

## Supplementary Form A – Whales and Dolphins (cetaceans) – Attachments

### Attachment 1: Predicted areas of operation for seismic commissioning and surveys

This permit application is intended to cover all Australian Commonwealth waters and international waters (New Zealand). However, see below for intended areas of operation for known seismic commissioning and survey activities on board RV *Investigator* within the next five years (the period of time this application is relevant to).

#### IN2019\_E01 (Seismic Commissioning)

During the voyage IN2019\_E01, the intended area of operation for the initial commissioning of the seismic system is between the following two waypoints: 9° 5.76'S; 132° 43.02'E and 11° 11.40'S; 139° 22.08'E (see Figure 1).

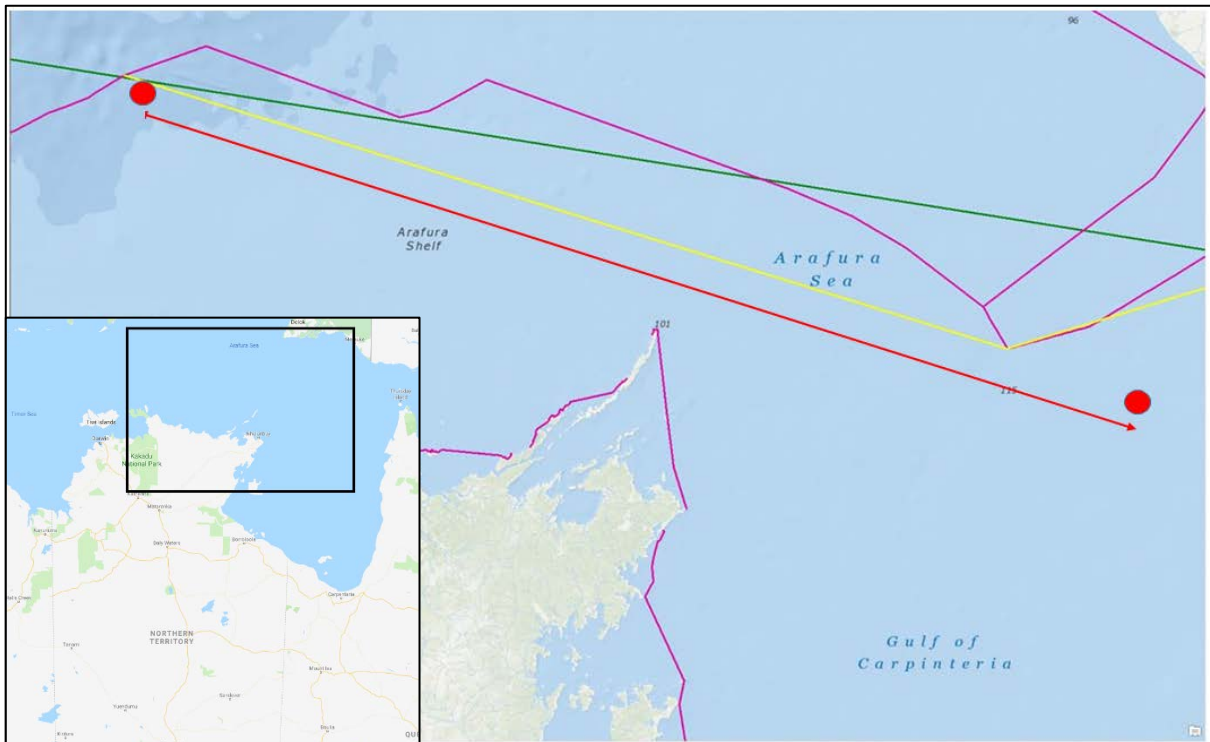


Figure 1: Map showing the intended area of operation for the seismic commissioning during voyage IN2019\_E01 (between the two red waypoints).

#### IN2020\_V01 (Coffin)

The proposed area of operation is William's Ridge (between 51°S-56°S and 77°E-85°E) and Broken Ridge (between 30°S-35°S and 93°E-103°E) in the Indian Ocean (see Figure 2).

