Hockey Bianchi 3D Seismic Survey Environment Plan Summary

EA-00-RI-10148.03

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CONTENTS:

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

Abbreviation	Description
AFMA	Australian Fisheries Management Authority
ALARP	As low as reasonably practicable
AMOSC	Australian Marine Oil Spill Centre Pty Ltd
AMSA	Australian Marine Safety Authority
APPEA	Australian Petroleum Production & Exploration Association
CFA	Commonwealth Fisheries Association
CMR	Commonwealth Marine Reserve
DoD	Department of Defence
DoE	(Australian) Department of the Environment
DoF	Department of Fisheries
DoT	Department of Transport
DPaW	Department of Parks and Wildlife
EMBA	Environment that May Be Affected
EP	Environment Plan
EPBC	Environment Protection and Biodiversity Conservation
EPO	Environmental Performance Outcome
EPS	Environmental Performance Standard
HSE	Health Safety Environment
IAP	Incident Action Plan
IMS	Invasive of Marine Species
IUCN	International Union for Conservation of Nature
KEF	Key Ecological Feature
L	Litre
LMS	Listed Migratory Species
LTS	Listed Threatened Species
MC	Measurement Criteria
MGO	Marine Gas Oil
MMA	Marine Managed Areas
MMO	Marine Mammal Observer
MNES	Matters of National Environmental Significance
MOC	Management of Change
MOU	Memorandum of Understanding
MP	Marine Park
MSS	Marine Seismic Survey
NEBA	Net Environmental Benefit Analysis

Abbreviation	Description
NOPSEMA	National Offshore Petroleum Safety and Environment Management Authority
NW Shelf	Western Australia's North West Shelf
NWMR	North West Marine Region
ODS	Ozone Depleting Substances
OPEP	Oil Pollution Emergency Plan
OPGGS(E)R	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
OSCP	Oil Spill Contingency Plan
OWA	Oiled Wildlife Advisors
PPA	Pearl Producers Association
UAV	Unmanned Aerial vehicles
VRASS	Vessel Risk Assessment
WA	Western Australia
WAFIC	Western Australian Fishing Industry Council

1. INTRODUCTION

Quadrant Northwest Pty Ltd (Quadrant) proposes to undertake the Hockey and Bianchi 3D Marine Seismic Survey (MSS) in Commonwealth waters on the North West Shelf (NWS) in permit areas shown in **Figure 2-1** of Western Australia (WA). The MSSs will take up to 60 days in total and will not occur between 1 May and 31 December.. The validity of the Environment Plan (EP) will remain until 31st December 2018, or completion of the MSS. The Hockey Bianchi MSS have been presented as one survey area but dependent on conditions may be split into 2 survey areas: Hockey (in the East) and Bianchi (to the west) as shown in **Figure 2-1**.

1.1 Titleholder

Quadrant Northwest Pty Ltd is the titleholder for petroleum activities covered under the EP within WA-510-P. For the purposes of the EP it will be referred to as Quadrant.

Titleholder details are as follows:

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1.2 Compliance

The overall purpose of the *Hockey Bianchi 3D Seismic Survey Environment Plan (EA-00-RI-10148.01)* (the EP) is to comply with statutory requirements of the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS (E) Regulations); and to ensure that the Activity is planned and conducted in line with Quadrant environmental policies and standards, including the corporate Environmental Policy. The EP was assessed and accepted by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) on 22nd December 2016. The EP summary has been prepared in accordance with the requirements of regulation 11 (4) of the OPGGS (E) Regulations.

1.3 Activity duration and timing

The Bianchi MSS will take approximately 23 days as a standalone survey and the Hockey survey approximately 25 days standalone. However, if the two surveys are conducted as a single, combined survey, the expected total duration is 42 days. To allow for contingency in event of prolonged shut down periods, weather or equipment/vessel issues, a conservative time of 60 days is assessed for in the EP. If the surveys are conducted separately, or a survey is only partially completed, there may be a period of time between the activities being undertaken, the total duration of the separate surveys will however not exceed 60 days. If this does occur, this will trigger new commencement notifications to stakeholders as per **Section 5**.

The exact timing of the MSSs are dependent upon vessel availability, weather conditions and receiving the necessary statutory approvals. The earliest date for commencement of the MSSs is December 2016 with all activity completed on or before 31st December 2018. The survey will not occur between 1 May and 31 December.

2. ACTIVITY LOCATION

The MSSs will consist of a 'survey area' and a larger 'operational area' (**Figure 2-1**). The survey area is located entirely within Commonwealth waters. The survey area is defined by that area which contains full-fold seismic coverage for the purpose of imaging the subsurface (i.e. the seismic source is discharged within the survey area only). The survey vessel will not enter State waters at any point during the activity.

The Hockey and Bianchi surveys may be acquired as a single survey or as two separate surveys (not concurrently), dependent on weather, vessel availability and regulatory and operator financial approvals.

The operational area is used for conducting operations ancillary to achieving full-fold coverage within the survey area. For the purpose of this activity, the Operational Area consists of "Operational Area" and "Operational Area 2". Activities conducted in the Operational Area include: acoustic emissions at full power on sail line 'run-outs'; acoustic emissions below full power for the purpose of 'soft start' or 'fauna alert' procedures; miscellaneous maintenance operations; and, vessel turns at the end of each sail line, necessary for the vessel to change to a new sail line. Within "Operational Area 2" (the area closest to Barrow Island) the activities conducted will be limited solely to passive streamer tow or drift and support vessels. For clarity, there will be no firing of source (at full or partial power), maintenance or vessel turns undertaken in Operational Area 2.

The Operational Area as defined overlaps into State waters due to the permit area abutting the State waters boundary, this accounts for the passive streamers entering State waters when the survey is being conducted along the boundary and streamers may pass through State waters, or drift due to currents when these lines are being acquired. The survey vessel and seismic source will not enter State waters.

It should be noted that the intersection of the operational area with the Barrow Island Marine Park is solely to allow for streamer drift across the boundary of the marine park, and the potential for support vessels to enter the park in the event of unplanned events such as potential for vessel collision. There is no intention to undertake any planned activity within the marine park, however, the operational area intersects the boundary to ensure a conservative approach.

Water depths in the operational area range from 30 m to 830 m. The survey vessel will not operate in water depths of less than 30 m. Bounding coordinates are presented in **Table 2-1**.

Table 2-1: Proposed Hockey Bianchi survey and operational area co-ordinates

LATITUDE	LONGITUDE	LATITUDE	LONGITUDE
Survey area			
20° 40' 58.369" S	114° 38' 18.388" E	20° 27' 30.274" S	115° 21' 41.934" E
20° 43' 15.394" S	114° 51' 1.941" E	20° 36' 8.103" S	115° 20' 48.255" E
20° 43' 16.884" S	114° 51' 11.607" E	20° 37' 27.071" S	115° 20' 35.143" E
20° 43' 17.912" S	114° 51' 21.337" E	20° 38' 44.100" S	115° 20' 12.478" E
20° 43' 18.476" S	114° 51' 31.113" E	20° 39' 58.159" S	115° 19' 40.545" E
20° 43' 18.575" S	114° 51' 40.905" E	20° 41' 8.270" S	115° 18' 59.768" E
20° 43' 18.206" S	114° 51' 50.690" E	20° 42' 13.506" S	115° 18' 10.692" E
20° 43' 17.371" S	114° 52' 0.443" E	20° 43' 12.993" S	115° 17' 13.957" E
20° 43' 16.074" S	114° 52' 10.137" E	20° 44' 5.943" S	115° 16' 10.318" E
20° 43' 14.317" S	114° 52' 19.751" E	20° 44' 51.650" S	115° 15' 0.622" E
20° 43' 12.103" S	114° 52' 29.258" E	20° 45' 29.515" S	115° 13' 45.795" E
20° 43' 9.442" S	114° 52' 38.632" E	20° 45' 59.021" S	115° 12' 26.826" E
20° 37' 52.972" S	115° 9' 35.417" E	20° 51' 15.704" S	114° 55' 29.186" E
20° 37' 45.238" S	115° 9' 56.114" E	20° 51' 25.862" S	114° 54' 53.413" E
20° 37' 35.314" S	115° 10' 15.727" E	20° 51' 34.305" S	114° 54' 17.136" E
20° 37' 23.333" S	115° 10' 34.000" E	20° 51' 41.007" S	114° 53' 40.451" E

20° 37' 9.455" S	115° 10' 50.689" E	20° 51' 45.954" S	114° 53' 3.454" E
20° 36' 53.860" S	115° 11' 5.570" E	20° 51' 49.134" S	114° 52' 26.235" E
20° 36' 36.757" S	115° 11' 18.448" E	20° 51' 50.542" S	114° 51' 48.897" E
20° 36' 18.377" S	115° 11' 29.154" E	20° 51' 50.162" S	114° 51' 11.528" E
20° 35' 58.960" S	115° 11' 37.544" E	20° 52' 14.022" S	114° 51' 16.225" E
20° 35' 38.761" S	115° 11' 43.504" E	20° 57' 1.447" S	114° 50' 18.047" E
20° 35' 18.054" S	115° 11' 46.962" E	20° 54' 22.843" S	114° 35' 34.466" E
20° 26' 40.307" S	115° 12' 41.135" E		
Operational Area			
20° 46' 32.584" S	115° 17' 38.130" E	20° 30' 10.311" S	115° 3' 23.062" E
20° 53' 11.998" S	115° 13' 22.742" E	20° 14' 59.617" S	115° 9' 49.733" E
21° 2' 45.688" S	114° 59' 10.851" E	20° 15' 41.854" S	115° 24' 29.900" E
20° 54' 51.211" S	114° 20' 52.767" E	20° 34' 55.376" S	115° 24' 7.720" E
20° 33' 44.755" S	114° 26' 6.900" E	20° 39' 12.429" S	115° 23' 37.578" E
20° 37' 1.607" S	114° 50' 52.322" E	20° 43' 30.864" S	115° 21' 10.884" E
Operational Area 2			
20° 25' 8.228" S	115° 24' 19.044" E	20° 43' 12.993" S	115° 17' 13.957" E
20° 34' 55.376" S	115° 24' 7.720" E	20° 42' 13.506" S	115° 18' 10.692" E
20° 39' 12.429" S	115° 23' 37.578" E	20° 41' 8.270" S	115° 18' 59.768" E
20° 43' 30.864" S	115° 21' 10.884" E	20° 39' 58.159" S	115° 19' 40.545" E
20° 46' 32.584" S	115° 17' 38.130" E	20° 38' 44.100" S	115° 20' 12.478" E
20° 47' 48.905" S	115° 14' 18.486" E	20° 37' 27.071" S	115° 20' 35.143" E
20° 47' 59.091" S	115° 13' 45.868" E	20° 36' 8.103" S	115° 20' 48.255" E
20° 45' 29.515" S	115° 13' 45.795" E	20° 27' 30.274" S	115° 21' 41.934" E
20° 44' 51.650" S	115° 15' 0.622" E	20° 25' 6.719" S	115° 21' 56.815" E
20° 44' 5.943" S	115° 16' 10.318" E	20° 43' 12.993" S	115° 17' 13.957" E

Permit numbers that the Operational Area overlaps are summarised below:

WA-205-P	WA-37-L	WA-22-L	WA-55-R	WA-59-R	WA-13-L	WA-42-R	WA-520-P	TL/8
WA-25-L	W16-23	WA-214-P	WA-33-R	WA-516-P	WA-358-P	WA-192-P	WA-29-L	WA-43-R
WA-290-P	WA-49-R	WA-510-P	WA-483-P	WA-392-P	TL/3	WA-50-R	WA-45-L	

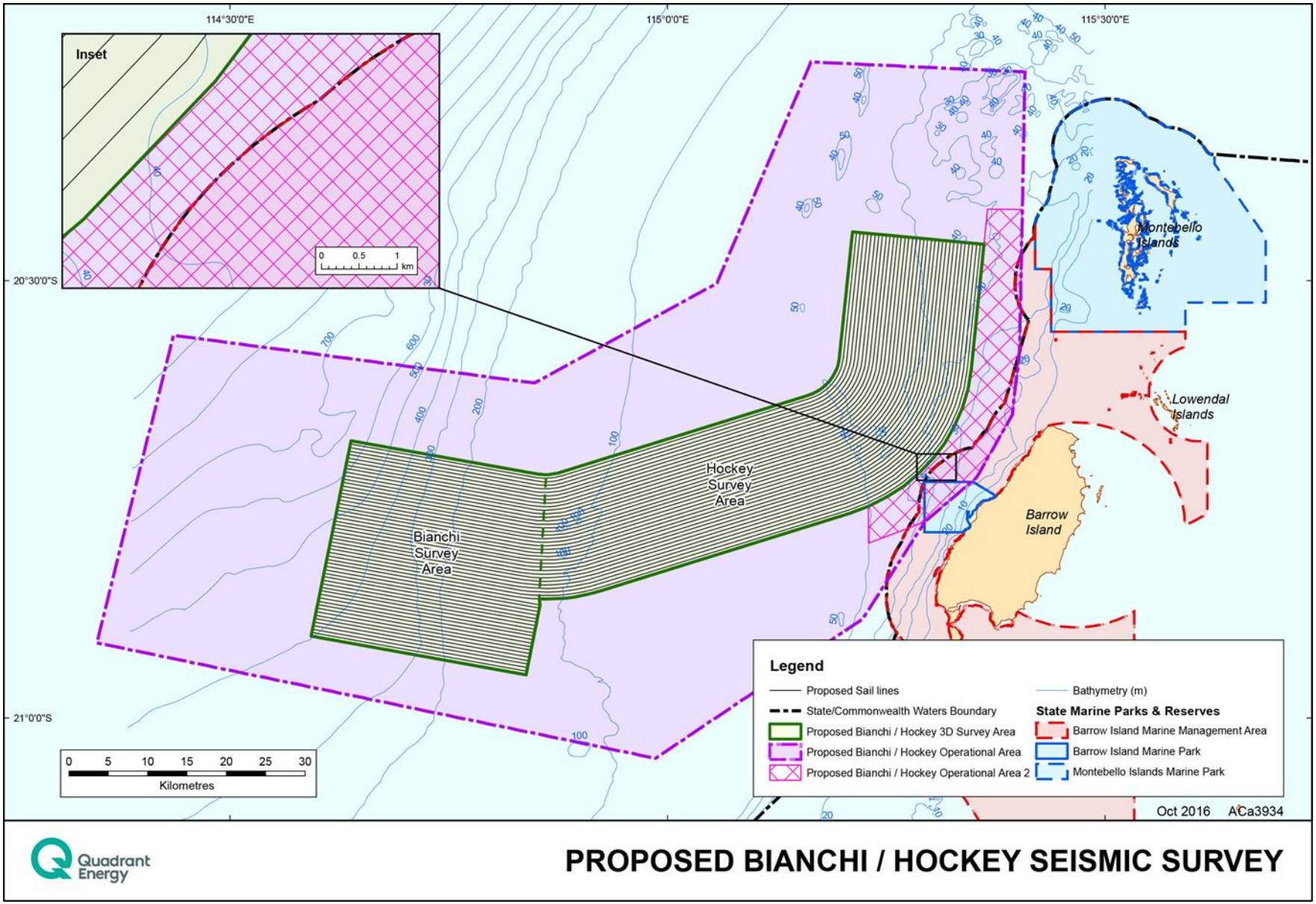

Figure 2-1: Location of the Bianchi and Hockey operational and MSS areas

3. DESCRIPTION OF THE ACTIVITY

3.1.1 MSS Parameters

The proposed MSS is a typical 3D MSS similar to others conducted in Australian marine waters (in terms of technical methods and procedures). No unique or unusual equipment or operations are proposed.

The proposed MSS will employ modern streamer technology (gel filled) and improved MSS design parameters, aimed at improving the resolution of the sub-surface image.

During the proposed activities, the survey vessel will traverse a series of pre-determined sail lines within the operational area at a speed of approximately 4 – 4.5 knots (8-9 km/hr). As the vessel travels along the sail lines a series of noise pulses (approximately every 4 - 10 seconds) will be directed down through the water column and seabed. The released sound is attenuated and reflected at geological boundaries and the reflected signals are detected using sensitive microphones arranged along a number of hydrophone streamers towed behind the survey vessel. The reflected sound is then processed to provide information about the structure and composition of geological formations below the seabed. The seismic array will comprise a maximum of 14 seismic streamers, with an approximate length of 8000 m. The seismic streamers are towed side by side and the spacing will be 50 - 100 m between each seismic streamer resulting in a maximum array width of approximately 1300 m. The seismic energy source tow depth will be 6-7 m and the streamer tow depth will be between approximately 7 to 20 m. The operating pressure for the seismic energy source will be approximately 2000 psi with a maximum volume of 3090 cui. The source will be fired at an interval of approximately 12.5 m horizontal distance. A total of 22 guns will be utilised during the survey.

The choice of source array is limited by commercial availability and varies from one vendor to another. All arrays are designed to “tune” the response such that the primary energy is directed downward into the subsurface and not horizontally away from the source. The size of the source volume is dependent on the depth below the seabed at which the geological targets occur. However, it is important to note that the energy produced is not directly proportional to total array volume.

3.1.2 Vessels

Quadrant proposes to conduct the MSSs using a suitable survey vessel that will have all necessary certification/registration and will be fully compliant with all relevant MARPOL and SOLAS convention requirements for a vessel of this size and purpose.

At least one support vessel, will accompany the survey vessel at all times, to provide logistical, safety and equipment management support and will be rigged and capable of towing the seismic vessel in the case of an emergency. It is likely that two vessels will be required, one to remain with the survey vessel at all times, and another to provide additional support e.g. re-supply, refuelling etc.

Support vessels may enter State waters for example to chase a third party vessel, retrieve dropped objects (floating) or for other safety reasons.

3.1.3 Logistics support

Vessel refuelling (with marine gas oil (MGO)) at sea may occur during the activity. Refuelling will only occur within daylight hours and providing weather and sea state conditions are suitable, and at the discretion of the Vessel Master. There will be no refuelling within State waters. Helicopters will be used to transfer crew and assist in Health Safety Environment (HSE) or operational emergencies as required.

4. DESCRIPTION OF ENVIRONMENT

4.1 Environment that May Be Affected (EMBA)

For the purposes of the EP, the operational area contains both Hockey and Bianchi operational areas. The operational area occurs entirely within the Northwest Shelf Province bioregion. The area that may be affected will encompass the environment that could be affected by unplanned events as this provides for the largest potential area that could be impacted. This area is derived from modelling worst case scenarios which are attributed to spills. The worst case credible spill scenario (loss of inventory in one fuel tank due to vessel collision) has been modelled to identify the worst case environmental extent that may be affected by this activity, this is known as the Environment that May Be Affected (EMBA).

The EMBA was used to complete a search of the Matters of National Environmental Significance (MNES) database, which in turn identified the environmental values and sensitivities within the existing environment. The EMBA search was conducted as a 42 km buffer around the operational area which reflects the distance which diesel could spread from anywhere within the operational area as a result of a vessel collision.

4.2 Physical environment and habitats

4.2.1 Physical environment

Northwest Shelf Province Bioregion

The Northwest Shelf Province Bioregion is located primarily on the shelf between North West Cape and Cape Bougainville. The bioregion has a total area of 238,759 km^2 and contributes to 19.6 % of the total area of the North-west Marine Region. Water depths within the bioregion range from 0-200 m, with more than 45% of the bioregion having a depth of 50-100 m (DSEWPaC, 2008).

The Northwest Shelf Province is located almost entirely on the continental shelf, except for a small area to the north of Cape Leveque that extends onto the continental slope. The shelf gradually slopes from the coast to the shelf break, but displays a number of seafloor features such as banks/shoals and holes/valleys. The dynamic oceanic environment influences sediment distribution throughout the bioregion. The seafloor of this bioregion is particularly strongly affected by cyclonic storms, long-period swells and large internal tides, which can resuspend sediments within the water column as well as move sediment across the shelf (DSEWPaC, 2008).

Northwest Province Bioregion

The Northwest Province Bioregion is located offshore between Exmouth and Port Hedland, covering an area of 178,651 km2. And covers 16.7% of the total North West Marine Region (NWMR). Water depths of the bioregion predominantly range from 1000 to 3000 m, with a maximum depth of 5170 m in the Exmouth Plateau (DSEWPaC, 2008).

The Northwest province lies entirely on the continental slope and is comprised of muddy sediments. A number of distinguishing topological features occur, notably the Exmouth Plateau. Significantly, this bioregion contains the steepest shelf break of the NWMR, along the Cape Range Peninsula near Ningaloo Reef (DSEWPaC, 2008). As with many other bioregions, currents are dominated by the circulation of the Indonesian Throughflow. Circulation is subject to both seasonal and inter-annual variation. The most distinguishing oceanographic feature of the Northwest Province (compared to other bioregions further north) is the strengthening of the Leeuwin current resulting from the narrowing of the continental shelf at the North West Cape (DSEWPaC, 2008).

4.2.2 Habitats

Northwest Shelf Province Bioregion

Low density benthic communities of bryozoans, molluscs and echinoids are supported within the bioregion. Sponge communities are also sparsely distributed on the shelf and are found only in areas of hard substrate. However the region between Dampier and Port Hedland is a hotspot for sponge biodiversity. Other benthic

and demersal species in the bioregion include sea cucumbers, urchins, prawns and squid. Benthic and pelagic fish communities are also highly diverse and strongly depth-related with a number of hotspots identified between Port Hedland and North West Cape. Numerous migratory species including humpback whales, whale sharks and dugongs travel through the bioregion. The bioregion also supports bottlenose and Indo-Pacific humpback dolphins, turtle nesting sites including green, hawksbill, flatback and loggerhead turtles, and several seabird breeding populations including wedge-tailed shearwaters, crested, bridled and sooty terns, brown boobies and lesser frigatebirds (DSEWPaC, 2008).

Northwest Province Bioregion

Benthic communities are likely to include filter feeders and epifauna. Soft bottom environments are likely to support patchy distributions of mobile epibenthos. Pelagic species occurring in the bioregion are likely to include small pelagic fish attracted to seasonal upwellings as well as larger predators such as billfish, sharks and dolphins. A number of migratory species have been recorded in the bioregion including whale sharks, cetaceans and marine turtles.

4.3 Protected and Significant Areas

For Commonwealth Marine Reserves (CMRs) designated after 2012, a suite of Management Plans were introduced. Due to the recent changes in Government, these Management Plans are no longer in force and 'transitional management arrangements' are in effect (DoE, 2014). The operational area overlaps with the Montebello CMR, and the EMBA overlaps with the Montebello CMR, Montebello Marine Park and Barrow Marine Park (**Figure 4-1**).

Under the transitional arrangements the Director of National Parks has issued a general approval for all new areas added to the Commonwealth marine reserve estate in the North and North-west Commonwealth Marine Reserves Network. The general approval for the North-west Commonwealth Marine Reserves Network provides for mining activities (including seismic surveys) to be carried out within the Montebello CMR. Once CMR management plans are finalised, requirements that apply to CMRs may change. Where the Operational area overlaps a CMR, the management plans will be complied with for the life of the activity. A description of the CMRs and other protected areas, and the environmental sensitivities within them, is provided below with compliance with the relevant International Union for Conservation of Nature (IUCN) principles of the protected areas summarised in **Table 4-1**.

Montebello CMR

The Montebello CMR is overlapped by the operational area and EMBA. The CMR is an IUCN VI zone (see **Table 4-1** for values) and is designated due to the following values:

Major conservation values

- Foraging areas adjacent to important breeding areas for migratory seabirds;
- Foraging areas for vulnerable and migratory whale sharks;
- Foraging areas adjacent to important nesting sites for marine turtles;
- Includes part of the migratory pathway of the protected humpback whale;
- The reserve includes shallow shelf environments with depths ranging from 15 metres to 150 metres and provides protection for shelf and slope habitats, as well as pinnacle and terrace seafloor features;
- Examples of the seafloor habitats and communities of the Northwest Shelf Province provincial bioregions as well as the Pilbara (offshore) meso-scale bioregion; and
- One key ecological feature for the region:
    - Ancient Coastline (a unique seafloor feature that provides areas of enhanced biological productivity) is represented in this reserve.

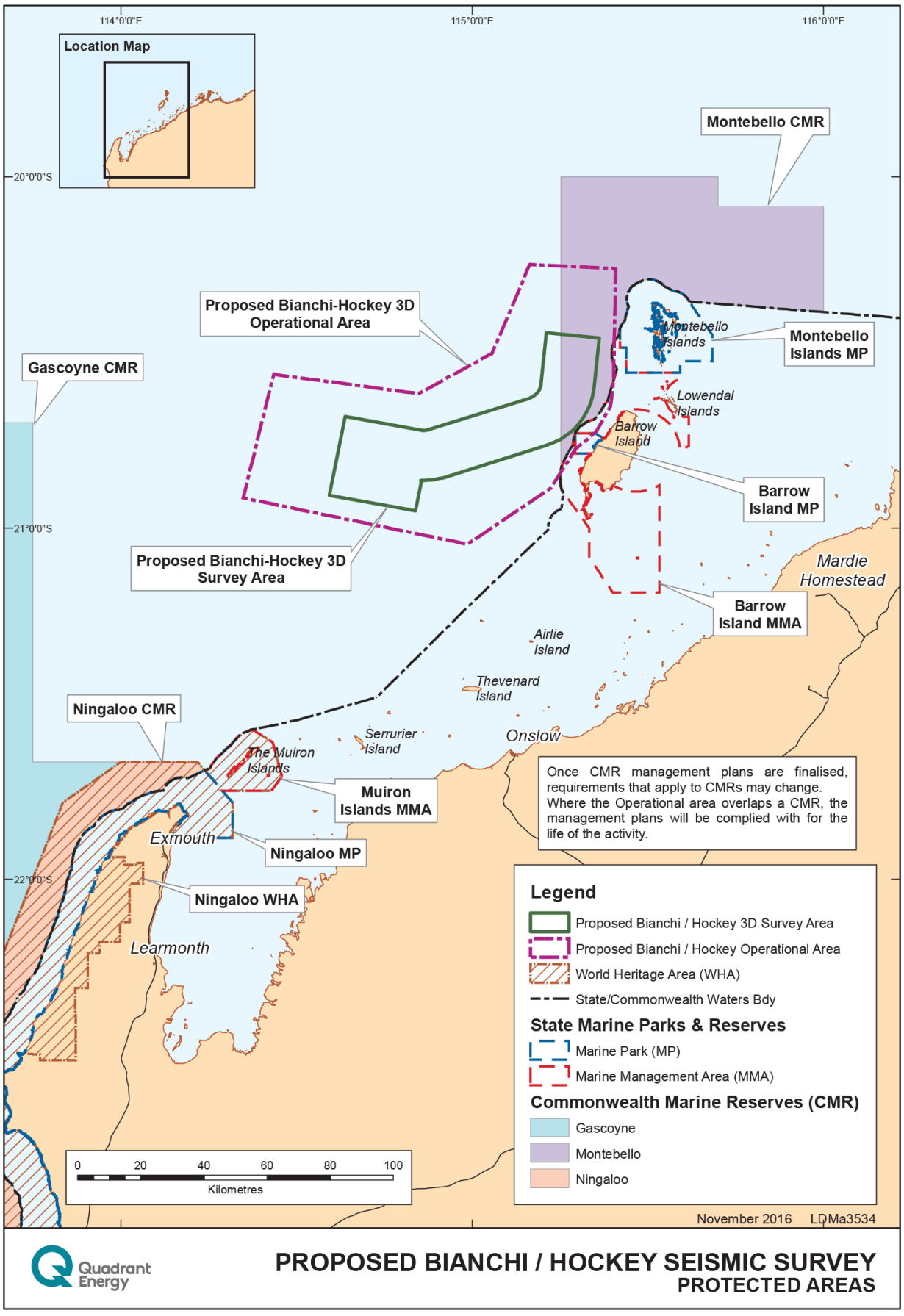

Figure 4-1: Commonwealth and State Marine Reserves in the vicinity of the operational area and EMBA

Summary of Ecological Values

- Geomorphology: A complex seabed and island topography consisting of subtidal and intertidal reefs, sheltered lagoons, channels, beaches and cliffs;
- Sediment quality: The sediments of the reserves are generally pristine, which is essential to the maintenance of healthy marine ecosystems;
- Water quality: The waters of the reserves are generally pristine, which is essential to the maintenance of healthy marine ecosystems;
- Coral reef communities: Undisturbed intertidal and subtidal coral reefs and bommies with a high diversity of hard corals;
- Mangrove communities: Six species of mangroves are found in the reserves, with the Montebello Islands' mangrove communities considered globally unique as they occur in lagoons of offshore islands;
- Macroalgal and seagrass communities: Extensive subtidal macroalgal and seagrass communities are important primary producers and refuge areas for fishes and invertebrates;
- Rocky shore/intertidal reef platform communities: Rocky shores predominate on most of the islands of the reserves and provide habitat for a variety of intertidal organisms, which in turn provide food for shorebirds;
- Intertidal sand/mudflat communities: The intertidal sand/mudflat communities are primary producers with an abundant invertebrate fauna, which provides a valuable food source for shorebirds;
- Subtidal soft-bottom communities: Subtidal sand and silt habitats support a variety of fauna including burrowing invertebrates and filter-feeding communities;
- Marine mammals: Ten species of cetaceans are recorded from the reserves, with the humpback whale passing through the area during its annual migration. Dugongs are found in the shallow warm waters;
- Turtles: Green, flatback, hawksbill, loggerhead and leatherback turtles are found in the reserves, with the Western Australian hawksbill population being the largest remaining in the Indian Ocean. Four species use sandy beaches in the reserves for nesting;
- Seabirds: The reserves provide important feeding and resting areas for migrating shorebirds. Islands within the reserves are nesting areas for 15 species of seabirds;
- Finfishes: A rich finfish fauna with at least 456 species; and
- Invertebrates: A diverse marine invertebrate fauna comprising mostly tropical species.

Summary of Social Values

- Hydrocarbon exploration and production industry: The Montebello/Barrow islands region is within the State's most productive petroleum area (for both oil and gas);
- Pearling: The warm pristine waters of the reserves provide optimal conditions for production of high quality pearls by the existing pearling operations;
- Nature-based tourism: The reserves are developing rapidly as an important area for the nature-based tourism industry, with charter boats taking tourists to the Montebello Islands to participate in activities such as fishing, diving, wildlife viewing, island exploring and surfing;
- Commercial fishing: The reserves are used by commercial fishers targeting a variety of finfish, sharks and beche de mer;
- Recreational fishing: Excellent shore and boat-based recreational fishing opportunities targeting a variety of pelagic and reef finfish species, mud crabs and other edible invertebrates;
- Water sports: The natural values, climate, and scenic values provide the basis for a wide range of recreational activities;
- European history/maritime heritage: The Montebello Islands have a history of European contact dating from 1622, which includes pearling, whaling, fishing for turtles and, more recently, British atomic testing; and
- Scientific research: The undisturbed nature and wide variety habitats and communities within the reserves provide unique opportunities for scientific research.

Barrow Island Marine Management Area

The operational area overlaps with the Barrow Island Marine Management Area (MMA). The Barrow Island MMA is an IUCN VI zone (see **Table 4-1** for values).

The MMA is the largest reserve within the Montebello/Barrow Islands marine conservation reserves, covering 114,693 ha (DEC 2007). The MMA includes most of the waters around Barrow Island, the Lowendal Islands and the Barrow Island Marine Park, with the exclusion of the port areas of Barrow Island and Varanus Island.

The MMA is not zoned apart from one specific management zone: the Bandicoot Bay Conservation Area. This conservation area is on the southern coast of Barrow Island and has been created to protect benthic fauna and seabirds. It includes the largest intertidal sand/mudflat community in the reserves, is known to be high in invertebrate diversity and is an important feeding area for migratory birds.

The Barrow Island MMA includes significant breeding and nesting areas for marine turtles and the waters support a diversity of tropical marine fauna, important coral reefs and unique mangrove communities (DEC 2007). Green, hawksbill and flatback turtles regularly use the island's beaches for breeding, and loggerhead turtles are also occasionally sighted.

Barrow Island Marine Park

The operational area overlaps the Barrow Island Marine Park.

The Barrow Island Marine Park covers 4,169 ha, all of which is zoned as sanctuary zone (the Western Barrow Island Sanctuary Zone) (DEC 2007). The Barrow Island Marine Park is an IUCN IA zone (see Table 4-1 for values). It includes Biggada Reef, an ecologically significant fringing reef, and Turtle Bay, an important turtle aggregation and breeding area (DEC 2007). Representative areas of seagrass, macroalgal and deep water habitat are also represented within the marine park (DEC 2007). Passive recreational activities (such as snorkelling, diving and boating) are permitted but extractive activities such as fishing and hunting are not permitted.

Montebello Islands Marine Park

The Montebello Islands Marine Park (MP) is immediately adjacent to the operational area.

Zoning within the Montebello Islands MP is a combination of sanctuary, recreation, special purpose (benthic protection), special purpose (pearling), and general use (DEC 2007). The Montebello Islands Marine Park contains both IUCN IA and II zones (see Table 4-1 for values). The Montebello Islands is an 'A' Class reserve (DEC 2007) and covers an area of 58,331 ha and its northern and western boundaries follow the seaward extent of Western Australian state waters (DEC 2007).

The Montebello Islands comprise over 100 islands, the majority of which are rocky outcrops; rocky shore accounts for 81% of shoreline habitat (DEC 2007). Other marine habitats within the marine park include coral reefs, mangroves, intertidal flats, extensive sheltered lagoonal waters, and shallow algal and seagrass reef platform extending to the south of the Montebello Islands to the Rowley Shelf. The complex seabed and island topography creates a unique environment where these diverse habitats occur in close proximity to each other.

Ecologically, the marine park's values include important turtle nesting sites, feeding and resting areas for migrating shorebirds, seabird nesting areas, dugong foraging areas, globally-unique mangrove communities, and highly diverse fish and invertebrate assemblages (DEC 2007) (**Table 4-1**). Also, the sediment and water quality of the marine park are considered pristine (DEC 2007) and are essential to the maintenance of the marine ecosystems and associated biota.

Economic values within the Montebello Islands MP include commercial pearl culture, commercial line and trap fishing, and an increasing recreational usage (DEC 2007). Special purpose zones for pearling are established for the existing leaseholder to allow pearling to be the priority use of these areas (DEC 2007). Commercial fishing includes a trap fishery for reef fishes, mainly in water depths of 30–100 m, and wet lining

for reef fish and mackerel. Fish trawling also occurs in the waters near to the Montebello Islands. A tourist houseboat operates out of Claret Bay, at the southern end of Hermite Island, during the winter months. The Montebello Islands are becoming more frequently used by recreational boaters for camping, fishing and diving activities.

