
Bight Petroleum Pty Ltd

# Lightning 3D Marine Seismic Survey (Bight Basin) Environment Plan

(EPP-41 & EPP-42)

Date: 21st March 2014

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# Revision history

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| Rev. | Date | Description | By | Chk'd | App. |

# Distribution list

| Copy number | Recipient |
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| 9 | Vessel Master – Support Vessel |
| 10 | Marine Environment Division - AMSA |
| 11 | Oil Spill Response Unit – SA Department of Planning, Transport & Infrastructure |

# Bight Petroleum Pty Ltd Environment Policy

**Health Safety and Environment Policy**

At Bight, we recognize our responsibility to meet community expectations and we are committed to an industry leading standard of Health, Safety and Environmental (HSE) performance.

We believe that Health and Safety Management as well as Environmental Stewardship are the responsibilities of all parties associated with Bight: Board, Management, Employees, Consultants and Contractors.

To achieve our goals we will:

- Establish HSE objectives and targets and then implement programs to achieve them
- Construct, maintain and continuously improve an HSE Management System in the company
- Monitor and review our HSE performance against defined objectives
- Ensure that we allocate sufficient resources necessary to achieve our HSE objectives
- Ensure that all employees, consultants and contractors understand and fulfil their individual HSE responsibilities
- Incorporate HSE performance assessment in employee, consultant and contractor appraisal, including recognition where appropriate
- Proactively pursue the identification and elimination of all hazards, or if that is not possible, we will manage hazards to a level of risk that is as low as reasonably practical
- Implement strategies to minimize pollution, manage waste effectively and use energy efficiently and address relevant biodiversity and heritage issues
- Promote the active participation of employees in managing their own and others' health, wellbeing and safety as well as in minimizing any environmental impacts arising from Bight's activities
- As a minimum standard, comply with all relevant legal and regulatory requirements

Matthew Philipchuk

Chairman and Chief Executive Officer

Revision 2.0 December 6, 2013

# Approvals

This Environment Plan has been prepared for Bight Petroleum Pty Ltd and is approved for the Lightning 3D Marine Seismic Survey.

| NAME | Signature | Date |
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| **Matt Philipchuk**<br><br>Chief Executive Officer<br>Bight Petroleum Pty Ltd |  | 21/03/2014 |

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# 1 Introduction

## 1.1 Activity Background

Bight Petroleum Pty Ltd ('Bight') is proposing to undertake the Lightning 3D Marine Seismic Survey (MSS) in the Commonwealth waters of the Bight Basin, South Australia (SA). This MSS area is located approximately 104km west of Kangaroo Island (SA) and 68km south of Cape Carnot (Eyre Peninsula) (SA) in Petroleum Exploration Permit Areas EPP41 and EPP42.

The objectives of this Environment Plan (EP) are to demonstrate:

- Compliance with all applicable legislation;
- The environmental operator understands how the proposed operations will interact with the environment;
- The environmental and other marine user impacts for normal (planned) and abnormal (unplanned) events have been identified and the impacts and risks have been reduced to a level which is acceptable and as low as reasonably practicable (ALARP);
- Appropriate environmental performance outcomes, environmental performance standards and measurement criteria are in place to measure the environmental performance of the Titleholder associated with the activity;
- Appropriate consultation has been undertaken with 'relevant' persons to understand possible activity impacts and identify mitigation measures (as far as possible); and
- There is systematic implementation of controls (i.e. management system strategies) and continued assessment of new hazards and risk throughout the activity to manage environmental impacts and risks associated with the activity.

## 1.2 Environmental Plan Scope & Structure

This EP covers activities associated with the proposed Lightning 3D MSS in EPP-41, EPP-42 and adjacent non-permit areas[1] utilising a purpose-built seismic vessel. The MSS is expected to take up to 70days to complete with the earliest commencement date of 1st March 2015 (or 2016) and the latest completion date of 30th May 2015 (or 2016).

Following this introduction, this EP is structured as follows:

- **Section 2** provides a description of the location of the activity and the equipment to be used during the seismic survey;
- **Section 3** provides a summary of the existing physical and cultural environment within the survey area;
- **Section 4** provides a summary of the legislative framework and relevant legislation applicable to the MSS activity;
- **Section 5** details the risk assessment process which has been undertaken. This section identifies MSS activities which potentially impact the physical and social

[1] For the purpose of defining the operational boundaries of this Environment Plan, all project vessels are considered to be undertaking the activity described in **Section 2** when located in the 'Lightning Vessel Turning Area' defined in **Section 2**. Environmental risks associated with the activity include both routine (operational) and non-routine (accidental) events within this boundary. Mobilisation and demobilisation activities, and deployment from site associated with port calls or emergencies are controlled under Australian maritime legislation (which reflect MARPOL requirements) and are **not included** within the operational boundary of this Environment Plan.

environment, provides the environmental management strategies to control the environmental impact and risk to acceptable and ALARP conditions and details the environmental performance outcomes, environmental performance standards and measurement criteria for the survey;

- **Section 6** details the implementation strategies to be followed during the survey to ensure environmental risk is managed and environmental management systems to identify roles and responsibilities, practices, processes and resources used to manage the environmental aspects of the survey (e.g. consultation, training, inspection, audit, review and monitoring activities); and
- **Section 7** provides details on internal and external reporting requirements; and
- **Section 8** details Oil Pollution Emergency Plan (OPEP) response arrangements for the Lightning MSS program.

## 1.3 Revisions to the Environment Plan

In the event the seismic program alters to include a new activity; a significant modification, change or new stage to the activity; a significant new or increased environmental impact or risk is identified during the activity and is not provided for in the EP/OPEP[2]; or at the request of the National Offshore Petroleum Safety & Environmental Management Authority (NOPSEMA); the Bight Petroleum Liaison Person (refer **Section 2.1**) will ensure this plan is revised and resubmitted to the regulator for acceptance in accordance with the *Offshore Petroleum & Greenhouse Gas Storage (Environment) Regulations 2009*[3].

In the event that there is a change in Titleholder and the change will result in the manner the environmental impacts and risks of the activity are managed, the new titleholder will be submit a revision to this Environment Plan to NOPSEMA.

[2] This includes oil-spill related risks and impacts.
[3] In accordance with *Offshore Petroleum & Greenhouse Gas Storage (Environment) Regulations 2009* (Regulation 17 & Regulation 18).

# 2 Seismic Program Activity

## 2.1 Seismic Activity Titleholder

Bight Petroleum Pty Ltd ('Bight') is the nominated Titleholder to undertake Eligible Voluntary Actions (EVA) under the Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Section 775C) for petroleum activities in Exploration Permits EPP41 and EPP42 located in the Commonwealth waters of the Bight Basin (offshore SA).

The registered office for the EPP41 & EPP42 Titleholder and Bight Liaison Person is as follows. Any changes to the Titleholder, Liaison Person or Company contact details will be advised by the Bight Petroleum Chief Executive Officer (CEO) to NOPSEMA and NOPTA (as required).

**TITLEHOLDER DETAILS:**

***Bight Petroleum Pty Ltd (ABN 61 143 444 106)***

159 Darley Rd, Randwick, NSW, 2031

**LIAISON PERSON:**

| | |
|---|---|
| Name: | [redacted] |
| Business Address: | GPO Box 1884, Adelaide 5001 |
| Telephone No: | [redacted] |
| Email: | [redacted] |

## 2.2 Survey Objectives

Bight Petroleum has been awarded Exploration Permits EPP-41/EPP-42 by the Australian Government which provides for the exploration of hydrocarbon resources in these areas located in offshore Commonwealth waters. These exploration activities support resource development within Australia through an economically rational framework which considers both short-term and long-term environmental/social considerations with future provision of income to the Australian Government.

The Australian Government, through the National Strategy for Ecologically Sustainable Development (1992) and associated institutional arrangements, has set policy frameworks which integrate ESD principles into strategy documents such as the National Greenhouse Response Strategy, the National Strategy for the Conservation of Australia's Biological Diversity, the National Waste Minimisation and Recycling Strategy, etc. These strategies underpin legislative documents relevant to, and observed in, this Environment Plan such as Conservation Management and Threat Abatement Plans, Marine Bioregional Plans, Threatened Species Recovery Plans, Waste Minimisation and Energy Efficiency Policies. Accordingly, through the adoption of all relevant legislation and underpinning policy documents in this EP Bight Petroleum will undertake all activity within EPP-41/EPP-42 consistent with the principles of ESD.

Bight intends to conduct the Lightning 3D MSS to better define the subsurface geology of the permit areas to accurately define potential prospective petroleum targets for exploration drilling within EPP41 and EPP42 in a suitable economic, commercial, environmental and technical manner. This is consistent with work-plans submitted for the exploration permits to the Commonwealth Department of Innovation (DOI) as part of permit award.

It should be noted that the Lightning MSS area has been designed to:

- Cover the most prospective parts of EPP-41 and EPP-42 (i.e. significantly less than the total area of the permits) and has been reduced in area as much as possible;
- The survey streamer selection (i.e. 8-10 streamers) allows the acquisition period to be minimised compared with the use of a vessel with a smaller number of streamers which will take a longer period of time and more seismic lines to minimising the period the vessels are at sea.

## 2.3 Seismic Survey Location

This Marine Seismic Survey, an exploration activity, does not require an Offshore Project Proposal acceptance by NOPSEMA prior to Environment Plan acceptance.

The Lightning 3D MSS area covers an area of approximately 3,000km$^2$ and is located entirely within Commonwealth waters (Refer **Figure 2-1**) of the Bight Basin (Duntroon and Ceduna sub-basins) (SA). The MSS area where data acquisition will occur is defined by coordinates shown in **Table 2-1**. The seismic vessel will also execute turns up to 10km outside this defined MSS area working within a 'Vessel Turning Areas' as shown in **Figure 2-2** and will operate in a south-east/north-west direction when acquiring seismic data maintaining a distance of at least 65km from the SA coastline. **Table 2-2** provides coordinates of the Vessel Turning Area associated with the survey activities.

The Lightning MSS area is located approximately 104km west of Kangaroo Island (SA) and 68km south of Cape Carnot (Eyre Peninsula) (SA). The closest landfall point is Liguanea Island (SA) located 65km north and North & South Neptune Islands (SA) located 68km NE. Approximately 62% of the survey is ocean-wards of the 200m isobath (i.e. on the continental slope area) with the water depth ranging from 130m along the northern boundary to 2400m along the southern margin of the survey area.

The MSS will be split into two racetracks as shown in **Figure 2-2**. Racetrack 1 will straddle the shelf edge (i.e. on shelf and slope). Racetrack 2 will be totally in deep water exceeding 1000m.

The MSS vessel will deploy and retrieve equipment off the continental shelf to avoid fisheries interaction. This will be managed by close cooperation between the Bight Offshore Representative, the local fishing fleet and the deployment of the scout/escort vessel to identify any conflicting fisheries activities if present. In addition, any unplanned turning circles due to such events as the proximity of cetaceans or third party vessels/equipment will, as long as safety considerations are taken into account be implemented in an offshore, as opposed to onshore, direction.

As discussed further in Section 4, for the survey area which lies outside EPP41 and EPP42 (in non-permit areas), an access authority will be obtained from NOPTA to allow for data acquisition in these areas.

It should be noted that this EP does not apply to transit activities where vessel(s) have left the MSS area for port call activities or during emergency shelter activities. It also does not apply to shore-based activities.

Figure 2-1: Proposed Lightning 3D MSS Location

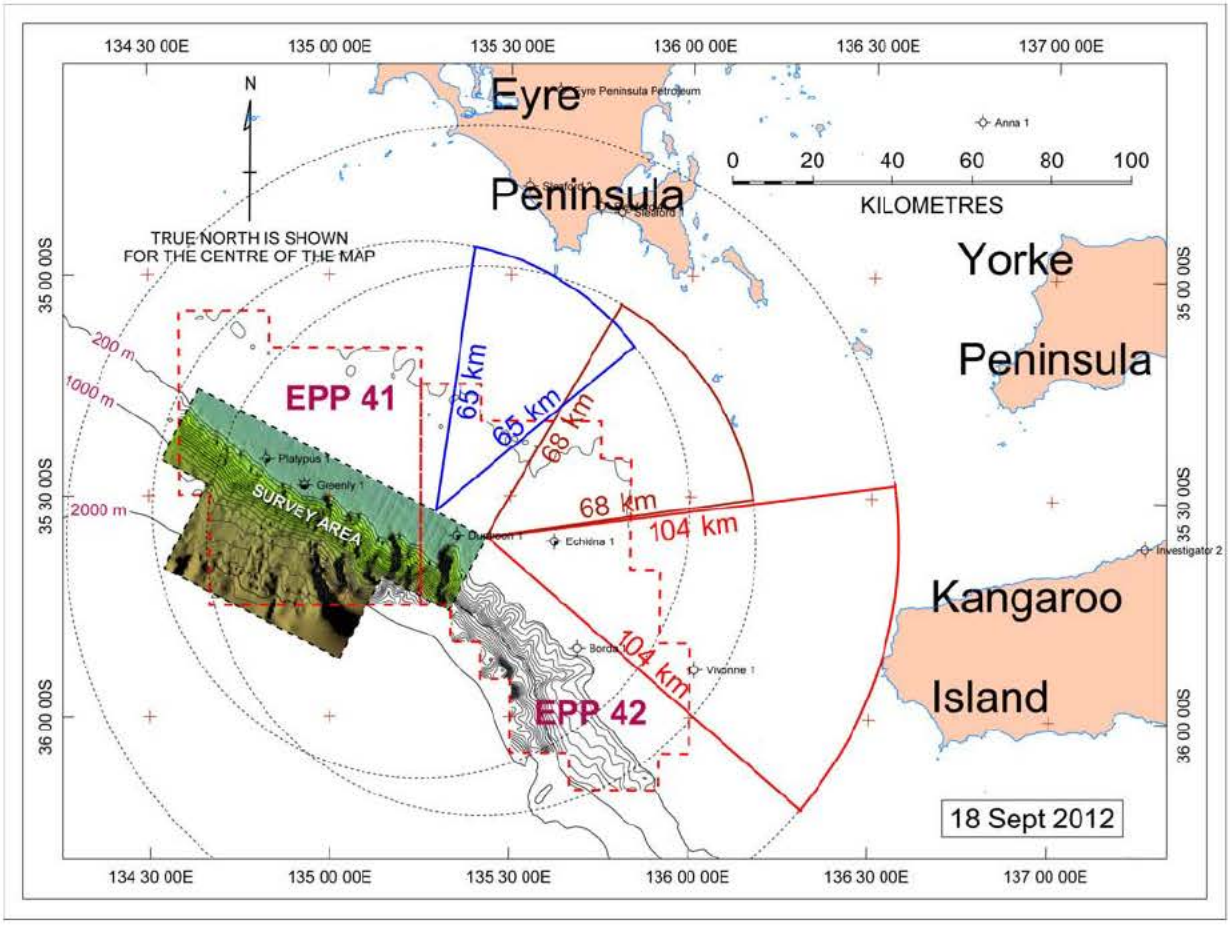



Table 2-1: Lightning 3D MSS Survey Area (Full-fold Data Acquisition) Boundary Coordinates

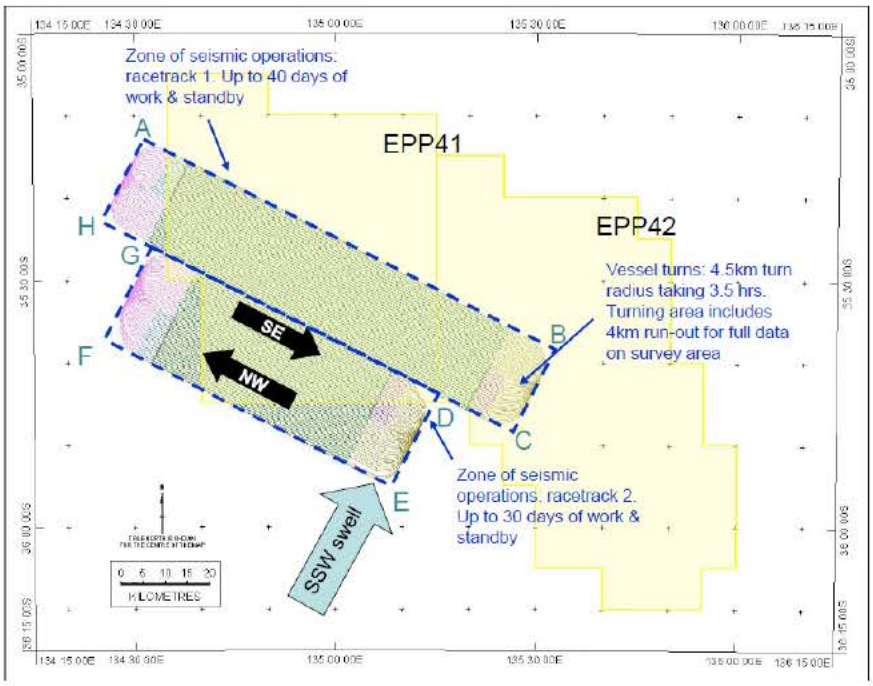
| Location Point | Latitude | | | Longitude | | |
|---|---|---|---|---|---|---|
| | Degrees | Minutes | Seconds | Degrees | Minutes | Seconds |
| 1 | 35 | 15 | 30.45 | 134 | 38 | 14.47 |
| 2 | 35 | 35 | 42.46 | 135 | 26 | 03.11 |
| 3 | 35 | 45 | 38.01 | 135 | 19 | 50.12 |
| 4 | 35 | 40 | 59.07 | 135 | 08 | 43.93 |
| 5 | 35 | 52 | 13.82 | 135 | 01 | 37.77 |
| 6 | 35 | 39 | 50.27 | 134 | 32 | 25.09 |
| 7 | 35 | 28 | 27.39 | 134 | 39 | 41.55 |
| 8 | 35 | 25 | 11.65 | 134 | 32 | 03.50 |

The Lightning 3D MSS seismic lines/area is provided diagrammatically in **Figure 2-2.**

Table 2-2: Lightning 3D MSS Survey Vessel Turning Area Boundary Coordinates

| Location Point | Latitude | | | Longitude | | |
|---|---|---|---|---|---|---|
| | Degrees | Minutes | Seconds | Degrees | Minutes | Seconds |
| A | 35 | 12 | 59.50 | 134 | 31 | 28.50 |
| B | 35 | 38 | 15.30 | 135 | 32 | 45.40 |
| C | 35 | 48 | 28.30 | 135 | 27 | 05.50 |
| D | 35 | 44 | 01.00 | 135 | 15 | 56.30 |
| E | 35 | 54 | 50.30 | 135 | 08 | 15.30 |
| F | 35 | 37 | 30.30 | 134 | 25 | 45.30 |
| G | 35 | 26 | 02.50 | 134 | 32 | 45.03 |
| H | 35 | 22 | 50.50 | 134 | 25 | 40.50 |

Figure 2-2: Proposed Lightning 3D MSS Seismic Area and Sequence Lines (including vessel turning area)



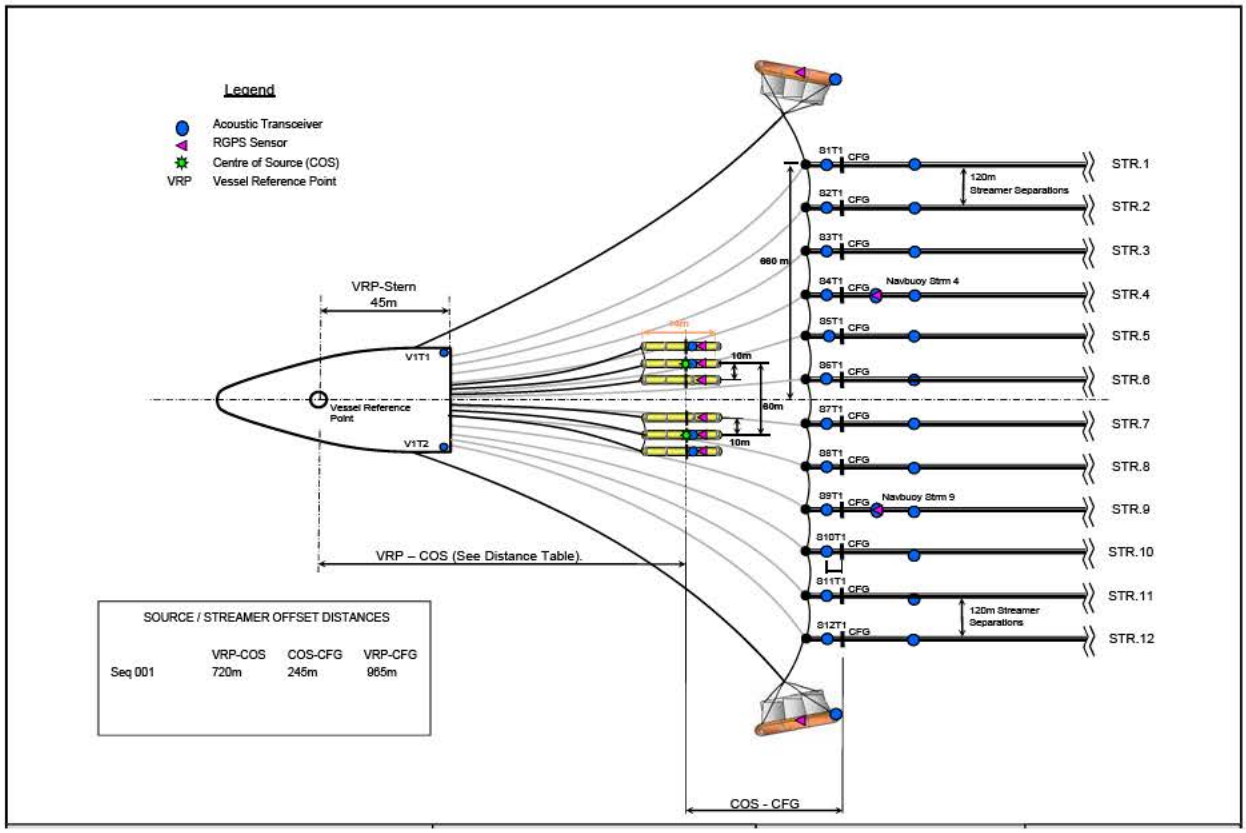

## 2.4 Seismic Program Scope

The Lightning 3D MSS will be undertaken by the seismic contractor utilising a purpose-built seismic vessel, towing seismic equipment along a series of predetermined seismic lines within the survey area. The vessel will, while acquiring seismic, travel at average speeds of approximately 8–9 km/h (4–4.5 knots). As the vessel travels along the survey lines a series of acoustic pulses (approximately every 11 seconds) will be directed down through the water column into the seabed via a dual source array. The acoustic signals are attenuated through the subsea geological structure; reflect at geological boundaries and the reflected signals detected using hydrophones, arranged in series along a number of cables (streamers) towed behind the survey vessel. Data collected by the hydrophones is stored in on-board computers for processing and analysis, allowing the structure of the underlying geological strata to be determined and potential hydrocarbon reservoir targets to be identified.

The seismic equipment will consist of up to twelve (12) hydrophone collectors ('streamers'), each with a maximum length of 8,100m separated by approximately 100-120m. The source array will be towed at a depth of approximately 6m and the streamer tow depth will be approximately 8m. The acoustic equipment on-board will consist of a dual source array, each up to 3250in$^3$ volume operating at 2000psi. These source arrays will be fired alternately, with a shot point interval of approximately 25m. Acoustic modelling performed on a 3090in$^3$ calculated a theoretical sound Sound Exposure Level (SEL) of 228dB re 1µPa$^2$.s (CMST, 2012).

The towing diagram for a two source array/twelve 8100m streamer configuration is shown in **Figure 2-3**. The MSS vessel will traverse the survey area along defined transects (or seismic lines) 500-720m apart in water depths from approximately 130m-2400m.

Figure 2-3: Proposed Lightning MSS Source and Streamer Towing Diagram




The hydrophone streamers have an outer jacket made of plastic. The jacket may be filled with a synthetic gel[4] which assists in maintaining the neutral buoyancy of the cable and prevent seawater ingress. The streamers comprise of 150m 'sections' which limit the amount of material which can be lost to the environment due to shark-bite or cable damage. For gel-filled streamers, each hydrophone in the streamer is housed in a small volume of Isopar M (a synthetic iso-paraffinic hydrocarbon) to allow for the reception of returning sound pressure waves (gel would otherwise attenuate the received levels to unacceptably low levels).

Synthetic rope strain members ('stretchers') are also inserted into the head and tail of the streamer to provide mechanical isolation from the various towing forces. These stretch sections are designed to stretch by about 10% under towing forces, and are filled with approximately 250-300litres of Isopar-M.

[4] In the event of streamer damage by shark bite of fishing gear presence, no material escapes into the marine environment.

Seismic acquisition will be undertaken 24 hours per day, seven days per week and is expected to continue for a total period of approximately 70days, dependent on weather conditions and operational efficiency. *It should be noted that although the vessel will be present in the area for this period the source arrays will probably not operate at full power 24 hours per day due to line changes and standby due to weather, potential shipping traffic, cetacean and fishing activity and some technical downtime for maintenance. It would be unusual for the source arrays to operate at full power for more than 70% of this time.*

Seismic activities are planned to occur in sea-states of less than 4.5m significant wave height. Streamer/gun deployment and retrieval are limited in sea-states greater than this.

The earliest commencement date of the Lightning 3D MSS is March 1, 2015 (or 2016) and latest completion date is May 30, 2015 (or 2016). The precise commencement and completion dates will be dependent on vessel availability and weather conditions.

Prior to commencement of MSS operations, Bight will issue, via the Australian Hydrographic Office (AHO), a Notice to Mariners for the program, to notify vessels which may be operating in nearby waters. Two vessels will be used for support/escort activities and will be on standby to direct any shipping traffic away from the MSS area. In addition, the MSS vessel and streamers will display appropriate navigational safety measures such as day shapes, lights and reflective tail buoys to indicate that the vessel is in tow and restricted in its ability to manoeuvre. A visual and radar watch will be maintained on the bridge at all times by trained and competent crew (STCW95 or equivalent).

The seismic vessel will operate under an approved Shipboard Oil Prevention Emergency Plan (SOPEP) which details actions to be taken in the event of a shipboard emergency or oil spill in accordance with MARPOL 73/78 Annex I requirements.

**Table 2-3** summarises the basic seismic parameters for the Lightning 3D MSS. Minimum standards for the selected vessel are defined in this Environment Plan.

Table 2-2: Lightning MSS 3D Seismic Program Parameters

| Parameter | Details |
|---|---|
| *Program Details* | |
| Earliest Seismic Commencement Date | 1 March 2015 (or 2016) |
| Duration of Survey (approx. max) | 70 Days |
| Speed (knots) | 4-4.5 (Seismic) |
| Total Area of Full Fold Survey | 3000km$^2$ |
| Lead in/out Distance (3D) | 10km |
| Depth of Water | 130-2400m |
| Distance between seismic lines | 500-720m |
| *Seismic Parameters* | |
| Total Volume of the Airgun array | 3250in$^3$ (dual source) |
| Airgun operating pressure | 2000psi |
| Streamer Type | Gel, solid |
| Length/Number of Streamer | 8100m/12 |
| Depth of Steamers | 8m (approx.) |
| Source Interval | 25m |
| Hours of Operation | 24/7 |
| Method of Crew Change | Port Call |
| Refuelling | Port Call or At Sea |
| Supply/Scout Vessel | Two vessels |
| Supply Port | Port Lincoln, Adelaide or Geelong |

## 2.5 Logistics Support

Port Lincoln (SA) will preferentially be used as a logistics and supply base for the operation however the Port of Adelaide (SA) or Geelong (Vic) may also be utilised. During the MSS there will be one support and an escort/chase vessel servicing the seismic vessel for logistical, safety and equipment management support. Functions of these vessels is to escort the MSS vessel; to scout ahead of the MSS vessel for marine hazards; to maintain a safe distance between the towed array and other vessels; to manage interactions with shipping and fishing activities; to act in an emergency-response capacity and, on a secondary basis, supply the MSS vessel with logistical supplies.

The vessels will not anchor at sea unless required in an emergency. Refuelling of vessels at sea will preferentially not occur[5].

Crew changes will preferably occur during port calls, however helicopter transfer may occur. Helicopter transfer from Port Lincoln or Adelaide will occur during daylight hours wherever possible however night transfer may be required in the event of an operational emergency, medical evacuation or other non-routine circumstance. Air ambulance services are based in Adelaide. There will be no helicopter refuelling on-board the seismic vessel.

Emergency medical facilities are available at Port Lincoln. If required, crew can be airlifted to Adelaide's medical facilities (Royal Adelaide Hospital).

[5] This has been included as a contingent activity in this Environment Plan.

# 3 Description of Environment

For the purposes of describing relevant environmental sensitivities and values associated with matters protected under the *Environment Protection and Biodiversity Act 1999* ('EPBC Act'), the following aspects of the environment should be noted based upon the nature and scale of the activity:

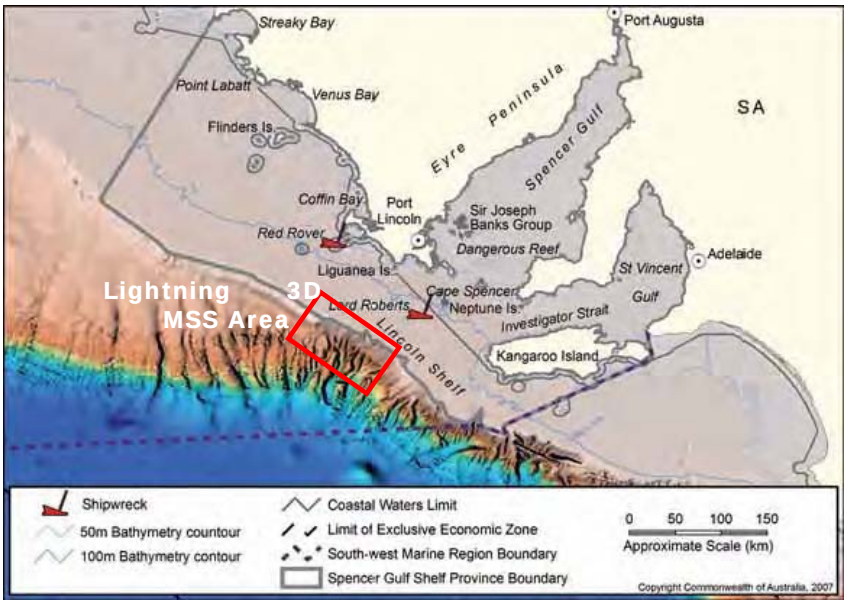
- The MSS activity will not be undertaken in, or effect a World Heritage Property[6], National Heritage Place[7], declared RAMSAR wetland[8], or threatened ecological community[9];
- The Commonwealth marine environment of the MSS area encompasses a portion of the Western Eyre Commonwealth Marine Reserve (i.e. multi-use zoning) (refer **Section 3.1.2** for environmental sensitivities, values and key ecological values);
- There will be a presence of EPBC-listed threatened and migratory species (refer **Section 3.4** for details).

## 3.1 Regional Setting

### 3.1.1 Southwest Marine Bioregion

The Lightning MSS is located in the South-West Marine Bioregion (DEWHA, 2007) and lies within the **Spencer Gulf Shelf Province** and **Southern Province Bioregions** (refer **Figure 3-1**).

Figure 3-1: Spencer Gulf/Southern Province Marine Bioregion (DEWHA, 2007)




[6] The closest World Heritage Property to the MSS area is the Royal Exhibition Building and Carlton Gardens (Melbourne) located approximately 890km to the east. Survey activities will not affect this area.
[7] The closest National Heritage Place to the MSS area is the Narracoorte Australian Fossil Mammal site located approximately 500km to the ESE. Survey activities will not affect this area.
[8] The closest RAMSAR wetland to the MSS area is the Coorong located approximately 330km to the east. Survey activities will not this area.
[9] The closest threatened ecological community to the MSS area is at Port Lincoln (Peppermint Box Grassy Woodland) located approximately 110km to the north. Survey activities will not affect this area.

The **Spencer Gulf Shelf Province** extends east from Ceduna to Cape Jaffa, occupying the 0-200m isobath range (DEWHA, 2007). Within this bioregion, seasonal winds and ocean currents interact with the seafloor features to produce irregular seasonal upwellings high in biological productivity. The Lightning MSS area lies adjacent to, an irregular upwelling area, lying on the shelf to the west of Kangaroo Island, known as the Kangaroo Island Pool. This is a 'pool' of sub-surface, cold, nutrient rich water which is upwelled along the shelf south of Kangaroo Island during late spring and summer, advected north-west along the western Eyre Peninsula (Pattiaratchi, 2007) and entrained between the 100m and 200m isobaths (McClatchie et al, 2006; cited in Blue Whale Study Inc. 2012). This upwelling relies on upwelling favourable winds and coastal trapped waves to create events which can occur over 3-10 days and some 2-4 times per season. The along-shore currents can be large (~40cm/s) and the vertical scale of the upwellings are of the order of 150km (off Kangaroo Island) (Middleton & Bye, 2007). Analysis of wind records obtained from Neptune Island during the summer (November to April) identified upwelling favourable winds were present 50% of the time (Ward et al, 2006; cited in Pattiaratchi, 2007). Inter-annual variability in upwelling activity (i.e. stronger events) appears linked to El Nino events (Pattiaratchi, 2007)

This province is regarded as a productive commercial fishing area in Australia, producing sardines and anchovies (finfish fishery) and for supporting migratory Tuna (Ward et al, 2006; cited in Blue Whale Study Inc., 2012; Pattiaratchi, 2007). As a result of this high biological productivity, aggregations of marine life such as New Zealand Fur Seals, Australian Sea Lions, dolphins, penguins, sharks, seabirds and cetaceans are also drawn to the area (DEWHA, 2007).

The **Southern Province** bioregion extends from the shelf break south of Kangaroo Island (SA) to the southern edge of the Naturaliste Plateau (WA) occupying waters deeper than 200m (DEWHA, 2007). The canyons south of Kangaroo Island, located approximately 120km southeast of the Lightning MSS area, and the adjacent shelf-break receive upwellings of nutrient-rich water. Canyon areas, both at the shelf edge and on the slope, appear to be an important aggregation area (spawning, mating and feeding) for a range of commercial species especially during winter (DEWHA, 2007). There are highly productive giant crab; lobster; and gummy shark grounds along the shelf edge. Commercially important south-eastern Australia slope species including blue grenadier, blue eye trevalla, ling, hapuka, warehou, gemfish, orange roughy and school shark are fished, or have been fished, in the area (DEWR, 2006). Given the area's high level of productivity the water column also supports large predator groups such as sharks, cetaceans and New Zealand Fur Seals (DEWHA, 2007).

### 3.1.2 Marine Conservation Areas

Commonwealth Marine Parks: The Lightning 3D MSS area is located within the Western Eyre Commonwealth Marine Reserve (Zoned Multiple Use Zone (IUCN VI) (refer **Figure 3-2**) (SEWPC, 2012t). Petroleum development is permissible in these zones with the approval of the Director of National Parks in addition to approvals required under the *EPBC Act 1999* and *OPGGSA 2006*. Major conservation values identified for this area include (SEWPC, 2011u):

- Seasonal calving habitat for the threatened Southern Right Whale in inshore areas;
- Important foraging habitat for the White Shark, Australian Sea Lion, Blue Whale, Sperm Whale and migratory seabirds (Short-Tailed Shearwater and Caspian Tern);
- Key ecological features including the:
    - Ancient coastline (high productivity) (refer **Section 3.3.1**);
    - Kangaroo Island Pool, canyons and adjacent shelf-break and Eyre Peninsula upwelling (high productivity and feeding aggregations) (refer **Section 3.3.2**);

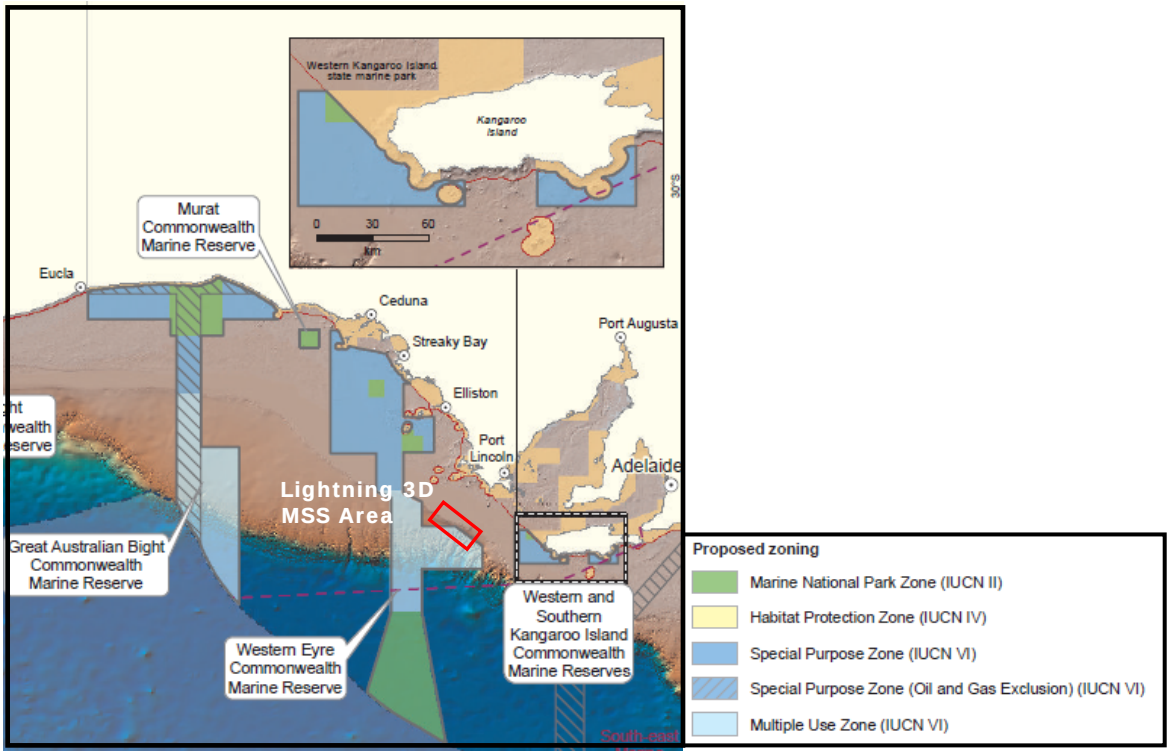
- Meso-scale eddies (high productivity and feeding aggregations) (refer **Section 3.3.3**);
- Benthic invertebrate communities of the eastern Great Australian Bight (high species diversity communities) (refer to **Section 3.4.2**); and
- Areas important for small pelagic fish (species with an important ecological role) (refer **Section 3.4.3**).

The MSS also lies approximately 70km west of the Western Kangaroo Island Commonwealth Marine Reserve and is 400km east of the Great Australian Bight Marine Park[10].

South Australian Marine Reserves: The Lightning MSS area lies in proximity to the following SA Marine Parks:

- **Neptune Islands Marine Group Marine Park** located approximately 60km NE of the MSS area. This park contains breeding populations of Sea Lions, hosts approximately half of the Australian population of New Zealand Fur Seals, is a feeding area for Great White Sharks and hosts roosting and nesting seabirds such as the Caspian Tern, Crested Tern Short-tailed Shearwater. Commercial fishing in the area targets shark, ocean leatherjacket, pilchards and rock lobster (DENR, 2012a);
- **Western Kangaroo Island Marine Park** located approximately 75km east of the MSS area. This park contains colonies of Australian Sea Lions and New Zealand Fur Seals; cetaceans and seabirds. Commercial fishing targets abalone, rock lobster and pilchards (DENR, 2012a);
- **Thorny Passage Marine Park** located approximately 60km NE of the MSS area. This park contains habitat which supports the Australian Sea Lion, New Zealand Fur Seals, white-bellied sea eagles and cetaceans (Southern Right Whale) at Sleaford Bay. Commercial fisheries target southern rock lobster, abalone, pilchards, western king prawn and smaller scalefish species (DENR, 2012a).

Figure 3-2: Commonwealth Marine Park & Zones within Bight Basin (SEWPC, 2012t)



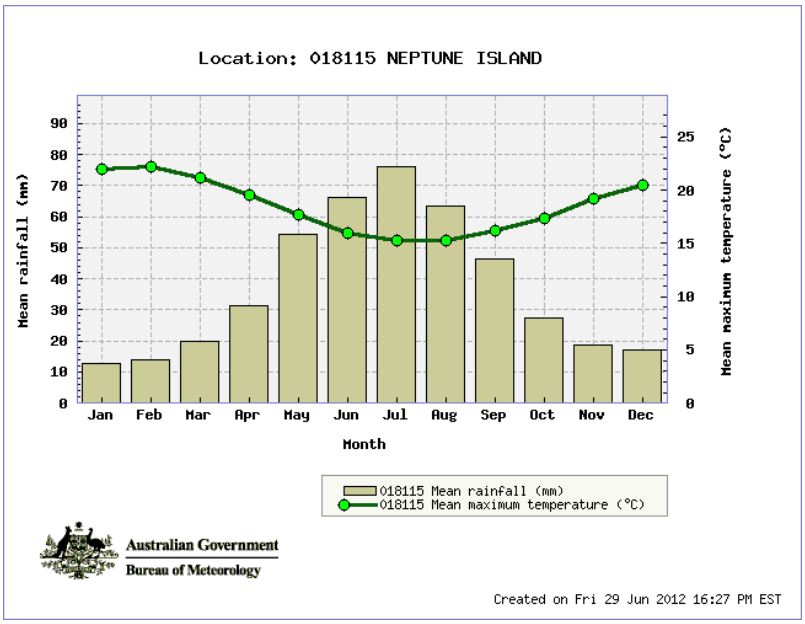

[10] Dimension is measured from nearest MSS boundary.

## 3.2 Physical Environment

### 3.2.1 Climate

The climate of the region is temperate with moderate to high rainfall mostly in winter. The area has a mean maximum temperature of 22.2°C (February) and a mean minimum temperature of 11.1°C (August) (BOM, 2012a). The annual average rainfall is 446mm with the predominant rainfall falling between May and September (refer **Figure 3-3**) (BOM, 2012a).

Figure 3-3: Mean Rainfall and Mean Maximum Temperature for Neptune Island (BOM, 2012a)




Wind roses for the March indicate winds predominate from the South-east direction. During the period April-May the winds are more evenly distributed predominantly occurring from the west (APASA, 2012). Wind roses for the Lightning MSS area are provided in **Figure 3-4.**

### 3.2.2 Oceanography

Sea surface temperatures are generally higher offshore than inshore during both winter and summer-autumn. Offshore waters are warmer during summer-autumn (19-23°C) than during winter (~17°C) (Ward et al, 2008).

The Leeuwin current predominates within the area influencing the biological productivity and biodiversity of ecosystems in the area. The Leeuwin current is a shallow (<300m), narrow (<100km wide) current transporting warm, nutrient-depleted water from the tropics along the southern coast of Western Australia, east to Tasmania. This current has marked seasonal variation with the strongest flows occurring in winter. During summer the Leeuwin current weakens and coastal winds generate west-bound coastal currents along the inner shelf. Beneath the Leeuwin current is the cooler water of the westward flowing Flinders Current which extends from the surface to a depth of 1000m with peak currents of 0.2m/s at about 600m depth. The Flinders current is stronger in summer (Pattiaratchi, 2007) with its strength affected by wind and water body density on the shelf. It can vanish or reverse direction at various times (DEWHA, 2007). The Flinders current facilitates irregular coastal upwellings during summer and autumn (Ward et al, 2008) when south-easterly winds favourable for upwelling events can dominate, however the timing of upwelling events is variable (Ward et al, 2008). Surface current roses for the Lightning MSS area are provided in **Figure 3-5**.

The MSS area lies adjacent to a small upwelling area west of Kangaroo Island, known as the 'Kangaroo Island Pool'. This 'pool' of cold, nutrient rich water upwells along the shelf south of Kangaroo Island between December and April (DEWHA, 2007) and moves north-west along the south and west of the Eyre Peninsula (Pattiaratchi, 2007) along the 100m isobaths (DEWHA, 2007). This upwelling is mainly wind driven but unlike the 'regular' Bonney upwelling near the SA/Victoria border, this upwelling does not appear to be connected directly to submarine canyons, potentially indicating a weaker upwelling mechanism (DEWR, 2006). Down-wellings of waters from the inner to outer-shelf and shelf-break occur during winter. Shallow gulf waters are cooler than the continental shelf waters in winter (~12°C) and warmer in summer (~24°C). In autumn when these waters cool, high salinity water at the head of the Spencer Gulf becomes dense enough to form a current known as 'Bonaparte's tongue'. This dense, salty water is around 20km wide and 20m thick flows out across the Lincoln shelf and fall over the edge of the shelf to approximately 250m water depth. This occurs in regular pulses over a period of approximately three (3) months (DEWHA, 2007).

Figure 3-4: Wind Roses Lightning MSS Area (APASA, 2012)

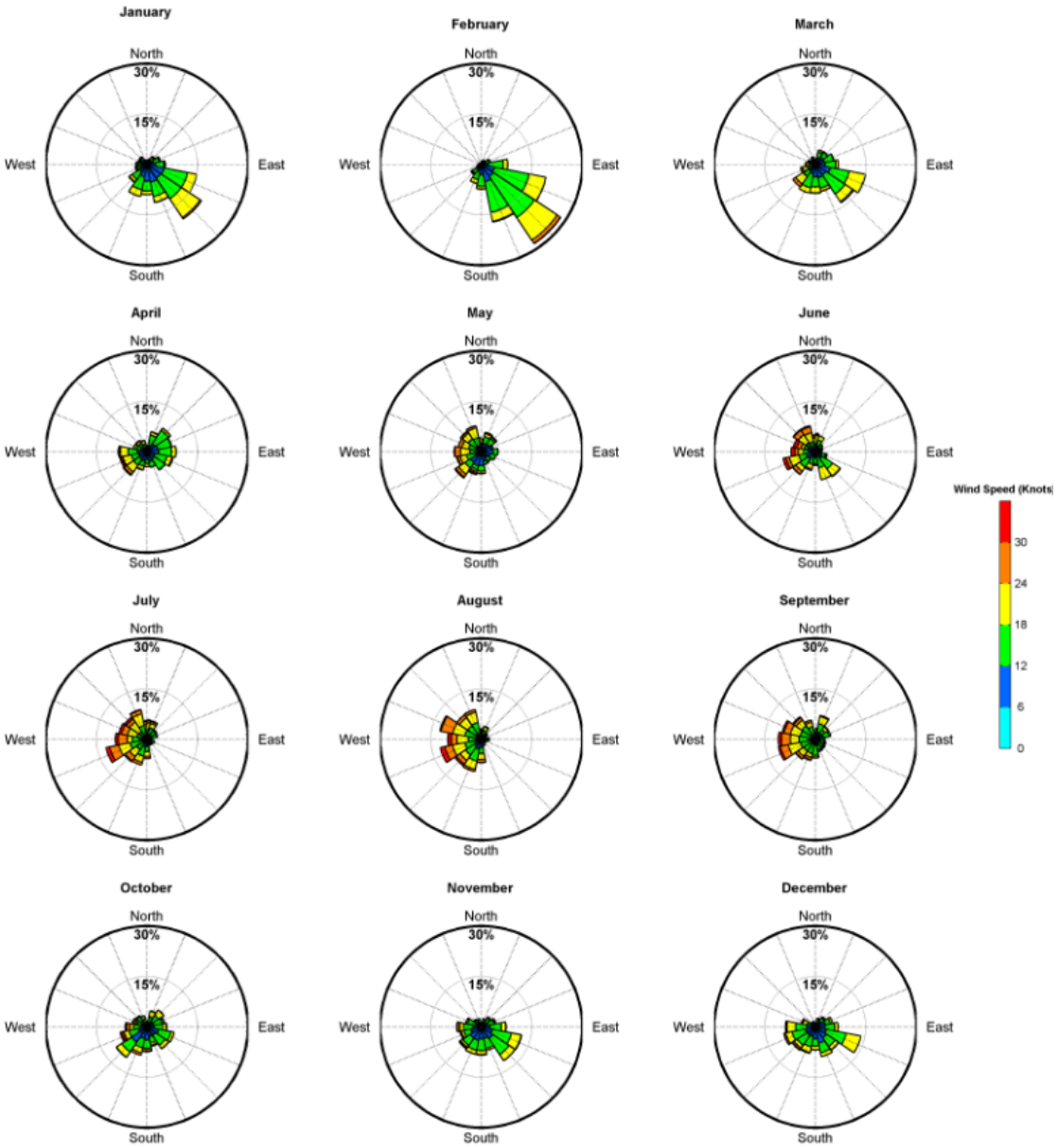
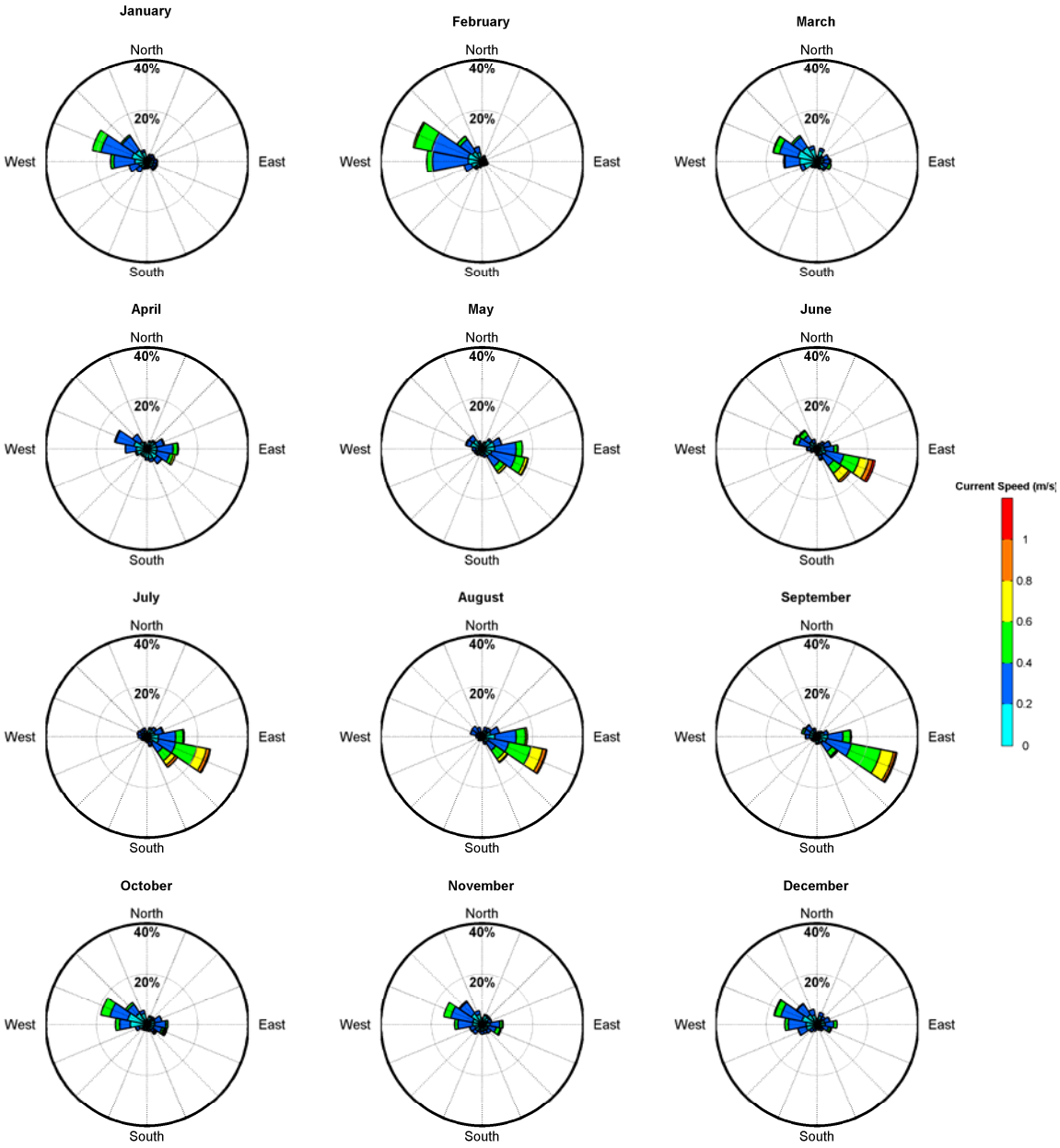


Figure 3-5: Current Roses for Lightning MSS Area (APASA, 2012)




The region has a moderate to high energy coastline with the tidal range in the area of the order of 0.8-1.2m (IMCRA, 1998). Swells predominate from the southwest and the eastern Great Australian Bight (GAB) coastline is subjected to high wave energies. Swell waves are generally 2-2.5m high and can reach 12-14m high on the outer shelf (Richardson et al, 2005). Shelf waters are well mixed in winter due to a strong Leeuwin current and swell/storm waves; and stratified (up to 7$^{o}$C) in summer from cooler Southern Ocean water intruding onto the shelf (Richardson et al, 2005).

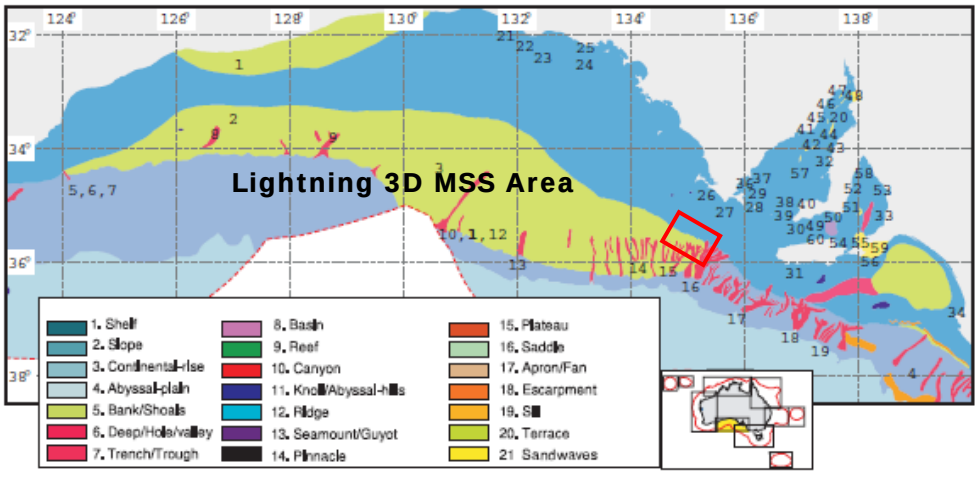
### 3.2.3 Bathymetry & Seabed Type

The proposed MSS area is located in depths of approximately 130-2400m within the Bight Basin over two distinct features: the Australian continental shelf and the continental slope incorporating a portion of the Murray Group of Canyons (specifically the Topgallant, Lincoln and Whidbey Canyons). In the eastern GAB, the gently sloping continental shelf narrows from approximately 100km wide to 30km adjacent to Kangaroo Island (Harris et al, 2005). The continental shelf extends approximately 85km offshore from the Eyre Peninsula and the continental slope starts at the 200m isobath.