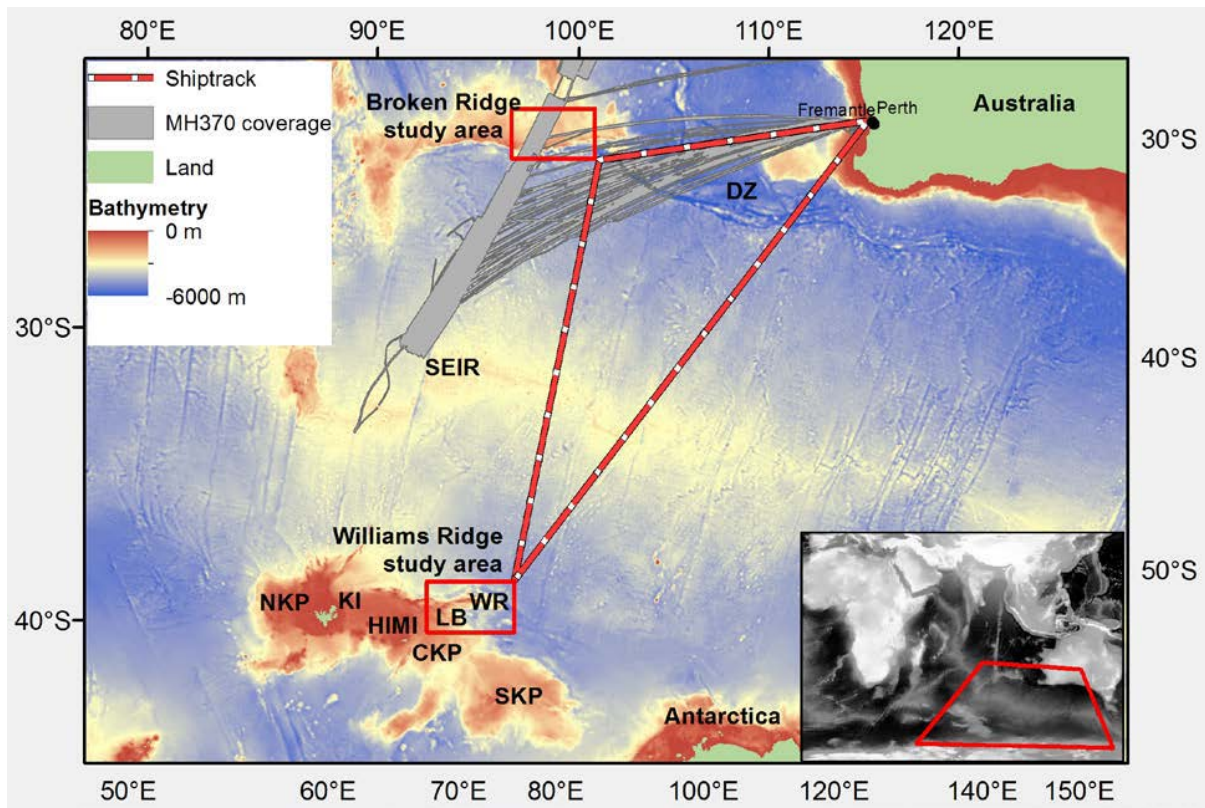


Figure 2: Map showing the intended area of operation for seismic surveys during voyage IN2020\_V01.

IN2020\_V07 (Jutzeler)

The location of the three volcanoes which will form the areas of operation for the voyage are shown below and Figure 3:

- Macauley caldera volcano: 30°12S, 178°29W
- Havre caldera volcano: 31°06'S, 179°02'W
- Healy caldera volcano: 35°S, 179°E

