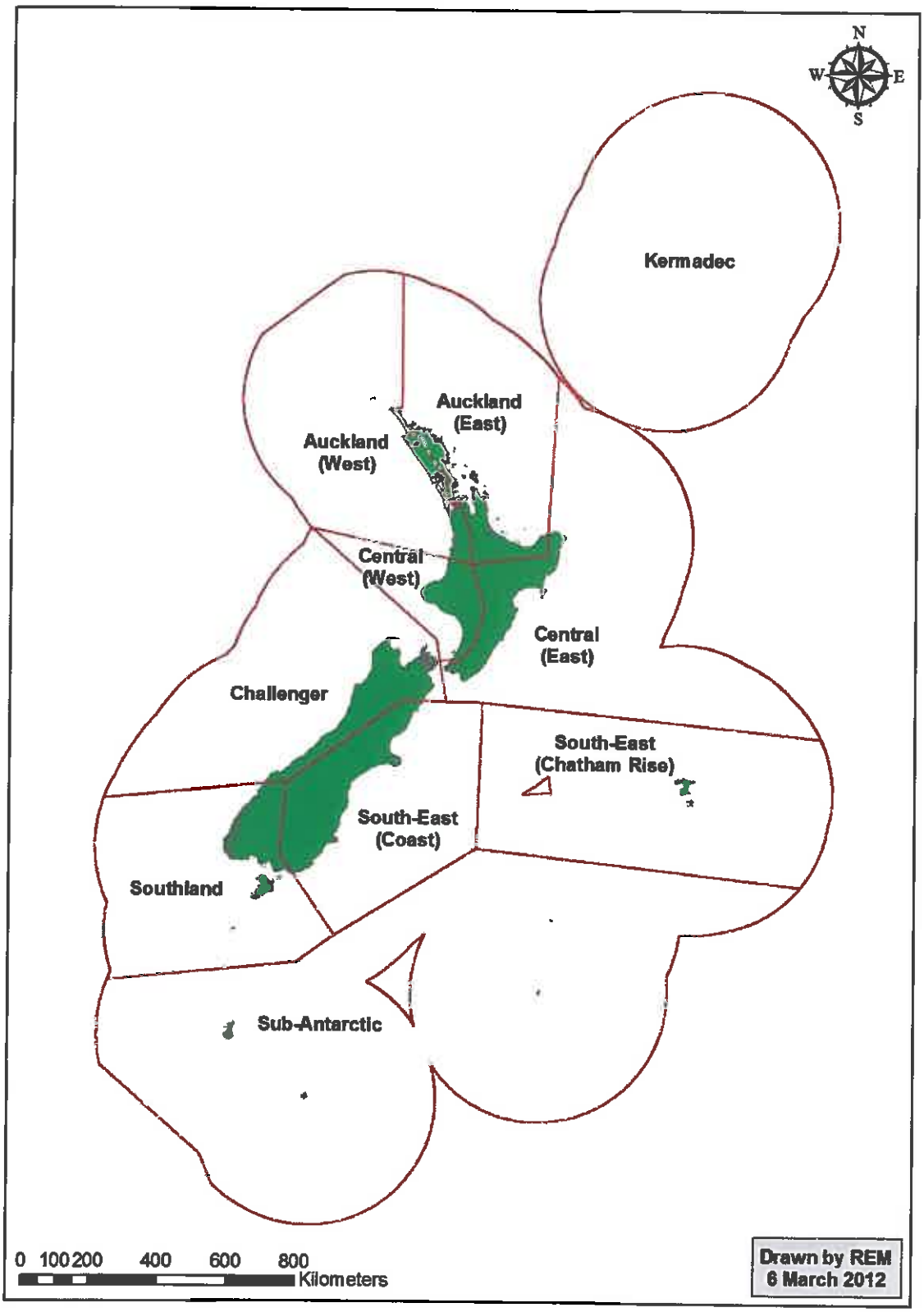

Figure 18: Fisheries Management Areas

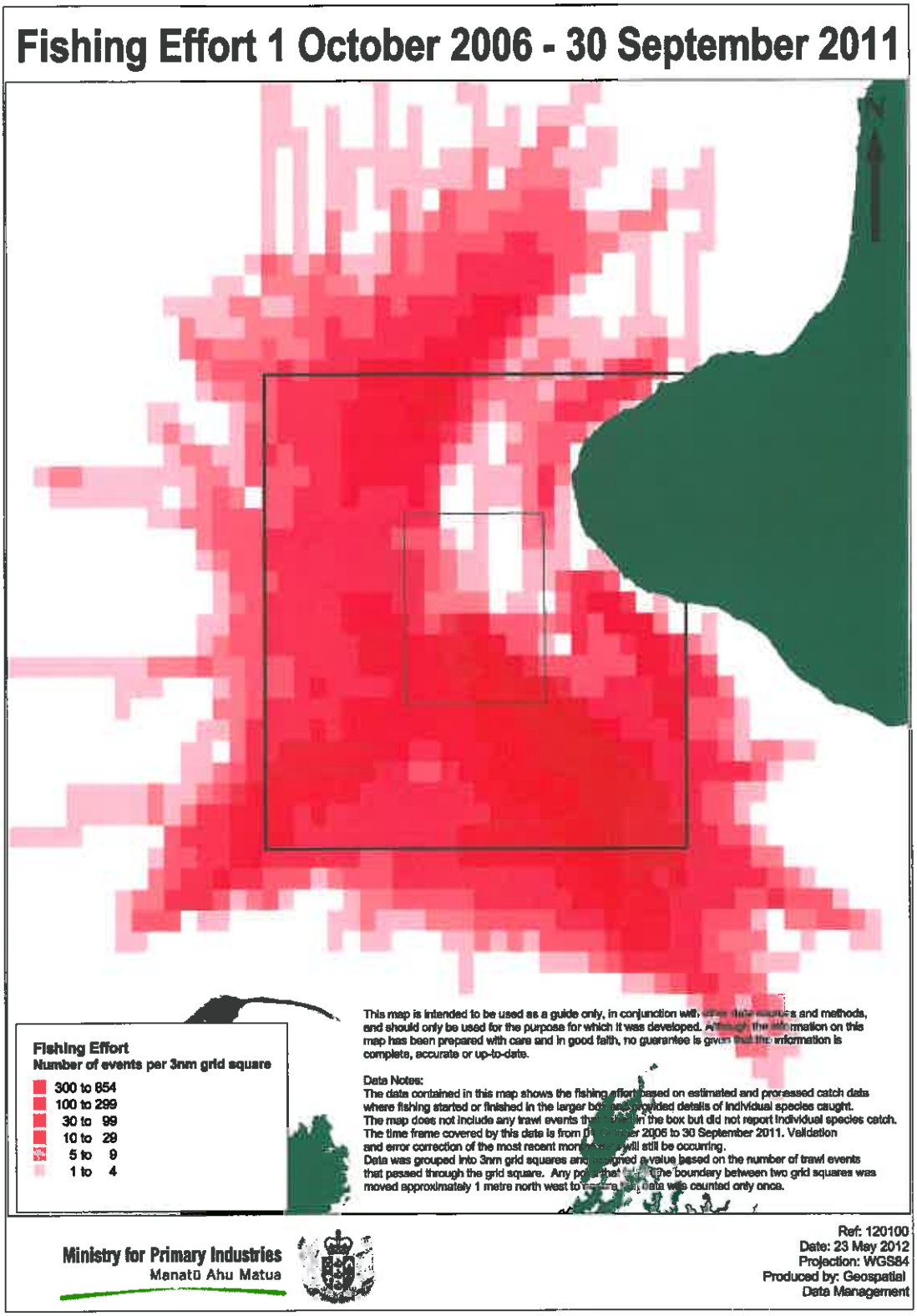

Figure 19: Fishing Effort around Survey Area from October 2006 – September 2011

(Source: MPI)

4.3.2.2 Recreational Fisheries

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. In general, the use of the marine environment for recreational fishing is increasing through time. However, the stretch of water around the Survey Area is not fished often by recreational fishers, as it is a long way from Port Taranaki and there is no reef structure nearby to concentrate fish numbers.

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.

4.3.3 Commercial Shipping

4.3.3.1 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 recreation activities (swimming, boating or fishing).

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 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 cargo 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.

4.3.3.2 Shipping Routes

In general, Maritime New Zealand recommends commercial vessels stay a minimum of 5 Nm from the mainland, any charted danger or offshore islands. It is assumed that shipping vessels will use the most direct path between two ports for the movement of goods. The general shipping route areas (provided by Maritime New Zealand), and direct routes between relevant NZ ports are illustrated in Figure 20. The routes for foreign destinations are likely to vary, and therefore have not been included.

In the NZ Nautical Almanac there is a note for vessels when navigating in the vicinity of production platforms and exploration rigs, that an adequate safe margin of distance should be allowed. It states where there is sufficient sea room, vessels should keep at least 5 Nm clear of the installations.

A precautionary area was established in offshore Taranaki by the International Maritime Organisation, which took effect in 2007. All ships traversing this area must navigate with particular caution in order to reduce the risk of a maritime casualty and resulting marine pollution.

This precautionary area is a standing notice in the annual Notice to Mariners that is issued each year in the NZ Nautical Almanac. The Almanac lists the navigation hazards within this precautionary area, which contains the Pohokura, Maui, Maari, Tui and Kupe fields.

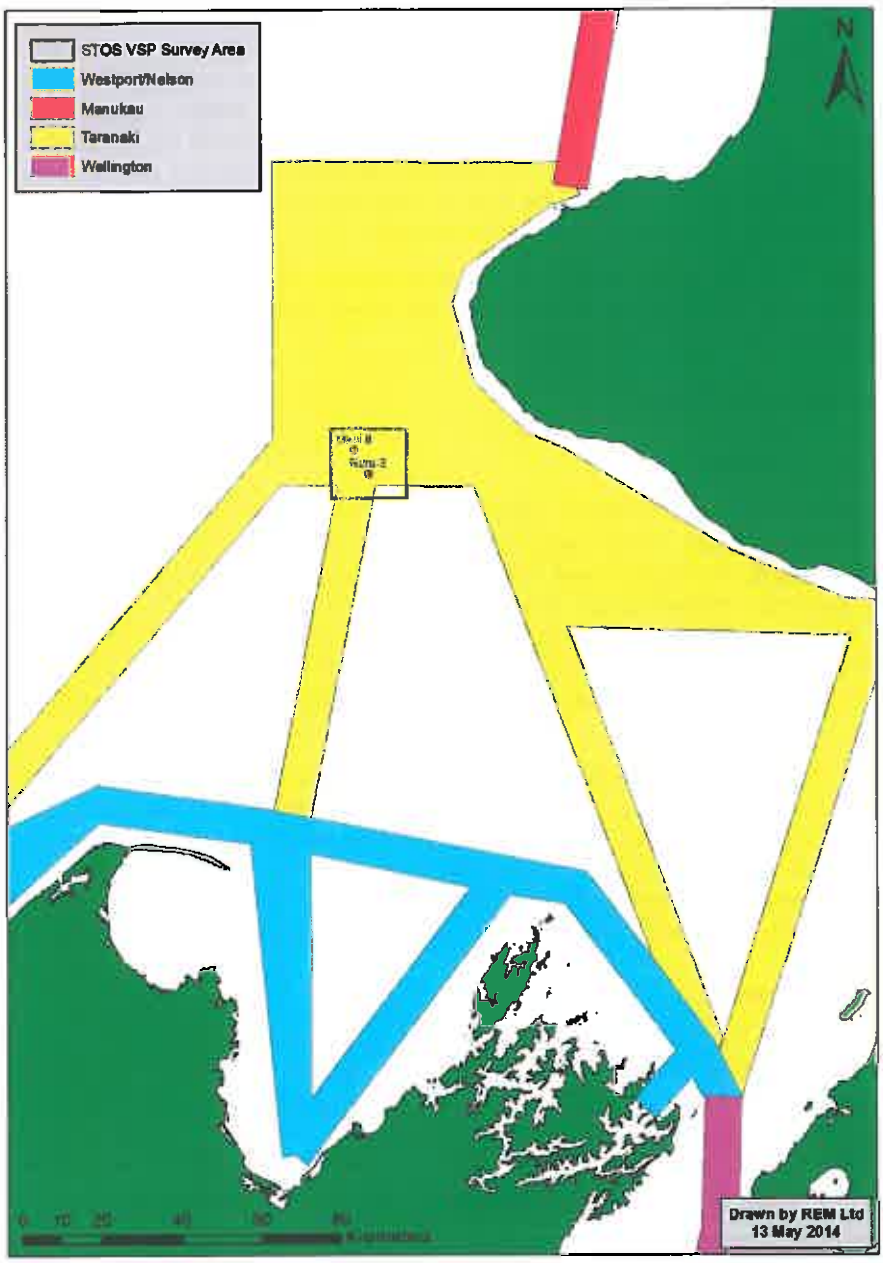

Figure 20: General Shipping Routes around Taranaki

4.3.4 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 the last decade. Producing offshore fields include: Maari, Māui, Kupe, Pohokura, and Tui. Figure 21 shows the current extent of offshore oil and gas exploration and production within the Taranaki Basin. Seismic operations have been commonplace off the Taranaki coastline since the 1950s. To date there have been no recorded incidents of harm to marine mammals as a result of these seismic operations.

Figure 21: Taranaki Oil and Gas Fields

(Source: http://www.teara.govt.nz/en/map/8934/taranaki-oil-and-gas-fields)

4.3.5 Other Uses

4.3.5.1 General

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 Ruru-2 and Māui 8 VSPs, although they will be required to remain at least 500 m away from the KTIV due to an exclusion zone being in place.

4.3.5.2 Tourism Industry

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

4.3.5.3 Research

Various organisations conduct research within or near the Survey Area. DOC, NIWA, MPI, and other 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 commonly conducted on Maui's dolphins within the West Coast North Island Marine Mammal Sanctuary.

The VSP will also contribute to the knowledge of marine mammals and other mega-fauna in the area by way of the presence of a dedicated MMO who will be stationed aboard the KTIV for the duration of the source testing and VSPs.

5 Potential Environmental Effects and Mitigation Measures

5.1 Introduction and Methodology

This chapter considers all of the likely environmental effects of the Ruru-2 and Māui 8 VSPs, 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 VSPs 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 actions which STOS 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 key environmental sensitivities.

The scale of the environmental effects has been classified into five categories specifically for the VSPs, which is based on the mitigation zones within the Code for a Level 1 seismic survey, and is outlined in Table 6.

Table 6: Potential Environmental Effects

Negligible Effect
• No significant environmental effects are predicted to occur. • The effect is predicted to be of small enough magnitude that it does not require further consideration, and no recovery period is required.
Minor Effect
• The effect is predicted to disappear almost immediately (within one hour) after cessation of the causative activity. • No further management measures are required for the return to the original situation or behaviour. • For marine mammals, this impact is likely to occur when exposed to sound levels less than 171 dB re 1 $\mu Pa^2.s$.
Moderate Effect
• The effect is predicted to occur at a level which requires a short period of recovery (up to 24 hours) following cessation of the activity. • No further management measures are required for the return to the original situation or behaviour. • For marine mammals, this impact is likely to occur when exposed to sound levels between 171 – 186 dB re 1 $\mu Pa^2.s$; behavioural changes are likely to occur.
Severe Effect
• The effect is predicted to occur at a level which requires a long period of recovery (greater than 24 hours) following cessation of the activity. • For marine mammals this impact is likely to occur when exposed to sound levels greater than 186 - 218 dB re 1 $\mu Pa^2.s$ and Temporary Threshold Shift is likely to occur.
Critical Effect
• The effect is predicted to occur at a level whereby no recovery is expected following cessation of the activity. • For marine mammals this impact is likely to occur when exposed to sound levels greater than 218 dB re 1 $\mu Pa^2.s$; Permanent Threshold Shift or other physiological damage is likely to occur.

