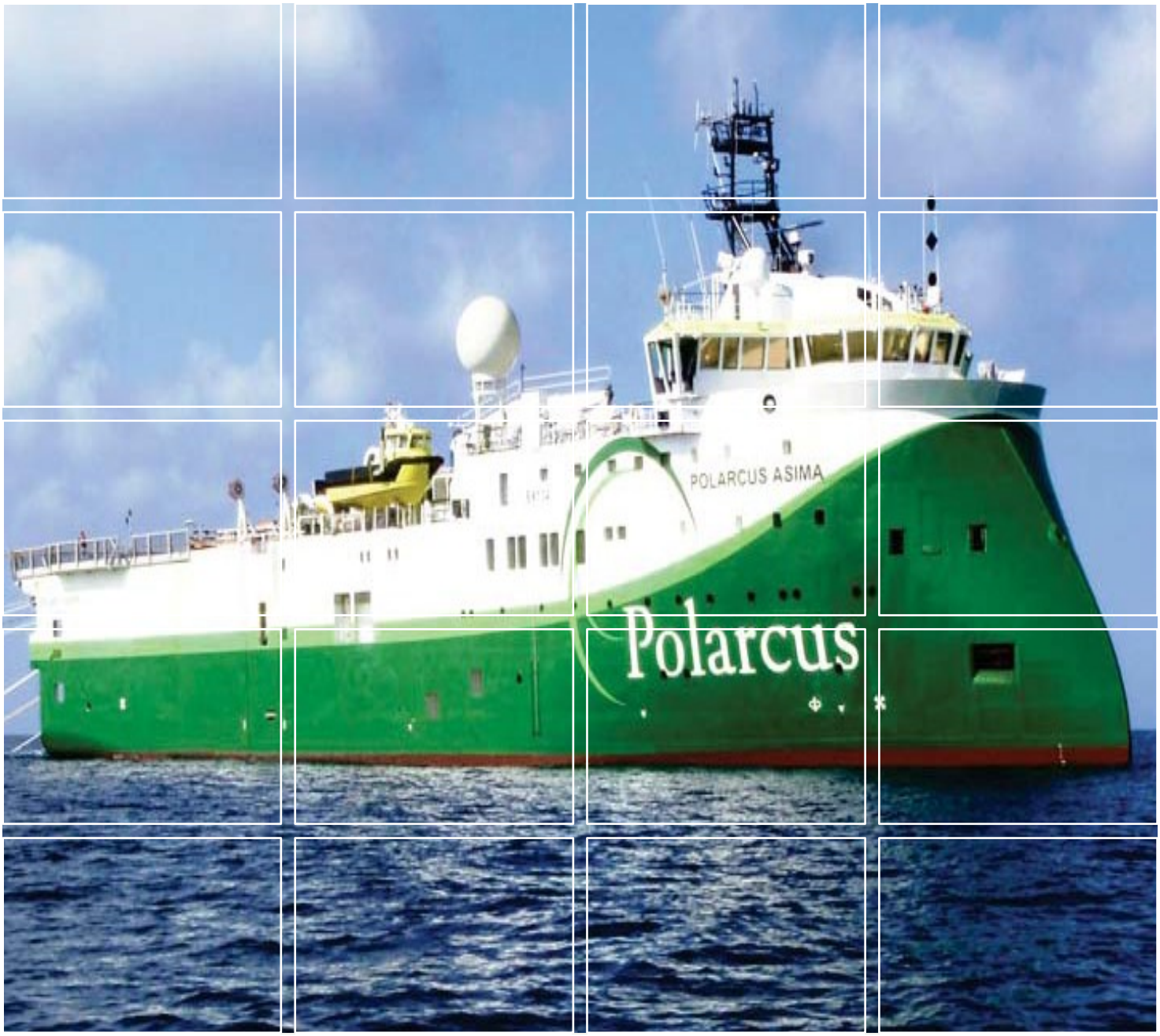

Capreolus 3D Multi-client Marine Seismic Survey 2015:

Enviroment Plan Summary

Polarcus®

Polarcus Seismic Limited

Rev 1

29 January 2015

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1 INTRODUCTION

Polarcus Seismic Limited (Polarcus) proposes to undertake a three-dimensional marine seismic survey (Capreolus 3D MSS) in Commonwealth waters of the Offshore Roebuck Basin, Western Australia, commencing in January 2015 for a period of up to six months. The survey will be undertaken in an area of the North West Shelf located approximately 120 km north of Port Hedland and approximately 320 km west of Broome (*Figure 2.1*).

An Environment Plan (EP) was prepared to meet the requirements of the *Offshore Petroleum and Greenhouse Gas Storage Act 2006 (OPGGS Act)* and the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS (E) Regulations). The EP was submitted to NOPSEMA on 11 November 2014 and accepted on 8 January 2015.

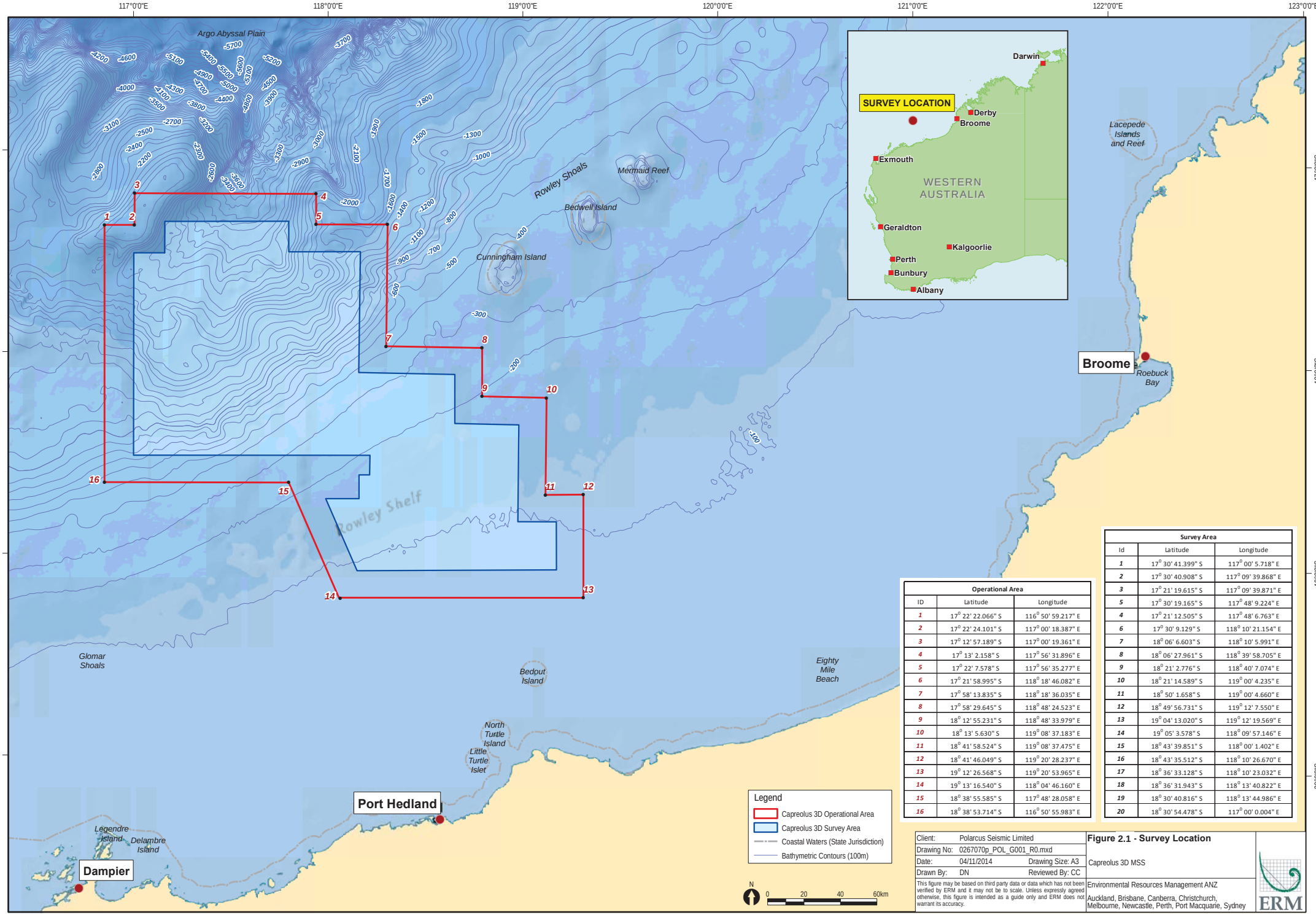
This EP Summary has been prepared in accordance with the OPGGS (E) Regulations to summarise Polarcus' commitment to undertake the Capreolus 3D MSS in a manner consistent with the principles of ecologically sustainable development and that environmental impacts and risks will be reduced to as low as reasonably practicable (ALARP) and acceptable levels.

2 ACTIVITY DESCRIPTION

2.1 LOCATION

The area (including boundary coordinates) within which the Capreolus 3D MSS will be undertaken is shown in *Figure 2.1*.

The survey area, which covers approximately 25,000 square kilometres (km^2), comprises the area within which Polarcus currently anticipate the 3D seismic acquisition will be undertaken. At its closest, the survey area is approximately 135 km north of Port Hedland and approximately 340 km west of Broome. The wider operational area of approximately 38,000 km^2 incorporates the necessary space for vessel manoeuvring, line run-outs and turns, source testing and soft starts. At its closest, the operational area is approximately 120 km north of Port Hedland and approximately 320 km west of Broome.