The continental slope contains numerous submarine canyons which are generally oriented perpendicular to the shelf-break (Harris et al, 2005). Ceduna canyon is located at 133°E and consists of a small V-shaped canyon with flat floor, lying adjacent opposite the boundary of the Eucla Basin and basement rocks (Harris et al, 2005). The Murray Canyon Group is located between longitudes 135-138°E (refer **Figure 3-6**). The topography of the canyons is extremely rough and is characterised by small steep furrows and several large deep canyons. The Murray and Sprigg Canyons located approximately 200km SE of the MSS area, are particularly large features each with a vertical relief in excess of 2000m. The heads of the canyons in this group are both amphitheatre and dendritic in shape (Harris et al, 2005). Canyons average around 35km in length and are 5km wide (Potter et al, 2006). Canyons provide pathways for transporting sediment, nutrients and biota off the continental shelf and slope onto the abyssal plain, either acting as a sink for relatively organic-rich material or directing it into deeper waters. Canyons are also conduits for upwelling and down-welling which influence nutrient availability and water temperature and form a link between habitats of different water depths (Richardson et al, 2005).

Swell and storm waves from the Southern Ocean influences seafloor sedimentation to depths of ~120m. Most erosion occurs on the middle shelf with ripples present at ~80m and little sedimentation occurring at shallower depths. In water depths 70-120m (outer shelf), exposed limestone substrate is inter-dispersed with patches of mobile sediment which is reworked by swell and storm waves during winter allowing some sedimentation to occur during summer (Richardson et al, 2005).

Figure 3-6: Geomorphic Features of the Southern Margin (Harris et al, 2005)




**Key:** 15 – Topgallant Canyon, 16 - Lincoln Canyon, 17 - De Couedic Canyon, 18 – Murray Canyon, 19 – Sprigg Canyon

The sediment types present on the continental shelf in the MSS area is provided in **Table 3-1**. Surveys indicate a transition from sand-dominated to mud-dominated sediment from the outer shelf to the slope, rise and abyssal plain (Potter et al, 2006).

Table 3-1: Sediment Types (Passlow et al, 2005)

| Parameter | Continental Shelf |
|---|---|
| Sand | 40-60wt% |
| Gravel | 40-60wt% |
| Mud | 0% |
| Mean Grain Size | 0.5-1mm |
| Carbonate Content | 80-100% |

## 3.3 Key Ecological Features

### 3.3.1 Ancient Coastline

The ancient coastline forms a prominent escarpment close to the middle of the continental shelf off the GAB at a depth of 90-120m. The area is relatively high in productivity and aggregations of marine life. It has high levels of biodiversity and endemism with values applying to benthic habitats and associated demersal communities (SEWPC, 2012b).

The SW Bioregional Plan (SEWPC, 2012b) identifies pressures on the integrity of this KEF include physical habitat modification (e.g. bottom trawling); sea level rise, changes to sea temperature, changes to oceanography and ocean acidification; and extraction of living resources (i.e. fishing). *Impact associated with the proposed Lighting MSS activity does not involve habitat modification; changes to sea temperature or oceanographic processes; or extract living resources. On this basis the MSS is not expected to impact on KEF functioning and impacts to the Ancient coastline are not considered further in this EP.*

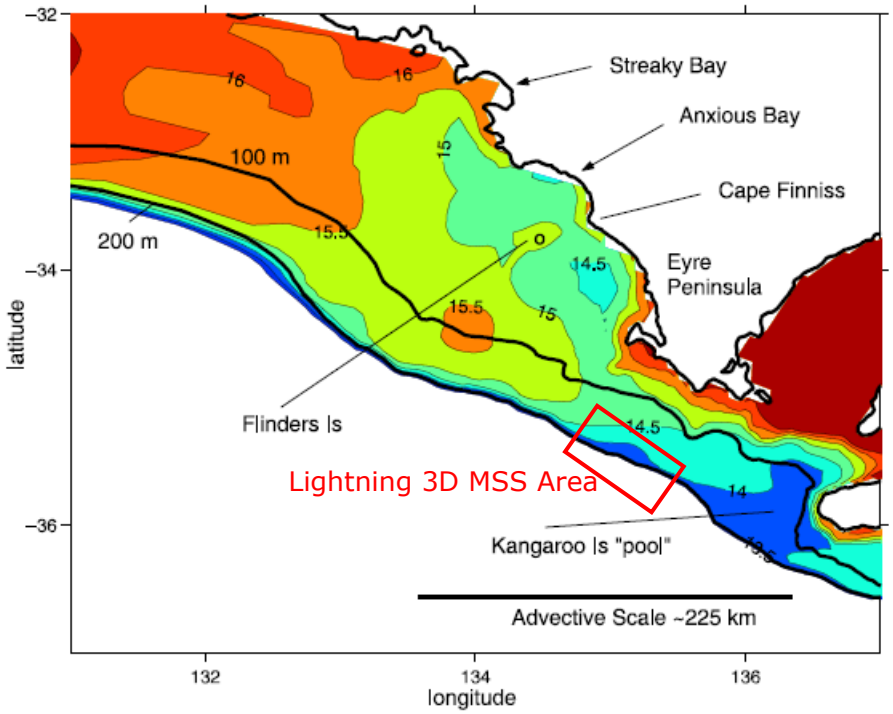
### 3.3.2 Kangaroo Island Pool, canyons and adjacent shelf-break & Eyre Peninsula Upwelling

The Kangaroo Island canyons are a small group of steep-sided narrow canyons commencing at the eastern end of the Ceduna Terrance in the Great Australian Bight (GAB) to the Murray Canyons in the south-east of SA (SEWPC, 2012b). This region supports a distinct Kangaroo Island-Eyre Peninsula marine 'upwelling' system which originates to the south and south-east of Kangaroo Island (Seuront et al, 2010). This canyon system appears to represent a focal point for the *inflow of up-welled nutrient-rich cold water* from a deep thermocline within the Flinders Current (about 600m deep) onto the continental shelf during the summer months (November – April) to the south of Kangaroo Island (Seuront et al, 2010). These upwelling events are unique as they only occur 2 to 4 times a year each over 3 to 10 days during 'upwelling favourable' south-easterly wind regimes (Seuront et al, 2010). Studies indicate (Griffin et al, 1997; Hahn, 1986; cited in Middleton & Platov, 2003) that the upwelling appears to be confined to depths of 150m or less and within 15km of the shelf-break. Studies (Middleton 2007; cited in Pattiaratchi, 2007) also indicate that there is inter-annual variability in the upwelling events and that stronger upwelling events are associated with El Nino conditions.

McClatchie et al (2006) identified from 2004 upwelling data that the shelf-break nutrient rich upwelling is confined to the Kangaroo Island region and does not occur farther to the west off the Eyre Peninsula. It is thought that the upwelled water is likely to remain in the Kangaroo Island "subsurface pool" until subsequent upwelling events draw the water into shallower and surface coastal regions of the Eastern Great Australian Bight (EGAB) (i.e. west of the Eyre Peninsula). **Figure 3-7** provides diagrammatically, water temperature distributions which can typically occur in summer in the Kangaroo Island KEF. Only sea water temperatures between 13-16°C have been colour-coded and dark lines correspond to the 100m and 200m isobaths.

Studies indicate that coastal upwellings in the EGAB during summer/autumn (Nov-April) are characterised by low sea surface temperatures and elevated concentrations of *chlorophyll a* (Ruth, 2009). During upwelling events, surface waters appear to be enriched with nutrients promoting high levels of primary productivity. Marine 'productivity' refers to the harnessing of solar energy producing organic compounds which are utilised by higher trophic levels (Ruth, 2009). Productivity in the EGAB shows significant spatial and temporal variation, reflecting regional and seasonal variation in meteorology and oceanography in the water mass present in the region. The overall productivity of a summer/autumn upwelling season is highly dependent on within-season variations in wind strength/direction which dictate the number, intensity and duration of upwelling events (Ruth, 2009).

Figure 3-7: Water Temperature within the Kangaroo Island/Eyre Peninsula Upwelling Area (McClatchie et al, 2006)




The SW Bioregional Plan (SEWPC, 2012b) identifies pressures on the integrity of this KEF include oil spills[11] affecting aggregations of species at upwellings; extraction of living resources and by-catch; changes in sea temperature, changes in oceanography and ocean acidification as a result of climate changes; and noise pollution[12] to marine mega-fauna (Blue Whale, Southern Right Whale, Humpback Whale, Sperm Whale, Sea Lion). The plan identifies that noise pollution is not a pressure on protected seabirds or shark species within the region however sustained noise disturbance to Southern Bluefin Tuna during their feeding season on the shelf might impact of growth of the species (SEWPC, 2012b).

[11] The Lightning MSS presents a lower risk of oil spill than containerships and oil tankers which utilise SA ports in the gulf areas (no new oil risk introduced as a result of vessel activities).
[12] The SW Bioregional Plan identifies that when an action is undertaken in accordance with the *EPBC Policy Statement 2.1: Interaction between Offshore Seismic Exploration and Whales* the risk of significant impact to whale species is low.

### 3.3.3 Meso-scale Eddies

Meso-scale eddies are pelagic KEFs which are recognised because of its ecological functioning (high productivity) and biodiversity (aggregations of marine life) values (SEWPC, 2012b). These eddies are known to form off the Eyre Peninsula Eddies and are important transporters of nutrients and plankton communities and are likely to attract higher trophic levels such as marine mammals, seabirds, tuna and billfish.

The SW Bioregional Plan (SEWPC, 2012b) identifies pressures on the integrity of the KEF as changes in sea temperature, change in oceanography and ocean acidification as a result of climate change. *Impact associated with the proposed Lighting MSS activity does not involve changes to sea temperature or oceanographic processes. On this basis the MSS is not expected to impact on KEF functioning and is not considered further in this EP.*

## 3.4 Marine Species

### 3.4.1 General

The EPBC Act 1999 lists both threatened and migratory species protected under Commonwealth legislation and various international conventions and treaties. A search of the EPBC Act Protected Matters Database (SEWPC, 2012a) identified the following species as potentially having habitat in the MSS area (refer **Table 3-2**):

- Twenty-eight (28) species of cetacean. Three (3) of these species have a threatened status and nine species have a migratory status under the EPBC Act;
- Two (2) additional mammal species with one having a threatened status under the EPBC Act;
- Three (3) reptile species listed as threatened and migratory;
- Three (3) species of shark. One species has a threatened status and all species have a migratory status under the EPBC Act;
- Seventeen (17) marine bird species are listed with twelve (12) listed an threatened and fourteen (14) listed as migratory; and
- Twenty-seven (27) species of fish are listed including twenty-two (22) species of pipefish, two (2) pipe-horse, two (2) sea-dragons and one (1) species of pipe-horse.

Table 3-2: EPBC Listed Species for the Region Which Includes the Lightning 3D MSS Area (SEWPC, 2012a)

Status:
E: Endangered
V: Vulnerable
M: Migratory
L:Listed

Likelihood of Occurrence:
LO: Species or species habitat likely to occur in area
MO: Species or species habitat may occur within area
FMO: Foraging/Feeding may occur within area
FKO: Foraging/Feeding known to occur in area
KO: Species or species habitat known to occur within area
FLO: Foraging/Feeding likely to occur in area
BO: Breeding known to occur in area

| Species Type | Scientific Name | Common Name | EPBC Status | Type of Presence |
|---|---|---|---|---|
| Marine Birds | Diomedea exulans amsterdamensis | Amsterdam Albatross | E, M | MO |
| | Diomedea exulans exulans | Tristan Albatross | E, M | FMO |
| | Diomedea exulans gibsoni | Gibson's Albatross | V, M | MO |
| | Diomedea exulans (sensu lato) | Wandering Albatross | V, M | MO |
| | Halobaena caerulea | Blue Petrel | V | MO |
| | Macronectes giganteus | Southern Giant-Petrel | E, M | MO |
| | Macronectes halli | Northern Giant-Petrel | V, M | MO |
| | Phoebetria fusca | Sooty Albatross | V, M | MO |

Status:
E: Endangered
V: Vulnerable
M: Migratory
L:Listed

Likelihood of Occurrence:
LO: Species or species habitat likely to occur in area
MO: Species or species habitat may occur within area
FMO: Foraging/Feeding may occur within area
FKO: Foraging/Feeding known to occur in area
KO: Species or species habitat known to occur within area
FLO: Foraging/Feeding likely to occur in area
BO: Breeding known to occur in area

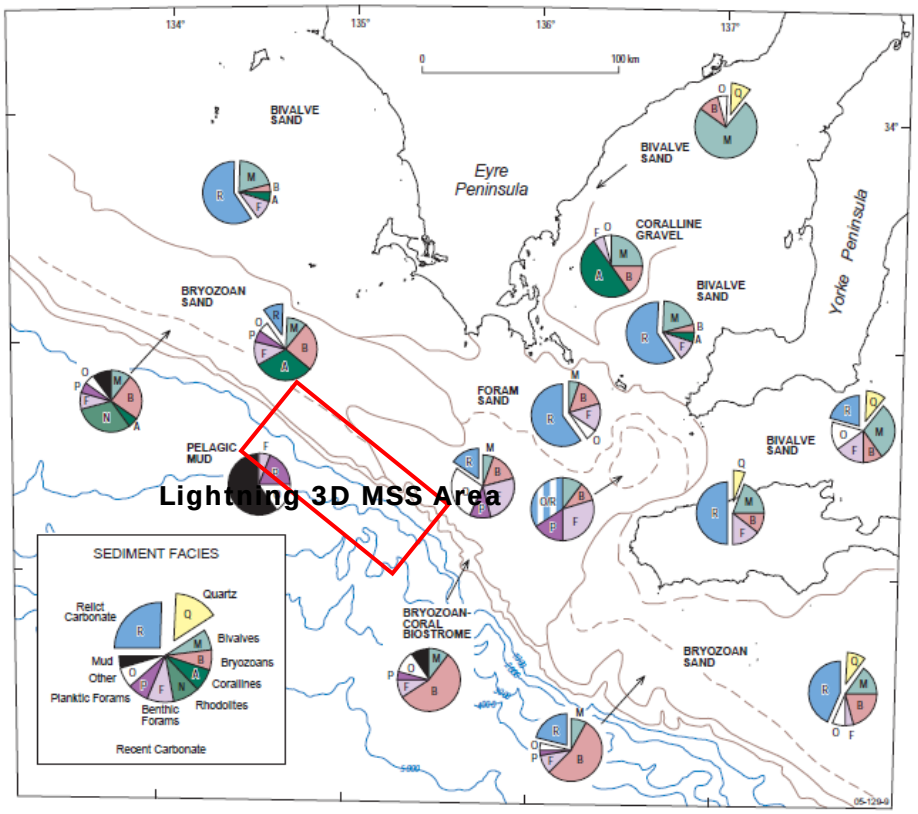
| Species Type | Scientific Name | Common Name | EPBC Status | Type of Presence |
|---|---|---|---|---|
| | Pterodroma mollis | Soft-plumaged Petrel | V | FKO |
| | Thalassarche cauta cauta | Tasmanian Shy Albatross | V, M | MO |
| | Thalassarche chrysostoma | Grey-headed Albatross | E, M | Mo |
| | Thalassarche melanophris | Black-browed Albatross | V, M | MO |
| | Thalassarche bulleri | Buller's Albatross | V,M | MO |
| | Thalassarche impravida | Campbell Albatross | V,M | MO |
| Marine Mammals | Balaenoptera musculus | Blue Whale | E, M | FKO |
| | Eubalaena australis | Southern Right Whale | E, M | KO |
| | Megaptera novaeangliae | Humpback Whale | V, M | LO |
| | Neophoca cinerea | Australian Sea-lion | V | FLO |
| | Balaenoptera bonaerensis | Antarctic Minke Whale | M | MO |
| | Balaenoptera edeni | Bryde's Whale | M | MO |
| | Caperea marginata | Pygmy Right Whale | M | MO |
| | Lagrnorhynchus obscurus | Dusky Dolphin | M | MO |
| | Orcinus orca | Killer Whale | M | MO |
| | Physeter macrocephalus | Sperm Whale | M | FKO |
| Sharks | Carcharodon carcharias | Great White Shark | V, M | MO |
| | Isurus oxyrinchus | Shortfin Mako | M | LO |
| | Lamna nasus | Porbeagle, Mackerel Shark | M | LO |
| Reptiles | Caretta caretta | Loggerhead Turtle | E, M | MO |
| | Chelonia mydas | Green Turtle | V, M | MO |
| | Dermochelys coriacea | Leatherback Turtle | E, M | LO |

### 3.4.2 Benthic Fauna & Flora

The South-west Marine Region is generally characterised by high species biodiversity, including a large number of species found nowhere else in the world. The biological communities lying in the southern areas of the region are predominantly temperate with the region generally having more than 1000 species of macro-algae, between 17 and 22 species of seagrass, 600 species of fish, 110 species of echinoderm and 189 species of ascidians recorded. Research indicates that the GAB is known to have one of the world's most diverse soft sediment ecosystems with recent sampling studies revealing assemblages including 360 different species of sponge, 138 species of ascidians and 93 species of bryozoans, many of which were newly discovered species (DEWHA, 2007). In general, the GAB continental shelf area allows for the establishment of temperate carbonate producing organisms given the lack of sedimentation entering the area from continental Australia (i.e. no major river systems)(Richardson, et al, 2005).

Outcropping substrate on the middle to outer shelf (50-170m) allows for the development of bryozoans, sponges and coralline algae. The abundance of these communities is observed into the outer shelf/upper slope due to high levels of upwelling and a deeper, less energetic environment (Richardson et al, 2005). Surveys undertaken specifically for the Eastern GAB identified that sediment on the inner shelf support bivalves, while outer shelf sediments support bryozoans (Richardson et al, 2005) (refer **Figure 3-8**).

Figure 3-8: Benthic communities within the Eastern GAB (Richardson et al, 2005)




### 3.4.3 Fish

The EPBC Act Protected Matters database search (SEWPC, 2012a) identified one species of shark as vulnerable, the Great White Shark (*Carcharodon carcharias)*; and two shark species as migratory, Shortfin mako (*Isurus oxyrinchus*) and porbeagle (*Lamna nasus*). Other shark species which are fished commercially are described in **Section 3.5.3**.

#### *3.4.3.1 Great White Shark*

The *Great White Shark (Carcharodon carcharias)*, a highly mobile migratory species listed as vulnerable, is widely distributed throughout temperate and sub-tropical regions in the northern and southern hemispheres. It is primarily found in coastal and offshore areas of the continental shelf and islands (EA, 2002) but can be encountered in outer continental shelf and slope areas (SEWPC, 2012c) and has been caught in varying depths up to 1280m (EA, 2002). White sharks mainly seem to occur between the coast and the 100m depth contour (DEWHA, 2007) and areas of frequent encounter appear to be around seal and sea lion colonies particularly when juveniles are present (EA, 2002). In South Australia, seal/sea lion colonies are known to occur at The Pages Islands (approx. 250km east); Dangerous Reef (approx. 110km NE); Seal Bay on Kangaroo Island (175km ESE); West Waldegrave Island (approx. 180km north); and Olive Island (approx. 290km NNW) (SEWPC, 2011a). Large New Zealand fur seal colonies are found at the North and South Neptune Islands (located approximately 64km NE), Kangaroo Island (approx. 105km east) and Linguanea Island (SA) (approx. 61km north) (DEWHA, 2007). New Zealand fur seals pup in early December with the adults/pups most vulnerable between mid-January and April (Bruce & Bradford, 2008). White sharks are regularly observed at Neptune Islands and Dangerous Reef (approx. 110km NE) which have large breeding colonies of New Zealand Fur Seals and Sea Lions respectively (DEWHA, 2007).

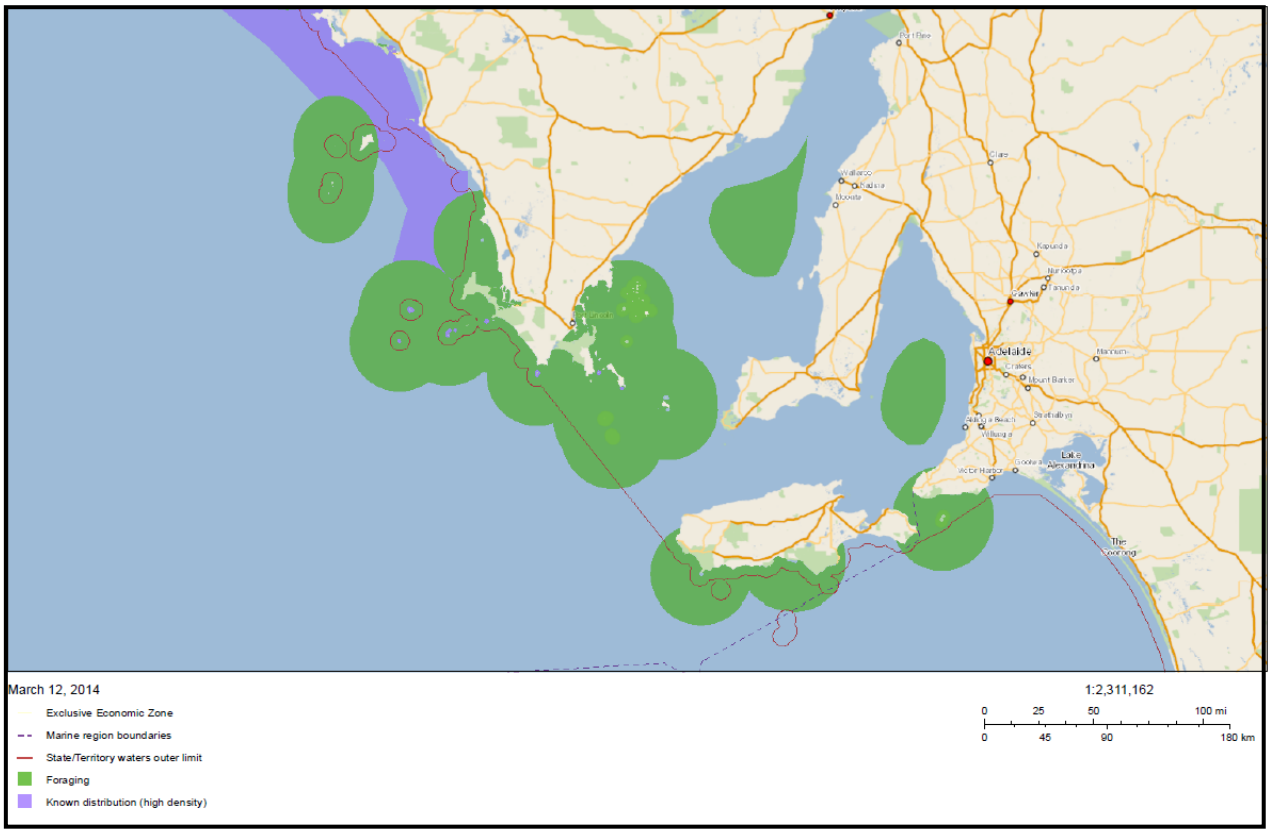
The Spencer Gulf and Gulf of St Vincent are considered important feeding grounds for sub-adult white sharks targeting dolphins, finfish and other sharks abundant in the gulfs (DEWHA, 2007). Resident juvenile White Sharks restrict their movement between shore and the 150m depth contour (Bruce & Bradford, 2008). **Figure 3-9** provides details of foraging habitats for the Great White Shark along the SA coastline which generally extends approximately 35km from the nearest coastline. Areas of high species abundance lie to the west of Eyre Peninsula (DoE, 2014a).

Great White sharks do not feed exclusively on pinnipeds, feeding also on small cetaceans, finfish (e.g. snapper), other sharks, reptiles and seabirds (EA, 2002). Studies of Great While Sharks sighted at pinniped colonies indicate that the sharks appear to be largely transient with only a few longer term residents (EA, 2002).

The location of shark pupping areas in Australia is not known, however juveniles aggregate seasonally in certain areas such as Goolwa (SA) (approx. 300km east), Corner Inlet-Lakes Entrance (Vic) (summer-autumn), Newcastle-Foster (NSW) (late winter-spring), Fraser Island (Qld) and Portland (Vic) (SEWPC, 2012c).

White sharks are considered temporary residents of the area however they do return on a seasonal basis and would hence appear to have a degree of fidelity to certain areas (DEWHA, 2007). It is possible that this species will be encountered as they transit the MSS area to potential feeding grounds.

Figure 3-9: Foraging Habitats for the White Shark (DoE, 2014a)



#### 3.4.3.2 Shortfin Mako Shark

The *Shortfin Mako Shark* (*Isurus oxyrinchus*) listed as migratory, is found worldwide in tropical and temperate waters. It is usually found in coastal and oceanic waters in depths of 150m, however can be found as deep as 740m and is one of the most active (fast swimming) shark species. The species prefers temperatures above 16°C and feeds on schools of fish, cephalopods, billfish and small cetaceans (SEWPC, 2012e). The *Shortfin Mako Shark* may be present in the MSS area during the proposed seismic activities however the MSS area does not contain important biological habitat for the species.

#### 3.4.3.3 Porbeagle (Mackeral Shark)

The *Porbeagle* or *Mackeral Shark* (*Lamna nasus*) listed as migratory, is a pelagic, oceanic fish, prefers cool waters (temperatures below 16°C) and has a depth range of 715m (Froese & Pauly, 2012). It is distributed from latitudes 76°N to 59°S. The species are abundant on continental shelves but have also been found well offshore as well as inshore. The Mackeral Shark feeds mainly on herring, mackerels; cod, white hake, red hake, haddock, cusk, and squid (WoRMs, 2011). The *Mackeral Shark* may be present in the MSS area during the proposed MSS activities however the proposed MSS area does not contain important biological habitat for the species.

#### 3.4.3.4 Other Continental Shelf Fish (including small pelagic fisheries)

The Spencer Gulf Shelf Province (bioregion) area is regarded as a productive commercial fishing area in Australia, producing sardines and anchovies (finfish fishery) and for supporting migratory Tuna (Ward et al, 2006; cited in Blue Whale Study Inc., 2012; Pattiaratchi, 2007). Peak spawning periods for sardines and anchovies in shelf waters is from January to March corresponding to peak upwelling periods (Dimmlich et al, 2004; cited in Pattiaratchi, 2007). Anchovy larvae (>10mm length) are found mainly in colder shelf waters (primarily close to shorelines) associated with the upwelling with larger larvae (>15mm length) present in shelf waters adjacent to upwelling regions (Dimmlich et al, 2004; cited in Pattiaratchi, 2007). Sardine and anchovy eggs and larvae are widely distributed in the shelf waters with higher densities in areas of high zooplankton biomass (predominantly to the west of Kangaroo Island and Eyre Peninsula) (Dimmlich et al, 2004; cited in Pattiaratchi, 2007). Sardines account for more than half of the prey species of juvenile southern blue-fin tuna (SBT) which also aggregate in the area (Ward et al, 2006; cited in Pattiaratchi, 2007).

Southern Bluefin Tuna spawn in tropical waters between Indonesia and North-west Australian (7°S-20°S) between September and March (Kailola et al, 1993). After spawning, SBT migrate south along the Western Australian coastline to, as far east as New Zealand and west to Southern Africa (DSE, 2003). Young fish are generally associated with coastal and continental shelf-waters, but by maturity the SBT is oceanic and pelagic (Kailola et al, 1993) usually found seawards of the continental shelf (DSE, 2003). The SBT appears off southern WA at around 12 months of age during spring-summer and predominantly inhabits in-shore waters up to the shelf-break (McClatchie et al, 2006). By April these fish have moved to the GAB where they tend to form aggregations over the deeper half of the shelf particularly near the shelf-break. At three years of age, juveniles are highly migratory making annual cyclical migrations between the inshore waters of the GAB for summer and the waters of the Indian Ocean during winter. Individuals over 5 years have a circum-global oceanic distribution and are rarely encountered in inshore waters (McClatchie et al, 2006). SBT are opportunistic and feed on cephalopods, crustaceans, fish and salps. Sharks, other tunas and fish, seabirds and killer whales are possible SBT predators at different stages of the SBT lifecycle (Kailola et al, 1993).

Other commercial fish species on the shelf area include smaller pelagic species such as the scaly mackerel, jack mackerel (yellowtail), blue mackerel, blue sprat, sandy sprat (DEWHA, 2007), round herring, redbait and saury (Ward et al, 2008). These species are considered an important trophic link between larger fish eating predators such as bronze-whaler and hammerhead sharks and salmon and barracouta (DEWHA, 2007).

Commercial fish landings taken from the shelf break and down the upper and mid-slope include the orange roughy, blue grenadier, bight redfish, school shark, gummy shark, angel shark, gemfish, deep water flatheads, leatherjackets, latchets, stingrays and stingarees (DEWHA, 2007). These fish are prey to deep-diving toothed whales and dolphins including sperm whales, killer whales, seabirds, tunas and other large predatory fish. There are also productive giant crab and lobster grounds along the shelf edge (DEWHA, 2007).

Refer to **Section 3.5.3** for further details on commercial fish species.

### 3.4.4 Cetaceans

The EPBC Act Protected Matters Search database (SEWPC, 2012a) lists 31 cetacean species that may have habitat in or around the proposed MSS area. Of these, three species are listed as threatened under the EPBC Act (refer **Table 3-2**); the Blue Whale (*Balaenoptera musculus*), Humpback Whale (*Megaptera novaeangliae*) and Southern Right Whale (*Eubalaena australis)*; and eight (8) are listed as migratory.

In addition to these mammal species identified under the Protected Matters Database the Fin (*Balaeonoptera physalus*) and Sei Whales (*Balaenoptera borealis*), which are listed under the EPBC Act as vulnerable and migratory, have also been observed in the eastern GAB (Kangaroo Island Council, 2012).

#### *3.4.4.1 Humpback Whale (Baleen Whale)*

The *Humpback Whale (Megaptera novaeangliae)*, a migratory species listed as vulnerable under the EPBC Act, is found throughout Australian Antarctic waters and Commonwealth offshore waters (SEWPC, 2012f). The Humpback Whale feeds on krill primarily during the summer months in Antarctic waters south of about 55°S (peak feeding season is mid-January-February) (SEWPC, 2012f). Some feeding has also been observed in Australia's coastal waters but this is thought to be opportunistic and forms only a small portion of their nutritional requirements (SEWPC, 2012f). Two recognised populations exist in Australia, the western Australian population of Humpbacks, which is a genetically distinct group from the eastern Australian Group. The WA population of the species commences a northerly migration from Antarctic waters in May reaching Australian offshore waters (southwest WA) in early-mid June and the eastern Australian group reaches southeast Australia in April-May. The species then migrates north along the WA coast to the NW Marine region (i.e. Camden Sound) where breeding/calving takes place between mid-August and early September; and to the Great Barrier Reef (14°S-27°S) where breeding takes place, after which the southern migration commences (SEWPC, 2012f). Migratory Humpbacks on their southern migration pathway are in southwest WA waters between mid-October-late November each year and south-east Australian waters in November-December each year (DEH, 2005c). Migratory pathways are distinct along the eastern and western Australian coastlines with a lower presence in the Great Australian Bight (DEH, 2005c).

The proposed Lightning MSS area is not located in biologically significant areas (breeding, feeding or migration pathways) for the Humpback Whale. It is considered unlikely that large numbers of Humpback Whales will be encountered during the proposed MSS given its location and proposed timing (March to May).

#### 3.4.4.2 Blue Whale (Baleen Whale)

The *Blue whale (Balaenoptera musculus)*, a migratory species listed as endangered, is present in waters off Australia's Antarctic Territory and are widespread in all Australian waters at various times of the year (SEWPC, 2012g). The species is oceanic and appears to undertake extensive migrations between warm water (low latitude) breeding areas and cold water (high latitude) feeding grounds between approximately 20°S and 60-70°S (Bannister et al, 1996). Migration patterns are not known however it is thought the species migrates to Antarctic waters in early summer and leaves in autumn migrating to tropical breeding areas (Indonesian and possibly SW Pacific waters) during winter (SEWPC, 2012g). Exact breeding ground locations are also not known (Bannister et al, 1996).

There are two recognised subspecies of the Blue whale in Australian waters - the true blue whale (*Balaenoptera musculus intermedia*) and the pygmy blue whale (*Balaenoptera musculus brevicauda)*. The Pygmy Blue Whales do not migrate as far south (to approximately 55°S) compared with the true Blue Whale (Bannister et al, 1996). True Blue whales appear to feed mainly, if not exclusively, in the Antarctic. Pygmy Blues are not generally found in the Antarctic and appear to feed in more temperate latitudes. It is therefore likely that records of Blue Whales feeding in Australian waters between late spring- autumn are Pygmy Blue Whales (DEH, 2005d) (*hereafter referred to as Blue Whales*).

Key feeding areas for the Blue Whale are the Bonney upwelling (Cape Otway to Robe seawards to just beyond the shelf break) (November-April); Perth Canyon (WA) (December-April) (SEWPC, 2012g); and Duntroon Basin (SA) (November-December) (Hughes, 2012; Blue Whale Study Inc., 2012; Gill & Morrice, 2011). Within the Bonney upwelling (300km SE of the MSS area), feeding aggregations normally occur at surface in shallow shelf waters (10-300m) enriched by seasonal cold water upwellings. In December 2003, Blue whales were found feeding on abundant krill swarms along the 200m shelf break to the west and south of Kangaroo Island (SEWPC, 2012g). This area is also considered to be part of the GAB upwelling system (as per the Bonney upwelling) but is not as strong or as regular as the Bonney Upwelling. All the observed sightings in 2003 were within 15km of the 200m depth contour with most sightings concentrated inshore of the steep slope canyon features (Morrice et al, 2004; cited in Pattiaratchi, 2007). Subsequent aerial surveys undertaken have found varied Blue Whale presence at this time of year indicating that the upwelling functions only in certain conditions (conditions not unknown) (SEWPC, 2012g). Additional observation data to support periods of Blue Whale presence in the area during November/December and not during the January-March period, has recently been obtained in the aerial survey monitoring programme undertaken by Blue Whale Study Inc. on behalf of Bight Petroleum in the eastern GAB for the 2011-2012 season (November-March). In this study Blue Whales were sighted in December (only) in proximity to the MSS area (Blue Whale Study Inc., 2012) (refer **Figure 3-10**). Additional data provided by other petroleum operators[13] within the area verified sightings of Blue Whales early or late in the MSS period, conducted during mid-November 2011 to end May 2012, with no sightings in the middle period of the survey (BP, Rochelle Smith, Aug 2012, pers com).

Blue Whale encounter rate has also been studied in the eastern GAB and south of Kangaroo Island (Gill & Morrice, 2011). This data indicates that November and December are the key months in the period November-May when the Blue Whales will be encountered in the area (Gill & Morrice, 2011).

Based on Blue Whale sighting data along the Southern margins from Bass Strait to the Perth Canyon, it is concluded that while the January-March period is considered as a peak season for Blue Whales in the Bonney upwelling area (more than 300km SW of the Lightning MSS), this same period has a lower likelihood of encounter in the eastern GAB upwelling area due

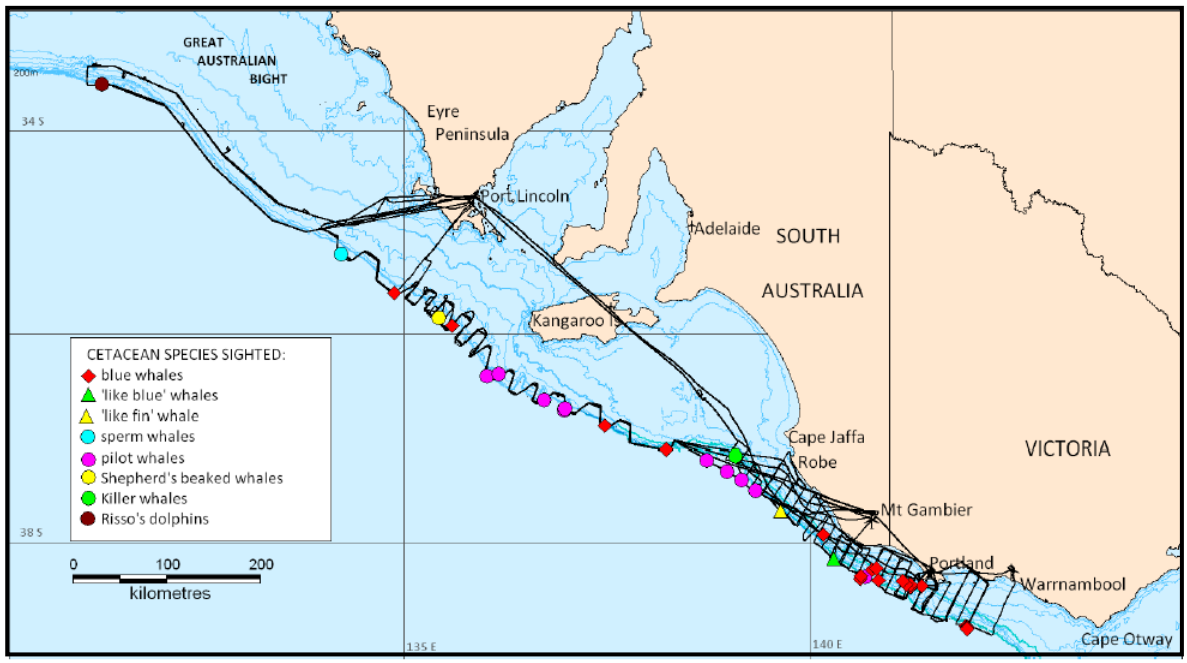
[13] BP Survey in the Central GAB area undertaken between mid-November 2011 to end May 2012.

to the fact it appears to have an earlier season (November-December) (Blue Whale Study Inc., 2012)

A recent survey undertaken by the International Fund for Animal Welfare (IFAW) between 26th April and 8th May 2013 reported no encounters of Blue or Southern Right Whales in the proposed survey area. This corresponds with data from aerial surveys carried out in the survey region during March/April in previous years.

It is possible that the Blue Whale may be encountered during the Lightning MSS however the timing of the MSS avoids peak encounter times (November-December). There is a low likelihood of encounter during the months January-March and May-October (SEWPC, 2011a) but a medium likelihood of encounter during April when they are migrating from the Bonney upwelling feeding grounds to the Perth Canyon on their way back to tropical breeding grounds. It should be noted that the whales will most likely be migrating through the area rather than feeding at that time.

Figure 3-10: Cetacean Survey (November 2011-March 2012) for East GAB (Blue Whale Study, Inc.)




### 3.4.4.3 *Southern Right Whale (Baleen Whale)*

The *Southern Right Whale (Eubalaena australis)* a migratory species listed as endangered, is seasonally present on the Australian Coast between mid-May and mid-November (SEWPC, 2012r) and is distributed in the southern hemisphere generally between 16°S and 65°S (SEWPC, 2012r). The species is pelagic in summer foraging in the open Southern Ocean (Bannister et al, 1996) between 40° and 65°S (SEWPC, 2012r) and migrates from the subantarctic to southern Australian coastal waters to calve and mate (Mustoe & Ross, 2004). Pregnant females generally arrive during late May and early June and depart with calves in September-October. Key breeding areas within the GAB where a high density of calving occurs includes Doubtful Island Bay (approx. 1400km west), Israelite Bay (approx. 1000km west) and Head of Bight (approx. 520km NW) (SEWPC, 2011r). Other areas along the GAB coastline provide seasonal calving habitat (SEWPC, 2011r). During calving, the whales are generally in shallow, protected waters within 2km of the shoreline with calving in waters less than 10m deep (SEWPC, 2012r). The closest calving area to the MSS is Sleaford Bay at the southern end of the Eyre Peninsula approx. 85km from the northern edge of the MSS.

Based upon 16 seismic surveys completed or partially acquired during April to July between the GAB and Western Tasmania since 2000, the likelihood of Southern Right Whale encounter is very low. The encounter rate during a total of 31867km of seismic traverse acquired over a cumulative period of 475 days is 1 per 79 days, ranging from 1 in 135 days in April; 1 in 52 days in May; and 1 in 99 days in June with no encounter during July. Of course, it is not known whether this low encounter rate is due to whales not being in the area or due to 'avoidance' of acoustic sources (Bight Petroleum, 2013).

As this species is seasonally present in coastal waters between mid-May and mid-November and given the observed encounter rates for Southern Right Whales in Southern margin waters, the timing of the Lightning MSS between March 1 to May 30 predominantly avoids the species and it is unlikely that large numbers of Southern Right Whales will be encountered during the proposed MSS.

#### 3.4.4.4 *Fin Whale (Baleen Whale)*

The Fin Whale (*Balaenoptera physalus*), a migratory species listed as vulnerable, has been sighted within the eastern GAB. Fin Whales are cosmopolitan species distributed widely in both hemispheres between latitudes 20°-75°, however the species is rarely sighted in inshore waters or close to ice (SEWPC, 2012w). It is likely that Fin Whales migrate through Australian waters between Antarctic/subantarctic feeding grounds and tropical breeding grounds (Indonesia, the northern Indian Ocean and south-west Pacific Ocean waters). There are no known mating or calving areas in Australia waters (SEWPC, 2012w). While Australian Antarctic waters are important feeding grounds for Fin Whales, the species has also been seen feeding in the Bonney upwelling area sometimes in the company of Blue and Sei Whales (SEWPC, 2012w). Areas of upwelling and interfaces with mixed and stratified waters may be an important feature of fin whale feeding habitat (DEH, 2005c).

It is possible that this species may be encountered during the proposed MSS activities, however as per Blue Whales, the timing of the MSS (autumn) is expected to avoid peak encounter periods particularly as Antarctic waters are known important feeding grounds for the species. The likelihood of encounter with this species is considered low.

#### 3.4.4.5 *Sei Whale (Baleen Whale)*

The Sei Whale (*Balaenoptera borealis*), a migratory species listed as vulnerable, has not been extensively studied. The movement and distribution of the species is unpredictable and not well documented (DEH, 2005c). Sei Whales have been sighted 20–60km offshore on the continental shelf in the Bonney Upwelling between December and April (2000–03), presumably feeding (P. Gill 2002, 2004; cited in SEWPC, 2012x) and have also been reported 200 nautical miles south-west of Port Lincoln (Dec, 1995) (SEWPC, 2012x). Available information suggests that the species has the same general pattern of migration as other baleen whales however the species is not often found near coasts and is infrequently recorded in Australian waters (DEH, 2005c).

It is possible that the species may be encountered during the proposed MSS however the likelihood of encounter is considered low.

#### 3.4.4.6 *Other Cetacean Species*

**Brydes' Whale (Baleen Whale)**: *Brydes' Whale (Balaenoptera edeni)* has been recorded in all states except the Northern Territory, and is restricted to temperate/tropical waters from the equator to approximately 40°N/S (or 20°C isotherm) in both oceanic and inshore locations (Bannister et al, 1996) based upon South African and Japanese observations of the species (SEWPC, 2012h). The species occupies waters exceeding 16.3°C (SEWPC, 2012h).

Species inhabiting inshore locations (<20miles from coast) are quite sedentary, with mating occurring in the autumn/winter timeframe. The inshore form is generally limited to the 200m depth isobath moving along the coast in response to suitable prey. The offshore form of the species found in deeper waters (500 to 1000m) (>50miles from coast) are considered to be pelagic and may migrate seasonally to subtropical and tropical waters (SEWPC, 2012h). Insufficient information is available on specific Australian feeding or breeding grounds for the species. Inshore coastal forms appear to breed and give birth during the year while the offshore form breeds during winter (SEWPC, 2012h). Dive times of the species are short ranging from 1.27min to 9mins (SEWPC, 2012h). Recorded Australian locations for the species are the Abrolhos Islands (WA); north of Shark Bay (WA) and Queensland. It is likely to be found along either the Australian east or west coast less so along the south coast (Bannister et al, 1996).

Given no biologically important areas for this species has been recognised along the southern coastline of Australia, the likelihood of encounter during the MSS period is considered low.

**Antarctic Minke Whale (Baleen Whale):** The Antarctic Minke Whale (*Balaenoptera bonaerensis*) has been found in all Australian states except the Northern Territory (NT) and occupies offshore and pelagic habitats within cold temperate to Antarctic waters between 20°S to 65°S (Bannister et al, 1996). In summer the species is found in pelagic waters from 55°S to the Antarctic ice edge. During winter most species retreat to breeding grounds between 10-30°S occupying oceanic waters exceeding 600m depth and beyond the continental shelf break (SEWPC, 2012i). Mating occurs from June through December, with a peak in August and September and calving peaks occur during late May and early June in warmer waters north of the Antarctic Convergence (SEWPC, 2012i).

No biologically important areas have been identified in proximity to the Lightning MSS area. As the proposed MSS is scheduled to occur in the autumn months, the likelihood of encounter with this species is considered low.

**Pygmy Right Whale (Baleen Whale):** The *Pygmy right whale (Caperea marginata)* is found in temperate and subantarctic waters in oceanic, pelagic and inshore location habitats between 30° and 52°S. The distribution of this species is found close to coastal upwellings and further offshore it appears that the Subtropical Convergence may be an important area for regulating the species distribution (Bannister et al, 1996). There is no evidence of large-scale movements of Pygmy Right Whales, with coastal strandings recorded throughout the year on the Australian coastline (SEWPC, 2012j). Concentrations of stranded animals have occurred at the entrance of the gulfs in South Australia, but live sightings have predominated in the area (SEWPC, 2012j). Key locations for the species include Kangaroo Island (SA) and southern Eyre Peninsula (SA) close to habitats rich in marine life and possibly the zooplankton upon which it feeds (Bannister et al, 1996).

As this species is present in Australian waters on a year-round basis, the Pygmy Right Whale may be encountered during the proposed MSS.

**Killer Whale (Odontocete):** The *Killer whale (Orcinus Orca)* has a distribution from polar to equatorial regions and has been recorded in all states except Northern Territory with frequent sightings in South Australia, Tasmania and Victoria. The species presence was observed during pre-survey monitoring undertaken in the Eastern GAB (MSS location) for the 2011-2012 upwelling season (November-March). Two killer whales were observed west of Robe (approx. 200km SE of Kangaroo Island) during late March (Blue Whale Study Inc., 2012).

The species is oceanic, pelagic and neritic in both warm and cold waters, and thought to be more common in cold, deep waters. In Australia, this species is often seen along the continental slope and shelf particularly near seal colonies. The specific diet of Australian Killer Whales is not known, but there are reports of attacks on dolphins, young Humpback Whales, Blue Whales, Sperm Whales, Dugongs and Australian Sea Lions. Literature indicates that this species is not known to be migratory but moves seasonally to areas of food supply (Bannister et al, 1996). No key localities are known for Killer Whales within continental

Australian waters, however, the Australian subantarctic territory, Macquarie Island may be a key locality as there are regular sightings (Bannister et al, 1996).

As pinniped colonies can be found in the coastal waters adjacent to the Lightning MSS area, it is possible that the Killer Whale might be encountered in low numbers during the proposed Lightning MSS.

**False Killer Whale (Odontocete)** (*Pseudorca crassidens*): This species is not considered threatened nor does it have a migratory status under Australian legislation. Species is circum-global from equator to 45°N and 45°S and widely recorded in all Australian states from stranding data (Bannister et al, 1996). No population estimates occur in Australian waters, however the species occurs in low abundance (DoE, 2014r). The species prefers deep, offshore waters and sometimes deep coastal waters. They approach land only where the continental shelf is narrow, possibly attracted to enhanced prey abundance (fish and cephalopods) along the continental slope (Bannister et al, 1996). The movement pattern of False Killer Whales, inferred from stranding data, is that a seasonal movement inshore or along the continental shelf of the southern and southeast coast occurs between May and September. They appear to be opportunistic feeders (DoE, 2014r). No calving areas are known in Australian waters and mating/calving occurs throughout the year with no seasonal pattern (Bannister et al, 1996). As the species has a low abundance in Australian waters encounter is considered unlikely.

**Sperm Whale (Odontocete):** The Sperm Whale (*Physeter macrocephalus*) has a worldwide distribution; has been recorded in all Australian states; and is a pelagic species usually found in the deep water (>200m) off the continental shelf. Sperm Whales tend to inhabit offshore areas with a water depth of 600m or more, and are uncommon in waters less than 300m deep (SEWPC, 2012l). Females and young males are restricted to warmer waters (i.e. north of 45°S) and are likely to be resident in tropical and sub-tropical waters year-round. Adult males are found in colder waters and to the edge of the Antarctic pack ice. Concentrations of Sperm Whales are found where seabeds rise steeply from a great depth associated with concentrations of food such as cephalopods.

Sperm whales are known to forage and concentrate at the shelf break south and south-west of Kangaroo Island in canyons and the adjacent shelf break; and deep waters off the Tasmanian west and south coasts (SEWPC, 2012u) (refer **Figure 3-13** for aggregation areas). The species is not seasonal however encounters to the south/southwest of Kangaroo Island are more frequent during August and September (SEWPC, 2012b). Aerial surveys undertaken in December 2003 identified seven sperm whales south-west of Kangaroo Island in deep waters (1000-2000m). Aerial surveys undertaken for the Lightning MSS for the upwelling season 2011-2012 (November-March) also identified four Sperm Whales during November (only) to the west of Port Lincoln (Blue Whale Study Inc., 2012). Sperm whales are prolonged and deep divers often diving for over 60minutes (Bannister et al, 1996) however studies have observed Sperm Whales do rest at, or just below, surface for extended periods (>1hr) (Gannier et al, 2002). In addition, female and juvenile sperm whales in temperate waters have been observed to spend several hours a day at surface resting or socialising (Hastie et al, 2003).

The proposed Lightning MSS period (March-May) avoids the peak August/ September period when there is an increased encounter rate in the area.

**Pygmy Sperm Whale** (*Kogia breviceps*) (Odontocete): This species is not considered threatened nor does it have a migratory status under Australian legislation. The species is cosmopolitan and oceanic (except for polar or sub-polar seas) and is not known to migrate or exhibit strong regional movements (Bannister et al, 1996). The species is recorded in all Australian states except the Northern Territory and no key localities have been identified in Australia (Bannister et al, 1996). This species diet consists of squid, benthic fish and crabs and does not appear to approach inshore areas as does the Dwarf Sperm Whale (refer below). Calving season is reported as spring with no known calving areas identified but is expected to be in temperate and tropical seas (Bannister et al, 1996). The species

communicates at frequencies between 60 and 200kHz (Simmonds et al, 2004). The species may be present in the MSS area during the survey period.

**Dwarf Sperm Whale** (*Kogia simus*) (Odontocete): This species is not considered threatened nor does it have a migratory status under Australian legislation. This species habitat is similar to the Pygmy Sperm Whale however it is known to approach the coast more often than the Pygmy Sperm Whale Species (Bannister et al, 1996). This species may be present in the MSS area during the survey period.

**Beaked Whales (Odontocetes):** This group of cetaceans is not considered as a threatened species or determined to have a migratory status under Australian legislation. Southall et al (2007) classifies Beaked whales as mid-frequency cetaceans with an estimated auditory bandwidth of 150Hz to 160kHz.

These species have not been well studied and while most are considered rare in Australian waters, they are known to have circumglobal/circumpolar distributions. All species identified as potentially being present in proximity to the survey area are known to be deep oceanic species occurring around close to undersea features such as submarine escarpments and sea mounts which may lead to areas of increased productivity and hence food sources (primarily cephalopods and fish). Beaked whales are identified as occurring in habitats associated with the continental slope to the abyssal plain along much of Australia's coastline (DoE, 2014b; DoE, 2014c; DoE, 2014c; DoE, 2014e; DoE, 2014f; DoE, 2014g; DoE, 2014h; DoE, 2014i; DoE, 2014j). In the eastern tropical Pacific beaked whales are generally sighted, on average, 1000km offshore with a range of 40-3750km (DoE, 2014e)

The following beaked whale species may be present within the region however are considered to have a low encounter rate during the proposed MSS activity (SEWPC, 2012a):

- **Arnoux's Beaked Whale** (*Berardius arnuxii*): Possible sightings of this species have been made inshore off South Australia however most sightings have been in the Tasman Sea and around the East Pacific rise. No key localities are known in Australian waters, however are thought to occur circumglobally from about latitude 34°S to the Antarctic ice (DoE, 2014b). Sightings of the species are rare and are seldom seen over continental shelves. They are thought to dive to 1000m for periods of 15-30minutes in pursuit of prey (Bannister et al, 1996). There are no known calving areas in Australia (Banister et al, 1996) and the species is not a common stranding species (Bannister et al, 1996).
- **Andrew's Beaked Whale (***Mesoplodon bowdoini):* Species are considered to have a southern circumpolar distribution north of the Antarctic convergence between 32°S and 54°34'S. In Australia the species is not considered abundant and sightings are rare with no key localities identified in Australia (DoE, 2014c). The breeding areas and habitats for the species is not known, however may move inshore in spring and summer (i.e. periods when most sightings have been made) possibly for calving and mating (DoE, 2014c). Not a common stranding species (Bannister et al, 1996).
- **Blainville's Beaked Whale** *(Mesoplodon densirostris)*: Species is considered to have an oceanic and circumglobal distribution occurring in low-mid latitudes in all oceans in both hemispheres preferring tropical waters (water temperatures of 22-32°C preferred) and warm temperate waters. Species is deep water (700-5000m) with diving durations of 20-40 minutes expected (DoE, 2014d). However, the species is not considered abundant and is rare in Australia. The species has rarely stranded in Australia compared with other areas in its range (e.g. South Africa) and no strandings have been recorded in South Australia (DoE, 2014d). No known breeding or calving areas occur in Australia, however calving is thought to occur during summer (Banister et al, 1996).
- **Gray's Beaked Whale** *(Mesoplodon grayi)*: Species appears to be circumpolar occupying waters between 30-50°S in water depths greater than 200m (DoE, 2014e). The species is not considered abundant as sightings and strandings are rare, however low level stranding has occurred in southern WA, South Australia, Victorian, Tasmania and NSW (DoE, 2014e) waters. The species may use waters over the continental shelf

for breeding and calving purposes in late spring-summer however the lack of sightings implies they do not come close to shore (DoE, 2014e).