5.2 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 VSPs, including the source sound or the physical presence of the rig and/or vessel.

Table 7 outlines the planned and unplanned components of the Ruru-2 and Māui 8 VSPs that have the potential to result in environmental effects. The following sections outline the potential effects of these activities, and the activities STOS propose to undertake to ensure these effects are avoided, remedied or mitigated.

Table 7: Vertical Seismic Profiling Activities and Potential Environmental Effects

Planned Activities
Physical presence of the KTIV and support vessels: Potential Effects: • Interference with local fishing activity; • Interaction or interference with marine traffic; • Interference and/or damage to marine archaeology, cultural heritage, or submarine infrastructure; • Introduction of marine pests; • Interaction or interference with seabirds; • Physical interaction or interference with marine mammals; and • Indirect effects, such as changes in the abundance, distribution or behaviour of fish species targeted by fisheries or marine predators.
Acoustic disturbance: Potential Effects: • Physiological effects on marine fauna from acoustic exposure or associated pressure effects; • Behavioural changes or displacement of marine fauna; • Disruption to feeding, breeding, migrating or resting of marine fauna; • Interference to natural acoustic signals used by marine mammals for communication, navigation, predator avoidance or foraging; and • Indirect effects such as changes in the abundance, distribution or behaviour of prey species targeted by fisheries or marine predators.
Solid and liquid wastes generated on the KTIV and support vessels: Potential Effects: • Generation of sewage and greywater; • Generation of galley waste and garbage; and • Generation of oily waters.
Unplanned Activities
Fuel/oil spill from vessels
Vessel collision or sinking

5.3 Effects of Planned Activities and Proposed Mitigation Measures

5.3.1 Physical Presence of the KTIV and Support Vessels

5.3.1.1 Interference with local fishing activity

Disturbance to offshore fishing activities could occur due to the physical presence of the KTIV and potential exclusion of fishing vessels within the 500 m radius exclusion zone. This could cause temporary loss or reduction of access to fishing grounds.

Deepwater mackerel trawlers use the surrounding area and have been notified of the drilling programme. The KTIV and support vessels will comply with the COLREGS, and the support vessels will assist with implementation of the 500 m exclusion zone around the KTIV.

Each well location is on a flat featureless seabed (Johnston & Forrest, 2012; Johnston *et al.*, 2012; Johnston *et al.*, 2012b), so there are no locations where fish are known to aggregate.

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 their operations accordingly.

The effects from the Ruru-2 and Māui 8 VSPs on fishing activities are considered to be ***negligible*** on account of:

- The mitigation measures described above;
- The relatively small area of excluded space; and
- The short duration of the VSP at each well location.

5.3.1.2 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 wells and the area covered by the KTIV's anchor pattern is not within a known navigation channel; therefore, navigation around the KTIV is not anticipated to cause any problems.

A Notice to Mariners will be broadcast daily on maritime radio so all marine traffic will be aware of the KTIV's location and can plan their movements accordingly.

The Survey Area is 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.

The support vessels will warn any vessels in the vicinity of the KTIV which may encroach on the 500 m exclusion zone.

The potential for disturbance to marine traffic is considered to be ***negligible*** based on the mitigations described above.

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

There are no known archaeological sites or sites of cultural significance identified within the footprint of the exploration drill sites. Most areas of cultural importance are restricted to the inshore reefs and coastlines.

With regard to submarine infrastructure, the Ruru-1 exploration well was drilled and abandoned in early 2011. The old Ruru-1 well is 58 m northeast of the Ruru-2 well site, and c. 7 km from Maui-8. The well was abandoned with no debris left on the seabed and all pipes removed to 5 m below the seabed. The Ruru-1 well is sufficiently distant from both of the wells for which VSPs will be undertaken, and the VSP process will not affect the abandoned well in any way.

In summary, it is considered that the potential interference with and/or damage to marine archaeology, cultural heritage or submarine infrastructure is ***negligible***.

5.3.1.4 Introduction of marine pests

The KTIV and support vessels associated with the drilling activity have been in New Zealand for at least nine months prior to the STOS VSP programme commencing. Prior to this the KTIV was dry docked, cleaned and inspected in Singapore prior to departing for NZ waters. MPI gave approval for the KTIV to enter NZ waters in August 2013.

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

5.3.1.5 Interaction or interference with seabirds

There is the potential for sea birds to interact with the KTIV and/or the support vessels. A potential positive interaction is that the campaign rig and vessels could provide loafing or perching opportunities that would not otherwise be available to seabirds. The effect has been previously documented for slow moving vessels and offshore installations; whereas, potential negative interactions include injury to seabirds through collision or entanglement.

Research has shown that artificial lighting can cause disorientation in seabirds, particularly for fledglings and novice flyers in nearshore waters (Telfer *et al.*, 1987). Seabirds are thought to navigate by starlight over the ocean, and in some cases artificial lights may interfere with this ability (Black, 2005; Guynup, 2003). It is also possible that fish and associated marine predators are attracted to installation lights; which would in turn attract seabirds (Black, 2005). Collisions or entanglements during the day are unlikely as most seabirds are agile flyers with keen eyesight.

DOC Taranaki Area Office reports that one bird is delivered to them every 3-4 years from manned offshore installations, all of which have been alive. In all cases the birds have been disorientated by the rig lights, whereupon they become lightly oiled after contact with machinery. No cases of rig entanglement have been reported. All oiled birds were decontaminated and released back to the wild off New Plymouth. Species affected reportedly include blue petrels, fairy prions and diving petrels.

The bird most commonly observed landing on the Māui platforms is the cape pigeon, which apparently use the platform to rest (Bruce Colgan, STOS, *pers. comm.*). While at the Tui FPSO to the north of the Survey Area, the only birds to have been observed landing on the facility are sparrows, swallows and finches which are believed to have hitched out on workboats and Offtake Tankers. No collisions or deaths of birds have been observed since the Tui FPSO has been on location.

It is likely that the KTIV and support vessels may provide resting opportunities for birds on railings, antennas etc. but collisions or entanglements are unlikely. The short term duration of the current STOS exploration drilling programme (~50 days at Ruru-2 and ~35 days at Māui 8), and the VSPs (c. 12 hours) will also reduce the potential for any long-term impacts on seabirds. Therefore, it is considered that the proposed VSPs would have ***negligible*** adverse effects on seabirds.

5.3.1.6 Physical interaction or interference with marine mammals

As outlined previously a number of marine mammal species may be present in close proximity to the Survey Area during the proposed Ruru-2 and Māui 8 VSPs.

Adverse effects of seismic surveys on marine mammals have not been unequivocally demonstrated in NZ, but concerns have been raised by the conservation community. Concerns have generally been related to potential acoustic disturbance which is discussed in Section 5.3.2.

Seismic surveys also have the potential to impact marine mammals simply through the physical presence of vessels or equipment in the marine environment. It is widely documented that some marine mammals are often attracted to vessel traffic (e.g. Bejder *et al* 1999, Wursig *et al* 1998) and low levels of underwater noise can also act as an attractant to marine mammals (Simmonds *et al* 2004). Evidence suggests that NZ fur seals are attracted to offshore structures, as they provide a food source and haul out area; this can be expected for the KTIV during the STOS VSP.

Marine mammals are at risk of ship strike when they come into close contact with vessels; this is typically not a problem for small cetaceans or seals as they are agile enough to move out of harm's way, and indeed they will often approach vessels to bowride. However, larger whales are less agile and are more susceptible to ship strike (Van Waerebeek *et al.* 2007).

In order to reduce the probability of detrimental physical interactions with marine mammals the VSP will operate in accordance with the Marine Mammal Protection Regulations 1992 which govern vessel behaviour in the vicinity of marine mammals. As a result of these mitigation measures it is considered that the impacts of the physical presence of the rig and support vessels on marine mammals as a result of this VSP would be ***negligible***.

5.3.1.7 Indirect effects, such as changes in the abundance, distribution or behaviour of fish species targeted by fisheries or marine predators

Offshore installations do tend to aggregate some fish species due to the infrastructure acting as an artificial reef and providing habitat for sessile organisms and associated fish species (Lokkeborg *et al* 2002). This can have positive effects on marine mammal species in the area as it potentially provides increased availability of prey. Potential benefits to fisheries are limited by the 500 m exclusion zone, as the increased reef fish abundance will be restricted to the immediate vicinity of the submerged infrastructure.

The positive effects from the 'artificial reef' effect are unlikely during the VSP surveys primarily on account of:

- The short duration over which the rig will be onsite for the Ruru-2 and Māui 8 VSPs;
- The KTIV was cleaned before deployment to NZ; and
- The KTIV has only been in NZ waters for approximately 9 months so sessile marine flora and fauna abundances are likely to be minimal.

For these reasons any potential effect in the Survey Area on fish species is considered to be ***negligible***.

5.3.2 Acoustic Disturbance

Exposure of marine fauna to acoustic disturbance will be determined by the firing sequence and the source level used which will be specific to each operation.

VSPs are significantly different to vessel-based 2D or 3D marine seismic surveys. During VSPs the acoustic source is limited to a single location, and the shots are spaced over relatively short survey durations (c. 12 hours). The Ruru-2 and Māui 8 VSPs will have a low source volume (2 x 250 in^3) with a maximum of 250 shots fired at an operating capacity of 1,800 psi. In comparison, most 3D seismic survey programmes typically run for 20 – 30 days continuously with the acoustic source fired every ~10 seconds.

The acoustic source for full array seismic data acquisition is typically 250-270 dB at frequencies generally lower than 1 KHz. In keeping with the limited and specific nature of VSPs, the seismic source proposed by STOS at the Ruru-2 and Māui 8 exploration wells will be slightly lower than this (~193 dB at a frequency of 2 - 250 Hz). Therefore, the proposed Ruru-2 and Māui 8 VSPs would be considered as a mid-level acoustic source.

The low-frequency signals created during seismic survey events propagate efficiently in water, with little loss due to attenuation (i.e. 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 sound waves into an ever increasing space) results in a reduction of 6 dB per doubling of distance. However, attenuation depends on propagation conditions. In good conditions, the signal may be above the background level for more than 100 km; in poor 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 physics of underwater sound mean that there is potential for seismic survey operations to have an adverse effect on most marine fauna.

The Code outlines the following potential impacts to marine mammals from seismic surveys:

- Physical effects (trauma or auditory damage);
- Auditory masking (reduced abilities to detect biologically relevant sounds);
- Behavioural effects (avoidance or attraction); and
- Disturbance or reduction of prey species.

However, marine mammals are not the only group which could be affected by acoustic disturbance; 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) also have the potential to be affected. 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.

5.3.2.1 Physiological effects on marine fauna from acoustic exposure or associated pressure effects

The sound intensities required to produce physiological effects are largely unknown for most marine fauna, and what is known is based on a limited number of experiments. Most free-swimming animals have been observed avoiding the range at which negative effects may occur; diving seabirds, marine mammals and many fish species are highly mobile and can be expected to temporarily avoid acoustic disturbances. However, animals which do not, or cannot avoid the acoustic source (because of behavioural or physical constraints) are more at risk of physiological effects. Such animals include plankton, fish eggs, some species of fish and sessile (i.e. non-mobile) organisms such as marine benthos.

There is limited published literature on the potential impacts of airgun noise emissions on sessile, benthic marine organisms, including hard and soft corals. It has been speculated that sound emissions from airguns could remove polyps from the calcium carbonate skeleton or that vibrations from pressure pulses propagating through the skeleton could damage polyps, but neither have been reported thus far in the literature. Woodside Energy Ltd conducted a 3D MSS around Scott Reef in Western Australia in deep water in 2007 where a pre and post seismic survey field experiment was conducted. Results of the post survey data did not reveal any detectable effects of airgun noise emissions on coral species (Woodside, 2007).

Most corals have a pelagic or planktonic phase in their lifecycle and mortality of plankton has been observed at close range (within 5 m) of the source of the seismic shot (DIR, 2007). However, the effects of seismic surveys on the planktonic phase of corals are considered to be *negligible* given the size of the planktonic populations and their high natural mortality rates resulting from stochastic events.

For marine mammals and fish, exposure to elevated sound can lead to auditory damage or threshold shifts (an elevation of the lower limit of auditory sensitivity). In most cases these threshold shifts will be temporary (Temporary Threshold Shift), that is a temporary loss of hearing sensitivity following exposure to high intensity sound. In extreme cases the threshold shift can be permanent (Permanent Threshold Shift) whereby hearing is permanently damaged. The sound exposure level (SEL) required to elicit Temporary Threshold Shift or Permanent Threshold Shift varies with species. For example, bottlenose dolphins exhibit Temporary Threshold Shift at 190 – 192 dB re 1 μPa^2-s (Schlundt *et al.*2000, Finneran *et al.* 2005), whereas studies with harbour porpoises have shown that Temporary Threshold Shift occurred at SEL 164 dB re 1 μPa^2-s (Lucke *et al.* 2009).

In general it is relatively difficult to determine the SELs for marine mammals which correspond to physiological effects. This is largely because protected species (i.e. most marine mammals) cannot be sacrificed for physical examinations and their large size is generally prohibitive of captive studies. However, the Code utilises SEL criteria defined by Southall *et al.* (2007) to predict thresholds for physiological changes (186 dB re 1 μPa^2-s), and the mitigation measures outlined in the Code are designed specifically to address these thresholds by protecting all marine mammals from physiological damage.

For the proposed Ruru-2 and Māui 8 VSPs, which have a low source volume (2 x 250 in^3) over a relatively short duration (c. 12 hours) with shots well-spaced (groups of three, 15 seconds apart, every five minutes), there is unlikely to be any physiological effects on seabirds, marine mammals or fish. Therefore, it is considered that acoustic effects are likely to be ***minor***, provided the provisions of the Code are adhered to.

5.3.2.2 Behavioural changes or displacement of marine fauna

Behavioural changes of marine mammals are readily documented in response to seismic surveys. Responses include:

- Avoidance: change in travel direction away from seismic source and/or lower density than expected in area affected by seismic surveys (e.g. Johnson *et al* 2007, Potter *et al* 2007, Koski *et al* 2009, Stone and Tasker 2006);
- Changes in vocal behaviour (e.g. Di Lorio and Clark 2010); and
- Changes in dive behaviour (e.g. Gailey *et al* 2007).

Temporary avoidance is the most commonly reported response by marine mammals in the vicinity of strong acoustic sources (Hammond *et al.*, 2002); although some species appear to be attracted to low/medium acoustic emissions into the marine environment (e.g. Wursig *et al* 1998, Simmonds *et al* 2004).

Other changes in localised movements in marine mammals include: swimming away from the source, rapid swimming at the surface, and breaching (McCauley *et al.*, 1998; McCauley *et al.*, 2003). However, McCauley *et al.* (2003) concluded that acoustic disturbance did not cause changes in the regional migration patterns of cetaceans, and research by Johnson *et al* (2007) also concluded that despite temporary avoidance, longer term population level impacts were unlikely.

Changes in vocal behaviour have been observed in baleen whales in particular (a group which produces low frequency sounds). However, toothed whales and dolphins which use high frequency sounds (> 5 kHz) are less likely to exhibit changes in vocal behaviours.

Changes in dive behaviour are less well documented, but Gailey *et al.* (2007) found that dive time in grey whales increased in response to seismic noise.

Less information is available on the behavioural responses of other marine fauna, but observations of fish congregating in the lights of a working seismic vessel suggest that they are not adversely affected by the operating seismic source (i.e. no behavioural

change detected). 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. Most pelagic fish are expected to avoid strong acoustic sources, as are seabirds.

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.