Operational Area		
ID	Latitude	Longitude
1	17° 22' 22.066" S	116° 50' 59.217" E
2	17° 22' 24.101" S	117° 00' 18.387" E
3	17° 12' 57.189" S	117° 00' 19.361" E
4	17° 13' 2.158" S	117° 56' 31.896" E
5	17° 22' 7.578" S	117° 56' 35.277" E
6	17° 21' 58.995" S	118° 18' 46.082" E
7	17° 58' 13.835" S	118° 18' 36.035" E
8	17° 58' 29.645" S	118° 48' 24.523" E
9	18° 12' 55.231" S	118° 48' 33.979" E
10	18° 13' 5.630" S	119° 08' 37.183" E
11	18° 41' 58.524" S	119° 08' 37.475" E
12	18° 41' 46.049" S	119° 20' 28.237" E
13	19° 12' 26.568" S	119° 20' 53.965" E
14	19° 13' 16.540" S	118° 04' 46.160" E
15	18° 38' 55.585" S	117° 48' 28.058" E
16	18° 38' 53.714" S	116° 50' 55.983" E

Survey Area		
Id	Latitude	Longitude
1	17° 30' 41.399" S	117° 00' 5.718" E
2	17° 30' 40.908" S	117° 09' 39.868" E
3	17° 21' 19.615" S	117° 09' 39.871" E
5	17° 30' 19.165" S	117° 48' 9.224" E
4	17° 21' 12.505" S	117° 48' 6.763" E
6	17° 30' 9.129" S	118° 10' 21.154" E
7	18° 06' 6.603" S	118° 10' 5.991" E
8	18° 06' 27.961" S	118° 39' 58.705" E
9	18° 21' 2.776" S	118° 40' 7.074" E
10	18° 21' 14.589" S	119° 00' 4.235" E
11	18° 50' 1.658" S	119° 00' 4.660" E
12	18° 49' 56.731" S	119° 12' 7.550" E
13	19° 04' 13.020" S	119° 12' 19.569" E
14	19° 05' 3.578" S	118° 09' 57.146" E
15	18° 43' 39.851" S	118° 00' 1.402" E
16	18° 43' 35.512" S	118° 10' 26.670" E
17	18° 36' 33.128" S	118° 10' 23.032" E
18	18° 36' 31.943" S	118° 13' 40.822" E
19	18° 30' 40.816" S	118° 13' 44.986" E
20	18° 30' 54.478" S	117° 00' 0.004" E

Client:	Polarcus Seismic Limited
Drawing No:	0267070p_POL_G001_R0.mxd
Date:	04/11/2014
Drawing Size:	A3
Drawn By:	DN
Reviewed By:	CC

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 2.1 - Survey Location

Capreolus 3D MSS

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

ERM

2.2 ACTIVITY DETAILS

Seismic data acquisition will be undertaken by two purpose-built, state of the art Polarcus-owned and operated survey vessels. The *Polarcus Alima* and *Polarcus Asima* (or vessels of comparable specifications) are expected be used, although final confirmation of the exact survey vessels has yet to be made. The *Polarcus Alima* and *Polarcus Asima* are "A-class vessels", built between 2010 and 2012 with near identical specifications. Each vessel measures 92 m in length and is fuelled using marine gas oil. These vessels are considered to be amongst the most environmentally sound seismic survey vessels in the market with diesel-electric propulsion, high specification catalytic convertors, double hull and advanced ballast water treatment/bilge water cleaning systems.

The two survey vessels will work independently of each other across the operational area, maintaining a separation distance of at least 40 km. Each survey vessel will tow an underwater seismic source immediately behind it, plus 12 cables or 'streamers' containing 'hydrophones'.

The seismic source consists of an array of 'airguns' that discharge downward-propagating pressure waves at approximately 5 second intervals as the survey vessel travels at a speed of approximately 4.5 knots along pre-determined survey lines. The total volume of the planned airgun seismic energy source for the survey is 3,480 in^3 with an operating pressure of approximately 2000 psi. This is the minimum source size considered sufficient to achieve the required output to meet the geophysical objectives of the survey. The resulting sound exposure level from the airguns, as measured according to established units for underwater sound, is approximately 238.2 dB re 1μPa^2.s at a frequency of 0-500 hertz.

The pressure wave generated by the airguns penetrates the seafloor and is reflected from subsurface features back to the hydrophones in the towed streamers. When analysed, these data establish a broad picture of the subsurface geology. Each towed streamer will be approximately 8-9 km in length. Tail buoys will be used to maintain position and clearly indicate the streamer ends. Depth monitor and control devices ('birds') positioned along the streamers are used to maintain the preferred tow depth.

In addition to the two survey vessels, three to four support vessels will be engaged:

- A chase vessel accompanying each survey vessel to assist with managing potential interactions with other users of the area; and
- At least one, and potentially two, supply vessels for resupply, refuelling and other support functions.

The survey and chase vessels will be refuelled at sea approximately every 35 days. Crew changes will also occur approximately every 35 days supported by helicopter.

2.3 SCHEDULE

The Capreolus 3D MSS is scheduled to be conducted within a period of approximately 180 days between January and June 2015. Seismic acquisition will occur in an east-west direction, with the survey commencing concurrently in both the northern and central portions of the survey area and then moving south. Survey timing and phasing has been planned to avoid as far as possible the most sensitive time periods and areas of biological activity in the wider area (refer to *Section 5*). Actual start and finish dates are dependent on regulatory approvals, vessel availability, weather conditions and scope completion, but the Capreolus 3D MSS is not planned to extend past the end of June 2015.

3 EXISTING ENVIRONMENT

The operational area lies within the Northwest Shelf Province and the Northwest Transition bioregions of the North-west Marine Region (the region) (SEWPaC 2012 and DEWHA 2008). The Northwest Shelf Province is located primarily on the continental shelf between North West Cape and Cape Bougainville and includes important sites for migrating humpback whales and breeding seabirds such as Eighty Mile Beach and the Lacepede Islands, as well as for the petroleum industry and commercial fishing operations (DEWHA 2008). The Northwest Transition includes shelf break, continental slope and the majority of the region's Argo Abyssal Plain. A key feature for the Northwest Transition is the Rowley Shoals (approximately 37 km to the north-east of the operational area), which comprises the Mermaid, Clerke and Imperieuse Reefs marine reserves (DEWHA 2008).

3.1 PHYSICAL ENVIRONMENT

3.1.1 Meteorology and Oceanography

The operational area is characterised by an arid, subtropical climate that experiences monsoonal patterns characterised by a wet season during the summer months of October to March and a dry season during the winter months of May to August (DEWHA 2008). The wet season is characterised by winds, primarily from the south-west, that can generate thunderstorm activity, high rainfall and pronounced cyclones. During the dry season, winds are predominantly from the east and rainfall is sparse. On average, about five cyclones occur each year, of which two typically make landfall and one is typically severe (category 3 or higher having wind gusts of at least 170 km/h) (BOM 2014; DEWHA 2008). The chance of a severe cyclone occurring is highest in March and April (BOM 2014).

Swell heights in the operational area typically range up to 2 m (but are primarily below 1.2 m) with periods of six to eight seconds (Pearce *et al.* 2003; Margvelashvili *et al.* 2006).

Apart from cyclonic events, sea states tend to be heaviest (i.e. >1 m wave heights) in winter and lightest in the summer (Pearce *et al.* 2003).

The operational area is dominated by surface currents heavily influenced by both tidal motions, the Indonesian Throughflow and the Holloway Current. Mean speeds for surface currents in the Northwest Shelf Province range from 0.033 m/s in January to 0.06 m/s in July (Brewer *et al.* 2007). In the Northwest Transition, surface current mean speeds range from 0.046 m/s (January) to 0.057 m/s (October) (Brewer *et al.* 2007).

The waters of the operational area are generally low in nutrient levels. Exceptions within or near the operational area include:

- potentially localised upwelling at the Rowley Shoals and at the canyons in the north-western portion of the operational area; and
- sporadic and short-lived upwellings as a result of internal wave, cyclonic or tidal activity (DEWHA 2008).

3.1.2 Bathymetry, Geomorphology and Sedimentology

The south-western half of the operational area that lies on the continental shelf consists of water depths that gradually increase from approximately 50 to 200 m. Minimum water depths in the survey area are approximately 70 m. The northern portions of the operational area lie within the continental slope and the transition into the Argo Abyssal Plain. Thus, water depths in these portions abruptly increase from approximately 200 to 3,500 m towards the north-west.

Seafloor features of the south-western half of the operational area within the continental shelf include banks, shoals, valleys, terraces and steps (Baker *et al.* 2008). The most prominent terraces and steps occur at approximately 125 m depth and are believed to be an important migratory pathway for cetaceans and whale sharks (DEWHA 2008). The northern portion of the operational area includes rises, ridges and canyons of the continental slope, as well as aprons/fans of the Argo Abyssal Plain. Sediments in the operational area are dominated by sands with the exception of the most north-western portion near the Argo Abyssal Plain, which is dominated by mud (DEWHA 2008).

3.2 ECOLOGICAL ENVIRONMENT

3.2.1 Plankton Communities

In the operational area, higher plankton concentrations generally occur during the winter months (dry season), from June to August (Hayes et al. 2005). Spatial distribution of plankton is irregular, both vertically and horizontally.

Aggregations can result from temperature and salinity gradients, water motion, light intensity or organic matter in the water column (Omori and Hamner 1982). Sporadic/short-lived and potentially localised episodes of nutrient upwelling that occur in the operational area will influence higher plankton concentrations.

3.2.2 *Benthic Assemblages*

The sandy substrates of the Northwest Shelf Province that cover the majority of the operational area are considered to support low density benthic communities of bryozoans, molluscs and echinoids (DEWHA 2008). Other benthic species abundant in the Northwest Shelf Province include sea cucumbers, prawns and squid. Mobile benthic species (deepwater sea cucumbers, crabs and polychaetes) are presumed to be associated with the Northwest Transition sandy and muddy seafloor and sparse populations of bentho-pelagic fish and cephalopods are supported in low densities (DEWHA 2008).

3.2.3 *Macrofauna*

A search of the Protected Matters database was undertaken for the operational area (including a 10 km buffer) to identify the likelihood of fauna listed under the EPBC Act occurring within the operational area. The search, which is not restricted by time/season, identified 22 migratory species, of which 9 are listed as threatened (*Table 3.1*). No Threatened Ecological Communities were identified.