- **Hector's Beaked Whale** (*Mesoplodon hectori)*: Only a small number of the species have been recorded in Australia (in Tasmania, SA and WA), is distributed between 35-55°S and is considered rare in Australia. The species is oceanic rarely venturing into continental seas (DoE, 2014f). No known breeding or calving areas occur in Australia however not much is known about reproductive behaviours (DoE, 2014f).
- **Strap-toothed Beak Whale** *(Mesoplodon layardii)*: This species is the most commonly stranded beaked whale in Australia (in WA, SA, Victorian, Tasmania, NSW and Queensland) and appears to be one of the more widespread and common beaked whales in the Southern Ocean between 30°S and the Antarctic convergence. However, the species is not considered abundant as sightings/strandings are rare (DoE, 2014g). The stranding events which have occurred are from January to April and there is an indication that the species may feed in higher productivity areas adjacent to the continental slope during mid-late summer. Breeding areas and habitats are unknown (DoE, 2014g).
- **True's Beaked Whale** (*Mesoplodon mirus*): Only a small number of this species have been recorded in Australia (WA, Victoria and Tasmania) and no key localities are known in Australian waters. Distribution is expected between 30-50°S in oceanic waters deeper than 200m however the species is not considered abundant as sightings/standings are rare. Confirmed sightings of species travelling parallel to a steep subsea drop-offs between 1000-1800m deep have been observed (DoE, 2014h). Little is known on the reproductive behaviours of the species (DoE, 2014h).
- **Cuvier's Beaked Whale** (*Ziphius cavirostris*): Species present in Australian waters (all states) mostly between January and July based on stranding data. Species has a worldwide distribution in all temperate and tropical waters from 60°N to 55°S. The species is not considered abundant in Australia as sightings and stranding are rare events (DoE, 2014i). The species is oceanic confined to waters within the 10°C isotherm and 1000m bathymetric contour. Mating and calving is inferred to be all year round however no carving areas are known in Australian waters (DoE, 2014i);
- **Shepherd's Beaked Whale** (*Tasmacetus shepherdi*): Species appears to prefer subantarctic (1-8°C) and temperate (10-20°C) deep oceanic waters and is only likely to be present on a circumpolar basis in deep waters between 33-55°S. No key localities are known in Australian waters (DoE, 2014j). The species is not considered abundant as sightings and strandings are rare (predominantly in WA in areas related to deep trenches/canyons allowing the species to come closer to land). Diet is poorly known but thought to consist of fish. The species is expected to dive deeply in pursuit of prey. No information is available on breeding and calving habits (DoE, 2014j).

**Dolphins (Odontocetes):** This group of cetaceans is not considered as threatened nor are they determined to have a migratory status (except the Dusky Dolphin) under Australian legislation. Dolphin species typically communicate at frequencies between 0.2 and 325kHz (Simmonds et al, 2004). The following dolphin species is recorded as having a possible presence in proximity to the MSS area (SEWPC, 2012a):

- **Dusky Dolphin:** The *Dusky Dolphin (Lagenorhynchus obscurus)* occurs in the southern hemisphere between latitudes 26-55°S and accordingly across southern Australia from WA to Tasmania (SEWPC, 2012k). The species inhabits temperate and subantarctic zones primarily in inshore locations, but is pelagic at times. The species is anticipated to be resident inshore for much of the year and seek out colder water (<18°C) as inshore temperatures rise in summer (Bannister et al, 1996). The species undertakes seasonal movements in Australia which may be linked to the position of the Subtropical convergence and with El Niño Southern Oscillation (ENSO) events, which expand the extent of cold waters (SEWPC, 2012k). Calves are born mainly in summer although no calving areas have been identified in Australian waters. Dusky Dolphins eat a wide diversity of prey, including schooling fish, especially Southern Anchovy, and mid-water

and benthic prey such as squid and lantern fish. They are considered to be surface feeders but have been known to dive to depths of 150m off New Zealand (SEWPC, 2012k). No confirmed biologically significant areas for this species is known to occur in Australian waters, however given their wide distribution, the species may be encountered during the proposed Lightning MSS.

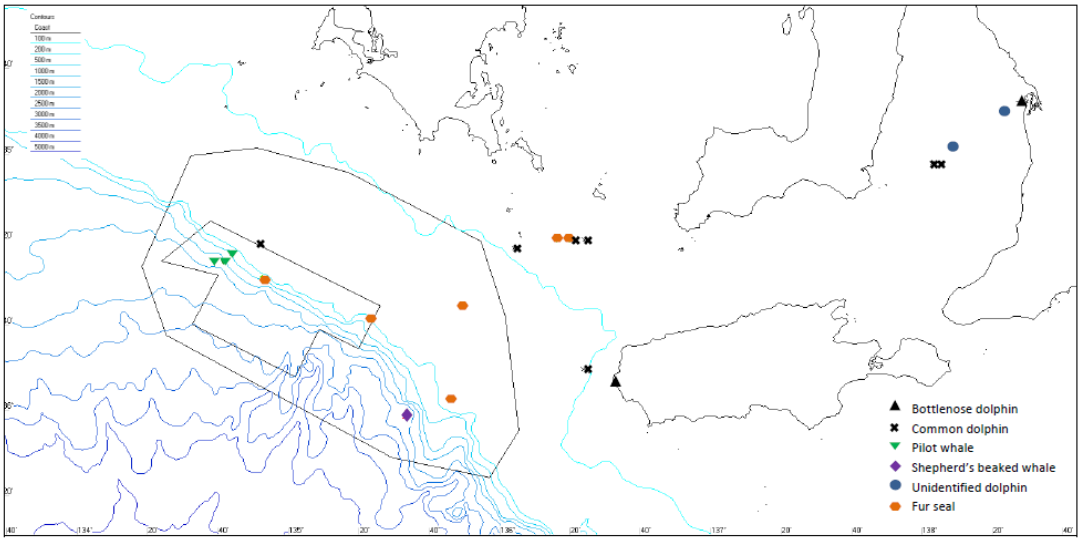
- **Risso's Dolphin** (*Grampus griseus*): Species is recorded in all Australia states except Tasmania and NT with expected depth ranges between 180 to 1500m between 60°N and 60°S (DoE, 2014k). Species has been sighted inshore and offshore and is generally considered pelagic and oceanic occurring mainly on the steep sections of the upper continental slope usually in water depths deeper than 1000m. The species is abundant in tropical and temperate latitudes throughout the world's oceans (water temperatures ~15-30°C) and not considered rare. They sometimes extend their range to cooler latitude in summer (DoE, 2014k). No calving areas are known in Australia and the calving and mating season is unknown (DoE, 2014k). This species may be encountered during the Lightning MSS.
- **Common Dolphin** (*Delphinus delphis*): Species are found in offshore waters (shallow and deep) on the continental shelf, have been recorded in all Australian states and territories but rarely seen in northern waters (prefers water temperatures 10-20°C). The species have been observed over specific oceanic features such as seamounts, ridges and escarpments and in habitats which contain small epipelagic fish such as anchovies and sardines (DoE, 2014l). Two main locations in Australia are one cluster in the southern SE Indian Ocean and the other in the Tasman Sea. Diet consists of epipelagic and mesopelagic fish and squid and also cephalopods and crustaceans. Reproduction data based upon data obtained from outside Australia indicates that calving occurs year round with peaks in spring and autumn. No specific calving areas are known in Australia (DoE, 2014l). This species may be encountered during the Lightning MSS.
- **Southern Right Whale Dolphin** (*Lissodelphis peronnii*): Species is pelagic found in southern Australian waters generally in deep water or on the outer edges of the continental shelf between the subtropical and subantarctic convergence (DoE, 2014m). No key localities are known is Australian waters but preferred water temperatures range from approximately 2-20°C (DoE, 2014m). Calving areas are not known, however there is evidence that the calving season is November to April (DoE, 2014m). This species may be encountered during the Lightning MSS.
- **Indian Bottlenose Dolphin** (*Tursiops aduncus*): Species is found in tropical and sub-topical coastal and shallow offshore waters and is distributed continuously around the Australian coastline in estuarine and coastal waters (<20m depth). Four main regions have been identified around Australia – Eastern Indian Ocean, Tasman Sea, Coral Sea and Arafura/Timor Seas (DoE, 2014n). The species feeds predominantly on fish and cephalopods. Calving season is summer however no areas have been identified in Australian waters (Bannister et al, 1996). This species is unlikely to be encountered during the Lightning MSS.
- **Bottlenose Dolphin** (*Tursiops truncatus):* Species has been recorded in Queensland, NSW, Tasmania, SA and SW Western Australia usually in latitudes lower than 45° in both hemispheres. They inhabit inshore areas (bays, lagoons, estuaries,), nearshore (open coast) and offshore environments. There appears to be two main locations for the species in Australia – South Pacific Ocean and Southern Indian Ocean (DoE, 2014o). Inshore species feed on fish and invertebrates while offshore species feed on mesopelagic fish and oceanic squid (DoE, 2014n). Calving season is diffuse but expected to be in summer with no known calving areas in Australia (Bannister et al, 1996). This species may be encountered during the Lightning MSS.

**Pilot Whales (Odontocetes):** This group of cetaceans is not considered as threatened or determined to have a migratory status under Australian legislation. Pilot whale species typically communicate at frequencies between 1 and 18kHz (Simmonds et al, 2004).The following species are recorded as having a possible presence in proximity to the MSS area (SEWPC, 2012a):

- **Long-finned Pilot Whale** (*Globicephala melas*): Species is distributed throughout the northern and southern hemisphere in circumpolar oceanic temperate and subantarctic waters in zones of higher productivity along the continental slope sometimes venturing into shallower waters on the shelf (<200m) in pursuit of prey species (squid and fish). No key localities in Australia have been identified (Bannister et al, 1996) however they are considered reasonably abundant is Australian waters (DoE, 2014p). There is some (in-conclusive) evidence that suggests the species moves along the edge of the continental shelf in southern Australian waters (Bannister et al, 1996) in response to prey abundance at bathymetric upper slopes and canyons (DoE, 2014p). Mating records from Tasmania indicate mating occurs in spring and summer with 85% of calves born between September and March although births do occur throughout the year. No calving areas are known in Australian waters (DoE, 2014p). This species may be encountered during the Lightning MSS.
- **Short-finned Pilot Whale** (*Globicephala macrorhynchus)*: Species is circumglobal between 45°N and 41°S in tropical and temperate waters. Distribution is Australian region includes oceanic waters (edge of continental shelf and over deep submarine canyons) and continental seas with possible offshore-inshore movement due to abundance in spawning prey (squid, cuttlefish, octopus and some fish) (Bannister et al, 1996). It has been hypothesised that the species undertaken deep dives (~600-800m for a maximum of 27minutes) at dusk and dawn following prey migration and near-surface (~100m) foraging at night. Species is considered to have high abundance in Australian waters (DoE, 2014q). Calving season is diffuse peaking in July and August however there are no known calving localities in Australia. This species may be encountered during the Lightning MSS.

In an acoustic/visual survey undertaken by IFAW between 26th April and 8th May 2013, four species of cetaceans (pilot whale, common dolphin, bottlenose dolphin and Shepherd's beaked whale) and one species of seal were observed. Sperm whales were detected acoustically in waters deeper than 1000m. Baleen whales were not detected during the survey (IFAW, 2013). The most common species encountered was the short-beaked common dolphin in waters less than 200m, with one sighting of a group of three Shepherds Beaked Whales outside the survey area in 2000-2500m water depths (refer **Figure 3-11**).

Figure 3-11: Marine Mammal Sightings during Survey (April-May 2013) (IFAW, 2013)



## 3.4.5 Other Marine Mammals

### *3.4.5.1 Australian Sea Lion*

The Australian Sea Lion (*Neophoca cinerea*), listed as vulnerable, is present from the Houtman Abrolhus Islands WA to the Pages Island east of Kangaroo Island (SA) (SEWPC, 2012m). The species hauls-out (or rests) and breeds on rocky platforms and sandy beaches on sheltered sides of islands on the Australian mainland (DEWHA, 2007) and avoids exposed rocky headlands. Sea Lion colonies are present within the adjacent coastal region to the Lightning MSS area (SEWPC, 2011a) and females show strong affinity to breeding sites (DEWHA, 2007) (refer **Figure 3-12**). Australian sea lions feed in continental shelf waters, most commonly in depths between 20-100m (Shaughnessy, 1999). They appear to be benthic foragers eating a variety of prey such as fish, small sharks, invertebrates (e.g. rock lobster), cephalopods and occasionally seabirds (DEWHA, 2008). Foraging areas for males can extend up to 200km from the coast across the entire continental shelf.

Biologically important areas on adjacent shorelines for the Australian Sea Lion are shown in **Figure 3-12** (DoE, 2014a). The northern boundary of the Lighting MSS area has minor overlap with the foraging areas for male Sea Lions (extends approximately 70km south of Liguanea Island and 68km west of Kangaroo Island) and no overlap with the female Sea Lion foraging area (extends approximately 40km south of Liguanea Island and 42km west of Kangaroo Island).

Figure 3-12: Biologically Important Areas for Sea Lions (DoE, 2014a)

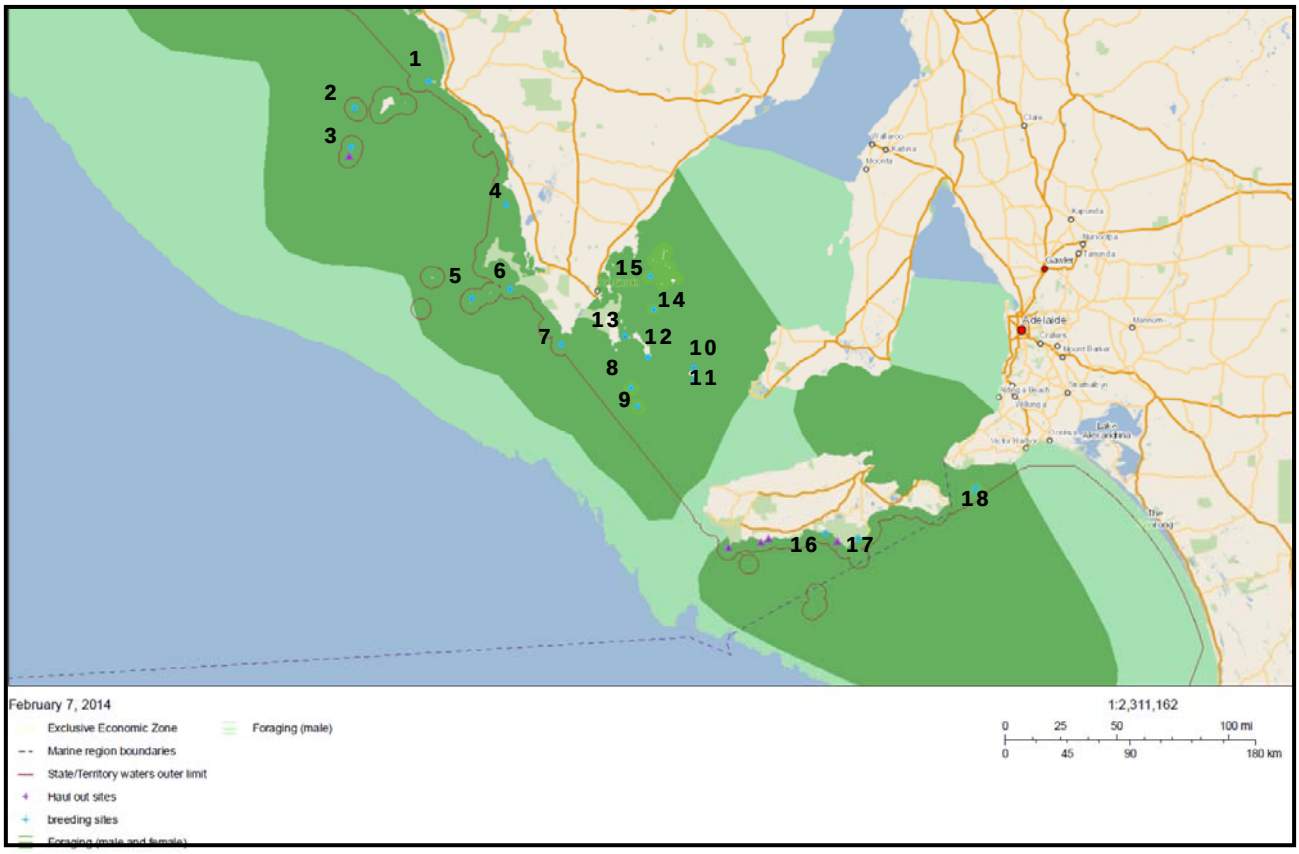
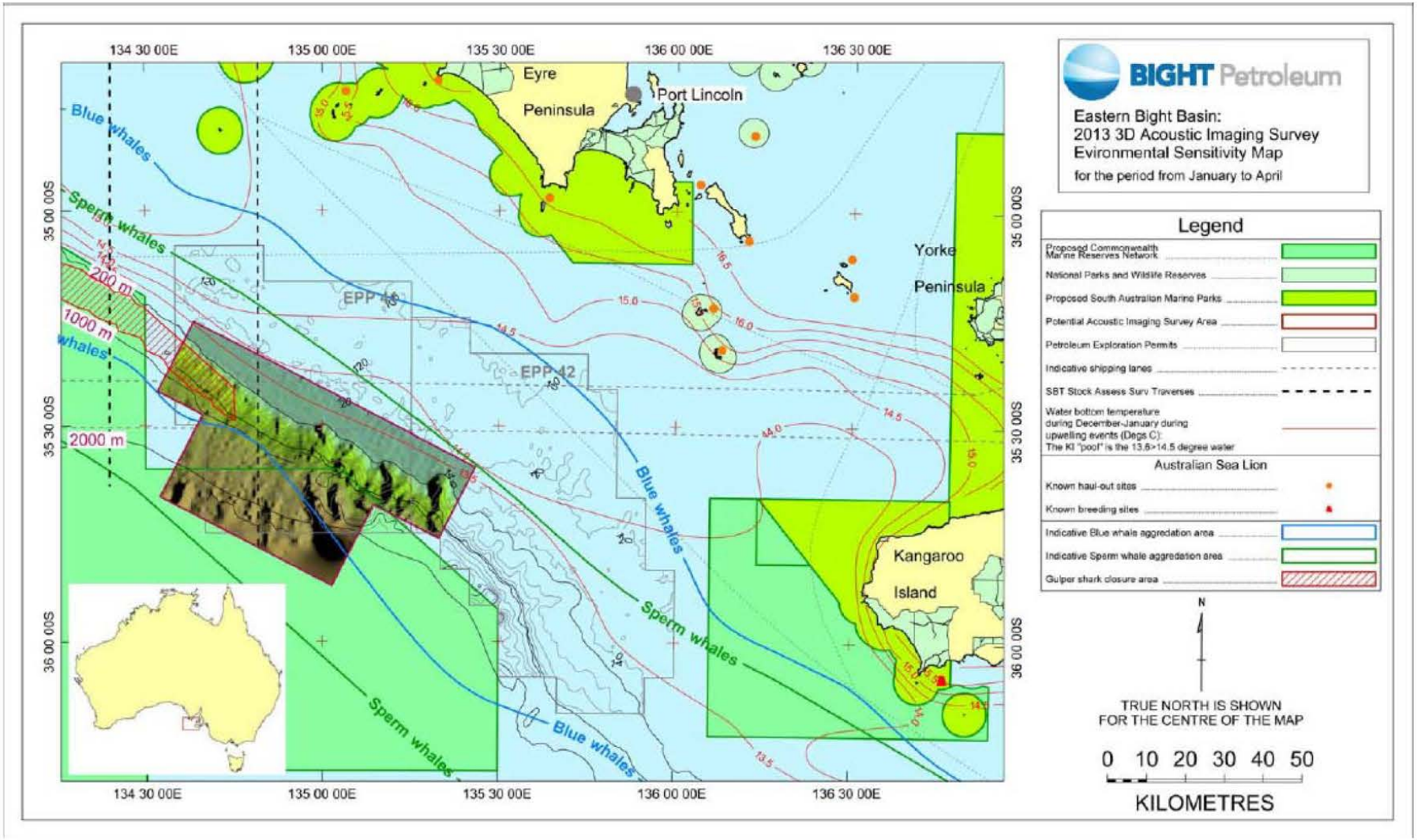
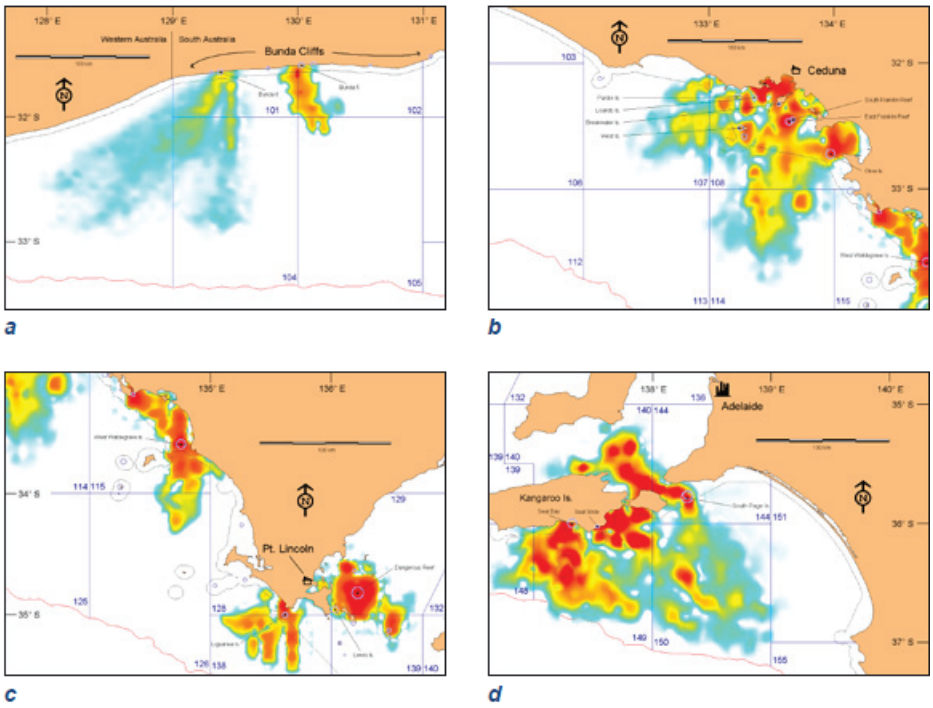


Figure 3-13: Environmental Sensitivities (Lightning MSS Area) (including Sperm Whale Aggregation Area)



Australian sea lions typically travel up to about 60km from their colony on each foraging trip with a maximum distance of around 190km when over shelf waters (SEWPC, 2013) and spend approximately 35% of the time at or close to the seafloor (SEWPC, 2013b).Lactating females generally forage in depths of less than 150m (SEWPC, 2012m). Adult males forage over the entire continental shelf and deeper waters out to sea (SEWPC, 2013). Studies undertaken on foraging areas for lactating females is provided in **Figure 3-14**. It should be noted that pups are typically nursed for 15-18months, weaned approximately one month prior to the birth of the next pup (SEWPC, 2013b). Typically, foraging patterns for females include one day foraging at sea, followed by a day of rest, whereas adult males typically spend longer – up to 2.5 days per trip (SEWPC, 2011b). Foraging capacity develops with age, with 3-18month old pups foraging near their natal colonies (~20km) (SEWPC, 2013b).

Figure 3-14: Distribution of foraging (at sea) effort of 115 tracked lactating Australian Sea Lions (High: red, Medium: orange, Low: blue) (SEWPC, 2013b)




Breeding colonies for the Australian sea lion are found only in South Australian and Western Australian waters (SEWPC, 2013). Most of the Australian Sea Lion population occurs in South Australia with an estimated 40% of the population found in the three largest colonies located at the eastern end of its range. Relative to the nearest point of the Lightning MSS area, these large colonies are found at The Pages Islands (approx. 250km east); Dangerous Reef (approx. 110km NE); and Seal Bay at Kangaroo Island (approx. 175km ESE) (SEWPC, 2012m). It should be noted that all these major colonies do not have direct aspects onto the survey area and are protected[14] from sound propagation associated with the survey activities. Smaller colonies occur at West Waldegrave Island (approx. 180km north); and Olive Island (approx. 290km NNW) (SEWPC, 2011a) and very small colonies exist at both Liguanea and North/South Neptune Islands. Haul-out sites occur on the western edge of Kangaroo Island (approx. 104km east) (SEWPC, 2011a). **Table 3-3** provides details of the breeding locations on islands lying adjacent to the mainland from the Lightning MSS area together with the number of pups present during the most recent survey (refer **Figure 3-13** for number references).

[14] For example Dangerous Reef is protected by Thistle Island and Lincoln National Park.

Table 3-3: Regional Breeding Locations for the Australian Sea Lion (DoE, 2014)

| Location No | Location Name | No Pups (Survey Year) | Distance from Nearest Lightning MSS Boundary |
|---|---|---|---|
| 1 | West Waldegrave Island | 157 (2003) | 180km North |
| 2 | Ward Island | 45 (2006) | 172km North |
| 3 | Pearson Island | 35 (2005) | 148km North |
| 4 | Rocky Island (North) | 16 (1996) | 126km NNE |
| 5 | Four Hummocks (North) Island | 12 (1996) | 70km North |
| 6 | Price Island | 25 (1996) | 95km NE |
| 7 | Liguanea Island | 43 (2004) | 65km NNE |
| 8 | North Neptune Island | 14 (2005) | 71km NE |
| 9 | South Neptune Island | 6 (2008) | 68km NE |
| 10 | North Island | 28 (2005) | 108km NE |
| 11 | Peaked Rocks | 24 (1990) | 106km NE |
| 12 | Albatross Island | 15 (2005) | 92km NE |
| 13 | Lewis Island | 131 (2007) | 95km NE |
| 14 | Dangerous Reef | 709 (2007) | 110km NE |
| 15 | English Island | 27 (2005) | 127km NNE |
| 16 | Seal Bay (Kangaroo Iisland) | 260 (2007) | 175km East |
| 17 | Seal Slide (Kangaroo Island) | 16 (2007) | 208km East |
| 18 | North & South Pages Islands | 312 (2005) & 331 (2005) | 250km East |

The Australian Sea Lion is the only pinniped species which does not have an annual breeding cycle that is also temporally asynchronous across its range. Birth intervals are approximately 17-18months (SEWPC, 2012m). The pupping period extends for 5 months at Seal Bay and 8-9 months at larger colonies (The Pages Islands and Dangerous Reef). A consequence of the 17-18 month breeding cycle, not synchronised between colonies is that pupping does not occur at the same time each year (Shaughnessy et al, 2011). Typically, females haul-out a day or two before giving birth and leave approximately 10days later to forage at sea (SEWPC, 2012m).

The predicted Sea Lion timing for breeding at Seal Bay for the 2014/2015 season is October to February, peaking in December (SEWPC, 2013b) and for Dangerous Reef is April to December 2015. Based upon observed breeding periods during surveys undertaken in 2009/10 (Goldsworthy et al, 2010). No other breeding period details are provided for the minor colonies in the region.

The Lightning MSS is likely to encounter adult male Sea Lions foraging in the marine environment during MSS activities.

#### 3.4.5.2 *New Zealand Fur Seal*

The New Zealand Fur Seal (*Arctocephalus forsteri*) is an EPBC listed marine species (SEWPC, 2012a) which is known to occur in the region. The species breeds in New Zealand and in southern Australia on the south coasts of Western Australia, South Australia and at Maatsuyker Island (Tasmania) (Shaughnessy et al, 1999). Most of the population (77%) is found in central South Australian waters (Kangaroo Island to South Eyre Peninsula). More specifically, large breeding populations which account for more than 80% of the national pup production for the species are found at North Neptune and South Neptune Islands (SA); Kangaroo Island (SA) and Liguanea Island (SA) (SEWPC, 2011b). The pupping season is between November and January (Shaughnessy et al, 1999). The species prefers the rocky parts of islands with jumbled terrain and boulders and prefers smoother igneous rocks to rough limestone. Colonies are occupied year-round but activity is greatest in summer

(Shaughnessy et al, 1999). During the non-breeding season - February to October, the breeding sites are occupied by pups and young juveniles, whilst adult females alternate between periods at the breeding sites and periods foraging at sea (SMM, 2012). **Figure 3-15** and **Figure 3-16** provides estimated at-sea foraging distribution for male and female New Zealand Fur Seals respectively.

Figure 3-15: Estimated At-Sea Foraging Habitat for male New Zealand Fur Seals (Goldsworthy & Page, 2009)

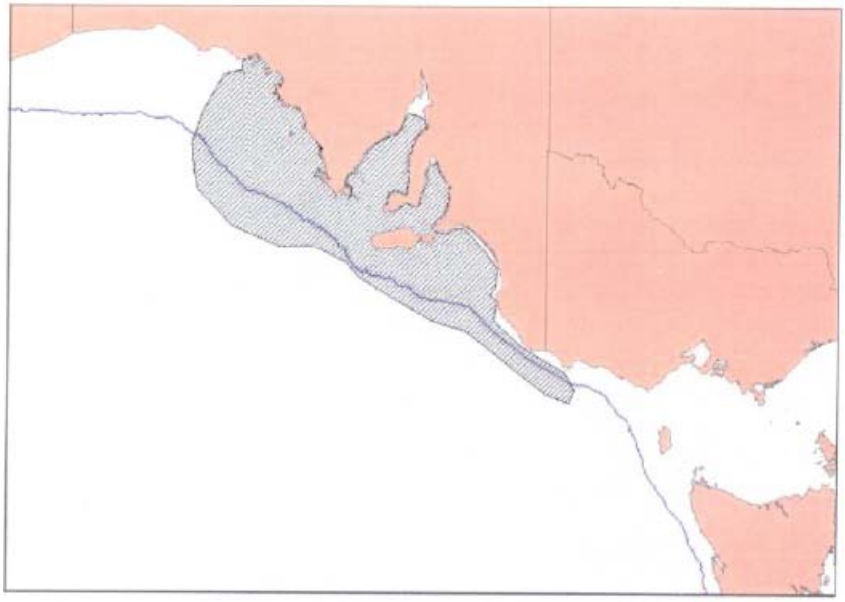
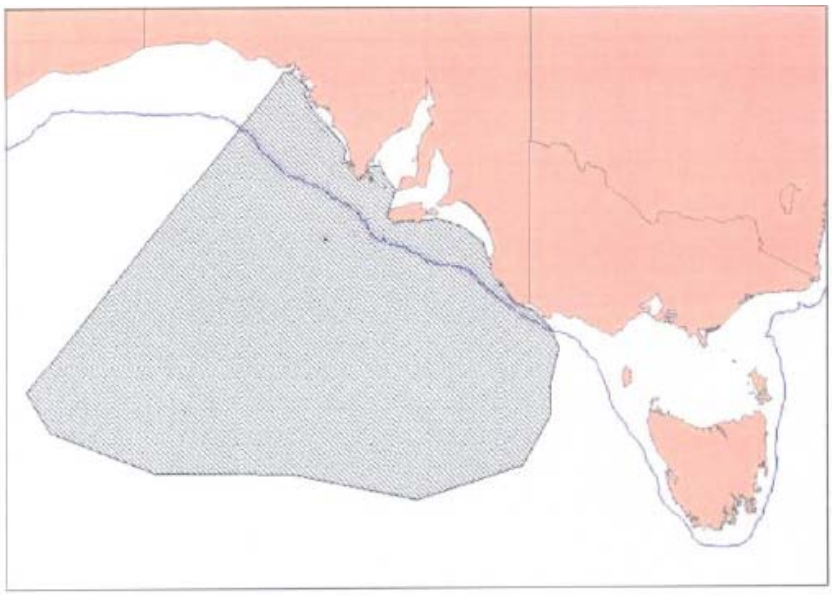


Figure 3-16: Estimated At-Sea Foraging Habitat for female New Zealand Fur Seals (Goldsworthy & Page, 2009)



The species diet is principally fish and cephalopods, but also includes seabirds such as little penguins (Shaughnessy et al, 1999). Female fur-seals dive usually to 80m during early lactation and later in their lactation they will dive to depths of 20-200m at distances 80-100km from shorelines. It is highly likely that the males can dive to over 200m (SMM, 2012).

The Lightning MSS may encounter New Zealand Fur Seals foraging in the marine environment during the proposed MSS.

### 3.4.6 Reptile Species

Three species of threatened marine turtles occur in the waters of South Australia (SEWPC, 2012a):

- Green turtle (*Chelonia mydas*) – Vulnerable;
- Loggerhead turtle (*Caretta caretta*) – Endangered; and
- Leatherback turtle (*Dermochelys coriacea*) – Endangered.

#### *3.4.6.1 Green Turtle*

These turtles nest, forage and migrate across tropical northern Australia usually between the 20°C isotherms although individuals may stray into temperate waters (SEWPC, 2012n). Green turtles are herbivores, feeding on shallow benthic habitats containing seagrass and/or algae including coral and rocky reefs, and inshore seagrass beds (DEWHA, 2007). Major nesting areas are found tropical regions of Western Australia, Northern Territory and Queensland (SEWPC, 2012n).

No biologically significant areas (i.e. feeding or breeding) for the Green Turtle are in proximity to the Lightning MSS area. The species may transit through the MSS area however is expected to have a low likelihood of encounter.

#### *3.4.6.2 Loggerhead Turtle*

The Loggerhead Turtle (*Caretta caretta*) has a global distribution throughout tropical, sub-tropical and temperate waters. In Australia, the Loggerhead Turtle occurs in the waters of coral and rocky reefs, seagrass beds and muddy bays throughout eastern, northern and western Australia (DEWHA, 2007). Nesting is mainly concentrated on sub-tropical beaches concentrated in southern Queensland and from Shark Bay to the North West Cape in Western Australia. Foraging areas are more widely distributed (SEWPC, 2012o). Loggerhead Turtles are carnivorous, feeding primarily on benthic invertebrates in habitat ranging from near-shore to 55m (SEWPC, 2012o).

No biologically significant areas (i.e. feeding or breeding) for the Loggerhead Turtle are in proximity to the Lightning MSS area. The species may transit through the MSS area however is expected to have a low likelihood of encounter.

#### *3.4.6.3 Leatherback turtle*

The Leatherback Turtle (*Dermochelys coriacea)* is a pelagic feeder, found in tropical, subtropical and temperate waters (Marquez, 1990). It's large body size, high metabolism, a thick adipose tissue layer and regulation of blood flow allows them to utilise cold water foraging areas unlike other sea turtle species. For this reason this species is regularly found in the high latitudes of all oceans including waters offshore from NSW, Victoria, Tasmania and Western Australia (SEWPC, 2012p). Adult turtles are found in both pelagic and coastal waters foraging throughout the water column from close to the surface to depths of more than 1200m (DEWHA, 2007). The species has been recorded feeding in all Australian states and while no major nesting areas have been recorded in Australia (DEWHA, 2007), scattered isolated nesting occurs in southern Queensland and the Northern Territory (SEWPC, 2012p). It is thought that most leatherback turtles found in Australian Waters have migrated from tropical nesting areas to feed in temperate waters (DEWHA, 2007). Adult turtles feed mainly on pelagic soft-bodied creatures such as jellyfish which occur in greatest concentrations at the surface in areas of upwelling or convergence (SEWPC, 2012p).

No biologically significant areas (i.e. feeding or breeding) for the Leatherback Turtle are in proximity to the Lightning MSS area. The species may transit through the MSS area however is expected to have a low likelihood of encounter.

### 3.4.7 Marine Seabirds

Fourteen (14) species of birds listed as Endangered or Vulnerable on the EPBC Protected Matters Database (SEWPC, 2012a) may occur within the MSS area and include both albatross and petrel species. Albatrosses and giant-petrels are among the most oceanic of all seabirds, and seldom come to land unless breeding (SEWPC, 2011c). Many species, such as Grey-headed Albatrosses, are extremely dispersive, spending most of their time over the pelagic waters of the High Seas while others like adult Shy Albatrosses, tend to remain sedentary, regularly foraging over coastal waters throughout their adult lives (SEWPC, 2011c).

Listed Albatross species (refer **Table 3-2**) have a widespread distribution throughout the southern hemisphere. They feed mainly on cephalopods, fish and crustaceans, using surface feeding or plunge diving to seize their prey (ACAP, 2012). Albatrosses are colonial, usually nesting on isolated islands and foraging across oceans in the winter months with most observations along the edge of the continental shelf (DEWHA, 2007). No breeding colonies or nesting areas for listed albatross species are located within, or adjacent to, the proposed Lightning MSS area. The closest breeding island to the survey area is Albatross Is (TAS) [Shy Albatross] (960km SE); and Macquarie Island [Black-browed Albatross, Grey-headed Albatross & Wandering Albatross] (2780km SE) (ACAP, 2012; SEWPC, 2011c).

Listed Petrels species (refer **Table 3-2**) are oceanic species, which have a widespread distribution throughout the southern hemisphere. They are colonial and breed on sub-Antarctic and Antarctic islands in a circumpolar band generally between $40^{O}$S and $60^{O}$S. Petrel species feed on small fish, cephalopods (octopus, squid & cuttlefish) and crustaceans along the edge of the continental shelf and open waters (DEWHA, 2007). No breeding colonies or nesting areas for listed petrel species are located within or adjacent to the proposed survey Lightning MSS area. The closest breeding island to the MSS area is Maatsukyer Is (TAS) [Soft Plumaged Petrel] (1290km SE); and Macquarie Island [Blue Petrel, Northern & Southern Giant Petrels] (2780km SE) (ACAP, 2012; SEWPC, 2011c).

No biologically significant areas (i.e. nesting and roosting areas) for these marine bird species lie in proximity to the proposed Lightning MSS area, however these birds may overfly and forage within the area during the MSS.

## 3.5 Social Environment

The landfall areas surrounding the Lightning MSS location predominantly support commercial fishing and ecotourism (Kangaroo Island). Defence activities (military flying) are also undertaken in South Australian waters in Investigator Strait and the adjacent gulfs (north and east of the MSS area) (DEWHA, 2007).

Besides Adelaide, key regional centres in the area include Port Lincoln, Ceduna and Whyalla (Gardner et al, 2006).

Specifically, the EPP41 and EPP42 permit areas are situated in a region recognised for commercial fisheries and commercial shipping.

### 3.5.1 Shipping

Key ports within the area include:

- Port Lincoln (handles grain, seed, fertiliser and petroleum);
- Withernell Bay, Port Bonython (handles petroleum);
- Port Pirie (handles zinc, lead, minerals, coal and ore);
- Wallaroo (handles seeds, grains and fertilisers);
- Port Giles (handles grains, seeds, petroleum);
- Whyalla (handles iron ore and steel products);

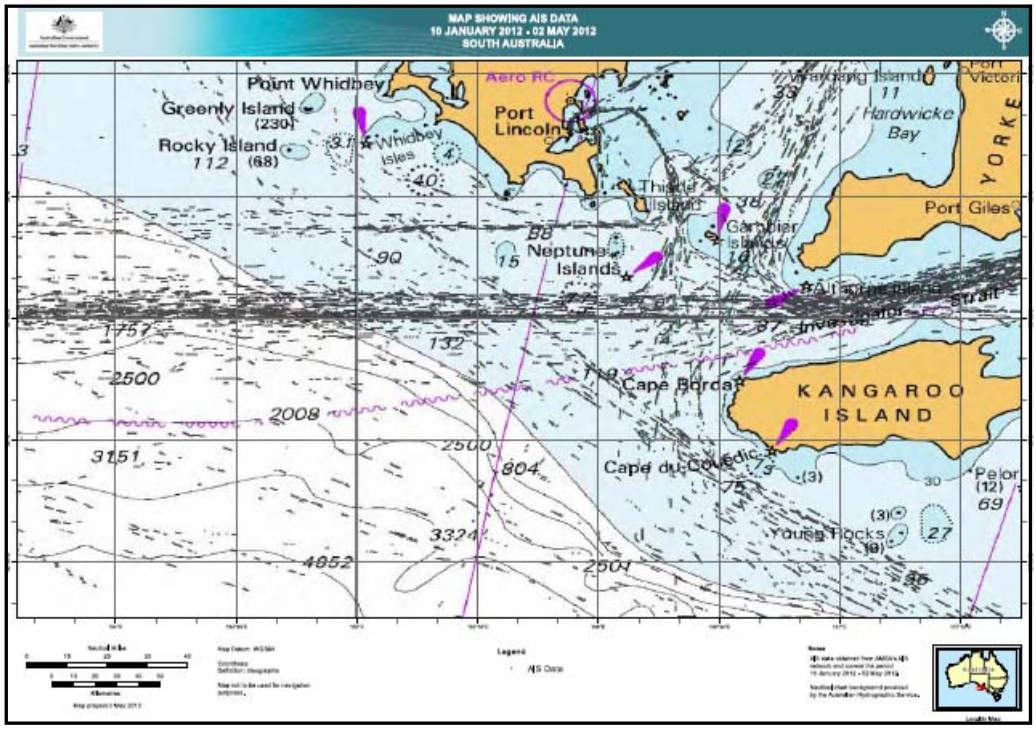
- Ardrossan (grain); and
- Port Adelaide (handles wine, meat, flour, fruit, fertiliser, timber).

Vessels involved in these activities include container ships, bulk carriers, cruise liners and oil tankers.

Ship visits to these ports (2002-2003) were in the range 1-250 (per port) however vessels visiting Port Adelaide in the same period were more than 1000 vessels (i.e. 3 vessels per day) (Gardner et al, 2006). Shipping data obtained from AMSA (Gardner et al, 2006) indicates that there is a major shipping channel running east-west through the Southern Ocean bypassing the Great Australian Bight, between Cape Leeuwin and eastern Australian ports (refer **Figure 3-17**). AMSA (2012) has identified that the main shipping channel from Investigator Strait to Cape Leeuwin passes through the Lightning MSS area. In accordance with advice provided by AMSA, the AMSA Rescue Coordination Centre (RCC) and the Australian Hydrographic Office (AHO) will be advised of the MSS details prior to MSS commencement such that RCC radio warnings and a Notice to Mariners can be issued to shipping.

With regard to the environmental context on the continental shelf areas immediately within and north of the MSS area, the major shipping channel creates significant background noise. For example, large vessels (tankers) have a low frequency sound emissions of between 180-190dB re 1µPa (at hull) and container ships have sound emissions at 181dB re 1µPa (at hull) (Simmonds et al, 2004). Medium sized vessels such as fishing trawlers produce sound in the range 165-180dB re 1µPa (UNEP, 2012).These shipping activities are considered to be in closer proximity to adjacent sensitive areas for pinnipeds such as Neptune Island and Liguanea Island compared with the Lightning MSS and will mask residual sound levels from MSS activities when conducted on the shelf area (refer **Section 5.5.1**).

Figure 3-17: Shipping Routes in the Lightning MSS Region (AMSA, 2012)



### 3.5.2 Marine Tourism

Marine tourism covers many activities in the region ranging from whale-watching, diving, recreational fishing, recreational beach use and cruise ship visits. Tourism activity in this region focuses on the Eyre Peninsula, Yorke Peninsula and Kangaroo Island (Gardner et al, 2006).

Marine-based tourism has expanded rapidly in the past two decades largely as a result of the environmental qualities of the region with the major tourism areas in South Australia identified in **Table 3-4**. Kangaroo Island Council provided more recent data to identify that tourist numbers had increased to 190,000 visitors per annum in recent years (Kangaroo Island Council, 2013).

The Eyre Peninsula offers as variety of natural landscapes, ranging from inland regional areas to coastal landscapes. A high proportion of the visitors to the peninsula are residents of regional SA (41%) or visitors from WA (6%). According to the South Australian Tourism Commission (2004), one of the most popular activities in the area is recreational fishing followed by visiting the beach (Gardner et al, 2006)

Table 3-4: Domestic and International Visitors to Key SA Tourism Areas 2003/3 (Gardner et al, 2006).

| Tourism Area | Total Number of Visitors | Domestic Visitors (%) | International Visitors (%) |
|---|---|---|---|
| Adelaide | 2 467 000 | 89 | 11 |
| Eyre Peninsula | 430 000 | 97 | 3 |
| Flinders Ranges | 680 000 | 92 | 8 |
| Yorke Peninsula | 526 000 | 99.5 | 0.5 |
| Fleurieu Peninsula | 565 000 | 98 | 2 |
| Kangaroo Island | 127 000 | 77 | 22 |

Kangaroo Island is listed by the Australian Tourism Commission (2005) as one of the nine unique wonders of Australia. Limited development on the island has ensured that an abundance of wildlife remains including sea lions, penguins, dolphins, koalas and kangaroos. The activities undertaken by tourists on the island include going to the beach, wildlife viewing, bushwalking or sightseeing (Gardner et al, 2006). The environment of Kangaroo Island is characterised by extensive areas of National Parks and Conservation Parks accounting for nearly 30% of the island (Kangaroo Island, 2013). Important key natural values important to Kangaroo Island are its spectacular coastal features; clean beaches; unspoilt natural settings; a diversity of native flora and fauna; a rare seal colony; and pollution and contamination free conditions[15] (Kangaroo Island Council, 2013).

Tourism is estimated to generate 15% of direct employment on the Island and this is projected to increase by 17.7% in 2021 (Kangaroo Island Council, 2013). The tourism market has been estimated at $63M per annum to the island community (Kangaroo Island Council, 2013).

The marine tourism activities of the area include:

- **Recreational Beach Use**: Sightseeing, swimming, surfing, snorkelling[16];
- **Diving:** Nine underwater heritage trails which explore historic shipwrecks are listed for SA and consist of the *Underwater Trail*, extending form Port Willunga to SE of Ardrossan (*Grecian*, *Zanoni*, *Star of Greece* and *Norma*); the *Garden Island Trail*, located inside the Port River (northern arm); the *Investigator Strait Trail* located between southern Yorke

[15] These natural values will remain unaffected by the Lightning MSS activities.
[16] These activities remain unaffected by seismic activities located more than 100km to the west.

Peninsula and Kangaroo Island; *Jervois Basin Trail* located in the upper reaches of the Port River; *Kangaroo Island Shipwreck Trail* (shipwrecks located at coastal points around the island); the *Port Elliott Trail* (Port Elliott); the *River Boat Trail* (Murray River from Border Cliffs to Goolwa); the *Southern Ocean Shipwreck Trail* (Victorian Border to Murray Mount); and *Wardang Island Maritime Heritage Trail* (near Port Victoria in Spencer Gulf) (DEWNR, 2014)[17].

- **Marine Mammal Watching:** Whale watching is becoming increasingly popular (~15% per year growth between 2001 and 2003) (Gardner et al, 2006). In SA, 159,900 people participated in whale watching in 2003 with an estimated expenditure of $10M. In 2003 there were 9 licenced operators with boat-based observation accounting for approximately 20% of viewing and the remainder land-based (Gardner et al, 2006). In SA whale watching is found in two main areas – along the coast of the southern Fleurieu Peninsula (80km south of Adelaide) and the Head of Bight Marine Park (land-based on the Yalata Indigenous Protected Area). These areas are significant for Southern Right Whales with tours operating from Fowlers Bay (110km west of Ceduna) and Victor Harbour between June and October (SA Whale Centre, 2014); and from Kangaroo Island between May and October (Planet Whale, 2014). These tours typically are 1-3hours long (total) and focus on near-shore Southern Right Whale activity. Timeframes for tours preclude whale-watching activities in the Lighting MSS area.
- **Charter Boating:** Coastal tourism includes an increasing number of commercial passenger vessels that take tourists sightseeing, fishing, diving, marine mammal watching and ferry them to island resorts (Gardner et al, 2006).In SA, charter boats are concentrated around Port Adelaide (refer **Figure 3-18**) however some are based on Kangaroo Island, the Eyre Peninsula and Streaky Bay. The most common activity for these boats is recreational fishing, closely followed by nature-based tourism. Fishing operators which use deeper waters in SA target offshore species such as the striped marlin (SEWPC, 2012b). The lack of charter boats along much of the SA coast reflects the often stormy and rough conditions common in the area and the lack of major population centres (Gardner et al, 2006). Charter boats to the Lightning MSS area are expected to be infrequent due to the prevailing oceanic weather conditions in the MSS area.
- **Recreational Boating:** Recreational boating in Australia has increased dramatically in recent years due to increases in disposal incomes and the decrease in boating costs. In 2002, 75000 boats were owned by South Australians reliant on available slipways, boat-lifters and over-beach launching facilities (Gardner et al, 2006). Recreational vessels are typically small non-ocean going vessels not suitable for the conditions within the Lightning MSS area. No recreational vessels are expected to be present in the survey area.
- **Yacht Racing:** Annual yacht races held in the region include the Melbourne to Adelaide yacht race (December) and the Blue Water Classic between Adelaide and Port Lincoln (February) which attracts more than 50 entrants. The socio-economic impact of yacht racing in the region is minor compared to the eastern states where there are 12 yacht races held each year (Gardner et al, 2006). These races are not affected by the Lightning MSS activities.
- **Cruise Ship Visits:** Penneshaw (north-eastern Kangaroo Island) has hosted cruise liners since 2012 when the new landing platform was completed. Between November 2012 and December 2014, eleven cruise ships are scheduled to visit the island (SA Tourism Commission, 2012). Routes taken by cruise liners to and from Penneshaw track the commercial shipping lanes defined in **Section 3.4.1**. No impact to this tourist activity is expected whilst the liners are located in Penneshaw.
- **Fishing (Recreational):** Based upon 2000-01 recreational fishing figures, approximately 4.4% of South Australian hold a recreational fishing Licence. The bulk of

[17] Seismic survey activities are not expected to affect these heritage trail activities.

recreational fishing on SA involves line fishing (84.5%) followed by pots and traps (10.7%) to catch lobster. The majority of fishing occurred in coastal environments (74.2%) while only 3.3% occurred offshore. Major areas of activity include waters off the southern and western Eyre Peninsula[18] and Kangaroo Island targeting tunas, striped marlin, snapper, Australian salmon and trevally (SEWPC, 2012b). Shore-based recreational fishing accounts for 62.3% and 37.6% is from boats. The recreational catch of fish in 2000-01 was 4200tonnes primarily consisting of inshore species such as the Australian Herring, King George and other whiting, mullet and garfish with non-fish species including squid/cuttlefish, blue swimmer crabs and macrobrachium/cherabin[19] (Gardner et al, 2006). As identified in **Figure 3-19**, recreational fishing in the survey area is considered to be low.

Figure 3-18: Charter Boat Operations in the SW Marine Region (Gardner et al, 2006)

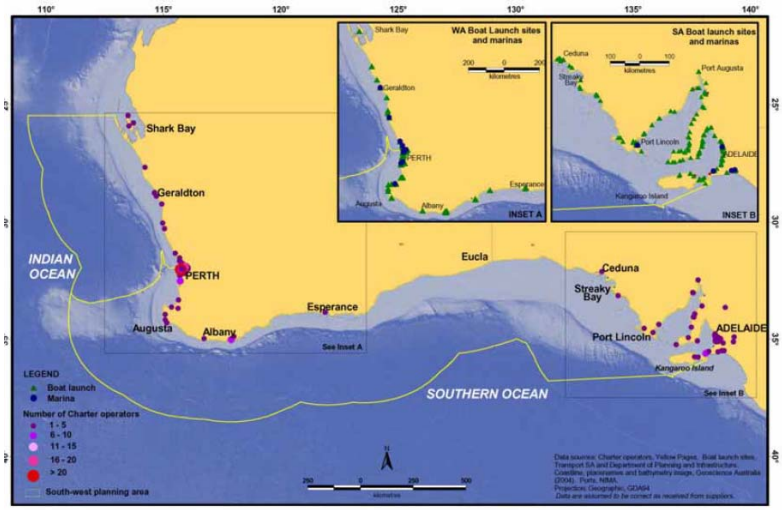
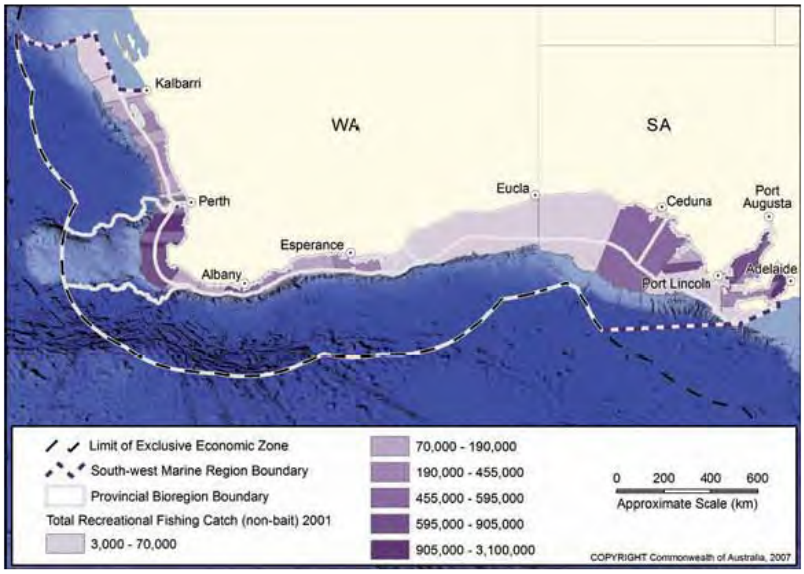



Figure 3-19: Distribution of Recreational Fishing Effort (2001) (SEWPC, 2012b)




[18] Tours target Wedge Island and Thorny Passage Islands (1 day tour). Longer tours (3 days) depart either from Port Lincoln to Wedge Island, Thistle Island, Neptune Islands and Kangaroo Island; or from Coffin Bay to Greenly and Rocky Islands or Pearson and Flinders Island (SA) between January to June (Why Not Fishing Charters, 2014; Absolute Fishing Charters, 2014)
[19] A crustacean (prawn) species.

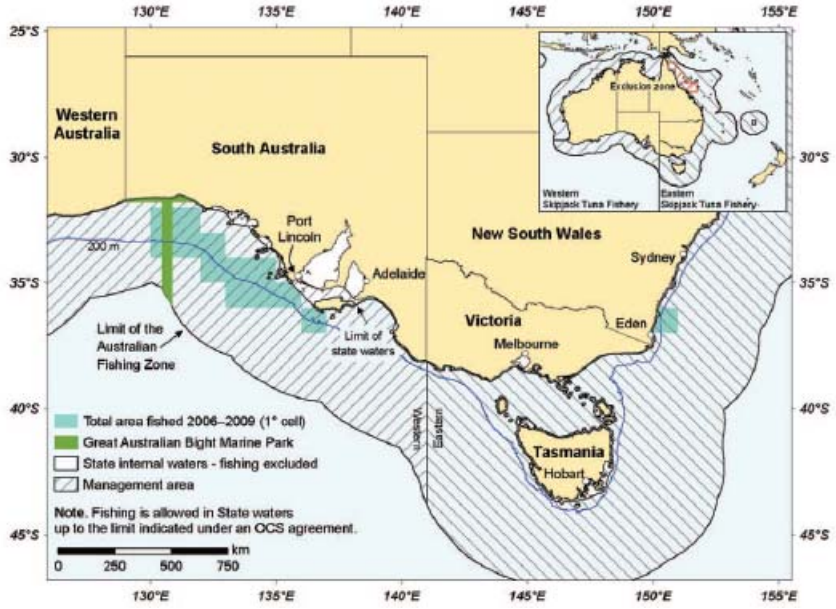
### 3.5.3 Commercial Fisheries

**Figure 3-31** provides a summary of the fishing industry employment, mean annual revenue and fishing methods engaged in the South West Marine Region (BRS, 2006). As indicated by this figure, within the MSS area fish capture rates are low and the primary methods of capture in the MSS area are line and trap.