Table 4-1: Australian IUCN reserve management principles (Schedule 8 of the EPBC Regulations 2000)

Category IA	IUCN principles	Evidence of addressing principles
• Barrow Island Marine Park • Montebello Islands Marine Park	The reserve or zone should be managed primarily for scientific research or environmental monitoring based on the following principles.	Yes - Addressed throughout this table and through management of the reserve by DoE, and consultation with the Conservation and Parks Commission
	Habitats, ecosystems and native species should be preserved in as undisturbed a state as possible	Yes – no behavioural impacts expected that would impact ecological processes. Potential impacts reduced to ALARP through controls demonstrated in the EP (Section 6) resulting in minimal behavioural or physiological disturbance, therefore maintaining the current state of the regions, communities, resources and species
	Genetic resources should be maintained in a dynamic and evolutionary state.	Yes – no behavioural impacts expected that would impact on breeding cycles given the temporary nature of the MSSs
	Established ecological processes should be maintained	Yes – no behavioural impacts expected that would impact ecological processes
	Structural landscape features or rock exposures should be safeguarded.	Yes – no anchoring or possible grounding will occur within the reserve
	Examples of the natural environment should be secured for scientific studies, environmental monitoring and education, including baseline areas from which all avoidable access is excluded	Yes - Reserve will not be accessed by the survey vessel. There may be an occurrence of streamers drifting into the area, this may occur due to currents in the area
	Disturbance should be minimised by careful planning and execution of research and other approved activities.	Yes – no impacts expected that would lead to disturbance of values and sensitivities
	Public access should be limited to the extent it is consistent with these principles.	Yes - Reserve will not be entered by the survey vessel. There may be a requirement for a support vessel to enter the reserve for safety reasons (e.g. avoid collision with third party vessels) or to retrieve a floating dropped object
Category II	**IUCN principles**	**Evidence of addressing principles**
• Montebello Islands Marine Park	The reserve or zone should be protected and managed to preserve its natural condition according to the following principles.	Yes - Addressed throughout this table and through management of the reserve by DoE
	Natural and scenic areas of national and international significance should be protected for spiritual, scientific, educational, and recreational or tourist purposes.	Yes - Reserve will not be entered by the survey vessel. There may be a requirement for a support vessel to enter the reserve for safety reasons (e.g. avoid collision with third party vessels) or to retrieve a floating dropped object

	Representative examples of physiographic regions, biotic communities, genetic resources, and native species should be perpetuated in as natural a state as possible to provide ecological stability and diversity	Yes – Park will not be entered. Potential impacts reduced to ALARP through controls demonstrated in the EP resulting in minimal behavioural or physiological disturbance, therefore maintaining the current state of the regions, communities, resources and species
	Visitor use should be managed for inspirational, educational, cultural and recreational purposes at a level that will maintain the reserve or zone in a natural or near natural state	N/A - Covered by park management (DoE) and regulator assessment of the EP.
	Management should seek to ensure that exploitation or occupation inconsistent with these principles does not occur.	N/A - Covered by park management (DoE)
	Respect should be maintained for the ecological, geomorphologic, sacred and aesthetic attributes for which the reserve or zone was assigned to this category.	Yes –Impacts to the environment and the ecological values that the zone has been implemented for managed to ALARP through controls identified in the EP
	The needs of indigenous people should be taken into account, including subsistence resource use, to the extent that they do not conflict with these principles.	Yes – Consultation has been undertaken with Aboriginal Corporations to understand if there is potential for the activity to impact on cultural or heritage activities. It is recognised that subsistence fishing may take place at low levels, however consultation did not raise any concerns regarding the proposed activity, and therefore no conflict with these principles is apparent. This was confirmed in consultation see **Table 5-2** of this document.
	The aspirations of traditional owners of land within the reserve or zone, their continuing land management practices, the protection and maintenance of cultural heritage and the benefit the traditional owners derive from enterprises, established in the reserve or zone, consistent with these principles should be recognised and taken into account.	Yes – Consultation has been undertaken with Aboriginal Corporations to understand if there is potential for the activity to impact on cultural or heritage activities. Consultation did not raise any concerns regarding the proposed activity, and therefore no conflict with these principles is apparent. This was confirmed in consultation see **Table 5-2** of this document.
Category VI	**IUCN principles**	**Evidence of addressing principles**
• Montebello Commonwealth Reserve • Barrow Island Marine Management Area	The reserve or zone should be managed mainly for the sustainable use of natural ecosystems based on the following principles.	Yes - Addressed throughout this table
	The biological diversity and other natural values of the reserve or zone should be protected and maintained in the long term.	Yes – addressed through the control measures identified in the EP
	Management practices should be applied to ensure ecologically sustainable use of the reserve or zone.	Yes – addressed through the control measures identified in the EP
	Management of the reserve or zone should contribute to regional and national	N/A - Covered by park management (DoE)

	development to the extent that this is consistent with these principles.	

Key Ecological Features

The operational area and EMBA overlap with two Key Ecological Features (KEFs); Continental Slope Demersal Fish Communities and the Ancient coastline at 90-120m depth.

Continental Slope Demersal Fish Communities

The Australian continental slope provides important habitat for demersal fish communities, characterised by high endemism and species diversity. Specifically, the continental slope between North West Cape and the Montebello Trough is the most diverse slope bioregion in Australia with more than 500 fish species, 76 of which are endemic (Last et al. 2005 in DSEWPaC 2012). The Timor Province and Northwest Transition bioregions are the second-richest areas for demersal fish across the entire continental slope (DSEWPaC 2012).

Ancient coastline at 90-120m depth

This coastline is found in the South-west Marine Region and contains several terraces and steps reflecting a gradual increase in sea level across the shelf that occurred during the Holocene. The most prominent of these occurs close to the middle of the continental shelf off the Great Australian Bight at a depth of 90-120m.

The area has important conservation value due to its potential for high productivity, biodiversity and aggregations of marine life. Benthic biodiversity and productivity occur where the ancient coastline forms a prominent escarpment of exposed hard substrates, where it is dominated by sponge communities of significant biodiversity and structural complexity (DSEWPaC 2012).

4.4 Marine Fauna

Desktop searches of the Operational Area and larger EMBA were undertaken using DoE's Protected Matters Search Tool for the purposes of identifying species listed under the EPBC Act. The search identified 21 Listed Threatened Species (LTS) and 36 Listed Migratory Species (LMS) as having the potential to occur within the EMBA**.**

An assessment of all the marine and coastal species was undertaken to identify if these species have the potential to occur in either the Operational Area or larger EMBA. Those fish, sharks, rays, marine mammals and marine reptiles listed as threatened or vulnerable species that have been identified as likely to be present in the vicinity of the Operational Area are shown in **Table 4-2**, **Figure 4-2**, **Figure 4-3** and **Figure 4-4**.

Table 4-2: Protected species and communities in the operational area and EMBA (EPBC search conducted on 14th November 2016)

Value/Sensitivity		EPBC Act Status CE = Critically Endangered E = Endangered V = Vulnerable M = Migratory	Operational Area presence	Particular values or sensitivities within Operational Area	EMBA presence	Particular values or sensitivities within EMBA	Relevant Events
Common Name	**Scientific Name**						
Protected Species and Communities: Fish and Sharks							
Grey Nurse Shark (west coast population)	*Carcharias taurus (west coast population)*	V	✓	Species or species habitat known to occur within area	✓	Species or species habitat known to occur within area	Planned • Light emissions • Noise emissions • Planned operational discharges • Spill response operations Unplanned • Hydrocarbon Releases • Non-hydrocarbon releases • Marine fauna collisions • Introduction of invasive marine species
Great white shark	*Carcharodon carcharias*	V,M	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	
Dwarf Sawfish, Queensland Sawfish	*Pristis clavata*	V, M	✓	Species or species habitat known to occur within area	✓	Species or species habitat known to occur within area	
Green Sawfish, Dindagubba, Narrowsnout Sawfish	*Pristis zijsron*	V,M	✓	Species or species habitat know to occur within area	✓	Species or species habitat known to occur within area	
Whale Shark	*Rhincodon typus*	V,M	✓	Foraging, feeding or related behaviour known to occur within area Overlap with foraging BIA	✓	Foraging, feeding or related behaviour known to occur within area Overlap with foraging BIA	
Shortfin mako	*Isurus oxyrinchus*	M	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area	
Longfin mako	*Isurus paucus*	M	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area	

Value/Sensitivity		EPBC Act Status CE = Critically Endangered E = Endangered V = Vulnerable M = Migratory	Operational Area presence	Particular values or sensitivities within Operational Area	EMBA presence	Particular values or sensitivities within EMBA	Relevant Events
Common Name	**Scientific Name**						
Reef manta Ray	*Manta alfredi*	M	✓	Species or species habitat known to occur within area	✓	Species or species habitat known to occur within area	
Giant manta ray	*Manta birostris*	M	✓	Species or species habitat likely to occur within area	✓	Species or species habitat known to occur within area	
Blind gudgeon	*Milyeringa veritas*	V			✓	Species or species habitat may occur within area	Unplanned events • Hydrocarbon spill
Protected Species and Communities: Marine Mammals							
Dugong	*Dugon dugon*	M	✓	Species or species habitat known to occur within area	✓	Species or species habitat known to occur within area	Planned • Noise emissions • Planned operational discharges • Spill response operations Unplanned • Hydrocarbon Releases • Non-hydrocarbon releases • Marine fauna collisions
Blue whale	*Balaenoptera musculus*	E,M	✓	Migration route known to occur within area Overlap with BIA for migration	✓	Migration route known to occur within area Overlap with BIA for migration	
Humpback whale	*Megaptera novaeangliae*	V,M	✓	Species or species habitat may occur within area Overlap with BIA for migration	✓	Congregation or aggregation known to occur within area Overlap with BIA for migration	
Southern Right Whale	*Eubalaena australis*	E,M	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	

Value/Sensitivity		EPBC Act Status CE = Critically Endangered E = Endangered V = Vulnerable M = Migratory	Operational Area presence	Particular values or sensitivities within Operational Area	EMBA presence	Particular values or sensitivities within EMBA	Relevant Events
Common Name	**Scientific Name**						
Bryde's whale	*Balaenoptera edeni*	M	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	
Indo-Pacific Humpback Dolphin	*Sousa chinensis*	M	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	
Spotted Bottlenose Dolphin	*Tursiops aduncus*	M	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area	
Killer whale	*Orcinus orca*	M	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	
Antarctic minke whale	*Balaenoptera bonaerensis*	M	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	
Sperm whale	*Physeter macrocephalus*	M	✓	Species or species habitat may occur within area	✓	Species or species habitat may occur within area	
Protected Species and Communities: Marine Reptiles							
Short-nosed Seasnake	*Aipysurus apraefrontalis*	CE	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area	Planned • Light emissions • Noise emissions • Planned operational discharges • Spill response operations Unplanned
Loggerhead turtle	*Caretta caretta*	E,M	✓	Congregation or aggregation known to occur within area Overlap with internesting BIA	✓	Breeding known to occur within area Overlap with internesting BIA	

Value/Sensitivity		EPBC Act Status CE = Critically Endangered E = Endangered V = Vulnerable M = Migratory	Operational Area presence	Particular values or sensitivities within Operational Area	EMBA presence	Particular values or sensitivities within EMBA	Relevant Events
Common Name	**Scientific Name**						
Green turtle	*Chelonia mydas*	V,M	✓	Congregation or aggregation known to occur within area Overlap with internesting BIA	✓	Breeding known to occur within area Overlap with internesting and foraging BIA	• Hydrocarbon Releases • Non-hydrocarbon releases • Marine fauna collisions
Leatherback turtle	*Dermochelys coriacea*	E,M	✓	Species or species habitat likely to occur within area	✓	Breeding likely to occur within area	
Hawksbill turtle	*Eretmochelys imbricata*	V,M	✓	Congregation or aggregation known to occur within area Overlap with internesting BIA	✓	Breeding known to occur within area Overlap with internesting, nesting and foraging BIAs	
Flatback turtle	*Natator depressus*	V,M	✓	Congregation or aggregation known to occur within area Overlap with internesting BIA	✓	Breeding known to occur within area Overlap with internesting, nesting and foraging BIA	
Protected Species and Communities: Marine Birds							
Southern giant petrel	*Macronectes giganteus*	E,M	✓	Species or species habitat may to occur within area	✓	Species or species habitat may occur within area	Planned • Light emissions • Noise emissions • Planned operational discharges
Soft-plumaged Petrel	*Pterodroma mollis*	V		Species or species habitat may to occur within area	✓	Species or species habitat may to occur within area	

Value/Sensitivity		EPBC Act Status CE = Critically Endangered E = Endangered V = Vulnerable M = Migratory	Operational Area presence	Particular values or sensitivities within Operational Area	EMBA presence	Particular values or sensitivities within EMBA	Relevant Events
Common Name	**Scientific Name**						
Curlew Sandpiper	*Calidris feruginea*	CE			✓	Species or species habitat may to occur within area	• Atmospheric emissions • Spill response operations Unplanned • Hydrocarbon Releases • Non-hydrocarbon releases • Marine fauna collisions
Eastern Curlew	*Numenius madagascariensis*	CE			✓	Species or species habitat may to occur within area	
Australian fairy tern	*Sternula nereis nereis*	V	✓	Breeding known to occur within area	✓	Breeding known to occur within area	
Roseate tern	*Sterna dougallii*	M	✓	Foraging, feeding or related behaviour likely to occur within area Overlap with breeding BIA	✓	Breeding known to occur within area Overlap with breeding BIA	
Osprey	*Pandion haliaetus*	M	✓	Species or species habitat likely to occur within area	✓	Breeding known to occur within area	
Lesser crested tern	*Sterna bengalensis*	M		Breeding known to occur within area Overlap with breeding BIA	✓	Breeding known to occur within area Overlap with breeding BIA	
Fork-tailed swift	*Apus pacificus*	M	✓	Species or species habitat likely to occur within area	✓	Species or species habitat likely to occur within area	
White-winged fairy-wren	*Malurus leucopterus edouardi*	V			✓	Species or species habitat likely to occur within area	Unplanned events • Hydrocarbon spill

Value/Sensitivity		EPBC Act Status CE = Critically Endangered E = Endangered V = Vulnerable M = Migratory	Operational Area presence	Particular values or sensitivities within Operational Area	EMBA presence	Particular values or sensitivities within EMBA	Relevant Events
Common Name	**Scientific Name**						
Wedge-tailed shearwater	*Puffinus pacificus*	M			✓	Breeding known to occur within area Overlap with breeding BIA	
Bridled tern	*Sterna anaethetus*	M			✓	Breeding known to occur within area	
Caspian tern	*Sterna caspia*	M			✓	Breeding known to occur within area	
Oriental plover	*Charadrius veredus*	M			✓	Species or species habitat may occur in area	
Oriental pratincole	*Glareola maldivarum*	M			✓	Species or species habitat may occur in area	
Bar-tailed godwit	*Limosa lapponica*	M, V			✓	Species or species habitat known to occur within area	
Crested tern	*Thalasseus bergii*	M			✓	Breeding known to occur in area	
Northern Siberian Bar-tailed Godwit (baueri)	*Limosa lapponica menzbieri*	CE			✓	Species or species habitat likely to occur in area	
Common greenshank	*Tringa nebularia*	M			✓	Species or species habitat likely to occur in area	

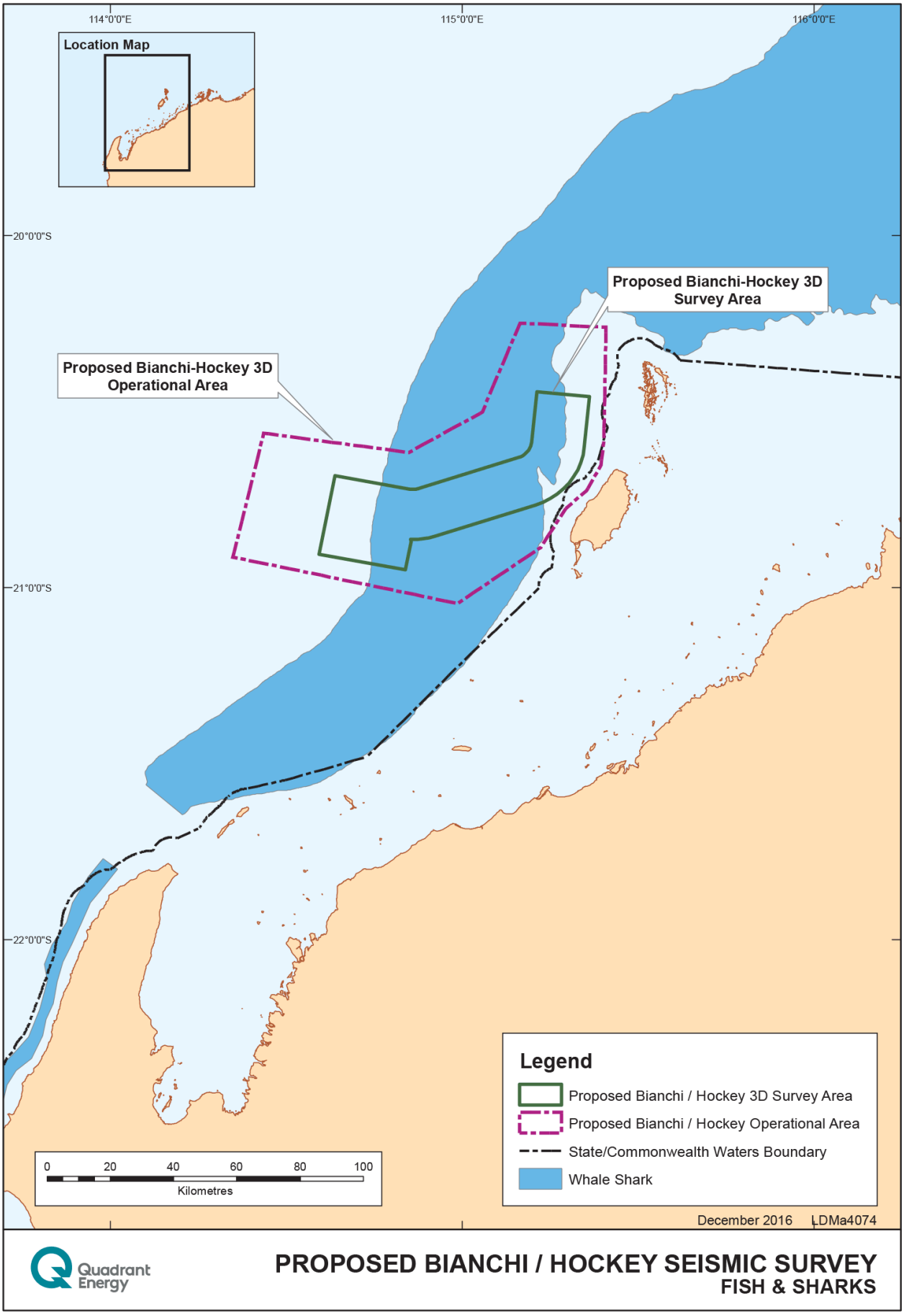

Figure 4-2: Biologically Important Areas for EPBC protected fish and sharks in the vicinity of the survey/ operational area and EMBA

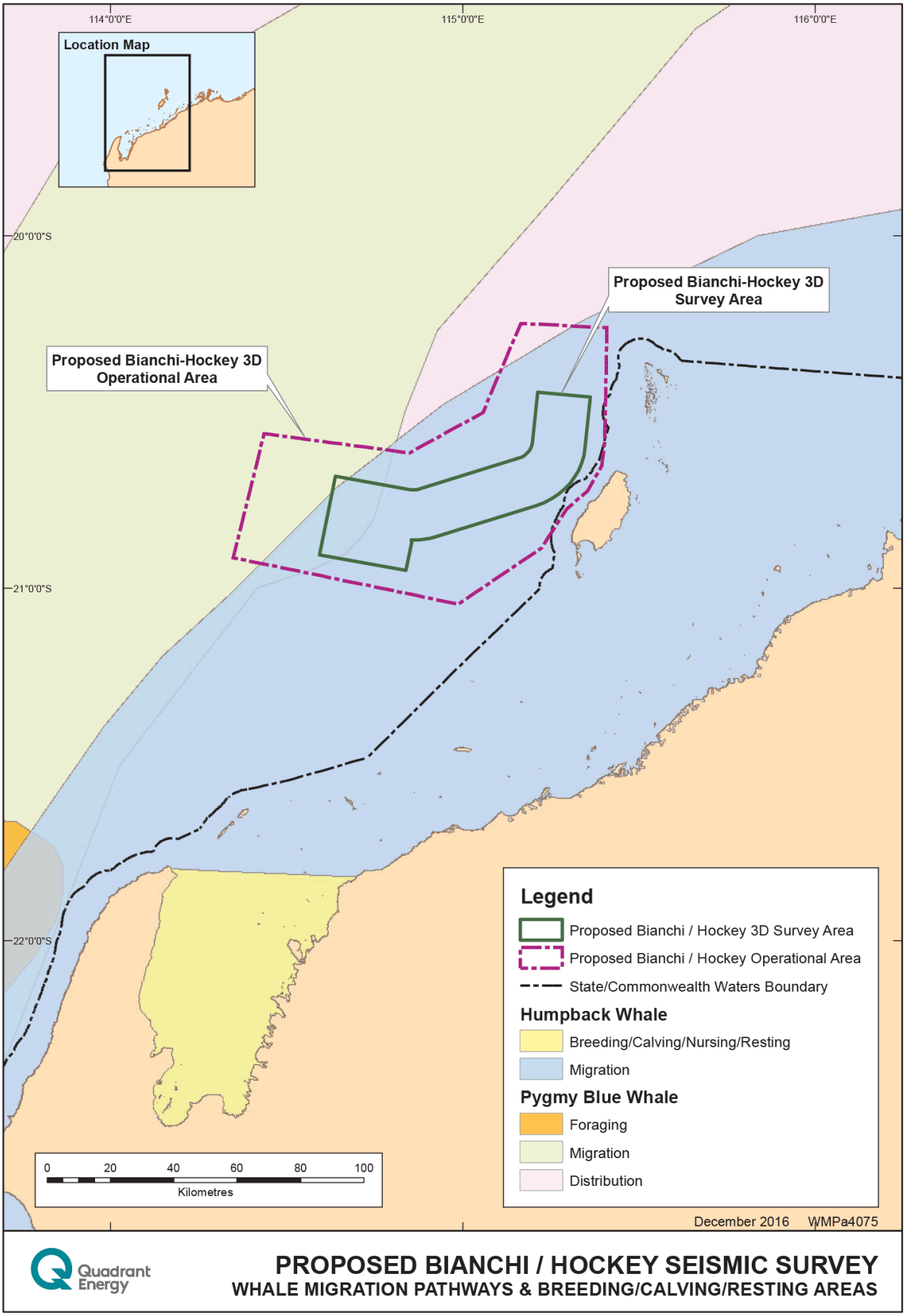

Figure 4-3: Migration pathways, calving and resting areas for EPBC Protected whales in the vicinity of the survey/ operational area and EMBA

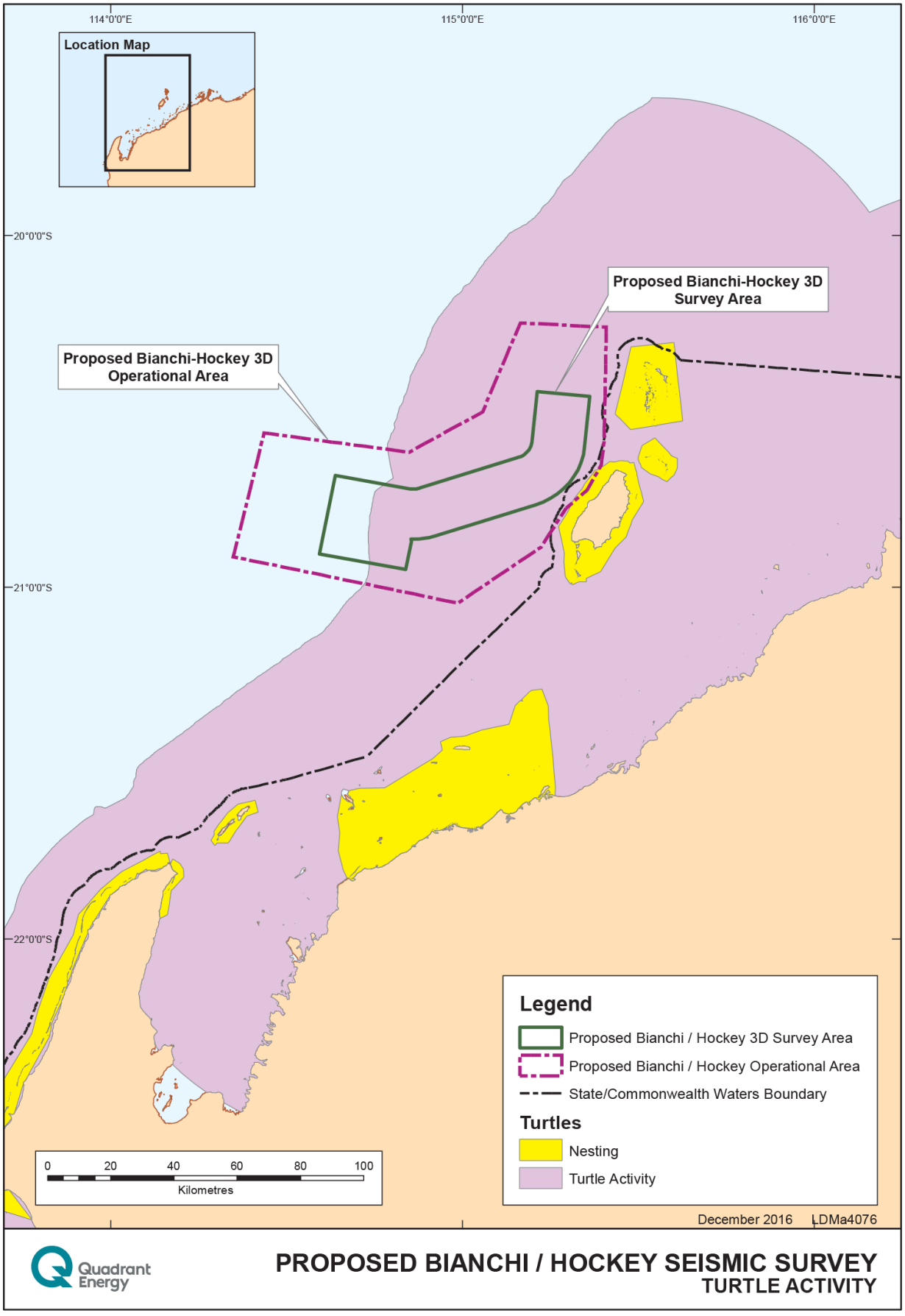

Figure 4-4: Biologically Important Areas for EPBC Protected Turtles in the vicinity of the survey/ operational area and EMBA

4.4.1 Recovery Plans

Recovery Plans set out the research and management actions necessary to stop the decline of, and support the recovery of listed threatened species. Table 3 4 summarises the actions relevant to the Activity with more information on the specific requirements of the relevant plans of management (including Conservation Advice and Conservation Management Plans) that would be applicable to the MSS activity, and demonstrates how current management requirements have been taken into account.

Receptor	Name	Recovery Plan / Conservation Advice/Management Plan	Threats/strategies identified as relevant to the Activity	Relevant Events
Mammals	Blue Whale	Blue Whale Conservation Management Plan	Noise Interference	Noise emissions
			Habitat Modification	Hydrocarbon release – vessel collision
			Vessel Disturbance	Marine fauna collisions
	Southern Right Whale	Conservation Management Plan for the Southern Right Whale	Vessel disturbance	Marine fauna collisions
			Habitat modification	Hydrocarbon release – vessel collision
			Noise Interference	Noise emissions
	Humpback Whale	Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale)	Noise Interference	Noise emissions
			Habitat degradation including coastal development and port expansion	Hydrocarbon release – vessel collision
Reptiles	Short-nosed Seasnake	Commonwealth Conservation Advice on *Aipysurus apraefrontalis* (Short-nosed Seasnake)	Oil and gas exploration	The entire activity
	Loggerhead Turtle	Recovery plan for marine turtles in Australia	Marine debris	Non-hydrocarbon release - solid
			Light Pollution	Light emissions
			Noise from seismic surveys	Noise emissions
	Green Turtle	Recovery plan for marine turtles in Australia	Deteriorating water quality	Hydrocarbon releases, non-hydrocarbon releases (liquid), planned operational discharges
			Marine debris	Non-hydrocarbon release - solid
			Light Pollution	Light emissions
			Noise from seismic surveys	Noise emissions
	Leatherback Turtle, Leathery Turtle	Commonwealth Conservation Advice on *Dermochelys coriacea*	Boat strike	Marine fauna collisions
			Changes to breeding sites	Hydrocarbon release – vessel collision
		Recovery plan for marine turtles in Australia	Deteriorating water quality	Hydrocarbon releases, non-hydrocarbon releases (liquid),

Receptor	Name	Recovery Plan / Conservation Advice/Management Plan	Threats/strategies identified as relevant to the Activity	Relevant Events
				planned operational discharges
			Marine debris	Non-hydrocarbon release - solid
			Loss of habitat	Hydrocarbon release – vessel collision, spill response operations
			Light Pollution	Light emissions
			Noise from seismic surveys	Noise emissions
	Hawksbill Turtle	Recovery plan for marine turtles in Australia	Deteriorating water quality	Hydrocarbon releases, non-hydrocarbon releases (liquid), planned operational discharges
			Marine debris	Non-hydrocarbon release - solid
			Loss of habitat	Hydrocarbon release – vessel collision, spill response operations
			Light Pollution	Light emissions
			Noise from seismic surveys	Noise emissions
	Flatback Turtle	Recovery plan for marine turtles in Australia	Deteriorating water quality	Hydrocarbon releases, non-hydrocarbon releases (liquid), planned operational discharges
			Marine debris	Non-hydrocarbon release - solid
			Loss of habitat	Hydrocarbon release – vessel collision, spill response operations
			Light Pollution	Light emissions
			Noise from seismic surveys	Noise emissions
Sharks	Grey Nurse Shark (west coast population)	Recovery Plan for the Grey Nurse Shark (*Carcharias taurus*)	Pollution and disease	Hydrocarbon releases, non-hydrocarbon releases (liquid), planned operational discharges
	Great White Shark	Recovery plan for the White Shark (*Carcharodon carcharias*)	Ecosystem effects as a result of habitat modification and climate change	Hydrocarbon release – vessel collision
	Dwarf Sawfish, Queensland Sawfish	Sawfish and River Sharks Multispecies Recovery Plan	Habitat degradation and modification	Hydrocarbon release – vessel collision

Receptor	Name	Recovery Plan / Conservation Advice/Management Plan	Threats/strategies identified as relevant to the Activity	Relevant Events
	Whale Shark	Approved Conservation Advice for *Rhincodon typus* (whale shark)	Boat strike from large vessels	Marine fauna collisions
			Habitat disruption from mineral exploration, production and transportation	Hydrocarbon release – vessel collision, Marine fauna collisions
			Marine debris	Non-hydrocarbon release - solid
Birds	Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit	Approved Conservation Advice for *Limosa lapponica baueri* (Bar-tailed godwit (western Alaskan))	Habitat loss and habitat degradation	Hydrocarbon release – vessel collision, spill response operations
	Southern Giant-Petrel	National recovery plan for threatened albatrosses and giant petrels 2011-2016	Marine pollution	Hydrocarbon releases, non-hydrocarbon releases (liquid), planned operational discharges
Protected Areas	Barrow Island and Montebello Marine Parks	Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves	Encourage a policy of zero discharge where alternatives to discharge exist	planned operational discharges
			Develop and enforce controls on the discharge of sewage from vessels in the reserves, including the prohibition of discharge in areas designated 'Zone 1'	planned operational discharges
			Ensure relevant industry activities are undertaken at times and places that do not conflict with humpback whale migration through the reserves	Marine fauna collisions
			Maintain records of the incidence of entanglement, boat collisions and stranding of marine mammals in the reserves	Marine fauna collisions
			Maintain a database of turtle mortality and incidents of entanglement in the reserves	Marine fauna collisions
			Ensure that important seabird and shorebird breeding and feeding areas are not significantly affected by human activities	Hydrocarbon release – vessel collision, Non-hydrocarbon release - solid

4.5 Socio-economic Environment

The Activity Operational Area is 5.5 km away from the nearest landfall on Barrow Island, and the nearest mainland town is Onslow (54 km South). Karratha, Dampier, Exmouth and Port Hedland are the main service and population centres for the region. Although initially developed for the iron ore industry, these towns have expanded to service the oil and gas industry located on the NWS. Table 4-3 identify the relevant State and Commonwealth fisheries that overlap the Operational Area. Active fisheries are identified in consultation with Western Australia Fishing Industry Council (WAFIC) and Department of Fisheries (DoF). **Table 4-5** presents the socio-economic values and sensitivities within the Operational Area.

Table 4-3: State and Commonwealth fisheries in the vicinity of the Operational Area

Value/Sensitivity	Description	Operational Area presence	Relevant events within the Operational Area and EMBA
Commonwealth Managed Fisheries			
North West Slope Trawl	Extends from 114° E to approximately 125° E off the WA coast between the 200 m isobath and the outer limit of the Australian Fishing Zone (AFZ).	✓	No active commercial fishing within the area in the past years; however fisheries overlap the EMBA and therefore fishing vessels could be encountered in low density.
Western Tuna and Billfish Fishery	Extends westward from Cape York Peninsula (142°30' E) off Queensland to 34° S off the WA west coast. It also extends eastward from 34° S off the west coast of WA across the Great Australian Bight to 141° E at the South Australian–Victorian border. No current effort on NWS	✓	
Western Skipjack Tuna Fishery	No current effort on NWS	✓	
Southern Bluefin Tuna	No current effort on NWS	✓	
State Managed Fisheries (Whole of State)			
Marine Aquarium Fish Fishery	All year Effort within the Operational Area and EMBA is unknown, but is unlikely due to the depth and the dive based method of collection	✓	Disruption to fishing activities unlikely given water depths operated within. Unplanned events which may occur in the EMBA could disrupt fishing activities, however the likelihood of these events is low.
Specimen Shell Managed Fishery	All year Effort within the Operational Area and EMBA is unknown, but it is unlikely due to the depth and the dive based method of collection Unlikely to occur	✓	
Beche-de-mer Fishery	All year Although permitted to fish within the Operational Area and EMBA, the fishery is restricted to shallow coastal waters suitable for diving and wading Unlikely to occur	✓	

Value/Sensitivity	Description	Operational Area presence	Relevant events within the Operational Area and EMBA
Mackerel Managed Fishery	Trolling or handline. Near-surface trolling gear from vessels in coastal areas around reefs, shoals and headlands	✓	The majority of the catch is taken in the Kimberley Area and therefore disruption is unlikely
Octopus	Caught as a by product in region.	✓	Fishery is in development phase. Effort within the operational area and EMBA is unknown, but is unlikely to be significant due to effort levels and pot collection method.
Abalone Managed Fishery	The commercial fishery harvest method is a single diver working off a 'hookah' (surface-supplied breathing apparatus) using an abalone 'iron' to prise the shellfish off rocks.	✓	Disruption is unlikely to occur in the operational area due to depths and method of collection. Unplanned events which may occur in the EMBA could disrupt fishing activities, however the likelihood of these events is low.
State Managed Fisheries (North Coast Bioregion)			
Pearl Oyster Managed Fishery (Zone 1)	Mostly operate March to June Operational Area does occur within the boundaries of the fishery, but is restricted to shallow diving depths.	✓	Given the water depths of the operational area, disruption to fishing activities are unlikely to occur Unplanned events which may occur in the EMBA could disrupt fishing activities, however the likelihood of these events is low.
Onslow Prawn Limited Entry Fishery	The boundaries of the OPMF are 'all the Western Australian waters between the Exmouth Prawn Fishery and the Nickol Bay prawn fishery east of 114º39.9' on the landward side of the 200 m depth isobath'.	✓	Significant disruption unlikely to occur due to vast area fished.
Pilbara Developing Crab Fishery	The majority of the commercially and recreationally-fished stocks are concentrated in the coastal embayments and estuaries between Geographe Bay in the south west and Nickol Bay in the north.	✓	Since operations are concentrated in coastal and estuarine habitats, disruption within the operational area is unlikely. Unplanned events which may occur in the EMBA could disrupt fishing activities, however the likelihood of these events is low.
Pilbara Demersal Scalefish Fisheries (includes trap, line and trawl fisheries)	Use a combination of vessels, effort allocations (time), gear limits, plus spatial zones (including extensive trawl closures) as management measures. The Trawl Fishery lands the largest component of the catch of demersal finfish in the Pilbara (and North Coast Bioregion) comprising more than 50 scalefish species. In comparison, the trap fishery retains a subset of about 45 to 50 scalefish species, and while the Line Fishery catch comprises a	✓	The Fishery is seaward of the 50 m isobath and landward of the 200 m isobaths As the maximum water depth in the operational area is 30 m, significant impacts are not expected. Unplanned events which may occur in the EMBA could disrupt fishing activities, however the likelihood of these events is low.