Table 3.1 Threatened and Migratory Species that May Occur at any time of year within the Operational Area (Including 10 km Buffer)

Type	Scientific Name	Common Name	Status
Birds	*Fregata ariel*	Lesser frigatebird	Migratory
	Phaethon lepturus	White-tailed tropicbird	Migratory
	Sterna albifrons	Little tern	Migratory
	Sterna dougallii	Roseate tern	Migratory
	Sula leucogaster	Brown booby	Migratory
Reptiles	*Caretta caretta*	Loggerhead turtle	Endangered, Migratory
	Chelonia mydas	Green turtle	Vulnerable, Migratory
	Dermochelys coriacea	Leatherback turtle	Endangered, Migratory
	Eretmochelys imbricata	Hawksbill turtle	Vulnerable, Migratory
	Natator depressus	Flatback turtle	Vulnerable, Migratory
Mammals	*Balaenoptera musculus*	Blue whale	Endangered, Migratory
	Megaptera novaeangliae	Humpback whale	Vulnerable, Migratory
	Balaenoptera bonaerensis	Antarctic minke whale	Migratory
	Balaenoptera edeni	Bryde's whale	Migratory
	Orcinus orca	Killer whale	Migratory

Type	Scientific Name	Common Name	Status
	Physeter macrocephalus	Sperm whale	Migratory
	Tursiops aduncus	Spotted bottlenose dolphin (Arafura/Timor Sea populations)	Migratory
Sharks and Rays	*Carcharodon carcharias*	Great white shark	Vulnerable, Migratory
	Rhincodon typus	Whale shark	Vulnerable, Migratory
	Isurus oxyrinchus	Shortfin mako	Migratory
	Isurus paucus	Longfin mako	Migratory
	Manta birostris	Giant manta ray	Migratory

Birds

Many shorebird (including those frequenting offshore islands), migratory bird and seabird species are known to occur in the region. The majority of migratory bird species forage and rest in the region on their way between Northern Hemisphere breeding grounds and Northern Australian feeding grounds (ie East Asian–Australasian Flyway).

Important areas for birds in proximity to the operational area include:

- Bedout Island (approximately 42 km away);
- Roebuck Bay and Eighty Mile Beach (approximately 310 and 110 km away, respectively); and
- Rowley Shoals (approximately 37 km away) (DEWHA 2008).

Most bird species in the region north of 20 °S (which includes the operational area) breed in autumn (March – May), which coincides with the survey period (DEWHA 2008). Generally summer is the period when most birds occur in the region and near the operational area, especially due to the large populations of migratory birds at Eighty Mile Beach during that time (DOE 2014a).

Due to the wide distribution and range of regional bird species, many can be expected to occur in the operational area during the survey. However, due to the water depths over the majority of the operational area, and the lack of seabed features with which prey aggregations may be associated, numbers are not expected to be significant.

Reptiles

Turtle nesting occurs along the north-west coast of WA between November and February, with some nesting occurring on the coastal islands (DOE 2014b). The operational area is at least 80 km from the coast and the closest island (Bedout Island) is approximately 42 km to the south.

While Bedout Island may support some turtle nesting it is not recognised as a significant rookery. Nearshore coastal waters are also likely to provide foraging grounds for turtles. However, due to the distance from shore and deeper waters of the operational area (>50 m), only occasional turtles are likely to pass through the area. Furthermore, the survey programme has been planned to avoid the more southerly shallower waters (<100 m) between December and March, the time when internesting flatback turtles may be present (DOE 2014b).

In addition to listed reptile species, other reptile species could also potentially occur within the operational area. At least 20 species of sea snake occur within the region, some of which are endemic (DEWHA 2008). However, most sea snake species tend to be found in the shallower parts of the region (DEWHA 2008) and are therefore not expected to be common in the operational area.

Mammals

Marine mammals have wide distributions and may be present in the operational area. However, they are likely to occur in low numbers relative to their overall populations.

The operational area is not known to represent biologically important habitat such as significant feeding or breeding habitat. Humpback whales pass through the area with some predictability during the annual migration to and from breeding grounds in Camden Sound.

However, the main seasonal migration is outside the timing of the survey period, with the northern migration peaking in mid-late July (DOE 2014b). Pygmy blue whales also migrate along the WA coast with some predictability from southern feeding grounds to breeding grounds in Indonesian waters. The pygmy blue whale Biologically Important Area (BIA) for migration identified in the Conservation Values Atlas (DOE 2014) overlaps the north-western half of the operational area. However, satellite tagging data and other literature suggests that solitary pygmy blue whales are more likely to be encountered transiting through waters averaging 3,300 m in depth in the area immediately north of the operational area (McCauley 2011, Double et al 2014). Pygmy blue whales are likely to travel northwards through the region of the operational area during April and May, though mostly in May (Double et al 2014). The southern migration past the operational area occurs between late October and December. Over these periods low numbers of pygmy blue whales may be encountered in the deep waters in the north of the operational area (Double et al. 2014; McCauley 2011). However, the survey has been scheduled such that during April to June one of the survey vessels will be operating in shallow waters (<200 m) where pygmy blue whales are unlikely to be encountered.

Other whale and dolphin species (including seven threatened and/or migratory species protected under the EBPC Act) may also pass through the operational area at the time of the survey but are not expected in significant numbers due to the absence of critical habitats (feeding, breeding, calving, resting or constricted migratory pathways).

Sharks and Rays

Five species of shark and ray listed as threatened and/or migratory under the EPBC Act may occur in the operational area. Given that the great white shark, longfin mako shark and shortfin mako shark are wide-ranging in offshore waters and occasionally frequent coastal areas, they are not expected to be commonly encountered during the survey (DOE 2014b). Whale sharks and manta rays may also occur in low numbers in the operational area, but the area does not contain critical habitat for these species (DOE 2014b). Whale sharks are known to aggregate in the waters around Ningaloo Reef to the south of the operational area between March and June and are therefore more likely to migrate through the region around this period (DOE 2014b).

Commercial Fish and Shellfish Species

A number of fish species are targeted by commercial fisheries within or near the operational area including the blacktip shark, goldband snapper, rankin cod, red emperor, pink snapper, sandbar shark, spanish mackerel, pearl oyster, and southern bluefin tuna.

The planned marine seismic survey will coincide with the spawning periods of some of the above species.

However, the preferred spawning habitats for the majority of those species include hard/rocky substrates, reefs, and/or shallow coastal waters, which are not commonly found within the operational area. Water depths over the majority of the survey area are anticipated to preclude the presence of spawning adults. Pearl oyster primary spawning occurs between mid-October and December, with a smaller secondary spawning occurring in February and March (DOF 2006 and 2014). However, as the seismic acquisition is planned to commence in the northern portion of the operational area and then move progressively south, the seismic vessels are not anticipated to be operating in areas sensitive for pearl oyster larvae over the spawning periods (conservatively assumed to be water depths < 100 m).

3.3 SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT

The operational area is located approximately 390 km to the north-east of the nearest World Heritage and National Heritage Site, namely the Ningaloo Coast.

The operational area is located approximately 130 km to the south-west of the nearest historic shipwreck (the *Lively*), as listed on the Australian National Shipwreck Database (DOE 2014c). A search of the National Native Tribunal Register did not identify any Native Title areas within the operational area.

A number of Commonwealth and State managed fisheries intersect the operational area. However, based on seasonality, effort, the distribution and habitat of target species and water depths in the operational area, the Capreolus 3D MSS has the potential to interact with only four fisheries. Two of these fisheries are trawl fisheries with wide operational areas (the North West Slope and Pilbara Fish Trawl Fisheries). One fishery uses line methods (Pilbara Line Fishery). The fourth potentially affected fishery is the Pearl Oyster Managed Fishery, for which the only interaction is with the distribution of the oyster brood stock landwards of the 100 m isobath.

The region currently supports a number of industries including petroleum exploration and production, as well as minerals extraction. Eleven active petroleum exploration permits are wholly or partially in the operational area. The closest active production licences to the operational area are located north of the Dampier Archipelago approximately 57 km south and 110 km south-west of the operational area, respectively, and are operated by Santos Limited.

Polarcus is aware that Searcher Seismic Limited (Searcher) has applied for a Special Prospecting Authority (SPA) and Access Authority (AA) to acquire approximately 20,300 line kilometres of two-dimensional (2D) data (Bilby 2D MSS) within an indicative operational area that encompasses the entire operational area of the Capreolus 3D MSS between January and June 2015.

Given their overlapping and concurrent activities, Polarcus and Searcher have coordinated their survey planning including undertaking joint stakeholder consultation, running a combined environmental risk assessment workshop and planning their respective activities to reduce any potential cumulative effects to ALARP and acceptable levels. Polarcus is also aware that other seismic survey companies have obtained approval under the *OPGGS Act* to conduct multi-client seismic surveys across a similar area and timeframe as the Capreolus 3D MSS. The business model for multi-client surveys relies on companies such as Polarcus 'selling' the acquired data to multiple petroleum titleholders. Like Polarcus, other seismic survey companies will have sought commercial undertakings with petroleum block titleholders for the 3D data they acquire. For commercial reasons, it is very unlikely that a petroleum block titleholder would purchase data from more than one multi-client seismic survey operator and as such, it is likely that only one seismic survey will actually proceed to mobilisation.

Consultation undertaken to date indicates that the operational area is used mainly for commercial shipping operations, transiting to and/or from the Port of Dampier and Port of Port Hedland.

Interactions between tourism and recreational activities in the operational area are considered unlikely as the majority of activities are carried out within WA State waters. The peak season for recreational fishing at Rowley Shoals (between September and December) (DPAW 2013) does not overlap with the timing of the Capreolus 3D MSS.

3.4 KEY REGIONAL RECEPTORS

Protected areas and coastal receptors in the vicinity of the operational area are listed in *Table 3.2*.

Table 3.2 Key Regional Sensitive Receptors

Receptor	Approximate Distance
Eighty Mile Beach Commonwealth Marine Reserve	32 km
Eighty Mile Beach Ramsar Site	100 km
Rowley Shoals Marine Park	23 km
Mermaid Reef Commonwealth Marine Reserve	115 km
Argo-Rowley Terrace Commonwealth Marine Reserve	Overlaps
Roebuck Commonwealth Marine Reserve	300 km
Kimberley Commonwealth Marine Reserve	245 km
Montebello Commonwealth Marine Reserve	180 km
Dampier Commonwealth Marine Reserve	130 km
Bedout Island	42 km
North Turtle Islet	75 km
Little Turtle Islet	90 km
Glomar Shoals	100 km
Lacepede Islands and Reef	350 km
Dampier Archipelago and surrounding islands (including Legendre and Delambre)	180 km
Kimberley Coast	315 km
Broome Coast	240 km
Port Hedland Coast	80 km
Dampier Coast	165 km

4 STAKEHOLDER CONSULTATION

Relevant stakeholders were identified by considering the interests and activities that occur within or around the operational area, taking into account the survey activities, timing, and potential environmental impacts and risks (of both planned activities and potential unplanned events) (*Table 4.1*).