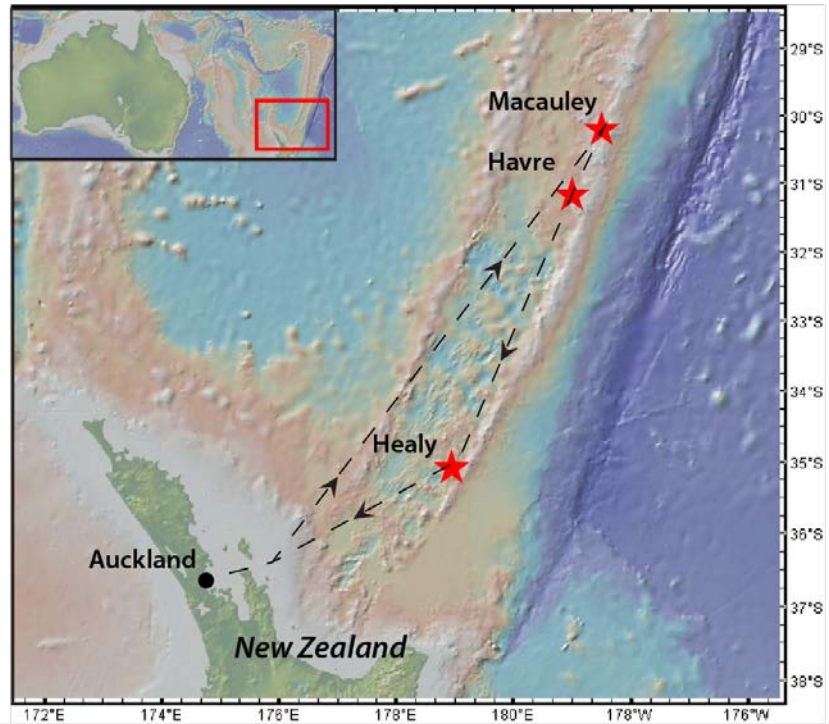


Figure 3: Intended areas of operation for IN2020\_V07.

IN2021\_V03 (Meekan)

The corners of latitude and longitude bounding the intended area of operation for this voyage are 16° 42' S, 120° 18' E; 16° 42' S, 121° 22' E; 18° 23' S, 121° 22' E; 18° 23' S, 120° 18' E (see Figure 4).

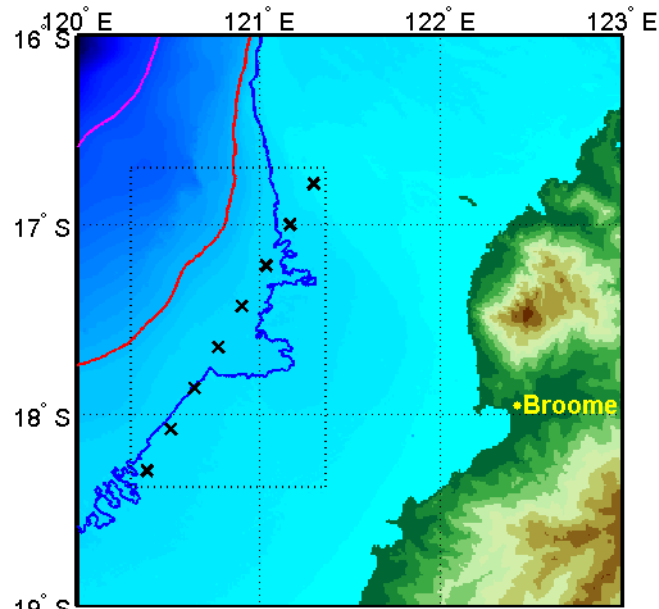


Figure 4: Map showing the intended area of operation for seismic surveys during voyage IN2021\_V03.

## **Attachment 2: The equipment and methods used to comply with the EPBC Act Regulations**

### ***Commissioning of the air guns***

Over 3-4 days during daylight hours, we intend to trial the deployment, operation and retrieval of 2 GI guns and 1-2 lengths of active streamer (maximum length: 225 m), recently procured by the Marine National Facility (MNF) in order to conduct scientific research onboard RV *Investigator*. These operations will be conducted by ASP deck crew and MNF Field Operations personnel, and are aimed at identifying safe working procedures for deployment and retrieval, as well as commissioning and validating the new seismic equipment. The GI guns will be operated periodically for some, but not all, of that time, observing all required precautions. The guns have previously been operated on RV *Investigator* during 2017, in a configuration identical to that proposed here, under Cetacean Permit C2016 - 0005.

Further commissioning and testing of the seismic system may occur during future trial and calibration voyages on board RV *Investigator* in different locations, and will be conducted using the same protocol and measures described here.

### ***Seismic surveys***

Planned seismic survey activities on board RV *Investigator* over the next two years (the period of time applied for in this permit application) are summarised below.

#### IN2020\_V01 (Coffin) – Development of William’s Ridge, Kerguelen Plateau: tectonics, hotspot magmatism, microcontinents, and Australia’s Extended Continental Shelf

This expedition to the Indian Ocean in January-March 2020 will focus on William’s Ridge, part of Earth’s second largest submarine plateau, the Kerguelen Plateau, and on the once adjoining Broken Ridge.