The following Commonwealth managed fisheries may operate within the proposed MSS area:

- **Skipjack Tuna (Western) Fishery**: Fishery lies in Australian Fishing Zone (AFZ) waters west of 114°E and targets Skipjack Tuna (*Katsuwonus pelamis*). The primary fishing technique is Purse Seine and the fishing season extends all year round from 1 July to 30 June each year (AFMA, 2010a). Despite the wide distribution of the Skipjack Tuna Fishery (STF) management area, the STF is confined to two main areas – an area off south-east NSW (main port is Eden) and a smaller catch area in the GAB east of the WA/SA state border (AFMA, 2009; Kailola et al, 1993) (refer **Figure 3-20**). Australia is considered at the edge of the species range and availability of tuna is highly variable reliant on recruitment from areas of abundance in equatorial regions (i.e. spawning in tropical regions) (Kailola et al, 1993) and not always present in the AFZ. There has been no fishing effort in the STF management area since the 2008-09 fishing season. *Skipjack Tuna Fishermen are not expected to be present in the MSS area at the time of the proposed survey*.

Figure 3-20: STF Area Fished (2006-2009) (Woodhams et al, 2013)




- **Small Pelagic Fishery (Western sub-area):** The Small Pelagic Fishery (SPF) lies in the AFZ in the southern waters of Australia extending from 28°10'00"S (east coast) to 30°00'00"S (west coast). The key target species of the fishery are Jack Mackerel (*Trachurus declivis*)[20], Blue Mackerel (*Scomber australasicus*)[21], Redbait (*Emmelichthys nitidus*)[22] and the Australian Sardine[23] (*Sardinops sagax*) however in 2011-12 primary

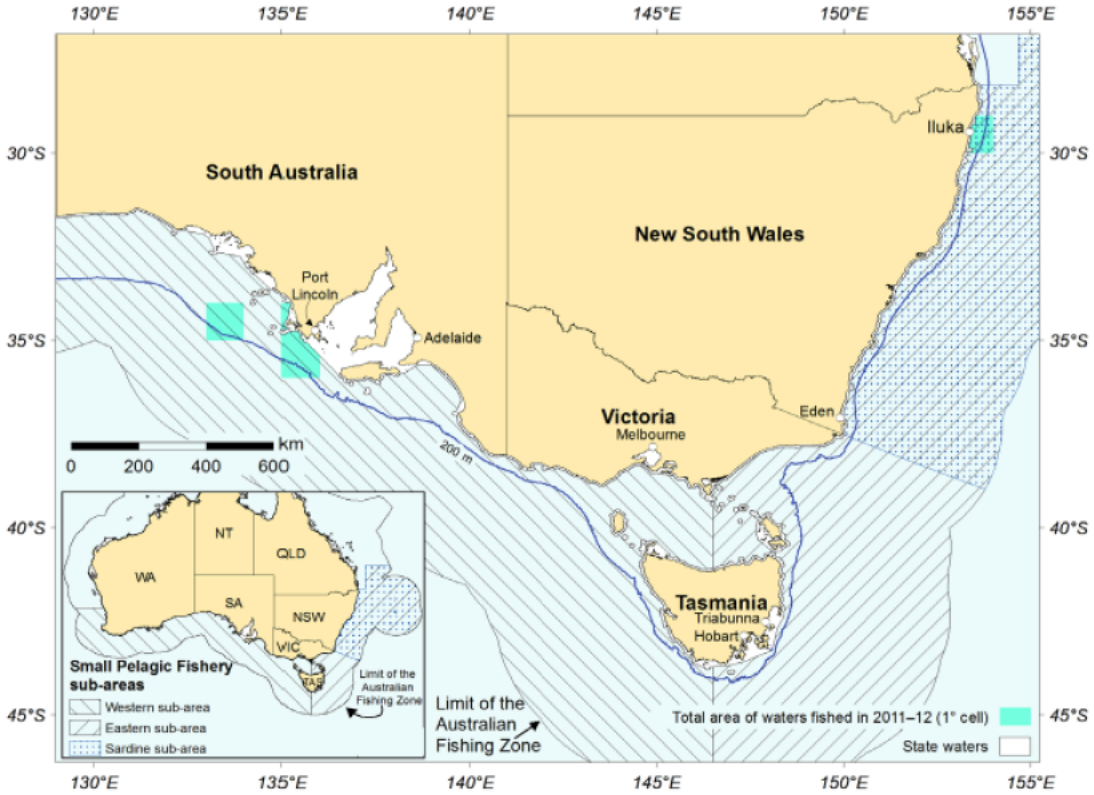
[20] Spawning widespread throughout the species range and occurs in the GAB in summer (Kailola et al, 1993).
[21] Present in depths of 40-200m of water. Species is widespread (Kailola et al, 1993) and is a serial spawner throughout late spring to early autumn. Egg surveys show highest abundances in depths of 40-120m and sea surface temperatures of 18-22°C. Results of an exploratory survey suggest the western GAB is an important spawning area (Ward et al, 2011; Ward et al, 2009).
[22] Commonly found in water depths between 20-100m (Bruce et al, 2002). Spawning takes place between October and January in Tasmanian waters (Kailola et al, 1993)

targets were the Australian Sardine (99% taken of the east coast) and Blue Mackerel. These species typically inhabit waters to a maximum depth range of 500m and the fishery utilises a purse seine fishing method. Literature indicates that this fishery has traditionally operated off the east coast of Tasmania with the primary landing ports of Triabunna, Eden, Iluka and Port Lincoln (refer **Figure 3-21**).

While **Figure 3-21** identifies fishing effort in the shelf areas to the west of the Eyre Peninsula only three vessels were active in the entire fishery with a total of 9 days effort in the 2011-12 fishing season (between NSW and SA). [redacted] In 2012 the SPF quota holders attempted to bring in a factory trawler to rationalise costs however the vessel was prevented from entering the fishery as a result of imposed environmental legislation (Woodhams et al, 2013).

*On the basis of consultation feedback and fishing literature, SPF permit holders are not expected to be encountered in the proposed MSS area at the time of the MSS.*

Figure 3-21: Small Pelagic Fishery – Area Fished (2011-12) (Woodhams et al, 2013)




- **Southern and Eastern Scalefish and Shark Fishery:**
  - **Great Australian Bight Trawl Sector (GABTS):** The GABTS lies in AFZ waters (excluding state fishery shelf waters) and extends from Cape Leeuwin (WA) to Cape Jervis (SA) targeting the shelf-break across the Great Australian Bight. The fishery is predominantly demersel and limited mid-water trawl. The fishery extends from approximately 300m water depth with the predominant target

[23] Present at all depths in the water column to approximately 200m. Multiple–batch spawning occurs in inshore continental shelf areas of the GAB during summer and autumn (January to March). In SA there is some evidence that juveniles remain in bays, inlets and estuaries until 12months of age before moving offshore (Bruce et al, 2002). Refer to more information under SA Sardine Fishery.

species being Deepwater Flathead (*Neoplatycephalus conatus*)[24] and Bight Redfish (*Centroberyx gerrardi*)[25] but also Blue Grenadier (*Macruronus novaezelandiae*)[26], Orange Roughy (*Hoplostethus atlanticus*)[27], Pink Ling (*Genypterus blacodes*)[28] and Western Gemfish (*Rexea solandri*)[29]. **Figure 3-23** provides details of the relative fishing intensity within the Great Australian Bight Trawl Fishery (Gardner et al, 2006). The fishery is concentrated within the GAB between longitudes 125°E and 133°E along the shelf-break (Gardner et al, 2006), but principally from 126-132°E at water depths 100-250m ([redacted] and operates on a year round basis (Woodhams et al, 2013). Five vessels are active in this fishery (Woodhams et al, 2013).

*On this basis, it is possible but very unlikely that GABTS fishermen will be present in the area during the proposed MSS.*

- **Gillnet Hook & Trap Sector (GHTS):** The GHTS lies in AFZ waters extending from the Victorian border across shelf waters to the SA/WA border (AFMA, 2012a) (refer **Figure 3-24**). While fishing effort is recorded within the Lightning MSS area, it is not identified as an area of high fishing intensity (i.e. less than 5 boats operating in the area). The fishery targets gummy shark (*Mustelus antarcticus*)[30] however elephant fish (*Callorhinchus milii*)[31], sawshark (*Pristiophorus cirratus, P. nudipinnus*)[32], school shark (*Galeorhinus galeus*)[33], pink snapper (*Pagrus auratus*)[34], whiskery shark (*Furgalus macki*)[35], broadnose sevengill shark (*Notorynchus cepedianus*), bronze whaler (*Carcharhinus brachyurus*)[36], spotted swellshark (*Cephaloscryllium laticeps*) and queen snapper (*Nemadactylus valenciennesi*)[37] are also taken from the fishery (Woodhams et al, 2013). The fishery predominantly uses demersel gillnets and dropline.

[24] The species is demersal with habitat on continental shelf/slope to 490m. Spawning period in GAB lasts from October to February (Kailola et al, 1993).
[25] Endemic to temperate waters of southern Australia and is a benthopelagic species on rocky reefs at depths 11-260m (Gomon & Bray, 2011)
[26] Species occupies water column with most common depths between 200-700m. Spawning area is located on the west coast of Tasmania with spawning occurring in winter (Bruce et al, 2002).
[27] Most catch comes from the grounds off Albany and Esperance with no catch in 2012-3 fishing year (Woodhams et al, 2013). The species occupies mid-slope depths between 700-1200m. Spawning occurs on seamounts with spawning off Tasmania in winter (Bruce et al, 2002). Now little fishing effort for this species following closure of the orange roughy fishing grounds (>750m) (Woodhams et al, 2013)
[28] Species present in continental shelf and slope waters between 40-700m. Spawning occurs off Strahan (Tas.), Lakes Entrance (Vic) and Gabo Island (NSW) during spring (Bruce et al, 2002).
[29] Species inhabits deeper continental shelf and upper slope waters from 100-700m (Kailola et al, 1993). Spawning of the western gemfish appears to occur in the west of the GAB in summer (Bruce et al, 2002)
[30] Adults are demersal on the continental shelf from inshore to approximately 80m. Species is broadly distributed around southern coastline between Geraldton and Townsville. Some records show long distance movements across southern Australia. Pupping frequency in SE Australia occurs every two years. Species does not have restricted and well defined nursery areas. Pups are generally born in shallow coastal areas. (Bruce et al, 2002)
[31] Species distributed throughout continental shelf areas (cool and temperate regions) to depths of at least 200m and distributed from Sydney to Esperance. Adult elephant fish migrate to shallower waters (generally >40m) of estuaries and bays in spring to breed (Bruce et al, 2002).
[32] Species is distributed from Caloundra (Qld) to Jurien Bay (WA) along the southern coastline and occurs in depths between 40-310m. (Bruce et al, 2001). Gestation and embryo development take place between October and January. No details are available on breeding locations (Kailola et al, 1993)
[33] Species has widespread distribution in temperate waters from Brisbane to Perth mostly on the continental shelf between inter-tidal areas to 800m. Pupping areas have been confirmed in certain estuaries, protected embayments and ocean beach habitats of Victoria and eastern and southern Tasmania (Bruce et al, 2002)
[34] Species is widespread in warm temperate and subtropical waters in water depths 1-200m with juveniles inhabiting inlets, bays and other sheltered marine waters. Species are serial spawners with spawning generally occurring between late October and early March in water depths less than 50m (Kailola et al, 1993)
[35] Species distributed continental shelf waters from eastern Victoria to Shark Bay (WA) more common in deeper continental shelf waters to 220m. No information available on breeding areas and timing (Kailola et al, 1993).
[36] Species is distributed in warm-temperate coastal waters from Coffs Harbour to Jurien Bay (WA) in water depths 1-100m occasionally entering estuarine waters. Birthing occurs at any time of year but peaks in summer with a known pupping site north of Adelaide in the Gulf of St Vincent (Kailola et al, 1993).
[37] Species is distributed from western Victoria to southern WA and are demersal fish found in inshore reefs to offshore in water depths of 40-240m. No information is available on breeding (Kailola et al, 1993).

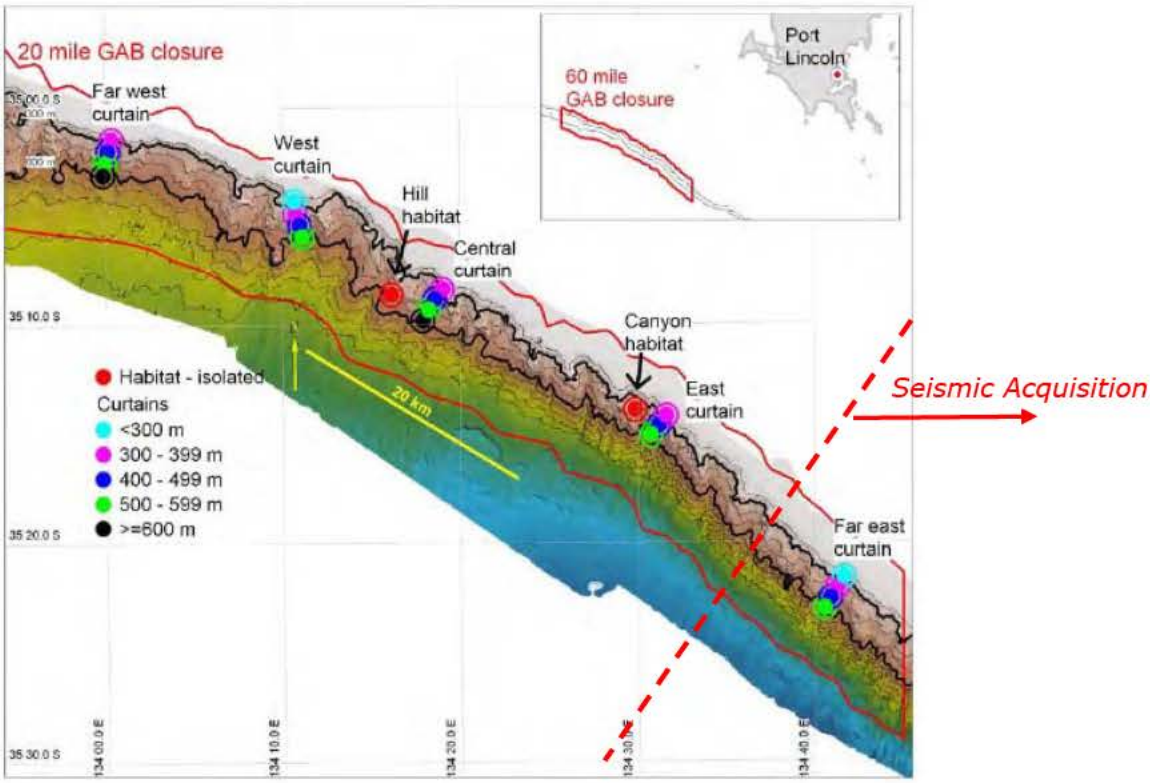
Fishery closures exist over portions of the Lightning MSS area to protect fishing stock (predominantly over-fished shark species such as the Gulper Shark or Southern Dogfish (*C. Zeehaani*)) (AFMA, 2012a) between 133°45'E and 134°45'E (60nm) and at depths between 200-850m (Williams et al, 2012). This closure is centred on a 30nm area where the southern dogfish is concentrated and mature females are observed. Buffers of 15nm have been added to the east and west of this area to allow for edge effects (Williams et al, 2012). The Gulper Shark GAB closure area (60miles) is provided in **Figure 3-22**. The purpose of this closure is to protect breeding stock and allow the fishery to rebuild.

The Gulper Shark inhabits upper to middle continental slope and some offshore seamounts in southern and eastern Australia mainly in depths between 350-800m but with an overall depth range of 275-1050m. Its diet consists of fish, cephalopods and crustaceans and is demersal. It has a low fecundity of one-two pups per 2-3years (Graham, 2013) which makes the species susceptible to rapid stock depletion from over-fishing.

It is estimated that the Lightning MSS area enters the eastern end of the closure by approximately 10-15km (~8nm) (refer **Figure 3-13** and **Figure 3-22**).

It should be noted that as a result of this closure and further closures arising from accidental by-catches of dolphins and sea lions, most of the South Australian demersal gillnetters have shifted to Victoria for fishing activities.

Figure 3-22: GAB Closure Area and Survey Area locations (Williams et al, 2012)




There are 46 active gill-net vessels (predominantly in eastern Bass Strait) and 23 active hook vessels operating in this fishery (Woodhams et al, 2013).

*On the basis of lack of consultation feedback, fishing closures within the area, and fishing intensity data for this fishery in the Lightning MSS area, it is very unlikely GHTS fishermen will be present during the proposed MSS.*

Figure 3-23: GABTS – Fishing Effort 2012-13 Season (Woodhams et al, 2013)

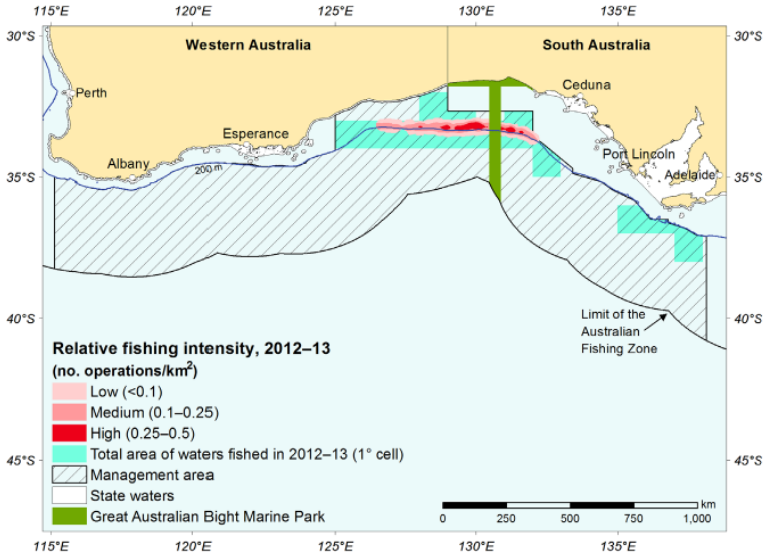
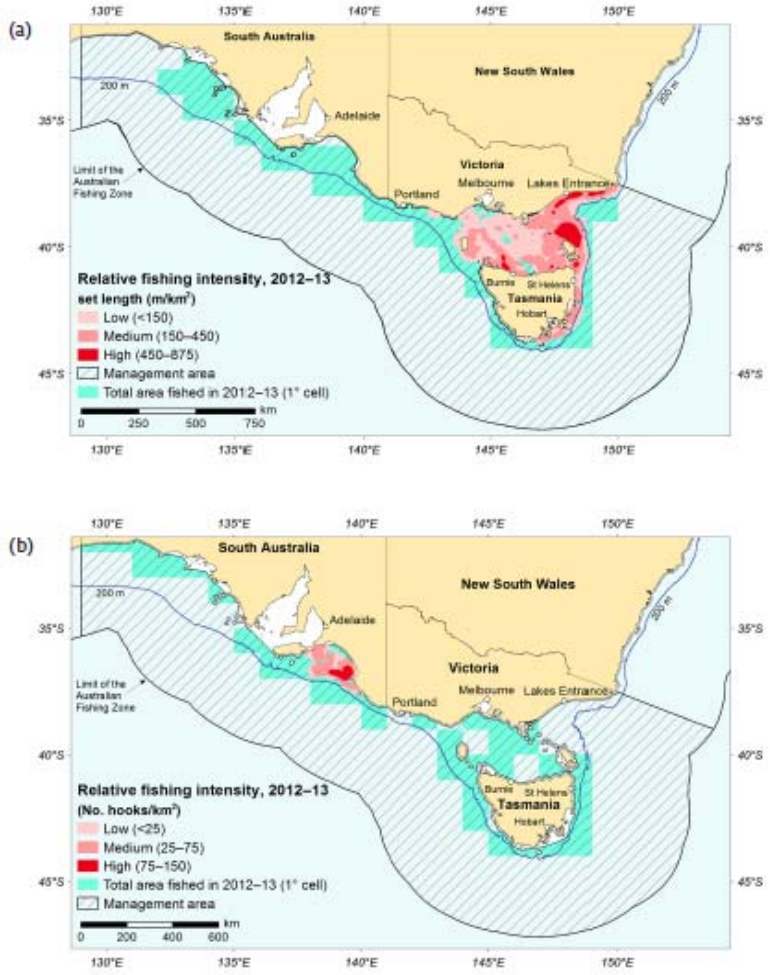



Figure 3-24: GHTS Relative Fishing Intensity in (a) the Shark Gillnet Sector and (b) the Shark Hook Sector, 2012-13 Fishing Season (Woodhams et al, 2013)



- **Southern Bluefin Tuna Fishery (SBTF):** The SBTF lies in the AFZ and extends around the entire Australian coastline with the principal target species - Southern Bluefin Tuna (*Thunnus maccoyli*)[38]. The fishing season runs from 1 December to 30 November each year however most fishing activity in the GAB has been completed by the end of February each year (B. Jeffriess pers. com, 2013 [Consultation Record 04]). A small proportion (5%) of the total catch is taken incidentally by the Eastern Tuna and Billfish Fishery (eastern Australia) and to a lesser extent the Western Tuna and Billfish Fishery (AFMA, 2010b) (refer **Figure 3-25**).

  Approximately 95% of the SBT is caught in the Great Australian Bight on or near the shelf-break to the south-west of Ceduna (DEWHA, 2007). The species actively feed on pilchards present within the area (PIRSA, 2005). Active vessels in the fishery are five (5) purse seine and 11 long-line vessels (Woodhams et al, 2013). SBT caught in the GAB (up to 98% of the Total Allowable Catch (TAC)) are juveniles (2-4 years old) taken by purse seine methods and towed live to Port Lincoln where they are 'grown-out' in floating sea cages (~3-5 months depending on market requirements) prior to export (McClatchie et al, 2006). It should be noted that the majority of SBT fishing effort within the GAB generally occurs NW of the MSS area (west of 133°E) (Eveson et al, 2008).

  [redacted]

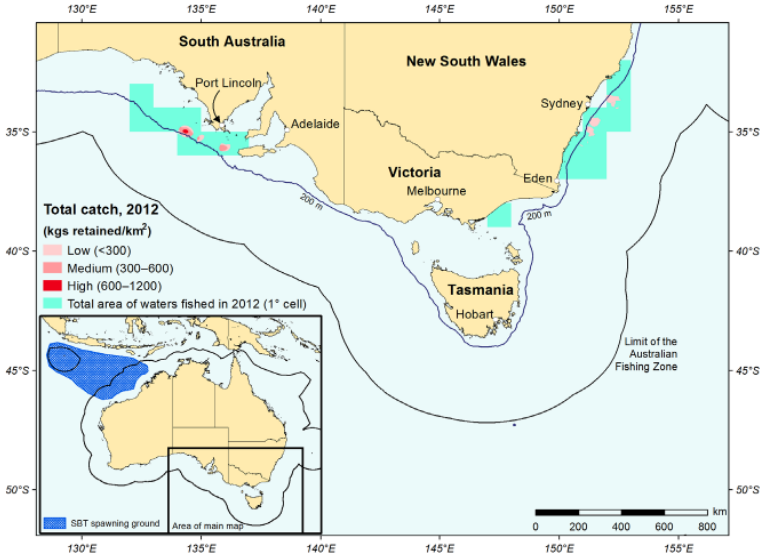
  It should be noted that an annual SBT aerial survey takes place from 1st January to 31st March each year along 15 evenly-spaced transect lines that run north-south from the coast to about the 800m contour off the continental shelf from Port Lincoln (SA) to beyond the WA border (CSIRO, 2010). The Lightning MSS may impact on the two most easterly survey lines with the most easterly survey line extending through the western part of the MSS area and the last but one survey line positioned more than 10 or more kilometres from the western edge of the MSS. *It is noted that the Australian Southern Bluefin Tuna Industry Association (ASBTIA) is not concerned about survey impacts to these results as key survey data was acquired in 2013 which set the 2014-2017 long term quotas*[39].

- **Western Tuna and Billfish Fishery (WTBF) (Southern Section):** The southern section of the WTBF lies in AFZ waters south of 34°S and west of 141°E. The target species of this fishery are the migratory yellowfin, bigeye and albacore tuna and broadbill swordfish with the principal methods of catch being purse seine and pelagic long-lining (AFMA, 2012b). **Figure 3-26** provides details of the relative fishing intensity (2012) (Woodhams et al, 2013) with no fishing activity recorded in the Lightning MSS area. The main pelagic long-lining effort in this fishery is concentrated off the WA coast west of 117°E (ABARES, 2010). *Encounter with WTBF fishermen is not expected*.

[38] Species is highly migratory and enter the tropical waters of the eastern Indian Ocean south of Java to spawn. Spawning occurs in every month except July but predominantly from September to March (Bruce et al, 2002; Kailola et al, 1993)

[39] ASBTIA, 30 March 2013 – [redacted] (Resubmission of proposal for a seismic survey in the Great Australian Bight)

Figure 3-25: SBTF Total Catch 2012 (Woodhams et al, 2013)




- **Southern Squid Jig Fishery (SSJF):** The Southern Squid Jig Fishery lies in AFZ waters extending from the Queensland/NSW border to the SA/WA border (excluding coastal waters) targeting Arrow Squid by squid jig methods. Fishing is carried out in continental shelf waters in depths of between 60-120m (inshore of the MSS area) between January and June with highest catches concentrated in March and April (Woodhams et al, 2013). Key areas are waters outside Port Phillip Bay (fished February-early March) and near Portland (March to June) (Woodhams et al, 2013) (refer **Figure 3-27**). Primary landing ports are Portland, Queenscliff and Hobart (Woodhams et al, 2013). While the area to the west and south of Kangaroo Island is also fished, fishing effort is very low (i.e. fishing occurs but too low to assign an intensity ranking). Active vessels in the entire fishery number 18 (Woodhams et al, 2013). Consultation undertaken with [redacted] the only SSJF fishermen based in Port Lincoln identified that he fishes in SW Victoria for squid and not SA waters.

  Gould's squid (*Nototodarus gouldi*)[40] is also caught as a by-product in the Commonwealth Trawl Sector. *On the basis of consultation feedback and fishing intensity data, the SSJF will not be encountered during the proposed MSS.*

[40] Species (including larvae) is most abundant on the continental shelf between depths of 50-200m. Spawns multiple times during the species lifespan of 12 months (Woodhams et al, 2013)

Figure 3-26: WTBF Fishing Effort (2003) (Woodhams et al, 2013)

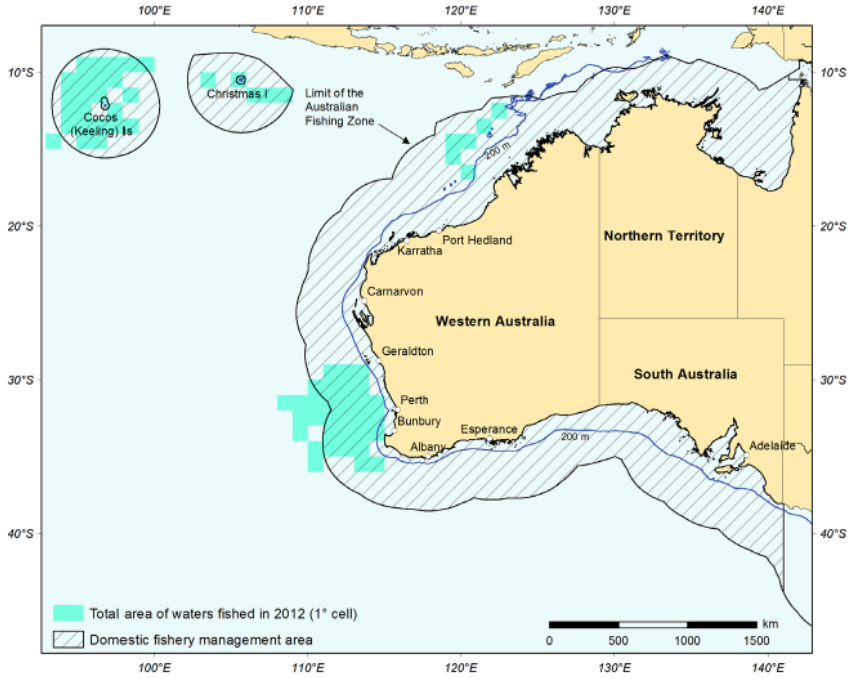
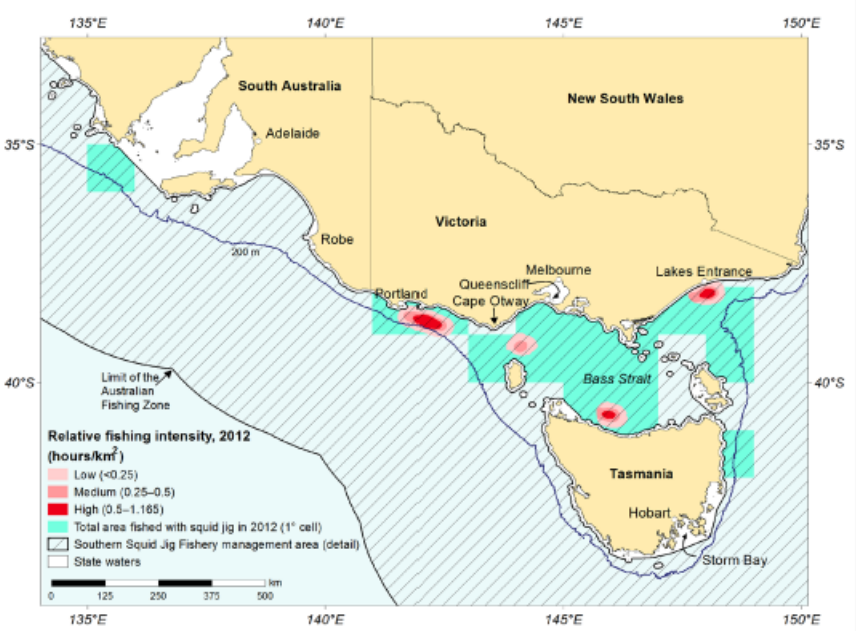



Figure 3-27: SSJF – Relative Fishing Intensity 2012 (Woodhams et al, 2013)




The following SA-state managed fisheries also operate within the proposed MSS area:

- **South Australian Rock Lobster Fishery (Northern Zone):** This fishery extends from the low water mark to the edge of the AFZ from the River Murray mouth to the WA border. The South Australian rock lobster fishery is a primarily single species, single method fishery, based on the capture of southern rock lobster, *Jasus edwardsii*. This species generally occur in a depth range of 0-200m and are capture via pots (PIRSA, 2007).

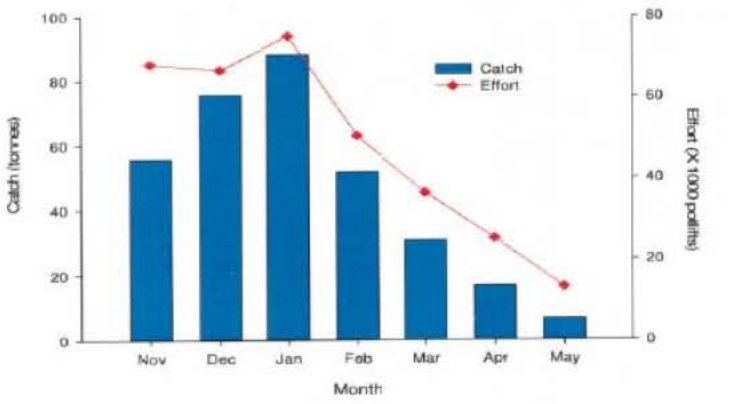
  The lifecycle of the Southern Rock Lobster (SRL) is complex – after mating in autumn, fertilized eggs are carried under the tail of the female for approximately three months before hatching typically between September and November/December (DPI, 2009; Kailola et al, 1993). A female lobster with a carapace length of 74mm can carry up to

69,000 eggs and a carapace length of 124mm can carry 400,000 eggs (Kailola et al, 1993). The eggs hatch into larvae (or *phyllosoma*) which undergo eleven developmental stages over a period of 12-24 months in pelagic environments while being dispersed and distributed by oceanic currents to distances at least 1100km from land (Kailola et al, 1993). Given the long-lived nature of the SRL larval phase, there can be up to two cohorts of larvae present in shelf waters at any one time. Larval distribution is initially in shelf waters with currents quickly dispersing larvae along shore and into offshore waters. Mixing of larvae and loss of *regional integrity* of larvae is prevalent in southeast SA, Tasmania and eastern Victoria. Additionally, *phyllosoma* are found over a variety of water depths and are assumed to have no affective horizontal swimming capacity in the marine environment (Bruce et al, 2007). During metamorphosis juvenile rock lobsters shift from a planktonic (*phyllosoma*) to a benthic existence (termed *puerulus*) (DPI, 2009) settling into coastal and shelf habitats. The long larval duration of the SRL is believed to provide ample opportunity for the transport of larvae from the source to distant regions. The highest *puerulus* settlement rates in South Australia occur during July and August, 8-9 months after hatching.

Species recruitment and growth can vary from year to year as a result of environmental changes including water temperature and movement of oceanic currents and the species presence within New Zealand and Australian waters has been demonstrated to comprise of a single stock (Ward et al, 2002). Transport of larvae in southern Australia is dominated by an easterly displacement from western natal spawning sites by currents running parallel to the coast from south-west Western Australia to the east coast of Tasmania. A complex field of eddies and currents in offshore waters in southern Australia serve to isolate some larvae from the predominant easterly flow with localized westerly displacement in some areas (particularly South Australian waters) (Bruce et al, 2007). With the exception of southwest WA, all regions receive more stock from outside their own boundaries than from self-recruitment (Bruce et al, 2007) with the *Southern Zone Fishery of SA having the highest level of egg production in southern Australia* and was an important source of *puerulus* for the overall south–eastern fishery (Linnane and Walsh, 2011).

The Northern Zone Lobster Fishery has been subject to significant reductions in its harvest quota for a number of years. Although there has been fishing at the shelf break historically, only 1% of the Northern Zone Catch came from waters deeper than 90m (Linnane et al, 2013). In recent years with a much smaller quota the focus has been on higher value red lobsters from inshore areas in depths less than 60m. The Northern Rock Lobster Fishery operates between 1 November and 31 May each year (PIRSA, 2002). Fishing effort in the Fishery for 2012 is provided in **Figure 3-28**.

Figure 3-28: Season Trends in Catch and Effort in the NZRLF (2012) (Linnane et al, 2013b)




[redacted]). Therefore fishing intensity in the survey area although

low may increase under the new harvest strategy however the remoteness of the survey area from home ports will limit activity. The timing of the deep water harvest is still under consideration but is likely to be in the late autumn and winter.

*On this basis it is possible lobster fishermen may be present in the area during the MSS.*

- **Giant Crab Fishery:** The Giant Crab Fishery encompasses the waters of, and fishing season timing is coincident with, the timing of the North Zone Rock Lobster Fisheries (PIRSA, 2002). The giant crab fishery utilises pots to capture the giant crab which inhabits waters between 20-600m in depth with the highest densities occurring at the shelf-break (approx. 200m) (Currie & Ward, 2009). Most crabs are caught in depths less than 120m (PIRSA, 2002) and usually as by-catch to the Rock Lobster Fishery. The fishery catch is not large totalling 19.35tonnes in 2004-5 although there are two dedicated giant crab fishermen. The fishery catch is not large totalling 19.35tonnes in 2004-5. Feedback from consultation associated with the survey identified that there was only a small amount of giant crab fishing undertaken in the MSS area [PIRSA, 2012[Consultation Record 16]) with minimal impact.

  *On this basis it is possible giant crab fishermen may be present in the area during the MSS.*

- **Marine Scale-fish Fishery (MSF):** The Marine Scalefish Fishery operates from the South Australian coastline (including gulf areas) seaward out to 200 nautical miles and is managed by South Australia through an Offshore Constitutional Settlement (OCS) that includes reciprocal arrangements for State and Australian Government managed species for by-catch limits. It extends from the Western Australian border (Longitude: 129ºE) to the Victorian border (Longitude: 141ºE). The Marine Scalefish Fishery consists of over 60 species of marine scalefish however the majority of fishing effort is concentrated on four primary species – King George Whiting[41] (*Sillaginodes punctata*), Southern Garfish[42] (*Hyporhampus melanochir*), Snapper[43] (*Pagrus auratus*) and Southern Calamari[44] (*Sepioteuthis australis*). Together these four species account for approximately 60% of the total fishery production and 70% of the fishery value. Most of these catches come from Spencer Gulf and Gulf of St Vincent, with the exception of King George Whiting where areas west of Spencer Gulf have historically accounted for over 40% of the total commercial catch (PIRSA, 2014). Other species which make a contribution to the fishery include the Vongole[45] (*Katelysia scalarine, K. peronei & K. rhytiphora*), Australian Herring[46] (*Arripis georgianus*), Western Australian Salmon[47] (*Arripis truttaceus*),

[41] Juveniles are found in shallow waters to 20m water depths, whilst adults are found in a variety of habitats to depths of 50m or greater. Nursery areas are shallow protected bays where post-larvae arrive during winter and spring each year. Spawning occurs in Investigator Strait along the north coast of Kangaroo Island; south-eastern Spencer Gulf around Corny Point and Wardang Island. Spawning typically occurs between March and May (PIRSA, 2013)

[42] Schooling species found in shallow inshore marine waters and are abundant in the two gulf regions of South Australia. Spawning throughout the SA gulfs extends from October to March (PIRSA, 2013).

[43] Spawning occurs in the northern Spencer Gulf in late November and finishes in early February. A one month lag in these spawning dates occurs in the southern Spencer Gulf and occurs in waters less than 50m (PIRSA, 2013)

[44] Species is found in coastal waters usually in depths less than 70m. Females are serial spawners and spawning occurs throughout the year. Eggs are preferentially attached to seagrass and macro-algae however they are also known to lay eggs on low rocky reefs and sand. Species follows a generalised anti-clockwise pattern of spawning within the Gulf of St Vincent with spawning occurring in late spring (Kangaroo Island) continuing in a clockwise direction to Edithburgh where spawning occurs in late winter (PIRSA, 2013)

[45] A clam species found in sheltered, sandy sub-tidal sediments of estuaries and tidal flats.

[46] Species are usually found in bays and estuaries over seagrass beds or near areas of seaweed (kelp) on rocky reefs and ocean beaches. Spawning commences in April and continues into June in WA (Kailola et al, 1993).

[47] Species inhabit continental shelf waters including estuaries, bays and inlets. They school in shallow open coastal waters and can move over reefs in depths just sufficient to cover their bodies but have also been caught in water depths to 80m. Spawning areas for the species occur in eastern Bass Strait (November to February) and Albany-Busselton (February to June) (Kailola et al, 1993)

Yellowfin Whiting[48] (*Sillago schomburgkii*) and a variety of shark species including Bronze and Dusky Whaler Shark (PIRSA, 2013)

Both gulfs contain significant areas of seagrass meadows, salt marshes and mangroves which are all recognised nursery areas for key commercial species such as King George Whiting, Southern Garfish, Blue Swimmer Crabs and Western King Prawns (PIRSA, 2013). Primary production in the more sheltered parts of the gulfs, as well as embayment's off the west coast of the Eyre Peninsula and the north coast of Kangaroo Island, is dominated by a number of seagrass species that occur at depths of about 20m (clear waters) and 10m (gulf waters). Key habitats types associated with the life history stages of primary MSF species is provided in **Table 3-5**. Fishing methods vary, but include haul and gill netting, hand-lining, long-lining and trapping (DEWHA, 2007). MSF participants in a survey undertaken in 2004 identified the following spatial distribution of fishing activities – Spencer Gulf/Coffin Bay (40%), Gulf of St Vincent/Kangaroo Island (32%), West Coast (22%) and other (6%) (PIRSA, 2013).

*Given the target species of the SMF all predominantly occupy inshore/gulf or coastal waters and recognising the available literature on the geographical fishing distribution, this fishery is not expected to be present in the MSS area.*

Table 3-5: Key Habitats associated with Life History Stages of Primary MSF Species (PIRSA, 2013)

| Life Stage | King George Whiting | Snapper | Southern Garfish | Southern Calamari |
|---|---|---|---|---|
| Early Juveniles (0+ age group) Nursery Areas | Sheltered Bays, tidal creeks with seagrass patches | Fine mud substrate, deeper gulf waters | Sheltered bays, tidal creeks, seagrass beds of both gulfs | Bare sand substrate in deeper waters of both gulfs |
| Sub-adults | Seagrass beds (patchy to dense) | Natural and artificial reefs | NA | NA |
| Adults (i.e. spawning or feeding areas) | Offshore low profile reefs, sponge/bare sand | Natural and artificial reefs, inshore mud substrate | Seagrass and algal beds | Seagrass and algal beds, low profile reefs |

- **Sardine Fishery:** The sardine fishery operates in all the waters adjacent to the State of South Australia out to the edge of the 200nm AFZ targeting *Sardinops sagax* (pilchards) (98% of the catch), utilising purse seine or pilchard net fishing methods. These fish are caught over 12 months of the year with fishing activities predominately undertaken at night, although some fish are captured in daylight (PIRSA, 2005). Sardines are the dominant clupeid off South Australia occurring in the southern portions of the Gulf of St Vincent and Spencer Gulf and over the continental shelf. Catch data (2001-2011) indicates that the primary fishing areas are within the Spencer Gulf and to the north of Kangaroo Island (refer **Figure 3-29**) (Ward et al, 2008).

  Movement patterns of species is largely unknown in SA however there is evidence that older fish mostly inhabit the shelf waters and smaller younger fish are mainly found in embayment's including Spencer Gulf (Ward et al, 2012). Sardines usually spawn in open waters between the coast and shelf break (mid-shelf waters) and in proximity to gulf areas during summer-autumn coinciding with upwellings (January to March). During this period female spawn 10,000-30,000 pelagic eggs once per week. Eggs are abundant in the southern gulf and shelf waters over this period as observed in **Figure 3-30** which identifies the distribution and abundance of eggs collected in January to March for 2009 and 2011[49] (Ward et al, 2012). The eggs hatch after approximately 2 days and then

[48] Species generally frequents inshore sandbanks and sandbars and the mouths of estuaries in shallow water (1-10m depth). Juveniles inhabit warmer water, mangrove –lined creeks and inshore areas. Spawning occurs between December and February (Kailola et al, 1993).

[49] It is noted in Ward et al, 2012 that the egg abundance in Spencer Gulf in 2012 was unusually low.

undergo a relatively long larval period of 1-2 months. In SA sardine eggs and larvae are usually abundant at temperature and salinity frons that form near the mouths of two gulfs during summer and autumn (Bruce and Short, 1990) and in mid-shelf waters off the southern Eyre Peninsula.

*Both literature and consultation feedback supports that this fishery is not expected to be present in the area during the MSS*.

Figure 3-29: Spatial trends in annual catch (2001-2011) (Ward et al, 2012)

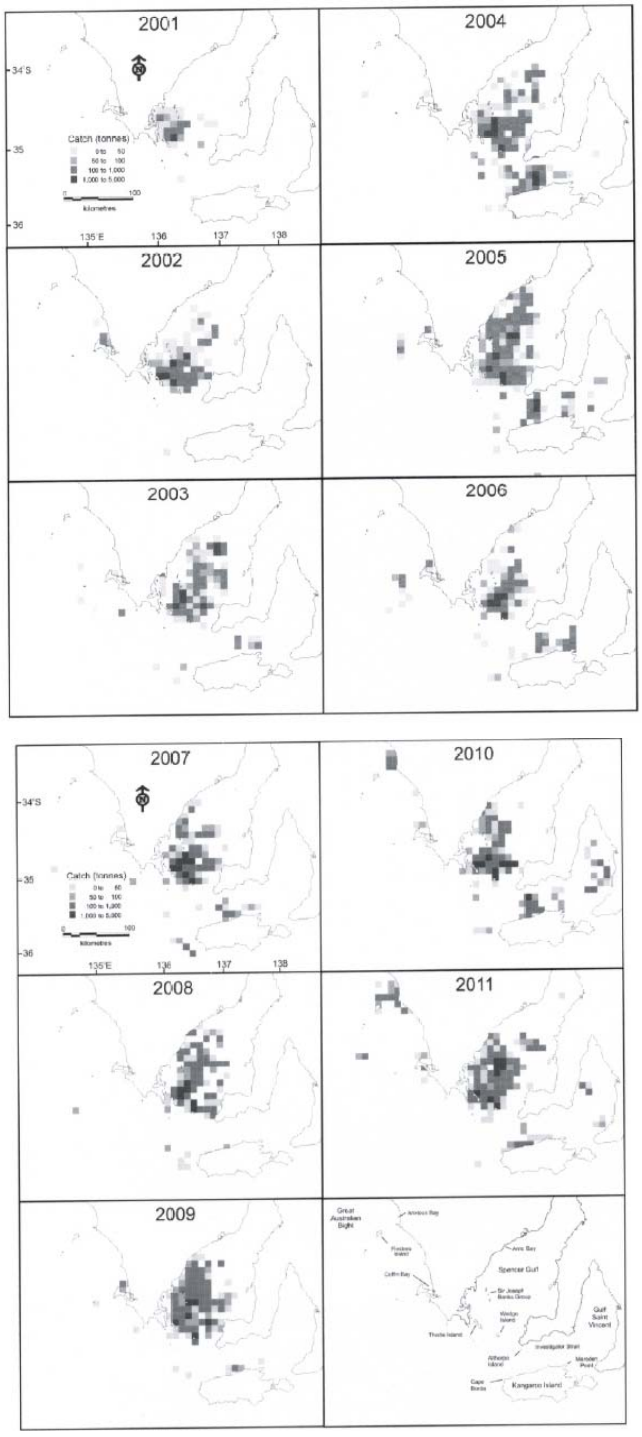


Figure 3-30: Distribution and Abundance of Eggs Collected in 2009 and 2011 (Ward et al, 2012)

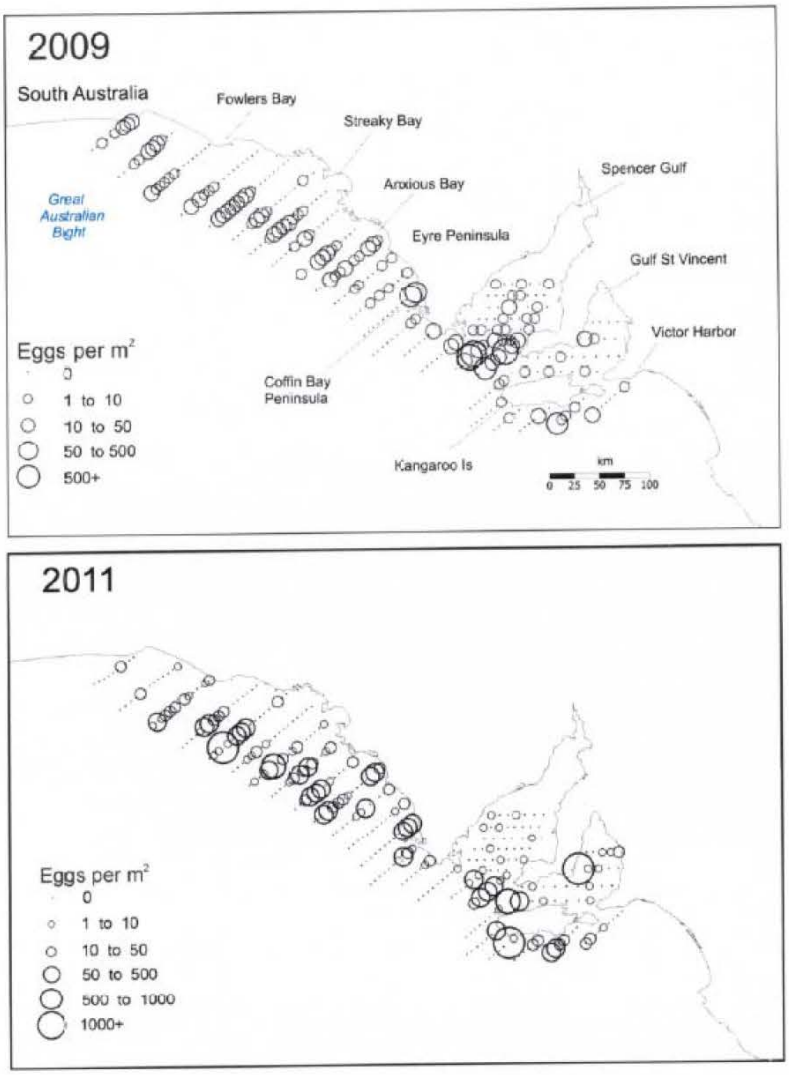
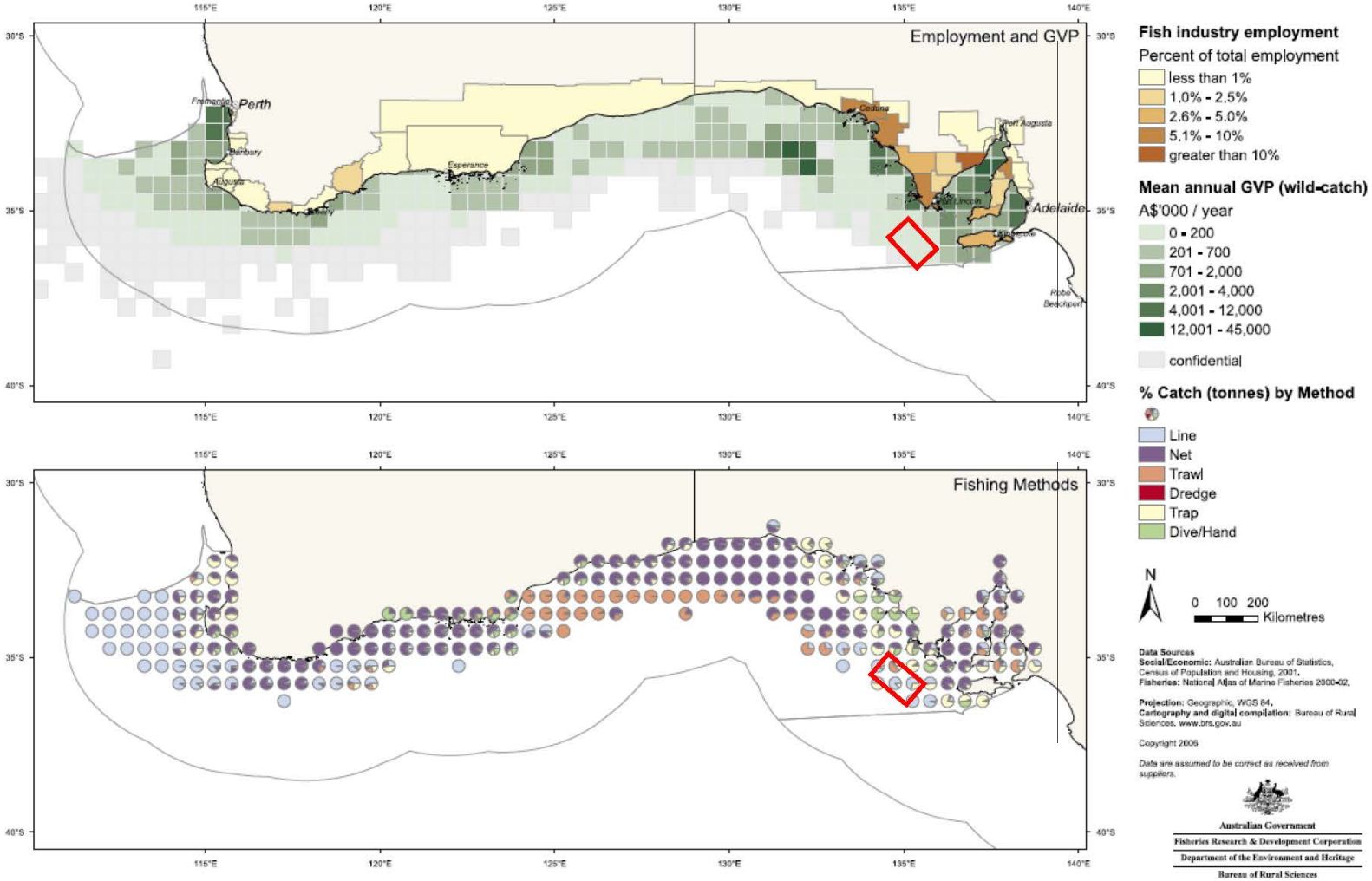


Figure 3-31: South–Western Region – Fishing Industry Employment, Income and Fishing Method (BRS, 2006)

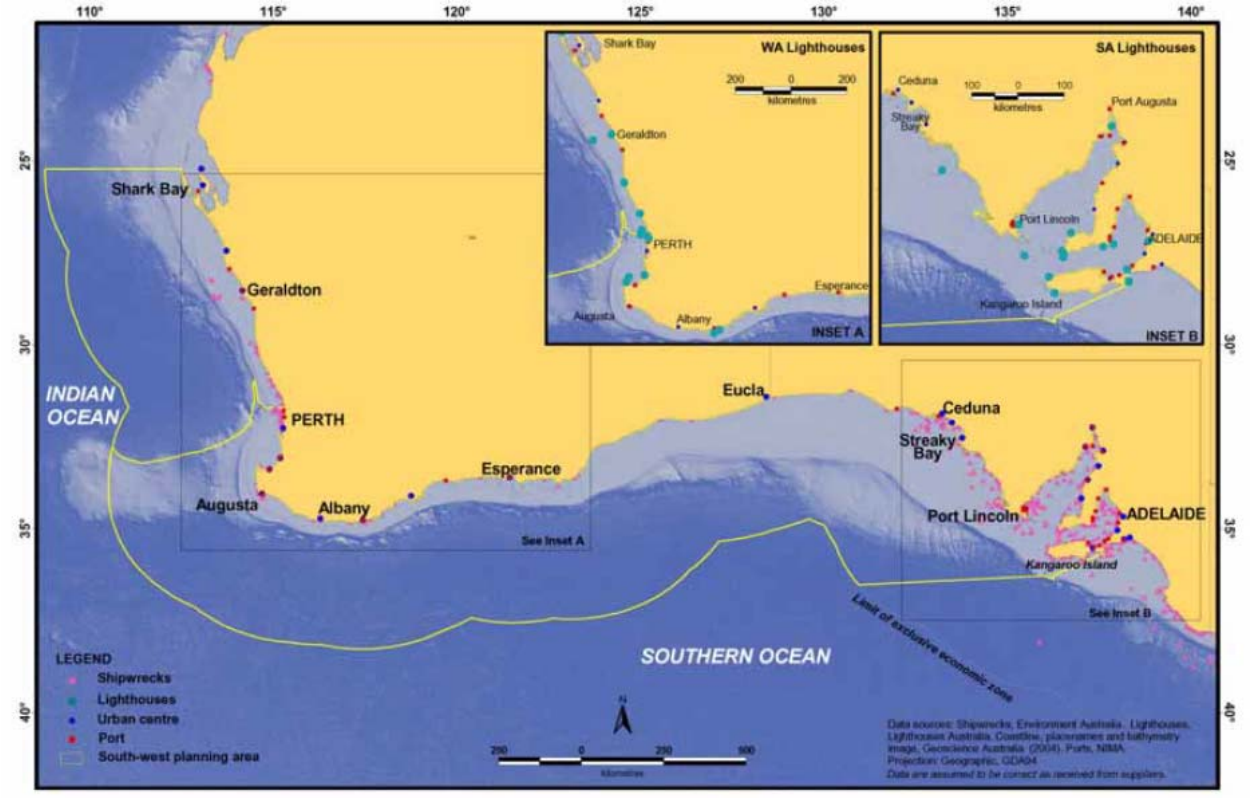


### 3.5.4 Cultural Heritage

There are no listed Commonwealth Heritage Places, National Heritage Places or places on the Register of National Estate within, or in the immediate vicinity of the proposed 3D MSS area.