Table 4.1 Relevant Stakeholders Consulted

Commonwealth Government	
• Australian Customs and Border Protection Service • Australian Hydrographic Office • Australian Maritime Safety Authority • Australian Fisheries Management Authority	• Department of Agriculture • Department of Communications • Department of Defence • Department of Industry • Native Title Tribunal • Federal Member for Durack
State Government	
• Department of Mines and Petroleum • Office of the Environmental Protection Authority • Department of Environmental Regulation • Department of Transport	• Department of Fisheries • Department of Parks and Wildlife • Member for Pilbara • Member for Kimberly • Shire of Broome • Town of Port Hedland
Fisheries	
• Relevant Commonwealth Fisheries • Relevant State Fisheries • Commonwealth Fisheries Association • Western Australian Fishing Industry Council • Australian Southern Bluefin Tuna Industry Association • Australian Council of Prawn Fisheries	• Australian Fishing Trade Association • Pearl Producers Association • Western Australian Northern Trawl Owners Association • RecfishWest • Western Australian Game Fishing Association
Tourism	
• Kimberly Marine Tourism Association	• Recreational Fishing and Marine Charter Operators
Environmental Non-Governmental Organisations	
• Australian Marine Conservation Society • Australian Conservation Foundation • Wilderness Society	• Conservation Council of WA • World Wildlife Fund
Ports and Shipping	
• Dampier Port Authority • Pilbara Ports Authority	• Broome Port Authority
Industry	
• APPEA • Broome Chamber of Commerce and Industry	• Port Hedland Chamber of Commerce • Telstra • Nextgen

An information fact sheet, including a map showing the survey area, was prepared and distributed by email to each relevant stakeholder on the 4 October 2014. Where no response was received, a follow up request was made. Where feedback was received, this was acknowledged in writing, information was provided (where requested) or subsequent engagement arranged to seek a resolution to valid concerns. A summary of key issues and concerns raised by stakeholders during consultation for the EP, and how Polarcus has addressed these, is provided in *Table 4.2*.

Table 4.2 Summary of Stakeholder Key Issues Raised

Theme	Key Issues Raised	How Addressed
Communication	Stakeholders requested certain notifications and updates to be made to them or other organisations before, during and after the survey.	Polarcus has included notification requirements (e.g. to the AHO and AMSA) as Environmental Performance Standards of the EP.
Interactions with other vessels	AMSA provided shipping traffic-related information (e.g. vessel track charts) and requirements (e.g. communication, speed and navigation).	The information provided and requirements indicated were acknowledged as relevant and useful to the survey. The information and requirements provided by AMSA have been used to define controls to reduce risks to other users of the area to ALARP (refer to *Table 5.1*).
Biological Sensitivities	Concern was raised about the potential for the seismic survey to affect key periods of biological significance.	The survey has been planned to avoid as far as possible key periods and areas of biological significance: • The survey will be undertaken outside the peak humpback whale migration period • The survey schedule has been planned to avoid areas that are seasonally used by internesting turtles, pearl oyster spawning and migrating pygmy blue whales.
	Concern was raised about the potential for the seismic survey to affect the health and productivity of pearl oysters that sustain the pearl oyster fishery off Eighty Mile Beach. In particular, concern was raised about the potential for systematic, sustained and spatially expansive seismic data acquisition to affect the spawn, larvae and adult oysters that support the fished stocks off Eighty Mile Beach. Stakeholders recognised that given water depths across the survey area (> 70 m), no interaction with pearl oyster fishing activities was likely.	Polarcus has engaged closely with representatives of the pearl oyster fishery during the preparation of this EP in order to understand the concerns and to reflect these in both the assessment of impacts and in the design of the Capreolus 3D MSS to avoid or reduce as far as practicable potential impacts on the fishery. The potential for the seismic survey to impact the various life stages of the pearl oyster has been assessed in the EP drawing on evidence available from fish spawn and larvae, other invertebrate species (including clams, lobsters, scallops, squid, prawns, shrimp) and on historical evidence from the pearl oyster fishery off Eighty Mile Beach. The assessment is summarised in *Section 5.3.6*. The assessment has conservatively assumed (as advised by the Pearl Producers Association) that pearl oyster brood stocks and spawn may be present within waters up to 100 m deep. While the overall duration of the

Theme	Key Issues Raised	How Addressed
		Capreolus 3D MSS covers approximately 6 months, activities within the 100 m isobath are calculated to be limited to only 25 days. Also, the area covered by the Capreolus survey lines within the 100 m isobath (approximately 2,377 km^2) is only a fraction of the area landward of the 100 m isobath within which the pearl oyster stock off Eighty Mile Beach may be present (and area of approximately 100,000 km^2). These conclusions have been shared with representatives of the pearl oyster fishery. Despite the low anticipated risk, the following precautionary measures have been adopted to reduce any potential for impact to levels that are ALARP: • Scheduling the survey to avoid overlap with the peak pearl oyster spawning period of October to December • Avoiding data acquisition within the 100 m isobath until the end of March, which avoids overlap with the secondary pearl oyster spawning period • Minimising the sound intensity of the acoustic source.

Polarcus will continue to engage with the relevant stakeholders prior to and during the Capreolus 3D MSS as appropriate. *Table 4.3* summarises the ongoing consultation.

Table 4.3 Schedule for Ongoing Consultation

Stakeholder	Ongoing communication schedule
Commonwealth Government	
Australian Customs and Border Protection Service	Provide advance notice of survey mobilisation in the operational area, including final survey location and timing. Provide advice of survey completion
AHO	Provide final survey location, vessel details and timing 2 weeks prior to survey commencement for issue of Notice to Mariners. Provide update should any details of area or timing change Provide notice of survey completion

Stakeholder	Ongoing communication schedule
AMSA	Advise AMSA RCC of survey commencement. Provide daily reports to RCC during data acquisition *or* ensure daily position information is provided via an operational Automatic Identification System on board the survey vessels. Provide notice of survey completion
NOPSEMA	Provide notice of start and end of the Capreolus 3D MSS. Provide monthly and incident reports during the survey and Environmental Performance Report following completion.
WA Government	
Department of Mines and Petroleum	Provide advance notice of survey commencement, including final survey location and timing. Engage again if the scope of the survey changes significantly Provide advice of survey completion
Department of Fisheries	Provide an update prior to survey commencing
Department of Transport (Maritime Environmental Emergency Response)	Provide advance notice of survey commencement, including final survey location and timing. Provide advice of survey completion
Department of Parks and Wildlife	Send courtesy follow up advising them of the final survey location and timing prior to survey commencement.
Fisheries	
Individual fisheries licence holders	Any responses received to the information mailed to them on 3rd November 2014 will be assessed for their merit, a response provided and records maintained. For licence holders in fisheries relevant to the operational area, send a courtesy follow up advising them of the final survey location and timing prior to survey commencement, advising them of the limited manoeuvrability of the survey vessels and therefore seeking confirmation on whether arrangements to minimise the risk of disrupting fishing efforts while seismic data is being acquired need to be agreed with them. Depending on the responses received, further information will be provided to licence holders during the survey, such as survey location reports, progress status and activity look ahead reports.
Pearl Producers Association	Provide courtesy follow ups of survey commencement and ongoing consultation as required
Tourism and Recreation	
Kimberly Marine Tourism Association	Advise of survey commencement including final survey location and timing. Provide advice of survey completion following completion.
Recreational Fishing and Marine Charter Operators	

Stakeholder	Ongoing communication schedule
Ports and Shipping	
Dampier Port Authority	Provide advance notice of survey commencement, including final survey location and timing. Provide update should any details of area or timing change during the course of the survey. Provide advice of survey completion following completion.
Pilbara Ports Authority	
Broome Port Authority	

Additional stakeholders may be identified throughout the course of the survey, in which case these new stakeholders will be contacted and given the opportunity to provide feedback as relevant.

5 ENVIRONMENTAL IMPACTS, RISKS AND CONTROLS

5.1 ASSESSMENT APPROACH AND METHOD

To identify and evaluate the environmental impacts and risks of the Capreolus 3D MSS, a comprehensive risk assessment was undertaken for all planned activities and potential unplanned events. The risk assessment was undertaken in alignment with the approaches of the Australian Standard/New Zealand Standard (AS/NZS) ISO 31000:2009 Risk Management and Handbook 203:2012 Managing Environment-Related Risk.

The identification and evaluation of potential adverse impacts and risks was informed by:

- experienced environmental and social practitioners, and subject-matter experts (e.g. in the effects of underwater noise on marine fauna, oil spill modelling and emergency response);
- experienced seismic operations personnel;
- knowledge of the existing environment, its values, sensitivities, and regional importance;
- predictive modelling (e.g. for oil spills);
- published scientific and research literature;
- industry experience; and
- results of stakeholder consultation (*Section 4*).

Each risk was evaluated using the Polarcus Risk Matrix (*Figure 5.1*).

Interpretation of Risk

Risk Conclusion	Interpretation	Explanation
LOW RISK	Acceptable	No additional controls are required. Consideration may be given to effective solutions or improvements that impose no significant cost burden. Monitoring is required to ensure that the controls are maintained.
MEDIUM RISK	Acceptable if ALARP	Efforts should be made to reduce the risk, but the cost of prevention should be measured and limited. Risk reduction methods should be implemented within a defined time period.
HIGH RISK	Not acceptable / intolerable	Work should not be started or continued until the risk has been reduced to an acceptable level. If it is not possible to reduce the risk even with unlimited resources, work has to remain prohibited.