Value/Sensitivity	Description	Operational Area presence	Relevant events within the Operational Area and EMBA
	similar number it also includes some deeper offshore species.		
West Coast Deep Sea Crustacean Managed Fishery	The fishery operates North of latitude 34° 24' S (Cape Leeuwin) and west of the Northern Territory border on the seaward side of the 150m isobath out to the extent of the AFZ, mostly in 500 to 800 m of water.	✓	Year round Unlikely to occur due to depths fished

A number of commercial fish species are known to spawn in the north coast bioregion where the Hockey Bianchi MSS is located. Timing of spawning and/or aggregations of fish and shark species are unknown, but an indication is provided by DoF in Table 4-4 of timing within the bioregion.

Table 4-4: Commercial fish species spawning grounds overlapping operational area1

Bioregion	Key Fish Species within zone	Spawning / Aggregation times
North Coast	Blacktip shark (*Carcharhinus tilstoni and C.limbatus*)	November - December
North Coast	Goldband snapper (*Pristipomoides multidens*)	January – April
North Coast	Pink snapper (*Pagrus auratus*)	May – July
North Coast	Rankin cod (*Epinephelus multiinotatus*)	August - October
North Coast	Red Emperor (*Lutjanus sebae*)	October – March
North Coast	Sandbar shark (*Carcharhinus plumbeus*)	October - January
North Coast	Spanish mackerel (*Scomberomorus commerson*)	August - November

[1] As advised by DoF through stakeholder consultation, see **Section 5**.

Table 4-5: Socioeconomic Activities in the vicinity of the operational area

Value/ Sensitivity	Description	Operational Area presence	Relevant events within Operational Area	Relevant Events within EMBA
Shipping	Shipping using NWS waters includes iron ore carriers, oil tankers and other vessels proceeding to or from the ports of Dampier, Port Walcott and Port Hedland; however, these are predominantly heading north from these ports. The high area of activity in the vicinity of the Hockey MSS is due to the operations at Quadrant's John Brookes facility. The proposed operational area does not overlap any major shipping, although heavy traffic may be encountered throughout the Hockey MSS area as commercial vessels transit around the Montebello Islands and support vessels conduct operations with the offshore infrastructure. The Bianchi MSS only will encounter mild commercial traffic transiting through the area.	✓	Planned Interactions with other marine users	Unplanned Hydrocarbon release from vessel collision
Recreational fishing	Within the operational area there are no known natural seabed features that would aggregate fishes and which are typically targeted by recreational fishers. Given the water depths and distance from the nearest mainland, it is unlikely recreational fishing would occur in the vicinity.	-	N/A	N/A
Defence	No known defence areas in the vicinity have been advised by the Department of Defence.	-	N/A	N/A
Shipwrecks	2 shipwrecks (Tanami and Trial) within Operational Area. 10 other shipwrecks occur within the EMBA.	✓	N/A	N/A
Oil and gas	Various petroleum exploration and production activities have been undertaken within the northwest shelf, however there are none in the vicinity of the operational area. Vessels servicing oil and gas operations in the region may pass through the area *en route* to facilities, however, since vessel transit is not classed as a petroleum activity, potential impacts to vessels are discussed under 'Shipping' above. Oil and gas facilities occur within the EMBA as do permits operated by other titleholders. As such, oil and gas activities could be impacted by unplanned events.	-	N/A	Unplanned Hydrocarbon release from vessel collision
Tourism	There are many sources of marine-based tourism within the environment that may be affected. Aquatic recreational activities such as boating, diving and fishing occur near the coast and Montebello Islands. These activities are concentrated in the vicinity of the population centres such as Exmouth, Dampier and Onslow. The socio-economic and heritage features in the region are of high value for the tourism industry. The potentially affected area is of high value for eco-tourism based on specific local values (whale sharks, game fish, nearshore reef snorkelling and diving). Social amenities of the area including beachside recreation	✓	Planned Interactions with other marine users	Unplanned Hydrocarbon release from vessel collision

	(camping, non-fishing water activities), “iconic” locations, landscape and scenery is also capitalised on by the tourism industry. There is a low likelihood of tourism occurring within the operational area given the distance from the mainland and island shorelines. However, given the overlap of the operational area to State waters (and the Montebello Marine Park) it is possible that tourism activity could to occur in the operational area and EMBA.			
Cultural Heritage	No known sites of Aboriginal Heritage significance within the operational area or EMBA.	-	N/A	N/A

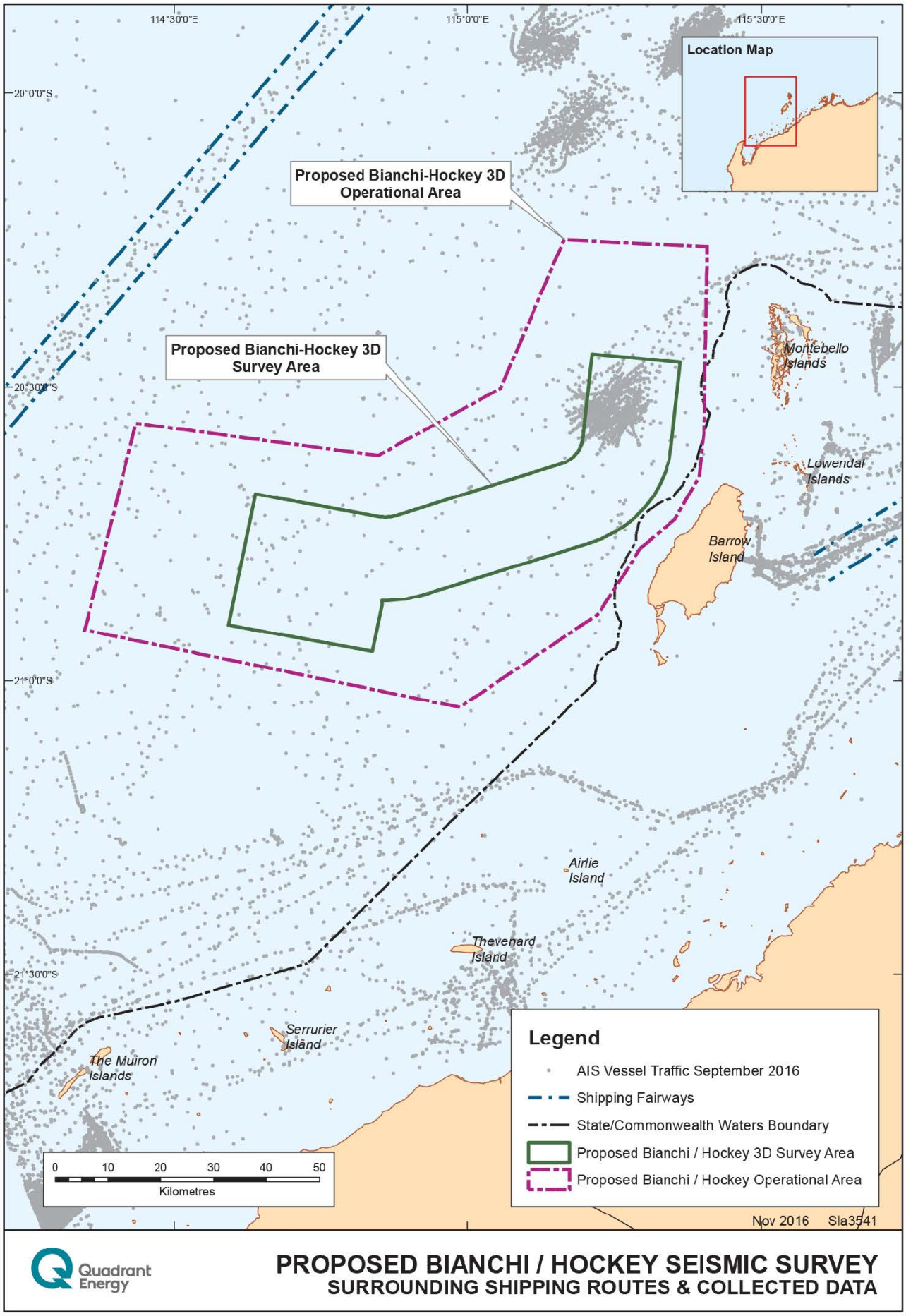

Figure 4-5: Shipping Data in the vicinity of the operational area

4.6 Windows of sensitivity

Timing of peak activity for threatened species and other relevant, significant sensitivities is given in **Table 4-6**.

Table 4-6: Windows of sensitivity in the vicinity of the EMBA

CATEGORY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Benthic Habitats												
Non-coral benthic invertebrates												
Fauna												
Plankton												
Fish/Sharks	Timing of spawning activity varies between species.											
Whale shark												
Short-nosed seasnake	Can occur at low density year round											
Hawksbill turtles resident adult and juveniles[1]	Widespread throughout NW Shelf waters, highest density of adults and juveniles over hard bottom habitat (coral reef, rocky reef, pipelines etc.)											
Hawksbill turtle mating aggregations[1]												
Hawksbill turtle nesting and internesting[1]												
Hawksbill turtle hatching[1]												
Flatback turtles resident adult and juveniles[1]	Widespread throughout NW Shelf waters, increased density over soft bottom habitat 10 – 60m deep, post hatchling age classes and juveniles spread across shelf waters											
Flatback turtle mating aggregations[1]												
Flatback turtle nesting and internesting[1]												
Flatback turtle hatching[1]												
Flatback turtle nesting[1]												
Green turtles resident adult and juveniles[1]	Widespread throughout the NW Shelf waters, highest density associated with seagrass beds and macro algae communities, high density juveniles in shallow waters off beaches, amongst mangroves and in creeks											
Green turtle mating aggregations[1]												
Green turtle nesting and internesting[1]												

CATEGORY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Green turtle hatching[1]												
Loggerhead turtles resident adult and juveniles[1]	Widespread throughout the NW Shelf waters, increased density associated with soft bottom habitat supporting their bivalve food source, juveniles associated with nearshore reef habitat											
Loggerhead turtle mating aggregations[1]												
Loggerhead turtle nesting and internesting[1]												
Loggerhead turtle hatching[1]												
Leatherback turtles	Can occur at low density across the NWS year round											
Humpback whale migration						northern			southern			
Humpback resting at Montebello's, Exmouth Gulf												
Blue whale migration					northern						southern	
Seabird nesting: terns, shearwaters, petrels												
Migratory shorebirds												
Socio-economic												
Commercial Managed Fisheries												
Oil and gas												
Shipping												
Tourism/ recreational fishing (none applicable)												
KEY / NOTES												

	Peak activity, presence reliable and predictable	[1]Information provided by K. Pendoley
	Lower level of abundance/activity/presence	
	Very low activity/presence	
	Activity can occur throughout year	

5. STAKEHOLDER CONSULTATION

Quadrant understands retaining a broad licence to operate depends on the development and maintenance of positive and constructive relationships with a comprehensive set of stakeholders in the community, Government, non-government and business sectors.

To allow an informed assessment by stakeholders of the potential impact of Quadrant's activities, Quadrant has established long-term and meaningful dialogue with those stakeholders who have demonstrated an interest in its present and planned future activities in Australia.

For the activities to be undertaken under the EP, a standardised approach is applied to identify key stakeholders for the Activity in question, beginning with a review of the stakeholder database, and of the stakeholders consulted over other recent activities in the area. In particular, the Operational Area for the Activity is used to identify relevant persons on an activity-by-activity basis, and will be used throughout the lifetime of the EP.

The key interested stakeholders identified for this activity are summarised in **Table 5-1**.

Table 5-1: Summary of Key Stakeholders Consulted for the Activity

Marine Conservation	• Conservation and Parks Commission • Department of the Environment (DoE) • Department of Fisheries (DoF) • Department of Parks and Wildlife (DPaW)
Shipping safety and security	• Australian Maritime Safety Authority (AMSA) • Department of Defence (DoD) • Department of Transport (DoT)
Adjacent regulator	• Department of Mines and Petroleum (State)
Fishing bodies	• A Raptis and Sons • Austral Fisheries • Australian Fisheries Management Authority (AFMA) • Australian Southern Bluefin Tuna Association (ASBTIA) • Commonwealth Fisheries Association (CFA) • Fat Marine • Marine Tourism WA • MG Kailis • Ocean Wild Tuna • Pearl Producers Association • Quest Maritime Services • Recfishwest • RNR Fisheries • Shark Bay Seafoods • Western Australian Fishing Industry Council (WAFIC) • Western Wild Fisheries • WestMore Seafoods
Local tourism operators	• Ahoy Buccaneers • Apache Charters • Blue Horizon Charters • Blue Lightning Game Fishing Charters • Keshi Mer Expeditions • Kimberley Expeditions • King's Ningaloo Reef Tours • Leeuwin Ocean Adventure Foundation Ltd • Master Fisheries • Migration Media • Montebello Island Safaris • Montebellos Sportfishing Charters • Ocean Eco Adventures

	• Odyssey Expeditions • Pelican Charters • Reel Teaser Charters • Sail Ningaloo • Sealife Charters • The Great Escape Charter Company • Top Gun Charters
Karratha Stakeholder Reference Group	• City of Karratha • Pilbara Port Authority
Non-government organisations	• Australian Conservation Foundation • Australian Marine Conservation Society • Australian Marine Mammal Centre • Centre for Whale Research • Conservation Council of WA • International Fund for Animal Welfare • Wilderness Society • World Wildlife Fund
Neighbouring oil and gas operators	• Chevron • ENI • Woodside • Finder • Tap Oil
Regional Aboriginal Corporations	• Buurabalayji Thalanyji Aboriginal Corporation (BTAC) • Kuruma Marthudhunera Aboriginal Corporation (KMAC) • Yaburara and Coastal Mardudhunera Aboriginal Corporation (YACMAC)
Commercial fisheries (relevant as advised in consultation with WAFIC and DoF)	• Western Tuna and Billfish (Commonwealth Managed) • North West Slope Trawl (Commonwealth Managed) • Pilbara Line (State Managed) • Pilbara Trap (State Managed) • Mackerel Area 2 (State Managed) • Abalone Fishery (State Managed) • Beche de mer Fishery (State Managed) • Marine Aquarium Fish Managed Fishery(State Managed) • Onslow Prawn Limited Entry Fishery (State Managed) • Pilbara Developing Crab Fishery (State Managed) • Pilbara Fish Trawl Interim Managed Fishery (State Managed) • Specimen Shell Managed Fishery (State Managed) • West Coast Deep Sea Crustacean (State Managed)

Quadrant maintains a comprehensive stakeholder database with stakeholders identified through the following mechanisms:

- Regular review of all legislation applicable to petroleum and marine activities;
- Identification of marine user groups and interest groups active in the area (e.g., recreational and commercial fisheries, other oil and gas producers, merchant shipping etc.);
- Annual update of State commercial fishing license holder database through DoF;
- Stakeholder and regulator feedback and advice;
- Active participation in industry bodies (e.g. Australian Petroleum Production & Exploration Association (APPEA) and Australian Marine Oil Spill Centre, (AMOSC); and
- Records from previous consultation activities in the area.

Details of the Hockey and Bianchi MSS including project summary, coordinates, location map, water depth, distances to key regional features, exclusion zone details and estimated timing were distributed to stakeholders (**Table 5-1**) in a detailed consultation package on February 19, 2016.

In consultation with DPaW, a list of relevant tourism operators in the region was provided and these operators were sent the same consultation package, via DPaW, on February 24, 2016.

No concerns with the MSS activity were raised during this consultation period.

Post this consultation period, changes were made to the boundaries of the survey and operational areas. The revised operational area overlaps the State waters boundary to allow for potential drift of the streamers outside of the survey area due to surface water currents and support vessel movements. Stakeholders were informed of these changes in Quadrant's June *Quarterly Consultation Update* distributed on June 24, 2016, which provided map, coordinates, water depth and approximate start date.

Selected relevant stakeholders, and newly identified stakeholders, received updated consultation in September 2016 as outlined in **Table 5-2**. Stakeholders who received these updates were identified as stakeholders who had expressed interest in seismic activities when consulted on previous Quadrant approvals, or newly identified stakeholders following regulatory advice. Where required these stakeholders were followed up with personal communications, usually phone, recognising the limited time provided to assess information. Despite this, Quadrant does not expect concerns or objections to be raised by stakeholder's post-submission of the EP, however will remain available to close any additional consultation queries which may arise.

5.1 Addressing consultation feedback

Quadrant's Consultation Coordinator is available before, during and after the Activity to ensure opportunities for stakeholders to provide feedback are available. Consultation material is provided to relevant internal, activity personnel to ensure the Quadrant business has a thorough understanding of how the Activity is being received by relevant persons.

Survey activities covered by the EP will be consulted via three tiers, the Activity Consultation Package distributed prior to EP acceptance (received December 22, 2016), a Notification Package prior to activity commencement when timing and other details are confirmed, and within Quadrant's *Quarterly Consultation Updates* (last issued September 2016, next planned for December 2016).

Stakeholder consultation will be ongoing and Quadrant will work with stakeholders to address any future concerns if they arise throughout the validity (5 years) of the EP. Should any new stakeholders be identified, they will be added to the stakeholder database and included in all future correspondence as required, including specific survey activity notifications.

5.2 Summary

Quadrant considers that consultation with regulators and key stakeholders for this activity has been adequate; all stakeholders and relevant parties have been actively engaged by Quadrant regarding its activities on the NW Shelf (including this Activity) and also, where applicable the proposed oil spill response strategies for these activities.

If stakeholders request additional information or raise concerns on any activity, a dialogue with these stakeholders can continue during or post the preparation of an EP and will be recorded for future reference. Quadrant commits to respond and address any comments to the satisfaction of both parties and keep any consultation on file during and post acceptance of an EP.

Table 5-2: Consultation summary for activity

Stakeholder	Assessment of Consultation Undertaken
Fishing bodies	
A Raptis and Sons	A Raptis and Sons were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. This operator was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 24, 2016, with a covering email which clearly and definitively stated there is a Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. No comment on this activity was provided to Quadrant, and the stakeholder has previously confirmed that no response means 'no concern' with the given activity. No action arising from this consultation for this EP.
Austral Fisheries	Austral Fisheries were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. This operator was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 24, 2016, with a covering email which clearly and definitively stated there is a Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. No comment on this activity was provided to Quadrant, and the stakeholder has previously confirmed that no response means 'no concern' with the given activity. No action arising from this consultation for this EP.
Australian Fisheries Management Authority	AFMA were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. This operator was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 24, 2016, with a covering email which clearly and definitively stated there is a Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. No comment on this activity was provided to Quadrant at time of submission of this EP, and the stakeholder has previously confirmed that no response means 'no concern' with the given activity. No action arising from this consultation for this EP.
Australian Southern Bluefin Tuna Industry Association (ASBTIA)	ASBTIA were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. This operator was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 24, 2016, with a covering email which clearly and definitively stated there is a Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. No comment on this activity was provided to Quadrant at time of submission of this EP.
Commonwealth Fishing Association (CFA)	The CFA were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. This operator was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 24, 2016, with a covering email which clearly and definitively stated there is a Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. No comment on this activity was provided to Quadrant at time of submission of this EP.
Fat Marine	Fat Marine were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. This operator was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 24, 2016, with a covering email which clearly and definitively stated there is a

Stakeholder	Assessment of Consultation Undertaken
	Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. Fat Marine was provided an update on the Hockey Bianchi activity via email on September 8, 2016. In a follow up phone call on September 13, 2016, Jimmy Money of Fat Marine confirmed the updated information had been received and he was aware of the activity. Mr Money registered his objection to offshore seismic activity, citing noise impacts have a negative effect on fish stocks. Quadrant queried when and if Fat Marine would be fishing in the area, and Mr Money advised that he was not able to give precise timing and that seismic activities at any time of year has a negative impact on fishing. Quadrant committed to keeping Mr Money informed of timing and other updates to the Hockey Bianchi proposal. Fat Marine responded to Quadrant's consultation update for the Hockey Bianchi MSS on September 20, 2016. Fat Marine referenced previous seismic surveys in the area and noted that Fat Marine does not condone any future seismic activities raising the following issues: • Fat Marine believes the area has had "its fair share of multiple seismic surveys over multiple years" which have created an adverse environmental impact. • Seismic surveys in the past resulted in a significant drop in average daily commercial fishing catch in correlation with seismic surveys, and areas where seismic has occurred have taken a long time to recover which results in the need to fish further from traditional fishing areas. • Seismic activities deny viable commercial fishing access to significant areas which impact the commercial viability of Fat Marine as a business. Fat Marine also noted: *Ultimately Fat Marine believes that the only fair, just, equal and rightful way to deal with this process would be in the order of appropriate compensation to the party that will be adversely impacted, in this case that would be Fat Marine.* Quadrant formally responded to consultation on October 10, 2016, noting potential behavioural responses detailed in the EP indicate fish move away from the source before physical damage can occur and available scientific literature on this subject does not indicate any long-term abandonment of fishing grounds by commercial species. Quadrant advised Fat Marine: *Quadrant is open to discussing Fat Marine's access rights to the survey area if you are able to provide Quadrant with the area Fat Marine intends to fish. Quadrant would need an understanding of the proposed timing, location and water depths of intended fishing grounds before management measures can be assessed.* Follow up phone calls occurred on October 18 and 24, 2016. In the latter Fat Marine advised Quadrant's letter was received and that Fat Marine still objected to the activity despite information presented in the letter as per the activity EP. Quadrant queried whether Fat Marine would be willing to discuss timing, location and water depths of intended fishing grounds to address the issue of access rights. Fat Marine advised this conversation could continue, Quadrant offered dates representatives would be in Exmouth in November 2016 and Fat Marine noted this could be organised closer to the time. In phone conversations on November 4 and 10, 2016, dates were discussed for meetings however absence of relevant persons for both Fat Marine and Quadrant delayed this face to face meeting. Both Quadrant and Fat Marine remained open to organising a face to face meeting and Quadrant commits to ongoing consultation with Fat Marine for the proposed activity. Quadrant assesses the merits of Fat Marine's concern as part of the activity risk assessment. The behavioural responses due to an approaching or passing seismic source, mortality or injury (fatal or recoverable) to individual fish are not expected and any impacts at the population level are considered negligible.

Stakeholder	Assessment of Consultation Undertaken
	Quadrant's review of existing literature does not indicate impacts to commercial fishery catches due to MSS, therefore no further control measures will be implemented for commercial fisheries.
Marine Tourism WA (MTWA)	MTWA were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. This stakeholder was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 24, 2016, with a covering email which clearly and definitively stated there is a Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. Marine Tourism WA were provided an update on the Hockey Bianchi activity via email on September 8, 2016, including an update on survey area changes. No comment has been received relating to Hockey and Bianchi MSS; previous interaction with stakeholder has reassured Quadrant that a response would only be received in the event of concern.
MG Kailis	MG Kailis were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. This stakeholder was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 24, 2016, with a covering email which clearly and definitively stated there is a Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. Kailis have not responded to Hockey and Bianchi MSS consultation package, however Kailis did respond to the March 2016 Quarterly Consultation Update noting no concern with listed activities.
Ocean Wild Tuna	Following advice from WAFIC (received via email on September 12, 2016) the Hockey Bianchi Consultation Package was provided to Ocean Wild Tuna via email on September 12, 2016. In a follow up phone call on September 15, 2016, Ray Davies advised he was currently offshore and suggested sending the email again. No response has been received to date however Quadrant commits to ongoing consultation with Ocean Wild Tuna to reduce any potential impact to the business as a result of Quadrant's activities.
Pearl Producers Association (PPA)	The PPA were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. This stakeholder was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 24, 2016, with a covering email which clearly and definitively stated there is a Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. The PPA were provided an update on the Hockey Bianchi activity via email on September 8, 2016. No comment on this activity was provided to Quadrant at time of submission of this EP. Quadrant does not expect objections to be raised regarding this activity, given historic consultation with the PPA has indicated their main concern lies in the 80 Mile Beach region.
Quest Maritime Services	Quest Maritime Services were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. This stakeholder was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 24, 2016, with a covering email which clearly and definitively stated there is a Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. Quest Maritime Services were provided an update on the Hockey Bianchi activity via email on September 8, 2016, including an update on survey area changes. No comment on this activity was provided to Quadrant at time of submission of this EP.

Stakeholder	Assessment of Consultation Undertaken
Recfishwest	Recfishwest were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. This stakeholder was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 24, 2016, with a covering email which clearly and definitively stated there is a Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. No comment on this activity was provided to Quadrant at time of submission of this EP.
RNR Fisheries	RNR Fisheries were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. This stakeholder was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 24, 2016, with a covering email which clearly and definitively stated there is a Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. RNR Fisheries were provided an update on the Hockey Bianchi activity via email on September 8, 2016, including an update on survey area changes. No comment on this activity was provided to Quadrant at time of submission of this EP.
Western Australian Fishing Industry Council (WAFIC)	WAFIC were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. This stakeholder was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 24, 2016, with a covering email which clearly and definitively stated there is a Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. WAFIC responded to Quadrant's Quarterly Consultation Update requesting additional information which was provided to WAFIC via email on September 8, 2016. WAFIC responded to this information on September 12, 2016, providing State-managed commercial fisheries: • Pilbara Line • Pilbara Trap • Mackerel And Commonwealth fisheries • Western Tuna and Billfish • North West Slope Trawl WAFIC noted their concerns around seismic consultation: *"I am concerned that it may have been some time since your previous engagement, fishers may not have responded because of a range of reasons, it doesn't mean they are not interested. It is not easy getting a response for O&G queries, stakeholder fatigue is high, especially in relation to seismic work, many licence holders feel that it is not worthwhile replying because it is a case of "coming through ready or not".* *The cumulative impacts of seismic work on commercial fishing activities has not been researched, licence holders are adamant there is long term ongoing disruption to the catch, fish dispersement and long term fish displacement. Seismic work often occurs in the same / similar / or close-by areas to previous seismic activities so licence holders are not only disrupted by the proposed Bianchi / Hockey program but have also been disrupted by seismic activities from other proponents (for example the Chevron OBN seismic survey, a six month survey almost parallel to the Quadrant survey and approximately ten kilometres outside of the western side of the Bianchi / Hockey operational area) which have been operating in the same / similar area – within the same fishing season and or the same calendar year."* Quadrant responded on September 13, 2016, advising WAFIC all license holders in the listed fisheries were consulted regarding the Hockey Bianchi Seismic Survey on

Stakeholder	Assessment of Consultation Undertaken
	September 8, 2016. Quadrant advised WAFIC that an annual approach to consultation with individual fishers was used to combat stakeholder fatigue. WAFIC emailed Quadrant on September 19, 2016, further highlighting fishers concerns regarding cumulative impacts of seismic activities occurring in similar regional locations. Quadrant has responded on September 19, 2016, and registered WAFIC's concerns with cumulative impacts and noted that this concern would be presented in the EP to the regulator. In regards to cumulative impacts, Quadrant recognised this is a subject of interest to fishers. However neighbouring surveys did not cross Quadrant permits, and Quadrant is committed to obtaining seismic data to meet program commitments on Quadrant operated petroleum permits. At time of EP preparation, no other MSS have been identified as having the potential to occur in the vicinity of the Hockey Bianchi MSS. However, through the process of access authority applications, Quadrant will be made aware of any surveys, and will maintain consultation other operators. In light of concerns raised by WAFIC in consultation, cumulative impacts have been further discussed in **Section 6.3.3.7** of the approved EP. Quadrant's review of existing literature does not indicate impacts to commercial fishery catches due to MSS, therefore no further control measures will; be implemented for commercial fisheries. WAFIC contacted Quadrant in response to earlier emails on September 19, 2016, noting their desire to "understand the number of responses received as unfortunately, stakeholder fatigue / resignation and the belief that the activity will occur when the proponent wants it to occur is a continuing theme that WAFIC and others constantly experience when discussing seismic activity with commercial fishers." WAFIC noted: *However, from a commercial fishers view, it means again seismic disruption in a similar area criss-crossing their commercial fishing areas in the same year or the same fishing season.* *I fully appreciate that Quadrant has done its duty regarding NOPSEMA's Guidance Notes, however, the reality amongst stakeholders and overall seismic impact is a reality.* *I also fully appreciate that as an individual operator Quadrant has obligations to meet work program commitments on petroleum permits. The timing of these commitments (in particular seismic work) also coincides with commercial fishing activity and when there are multiple surveys in the same broad region over a season or calendar year it absolutely disrupts and impacts the commercial fishers business.* Quadrant formally responded to WAFIC's concerns on October 10, 2016, by email, noting consultation from one individual fisher had been received and logged against the Hockey Bianchi activity. It was noted Quadrant remains open to scientific literature and commits to reviewing a number of items over time. WAFIC has not responded to this final consultation. WAFIC is a valued stakeholder and Quadrant commits to ongoing consultation with WAFIC around all activities on the North West Shelf.
Western Wild Fisheries	Western Wild Fisheries were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. This stakeholder was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 24, 2016, with a covering email which clearly and definitively stated there is a Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. Western Wild Fisheries were provided an update on the Hockey Bianchi activity via email on September 8, 2016, including an update on survey area changes. No comment on this activity was provided to Quadrant at time of submission of this EP.

Stakeholder	Assessment of Consultation Undertaken
WestMore Seafoods & Shark Bay Seafoods	These fishers were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. This stakeholder was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 24, 2016, with a covering email which clearly and definitively stated there is a Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. Westmore Seafoods also represents Shark Bay Seafood, and operates within the Western Deep Water Trawl Fishery, North West Slope Trawl Fishery, Shark Bay Prawn Fishery, Pilbara Fish Trawl, Nickol Bay Prawn Fishery and the Kimberley Prawn Fishery zones. No comment on this activity was provided to Quadrant at time of submission of this EP, and the stakeholder has previously confirmed that no response means 'no concern' with the given activity. No action arising from this consultation for this EP.
Karratha/Dampier Stakeholder Reference Group	
Pilbara Port Authority	The Pilbara Port Authority were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. This stakeholder was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 24, 2016, with a covering email which clearly and definitively stated there is a Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. No comment on this activity was provided to Quadrant at time of submission of this EP.
City of Karratha	The City of Karratha were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. This stakeholder was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 24, 2016, with a covering email which clearly and definitively stated there is a Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. The City of Karratha responded on February 23, 2016, with no comment on the activity.
Marine Conservation	
Conservation and Parks Commission (CPC)	At the request of DMP, the Commission were contacted by phone on July 11, 2016, the Commission advised Quadrant the activity would be presented to the Commission at their meeting on July 22, 2016. Quadrant advised if a subject matter expert was required at any point, Quadrant would be happy to present to the Commission. Information was provided to the Commission by email on July 12, 2016, and a representative confirmed this was sufficient and had been received on July 13, 2016. The Commission advised in phone consultation on July 22, 2016, that the activity was presented in their monthly meeting and the Commission will meet again to discuss on August 19, 2016, with a potential briefing from DPaW on the activity. In follow up phone consultation on August 16, 2016, the CPC Director advised Quadrant the Hockey Bianchi activity was discussed at the last meeting and there was no follow up required. The CPC advised Quadrant to continue consultation with DPaW as normal, and they would advise Quadrant if any additional issues were raised. Quadrant understand the CPC are an advisory body on the values and sensitivities of the Marine Park. These values and sensitivities have been assessed by Quadrant in the production of this EP. The CPC is a valued stakeholder and Quadrant commits to open on ongoing consultation before, during and after this activity. Historically Quadrant has consulted with the Marine Parks and Reserves Authority on similar activities, including the *Outer Barrow Exploration and Development Environment*

Stakeholder	Assessment of Consultation Undertaken
	Plan (EA-00-RI-10066) which is over similar location and many of the same permit areas. No concern was raised by the MPRA in response to Quadrant activities previously presented to them.
Department of the Environment	DoE were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. The DoE do not comment on offshore seismic activities as these are not in their jurisdiction and will be regulated by NOPSEMA.
Department of Fisheries	Quadrant first submitted details of the proposed Hockey and Bianchi MSS through DoF's online submission form on December 16, 2015. DoF have provided advice in February, 2016, regarding fishing activities and fish spawning grounds in the area, OPEP advice and biosecurity. In advice from DoF the following commercial fishing interests were identified: • Abalone Fishery • Beche de mer Fishery • Mackerel Managed Fishery • Marine Aquarium Fish Managed Fishery • Onslow Prawn Limited Entry Fishery • Pearl Oyster Fishery • Pilbara Developing Crab Fishery • Pilbara Fish Trawl Interim Managed Fishery • Pilbara Line Fishery • Pilbara Trap Managed Fishery • Specimen Shell Managed Fishery • West Coast Deep Sea Crustacean DoF receive all Quadrant's *Quarterly Consultation Updates*, including revised survey and operational areas for Hockey Bianchi in the June 2016 update. Following this update, DoF requested by email on July 14, 2016, additional information on the source level to be used and management strategies for impacts to fish. Quadrant noted advice from DoF: *"the Department are concerned with the survey coming into shallow waters with reference to Popper et al 2014 who states that permanent hearing loss or mortality: SEL~ >182 dB re 1µPa^2.s (equivalent of 207 dB peak dB re 1µPa) which is a distance of ~ 50 m from the sound source, therefore there is a risk to fish in water depths >50m, if they don't or can't (invertebrate species) move away from the sound source."* Quadrant responded closing out DoF's query on July 19, 2016, noting: *Quadrant will be using a lower-level source for this survey at 3090 cui throughout the survey area, rather than the usual 4,130 cui. Approximately ten per cent of the survey occurs in water depths of less than 50 m.* In phone consultation on July 27, 2016, DoF noted receipt of email and advised a response would be provided. A DoF representative responded on September 15, 2016, stating: *The Department does not support the Hockey and Bianchi seismic survey occurring in waters less than 50m in depth. Whilst the Department supports the use of soft starts and using the lowest possible sound source, the area in which the seismic survey is occurring supports a large number of important demersal stocks. The key spawning time for these stocks are between Nov-March, so it is also preferred that no 3D seismic survey activity occurs in this area during these months. Until such time as the seismic survey risk assessment workshop is undertaken (as previously discussed), the Department will apply the precautionary principles as defined under the Fish Resources Management Act 1994.* Quadrant acknowledges DoF's concerns with the activity. Potential impacts to fish and invertebrate species have been revised in light of concerns raised by DoF with regards to demersal fish and is further detailed in **Section 6.3.2 of the accepted EP**. Any

Stakeholder	Assessment of Consultation Undertaken
	potential impacts are expected to be isolated to individuals and not affect the population as a whole, and therefore the fishery. The exact timing of the MSSs are dependent upon vessel availability, weather conditions and receiving the necessary statutory approvals and therefore could take place at any time of year, therefore Quadrant are unable to commit to avoiding certain periods for fish spawning, particularly given that fish spawning occurs all year round throughout the north-coast bioregion and there are EPBC listed marine fauna to consider (whales, turtles) with known temporal and spatial periods of sensitivity. Quadrant's review of existing literature does not indicate impacts to commercial fishery catches due to MSS, therefore no further control measures will; be implemented for commercial fisheries. In response to DoF, Quadrant commits to open ongoing consultation, including discussion around DoF's seismic survey risk assessment workshop. Quadrant incorporates this advice from DoF in all Quadrant EPs. Quadrant commits to ongoing consultation with DoF to ensure this advice remains valid through the lifecycle of the EP using DoF's online Environmental Impact Assessment form. Quadrant requested commercial fishing license holder details for 23 fisheries on July 1, 2016, as part on the annual commitment to update these details. These were provided via email on July 12 and 13, 2016. Note Pearl Oyster Fishery is represented by the Pearl Producers Association and DoF do not provide details for this fishery.
Department of Parks and Wildlife	DPaW were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's Quarterly Consultation Update documents. DPaW formally responded to consultation on February 19, 2016, raising no objection to the activity and recommending Quadrant provide and interpret the following information to the satisfaction of the regulator: • maximum received SELs in the Montebello and Barrow islands marine parks and reserves; • a comparison between the received SELs within the marine parks and reserves, including zones of high protection within those reserves, and levels likely to cause injury, or trigger the behavioural disturbance of specially protected species that inhabit, or migrate through, the reserves; • survey design and operational management procedures that will be implemented in order to avoid, or minimise impacts on specially protected species and other reserve values; • the potential cumulative impacts of multiple seismic surveys by Quadrant and other operators in the area on specially protected species. DPaWs recommendations have been incorporated into the development of this EP. DPaW raised no objection to consultation as long as the activity EP and OPEP are written to the satisfaction of the relevant regulator. The following EP and OPEP sections address their specific advice: **Section** 6.6 of the EP and Section 16 OPEP: regarding baseline monitoring **Section** 6.6 of the EP and Section 14 OPEP: regarding Oiled Wildlife Response **Section** 6.6 of the EP and Section 16 OPEP: regarding Post-spill monitoring Section 14 OPEP: regarding costs associated with DPaW assistance **Section** 2 of the EP outlines the parameters of the MSS activity **Section** 6.3 of the EP details the noise impact assessment including potential cumulative impacts **Section** 8.6 of the EP details the control measures to minimise impacts Relevant tourism operators were provided the activity consultation package on February 23, via DPaW's licensing department. DPaW advised any queries should be send to Quadrant. No responses have been received via Quadrant or DPaW. Tourism operator details provided by DPaW have been added to Quadrant's stakeholder list for ongoing consultation.