In summary, large mobile fauna have been routinely observed to stay away from the airgun source at the higher source levels, thereby reducing their exposure times. The sound level proposed for the Ruru-2 and Māui 8 VSPs is considerably lower than most marine seismic surveys and therefore it is considered that potential behavioural effects on marine fauna would be ***negligible***.

5.3.2.3 Disruption to feeding, breeding, migrating or resting of marine fauna

The immediate vicinity of the Ruru-2 and Māui 8 wells has not been documented as critical habitat for any species of marine fauna, and for those species that could potentially be present it is expected no long lasting impacts on feeding, breeding, migrating or resting behaviours. International research supports the notion that most marine fauna in close proximity to the acoustic source would move away during operations. The only species for which an expected variance to this trend is the NZ fur seal (see Section 4.2.8.1).

Therefore, it is considered that the potential effects on life history traits of marine fauna in response to the VSP would be ***negligible*** on account of the short survey duration (c. 12 hours) and the relatively low sound source.

5.3.2.4 Interference to natural acoustic signals used by marine mammals for communication, navigation, predator avoidance or foraging

Many cetaceans emit sound for a variety of reasons; communication, navigation, predator avoidance and prey location. 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 Lorio & Clark, 2009). When underwater sound from anthropogenic sources increases, then marine mammal acoustics can be 'masked' and hence no longer fulfil their original function.

Seismic surveys could have significant impacts on natural marine mammal acoustics particularly when the sounds generated by the survey overlap with the frequency range used by marine mammals (Richardson *et al.*, 1995).

Table 8 summarises the known frequencies of echolocation and communication calls for selected species of toothed whales and dolphins. These species could be present in the Survey Area at the time of the survey. For the most part the echolocation frequencies for those species listed are much higher (6 - 130 kHz) than the VSP seismic source (2 – 250 Hz). There is however limited potential for interference with lower frequency marine mammal communications; i.e. for blue whales a small overlap occurs at the highest end of the seismic spectrum and the lowest end of the cetacean communication spectrum.

A study undertaken by Di Lorio & Clark (2009) investigated changes in blue whale vocal behaviour during a low-medium power seismic survey using sparker technology (mean seismic source = 131 dB re 1µPa (30 – 500 Hz), mean SEL = 114 dB re 1µPa^{2}s. Results showed that blue whales called consistently more on seismic exploration days than on non-exploration days. This increase in calling was observed for the discrete, audible calls

that are emitted during social encounters and feeding and was consistent with findings from Melcon *et al.* (2012). It is believed that an increase in calling rate increased the probability of blue whale signals being successfully received by conspecifics.

From the literature reviewed it is considered that the VSP may have a ***minor*** effect on naturally-produced acoustic signals of marine fauna if they are close to the Ruru-2 and Māui 8 well locations.

Table 8: Frequencies of Cetacean Vocalisations

(Summarised from Simmonds *et al.* 2004)

Species	Vocal component	Frequency range (kHz)
Humpback whale	Grunts	0.025-1.9
	Horn blasts	0.41-0.42
	Moans	0.02-1.8
	Pulse trains	0.025-1.25
	Songs	0.03-8
	Social calls	0.05-10
	Shrieks	0.75-1.8
	Slaps	0.03-1.2
Blue whale	Moans	0.012-0.4
Bryde's whale	-	No data available
Fin whale	Clicks	16-28
	Constant call	0.02-0.04
	Moans	0.016-0.75
	Down sweeps	0.014-0.118
	Up sweeps	0.03-0.075
	Pulses	0.018-0.075
	Ragged pulses	<0.03
	Rumble	0.01-0.03
	Whistles and chirps	1.5-5
Minke whale	Down sweeps	0.06-0.13
	Moans, grunts	0.06-0.14
	Ratchet	0.85-6
	Sweeps, moans	0.06-0.14
	Thump trains	0.1-2
Sei whale	Sweeps	1.5-3.5
Southern Right whale	Pulsive calls	0.03-2.2
	Tonal calls	0.03-1.25
Beaked whales*	Whistles	3-16
	Clicks	2-26
Sperm whale	Clicks	0.1-30
Common dolphin	Whistles	2-18
	Chirps	8-14
	Barks	<0.5-3
	Clicks	0.2-150
Killer whale	Whistles	1.5-18
	Clicks	0.1-35
	Scream	2
	Pulse calls	0.5-25
	Echolocation clicks	12-25
Bottlenose dolphin	Whistles	0.8-24
	Clicks	0.2-150
	Barks	0.2-16
	Low frequency calls	0.05-0.9
	Echolocation clicks	110-130

Maui's/Hector's dolphin	Echolocation clicks	129**
Pilot whale	Whistles Clicks Echolocation clicks	1-8 1-18 6-11
Dusky dolphin	Echolocation clicks	40-50 and 80-110 (2 peaks)***
False killer whales	Whistles Echolocation clicks	1.87-18.1 25-130
Striped dolphin	Whistles	1.1-24+
Pygmy sperm whale	Clicks	60-200
Pygmy right whale	-	No data available

** The bottlenose whale is used here as a beaked whale example, however frequency ranges of vocalisations are likely to vary between species. Very little data is available for beaked whales*
*** Kyhn et al (2009).*
**** Au and Wursig (2004).*

5.3.2.5 Indirect effects, such as changes in the abundance, distribution or behaviour of prey species targeted by fisheries or marine predators

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). In NZ no formal research into this topic has been conducted, but anecdotal reports suggest that tuna are harder to catch off Taranaki during seismic surveys. However, the 2013 game fish season overlapped with the WesternGeco marine seismic survey, and this fishing season yielded higher numbers of game fish than previous years.

During the summer months in Taranaki nutrient rich waters move south bringing an abundance of bait fish and pelagic predators. Hence, over summer there are likely to be higher abundances of pelagic fish in the vicinity of the Ruru-2 and Māui 8 wells. This in turn is likely to attract higher numbers of marine predators, so any indirect effects related to prey availability could be expected to be greatest during summer.

As discussed earlier, it is expected that most fish, seabirds and marine mammals would temporarily avoid the area during the VSP operations. This temporary and localised change in abundance is highly unlikely to have lasting impacts at a population level in relation to prey availability.

The Ruru-2 and Māui 8 VSPs are scheduled for winter, by which time the large aggregations of bait fish and pelagic predators should have dispersed. Therefore, any effects on availability of prey species during the Ruru-2 and Māui 8 VSPs are considered to be ***negligible***.

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

There is the potential for effects on the marine environment through inappropriate management of sewage, galley waste, garbage and oily water on the KTIV and support vessels during the VSPs.

However, STOS will comply with 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. A record book is kept of all discharges.

5.3.3.1 Generation of sewage and greywater

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

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

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

Given the remoteness of the Ruru-2 and Māui 8 drilling locations and no known sensitive habitats nearby (Johnston *et al.*, 2012; Johnston *et al.*, 2012b; Johnston & Forrest, 2012) and the treatment systems onboard, the environmental effects arising from sewage and greywater discharges is anticipated to be ***negligible***.

5.3.3.2 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 MPR Part 200. Comminuted waste passed through a 25 mm filter can be discharged beyond 3 Nm from the shore and these discharges will rapidly dilute to non-detectable levels in the offshore marine environment.

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 STOS.

Table 9 summarises garbage disposal restrictions.

For these reasons it is considered that the generation of galley waste and garbage from the KTIV during the VSPs will be ***negligible***.

5.3.3.3 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 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). Both the support vessels and KTIV hold an International Oil Pollution Prevention Certificate (IOPPC) which certifies that the MARPOL standards can be met.

Compliance with MARPOL protocols will negate any environmental effects related to the discharge of oily water; hence effects are considered to be ***negligible***.

Table 9: Waste Streams under MARPOL Annex V Classification

Garbage Type	Appropriate Disposal Route

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.

5.4 Impacts of Unplanned Activities and Mitigation Measures

Unplanned activities, including fuel/oil spills and vessel collision are rare during marine seismic operations. Risks are reduced further during a VSP which is essentially a stationary operation. Despite this, support vessels still pose a risk with regards to oil spills and collisions and these risks are considered below.

Note that well control is considered under separate legislation and the wells will be stabilised prior to any VSP being undertaken (i.e. cement would have been set and the blow-out preventer would be in place), hence the chances of a loss of well control during VSP are very unlikely. For the Ruru-2 and Māui 8 exploration wells there will be no flowing of hydrocarbons, only the logging of data, and the introduction of a hydrophone device or wireline tools into the well will not affect this likelihood, so well control risks are not considered as part of this MMIA.

5.4.1 Fuel/Oil Spill from Vessels

A fuel/oil spill from the KTIV or support vessels during the VSPs could occur on account of:

- 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 VSPs 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.

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. Refuelling would usually only be undertaken during daylight hours with visual observers on-hand to ensure there are no leaks. 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, and typically only during daylight hours;
- During refuelling an observer is present to check for leaks;
- Use of wire-reinforced hoses; and
- Transfer hoses are fitted with 'dry break' couplings.

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.

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 Maritime New Zealand, 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 VSP. 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***.

5.4.2 Vessel/Rig Collision or Sinking

The most significant environmental effects associated with a vessel collision or sinking is associated with the unplanned discharge of hazardous substances (e.g. oil and lubricants) and/or the vessel making contact with the sea floor.

The unplanned discharge of hazardous substances is considered under different legislation (Maritime Transport Act 1994 – Marine Protection Rules), and accordingly a DMP has been prepared for this drilling programme. The DMP process requires that this document is approved by Maritime New Zealand prior to the commencement of drilling and that it outlines all the hazardous substances onboard, their potential environmental effects in the event of a spill, and all measures which will serve to avoid, remedy or mitigate spill related effects.

As discussed in Section 5.3.1.3 there are no submarine features of significance in the vicinity apart from the abandoned Ruru-1 well. Because no debris was left on the seabed at the Ruru-1 site and all pipes were removed to 5 m below the seabed, it is unlikely that the abandoned well would be affected in the event of a vessel sinking to the seafloor here.

A collision or sinking is considered to be very unlikely: by the time the VSPs occur, the KTIV will have been on location for the duration of the drilling period (~ 50 days at Ruru-2 and ~35 days at Māui 8), and the risks with regard to the collision or sinking of the KTIV are mitigated through the presence of support vessels at all times. The International COLREGS will be followed at all times and users of the marine environment will be aware of the KTIV's location. Therefore, it is considered the potential impacts from vessel collision or sinking are ***negligible***.

5.5 Mitigation Measures

5.5.1 2013 Code of Conduct Mitigation Measures and Variances

In order to minimise any adverse effect to marine mammals STOS will adhere to the mitigation measures stipulated in the Code under the Level 1 classification for the Ruru-2 and Māui 8 VSPs, with the exception of the agreed variances listed below:

- No sound transmission loss modelling will be required prior to the STOS VSPs
- Only one trained and qualified Marine Mammal Observer (MMO) will be onboard the KTIV for the acoustic source testing and for the duration of the VSPs, and will maintain a watch for marine mammals while the acoustic source is in the water (during daylight hours);
- PAM is to be operational at all times the seismic source is active, and the support vessel will be used as the PAM platform as the sound field emanating from the KTIV is unknown and could decrease the accuracy of acoustic detections. Therefore, the PAM hydrophone array will be towed from the support vessel, circling within a 1 km radius of the KTIV;
- Only one DOC-approved PAM operator will be onboard the support vessel for the duration of the survey unless the VSP operation is considered likely to go over 12 hours in which case two trained PAM operators will be deployed; and
- If NZ fur seals are entering and leaving the 200 m mitigation zone regularly, every effort will 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 will 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 active.

A Marine Mammal Mitigation Plan has been prepared in accordance with the requirements of the Code (Appendix 3). This plan outlines the operational procedures for the MMOs who will be present on the KTIV during the Ruru-2 and Māui 8 VSPs, and outlines in detail the requirements under the Code and the agreed variations which are summarised above.

5.6 Cumulative Effects

Cumulative effects on the marine environment may arise over time or in combination with other effects. Currently the Taranaki offshore environment is extensively used for fishing, shipping and hydrocarbon production and exploration. These activities have historically occurred concurrently and will continue both during and after the Ruru-2 and Māui 8 VSPs.

Directionality of the acoustic source and bathymetry of the surrounding area play an important part in attenuation of the sound source. For the Ruru-2 and Māui 8 well locations, 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 activity warrants a mention here; however, the Ruru-2 and Māui 8 VSPs will only occur for a very short duration and at a relatively low source volume, therefore will not contribute significantly to the ongoing acoustic disturbance in offshore Taranaki waters.

The STOS VSP will be following the Code to mitigate any effects on marine mammals, and will shut down or delay starting if marine mammals are within the relevant mitigation zones. To the best of our knowledge and based on the predicted timing of the survey the STOS VSPs will not overlap with any other seismic surveys off Taranaki. For these reasons it is considered that the potential cumulative effect on the marine environment to be ***negligible***.

5.7 Summary of Environmental Effects and Mitigation Measures

Table 10 summarises the project activities, predicted effects, mitigation actions and our determination of the overall effect of the activity.

Table 10: Vertical Seismic Profile 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 VSP (c. 12 hours). Compliance with COLREGS. Presence of support vessels at all times. Notice to Mariners will be issued. 500 m exclusion 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 the Survey Area offshore, and the lack of any existing seabed infrastructure associated with the abandoned Ruru-1 well.	Best Practice.	Negligible.
	Introduction of marine pests.	Low.	Biosecurity clearance was gained before KTIV entered NZ. Antifouling systems in place. Regular maintenance undertaken.	Negligible.
	Physical interaction or interference with seabirds.	Likely. KTIV may provide resting opportunities for birds. Collisions or entanglements are unlikely during daylight, but could occur at night.	No mitigation options available. MMOs will record any seabird strikes that are witnessed.	Negligible.
	Physical interaction or interference with marine mammals.	Low.	Compliance with the Code and mitigation zones. One MMO onboard the KTIV and 1-2 PAM operators will be onboard the support vessel observing for mammals while the acoustic source is active. Short duration of VSP (c. 12 hours). Low source volume.	Negligible.
	Indirect effects – changes in availability of fish to fisheries or marine predators.	Low.	Short duration of VSP (c. 12 hours).	Negligible.
Acoustic disturbance.	Physiological effects on marine fauna from exposure to sound or associated pressure effects.	Low.	Compliance with the Code. Presence of one trained MMO on the KTIV and 1-2 DOC-approved PAM operators 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 VSP (c. 12 hours). Low source volume.	Minor.
	Behavioural changes or displacement of marine fauna.	Low.		Negligible.
	Disruption to feeding, breeding, migrating or resting of marine fauna.	Low.		Negligible.
	Interference to natural acoustic signals used by marine mammals.	Low.		Minor.
	Indirect effects (e.g. changes in abundance, distribution or behaviour of prey).	Low.		Negligible.
Solid and liquid wastes generated on the KTIV and support vessels.	Generation of sewage and greywater.	Will occur.	Only biodegradable waste will be discharged. Discharges will dilute to non-detectable levels. Adherence to MARPOL Annex IV.	Negligible.

Aspect or Source	Potential Effect	Probability of Occurrence or Exposure	Proposed Monitoring or Mitigation Measures	Residual Outcome or Effect
			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 olly 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 and stationary nature of survey	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 VSP (c. 12 hours). Compliance with COLREGS. Presence of support vessels. 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.

6 Conclusion

VSPs 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, STOS will comply with the Code which is now a requirement under the EEZ Act – Permitted Activities; with the exception of a number of minor variances which have been developed in consultation with DOC and are deemed appropriate on account of the short duration of the proposed VSPs.