				LIKELIHOOD				
				Occurs all the time	Regularly occurs	Occasionally occurs	Rarely occurs	Never heard of
				An event which occurs each time or almost every time we carry out the task.	An event which may occur 2 or 3 times a month	An event which may occur once a month.	An event which may occur once or twice a year.	An event occurs which has never been heard of in our business or the business the persons carrying out the assessment have previously been involved in.
				E	D	C	B	A
CONSEQUENCE	Massive	Persistent severe environmental damage. Loss of commercial use, recreational use or nature conservancy resulting in major financial consequences for the company. Ongoing breaches well above statutory or prescribed limits.	5					
	Major	Severe environmental damage. The company is required to take extensive measures to restore the damaged environment. Widespread nuisance or extended breaches of statutory or prescribed limits.	4					
	Extensive	Limited discharges affecting the immediate area and damaging the environment. External resources required to assist in clean-up. Many complaints or repeated breaches of statutory or prescribed limits.	3					
	Minor	Sufficiently large contamination or discharge and damage to the environment, but with no lasting effects, may evaporate, dissipate or may be cleaned internally. Single complaint or breach of statutory or prescribed limit.	2					
	Slight	Slight environmental damage, causing slight sheen to water surface or land.	1					

Figure 5.1 Polarcus Risk Matrix

Controls were developed to reduce the likelihood of the impact occurring (i.e. preventative) and/or reduce the consequence of the impact (i.e. mitigation) to in turn reduce the risk to ALARP. In accordance with the Polarcus Risk Management Procedure, the following hierarchy of controls was applied:

- **Eliminate:** Redesign the activity or substitute a substance so the hazard is removed or eliminated;
- **Reduce:** Replace the material or process with a less hazardous one and one which does not introduce another hazard;
- **Isolate:** Measures to prevent the hazard escalating;
- **Control:** identifying and implementing procedures, administrative controls, competency and training; and
- **Respond:** ensuring the mechanisms are in place to respond to an unplanned event.

To determine whether impacts and risks were reduced to levels that are ALARP, consideration was given to trade-offs of implementing alternatives / substitutes to the activity, or of implementing additional controls in terms of cost, technical, environmental, safety and logistical implications. An impact and risk was then determined to be acceptable if it was evaluated to be 'low' or 'medium' risk on the risk matrix, demonstrably ALARP and compliant / consistent with regulatory requirements, industry standards and guidelines.

The resulting impacts and risks and committed controls have been translated into environmental performance outcomes to be achieved and standards to be implemented throughout the Capreolus 3D MSS.

A summary of the environmental hazards, impacts and controls determined through the risk assessment is provided in *Table 5.1*. In order to demonstrate the range of issues considered and provide additional detail on those aspects of the seismic survey considered to be of greatest interest to stakeholders, further detail on impacts associated with physical presence and noise emissions has been provided thereafter.

Table 5.1 Environmental Impacts, Risks and Controls

Activity / Environmental Hazard	Environmental Impact	Controls	Residual Risk		
			Cons	Like	Risk
Survey and support vessels in operational area	Collision/entanglement with large marine fauna resulting in injury/death	• Survey scheduled to avoid peak humpback whale migration periods. • Survey planned to avoid southern, shallower areas where internesting flatback turtles may be present between December and March, and to avoid the deepest, northernmost waters where pygmy blue whales may be encountered during their northerly migration (April to June). • Application of the requirements of EPBC Act Policy Statement 2.1 seismic interaction with whale guidelines for both cetaceans and whale sharks will serve to reduce the risk of physical interaction (see under Noise). • Compliance with EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans. • Use of soft start procedures in accordance with EPBC Act Policy Statement 2.1 seismic interaction will encourage gradual avoidance by marine mammals. • Turtle guards installed on tail buoys. • Survey vessels operate at low speeds (~4.5 knots). • Marine Fauna Observers (MFOs) on board. • Any entangled fauna will be returned to sea, with subsequent required reporting.	Extensive (3)	Rarely occurs (B)	Low

	Disruption / interference with other users in the area	• Stakeholders who may be present in the operational area (as determined during consultation for the EP) are consulted prior to the survey commencing, during the survey and on survey completion as appropriate.
		• Notice to Mariners prior to commencement.
		• Daily reporting to AMSA RCC.
		• Adherence with requirements of the International Regulations for Preventing Collisions as Sea 1972 (COLREGS) and Chapter 5 of Safety of Life at Sea as implemented in Commonwealth Waters through the *Navigation Act 2012* and associated Marine Orders Parts 21, 30, 59 - navigation, collision, support vessels, including:
		  • Appropriate lighting, navigation and communication to inform other users.
		  • Use of radar and 24/7 watch.
		• Support vessel with survey vessel at all times.
			Minor (2)	Rarely occurs (B)	Low

Activity / Environmental Hazard	Environmental Impact	Controls	Residual Risk		
			Cons	Like	Risk
		• Separation distance during data acquisition of minimum 40 km agreed with operator of Bilby 2D seismic survey. • Streamer ends marked with tail buoys.			
Routine discharge of domestic wastes (treated sewage, grey water, putrescible waste)	Temporary and localised reduction in water quality (increase in nutrient levels) resulting in impacts on marine biota	• Discharges in accordance with relevant regulatory requirements (MARPOL). • Approved Sewage Treatment Plant. • Offshore discharge only (no discharge within 12 Nm of coastline). • Vessel Waste Management Plan. • Marine Orders – Part 95 (Marine pollution prevention — garbage); and Part 96 (Marine pollution prevention — sewage).	Slight (1)	Rarely occurs (B)	Low
Deck drainage and oily wastes	Temporary and localised reduction in water quality resulting in impacts on marine biota	• Approved oil water separator used prior to discharge (hydrocarbons less than 15 ppm). • Preventative/Planned Maintenance System. • Offshore discharge only (no discharge within 12 Nm from coastline). • Current International Oil Pollution Prevention Certificate. • Vessel waste log books.	Slight (1)	Occasionally occurs (C)	Low
Routine management of solid hazardous and non-hazardous waste	Incorrect disposal leading to onshore impacts	• Waste segregation on board. • Use of appropriate waste transfer, management and disposal companies. • Vessel waste log books.	Minor (2)	Rarely occurs (B)	Low
Noise generated by seismic acoustic source in operation	Physiological damage to marine fauna Disruption to behaviour patterns of marine fauna	• Seismic survey activities will be conducted outside the peak humpback whale migration season. • Survey programme planned to avoid southern, shallower areas where internesting flatback turtles may be present between December and March, and to avoid the deepest, northernmost waters where pygmy blue whales may be encountered during their northerly migration. • Survey programme planned to avoid southern, shallower areas (<100 m) over pearl oyster spawning periods (December and February-March). • EPBC Act Policy Statement 2.1 seismic interaction with whale guidelines, to be used for	Extensive (3)	Rarely Occurs (B)	Low

Activity / Environmental Hazard	Environmental Impact	Controls	Residual Risk		
			Cons	Like	Risk
		both whales and whale sharks with implementation of the following precaution zones: • Observation zone: 3+ km horizontal radius from the acoustic source. • Low power zone: 2 km horizontal radius from the acoustic source. • Shut-down zone: 500m horizontal radius from the acoustic source. • MFO on board each survey vessel during all activities. • Crew induction will include whale observation, separation distance estimation, controls and reporting. • PAM to be used to assist MFOs with visual observations for marine mammals. • Shut down if three whale-instigated shut-downs in 24 hours occur and move to another line away from pods of whales. • Minimum operating water depth of 30 m. • Soft-start procedures, in accordance with EPBC Act Policy Statement 2.1 seismic interaction with whale guidelines will be implemented. • Minimum 40 km separation between operating seismic vessels (including with the seismic vessel for the Bilby 2D Survey). • Size of the seismic source (airgun array) reduced to the minimum operating requirements.			
Noise generated by vessel thrusters/engine operation	Disruption to behaviour patterns of marine fauna	• Surveys will be conducted outside peak humpback whale migration season. • Vessel activities will be undertaken in accordance with EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans. • MFO on board each survey vessel during all activities. • Crew induction will include whale observation, separation distance estimation, controls and reporting. • Propulsion systems to be maintained in good working order (manufacturer's specifications). • High specification catalytic converters on survey vessels serve to reduce exhaust noise.	Slight (1)	Regularly Occurs (D)	Low
Noise generated by helicopters transferring crew	Disruption to behaviour patterns of marine fauna	• Surveys will be conducted outside peak humpback whale migration season. • Helicopter movements will be undertaken in accordance with EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans.	Minor (2)	Rarely Occurs (B)	Low

Activity / Environmental Hazard	Environmental Impact	Controls	Residual Risk		
			Cons	Like	Risk
		• Helicopters will avoid identified sensitive areas for birds and maintain minimum altitudes as far as practicable.			
Navigational and safety lighting for survey/support vessels	Disruption to behaviour patterns of marine fauna	• Lighting will be reduced as far as practicable, whilst not jeopardising safety (e.g. non-essential lighting to be turned off when not in use). • Opportunities to further reduce lighting will be considered during pre-survey environmental checks.	Minor (2)	Rarely occurs (B)	Low
Air emissions associated with power generation for vessel and equipment operation	Temporary and localised reduction in air quality	• Vessel engines and incinerator will be maintained and operated in accordance with manufacturer's specification. • Vessels will have valid International Air Pollution Prevention (IAPP) certificate. • Survey vessels will use low sulfur marine gas oil (MGO). • Adherence with Marine Orders – Part 97 (Marine pollution prevention - air pollution).	Slight (1)	Occurs all the time (E)	Low
	Increased greenhouse gases in atmosphere	• Limited emissions volumes and survey duration. • Adherence with Marine Orders – Part 97 (Marine pollution prevention - air pollution). • Survey vessel's high specification catalytic converters reduce NOx emissions.	Slight (1)	Occurs all the time (E)	Low
Air emissions from on board waste incinerator	Temporary and localised reduction in air quality	• MARPOL 73/78 Annex VI (Prevention of Air Pollution from Ships) requirements. • Vessels will hold valid IAPP certificate.	Slight (1)	Regularly occurs (D)	Low
Biofouling of vessel hull	Introduction of IMS resulting in alterations to local ecosystems	• IMS inspection prior to mobilisation into Australian waters and confirmed free of potential IMS. • Compliance with the National Biofouling Management Guidance for the Petroleum Production and Exploration Industry guidelines. • Valid hull anti-fouling certificate that meets the requirements of Annex 1 of the International Convention on the Control of Harmful Anti-Fouling Systems on Ships and the requirements of the *Protection of the Sea (Harmful Antifouling Systems) Act 2006.*	Extensive (3)	Rarely occurs (B)	Low
Biofouling of in-water survey equipment		• Regular cleaning and maintenance of equipment during deployment, retrieval or in-water during operations.	Minor (2)	Rarely occurs (B)	Low