Stakeholder	Assessment of Consultation Undertaken
	Due to interest DPaW had shown in the surveys proximity to the Barrow Island Marine Park boundary, DPaW was contacted by phone regarding survey and operational area boundary changes. In phone consultation on July 14, 2016, DPaW requested additional information including justification for operational area changes, detailed map showing the proximity of the seismic source to the Barrow Island MMA and SELs in the Barrow Island MMA. Quadrant provided a full response to DPaW's queries by email on July 19, 2016, including detailed information on SELs to whales, turtles, fish and invertebrates. Information presented to DPaW regarding operational details for seismic acquisition was for a potential worst case scenario where streamers may trail across the State boundary. Sail lines have since been updated and are not expected to cross the State boundary unless streamers drift due to currents, as outlined in **Section 2** of this document. DPaW was not updated in consultation as there was no increase in risk identified. DPaW responded to the consultation on August 19, 2016. DPaW noted NOPSEMA is the regulator for the activity and would assess potential environmental impacts of the proposed survey. DPaW advised Quadrant has no authority to operate air guns within the Barrow Island MMA. No other points were raised. Quadrant responded to this consultation on September 15, 2016, confirming Quadrant's commitment that air guns would not be fired within State waters, which encompasses the Barrow Island MMA and Marine Park, see performance standard in **Section 6.2.3**. Additionally Quadrant reiterated there may be occasion where smaller support vessels are required to cross the marine park boundary, as mentioned in consultation material. DPaW were additionally contacted by email and phone in October, to update information that was previously provided (on July 19, 2016) as a result of further planning and refinement of the MSSs. A DPaW representative advised Quadrant this information was appreciated however a DPaW response would only be provided if necessary. It was reiterated in this consultation Quadrant maintains the commitment that air guns would not be fired within State waters, which encompasses the Barrow Island MMA and Marine Park, see performance standard in Table 8.3 of the EP, following DPaW's previously received advice. DPaW is a valued stakeholder for this activity. Quadrant considers consultation with DPaW has been adequate, and that DPaW will have no ongoing concerns with the proposal as long as the activity is conducted to the satisfaction of the regulator.
Shipping safety and security	
Australian Maritime Safety Authority	AMSA were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Activity Update* documents. This stakeholder was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 24, 2016, with a covering email which clearly and definitively stated there is a Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. AMSA responded to this consultation on February 24, 2016, noting vessel traffic in the area mainly consists of support craft. Quadrant ensures control measures are in place during activities to manage and minimise risk in relation to the presence of other sea users, marine navigation and vessel safety. AMSA were provided an update on the Hockey Bianchi activity via email on September 8, 2016, and updated GIS shape file data on September 14, 2016. AMSA responded on September 28, 2016, to Quadrants update noting heavy traffic and support craft will be encountered in the survey area and survey and support vessels should exercise caution. AMSA advises excellent communication should be maintained. Quadrant responded to this email on November 15, 2016, updating AMSA that survey timing had not been confirmed and confirming visual and radar watches will be

Stakeholder	Assessment of Consultation Undertaken
	maintained at all times. As per standard operations, the appropriate day shapes, lights and streamers and reflective tail buoys, to indicate the vessel is towing will be displayed. Additionally Quadrant committed to providing notifications prior to activity commencement as advised by AMSA. Quadrant has addressed AMSA's recommendations including navigation equipment and procedures implemented on all vessels to reduce potential for collision or interference with other marine users. Quadrant commits to ongoing consultation with AMSA for up to date shipping advice.
Department of Defence	The Department were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. This stakeholder was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 24, 2016, with a covering email which clearly and definitively stated there is a Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. No comment on this activity was provided to Quadrant at time of submission this EP.
Department of Transport	DoT were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. This stakeholder was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 24, 2016, with a covering email which clearly and definitively stated there is a Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. Advice received through previous consultation and interaction with DoT has been adopted by Quadrant in its preparation of OPEPs. DoT were provided a stakeholder update via email on July 22, 2016, and followed up by phone on July 25, 2016. A DoT representative confirmed the update was received and reviewed, and requested to see the activity OPEP following submission to the regulator. It was noted any comment by DoT would be incorporated into the activity OPEP at a later date. DoT noted comment would not normally be provided on Commonwealth seismic activities and said consultation had been adequate at time of submission.
Adjacent Regulators	
State Department of Mines and Petroleum	DMP were provided the Hockey and Bianchi MSS consultation package on February 19, 2016, and receive all Quadrant's *Quarterly Consultation Update* documents. DMP responded to consultation on February 25, 2016, with questions around zone of potential impact, and whether the survey vessel would enter State waters. Quadrant responded on March 15, 2016, providing maps relating to zone of potential impact from an oil spill and sail lines demonstrating the survey vessel would not enter State waters. DMP were provided additional information in line with their consultation guidelines on April 1, 2016. In phone consultation on July 11, 2016, the revised Operational and Survey area boundaries were raised including the overlap with the State waters boundary of support vessels and seismic vessel streamers. DMP advised Quadrant there was no additional EP submission to DMP required, as long as there is no seismic source emissions (shooting) within State waters. DMP were not concerned that there was potential for support vessels/ streamers to come within State waters, as they would not be emitting seismic pulse. DMP advised Quadrant to undertake consultation with Conservation and Park Commission (CPC) regarding the proposed seismic activity. Quadrant provided DMP this revised operational and survey area via email, as a follow up. DMP responded on July 14, 2016, noting no further information would be required. Information presented to DMP regarding operational details for seismic acquisition was for a potential worst case scenario where streamers may trail across the State boundary. Sail lines have since been updated and are not expected to cross the State boundary

Stakeholder	Assessment of Consultation Undertaken
	unless streamers drift due to currents, as outlined in **Section 2** in this document. DMP was not updated in consultation as there was no increase in risk identified. DMP is a valued stakeholder and Quadrant commits to open on ongoing consultation before, during and after this activity Including the provision of pre-start and cessation notifications as per DMP's consultation guidelines.
Local tourism operators	
Ahoy Buccaneers	This operator received the Hockey and Bianchi MSS consultation package on February 24, 2016. This operator was provided Quadrant's June 2016 *Quarterly Consultation Update* on June 28, 2016, with a covering email which clearly and definitively stated there is a Hockey Bianchi Marine Seismic Survey activity update and presented the revised survey area. No comment on this activity was provided to Quadrant at time of submission of this EP.
Apache Charters	This operator received the Hockey and Bianchi MSS consultation package on February 24, 2016. Additionally this operator was provided an activity update and presented the revised survey area on June 28, 2016, in Quadrant's *Quarterly Consultation Update*. No comment on this activity was provided to Quadrant at time of submission of this EP.
Blue Horizon Charters	This operator received the Hockey and Bianchi MSS consultation package on February 24, 2016. Additionally this operator was provided an activity update and presented the revised survey area on June 28, 2016, in Quadrant's *Quarterly Consultation Update*. No comment on this activity was provided to Quadrant at time of submission of this EP.
Blue Lightning Game Fishing Charters	This operator received the Hockey and Bianchi MSS consultation package on February 24, 2016. Additionally this operator was provided an activity update and presented the revised survey area on June 28, 2016, in Quadrant's *Quarterly Consultation Update*. No comment on this activity was provided to Quadrant at time of submission of this EP.
Keshi Mer Expeditions	This operator received the Hockey and Bianchi MSS consultation package on February 24, 2016. Additionally this operator was provided an activity update and presented the revised survey area on June 28, 2016, in Quadrant's *Quarterly Consultation Update*. No comment on this activity was provided to Quadrant at time of submission of this EP.
Kimberley Expeditions	This operator received the Hockey and Bianchi MSS consultation package on February 24, 2016. Additionally this operator was provided an activity update and presented the revised survey area on June 28, 2016, in Quadrant's *Quarterly Consultation Update*. No comment on this activity was provided to Quadrant at time of submission of this EP.
King's Ningaloo Reef Tours	This operator received the Hockey and Bianchi MSS consultation package on February 24, 2016. Additionally this operator was provided an activity update and presented the revised survey area on June 28, 2016, in Quadrant's *Quarterly Consultation Update*. No comment on this activity was provided to Quadrant at time of submission of this EP.
Leeuwin Ocean Adventure Foundation Ltd	This operator received the Hockey and Bianchi MSS consultation package on February 24, 2016. Additionally this operator was provided an activity update and presented the revised survey area on June 28, 2016, in Quadrant's *Quarterly Consultation Update*. No comment on this activity was provided to Quadrant at time of submission of this EP.
Master Fisheries	This operator received the Hockey and Bianchi MSS consultation package on February 24, 2016. Additionally this operator was provided an activity update and presented the revised survey area on June 28, 2016, in Quadrant's *Quarterly Consultation Update*. No comment on this activity was provided to Quadrant at time of submission of this EP.
Migration Media	This operator received the Hockey and Bianchi MSS consultation package on February 24, 2016. Additionally this operator was provided an activity update and presented the revised survey area on June 28, 2016, in Quadrant's *Quarterly Consultation Update*.

Stakeholder	Assessment of Consultation Undertaken
	No comment on this activity was provided to Quadrant at time of submission of this EP.
Montebello Island Safaris	This operator received the Hockey and Bianchi MSS consultation package on February 24, 2016. Additionally this operator was provided an activity update and presented the revised survey area on June 28, 2016, in Quadrant's *Quarterly Consultation Update*. No comment on this activity was provided to Quadrant at time of submission of this EP.
Montebellos Sportfishing Charters	This operator received the Hockey and Bianchi MSS consultation package on February 24, 2016. Additionally this operator was provided an activity update and presented the revised survey area on June 28, 2016, in Quadrant's *Quarterly Consultation Update*. No comment on this activity was provided to Quadrant at time of submission of this EP.
Ocean Eco Adventures	This operator received the Hockey and Bianchi MSS consultation package on February 24, 2016. Additionally this operator was provided an activity update and presented the revised survey area on June 28, 2016, in Quadrant's *Quarterly Consultation Update*. No comment on this activity was provided to Quadrant at time of submission of this EP.
Odyssey Expeditions	This operator received the Hockey and Bianchi MSS consultation package on February 24, 2016. Additionally this operator was provided an activity update and presented the revised survey area on June 28, 2016, in Quadrant's *Quarterly Consultation Update*. No comment on this activity was provided to Quadrant at time of submission of this EP.
Pelican Charters	This operator received the Hockey and Bianchi MSS consultation package on February 24, 2016. Additionally this operator was provided an activity update and presented the revised survey area on June 28, 2016, in Quadrant's *Quarterly Consultation Update*. No comment on this activity was provided to Quadrant at time of submission of this EP.
Reel Teaser Charters	This operator received the Hockey and Bianchi MSS consultation package on February 24, 2016. Additionally this operator was provided an activity update and presented the revised survey area on June 28, 2016, in Quadrant's *Quarterly Consultation Update*. No comment on this activity was provided to Quadrant at time of submission of this EP.
Sail Ningaloo	This operator received the Hockey and Bianchi MSS consultation package on February 24, 2016. Additionally this operator was provided an activity update and presented the revised survey area on June 28, 2016, in Quadrant's *Quarterly Consultation Update*. No comment on this activity was provided to Quadrant at time of submission of this EP.
Sealife Charters	This operator received the Hockey and Bianchi MSS consultation package on February 24, 2016. Additionally this operator was provided an activity update and presented the revised survey area on June 28, 2016, in Quadrant's *Quarterly Consultation Update*. No comment on this activity was provided to Quadrant at time of submission of this EP.
The Great Escape Charter Company	This operator received the Hockey and Bianchi MSS consultation package on February 24, 2016. Additionally this operator was provided an activity update and presented the revised survey area on June 28, 2016, in Quadrant's *Quarterly Consultation Update*. No comment on this activity was provided to Quadrant at time of submission of this EP.
Top Gun Charters	This operator received the Hockey and Bianchi MSS consultation package on February 24, 2016. Additionally this operator was provided an activity update and presented the revised survey area on June 28, 2016, in Quadrant's *Quarterly Consultation Update*. No comment on this activity was provided to Quadrant at time of submission of this EP.
Non-government organisations	
Australian Conservation Foundation (ACF)	The Hockey Bianchi consultation package was provided to this stakeholder on September 8, 2016. Quadrant left voice mails for the ACF on September 13, 2016, referring to the email sent and providing return contact details. No comment was received on the activity and Quadrant does not expect a response given the nature of the activity, assessment of consultation presented in EP summaries for other similar activities on the North West Shelf and noting compliance with the EPBC Act Policy

Stakeholder	Assessment of Consultation Undertaken
	Statement 2.1 in consultation. Quadrant commits to remaining available post submission and acceptance of this EP to respond to any future consultation enquiries.
Australian Marine Conservation Society (AMCS)	The Hockey Bianchi consultation package was provided to this stakeholder on September 8, 2016. The AMCS were followed up by phone on September 13, 2016, and it was confirmed this consultation package was received. Quadrant offered to provide additional information and answer any questions the AMCS may have on the activity at any time. The AMCS did not provide a response nor raise concern regarding the activity. Quadrant does not expect a response given the nature of the activity, assessment of consultation presented in EP summaries for other similar activities on the North West Shelf and noting compliance with the EPBC Act Policy Statement 2.1 in consultation. Quadrant commits to remaining available post submission and acceptance of this EP to respond to any future consultation enquiries.
Australian Marine Mammal Centre	The Hockey Bianchi consultation package was provided to this stakeholder on September 8, 2016. No comment was received on the activity and Quadrant does not expect a response given the nature of the activity, assessment of consultation presented in EP summaries for other similar activities on the North West Shelf and noting compliance with the EPBC Act Policy Statement 2.1 in consultation. Quadrant commits to remaining available post submission and acceptance of this EP to respond to any future consultation enquiries.
Centre for Whale Research	The Hockey Bianchi consultation package was provided to this stakeholder on September 8, 2016. No comment was received on the activity and Quadrant does not expect a response given the nature of the activity, assessment of consultation presented in EP summaries for other similar activities on the North West Shelf and noting compliance with the EPBC Act Policy Statement 2.1 in consultation. Quadrant commits to remaining available post submission and acceptance of this EP to respond to any future consultation enquiries.
Conservation Council of WA (CCWA)	The Hockey Bianchi consultation package was provided to this stakeholder on September 8, 2016. The CCWA were followed up by phone on September 13, 2016, and it was confirmed this consultation package was received. Quadrant offered to provide additional information and answer any questions the CCWA may have on the activity at any time. The CCWA did not provide a response nor raise concern regarding the activity. Quadrant does not expect a response given the nature of the activity, assessment of consultation presented in EP summaries for other similar activities on the North West Shelf and noting compliance with the EPBC Act Policy Statement 2.1 in consultation. Quadrant commits to remaining available post submission and acceptance of this EP to respond to any future consultation enquiries.
International Fund for Animal Welfare	The Hockey Bianchi consultation package was provided to this stakeholder on September 8, 2016. IFAW responded with thanks on September 14, 2016, and noted due to limited resources IFAW would not be commenting on this activity which is consistent with consultation with NGOs in EP Summaries of similar activities on the North West Shelf, on the NOPSEMA website.
Wilderness Society	The Hockey Bianchi consultation package was provided to this stakeholder on September 8, 2016. The Wilderness Society were followed up by phone on September 13, 2016, and it was requested the consultation package be sent to an alternate email address. In a follow up phone call on September 15, 2016, Quadrant offered to provide additional information and answer any questions on the activity at any time. The Wilderness Society did not provide a response nor raise concern regarding the activity. Quadrant does not expect a response given the nature of the activity, assessment of consultation presented in EP summaries for other similar activities on the North West Shelf and noting compliance with the EPBC Act Policy Statement 2.1 in consultation. Quadrant commits to remaining available post submission and acceptance of this EP to respond to any future consultation enquiries.

Stakeholder	Assessment of Consultation Undertaken
World Wildlife Fund (WWF)	In phone consultation on September 13, 2016, a representative from the WWF advised due to limited resourcing the WWF do not comment on activities of this nature. A consultation package was provided for reference on September 13, 2016, however Quadrant does not expect a response from this stakeholder as this is consistent to their response evidenced in similar activities EP Summaries on NOPSEMA's website.
Adjacent operators	
Chevron	The Hockey Bianchi consultation package was provided to this stakeholder on September 8, 2016. Quadrant has had extensive discussions with Chevron through the ingress/access authority process, including discussions of potential impacts to the Jansz-Gorgon pipeline. Quadrant has assured Chevron via email on September 15, 2016, there would be no impacts to the pipeline given the seismic contractor will not enter water depths that would allow trailing gear to impact seabed infrastructure. For consultation purposes Quadrant is satisfied Chevron are aware of the proposal in relation to their infrastructure in the area. Quadrant will continue discussions with Chevron through the ingress/access authority process.
ENI	The Hockey Bianchi Consultation Package was provided to ENI on September 15, 2016. Quadrant will continue discussions with ENI through the ingress/access authority process. No concerns have been raised.
Woodside	The Hockey Bianchi Consultation Package was provided to Woodside on September 13, 2016. In a follow up phone call and email on September 14, 2016, Woodside confirmed they were aware of the proposal and were happy to continue discussions with Quadrant through the ingress/access authority process. No concerns were raised.
Finder	The Hockey Bianchi Consultation Package was provided to Finder on September 13, 2016. Quadrant will continue discussions with Finder through the ingress/access authority process. A Finder representative responded via email on September 16, 2016, noting information was received and raising no concerns with the activity.
Tap Oil	The Hockey Bianchi Consultation Package was provided to Tap Oil on September 13, 2016. Quadrant will continue discussions with Tap Oil through the ingress/access authority process. No concerns have been raised.
Regional Aboriginal Corporations	
Kuruma Marthudhunera Aboriginal Corporation (KMAC)	In phone consultation on September 12, 2016, Quadrant outlined the Hockey Bianchi seismic project and queried whether this could impact cultural activities in the area that had an offshore nature, such as fishing. KMAC representative advised the cultural and heritage qualities of the Montebello's, Barrow Island and neighbouring land masses are generally managed as a collaboration between KMAC, YACMAC and Thalanyji. Suggested providing details via email for assessment. The Hockey Bianchi Consultation Package was provided to KMAC via email and in response on September 13, 2016, KMAC advised given the nature of the activity there should not be any impact to members. KMAC advised in the future they may be interested should the project develop to a stage where land masses were impacted. In response Quadrant re-iterated that land impacts are not planned for this activity. In the event of land based response activities, KMAC may be identified and consulted with. Following consultation, Quadrant believes Indigenous heritage and traditional values will not be adversely effected by the planned activities.
Buurabalayji Thalanyji Aboriginal Corporation	In phone consultation on September 13, 2016, Quadrant outlined the Hockey Bianchi seismic project and queried whether this could impact cultural activities in the area that had an offshore nature, such as fishing. A Thalanyji representative advised it was unlikely any cultural or heritage interests would be adversely effected by the activity if there were no plans for camping or setting up infrastructure on the islands. A

Stakeholder	Assessment of Consultation Undertaken
	consultation package was provided via email for future reference on September 13, 2016, and Quadrant committed to being available at any time to ask and questions which may arise. In the event of land based response activities, Thalanyji representatives may be identified and consulted with. Following consultation, Quadrant believes Indigenous heritage and traditional values will not be adversely effected by the planned activities.
Yaburara and Coastal Mardudhunera Aboriginal Corporation (YACMAC)	Voice mails were left for YACMAC on September 12, 2016, and September 13, 2016, briefly outlining the proposed activity and providing return contact details. Following consultation with KMAC, the Hockey Bianchi Consultation package was provided to YACMAC via email on September 14, 2016. No response has been received. In the event of land based response activities, YACMAC representatives may be identified and consulted as outlined in **Table 15-4** of the OPEP. Quadrant believes Indigenous heritage and traditional values will not be adversely effected by the planned activities.
Commercial fisheries (relevant as advised in consultation with WAFIC and DoF)	
Western Tuna and Billfish (Commonwealth Managed)	As outlined in consultation with WAFIC, one Western Tuna and Billfish license holder is active in this fishery, Ocean Wild Tuna is listed in **Table 5-1** and will receive all Hockey Bianchi consultation.
North West Slope Trawl (Commonwealth Managed)	Fishers active in North West Slope Trawl fishery are listed in **Table 5-1** and receive all Hockey Bianchi consultation. • Austral Fisheries • A Raptis and Sons • Westmore Seafoods
Pilbara Line (State Managed)	Quadrant's Annual Stakeholder Update, including detailed description of proposed Hockey Bianchi activity with location map, coordinates, distances to key regional features, approximate timing, duration and return contact details, was provided to all license holders in this fishery as specified by DoF on September 8, 2016. No response has been received. Fishers from Pilbara Line who have previously expressed interest in Quadrant activities are listed in **Table 5-1** and receive all Hockey Bianchi consultation. Quadrant does not expect a response to this postal consultation, given lack of response to previous postal consultation.
Pilbara Trap (State Managed)	Quadrant's Annual Stakeholder Update, including detailed description of proposed Hockey Bianchi activity with location map, coordinates, distances to key regional features, approximate timing, duration and return contact details, was provided to all license holders in this fishery as specified by DoF on September 8, 2016. No response has been received. Quadrant does not expect a response to this postal consultation, given lack of response to previous postal consultation.
Mackerel Area 2 (State Managed)	Quadrant's Annual Stakeholder Update, including detailed description of proposed Hockey Bianchi activity with location map, coordinates, distances to key regional features, approximate timing, duration and return contact details, was provided to all license holders in this fishery as specified by DoF on September 8, 2016. No response has been received. Fishers from the Mackerel fishery who have previously expressed interest in Quadrant activities are listed in **Table 5-1** and receive all Hockey Bianchi consultation. Quadrant does not expect a response to this postal consultation, given lack of response to previous postal consultation.
Abalone Fishery	Quadrant's Annual Stakeholder Update, including detailed description of proposed Hockey Bianchi activity with location map, coordinates, distances to key regional features, approximate timing, duration and return contact details, was provided to all license holders in this fishery as specified by DoF on September 8, 2016. No response

Stakeholder	Assessment of Consultation Undertaken
	has been received. Quadrant does not expect a response to this postal consultation, given lack of response to previous postal consultation.
Beche de mer Fishery	Quadrant's Annual Stakeholder Update, including detailed description of proposed Hockey Bianchi activity with location map, coordinates, distances to key regional features, approximate timing, duration and return contact details, was provided to all license holders in this fishery as specified by DoF on September 8, 2016. No response has been received. Quadrant does not expect a response to this postal consultation, given lack of response to previous postal consultation.
Marine Aquarium Fish Managed Fishery	Quadrant's Annual Stakeholder Update, including detailed description of proposed Hockey Bianchi activity with location map, coordinates, distances to key regional features, approximate timing, duration and return contact details, was provided to all license holders in this fishery as specified by DoF on September 8, 2016. No response has been received. Quadrant does not expect a response to this postal consultation, given lack of response to previous postal consultation.
Onslow Prawn Limited Entry Fishery	Quadrant's Annual Stakeholder Update, including detailed description of proposed Hockey Bianchi activity with location map, coordinates, distances to key regional features, approximate timing, duration and return contact details, was provided to all license holders in this fishery as specified by DoF on September 8, 2016. No response has been received. Quadrant does not expect a response to this postal consultation, given lack of response to previous postal consultation.
Pilbara Developing Crab Fishery	Quadrant's Annual Stakeholder Update, including detailed description of proposed Hockey Bianchi activity with location map, coordinates, distances to key regional features, approximate timing, duration and return contact details, was provided to all license holders in this fishery as specified by DoF on September 8, 2016. No response has been received. Quadrant does not expect a response to this postal consultation, given lack of response to previous postal consultation.
Pilbara Fish Trawl Interim Managed Fishery	Quadrant's Annual Stakeholder Update, including detailed description of proposed Hockey Bianchi activity with location map, coordinates, distances to key regional features, approximate timing, duration and return contact details, was provided to all license holders in this fishery as specified by DoF on September 8, 2016. No response has been received. Quadrant does not expect a response to this postal consultation, given lack of response to previous postal consultation.
Specimen Shell Managed Fishery	Quadrant's Annual Stakeholder Update, including detailed description of proposed Hockey Bianchi activity with location map, coordinates, distances to key regional features, approximate timing, duration and return contact details, was provided to all license holders in this fishery as specified by DoF on September 8, 2016. No response has been received. Quadrant does not expect a response to this postal consultation, given lack of response to previous postal consultation.
West Coast Deep Sea Crustacean	Quadrant's Annual Stakeholder Update, including detailed description of proposed Hockey Bianchi activity with location map, coordinates, distances to key regional features, approximate timing, duration and return contact details, was provided to all license holders in this fishery as specified by DoF on September 8, 2016. No response has been received. Quadrant does not expect a response to this postal consultation, given lack of response to previous postal consultation.

5.3 Ongoing consultation

The Hockey and Bianchi MSS will be consulted via three tiers, the Consultation Package distributed prior to EP submission, a survey specific Notification Package approximately four weeks prior to activity commencement when activity timing and other details are confirmed, and within Quadrant's *Quarterly Consultation Updates*.

5.3.1 Stakeholder Notifications

Prior to undertaking the Hockey and Bianchi MSS, Quadrant will provide an activity specific notification to each relevant stakeholder identified; in the form of a Quadrant Notification Package. All feedback will be assessed, evaluated and closed out prior to commencing the activity.

Stakeholder Notification Packages will be distributed to stakeholders prior to an activity commencing under the EP, and will include specific timing, location and vessel details. Four weeks is given to allow stakeholders to assess the information provided and advise Quadrant of any concerns or comments on the activity, and give Quadrant an appropriate amount of time to respond and address these comments to the satisfaction of both parties. However Quadrant does not expect comments on the activity given the extensive consultation period that has occurred prior to EP submission.

If the surveys are only partially completed (e.g. due to multiple fauna shut downs or weather) or a completed as two separate surveys, a cessation notification would be issued and a new commencement notification would be issued prior to commencing each activity or stage, noting that the total duration of the Hockey Bianchi MSSs would not exceed 60 days.

5.3.2 Quarterly Consultation Update

Activities covered under the EP will continue to be included in *Quarterly Consultation Updates* until they can be listed as a 'completed activity', with updates scheduled for approximately June, September, December and March annually.

5.3.3 Annual fishing license holder update

Quadrant's Stakeholder Consultation Strategy outlines the commercial fishing license holder database is to be updated annually in collaboration with DoF, to capture any changes or additional license holders for all Quadrant offshore permits. These license holders will be contacted annually with detailed information about the company and its offshore activities (ongoing and proposed) and encouraged to be added to Quadrant's email database if they wish to receive consultation about upcoming activities. This annual update was most recently distributed on September 8, 2016.

Commercial State Fisheries obtained by DoF in July 2016:

- Abalone
- Abrolhos Island and Mid West Trawl Fishery
- Beche De Mer Fishery
- Broome Prawn Fishery
- Exmouth Gulf Prawn Fishery
- Gascoyne Demersal Scalefish Fishery
- Land Hermit Crab
- Mackerel Managed Fishery
- Marine Aquarium Fishery
- Nickol Bay Prawn
- Northern Demersal Scalefish Industry
- Octopus Interim Managed Fishery
- Onslow Prawn Fishery
- Pilbara Crab
- Pilbara Fish Trawl Fishery
- Pilbara Line Fishery
- Pilbara Trap Fishery
- Shark Bay Prawn Managed Fishery
- Shark Bay Scallop Managed Fishery
- Specimen Shell
- West Coast Deep Sea Crustacean Managed Fishery

- West Coast Demersal Scalefish Interim Managed Fishery

Quadrant does not expect a response from these license holders as they have previously been consulted on Quadrant's offshore activities and permits, and those of similar nature by other offshore operators, and not provided response.

In the past Quadrant has distributed *Quarterly Consultation Updates* by post to individual fishing licence holders on the North West Shelf. Since licence holders first received a *Quarterly Consultation Update* in March 2013, Quadrant has received only five responses and requests to continue sending information. Each of these stakeholders has been added to the more detailed and regular *Quarterly Consultation Update* circulation list and received all subsequent Updates. This list is more comprehensive than the relevant stakeholder list for Hockey and Bianchi Seismic.

Quadrant has formed the view that the remainder of the fishing licence holders it contacted in this way do not have any concerns with Quadrant operations and therefore ceased sending this documentation to license holders by post in June 2015. As aforementioned, they are now contacted annually.

5.4 Consultation performance standards

Control measure	Performance standards	Measurement criteria
Stakeholder Engagement undertaken to ensure all stakeholder adequately informed	Relevant persons identified and notified of the Activity by provision of a Stakeholder Consultation Package prior to submission of this EP.	Quadrant Energy correspondence to relevant stakeholders
	Relevant persons identified and notified of the Activity covered by this EP, by provision of a Stakeholder Notification 4 weeks prior to the Activity commencement.	Quadrant Energy correspondence to relevant stakeholders
	Provision of a Stakeholder Notification 48 hrs prior to Activity commencement to AMSA Joint Rescue Coordination Centre (JRCC)	Quadrant Energy correspondence to relevant stakeholders
	Provision of a Stakeholder Notification prior to Activity commencement to AHS	Quadrant Energy correspondence to relevant stakeholders
	Information regarding the Activity provided to DoF by email or through the online Environmental Impact Assessment form 3 months prior to activity commencement	Quadrant Energy correspondence to relevant stakeholders
	All correspondence with external stakeholders is recorded in the stakeholder database.	Stakeholder database
	Quadrant Energy's Consultation Coordinator remains available before, during and after the Activity to ensure stakeholder feedback is evaluated and considered during the operational activity phases.	Consultation Coordinator contact details provided to relevant persons in all correspondence
Stakeholders kept informed of Activity commencement and cessation	The maximum period of time that the Activity will take place for is 60 days. If the Activity is split over time e.g. acquired as two separate surveys or halted and returned to at a later date, an EP review will be conducted in line with Section **Error! Reference source not found.** to ensure stakeholders are aware of the Activity and the EP is still fit for purpose	Quadrant Energy correspondence to relevant stakeholders

5.5 Oil Pollution Emergency Plan (OPEP) Consultation

In preparing the OPEP and number of parties are identified to provide spill response services and actions to support the OPEP. These OPEP stakeholders are identified through evaluation of the activity and spill

potential for all Quadrant OPEPs, including the *Hockey and Bianchi 3D Seismic Survey Oil Pollution Emergency Plan (EA-00-RI-10077.02)*.

Consultation, agreements or contracts have been put into place with agencies and organisations throughout the development of Quadrant's oil spill response strategies and tactics so that roles and responsibilities are understood and accepted as outlined in **Table 5-3.**

Table 5-3: Spill Response Consultation Summary

Stakeholder	Assessment of Consultation Undertaken
Australian Marine Oil Spill Centre (AMOSC)	• Historically AMOSC reviewed Oil Spill Contingency Plans (OSCPs) and OPEPs and are satisfied with the description of their support. AMOSC now request to only view OPEPs once they are accepted by the regulator and before the activity commences. • Roles and responsibilities defined in the OPEP reflect the arrangements established under contract conditions as a Participating Member of AMOSC under the AMOSCPlan.
Australian Marine Safety Authority (AMSA)	• Historically AMSA reviewed OSCPs and OPEPs and are satisfied with the description of their support. AMSA now request to only view OPEPs once they are accepted by the regulator and before the activity commences. • Roles and responsibilities defined in the OPEP reflect the arrangements established within a Memorandum of Understanding between AMSA and Quadrant.
Logistics provider	Quadrant has a select number of logistics providers under contract conditions. All arrangements defined in the OPEP nominating a provider have been supplied by that provider and reflect contracted services.
Field support organisation	Quadrant has a select field support organisation under contract conditions. All arrangements defined in the OPEP nominating a provider have been supplied by that provider and reflect contracted services.
Department of Environmental Regulation (DER) (Waste Management Branch)	• The DER Waste Management Branch have reviewed and have had input in defining the Waste Management Plan contained in Quadrant OSCP/OPEPs. • The waste management processes do not change between OPEPs, so the original consultation is sufficient for the OPEP.
Department of Parks and Wildlife	DPaW were contributors to development of the WA Oiled Wildlife Response Plan (OWRP) defined in the OPEP. Descriptions of the Quadrant interface with the WAOWRP contained within the OPEP are consistent with the intent of DPaW (and AMOSC) for oiled wildlife response. No further consultation is required.
Department of Transport (Hazard Management Authority)	• The DoT are supplied Quadrant OPEPs during development, and have opportunity to provide feedback on any area that they consider within their remit. • All roles and responsibilities defined within the OPEP for DoT reflect the Interim Arrangements for the DoT Offshore Petroleum Industry Guidance Note, Marine Oil Pollution: Response and Consultation Arrangements.
Oil Spill Response Limited (OSRL)	OSRL operate under contract conditions with Quadrant. All arrangements defined in the OPEP nominating this provider have been supplied by that provider and reflect contracted services.
Neighbouring operators	Chevron have been notified on the potential impacts to Barrow Island from a vessel collision incident, and have agreed to the arrangements defined within the OPEP reflecting the process to activate Chevron under Mutual Aid arrangements contained in the AMOSPlan for spill response on Barrow Island.

Stakeholder	Assessment of Consultation Undertaken
Vessel providers	Quadrant has a select number of vessel providers under contract conditions. All arrangements defined in the OPEP nominating a provider have been supplied by that provider and reflect contracted services.
Aircraft providers	Quadrant has a select number of aircraft providers under contract conditions. All arrangements defined in the OPEP nominating a provider have been supplied by that provider and reflect contracted services.
Spill modelling provider	Quadrant has a select spill modelling provider under contract conditions. All arrangements defined in the OPEP nominating a provider have been supplied by that provider and reflect contracted services.
Waste contractor	Quadrant has a select provider under contract conditions. All arrangements defined in the OPEP nominating a provider have been supplied by that provider and reflect contracted services.
Australian Marine Oil Spill Centre (AMOSC)	• Historically AMOSC reviewed Oil Spill Contingency Plans (OSCPs) and OPEPs and are satisfied with the description of their support. AMOSC now request to only view OPEPs once they are accepted by the regulator and before the activity commences. • Roles and responsibilities defined in the OPEP reflect the arrangements established under contract conditions as a Participating Member of AMOSC under the AMOSCPlan.
Australian Marine Safety Authority (AMSA)	• Historically AMSA reviewed OSCPs and OPEPs and are satisfied with the description of their support. AMSA now request to only view OPEPs once they are accepted by the regulator and before the activity commences. • Roles and responsibilities defined in the OPEP reflect the arrangements established within a Memorandum of Understanding between AMSA and Quadrant.
Department of Environmental Regulation (DER) (Waste Management Branch)	• The DER Waste Management Branch have reviewed and have had input in defining the Waste Management Plan contained in Quadrant OSCP/OPEPs. • The waste management processes do not change between OPEPs, so the original consultation is sufficient for the OPEP.
Department of Parks and Wildlife	• DPaW were contributors to development of the WA Oiled Wildlife Response Plan (OWRP) defined in the OPEP. Descriptions of the Quadrant interface with the WAOWRP contained within the OPEP are consistent with the intent of DPaW (and AMOSC) for oiled wildlife response. No further consultation is required.
Department of Transport (Hazard Management Authority)	• The DoT are supplied Quadrant OPEPs during development, and have opportunity to provide feedback on any area that they consider within their remit. • All roles and responsibilities defined within the OPEP for DoT reflect the Interim Arrangements for the DoT Offshore Petroleum Industry Guidance Note, Marine Oil Pollution: Response and Consultation Arrangements.