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 Ruru-2 and Māui 8 VSPs are considered minor operations in comparison with a vessel based 2D or 3D marine seismic survey. The VSPs will only occur for a short duration (c. 12 hours), at low source volumes (2 x 250 in^3), with a maximum of 250 shots fired at an operating pressure of 1,800 psi. Most marine seismic survey programmes tend to run for 20 – 30 days continuously with the acoustic source fired every ~10 seconds. As a comparison, the shots fired for the Ruru-2 and Māui 8 VSPs (~250 at each location), would constitute less than an hours' worth of operating during a conventional vessel based survey.

The potential effects and mitigation measures which STOS will implement to minimise any environmental effect have been described in this MMIA. In summary, effects to the marine environment from the Ruru-2 and Māui 8 VSPs are considered to be ***minor or negligible.***

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Appendices

This report contains the following appendices.

Number	Title
1	Consultation Register and Relevant Correspondence
2	Passive Acoustic Monitoring Specifications
3	Marine Mammal Mitigation Plan

APPENDIX 1

Consultation Register and Relevant Correspondence

Stakeholder	Engagements	Key Feedback	Engagement Date
Taranaki Iwi	Ongoing face-to-face discussions, as part of STOS's regular consultation programme, and discussions at community events. Regular written correspondence received including news clippings and newsletters. Taranaki Iwi joined STOS at the Māui Production Station to co-host Ngā Kaihautū Tikanga Taiao, the statutory advisory committee for the EPA.	Ongoing updates and engagement. Continue to work with Iwi on names for potential additional exploration prospects which are yet to be confirmed. Talks ongoing on social impacts. Iwi to write cultural impact report.	5 April 2013. 5 September 2013
Ngāti Tara Hapū	Ongoing discussions. Regular written correspondence received including news clipping and newsletters.		April 2013.
Nga Ruahine Iwi Authority	Conversation and written updates.	Ongoing discussions.	9 August 2013.
Ngāti Ruanui	Conversation and written updates.	Ongoing discussions.	August 2013.
Māui Community Advisory Group	Ongoing face-to-face discussions at quarterly CAG meeting and community events. Written update via Māui newsletter.	Update at next September CAG meeting.	10 June 2013. 23 September 2013.
Māui neighbours	Written update via Māui newsletter.	Ongoing discussions.	12 August 2013.
EPA	Conversation, as part of STOS's regular consultation programme.	Submission of the EIA.	Late 2012.
Taranaki Regional Council	Conversation, as part of STOS's regular consultation programme.	Ongoing discussions. Submission of the DMP.	Update at next engagement.
Maritime NZ	Conversation, as part of STOS's	Submission of the DMP.	Update at next

	regular consultation programme.		engagement, 16 August.
Port Taranaki	Conversation, as part of STOS's regular consultation programme.	Ongoing discussions.	Early 2013.
South Taranaki District Council	Conversation, as part of STOS's regular consultation programme.	Ongoing discussions.	Update at next engagement.
DOC	Conversation, as part of STOS's regular consultation programme.	Ongoing discussions.	Update at next engagement, 21 August.
Cape Egmont Boat Club	Conversation and written update.	Ongoing discussions. Update of schedule closer to the time.	8 August 2013.
Taranaki Commercial Fisheries	Conversation and written update.	Ongoing updates and engagement.	April 2013.
Seafood NZ	Conversation and written update.	Ongoing updates and engagement.	April 2013.
Taranaki Recreational Fisheries	Conversation and written update.	Ongoing updates and engagement.	April 2013.
Deepwater Group	Conversation and written update.	Ongoing updates and engagement.	8 August 2013.
NZ Marine Farmers Association	Conversation and written update.	Ongoing updates and engagement.	8 August 2013.
Challenger Finfish Management Company	Conversation and written update.	Ongoing updates and engagement.	8 August 2013.
NZ Federation of Commercial Fisherman	Conversation and written update.	Ongoing updates and engagement.	8 August 2013.
Dr R. Constantine, Auckland University	Conversation and email correspondence	No formal consultation requested	20 August 2014
Dr W. Roe, Massey University	Conversation and email correspondence	No formal consultation requested	20 August 2014
Dr W. Rayment, Otago University	Conversation and email correspondence	A request for further information has been fulfilled. Awaiting response	20 August 2014

Helen McConnell

From:
Sent: Friday, 22 August 2014 6.30 p.m.
To: Helen McConnell
Subject: Re: seismic survey consultation

Hi Helen

Thanks for asking but I don't think I can be helpful at this time. It's a bit hectic and would take me a while to get my head around this.

Keep me on your list though. It was lovely to see you again after so long. I am so pleased there are folks like you now engaging in this industry, it's reassuring.

Cheers

On 20/08/2014, at 8:18, "Helen McConnell" z> wrote:

> Hi I
>
> Just a very quick note...
>
> It was great to catch up with you at the conference last week and to hear about some of your research plans. Excited for you about the Kermadec project!
>
> Following up on our brief conversation about the STOS vertical seismic profiling survey off Taranaki (4 – 6 hours of intermittent seismic at the completion of drilling each of two exploration wells) – can you confirm that you would rather not to be included in the consultation process for this survey?
>
> All the very best,
> Helen
>
> <image001.jpg> Resource and Environmental Management Limited
>
> **Helen McConnell** BSc (Zoology), MSc (Marine Science)
> *Marine Ecologist*

Helen McConnell

From:
Sent: Wednesday, 20 August 2014 12:35 p.m.
To: Helen McConnell
Subject: RE: seismic survey consultation

Hi Helen
That sounds perfect to me – I don' t think we need to be involved in this one.
Cheers

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

THE ENGINE OF THE NEW NEW ZEALAND

50 YEAR ANNIVERSARY

From: Helen McConnell [
Sent: Wednesday, 20 August 2014 10:30 a.m.
To:
Subject: seismic survey consultation

Hi

Good to talk earlier!

Regarding the STOS vertical seismic profiling survey off Taranaki (4 – 6 hours of intermittent seismic at the completion of drilling each of two exploration wells), and as per our discussion – can you confirm that you would prefer not to be included in the formal consultation process for this survey?

DOC have not suggested any necropsy requirement to STOS for this project - presumably on account of its extremely short duration and the compliance with all requirements of the Code of Conduct for a Level 1 seismic survey.

Cheers,
Helen

REM Resource and Environmental Management Limited

Helen McConnell BSc (Zoology), MSc (Marine Science)
Marine Ecologist

Helen McConnell

From: Helen McConnell
Sent: [illegible]day, 15 September 2014 1:55 p.m.
To:
Subject: RE: STOS VSP survey
Attachments: VSP Information Sheet.pdf

As discussed a few weeks ago. Here is the information sheet for the two vertical seismic profile surveys that STOS is running shortly. Let me know if you have any concerns or would like to discuss further.

Cheers,
Helen

From: Helen McConnell [
Sent: [illegible]14 4:26 p.m.
To:
Subject: STOS VSP survey

Hi

Good to talk earlier. I'm just waiting on STOS to send through their most recent information sheet about the seismic project. I'll forward it through to you once I receive it.

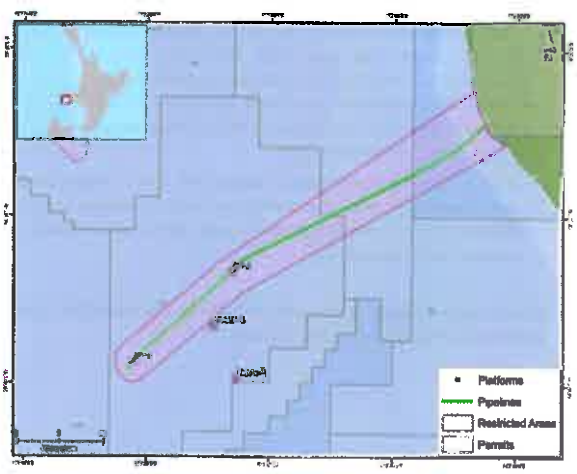
Cheers,
Helen

Resource and Environmental Management Limited

Helen McConnell BSc (Zoology), MSc (Marine Science)

Ruru 2 and Māui 8 Vertical Seismic Profile Surveys, Taranaki Basin

Shell Todd Oil Services Limited (STOS) will undertake two vertical seismic profile surveys (VSPs) at the Ruru 2 and Māui 8 exploration wells (Figure right) following the completion of their drilling. The VSPs will be conducted to confirm reservoir location and increase data resolution at each well, and are expected to be completed within approximately 12hours.



Both surveys will utilise two 250 in^3 airguns deployed from the Kan Tan IV (KTIV) drilling rig to a depth of 5 m and will be fired 3 – 5 times (at 15 second intervals) at an operating pressure of 1,800 psi and frequency of 2 - 250 Hz. A hydrophone deployed down the well will record the received sound. The hydrophone's depth is adjusted and the firing sequence is repeated with some 40 – 50 recording depths for each well. Prior to the VSP commencing, the acoustic source will be tested 10 – 20 times over a 1 - 2 hour period.

Due to the introduction of sound into the marine environment STOS will operate in accordance with the Department of Conservations (DoC) '2013 Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations' (The Code) as required under the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012. A Marine Mammal Impact Assessment (MMIA) has been produced and will be made available on the DoC website once submitted.

In complying with The Code the following marine mammal mitigation measures will be employed:

- The use of pre-start observations to detect marine mammals (both visually and acoustically) prior to the commencement of seismic operations;
- Passive Acoustic Monitoring (PAM) is to be operational whilst the source is active;
- The delay of operations in the event that marine mammals (with the exception of NZ fur seals) are detected within the mitigation zones defined in the Code;
- The use of 'soft-starts' whereby the acoustic power is gradually increased over 20 – 40 minutes at the start of the survey to give any marine mammals the opportunity to leave the survey area before full power is reached; and
- The shut-down of the acoustic source if 'species of concern' enter the mitigation zones defined in The Code.

A small number of variances from the requirements of The Code have been developed in consultation with the Department of Conservation (DOC) and relate to the limited duration of each survey. These are:

- **No sound transmission loss modelling will be required prior to the STOS VSPs;**
- **Only one trained and qualified Marine Mammal Observer (MMO) will be onboard the KTIV for the duration of the VSPs;**
- **The support vessel will be used as the PAM platform as the sound field emanating from the KTIV is unknown and could decrease the accuracy of acoustic detections. Therefore, the PAM hydrophone array will be towed from the support vessel, circling within a 1 km radius of the KTIV; and**
- **If NZ fur seals are entering and leaving the 200 m mitigation zone regularly, every effort will 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 will be made to fire the acoustic source when the seals are at the surface, rather than diving.**

Please contact Helen McConnell (Telephone: 03-548-4019, Email: helen@remltd.co.nz) if you have any further questions in regards to the VSP surveys.

APPENDIX 2

Passive Acoustic Monitoring Specifications

Seiche Measurements Ltd
Bradworthy Industrial Estate
Langdon Road, Bradworthy
Holsworthy, Devon EX22 7SF
United Kingdom
Tel: +44 (0) 1409 404050
Fax: +44 (0) 1409 240276
Email:info@seiche.eu.com
Web: www.seiche.eu.com

Seiche Measurements LLC
10801 Hammerly Boulevard
Suite 114, Houston
Texas TX77043
USA
Cell: +1 (713) 201 5726
Fax: +1 (713) 984 9628
Email: bpadovani@seiche.eu.com
Web: www.seiche.eu.com

11 November 2014

250m Array System and 230m tow with 20m detachable array System Specifications

Commercial in Confidence

Contents

1)Towed PAM

The system is designed to give a flexible approach to the monitoring of marine noise from a towed hydrophone system. The system comprises an array cable, tow cable, deck cable, an electronics processing unit and laptops supporting Pamguard software.

The electronic processing unit contains a buffer processing unit comprising of power supplies, buffer boards, national instrument card for high frequency signal and usb1208 for depth. There is also a radio transmission system that is used to process hydrophone signals for audio output to remote headphones.

Figure 1: 8U Base unit with Rack-mounted PC and LF and HF monitors

Remote Monitoring Station

Figure 2: Remote station on bridge and set up screen for Rack mounted base unit

The remote monitoring station enables the base unit to be rack-mounted with other ship based computer equipment and by using the ships internal ethernet system, link to screens in an alternative location on the vessel.

Electronics Monitoring Base Unit

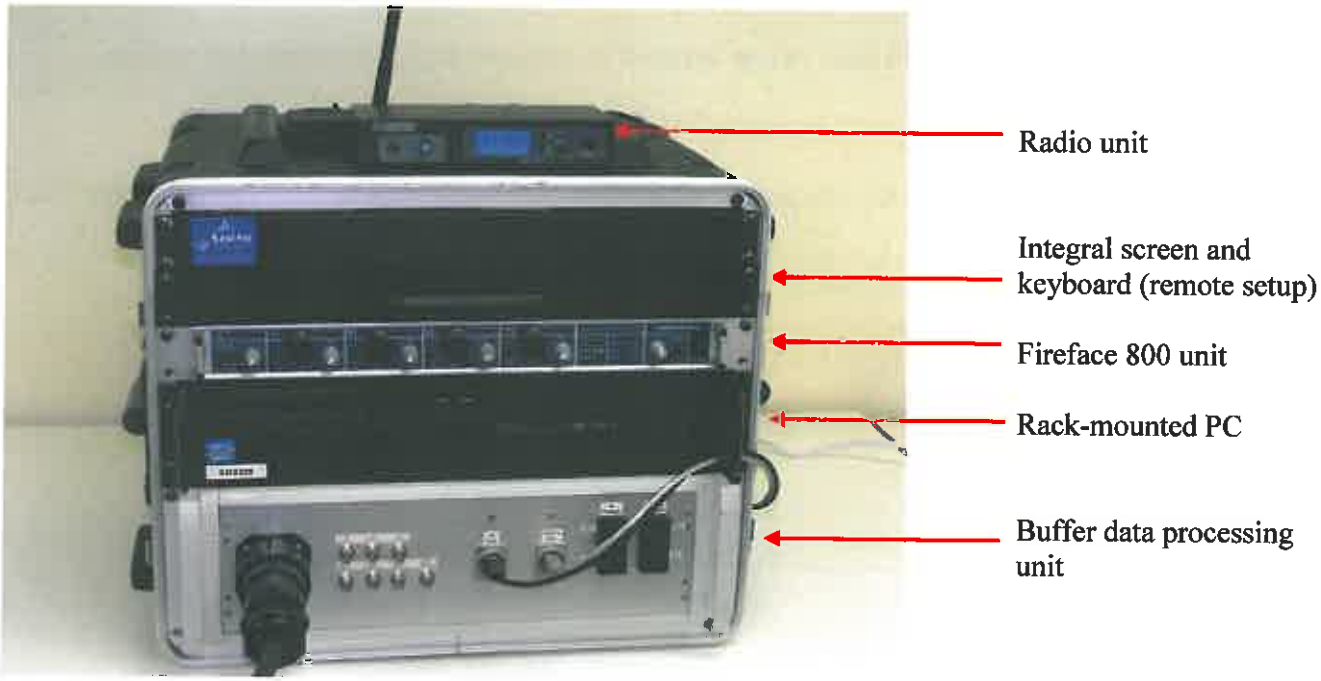


Figure 3: Electronics monitoring base unit

Radio unit
The radio system provides a remote headphone output from the audio output system. (Note: it is limited in frequency to 16 kHz)

Integral screen and keyboard
The rack-mounted integral screen and keyboard can be used to run the rack-mounted PC for monitoring or for troubleshooting. It is contained in a 1U housing which slides out and flips up when in use.

Fireface 800 unit
This unit is used for the low frequency signal. The analog signal from each hydrophone is sent from the back of the buffer data processing unit to the fireface unit. The detected signals are filtered and amplified then fed to the rack-mounted PC via the firewire cable.