**Figure 3-32** identifies shipwrecks adjacent to the Lightning MSS area. Review of the National Shipwreck Database (SEWPC, 2012s) indicated that no shipwrecks lie within the Lightning MSS area. The closest registered shipwreck is the *Lord Roberts* (1902) located approximately 60km NE of the MSS area; the *Gypsy Rose* (1988) and *St. Michele* (1965) located approximately 68km NE at the Neptune Islands; and the *Vale* (1900), *Mermaid* (1914); *Atalanta* (1860) and *Loch Vennachar* (1905) located approximately 104km east on the west coast of Kangaroo Island (refer to **Section 3.4.2** for Heritage trail information).

Figure 3-32: Shipwrecks within the SW Marine Region (Gardner et al, 2006)



# 4 Applicable Environmental Legislation

## 4.1 Regulatory Framework

This section provides a brief summary of the legal framework applicable to the Lightning 3D MSS together with a register of relevant environmental legislation for the MSS activity.

The proposed MSS area is situated approximately 65km from the nearest Australian shoreline and falls under Commonwealth legislation (between 3 to 200 nautical miles from territorial baseline). The supply base for the survey will be located in Port Lincoln, Port of Adelaide (SA) or Port of Geelong (Vic) and as such South Australian (SA) or Victorian legislation will apply to activities at the supply base.

The area for the proposed seismic activity is primarily governed by the *Offshore Petroleum and Greenhouse Gas Storage Act (OPGGSA) 2006* and its associated legislation however other Commonwealth legislation is also applicable. The Commonwealth OPGGSA is administered by a Joint Authority which consists of the South Australian Department for Manufacturing, Innovation, Trade, Resources and Energy (DMITRE) and the Commonwealth Department of Innovation (DOI) on advice from the National Offshore Petroleum Titles Administrator (NOPTA). The offshore tenements involved in the Lightning 3D MSS, EPP-41 and EPP-42, have been awarded to Bight under the Commonwealth OPGGSA. Ingress into adjacent non-permit areas will be undertaken in accordance with an Access Authority obtained from NOPTA.

Bight is the titleholder for exploration activities within the tenements in accordance with *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (OPGGSER) Regulation 31[50]. The OPGGSER are administered by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). This MSS, an exploration activity, does not require an Offshore Project Proposal acceptance by NOPSEMA prior to Environment Plan acceptance. As required by these regulations, this Environment Plan (EP) has been prepared for the Lightning 3D MSS for submission and acceptance by NOPSEMA.

Prior to the issue of new OPGGSER on February 28, 2014, Bight Petroleum had submitted an EPBC Referral for the proposed Lightning MSS (No: 2013/6770). Significant stakeholder consultation has been undertaken associated with this referral process, reflected in both **Section 6.4.2** and **Appendix B**, which has assisted in informing the survey. EPBC Referral 2013/6770 was withdrawn on 28th February 2014 however information obtained during this process has been used within this submission. Bight considers the new stream-lined environmental approvals process as a more effective and efficient process for obtaining approvals under both the OPGGSER and EPBC Act including the relevant approval from the Commonwealth Director of National Parks to undertake MSS activities in the Western Eyre Commonwealth Marine Reserve.

Relevant Commonwealth and State legislation as it applies to the Lightning 3D MSS is provided in **Table 4.1** (Commonwealth), **Table 4.2** (South Australia) and **Table 4.3** (Victoria) respectively.

## 4.2 APPEA Code of Environmental Practice

The Australian Petroleum Production and Exploration Association (APPEA) have developed general industry guidelines as to seismic practices which are considered to represent good industry practice in the petroleum industry. These guidelines (2008) have no legislative force and are intended to provide industry guidance in the setting of environmental objectives and performance standards.

[50] Title via access authorities for adjacent non-permit areas will be obtained from NOPTA

## 4.3 Other Guidelines & Management Plans

Other guidelines which apply to the Lightning 3D MSS include:

- NOPSEMA Guidance Note (N4750-GN1344) – Environment Plan Content Requirements (Rev 0) (2014);
- NOPSEMA Explanatory Note: Oil Spill Preparedness and Response Arrangements for Offshore Petroleum Activities in Commonwealth Waters (NOPSEMA, RET, and AMSA) (2012a);
- NOPSEMA Guidance Note (N4700-GN1072) – Regulator Interpretation: Petroleum Activity (Rev 0) (December 2012b)
- NOPSEMA Guidance Note (N-04750-GN1394) - Oil Spill Contingency Planning (Rev 0) (2014);
- NOPSEMA Information Paper (N04750-IP1378) – Transitional Arrangements for the 2014 Amendments to the OPGGS(Environment) Regulations 2009 (Rev 0, 2014);
- NOPSEMA Information Paper (N04750-IP1382) – Streamlining Environment Regulation of Petroleum Activities in Commonwealth Waters (Rev 0, 2014);
- NOPSEMA Guidance Note (N-03000-GN0926) – Notification and reporting of Environmental Incidents (Rev 4, 2014);
- NOPSEMA Guidance Note (N-04300-GN0166) – ALARP (Rev 4, 2012);
- Technical Guideline for the Preparation of Marine Pollution Contingency Plans for Marine and Coastal Facilities (AMSA, 2013);
- Advisory Note for Offshore Petroleum Industry Consultation with Respect of Oil Spill Contingency Plans (AMSA, 2012);
- National Biofouling Management Guidance to the Petroleum Production & Exploration Industry (Commonwealth of Australia, 2009);
- Australian Ballast Water Management Requirements (DAFF, 2011a);
- Offshore Installations Quarantine Guide (DAFF, 2011b);
- EPBC Act Policy Statement 1.1 – Significant Impact Guidelines – Matters of National Environmental Significance (DoE, 2013);
- EPBC Act Policy Statement 2.1- Interaction between offshore seismic exploration and whales (DEWHA, 2008);
- National Recovery Plan for Threatened Albatross on Giant Petrels (SEWPC, 2011d);
- National Recovery Plan for Ten Species of Seabird (DEH, 2005b);
- Blue, Fin & Sei Recovery Plan 2005-2010 (DEH, 2005d);
- Humpback Whale recovery Plan 2005-2010 (DEH, 2005c);
- Conservation Management Plan for Southern Right Whale (SEWPC, 2012y);
- Threat Abatement Plan for Impacts of marine debris on vertebrate marine life (DEWHA, 2009);
- Recovery Plan for the Australia Sea Lion (SEWPC, 2013);
- Recovery Plan for the Great White Shark (SEWPC, 2013c);
- Recovery Plan for Marine Turtles in Australia (DEH, 2003);
- Marine Bioregional Plan – Southwest Region (SEWPC, 2012);
- Australian IUCN Reserve Principles for Commonwealth Marine Protected Areas (EA, 2002b).

Table 4-1: Key Commonwealth Legislation

| Legislation | Coverage & **Applicability to Activity** | International Convention Enacted | Administering Authority |
|---|---|---|---|
| *Offshore Petroleum & Greenhouse Gas Storage Act 2006 & OPGGS (Environment) Regulations 2009* | The OPGGSA addresses all **licensing, health, safety, environmental** and royalty **issues for offshore petroleum exploration and development operations** extending beyond the 3 nautical mile limit. The OPGGS (Environment) Regulations 2009 ensures that petroleum activities are undertaken in an ecologically sustainable manner and in accordance with an environmental plan which has appropriate environmental Performance Outcomes, standards and criteria. | | Department of Industry (DOI)/NOPSEMA |
| *Environment Protection & Biodiversity Act 1999* | This Act focuses on environmental matters of National Significance, streamlines the Commonwealth environmental assessment and approval process and provides an integrated system for biodiversity conservation and management of protected areas. **Matters of national environmental significance** are world heritage properties; RAMSAR wetlands; listed threatened species and communities; migratory species under international agreements; nuclear actions and the commonwealth marine environment. World heritage properties are also protected under this act.<br>*Sensitive species contained within the associated international conventions enacted by this legislation have been identified within this EP.* | • 1992 Convention on Biological Diversity & Agenda 21<br>• Convention on International Trade in Endangered Species of Wildlife and Flora 1973 (CITES)<br>• Japan/Australia Migratory Birds Agreement 1974 (JAMBA)<br>• China/Australia Migratory Birds Agreement 1974 (CAMBA)<br>• Republic of Korea Migratory Birds Agreement 2006 (ROKAMBA)<br>• USSR-Australia Migratory Bird Agreement<br>• Convention on Wetlands of International Importance especially waterfowl habitat 1971 (RAMSAR)<br>• International Convention on Whaling 1946<br>• Convention on the Migratory Species of Wild Animals (Bonn Convention) 1979 (Conserve terrestrial, marine and avian species over their whole range) | Department of Environment (DOE) |
| *Australian Heritage Council Act 2003* | Establishes the Australian Heritage Council which nominates and assesses places for National and Commonwealth Heritage lists. | World Heritage Convention 1972 | Australian Heritage Council |
| *Environment Protection (Sea Dumping) Act 1981* | The Act protects the waters surrounding Australia's coastline from wastes and pollution dumped at sea and regulates waste loading and dumping activities, incineration at sea and artificial reef placement. Act prevents the deliberate **disposal of wastes** (loading, dumping, and incineration) at sea from vessels, aircraft, and platforms.<br>*Requirement observed within practices developed for this activity.* | Convention on the Prevention of Marine Pollution by dumping of waste & other materials 1972 (London Convention) MARPOL (*Regulates vessel routine/non-routine operations*) | DOE |

| Legislation | Coverage & **Applicability to Activity** | International Convention Enacted | Administering Authority |
|---|---|---|---|
| *Hazardous Waste (Regulation of Exports and Imports) Act 1989* | Relating to the controls over the importing and exporting of hazardous (intractable) materials. Permits are required to dispose of waste overseas or to import waste into Australia.<br>*Intractable waste will not be generated in this activity.* | | DOE |
| *Australian Maritime Safety Authority Act 1990* | Facilitates international cooperation and mutual assistance in **preparing and responding to a major oil spill incident** and encourages countries to develop and maintain an adequate capability to deal with oil pollution emergencies. Requirements are given effect through AMSA.<br>*Authority is included into necessary OPEP/SOPEP response documents for reporting purposes.* | International Convention on Oil Pollution (Preparedness, Response and Cooperation) 1990 (OPRC) (*Relates to non-routine operations (oil spills) and sets up a system of oil pollution contingency plans and cooperation in fighting oil spills*) | Australian Maritime Safety Authority (AMSA) |
| *Historic Shipwrecks Act 1976* | Protects the **heritage values of shipwrecks and relics** for shipwrecks over 75 years or more. It is an offence to interfere with a shipwreck covered by this act**.**<br>*Available historic shipwreck locations covered by international conventions enacted by this legislation have been identified & assessed (as applicable) within this EP.* | • Convention on Conservation of Nature in the South Pacific (APIA Convention) 1976<br>• Australian-Netherlands Agreement concerning old Dutch Shipwrecks 1972<br>• Convention on Protection of Underwater Cultural Heritage 2001 | DOE |
| *Ozone Protection & Synthetic Greenhouse Gas Management Act 1989* | Regulates the manufacture, importation and use of **ozone depleting substances (ODPs)** (typically used in fire-fighting equipment and refrigerants).<br>*Applicable to the handling of any ODP Substances.* | • MONTREAL Protocol on substances that deplete the ozone layer 1987 (Concerns the phase-out of ODPs)<br>• UN Framework Convention on Climate Change 1992 (Stabilise greenhouse gas concentrations in the atmosphere at a level which would prevent dangerous interference with the climate system) | DOE |
| *National Environment Protection Council Act 1994* | Council develops (in conjunction with other state authorities) through the Intergovernmental Agreement on the Environment (IGAE) on consistent environmental standards to be adopted between states. These requirements take the form of a National Environmental Protection Measure (NEPM) and include the *National Pollutant Inventory*. | | Environment Protection & Heritage Council |
| *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* | Regulates ship-related operational activities and invokes certain requirements of the **MARPOL convention (Annexes I, II, III, IV, V & VI) relating to discharge of oil, noxious liquid substances, sewage, garbage, air pollution etc.**<br>*Requirement observed within practices developed for survey vessel activities.* | International Convention for the Prevention of Pollution from Ships [MARPOL 73/78] provisions and unified interpretations of the articles, protocols and Annexes of MARPOL 73/78, including the incorporation of all of the amendments that have been adopted by the MEPC and have entered into force, up to and including the 2000 amendments (as adopted by resolution MEPC.89(45)) | Australian Maritime Safety Authority (AMSA) |

| Legislation | Coverage & **Applicability to Activity** | International Convention Enacted | Administering Authority |
|---|---|---|---|
| *Quarantine Act 1908* | The Act empowers authorities to quarantine goods, vessels and people to **prevent the introduction, establishment or spread of diseases or pests (e.g. invasive marine species)** affecting human beings, animals, or plants.<br>*Requirement observed within practices developed for survey vessels during international transits.* | International Convention for the Control and Management of Ships Ballast Water & Sediments 2004 | Department of Agriculture (DOA) |
| *Navigation Act 2012* | Regulates ship-related activities and invokes certain requirements of the MARPOL convention relating to **equipment and construction of ships.**<br>*Observed in the selection of vessels for survey activities.* | International Convention for the Prevention of Pollution from Ships [MARPOL 73/78] (certain sections) | Department of Infrastructure & Regional Development/AMSA |
| *Protection of the Sea (Harmful Anti-fouling Systems) Act 2006* | Regulates the use of harmful **anti-fouling systems employed on boats** and their effects on the marine environment.<br>*Observed in the selection of vessels for survey activities.* | International Convention on the Control of Harmful Anti-fouling Systems on Ships 2001 | Department of Infrastructure & Transport & Regional Development/AMSA |
| *Protection of the Sea (Powers of Intervention Act) 1981* | This Act gives AMSA appropriate powers to intervene in shipping operations to protect the Australian coastline.<br>*AMSA authority acknowledged in these seismic activities.* | Convention relating to the Intervention on the High Seas in Cases of Oil Pollution Casualties (Provides for state parties to intervene on ships on the high seas when their coastlines are threatened by an oil spill from that ship). | AMSA |
| *Protection of the Sea (Civil Liability) Act 1981* | This Act imposes civil liability for pollution damage and requires ships carrying more than 2000tonnes of oil in bulk as cargo to maintain insurances to cover liability for pollution damage. | International Convention on Civil Liability for Oil Pollution Damage 1992 (Provides for the establishment of an International Fund for Compensation for oil pollution damage including a system of compulsory insurance and strict liability for damages suffered as a result of an oil accident. | AMSA |
| *Protection of the Sea (Oil Pollution Compensation Fund) Act 1993* | This act implements the requirements of the International Convention for the Establishment of an International Fund for Compensation of Oil Pollution Damage | International Convention for the Establishment of an International Fund for Compensation of Oil Pollution Damage 1992 | AMSA |
| *Protection of the Sea (Civil Liability of Bunker Oil Pollution Damage) Act 2008* | This act implements the requirements for the International Convention on Civil Liability for Bunker Oil Pollution Damage. | International Convention on Civil Liability for Bunker Oil Pollution Damage 2000 | AMSA |
| *National Greenhouse and Energy Reporting Act 2007* | Introduces a single **national reporting framework** for the reporting and dissemination of information about **greenhouse gas emissions**, greenhouse gas projects and **energy use and production of corporations.** | | Clean Energy Regulator |

Table 4-2: Key South Australian Legislation

| Legislation | Coverage |
|---|---|
| *Environment Protection Act 1993* | Act which seeks to protect, restore and enhance the quality of the environment and provides the framework for waste disposal aspects. Administered by the Environment Protection Authority (SA). |
| *Protection of Marine Waters (Prevention of Pollution from Ships) Act 1987* | This Act is the South Australian state legislation giving effect to the requirements of MARPOL 73/78 within state waters (i.e. pollution by oil and other substances). Administered by the SA Department of Planning, Transport and Infrastructure (DPTI). |
| *Dangerous Substances Act 1979* | This Act regulates keeping, handling, transport, conveyance, use and disposal of dangerous substances. Administered by Safework SA. |

Table 4-3: Key Victorian Legislation

| Legislation | Coverage |
|---|---|
| *Environment Protection Act 1970* | This Act is the key Victorian Legislation regulating emissions to the environment within Victoria (relevant for waste disposal and transfer, national pollutant inventory reporting). Administered by the Victorian Environment Protection Authority. |
| *Pollution of Waters by Oil and Noxious Substances Act 1986* | This Act is the Victorian state legislation giving effect to the requirements of MARPOL 73/78 within state waters. Administered by the Victorian Environment Protection Authority |
| *Marine Act 1988* | This Act provides for the registration of shipping vessels and navigational requirements within Victorian Territorial waters. Administered by Marine Safety Victoria. |
| *Dangerous Goods Act 1985* | This Act is the Victorian legislation regulating the storage and handling of chemicals with immediate physical impacts. Administered by Victorian Workcover Authority. |

# 5 Assessment of Environmental Impacts & Risks

This section describes the environmental hazard review undertaken to identify potential environmental impacts specific to the proposed Lightning 3D MSS and control measures to eliminate or reduce the identified impacts to an acceptable impact/risk level and to a level which is as low as reasonably practicable (ALARP). An assessment of the residual impact and risk associated with each of the identified hazards is also provided with the control measures implemented. The control measures adopted for this survey are summarised in **Table 5-11.**

## 5.1 Potential Environmental Impact Identification & Methodology

The environmental hazards, possible impacts and associated risks with the Lightning 3D MSS have been identified and risk-assessed by undertaking the following steps:

- Defining the activity and associated environmental aspects (activities) (refer **Section 2**);
- Identifying the environmental and social values at risk within and adjacent to the survey area (i.e. the environmental context of the activity) (refer **Section 3**);
- Determining the inherent risk of each credible environmental hazard associated with the proposed MSS. To achieve this, the worst-case environmental impact of the hazard was identified and, given no control measures, the likelihood of occurrence determined. The associated inherent environmental risk was assessed (refer **Table 5-11**);
- Determining the residual risk of each credible environmental hazard with identified control measures adopted. In this instance, the environmental impact and likelihood of occurrence was reassessed with control measures implemented and the residual risk calculated; and
- With controls implemented, establish if the impact/residual risk lies at acceptable levels and ALARP. If ALARP is not achieved, review the activity and additional control measures until the impact and residual risk can be demonstrated to be ALARP.

The impact and risk for each credible environmental hazard has been evaluated using a Qualitative Environmental Risk Assessment (ERA) process defined by Bight Petroleum. The Bight Petroleum risk assessment framework is consistent with the approach outlined in ISO140001 (*Environmental Management Systems*), ISO31000:2009 (*Risk Management*) and HB203: 2012 (*Environmental Risk Management – Principles and Process*). In accordance with these processes, environmental risk is assessed as follows for credible hazards:

**Risk = Likelihood of Occurrence (as it applies to the end-point environmental impact and not the incident) x Environmental Consequence Severity**

This framework identifies and assesses environmental risk associated with each credible environmental hazard in accordance with the Bight Petroleum Qualitative Risk Matrix (**Table 5-3**) using the definitions for Consequence and Likelihood contained in **Tables 5-1** and **5-2. Table 5-4** provides the defined management actions and responsibilities for residual risk categories. In this Table, residual risks defined as high are unacceptable and further action must be taken to reduce the risk further. Residual risk in the medium classification requires further risk reduction controls to be implemented (if possible) via a risk treatment plan. Residual risk assessed as low requires no risk treatment plan however continuous improvement should be attained by implementation of best practice management.

### 5.1.1 Environmental Hazard Identification

Identifying the environmental hazards is the first step in the ERA process. This involves collection of information on all activities and processes and identification of potential environmental 'hazards' within the environmental context of the activity. This includes all hazards from routine activities (i.e. operational) or potential emergency conditions.

Environmental hazard identification was undertaken via brainstorming and peer reviews utilising industry experts which cover different 'areas' of seismic operation. Reviewers have included seismic vessel representatives, experienced seismic proponents, company representatives and environmental specialists. Information utilised within the hazard identification process includes information obtained from the following sources:

- MSS program details including acoustic array/streamer details/equipment type, proposed location and timing of survey and the support activities which are proposed (e.g. escort vessel, possible wastes generated from seismic acquisition (e.g. lithium batteries), possible fluid discharges from streamers, etc.,);
- An understanding of general vessel activities/operations during periods of MSS acquisition and non-seismic acquisition and the possible threats to marine species and habitats (including mobilisation/demobilisation);
- The environmental sensitivity of the receiving environment with respect to species distribution, subsea habitat types and location of environmentally sensitive areas (i.e. breeding, resting, etc.,) undertaken as part of literature reviews; and
- Feedback from marine stakeholders to understand possible socio-economic activities which may conflict with seismic operations via communication and consultation activities.

Within this context, a listing of credible activity-related environmental hazards and possible impacts were been identified for the MSS program.

Table 5-1: Definition of Consequence

| Consequence | Description |
|---|---|
| 5. Critical | **S:** Extensive Injuries (Multiple Fatalities).<br>**E:** Large scale catastrophic impact; significant recovery work over years/decades; Tier 3 oil spill (>1000tonnes); potential revocation of Licence or Permit.<br>**A:** Extensive Damage (>$25M).<br>**R:** Extreme adverse public, political or media outcry resulting in international media coverage; critical impact on business reputation. |
| 4. Major | **S:** Major Injury (Single Fatality).<br>**E:** Major environmental impact with recovery work over a few months; Tier 2 oil spill (10-1000tonnes); material breach of licence, permit or act.<br>**A:** Major Damage ($10M-$25M).<br>**R:** Significant impact on business reputation and/or national media exposure; local community complaint. |
| 3. Significant | **S:** Significant Injury (Lost Time Injury (LTI) or Restricted Work Day Case (RWDC)).<br>**E:** Significant environmental impact with recovery work over a few days/weeks; Tier 1 oil spill (<10tonnes); impact/damage to item of National Environmental Significance (NES); possible administrative fine level.<br>**A:** Significant damage ($5M-$10M).<br>**R:** Serious local adverse public media attention or complaints; local user concern; moderate to small impact on business reputation. |
| 2. Minor | **S:** Minor Injury (Medical Treatment Injury)<br>**E:** Local environmental impact, negligible remedial/recovery work; <1BBl oil spill; no significant impact to others; regulatory notification required.<br>**A:** Minor Damage ($1M-$5M).<br>**R:** Public awareness but no public concern beyond local users; Minor impact on business reputation. |

| Consequence | Description |
|---|---|
| 1. Negligible | **S:** Slight Injury (First Aid Treatment).<br>**E:** Negligible Impact, Effect contained locally; no statutory reporting.<br>**A:** Slight Damage (0-$1M).<br>**R:** Negligible Impact on Reputation; no public or regulator interest. |

**Legend: S:** Safety, **E:** Environment, **A:** Asset Damage, **R:** Business Reputation

Table 5-2: Definition of Likelihood

| Consequence | Description |
|---|---|
| 5. Very likely | Expected to occur in most circumstances |
| 4. Likely | Probably occur in most circumstances |
| 3. Possible | Might occur at some time |
| 2. Unlikely | Could occur at some time |
| 1. Very Unlikely | Only occurs in exceptional circumstances |

### 5.1.2 Risk Assessment

Credible hazards were then risk assessed. For each hazard, the inherent risk (no controls) was determined by the following technique:

- Impact severity was assessed according to the consequence definition contained in **Table 5-1**. Impact attributes such as: quantities emitted, concentrations released and time scale of release were considered in determining the severity. In assessing consequence the 'worst credible'[51] was assigned in the context of the environmental sensitivities of the area was assigned;

- Likelihood was allocated according to the likelihood categories contained in **Table 5-2.** The likelihood of environmental impact was based on available quantitative incident databases, expertise of experienced professionals based on industry experience and professional judgment. Likelihood also considered how frequently the activity was performed.

Controls (preventative and mitigation) were then identified and documented to either eliminate and/or minimize impacts. The assessment preferentially adopts control measures in the upper section of the controls hierarchy[52] (i.e. hazard substitution, prevention and engineering controls) above procedural controls. On the basis of control implementation, impact and likelihood was reassessed and a residual risk ranking assigned. The environmental risk raking therefore represents residual risk levels which reflect the likelihood of occurrence of the *worst credible environmental impact end-point* (hence conservative) taking into account the implemented controls.

Risks were ranked using the Qualitative Risk Matrix in **Table 5-3**. Where residual risks were found to be intolerable (high) or within the ALARP region (medium) were reassessed for elimination potential and/or additional controls until the residual impact and risk associated with the hazard is at a level which is ALARP (i.e. if a measure is practicable and it cannot be shown that the cost of the measure is grossly disproportionate to the benefit gained, the measure is considered reasonably practicable).

[51] This allows for the conservative identification of 'reportable incidents'.
[52] Controls hierarchy (a key principle underpinning the ALARP principle (NOPSEMA, 2012)) where the principles of prevention influence control selection:
- **Elimination:** Complete removal of the hazard;
- **Prevention:** Preventing hazardous events occurring;
- **Reduction:** Reducing the consequence should the event occur;
- **Mitigation:** Practices to mitigate the consequences once realized.

The descriptions for the categories of risk and the associated management response to residual risk rankings are listed in **Table 5.4**.

Table 5-3: Bight Qualitative Risk Matrix

| | | Consequence | | | | |
|---|---|---|---|---|---|---|
| | | 1. Negligible | 2. Minor | 3. Significant | 4. Major | 5. Critical |
| Likelihood | 5. Very Likely | | | | | |
| | 4. Likely | | | | | |
| | 3. Possible | | | | | |
| | 2. Unlikely | | | | | |
| | 1. Very Unlikely | | | | | |

Table 5-4: Definition of Risk Acceptability and Management Response

| Category | Description & Response |
|---|---|
| High | **High Risk:** Work cannot proceed as currently planned. Urgent remedy and resources required for immediate risk reduction. If risk is to be accepted temporarily then approval from the CEO must be obtained and the Board consulted. |
| Medium | **Medium Risk:** Risk reduction measures need to be implemented in keeping with other priorities. Generally acceptable level of risk where further risk reduction is shown not to be practicable. |
| Low | **Low Risk:** Risks are sufficiently low to be acceptable (i.e. at ALARP). Manage for continuous improvement by application of best practice. |

Acceptable Level (Impact and Risk) Demonstration

In determining whether impact and risk levels are at an acceptable level the following criteria had been adopted by Bight:

- The principles of Ecologically Sustainable Development (ESD) are fulfilled (refer **Section 2.2**);
- Bight Petroleum HSE Policy objectives are achieved;
- All relevant Commonwealth/State legislative criteria are met;
- The activity does not contravene management plans or result in unacceptable impacts[53] to protected matters under the EPBC Act 1999[54];
- Stakeholders have been provided information sufficient to understand and respond to relevant interests which are then addressed; and
- Risk and impact have been demonstrated to be ALARP.

[53] This is defined by relevant EPBC Policy Statements and Management Plan requirements including but not limited to Policy 1.1/1.2 Significant Impact Guidelines, Species Recovery Plans, Threat Abatement Plans, Wildlife Conservation Plans, Bioregional Plans (including Conservation Values Atlas), Marine Reserve Plans of Management (or IUCN Reserve Management Principles in the absence of Management Plans).
[54] For this survey this relates predominantly to threatened and migratory species and the Commonwealth Marine area.

It should be noted that the Bight Petroleum qualitative risk methodology also defines risk criteria whereby risk levels are considered to be acceptable.

ALARP Demonstration

Under-pinning the control identification are the key principles of environmentally-safe design (i.e. adoption of the hierarchy of controls); options analysis to ensure the most environmentally-sound practice is adopted; and adoption of industry standards and codes. Demonstration of ALARP within this Environment Plan includes one or a combination of the following approaches:

- *Hazard/Risk Criteria Approach*: The Bight Qualitative Risk methodology defines risk criteria which it considers is at a level which is ALARP;
- *Hierarchy of Controls*: Controls identification according to a hierarchy which ensures reliable, effective controls are selected in preference to administrative controls;
- *Comparative Options Assessment of Risks, Costs and Benefits*: Evaluation of a range of control measure options describing the relative merits and drawbacks with selection of options which are practicable;
- *Comparison with Standards & Codes:* Comparison of activity design, operational standards adopted, management system frameworks and operational procedures against recognised national, international and industry standards or codes of practice; and
- *Cost Benefit Analysis*: Numerical assessment of costs relating to the control measure, the expected risk reduction expected and the cost of the measure to be implemented.

### 5.1.3 Performance Outcomes, Standards and Measurement Criteria

In the following environmental risk assessment sections for each credible environmental hazard the following have been defined:

- Environmental performance outcomes and associated measurement criteria; and
- For each control measure associated performance standards and measurement criteria have been identified.

Where measurement criteria associated with *performance outcomes or performance standards* have not met, a recordable incident is recognised and will be reported to NOPSEMA (refer **Section 7.2.1**). It is the responsibility of the on-board Bight Offshore Representative to monitor and verify control measure implementation and performance standard achievement for the duration of the survey.

The following legislative and guideline definitions are used within the relevant sections:

- **Environmental performance outcomes** (EPO) are defined as a measureable level of performance required for the management of the environmental aspects of an activity to ensure the environmental impacts and risks will be of an acceptable level; and
- **Environmental performance standards** are defined as a statement of performance required of an adopted control measure.

## 5.2 Lightning MSS Environmental Hazards

A total of nineteen (19) hazards, with the potential to impact the environment, were identified for the Lightning MSS (refer **Table 5-11**). These can be grouped into the following broad categories:

- Mobilisation of the seismic and support vessels to the proposed survey area (refer **Section 5.3**):
  - Introduction of non-indigenous invasive marine species (IMS) from ballast water discharge or biofouling.
- Physical presence of the Seismic Vessel[55] (refer **Section 5.4**):
  - Disruption to commercial fishing activities;
  - Disruption to commercial shipping;
  - Disruption to Tourism; and
  - Light pollution due to 24 hour MSS activities.
- Seismic acquisition (refer **Section 5.5**):
  - Discharge of acoustic source pulses in the proposed MSS area;
  - Sound from operation of vessels; and
  - Sound from operation of helicopters.
- General vessel operations (refer **Section 5.6**):
  - Routine waste discharges from the seismic and support vessels (oily water, sewage, food-scraps); and
  - Air emissions.
- Non-Routine events (refer **Section 5.7**):
  - Accidental hydrocarbon spill due to collision with another vessel;
  - Chemical/oil spill through deck drain system;
  - Oil spill during refuelling at sea;
  - Solid non-biodegradable/hazardous waste overboard incident;
  - Seismic streamer perforation and/or loss in the marine environment; and
  - Collision with a cetacean.

A discussion of these hazards is provided below. The controls and risk assessment outcomes are summarised in **Table 5-11**.

[55] Note the vessels will not be anchoring whilst performing the seismic survey (except in emergency situations). This impact/risk is considered ALARP on this basis.

## 5.3 Mobilisation

### 5.3.1 Invasive Marine Species Introduction

#### *5.3.1.1 Activity & Background*

Potential sources of IMS introduction into the MSS area include both hull/niche biofouling and ballast water exchange during MSS activities. If an IMS is introduced and survives in the new environment, such colonisation may result in a range of ecological impacts including increased competition with native species and changes in ecosystem function. Colonisation however, requires favourable environmental conditions for the particular IMS, including water temperature, water depth and habitat range.

The MSS vessel[56] contracted for the Lightning MSS may either mobilise from Australian or International waters to the Lightning MSS area. If the MSS vessel mobilises from International waters it will not go directly to the Lightning MSS area but will dock initially at an Australian port where it will undergo customs/quarantine inspections as required by regulatory authorities. Where possible, the survey support/escort vessels will mobilise from Australian and local South Australian waters.

Prior to entry into South Australian waters, the MSS Vessel and support/escort vessel (as applicable) will conform to the following requirements:

- Ballast water exchange in accordance with the Vessel's Ballast Water Management Plan which is consistent with the Australian Ballast Water Management Guidelines (DAFF, 2011). International vessels will submit a QPAR form to the Australian Quarantine Inspection Service (AQIS) 96-12hours prior to arrival in the Australian port where ballast water logs are confirmed; and
- A Risk Assessment for the seismic vessel(s) (as required) will be undertaken in accordance with the *National Biofouling Management Guidance for the Petroleum Production and Exploration Industry* (Commonwealth of Australia, 2009); and corrective actions arising from the assessment (dry-docking, cleaning and anti-fouling paint application (as required)) will be implemented prior to entry into Australian waters such that the risk of IMS introduction from biofouling is assessed as low; and
- All in-field equipment, operating between 5-10m below sea level, will be cleaned between survey operations which do not occur in adjacent bioregion waters (i.e. adjacent permits) such that it does not present a risk of IMS introduction.

#### *5.3.1.2 Environmental Risk Assessment*

The National Database for Marine Pest incursions (DAFF, 2012) identifies that no known pests have been introduced to the waters surrounding the proposed MSS area. Should an IMS be introduced to, and colonise the area, it may have a major environmental impact (ecosystem disruption). However as the MSS will be undertaken in oceanic waters of depths between 130-2400m, light limitations would be expected to inhibit the success of any IMS colonisation.

With the adoption of the listed ballast water management and biofouling control measures, the likelihood of IMS introduction during the MSS is considered to be very unlikely. The residual environmental risk is assessed as medium.

A summary of the EPO for IMS impacts associated with the Lightning MSS; performance standards relating to the control measures adopted and associated measurement criteria is shown in the table below:

[56] Support vessels will be contracted from Australian locations.

| | | |
|---|---|---|
| Environmental Hazard/ Aspect | *Introduction of Invasive Marine Species (IMS)* | |
| Environmental Performance Outcomes | *Ballast Water: Ballast water exchange procedures in accordance with Australian Ballast Water Management Guidelines requirements have been implemented during international transits.*<br>*Biofouling: A Risk assessment has been undertaken on all vessels which enter the Bight Basin (i.e. not local vessels) and risk assessment corrective actions implemented prior to entry.* | |
| Measurement Criteria | *Ballast Water: Records of ballast water exchange show adherence to Australian Ballast Water Management Guidelines.*<br>*Biofouling: Records identify that all corrective actions from risk assessment have been implemented.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| MSS Vessel to undergo Ballast Water Exchange prior to entry to Australian Waters (i.e. deemed low-risk) | Ballast water exchange has been undertaken in accordance with the vessel's Ballast Water Management Plan which conforms with the *Australian Ballast Water Management Requirements* (DAFF, 2011). | Ballast Water Exchange Records show adherence to DAFF Requirements<br>Records identify that QPAR form submitted to AQIS is accepted prior to entry into port facilities. |
| Risk assessment undertaken for *non-local* vessels with corrective actions implemented prior to entry. | A risk assessment undertaken in accordance with the *National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (2009)* determines the IMS risk level of the vessels with corrective actions undertaken (as appropriate) reduces the IMS risk to low. | Biofouling Risk Assessment Records identify for non-local vessels all corrective actions have been implemented and the vessel carries a low risk. |
| In-field survey equipment does not present an IMS risk. | All in-field equipment has been removed from the water, inspected and cleaned prior to deployment in South Australian waters. | Records identify that the in-field equipment has been cleaned and inspected prior to deployment if mobilising from waters outside South Australia. |

#### 5.3.1.3 *Acceptability and ALARP Demonstration*

An evaluation of possible IMS impact and risk, against acceptability criteria detailed in **Section 5.1.2,** is provided below. On the basis of this information, both residual impact and risk is considered acceptable.

| *Acceptability Demonstration* | |
|---|---|
| Meeting Bight Petroleum HSE Policy Objectives: | The IMS risk management strategy reflects Bight's HSE Policy goals of proactively identifying hazards, eliminating risks where possible and where this is not possible managing the risk to ALARP and establishing strategies to address biodiversity issues. |
| Legal Compliance with: | Quarantine Act 1908 (Ballast Water).<br>*No legislation currently regulates biofouling management.* |
| EPBC Protected Matters Assessment: | Introduction and establishment of an IMS via the Lightning MSS into EPP-41 and EPP-42 is unlikely due to the water depths in the area (130-2400m) which are light limited.<br>With the identified and implemented control measures nominated above, and as reinforced in the SW Marine Bioregional Plan (SEWPC, 2012b), the activity carries a low risk of significant impacts to the Commonwealth Marine Environment (Significant Impact Guidelines 1.1). Also in accordance with that Plan, it does not introduce KEF integrity issues to the Kangaroo Island Upwelling Pool, meso-eddies or Ancient Coastline (SEWPC, 2012b).<br>*With control measures implemented the action will not impact of items of National Environmental Significance (NES), it meets the requirements of the SW Marine Bioregional Plan and upholds IUCN Management Principles for Marine Reserves (Category VI) (ES, 2002) relevant to the West Eyre Marine Protected Area (MPA).* |
| Social Acceptability: | No issues have been raised by stakeholders with respect to IMS introduction during the Lightning MSS. It should be noted the survey area is located on a major shipping channel (expected to provide a higher IMS exposure than survey activities). |
| Risk/Impact are demonstrated to be ALARP: | As per demonstration assessment below, both residual impact and risk has been assessed as ALARP. |

A demonstration of ALARP with respect to residual impacts and risks associated with IMS introduction with control measures implemented is provided below. On the basis of this demonstration, both residual impact and risk is considered ALARP.

| *ALARP Demonstration* | |
|---|---|
| Hierarchy of Controls: | **Elimination:**<br>• Implementation of Biofouling risk assessment corrective actions ensures vessel entry into Australia eliminates IMS into Australian waters.<br>• Ballast water exchange in deep waters is seen to remove risk of IMS translocation.<br>• Where possible local vessels will be used to support survey activities<br>**Prevention:** *No prevention measures identified.*<br>**Reduction:** Survey area is located in deep water (light–limited) therefore IMS colonisation should not occur.<br>**Mitigation:** *No mitigation measures have been identified.*<br>*No additional controls can be identified which reduce impacts or risks further (refer to options analysis).* |
| Compliance with Standards and Codes: | Government-related standards which recognize the potential for IMS introduction will be implemented during the Lightning survey:<br>• Australian Ballast Water Management Guidelines (DAFF, 2011);<br>• National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (2009). |
| Comparative Assessment of Options: | Limited exploration techniques are available to the oil and gas industry to identify hydrocarbon reservoirs. Alternate technologies such as marine controlled –source electromagnetic technology (CSEM) (still requires vessel) and satellite imaging technology provide insufficient resolution for defining drilling prospects and are not a viable alternative to seismic surveys.<br>A 'do-nothing' approach (i.e. no survey) does not align with obligations contained in work-plans approved as part of the permit release with the Australian Government.<br>Marine vessels are required to undertake MSS activities. Wherever possible local vessels are utilised, however, given the specialised nature of MSS vessels, vessel availability is limited and mobilisation from international waters/ports is generally required.<br>No additional controls can be identified which can further reduce the residual impact and risk associated with IMS introduction. |
| Hazard/Risk Criteria: | In accordance with the Bight Petroleum Qualitative Risk Matrix, the residual risk associated with this hazard is assessment as medium. On this basis, additional risk measures should be identified and assessed for practicability (refer *Comparative Assessment of Options Section*).<br>On the basis that no additional practicable controls can be identified to further reduce IMS impact and risk, and, in accordance with the Bight Risk Tolerability Criteria, the residual impacts and risk control strategy is considered ALARP. |
| Cost Benefit Analysis: | Not applicable to this assessment. |

## 5.4 Physical Presence of Vessel

### 5.4.1 Disruption to Commercial Fishing

#### *5.4.1.1 Activity & Background*

The Lightning MSS area is located within seven (7) commonwealth and four (4) state fishing management areas. Review of fisheries literature and information obtained during consultation activities with fishery stakeholders (refer **Section 6.4.2**) has identified the following:

- Analysis of information provided through consultation and fishing intensity data available for Commonwealth-managed fisheries in **Section 3.4.3** has identified the following Commonwealth fishing presence in the Lightning MSS area (Fisheries identified by asterisk (*) require or have requested ongoing consultation):

| Fishery | Intensity/Effort | Presence during Survey |
|---|---|---|
| Skipjack Tuna Fishery (STF) | No Fishing Effort since 2008/9 | Not expected to be present |
| Small Pelagics Fishery (SPF) (*via Commonwealth Fisheries Association) | 3 Vessels operate in entire fishery (NSW/Qld Border to Jurien Bay (WA) with 9 days of effort in 2011/12<br>Permit Holders do not always participate in fishery instead operating under licences in Sardine Fishery (inshore)<br>Fishery not economic under current arrangements<br><5 vessel log book density in 2011/12 | Not expected to be present |
| Great Australian Bight Trawl Sector (GABTS) * | Fishery concentrated between 125-133°E<br>5 vessels active<br><5 vessel log book density in 2011/12 | Possible but very unlikely presence |
| Gillnet Hook & Trap Sector * | Areas have closure for Gulper Sharks<br>Most gillnet fishermen have shifted to Victoria<br><5 vessel log book density in 2011/12 | Possible but very unlikely presence |
| Southern Bluefin Tuna * | Fishery known to operate in northern section of MSS area. | Fishery expected to be completed in February but contingencies in place for March timeframe |
| Western Tuna and Billfish Fishery (WTBF) | No fishing effort in SA waters | Not expected to be present |
| Southern Squid Jig Fishery (SSJF) | Only Port Lincoln SSJF fishermen fishes in Victorian waters.<br><5 vessel log book density in 2011/12. | Not expected to be present |

- Analysis of information provided through consultation and available data for SA-based fishing management areas in **Section 3.4.3** has identified the following SA State Fishery presence in the Lighting MSS area (Fisheries identified by asterisk (*) require or have requested ongoing consultation):

| Fishery | Intensity/Effort | Presence during Survey |
|---|---|---|
| Sardine Fishery[57]* | Fishing effort occurs within Gulfs and north of Kangaroo Island. No identified presence of fishermen in survey area. | Not expected to be present |
| Scale-fish Fishery | Fishery operates inshore, coastal and within gulfs. Target species all lie in inshore habitats. | Not expected to be present |
| Giant Crab Fishery * | Consultation identified that small amount of crab fishing may be present in the survey area. | Possible presence |
| Northern Rock Lobster Fishery * | Historically 1% of catch lies in water depths greater than 90m | Possible presence |

- Consultation with the SBT fishermen has identified the following control measures to minimise impacts to this fishery:
    - Prior to April 1, seismic acquisition will commence on the deep water racetrack (i.e. during March) to avoid conflict with pontoons being towed over the shelf portion of the MSS area;
    - Close on-water communication between seismic and fishing operations is required;
    - Towed pontoons will have right-of-way over seismic vessels; and
    - The source will not be activated or will be shut-down if a towed pontoon comes within 3km of the source.

[57] Sardine Industry Association specifically requested to be informed of the survey.

More general actions to be undertaken to ensure that fisheries are aware of the MSS activities and to avoid spatial conflicts include the following:

- Consultation during the planning phase of the Lightning MSS has provided information to marine stakeholders and identified 'relevant' affected fishery stakeholders and the seasonality of these activities;
- The MSS vessel will deploy and retrieve equipment off the continental shelf to avoid fisheries interaction (in water depths greater than 500m). This will be managed by close cooperation between the Bight Offshore Representative, the local fishing fleet and the deployment of the scout/escort vessel to identify any conflicting fisheries activities;
- The Australian Hydrographic Office (AHO) will be notified of the Lightning MSS activity six weeks prior to the MSS commencement. The notification will describe the location and duration of the survey. The AHO will advise other marine users by issue of a Notice to Mariners for the duration of MSS activity;
- Mobilisation/demobilisation notification will be issued to all relevant fishing industry stakeholders within the region, with consultation continuing during the survey period;
- The Australian Maritime Safety Authority (AMSA) Rescue Coordination Centre (RCC) will be notified two weeks prior to the MSS activity commencing. The notification will describe the locations, activities and durations of the MSS. AMSA RCC will issue an AusCoast warning to marine users providing details of the of the MSS activities to minimise the potential for marine activity conflicts;
- Bulletins will be provided to fishermen who fish in the area providing details of which sections (e.g. racetracks) of the survey area are being utilised for data acquisition and the likely acquisition period. Any changes to schedule will be relayed to relevant fishermen; and
- Support/escort vessels will scout within the MSS area to ensure that possible spatial conflicts between seismic/fishing vessels are avoided; and
- Cooperation based on the recognition that the seismic trailing equipment (source array and streamers) and fishing gear (such as lobster pots) cannot be in the same area at the same time due to entanglement and safety hazards. Thus, a willingness by Bight to consider compensation to fishermen for potential impacts to equipment and resultant loss of catch[58].

Fishery consultation results are provided in **Section 3.4.3** (according to fishery) and **Section 6.4.2**.

#### *5.4.1.2 Environmental Risk Assessment*

The presence of the MSS vessel and MSS activity has the potential to disrupt fishing activity which is present in the area for a period of approximately 70days acquiring seismic data. Review of the regional fishing data and information provided by stakeholder groups indicates that the MSS vessel has a low likelihood of encounter with both Commonwealth (GABTS and GHTS) and state fishery groups (Giant Crab and Rock Lobster) given the seasonal fishing distribution and the distance of the survey area from fishing ports.

The SBTF season is expected to be completed in February based on the most recent seasonal fishing data however on a contingency basis if fishing continues into March, control measures have been developed with ASBTIA to prevent spatial conflict with fishing activities. It is possible, although unlikely, that SBT fishermen might be present on shelf areas to the north of the Lightning MSS area during March towing SBT pontoons to Port

[58] Determined by comparison between historical and actual catch statistics with similar levels of fishing effort

Lincoln. If this situation eventuates, data acquisition will commence over the deep water section of the survey area which separates spatially the survey activity and fishermen.

Given the known low effort of commercial fishing within the area, with the possible exception presence of SBT fishermen on the shelf during March, spatial conflicts are expected to be minor[59] (Consequence: 2). With industry standard and specific SBTF controls implemented (during March) spatial conflict with fisheries is considered very unlikely and on this basis the residual risk is assessed as low.

A summary of the EPO for commercial fishing disruption associated with the Lightning MSS; performance standards relating to the control measures adopted and associated measurement criteria is shown in the table below:

| Environmental Hazard/Aspect | *Disruption to Commercial Fishing Activities* | |
|---|---|---|
| Environmental Performance Outcome | *No incidents of spatial conflict* with fishing vessels/equipment occurs during the Lightning MSS*<br>**Defined as towed pontoons containing SBT not being given right-of-way over the seismic vessel; use of source within 3km of a SBT towed pontoon; other (non-SBT fisheries) having to retrieve fishing equipment due to the presence of the MSS activity or deviation of the MSS vessel from a seismic line due to the presence of a fishing vessel.* | |
| Measurement Criteria | *Incident records identify no incidents of spatial conflict with fishing vessels.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Consultation during planning phase of the Lightning MSS to identify affected stakeholders & provide information on MSS activities | On the basis of consultation information received, fishing stakeholders which may be present in the area during MSS activities are clearly identified for continued liaison and information is provided to these stakeholders through the survey activities. | Environment Plan (**Section 6.4.2**) clearly identifies fishery stakeholders which require on-going consultation. |
| | | Consultation records verify these stakeholders have been informed of MSS activities throughout the survey period. |
| Streamer deployment activity to occur in location which does not affect fishermen | The MSS vessel will deploy/retrieve equipment off the continental shelf to avoid fisheries interaction (in water depths greater than 500m). | Vessel log verifies streamer deployment occurred in deep waters off continental shelf. |
| AHO issue of Notice to Mariners | AHO is advised 6 weeks prior to Lightning MSS commencement to allow for the issue of a Notice to Mariners.<br>The notification will describe the location, activity and duration of the survey. | Records verify that Notice to Mariners issued by AHO prior to Lightning MSS commencement |
| Mobilisation and demobilisation notification issued to relevant fishing stakeholders. | Mobilisation notifications issued to relevant stakeholders (Section 6.4.2) five days prior to MSS commencement. | Records verify mobilisation notifications have been sent to all relevant stakeholders within nominated timeframe. |
| | Demobilisation notifications issued to relevant stakeholders three days after MSS completion. | Records verify demobilisation notifications have been sent to all relevant stakeholders within nominated timeframe |
| Notification to AMSA RCC of the Lightning MSS activity | AMSA RCC will be notified two weeks prior to the MSS activity commencing. The notification will describe the location, activities and duration of the MSS. | Records indicate the AMSA RCC AusCoast warning is issued for the duration of the Lightning MSS activity. |
| Fishermen provided with MSS activity updates | Routine bulletins provided to fishermen who fish in the area updating details on activities in sections (e.g. racetracks) of the survey area together with how long the vessel is likely to be operating in that section. This will include schedule changes to relevant fishermen. | Routine bulletin records issued to fishermen verify activity information has been provided. |

[59] Consequence assessed based upon SBTF presence. Other fisheries which may be present in the area are expected to have lower consequence rankings given available fishing distribution data.

| Environmental Hazard/Aspect | *Disruption to Commercial Fishing Activities* | |
|---|---|---|
| Environmental Performance Outcome | *No incidents of spatial conflict* with fishing vessels/equipment occurs during the Lightning MSS*<br>**Defined as towed pontoons containing SBT not being given right-of-way over the seismic vessel; use of source within 3km of a SBT towed pontoon; other (non-SBT fisheries) having to retrieve fishing equipment due to the presence of the MSS activity or deviation of the MSS vessel from a seismic line due to the presence of a fishing vessel.* | |
| Measurement Criteria | *Incident records identify no incidents of spatial conflict with fishing vessels.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Support & scout vessel available to prevent spatial conflicts with fisheries | A support vessel will scout within the MSS area for the duration of the MSS activity to ensure that possible spatial conflicts between MSS and other vessels are avoided. | Vessel logs verify support vessel is present in the MSS area for the duration of MSS activities. |
| Fishing Compensation for Temporarily displaced/ damaged Fishing Equipment | Compensation is paid to affected fishermen within the stated timeframe within Fishing Displacement Compensation Agreement | Records of compensation confirm payment within stated timeframes. |
| Towed SBT Pontoons given right-of-way | In the event of spatial conflict towed SBT pontoons are given right-of-way over the seismic vessel. | Vessel log verifies that on encounter with SBT Pontoons, vessel allows right-of-way of pontoons. |
| Source not activated and shut-down in proximity to towed pontoon | The acoustic array will not commence soft-start activities, and if operational will be shut-down, in the event that the seismic vessel is within 3km of a towed pontoon. | MMO Master Sheet indicates that procedures for soft-start and shutdown are implemented appropriate to the towed pontoon presence. |

### 5.4.1.3 *Acceptability and ALARP Demonstration*

An evaluation of possible commercial fisheries impacts and risks, against acceptability criteria detailed in **Section 5.1.2,** is provided below. On the basis of this information, both residual impact and risk associated with the hazard is considered acceptable.

| *Acceptability Demonstration* | |
|---|---|
| Meeting Bight Petroleum HSE Policy Objectives: | Bight's HSE Policy recognises the requirement to meet community expectations and high levels of HSE performance. Bight has engaged with commercial fisheries to identify possible impacts, provide information (as available & required) on seismic impacts to fisheries and identify controls whereby fishery impacts are reduced to ALARP. This has been achieved as evidenced by the control measures to be implemented in this MSS. |
| Legal Compliance with: | *Offshore Petroleum & Greenhouse Gas Storage Act 2006* (Com) (S350) – *Interference with Other Rights.*<br>*Navigation Act 2012* (Com) & subordinate legislation (Marine Orders):<br>• Marine Order 30 (Prevention of Collisions) 2009<br>*Marine Safety (Domestic Commercial Vessel) National Law Act 2012* (Com) |
| EPBC Protected Matters Assessment: | The interaction of commercial fishing with petroleum activities is not regulated under the EPBC Act nor is it an EPBC Protected Matters issue. *Criteria not applicable to this particular hazard.* |
| Social Acceptability: | Issues raised by fishing stakeholders regarding spatial conflict and possible impacts to fishing have been addressed satisfactorily during stakeholder consultation activities. Controls raised by ASBTIA regarding spatial conflict have been included within the EP. Bight considers that the adoption of stakeholder 'control measures' within the EP addresses stakeholder concerns and meets social acceptance criteria. |
| Risk/Impact are demonstrated to be ALARP: | As per demonstration assessment below, both residual impact and risk has been assessed as ALARP. |

A demonstration of ALARP with respect to residual impacts and risks associated with Commercial Fishing Disruption is provided below. On the basis of this demonstration, both residual impact and risk is considered ALARP when measured against the criteria.

| *ALARP Demonstration* | |
|---|---|
| Hierarchy of Controls: | **Elimination:** Survey window avoids the predominant SBT harvesting season when they will be in shelf waters (Jan-Feb). Streamers also deployed in deep water to avoid spatial conflicts. *It should be noted that the MSS area is not heavily fished by commercial operators (most fishing inshore of survey area except for Rock Lobster/Crab State Fishery).*<br>**Prevention:** Contingent controls for the March timeframe have been developed for SBT fishermen. Notification protocols to fisheries and marine warnings implemented for all vessels which may utilise the area. MSS vessels also carry radar, AIS and ARPA to ensure that marine hazards can be identified in a timely manner. Survey area reduced to smallest practicable area and survey duration reduced as far as possible through use of a multiple streamer vessel.<br>**Reduction:** Survey utilises support/scout vessels to identify possible fishing/seismic impacts and warn fishermen of the hazard.<br>**Mitigation:** Fishing compensation arrangements in the event that equipment is damaged or temporarily displaced by activity.<br>*No additional controls can be identified which reduce impacts or risks further (refer to options analysis).* |
| Compliance with Standards and Codes: | Code of Environmental Practice (APPEA, 2008) objectives met for offshore geophysical operations. |
| Comparative Assessment of Options: | Limited exploration techniques are available to the oil and gas industry to identify hydrocarbon reservoirs. Alternate technologies such as marine CSEM (still requires vessel) and satellite imaging technology provide insufficient resolution for defining drilling prospects and are not a viable alternative to seismic surveys. Marine vessels are required to undertake MSS activities.<br>A 'do-nothing' approach (i.e. no survey) does not align with obligations contained in work-plans approved as part of the permit release with the Australian Government.<br>The Lightning MSS program has been designed to cover the most prospective parts of EPP-41 and EPP-42 (i.e. survey area minimised) and the use of a MSS vessel with multiple streamers (~8-10) minimises the acquisition period (refer **Section 2.2**).<br>A thorough review of all commercial fishing activity and weather conditions suitable to MSS activities has identified that the March-May period has the least potential of spatial conflict. The original survey window considered the period January to May however this has now been readjusted to 1 March – 30 May to accommodate SBT fishing. Other fishing activities are very 'low intensity' and spatial conflict considered very unlikely.<br>Routine oil and marine industry practices associated with fishery notification/survey updates; marine warnings; and support/escort vessel surveillance are considered suitable controls.<br>*No additional options/controls can be identified which can further reduce the residual impact and risk associated with MSS/commercial fishing disruption.* |
| Hazard/Risk Criteria: | In accordance with the Bight Petroleum Qualitative Risk Matrix, the residual risk associated with this hazard is assessment as low. The Bight Risk tolerability criteria identified in **Section 5.1** identify that the residual risk is acceptable and the risk control strategy is considered to be ALARP. |
| Cost Benefit Analysis: | Not applicable to this assessment. |

## 5.4.2 Disruption to Commercial Shipping Activities

### *5.4.2.1 Activity & Background*

As per information provided in **Section 3.4.1**, AMSA has identified the major shipping channel running east-west from Investigator Strait to Cape Leeuwin passes through the Lightning MSS area (refer **Figure 3-8**). This traffic includes international and national cargo trade, passenger services and petroleum tankers.