6. ENVIRONMENTAL HAZARDS AND CONTROLS

6.1 Methodology

The impact and risk assessment approach is consistent with the requirements of AS/NZS ISO 31000:2009 Risk Management – Principles and guidelines and ISO/IEC 31010 Risk management – Risk management techniques. The approach can be mapped to the requirements of the OPGGS (E) Regulations for an EP, as described by NOPSEMA (N4700-GN1074 Rev 1 2013). The key steps are illustrated in **Figure 6-1**.

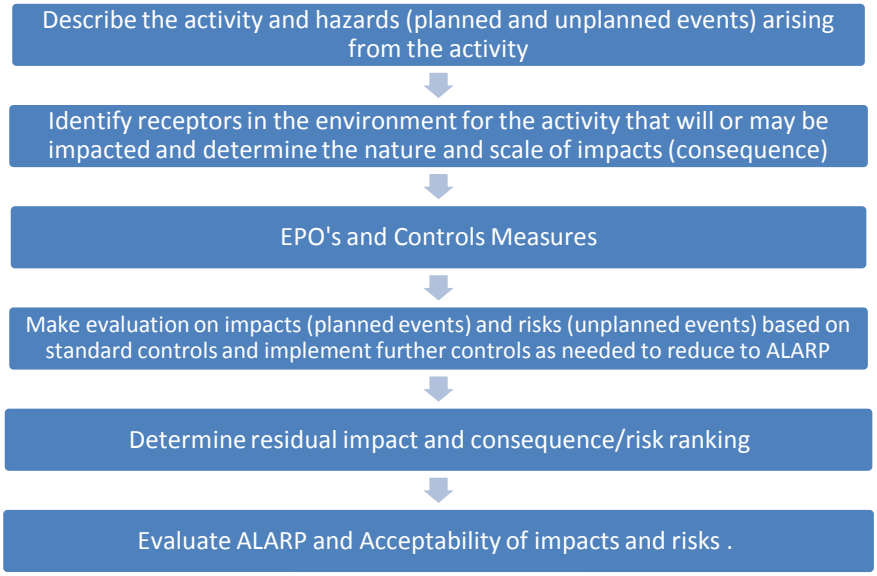

Figure 6-1: Risk and Impact Process

An assessment against the Activity was undertaken and the environmental hazards or aspects were then identified.

The extent of actual or potential impacts from each planned or unplanned event is assessed using, where required, modelling (e.g. for hydrocarbon spill modelling) and scientific reports. The duration of the event is also described including the potential duration of any impacts should they occur. Receptors identified as potentially occurring within impacted area(s) are detailed in **Section 4**.

Impact mechanisms and any thresholds for impact are determined and described, using scientific literature and modelling where required. This step looks at the causal effect between the aspect/hazard and the identified receptor. Impact thresholds for different critical life stages are also identified where relevant.

The consequence level of the impact is then determined for each planned and unplanned event based on the severity of the impact to relevant receptors. This process determines a consequence level based on set criteria for each receptor category and takes into consideration the duration and extent of the impact, receptor recovery time and the effect of the impact at a population, ecosystem or industry level. The consequence definitions are outlined in **Table 6-1** below.

Table 6-1: Consequence level description

Consequence Level		Consequence Level description
A	Negligible	No impact or negligible impact.
B	Minor	Detectable but insignificant change to local population, industry or ecosystem factors. Localised effect with rapid recovery
C	Moderate	Significant impact to local population, industry or ecosystem factors. Medium term recovery

D	Major	Major long-term effect on local population, industry or ecosystem factors. Slow recovery over decades
E	Critical	Complete loss of local population, industry or ecosystem factors AND/ OR major wide-spread regional impacts with slow recovery.

For unplanned events, a risk ranking is also determined using an assessment of the likelihood (likelihood ranking) of the event as well as the consequence level of the potential impact should that event occur. A description of likelihood as per Quadrant's Risk Matrix.

Table 6-2: Likelihood description

No.	Matrix	Description
7	Expected	1. Consequence can reasonably be expected to occur in life of facility or this type of operation/project. 2. Greater than 1 incident per annum.
6	Probable	1. Consequence or event has occurred within the Company. 2. Between 1 and 10 incidents every 10 years (i.e. up to frequency 1/year).
5	Likely	1. Has occurred more than once in the Industry & team have had first-hand experience. 2. Between 1 and 10 incidents every 100 years (i.e. up to frequency 10-1/year).
4	Unlikely	1. Has occasionally occurred within the Industry & team has had first-hand experience. 2. Between 1 and 10 incidents every 1000 years (i.e. up to frequency 10-2/year).
3	Very Unlikely	1. Has occasionally occurred within the Industry & team has not had first-hand experience. 2. Between 1 and 10 incidents every 10,000 years (i.e. up to frequency 10-3/year).
2	Rare	1. Has occurred within industry but team not has not had first-hand experience. 2. Between 1 and 10 incidents every 100,000 years (i.e. up to frequency 10-4/year).
1	Very Rare	1. Unheard of in industry but team agrees that it could happen under exceptional circumstances. 2. Less than 1 incident every 100,000 years (i.e. up to frequency 10-5/year).

Table 6-3: Quadrant Energy risk matrix used for risk rankings

LIKELIHOOD	SEVERITY				
	1. Negligible	2. Minor	3. Moderate	4. Major	5. Critical
7. Expected					
6. Probable					
5. Likely					
4. Unlikely					
3. Very Unlikely					
2. Rare					
1. Very Rare					

Unnacceptable Risk	Work cannot progress as currently planned. Risk reduction required before work can proceed.
ALARP	Risk reduction measures may be implemented – ALARP principle applies
Tolerable Risk	Risk reduction not normally undertaken

For each planned and unplanned event a set of Environmental Performance Outcome(s) (EPO's), Environmental Performance Standards (EPS) and Measurement Criteria (MC) are identified. The definitions of the performance outcomes, standards and measurement criteria are consistent with the OPGGS (E) Regulations. For planned and unplanned events, an ALARP and Acceptability assessment is also undertaken.

6.1.1 Acceptability Evaluation

Quadrant considers the impacts or risks associated with the Activity to be acceptable if the following criteria are met:

1. A consequence from a planned event is ranked as A or B; or a risk of impact from an unplanned event is ranked low to medium/high;
2. An assessment has been completed to determine if further information/studies are required to support or validate the consequence assessment;
3. Performance standards are consistent with legal and regulatory requirements;
4. Performance standards are consistent with Quadrant Environmental Management Policy;
5. Performance standards are consistent with stakeholder expectations, and
6. Performance standards have been demonstrated to reduce the impact or risk to ALARP.

6.1.2 ALARP Evaluation

For planned and unplanned events, an ALARP assessment is undertaken to demonstrate that the standard control measures adopted reduce the impact or risk to as low as reasonably practicable (ALARP). This process relies on demonstrating that further potential control measures would require a disproportionate level of cost/effort for the level of impact or risk reduction they would provide. If this cannot be demonstrated then further controls are implemented. The level of detail included within the ALARP assessment is based upon the nature and scale of the potential impact and risks.

6.2 Environmental risk treatment summary – Planned events

The environmental risk identification procedure identified 6 potential sources of environmental impact associated with the activity planned to be undertaken in the operational area.

6.2.1 Interaction with other marine users

Event: Interactions with Other marine users	Interactions with other users of the sea through undertaking the activity. The presence of vessels in the operational area could potentially inhibit marine user groups, tourism, commercial shipping, fishing and other oil and gas activities and the presence of vessels and the towed streamers could pose a collision risk and inconvenience to fishing practices during these operations.
Potential receptors	Marine user groups, commercial fishers, tourism, shipping traffic and other oil and gas activities.
Potential Impacts	Potential impacts to commercial fisheries include temporary loss of fishing area, and a potential inconvenience to fishing practices. Tourism activities are expected to occur infrequently in the operational area given the water depths. Activities such as diving and recreational fishing may occur around the Montebello Islands, and traditional or subsistence fishing however interaction with these activities and the survey vessel are unlikely to occur. Given the distance to these islands (>5km away), noise levels from the MSSs are unlikely to lead to behavioural impacts of target species (for fishing or diving) or have implications for human health. Two shipwrecks, the Trial and Tanami, are located within the operational area, however due to strong currents and swells, diving here is dangerous and therefore the wrecks are not popular dive sites. As such, impacts to tourism are not expected. The requested exclusion zone around the survey vessel and streamers will result in an overlap with the marine park for a short period of time (matter of hours) whilst the vessel is sailing past.

	There are no designated commercial shipping routes through the operational area although heavy traffic will be encountered throughout the Hockey MSS area as commercial vessels transit around the Montebello Islands and support vessels conduct operations along the offshore seabed infrastructure. The Bianchi MSS will encounter mild commercial traffic transiting through the area. (Should commercial vessels need to deviate from planned routes to avoid the survey vessel, this may slightly increase transit times and fuel consumption. The presence of the operational area during the activity may be an obstacle for shipping traffic in the region and may disrupt commercial fishing and other oil and gas operations e.g. Chevron undertake activities on Barrow Island. These impacts can include a loss of access to the area as well as navigational hazards and a collision risk. As the operational area occurs in open waters with no grounding or navigational hazards, it is not likely that any such deviation would increase the potential for vessel collision or grounding
Impact assessment	
Receptor	**Consequence**
Socio-economic Receptors	A review of shipping data indicates that there will not be a significant disruption to commercial shipping due to the distance of the activity from the nearest shipping lane and lack of concerns raised through consultation; however there is an elevated level of traffic in the vicinity of the operational area as indicated in **Figure 4-5**. Vessels could be expected to divert around the operational area but this would be a temporary exclusion given the duration of the MSSs. Tourism activity in the area is expected to be low, although a minimal amount of displacement could occur due to the activity. The possibility of disruption to tourism activities would only occur within or close to State waters, given the nature of tourism based activities. The seismic vessel will only be operating in these areas for short duration (hours at most) reducing the potential impact on this socioeconomic factor. There may be some commercial fishing activities occurring in the area. Marine users currently plan their activities in consideration of other petroleum activities and other marine users (fisheries and shipping) in the region. It is possible that indigenous users of the marine environment may be present, although there are no recorded seabed aboriginal sites in the waters of the Montebello and Barrow Island Reserves (DEC, 2007). Subsistence fishing and traditional hunting may occur in waters close to shorelines. Given the distance of Barrow Island and the Montebello Islands from the mainland, traditional use of this area is expected to be low. Consultation has been undertaken with indigenous users and no concerns have been raised about the activity in offshore waters. Oil and gas operators in the area include Chevron undertaking activities on and around Barrow Island. Consultation with Chevron has not indicated any concern with the proposed MSS, however consultation will remain open, and through the access authority agreements in place prior to activity commencement, other titleholders will be aware of the activity. AMSA require a high level of communication during the activity therefore reducing the likelihood of interaction with other sea users.
Overall Consequence Ranking	B - Minor

Management Control	**Effectiveness of Control**
Maritime notices are issued prior to activity commencement to reduce potential for collision or interference with other marine user activities	Ensure other marine users are aware of the presence of the seismic vessel and streamers, and the relative low mobility of vessel to suddenly change course or avoid other vessels.
Maintaining up to date environment description to ensure relevant scientific studies, conservation management plans and any other relevant updates are considered in impacts and risk assessments.	Ensures any new environmental sensitivities are identified and potential impacts and risks are appropriately assessed and mitigated.
Exclusion zone and access authority established to reduce potential for collision	Exclusion zones around the vessel and streamers prevents other vessels from getting too close and causing damage to equipment of

or interference with other marine user activities	either party. Gaining access authority ensures that other titleholders are aware of the vessel and activities preventing interference with the titleholders activities.
Support vessel in place during activity to reduce potential for collision or interference with other marine users	Identifies and communicates with approaching third-party vessels to ensure exclusion zone is observed, preventing potential interaction or interference
	Reduces risk of environmental impact from vessel collisions due to ensuring safety requirements are fulfilled.
Navigation equipment and procedures implemented on all vessels to reduce potential for collision or interference with other marine users	Ensure other marine users are aware of the presence of the seismic vessel and streamers, and the relative low mobility of vessel to suddenly change course or avoid other vessels.

6.2.2 Light emissions

Event: Light emissions	During the activity, safety and navigational lighting on the vessels will generate light emissions that may potentially affect marine fauna behaviour. Lighting typically consists of bright white (metal halide, halogen, fluorescent) lights. Minimum lighting is required for safety and navigational purposes on board the vessel so it cannot be eliminated if the proposed activity is to proceed
Potential receptors	Fish, marine turtles and seabirds
Potential Impacts	Continuous lighting in the same location for an extended period of time may result in alterations to normal marine fauna behaviour, as discussed below for each fauna group. The combination of colour, intensity, closeness, direction and persistence of a light source are key factors in determining the magnitude of environmental impact (EPA, 2010). For this activity, survey and support vessels will be sufficiently far (~5km) from conservation significant islands to ensure that lights (and light glow) are not visible from the beaches or surrounding sea. Should conservation significant marine fauna be within or near the operational area, potential lighting impacts are expected to be temporary given the short duration the survey vessel will be in proximity to shoreline. <u>Fish</u> The response of fish to light emissions varies according to species and habitat. Experiments using light traps have found that some fish and zooplankton species are attracted to light sources (Meekan et al., 2001), with traps drawing catches from up to 90 m away (Milicich et al., 1992). Lindquist et al. (2005) concluded from a study that artificial lighting associated with offshore oil and gas activities resulted in an increased abundance of clupeids (herring and sardines) and engraulids (anchovies); these species are known to be highly photopositive. Overall, a short-term localised increase in fish activity as a result of vessel lighting is expected to occur, however with negligible impacts. <u>Marine turtles</u> Light pollution is highlighted as a factor requiring management for successful marine turtle nesting (Commonwealth of Australia, 2013). The most significant risk posed to marine turtles from artificial lighting is the potential disorientation of hatchlings following their emergence from nests, although breeding adult turtles can also be disoriented (Rich and Longcore, 2006 in EPA 2010). Once in the ocean, hatchlings are thought to remain close to the surface, orient by wave fronts and swim into deep offshore waters for several days to escape the more predator-filled shallow inshore waters. During this period, light spill from coastal port infrastructure and ships may 'entrap' hatchling swimming behaviour, reducing the success of their seaward dispersion and potentially increasing their exposure to predation via silhouetting (Salmon et al., 1992). For this activity, survey and support vessels will approach ~5 km from the nearest significant flatback and green turtle nesting habitats in Barrow Island. The WA Environmental Protection Authority (EPA) conservatively estimates there is only a light influence on marine turtles if the light source is within 1.5 km of the nesting beach (EPA,

	2010). Peak nesting season for hawksbill, green, loggerhead and flatback turtles (most likely to occur in the operational area due to the nesting sites on Barrow and Montebello islands) is from 1 October to 28 February when nesting and inter-nesting turtles are likely to be present. The seismic vessel will be continually moving and therefore any potential light disturbance to marine turtles will be temporary and of short duration. The risk of population level impacts to marine turtles from light associated with the survey vessel and support vessel is considered very low. <u>Seabirds</u> Studies conducted between 1992 and 2002 in the North Sea confirmed that artificial light was the reason that birds were attracted to and accumulated around illuminated offshore infrastructure (Marquenie et al., 2008). The light sources associated with the vessels may also provide enhanced capability for seabirds to forage at night. The survey vessel in particular will not be stationary nor in the operational area for long periods of time (approximately 77 days in total), and so unlikely to attract large numbers of seabirds to one fixed location. <u>Other marine fauna</u> There is no evidence to suggest that artificial light sources adversely affect the migratory, feeding or breeding behaviours of cetaceans. Cetaceans predominantly utilise acoustic senses to monitor their environment rather than visual cues (Simmonds et al., 2004), therefore impacts are thought to be unlikely
Impact assessment	
Receptor	**Consequence**
Threatened / Migratory Fauna	Continuous lighting in the same location for an extended period of time may result in alterations to normal marine fauna behaviour. Sensitive receptors that may be impacted include fish at surface, marine turtles and mammals, and seabirds. Given that the activity will be a once off, for a limited duration, and is located ~5.6 km from the nearest coastline. At these distances lighting is unlikely to be at a level that could impact nesting turtles or hatchlings. Impacts to fish and birds will be limited to short-term behavioural effects.
Protected Areas	The operational area overlaps with Barrow Island and is adjacent to Montebello Islands Marine Parks. Within the parks, key sensitivities include the closest nesting beaches occurring ~5.6 km from the MSS area (Barrow Island).
Overall Consequence Ranking	A - Negligible
Management Control	**Effectiveness of Control**
Navigation equipment and procedures implemented on all vessels to reduce potential for collision or interference with other marine users	Reduces risk of environmental impact from vessel collisions due to ensuring safety requirements are fulfilled.

6.2.3 Noise Emissions

Event: Noise emissions	Noise emitted during seismic activities from vessels and helicopter operations and seismic operations may result in physiological or behavioural impacts to marine fauna, especially to marine mammal species that use sound for navigation and communication
Potential receptors	Threatened / Migratory / Protected Fauna – fish, sharks, turtles, marine mammals Protected areas – Montebello/Barrow Islands Marine Conservation Reserves Socio-economic – fisheries
Potential Impacts	<u>Potential impacts from helicopters and vessel noise</u> Reactions of cetaceans to circling aircraft (fixed wing or helicopter) are sometimes conspicuous if the aircraft is below an altitude of 300m, uncommon at 460m and generally

	undetectable at 600m (NMFS, 2001). Baleen whales sometimes dive or turn away during over-flights, but sensitivity seems to vary depending on the activity of the animals. The effects on cetaceans seem transient, and occasional over-flights probably have no long-term consequences on cetaceans. Observations by Richardson and Malme (1993) indicate that, for bowhead whales, most individuals are unlikely to react significantly to occasional single-pass low-flying helicopters transporting personnel and equipment at altitudes above 150m. Leatherwood et al. (1982) observed that minke whales responded to helicopters at an altitude of 230m by changing course or slowly diving. Noise emitted by vessels and helicopters during the activity will be short in duration and is likely to be reduced to background levels within kilometres to tens of kilometres. During aerial surveys a helicopter will fly over a small area (the turtle survey area) a number of times but will be at a minimum height of 150m for safety reasons and won't hover over marine fauna. As such, any potential related marine fauna behavioural impacts are expected to be temporary and short ranged. Therefore the aspect of underwater noise considered to have the greatest potential impact is noise emitted from the seismic source array and is discussed next <u>Potential impacts from seismic source</u> Marine fauna use sound in a variety of functions, including social interactions, foraging, orientation, and responding to predators. Underwater noise can affect marine fauna in three main ways: • Injury to hearing or other organs. Hearing loss may be temporary (temporary threshold shift (TTS)) or permanent (permanent threshold shift (PTS)); • Disturbance leading to behavioural changes or displacement of fauna. The occurrence and intensity of disturbance is highly variable and depends on a range of factors relating to the animal and situation; and • Masking or interfering with other biologically important sounds (including vocal communication, echolocation, signals and sounds produced by predators or prey). Receptors with the potential to be impacted by underwater noise include: • Marine mammals (cetaceans and dugongs); • Marine turtles; • Elasmobranchs; • Fish, fish eggs and larvae (including plankton); and • Benthic invertebrates. Noise modelling has also been conducted to inform the impact and risk assessment. A summary of the evaluation of impacts of seismic noise on sensitive receptors is provided in **Table 6-4**.
Impact assessment	
Receptor	**Consequence**
Threatened / Migratory Fauna	The humpback whale and pygmy blue whale migration pathways may overlap the operational area (depending on the time of year). The acoustic modelling report indicates that behavioural impacts could be expected within 7.5km of the seismic source. A possible humpback resting area may be present within the EMBA during the migration period but no other breeding or aggregating areas are recorded nearby to the MSSs area. Noise levels are not expected to occur at levels high enough to lead to behavioural response of individuals in the resting area. Tagging surveys have shown pygmy blue whales migrate northward within 100km of the Australian coastline until reaching North West Cape after which they travelled offshore (240 km) to Indonesia. Passive acoustic data documented pygmy blue whales migrating along the Western Australian shelf break (Woodside 2012). The National Conservation Values Atlas

	has identified the pygmy whale migration pathway on the continental shelf edge at depth of 500 to 1,000 m (McCauley & Jenner 2010). Impacts to blue and humpback whales associated with the MSSs are limited to a short term, behavioural response of individuals traversing the area. With the management controls in place, impacts to migrating whales are reduced as the survey will not be conducted during migration season (1 May to 31 December). Marine turtles nest on beaches of the Montebello and Barrow islands and internest in the shallow waters adjacent to these islands. Given the distance to nesting beaches and suitable internesting habitat, behavioural impacts are unlikely to occur. Short term behavioural responses are expected only to low numbers of transient individuals given the management controls in place. Behavioural impacts to mating and internesting green turtles could be expected within 4.14 km of the seismic source which overlaps waters where aggregating/inter-nesting turtles could occur during peak season (1 October – 28 February) off the west coast of Barrow Island. If the survey takes place during this period, additional control measures to protect internesting turtles will be implemented. Guidance from DoF (2013), proposes using soft starts for every event during seismic surveys and avoiding restricting movement of fish away from the source of seismic. Through the application of EPBC Policy Statement 2.1 Part A (soft start operating procedures), fish species are unlikely to be impacted at a population level, and there is no barrier to the fish moving away from the source. It is recognised that some species may be spawning in the area, and their behavioural response to seismic activity may differ at different times of year. It is therefore possible that impacts to individuals within the fish population may occur (including to commercial species) (See below). The EPBC regulations (Part 8) require helicopters to stay higher than 500 m above a cetacean within a 500m radius. The draft *Australian National Guidelines for Whale and Dolphin Watching* (DoEE, 2016) were also reviewed which outline the same distance. As turtle aerial surveys using a helicopter will be conducted outside of the peak blue and humpback whale migration season, it is unlikely that large numbers of cetaceans will be encountered and therefore the helicopter should be able to fly at the minimum safety height of 150m above the sea surface. However, if cetaceans are encountered, the helicopter would fly higher to meet EPBC regulations for cetaceans. It is not considered appropriate to fly at a height of 500 m during the turtle aerial survey as this would make it difficult to meet the objectives of the turtle aerial surveys. Noise interference is identified as a potential threat to a number of marine fauna species in relevant Recovery Plans and Conservation Advice, most of which recommend the use of the EPBC Policy Statement 2.1 which Quadrant adopts for the MSS. The marine turtle recovery plan states that soft starts should be implemented during MSS to reduce the potential for impacts on marine turtles, and implementation of EPBC Policy Statement 2.1 is also recommended in the whale conservation management plans and advice. The conservative precaution zones will also be adopted in line with EPBC Policy Statement 2.1 (i.e. a 2km low power zone). With controls in place, the Activity will be conducted in a manner that is considered acceptable.
Physical Environment/ Habitat	Likely habitats to be impacted from noise in the area are benthic habitats which have non-coral invertebrates (such as sea fans and gorgonians) and potentially small patches of corals which are not significantly impacted by noise emissions.
Protected Areas	Marine fauna and habitats found within the operational area potentially impacted from noise emissions are discussed above. The seismic source will not be discharged within any protected area. A strategy of the Management Plan for the Montebello/ Barrow Islands Marine Conservation Reserves strives to 'ensure relevant industry activities are undertaken at times and places that do not conflict with humpback whale migration through the reserves'. Since the activity does not occur within the park, and that control measures ensure that disruption to humpback whale migration outside the park is minimised, the Activity will be conducted in a manner consistent with this plan.

Socio-economic Receptors	Noise levels are not expected to impact on socio-economic receptors due to their low activity level within the vicinity of the operational area. Impacts to fish may result in indirect impacts to fisheries in the area. However, given the levels of fish in the commercial fisheries are at sustainable levels, the short duration of the survey, the available area for commercial fishermen to catch, the area over which commercial species spawn and the lack of evidence of reduced catch following seismic surveys (e.g. Thompson et al., 2010) impacts to fisheries are considered acceptable.
Overall Consequence Ranking	B - Minor

Management Control	**Effectiveness of Control**
Maintaining up to date environment description to ensure relevant scientific studies, conservation management plans and any other relevant updates are considered in impacts and risk assessments.	Ensures any new environmental information is identified and potential impacts and risks are appropriately assessed or re-assessed should this information arise after EP acceptance, and mitigated.
Marine fauna observations undertaken to minimise the disturbance to fauna caused by the Activity	Reduces risk of physical and behavioural impacts to cetaceans, whale sharks, dugongs and turtles from vessels, and close proximity to seismic source
EPBC Regulations (Part 8) for interacting with cetaceans	Reduces risk of physical and behavioural impacts to cetaceans from vessels, helicopters and seismic source
Temporal Management for Peak Whale Migration	
Implementation of EPBC Policy Statement 2.1 (Part A): • pre start-up visual observation • Soft start procedures • Start-up delay procedure • Operations procedure • Stop work procedure • Night time and low visibility procedures	
Implementation of EPBC Policy Statement 2.1 (partial part B): • Use of 2 MMOs on board the seismic vessel (Part B.1) • Adaptive management for increased likelihood of encountering whales (Part B.6)	
Two MMOs have at least 6 months accumulated experience in a similar role	Sufficiently experienced and qualified personnel act as MMO ensuring correct implementation of management measures in place to protect marine fauna occurs
Seismic survey vessel will not enter State Waters and no seismic source will be discharged in State Waters	Ensures regulatory compliance with this EP and commitments made to State regulators in consultation (e.g. DMP)
If concurrent seismic surveys occur, distance between seismic vessels is greater than 40km	Distance between seismic vessels is greater than 40km to allow a “corridor” for marine fauna
Adaptive management of green turtles - pre survey aerial observation during 1 October-28 February	Reduces potential impacts to inter-nesting green turtles during peak nesting season and therefore limits potential impacts to individuals only and affords protection to aggregations in the unlikely event they are present.

Reduce duration of the MSSs or schedule to avoid species nesting/ migration periods.	Reducing duration of survey would reduce potential impacts to the marine environment. Avoidance of nesting/ migration periods would eliminate any potential impact to marine fauna during these times.
Quadrant Energy commits to not undertaking the seismic survey in the period of 1 May through to 31 December to avoid peak blue and humpback whale migration periods.	

Table 6-4: Evaluation of impacts of seismic noise on sensitive receptors during the Activity

Receptor	Summary of impacts	Vulnerable / Endangered species	Evaluation of impact
Cetaceans	Baleen whales use low-frequency signals for communication. Studies suggest their hearing apparatus is also best adapted for low frequency sound. The defined threshold adopted by the EPBC Policy Statement 2.1 (DEWHA, 2008) is SEL 160 for 95% of seismic shots at 1 km range, which could be expected within 4.48km of the seismic source when utilising the R_{max} value, and 3.36km when utilising $R_{95\%}$. Other recent studies (NMFS, 2012) propose a threshold SPL 160 for behavioural impacts which could be expected within 7.53 km (R_{max}) of the seismic source. It is assumed that avoidance would be expected at lower noise levels beyond these distances. In support of the above distances derived from modelling (Jasco, 2016) avoidance of seismic operations by humpback whales in key habitat (such as breeding, resting or feeding areas) is reported to occur between 7 and 12 km of a survey vessel, whereas migrating individuals have been seen to adjust course and speed when received sound level is in the range of SPL 157 to 164. Toothed cetaceans produce a wide range of whistles, clicks, pulsed sounds and echolocation clicks in a higher frequency range compared to baleen whales. As such, disruption to communication is not considered as relevant to toothed whales. Potential for TTS in toothed cetaceans is reportedly SPL 195, this level could be reached within 400 m of the seismic source. Local displacement of small toothed cetaceans, including killer whales, around seismic survey activity suggests low level behavioural response reducing the potential for TTS to occur.	Blue whale Humpback whale Southern right whale	The blue whale and humpback whale migration pathways may overlap the operational area, although few blue whales are expected to be encountered given the preferred distances from shore (100km) of this species during migration. Modelling conducted for this survey indicates that behavioural effects in cetaceans could be expected within ~7.5 km of the airgun array (when the threshold is >SPL 160). It is considered that avoidance behaviour represents only a minor impact to the individual or species unless the avoidance results in displacement of whales from nursery, resting or feeding areas. Although female humpback whales and their calves are known to rest in areas around the Montebello Islands during southern migration (**Figure 4-3**) 17 km from the operational area, the resting sites are located on the eastern side of the Montebello Island complex. Therefore, noise levels are not expected to be elevated due to islands lying between the operational area and the resting area, with the resting area occurring in the sound shadow of these islands. As such, individuals found in this resting area are unlikely to be displaced or disturbed by the activity. Through the implementation of no surveys during peak whale migration (1 May to 31 December) and through implementation of EPBC Policy Statement 2.1 Part A and partial part B, impacts to migrating or individual whales and other cetaceans would result in no significant impact to the individual or population level. It is possible that killer whales, Bryde's whales, (and others listed in **Table 4-2**) may traverse the operational area. However, a very low number of encounters is expected and any disturbance would be temporary and localised as there are no identified key areas for these species in the operational area.

Dugong	Although there has been no documented evidence of MSSs being detrimental to populations of dugongs, there have also been no detailed studies. Impacts could include interference with the animal's natural acoustic communication signals, damage to hearing systems and behavioural changes including disturbance reactions. The audible frequency range of sirenians ranges from 250 Hz – 90 kHz and therefore overlaps with the frequency of seismic survey activity. The PTS threshold values for sirenians were calculated to be weighted SEL 192 and SPL 218. The TTS threshold was calculated to be weighted SEL 172 and peak SPL 218, and a behavioural threshold of SEL 172 (Finneran and Jenkins, 2012). These levels could be reached within 155m (PTS) and 1.64km (behavioural response) as derived from the modelling (Jasco, 2016).	Dugong	No BIAs for dugongs are present within the operational area or EMBA. The closest known aggregations of dugong occur within the Shark Bay World Heritage Area, >400 km from the operational area. While dugongs have been known to travel long distances sporadically, they are not expected to aggregate in large numbers in the offshore waters. They may be present in the known feeding areas around Barrow, Montebello and Lowendal Islands, and consequently individuals may transit though the operational area. Given that only low numbers of individuals are expected to be encountered, disturbance to dugong from the activity is unlikely to lead to impacts at the population level and therefore the risk is considered low. Controls in place to observe for dugongs during marine fauna observations on the vessel will reduce potential impacts to dugong.
Elasmobranchs	Sharks are known to be highly sensitive to low frequency sounds between 40-800 Hz sensed solely through the particle-motion component of an acoustic field. Studies have observed that sharks can withdraw immediately if the sound is increased by 20 dB re 1µPa. Trauma from acoustic sources to fish species appears dependent of the presence of a swim bladder. Elasmobranchs (sharks and rays), many pelagic fish (e.g. mackerel), flatfishes and lizardfish do not have swimbladders and are therefore less likely to experience trauma. It must also be mentioned that fish attacks on seismic streamers from large pelagic species is not uncommon as evidenced by damaged hydrophone streamers indicating limited sensitivity to acoustic noise. Studies by Popper et al (2014) indicate that fish with no swim bladder may experience physiological impacts at SPL>213. The acoustic modelling indicates that this could occur within 115m of the seismic source, however it is likely that these impacts are recoverable given the number of fish attacks on seismic streamers that have been sighted.	Grey Nurse Shark Great white shark Dwarf Sawfish Green Sawfish Whale Shark Narrowsnout Sawfish	The operational area and EMBA overlap with a BIA for migrating whale sharks and therefore individuals may transit the area. No aggregation areas are known with the EMBA, with the nearest being Ningaloo Reef >200 km from the operational area. The great white shark are occasional visitors to the Barrow Island area. Grey nurse sharks are regionally widespread and are believed to be in the waters surrounding the Montebello/Barrow Islands. There is no recognised critical habitat within the vicinity of the operational area for the listed protected species and therefore they are not expected in significant numbers. Given the lack of impacts to elasmobranchs as a result of seismic discharges significant impacts at the population level are not expected.

Marine turtles	Electro-physical studies have indicated that the best hearing range for marine reptiles is between 100–700 Hz. The auditory sensitivity of marine turtles is reported to be centred in the 400 to 1,000 Hz range, with a rapid drop-off in noise perception on either side of this range, therefore seismic survey activity could be audible to turtles. Hearing sensitivity of caged loggerhead turtles altered after exposure to several hundred pulses within 30-65 m of a single seismic source component. Approximately 50% of the exposed individuals indicated altered hearing sensitivity therefore, it is possible that marine turtles could be exposed to noise levels sufficient to temporarily alter hearing sensitivity (should a seismic source start suddenly with turtles nearby (30-65 m). In circumstances where seismic sources are already operating, individuals would be expected to implement avoidance measures before entering ranges at which physical damage might take place. Popper et al (2014) define a threshold for turtles at which potential mortality could occur as >SPL 207. Behavioural responses of caged turtles in response to different noise levels demonstrates that behavioural responses are apparent at >SPL 166. 100% of sea turtles showed short-term reaction to low-frequency underwater noise emitted by anthropogenic sources. Responses included agitated behaviour, abrupt body movements, startle responses and prolonged activity at the bottom of the tank. The NSF (2011) SPL criteria of SPL 166 were utilised when assessing the potential impacts in the acoustic modelling (Jasco, 2016) to determine the potential for behavioural impact to turtles. Given the importance of adjacent islands providing beaches and habitat for nesting turtles at certain times of the year, the behavioural impact threshold was considered the more conservative to use. The acoustic modelling report indicates that the potential for behavioural impact to marine turtles is within 4.14 km (R_{max}) or 3.38km ($R_{95\%}$) of the seismic source.	Short nosed sea snake Loggerhead turtle Green turtle Leatherback turtle Hawksbill turtle Flatback turtle	Green, flatback, hawksbill, loggerhead and leatherback turtles are found in the EMBA, with the operational area overlapping inter-nesting BIAs for all species except the leatherback turtle. The extent of the BIAs are shown in **Figure 4-4,** but generally encompass: • 80 km radial buffer around Barrow Island, Montebello Islands and mainland coastline for flatback turtles; • 20 km buffer around Barrow Island, Lowendal Islands, Montebello Islands and Thevenard Island for hawksbill turtles; • 20 km buffer around Barrow Island, Lowendal Islands and Montebello Islands for green turtles; and • 20 km buffer around the Montebello and Lowendal islands for loggerhead turtles. There is a paucity of information regarding the movements of inter-nesting turtles and the BIAs are defined based on limited information gained from tagging studies. Results of these studies show that distances of up to 80 km (flatback) and 20 km (green, loggerhead and hawksbill) have been travelled by inter-nesting females, however, these individuals remained in shallow water depths typical of inter-nesting habitat, as discussed below. When assessing the potential impacts of the activity on inter-nesting females, it is more useful to consider the proximity of the survey area to suitable inter-nesting habitat, rather than buffers which are based on distance alone and do not take into account important spatial variability in habitat suitability. During inter-nesting, female green turtles are typically found close to shore in water depths of less than 10 m (Pendoley, 2005, Hays *et al*. 1999, Craig *et al*. 2004, Troeng *et al*. 2005, Fuller *et al*. 2008). Loggerhead turtles internest in water depths less than 15 m (Pendoley, 2005, Hays *et al*. 1999, Craig *et al*. 2004, Troeng *et al*. 2005, Fuller *et al*. 2008, Tucker *et al*. 1995). Less is known about flatback and hawksbill inter-nesting habitat. However, tracked flatback turtles from nesting sites on Barrow Island revealed that inter-nesting movements were typically in shallow, nearshore waters (Whittock, Pendoley and Hamann, 2014). Aerial surveys undertaken in 2010 (Jenner and Jenner, 2010) indicated that turtles (unknown species) were predominantly located inside the 30m bathymetry contour. Green turtles generally remain within the inshore areas during inter-nesting periods (Jenner and Jenner, 2010). Studies indicate that inter-nesting grounds are close to nesting beaches in 10-18m of water, tracking data for Barrow Island suggest a similar trend (Stoneburner 1982, Tucker et al., 1995) and within 10 km of the nesting beaches. In addition, the large body of data that are available for public review on www.seaturtle.org suggests that flatback turtles nesting on offshore islands on the NW Shelf primarily internest in nearshore shallow waters along the mainland coast of the Pilbara and none have been observed inter-

			nesting seaward of the coastal island chains. Unpublished information on hawksbill turtles nesting on Varanus and Rosemary Island suggests that females remain within several kilometres of their nesting beaches on Varanus Island and within 1 km of nesting beaches on Rosemary Island (Pendoley, 2005), in shallow waters. In Queensland, tagged hawksbill turtles were recorded diving to a mean depth of 5.7 m during inter-nesting (range of 0.9 – 20.6 m of over 65,000 recorded dives) (Bell and Parmenter, 2008). This published and unpublished data suggest that hawksbill and flatback turtles show preference for shallow water (<20 m water depth, though shallower depths appear more common) inter-nesting habitats similar to other marine turtle species. During inter-nesting, marine turtle behaviour is understood to be inactive (Hays *et al.* 1999; Fossette *et al*. 2012), presumably to conserve energy for successive reproductive events (Hays *et al.* 1999). Given this inactive state, individuals are less likely to be displaced or display avoidance measures, reducing the potential for behavioural impacts. Large numbers of inter-nesting turtles are not expected to be encountered by the vessel given the control measures in place in the event the survey takes place during peak green turtle nesting season (aerial surveys). At the closest point (taking into account operational water depths), the seismic source could be discharged a minimum of 5 km from suitable inter-nesting habitat (assuming a conservative 20 m water depth). Given the importance of Barrow Island for green turtles, it is assumed this species will be the most likely to be encountered in peak nesting/aggregating season. Up to 4.14 km ($_{Rmax}$) from the seismic source the acoustic modelling indicates that airgun sounds may exceed the SPL166 threshold for behavioural effects on turtles. Adaptive management controls outlined in **Section 6.2.3.1**, further reduce the (already low) likelihood of inter-nesting turtles being impacted by the seismic vessel by preventing the risk of physical damage occurring to inter-nesting turtles (as described above; Moein *et al.* 1994). Furthermore, the vessel will be constantly moving (at a speed of 8/9 km/hr, and so the vessel would be operating at these distances temporarily (a matter of hours only). When taking into account the length of the turtle inter-nesting season (October-February, **Section 4.6**), the amount of time inter-nesting turtles could be exposed to >SPL 166, represents a negligible proportion of the overall nesting season. Given the maximum expected SPLs potentially exposed to inter-nesting turtles, and the short duration of this exposure, the activity is not expected to negatively impact green turtle breeding behaviour. Quadrant recognises the importance of the Barrow Island Marine Park and Marine Management Area (MMA) for green turtles and have proposed the use of pre-survey aerial observations in the event that the activity takes place during peak green turtle nesting season when inter-nesting is expected and aggregations are possible (October-February).