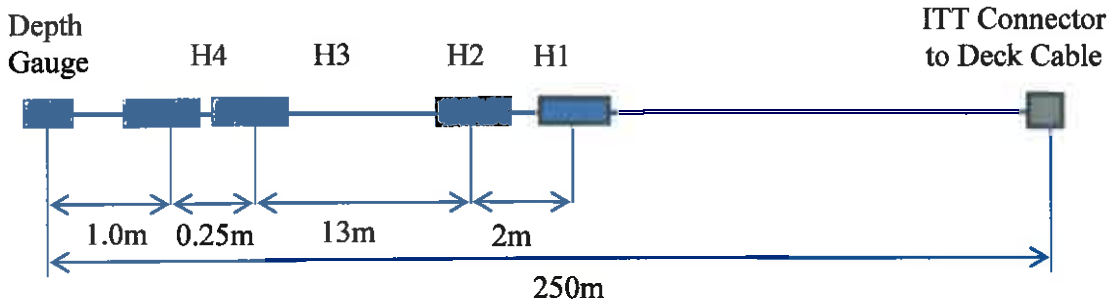
Rack-mounted PC
The rack-mounted PC system has an Intel quad core i5 processor with 8 GB of RAM. This custom built PC system has enough power to run both high and low frequency audio data through Pamguard simultaneously from up to 4 hydrophones.

Buffer data processing unit
This unit connects the deck cable into the system and splits the analog signal from up to 4 hydrophones into high and low frequency acoustic data. The high frequency analog signal is converted into a digital signal and is fed via USB to the rack-mounted PC for real time analysis and display. The low frequency analog signal from 4 hydrophones is fed into the fireface unit which is connected to the PC via firewire. The high and low frequency signal can also be listened to using the BNC connectors for troubleshooting. There is a second USB that enables the depth sensor readings to be input to the PC.

Towed Sensors

Note that frequency bandwidths can be tailored to suit specific applications and country requirements.

250m Towed Array
The sensor array comprises a 250m array with integral hydrophones and a depth sensor array.



Mechanical Information

Length:	250m
Depth Rating:	100m (not connector)
Diameter:	14mm over cable, 32mm over mouldings, 64mm over connectors
Weight:	60kg
Connector:	ITT 19 pin
BS	500 kg

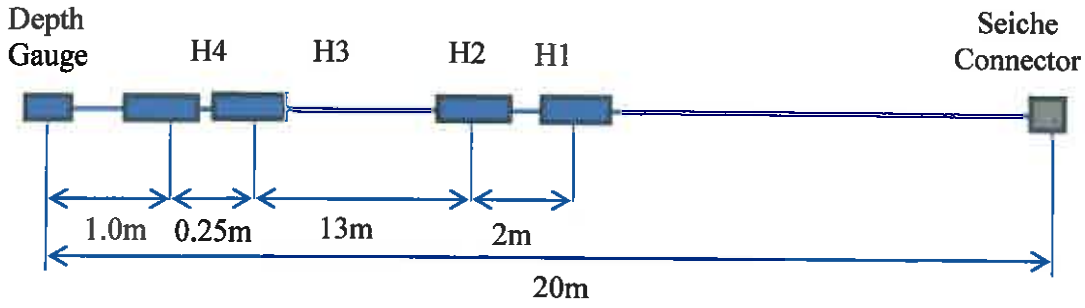
Hydrophone elements

H1	Broadband	10 Hz to 200 kHz (3dB points)
H2	Broadband	10 Hz to 200 kHz (3dB points)
H3	Wideband	2 kHz to 200 kHz (3dB points)
H4	Wideband	2 kHz to 200 kHz (3dB points)

Spacing H1 - H2 (HF detection)	2.00m	1.28mSecs
Spacing H2 - H3 (HF detection)	13.00m	8.32mSecs
Spacing H3 - H4 (LF detection)	0.25m	0.16mSecs

20m Towed array

The sensor array comprises a 20m detachable array section with a 230m heavy tow cable. The connectors are designed in house and are fully waterproof. Longer array sections can be provided to improve detections of low frequency vocalising marine mammals.



Mechanical Information

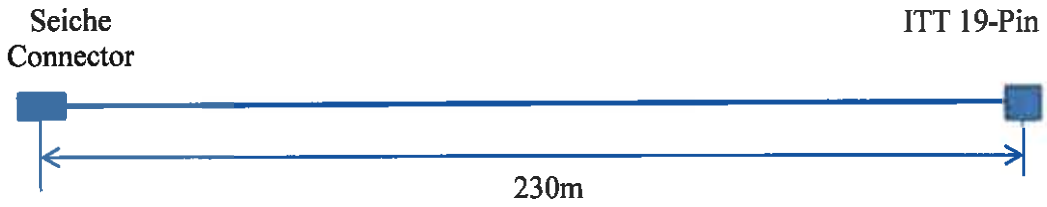
Length:	20m
Depth Rating:	100m (not connector)
Diameter:	14mm over cable, 32mm over mouldings, 45mm over connectors
Weight:	60kg
Connector:	Seiche
BS	500 kg

Hydrophone elements

H1	Broadband	10 Hz to 200 kHz (3dB points)
H2	Broadband	10 Hz to 200 kHz (3dB points)
H3	Wideband	2 kHz to 200 kHz (3dB points)
H4	Wideband	2 kHz to 200 kHz (3dB points)

Spacing H1- H2 (HF detection)	2m	1.28mSecs
Spacing H2 - H3 (HF detection)	13m	8.32mSecs
Spacing H3 - H4 (LF detection)	0.25m	0.16mSecs

230m Tow cable

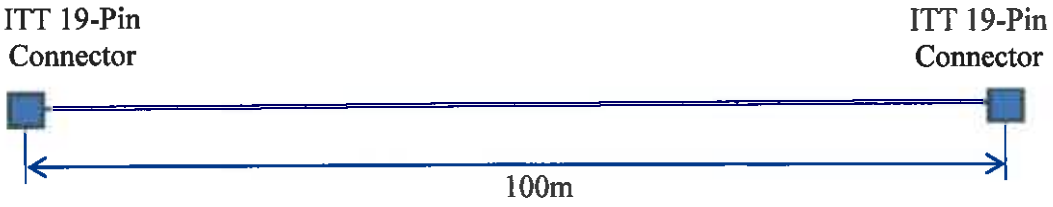


Mechanical Information

Length	230m
Diameter	17mm over cable
Connector	Seiche 36-pin 45mm over connectors
	ITT 19-pin 65mm over connectors
Weight	95 kg
BS	960 kg

100m Deck Cable

The deck cable is used for all array options



Mechanical Information

Cable Length:	100m
Diameter:	14mm
Connectors:	19 pin ITT (one male, one female)
Connector Diameter:	64mm
Weight:	25 kg
BS	500 kg

2)System Sensitivity

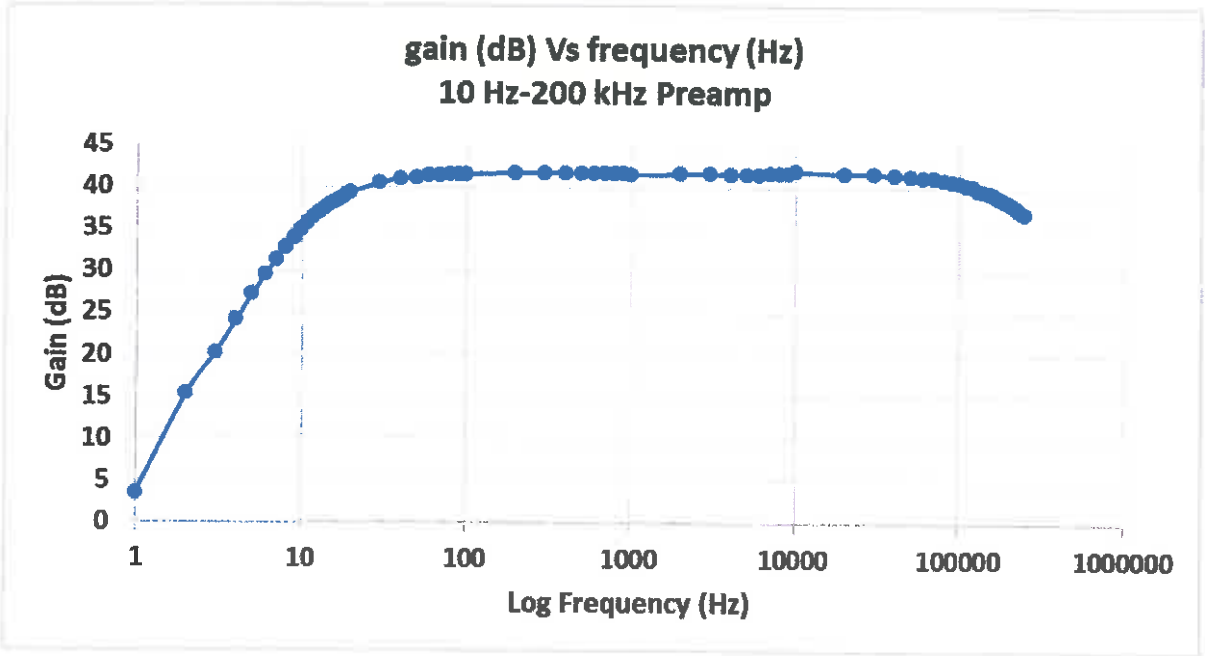


Figure 4: Hydrophone Sensitivity

The array sections consist of four hydrophones.
Two are set with a bandwidth of 10 Hz to 200 kHz, per Figure 4 above, which demonstrates that the sensitivity of the hydrophone starts to roll off at 10 Hz, but remains sensitive down to 1 Hz where it will still register 4 dB

The second pair of hydrophones is set to a bandwidth of 2 kHz to 200 kHz sensitivity. This will ensure that if the lower frequency pair of hydrophones is saturated by vessel noise, the system will still be capable of detecting vocalising marine mammals.

APPENDIX 3

Marine Mammal Mitigation Plan

Marine Mammal Mitigation Plan:

Shell Todd Oil Services Limited, Taranaki Basin Exploration Drilling, Vertical Seismic Profiling Survey

BPM-14-STOS-Taranaki Basin VSP-MMMP-v**1.5**

22/08/2014

BLUE PLANET MARINE

Document Distribution List

Date: 22/08/2014

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REM Ltd	Helen McConnell, Environmental Consultant	3
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BPM	Simon Childerhouse, Senior Research Scientist	5
BPM	Rob Slade, Operations Manager	6

Document Revision Record

Rev.	Date	Description	Prepared	Reviewed	Approved
1.0	09/06/2014	Draft	LD	SC, HM	
1.1	12/06/2014	Comments incorporated	LD	SC, PW	
1.2	19/06/2014	Comments incorporated	LD	SC	SC
1.3	23/06/2014	Updates from STOS – via HM	HM, LD	SC	SC
1.4	14/07/2014	Updates from STOS – via HM	LD	SC	SC
1.5	22/08/14	Updates from DOC – via HM	SC	LD	SC

Document Reference Number: BPM-14-STOS-Taranaki Basin VSP-MMMP-v1.5

Prepared by: Lesley Douglas

Last updated: 22/08/2014

www.blueplanetmarine.com

Table of Contents

List of Figures

List of Tables

List of Addenda

1. Introduction

This document has been developed by Blue Planet Marine (BPM) for Shell Todd Oil Services Limited (STOS) in order to meet the requirements for a Marine Mammal Mitigation Plan (MMMP) for the Taranaki Basin Exploration Drilling Vertical Seismic Profiling Survey (the survey). The operational area for the survey will be located within Petroleum Mining License (PML) 381012.

This MMMP outlines the procedures to be followed by observers and crew in order to guide survey operations. It should be read in conjunction with the *2013 Code of Conduct for Minimising Disturbance to Marine Mammals from Seismic Survey Operations* (the Code) and the STOS Marine Mammal Impact Assessment (MMIA) developed by Resource and Environmental Management Limited (REM) specifically for this survey. Information provided in the draft MMIA for the survey area has been used by BPM in the development of this MMMP.

The Code is the primary tool for describing mitigation and reporting required for seismic surveys consistent with NZ legislation. It should be the primary reference for Marine Mammal Observers (MMO) and Passive Acoustic Monitoring Operators (PAMO) during a survey. This MMMP provides additional and supplemental information specific to this survey and useful in the completion of MMO and PAM roles.

2. The Shell Todd Oil Services Limited, Taranaki Basin Exploration Drilling, Vertical Seismic Profiling Survey

REM was engaged by STOS and its joint venture partners to prepare a MMIA for two vertical seismic profiles (VSPs), one each to be undertaken at the Ruru-2 and Māui 8 exploratory wells, southwest of Cape Egmont in the Taranaki Basin within PML 381012 (Figure 1). The survey is being conducted in order to increase the subsurface data resolution, confirm reservoir location and allow the conventional seismic data that were acquired through previous 3D seismic surveys to be correlated with geological interval depths for the two exploration wells. The survey is scheduled to commence in late September-October 2014.

The survey will be conducted by the semi-submersible drilling rig *Kan Tan IV* (KTIV) (Figure 2). The acoustic source will comprise an airgun array of two 250 in^3 airguns, fired at an operating pressure of 1,800 psi and frequency of 2 - 250 Hz. The airguns will be fired 3-5 times (with 15 second intervals) at a maximum of 50 depths at each of the two exploratory wells. Each VSP is expected to take approximately 10 hours, with a period of source testing (10-20 tests over a 1 - 2 hour period) prior to commencement of each survey. The acoustic source will remain in the water after source testing until each VSP survey commences. The most conservative estimate of maximum time between the first test shot and the last acquisition shot would be 18 hours. However without operational delays, the survey and testing is expected to be completed within 12 hours.

Given the cumulative volume of the airguns being used (i.e. 500 in^3), the survey is classified as a Level 1 survey under the Code. The mitigation procedures set out in this MMMP (see section 4.1) adhere to the requirements of the Code for 'Level 1 surveys' and 'Borehole seismic surveys' with the exception of variances developed by STOS in consultation with the Department of Conservation (DOC) (see section 4.1).

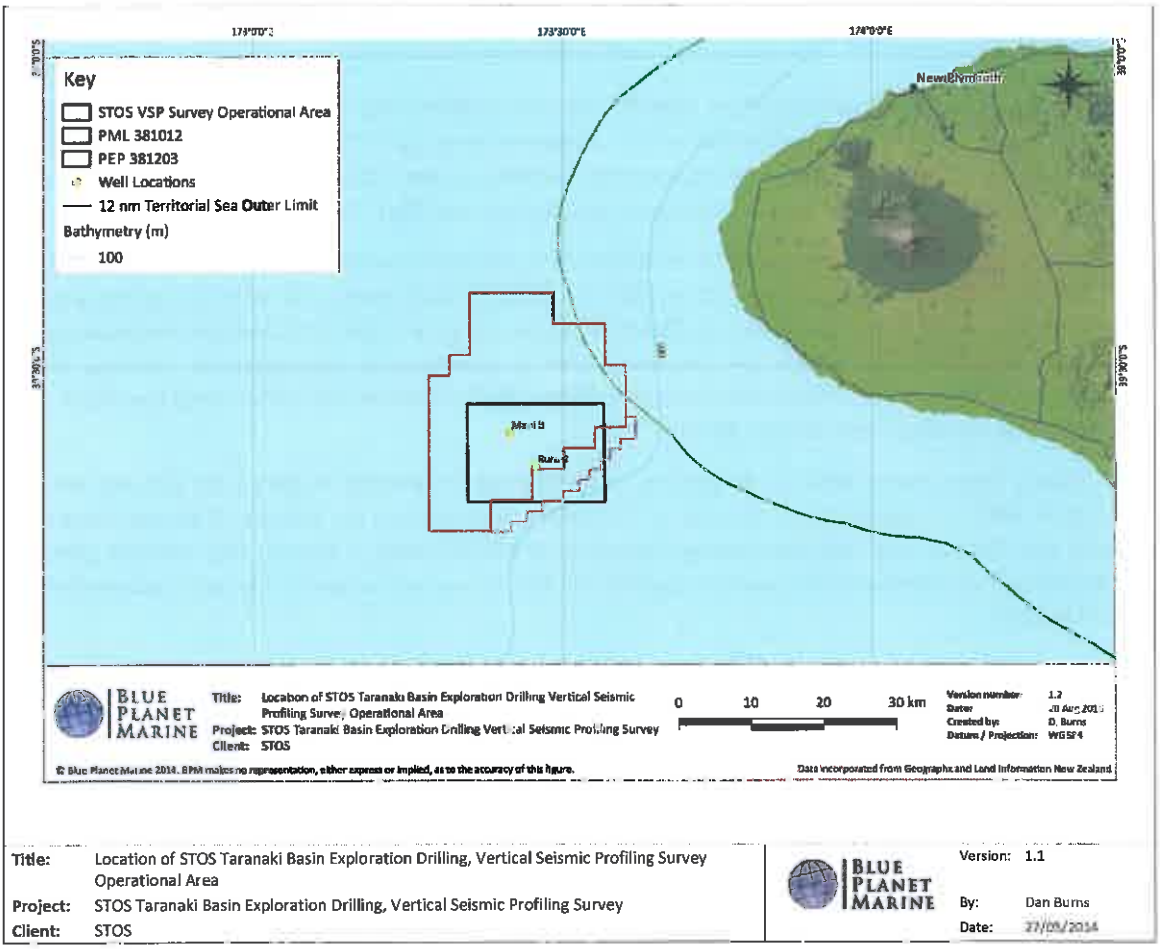


Figure 1: Location of the STOS Taranaki Basin Exploration Drilling, Vertical Seismic Profiling Survey.