Activity / Environmental Hazard	Environmental Impact	Controls	Residual Risk		
			Cons	Like	Risk
Ballast water exchange		• No planned ballast water exchange during the survey. • Compliance with Australian Ballast Water Management Requirements. • Advanced ballast water treatment systems will be on board which eliminate any organisms in ballast water prior to discharge.	Extensive (3)	Rarely occurs (B)	Low

Fuel tank rupture from vessel collision leading to release of MGO	Acute and chronic toxic effects to marine biota from exposure to surface, entrained and shoreline hydrocarbons
	Oiling of marine mammals, reptiles and seabirds
	Oiling of islands and emergent coral reefs/submerged shoals
	Disruption to commercial and coastal fishing and shipping activities
		Prevention Controls
		• Controls in place to avoid disrupting other marine user also serve to reduce the potential for a collision.
		• Fuel stored in multiple segregated tanks.
		• Survey vessels double hulled.
		• Adherence with requirements of the International Regulations for Preventing Collisions as Sea 1972 (COLREGS) and Chapter 5 of Safety of Life at Sea as implemented in Commonwealth Waters through the *Navigation Act 2012* and associated Marine Orders Parts 21, 30, 59 - navigation, collision, support vessels, including:
		  • Appropriate lighting, navigation and communication to inform other users.
		  • Use of radar and 24/7 watch.
		Response Arrangements
		• Source control measures in accordance with the vessel Ship Oil Pollution Emergency Plan (SOPEP).
		• Implement response and notification procedures in accordance with the OPEP, with the response strategy commensurate to the level of the emergency and the nature of the spill and the receiving environment.
		• Support vessel within 10 nm of the survey vessel at all times.
		• Spill kits and scupper plugs are available on board survey vessel.
			Extensive (3)	Rarely Occurs (B)	Low

Refuelling spill leading to release of MGO	Toxic effects to marine biota	Prevention Controls • Use of dry-break couplings for refuelling. • No refuelling at sea within 25 km of land, shoals or islands. • At sea refuelling during daylight hours and in suitable weather conditions. • Adherence with the Polarcus Bunkering Procedure, including completion of the Permit to Work Refuelling At Sea Checklist and Bunkering Checklist ensuring that anti-pollution equipment is ready and scuppers plugged before bunkering commences and maintaining	Minor (2)	Rarely Occurs (B)	Low

Activity / Environmental Hazard	Environmental Impact	Controls	Residual Risk		
			Cons	Like	Risk
		good communication. • Fuel transfer equipment maintained and checked prior to use. Response Arrangements • Source control measures in accordance with the vessel SOPEP. • Implement response and notification procedures in accordance with the OPEP, with the response strategy commensurate to the level of the emergency and the nature of the spill and the receiving environment. • Spill kits and scupper plugs are available on board survey vessel.			
Single point failure resulting in the release of < 1 m^3 of hydraulic fluid or 20 m^3 of urea into the marine environment	Reduction in water quality and toxic effects on marine biota	Prevention Controls • Storage, handling and use of chemicals in accordance with Material Safety Data Sheets (MSDS). • Bunded areas, spill kits and drains maintained and monitored. • Transfer of urea only during daylight hours and in suitable weather conditions. • Hydraulic fluids and chemicals used will be selected to have the lowest environmental toxicity possible whilst meeting operational performance requirements. Response Arrangements • Spill kits and scupper plugs available on board. • Implement source control measures in accordance with the vessel SOPEP. • Spills cleaned up as soon as practicable with contaminated material managed in accordance with vessel Waste Management Procedure.	Minor (2)	Rarely Occurs (B)	Low
Accidental loss of equipment (streamer or array) during deployment or towing	Potential hazard to navigation, disruption to other users of the area	• Procedures for lifting activities and streamer deployment/retrieval. • Equipment deployments carried out during appropriate weather conditions. • Appropriate storage of equipment on board. • Streamers are fitted with additional (redundant) retainers to prevent equipment loss, and have tail buoys fitted with relative GPS to aid recovery. • Streamers are fitted with automatic recovery devices. • Solid streamers (rather than oil filled) – such that if lost, there is no risk of oil loss. • All lifting gear to be load rated as appropriate for the working load. • Supply/chase vessels available to assist.	Minor (2)	Occasionally occurs (C)	Low
	Seabed disturbance		Slight (1)	Rarely occurs (B)	Low

Activity / Environmental Hazard	Environmental Impact	Controls	Residual Risk		
			Cons	Like	Risk
		• AMSA notified in the event of equipment loss to provide a warning to shipping.			
Accidental loss of solid non-hazardous and hazardous waste	Temporary and localised reduction in water quality resulting in impacts on marine biota Physiological damage to marine fauna	• No overboard disposal. • Waste will be stored, handled and transferred on board in accordance with the vessel Waste Management Plan which also requires compliance with regulatory requirements (i.e. *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and Marine Orders – Part 94 (Marine pollution prevention - packaged harmful substances)). • If safe to do so, recovery of lost overboard material will be carried out.	Slight (1)	Rarely occurs (B)	Low
Unplanned anchoring	Seabed disturbance	• No anchoring planned. • Propulsion redundancy. • Support/chase vessels available to assist. • No anchoring within state protected areas.	Slight (1)	Rarely occurs (B)	Low

Cons = Consequence; Like = Likelihood

5.2 PHYSICAL PRESENCE

5.2.1 Potential Impacts to Marine Fauna

Large marine fauna (i.e. cetaceans, turtles, whale sharks) occurring in the operational area have the potential to become entangled in seismic equipment or collide with survey or support vessels, which can lead to injury or death. However, the survey has been scheduled and planned such that none of these marine megafauna are expected to be present in the operational area in large numbers at the time of the survey (*Section 3.2.3*). In particular:

- The survey is proposed to be completed outside of the peak migration periods for humpback whales and whale sharks in the region.
- While the survey intersects with the pygmy blue whale BIA and coincides with the northerly migration for pygmy blue whales through the region (April to June), the evidence provided in *Section 3.2.3 / Mammals* indicates that only solitary pygmy blue whales may be encountered transiting the area during this time and most likely in the deeper waters (> 200 m) in the far north west of the operational area.
- While the far south of the operational area (but not the survey are) intersects with biologically important areas for internesting turtles around Bedout Island, given the distance from the closest nesting beach (42 km) and the deeper waters of the operational area (>50 m), only occasional turtles are likely be encountered during the survey.
- As the operational area does not contain habitats that support significant aggregations of large marine fauna during the survey period, encounters with large marine fauna, including other cetacean species are expected to be limited to individuals transiting through the area.

The risk of causing impact to large marine fauna as a result of collision or entanglement was therefore determined to be low given that only individuals are likely to be affected with no population-wide impacts. Polarcus has adopted a number of controls to reduce risks to levels that are demonstrably ALARP, including:

- Designing the survey execution programme to avoid data acquisition in:
    - the northern-most and deepest waters of the operational area between April and June, during the pygmy blue whale's northerly migration; and
    - the more southerly shallower waters (<100 m) between December and March, the time when internesting flatback turtles may be present.
- Conducting the survey at slow speeds (~ 4.5 knots).

- Selecting the minimum seismic source to achieve survey objectives (3,480 in^3).

- Complying with relevant requirements of EPBC Regulations 2000 – Part 8 Division 8.1 regarding vessel speed and maintaining physical separation with a sighted cetacean.

- Maintaining continual 'watch' for marine fauna using marine fauna observers (during the day) and passive acoustic monitoring (PAM) equipment (at night and during low visibility).

- Fitting turtle guards to all streamer tail buoys.

Polarcus considered the feasibility of avoiding data acquisition entirely within the pygmy blue whale BIA during the period April to June. However, this was determined to be impractical; as it would mean either sacrificing data collection during the survey period (and thereby affecting the commercial viability of the survey), extending the survey duration (adding cost to the survey and also introducing new risks of encountering humpback whales) and/or sacrificing the commitment to avoid data acquisition within the 100 m isobath between December and March.

Given the circumstances within which the survey will be undertaken and the controls that will be implemented by Polarcus, impacts and risks to marine fauna from the physical presence of vessels and equipment were determined to be low and reduced to levels that are ALARP and acceptable.

5.2.2 Potential Impacts to Other Users of the Operational Area

A range of other activities, including commercial fishing and commercial shipping take place in the operational area and therefore have the potential to interact with the survey (refer to *Section 3.3*).

Based on seasonality, effort, the distribution and habitat of target species and water depths in the operational area, the Capreolus 3D MSS has the potential to physically interact with only three fisheries; namely the North West Slope Trawl Fishery, the Pilbara Fish Trawl Fishery and the Pilbara Line Fishery[1]. However, no significant disruption to fishing operations is anticipated for the following reasons:

- The fisheries cover wide spatial areas with only a portion of the fishing area falling within the operational area of the Capreolus 3D MSS.

[1] Water depths of > 50 m in the operational area preclude any potential for physical interaction with the dive activities of the Pearl Oyster Managed Fishery.

- Based on current survey design, data acquisition will be limited to approximately 25,000 km^2 and only a fraction of this survey area (less than approximately 0.4%) will be surveyed in any 24 hour period[2].

- The transient nature of both the trawl vessels and the seismic survey vessels means that an area is only temporarily unavailable to trawling.

- No concerns were raised to Polarcus by fishery licence holders during consultation for this EP.

- Ongoing consultation with licence holders of these fisheries will enable them to plan their fishing activities to avoid disruption.

Given these conditions, any inconvenience to fishing licence holders is expected to be temporary and localised.

Commercial shipping traffic is known to transit through the operational area to and from the ports of Dampier and Port Hedland. However, a notice to mariners will be in place throughout the survey notifying other vessels of the presence (and limited manoeuvrability) of the survey vessels and Polarcus have committed to provide updates to relevant port and maritime authorities (see *Table 5.1).* Other controls such as a permanent chase vessel supporting each survey vessel and the display of appropriate lighting and signage will also warn shipping of survey activities. As for commercial fishing, because survey activities are transient, any disruption to shipping is anticipated to be localised and temporary.