<table>
<tr><td></td><td></td><td></td><td>Hatchlings, once they have traversed the beach and entered the sea, rapidly become widely dispersed in open ocean by currents. As such, high densities of hatchlings are unlikely to occur within the range of the operating survey vessel which could lead to physical damage. Therefore, the activity is not expected to negatively impact overall population persistence and viability of green, loggerhead, flatback or hawksbill turtles.</td></tr>
<tr><td>Fish</td><td>The following anatomical features are important in determining the level of acoustic noise impacts on fish:
Fish with a swim-bladder will be more at risk than those without;
Of fish with a swim-bladder, large fish with a swim-bladder of resonate frequency in the order of several hundred hertz may be more sensitive to seismic sounds; and
Fish with a mechanical coupling of swim-bladder to ear will be most susceptible to ear trauma from the transmission of sound.
The potential effects of MSSs were assessed and it was concluded that negligible to potentially adverse effects on fish may occur from MSSs (MMS, 2004). These effects were not, however, considered to be biologically significant due to the following factors:
MSS noise may disturb fish and may produce temporary or permanent hearing impairment in some individuals, but it is unlikely to cause death or life-threatening injury;
MSSs are not expected to cause long term or permanent displacement of any listed species from critical/preferred habitat; and
MSSs are not expected to result in destruction or adverse modification of critical or essential fish habitat.
Guidelines for use of seismic sources for different categories of fish are as follows:<table><tr><th>Fish type</th><th>Mortality /potential fatal injury</th><th>Recoverable injury</th></tr><tr><td>No swim bladder</td><td>>SEL 219 or
>SPL 213</td><td>>SEL 216 or
>SPL213</td></tr></table></td><td>NA</td><td>Impacts to mobile pelagic species are unlikely to be significant given the low level and temporary behavioural responses observed and the ability of individuals to move away reduces risk of physical damage. Impacts to site attached species require further assessment.
No known reefs or shoals are present within the operational area and therefore site attached fish species present are limited to demersal finfish such as snappers and emperors which may be present in the area, although exact locations are unknown.
Some commercial fish species are known to spawn within the north coast bioregion and the timing of these spawning/aggregating species varies between species. It is unknown which areas each of the species aggregates or spawns in as this can occur across the north-coast bioregion as provided by DoF in consultation (Section 5). It is possible that the noise levels will exceed the thresholds for TTS of some of these commercial fish species given the SPL of the array will be SPL262 (at 1 m). However, as these fish species are not EPBC listed as threatened or migratory and are available to fish commercially, the populations are considered to be at sustainable levels (according to most recent AFMA reports). Additionally, Popper et al (2014) have found no evidence to date showing a direct mortality of fish as a result of seismic survey activity.
Studies of catch statistics post seismic survey do not clearly indicate reduced landings due to seismic survey activities (Hassel et al. 2004) as studies have indicated that catch levels returned to pre-survey levels after seismic survey activity had occurred.
Given the temporary nature of the proposed survey, it is not expected that the survey will have impacts at a population level. Although individuals may be impacted, this is not expected to have a flow on effect to the commercial fisheries.
While site-attached species may demonstrate behavioural responses due to an approaching or passing seismic source, mortality or injury (fatal or recoverable) to individuals could be expected to site attached species and other demersal finfish but any impacts at the population level are considered negligible.</td></tr>
</table>

Swim bladder not involved in hearing	SEL 210 or >SPL207	SEL 203 or >SPL207
Swim bladder involved in hearing	SEL 207 or >SPL 207	SEL 203 or >SPL207

It is noted in Popper *et al* (2014) that occurrences of mortality from exposure to seismic sources have not been recorded but it is evident that animals do adjust their behaviour. The distances at which fish could experience mortality or recoverable injury does not differ. Acoustic modelling indicates that the maximum distance from the source that impacts to fish could be expected is 155m based on these thresholds (Popper et al, 2014). Distances less than this depend on the direction from the array and the presence of a swim bladder as summarised above, therefore a worst case distance is assumed.

The behavioural responses outlined above allow fish to move away from the source before physical damage can occur. Studies have shown that some fish species that are caged, and therefore unable to swim away from the noise source, can suffer physiological damage to eyes and hearing. For pelagic fish, this is unlikely to occur, given the ability of fish to move away from the sound source. Site attached fish however, such as demersal or reefal fish species are limited in this ability. Demersal fish species may be present in the potential area of impact, but no coral reefs or shoals are nearby, therefore impacts to reefal fish are not expected.

Invertebrates	Few marine invertebrates have sensory organs that can perceive sound pressure, but many have organs or elaborate arrays of tactile 'hairs', called mechanoreceptors, that are sensitive to hydro-acoustic disturbances. The mechano-sensory system of many benthic crustaceans will perceive the 'sound' of compressed air pulses, but for most species such stimulation would only occur within the near-field or closer, perhaps within distances of several metres from the source. Studies indicate that impacts to crustacean and mollusc physiology, behaviour and catch rates are likely to be negligible if at all and mass mortality is not expected (Day *et al*, 2016), although sub-lethal effects were observed such as reflexes in lobster (tail extension and righting, and damage to the sensory hairs of the statocyst) and reduction in classic behaviour in scallops as well as reflexes such as slowed righting times.	NA	Given the lack of impact (behavioural or physical) from MSSs reported, the likelihood of negative effects at the population level for marine invertebrates is considered unlikely as mass mortality is not expected. Within the area of potential impact from the seismic survey there is the Onslow prawn managed fishery suggesting that prawns are present in the area in large enough numbers to commercially fish. Although individuals may be impacted, this is not expected to have a flow on effect to the commercial fisheries, particularly as there has been no evidence of impacts at an embryo stage (e.g. in lobster) Day *et al*, 2016. There are no bivalve fisheries within the operational area of the survey.

Coral Plankton	For hard corals, it is anticipated that some protection against sound pressure waves generated by seismic survey activity is provided by the calcified skeleton surrounding the polyps. As the polyps do not contain voids or internal airspaces, it is thought that any vibration caused by pressure pulses from seismic emissions will not be significant enough to remove or damage polyps from the protection of the calcium carbonate skeleton. Soft corals, because of their flexibility which allows them to minimise stress by reconfiguring in response to fluid forces, are not expected to be injured by sound pulses produced by seismic survey activity as close as 1m away from the source. There is a current paucity of knowledge on the effects of seismic survey activity on coral gametes or planular larvae in the plankton. However, impacts on other planktonic organisms have been shown to be insignificant and restricted to within 155 m of the seismic energy source (see below). Except for fish eggs, larvae and other minute planktonic organisms within a few metres of an airgun, no planktonic organisms are likely to be affected significantly by airgun array discharges. Criteria for mortality or potential injury to fish eggs and larvae is SPL 207 (Popper *et al,* 2014). The acoustic modelling report indicates that this could be experienced within 155m of the seismic source. Distances less than this depend on the direction from the array, therefore a worst case distance is assumed.	NA	While coral reefs may occur within the shallower waters of the operational area, the MSSs are not expected to cause any physiological damage to coral form and function. Mass coral spawning in the region occurs in March and April each year, and therefore may coincide with the activity. However, the closest significant reef is Ningaloo reef >200 km from the operational area. Other smaller reefs occur around the Montebello Islands but given the low level impact expected, significant impacts to the reef function and health are not expected. Some fish species may be present and spawning within the operational area. Due to ocean currents and oceanographic processes, any fish eggs or larvae present will be greatly dispersed across the open ocean. Therefore, any negative effect on fish eggs or larvae will be insignificant on a population scale when considering the number of eggs or larvae in the wider marine environment. Furthermore, the spatial and temporal presence of the survey vessel occupies only a small proportion of the open ocean habitat available and the length of the spawning periods of these species. Given the natural low rates of egg/larval survival to adulthood for the majority of fish species, any impacts of the seismic survey are considered insignificant at the population level.

Protected areas	Impacts to individual sensitivities are discussed above	Included above	The survey area abuts the Barrow Island Marine Park which was established in part to protect turtles due to the nesting habitats on the adjacent beaches of Barrow Island. Other values include seagrass, macroalgae and Biggada reef. The values and sensitivities found within these areas are described in **Section 4**, and potential impacts of noise on these sensitivities are discussed above. The seismic vessel and source will be approximately 500 m from the boundary of the Marine Park at its closest point. At this distance, received levels at the boundary will likely be in the range of SPL 160-170 and will quickly decrease. Given that turtles have been shown to have a behavioural response at SPL 166, some behavioural disturbance of turtles within the Marine Park is possible as described previously. As the survey has been designed to run parallel to the marine park boundary in a south-north direction and will be close to shallow waters for a few hours each time only, the vessel will approach the marine park whilst conducting the survey at a consistent speed. Given the survey design, speed of the vessel and distance from the source at which behavioural disturbance could occur, turtles in the marine park area are not expected to be significantly impacted at an individual or population level. Whales could transit through the Marine Park. Behavioural disturbance could occur at levels of SPL 160 and approximately 7.5km from the source and therefore could result in behavioural disturbance to whales if within the marine park. Given only low numbers of individuals are expected (as no survey activity during peak migration) and the short duration that the vessel will be in the vicinity and the approach of the survey vessel, it is likely that whales will swim away from the source resulting in a temporary and minor behavioural impact. No breeding, feeding or resting areas are present within the marine park and therefore no significant impacts at a population level are expected. Fish species within the marine park could display a behavioural response, however this will likely be limited to demersal and pelagic fish and not those fish associated with Biggada Reef situated in shallower water depths as the reef is largely intertidal and therefore close to shore. No impacts to this reef are expected from the survey. Seagrass and macroalgae are not impacted by noise levels, although their presence indicates that dugongs may be feeding in shallow waters. Given that only low numbers of individuals are expected to be encountered, disturbance to dugong from the activity is unlikely to lead to impacts at the population level and therefore the risk is considered low.

6.2.3.1 Green turtle adaptive management

If the MSS is undertaken between 1 October and 28 February, aerial surveys will be undertaken to spot aggregations of green turtles. If aggregations are spotted within the defined Turtle Survey Area (red polygon on **Figure 6-2**), the survey vessel will not acquire data within the Seismic Survey Turtle Protection Zone (yellow polygon **Figure 6-2**).

Quadrant Energy has spatially defined the Turtle Survey Area (red polygon), and within the seismic survey area itself the Seismic Survey Turtle Protection Zone (yellow polygon) as described below, and depicted in **Figure 6-2**.

Area/ Zone Definition	Description
Zone of potential impact from seismic source	The zone of potential impact from the seismic source based on modelling is 3.38 km from the seismic source. As a worst case for potential impacts to internesting turtles, a zone of 3.38km to the east of the easternmost survey line (shallowest water depth) is represented by the green area in **Figure 6-2.**
Turtle Buffer Area	Assuming turtle aggregations are conservatively in water depths of up to 30m, a 3.38km "buffer" beyond this (i.e. to the west, towards the seismic survey area) is depicted by the bold orange line in **Figure 6-2** to demonstrate the area within which the source must be before behavioural effects to aggregating green turtles may occur.
Turtle Survey Area	The *Turtle Survey Area* (red polygon) is defined by the overlap between the *Zone of potential impact from seismic source* and water depths of 30m or less. The easternmost sail line defines the worst case and, therefore, the maximum area that the seismic source may have behavioural impacts on aggregating green turtles.
Seismic Survey Turtle Protection Zone	The *Seismic Survey Turtle Protection Zone* (yellow polygon) is defined by that area of the seismic survey that lies within the 3.38km buffer from the 30m bathymetric contour, depicted as the yellow polygon in **Figure 6-2**.

Given the survey could impact on inter-nesting turtles if present within 3.38km of the seismic source, and the requirement to acquire data over the entirety of permit area WA-510-P, Quadrant will adopt a precautionary approach regarding potential presence of internesting green turtles. If the survey takes place in peak nesting season for green turtles (1 October through to 28 February), an aerial survey will be undertaken of the Turtle Survey Area, an area of up to 33km^2, shown in **Figure 6-2**. As the vessel conducts the sail lines further away from the 30m bathymetry contour, the Turtle Survey Area subsequently reduces. During 1 October and 28 February, the sections of sail lines within the Seismic Survey Turtle Protection Zone shown in **Figure 6-2** will be conducted in daylight hours only, following confirmation of no aggregating turtles, to ensure individual turtles can also be spotted in the 500m zone.

Given the proximity of the survey to Barrow Island where green turtles are known to nest in significant numbers, Quadrant could plan the survey to avoid the peak green turtle nesting season when turtles are aggregating and inter-nesting (1 October through to 28 February). However, it is not possible to commit to this given vessel availability, weather, operational and regulatory approvals and it is therefore possible that the activity will take place in this period. In the event that the survey takes place during peak season, the sail lines will be planned to minimise interference. For example, if the survey commences towards the end of the peak turtle nesting season, the sail lines furthest from Barrow Island will commence first so that the vessel moves closer to the island as the nesting season finishes, therefore minimising the time spent in close proximity to potentially inter-nesting turtles.

Turtle habitat and behaviour

Studies indicate that inter-nesting turtles tend to stay in water depths of 20m or less, however aerial surveys show they may be present in aggregations in water depths of 30m or less (Prince *et al*., 2001). Discussions held with Pendoley Environmental (pers comms, October 2016) indicate that inter-nesting green turtles are likely to occur over hard substrate patches in shallow waters (<20m) around Barrow Island rather than soft sandy sediments. From the bathymetry data in the operational area, it is unlikely that large areas of hard

substrate exist in water depths >30m. The Marine Turtle Recovery Plan (Commonwealth of Australia, 2003) identifies that marine turtles may be vulnerable when forming aggregations and also confirms aggregating turtles are usually found in depths of approximately 20m. To be conservative, Quadrant has assumed that aggregations could occur in water depths up to 30 m deep. In >30 m water depth, occurrences of individual turtles are possible during internesting season and therefore the vessel may encounter individual turtles in the water depths it is surveying (>30m deep). Controls in place for individual turtles include turtle guards on streamers, visual observations in the 500m zone for turtles prior to soft start commencement, and shut downs for turtles within 500 m of the vessel. However, aggregating turtles could still be impacted by the seismic source due to the distance the sound travels.

There is no definition for delineating a turtle aggregation, as they can occur in aggregations of 10-100's of turtles. Aggregations could be considered a key stage of the lifecycle as mating is occurring during this period and therefore impacts to aggregations for prolonged periods could result in impacts to turtle mating behaviour. Aerial sea turtle surveys undertaken by Prince *et al* (2001) indicated turtles were sighted in groups of 10 or more. To be conservative, Quadrant have defined an aggregation as being more than 10 turtles over an area of 50m x 50m. The 50m x 50m area was selected as this is an area that is possible to be determined (in air) by a trained aerial observer, particularly when there is no land mass reference to assist.

Acoustic modelling

Based on acoustic modelling results the distance from the source that airgun sounds exceed the SPL 166 threshold for behavioural effects on marine turtles is 3.38km ($R_{95\%}$) or 4.14km (R_{max}). In determining the mitigation measures to implement, Quadrant are utilising the $R_{95\%}$ as an appropriate measure as this encompasses 95% of the emitted sound level, and better represents the practical zone of potential impact. This is also consistent with the approach utilised in determining precautionary zones within EPBC Policy Statement 2.1.

The 3.38 km buffer (zone of potential impact from the seismic source as determined from the modelling $R_{95\%}$) to the east of the easternmost survey line (closest to Barrow Island) is represented by the green area in **Figure 6-2.** Assuming turtle aggregations can conservatively occur in water depths of up to 30m, the region defined by the overlap of the green area into water depths of less than 30m defines the maximum area that the seismic source may have behavioural impacts on aggregating green turtles. This area is shown in red and named the *Turtle Survey Area* and is specific to the easternmost survey line in **Figure 6-2**. In applying this same process to each survey line within the *Seismic Survey Turtle Protection Zone*, the area of potential behavioural impact to aggregating green turtles can be determined. As the survey lines move further west (away from Barrow Island), the area of potential behavioural impact to aggregating green turtles reduces and subsequently so does the *Turtle Survey Area*. The turtle buffer (3.38km buffer line beyond the 30m bathymetric contour) is depicted by the bold orange line and the *Seismic Survey Turtle Protection Zone* is depicted in red on **Figure 6-2***.*

The time taken to survey the portions of the survey lines within the *Seismic Survey Turtle Protection Zone* ranges from 25 minutes, for the least affected line, through to 160 minutes for the most affected (easternmost) survey line. The total survey time spent within the *Seismic Survey Turtle Protection Zone* equates to less than half a day of the expected 42 day total survey duration. Due to the duration of the sail lines and line turns, the vessel will take approximately 34 hours to do a full cycle and return to the start of the *Seismic Survey Turtle protection zone*. Approximately 6 sail lines will occur within the *Seismic Survey Turtle protection zone*.

If the less representative R_{max} value is utilised, the potential mitigation impacts of conducting aerial surveys becomes grossly disproportionate to the potential benefit gained. The number of sail lines that would intersect the *Seismic Survey Turtle Protection Zone* would increase and the *Turtle Survey Area* also increases resulting in increased aerial survey duration. The number of helicopter flights would increase from 6 to 9.

Although there is a marginal difference in the number of flights, it is assumed that this is the minimum number of flights required to be conducted during the MSS. If aggregations are spotted and the survey vessel

cannot acquire data in the *Seismic Survey Turtle Protection Zone*, the vessel may return to the same sail line at a later date to acquire data, therefore requiring an additional survey line.

Given the conservatism built into the modelling, the short duration of time that the survey will be conducted in the *Seismic Survey Turtle Protection Zone* and the requirements to acquire data in the *Seismic Survey Turtle Protection Zone*, the additional buffer if R_{max} is used is considered to be operationally constraining, introducing safety risks beyond that which is acceptable to the business, and additional cost that make the survey non-viable. Through implementing the widely accepted R_{95} distance as a buffer, Quadrant considers that potential impact beyond this area would be to individuals. In addition, these buffers consider behavioural impacts, therefore potential injury impacts would be within much shorter distances.

Aerial Surveys

An aerial survey will be conducted over the *Turtle Survey Area* (red polygon) prior to the survey vessel arriving at the southern point of the *Seismic Survey Turtle Protection Zone* to observe for turtle aggregations. The aerial survey will be undertaken in daylight hours to ensure aggregations of turtles can be identified. A trained aerial observer will undertake observations prior to the seismic vessel arriving at the Southern point of the *Seismic Survey Turtle Protection Zone*. The vessel will be travelling in a South to North direction each time.

The vessel will not fire the source in the *Seismic Survey Turtle Protection Zone* unless an aerial survey has been conducted. The aircraft will fly over the *Turtle Survey Area* (estimated to be approximately 1 hour) at a height no lower than 150 metres above sea level (to meet safety regulations) to ensure that adequate time is spent observing for turtles and potential aggregations can be confirmed. Given the maximum area that will be surveyed is approximately 33km^2, this is considered an appropriate length of time.

Maps will be provided to the helicopter with co-ordinates of a rectangle encompassing the *Turtle Survey Area* of interest. During the aerial survey, marine fauna sightings will be recorded. Following completion of the aerial survey, this will be communicated to the survey vessel directly from the helicopter or via Varanus Island.

Window of aerial survey

The vessel will sail from south to north along the survey lines adjacent to Barrow Island. Prior to the survey vessel entering the *Seismic Survey Turtle Protection Zone*, the aerial survey must have been completed within 4 hours of vessel arrival at the *Seismic Survey Turtle Protection Zone*. Aggregating turtles have been observed to stay within the same area for prolonged periods, therefore this allows appropriate time for aggregations to be identified and avoided.

If aggregating turtles are observed

If aggregating turtles (>10 turtles in an area of 50m x 50m) are observed, the seismic source cannot be fired within the *Seismic Survey Turtle Protection Zone* shown in **Figure 6-2**. The seismic source will be switched off prior to entering the *Seismic Survey Turtle Protection Zone* and the vessel will sail through to the end of the sail line prior to commencing soft starts and continuing the survey (vessel sails from south to north). It will then be approximately 34 hours until the vessel returns to the southernmost point of the *Seismic Survey Turtle Protection Zone* again.

Aerial observation surveys will be required each time prior to the vessel reaching the southern point of sail lines within the *Seismic Survey Turtle Protection Zone*. Therefore multiple aerial surveys may be conducted during the MSS when the survey vessel is within the *Seismic Survey Turtle Protection Zone* during the period 1 October through to 28 February. No seismic source can be fired in the *Seismic Survey Turtle Protection Zone* if aggregating turtles have been observed in the aerial survey prior to the vessel reaching the *Seismic Survey Turtle Protection Zone*, including soft starts and ramp up. It is unknown how long turtle aggregations last for, however given the duration of the inter-nesting season (months), it is assumed that aggregations may last for hours allowing appropriate time for aggregations to be identified and avoided.

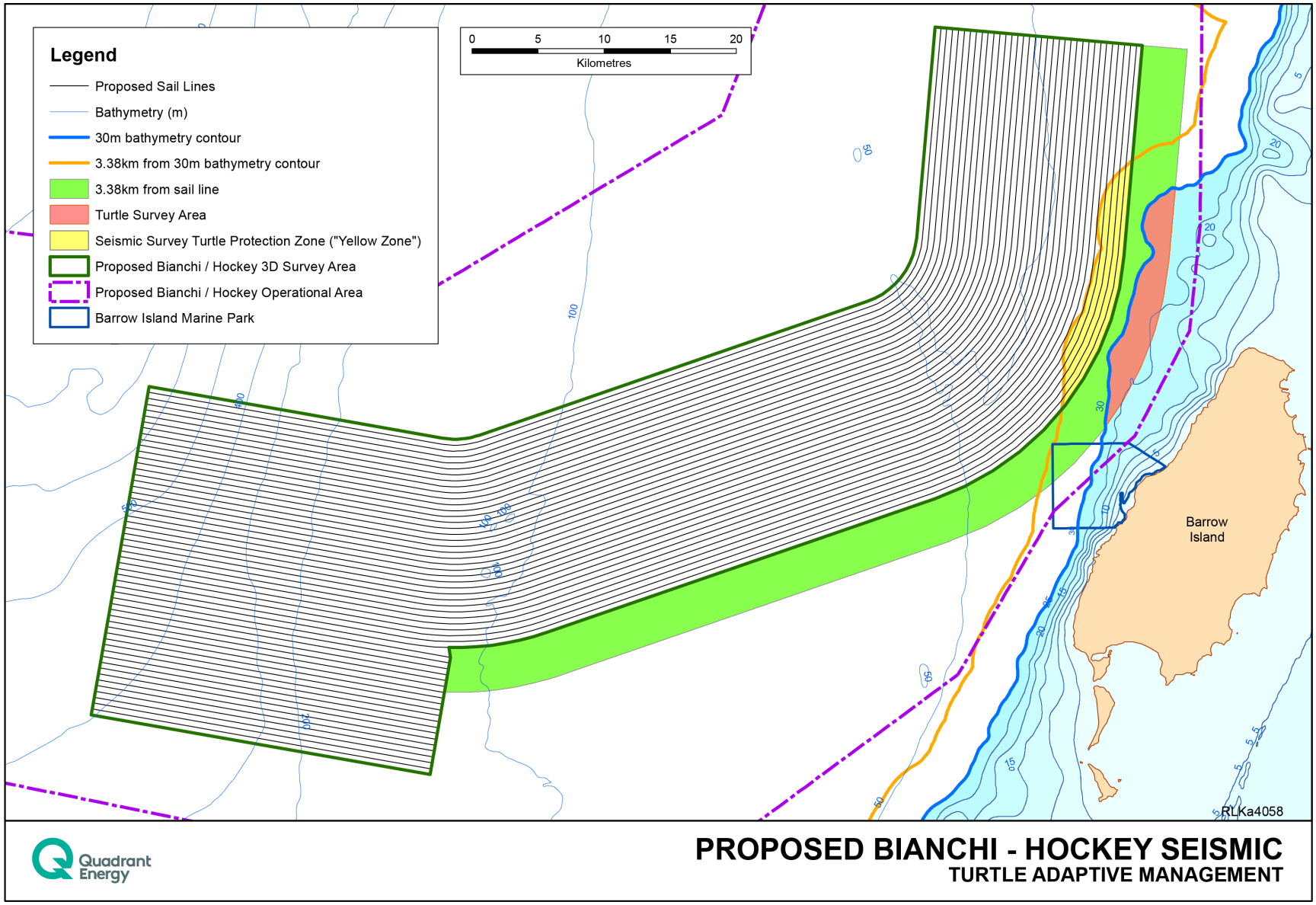

Figure 6-2: Portion of survey area affected by Adaptive Management for Turtles defined as the *Seismic Survey Turtle protection Zone* and *Turtle Survey Area* for Hockey Bianchi Seismic Survey

Implications of aerial surveys

This is a considerable increased risk and cost to Quadrant as the seismic survey may not be completed if large numbers of aggregating turtles are seen. Given the conservatism of the 30m water depth (rather than 20m suggested by published literature and surveys) for internesting turtles, and the potential behavioural level of impact within 3.38km, this is considered an appropriate management control. In addition, the time that the survey vessel will be within the *Seismic Survey Turtle Protection Zone* is up to 160 minutes (on the easternmost line) and is of short duration.

6.2.4 Planned Operational Discharges (surface)

Event: Planned Operational Discharges	In order to operate the vessel, a number of routine discharges to the marine environment will be required. These discharges will occur at the sea surface: sewage, food waste, brine, cooling waters, anti-scalant, deck drainage and oily water discharges from vessels. No food or sewage discharges will occur in State waters. No oily water will be discharged within a marine park.
Potential receptors	Fish (pelagic) & sharks, marine mammals, marine turtles and seabirds
Potential Impacts	Planned non-hazardous discharges will be small and continuous, with volumes dependent on a range of variables. The discharge of non-hazardous wastes to the marine environment may result in a localised reduction in water quality. This would be expected to be temporary (minutes to hours), localised and limited to surface waters (<5 m). The discharges are expected to be dispersed and diluted rapidly, with concentrations of wastes significantly dropping with distance from the discharge point. Changes to ambient water quality outside of the operational area are considered unlikely to occur. Specifics of potential impacts to water quality from the discharge of non-hazardous wastes are as follows. <u>Salinity increases</u> The desalination of seawater results in a discharge of brine with a slightly elevated salinity (around 10% higher than seawater). On discharge to the sea, the desalination brine, being of greater density than seawater, will sink and disperse in the currents. On average, seawater has a salt concentration of 35,000 ppm. The volume of the discharge is dependent on the requirement for fresh (or potable) water and the number of people on board. Most marine species are able to tolerate short-term fluctuations in salinity in the order of 20–30% (Walker and McComb, 1990), and it is expected that most pelagic species would be able to tolerate short-term exposure to the slight increase in salinity caused by the discharged brine. Given the relatively low volume of discharge, low salinity increase and deep, open water surrounding the vessels, impact on water quality in the operational area is expected to be low. <u>Changes in temperature</u> Cooling water will be discharged at a temperature above ambient seawater temperature. Upon discharge it will be subjected to turbulent mixing and transfer of heat to the surrounding waters. Temperature dispersion modelling shows that water temperature of discharged water will decrease rapidly as it mixes with the receiving waters, with discharge waters being less than 1°C above background levels within less than 100 m (horizontally) of the discharge point. Vertically, the discharge will be within background levels within 10 m (Woodside, 2008). Cooling water discharge points vary for each vessel, however, they all adopt the same discharge design that permits cooling water to be discharged above the water line, in order to facilitate cooling and oxygenation of this wastewater stream before mixing with the surrounding marine environment. Given the relatively low volume of cooling water, temperature differential, the deep, open water surrounding the vessels, impact on water quality is expected to be low and short-term. <u>Oily water</u>

	Oily water discharged from vessels will be treated to a concentration (<15 ppm) that will unlikely lead to any impacts to the receiving environment.
Impact assessment	
Receptor	**Consequence**
Threatened / Migratory Fauna **Physical Environment/ Habitat** **Socio-economic receptors**	Operational discharges in the same location for an extended period of time may result in significant water quality perturbations and alteration to marine fauna behaviour. Sensitive receptors that may be impacted include fish at surface, marine turtles and mammals, and seabirds. Given that the activity will be for a limited duration, and is located ~5.6 km from the nearest shoreline, impacts will be limited to short-term water quality impacts and temporary behavioural effects observed in fish and seabirds. Impacts to water quality will be experienced in the discharge mixing zone which will be localised and will occur only as long as the discharges occur (i.e. no sustained impacts), therefore recovery will be measured in hours to days. No discharge of food waste or sewage will occur in State waters.
Protected Areas	The Barrow Island MP is 5.6 km east of the operational area. With the short duration of the MSSs, and controls in place to minimise impacts generated from planned discharges, the risk to the marine environment is considered low. The Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves, which refers to DoT's Strategy for Management of Sewage Discharge from Vessels into the Marine Environment, classifies the Barrow Island Marine Park as a Zone 1 category, therefore no discharge of sewage is permitted in the marine park.
Overall Consequence Ranking	A - Negligible

Management Control	**Effectiveness of Control**
Vessel Certification checked to ensure vessels have correct and up to date certification for operating in Australia and managing sewage and garbage	Ensures vessel are compliant with legislation that decreases risks of pollution due to poor sewage or garbage management.
Standard Operating Procedures implemented to ensure discharges meet vessel requirements	Reduces potential impacts of poorly managed discharges
Sewage treatment system to reduce environmental impacts to the marine environment from discharges	Reduces potential impacts of inappropriate discharge of sewage. No discharge of sewage in State waters
Waste (garbage) management procedure reduces potential for accidental overboard release	Reduces probability of garbage being discharge to sea, reducing potential impacts to marine fauna. Ensures food waste is discharged in manner that does not pose risks to the environment
Machinery Maintenance to reduce potential impacts from machinery not operating efficiently	Reduces risk of impact to marine fauna from unplanned discharges due to poor machinery maintenance
Oily water discharges managed to minimise impacts to the marine environment	Reduces potential impacts of planned discharge of oily water to the environment and sensitivities within marine parks

6.2.5 Atmospheric emissions

Event: Atmospheric emissions	The use of fuel (specifically MGO) to power vessels engines, generators, mobile and fixed plant and equipment will result in emissions of greenhouse gases (GHG) such as carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O), along with non-GHG such as sulphur

	oxides (SOx) and nitrous oxides (NOx). Vessels may also use an incinerator for waste during the activity. Vessels may utilise ozone-depleting substances (ODS) in closed-system rechargeable refrigeration systems.
Potential receptors	Seabirds and humans
Potential Impacts	Hydrocarbon combustion may result in a temporary, localised reduction of air quality in the environment immediately surrounding the discharge point during the activity. Non-GHG emissions, such as NOX and SOX, and GHG emissions can lead to a reduction in local air quality which can impact humans and seabirds in the immediate vicinity and add to the national GHG loadings. As Quadrant's proposed MSS will occur in offshore waters, the combustion of fuels and incineration in such remote locations will not impact on air quality in coastal towns, the nearest being Onslow (54 km south). The quantities of gaseous emissions are relatively small and will quickly dissipate into the surrounding atmosphere. Accidental release and fugitive emissions of ODS has the potential to contribute to ozone layer depletion. Air emissions will be similar to other vessels operating in the region for both petroleum and non-petroleum activities. Maintenance of refrigeration systems containing ODS is on a routine, but infrequent basis, and with controls implemented, the likelihood of an accidental ODS release of material volume is considered rare
Impact Assessment	
Receptor	**Consequence**
Threatened / Migratory Fauna	Short term behavioural impacts to seabirds could be expected if they overfly the location; they may avoid the area.
Socio-economic receptors	As Quadrant's proposed activity occurs in offshore waters, the combustion of fuels in such remote locations will not impact on air quality in coastal towns. The quantities of gaseous emissions are relatively small and will under normal circumstances, quickly dissipate into the surrounding atmosphere. The highly dispersive nature of local winds (i.e. strong and consistent) is expected to reduce potentially harmful or 'noticeable' gaseous concentrations within a short distance from the vessels.
Overall Consequence Ranking	A - Negligible

Management Control	**Effectiveness of Control**
Waste incineration compliant with MARPOL	Reduces potential impact of inappropriate waste incineration to the environment
Fuel oil quality demonstrates vessel emissions comply with limits specified in AMSA Marine Order (AMSA Act) Part 97/ MARPOL Annex VI	Reduces potential impacts of sulphur discharge into the environment
Air pollution prevention certification demonstrates vessel emissions comply with Marine Order (under the AMSA Act) Part 97 / MARPOL Annex VI	Reduces probability of potential impacts to air quality due to ODS emissions, high NOx, SOx and incineration emissions.
Ozone-depleting substance handling procedures implemented to reduce potential for accidental release of ODS	Reduces probability of potential impacts to air quality due to ODS emissions

6.2.6 Spill Response operations

All incidents involving vessels and with level 2 spills will be under AMSA/DoT control in Commonwealth/State waters respectively. In the event of a hydrocarbon spill, oil spill response strategies will be implemented

where possible to reduce environmental impacts. The selection of strategies will be undertaken through the Net Environmental Benefit Analysis (NEBA) process, outlined in the OPEP. Risks and impacts from oils spill response strategies proposed for this activity are assessed in this EP through the use of vessels. The risk and impacts of oiled wildlife response was the only identified risk not previously assessed as part of the planned activity.