(Note: MMOs and PAMOs to refer to the VADAR system for the coordinates of the survey operational area.)

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

(Source: MMIA produced for STOS by REM Ltd)

3. Record Keeping and Reporting

The observers (MMO and PAMOs) 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 reporting requirements are detailed in Appendix 2 of the Code.

Observers are to accurately determine distances/bearings and plot positions of marine mammals whenever possible throughout the duration of sightings/detections. Positions of marine mammals should be plotted in relation to the vessel throughout a detection. GPS, sextant, reticle binoculars, compass, measuring sticks, angle boards, or any other appropriate tools should be used to accurately determine distances/bearings and plot positions of marine mammals.

The operator will ensure that information relating to the activation of an acoustic source and the power output levels employed throughout survey operations is readily available (e.g. in a place of convenience for the qualified observers while conducting their normal duties) to support the activities of the qualified observers in real time by providing a display screen for acoustic source operations.

Observers: 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].

Note: the Code is mandatory within the NZ EEZ (but not necessarily within the Territorial Sea (0-12 nm offshore), and as such record keeping should be of a high standard as it may form the basis of compliance or enforcement action by the authorities.

All data must be recorded in a standardised 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 VSP surveys so outline survey type in 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 by the qualified observer directly to the Director-General (refer Appendix 5 of the Code for postal and email addresses) within 14 days of a completed MMO/PAMO rotation or end of the survey. Prior to submission to DOC, these data sheets are to be reviewed by the BPM Project Manager so please ensure that sufficient time is available for that.

There are a number of situations that require immediate notification to DOC. These are listed in Table 2, page 20. Where uncertainty or ambiguity in application of the Code arises, clarification can be sought from the Director-General.

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

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

BPM will compile an end-of-survey summary report based on the data collected throughout each survey. The contents of this report are summarised in Appendix 2 of the Code.

3.1 Contact details for the Department of Conservation

During the survey the first point of contact within DOC is Ian Angus (, . If a response is required urgently then telephone but in all other circumstances use email[2]. Should Ian Angus be unavailable, please phone 0800DOCHOT (0800-362-468) and state the following:

1) You wish to provide information to the Marine Species and Threats team, National Office;
2) The name of the relevant MMO/PAMO, the seismic survey and boat/rig you are on;
3) The time and date;
4) The issue/enquiry you wish to pass on to Ian Angus; and
5) Where you can be contacted with a reply (if appropriate).

3.1.1 Communication protocol

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

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

- MMO Team Leader to contact BPM Project Manager ashore ;
- BPM to contact STOS ;
- STOS to contact REM and
- REM to contact DOC (Ian Angus or other).

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

- Observer undertaking direct communication with DOC must inform the MMO Team Leader, Party Chief (or nominated STOS person) and the Client Reps of the issue and intention to contact DOC, and keep these people informed of discussions and associated events;
- The BPM Project Manager and onshore STOS Project Manager 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 phone must be followed up by an email to DOC and STOS at the earliest opportunity in order to provide written confirmation of the message.

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

4. Mitigation Measures Required Under the Code

Under the Code, the survey is classified as a Level 1 survey and a Borehole seismic survey. Within the operational area, the marine mammal impact mitigation measures required can be divided into three principal components:

1) The use of dedicated observers (i.e. Marine Mammal Observers (MMOs) and Passive Acoustic Monitoring operators (PAMOs));
2) The mitigation measures to be applied; and
3) The mitigation actions to be implemented, should a marine mammal be detected.

4.1 Variations from the Code

Due to the nature of this survey STOS and DOC have agreed variations to the mitigation measures specified in the Code for a Level 1 survey. These variations are provided in the MMIA (section 5.5.1) and those relevant to the duties of observers are copied below:

- Only one trained and qualified MMO will be on board the KTIV for the acoustic source testing and for the duration of the VSP, and will maintain a watch for marine mammals while the acoustic source is in the water (during daylight hours);
- Two DOC-approved PAMOs will be on board the support vessel for the duration of the survey, where PAM is to be operational at all times while the seismic source is active. The deployment of two PAMOs will account for the possibility of VSP operations exceeding 12 hours in any 24-hour period. The support vessel will be used as the PAM platform 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; and
- If New Zealand (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 active.

This MMMP is otherwise consistent with the Code and MMIA.

4.2 Dedicated observers (MMOs and PAMOs)

A Level 1 survey requires at least two qualified MMOs and two DOC-approved PAMOs on board for the duration of the survey. However, given the short duration of each VSP (~12 hours), DOC requires only one MMO for the acoustic source testing and VSP surveys. In order to account for the possibility of VSP operations exceeding 12 hours in any 24-hour period, STOS have decided to deploy two PAMOs (section 4.1). The training and experience of the observers will meet the requirements stipulated in section 3.4 of the Code.

For Level 1 surveys, at least one qualified MMO (during daylight hours) and two PAMOs (24 hours) are required to maintain a watch for marine mammals at all times the acoustic source is in the water in the operational area and for pre-start procedures.

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 PAMOs will be on the support vessel. Communications between the observers will be facilitated by way of handheld radio in the first instance, and ship phone or VHF as a backup. Observers may stand down from active observational duties while the acoustic source is in the water but inactive for extended periods.

It is recommended that:

- MMOs conduct daylight observations from half an hour before sunrise to half an hour after sunset;

- Fatigue and effective watch-keeping be managed by limiting watches to a maximum of 4 hours;

- The maximum on-duty shift duration must not exceed 12 hours in any 24-hour period, and

- Undertaking work-related tasks, such as completing reporting requirements while monitoring equipment is allowed during duty watch, but PAM operators must not be distracted by non-work activities such as listening to music or watching TV/DVDs, etc.

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. Any qualified observer on duty has the authority to delay the start of operations or shut down an active survey according to the provisions of the Code. In order to work effectively, clear lines of communication are required and all personnel must understand their roles and responsibilities with respect to mitigation.

It is recommended that:

- Where possible, both the MMO and a PAMO must be on watch during pre-start observations and soft starts;

- While on transit to the prospect the observers deliver a presentation to crew members detailing observer roles and mitigation requirements;

- 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).

4.2.1 Safety drills

Attendance at a safety drill at least once during each swing is typically mandatory (e.g. the vessel/rig HSE plan 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. When the acoustic source is active and/or in the water the off-duty PAMO will endeavour to attend drills as required. At other times (e.g. when the acoustic source is inactive or not in the water), the MMO and PAMOs will endeavour to attend drills as required. In all cases, observers must comply with the mandatory safety code of the vessel/rig.

4.2.2 PAM not operational

Section 4.1.2 of the Code states: "*At all times while the acoustic source is in the water, at least one qualified MMO (during daylight hours) and at least one qualified PAM operator will maintain watches for marine mammals*".

The Code defines PAM as *"calibrated hydrophone arrays with full system redundancy"*. BPM has provided full redundancy for this survey by providing two full sets of PAM equipment However, there may be occasions where PAM is not operational.

The Code was first implemented in 2012. In 2013 it was updated. One update relates to times when PAM is not operational. Section 4.1.2 of the Code states that:

"If the PAM system has malfunctioned or become damaged, operations may continue for 20 minutes without PAM while the PAM operator diagnoses the issue. If the diagnosis indicates that the PAM gear must be repaired to solve the problem, operations may continue for an additional 2 hours without PAM monitoring as long as all of the following conditions are met:

- *It is daylight hours and the sea state is less than or equal to Beaufort 4*
- *No marine mammals were detected solely by PAM in the relevant mitigation zones in the previous 2 hours*
- *Two MMOs maintain watch at all times during operations when PAM is not operational*
- *DOC is notified via email as soon as practicable with the time and location in which operations began without an active PAM system*
- *Operations with an active source, but without an active PAM system, do not exceed a cumulative total of 4 hours in any 24 hour period."*

NOTE: The agreed variations to the mitigation measures for this survey mean that only one MMO will maintain watch during operations when PAM is not operational.

It is recommended that MMOs and PAMOs familiarise themselves with this revision to the Code, including the conditions. For clarity, the period that a survey may operate without PAM is a maximum of 2 hours 20 minutes during any single PAM failure event and only when the conditions identified in section 4.1.2 of the Code are satisfied. Once this time is exceeded, the source must be shut down until PAM is operational again.

4.3 Crew observations

As per section 3.8.6 of the Code:

'If a crew member onboard any vessel involved in survey operations (including chase or support vessels) observes what may be a marine mammal, he or she will promptly report the sighting to the qualified MMO, and the MMO will try to identify what was seen and determine their distance from the acoustic source.

In the event that the MMO is not able to view the animal, they will provide a sighting form to the crew member and instruct on how to complete the form. Vessel crew can relay either the form or basic information to the MMO. If the sighting was within the mitigation zones, it is at the discretion of the MMO whether to initiate mitigation action based on the information available. Sightings made by members of the crew will be differentiated from those made by MMOs.'

4.4 Mitigation procedures

During the survey, STOS will adhere to the mitigation measures stipulated in the Code for Level 1 surveys and Borehole seismic surveys classifications. There are some variances to these measures due to the nature of VSPs compared to conventional marine seismic surveys (i.e. a lower acoustic volume undertaken in a single location with a considerably shorter survey duration of ~12 hours). These variances have been approved by DOC (refer section 5.5.1 of the MMIA and section 4.1 of this MMMP).

An overview of the main mitigation procedures is provided in Figure 3. The proponent will observe the following mitigation practices:

4.4.1 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. The operational area is defined by the following coordinates (Table 1) and has been loaded into VADAR for real time monitoring of vessel/rig location and marine mammal detections relative to the operational area.

Table 1: Survey operational area coordinates.

Longitude (decimal degrees West)	Latitude (decimal degrees South)
173.3465	-39.5605
173.5636	-39.5601
173.5661	-39.7176
173.3473	-39.7179

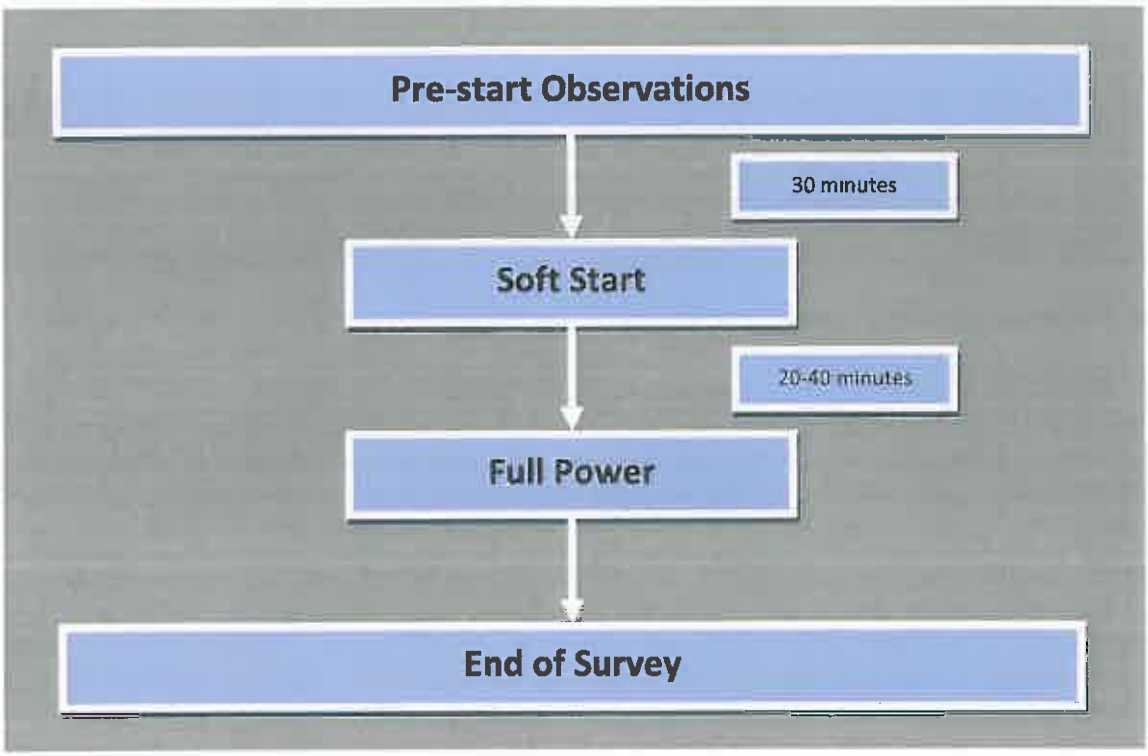


Figure 3: Overview of main mitigation procedures for the survey.

4.4.2 Operational capacity

The operational capacity of the acoustic source is notified in the MMIA and outlined in section 2 of this MMMP. This operational capacity should not be exceeded during the survey, except where

unavoidable for source testing and calibration purposes only[3]. All occasions where activated source volume exceeds notified operational capacity must be fully documented in observer reports. It is the responsibility of the operator to immediately notify the qualified observers if operational capacity is exceeded at any stage[4].

4.4.3 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.

Beaufort 3

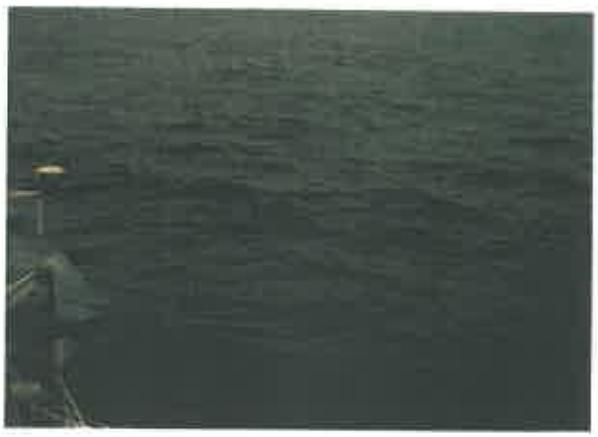
- Gentle breeze: 7–10 knots
- Wave height: 0.5–1 metre
- Large wavelets. Crests begin to break; scattered whitecaps

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 knots
- Wave height: 1–2 metres
- 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

[3] D Lundquist, DOC (25 March 2014): "Please note that if the operational capacity is exceeded at any other time (including soft starts), this is a non-compliance incident and should be reported as such."
[4] D Lundquist, DOC (25 March 2014): "qualified observer should be able to monitor this via a dedicated screen as described in section 3 [of this MMMP]."