Along with the collection of multibeam bathymetry, backscatter, gravity, water column echo sounding and sub-bottom profiling data, this voyage intends to collect seismic reflection data. This will be achieved by conducting four ~60 nautical mile long profiles perpendicular to the strike of William’s Ridge, two ~60 nautical mile long profiles perpendicular to the strike of Broken Ridge, and one 200 nautical mile long profile along the strike of William’s Ridge on its crest following multibeam and sub-bottom profile data acquisition that defines the feature’s bathymetry and shallow sediment cover. Seismic reflection data acquisition will be undertaken at 5 kts, and transits between lines will be conducted at 10 kts, requiring a total of eight days. Seismic reflection data have not been acquired previously from William’s Ridge, and are needed to address the structural, tectonic and ECS objectives of this project.

This project will require additional permitting issued under the Territory of Heard Island and McDonald Islands (HIMI) Environment Protection and Management Ordinance 1987 (the EPMO) to operate and conduct research within the Heard Island and McDonald Islands (HIMI) Marine Reserve.

#### IN2020\_V07 (Jutzeler) – Sedimentation at its extreme: how powerful are submarine caldera-forming eruptions (Kermadec arc)?

This expedition in October-November 2020 will collect new information on volcanoes responsible for the largest types of volcanic eruptions, focusing on those located along the submarine Kermadec volcanic arc, northeast of New Zealand. The voyage will target three massive caldera volcanoes (Macauley, Havre and Healy), aiming to acquire their internal structure to infer eruption style and depositional processes. Seismic reflection profiles will be conducted to allow geometrical and volumetric characterisation of thick sub-seafloor volcanic sediment packages. Seismic reflection data

acquisition will be undertaken at 5 knots (120 miles/day), and transits between the lines will be conducted at 10 knots. Total seismic reflection survey will be 5.5 days (2.5 days at Macauley, 2.5 days at Havre, 0.5 day at Healy). Watches for marine mammals will be organised during seismic surveys, and operations will be immediately stopped in case of encounter.

As this project is being conducted within a protected zone administered by New Zealand, additional permit applications will be made to the New Zealand Government, separate from this permit application.

### IN2021\_V03 (Meekan) – Evaluating the impact of seismic surveys on the zooplankton communities of the North West Shelf

This voyage, in May-June 2021, will address the question: do the high energy impulse signals generated during seismic surveys for oil and gas in marine systems significantly impact zooplankton populations? Specific aims are to:

- Determine if the distribution, abundance, behaviour, biology and mortality of zooplankton in an area off the north-west coast of Western Australia are significantly altered by marine seismic survey operations.
- Identify potential mechanisms for injury associated with any impacts generated by seismic survey operations.

This project will deploy a full-scale commercial seismic array on the RV *Investigator* and document the effect of seismic surveys on the plankton community on the shelf and offshore. The work will describe the distribution, abundance, behaviour and mortality of plankton using a variety of techniques including sonar surveys, plankton nets and pumps and light traps. Zooplankton exposed to surveys will be held in the laboratory on board to examine behaviour, growth and reproduction rates. Using a combination of gene expression, immunological and histology studies we will seek to understand the mechanisms underlying any documented impacts on the zooplankton community. This study will employ a before-after-control-impact (BACI) and dose-response (DR) sampling design to assess responses of zooplankton exposed to a seismic survey source that will be operated from the RV *Investigator*. One seismic line will be conducted each day, for eight days, alternating between lines with airguns operational and inactive, providing four experimental replicates in 'exposed' and 'vessel control' treatments, respectively.

#### **Source characteristics and exposure thresholds**

The seismic commissioning will use 2 Sercel Generator-Injector (GI) airguns with a combined capacity of 6.88 litres. This represents a volume of about 10% of a typical airgun array used in petroleum industry surveys. GI guns can be used in airgun mode where the entire volume is used to generate sound, or in GI gun mode where about 60% of the air is injected into the initial bubble to prevent bubble collapse and produce a cleaner signal. The airguns will be towed about 30 m behind the vessel during trials.