Event: Spill Response Operations	While response strategies are intended to reduce the environmental consequences of a hydrocarbon spill, poorly planned and coordinated response activities can result in a lack of, or inadequate, information being available upon which poor decisions can be made, exacerbating or causing further environmental harm. An inadequate level of training and guidance during the implementation of spill response strategies can also result in environmental harm over and above that already caused by the spill.
Potential receptors	Threatened / Migratory / Protected Fauna - fish, marine mammals, marine turtles and seabirds
Potential Impacts	Wildlife operations may be required to deter fauna from an area that has been or is likely to be oiled and if fauna is oiled. Potential impacts to fauna from capturing and cleaning can range from disruption to natural activities, injury or death. Oiled wildlife response will likely require further vessels, aircraft and personnel. This will increase the physical presence and amounts of routine discharges, as well as the potential for non-planned events (as discussed in this section). Hazing and other response actions have the potential to disrupt the behaviour of local fauna populations. Migratory / breeding populations have the highest potential for impact. In the event that migratory or breeding fauna populations have been identified as having the potential to be oiled, a NEBA will be undertaken to determine the best method of management. Transient individuals may be migrating through or foraging in the area. Therefore there is the possibility of encountering oiled individuals.
Impact Assessment	
Receptor	**Consequence**
Threatened / Migratory / Protected Fauna	The environment that may be affected in the event of a hydrocarbon spill is relatively small (up to 42 km). Subsequently there is the potential for marine fauna to be affected. Barrow, Montebello and Lowendal Islands have sensitivities as described throughout **Section 4**. If hazing or capturing are not managed appropriately to the species, then there is the potential to cause a net environmental impact to species. However, if control measures are implemented, then it is likely that the risk of further impact from these operations will be outweighed by the impact of the spill event. However, although disturbance could occur, it is not expected to expose entire local populations and subsequently is unlikely to result in a long term decline in the local population.
Overall Consequence Ranking	A - Negligible

Management Control	**Effectiveness of Control**
Support vessel and aircraft compliance with EPBC Act Regulation 8 (cetacean interactions)	Reduces potential for behavioural disturbance
Review shoreline lighting to a type (colour) that will reduce impacts to fauna.	Reduces potential for behavioural disturbance
Use of directional lighting for shoreline operations	Reduces potential for behavioural disturbance

Selection of shoreline operations areas in consultation with Department of Transport (DoT) and DPaW	Reduce noise/ light disturbance to sensitive fauna areas
Vessels meet applicable MARPOL and Marine Park sewage disposal requirements	Reduces water quality impacts in nearshore environment
Vessels meet applicable MARPOL and Marine Park sewage disposal requirements	Reduces water quality impacts in nearshore environment
Vessel meet applicable MARPOL requirements for oily water (bilge) discharges	Reduces water quality impacts in nearshore environment
Onshore equipment washdown in decontamination unit	Prevents spreading of oily water
Low pressure flushing of shoreline habitats	Reduces habitat damage, penetration of oil into sediments and erosion
Selection of appropriate water (salinity/temperature) for flushing	Reduces habitat damage
Use of booms to contain shoreline flushing liquids	Reduces spread of oily water
Compliance with controlled waste and landfill regulations	Prevents secondary contamination from oil waste
Use of no-leachate containers	Prevents secondary contamination
Competent personnel	Prevents secondary contamination
Minimise waste going to landfill	Reduces volume of waste to be landfilled
Use of shallow draft vessels for shoreline and nearshore operations	Reduce seabed and shoreline habitat disturbance
Use of competent vessel crew/personnel	Reduce seabed and shoreline habitat disturbance and coastal habitat fauna disturbance onshore
Vessel Risk Assessment Scoresheet (VRASS) completed for interstate and international vessels (only)	Reduce risk for introduction of invasive marine species as part of vessel biofouling
Conduct shoreline/nearshore habitat/bathymetry assessment	Reduce seabed and shoreline habitat disturbance
OSRT Team Leader assessment/selection of vehicles appropriate to shoreline conditions	Reduce coastal habitat and fauna disturbance
Establish demarcation zones for vehicle and personnel movement considering sensitive vegetation, bird nesting/roosting areas and turtle nesting habitat	Reduce coastal habitat and fauna disturbance
Operational restriction of vehicle and personnel movement to limit erosion, compaction and disturbance to birdlife	Reduce coastal habitat erosion and compaction and disturbance to birdlife
Prioritise use of existing roads and tracks	Reduce coastal habitat and fauna disturbance
Use of competent personnel	Reduce coastal habitat and fauna disturbance
Use of Heritage Advisor if spill response area overlapped with potential areas of cultural significance	Reduce disturbance to culturally significant sites
Consultation with:	Reduce disturbance to culturally significant sites

• Kuruma Marthudhunera Aboriginal Corporation (KMAC) • Buurabalayji Thalanyji Aboriginal Corporation • Yaburara and Coastal Mardudhunera Aboriginal Corporation (YACMAC) on potential Montebello Islands spill response activities	
Pre-cleaning and inspection of equipment (quarantine)	Prevent introduction of invasive species
Soil profile assessment prior to earthworks	Reduce habitat disruption and erosion
Stakeholder consultation	Early awareness of spill response activities which reduces potential disruption

6.3 Environmental risk treatment summary – Unplanned events

The environmental risk identification procedure identified 6 potential sources of environmental impact associated with the unplanned events that could occur during the planned activity.

6.3.1 Minor Hydrocarbon Release (surface)

Event: Minor Hydrocarbon Release (surface)	A minor spill (~37.5 m^3) of MGO could occur during refuelling resulting in a loss of hydrocarbons to the marine environment at sea surface. Spills of MGO during refuelling events have the potential to cause impacts to the marine environment through a reduction in water quality and marine fauna exposure. Spills during refuelling can occur through several pathways, including fuel hose breaks, coupling failure or tank overfilling. Accidental loss of other hydrocarbon based liquids (e.g. used lubricating oils, cooking oil, and hydraulic oil) to the marine environment could occur via tank pipework failure or rupture, hydraulic hose failure, inadequate bunding and/or storage, insufficient fastening or inadequate handling which could result in impacts to water quality and hence sensitive environmental receptors
Potential receptors	Fish, sharks, marine mammals, marine reptiles and seabirds
Potential Impacts	A spill of MGO as a result of refuelling would result in a localised reduction in water quality that may be harmful to marine fauna in surface waters and upper layers (~1 m) of the water column. It is predicted that 100 % of the largest credible MGO spill (from refuelling) will likely disperse and evaporate within 6 hours of the spill occurring within 19 km of the source. The potential impacts to the environment will be greatest in the immediate vicinity of the spill when the toxic aromatic components of the fuel will be at their greatest concentration and when the hydrocarbon is at its thickest on the surface of the receiving waters. The potential sensitive receptors in the immediate areas of the spill will include fish, cetaceans, marine reptiles and seabirds at the sea surface, which may ingest the MGO or become coated. Entrained MGO may pose different risks to habitats and fauna compared to a surface slick. However, as a result of the dilution of entrained oil in the water column, toxic impacts of entrained MGO are likely to be less than that of a surface slick. As the entrained hydrocarbons will be in the surface waters only, the extent of entrained hydrocarbons is predicted to be the same as that as the surface hydrocarbon spread. <u>Toxic effects</u> Given the small area likely to be affected by a surface spill (estimated at a maximum of 19 km from the source), the short lived nature of the spill (approximately 6 hours) and short exposure times likely to be experienced by potential receptors, minimal impacts from exposure to toxic hydrocarbons are anticipated. The high volatility of the MGO will also result in the rapid evaporation and loss of the more toxic aromatic components of the MGO,

	resulting in a reducing toxicity threat to marine fauna with time. Passive / low mobility fauna such as plankton and small fish in the surface water are most likely to be affected by the MGO. Significant impacts to larger marine fauna species such as marine mammals, fish (sharks), marine reptiles and seabirds are unlikely (but possible) given the relatively small area of impact anticipated and the short duration of the spill. Physical effects In the immediate spill area, marine fauna interacting with surface waters may be exposed to hydrocarbons on the surface at concentrations about the threshold of 10 g/m^2 used for oiling impacts to sensitive receptors, but given the low adhesive potential of the hydrocarbon, significant impacts are not anticipated. Impacts are not expected to be significant at the sea surface with the high volatility and low adhesive potential of the hydrocarbon resulting in low persistence in the environment		
Impact assessment			
Receptor	**Consequence**		
Threatened / Migratory Fauna	In the event of a minor hydrocarbon spill, the quantities would be limited to approximately 37.5 m^3. The small volumes and dilution and dispersion from natural weathering processes such as ocean currents indicate that the extent of exposure will be limited in area and duration (19 km over 6 hours). The number of receptors present at the activity location are expected to be limited to a small number of transient individuals. Since refuelling will not occur within 20 km of a shoreline, no impacts to shoreline habitats are expected. The susceptibility of marine fauna to hydrocarbons is dependent on hydrocarbon type and exposure duration however given that exposures would be limited in extent and duration, exposure to marine fauna from this hazard is not expected to result in a fatality. As the MGO is a highly volatile substance, the impacts to receptors will decline rapidly with time and distance at the sea surface. Rapid dilution at depth would also result in the impacts to receptors declining rapidly with time and distance. Deteriorating water quality and marine pollution are identified as potential threats to a number of marine fauna species in relevant Recovery Plans and Conservation Advice. The above information demonstrates that the Activity will be conducted in a manner that reduces potential impacts to ALARP and of acceptable level. Given that refuelling will not occur within 20 km of a shoreline, and the lack of significant habitat within the operational area, only a small number of marine fauna has the potential to be exposed to a minor hydrocarbon spill given the transient nature of fauna in this area and lack of sensitive benthic receptors. There is the potential for short term impacts to a small proportion of the local population. Although humpback and blue whales may be exposed, this event is not expected to interfere with this critical lifecycle activity. Toxic impacts are not expected to the benthic community due to the water depths. Deteriorating water quality is identified as a potential threat to turtles in the marine turtle recovery plan, and some bird and shark species. However, the potential minor hydrocarbon releases are not expected to significantly impact the receiving environment with management controls proposed to prevent releases and therefore the Activity will be conducted in a manner that is considered acceptable. Given that a small hydrocarbon spill would not result in a decreased population size at a local or regional scale, It is expected that a spill of this nature would result in a negligible consequence.		
Likelihood	The likelihood of a small hydrocarbon release occurring is limited given the set of mitigation and management controls in place for this activity. Refuelling incidents reported internally by Quadrant for all activities in 2015 included only 1 spill related to refuelling with 120 L of diesel entering the marine environment. Subsequently the likelihood of releasing significant volume of MGO to the environment is considered to be unlikely.		
Likelihood ranking	4 - Unlikely	**Consequence ranking**	A –Negligible

Residual Risk Ranking	Tolerable
Management Control	**Effectiveness of Control**
Bulk liquid transfer procedures reduce potential for accidental overboard release	Prevents probability of unplanned hydrocarbon spills or leaks occurring during bunking leading to negative impacts to the marine environment.
Oily water discharges managed to minimise impacts to the marine environment	Reduces potential impacts of planned discharge of oily water to the environment and sensitivities within marine parks
Equipment Maintenance to reduce potential impacts from equipment not operating efficiently	Ensures that lifting equipment is maintained and certified, and that lifting procedures are followed reducing probability of dropped objects occurring with the potential to result in hydrocarbon spills.
Oil pollution emergency plan (OPEP) provides options for controlling the source of any unplanned hydrocarbon/chemical spills and mitigate potential impacts	Implements response plans to deal with an unplanned hydrocarbon release quickly and efficiently in order to reduce impacts to the marine environment.
Survey and support vessel spill response plans provide options for controlling the source of any unplanned hydrocarbon/chemical spills and mitigate potential impacts	

Table 6-5: Impacts of entrained and surface MGO on sensitive receptors found within the EMBA

Receptor	Impacts of MGO		
	Entrained	**Surface**	**Beached**
Marine fauna			
Plankton (including zooplankton; fish and coral larvae)	There is potential for localised mortality of plankton due to reduced water quality and toxicity. Effects will be greatest in the upper 10 m of the water column and areas close to the spill source where hydrocarbon concentrations are likely to be highest.	Surface MGO will have no impact on plankton.	N/a
	The MSSs have potential to overlap with spawning of some fish species given the year round spawning of some species. In the unlikely event of a spill occurring, fish larvae may be impacted by MGO entrained in the water column. However, following release, the MGO will rapidly evaporate and disperse in the offshore environment, reducing the concentration and toxicity of the spill. Given duration of fish spawning periods, lack of suitable habitat for aggregating fish populations near the surface, combined with the quick evaporation and dispersion of MGO, impacts to overall fish populations are not expected to be significant.		N/a
Marine mammals	Lethal or sub-lethal physical and toxic effects such as irritation of eyes/mouth and potential illness.	At risk of direct contact with MGO due to chance of surfacing within slick. Effects include irritation of eyes/mouth and potential illness. Surface respiration could lead to accidental ingestion of hydrocarbons or result in the coating of sensitive epidermal surfaces.	N/a
	Nine migratory cetacean species were identified by the EPBC Protected Matters search (**Section 4**). Of these, three are listed as threatened and one as vulnerable: Humpback whale: In the unlikely event of an MGO spill, migrating humpback whales or female whale and calf resting at Montebello Island may encounter entrained and surface MGO. However, given the rapid evaporation of MGO, significant numbers are not expected to be impacted. Blue whales: The MSSs may overlap with the blue whale migratory period. Since blue whales show preference for water depths > 500 m, a small number of individuals may encounter entrained or surface MGO. However, the absence of any known feeding, resting or breeding areas in operational or EMBA means significant numbers are unlikely to be impacted. Southern Right whales: In the unlikely event of an MGO spill, transient individuals may encounter entrained and surface MGO. However, the absence of any known feeding, resting or breeding areas means significant numbers are unlikely to be impacted.		N/a

	Other migratory cetaceans may encounter either surface or entrained MGO, however, the absence of any known feeding, resting or breeding areas means significant numbers are unlikely to be impacted. Dugong: Transient dugongs are known to feed around Barrow, Lowendal and Montebello Islands, however the nearest BIA for breeding and foraging is situated 161 km south west of the operational area (122 km south west of the EMBA) so significant numbers are not expected to be impacted by surface or entrained MGO.		
Marine reptiles	Lethal or sub-lethal physical and toxic effects such as irritation of eyes/mouth and potential illness.	At risk of direct contact with MGO due to chance of surfacing within slick. Effects include irritation of eyes/mouth and potential illness. Surface respiration could lead to accidental ingestion of hydrocarbons or result in the coating of sensitive epidermal surfaces	Shoreline contact and beached MGO may result in toxic impacts to turtle nesting habitat potentially impacting adults, eggs and hatchlings.
	Six species of threatened marine reptile were identified as possibly being impacted by a spill. Short-nosed seasnake, flatback, hawksbill, leatherback, green and loggerhead turtles are widely dispersed at low densities across the NWS and in the unlikely event of a MGO spill occurring, individuals traversing open water may come into contact with entrained or surface MGO. Given the distance to turtle nesting beaches (5.5 km) should a spill occur during hatchling season, hatchlings could be impacted. Given that a spill would only persist for 13 hours, the number of hatchlings or transient adults encountering MGO is likely to be low and would not represent a significant proportion of the local population.		At the closest point, the operational area is 5.5 km from the closest nesting sites (Barrow Island). While the impacts to nesting turtles, eggs and hatchlings may be severe, the small volumes potentially stranded and the short duration of MGO persistence means that the number of individuals potentially affected would be low.
Seabirds	Lethal or sub-lethal physical and toxic effects such as irritation of eyes/mouth and potential illness. May encounter entrained MGO while diving and foraging.	Particularly vulnerable to surface MGO. As most fish survive beneath floating slicks, they will continue to attract foraging seabirds, which typically do not exhibit avoidance behaviour. Smothering can lead to reduced water proofing of feathers and ingestion while preening. In addition, MGO can erode feathers causing chemical damage to the feather structure that subsequently affects ability to thermoregulate and maintain buoyancy on water.	Beached MGO poses a risk to species that utilize the shoreline for foraging. Ground nesting species may also be impacted. Direct contact with surface hydrocarbons can lead to irritation of skin and eyes. Smothering can lead to reduced water proofing of feathers leading to hypothermia. Smothering of feathers can also lead to excessive preening, diverting time away from other behaviours leading to starvation and dehydration. Preening of oiled feathers will also result in to ingestion of hydrocarbons and the associated

			impacts of toxicity and potential illness.
	Fifteen species of bird, including 14 migratory and three threatened species, as identified by the EPBC Protected Matters database search, may be encountered during the MSSs and may have foraging or feeding habitat in the vicinity. Of the three threatened species, the fairy wren is a terrestrial species that would not be impacted by an MGO release. The Australian fairy tern has foraging habitat in the area and so may be impacted by surface and entrained diesel while foraging (dive and skim feeding). Higher numbers would be expected during the breeding period of July to September. Due to the quick evaporation and dispersion of MGO, significant impacts are not anticipated. While the Southern giant petrel is known to occur in the area, no BIAs are designated for breeding or foraging within the EMBA so significant numbers are not expected and any impacts would be limited to transient individuals. Therefore the risk of surface and entrained diesel to seabirds is considered low.		Beached MGO will evaporate quickly in the temperatures experienced on the NWS. However, reduced prey may be available to foraging shorebirds due to mortality or avoidance, and nesting individuals may be temporarily disrupted.
Fish and sharks	Hydrocarbon droplets can physically affect fish and sharks exposed for an extended duration (weeks to months). Smothering through coating of gills can lead to the lethal and sub-lethal effects of reduced oxygen exchange, and coating of body surfaces may lead to increased incidence of irritation and infection. Fish may also ingest hydrocarbon droplets or contaminated food leading to reduced growth. There is potential for localised mortality of fish eggs and larva due to reduced water quality and toxicity. Effects will be greatest in the upper 10 m of the water column and areas close to the spill source where hydrocarbon concentrations are likely to be highest and therefore demersal fish communities are not expected to be impacted.	While fish and sharks do not generally break the sea surface, individuals may feed at the surface. However, since the MGO is expected to have fully dispersed and evaporated within 13 hours, and the low frequency of breaches at the surface, the probability of prolonged exposure to a surface slick by fish and shark species is low.	N/a
	The NWS supports a diverse assemblage of fish, including 456 species of finfish, particularly in shallower water near the mainland and islands. Threatened species identified by the EPBC protected matters search include the great white shark, whale shark, grey nurse shark, green and dwarf sawfish, and the blind gudgeon which may be present in the affected area. However given the absence of critical habitat for most of these species, significant numbers are not expected to be impacted. The only BIA overlapping the EMBA is for the whale shark. While this is for foraging it is not for high density prey where congregations are expected so impacts would be limited to transient migrating individuals. Grey nurse sharks could be present at low densities all year round within the operational area and EMBA, however, the absence of any known feeding, resting or breeding areas means significant numbers are unlikely to be impacted if an unplanned release were to occur.		
Habitats			

Sandy beaches (including intertidal and subtidal sand)	Sandy beaches have a relatively low biodiversity although they do provide important habitats for nesting turtles, breeding and foraging seabirds, and shorebirds. They also provide habitat for polychaetes, molluscs, marine crustaceans, semi-terrestrial crustaceans and insects.		
	Entrained hydrocarbons will not become stranded on the shoreline and therefore will have no impact on sandy beaches.	Surface hydrocarbons may accumulate on sandy beaches, impacting the area by physically smothering the habitat. Stranded oil may have toxic effects on invertebrates with knock on impacts on the shorebirds that forage upon them.	Beached MGO may accumulate on sandy beaches, impacting the area by physically smothering the habitat. Stranded oil may have toxic effects on invertebrates with subsequent impacts on the shorebirds that forage upon them. Impacts to nesting turtles are described above.
	Sandy beaches occur within the EMBA and could potentially impacted by a spill. However, given the relatively small volumes potentially making contact with shorelines, and the rapid evaporation of MGO, impacts are not expected to be significant.		
Intertidal reefs (including coral communities, intertidal limestone pavement and macroalgae communities)	Intertidal reefs occur within the operational area (notably Montebello and Lowendal Islands).		
	Physical effects from entrained oil have the potential to coat contacted coral reefs. The phenomena of smothering of exposed coral surfaces or polyps by oil spills has only been reported where very large oil spill quantities, or very sticky oil slicks, have been encountered. Response to hydrocarbon exposure can include impaired feeding, fertilisation, larval settlement and metamorphosis, larval and tissue death and decreased growth rates. Entrained oil also has the potential to impact reef fauna (fish, turtles, and marine mammals) as outlined in rows above.	Surface hydrocarbons may make contact with intertidal reefs should reef features become emergent, for example during low tide. Impacts of contact with surface oil can include impaired feeding, fertilisation, larval settlement and metamorphosis, larval and tissue death and decreased growth rates. Surface oil also has the potential to impact reef fauna (turtles, marine mammals) as outlined in rows above.	See 'Surface'.
	Intertidal reefs occur within the area potentially impacted by a spill and therefore impacts to this receptor may occur due to an unplanned release of MGO. Significant impacts to intertidal reef habitats are not expected due to the quick dispersal and evaporation of MGO in the marine environment. Impacts to species associated with intertidal habitats are assessed above.		
Submerged reefs	Submerged reefs and shallow shoals are found throughout the operational area and EMBA.		
	Physical effects from entrained oil have the potential to coat contacted coral reefs. The phenomena of smothering of exposed coral surfaces or polyps by oil spills has only been reported where very large oil spill quantities, or very sticky oil slicks, have been encountered. Response to hydrocarbon exposure can include impaired feeding, fertilisation, larval	The likelihood of surface hydrocarbons contacting submerged reefs and shoals is low, largely due to the distance between the sea surface and the submerged habitat.	N/a

	settlement and metamorphosis, including larval and tissue death and decreased growth rates (Villanueva *et al.*, 2008). Filter feeders such as molluscs are especially liable to ingest oil with lethal and various sub-lethal effects. This includes alteration in respiration rates, decreases in filter feeding activity, reduced growth rates, biochemical effects, increased predation, reproductive failure and mechanical destruction by waves due to inability to maintain hold on substrate (Ballou *et al*. 1989; Connell and Miller 1981). Entrained oil also has the potential to impact marine fauna (fish, turtles, marine mammals) as outlined in rows above.		
	Submerged reefs and shoals occur within the area potentially impacted by a spill and therefore impacts to this sensitivity may occur due to an unplanned release. Significant impacts to submerged reefs are not expected due to the quick dispersal and evaporation of MGO in the marine environment. Impacts to species associated with intertidal habitats are assessed above.		
Mangroves	Mangroves are present in the shorelines of the Barrow Island MMA.		
	Entrained hydrocarbons may potentially impact mangrove communities through the sediment/mangrove root interface. Entrained hydrocarbons contain contaminants that may become persistent in the sediments (e.g. trace metals, PAHs), leading to direct effects on mangroves due to direct uptake, or indirect effects due to impacts on benthic infauna and thus leading to reduced rates of bioturbation and subsequent oxygen stress on the plants root systems.	The impacts of surface hydrocarbons on mangroves include damage as a result of smothering of lenticels (mangrove breathing pores) on pneumatophores or prop roots, or by the loss of leaves (defoliation) due to chemical burning. It is also known that mangroves take up hydrocarbons from contact with leaves, roots or sediments, and it is suspected that this uptake causes defoliation through leaf damage and tree death.	See 'Surface'
	Mangroves occur within the area potentially impacted by a spill and therefore impacts to this sensitivity may occur in the event of an unplanned release. Significant impacts to mangrove habitats are not expected due to the quick dispersal and evaporation of MGO in the marine environment.		
Socioeconomic			
Fisheries	Entrained MGO can have toxic effects on fish (as outlined above) reducing catch rates and rendering fish unsafe for consumption.	In addition to the effects of entrained oil, exclusion zones surrounding a spill can directly impact fisheries by restricting access for fishermen.	N/a
	Both entrained and surface MGO have the potential to lead to temporary financial losses.		N/a

Tourism	There are many sources of marine-based tourism within the environment that may be affected. Aquatic recreational activities such as boating, diving and fishing occur around the Montebello Islands but are concentrated in the vicinity of the population centres such as Exmouth, Dampier and Onslow. In the waters immediately surrounding the operational area, tourism activities are expected to be low, however exclusion zones surrounding a spill will reduce access for vessels for the duration of the response undertaken for spill clean-up (if applicable).		Stranding of MGO on sandy beaches may impact some tourism activities.
Shipping	Entrained oil will have no effect on shipping.	Exclusion zones surrounding a spill will reduce access for shipping vessels for the duration of the response undertaken for spill clean-up (if applicable); vessel may have to take large detours leading to potential delays and increased costs.	N/a
Defence	The level of defence activities carried out in the vicinity of operational area is low , if any, and therefore interference of defence activities due to a MGO spill are likely to be minimal.		Beached MGO will have no impacts on defence activities.
Shipwrecks	Surface oil will have no impact on shipwrecks. Entrained oil from a vessel collision will remain in the surface waters and is therefore unlikely to have an impact on shipwrecks.		N/a
Indigenous	The level of activities undertaken by indigenous users is expected to be low, if any, therefore interference due to an MGO spill are likely to be minimal, however in event there is a requirement for land based response activities/ disturbance relevant representatives will be contacted as outlined in the OPEP Table 15-4.		Stranding of MGO and response activities may impact indigenous values of land masses.
Existing oil and gas activity	Exclusion zones surrounding spills will reduce access potentially leading to delays to work schedules with subsequent financial implications. Chevron undertake a number of activities on Barrow Island and therefore may be impacted in the event of an unplanned spill event through exclusion from undertaking activities.		N/a
Protected areas	Protected areas are described in **Section 4.2.2** but are summarised below. **Montebello Island Marine Park (MP)** The Montebello MP has a designated multiple use zone which allows for petroleum activities to be undertaken within it. This MP exists to protect foraging areas and habitats for EPBC listed species including whales, sharks, turtles, migratory birds and some seafloor features. **Barrow Island MMA** The Barrow Island MMA includes significant breeding and nesting areas for marine turtles and the waters support a diversity of tropical marine fauna, important coral reefs and unique mangrove communities (DEC 2007). Green, hawksbill and flatback turtles regularly use the island's beaches for breeding, and loggerhead turtles are also occasionally sighted. **Barrow Island MP**		Potential impacts of beached MGO on receptors listed in each protected areas are described in rows above.

	The Barrow Island Marine Park includes Biggada Reef, an ecologically significant fringing reef, and Turtle Bay, an important turtle aggregation and breeding area (DEC 2007). Representative areas of seagrass, macroalgal and deep water habitat are also represented within the marine park (DEC 2007). **Montebello CMR** Includes mangroves, seagrass, subtidal and intertidal reefs. These habitats provide foraging and breeding areas for seabirds and marine turtles.	
	As discussed above, marine mammals, seabirds, sharks and reptiles are at risk of direct contact with MGO due to chance of surfacing within slick. Effects include irritation of eyes/mouth and potential illness. Surface respiration could lead to accidental ingestion of hydrocarbons or result in the coating of sensitive epidermal surfaces.	

6.3.2 Hydrocarbon Release from Vessel Collision (Surface)

Event: Hydrocarbon Release from Vessel Collision (Surface)	There is a possibility of a vessel collision occurring between the vessels (either project and support vessels, or 3rd party) within the operational area. The worst-case environmental incident resulting from a vessel collision is the rupturing of a vessel fuel tank resulting in the release of MGO to the environment. There are no additional collision hazards (such as shallow seabed or surface infrastructure) within the operational area. An analysis of the layout of the potential vessel to be used during the activity was undertaken to assess the likelihood of fuel tanks rupturing as a result of a collision. The analysis considered the tanks on board all vessels proposed to be used and the degree to which they were 'exposed' (could be damaged through collision).
Potential receptors	Fish, sharks, marine mammals, marine reptiles and seabirds Habitats - sandy beaches, intertidal and submerged reefs, mangroves; Protected areas and socio-economic receptors
Potential Impacts	As described in Section 6.3.1, a loss of MGO to the marine environment would result in a localised reduction in water quality in the upper surface waters of the water column. As described above, the maximum distance a surface spill could travel is 42 km from the source. Given the proximity of the operational area to land, shoreline contact is possible. In addition to sensitivities found at these shorelines, transient fauna may traverse the area potentially impacted by a spill. The impacts of surface, entrained and beached MGO to both shoreline and transient receptors are summarised in **Table 6-5**.
Impact assessment	
Receptor	**Consequence**
Threatened / Migratory Fauna Habitats Protected areas	In the event of a vessel collision, the volume of hydrocarbons released would be a finite amount limited to the maximum credible spill of a full tank inventory release. Given the nature of the MGO and the distance from shorelines, dilution and dispersion from natural weathering processes such as ocean currents indicate that the extent of exposure will be limited in area and duration. The susceptibility of marine fauna to hydrocarbons is dependent on hydrocarbon type and exposure duration however given that exposures would be limited in extent and duration, exposure to marine fauna from this hazard is not expected to result in a fatality. Habitat modification/degradation/disruption/loss, deteriorating water quality and marine pollution are identified as potential threats to a number of marine fauna species in relevant Recovery Plans and Conservation Advice. The above information demonstrates that the Activity will be conducted in a manner that reduces potential impacts to ALARP and of acceptable level. In addition, the Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves states that DPaW should 'Ensure that important seabird and shorebird breeding and feeding areas are not significantly affected by human activities'. The potential impacts of a hydrocarbon release on seabird breeding and feeding areas are discussed in **Table 6-5**. The low shipping and fishing activity expected in the direct area of the activity and the management controls in place are considered to result in a low risk of a collision occurring. In the unlikely event that a collision did occur within the operational area, the potential impacts to the environment would be greatest several kilometres from the spill when the toxic aromatic components of the fuel will be at their highest concentration and when the hydrocarbon is at its thickest on the surface of the receiving waters. The MGO will also rapidly lose toxicity with time and spread thinner as evaporation continues. The potential sensitive receptors in the surrounding areas of the spill will include fish, marine mammals, marine reptiles and seabirds at the sea surface, as discussed in **Table 6-5**. Marine and shoreline habitats may also be impacted as discussed in **Table 6-5**. There would potentially be shoreline contact given the Montebello Islands, Lowendal Islands, Barrow Islands, Airlie Island and Thevenard Island are all within the EMBA (i.e. 42 km). The greatest potential volume of MGO that could become stranded MGO is 288 m^3 at Barrow Island.

	Indigenous users may be impacted in the event that a land based response is required, however consultation will ensure potential impacts are reduced to acceptable levels. Given that a vessel collision hydrocarbon spill would not result in a decreased population size at a local or regional scale, it is expected that a spill of this nature would result in a minor consequence.		
Likelihood	A hydrocarbon release resulting from a vessel collision is unlikely to have widespread ecological effects given the nature of the hydrocarbons on-board, the finite volumes that could be released, the depth and transient nature of marine fauna in this area. Deteriorating water quality is identified as a potential threat to turtles in the marine turtle recovery plan, and some bird and shark species. Habitat modification/degradation/ disruption, pollution and/or loss of habitat are also identified as threats to sharks, birds, cetaceans and turtles in conservation management and recovery plans. However, the potential hydrocarbon releases as a result of vessel collision are not expected to significantly impact the receiving environment with management controls proposed. Additionally, long term impacts resulting in complete habitat loss or degradation are not considered likely given the controls proposed to prevent releases and therefore the Activity will be conducted in a manner that is considered acceptable. The likelihood of a hydrocarbon release occurring due to a vessel collision is limited given the set of mitigation and management controls in place for this program. Subsequently the likelihood of a vessel collision releasing hydrocarbons to the environment which results in a minor consequence is considered to be rare.		
Likelihood ranking	2 - Rare	**Consequence ranking**	B - Minor
Residual Risk Ranking	Tolerable		

Management Control	**Effectiveness of Control**
Maritime notices are issued prior to activity commencement to reduce potential for collision or interference with other marine user activities	Ensure other marine users are aware of the presence of the seismic vessel and streamers, and the relative low mobility of vessel to suddenly change course or avoid other vessels.
Maintaining up to date environment description to ensure relevant scientific studies, conservation management plans and any other relevant updates are considered in impacts and risk assessments.	Ensures any new environmental sensitivities are identified and potential impacts and risks are appropriately assessed and mitigated.
Exclusion zone and access authority established to reduce potential for collision or interference with other marine user activities	Exclusion zones around the vessel and streamers prevents other vessels from getting too close and causing damage to equipment of either party. Gaining access authority ensures that other titleholders are aware of the vessel and activities preventing interference with the titleholders' activities.
Dynamic positioning system maintenance reduces potential for vessel collision	Prevents unintentional movements by vessel decreasing risk of collision or grounding reducing the risk of hydrocarbons being discharged to the marine environment
Navigation equipment and procedures implemented on all vessels to reduce potential for collision or interference with other marine users	Reduces risk of environmental impact from vessel collisions due to ensuring safety requirements are fulfilled.
OPEP provides options for controlling the source of any unplanned hydrocarbon/chemical spills and mitigate potential impacts	Implements response plans to deal with an unplanned hydrocarbon release quickly and efficiently in order to reduce impacts to the marine environment.
Survey and support vessel spill response plans provide options for controlling the	

source of any unplanned hydrocarbon/chemical spills and mitigate potential impacts	

6.3.3 Non-hydrocarbon release (surface) – Liquid

Event: Non-hydrocarbon release (surface) – Liquid	Hazardous liquids including miscellaneous chemicals and waste streams (cleaning and cooling agents, stored or spent chemicals and leftover paint materials) are used or stored on board the vessel during the activity. The main engines and equipment such as pumps, cranes, winches, power packs and generators require MGO for fuel and a variety of hydraulic fluids and lubricating oils for efficient operation and maintenance of moving parts. These products are present within the equipment and also held in storage containers and tanks on the vessels, small hydrocarbon leaks could occur and are discussed in Section 6.3.1, chemical leaks are discussed further here. Seal oil could potentially leak from the vessel thruster/propeller stern tube directly to sea as a result of leaking seals or mechanical damage. The header tank for stern tube oil is approximately 1 m^3 and is equipped with limit switches in the event of a leak, thus preventing complete loss. Outside the vessel, the largest credible spill would be release of <1 m^3 of stern tube oil (non-hydrocarbon based lube oil) from the vessel thruster/propeller stern tube. Accidental loss of liquid wastes to the marine environment could occur via tank pipework failure or rupture, inadequate bunding and/or storage, insufficient fastening or inadequate handling may result in impacts to water quality and hence sensitive environmental receptors.
Potential receptors	Fish, sharks, marine mammals, marine reptiles and seabirds Habitats - benthic;
Potential Impacts	Environmentally hazardous chemicals and wastes lost to the marine environment may lead to contamination of the water column in the vicinity of the vessel. The potential impacts would most likely be highly localised and restricted to the immediate area surrounding the spill, with rapid dispersal to concentrations below impact thresholds likely to occur in the open area of ocean. The changes to water quality that may result could potentially lead to short-term impacts on marine fauna (e.g. pelagic/benthic fish, epifauna, cetaceans, marine reptiles and seabirds), with chronic impacts not expected owing to the short exposure times likely. The area that may be affected by this risk for the majority of spilt material would most likely be restricted to a small area within the operational area. Discharge hazardous chemicals from spills is unlikely to have widespread ecological effects given the nature of the chemicals onboard, the small volumes that could be released, and the depth and exposure of the location. There is no emergent habitat that could be impacted by a non-hydrocarbon surface spill and given the water depths, any spilled material is unlikely to reach any of the demersal species or benthic habitats at the seabed..
Impact assessment	
Receptor	**Consequence**
Threatened / Migratory Fauna	In the event of a non-hydrocarbon liquid spill, the quantities would be limited to approximately 1m^3 of stern oil. The small volumes, dilution and dispersion from natural weathering processes such as ocean currents indicate that the extent of exposure will be limited in area and duration. The susceptibility of marine fauna to chemicals is dependent on the type and exposure duration however given that exposures would be limited in extent and duration, exposure to marine fauna from this hazard is not expected to result in a fatality. Impacts from small volumes (1 m^3) discharged to the marine environment to water quality would be short-term and localised, due to the nature and behaviour of the chemicals / liquid wastes identified as

	being at risk of spilling; only pelagic fauna present in the immediate vicinity of the spill would likely be at risk of impact. Deteriorating water quality and marine pollution are identified as potential threats to a number of marine fauna species in relevant Recovery Plans and Conservation Advice. The above information demonstrates that the Activity will be conducted in a manner that reduces potential impacts to ALARP and of acceptable level. The lack of significant habitat within the operational area indicates that only a small number of marine fauna has the potential to be exposed to a small hydrocarbon spill given the transient nature of fauna in this area. Deteriorating water quality is identified as a potential threat to turtles in the marine turtle recovery plan, and some bird and shark species. However, the potential non-hydrocarbon releases of liquids are not expected to significantly impact the receiving environment with management controls proposed to prevent releases and therefore the Activity will be conducted in a manner that is considered acceptable. Given that a small chemical spill would not result in a decreased population size at a local or regional scale, it is expected that a spill of this nature would result in a negligible consequence		
Likelihood	A small non-hydrocarbon liquid release is unlikely to have widespread ecological effects given the nature of the chemicals on-board, the small volumes that could be released, the depth and transient nature of marine fauna in this area and the prevention and management procedures in place to clean up a spill. Quadrant recorded 42 non-hydrocarbon spills and leaks from equipment and machinery in 2015 (due to split hoses, small leaks, or handling errors). Most of the spills and leaks reported occurred within bunded areas, were all less than 100 L and cleaned up immediately. The likelihood of a small non-hydrocarbon release occurring is limited given the set of mitigation and management controls in place for this program. Subsequently the likelihood of releasing non-hydrocarbon liquids to the environment which results in a negligible consequence is considered to be unlikely.		
Likelihood ranking	4 - Unlikely	**Consequence ranking**	A - Negligible
Residual Risk Ranking	Tolerable		

Management Control	**Effectiveness of Control**
General chemical management procedures help reduce the environmental impact to marine environment caused by discharge of subsea hydrocarbons/chemicals	Potential impacts to the environment are reduced through following correct procedures for the safe handling of chemicals
Equipment Maintenance to reduce potential impacts from equipment not operating efficiently	Ensures that lifting equipment is maintained and certified, and that lifting procedures are followed reducing probability of dropped objects occurring with the potential to result in hydrocarbon spills.
OPEP provides options for controlling the source of any unplanned hydrocarbon/chemical spills and mitigate potential impacts	Implements response plans to deal with an unplanned hydrocarbon release quickly and efficiently in order to reduce impacts to the marine environment.