The presence of the MSS vessel, towed array and maintenance of a requested 'safe distance' around the MSS vessel and array may exclude commercial shipping vessels from portions of the Lightning MSS area over a period of approximately 70days. A safe distance shall be defined by the MSS Vessel Master according to the weather, sea conditions and currents in the area (i.e. ocean currents can cause towing equipment to move quite a significant distance laterally from the vessel path, although it is not expected in this area

due to the currents being in the same direction as the recording direction). This control is implemented to prevent interference/collision with towed equipment/vessels and to prevent interruptions to survey activities. This may require commercial vessels to deviate from planned routes to avoid the survey activities increasing transit times and resulting in small increases in fuel consumption.

As per fishing activities, the following actions will be undertaken to ensure that commercial shipping is aware of the MSS activities to avoid spatial conflicts:

- A Notice to Mariners will be issued via the AHO for the duration of the activity;
- Vessel activity reports will be reported to AMSA RCC who will issue shipping warnings to minimise the potential for marine activity conflicts; and
- Support/escort vessels will scout within the MSS area to ensure that possible spatial conflicts between seismic/commercial shipping vessels are avoided, and if encountered alerts (i.e. flares) will be implemented to identify potential hazards.

Additionally the following measures will be adopted:

- Mobilisation routes to/from the proposed MSS area will avoid recognised shipping routes wherever possible and for those routes which cannot be avoided, the vessels will cross on a perpendicular basis; and
- Vessels maintain a 24/7 watch with trained crew[60] (STCW95) and appropriate navigation safety equipment (radar[61], radio, AIS, etc.) is available on-board to ensure early detection of third party vessels with implementation of vessel diversion (as necessary).

#### 5.4.2.2 *Environmental Risk Assessment*

The presence of the seismic/escort vessels in the Lightning MSS area may cause minor disruption to commercial shipping vessels given the observed vessel density in the area (Consequence: 2). As the survey will take place for a limited period (70days) and with the controls implemented, it is expected that commercial vessel disruption is very unlikely to occur during the MSS acquisition period. On this basis, the residual risk is assessed as low.

A summary of the EPO for commercial shipping disruption associated with the Lightning MSS; performance standards relating to the control measures adopted and associated measurement criteria is shown in the table below:

| Environmental Hazard/Aspect | *Disruption to Commercial Shipping Activities* | |
|---|---|---|
| Environmental Performance Outcome | *No incidents of spatial conflict* with commercial vessels occurs during the Lightning MSS.*<br>**Defined as MSS vessel deviating from a seismic line due to the presence of a commercial vessel* | |
| Measurement Criteria | *Incident records indicate no spatial conflict with commercial shipping occurs during the Lightning MSS.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Consultation with AMSA on commercial shipping controls required is conducted during MSS planning | AMSA recommended controls obtained from consultation feedback are adopted for the MSS and implemented for the duration of MSS activities. | Environment Plan reflects AMSA controls for the MSS |
| | | Records indicate that the controls are implemented for the duration of the survey (*refer to Support Vessel, AHO and AMSA RCC records below*) |

[60] Personnel on duty on the support and seismic vessels shall ensure the radar is continuously operating and set to identify any seagoing traffic that may pass within a nominated distanceof the seismic vessels survey line. Whenever such a target is identified, the closest point of approach of the vessel shall be determined and an attempt shall be made to contact the vessel, to ensure that it is aware of the MSS vessel location and of the clearance requested. Bight's On-board Representative shall also review any schedule of arrivals and departures provided to the vessel so as to have advance knowledge of expected vessel traffic.

[61] The radar system installed on the support and seismic vessels will be used to plot the expected track of seagoing traffic. This will allow the seismic vessel to have early notice of any approaching vessel detected by radar.

| Environmental Hazard/Aspect | *Disruption to Commercial Shipping Activities* | |
|---|---|---|
| Environmental Performance Outcome | *No incidents of spatial conflict* with commercial vessels occurs during the Lightning MSS.*<br>**Defined as MSS vessel deviating from a seismic line due to the presence of a commercial vessel* | |
| Measurement Criteria | *Incident records indicate no spatial conflict with commercial shipping occurs during the Lightning MSS.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Vessel Master to set 'Safe Distance' around the vessel/array to prevent interference. | The Vessel Master shall define based upon prevailing weather and sea-state conditions, the 'safe distance' to be implemented as separation distance between third party vessels and the MSS Vessel/Equipment.<br>Marine crews shall adopt this distance and communicate with/warn third party vessels on this basis. | Vessel log records the 'safe distance' to be adopted between the MSS Vessel/Equipment and Third Party Vessels.<br>Vessel log contains communication records to third parties based upon the 'safe distance' requirements. |
| Notification to AMSA RCC of the Lightning MSS activity | AMSA RCC will be notified two weeks prior to the MSS activity commencing. The notification will describe the locations, activities and durations of the MSSs. | Records verify the AMSA RCC AusCoast warning for the duration of the Lightning MSS activity |
| Support/chase vessel available to prevent spatial conflicts with shipping | A support vessel will scout within the MSS area for the duration of the MSS activity to ensure that possible spatial conflicts between MSS and other vessels are avoided. | Vessel logs verify support vessel is present in the MSS area for the duration of MSS activities. |
| AHO issue of Notice to Mariners | AHO is advised 6 weeks prior to Lightning MSS commencement to allow for the issue of a Notice to Mariners.<br>The notification will describe the location, activity and duration of the survey. | Records verify that Notice to Mariners issued by AHO prior to Lightning MSS commencement |
| Navigational safety equipment (AIS, navigation lighting, day shapes, ARPA and radio) are available for all vessels involved in the survey. | Vessels selected for the MSS to conform to the hardware requirements of AMSA *Marine Order 30: Prevention of Collisions* for AIS, navigation lighting, sound signals, day shapes, ARPA[62] and *Marine Order 27 – Radio Equipment* for radio equipment to ensure navigation safety equipment is present on vessels to prevent collisions. | Pre-mobilisation audit records verifies that navigation safety equipment is present on all MSS vessels |
| | Navigation safety equipment (ARPA, AIS, radio, navigation lights – including backups) is maintained in accordance with Manufacturer's specifications via the Vessel(s) Planned Maintenance System (PMS) to ensure functionality for the duration of the MSS. | PMS records verify navigation safety equipment - ARPA, AIS, radio, navigation lights - are functional and operating to specification |
| Personnel are trained & competent (e.g. STCW95) in measures to identify presence and communicate with third party vessels. | All marine crews are trained, experienced and competent against the *International Convention on Standards of Training, Certification and Watch-keeping for Sea-farers* requirements to ensure the identification of and communication with third party vessels during the MSS. | Training and Competency Records indicate that all relevant marine crew are competent to STCW95 standards. |
| Vessels maintain a 24/7 watch for commercial vessels | All marine crews will maintain a 24/7 watch for the duration of the MSS activity. | Records of bridge watch activities show adherence to these requirements. |

### 5.4.2.3 *Acceptability and ALARP Demonstration*

An evaluation of possible commercial shipping impacts and risks, against acceptability criteria detailed in **Section 5.1.2,** is provided below. On the basis of this information, both residual impact and risk associated with the hazard is considered acceptable.

[62] Not required on escort vessel.

| *Acceptability Demonstration* | |
|---|---|
| Meeting Bight Petroleum HSE Policy Objectives: | Bight's HSE Policy recognises the requirement to meet community expectations and high levels of HSE performance. Bight has engaged with AMSA, Shipping Australia and AHO to identify controls whereby commercial shipping impacts are acceptable and reduced to ALARP. This has been achieved as evidenced by the control measures to be implemented for commercial shipping in this MSS. |
| Legal Compliance with: | *Offshore Petroleum & Greenhouse Gas Storage Act 2006* (Com) (S350) – *Interference with Other Rights.*<br>*Navigation Act 2012* (Com) & subordinate legislation (Marine Orders):<br>• Marine Order 21 (Safety of Navigation and Emergency Procedures) 2012<br>• Marine Order 30 (Prevention of Collisions) 2009<br>• Marine Order 58 (International Safety Management Code) 2002<br>*Marine Safety (Domestic Commercial Vessel) National Law Act 2012* (Com) |
| EPBC Protected Matters Assessment: | The interaction of commercial shipping with petroleum activities is not regulated under the EPBC Act nor is it an EPBC Protected Matters issue. *Criteria not applicable to this particular hazard.* |
| Social Acceptability: | Controls raised by maritime safety authorities and Shipping Australia regarding spatial conflict with commercial vessels have been included within the EP as a result of stakeholder consultation activities. Bight considers that the adoption of stakeholder 'control measures' within the EP addresses stakeholder concerns and meets social acceptance criteria. |
| Risk/Impact is demonstrated to be ALARP: | As per demonstration assessment below, both residual impact and risk has been assessed as ALARP. |

A demonstration of ALARP with respect to residual impacts and risks associated with commercial shipping disruption is provided below. On the basis of this demonstration, both residual impact and risk is considered ALARP when measured against the criteria.

| *ALARP Demonstration* | |
|---|---|
| Hierarchy of Controls: | **Elimination:** *No elimination controls identified.*<br>**Prevention:** Marine warnings issued to all vessels which may utilise the area. Vessel to set "safe operating distance" to be observed between MSS vessel and third Party Vessels. MSS vessels also carry radar and ARPA to ensure that marine hazards can be identified in a timely manner and have navigation safety devices to warn third party vessels of presence. Crews maintain 24/7 watch with STCW95 competencies. Survey area reduced to smallest practicable area. Survey duration reduced as far as possible through use of a multiple streamer vessel.<br>**Reduction:** Survey utilises support/scout vessels to identify possible commercial shipping/MSS impacts and warn vessels of the hazard.<br>**Mitigation:** MSS vessel will take avoidance action to minimise serious spatial conflict (i.e. threat of collision) and divert from seismic line or sacrifice cables and divert to prevent collision (refer **Section 5.7.1**).<br>*No additional controls can be identified which reduce impacts or risks further (refer to options analysis).* |
| Compliance with Standards and Codes: | Code of Environmental Practice (APPEA, 2008) objectives met for offshore geophysical operations. |
| Comparative Assessment of Options: | Limited exploration techniques are available to the oil and gas industry to identify hydrocarbon reservoirs. Alternate technologies such as marine CSEM (still requires vessel) and satellite imaging technology provide insufficient resolution for defining drilling prospects and are not a viable alternative to seismic surveys. Marine vessels are required to undertake MSS activities.<br>A 'do-nothing' approach (i.e. no survey) does not align with obligations contained in work-plans approved as part of the permit release with the Australian Government.<br>The Lightning MSS program has been designed to cover the most prospective parts of EPP-41 and EPP-42 (i.e. survey area minimised) and the MSS vessel utilises multiple streamers (~8-10) which minimises the acquisition period (refer **Section 2.2**).<br>Marine industry standard controls include marine warnings to inform other commercial vessels of MSS activity in the area; all relevant navigation safety equipment available on-board; and crews appropriately trained to recognised standards. Oil industry standard control of support/escort vessel surveillance is also considered a suitable control.<br>*No additional options (i.e. area & timing) can be identified which can further reduce the residual impact and risk associated with MSS/commercial shipping disruption.* |

| *ALARP Demonstration* | |
|---|---|
| Hazard/Risk Criteria: | In accordance with the Bight Petroleum Qualitative Risk Matrix, the residual risk associated with this hazard is assessment as low. The Bight Risk Tolerability criteria identified in **Section 5.1** considers the residual risk as acceptable and the risk control strategy at ALARP. |
| Cost Benefit Analysis: | Not applicable to this assessment. |

## 5.4.3 Artificial Lighting Impacts

### *5.4.3.1 Activity & Background*

Lighting is required for safety and navigational purposes on the seismic/support vessels 24 hours a day during MSS activities. Lighting provides for marine safety to ensure clear identification of the vessels to other marine users; and allows for safe movement of personnel during hours of darkness. For intermittent periods during night hours, spot lighting will be required for in-sea equipment inspection, deployment, and retrieval (this will mainly involve the use of spot-lights focusing aft of the vessel towards the source and deflectors). The use of such lighting is minimized as far as possible. It should be noted that prevailing sea state conditions in the region may preclude in-water night-hour inspections on a personal safety basis.

Light on vessels operating offshore may create light pollution which has the potential to affect marine fauna, notably marine turtles (particularly during breeding season on nesting beaches), fish and seabirds.

Given there are no turtle nesting beaches in southern Australia, no impacts are expected to these species. Potential impacts to other marine fauna, such as invertebrates, fish and seabirds are expected to be restricted to localised and temporary impacts as the vessel transits though the area (i.e. constant movement). Light emissions are considered to be similar to passing commercial shipping and fishing vessels.

On this basis on-board vessel lighting will provide for:

- Use of standard navigational identification features (e.g. lighting, beacons, signals) to align with the navigation safety requirements of the *Navigation Act 2012*;
- Deck lighting which is required for workplace safety will be directed in-board to minimise the amount of direct light spill onto marine waters; and
- Night hour in-sea equipment inspections activities are be minimised as far as possible.

A pre-mobilisation inspection will identify any opportunities to reduce stray light spill to the marine environment. These opportunities will be corrected prior to mobilisation.

### *5.4.3.2 Environmental Risk Assessment*

High levels of marine vessel lighting can attract and disorient species resulting in species behavioural changes in the vicinity of the light source. Potential impacts to marine fauna present, such as fish and seabirds, are expected to be restricted to localised and temporary attraction. It is understood that bird strikes have been recorded on fishing vessels in the Southern Ocean where powerful ice lights are used in back-deck activities, however bird mortality arising from these events are generally low (Black, 2004). As the seismic vessels do not utilise such lighting, impacts arising from light emissions are considered to be similar to passing commercial shipping and fishing vessels and is expected to have negligible impact to these species transiting through the MSS area (Consequence: 1).

In-sea inspection activities occur for short periods of time. The use of spot-lights is minimised as far as possible and will have minor impacts (Consequence 2) to species while operational.

Given the limited duration of MSS acquisition and constant movement of the vessel, permanent alteration to marine species foraging patterns or behavioural impacts are

considered to be very unlikely. On this basis the residual environmental risk to marine species from light spill is assessed as low.

A summary of the EPO for artificial lighting impacts associated with the Lightning MSS; performance standards relating to the control measures adopted and associated measurement criteria is shown in the table below:

| Environmental Hazard/Aspect | *Artificial Lighting Impacts to Marine Species* | |
|---|---|---|
| Environmental Performance Outcome | *Vessel lighting onto marine waters is limited to navigational and occupational safety requirements.* | |
| Measurement Criteria | *Records indicate no instances of additional light sources emitted to the environment.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Navigation lighting is available on all vessels involved in the survey and conforms to maritime requirements. | Vessels selected for the MSS conforms to the requirements of AMSA Marine Order 30: Prevention of Collisions which provides for certification of navigation lighting. | Pre-mobilisation audit records verifies that navigation lighting, is present and functional in all vessels |
| | Navigation lighting is maintained in accordance with Manufacturer's specifications via the Vessel(s) Planned Maintenance System (PMS) to ensure functionality for the duration of the MSS. | PMS records verify navigation lights are functional and operating to specification |
| Lighting required for deck workplace safety minimises the amount of light spill onto marine waters | A pre-mobilisation audit identifies opportunities to reduce deck light spill to the marine environment; and these opportunities are implemented Prior to MSS acquisition activities | Corrective action records verify opportunities to reduce light spill have been implemented. |
| Night-time in-sea equipment inspections | Vessel equipment planning meetings avoid night-time in-sea equipment inspections to eliminate direct lighting onto marine waters | Written records of vessel equipment inspection planning meetings verify night-time inspection activities are eliminated where practicable. |

### 5.4.3.3 *Acceptability and ALARP Demonstration*

An evaluation of artificial lighting impacts and risks, against acceptability criteria detailed in **Section 5.1.2,** is provided below. On the basis of this information, both residual impact and risk associated with the hazard is considered acceptable.

| *Acceptability Demonstration* | |
|---|---|
| Meeting Bight Petroleum HSE Policy Objectives: | The risk management strategy for artificial lighting impacts reflects Bight's HSE Policy goals of proactively identifying hazards, eliminating risks where possible and where this is not possible managing the risk to ALARP and to implement strategies which minimise pollution. |
| Legal Compliance with: | *Navigation Act 2012* (Com) & subordinate legislation (Marine Orders):<br>• Marine Order 11 (Living & Working Conditions on Vessels) 2013<br>• Marine Order 30 (Prevention of Collisions) 2009 |
| EPBC Protected Matters Assessment: | Continuous vessel lighting on-board the survey vessels will be limited to the minimum requirements for all vessels transiting the area (navigation/workplace safety requirements). On an intermittent basis, temporary spot lighting may be used for in-field inspections during night hours however given the prevailing sea-states, inspection activities are expected to be infrequent.<br>With the identified and implemented control measures nominated above the hazard carries a low risk of significant impacts to the Commonwealth Marine Environment (Significant Impact Guidelines 1.1). Also it does not introduce KEF integrity issues to the Kangaroo Island Upwelling Pool, meso-eddies or Ancient Coastline (SEWPC, 2012b).<br>*With control measures implemented the action will not impact of items of National Environmental Significance (NES), it meets the requirements of the SW Marine Bioregional Plan and upholds IUCN Management Principles for Marine Reserves (Category VI) (ES, 2002) relevant to the West Eyre Marine Protected Area (MPA).* |
| Social Acceptability: | No issues have been raised by stakeholders regarding issues of artificial lighting during the Lightning MSS. It should be noted that the survey area is located on a major shipping channel where navigation and workplace safety lighting routinely occurs. |

| *Acceptability Demonstration* | |
|---|---|
| Risk/Impact is demonstrated to be ALARP: | As per demonstration assessment below, both residual impact and risk has been assessed as ALARP. |

A demonstration of ALARP with respect to the residual impacts and risks with artificial lighting is provided below. On the basis of measurement against this criteria both residual impact and risk is considered ALARP.

| *ALARP Demonstration* | |
|---|---|
| Hierarchy of Controls: | **Elimination:** Navigation and vessel workplace lighting do not use powerful ice lights (or equivalent) which are known to attract marine species (particularly birds).<br>**Prevention:** In-water equipment inspections are minimised as far as possible. Via pre-mobilisation audit, deck lighting will be confirmed as directed in-board and other opportunities to eliminate stray light implemented. Survey duration reduced as far as possible through use of a multiple streamer vessel.<br>**Reduction:** Vessel is constantly moving with low level lighting. Exposure to species on this basis is temporary and not concentrated in one area.<br>**Mitigation:** *No mitigation controls have been identified.*<br>*No additional controls can be identified which reduce impacts or risks further (refer to options analysis).* |
| Compliance with Standards and Codes: | ILO Code of Practice: Accident Prevention on board ship at sea and in Port (1996)<br>National Standard for Domestic Commercial Vessels |
| Comparative Assessment of Options: | Limited exploration techniques are available to the oil and gas industry to identify hydrocarbon reservoirs. Alternate technologies such as marine CSEM (still requires vessel) and satellite imaging technology provide insufficient resolution for defining drilling prospects and are not a viable alternative to seismic surveys. Marine vessels are required to undertake MSS activities.<br>A 'do-nothing' approach (i.e. no survey) does not align with obligations contained in work-plans approved as part of the permit release with the Australian Government.<br>The Lightning MSS program has been designed to cover only the most prospective parts of EPP-41 and EPP-42 (i.e. survey area minimised) and the use of a MSS vessel with multiple streamers (~8-10) minimises the acquisition period (refer **Section 2.2**).<br>All vessels in Australian waters adhere to navigation safety requirements contained in the *Navigation Act 2012* and subordinate Marine Orders with respect to navigation and workplace safety equipment (i.e. lighting). Elimination or reduction of lighting on-board would increase the risk of collision risk, introduce safety risks to marine crews and would be non-compliant with marine code and regulations.<br>*No additional options/controls can be identified which can further reduce the residual impact and risk associated with artificial lighting impacts to the marine environment.* |
| Hazard/Risk Criteria: | In accordance with the Bight Petroleum Qualitative Risk Matrix, the residual risk associated with this hazard is assessment as low. The Bight Risk tolerability criteria identified in **Section 5.1** identify that the residual risk is acceptable and the risk control strategy is considered to be ALARP. |
| Cost Benefit Analysis: | Not applicable to this assessment. |

## 5.4.4 Disruption to Tourism Activities

### *5.4.4.1 Activity & Background*

As identified in **Section 3.4.2**, given the distance of the Lightning MSS area from land or coastal islands there is little marine-based tourism which occurs in the area. Specifically the marine tourism activities (values) of the region are as follows:

- Recreational beach use (sightseeing, swimming, surfing and snorkelling) and diving (located in coastal areas). *Coastal locations are not considered to be at threat from survey activities*;
- Charter boating for activities such as sightseeing, fishing, diving, marine mammal watching. *Charter boat operators involved in recreational fishing activities may have a presence in the MSS area (refer recreational fishing). Other charter activities will not occur in the MSS area.*
- Marine Mammal Watching Operations. These activities are focussed around the Southern Right Whale which calves in coastal habitats. Most operators run tours between June and

October (outside the survey period) and operate on half day tours (insufficient time allowance to transit to the Lightning MSS area). *Marine Mammal watching operations will not be affected by the survey activities*;

- Recreational boating utilises small inshore craft which are not expected in the oceanic conditions of the Lightning MSS area;
- Yacht Racing occurs inshore of the survey area in December and February. *Survey activities will not affect these events*.
- Cruise ship visits to Kangaroo Island dock at Penneshaw (NE corner of the island). Access to this area is covered in Commercial shipping. *No other effects are expected to cruise liners*;
- Recreational (game) fishing is primarily carried out around coastal islands along the SA coastline however the area is recorded as having a low recreational fishing effort. Game fishing also occurs between January and June which is within the survey period.

The presence of the MSS vessel, towed array and maintenance of a requested 'safe distance' around the MSS vessel/array may exclude recreational fishermen from portions of the Lightning MSS area over a period of approximately 70days. This control prevents interference/collision with towed equipment/vessels and interruptions to survey activities.

As per commercial fishing activities, the following actions will be undertaken to ensure that recreational fishermen are aware of the MSS activities to avoid spatial conflicts:

- A Notice to Mariners will be issued via the AHO for the duration of the activity;
- Vessel activity reports will be directed to AMSA RCC who will issue AusCoast warnings to minimise the potential for marine activity conflicts;
- Mobilisation and demobilisation notifications will be issued to the SA Recreational Fishing Advisory Council to advise of survey activity in the area; and
- Support/escort vessels will scout within the MSS area to identify third party vessels which may have spatial conflicts between seismic vessels and warn them of the activity.

Additionally the following measures will be adopted:

- Vessels maintain a 24/7 watch with trained crew[63] (STCW95) and appropriate navigation safety equipment (radar[64], radio, AIS, etc.) is available on-board to ensure early detection of third party vessels with implementation of vessel diversion (as necessary).

#### 5.4.4.2 Environmental Risk Assessment

The presence of the seismic/escort vessels in the Lightning MSS area may cause minor disruption to recreational fishing activities given the observed low level fishing effort in the area (Consequence: 2). As the survey will take place for a limited period (70days) and with the controls implemented, it is expected that recreational fishing activities will utilise other fishing areas and the risk of impact is very unlikely. On this basis, the residual risk is assessed as low.

A summary of the EPO to prevent disruption to tourism activities (recreational fishing) associated with the Lightning MSS; performance standards relating to the control measures adopted and associated measurement criteria is shown in the table below:

[63] Personnel on duty on the support and seismic vessels shall ensure the radar is continuously operating and set to identify any seagoing traffic that may pass within a nominated distanceof the seismic vessels survey line. Whenever such a target is identified, the closest point of approach of the vessel shall be determined and an attempt shall be made to contact the vessel, to ensure that it is aware of the MSS vessel location and of the clearance requested. Bight's On-board Representative shall also review any schedule of arrivals and departures provided to the vessel so as to have advance knowledge of expected vessel traffic.

[64] The radar system installed on the support and seismic vessels will be used to plot the expected track of seagoing traffic. This will allow the seismic vessel to have early notice of any approaching vessel detected by radar.

| Environmental Hazard/Aspect | *Disruption to Tourism (Recreational Fishing) Activities* | |
|---|---|---|
| Environmental Performance Outcome | *No incidents of spatial conflict* with recreational fishing vessels during the Lightning MSS.*<br>**Defined as MSS vessel deviating from a seismic line due to the presence of a recreational vessel* | |
| Measurement Criteria | *Incident records indicate no spatial conflict with recreational fishing vessels occurs during the Lightning MSS.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Notification to AMSA RCC of the Lightning MSS activity | AMSA RCC will be notified two weeks prior to the MSS activity commencing. The notification will describe the locations, activities and durations of the MSSs. | Records verify the AMSA RCC AusCoast warning for the duration of the Lightning MSS activity |
| Mobilisation and demobilisation notification issued to relevant recreational fishing stakeholders. | Mobilisation notifications issued to relevant stakeholders (Section 6.4.2) five days prior to MSS commencement. | Records of Mobilisation have been sent to all relevant stakeholders within nominated timeframe. |
| | Demobilisation notifications issued to relevant stakeholders three days after MSS completion. | Records of demobilisation have been sent to all relevant stakeholders within nominated timeframe |
| Support/chase vessel available to prevent spatial conflicts with recreational fishing vessels | A support/chase vessel will scout within the MSS area for the duration of the MSS activity to ensure that possible spatial conflicts between MSS and other vessels are avoided. | Vessel logs verify support vessel is present in the MSS area for the duration of MSS activities. |
| AHO issue of Notice to Mariners | AHO is advised 6 weeks prior to Lightning MSS commencement to allow for the issue of a Notice to Mariners.<br>The notification will describe the location, activity and duration of the survey. | Records verify that Notice to Mariners issued by AHO prior to Lightning MSS commencement |
| Navigational safety equipment (AIS, navigation lighting, day shapes, ARPA and radio) are available for all vessels involved in the survey. | Vessels selected for the MSS to conform to the hardware requirements of AMSA *Marine Order 30: Prevention of Collisions* for AIS, navigation lighting, sound signals, day shapes, ARPA and *Marine Order 27 – Radio Equipment* for radio equipment to ensure navigation safety equipment is present on vessels to prevent collisions. | Pre-mobilisation audit records verifies that navigation safety equipment is present on all MSS vessels |
| | Navigation safety equipment (ARPA, AIS, radio, navigation lights – including backups) is maintained in accordance with Manufacturer's specifications via the Vessel(s) Planned Maintenance System (PMS) to ensure functionality for the duration of the MSS. | PMS records verify navigation safety equipment - ARPA, AIS, radio, navigation lights - are functional and operating to specification |
| Personnel are trained & competent (e.g. STCW95) in measures to identify presence and communicate with third party vessels. | All marine crews are trained, experienced and competent against the *International Convention on Standards of Training, Certification and Watch-keeping for Sea-farers* requirements to ensure the identification of and communication with third party vessels during the MSS. | Training and Competency Records indicate that all relevant marine crew are competent to STCW95 standards. |
| Vessels maintain a 24/7 watch for recreational fishing vessels. | All marine crews will maintain a 24/7 watch for the duration of the MSS activity. | Records of bridge watch activities show adherence to these requirements. |

### 5.4.4.3 *Acceptability and ALARP Demonstration*

An evaluation of possible tourism (recreational fishing) impacts and risks, against acceptability criteria detailed in **Section 5.1.2,** is provided below. On the basis of this information, both residual impact and risk associated with the hazard is considered acceptable.

| *Acceptability Demonstration* | |
|---|---|
| Meeting Bight Petroleum HSE Policy Objectives: | Bight's HSE Policy recognises the requirement to meet community expectations and high levels of HSE performance. Bight has engaged with recreational fishing groups to identify possible issues and identify controls whereby impacts are reduced to ALARP. Limited feedback has been provided which is not unexpected given the distance of the survey area from ports however control measures to be implemented in this MSS are expected to limit disruption to the fishermen. |
| Legal Compliance with: | Offshore Petroleum & Greenhouse Gas Storage Act 2006 (S350) – *Interference with Other Rights.*<br>*Navigation Act 2012* (Com) & subordinate legislation (Marine Orders):<br>• Marine Order 30 (Prevention of Collisions) 2009<br>*Marine Safety (Domestic Commercial Vessel) National Law Act 2012* (Com) |
| EPBC Protected Matters Assessment: | The interaction of tourism (recreational fishing) fishing with petroleum activities is not regulated under the EPBC Act nor is it an EPBC Protected Matters issue. *Criteria not applicable to this particular hazard.* |
| Social Acceptability: | No issues have been raised by recreational fishing stakeholders regarding spatial conflict or possible impacts to fishing during stakeholder consultation activities. On the basis the activity is considered acceptable from this stakeholder group. |
| Risk/Impact are demonstrated to be ALARP: | As per demonstration assessment below, both residual impact and risk has been assessed as ALARP. |

A demonstration of ALARP with respect to residual impacts and risks associated with tourism disruption is provided below. On the basis of this demonstration, both residual impact and risk are considered ALARP when measured against the criteria.

| *ALARP Demonstration* | |
|---|---|
| Hierarchy of Controls: | **Elimination:** *No elimination controls identified.*<br>**Prevention:** Notification protocols to fisheries and marine warnings implemented for all vessels which may utilise the area. MSS & support vessel also carry radar/ARPA to ensure that marine hazards can be identified in a timely manner by trained crew on a 24/7basis. Survey area reduced to smallest practicable area. Survey duration reduced as far as possible through use of a multiple streamer vessel.<br>**Reduction:** Survey utilises support/scout vessels to identify possible fishing/seismic impacts and warn fishermen of the hazard.<br>**Mitigation:** *No mitigation controls identified.*<br>*No additional controls can be identified which reduce impacts or risks further (refer to options analysis).* |
| Compliance with Standards and Codes: | Code of Environmental Practice (APPEA, 2008) objectives met for offshore geophysical operations. |
| Comparative Assessment of Options: | Limited exploration techniques are available to the oil and gas industry to identify hydrocarbon reservoirs. Alternate technologies such as marine CSEM (still requires vessel) and satellite imaging technology provide insufficient resolution for defining drilling prospects and are not a viable alternative to seismic surveys. Marine vessels are required to undertake MSS activities.<br>A 'do-nothing' approach (i.e. no survey) does not align with obligations contained in work-plans approved as part of the permit release with the Australian Government.<br>The Lightning MSS program has been designed to cover the most prospective parts of EPP-41 and EPP-42 (i.e. survey area minimised) and uses a MSS vessel with multiple streamers (~8-10) which minimise the acquisition period (refer **Section 2.2**).<br>Routine industry practices associated with fishery notification/survey updates; marine warnings; and support/escort vessel surveillance are considered suitable controls for this expected low frequency activity which is expected in the area.<br>*No additional options can be identified which can further reduce the residual impact and risk associated with Tourism (Recreational Fishing) Disruption.* |
| Hazard/Risk Criteria: | In accordance with the Bight Petroleum Qualitative Risk Matrix, the residual risk associated with this hazard is assessment as low. The Bight Risk tolerability criteria identified in **Section 5.1** identify that the residual risk is acceptable and the risk control strategy is considered to be ALARP. |
| Cost Benefit Analysis: | Not applicable to this assessment. |

## 5.5 Acoustic Disturbance

### 5.5.1 Seismic Acquisition

#### *5.5.1.1 Activity & Background*

**Activity Impacts:** MSSs use compressed air discharges to create acoustic pulses that are reflected back from geological structures and recorded by receivers towed behind the MSS vessel. Impacts to marine fauna will vary with seismic discharge intensity, distance from source and species type. Potential impacts may range from physiological damage with exposure to high sound levels; temporary or permanent shifts in hearing thresholds; associated interference with species acoustic signals; or behavioural changes (i.e. avoidance activities) (McCauley, 1994; McCauley et al., 2000). However, during 40 years of MSS using compressed air as the source, no verified impacts other than (cetacean) avoidance of the source or vessel have been recorded. It should be noted that one of the key mitigation measures used in MSSs, the "soft-start" or "ramp-up" of the acoustic array, is based on the concept of avoidance.

MSS sounds are of high energy and low frequency (APPEA 2006) that typically, for arrays, have dominant frequencies less than 200Hz (predominantly between 6-100Hz (McCauley, 1994)) with maximum sound pressure levels 230-255dBA re 1µPa@1m from the source (APPEA, 2006) with lower levels in the 200-1000Hz range. By comparison, background ambient marine sound within this frequency band ranges from 80-120dBA and sound from shipping has been measured at 200dBA re 1µPa in the frequency range from 10-100Hz (close to hull) (APPEA, 2006). The intensity of sound drops rapidly with increasing distance and depending on local conditions, seismic sound can be reduced to background intensity within a few tens of kilometres (APPEA, 2006). Typical sound intensities produced from differing sources in the marine environment are provided in **Table 5-5.**

Table 5-5: Sound Pressure Levels (dB re 1uPa) @ 1m from source (APPEA, 2006)

| Source | Sound Intensity (dB) | Frequency (Hz) |
|---|---|---|
| Undersea Earthquake [1] | 272 | 50 |
| Seafloor Volcanic Eruption [1] | 255+ | Varied |
| Lightning Strike (sea surface) [1] | 250 | Varied |
| Sperm Whale Clicks [1] | Up to 235 | 100-30,000 |
| Bottlenose Dolphin Clicks [1] | Up to 229 | Up to 120,000 |
| Breaching Whale [1] | 200 | 20 |
| Blue Whale Vocalisation [1] | 190 | 12-400 |
| Humpback Whales (Fluke & Flipper Slaps) [2] | 192 | 30-1200 |
| Ambient Sea sound [1] | 80-120 | Varied |
| Anthropogenic Noises | | |
| Seismic Acoustic Source [1] | 230-255 | <200 |
| Ship sound (close to hull) [1] | 200 | 10-100 |
| Vertical Seismic Profiling [3] | 190 | 200 |
| Vessels- Tugs & Barges [3] | 171 | 100-2000 |
| Helicopter Flyover [3] | Varies on type and size of helicopter and height above sea level | 20 |

**References:** (1) APPEA, 2006; (2) Thompson & Cummings (1986); (3) WCDS (2003).

When considering transmission of sound underwater it is the near horizontal energy output from the acoustic source which is the most critical. The devices towed by a seismic vessel are arranged in precise groups (arrays) which are specifically oriented such that the sound waves are directed towards the seafloor. Thus energy is not directed, nor does it travel very far horizontally. Seismic sound also increases in wavelength with distance from the source experiencing rapid loss of the higher frequencies. The initial seismic pulse lasts a few milliseconds but after travelling a few kilometres from the source, its wavelength has increased (Swan et al, 1994).

The maximum calculated Sound Energy Level (SEL) emitted by the source in the Lightning MSS has been calculated at 228dB re 1µPa$^2$s (CMST, 2012). Acoustic modelling (CMST, 2012) has been undertaken for the Lightning MSS utilising a 3090in$^3$ array for the purpose of identifying Sound Exposure Levels (SELs) at three locations representative of the different propagation conditions within the Lightning MSS area. These points were located on the continental shelf (@200m water depth) within the MSS area at a point closest to Kangaroo Island (P1); on the continental shelf in the centre of the MSS area (P2) (@200m water depth) and on the continental slope in the centre of the deep water section of the MSS (@2000m water depth) (P3). In addition, the closest point to Kangaroo Island (P1) was modelled with a 4130in$^3$ array to compare the sound levels with the 3090in$^3$ array. The threshold of 160dB re 1µPa$^2$.s selected on these plots reflects EPBC Policy 2.1 Guideline SEL thresholds for the conservative basis for determining acoustic levels which may damage cetaceans (DEWHA, 2008).

SEL modelling results indicate the following:

- The maximum Sound Energy Level (SEL) at the 50m water depth contour just off the Western end of Kangaroo Island from P1 (approx. 104km) is predicted to be less than 120dB re 1 µPa$^2$s for both arrays with the 3090in$^3$ source array approximately 5dB re 1 µPa$^2$s lower (i.e. 115dB re 1µPa$^2$.s) than the 4130in$^3$ source array. Similar SELs are also predicted just off the coast of the Eyre Peninsula (approx. 67km). These levels are much lower than levels at which hearing TTS (Temporary Threshold Shift) in species is considered to occur (refer **Figure 5-1** for 3090in$^3$ SEL spherical spreading loss);
- SELs are predicted to attenuate rapidly up the continental slope when operating off the shelf. For example, from the modelling point P3, the sound energy levels at the edge of the shelf will have reduced to 120dB re 1 µPa$^2$s (Refer **Figure 5-2**);
- SEL's are also predicted to attenuate rapidly on the shelf such that, from point P2 (water depth 200m) the SEL's have reduced to 120dB re 1 µPa$^2$s by the 100m water depth contour in the direction towards the coast and attenuated to 130dB re 1 µPa$^2$s at each end of the survey area along the shelf edge (Refer **Figure 5-3**);
- When the vessel is operating on the shelf, the SEL's received at one end of the survey from source points at the other end of the survey will be less than 120dB re 1 µPa$^2$s; and
- Confirmation that SELs attenuate rapidly in most areas. For example, even though the 3090in$^3$ source is modelled at 228 re 1µPa$^2$.s@1m, the SEL in dB re 1µPa$^2$.s at different distances close to the source are detailed in **Table 5-6**.

Table 5-6: SELs (dB re 1µPa$^2$.s) versus Distance from Source (m)

| Distance from Source (m) | SEL (dB re 1µPa$^2$.s) |
|---|---|
| 50 | 195 |
| 300 | 180 |
| 900 | 170 |

It should also be noted that the smallest array size (~3090in$^3$ versus 4130in$^3$) has been selected for the Lightning MSS to achieve seismic acquisition objectives which minimise possible impacts as far as possible.

Figure 5-1: $SEL_{max}$ versus range for P1 using 3090in$^3$ array (CMST, 2012)

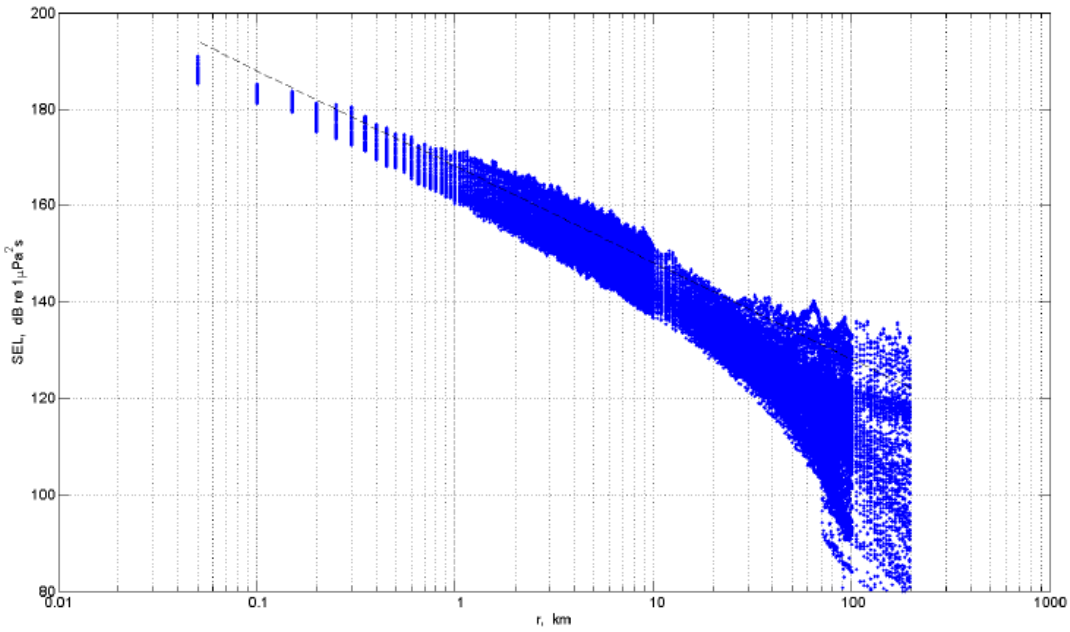



Figure 5-2: Maximum received SEL at any depth at MSS shelf location closest to Kangaroo Island (CMST, 2012)

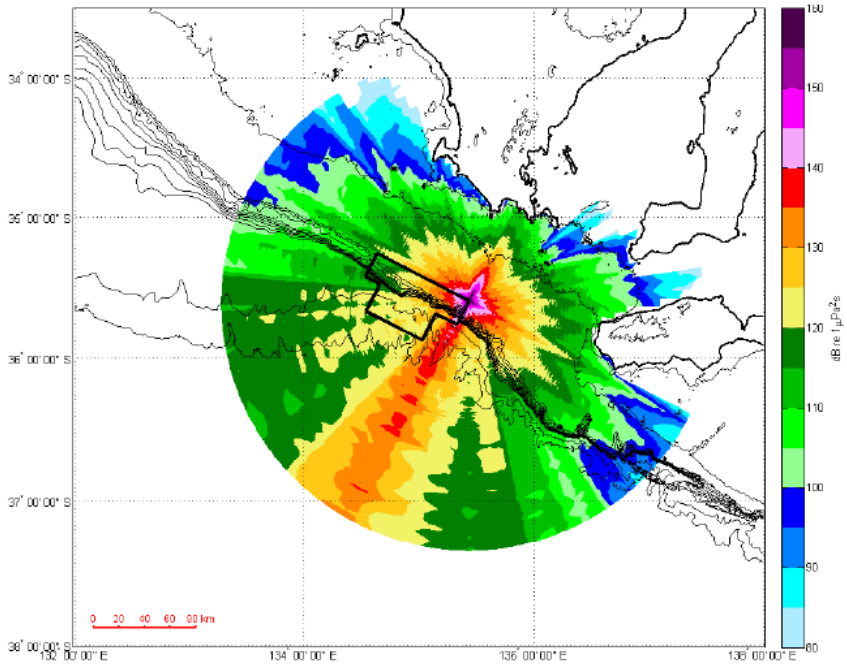
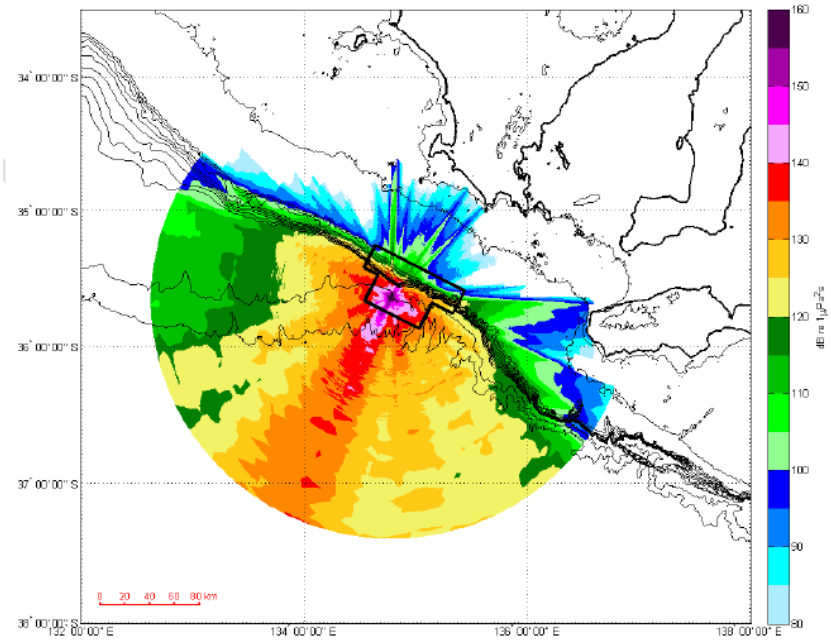


Figure 5-3: Maximum received SEL at any depth at deep-water location (2000m) (CMST, 2012)




A study undertaken for the Casino MSS (CMST, 2007), located in the Otway Basin in proximity to Logan's Beach, utilising a combination of measured survey sound levels from past MSS data of similarly sized acoustic arrays (3147in$^3$) and modelled data, established sound exposures for adjacent shorelines. Both modelled and measured data agreed that the shallow near-shore water at distances 15-20km from the proposed Casino MSS acoustic array would not be detectable. As the Lighting MSS is located over 60km from shore, received shoreline sound levels from the survey are not expected to be above ambient conditions. It is likely that sound levels from commercial shipping may have a greater impact upon ambient sound levels in the adjacent coastal areas.

**Cetaceans:**

*Response to Acoustic Sound*: Marine mammals are sensitive to sound in the marine environment. Their extensive use of sound for communication, prey capture, predator avoidance, navigation, and their physical makeup (i.e. large gas-filled organs) make them vulnerable to both disturbance and physiological damage from underwater sound of sufficient magnitude.

*Baleen whales* (e.g. Blue, Southern Right & Humpback whales) are considered the most sensitive of the marine mammals to seismic arrays due to their use of low-frequency signals (Range: 12Hz-8kHz but predominantly less than 1kHz) for communication (McCauley, 1994). Their low frequency hearing capability is believed to overlap the sound output frequency of the marine seismic and the potential for disturbance in this species is considered higher than for toothed whales ('odontocetes') (DOIR, 2007). However, it should be noted that each of these species spend the summer season feeding in Antarctic waters which is a substantial sound environment (the sound of calving ice has been recorded along the southern coast of Australia on sea-bed loggers approx. 3000km away). Additionally, Blue Whales vocalise at 190dBa re 1µPa at a frequency between 12-400Hz and breaching Humpbacks create sounds with similar signatures to the individual elements of seismic acoustic arrays.

Little is known about the sound levels at which hearing damage or physical injury occurs in cetaceans. There have only been two studies which have measured TTS onset levels in cetaceans in response to airgun-like pulses. Finneran et al (2002; cited in Gedamke et al, 2011) identified a Temporary Threshold Shift (TTS) in hearing for one beluga whale at 186dB re 1μPa$^2$.s and no TTS was observed in one bottlenose dolphin at approximately 188dB re 1μPa$^2$.s. Sound modelling results showed that these sound levels lie only within 300m of the source for all locations modelled (refer **Figure 5-1**) (CMST, 2012).

Behavioural responses to acoustic sound in Baleen whales range from tolerance at low/moderate acoustic levels (McCauley et al, 2003); to graduated behavioural responses including shifts in respiratory and diving patterns (McCauley, 1994) at higher levels. Researchers have found that Gray & Bowhead whales practiced avoidance at received sound pressure levels between 150-180dB re 1μPa (Richardson et al, 1995; cited in McCauley et al 2000). McCauley (2000) observed 'stand-off' behaviour for migrating Humpback Whales at received sound pressure levels of 157-164dB re 1μPa; with resting pods (including cows) exhibiting stand-off at received sound levels of 143dB re 1μPa and avoidance at 140dB re 1μPa. Additional observations also indicate that rapidly changing vessel sound often evokes a strong avoidance response, while a slow non-aggressive vessel approach can result in little response from cetaceans (URS, 2001). It is expected that with acoustic sources operational, most baleen whales will practice avoidance (as per above behavioural observations) and not position themselves at a range whereby physical damage from sound will occur. Soft-start procedures which 'ramp-up' acoustic sources also facilitate this expected response behaviour and protect whales from sudden acoustic sound which may be damaging.

It has also been observed that cetacean avoidance behaviour to differing acoustic levels depends on their activity at the time and is variable between/within species (Richardson *et al.*, 1995; McCauley *et al*., 1998). Studies indicate that cetaceans are less responsive when migrating or feeding than when suckling, resting or socialising (SCAR, 2002). It is considered that avoidance behaviour represents only a minor effect to the individual or species unless the avoidance results in displacement of species from nursery, resting or feeding areas.

Behavioural responses of Eastern Gray Whales in a study in the Bering Sea identified that 10% the whales stopped feeding at a received sound level >163dB re 1μPa while other whales continued to feed at 177dB re 1μPa (Malme et al, 1986;cited in Richardson 1995). In that study, whales that stopped feeding and moved away resumed feeding within 1hr after the seismic noise ended.

A mitigation strategy adopted during the 2001 Odoptu 3D MSS, based on *existing literature on gray whales and known exposure levels which would cause cessation of feeding*, involved reducing the sound exposure of gray whales to less than 163dB$_{rms}$ re 1μPa (Johnson et al, 2007; cited in Yazvenko et al, 2007) corresponding to a SEL of 156dB re 1μPa$^2$.s (Nowacek et al, 2013). Results of this study identified the species continued to occupy the main feeding area during the MSS and there was no significant displacement outside these grounds.

Observations of behavioural responses of Blue Whales to seismic surveys along the Southern margins of Australia have also been documented. MMO data obtained collected from a collection of surveys undertaken in the region follows:

- March 2008 Seismic Survey (Western Tasmanian waters): A total of 5 Blue whale sightings were recorded during this 8-day survey during March. Two of the sightings lead to shutdowns with the low power zone set at 2km for the survey. The following observations were recorded:
  - *i) The vessel was in full production and moving towards a pod of blue whales that were milling on the surface. Earlier, whales were seen just before the soft start but were well outside the 2km low power zone (approx. 4.5-5km forward of the ship at 14:44) thus allowing operations to continue whilst the MMO monitored the sighted whales. Additional sightings over the next 5-7 minutes indicated that the whales had not moved and as such, the vessel was approaching the 2km low power zone.*

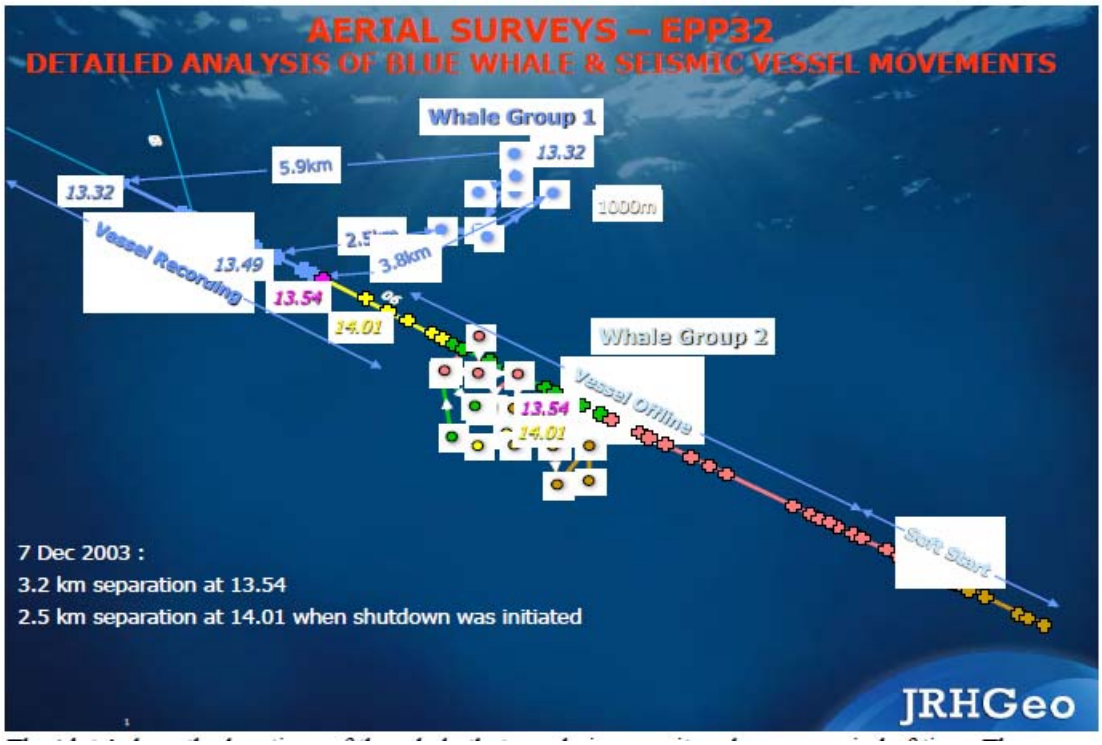
*At 14:57 and 15:00 two blows were sighted within the 2km of the vessel bow and the MMO informed the Party Chief they were inside the power down zone. Soon after there was another blow at 1400m from the vessel bows. At this point the Party Chief gave the order to power down the array. The array was powered down at 15:01 at the same time as a whale appeared 1000m from the bow, or 1200m from the array.*

*ii) The vessel was in full production when whales appeared 1200m ahead of the vessel (approx. 1400m from the acoustic source). The sea state at this time was Beaufort Scale 6. The MMO indicated to the Chief Mate that they were inside the zone and he immediately contacted the array operators and shut the source down. The whales passed down the port side of the vessel. The closest distance the whales came to the array when it was shut down was 600m.*

Both of these sightings indicate that Blue Whales were about 1200m from the active source without exhibiting any behavioural effects. It is feasible they may have come closer to the operating source had it not been shutdown.

- Santos EPP-32 Seismic Survey (Morrice et al, 2004): Aerial surveys conducted during this 2003 MSS west of Kangaroo Island (same area as Bight) observed no discernable behavioural reaction to Blue Whale behaviour (i.e. avoidance of the operating vessel) within 2.2km of the active source before it was shut-down. **Figure 5-4** shows an example of such an occurrence. The 'dots' on **Figure 5-4** show locations of whales being monitored over a period of time. The 'crosses' show the position of the source which was shut-down at 1401hrs when the distance between the blue whales and active source was 2.5km. The colour of the 'dots' and crosses' represent the movement of the blue whale relative to the movement of the source during the same time period.

Figure 5-4: EPP-32 Marine Vessel and Blue Whale Interaction (Morrice et al, 2004)




The key points derived from this analysis are:

a. Blue whales did not move away from the oncoming vessel – they continued to feed on the very small scattered krill swarms present just off the edge of the shelf, even though there were much larger krill swarms where other whales were feeding, on the shelf to the north.

b. The shortest distance between the blue whale and the active source was 2.5km. Given the precautionary power-down distance used for this survey, it is not known at what distance whales would have responded to the approaching source.