5.3 NOISE EMISSIONS

Underwater noise is associated with the operation of the seismic source, general vessel activities (including engine noise and operation of thrusters) and helicopter movements. The seismic source, being the most significant noise contributor of the proposed activity, has been calculated to have a sound exposure level (SEL) of 238.2 dB re 1µPa^2.s at 1 m, with a frequency of less than 500 Hz (SVT 2014).

The assessment of noise emissions presented in the EP also considered the potential cumulative effects of exposure to multiple seismic sources over a similar area and timeframe, namely from the two Capreolus vessels, and concurrently with any other 2D or 3D marine seismic survey occurring in the same area over a similar timeframe.

[2] The seismic acquisition will be conducted in lines, with each line being on average approximately 130 km in length. At a planned acquisition speed of 4.5 knots, each line will take approximately 16 hours to complete. A line turn is then estimated to take approximately 5 hours. This would result in seismic operations over any 24 hour period being undertaken over an area of approximately 97 km^2, representing < 0.4% of the Capreolus survey area.

Impacts and risks associated with noise on key environmental and social receptors as a result of the Capreolus 3D MSS are summarised below.

5.3.1 Potential Impacts on Marine Mammals

Marine mammals, in particular cetaceans, are the receptor most susceptible to impacts from seismic activity. Evidence from McCauley 1994, Southall et al 2007, DEWHA 2008a, McCauley et al 1998 and Richardson et al 1995 has been used to inform the assessment of impacts and risks.

Underwater noise levels from the seismic source are anticipated to drop below sound pressure levels that may result in damage to hearing (as determined by Southall et al 2007) within 500 m of the source, which is consistent with the shut-down zone control proposed for the Capreolus 3D MSS (see *Table 5.1*). Implementation of the low power zone at 2 km from the source will further protect individuals from hearing damage as a result of cumulative exposure to multiple pulses from the seismic source.

Noise levels at which behavioural disturbance could occur may extend over a much larger area (tens of km). Behavioural changes as a result of noise can include cessation of normal activities such as regular diving patterns and commencement of avoidance or 'startle' behaviour, particularly when the noise source is intermittent. Startle behaviour as a result of noise from the Capreolus 3D MSS is unlikely given the implementation of precaution zones, pre-survey visual observations and soft-start procedures (see *Table 5.1*).

Avoidance of the survey vessel and/or other behavioural responses by marine mammals may be expected over a wide area (up to tens of kilometres). However, as described in Sections 3.2.3 and 5.2.1, marine mammals are not expected to be encountered frequently in the operational area given the location and timing of the survey programme. Furthermore, during the northern migration for pygmy blue whales (April and May), only one of the survey vessels will be operating in the shallower parts of the pygmy blue whale BIA and will be inshore of the main migratory routes (see *Sections 3.2.3* and *5.2.1)*. As such, any avoidance behaviour would likely result in whales passing slightly further offshore, but still within the broad area of the BIA. Therefore, ecological implications are not expected to be significant as the area of avoidance (a few tens of kilometres from the acoustic sources) is small compared to the broad extent of the BIA (more than 100 km wide).

Given that a minimum separation distance of 40 km will be maintained between the Capreolus survey vessels and between these and any third party seismic vessel, a worst case situation of an animal being positioned equidistant from multiple seismic vessels was assessed in the EP. Drawing on the work of Salgado-Kent and McCauley 2014 (unpublished) and Sujatha 2010, the worst case cumulative received level for an animal exposed to multiple seismic courses was well below the level at which impacts to hearing in marine mammals and other fauna are known to occur.

The main effect would be that individuals passing through the region may exhibit a wider area of avoidance as a result of the concurrent activities. This area of avoidance could potentially extend to a few tens of kilometres around each seismic source vessel and would not be significantly increased by the proximity of more than one source vessel at a minimum distance of 40 km. Given the absence of critical habitats such as feeding, breeding or resting areas in proximity to the operational area, such avoidance is not expected have long-term implications for either individuals or populations.

Despite the evaluated low likelihood of encountering significant marine mammals during the survey, Polarcus will implement a number of controls consistent with regulatory requirements and industry good practice to reduce impacts and risks to marine mammals to levels that are low, ALARP and acceptable. These controls are summarised previously in *Table 5.1*.

5.3.2 Potential Impacts on Marine Turtles

Marine turtles are generally considered to be less sensitive to noise than marine mammals as they do not have an external hearing organ. Nevertheless, marine turtles can detect sound through bone-conducted vibration in the skull and by using their shell as a receiving surface (Lenhardt et al. 1985). The assessment of noise impacts on marine turtles has drawn on the work of Bartol and Musick (2003), Moein et al. (1994), Moein et al. (1995) and McCauley et al. (2000) to understand the extent to which marine turtles may be influenced by the Capreolus 3D MSS and other concurrent seismic surveys in the area. Based on the available evidence, potential avoidance and behavioural responses by marine turtles to the Capreolus 3D MSS are determined to be possible up to approximately 20 km from the survey vessels.

Given the location of the operational area and the distance to critical nesting and foraging habitats for turtles (see *Section 3.2.3*), the risk of significant impacts from seismic noise disturbance to turtles as a result of the Capreolus 3D MSS has been assessed to be low. There is also not expected to be a cumulative impact on turtles as a result of concurrent surveys for the Capreolus 3D MSS and Bilby 2D Survey given the separation distance between vessels and the limited spatial extent of impact to turtles from each vessel.

5.3.3 Potential Impacts on Fish, Sharks and Rays

The assessment of noise impacts on fish, sharks and rays considered impacts on all life-stages, including eggs, larvae, juveniles and adults. The assessment made reference to the work of Popper et al. (2014), McCauley and Cato (2000), Ladich (2000), Finneran and Hastings (2000), Hastings et al. (2008), McCauley et al. (2000), Wardle et al. (2001), Simmonds and MacLennan (2005), Pearson et al (1992), McCauley (1994), DNV Energy (2007), Payne et al (2004) and Myberg (2001).

A comprehensive review of scientific studies into the impact of seismic activity on fish and the fisheries industry concluded that physical damage to fish caused by sound emitted by seismic sources would only occur within less than a few metres of the source (DNV Energy, 2007). Adult fish would typically move away from the sound, but eggs and larvae, which are not actively mobile, may be affected by the signals within a similar distance. Research by Payne el al (2004) suggests a range of 5 – 6 m as the maximum range for potential injury, and hence longer term effects to fish eggs, larvae and fry in response to peak pressure.

The assessment determined that mainly pelagic species are likely to be found in the open waters of the operational area, which are highly mobile, and are likely to move away from the source if the received sound levels become uncomfortable, particularly with the implementation of the agreed soft-start procedures (McCauley et al. 2000). Therefore, physiological impacts to pelagic species are unlikely to occur, but temporary changes to behaviour may arise.

Behavioural effects of noise on fish may include changes to schooling behaviour and avoidance of the noise source (Simmonds and MacLennan 2005). However, once acoustic disturbances are removed, fish are expected to return to normal behaviour within as little as an hour (Wardle et al. 2001; Pearson et al. 1992). Because the seismic lines are widely dispersed (11 km apart) and the vessel and equipment will only travel along any seismic line once (under normal conditions), in one direction, at a rate of approximately 4.5 knots when the source is at full power, any behavioural changes would be localised and temporary, with displacement of pelagic fish unlikely to have significant effects at a population level (McCauley 1994).

Whale sharks may show avoidance behaviour to the seismic source and are unlikely to remain close enough to the source to suffer physiological trauma. Given the protected status of the whale shark and the tendency of individuals to be present in surface waters where they may be detected through visual observation, the precaution zones in EPBC Policy Statement 2.1 that will be implemented for whales in the Capreolus 3D MSS will also be applied for whale sharks, thereby reducing the risk of potential impact to this species.

5.3.4 Potential Impacts on Commercial Fisheries (excluding Pearl Oyster Fishery)

Increased noise levels associated with seismic acquisition may impact on target fish species for several commercial fisheries identified to overlap the operational area (*Section 3.3*). While there is the potential for fish to modify their behaviour in proximity of the seismic source, which may also have the potential to affect catch in the affected area, due to the relative area of increased sound associated with the seismic survey and the transient nature of the data acquisition operations, it is thought that changes in behaviour will be localised and short term. Once acoustic disturbances are removed fish are expected return to normal behaviour, which may occur in as little as an hour (Wardle et al. 2001; Pearson et al. 1992).

Fisheries employing trawling techniques such as the North West Slope Trawl Fishery and the Pilbara Fish Trawl Fishery are unlikely to be significantly affected by the seismic survey because the fisheries target pelagic species which, as described above, are likely to move away from the source if the received sound levels become uncomfortable. Because of the transient nature of both the trawl and the seismic survey vessel, and the expectation that fish behaviour would return to normal soon after noise disturbance had returned to background levels, the spatial extent covered by trawling is large enough to accommodate any limited behavioural changes exhibited by target species. No concerns were raised by the trawl fisheries engaged by Polarcus during the preparation of this EP.

For fisheries using line methods, such as the Pilbara Line Fishery, increased noise generated by the survey will be limited to areas covered by the seismic survey that are also targeted by line fishers. Because seismic activities are transient, and fishing lines used by the Pilbara Line Fishery are understood to be deployed for periods of time varying from 2 hours to overnight (Newman et al 2008), it is expected that overall catch would not be significantly affected by any temporary and localised changes in behaviour. Furthermore, neither prior to nor since submission of the EP, have any concerns been raised about the seismic survey by licence holders of the Pilbara Line Fishery engaged by Polarcus.