4.4.4 Pre-start observations

A Level 1 acoustic source can only be activated if it is within the specified operational area, and no marine mammals have been observed or detected in the relevant mitigation zones as outlined in section 4.6.

An update to the Code in 2013 (section 4.1.3) relates to commencement of operations in a new location in the survey programme for the first time. When arriving at a new location the initial acoustic source activation must not be undertaken at night or during poor sighting conditions unless either:

- The MMO[5] has undertaken observations within 20 nautical miles of the planned start up position for at least the last 2 hours of good sighting conditions preceding proposed operations, and no marine mammals have been detected; or
- Where there have been less than 2 hours of good sighting conditions preceding proposed operations (within 20 nautical miles of the planned start up position), the source may be activated if[6]:
    - PAM has been conducted for 2 hours immediately preceding proposed operations, and
    - The MMO[7] has conducted visual monitoring in the 2 hours immediately preceding proposed operations, and
    - No Species of Concern have been sighted during visual monitoring or detected during acoustic monitoring in the relevant mitigation zones in the 2 hours immediately preceding proposed operations, and
    - No fur seals have been sighted during visual monitoring in the relevant mitigation zone in the 10 minutes immediately preceding proposed operations, and
    - No other marine mammals have been sighted during visual monitoring or detected during acoustic monitoring in the relevant mitigation zones in the 30 minutes immediately preceding proposed operations.

It is recommended that MMOs and PAMOs familiarise themselves with this revision to the Code including the conditions.

When continuing seismic operations at a given location, the source cannot 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 binoculars and the naked eye, and no marine mammals (other than fur seals) have been observed in the relevant mitigation zones for at least 30 minutes, and no fur seals have been observed in the relevant mitigation zones for at least 10 minutes; and

[5] The Code stipulates that more than one MMO should undertake these observations, however, the agreed variations to the mitigation measures for this survey mean that only one MMO is on board.

[6] D Lundquist, DOC (25 March 2014): "Please note that this option may only be used if there have not been two hours of good sighting conditions preceding operations. It cannot be used if there were 2 or more hours of good sighting conditions and marine mammals were sighted (i.e., the second option may only be used if weather conditions prevented the first condition being met, not if marine mammal presence prevented the first condition being met)."

[7] The Code stipulates that two MMOs should conduct this visual monitoring, however, the agreed variations to the mitigation measures for this survey mean that only one MMO is on board.

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

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

When continuing seismic operations at a given location, the source cannot be activated during night-time hours or poor sighting conditions unless:

- PAM for the presence of marine mammals has been carried out by a qualified PAMO for at least 30 minutes before activation, and
- The qualified observer has not detected vocalising cetaceans in the relevant 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.

4.4.5 Acoustic source tests

The soft start procedure (section 4.4.6) will be applied to testing of the acoustic array, though the 20-minute minimum does not apply. The soft start procedure does not apply if the maximum combined source capacity being tested is equal to, or less than, 150 in^3. Given that the anticipated acoustic source will comprise an airgun array of two 250 in^3 airguns, soft start procedures will be adhered to for gun testing activities during this survey.

4.4.6 Soft starts

The soft start procedure will be followed every time the acoustic 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 acoustic source in the array. The MMIA for the survey (section 2.3) describes the soft start procedures to be conducted as:

- *"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."*

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 is when the acoustic source is being reactivated after a single break in firing (not in response to a marine mammal observation within a mitigation zone) of less than 10 minutes immediately following normal operations at full power (see section 3.8.10 of the Code). However, it is not permissible to repeat the 10-minute break exception from soft start requirements by sporadic activation of acoustic sources at full or reduced power within that time.

Explanatory note from MMIA "If there are operational delays to the VSP, 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 minute of soft start firing would, keeping the VSP in continuous operations."

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 prestart requirement), and will occur only once. If the operational delay takes longer than 20 minutes to resolve then a full soft start will need to be undertaken before the survey continues

Note: for each swing, 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).

4.5 Species of Concern

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

4.6 Mitigation zones

The Code stipulates standard mitigation zones for Level 1 surveys (refer Figure 4):

1) 1.5 km from the centre of the acoustic source for SOC **with** calves;
2) 1.0 km 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**)[8].

4.6.1 PAM and calves

PAM cannot distinguish calves from adults, the Code therefore requires the proponent to apply the precautionary principle and the 1.5 km mitigation zone for any cetacean SOC detected by PAM.

PAMOs must be familiar with this requirement.

[8] After discussions with DOC during the development of the survey MMIA, mitigation procedures in respect of NZ fur seals have been amended (refer section 4.1 and 4.7.3 for further details).

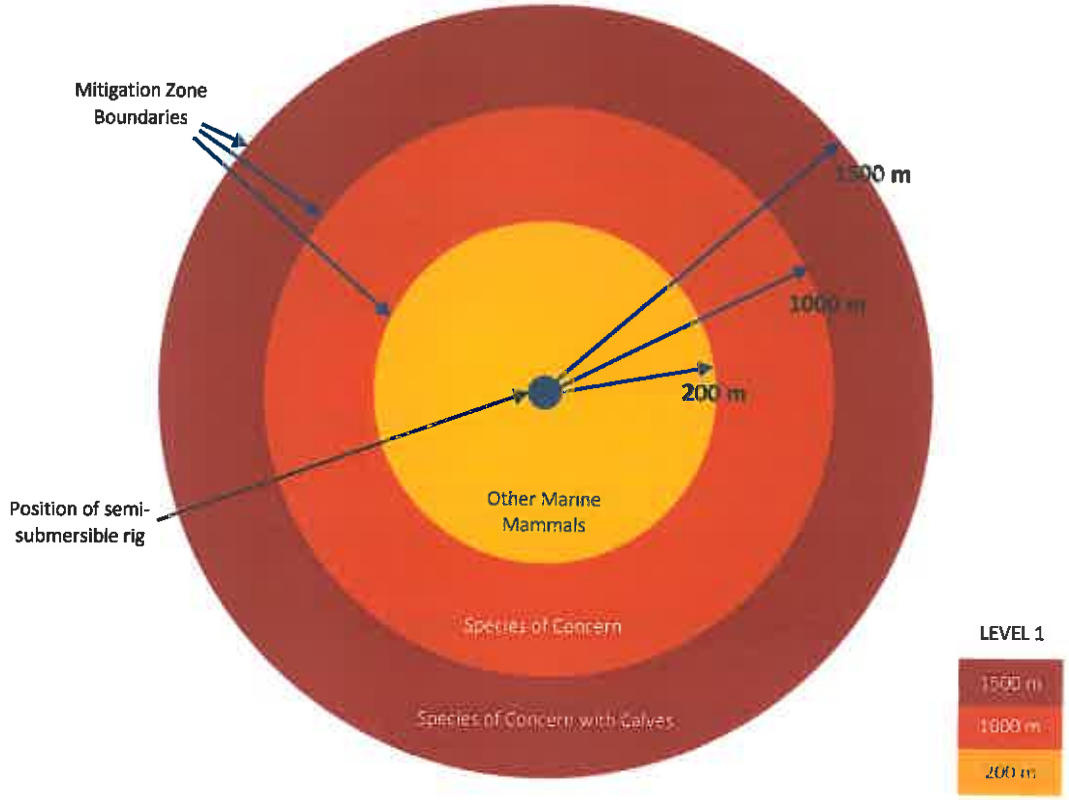


Figure 4: Mitigation zone boundaries for the survey.

4.7 Mitigation actions

In the event that marine mammals are detected by the observer within the designated mitigation zones of **1.5 km, 1.0 km** and **200 m**, the observer will either delay the start of operations or shut down the source. These mitigation actions will apply to:

4.7.1 Species of Concern with calves

If during pre-start observations or when the acoustic source is active (including soft starts) the observer (MMO or PAMO) detects at least one cetacean SOC with a calf within 1.5 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 1.5 km from the source; or
2) Despite continuous observation, 30 minutes has elapsed since the last detection of the group within 1.5 km of the source, and the mitigation zone remains clear.

In regard to cetacean SOC with a calf: note that the requirements above apply to the entire group containing that calf. An explanatory note from DOC[9]: " *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.*"

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

Due to the limited detection range of current PAM technology for ultra-high frequency cetaceans[10] (<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'.

It is also recommended that observers monitor the area immediately beyond the 1.5 km mitigation zone. If SOC are approaching this zone, observers notify the seismic operator that a delay start or shutdown may be required.

4.7.2 Species of Concern without calves

If during pre-start observations or when the acoustic source is active (including soft starts) the observer (MMO or PAMO) detects a SOC (without calves) 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 SOC 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 SOC within 1.0 km of the source, and the mitigation zone remains clear.

Due to the limited detection range of current PAM technology for ultra-high frequency cetaceans[11] (<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'.

4.7.3 Other Marine Mammals

If, during pre-start observations prior to initiation of a Level 1 acoustic source soft start, a qualified observer detects a marine mammal (other than NZ fur seals – see section 4.7.4) 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 any other marine mammal within 200 m of the source, and the mitigation zone remains clear.

If all mammals detected within the relevant mitigation zones are observed moving beyond the respective areas, there will be no further delays to initiation of soft start.

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.

[10] For the purposes of the Code, ultra-high frequencies are defined as those between 30 and 180 kHz - e.g. Maui's or Hector's dolphins.
[11] For the purposes of the Code, ultra-high frequencies are defined as those between 30 and 180 kHz - e.g. Maui's or Hector's dolphins.

4.7.4 Other Marine Mammals – New Zealand fur seals

The MMIA approved by DOC specifies that mitigation requirements for NZ fur seals may be amended during the survey programme as follows: delay to soft start procedures will not be required for NZ fur seals. However, the survey may proceed on the following basis:

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 NZ fur 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.

MMOs should pay particular attention to the reactions and behaviour of NZ fur seals in close proximity to the 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.

4.7.5 Mitigation posters and summary

Refer to Addenda 2 of this MMMP for posters detailing mitigation action procedures.

5. Further Mitigation Measures

No additional mitigation measure will be implemented during this survey.

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 survey.

If a situation arises that requires a more direct line of communication from the observers to DOC, then the MMO Team Leader is to first inform the Party Chief of the issue and intended action. 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 (If a response is required urgently then telephone, but in all other circumstances use email. Should Ian Angus be unavailable, please phone 0800DOCHOT and state the information as outline in section 3.1.

For any Maui's/Hector's dolphin sighting also contact (rom the Taranaki office of DOC on) 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 2: Events that require DOC to be notified.

Situation	Timing of notification	Comments
The PAM system becomes non-operational	Immediate	This refers to when both primary and backup systems are non-operational
Any instances of non-compliance with the Code	Immediate	This is a standard requirement under the Code and includes instances where the operational capacity notified in the MMIA is exceeded – refer section 4.4.2 of this MMMP.
Observation of any dead marine mammals seen in the operational area	Immediate	MMOs should report to DOC immediately any dead marine mammals seen in the survey operational area
If PAM is being repaired, and operations continue without active PAM for maximum of 2 hours 20 mins per event	As soon as practicable	DOC is notified via email as soon as practicable with the time and location in which operations began without an active PAM system (Code 4.1.2)
Sighting of a Maui or Hector's dolphin	Immediate	MMOs should report to DOC immediately any Maui or Hector's dolphin seen in the survey operational area

Addenda 1: Species of Concern as defined in the Code

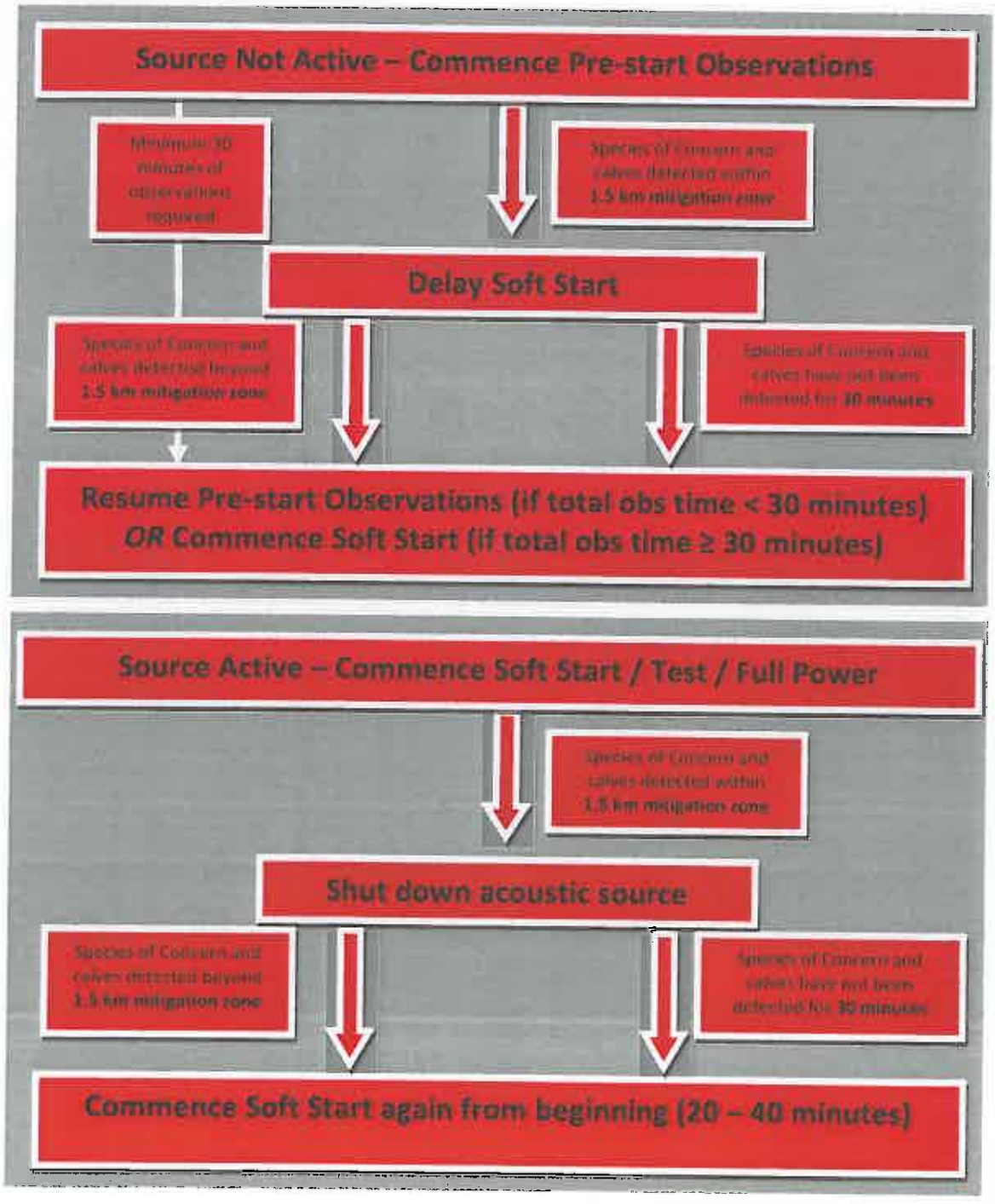
Common name	Latin name
Andrew's beaked whale	*Mesoplodon bowdoini*
Antarctic minke whale	*Balaenoptera bonarensis*
Arnoux's beaked whale	*Berardius arnuxii*
Blainville's beaked whale	*Mesoplodon densirostris*
Blue whale	*Balaenoptera musculus*
Bottlenose dolphin	*Tursiops truncatus*
Bryde's whale	*Balaenoptera 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*