Breitzke et al. (2008) measured the source level of a single GI gun in airgun mode and found a source sound exposure level of 202 dB re 1  $\mu\text{Pa}^2 \text{ s}$  @ 1 m. They also measured a 3 GI gun array, finding a sound exposure level of 211 dB re 1  $\mu\text{Pa}^2 \text{ s}$  @ 1 m. In the absence of measurements for 2 GI guns, we have estimated the source level of 2 GI guns as double that of one i.e. 208 dB re 1  $\mu\text{Pa}^2 \text{ s}$  @ 1 m. This source level is below the threshold for injury for a single pulse suggested by Southall et al. (2007) and below the level for injury for multiple pulses within a few meters of the guns. It also means that the Department of Environment preferred threshold for Temporary Threshold Shift (TTS) in whale hearing of 160 dB re 1  $\mu\text{Pa}^2 \text{ s}$  @ 1 m is reached at 251 m from the source, assuming

spherical spreading of the sound. This means that the TTS threshold will be reached in a circle much less than 1 km and that extends about 130 meters in front of the vessel. The 2 GI gun array has a source level comparable to some natural sound sources. For instance, icebergs produce source levels of 220-245 dB re 1  $\mu$ Pa-rms @ 1 m with similar frequency content to airguns (Matsumoto et al. 2014). Meanwhile, earthquakes and submarine volcanic eruptions have been shown to generate sound pressure levels in excess of 200 dB re 1  $\mu$ Pa (Miller et al. 2002). A single GI gun produces 216 dB re 1  $\mu$ Pa-rms @ 1 m and 3 GI guns produce 225 dB re 1  $\mu$ Pa-rms @ 1 m (Breitzke et al. 2008).

In summary, the seismic source for the proposed survey will produce sound pulses which will be within the range of natural sources and below TTS levels beyond 251 m from the airgun.

### ***Area of operation***

The maps in Attachment 1 indicate known areas of operation for seismic commissioning and surveying on board RV *Investigator* within the next two years. However, due to the variability in the location of these activities and the potential for additional seismic activities to occur during voyages in other areas, we are applying for a permit to cover all Commonwealth waters off the mainland and Tasmania, along with international waters (New Zealand). There are 46 species of cetacean listed as occurring in Australia's Commonwealth waters, along with a number of sea bird species.

The sea birds will not be affected by the survey because it involves no fishing activities, is well away from potential breeding sites and the vessel has best practise waste management plans that prevent discharges that may attract birds. The interaction with cetaceans will be minimised as set out below.

### ***Cetaceans in the area of operation***

Intended areas of operation shown for the proposed actions are flexible. As such, exact deployment sites are able to be modified in order to minimise potential interactions with cetaceans in the area.

It is difficult to assess the numbers of cetaceans likely to be encountered in any particular area off the Australian or New Zealand coastline, as the distribution of cetaceans is not uniform. The estimated number of cetaceans that will be affected by the proposed activities (shown in column 4 of the table in Part 1 of Supplementary Form A – Whales and Dolphins) have been significantly scaled up to account for the possibility of encountering a large pod of dolphins or whales and represent a large overestimation of the numbers that will likely be encountered based on data available in the Atlas of Living Australia and National Marine Mammal Database. The results of a search of the Atlas of Living Australia for all cetacean records for Australia's Exclusive Economic Zone (EEZ) is shown in Figure 5 below.