5.3.5 Potential Impacts on Invertebrates

Generally, marine invertebrates are considered to have poorly developed mechano-sensory systems and are considered little affected by noise generated by seismic surveys. The assessment examined evidence from a variety of invertebrate species including crayfish (Tautz and Sandeman 1980); clams (La Bella et al. 1996); shrimp (Heinisch and Wiese 1987; and Andriguetto-Filho et al. 2005); prawns (Steffe and Murphy 1992); commercial scallops (Harrington et al. 2010); rock lobsters (Parry and Gason 2006); and squid (Fewtrell and McCauley 2012). Overall, research indicates that the majority of marine benthic invertebrates will only respond to seismic sources at extremely close range (McCauley 1994) and more sensitive pelagic species, such as squid, may demonstrate avoidance of the source. The risk of significant impacts from seismic noise disturbance to invertebrates as a result of the Capreolus 3D MSS has therefore been assessed as low; however in response to stakeholder concerns a more detailed assessment of the potential impacts to pearl oysters in the context of the pearl oyster fishery off Eighty Mile Beach is provided below.

5.3.6 Potential Impacts on the Pearl Oyster Fishery

Pearl oysters are reported to occur off the Western Australian coast in water depths up to approximately 50 m, with fishing occurring in areas where the pearl oysters are at appropriate depths to accommodate safe diving and concentrations sufficient for harvesting to occur at economically viable levels (Fletcher et al 2006).

Given that the operational area is primarily located in water depths greater than 50 m, and data acquisition will occur in water depths > 70 m, the seismic source will operate some distance from the fished pearl oyster beds. As discussed for invertebrates, evidence indicates that oysters are only likely to respond to seismic sources at extremely close ranges and as such, the Capreolus 3D MSS is unlikely to affect oysters settled in the fished areas.

There will be some overlap between the timing of the Capreolus 3D MSS and seasonal spawning for pearl oysters (*Section 3.2.3*). The primary spawning, which occurs between mid-October and December will be avoided but the survey will coincide with a smaller secondary spawning occurring in February and March. However, the seismic acquisition has been planned to commence in the northern portion of the operational area and then move progressively south, thereby avoiding operating in areas sensitive for pearl oyster spawn and larvae over this secondary spawning period (conservatively assumed to be water depths < 100 m). As identified in relation to fish larvae (*Section 5.3.3*), impacts to pearl oyster spawn and larvae are understood to be restricted to very close proximity of the seismic source. Impacts to pearl oyster larvae are therefore not expected.

Although approximately 5,000 km^2 (or 13 %) of the wider Capreolus 3D MSS operational area lies within the 100 m isobath (the area within which there are claims pearl oyster stocks that support the fishery may occur), seismic data acquisition will only be undertaken over an area of approximately 2,377 km^2 within the 100 m isobath. Furthermore, data acquisition in this area will only take approximately 25 days to complete. This area represents a small fraction of the area landward of the 100 m isobath within which pearl oyster larvae or brood stock may be present. Impacts of the Capreolus 3D MSS on the pearl oyster fishery are therefore anticipated to be negligible.

To support this conclusion, Polarcus notes that seismic activity has been occurring in the vicinity of the Eighty Mile Beach Pearl Oyster fishery for decades. Based on data reported by the Western Australian Department of Fisheries (Fletcher et al 2006) the total catch from the main fishing grounds of the Pearl Oyster Fishery (i.e. Zone 2/3) reported over a 10 year period preceding the report remained stable, varying by less than 10%. Over the same time period as the reported catch data, 7,900 line kilometres of seismic data has been acquired within water depths of less than 100 m in the area off the Eighty Mile Beach Fishery (from Port Hedland to Cape Leveque). Therefore, based on historic evidence and consistent with available scientific research, it is thought that seismic acquisition has not had any significant negative impacts on pearl oyster settlement and growth due to increased noise emissions, thereby not affecting the long term productivity of the fishery.

The EP includes an Oil Pollution Emergency Plan (OPEP) appropriate to the nature and scale of the activity and the credible spill scenarios identified (as identified in *Table 5.1*). In the unlikely event of an oil spill to the marine environment occurring during the Capreolus 3D MSS, the OPEP will be implemented with the response strategy adopted being commensurate to the level of emergency and nature of the spill and receiving environment.

The planning and response capability detailed in the OPEP aligns with applicable statutory oil spill contingency plans. The overall survey OPEP is therefore represented by various levels of emergency plan, which comprise:

- Vessel(s) SOPEP – for spills contained on the vessel or spills overboard which can be managed by the vessel. Vessel SOPEPs have been prepared in accordance with the IMO guidelines for the development of shipboard oil pollution emergency plans. The Vessel Master is responsible for activating and implementing the vessel SOPEP and the shipboard Oil Pollution Prevention Team is responsible for both prevention and response activities.

- The National Plan for Maritime Environmental Emergencies (National Plan) (AMSA, 2014) - AMSA is the jurisdictional authority and control agency for spills from vessels which affect Commonwealth waters i.e. outside of 3 nm from the coast. For Commonwealth waters initial response actions will be undertaken by the vessel with subsequent actions determined in consultation with the regulatory authorities (AMSA) under the National Plan, having regard to the potential impacts posed by the spill. Upon notification of an incident, AMSA will assume control and will respond in accordance with its Marine Pollution Response Plan as approved by the AMSA Executive.

- The Western Australian State Emergency Management Plan for Marine Oil Pollution (WestPlan-MOP; DOT, 2010a) and associated Marine Oil Spill Contingency Plan (MOSCP) (DOT, 2010b) – for spills from vessels which affect WA State waters. If surface slicks appear likely to enter WA State waters (which modelling results shows to be highly unlikely to occur), subsequent actions will be determined in consultation with the DOT under WestPlan–MOP and the MOSCP. The DOT is the designated Combat Agency for oil spills from vessels in WA State jurisdiction.

Notification arrangements have been documented to activate any required involvement from relevant combat agencies.

Given the offshore location of the operational area and the credible spill scenarios identified which involve marine gas oil (*Table 5.1*), the preferred response strategy that is expected to deliver a net environmental benefit is to allow small spills to disperse and evaporate naturally, and monitor the position and trajectory of any surface slicks.

Physical break up by repeated transits through the slick may be considered for larger spills (following consultation with the Combat Agency – AMSA).

7 MANAGEMENT FRAMEWORK AND IMPLEMENTATION STRATEGY

The Capreolus 3D MSS will be undertaken in accordance with the NOPSEMA-accepted EP, applicable legislation and the Polarcus Management System. The Polarcus Management System is an integrated system addressing environment, safety and quality management which is based on the International Association of Oil and Gas Producers (OGP)-IPIECA's Report No. 510 (OGP-IPIECA 2014).

The Polarcus Management System incorporates a number of documented manuals, plans and procedures, registers and tools that will be implemented for the Capreolus 3D MSS such that identified environmental impacts and risks are continually reduced to ALARP and that monitoring of Polarcus' environmental performance is ongoing. The Polarcus Environmental Management Procedure, amongst other procedures, provides for the implementation of the commitments in the EP. Ongoing monitoring to track environmental performance during the MSS includes pre-survey and in-survey environmental inspections, record collection and various scheduled meetings during which any environmental issues that arise are tabled for discussion. Records will be produced for each of these activities that will feed into the Polarcus compliance register ensuring ongoing compliance with the EP. The compliance register will serve as an audit tool during the MSS to establish that environmental performance outcomes and standards are being met in accordance with the EP.

The implementation strategy presented in the Capreolus 3D MSS EP describes the organisational structure, roles/responsibilities and competency/training requirements for all personnel involved in the survey relevant to the controls described in *Table 5.1*. It also further describes the processes in place to meet the monitoring, auditing and reporting requirements defined in the EP and to manage non-conformance, incidents and emergency situations, including oil spills. These processes are underpinned by the Polarcus Management System. The reporting requirements for environmental incidents and reporting on overall compliance of the Capreolus 3D MSS with the EP are also detailed.

7.1 AUDITS

Polarcus will maintain a Compliance Register that will serve as an audit tool during the Capreolus 3D MSS. The register includes detail on environmental performance outcomes and environmental performance standards relevant to the survey, measurement criteria and the person/party responsible for implementing the performance standard/ In accordance with the Polarcus Environmental Management Procedure, Polarcus will complete the following audits during the conduct of the Capreolus 3D MSS:

- a pre-survey environmental checklist addressing pre-survey planning, preparedness for compliance with regulatory requirements, operational considerations and on board preparedness;

- an audit of the on-board spill response capability against Vessel SOPEPs to verify spill preparedness prior to mobilisation; and

- a compliance audit against the EP during the survey.

Any required actions will be followed up and a copy of the environmental audit will be forwarded to NOPSEMA on request, with any lessons learnt included in the Environmental Performance Report.

7.2 MONITORING

The following aspects will be monitored and recorded during the conduct of Capreolus 3D MSS:

- emission to air (based on fuel consumption figures);

- discharges to water (including oily water discharges, macerated food waste and sewage and grey water discharges);

- waste types and quantities transferred to shore for reuse, recycling or disposal;

- marine fauna sightings; and

- Interactions with any third party vessels.

The corresponding parameters, records and responsibilities of such monitoring are detailed in the EP.

7.3 REVIEW OF ENVIRONMENTAL PERFORMANCE

In accordance with the Polarcus Environmental Management Procedure, health, safety and environmental (HSE) matters in general, as well as environmental performance will be continually reviewed during the survey through daily on-board meetings, on-board HSE Committee meetings and tool box meetings. Records will be produced for each of these activities.

The audits described in *Section 7.2* also provide evidence of environmental performance. In accordance with the Polarcus Environmental Management Procedure, audits also trigger remedial actions should any non-compliance or opportunities for improvement be identified.

On completion of the survey Polarcus will undertake an internal review of the environmental performance of the Capreolus 3D MSS. The review will consider:

- an evaluation of conformance with the compliance register;
- improvements to the implementation strategy included within the EP;
- compliance with Polarcus' policies, manuals and procedures;
- the management of non-conformances identified during the survey, including reportable and recordable incidents; and
- concerns identified by stakeholders during and after the completion of the survey, followed by appropriate liaison as required.

The outcomes of the review will be used to inform future Polarcus activities. Polarcus will also report to NOPSEMA on its environmental performance following completion of the survey.

8 TITLEHOLDER'S NOMINATED LIAISON PERSON

The titleholders nominated liaison person, who can be contacted for further information about the Capreolus 3D MSS, is:

Ms Nina Neshpor, Multi-Client Project Supervisor
c/o Polarcus DMCC, PO Box 283373, Dubai, United Arab Emirates
Tel: +971 4 43 60 959
Email: nina.neshpor@polarcus.com.

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