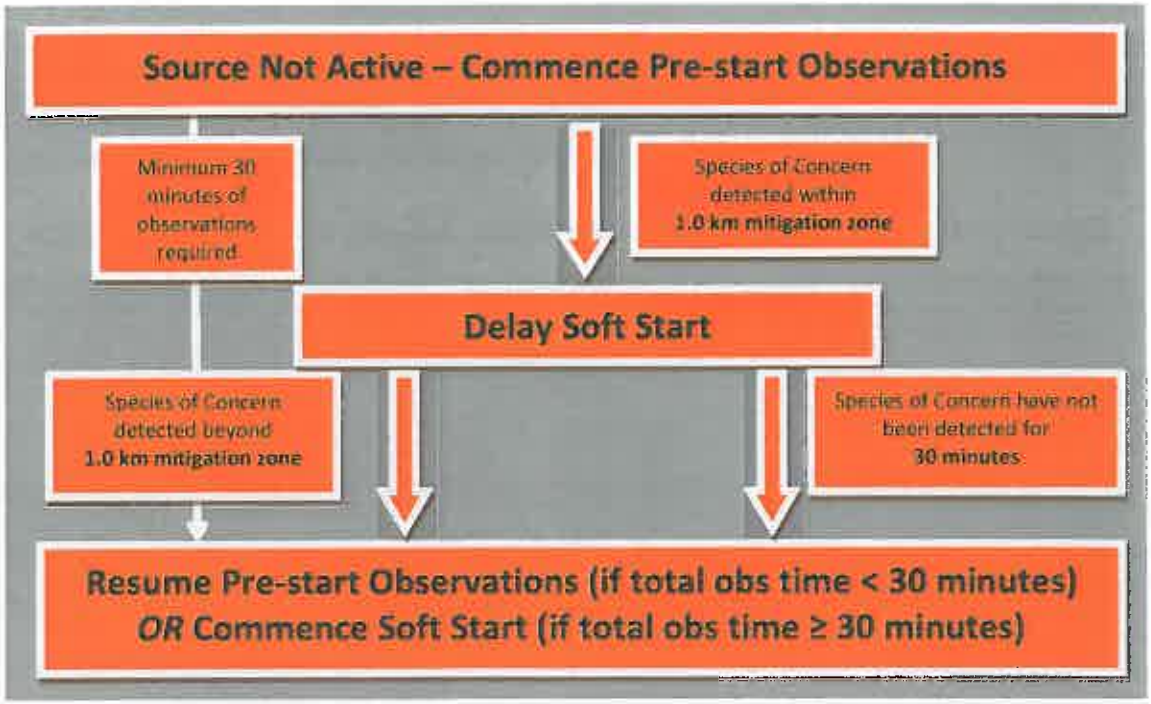
Addenda 2: Mitigation Procedures – Good Sighting Conditions (poster format)

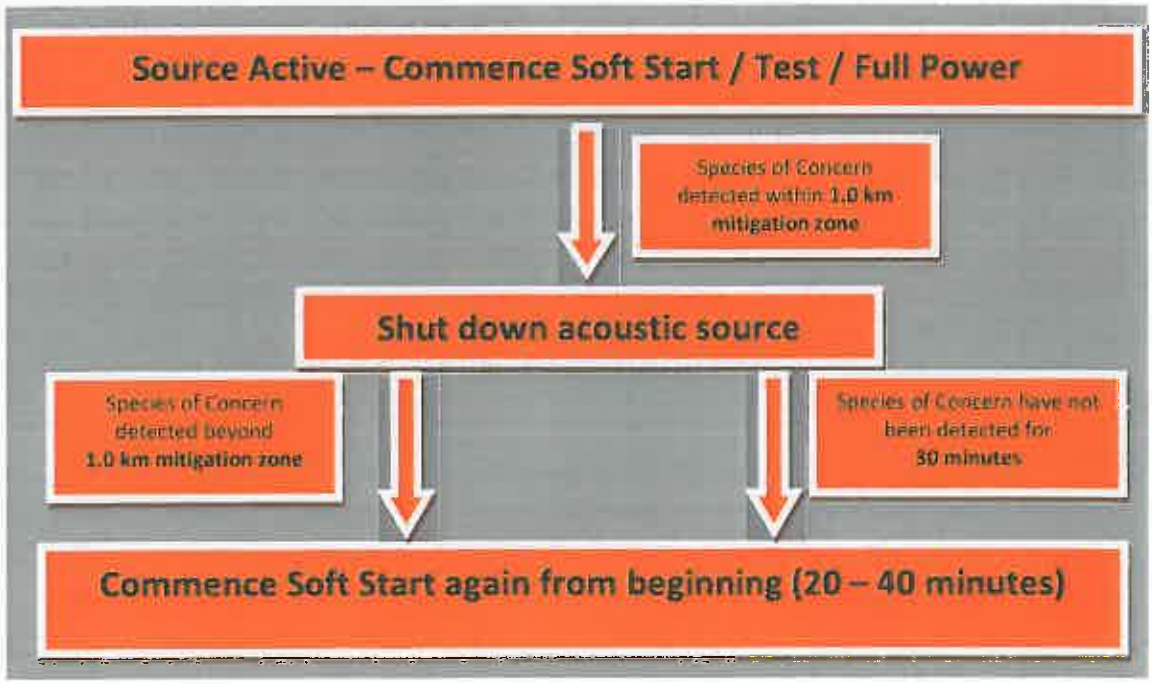
The following posters depict mitigation procedures. It is recommended they be posted in the instrument room, the PAM station and on the bridge. Operational flowcharts are also found in Appendix 4 of the Code.

Species of Concern with Calves within 1.5 km of Acoustic Source



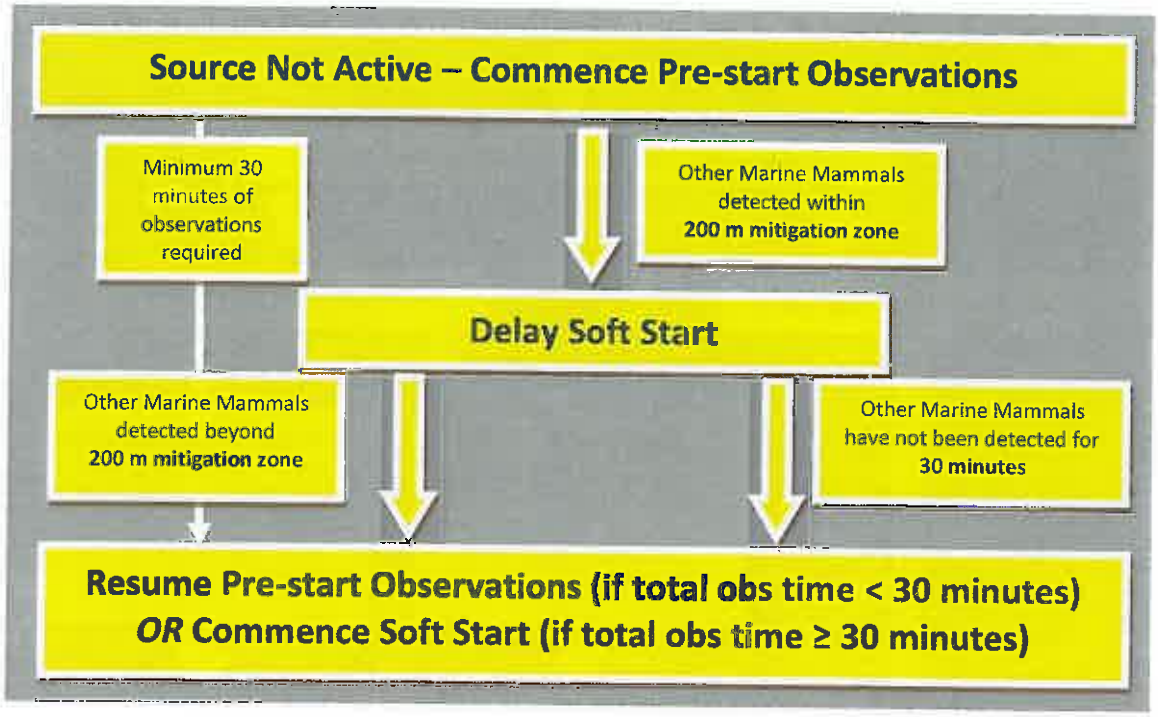
Species of Concern (no Calves) within 1.0 km of Acoustic Source



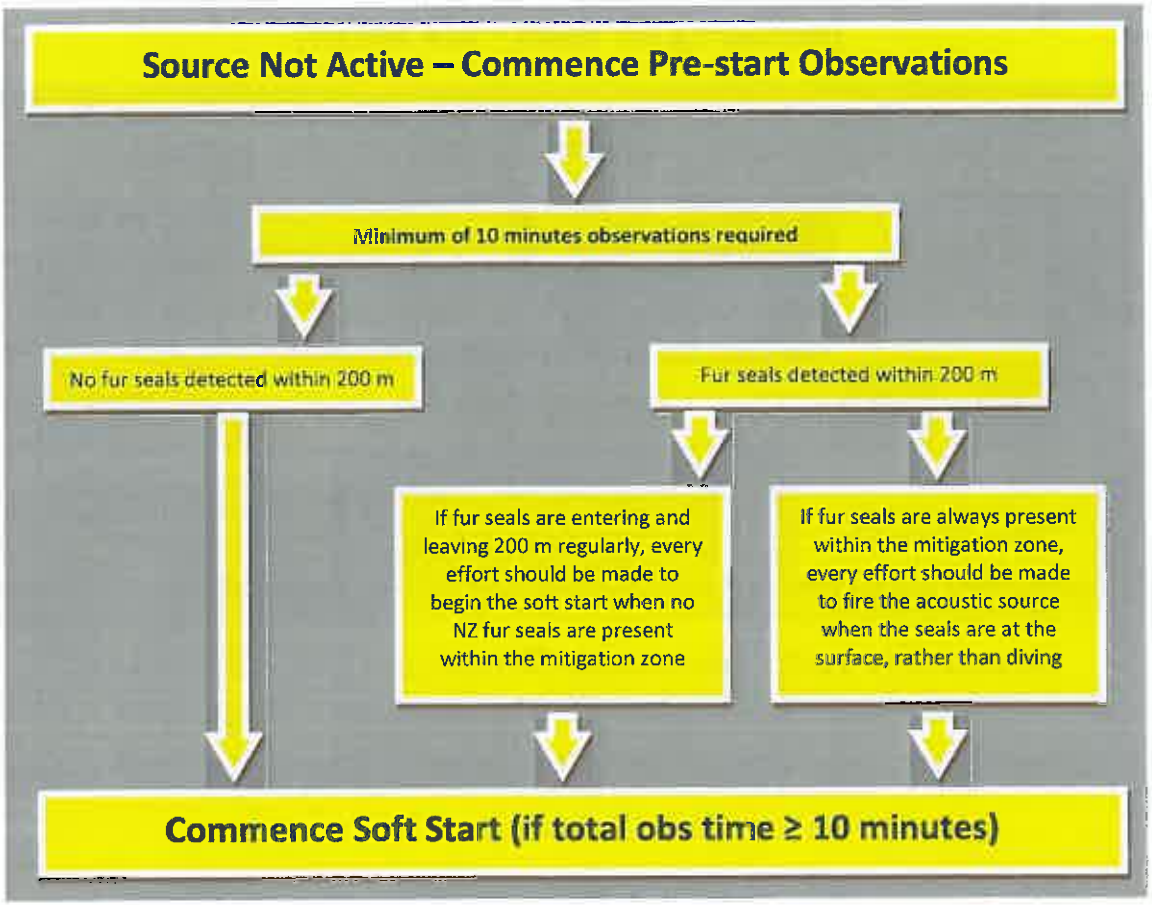


Other Marine Mammals within 200 m of Acoustic Source

(excluding fur seals – see below)



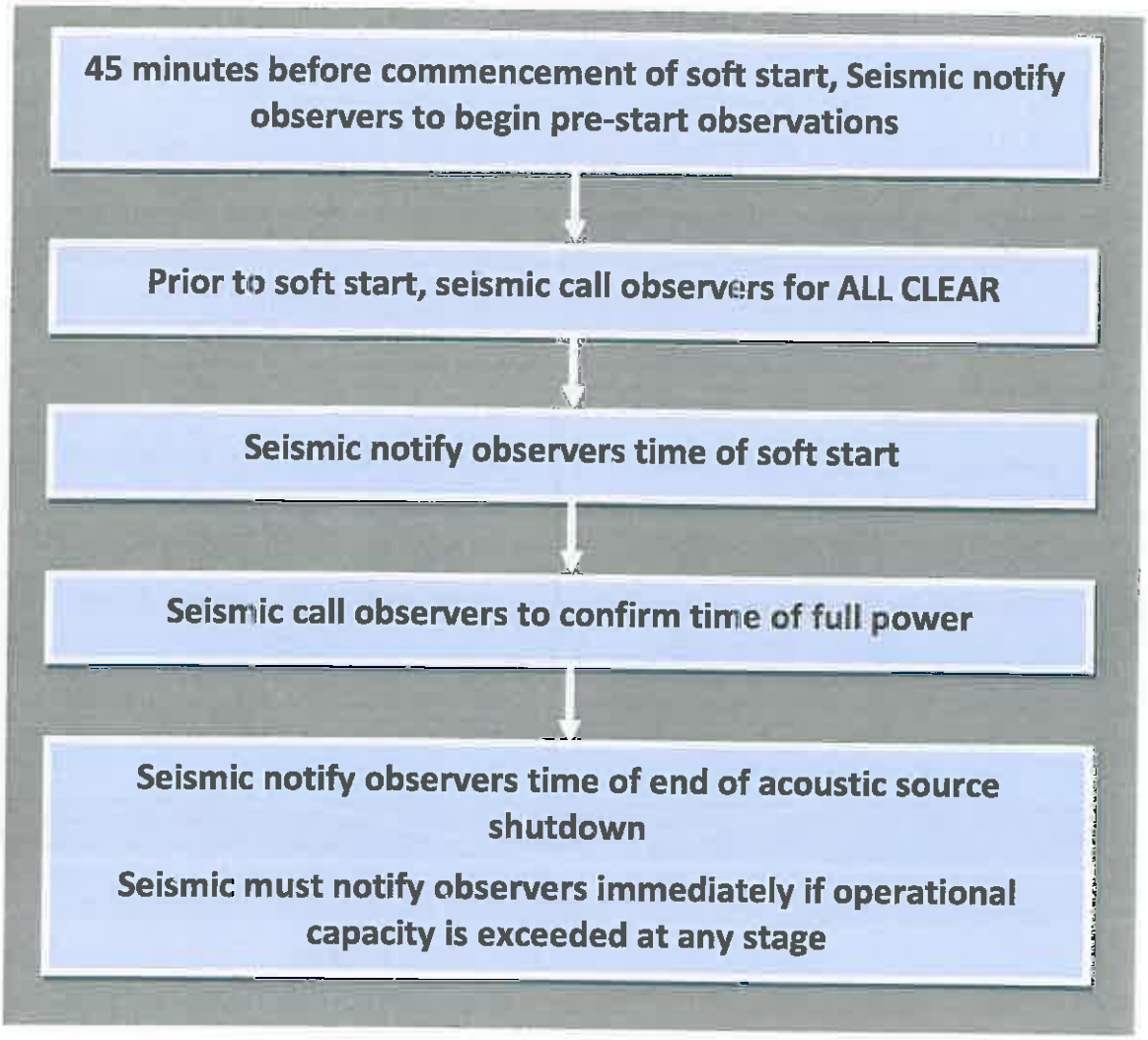
NZ fur seals within 200 m of Acoustic Source



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 acoustic source

Normal Operations - No Marine Mammal Sighting/Detection



Delayed Soft Start or Shutdown – Marine Mammal Sighting/Detection