6.3.4 Non-hydrocarbon release (surface) – Solid

Event: Non-hydrocarbon release (surface) – Solid	Non-hazardous solid wastes including paper, plastics and packaging, and hazardous solid wastes such as batteries, fluorescent tubes, medical wastes, and aerosol cans may be dropped unintentionally to the marine environment, potentially impacting on sensitive receptors. Release of these waste streams may occur as a result of overfull and/or uncovered bins, incorrectly disposed items or spills during transfers of waste. Dropped objects/lost equipment such as a streamer could also result in seabed disturbance or floating obstacles.

	Up to 14 seismic streamers of 8000 m length will be used during the MSSs. The streamers are jell-filled, which has the characteristics of a 'flexible' solid and will not flow into the marine environment if the streamer skin is punctured, however if the streamer is lost, it will remain buoyant and potentially be a floating obstacle.
Potential receptors	Benthic and shoreline habitats Marine fauna – marine mammals, dugong, marine turtles, seabirds and fish. Socioeconomic – other sea users (fisheries, shipping, oil and gas operators)
Potential Impacts	Non-hazardous solids such as plastics have the potential to smother benthic environments and harm marine fauna through entanglement or ingestion. Marine turtles and seabirds are particularly at risk from entanglement. Marine turtles may mistake plastics for food; once ingested, plastics can damage internal tissues and inhibit physiological processes, which can both potentially result in fatality. Marine debris has been highlighted as threat to marine turtles in the Marine Turtle Recovery Plan (Commonwealth of Australia, 2013) with a number of recovery actions to help combat this threat. Of relevance to this Activity is the legislation for the prevention of garbage disposal from vessels. Release of hazardous solids (e.g. wastes such as batteries) may result in the pollution of the immediate receiving environment, leading to detrimental health impacts to marine flora and fauna. Physiological damage can be through ingestion or absorption may occur to individual fish, cetaceans, marine reptiles or seabirds. The area of potential disturbance due to a non-buoyant dropped object would be restricted to the operational area. The seabed within the operational area is likely to be soft sediment with a sparsely distributed flora and invertebrate population; this habitat type is widely distributed and well represented in the NWS region. While soft sediment benthic habits will not be destroyed, disturbance of the communities on and within them (i.e. the infauna) will occur in the event of a dropped object and depressions may remain on the seabed for some time after removal of the dropped object as it gradually infills over time. In the unlikely event of damage to or loss of the seismic streamer, potential environmental effects could be limited to physical impacts on benthic communities arising from the streamer and associated equipment sinking to the seabed. Seismic streamers are fitted with pressure-activated, self-inflating buoys that are designed to bring the equipment to the surface if lost accidentally during a MSS. As the equipment sinks it passes a certain water depth at which point the buoys inflate (compressed CO2 gas cartridge) and bring the equipment back to the surface where it can be retrieved by the seismic or support vessel. Given the water depths of the operational area, benthic impacts from loss of a streamer are not considered credible. Buoyant objects may cause interference with other sea users depending on the size of the object(s). Loss of a streamer (or part of) could create marine debris potentially interfering with other sea users by snagging equipment. Dropped objects could also impact water quality and lead to potential injury to fauna depending on the contents of the object e.g. a drum containing chemicals. Impacts from lost liquid materials / wastes are discussed in **Section 6.3.3**.
Impact assessment	
Receptor	**Consequence**
Physical Environment	In the event of a dropped object, the seabed is expected to be damaged by the object. The extent of the impact is limited to the size of the dropped object and given the size of standard materials transferred, any impact is expected to be very small. Surveys of previous seabed disturbances from drilling activities indicate that recovery of benthic fauna in soft sediment substrates occurs between 6-12 months after the activity ceases (URS, 2001). Subsequently any impacts are short term in duration. Any impact to seabed through dropped objects would result in a negligible reduction in habitat area/function impacted.
Threatened / Migratory Fauna	In the event of a non-hazardous or hazardous solid waste loss, the quantities would be limited. This waste stream could cause localised impacts to water quality and the benthic or shoreline environment if the solid can degrade, leading to impacts on localised flora and fauna

	species. Ingestion of solid wastes could occur in small quantities. Only small volumes of this waste stream would be generated during the activity, as a result, any accidental loss to the environment would be small in size. Any impacts would be restricted to a small number of individuals in the close proximity to the release, if any. As such there is the potential for short term behavioural impacts only to a small proportion of a local population and not during critical lifecycle activity for cetaceans, marine turtles or fish. Marine debris is identified as a potential threat to a number of marine fauna species in relevant Recovery Plans and Conservation Advice. The above information demonstrates that the Activity will be conducted in a manner that reduces potential impacts to ALARP and of acceptable level. In addition, the Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves states that DPAW should 'Ensure that important seabird and shorebird breeding and feeding areas are not significantly affected by human activities'. The potential impacts of unplanned solid discharges (e.g. litter) on seabird breeding and feeding areas are discussed above. The limited quantities associated with this event indicate that even in a worst case release of solid waste, the number of fatalities would be limited to individuals and is not expected to result in a decrease of the local population size and the consequence level is therefore negligible.
Socio-economic	In the event of a release of a buoyant object that cannot be recovered, it could present an obstacle to other sea users or have aesthetic impacts to tourism. Eventually the buoyant object may become non-buoyant and sink to the seabed where it may degrade over time. The time taken for this is dependent on the material released and any impacts to marine fauna and the seabed are described above. Given the likely size of buoyant equipment and it will drift with the currents, it is considered unlikely to present a significant hazard to other sea users or significant aesthetic impact and the consequence level is therefore negligible.
Likelihood	A set of mitigation and management controls and checks have been proposed to ensure that the risks of dropped objects, lost equipment or release of solid waste to the environment has been minimised. The likelihood of transient marine fauna occurring in the operational area is limited and given the controls in place, the likelihood of releasing non-hydrocarbon solids to the environment resulting in a negligible consequence is considered low.
Likelihood ranking	4 - Unlikely
Consequence ranking	A - Negligible
Residual Risk Ranking	Tolerable

Management Control	**Effectiveness of Control**
Waste (garbage) management procedure reduces potential for accidental overboard release	Reduces probability of garbage being discharge to sea, reducing potential impacts to marine fauna. Ensures food waste is discharged in manner that does not pose risks to the environment
General chemical management procedures help reduce the environmental impact to marine environment caused by discharge of subsea hydrocarbons/chemicals	Potential impacts to the environment are reduced through following correct procedures for the safe handling of chemicals
Communications systems during lifts to reduce potential dropped objects	Potential impacts to the environment are reduced through prevention of dropped objects occurring
Dropped object prevention procedures reduce risk of unplanned releases overboard	Impacts to environment are reduced by preventing dropped object and by retrieving dropped objects where possible
Streamer deployment/ retrieval procedure reduce risk of streamer loss during activity	Reduces potential impacts to the marine environment due to streamer loss or damage.
Equipment Maintenance to reduce potential impacts from equipment not operating efficiently	Ensures that lifting equipment is maintained and certified, and that lifting procedures are followed reducing probability of dropped objects occurring with the potential to result in hydrocarbon spills.

OPEP provides options for controlling the source of any unplanned hydrocarbon/chemical spills and mitigate potential impacts	Implements response plans to deal with an unplanned hydrocarbon release quickly and efficiently in order to reduce impacts to the marine environment.
Survey and support vessel spill response plans provide options for controlling the source of any unplanned hydrocarbon/chemical spills and mitigate potential impacts	

6.3.5 Marine Fauna Collisions

Event: Marine Fauna Collisions	There is the potential for vessels/equipment from the vessels involved in the activity to collide with marine fauna including cetaceans, fish, marine reptiles and seabirds. The main collision risk associated with the activity is through vessel collision or equipment collision with large, slow moving cetaceans; potentially resulting in severe injury or mortality.
Potential receptors	Marine fauna – Fish, cetaceans, marine reptiles, seabirds
Potential Impacts	Cetaceans are naturally inquisitive marine mammals that are often attracted to vessels underway; for example, dolphins commonly 'bow ride' with vessels. Marine fauna in surface waters that would be most at risk from vessel collision include marine mammals, marine turtles and whale sharks. The worst potential impact from vessel collision would be mortality or serious injury of an individual. Collisions between vessels and cetaceans are most frequent on continental shelf areas where high vessel traffic and cetacean habitat occur simultaneously (WDCS, 2006). There have been recorded instances of cetacean deaths as a result of vessel collisions in Australian waters (e.g. a Bryde's whale in Bass Strait in 1992) (WDCS, 2006), though the data indicates this is likely to be associated with container ships and fast ferries. Whale and Dolphin Conservation Society (WDCS) (2006) also indicates that some cetacean species, such as humpback whales, can detect and change course in order to avoid a vessel. The reaction of whales to the approach of a ship is quite variable. Some species remain motionless when in the vicinity of a ship while others are known to be curious and often approach ships that have stopped or are slow moving, although they generally do not approach, and sometimes avoid, faster moving ships (Richardson et al., 1995). Marine turtle mortality due to boat strike has been identified as an issue in Queensland waters in the Marine Turtle Recovery Plan (Commonwealth of Australia, 2013). However, turtles appear to be more vulnerable to boat strike in areas of high urban population where incidents of pleasure crafts are higher. WA turtle populations have not been highlighted as those most affected by boat strike, possibly due to the relatively low human population density of the NWS coast line. Interaction between marine turtles and seismic activities, either through collision with the seismic vessel or entanglement with the streamers, have not been identified as a significant threat to marine turtle species. The tail buoys also have turtle guards on them to deflect turtles and reduce risk of entanglement. Given that the survey and support vessels will move slowly (<5 knots) within the operational area, the risk of collision with marine fauna is extremely low. Additionally, the observed avoidance behaviour exhibited by marine fauna in response to seismic discharges (see **Section 6.2.3**), means that cetaceans, marine reptiles and fish species are likely to avoid any moving vessels further reducing potential risks
Impact assessment	
Receptor	**Consequence**
Threatened / Migratory Fauna	In the event of a collision with marine fauna, there is the potential for injury or death to an individual. The number of receptors present at the survey area are expected to be limited to

	a small number of transient individuals, no significant areas of habitat are present in the immediate vicinity of the survey area and the presence of the seismic source. Boat strike and vessel disturbance are identified as potential threats to a number of marine fauna species in relevant Recovery Plans and Conservation Advice. The above information demonstrates that the Activity will be conducted in a manner that reduces potential impacts to ALARP and of acceptable level. In addition, the Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves states that DPAW should 'Maintain records of the incidence of entanglement, boat collisions and stranding of marine mammals in the reserves' and 'Maintain a database of turtle mortality and incidents of entanglement in the reserves'. Such incidents are recorded and reported by Quadrant. Additionally, the Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves states that relevant industry activities should be undertaken at times and places that do not conflict with humpback whale migration through the reserves. Quadrant will not undertake the survey during whale migration season (1 May through to 31 December). It is recognised that individual blue and humpback whales may be present at any time, and therefore potential impacts outside of peak migration periods may occur. For this reason Quadrant Energy will still implement EPBC Policy Statement 2.1 Part A and Part B.1 and B.6. With controls in place ensuring the vessel is compliant with EPBC Regulations, the risk of marine fauna collision is reduced. The seismic survey vessel will not enter the Barrow Island Marine Park. As such there is the potential for death or injury of EPBC listed individual species, however as they would represent a small proportion of the local population it is not expected that it would result in a decreased population size over what would usually occur due to natural variation, at a local or regional scale, It is expected that the loss of an individual would be a minor consequence.
Likelihood	The Australian National Marine Safety Committee (NMSC) reports that during 2009, there was one report of a vessel collision with a marine animal (species not defined) (NMSC, 2010). No known aggregation areas occur within the operational area and therefore concentrations of milling individuals are unlikely. Pygmy blue whales may be encountered in the operational area, which overlaps with BIA for migration. Tagging surveys have shown pygmy blue whales migrating northward relatively near to the Australian coastline (100 km) until reaching North West Cape after which they travelled offshore (240 km) to Indonesia. Passive acoustic data documented pygmy blue whales migrating along the Western Australian shelf break (Woodside, 2012). The National Conservation Values Atlas has identified the pygmy whale migration pathway on the continental shelf edge at depth of 500 to 1,000 m (McCauley & Jenner 2010). Breeding areas have not yet been identified however it is likely that pygmy blue whales calve in tropical areas of high localised production such as deep offshore waters of the Banda and Molucca Seas in Indonesia (Double et al. 2014). There are no known breeding areas of significance to blue whales in waters from Busselton to the Northern Territory border. Vessels will be moving very slowly whilst inside the operational area, posing a low risk of collision with marine fauna. Whilst no speed restrictions are in place within the operational area, it is common practice to maintain a slow speed during normal operations. In addition, the presence of the seismic source will deter marine fauna from coming in close proximity to vessels. Subsequently the likelihood of a collision with marine fauna resulting in a minor consequence is considered to be unlikely.
Likelihood ranking	4 - Unlikely
Consequence ranking	B - Minor
Residual Risk Ranking	Tolerable

Management Control	**Effectiveness of Control**
EPBC Regulations (Part 8) for interacting with cetaceans implemented to minimise	Reduces risk of physical and behavioural impacts to cetaceans

the disturbance to fauna caused by noise or aircraft strike	
Marine fauna observations undertaken to minimise the disturbance to fauna caused by the Activity	
Turtle guards fitted to minimise risk of entanglement with marine fauna	Tail buoys on the streamers will be fitted with turtle guards to minimise the risk of entanglement of marine fauna.
Adaptive management of green turtles- pre survey aerial observation conducted	Reduces potential impacts to green turtles during peak nesting season and therefore limits potential impacts to individuals only and affords protection to aggregations in the unlikely event they are present

6.3.6 Introduction of Invasive Marine Species

Event: Marine Fauna Collisions	Invasive marine species (IMS) can be introduced into the operational area and surrounds by vessels carrying IMS on external biological fouling, internal systems (sea chests, seawater systems etc.), on marine equipment (streamers etc.), or through ballast water exchange. Cross contamination between vessels can also occur.
Potential receptors	Marine fauna - fish; benthic habitats Socio-economic - fisheries
Potential Impacts	IMS are marine plants, animals and algae that have been introduced into a region that is beyond their natural range but have the ability to survive, and possibly thrive (DAFF, 2011). The majority of climatically compatible IMS to the NWS are found in south-east Asian countries. Some IMS pose a significant risk to environmental values, biodiversity, ecosystem health, human health, fisheries, aquaculture, shipping, ports and tourism (DAFF, 2011; Wells et al., 2009). When IMS achieve pest status, they are commonly referred to as introduced marine pests or IMPs. IMPs can cause a variety of adverse effects in a receiving environment, including: • over-predation of native flora and fauna; • out-competing of native flora and fauna for food; • human illness through released toxins; • depletion of viable fishing areas and aquaculture stock; • reduction of coastal aesthetics; and • damage to marine and industrial equipment and infrastructure. The success of IMS establishment is complex and dependent upon a number of factors such as the physical, chemical and biological conditions that the species has been translocated to.
Impact assessment	
Receptor	**Consequence**
Threatened / Migratory Fauna	Ballast water is responsible for 20–30% of all marine pest incursions into Australian waters, however, research indicates that biofouling (the accumulation of aquatic micro-organisms, algae, plants and animals on vessel hulls and submerged surfaces) has been responsible for more foreign marine introductions than ballast water (DAFF, 2011). IMS, if they successfully establish, can out-compete native species for food or space, preying on native species or changing the nature of the environment and can subsequently impact on fisheries or aquaculture. If an IMS is introduced, they have been known to colonise areas outside of the areas they are introduced to. Subsequently there is the potential for an introduction. In the event that an IMS is introduced into the operational area, given the lack of diversity and extensiveness of similar benthic habitat in the region, there would only be a minor reduction in the physical

	environment. No threatened ecological communities are present in the area that could be affected. The overall consequence level was assessed as minor.		
Likelihood	The pathways for IMS introduction are well known, and subsequently standard preventative measures are proposed. The ability for invasive marine species to colonise a habitat is dependent on a number of environmental conditions. It has been found that highly disturbed environments (such as marinas) are more susceptible to colonisation than open water environments where the number of dilutions and the degree of dispersal are high (Paulay et al., 2002). Given the depth of the operational area (30-830 m), it is unlikely that an IMS would be able to successfully translocate from the operational area to surrounding shallower habitats. With controls in place to reduce the risk of introduction of IMS the likelihood of introducing an IMS is considered unlikely.		
Likelihood ranking	4 - Unlikely	**Consequence ranking**	B - Minor
Residual Risk Ranking	Tolerable		

Management Control	**Effectiveness of Control**
Biofouling vessel risk assessment (VRASS) undertaken to reduce likelihood of IMS entering the Operational Area	The risk of introducing IMS are reduced due to assessment procedure
Biofouling system reduces the likelihood of IMS entering Operational Area as bio-fouling	The risk of introducing IMS are reduced due to anti-foulant systems
Ballast water management plan implemented to reduce likelihood of IMS entering the Operational Area	Reduces the risk of introducing IMS through procedures managing ballast water exchange and identifying high risk ballast water

7. MANAGEMENT APPROACH

The Hockey Bianchi seismic survey activity will be managed in compliance with all measures and controls detailed within the EP accepted by NOPSEMA under the OPGGS (E) Regulations, other environmental legislation and Quadrant's Management System (e.g. Environmental Management Policy).

The objective of the EP is to ensure that potential adverse environmental impacts associated with unplanned events and planned events associated with the survey, are identified and assessed, and to stipulate mitigation measures to avoid and/or reduce any adverse impacts to the environment to ALARP.

The EP details specific performance objectives, standards and procedures, and identifies the range of controls to be implemented (consistent with the standards) to achieve the performance objectives. The EP also identifies the specific measurement criteria and records to be kept to demonstrate the achievement of each performance objective.

As described in the EP, the implementation strategy includes the relevant details of the following:

1. Environmental Management System;
2. Environmental management policy;
3. Leadership, Accountability and Responsibility;
4. Workforce training and competency;
5. Hazard Identification, Risk and Impact Assessment and Controls;
6. Environmental performance standards and outcomes;
7. Workforce involvement and stakeholder communications;
8. Information management and document control; and
9. Operations management;

During the period that activities described in the EP are undertaken, Quadrant will ensure environmental performance is managed through an inspection and monitoring regime undertaken by Quadrant representatives or delegates based on the vessels.

Environmental compliance of an activity with the EP (and the EPO's) is measured using planned and systematic audits or inspections to identify weaknesses and non-conformances in the system and processes so that they can be identified. Improvement opportunities identified through monitoring, audits and incident investigations are implemented in a controlled manner and communicated to all relevant workforce, contractors and relevant third parties. Audits and inspections are in place to identify possible incidents and actions taken to prevent them from happening.

Non-conformances found are addressed and resolved by a systematic corrective action process and are reported to NOPSEMA where relevant.

Senior Quadrant and vessel contractor personnel will be accountable for ensuring conformance with environmental performance outcomes and standards and all personnel will be empowered to 'stop-the-job' to ensure the activity is being implemented in an environmentally responsible manner. The EP identifies specific responsibilities for each role during the activity.

Incident notification and reporting to NOPSEMA and other regulators will be conducted as per the OPGGS(E)R, as detailed within the EP. Reported HSE incidents and hazards will be communicated to personnel during daily operational meetings.

7.1 Management of Change

Quadrant's *Environmental Management of Change Procedure* (EA-91-IQ-10001) (MOC) process provides a systematic approach to initiate, assess, document, approve, communicate and implement changes to EPs and OPEPs (currently in force) whilst meeting the requirements of the OPGGS (E) R.

The MoC process considers Regulation 7, 8 and 17 of the OPGGS(E) Regulations, and determines if a proposed change can proceed and the manner in which it can proceed, or if a revision of the EP and OPEP needs to be

submitted to NOPSEMA for a determination on whether it can proceed. For a change to proceed, the associated environmental impacts and risks must be demonstrated to be acceptable and as ALARP. Additional stakeholder consultation may be required depending on the nature and scale of the change. Additional information on the MoC process is provided in **Figure 7-1.**

Accepted MoCs become part of the in force EP or OPEP, will be tracked on a register and made available on Quadrant's intranet. Where appropriate, Quadrant's environmental compliance register will be updated to ensure control measure or environmental performance standard changes are communicated to the workforce and implemented.

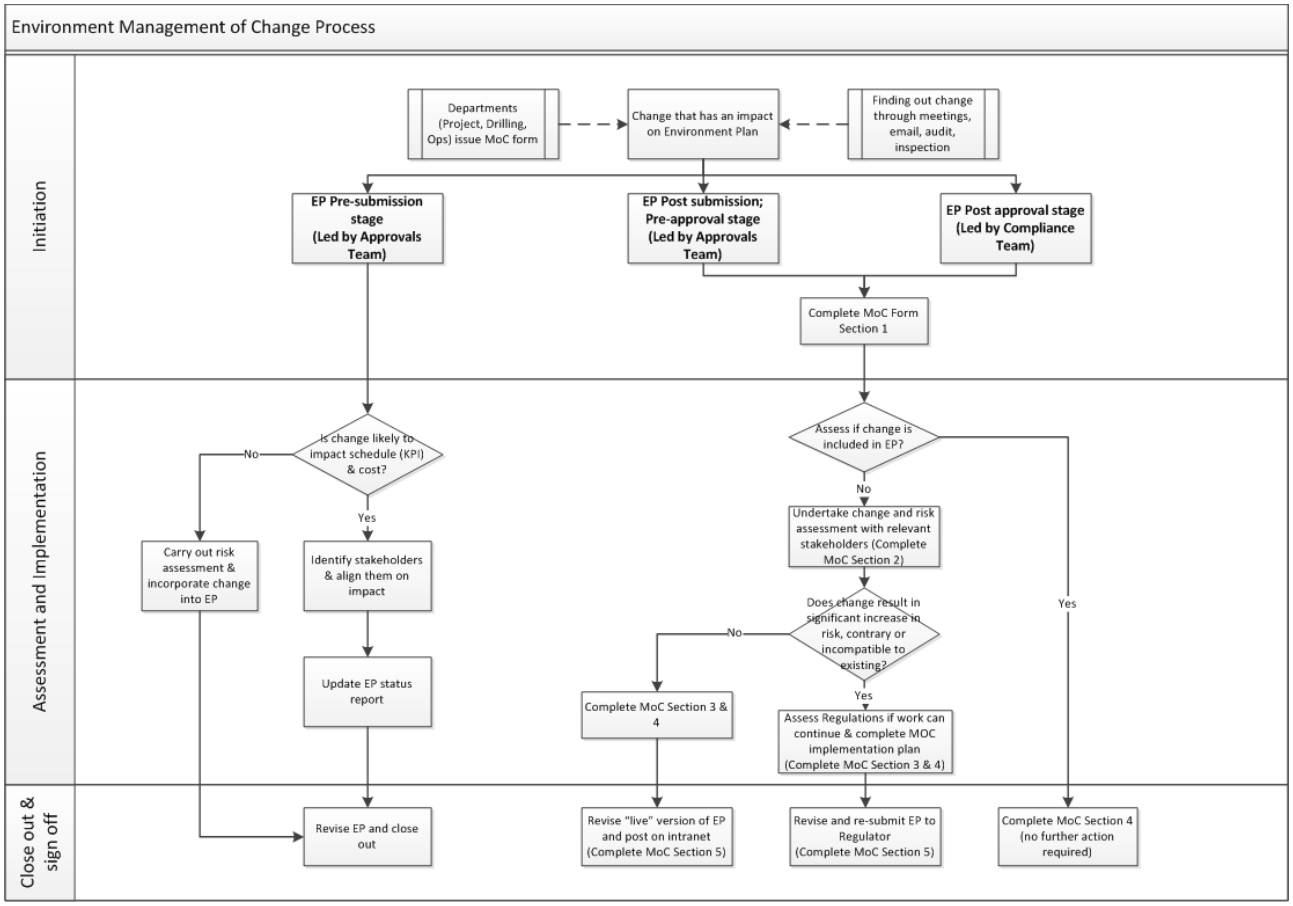

Figure 7-1: Environment Management of Change Process

8. HYDROCARBON SPILL RESPONSE ARRANGEMENTS

In the event of a hydrocarbon spill, oil spill response strategies will be implemented where possible to reduce environmental impacts. The selection of strategies will be undertaken through the Net Environmental Benefit Analysis (NEBA) process, outlined in the OPEP.

The following response strategies may be applicable to the identified credible Marine Gas Oil (MGO) spill scenarios:

- Source Control activities;
- Monitor and evaluate;
    - Vessel surveillance;
    - Aerial surveillance;
    - Tracking buoys;
    - Satellite imagery;
    - Unmanned Aerial vehicles (UAV) (Drones with cameras); and
    - Spill fate modelling
- Shoreline clean-up operations;
- Wildlife response operations including hazing and capture and rehabilitation; and
- Scientific monitoring to assess oil impact and recovery.

8.1 Preparedness and Implementation of Response Arrangements

Seismic and support vessels are required to have and implement incident response plans, such as an emergency response plan and SOPEP. Regular incident response drills and exercises (e.g. as defined in emergency response plan, SOPEP etc.) will be carried out on seismic vessels and support vessels to refresh the crew in using equipment and implementing incident response procedures.

Quadrant will implement the Hockey and Bianchi Oil Pollution Emergency Plan (EA-00-RI-10148.02) in the event of a significant hydrocarbon spill (Tier 2 or 3). To maintain a state of oil spill preparedness, personnel with OPEP responsibilities will be made aware of their obligations, oil spill response equipment will be maintained, contracts with critical equipment and personnel suppliers will be managed, and agreements will be in place with national regulatory agencies for support in oil spill response. Quadrant will also implement its oil spill response exercise and training schedule.

Following acceptance of an OPEP, the arrangements of the plan are tested by the Emergency & Oil Spill Coordinator through testing and exercising of personnel, organisations and suppliers with roles defined within the plan, including a pre-start Communications Test. The external agencies and companies/suppliers are notified of the start-up schedule of the activity and are evaluated for the preparedness to deliver on their committed function. The Communications Tests are repeated annually for activities that extend longer than 1 year, and are repeated if the response arrangements change over time. If the surveys are acquired separately, a communications test will be completed prior to each one.

Table 8-1: Spill response strategies considered for the mitigation of contact from hydrocarbon spills

Oil Spill Response Strategy	MGO	Justification	Relevant impacts in the EP
Source Control	Yes	Source control is one of the first response strategies implemented when mounting a spill response. Source control minimises the volume of hydrocarbons lost to the environment by securing the source of the spill.	Source control activities are vessel based, vessel impacts and risks have been described and evaluated in Section 6.
Monitor and Evaluate	Yes	Surveillance is used to monitor and evaluate the dispersion of the released hydrocarbon, and to identify and report on any potential contacts to environmental sensitive receptors that may occur while the spill disperses. Surveillance results are used to assist in escalating or de-escalating response strategies as required.	Monitoring and evaluation activities are vessel based (when not office based). Vessel impacts and risks have been described and evaluated in Section 6. Tracker buoys for trajectory evaluation may be deployed from vessels. No additional impacts to those identified from vessel operations associated with Monitor and Evaluate activities have been identified. There are not significantly greater impacts or risks from vessels associated with Monitor and Evaluate activities than have already been described within the approved EP.
Physical Dispersion	No	Physical dispersion is undertaken by running vessels through the hydrocarbon plume and using the turbulence developed by the propellers or hydro-blasting from vessel hydrants to break up the slick. Once dispersed in the water column in the form of smaller droplet sizes, biodegradation processes are enhanced. Considered an opportunistic strategy, it is usually used on targeted, small, breakaway areas. Physical dispersion is not applicable as a response strategy because of the nature of the MGO—preferentially relying on evaporation rather than dispersing toxic components of the fuel into the water column, and the physical environment in the spill location – wave energy able to provide the mixing that could be provided by propellers. However, its applicability will be assessed during the NEBA.	N/A
Protection and deflection	No	Protection and deflection activities involve the use of booms to protect sensitive receptors, to deflect spills away from sensitive receptors or shorelines, or to deflect spills to an area that provides increased opportunity for recovery activities. Given the rapid evaporation and dispersion of MGO (13 hours) it is unlikely that booms will be deployed before the majority of the slick had evaporated or dispersed.	N/A

Oil Spill Response Strategy	MGO	Justification	Relevant impacts in the EP
Containment and recovery	No	Containment and recovery of hydrocarbons can offer a preventive form of protection to sensitive receptors. Skimmers (mechanical) and booms may be used at sea. This strategy, however, is often technically unfeasible due to weather conditions and hydrocarbon characteristics e.g. containment and recovery operations need to have a high hydrocarbon thickness, which is not compatible with MGO. Containment and recovery is not applicable as a response strategy due to the ineffectiveness of containment and recovery methods on thin surface MGO films and the rapid evaporation rate of MGO, the use of containment and recovery as a response strategy for a MGO spill is not applicable.	N/A
Shoreline clean-up	Yes	Shoreline clean-up would involve removal of all recoverable oil and response generated waste. Response strategies may include manual bagging of stranded oil where access can be gained, surf washing where wave action and sandy beaches are accessible by machinery, tilling and turning the sand to aid bioremediation where wave action is not strong enough to drive surf washing, rock flushing with high volume low pressure sea water, or leaving the weathered oil in-situ to breakdown where access for man or machinery is not possible. However a stranded MGO would evaporate very quickly in the high temperatures experienced on the land and so it is highly unlikely these strategies would be required. A NEBA would be used to assess their suitability as per the OPEP.	Shoreline clean-up response activities are vessel and land based operations. Vessel impacts and risks have been described and evaluated in Section 6. Land based operations are assessed using NEBA as per the OPEP.
Oiled Wildlife Response	Yes	Wildlife operations may be required to deter fauna from an area that has been or is likely to be oiled and if fauna is oiled. It is applicable for marine fauna that contact, or come close to the spill when on the water.	Oiled wildlife response activities are vessel and land based operations. Vessel impacts and risks have been described and evaluated in **Section 6.** Activities specific to oiled wildlife response have also been assessed in Section 6.
Operational and Scientific Monitoring	Yes	Extent of spill to determine the extent of operational and scientific monitoring. Resources are available to implement operational and scientific monitoring as required.	Monitoring and evaluation activities are vessel or aircraft based (when not office based). Vessel and aircraft impacts and risks have been described and evaluated in Section 6.
In Situ Burning	No	In-situ burning is not an applicable response strategy given several limiting factors that are likely to prevent implementation. In-situ burning cannot be undertaken in rough conditions as containment is likely to be interrupted by winds greater than approximately 20 knots and	N/A

Oil Spill Response Strategy	MGO	Justification	Relevant impacts in the EP
		waves are higher than 3 feet (Allen 1990). Furthermore, for in-situ burning to be undertaken oil has to be thicker than 1-2 mm and as MGO tends to have high evaporation rates and spread into very thin films this strategy is not applicable for this activity. As such, this response strategy is not applicable for this activity.	

8.2 Net Environmental Benefit Analysis

During any response incident, there is a documented decision making process to ensure that response strategies are identified and evaluated prior to implementation via the Incident Action Plan (IAP). The Incident Control Team use a Net Environmental Benefit Analysis (NEBA) process to inform the development and refinement of the IAPs, to ensure the most effective response strategies with the least detrimental environmental impacts are identified, documented and executed. The Environmental Team Lead is responsible for reviewing the priority receptors identified within the EP and the OPEP, and with real time knowledge of the fate and transport of the spill, apply the NEBA.

The application of the NEBA is to:

- Identify sensitivities within the area potentially affected by a spill at that time of the year;
- Assist in prioritising and allocating resources to sensitivities with a higher ranking; and
- Assist in determining appropriate response strategies.

8.3 Oil Spill Response Resources

Oil spill response equipment and resources are a combination of Quadrant, AMOSC (Australian Marine Oil Spill Centre Pty Ltd), AMSA, DoT, National Plan (NatPlan), OSRL (Oil Spill Response Limited), and other operator resources available through the AMOSPlan mutual aid arrangements. Under the Memorandum of Understanding (MOU) between AMSA and Quadrant, AMSA will provide all resources available through NatPlan to support a Quadrant spill response. The DoT coordinates the State Response Team (SRT) oil spill response personnel and equipment resources. The DoT will work with Quadrant in an oil spill response and will define termination criteria for the shoreline operations designed to reduce the environmental impacts and risk to ALARP in State waters. Where oil contacts shorelines in Commonwealth waters, Quadrant will work with the Department of the Environment to establish shoreline clean-up priorities, activities and termination criteria.

In the event of an oiled wildlife response, Quadrant will activate the West Australian Oiled Wildlife Response Plan (WAOWRP) and work with DPaW in determining resources and capability requirements. DPaW and Industry (AMOSC) Oiled Wildlife Advisors (OWAs) ensure minimum standards for oiled wildlife response, as outlined within the WAOWRP, are met and ensure timely mobilisation of appropriate resources (equipment and personnel) through communication with the wildlife logistics team. Quadrant are able to access:

- AMOSC core group responders;
- DPaW staff and approved volunteers/subject matter experts;
- Additional local resources under current contracts and suppliers; and
- Access international support through Wildlife Response Services.

During and post-spill scientific response monitoring activities require resources external to Quadrant and include specialist technical capabilities. If additional support is required, Quadrant has Master Service Agreements with other service providers to support scientific response monitoring activities.

9. CONTACT DETAILS

Further information about the Hockey Bianchi 3D Seismic Survey can be obtained from:

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