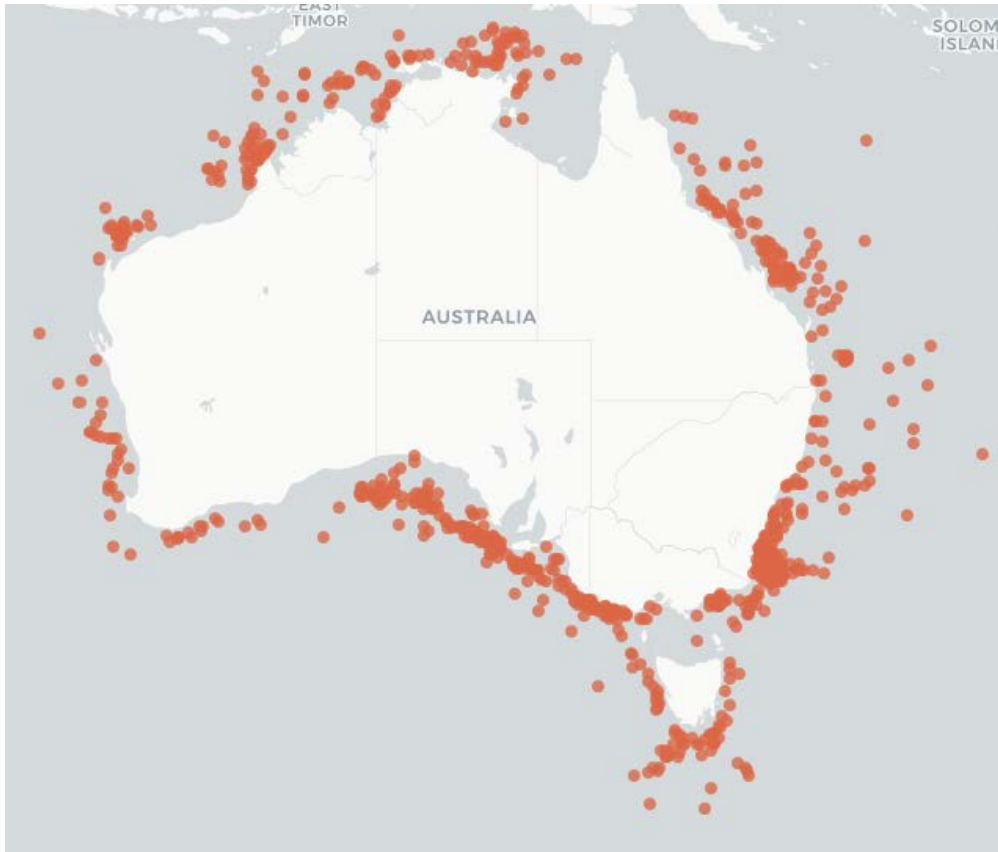


Figure 5: All cetacean occurrence records within the Atlas of Living Australia for Australia’s Exclusive Economic Zone (EEZ).

The nature of encounters with the proposed action will also be different to encounters by cetacean surveys. In dedicated cetacean surveys, an encounter is an observation within a visual radius from the observer ship. This observable radius is much larger than the TTS radius for the GI guns. The estimated encountered numbers means a small number of whales could be within audible range of the airgun. The survey will target a very small proportion of the total habitat used by cetaceans. The small source will be audible to a few whales that represent a small proportion of the total whale population using the waters of Australia’s Commonwealth marine areas. Though audible, the source will not exceed TTS levels unless a whale is very close to the airgun (<251 m). This will be managed by standard mitigation strategies.

**Mitigation methods**

Personnel will include a dedicated observer who will be stationed on the vessel bridge during airgun operations, in accordance with the mitigation methods set out in EPBC Act Policy Statement 2.1 - Interaction between offshore seismic exploration and whales (Department of Environment, Water, Heritage and the Arts, September 2008). Airgun operations will be conducted under the other considerations of the EPBC Act Policy Statement 2.1., including pre start-up visual observations, soft start procedures, start-up delay procedures and stop work procedures. A soft start will be achieved using one airgun at the start.

When operating in areas with an increased likelihood of encountering cetaceans (i.e. within migration routes during known migration seasons or within Biologically Important Areas), the following additional mitigation measures will be employed:

- Use of an additional observer.
- Target operation to daylight hours only, as much as practicable.

## References

Atlas of Living Australia occurrence download at

[https://regions.ala.org.au/Other%20regions/Exclusive%2520Economic%2520Zone#group=Mammals&subgroup=Dolphins,+Porpoises,+Whales&guid=urn%3AIsid%3AAbiodiversity.org.au%3Aafd.taxon%3A8d201546-a692-4bac-9513-eccd069050c4&from=1853&to=2019&tab=speciesTab&fq=taxon\\_concept\\_Isid%3A%22urn%3AIsid%3AAbiodiversity.org.au%3Aafd.taxon%3A8d201546-a692-4bac-9513-eccd069050c4%22](https://regions.ala.org.au/Other%20regions/Exclusive%2520Economic%2520Zone#group=Mammals&subgroup=Dolphins,+Porpoises,+Whales&guid=urn%3AIsid%3AAbiodiversity.org.au%3Aafd.taxon%3A8d201546-a692-4bac-9513-eccd069050c4&from=1853&to=2019&tab=speciesTab&fq=taxon_concept_Isid%3A%22urn%3AIsid%3AAbiodiversity.org.au%3Aafd.taxon%3A8d201546-a692-4bac-9513-eccd069050c4%22) accessed on Fri May 03 11:31:24 AEDT 2019.