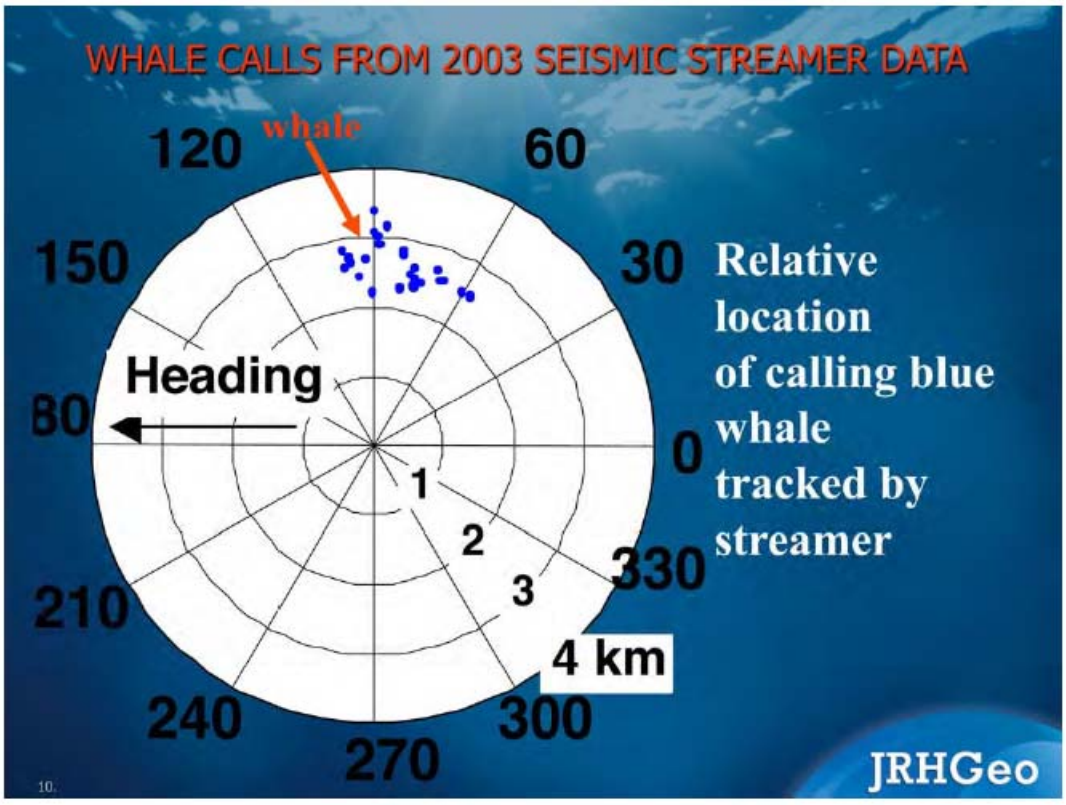
c. When the soft start recommenced as a result of whales being more than 6km away from the source (i.e. beyond the tail of the 6km streamer), it's interesting to note that it foraged in the general direction of the source.

It is also useful to consider these observations and the analysis of acoustic data from the 2003 survey (conducted in this same area as the proposed Bight survey) as support for the behavioural sound threshold level proposed later in this section.

As outlined for the above MSS, during the aerial survey in which the behaviour of blue whales was being closely monitored, it was noted that a blue whale continued feeding on small krill swarms off the shelf edge while the operating seismic vessel approached. The whale showed no behavioural response right up to the time the observers in the aircraft instructed the vessel to stop recording when it was realized that the whale was within the nominated 3km power-down zone.

The distance between the source and the whale at this point was between 2 and 3km. Seismic records acquired during this survey were subsequently analysed by Curtin University Centre for Marine Science and Technology for whale calls and the following plot (refer **Figure 5-5**) produced which shows that blue whale calls can be detected on different sections of the 6km streamer and the resultant detections triangulated to provide an estimate of the distance from the source.

Figure 5-5: Whale Calls as a function of Distance from Source (Morrice et al, 2004)




This demonstrates that the distance (or sound) "threshold of concern" whereby behavioural impacts are observed is similar to the conservative 160dB re 1μPa$^2$.s SEL identified in EPBC Act Policy Statement 2.1 for "physiological impacts".

An important international study is being conducted over a period of four seasons (2010, 2011, 2013 and 2014) in Australian Waters is the "Behavioural Responses of Australian Humpback Whales to Seismic Surveys (BRAHSS)" as described in EPBC Referral 2013/6927.

Within the approval criteria for that research project, the SEL thresholds (which are based on the potential for inducing TTS) include the requirements that "no individual whale is to receive a cumulative dose of 183 dB re 1 $\mu Pa^2$.s or greater" and "for a single airgun shot, (the sound exposure level) is no greater than 170 dB re 1 $\mu Pa^2$.s". These thresholds are based on very close monitoring of potential humpback whale reactions by researchers from Curtin University, Sydney University and the University of Queensland, however demonstrates that the adopted criteria within EPBC Policy 2.1 is conservative.

Additionally, it must be noted that:

- Blue whales are exposed to other natural sounds such as breaching or vocalisations that are similar in intensity to seismic sounds. The source level of breaching whales has been measured at 200dB re 1uPa and vocalisations of true blue whales in Antarctic waters have been measured at a mean source level of 189 dB re $1uPa_{rms}$ @1m. These measurements and observations indicate that blue whales are often exposed to natural sound levels greater than 160dB re 1 $\mu Pa^2$.s; and
- A commercial shipping lane runs right through EPP-41/EPP-42 and the potential blue whale feeding grounds (refer **Figure 3-17**). Vessels such as tankers, container ships and even cruise liners are known to emit sounds up to 200dB re 1uPa at the hull and travel at speeds significantly greater than a seismic vessel. No mitigation measures are currently applicable to commercial shipping passing through the area and the risk to blue whales, both physically and acoustically, from commercial shipping are considered to be substantial. Despite this, unlike offshore California where it is estimated 6 blue whales per year perish as a result of vessel collisions, Bight understand no reports of incidents with blue whales have been reported in this area. Given the context of the EPP-41/EPP-42 environment, Bight considers the 160dB re 1 $\mu Pa^2$.s is considered an acceptable sound threshold for behavioural disturbance to blue (baleen) whales.

Based on observations of blue whale presence in the vicinity of seismic surveys in Australian waters and the 'conservative' thresholds used to define power-down distances in EPBC Act Policy Statement 2.1; and the environmental context to EPP-41/EPP-42, Bight considers the adoption of a SEL of 160 dB re 1 $\mu Pa^2$.s as the appropriate sound threshold for behavioural disturbance threshold to blue whales if present and if feeding in the area.

*Odontocetes* (i.e. toothed cetaceans such as sperm whales, killer whales and dolphins) produce echo clicks that have the highest source levels of any recorded marine mammal sound ranging from 220-230dBA at 1µPa@1m at frequencies up to 30kHz (APPEA, 2006). Mohl (2004; cited in ICES, 2005) identified that Sperm Whale clicks bear some resemblance to sonar (i.e. 235 dB re 1µPa [or 196 dB re 1$\mu Pa^2$.s]) in the frequency range 5-20 kHz although Sperm whales emit a very narrow beam of energy compared with the wide radiation pattern of sonars (ICES, 2005).

The majority of toothed whales have their highest hearing sensitivity to sound in the ultrasonic range (>20,000Hz) although most have a moderate sensitivity from 1000-20,000Hz (APPEA, 2006). Southall et al (2007) categorised the Dusky Dolphin, and the Killer and Sperm Whale's hearing in a 'mid-frequency cetacean' grouping with an auditory bandwidth of 150Hz to 160kHz. In general, the larger species seem to have an upper limit of hearing around 100 kHz (e.g. killer whale) and smaller species have higher upper limits of hearing around 150 kHz (e.g. bottlenose dolphin) (ICES, 2005).

Stone (2003), in a review of the effects of seismic on marine mammals in UK waters during the period 1998-2000, identified for surveys with large airgun arrays, small odontocetes (dolphins and porpoises) had the strongest avoidance response to low frequency sound. **Figure 5-6** provides a comparison of small toothed whales and medium/ large cetaceans sightings within specified distance of acoustic sources (operational and non-operational) (Stone, 2003). While the sighting data of small toothed whales occurring within a given range reduced, on a statistically significant basis during periods of seismic acquisition, it

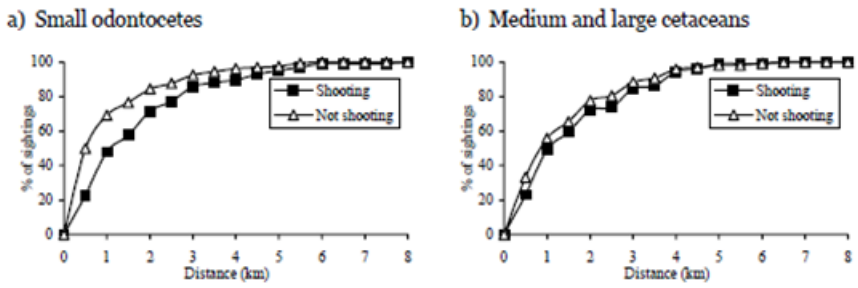
should be noted that 40% of small toothed whales are still sighted within 1km of the acoustic source. .

Several species were seen less often during periods of seismic acquisition, remaining further from the air-guns and showing altered behaviour (e.g. less bow-riding, orienting away from vessel, faster swimming). Stone also identified in the same study that Killer Whales also showed some localised avoidance to seismic surveys.

Key observations that can be made from the study are as follows:

- The key difference is responses to the status of the source array are seen within 2-3km;
- The differences relative to source status are insignificant beyond 2-3km;
- Although Stone stated that "*small odontocetes (dolphins and porpoises) had the strongest avoidance response to seismic activity*" it would appear that avoidance behaviour when the source is active is similar as that for medium and large cetaceans.

Figure 5-6: Marine Mammal Sightings within Specified Distances from Acoustic Sources (Operational and non-operation) (Stone, 2003)




Studies undertaken on the Sperm Whale's behaviour during seismic activity have produced varying results:

- Stone (2003) identified that while sperm whales were a frequently observed species during the surveys, the species did not show any observable effects from seismic operations;
- Jochens et al (2008) found no horizontal avoidance of Sperm Whales to MSS activity, however a decrease in foraging activity during full array acquisition was more than likely for a small number of Sperm Whales studied; and
- Southall et al (2007) reviewed behavioural observations of mammals by 'hearing group' and did not find, for the Sperm Whale, a clear tendency for an increased probability of behavioural response with increasing sound levels. Under certain conditions (multiple acoustic pulses at relatively low received levels) the sound temporarily silenced individual vocal behaviour, while in other cases (received levels of 120-180dB re 1µPa) acoustic sound failed to elicit reactions from a significant percentage of individuals

Beaked whales are also known to be sensitive to high-energy, **mid-frequency** (*not used in this survey*) military sonars (i.e. ping energy 221-235 dB re 1µPa$^2$.s between 2.6 to 8.2 kHz of long duration ~1 second) (ICES, 2005). Mass strandings of beaked whales are thought to be related to the use of this equipment in areas where there was the presence of a shelf-break very close to the coast and there was a documented presence of a beaked whale foraging in this deep water habitat (ICES, 2005).

*Cetacean Presence:* The Lightning MSS, undertaken in the period 1 March to 30 May, will avoid peak periods where the whales may be present in the MSS area (refer to **Section 3.3.4**).

*Cetacean Impact Control Measures*: The Lightning MSS will adopt the following controls to ensure that impacts to whales are not significant. These are measures which reflect the requirements of the EPBC Policy Guidelines 2.1 (Pat A and Part B):

- Prior to the commencement of the Lightning MSS[65], Bight will engage a spotter aircraft to undertake a once-off aerial survey to determine the presence of whale species (predominantly Blue Whales, Sperm Whales, Southern Right Whales and SBT pontoon towing) in the MSS area three (3) days ahead of the vessel and support vessels arriving in the survey area. This will efficiently assist in determining adaptive management measures and if required choose an optimum part of the survey to commence recording. If it is not possible to conduct aerial surveys during this 3-day period, the MSS support vessels will be utilised to conduct on water surveys in the area that the survey is due to commence.

  The aerial survey control measure is only to inform the vessel prior to start-up about any cetacean/SBT presence in the survey area for potential adaptive management to be considered. There are a number of possible scenarios that will be considered in terms of where the vessel will commence recording:

  - If blue whales are feeding or tuna pontoons are being towed (in the northern race-track) the vessel will start recording in the southern racetrack;
  - If Sperm whales are feeding in the Southern racetrack and there are no blue whales feeding or tuna pontoons being towed in the northern racetrack, the survey will commence in the northern racetrack;
  - In the very unlikely event that all three events occur (blue and sperm whale feeding and tuna pontoons being towed), the seismic vessel will commence recording in the least sensitive area but shutdown protocols as per controls outlined in this EP will be implemented.

  Once the vessel and support vessel are in the survey area, Marine Mammal Observers (MMOs) will maintain observation activities from the MSS and support vessels.

- Throughout the MSS, standard management controls detailed in the *EPBC Act Policy Statement 2.1* (Part A), adopting a 2km low power zone and a 500m shutdown zone with the addition of four MMOs (refer below) to monitor for the presence of whale species will be adopted. As a diversity of whales may be encountered during the MSS, the EPBC Policy 2.1 (Part A) Procedures will apply to:

  - All Baleen Whales;
  - Sperm Whale, Killer Whale, Pilot Whale and False Killer Whales; and
  - All Beaked Whale species.

  These procedures will not be applied to dolphins or porpoises (DEWHA, 2008).

- Low Visibility/Night Operations: Additional measures, providing for "adaptive management" contained within the *EPBC Act Policy Statement 2.1* (Part B) will be adopted for the survey as follows. If whales are encountered in the area, prior to night operations the area ahead of the seismic vessel will be inspected by a scout vessel. If whales are sighted by the scout vessel then the seismic vessel will operate in an alternate area away from where the whales are detected. Except for species detectable during the hours of darkness by passive acoustic monitoring (PAM) such as Sperm Whales, Beaked Whales and Pilot Whales, if 3 or more power-downs due to whales entering the 2km power-down zone occurs in a 24hr period then no night-time recording will continue until a full day's operation has elapsed without power-downs due to whale sightings. Specific measures include:

[65] While the seismic vessel is deploying its trailing equipment in deeper water to the south.

- *Sperm Whales, Beaked, Pilot and Killer Whales*: Use of PAM which can detect whale vocalisations/presence during night-time and periods of poor visibility;
- *Blue and Southern Right Whales*: These whales are visually detected and may be seen from the survey vessel. Four MMOs are proposed to observe from the available vessels. Two MMOs will be located on the seismic vessel and one MMO on each of the support vessels. During all daylight hours when whales are known to be in the area of the operations (i.e. as a result of aerial surveys, vessel surveys or previous sightings), a scout vessel will scout the area 5-10km ahead (30-60minutes) of the MSS vessel to assist with managing behavioural impacts to the species. However in addition, when whales are known to be in the vicinity, during the 4 hours prior to darkness, the scout vessel will scout the area that is scheduled to be traversed by the operating MSS vessel during the night and, if whales are present in the area, the vessel will record on the least sensitive part of the survey area.

- All personnel on-board the vessel will be made aware of these arrangements via an environmental induction prior to mobilisation;
- The Vessel Master, Party Manager and MMOs will be responsible for ensuring that the requirements of the guidelines are followed. Detailed reports of all cetacean sightings will be recorded using the DOE Cetacean Sightings Application (database) (http://data.aad.gov.au/aadc/ammc/index.cfm). A copy of the sighting forms are to be submitted to the Bight Project Manager after completion of the survey.

With the adoption of these controls which prevent whales from being exposed to high sound levels, no physiological impacts to whale species are expected. With adopted controls associated with the escort vessel scouting ahead of operations on a 5-10km basis to identify the presence of whales and provide information on adaptive measurement strategies, behavioural impacts (i.e. area avoidance) are not expected.

**Turtles:** Electro-physical studies have indicated a hearing range for marine turtles between 100–700 Hz (McCauley, 1994) with best hearing between 250-700Hz (LGL, 2003). Studies indicate that turtles may begin to show behavioural responses (i.e. increase in swimming behaviour) to an approaching seismic array at received sound levels of approximately 166dB re 1µPa (rms), and avoidance at around 175dB re 1µPa (rms) (McCauley et al., 2003). From measurements of a vessel operating a typical airgun array (2678in$^3$, 12 elements) in 100-120m of water, sound levels would create behavioural changes at approximately 2km and avoidance at 1km (LGL, 2003).

Little is known about the source levels and associated frequencies that will cause physical injury to turtles. Data addressing Temporary Threshold Shifts (TTS) in turtle hearing (Moein et al, 1994; cited in LGL, 2003) concluded that TTS in turtles was observed upon exposure of turtles to moderately strong airgun pulses. The report did not state the size of the airgun used or the received sound levels at various distances but did indicate that the turtles were confined and unable to move more than about 65m away. It should also be noted that testing was undertaken on a very small population size. Given the observed behavioural responses, in circumstances where seismic arrays are already operating or commencing start-up (soft-starts), it is expected that affected turtles would undertake avoidance measures before entering ranges that caused 'physical damage' to hearing.

With the adoption of controls which prevent whales from being exposed to high sound levels, it is expected that impacts to turtle species are also expected to be behavioural only.

**Pinnipeds:** A study undertaken by SCAR (2002) identified that Phocid Seals (e.g. gray seals) have a hearing range between 1kHz-50kHz with sensitivity dropping above 50kHz. Otariid Seals (fur seals and sea lions) have a lower hearing sensitivity than Phocid Seals below 1kHz; and similar hearing between 1kHz and 36-40kHz (their high frequency cut-off). Additional studies undertaken by Kastak & Schusterman (1998) identified for Californian Sea Lions, relatively poor underwater hearing at frequencies below 1000Hz (i.e. sound thresholds required were greater than 100dB re 1µPa). Southall et al (2007) has estimated

that the functional hearing of pinnipeds (general classification) under water is between 75Hz and 75kHz.

Sound exposures that elicit TTS in pinnipeds under water have been measured for Harbour Seals, Californian Sea Lions and Northern Elephant Seals. Kastak et al (2005; cited in Southall et al, 2007) identified that, under test conditions, TTS occurred in Harbour Seals at 183dB re 1μPa$^2$.s, in Sea Lions at 206dB re 1μPa$^2$.s and the Northern Elephant Seal at 204dB re 1μPa$^2$.s. All animals showed full recovery in 24hours. Finneran et al (2003: cited in Southall et al, 2007) identified that there was no measurable TTS following exposure of two Californian Sea Lions to sound levels of 183dB re 1μPa or 163dB re 1μPa$^2$.s, however the two test animals showed avoidance responses at these levels. Southall et al (2007) has estimated that SEL thresholds of 186dB re 1μPa$^2$.s (or 218dB re 1μPa (peak)) may induce PTS in harbour seals. Note that this threshold is based on cetacean TTS-onset data and relativities between species TTS-onset thresholds. The threshold for onset of mild TTS for a Harbour Seal has been estimated at a SEL of 171dB re 1μPa$^2$.s (Southall et al, 2007; cited in LGL, 2009) and it is expected that TTS onset would occur at appreciably higher received levels in Californian Sea Lions than in Harbour Seals (Kastak et al, 2005; cited in LGL, 2009). Sound modelling results showed that sound levels of 186dB re 1μPa$^2$.s lie within 300m of the source and 171dB re 1μPa$^2$.s within 1km of the source (CMST, 2012).

The shortest distance from the MSS boundary to the SA coastline is 64km. Given the observed attenuation of the seismic signal (CMST, 2012) at the coastline this sound level is estimated at less than 115dB re 1 μPa$^2$s. At the *southern edge of the female Sea Lion foraging area* south of the Eyre Peninsula residual acoustic sound levels are estimated at 145dB re 1μPa$^2$.s (~175dB re 1μPa)[66]. It should be noted that these modelled exposures will only occur on the closest seismic line to shore. Additionally, the environmental context of the continental shelf area includes a major shipping lane which passes through the Lightning MSS area is closer to pinniped colonies located at Liguanea and Neptune Islands than the Lightning survey activity (refer **Figure 3-13**). The shipping lane carries traffic such as container ships, oil tankers and cruise liners which emit a low frequency sound level of at least 180-190dB re 1μPa (at hull)(Simmonds et al, 2004). Sound levels from third party vessels (which frequently use ports in the gulf areas) create higher sound levels within these foraging grounds and are expected to predominate over the predicted residual sound levels from survey activities.

Few studies have been published with respect to the reactions of pinnipeds to seismic activity however the species has been observed during a number of seismic monitoring studies. Some pinnipeds show avoidance reactions to airguns, but their avoidance reactions are generally not as strong or consistent as those of cetaceans (LGL, 2009). Studies (Harris et al, 2001) undertaken on the behaviour of seals during a near-shore seismic program in Alaska observed that approximately 79% of seal sightings occurred within 250m of the seismic vessel. There was partial avoidance of the zone at less than 150m from the vessel during full array seismic, but seals did not move much beyond 250m.

Studies undertaken on Sea Lion behavioural response to mid-frequency (3.2-3.5kHz) sonar provides some guidance on the dose-response relationship for behavioural change in the species (Houser et al, 2013). Sea Lion hearing is best within the range 1kHz to 50kHz and hence this study provides guidance on behavioural responses within the species within its dominant hearing frequency range. It is to be emphasised that seismic sources are low frequency (<1kHz with the predominant frequency less than 200Hz) and larger sound thresholds (dB) would be expected in the 'poorer hearing range frequencies' to illicit the same response if the response occurs at all.

Houser et al (2013) identified a dose-response relationship for Sea Lions at sound pressure levels (SPLs) of 125, 140, 155, 170 and 185 dB re 1μPa by observing the following

[66] Note this is applicable to the small portion of survey activities which will be undertaken on the continental shelf. For the survey activities undertaken in the deeper areas on the continental slope sound levels will be less than 85db re 1μPa$^2$.s in foraging areas.

behaviours - change is respiration, prolonged submergence, refusal to participate in the trial, haul-out and no response. **Table 5-7** provides details of the responses for adult Sea Lions as a function of SPL exposure.

Table 5-7: Percentage of contributing responses according to SPL exposure in Adult Californian Sea Lions (Houser et al, 2013)

| Received SPL (dB re 1µPa) | Change in Respiration | Prolonged Submergence | Refusal to participate in the Trail | Haul-out | No Response |
|---|---|---|---|---|---|
| 125 | 30.0 | 0 | 0 | 0 | 70.0 |
| 140 | 0 | 0 | 6.7 | 0 | 93.3 |
| 155 | 35.0 | 0 | 0 | 0 | 65.0 |
| 170 | 5.0 | 15.0 | 75.0 | 5.0 | 0 |
| 185 | 6.7 | 0 | 56.7 | 16.7 | 20 |

Houser et al (2013) identified that there was a large amount of variability in the normal behaviours of the Sea Lion. The study identified that a change in respiration indicated the perception of the acoustic signal, but in the absence of other responses, the behaviour suggested that perceived signal is neither immanently threatening nor intolerable. Equally, a refusal to participate, given the reward was food, suggested that the acoustic signal was sufficiently threatening or harassing that the Sea Lions were willing to forgo a food reward in order to avoid the signal. From these observed results, a received SPL of 170dB was observed to be a threshold whereby adult Sea Lions start to experience behavioural responses. On this basis, residual acoustic sound produced during shelf acquisition of data during the Lightning survey (38% of survey period)[67] may result in avoidance of male Sea Lions to a distance of approximately 10km around the acoustic source. Small (i.e. very localised) levels of avoidance behaviour may be observed in female Sea Lion foraging behaviour at *the southern boundary of the identified female foraging grounds*[68]. Sound levels closer to shore from Lightning MSS activities (during data acquisition on the shelf) diminish to 115dB re 1µPa$^2$.s (~145dB re 1µPa) which should not elicit behaviour changes in adult Sea Lions. Again it is emphasised that these stated thresholds for behavioural change are based upon mid-frequency sound impacts which are within the normal hearing range for pinnipeds. Thresholds for low frequencies would be expected to be larger in magnitude.

It is also to be noted that sound from commercial shipping will predominate through the area and is expected to be more of a behavioural deterrent to foraging activity, particularly in the female foraging grounds in the region, than the residual sound impacts from the proposed MSS activity.

While Sea Lions and New Zealand Fur Seals may be encountered during the MSS; given the species poor hearing below 1000Hz; the high SELs that may induce TTS in hearing; and the observed avoidance characteristics in proximity to sound sources at 170dB re 1µPa in the mid-frequency range; the proposed MSS activities may result in localised, temporary (behavioural) avoidance by male Sea Lions or New Zealand Fur Seals (Pidcock et al, 2003) when the survey is acquiring data on the shelf areas.

Additionally, as adjacent coastal regions which support breeding pinniped populations falls below the 170dB re 1µPa, the threshold for possible behavioural changes, no impacts to breeding behaviour is expected.

**Sharks:** Limited research has been conducted on shark responses to MSSs. Sharks are known to be highly sensitive to low frequency sounds between 40-800Hz sensed solely

[67] This does not consider the sound contribution above this level which would be emanating from shipping activities.
[68] Foraging ground for lactating females adjacent to the survey area on the shelf is rated medium and not high which also ameliorates the impacts to the species.

through the particle-motion component[69] of an acoustic field. Free ranging sharks are attracted to sounds possessing specific characteristics – irregular pulse, broadband frequency and transmitted with a sudden increase in intensity (i.e. resembling struggling prey). Studies have also observed that sharks can withdraw immediately if sound intensity suddenly increases by 20dB re 1µPa (10 times) or more above the previous transmission (Myberg, 2001).

Trauma from acoustic sources to marine species appears dependent of the presence of a swim bladder, a gas filled chamber which assists with buoyancy or as an aid in hearing. Because of the disparity of acoustic impedance between water and gas filled chambers, vibrations in water may induce trauma in species with swim bladders. Many adult fish do not possess a swim-bladder and so are not susceptible to this trauma. This includes Elasmobranchs (sharks and rays), many pelagic fish (e.g. Mackerel/Tuna species), flatfishes and lizardfish (McCauley, 1994). It must also be mentioned that fish attacks on seismic streamers from large pelagic species is not uncommon as evidenced by damaged hydrophone streamers (shark-bites) (Colwell & Coffin, 1987; cited in McCauley 1994).

Given the wide-ranging habitat of most shark species present in the MSS area; the lack of an air-bladder; their known avoidance response to sudden sound increases; and given the sound characteristics of seismic activity (regular, not sudden); it is possible the impact to shark species is, at most, very localised avoidance of the MSS activity (i.e. negligible consequence) . Given the open ocean environment of the MSS, free-ranging sharks are not expected to be significantly impacted as they transit through the region to feeding grounds.

For species which are not wide-ranging but inhabit certain depth ranges (i.e. Gulper Shark) with the presence of sensitive habitat adjacent to the acquisition area impacts based upon reported shark behaviour is expected to be negligible with received SELs less than 140dB re 1µPa$^2$.s. The survey area overlaps the eastern buffer area of the closure area by approximately 7nm. In the very unlikely event that some displacement of the species occurs to the west along the continental slope as a result of survey activities significant closure area remains to the west (~50nm) to protect the species.

**Fish:** McCauley (1994) identified that the following anatomical features were important in determining the level of acoustic sound impacts on fish:

- Fish with a swim-bladder[70] 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.

Hence larger benthic fish such as emperors, sea bream, snappers and perch should be more at risk than pelagic fish such as mackerels and some tuna species which do not have a swim-bladder; or smaller reef fish that lack swim-bladder to ear linking.

Most fish can hear in the frequency range 100-1000Hz but there is significance variance according to species outside that range (McCauley, 1994). Within this range, minimum hearing thresholds vary widely, with the hearing specialists having best sensitivity as low as 50dB re 1µPa, and non-hearing specialists having best sensitivities as high as 110dB re 1µPa (McCauley, 1994).

Lethal effects from acoustic sources have been shown to occur for some plankton at close range to an operational acoustic source (<10m distance) and fish eggs (~5m) however, mortality to adult fish and invertebrates directly exposed to acoustic sources has not been

[69] This is most dominant in the near-field of the survey in close proximity to the acoustic source.
[70] A critical parameter in determining sensitivity to acoustic noise is the presence of a swim-bladder which occurs in some species of teleost or bony fish. The swim-bladder acts as a buoyancy aid and is also sensitive to the pressure component of a sound wave, resonating as a signal that stimulates fish hearing (Hawkins, 1993). Because of the disparity of acoustic impedance between water and gas filled chambers, vibrations in water may be severe enough to physically damage, stun or disorient fish with a swim bladder.

observed (McCauley, 1994). Woodside (APPEA, 2009) studies undertaken at Scott Reef on tropical reef fish during MSS activities support this identifying the following:

- No lethal or sub-lethal effects on fish were experienced. Behavioural responses were observed at close range with general movement from the water column to the seabed, however normal feeding behaviour returned within 20 minutes of the MSS vessel passing and when the vessel was beyond a distance of 1.5km (Woodside, 2012a);
- Fish exposed to acoustic pulses shown no structural abnormalities, tissue trauma or lesions, or auditory threshold changes (highest exposure level 190dB re 1μPa$^2$.s). However, a small number of damaged hair cells (less than 1% of fish hearing capacity) were observed in fish exposed to acoustic sound (Woodside 2012b); and
- No significant decreases in the diversity and abundance of fish after the MSS were detected compared with the long term temporal trend before the MSS (Woodside, 2012c).

As reef fish are considered 'site –attached', there is reluctance for the species to move away from their specific habitat and hence physiological impacts are expected to be greater than for pelagic fish (non-site attached).

It has been observed that acoustic sound can lead to behavioural responses in fish however the nature and extent of the response varies and depends on a range of parameters including the species involved, propagation and aspect of the array. McCauley (1994) applying the behavioural observations of benthic fish to sound observed by Pearson et al (1992), in a simple spherical spreading model, indicated for an array (source level 250dB re 1μPa-m) approximate distances at which behavioural changes in fish would be observed include:

- A startled response (at ~200-205dB re 1μPa) occurs approximately 178-316m directly beneath the array. At this point most fish flee the sound of the array (i.e. sudden flexions of the body followed by rapid swimming or a series of shudders with each air gun discharge);
- An alarm response (at ~180dB re 1μPa) occurs at a much greater distance 630-2000m. This includes increased general activity and changes in schooling of the species; and
- A subtle behavioural response (at ~160dB re 1μPa) at a distance of 2.1-12km.

The impacts of these behavioural changes in fish have been reported to lead to smaller commercial fishery catches. Catch studies undertaken on redfish species (Malme et al, 1986; Pearson et al, 1987; Skalski et al, 1992; all cited in DNV, 2007) identified reduced catches after MSS activity resulting from fish increasing their depth range and being drawn into seabed structures. On this basis, it was observed that fish with an affinity for the seabed appear less likely to disperse compared with pelagic fish species located in less unique bank areas. Other studies (Lokkeborg, 1991; Engas et al, 1996; cited in DNV, 2007) also identified decreased catches within, and adjacent to, the immediate seismic area that lasted for at least five days after seismic acquisition ceased. Following release of the daily catch results for peer review approximately 18 years after the original study was carried out there has been some question as to the interpretation of data from this study (Hughes, 2011).

Further studies undertaken on MSS impacts to fish 'catch' identified:

- For a study of fish catch in the vicinity of a MSS conducted in Norway results were contradictory. Gillnet catches of Greenland halibut and redfish increased during, and remained higher after the MSS; however longline catches decreased. It was also observed that gillnet catches of saithe decreased (but not on a statistical basis) (Lokkeborg et al, 2010; cited in Boertmann et al, 2010); and
- Review of catch statistics in Norway in 2008 (Vold et al, 2009; cited in Boertmann et al, 2010) identified that catch rates of Atlantic cod, ling, tusk and Atlantic halibut did not change significantly. Catch rates of redfish and monkfish appeared to increase; gillnet catches of saithe and haddock decreased and catches with other fishing equipment were not affected.

The Lightning MSS area is located close to the edge of the continental shelf and over the continental slope. Review of commercial fishing species which are present in the area identifies that fish which spawn over the March-May period on the mid-outer continental shelf include the Australian Sardine (mid continental shelf area, serial spawners on a weekly basis between January and March, larvae predominantly present in inshore waters) and Pink Snapper (water depths less than 50m, serial spawners between late October and early March) (refer **Section 3.4.3**). As previously identified, lethal effects from acoustic sources have been shown to occur for some plankton at close range to an operational acoustic source (<10m distance) and fish eggs (~5m) (McCauley 1994). Given the location of the Lightning MSS area relative to the recognised spawning areas for fish species, acoustic sources will be distant from these known areas with negligible impacts expected.

Fisheries and Oceans Canada (2004) reviewed scientific information available on the impacts of MSS on fish and concluded that the ecological significance on fish is expected to be low, except where there may be a dispersion of spawning aggregations or deflections in migration paths, however, the magnitude of effects will be dependent on the biology of the species and the extent of the dispersion or deflection. This is also reflected by McCauley (1994) who indicates that the nature and extent of behavioural changes in fish species will vary according to the species involved with evidence indicating that for some fish species seismic is no more than a nuisance factor (McCauley, 1994). On this basis, the impact of acoustic sound on fish stock is considered as localised and transitory with the impact to, and displacement of, fish insignificant at a population level (NOO, 2001).

**Crustaceans:** Crustaceans, such as crabs and lobster, do not possess gas-filled cavities and hence are at lesser risk of physiological damage compared with marine mammals and fish with air bladders (Parry & Gason, 2006). Most field studies undertaken for MSS on marine populations have focussed on marine mammals and for this reason field studies relating to MSS impacts on invertebrates is scarce. During the 1960s, when explosive charges were used as a source for MSS, studies indicated that 25lb charges killed a variety of fish species, but when discharged 14m above rock lobster pots no discernible damage occurred to the rock lobsters (Anon, 1966; cited in Parry & Gason, 2006). This is consistent with other studies identifying the remarkable resistance of crustaceans to high force explosive events. Studies undertaken into the effects of thirty-three (33) MSSs on catch rates of Rock Lobsters (Parry & Gason, 2006) in western Victoria between 1978 and 2004 identified that there was no evidence indicating a decline in Rock Lobster catch rates for the period both on a long-term and short-term basis.

Limited research has been undertaken on the effects of marine seismic on marine invertebrate larvae. Available research for crustacean species includes:

- Pearson et al (1994) conducted experiments with air-guns on early life stages of Dungeness crabs (*Cancer magister*). From a seven air-gun array (acoustic sound levels of 231dB re 1µPa and capacity 13.8litres) Pearson exposed early stage II zoeal crab larvae to acoustic sound at 1m, 3m and 10m. The study was specifically designed so that exposures were at the high end realistically expected during a typical survey operation. No statistically significant differences were found in immediate survival rates, long-term survival rates or time to moult between the exposed and control larvae, even within 1m of the source. Post-hoc power calculations to statistically confirm the adequacy of the study sample and 'effect' size identified here was adequate replication to detect Type II errors or 'false negative' effects. *'Failure to detect effects in the experiment which had adequate power, replication, randomization, and blind trials indicates that any effects on survival and time to moult were small (e.g. <10% for survival, <1day for time to molt to Stage II)'* (Pearson et al, 1994)[71] (i.e. study results are robust);

[71] Interpretation of post-hoc power results by Parry and Gason (2006) interpreted these results to mean 'airguns were very unlikely to have caused more than a 7-12% reduction in survival of these crab larvae. Interpretation by Pearson et al (1994) is provided in the above assessment as it is considered more indicative of reason for the statistical analysis (i.e. robustness of test methodology and failure to detect effects) rather than providing a re-interpretation of statistical outcomes.

Pearson's findings while not providing a direct comparison with studies undertaken on survival of fish eggs from seismic sound suggests that the zoeal stage of the Dungeness crab may be more resistant to energy effects from air-guns than fish eggs and larvae.

- Christian et al (2004) undertook research of seismic impacts to snow crabs including observation developmental differences in fertilized eggs between control and test groups. Crabs were exposed at a distance of 2m from a single 40in$^3$ air-gun of 200 shots at 10 second intervals (received peak sound pressure levels of approximately 216dB re 1µPa). Twelve weeks after this exposure, the fertilized eggs showed a 1.6% higher mortality compared with the control group, and 25.7% fewer eggs had developed to the next developmental stage in the exposed group. It should be pointed out that these crabs were exposed at very close distances to the air-guns. Snow crabs (as per Rock Lobsters) in natural situations are not this close to a seismic array and these received levels because the eggs are held by the adult females beneath their tails on the seabed. *No impacts to lobster eggs are expected from the Lightning MSS due to the water depths (130-1000m) in the survey area*.

The MSS is therefore not expected to impact upon crustacean resources in the MSS area.

#### *5.5.1.2 Environmental Risk Assessment*

**Cetaceans:** Literature indicates that high acoustic sound levels (i.e. Sound levels above 230dB re 1µPa) might be expected to cause injury to cetaceans. Although these types of sound levels (and hence impacts) would only occur in close proximity to the seismic source they are considered a 'significant' consequence (Consequence 3) in accordance with the Bight Qualitative Risk Matrix.

The selected timing for the proposed MSS (1 March – 30 May):

- Avoids peak periods where migratory species (Humpback) may be present in the area;
- Has minor overlap with Southern Right Whale species with the first species observed in be arriving the area from mid-to-late May;
- Avoids observed 'high presence' periods (August-September) for the Sperm Whale; and
- Avoids the peak presence period for Blue Whales (December) although the species is recorded in the SW Marine Bioregional Plan as occurring in the area between November and May. Surveys undertaken to support survey timeframe selection has identified the species presence in the period March to May is low. It should be noted that 'upwelling conditions' which attract aggregations of Blue Whales is irregular (not as consistent as the Bonney upwelling). Additionally, the upwelling conditions are intermittent at Kangaroo Island (i.e. 2-4 instances lasting 3-10days per year if upwelling conditions are present). Wind roses for the area (refer **Figure 3-4**) indicate that favourable SE wind regimes may occur in March however the likelihood of these conditions occurring in April and May are low.

With control measures identified in the DEWHA Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales (2008) – Part A (Standard Management) and Part B (Adaptive Management) exposure of cetaceans to unacceptable sound levels (i.e. physiological or behavioural changes) is considered rare (very unlikely) and the residual environmental risk to the species is assessed as low.

**Turtles:** Little is known about the source levels and associated frequencies that will cause physical injury to turtles however avoidance behaviour has been observed at approximately 175dB re 1µPa (rms). For risk assessment purposed, it has been assumed that turtles may be at risk of physical damage if exposed to sudden levels of acoustic activity (i.e. in close proximity to an operating array starting up at full power). These types of impacts are considered a 'significant' consequence (Consequence 3) in accordance with the Bight Qualitative Risk Matrix.

The Lightning MSS area does not contain important biological habitat (i.e. feeding, resting & breeding) critical to the identified turtle species however, the species may transit through the area.

Control measures adopted in the DEWHA Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales (2008) with respect to soft starts procedures will allow turtles to relocate from the area before the potential for physical damage occurs. For continuous acoustic sound, turtles will practice avoidance. On this basis the likelihood of significant impacts to turtles is considered very unlikely and the residual risk to the species is assessed as low.

**Pinnipeds:** The following assessment is made with respect to physical damage, behavioural and breeding impacts/risks to pinniped species which may be present on a transitory basis in the Lightning MSS area during survey activities:

- Physical: Based upon available scientific literature, the threshold for mild TTS-onset for a harbour seal (i.e. TTS in hearing [Consequence 3]) is estimated at a received SEL of 171dB re 1μPa$^2$.s which is localised around the vessel within 1km of the acoustic array. The estimated TTS for Sea Lions is expected to be significantly higher based on observed PTS data. Given the controls adopted during survey activities for cetaceans (i.e. soft-starts) pinniped relocation is expected to occur prior to any physical damage occurring and hence TTS impact is expected to be very unlikely. The risk to pinnipeds associated with TTS impacts is therefore low.
- Behavioural/Foraging: Based upon available scientific literature for *mid-frequency* sources behavioural impacts would be expected at sound thresholds of approximately 175dB re 1μPa (or 145dB re 1μPa$^2$.s). According to **Figure 5-1**, this threshold is achieved within 10km of the acoustic array. Male Sea Lions, based upon the nominated behavioural impact thresholds, will displace approximately 10km around the acoustic source (localised impacts - Consequence 2)). Female Sea Lions foraging inshore of the Lightning MSS area may have some localised (negligible) displacement however major encroachment and impacts into this foraging area, based upon available modelling, is unlikely. *It should also be noted that these threshold sound levels are based upon mid-frequency sound which also offers a level of conservativeness to this analysis and does not consider the sound levels from shipping activities in the foraging area.*

  The area also provides foraging grounds for the New Zealand Fur Seal. These foraging grounds are extensive across the region with no known key foraging areas identified (SEWPC, 2012b). On the basis of behavioural change sound thresholds observed in the Sea Lion, it is expected that seals would also practice localised avoidance of the area around the acoustic source (Consequence 2). Given the areas for foraging within the region are extensive, it is unlikely that impacts to the species will be realised and the risk is considered to be low.
- Breeding: Sound levels at Sea Lion and seal colonies are unlikely to exceed 115dB re 1μPa$^2$.s (or ~145dB re 1μPa). These sound levels are below thresholds for behavioural change and therefore are not expected to have any impact on breeding success. Additionally for seals, breeding periods occur outside the MSS period (for New Zealand Fur Seals between November and January) and no impacts would be expected. On the basis of available scientific information breeding impacts (Consequence 3) to these species are considered very unlikely and the risk is assessed as low.

**Fish / Sharks:** McCauley (1994) reported that no lethal effects from seismic sources have been observed for adult fish, crustaceans or shellfish exposed to seismic arrays. Studies indicate that some fish may relocate from areas where unacceptable sound impacts are present creating temporary displacement of fish stock. Juvenile fish species (eggs & larvae) may also be impacted in close proximity to the acoustic source, however at a population level these impacts are not considered to be significant. On this basis, impacts to fish are considered short-term (for duration of seismic) and localised with temporary displacement of fish (i.e. 'minor' consequence) possible. The environmental risk to fish on a short-term basis is therefore considered to be medium and on a long-term basis is considered low.

*No impacts are expected to crustaceans.*

The EPO to be attained to prevent impacts to marine fauna from acoustic operations during the Lightning MSS; and a summary of performance standards relating to the adopted control measures is shown in the table below.

| Environmental Hazard/ Aspect | *Seismic Acquisition Acoustic Disturbance Impacts to Marine Fauna* | |
|---|---|---|
| Environmental Performance Outcome | *Soft-start procedures are utilised during all array start-up activities to provide time for sound-sensitive species to relocate from the area prior to acquisition activities.*<br>*Source power-down if whales are identified within 2km of the operating array and source shut-down occurs if within 500m of operating array.* | |
| Measurement Criteria | *MMO Master Sheet records indicate that these conditions are met for the duration of the survey.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Pre-mobilisation Aerial Survey | Three days prior to survey activity commencing (weather permitting) an aerial survey is undertaken to inform the location of MSS activities. | Bight and MMO records indicate that an aerial survey was undertaken 3 days prior (weather permitting) and information was used to determine MSS activities. |
| All field crew are inducted into the environmental sensitivities of the Lightning MSS Area including marine fauna interaction protocols | Induction will be provided for all crew members to ensure they are aware and familiar with the environmental sensitivities and activity hazards; controls to prevent significant impacts to marine fauna from MSS activities and their individual responsibilities throughout the campaign. | Record of the content of the induction program includes acoustic sound impacts and measures to minimise impacts to marine fauna. |
| | | Induction records indicate that all marine and seismic crews have participated. |
| Acoustic source size will be smallest required to achieve survey objectives for the Lightning MSS. | The acoustic source size to achieve data acquisition objectives for the Lightning MSS will be established and the selected source size will be the minimum to achieve the data acquisition objectives. | Records indicate that the Lightning acoustic source adopted for the MSS is the minimum size to achieve data objectives. |
| MSS Vessel procedures are available for acoustic source 'soft-start', 'power-down' and 'shut-down' activities. | MSS vessel procedures reflect *EPBC Policy 2.1 – Interaction between Offshore Seismic Exploration and Whales (2008)* requirements for soft-start, power-down and shut-down are available on-board the vessel for utilisation during MSS activities. | Pre-mobilisation audit records verify that Vessel Interaction Procedures available on-board the MSS vessel |
| | Procedures for minimising disturbance to marine fauna (soft-start, power-down and shutdown) including relevant distances for power-down/shut-down and low visibility conditions are followed at all times | MMO Master Data Sheet indicates that all procedures (i.e. soft-starts, power-downs & shutdowns) are observed and implemented for seismic acquisition periods appropriate to the cetaceans sighted |
| Visual observation will be undertaken for whales during daylight hours | Four qualified MMOs will be engaged for the survey to observe for whales. Two will be located on the MSS vessel, with one MMO on each of the scout/survey vessels during daylight hours while acquiring seismic data. | POB listing identifies two MMOs present on the MSS vessel, and one MMO on each of the support/scout vessels to undertake MMO observations. |
| | | Records (CV) that the MMOs are trained and competent to undertake MMO duties |
| | | MMO Master Data Sheet provides visual observation record for daylight hours |
| Adaptive Management Measures are implemented | Passive Acoustic Monitoring (PAM) (towed) will be utilised during the Lightning MSS to detect for **Sperm Whales, Killer Whales, Pilot Whales and Beaked Whales** during night-time or low visibility conditions. | MMO records indicate that PAM is operational during night-time or periods of low visibility.<br>Records show power-down if whales are within 2km of the operating sources. |

| | | |
|---|---|---|
| Environmental Hazard/ Aspect | *Seismic Acquisition Acoustic Disturbance Impacts to Marine Fauna* | |
| Environmental Performance Outcome | *Soft-start procedures are utilised during all array start-up activities to provide time for sound-sensitive species to relocate from the area prior to acquisition activities.*<br>*Source power-down if whales are identified within 2km of the operating array and source shut-down occurs if within 500m of operating array.* | |
| Measurement Criteria | *MMO Master Sheet records indicate that these conditions are met for the duration of the survey.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| | For Blue and Southern Right Whales, support/scout vessel 'scouting' is undertaken if whales are known to be in the area. This includes:<br>• A scout vessel scanning the area 5-10km ahead (30-60minutes) of the MSS vessel; and<br>• Four hours prior to darkness, one scout vessel surveys the area to be traversed by the MSS vessel during the night and if whales are present the vessel will record in an alternative area of the survey. | MMO records verify that when Blue and Southern Right Whales are known to be in the area, these measures are adopted. |
| Acoustic source is powered down to the lowest practicable setting on line turns while not acquiring seismic data | Acoustic source is powered down to the lowest practicable setting on line turns while not acquiring seismic data in accordance with *EPBC Policy 2.1 – Interaction between Offshore Seismic Exploration and Whales (2008)* | MMO Master Data Sheet indicates that the acoustic source is powered down to the lowest extent during line turns. |

### 5.5.1.3 *Acceptability and ALARP Demonstration*

An evaluation of impacts and risks to marine fauna from acoustic operations, against acceptability criteria detailed in **Section 5.1.2,** is provided below. On the basis of this information, both residual impact and risk associated with the hazard is considered acceptable.

| *Acceptability Demonstration* | |
|---|---|
| Meeting Bight Petroleum HSE Policy Objectives: | This risk management strategy for preventing marine fauna impacts from acoustic operations reflects Bight's HSE Policy goals of proactively identifying hazards, eliminating risks where possible and where this is not possible managing the risk to ALARP (addressing biodiversity issues). |
| Legal Compliance with: | *Environment Protection & Biodiversity Conservation Act 1999* |

| *Acceptability Demonstration* | |
|---|---|
| EPBC Protected Matters Assessment: | Noise pollution is identified as a 'pressure' of *potential concern*[72] within the SW Bioregional Plan the Kangaroo Island KEF (i.e. marine mega-fauna impacts); and for whale (Blue, Southern Right and Humpback), Sea Lion and SBT[73] species present within the region. 'Noise' in the context of the SW Bioregional Plan includes shipping, marine infrastructure construction and operation involving underwater blasting and pile driving, defence naval activities and seismic surveys. It should be also noted that the existing environment of the survey area includes a major shipping channel to ports located in the Gulf regions of South Australia. Many large ships transiting the area will carry sound signatures above ambient (i.e. no marine activity) sound conditions.<br>Biologically important areas present in proximity to the Lightning MSS area include:<br>• Blue Whale aggregation area located in the eastern GAB upwelling and Kangaroo Island canyons between November and May but peaking in December;<br>• Sperm Whales found in deep offshore waters which forage along the shelf-break of the eastern GAB and waters to the south of Kangaroo Island. The species is not seasonal but appears more frequent in August-September;<br>• Southern Right Whales calving along the coastline between May and November (MSS location is not in proximity to high density calving grounds but calving may occur at Sleaford Bay 85km north of the survey area);<br>• Foraging areas for the Australian Sea Lion (present all year).<br>The SW Marine Bioregional Plan (2012b) identifies for activities which have:<br>• The real chance of increasing noise above ambient levels in any biologically important area for the Blue and Southern Right Whale when the species is present a high risk of significant impact, except when the activity is undertaken in accordance with the EPBC Policy Statement 2.1 Part A, and where relevant, Part B, the risk of significant impact to the species is low. It should be noted that ambient sound at calving locations are not expected to increase as a result of survey activities (CMST, 2007). Additionally, with measures adopted from EPBC Policy 2.1 which adopt a 160dB re 1µPa2.s SEL as the behavioural disturbance threshold to Blue whales, no displacement from feeding grounds is expected if the species is present (& in the unlikely event of feeding events during March to May);<br>• For the Sperm Whale, if seismic activities are undertaken in accordance with EPBC Policy Statement 2.1, there is a low risk of significant impact to the species; and<br>• For Sea Lions, if seismic activities are undertaken beyond the continental shelf (depths>200m) there is a low risk of significant impact; and for activities which have a real chance of increasing ambient noise levels within female foraging areas to a level which might result in site avoidance or other physiological or behavioural responses there is a high risk of significant impact. With respect to ambient noise levels within the female foraging areas the following is provided:<br>o Sound attenuation across shelf areas from data acquisition occurring on the shelf[74] is expected to reach ~175dB re 1µPa (max) at the southern boundary of the female Sea Lion foraging area;<br>o Conservatively, studies have identified that behavioural changes are observed in Sea Lions at approximately 170dB re 1µPa (in mid-frequency sound ranges);<br>o A shipping channel intersects the Lighting survey area through the Sea Lion foraging area. Ambient noise levels within the foraging area will be significantly higher than attenuated seismic acoustics with the sound emitted at the hull of a tanker/container ship ~180-190dB re 1µPa. On this basis the seismic survey is not considered to significantly increase the ambient noise levels within the region.<br>Adoption of control measures in accordance with the *EPBC Policy Statement 2.1: Industry – Interaction between offshore seismic surveys and whales* (Part A and Part B) the SW Marine Bioregional Plan documents a low risk of significant impact to threatened or migratory species as defined by the Significant Impact Guidelines 1.1 (2013). With implemented controls it is expected that there will be no reduction in occupancy of a species of conservation value.<br>*With control measures implemented the action will not impact of items of National Environmental Significance (NES), it meets the requirements of the SW Marine Bioregional Plan and upholds IUCN Management Principles for Marine Reserves (Category VI) (ES, 2002) relevant to the West Eyre Marine Protected Area (MPA).* |

[72] 'Potential Concern' indicates the conservation value is vulnerable to the identified pressure but there is limited evidence of a substantial impact in the region; the pressure is widespread or likely to increase in the region; and there are no management measures in place to mitigate potential or future impacts, or there is inadequate or inconclusive evidence of the effectiveness of management measures.

| *Acceptability Demonstration* | |
|---|---|
| Social Acceptability: | Stakeholders have provided significant comment on preventing impacts to marine fauna associated with seismic operations[75]. This has included:<br>• Avoidance of the survey between November and May (particularly November-December) when Blue Whales are likely to be present in the area;<br>• Cetacean (& other biodiversity surveys) before, after and during surveys. This included suggestions of full baseline studies, 'independent' monitoring of 'at-sea' activities and critical habitats, continuous acoustic monitoring of critical habitats (pre-and post-seismic survey) and increased effort to monitor strandings during the activity;<br>• Enhanced mitigation measures (expanded observation and low-power zones; provision of additional MMOs (4); Blue Whale/krill aerial and vessel-based observations prior to and during the survey; restrictions on night-time/low visibility surveying or plans for 24hour detection, use of passive acoustic monitoring for detection of whales [particularly Sperm/Beaked Whales]);<br>• Use of the most sensitive and accurate seismic equipment to reduce noise levels required;<br>• Adoption of EPBC Policy Statement 2.1 – Interaction between offshore seismic exploration and whales (source reduction, geographical and seasonal restrictions, exclusion zones, visual surveillance and soft-start/ramp-up techniques); and<br>• Fishing compensation for demonstrated loss of catch (refer **Section 5.4.1**).<br>As these items are all assessed within the options analysis for practicality, with the practicable controls/options selected for inclusion into the EP, we believe the controls within this EP meet with stakeholder acceptance. |
| Risk/Impact are demonstrated to be ALARP: | As per demonstration assessment below, both residual impact and risk has been assessed as ALARP. |

A demonstration of ALARP with respect to residual impacts and risks associated with acoustic impacts to marine fauna with control measures adopted is provided below. On the basis of this demonstration, both residual impact and risk are considered ALARP when measured against the criteria.

| *ALARP Demonstration* | |
|---|---|
| Hierarchy of Controls: | **Elimination:** Survey area is not located in proximity to high density Southern Right Whale breeding areas and there is only minor overlap of the MSS activity in seasonal timeframe with species presence in the area (i.e. late May when low numbers of species are observed).<br>Survey activities undertaken off the shelf area (62% of the survey area) in deeper waters results in maximum residual sound levels in continental shelf areas of approximately 115dB @1µPa$^2$.s (or~145dB re 1µPa) which is expected to result in little-no avoidance behaviour by whales or sea lions.<br>Turtle presence within the area is expected to be transient and low in numbers (i.e. no biologically significant areas in proximity to the survey area).<br>Three (3) days prior to the survey, a once-off aerial survey will assess the survey area for the presence of whales and SBT pontoon presence. Adaptive management will be implemented based on the results of this survey to determine which survey 'racetrack' or least sensitive location should be adopted to avoid whale/SBT impacts. |

[73] Note SBT harvesting is expected to be complete at the time of survey commencement. Deep water acquisition is the preferred strategy, which will not affect SBT, if the SBT pontoons are still present on the shelf in March.
[74] no impacts are expected for seismic acquisition undertaken off the shelf in deeper waters
[75] Drilling exploration-related impacts are not included in the scope of this document.

| *ALARP Demonstration* | |
|---|---|
| Hierarchy of Controls (Con't): | **Prevention:** MSS activity avoids 'peak' seasonal timeframes[76] for Blue Whale presence (i.e. December) and Sperm Whale presence (August-September). Residual acoustic sound at the edge of the Female Sea Lion foraging area from seismic acquisition on shelf areas is expected to have very limited (negligible) behavioural impacts or increase in ambient sound levels.<br>Active watch on all vessels by MMOs during daylight hours for the presence of cetaceans to identify and prevent possible spatial impacts. Support/scout vessels (with MMOs) to scout ahead 5-10km (30-60mins prior to survey) to identify presence of Blue or Southern Right Whales to inform survey activities. Support/scout vessels (with MMOs) will also scout in the survey area to be traversed by the MSS vessel (during night-hours) at least four(4) hours prior to darkness to inform the survey on the least sensitive area of the survey for recording.<br>Soft-start procedures undertaken at the commencement of acoustic array operation to allow mobile marine fauna to move away from the source before the source reaches full power (displace). PAM will be adopted to assist in the detection of deep-diving species such as Beaked/Sperm Whales.<br>Source will be powered-down to the lowest practicable setting or shut-down on line-turns while not acquiring seismic data.<br>**Reduction:** Acoustic source selected such that it is the smallest source required to achieve the survey objectives. MMOs to implement shut-down and power-down procedures in the event of a whale entering, or being detected by PAM, in the shut-down (500m from source) or low-power zone (2km from source).<br>**Mitigation:** Marine fauna will avoid areas of high acoustic disturbance.<br>*No additional controls can be identified which reduce impacts or risks further (refer to options analysis).* |
| Compliance with Industry Standards and Codes: | *EPBC Policy Statement 2.1: Industry – Interaction between offshore seismic surveys and whales (Part A–Standard Management and Part B-Adaptive Management).* |
| Comparative Assessment of Options: | Limited exploration techniques are available to the oil and gas industry to identify hydrocarbon reservoirs (e.g. seismic survey, exploration drilling). Advances in seismic acquisition technology (e.g. directional acoustic propagation, solid streamer technology) have seen the reduction in environmental impacts from MSS activity. Alternate technologies such as marine controlled-source electromagnetic technology (CSEM), satellite imaging technology, etc. provide insufficient resolution for defining drilling prospects and are not a viable alternative to this activity.<br>The existing reprocessed and remapped 2D seismic, while identifying exploration targets requires 3D survey data to validate these locations. Without this data, the concept of increasing exploration drilling to identify oil and gas reservoirs on the basis of less accurate subsurface imaging is not a practical alternative to MSS because it is costly; and carries higher potential safety/environmental impacts and associated risks.<br>A 'do-nothing' approach (i.e. no survey) does not align with obligations contained in work-plans approved as part of the permit release with the Australian Government.<br>Survey design considered a number of parameters which reduce environmental impacts:<br>• Sound Source Size: An array of 5,880in$^3$ was used by GXT/ION (Referral 2009/4750) and a 4,130in$^3$ array by BP (Referral 2011/5969) for recent surveys in the GAB. To achieve the technical objectives of the survey a medium sized array (between 3000 and 3250in$^3$) is considered the smallest source size which can be considered. Accordingly this smallest source size has been selected for the survey.<br>• Streamer Configuration: The vessel will complete 'racetracks' over the survey area. Streamers numbering 8-10 are considered for this survey. Generally the more streamers utilised, the quicker the survey can be completed and lesser source points[77] are needed which reduce the environmental exposure.<br>• Area of Survey: The area of the survey covers the most prospective parts of the permits based on research and is significantly smaller than the total permit areas. It is considered the most targeted and efficient solution to acquire the necessary data.<br>• Length of Survey: Various timeframes have been considered for the survey from 45days to 70days. The proposed survey length of up to 70days is considered to be the shortest possible to achieve the survey objectives. The survey will be completed as quickly as possible subject to poor weather, whale encounter shutdowns, equipment downtime and potential fishing spatial conflicts. |

[76] Upwellling conditions, which support seasonal presence of Blue Whales, can occur between November and April (2-4 times per year over 3-10days) but only during upwelling favourable SE wind regimes. The upwelling appears confined to depths of less than 150m within 15km of the shelf-break.