Breitzke, M., Boebel, O., El Naggar, S., Jokat, W. and Werner, B., 2008. Broad-band calibration of marine seismic sources used by *R/V Polarstern* for academic research in polar regions. *Geophysical Journal International*, 174, 505-524.

Matsumoto, H. et al. 2014. Antarctic icebergs: A significant natural ocean sound source in the Southern Hemisphere. *Geochemistry, Geophysics, Geosystems*, 15, 3448-3458.

Miller, H., Gohl, K., Uenzelmann-Neben, G., Müller, C., and Jokat, W., 2002. *Polarforschung*, 72, 109-114.

*National Marine Mammal Database search at <https://data.marinemammals.gov.au/nmmdb> accessed on Fri May 03, 2019.*

Southall et al. 2007. Marine mammal noise exposure criteria: initial scientific recommendations. *Aquatic Mammals*, 33, 411-521.

*South-east marine region profile: A description of the ecosystems, conservation values and uses of the South-east Marine Region, Commonwealth of Australia 2015a.*

National Conservation Values Atlas database search at <http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf> accessed Fri May 07, 2019. Commonwealth of Australia 2015b.

## Attachment 3: What steps will be taken to minimise impacts on cetaceans

- The use of a two airgun source is consistent with the Scientific Committee for Antarctic Research (SCAR) recommendation to use the smallest source necessary to achieve survey objectives.
- During commissioning, the minimum level of operation required to sufficiently test the airguns will be conducted.
- During surveys, the minimum level of operation required to achieve the scientific objectives of the project will be conducted.
- Airgun operations will be conducted under considerations of the EPBC Act Policy Statement 2.1., including pre start-up visual observations, soft start procedures, start-up delay procedures and stop work procedures. A soft start will be achieved using one airgun at the start.
- Operations will be undertaken in a location which minimises impact to cetaceans.
- A dedicated observer will be stationed on the bridge during seismic operations.



When operating in areas with an increased likelihood of encountering cetaceans (i.e. within migration routes during known migration seasons or within Biologically Important Areas), the following additional mitigation measures will be employed:

- Use of an additional observer.
- Target operation to daylight hours only, as much as practicable.

#### **Attachment 4: The objectives and purposes of the action**

##### IN2019 E01 (Seismic Commissioning)

The objectives of the seismic commissioning are to test the deployment, operation and retrieval of components of a recently acquired seismic system, procured in order to conduct scientific research on board RV *Investigator*. These components are two GI air guns and 1-2 lengths of streamer (maximum length: 225 m). The purpose of the operation is to train staff in the deployment and retrieval of the equipment and to test its operation. This action does not involve a traditional seismic survey and the minimum data required to validate the system will be collected.

##### IN2020 V01 (Coffin)

The objectives of the voyage are to acquire and analyse rock samples and geophysical data from these ridges to understand how they formed and evolved. The research conducted during this voyage will resolve questions around the plate tectonics of the Indian Ocean, determine if William's Ridge is a continental sliver, help understand massive volcanism triggered by mantle hotspots, and potentially contribute to expanding Australia's sovereign undersea territory.

##### IN2020 V07 (Jutzeler)

The aim of this project is to link the behaviour of deep submarine eruptions with the morphology of their deposits. Modelling calculations of sediment mass fluxes will permit the first-ever hazard mapping scheme for submarine volcanoes globally (tsunami and sediment flows), and provide new ore vectoring strategies for exploration in Australia.

##### IN2021 V03 (Meekan)

Marine seismic surveys produce sound that penetrates the seafloor in order to identify oil and gas deposits. Recent studies suggest that this noise can harm zooplankton. This is important because these small animals form the base of the food chain for all other marine organisms, thus are vital for ocean health. We will examine the scale and significance of impacts of noise from a commercial seismic survey on zooplankton on the NW Shelf, off the coast of WA, using techniques including sonar, net tows and light traps to describe the distribution, abundance, behaviour and mortality of zooplankton.