[77] This is subject to weather, downtime and other factors.

| *ALARP Demonstration* | |
|---|---|
| Comparative Assessment of Options (Con't): | Survey Window: Various activity windows have been assessed with the original timeframe set between January-April. The selected window of time (March-May) considers the varying environmental sensitivities in the area such as Blue Whale peak presence[78] (November to December [peak feeding activities]); Southern Right Whale and Sperm Whale peak presence (June to October[79]); SBT 'peak' ranching (January to February) and a weather window which is suitable for the vessel to acquire data efficiently. On this basis the window March-May minimises the presence of environmental sensitivities while providing suitable weather conditions to achieve survey objectives.<br>Adoption of the requirements of *DEWHA Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales (2008) (Part A)*, together with survey specific "adaptive management" arrangements for Blue Whales, Southern Right Whales and Sperm Whales as provided for in *Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales (2008) (Part B)* for this activity, manages the interaction between seismic sources and cetaceans which might be present in the area. The *DEWHA Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales (2008)* is an accepted industry standard under the EPBC Act 1999 and is based upon very precautionary principles (i.e. physiological impacts to whales at 160dB re 1μPa$^2$.s). *With controls adopted no physiological or displacement impacts are expected*.<br>Bight has participated in pre-survey baseline studies during 2011/12 (November-March) to assess for the presence of Blue Whales, other cetaceans and other marine species in the area in preparation for Lightning MSS activities. Further baseline studies were also undertaken by IFAW (2013) to verify the presence of whales during the April-May period. A collective baseline dataset has been established which has been used for MSS planning and will be supplemented by observations made during the Lightning MSS. *No further baseline monitoring is considered warranted*.<br>The use of PAM for this survey has been assessed. Towed PAM has been used to detect whales that vocalise at high frequencies/intensities such as Sperm Whales during seismic surveys and can enhance the effectiveness of visual monitoring. PAM systems adopted during non-seismic surveys, can also assist in detection of long-period deep-diving species, which do not have a surface presence such as the Baleen Whales. Additionally, PAM has the advantage of potentially detecting cetaceans during night hours and periods of poor visibility when they cannot be visually detected.<br>While PAM can potentially be a valuable tool in identifying the presence of cetaceans, the following observations have been made with respect to the technology which may limit its effectiveness:<br>• PAM is only effective if the animal emits sound which can be detected by the system (Bingham et al, 2011). PAM relies on whales vocalising. Blue whales produce low frequency calls (~10Hz) which can be detected over large distances (~10s kilometres or more) whereas other species such as porpoises echolocate with ultrasonic clicks (105-150kHz). Some mammals vocalise at surface, others at depth. Some remain silent for long periods of time. Accordingly PAM works better with some species than others. Use of a PAM system can also create the assumption that no detected vocalisation means an absence of the mammal. For example, Sperm Whales during rest periods (>1hr) at the surface or just below the surface do not produce regular clicks, hence when the mammals are not involved in diving (clicking) there may be a problem with detection (Gannier et al, 2002). Also Sperm Whales do not vocalise when they are at surface with surfacing intervals typically less than 15minutes (Hastie et al, 2003). Additionally, female Sperm Whales and their young living in temperate waters have been observed to spend several hours a day resting or socialising and rarely producing clicks (Hastie et al, 2003). On this basis, the reliability of PAM has its limitations.<br>Call intensity also needs to be considered. Sperm Whales are known to make frequent and unique vocalisations between 0.1-30kHz (Simmonds et al, 2004) which can be detected (during non-seismic operations) at distances of several tens of kilometres (Barlow and Taylor, 2005; cited in Mellinger et al, 2007). Tonal calls for the Sperm Whale has been measured at instantaneous levels up to 223dB re 1μPa *rms*; are known to be highly directional (i.e. at least 35dB louder in some directions than others (Mohl et al, 2000); and are detectable at 10-16km under optimal conditions (Barlow and Taylor, 2005). As a comparison, it would be difficult for towed PAM to successfully pick up the vocalisations of Blue Whales due to the call length (~120s), frequency (12-40Hz) and the masking effect created by streamer 'tow' noise on the hydrophone. It is considered that PAM has been successfully used on species such as beaked whales in the absence of seismic operations (Yack et al, 2013). |

[78] A recent survey undertaken by the International Fund for Animal Welfare (IFAW) between 26th April and 8th May 2013 reported no encounters of Blue or Southern Right Whales in the proposed survey area. This corresponds with data from aerial surveys carried out in the survey region during March/April in previous years. Although Sperm Whales were acoustically and not visually detected, the majority of Sperm Whale acoustic detections were off shelf waters in depths greater than 500m.

| *ALARP Demonstration* | |
|---|---|
| Comparative Assessment of Options (Con't): | • PAM system limitations (OGP, 2004):<br>System selection focuses on the species present which requires monitoring (i.e. Sperm Whale). This will therefore fix detection frequencies and the species which may be detected. Species with similar communication characteristics to Sperm Whale include:<br>▪ Killer Whale with source levels of 206dB re 1µPa-m rms; frequency 12-80kHz with a focussed directionality;<br>▪ Beaked whales with a relative flat spectrum from 30-40kHz (sound emitted during foraging dive at between 26-80kHz with source levels from 124-132 dB re 1µPa) (Dunn et al, 2013). It is likely that due to the low sound intensity levels that the species may not be detected; and<br>▪ Pilot Whales: Long-finned Pilot Whales emit sound at frequencies between 1-8kHz and Short-finned Pilot Whales between 2-14kHz with source levels between approximately 160-180dB re 1µPa (Fish & Turl, 1976).<br>Bearing accuracy and particularly range is limited in towed systems and in many cases the accuracy of the PAM system is not as accurate or reliable as visual observation. For example, a study undertaken in Mexico (Barousse et al, 2012) identified that while visual sightings of whales on a MSS were made every 54.4hrs of visual monitoring hours, acoustic sightings were made every 144.5hrs.<br>A limited number of species are detectable, partly due to the vocalisation database. Operator interpretation is sometimes required to supplement auto-detection.<br>Detection range is dependent on background noise levels (i.e. sea state conditions [interference]; acoustic signals generated from the towing vessel [interference]; and surrounding bathymetry [transmission losses]).<br>On this basis, as part of a seismic operation PAM may be successful for the detection of odontocetes with similar communication frequencies/behavioural characteristics (deep, long-period divers) as long as they vocalise at relatively high intensity levels (i.e. Sperm Whales). Lower intensity vocalisers such as pilot/killer whales may be detected as long as the signals reaching the receivers are sufficiently intense to be detected against the background of seismic and vessel sound. *Towed PAM will be adopted for the survey*.<br>Surveillance Activities: The Lightning MSS will adopt vessel-based surveillance surveys with support/escort vessels (with MMOs on-board) during the survey however one aerial survey will be undertaken at the commencement of the survey to inform the adaptive management strategy for the survey. Vessel-based surveillance with MMOs on-board are considered an effective way of identifying the presence of whale species particularly with the proposed adaptive management measures of scanning ahead of the survey vessel and surveillance in areas of night-hour acquisition. Additionally, vessels are always present in the survey area, aerial surveillance is limited by weather conditions and endurance of the aircraft selected. *On this basis, additional aerial surveillance during the survey is not considered to add sufficient value nor be a superior option to the vessel-based surveillance and will not be adopted for the survey.*<br>Acoustic Seabed Loggers: These were considered and could be deployed on the seabed in the vicinity of key sites such as Southern Right Whale calving areas to gather information about the sound environment. However, based on modelling previously carried out and empirical measurements available along other Southern Margins continental shelf activities, sound arrivals at biologically important areas inshore are going to be at ambient conditions. All sea-bed acoustic logger measurements, conducted on the Southern margins continental shelf showed rapid attenuation towards the coast (CMST, 2007). It is noted that this is not considered a management or mitigation measure as it will not inform the survey activities. *No seabed logging is proposed for this survey*.<br>Sonobuoys: Bight has evaluated the potential for deployment over such a large area as the survey area to detect baleen whales in the vicinity of a moving platform. This has been discussed with AAD and researchers. Bight's assessment of this is that the measure is highly research oriented and procurement and deployment of such equipment would be difficult (perhaps impossible). Additionally the chances of the system being effective for the detection of Blue Whales within 3-10km of a moving platform (i.e. seismic vessel) is considered low as the vessel will move over an area of 80km. The operational logistics of deploying large numbers of son-buoys would be significant and Bight would be concerned about the environmental issues of allowing them to sink to the seabed after their 6-8hr life. Additionally, there would be significant issues in transmitting the signal recorded at the sonobuoy back to the seismic vessel in real time such that any low frequency, long time series vocalisations from baleen whales could be recognised quickly and mitigation measures implemented. Accordingly the survey will not to deploy sonobuoys as a management measure during the Lightning MSS. |

[79] This season also encounters extreme sea and weather conditions and data acquisition in these conditions would mask the received acoustic signal. Significant OHS risk is also present and due to the limited survival of equipment in these conditions and its constant retrieval, the survey period would be extended considerably.

| *ALARP Demonstration* | |
|---|---|
| Comparative Assessment of Options (Con't): | Independent Monitoring: Independent monitoring of marine fauna impacts during survey activities 'at sea' will be undertaken by MMOs present on the survey vessels. This information will be provided at the end of the survey to both DoE and NOPSEMA together with an assessment of environmental performance against the control measures adopted. *No additional independent monitoring is considered warranted for the survey.*<br>Stranding Surveillance: *Additional effort into the monitoring for cetacean 'strandings' which may occur as a result of MSS activities is not considered warranted* as no established link has been made between the two events. For example, cetacean strandings around Tasmania frequently occur, however very little seismic survey activity has ever been conducted around the island and no correlations have been found.<br>It should also be noted that marine fauna affected, in varying degrees, by acoustic sound (i.e. cetaceans, turtles, sea lions, seals, sharks and fish) all practice avoidance to sound sources considered damaging.<br>*No additional options/controls can be identified which can further reduce the impact and residual risk associated with helicopter operation disturbance to cetaceans.* |
| Hazard/Risk Criteria: | In accordance with the Bight Petroleum Qualitative Risk Matrix, the residual risk associated with this hazard is assessment as low. The Bight Risk tolerability criteria identified in **Section 5.1** identify that the residual risk is acceptable and the risk control strategy is considered to be ALARP. |
| Cost Benefit Analysis: | Not applicable to this assessment. |

## 5.5.2 Vessel Operation

### *5.5.2.1 Activity & Background*

Typically, marine vessels produce low frequency sound (i.e. below 1 kHz) from the operation of machinery on-board; from hydrodynamic flow noise around the hull; and from propeller cavitation, which is typically the dominant source of sound (Ross, 1987; 1993 in Skjoldal et al., 2009). Most sounds associated with vessels are broadband (i.e. contain a broad range of frequencies), though, tones are also associated with the harmonics of the propeller blades (Ross, 1987; 1993 in Skjoldal et al., 2009). McCauley (1998) examined the sound from a 64m, 2,600tonne rig tender vessel underway, which had a broadband source level of 177dB re 1µPa in approximately 110m water depth. The use of thrusters or main propellers under load produced very high levels of cavitation noise. During these activities, the measured vessel noise was broadband in nature, with the highest level measured at 137 dB re 1mPa at 405 m astern; levels of 120 dB re 1mPa recorded at 3-4km; and the noise audible at up to 20 km against a 'natural background level' of 90 dB re 1µPa.

Usually, the larger the vessel or the faster a vessel moves results in more sound emissions (Richardson et al., 1995). Depending on the vessel, source levels can range from less than 160dB (trawlers) to over 200dB re 1µPa @1m (super-tankers) (WDCS, 2003). The potential sound impacts from the MSS survey vessels are unlikely to be greater than that from existing vessels which may be operating in the vicinity of the Lightning MSS area. The MSS vessel will be generally operating at a low speed 4-4.5knots during the survey, although the support vessels may operate at faster speeds in order to effectively patrol the requested clearance area around the MSS vessel.

As identified in the previous section, sound levels from vessel operations are not expected to be high enough to cause physical damage to marine fauna, however temporary behavioural changes (avoidance) in species (cetaceans, turtles, fish) may be observed. It is expected that sound levels which might be expected to cause significant disturbance in marine fauna would be expected to be confined to the immediate vicinity of the vessels; within a radius of a few metres of the sound source. Given the vessels will be continually operating within the lightning MSS operational area (i.e. continuous sound) it is likely that marine fauna present would avoid approaching vessels if sound disturbance was too high.

Controls to be adopted to avoid vessel sound impacts to marine species include:

- Vessel propulsion systems undergo regular preventative maintenance and routine inspection against manufacturers specifications;

- Proximity distances and low speeds will be adopted in accordance with the EPBC Regulations 2000 (Part 8) for cetaceans to avoid behavioural impacts (i.e. *for support vessels*);
- The MMOs on-board the MSS vessel will keep watch for cetaceans and will report on these interactions in accordance with this section.

This requirement will be included in the environmental induction for the Lightning MSS.

#### 5.5.2.2 *Environmental Risk Assessment*

Sound from the operation of vessels during the MSS, based upon scientific literature, may create extremely localised behavioural impacts (i.e. avoidance) to marine fauna (i.e. 'negligible' consequence – Consequence: 1). With the adoption of controls detailed above, it is considered possible that with these temporary, negligible impacts may occur during the activity. On this basis the residual environmental risk posed by the activity is assessed as low.

The EPO to be attained to prevent impacts to marine fauna from vessel operations during the Lightning MSS; and a summary of performance standards relating to the adopted control measures is shown in the table below.

| Environmental Hazard/Aspect | *Vessel Operation – Sound Impacts to Marine Fauna* | |
|---|---|---|
| Performance Outcome | *Vessel(s) propulsion systems meet Manufacturers Specifications with respect to sound emissions.* | |
| Measurement Criteria | *PMS records verify vessel propulsion system operates to specification.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Vessel propulsion systems undergo preventative maintenance and inspection | The vessel(s) propulsion systems are routinely maintained in accordance with manufacturer's specifications to maintain equipment performance with respect to lowest emitted sound levels. | Records indicate that the vessel's propulsion system is operating to specification. |
| All vessels to observe cetacean proximity distances and low speeds during transits in the operational area. | Vessel Masters observe speed restrictions and proximity distances as required in the EPBC Regulations 2000 (Chapter 8). | MMO Master Data Sheet verifies interaction between the MSS vessel and cetaceans comply with these requirements<br>Support/Chase Vessel Logs verify interactions between the vessel and cetaceans comply with these requirements. |
| Environmental Induction | All crew have completed an environmental induction covering the requirements for cetacean/vessel interaction consistent with EPBC Regulations 2000 (Chapter 8) and are familiar with the requirements. | Induction records verify that all crews have completed an environmental induction. |

#### 5.5.2.3 *Acceptability and ALARP Demonstration*

An evaluation of impacts and risks of marine fauna disturbance from vessel sound against acceptability criteria detailed in **Section 5.1.2** is provided below. On the basis of this information, both residual impact and risk associated with the hazard is considered acceptable.

| *Acceptability Demonstration* | |
|---|---|
| Meeting Bight Petroleum HSE Policy Objectives: | This risk management strategy for preventing marine fauna disturbance from vessel operation reflects Bight's HSE Policy goals of proactively identifying hazards, eliminating risks where possible and where this is not possible managing the risk to ALARP (addressing biodiversity issues). |
| Legal Compliance with: | *Environment Protection & Biodiversity Conservation Act 1999*<br>*Environment Protection and Biodiversity Conservation Regulations 2000 (Part 8)* |

| *Acceptability Demonstration* | |
|---|---|
| EPBC Protected Matters Assessment: | Noise pollution is identified as a 'pressure' of *potential concern*[80] within the SW Bioregional Plan the Kangaroo Island KEF (marine mega-fauna impacts); whale, turtle and Sea Lion species present within the ZPI. 'Noise' in the context of the SW Bioregional Plan includes shipping, marine infrastructure construction and operation involving underwater blasting and pile driving, defence naval activities and seismic surveys. The existing environment of the survey area includes a major shipping channel to ports located in the Gulf regions of South Australia. Many large ships transiting the area will carry sound signatures above ambient (i.e. no marine activity) sound conditions.<br>Sound from the operation of marine engines on the survey vessels is expected to be lower than the sound signatures of larger container ships transiting the area, with the sound impacts localised to the survey area (closest proximity to coastal areas is 65km). Additionally, vessel sound impacts are also only temporary for the duration of the survey period. Given the level of sound generated by the vessels is lower than that identified as causing physiological or significant behavioural impacts to marine species (refer **Section 5.5.1**) impacts are limited and not expected to trigger significant impact criteria for threatened/migratory species, as defined by the Significant Impact Guidelines 1.1 (2013) (i.e. no reduction in the occupancy area; fragmentation of a population; disruption of breeding cycles or long-term population decrease).<br>*With control measures implemented the action will not impact of items of National Environmental Significance (NES), it meets the requirements of the SW Marine Bioregional Plan and upholds IUCN Management Principles for Marine Reserves (Category VI) (ES, 2002) relevant to the West Eyre Marine Protected Area (MPA).* |
| Social Acceptability: | Stakeholders have not raised any issues with respect to vessel operation and associated sound impacts for the Lightning MSS. On this basis, the activity is considered acceptable from this stakeholder group. |
| Risk/Impact are demonstrated to be ALARP: | As per demonstration assessment below, both residual impact and risk has been assessed as ALARP. |

A demonstration of ALARP with respect to residual impacts and risks associated with vessel operation (sound impacts) is provided below. On the basis of this demonstration, both residual impact and risk are considered ALARP when measured against the criteria.

| *ALARP Demonstration* | |
|---|---|
| Hierarchy of Controls: | **Elimination:** Survey area is not located in proximity to high density Southern Right Whale breeding areas and there is only minor overlap of the MSS activity in seasonal timeframe where the species is present in the area (i.e. late May when low numbers of species are observed).<br>Sound from vessels is not at a level where physiologically impacts are expected on marine fauna species. Only very localised behavioural impacts may be expected.<br>**Prevention:** MSS activity avoids 'peak' seasonal timeframes for Blue Whale presence (i.e. December) and Sperm Whale presence (August-September). Active watch on all vessels for the presence of cetaceans and adoption of EPBC Regulation 2000 (Part 8) requirements for proximity distances and vessel management if cetaceans are identified will minimise disturbance impacts. All crews are inducted into these requirements.<br>**Reduction:** Adoption of EPBC Regulation 2000 (Part 8) requirements provides for vessel management actions (i.e. low speed) which would reduce the consequence to the cetacean should an impact occur. Additionally, marine engines on-board survey vessels will be maintained in accordance with manufacturer's specifications to ensure sound signatures are minimised (reducing consequences).<br>**Mitigation:** Marine species will practice localised avoidance around the marine vessel operations if the sound disturbance is too high.<br>*No additional controls can be identified which reduce impacts or risks further (refer to options analysis).* |
| Compliance with Industry Standards and Codes: | Code of Environmental Practice (APPEA, 2008) objectives met for offshore geophysical operations. |

[80] 'Potential Concern' indicates the conservation value is vulnerable to the identified pressure but there is limited evidence of a substantial impact in the region; and the pressure is widespread or likely to increase in the region; and there are no management measures in place to mitigate potential or future impacts, or there is inadequate or inconclusive evidence of the effectiveness of management measures.

| *ALARP Demonstration* | |
|---|---|
| Comparative Assessment of Options: | As before, limited exploration techniques are available to the oil and gas industry to identify hydrocarbon reservoirs. Alternate technologies provide insufficient resolution for defining drilling prospects and are not a viable alternative to seismic surveys. Marine vessels are required to undertake MSS activities.<br>A 'do-nothing' approach (i.e. no survey) does not align with obligations contained in work-plans approved as part of the permit release with the Australian Government.<br>Elimination of vessels from the survey scope (i.e. support/escort vessels) is possible, however may compromise safety to other marine users and lead to larger environmental risks associated with oil spills. This option is not considered practicable on this basis.<br>Adoption of EPBC Regulation 2000 (Part 8) requirements ensures that all survey vessels minimise the potential for vessels to interfere with cetaceans. Industry-standard requirements for equipment maintenance also will minimise disturbance to marine fauna.<br>*No additional options/controls can be identified which can further reduce the impact and residual risk associated with operational vessel sound impacts to marine fauna.* |
| Hazard/Risk Criteria: | In accordance with the Bight Petroleum Qualitative Risk Matrix, the residual risk associated with this hazard is assessment as low. The Bight Risk tolerability criteria identified in **Section 5.1** identify that the residual risk is acceptable and the risk control strategy is considered to be ALARP. |
| Cost Benefit Analysis: | Not applicable to this assessment. |

## 5.5.3 Helicopter Operation

### *5.5.3.1 Activity & Background*

Helicopters may be used for crew change and medical emergencies during survey activity however crew change will preferentially occur in port due to the weather conditions expected within the survey area. There will be no helicopter refuelling on-board the MSS vessel.

Helicopter operations produce strong underwater sounds for brief periods when the helicopter is directly overhead (Richardson et al., 1995). The received Helicopter sound level underwater depends on source altitude and lateral distance, receiver depth and water depth. Sound emitted from helicopter operations is typically below 500Hz and sound pressure in the water directly below a helicopter is greatest at the surface but diminishes quickly with depth. Reports for a Bell 214 (stated to be one of the noisiest) indicated that sound is audible in the air for 4 minutes before the helicopter passed over underwater hydrophones. The Helicopter was audible underwater for only 38s at 3m depth and 11s at 8m depth (BHP Billiton, 2006). Sound levels reported for a Bell 212 helicopter during fly-over is 162dB re 1µPa and for a Sikorsky-61 is 108dB re 1µPa at 305m (WDCS, 2003).

The reaction of cetaceans to circling aircraft (fixed wing or helicopter) is sometimes conspicuous if the aircraft is below an altitude of 300m, uncommon at 460m and generally undetectable at 600m (NMFS, 2001; cited in Santos, 2004). 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 whales seem transient, and occasional over-flights probably have no long-term consequences (NMFS, 2001; cited in Santos, 2004). 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.

Controls which will be adopted to avoid helicopter sound impacts to cetaceans in the area include:

- Crew change will preferentially occur during port calls, minimising the need for helicopter support;
- Proximity distances will be adopted for Helicopters in accordance with the EPBC Regulations 2000 (Part 8) to avoid behavioural impacts to marine fauna. In particular helicopters will not fly within 500m of a whale or dolphin; and

- The MMOs on-board the MSS vessel will keep watch for cetaceans and will report on interactions managed in accordance with this section.

### 5.5.3.2 *Environmental Risk Assessment*

Sound from the operation of helicopter during the survey, based upon scientific literature, may have extremely localised and temporary behavioural impacts (i.e. avoidance) on cetaceans (i.e. 'negligible' impact, Consequence: 1). It is considered with the implementation of the nominated controls and the infrequent use of helicopters, that impacts to cetaceans are very unlikely. On this basis, the residual environmental risk posed by the activity is assessed as low.

The EPO to be attained to prevent impacts to cetacean from helicopter operations during the Lightning MSS; and a summary of performance standards relating to the adopted control measures is shown in the table below.

| Environmental Hazard/ Aspect | *Helicopter Operation – Sound Impacts to Marine Fauna* | |
|---|---|---|
| Performance Outcome | *Proximity distances to cetaceans from Helicopters are observed (no lower than 500m within a 500m radius)* | |
| Measurement Criteria | *MMO records indicate no instances of helicopter activity within 500m of a cetacean.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Helicopters will maintain a minimum of 500m buffer between dolphins and whales. | Helicopter crews have completed the Environmental Induction containing cetacean proximity distances and are familiar with the distances to cetaceans required by the EPBC Regulations 2000 (Chapter 8). | Induction records indicate that all helicopter crews have completed an Environmental Induction. |
| | MMOs will monitor for helicopter proximity distance to cetaceans (i.e. must not fly within a 500m radius of the cetaceans or hover over that area) and report on these activities. | MMO Master Data Sheet indicates that all interactions of helicopters and cetaceans have been observed and comply with distances. |

### 5.5.3.3 *Acceptability and ALARP Demonstration*

An evaluation of impacts and risks of cetacean disturbance from helicopter operations, against acceptability criteria detailed in **Section 5.1.2,** is provided below. On the basis of this information, both residual impact and risk associated with the hazard is considered acceptable.

| *Acceptability Demonstration* | |
|---|---|
| Meeting Bight Petroleum HSE Policy Objectives: | This risk management strategy for preventing disturbance to cetaceans from helicopter operation reflects Bight's HSE Policy goals of proactively identifying hazards, eliminating risks where possible and where this is not possible managing the risk to ALARP and address biodiversity issues. |
| Legal Compliance with: | *Environment Protection & Biodiversity Conservation Act 1999*<br>*Environment Protection and Biodiversity Conservation Regulations 2000 (Part 8)* |
| EPBC Protected Matters Assessment: | Disturbance to cetaceans from helicopter operations is not identified as an issue (pressure) of concern within the SW Bioregional Plan for any species.<br>Given the low frequency of helicopter activity expected during the Lightning MSS, the control measures to be adopted to prevent disturbance (i.e. EPBC Regulations 2000 [Part 8]) disturbance impacts would be expected to be isolated to individuals only and not species 'populations'. No significant impact criteria for threatened/migratory species, as defined by the Significant Impact Guidelines 1.1 (2013) will be triggered (i.e. no reduction in the occupancy area; fragmentation of a population; disruption of breeding cycles or long-term population decrease) through this activity.<br>*With control measures implemented the action will not impact of items of National Environmental Significance (NES), it meets the requirements of the SW Marine Bioregional Plan and upholds IUCN Management Principles for Marine Reserves (Category VI) (ES, 2002) relevant to the West Eyre Marine Protected Area (MPA).* |
| Social Acceptability: | Stakeholders have not raised any issues with respect to helicopter operations for the Lightning MSS. On this basis, the activity is considered acceptable from this stakeholder group. |

| *Acceptability Demonstration* | |
|---|---|
| Risk/Impact are demonstrated to be ALARP: | As per demonstration assessment below, both residual impact and risk has been assessed as ALARP. |

A demonstration of ALARP with respect to residual impacts and risks of helicopter disturbance to cetaceans is provided below. On the basis of this demonstration, both residual impact and risk are considered ALARP when measured against the criteria.

| *ALARP Demonstration* | |
|---|---|
| Hierarchy of Controls: | **Elimination:** Crew changes will preferentially occur in port areas.<br>**Prevention:** MSS activity avoids 'peak' seasonal timeframes for Blue Whale presence (i.e. December), Sperm Whales (August-September) and has minor overlap with Southern Right Whale presence. Active watch on the MSS vessel by MMOs identifies the presence of cetaceans to minimise possible impacts. Adoption of EPBC Regulation 2000 (Part 8) requirements for helicopter proximity distances avoids disturbance and all helicopter crews will be inducted into these requirements.<br>**Reduction:** *No reduction measures identified.*<br>**Mitigation:** *No mitigation controls identified.*<br>*No additional controls can be identified which reduce impacts or risks further (refer to options analysis).* |
| Compliance with Industry Standards and Codes: | Code of Environmental Practice (APPEA, 2008) objectives met for offshore geophysical operations. |
| Comparative Assessment of Options: | As before, limited exploration techniques are available to the oil and gas industry to identify hydrocarbon reservoirs. Alternate technologies provide insufficient resolution for defining drilling prospects and are not a viable alternative to seismic surveys. Marine vessels are required to undertake survey activities and crew changes are required within the proposed 70day survey window.<br>A 'do-nothing' approach (i.e. no survey) does not align with obligations contained in work-plans approved as part of the permit release with the Australian Government.<br>Helicopter operations to the survey area will be minimised wherever possible given the expected prevailing weather conditions. Helicopter presence may be required in the field during the survey to allow for medical emergencies (i.e. fast response to possible life-threatening incidents). Alternatives to helicopters for medevac (i.e. vessel deployment from the field) may not achieve objectives (i.e. emergency response time contributing to death). Helicopter elimination from the program is not considered practicable on this basis.<br>Adoption of EPBC Regulation 2000 (Part 8) requirements ensures that all helicopters operate to minimise potential disturbance to cetaceans.<br>*No additional options/controls can be identified which can further reduce the impact and residual risk associated with helicopter operation disturbance to cetaceans.* |
| Hazard/Risk Criteria: | In accordance with the Bight Petroleum Qualitative Risk Matrix, the residual risk associated with this hazard is assessment as low. The Bight Risk tolerability criteria identified in **Section 5.1** identify that the residual risk is acceptable and the risk control strategy is considered to be ALARP. |
| Cost Benefit Analysis: | Not applicable to this assessment. |

## 5.6 Routine Vessel Discharges

### 5.6.1 Treated Bilge Water Discharges

#### *5.6.1.1 Activity & Background*

Routine drainage system discharge from survey vessels has the potential to contain hydrocarbons from vessel drainage areas.

All vessels engaged on the Lightning MSS will have bilge water treatment systems compliant to MARPOL 73/78 Annex I requirements in accordance with the *Protection of the Seas (Prevention of Pollution from Ships) Act 1981* (S9), or retain all bilge/machinery space water on-board the vessel for onshore disposal.

Controls to be adopted for all vessels to reduce impacts from treated bilge water discharges include:

- All shipboard operations associated with oil transfer/movement are recorded in the Oil Record Book;
- Oil-water discharges will be compliant to MARPOL 73/78 Annex I as follows:
  - Where an oil-water separation system is installed :
    - The time of discharge, quantity of discharge and position of vessel will be recorded in the Oil Record Book:
    - The oil-water separation system with achieve an Oil-in-Water (OIW) discharge concentration of 15ppm and will operate in accordance with the vessel's current International Oil Pollution Prevention Certificate (IOPP) (or similar according to class);
    - The treated bilge water discharge stream, on detection of an OIW discharge concentration greater than 15ppm shall be shut-in, or directed in-board for further treatment or storage;
    - The Oil Detection Monitoring Equipment (ODME) on the discharge stream will be routinely calibrated to ensure the validity of OIW concentrations overboard and the treatment system will be maintained in accordance with manufacturer's specifications via the vessel's Planned Maintenance System (PMS); and
    - Oil residues separated in the treatment system will be collected in dedicated on-board tanks and transferred to shore for disposal by a licenced contractor in accordance with state waste disposal regulations. The MSS vessel may also incinerate oily residues on-board (refer **Section 5.6.4**).
  - Where an oil-water separation system is not installed there will be no discharge of bilge water. Bilge water will be transported to shore to be treated in an approved onshore facility.

#### *5.6.1.2 Environmental Risk Assessment*

The intermittent discharge of treated bilge water at 15ppm OIW to the marine environment may result in temporary, localised increases in oil content of marine waters immediately surrounding the vessel discharge point. This small waste stream as it enters the marine environment will be compliant with MARPOL 73/78 Annex 1 requirements; discharged only while vessels are *en route*; and at distances of more than 60km from the nearest coastline in the highly dispersive Southern Ocean waters. On this basis environmental impacts from the discharge will be extremely localised and temporary (i.e. 'negligible' consequence). Given these discharges will occur at intermittent periods during the survey period; the small volumes involved; the constant vessel movement; and the assimilative/dispersive nature of the receiving environment, it is considered very unlikely that this discharge will impact water quality to the extent that toxic impacts to marine fauna will occur. The residual environmental risk for this discharge is assessed as low.

A summary of the EPO for treated bilge water discharges associated with the Lightning MSS; performance standards relating to the control measures adopted and associated measurement criteria is shown in the table below:

| Environmental Hazard/ Aspect | *Routine Vessel Discharges – Oil Water* | |
|---|---|---|
| Performance Outcome | *Treated bilge water discharge from treatment systems (if discharged) meet an oil-in-water content of 15ppm (max) (MARPOL Annex I requirements).* | |
| Measurement Criteria | *Monitoring records verify no incidents of oily water discharges exceeding 15ppm oil-in-water content.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| For vessel with oil-water separation systems installed, discharge will be compliant to MARPOL Annex I requirements. | Oil water treatment systems will be capable of achieving 15ppm oil in water concentrations. | As applicable, current IOPP (or equivalent equipment specification) indicates the system is capable of achieving 15ppm OIW concentration. |
| | On detection of an OIW concentration of greater than 15ppm, the discharge stream shuts-in or directs discharge in-board. | As applicable, current IOPP (or equivalent equipment specification) verifies detection system is available. |
| | | Oil record book verifies oily water discharges meet a 15ppm discharge criteria. |
| | The system is operated in accordance with the IOPP (or equivalent equipment specification) and is maintained in accordance with manufacturer's specifications (via PMS) to ensure system performance. | Records indicate the oily water treatment system is operating to specification. |
| | Oily water discharges will occur only when the vessel is proceeding *en route*. | The oil record book verifies that all vessel oily water discharges have occurred whilst the vessel is preceding *en-route*. |
| | Whole oils are collected in dedicated tanks and discharged onshore or combusted in incinerator in MSS vessel. | Oil Record Book shows whole oil disposed onshore or incinerated within MSS vessel incinerator. |
| ODME provides an accurate measure of the OIW concentration emitted overboard. | As applicable, ODME is routinely calibrated in accordance with manufacturer's specifications to ensure oil-in water concentrations do not exceed 15ppm. | Calibration records indicate that the ODME has been calibrated in accordance with manufacturer's requirements and is operating to specification. |
| For vessel without oil-water separation systems installed – no discharge to sea. | Oily residues are contained on-board for onshore disposal | Oil Record Book shows oily water disposed to licenced onshore facilities. |

### *5.6.1.3 Acceptability and ALARP Demonstration*

An evaluation of treated bilge water discharge impacts and risks, against acceptability criteria detailed in **Section 5.1.2,** is provided below. On the basis of this information, both residual impact and risk associated with the hazard is considered acceptable.

| *Acceptability Demonstration* | |
|---|---|
| Meeting Bight Petroleum HSE Policy Objectives: | The risk management strategy for treated bilge water discharges reflects Bight's HSE Policy goals of proactively identifying hazards, eliminating risks where possible and where this is not possible managing the risk to ALARP and to implement strategies which minimise pollution and effectively manage waste. |
| Legal Compliance with: | *Navigation Act 2012* (Part 3 – *Vessels Polluting or Damaging the Australian Marine Environment* & Part 4 – *Directions Relating to Foreign Vessels*)<br>*Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Section 9 - *Prohibition of Discharge of oil or oily mixture into Sea*)<br>• Marine Order 91 (Marine Pollution Prevention – Oil) 2006 (Implements MARPOL 73/78 Annex I requirements) |

| *Acceptability Demonstration* | |
|---|---|
| EPBC Protected Matters Assessment: | Treated bilge water is not identified as a 'pressure' or potential concern within the SW Marine Bioregional Plan. Treated bilge water discharge routinely occurs in these waters as a result of commercial vessel transit and is rapidly assimilated due to the dynamic nature of the marine environment in the region.<br>Treated bilge water discharges with implemented control measures nominated above will not result in a significant impact to the Commonwealth Marine Environment (Significant Impact Guidelines, 2013) as it does not result in a substantial change in water quality or introduce persistent organic chemicals which adversely affect biodiversity, ecological function or integrity, social amenity or human health.<br>*With control measures implemented the action will not impact of items of National Environmental Significance (NES), it meets the requirements of the SW Marine Bioregional Plan and upholds IUCN Management Principles for Marine Reserves (Category VI) (ES, 2002) relevant to the West Eyre Marine Protected Area (MPA).* |
| Social Acceptability: | No issues have been raised by stakeholders regarding oily water discharges. On the basis the activity is considered acceptable from this stakeholder group. |
| Risk/Impact are demonstrated to be ALARP: | As per demonstration assessment below, both residual impact and risk has been assessed as ALARP. |

A demonstration of ALARP with respect to residual impacts and risks associated with treated bilge water discharge is provided below. On the basis of this demonstration, both residual impact and risk are considered ALARP when measured against the criteria.

| *ALARP Demonstration* | |
|---|---|
| Hierarchy of Controls: | **Elimination:** For vessels without treatment systems, waste is held on-board for onshore treatment and disposal.<br>For vessel with treatment systems whole oils are retained on-board for onshore treatment/disposal.<br>**Prevention:** For vessels with treatment systems – treatment systems are capable of treating to an oil-in-water content of 15ppm, calibrated ODME to verify discharge quality. Equipment is routinely maintained.<br>**Reduction:** Shut-down device (or redirection inboard) if oil concentration exceeded. All discharges occur more than 12nm from coastline which, with the vessel proceeding en-route when discharging and given the dynamic nature of the marine environment, assimilates and rapidly degrades the waste.<br>**Mitigation:** Discharge occurs in an extremely dynamic and dispersive marine environment contributing to biodegradation.<br>*No additional practicable controls can be identified which reduce impacts or risks further (refer to options analysis).* |
| Compliance with Industry Standards and Codes: | Code of Environmental Practice (APPEA, 2008) objectives met for offshore geophysical operations.<br>National Standard for Domestic Commercial Vessels |
| Comparative Assessment of Options: | Limited exploration techniques are available to the oil and gas industry to identify hydrocarbon reservoirs. Alternate technologies such as marine CSEM (still requires vessel) and satellite imaging technology provide insufficient resolution for defining drilling prospects and are not a viable alternative to seismic surveys. Marine vessels are required to undertake MSS activities.<br>A 'do-nothing' approach (i.e. no survey) does not align with obligations contained in work-plans approved as part of the permit release with the Australian Government.<br>The Lightning MSS program has been designed to cover the most prospective parts of EPP-41 and EPP-42 (i.e. survey area minimised) and use of a MSS vessel with multiple streamers (~8-10) minimises the acquisition period (refer **Section 2.2**).<br>Discharge standards adopted during the survey are consistent with third party commercial vessels which transit the area. Vessels may choose to retain untreated bilge water on-board the vessel for onshore disposal however this may affect the endurance of the vessel leading to greater port calls and associated fuel use; or transfer bilge water between vessels which carries a greater environmental risk. *On this basis treated bilge water discharge during survey activities is considered most practical.*<br>*No additional options/controls can be identified which can further reduce the residual impact and risk associated with treated bilge water discharges.* |
| Hazard/Risk Criteria: | In accordance with the Bight Petroleum Qualitative Risk Matrix, the residual risk associated with this hazard is assessment as low. The Bight Risk tolerability criteria identified in **Section 5.1** identify that the residual risk is acceptable and the risk control strategy is considered to be ALARP. |
| Cost Benefit Analysis: | Not applicable to this assessment. |

## 5.6.2 Sewage & Grey-water Discharges

### *5.6.2.1 Activity & Background*

The discharge of untreated sewage to the marine environment may reduce water quality and stimulate algal and bacterial growth. This may have both visual amenity impacts and possible health risks to marine fauna.

All vessels engaged on the Lightning MSS will have sewerage treatment systems compliant to MARPOL 73/78 Annex IV requirements or comply with sewage discharge requirements of the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*. This includes:

- Sewage treated in a certified Sewage Treatment Plant meeting the requirements of MARPOL 73/78 Annex IV (R9) may be discharged if the effluent does not produce visible floating solids and discolouration of the sea;
- Comminuted and disinfected sewage may be discharged at distances greater than 3nm from the nearest land; and
- Sewage stored in holding tanks, not comminuted will be discharged at distances greater than 12nm from the nearest land at a moderate rate with the vessel proceeding at a speed of at least 4knots.

For vessels with treatment facilities on-board, the Vessel Masters will ensure that persons on board (POB) will not exceed the design capacity of the treatment system. Sewage treatment equipment will be routinely inspected and maintained in accordance with manufacturer's specifications in accordance with the vessel's Planned Maintenance System (PMS).

### *5.6.2.2 Environmental Risk Assessment*

The discharge of treated sewage to the marine environment may result in temporary, localised increases in nutrient/BOD loading immediately surrounding the discharge point. This small waste stream as it enters the marine environment will be compliant with MARPOL 73/78 Annex IV requirements and discharged at distances of more than 60km from the nearest coastline in the highly dispersive Southern Ocean waters. On this basis environmental impacts will be localised and temporary (i.e. 'negligible' consequence). Given these treated sewage/grey-water discharges will occur at intermittent periods during the survey period, the biodegradable nature of the discharge and the dispersive nature of the receiving environment, it is considered very unlikely that this discharge will impact water quality to the extent that impacts to marine fauna will occur. The residual environmental risk assessed for this discharge is assessed as low.

A summary of the EPO for sewage discharges associated with the Lightning MSS; performance standards relating to the control measures adopted and associated measurement criteria is shown in the table below:

| Environmental Hazard/Aspect | *Routine Vessel Discharges - Sewage* | |
|---|---|---|
| Performance Outcome | *Vessel sewage discharges to offshore marine waters complies with the requirements of the Protection of the Sea (Prevention of Pollution from Ships) Act 1983.* | |
| Measurement Criteria | *Records identify all sewage discharge events comply with legislative conditions.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Vessel sewage discharges will be compliant with MARPOL Annex IV requirements. | For vessels with installed STPs compliant to MARPOL 73/78 (R9), sewage may be discharged at any time providing visible floating solids and discolouration is not evident. | As applicable, Vessel ISPP or equipment specification verifies that the STP can achieve this standard of treatment. |
| | | Vessel log indicates the location of sewage discharge conforms to requirements. |

| | | |
|---|---|---|
| Environmental Hazard/Aspect | *Routine Vessel Discharges - Sewage* | |
| Performance Outcome | *Vessel sewage discharges to offshore marine waters complies with the requirements of the Protection of the Sea (Prevention of Pollution from Ships) Act 1983.* | |
| Measurement Criteria | *Records identify all sewage discharge events comply with legislative conditions.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| | The treatment system is routinely maintained in accordance with manufacturer's specifications (via PMS) to ensure discharge specifications can be met. | PMS records for treatment systems verify that the system is operating to specification. |
| | Vessel masters ensure that the POB does not exceed stated maximum carrying capacity for treatment equipment. | Vessel log indicates that POB has not exceeded treatment equipment carrying capacity. |
| | For vessels without STP but having maceration and disinfection facilities, the vessel will discharge sewage at a distance of more than 3nm from land. | Vessel log indicates the location of sewage discharge complies with this requirement. |
| | For vessels without STP and maceration/ disinfection equipment the vessel will discharge untreated sewage at a distance of more than 12nm from land while proceeding *en-route*. | Vessel log indicates the location of sewage discharge complies with this requirement. |

### 5.6.2.3 *Acceptability and ALARP Demonstration*

An evaluation of sewage discharge impacts and risks, against acceptability criteria detailed in **Section 5.1.2,** is provided below. On the basis of this information, both residual impact and risk associated with the hazard is considered acceptable.

| *Acceptability Demonstration* | |
|---|---|
| Meeting Bight Petroleum HSE Policy Objectives: | The risk management strategy for sewage discharges reflects Bight's HSE Policy goals of proactively identifying hazards, eliminating risks where possible and where this is not possible managing the risk to ALARP and to implement strategies which minimise pollution and effectively manage waste. |
| Legal Compliance with: | *Navigation Act 2012* (Part 3 – *Vessels Polluting or Damaging the Australian Marine Environment* & Part 4 – *Directions Relating to Foreign Vessels*)<br>*Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Section 26D - *Prohibition of Discharge of sewage into the sea*)<br>• Marine Order 96 (Marine Pollution Prevention – Sewage) 2013 (Implements MARPOL 73/78 Annex IV requirements) |
| EPBC Protected Matters Assessment: | Sewage discharges are not identified as a 'pressure' or potential concern within the SW Marine Bioregional Plan. Sewage discharges routinely occur in these regional waters as a result of commercial vessel transit with the discharge rapidly assimilated due to the dynamic nature of the marine environment in the region.<br>Sewage discharges with implemented control measures nominated above will not result in a significant impact to the Commonwealth Marine Environment (Significant Impact Guidelines, 2013) as it does not result in a substantial change in water quality or introduce persistent organic chemicals which adversely affect biodiversity, ecological function or integrity, social amenity or human health.<br>*With control measures implemented the action will not impact of items of National Environmental Significance (NES), it meets the requirements of the SW Marine Bioregional Plan and upholds IUCN Management Principles for Marine Reserves (Category VI) (ES, 2002) relevant to the West Eyre Marine Protected Area (MPA).* |
| Social Acceptability: | No issues have been raised by stakeholders regarding sewage discharges. On the basis the activity is considered acceptable from this stakeholder group. |
| Risk/Impact are demonstrated to be ALARP: | As per demonstration assessment below, both residual impact and risk has been assessed as ALARP. |

A demonstration of ALARP with respect to residual impacts and risks associated with sewage discharges is provided below. On the basis of this demonstration, both residual impact and risk are considered ALARP when measured against the criteria.

| *ALARP Demonstration* | |
|---|---|
| Hierarchy of Controls: | **Elimination:** *No elimination controls have been identified.*<br>**Prevention:** For vessels with treatment systems – treatment systems are capable of treating sewage to lower the Biological Oxygen Demand (BOD) or increase surface area (i.e. maceration) to enhance organic degradation. Equipment meets legislated requirements and is routinely maintained to achieve performance.<br>**Reduction:** All discharges occur more than 12nm from coastline which, with the vessel proceeding en-route rapidly disperses the effluent.<br>**Mitigation:** Discharge occurs in an extremely dynamic and dispersive marine environment contributing to biodegradation.<br>*No additional practicable controls can be identified which reduce impacts or risks further (refer to options analysis).* |
| Compliance with Industry Standards and Codes: | Code of Environmental Practice (APPEA, 2008) objectives met for offshore geophysical operations.<br>National Standard for Domestic Commercial Vessels |
| Comparative Assessment of Options: | Limited exploration techniques are available to the oil and gas industry to identify hydrocarbon reservoirs. Alternate technologies such as marine CSEM (still requires vessel) and satellite imaging technology provide insufficient resolution for defining drilling prospects and are not a viable alternative to seismic surveys. Marine vessels are required to undertake MSS activities.<br>A 'do-nothing' approach (i.e. no survey) does not align with obligations contained in work-plans approved as part of the permit release with the Australian Government.<br>The Lightning MSS program has been designed to cover the most prospective parts of EPP-41 and EPP-42 (i.e. survey area minimised) and the use of a MSS vessel with multiple streamers (~8-10) minimises the acquisition period (refer **Section 2.2**).<br>Discharge standards adopted during the survey are consistent with third party commercial vessels which transit the area. Vessels may choose to retain untreated sewage on-board the vessel for onshore disposal however this may affect the endurance of the vessel leading to greater port calls and associated fuel use. *Sewage discharge in accordance with MARPOL 73/78 is therefore considered most practical.*<br>*No additional options/controls can be identified which can further reduce the residual impact and risk associated with sewage discharges.* |
| Hazard/Risk Criteria: | In accordance with the Bight Petroleum Qualitative Risk Matrix, the residual risk associated with this hazard is assessment as low. The Bight Risk tolerability criteria identified in **Section 5.1** identify that the residual risk is acceptable and the risk control strategy is considered to be ALARP. |
| Cost Benefit Analysis: | Not applicable to this assessment. |

## 5.6.3 Food-scrap Discharges

### *5.6.3.1 Activity & Background*

The discharge of food-scraps to the marine environment may reduce water quality. Marine fauna, such as fish and seabirds, attracted to the food source may also alter their natural behaviour and increase vessel interactions.

Food-scrap discharges from vessels engaged on the survey will either:

- Macerate the waste stream on-board to a size which is less than 25mm prior to discharge overboard at a distance greater than 3nm from the territorial baseline (chartered reef or coastline) in accordance with MARPOL 73/78 Annex V requirements; or
- Discharge the waste stream at sea at a distance greater than 12nm from the territorial baseline in accordance with MARPOL 73/78 Annex V requirements; or
- Freeze for disposal at an onshore facility.

Controls to be adopted to reduce impacts from food-scrap discharges include:

- Macerators can achieve the 25mm particle size and are regularly maintained and inspected as per manufacturer's specifications;

- The vessels will operate under a Shipboard Waste Management Plan which details the requirements for collecting, storing, processing and disposing of garbage and all personnel will be trained/inducted into these requirements;
- Placards displayed on the vessel provide guidance on vessel garbage management requirements;
- Food waste disposed overboard will be recorded in the Garbage Record Book.

No other solid or hazardous waste materials (excluding oily water and sewage previously discussed) will be disposed overboard.

#### 5.6.3.2 *Environmental Risk Assessment*

The intermittent discharge of food-scraps to the marine environment may result in temporary, localised increases in nutrient/BOD loading in marine waters immediately surrounding the discharge point. This small waste stream as it enters the marine environment will be compliant with MARPOL 73/78 Annex V requirements and will be discharged at distances of more than 60km from the nearest coastline in the highly dispersive waters of the Southern Ocean. On this basis environmental impacts will be localised and temporary (i.e. 'negligible' impact, Consequence: 1). Given food-scraps discharges will occur at intermittent periods during the survey period; and also given the dispersive nature of the receiving environment, it is considered very unlikely that this discharge will impact water quality to the extent that impacts to marine fauna will occur. Also given the constant movement of the vessels, species behavioural changes are not expected. The residual environmental risk for this discharge is assessed as low.

The EPO for food-scrap discharges associated with the Lightning MSS; and a summary of performance standards relating to the control measures adopted and associated measurement criteria is shown in the table below:

| Environmental Hazard/ Aspect | *Vessel Discharges – Food-scraps* | |
|---|---|---|
| Performance Outcome | *Disposal of food waste to offshore marine waters compiles with the requirements of the Protection of the Sea (Prevention of Pollution from Ships) Act 1983.* | |
| Measurement Criteria | *Records indicate that all food-scrap discharges are compliant with legislation.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Vessel food-scrap discharges are compliant with MARPOL Annex V requirements | Macerated food scraps discharged from a vessel will be discharged at a distance of at least 3nm from the nearest coastline. | Garbage Record Book indicates the volume and location of macerated food scrap discharge complies with this requirement |
| | Equipment used to macerate food scraps allows for a particle size of 25mm to be achieved prior to discharge. | Manufacturer's Specification for macerator verifies that this performance standard can be achieved. |
| | Maceration equipment is routinely maintained in accordance with manufacturer's specifications (via PMS) to ensure discharge specifications are met | PMS records for the maceration equipment verify that the system is operating to specification. |
| | Non-macerated food-scraps are discharged at a distance of at least 12nm from the nearest coastline. | Garbage Record Book verifies the volume and location of macerated food scrap discharge complies with this requirement |
| Vessels operate under a Shipboard Garbage Management Plan | All personnel are aware of the vessel garbage management arrangements through the information provided in the vessel survey induction. | Induction records indicate that all crew have completed the vessel induction which included garbage management plan arrangements. |
| | Placarding is provided on-board the vessel, consistent with the Vessels Garbage Management Plan, to provide guidance to personnel on the kinds of garbage which may or may not be disposed from the ship and the conditions of disposal. | Environment Plan Compliance audit records verify that placards is available on all survey vessels and meets these requirements. |

### 5.6.3.3 *Acceptability and ALARP Demonstration*

An evaluation of food-scrap discharge impacts and risks, against acceptability criteria detailed in **Section 5.1.2,** is provided below. On the basis of this information, both residual impact and risk associated with the hazard is considered acceptable.

| *Acceptability Demonstration* | |
|---|---|
| Meeting Bight Petroleum HSE Policy Objectives: | The risk management strategy for food-scrap discharges reflects Bight's HSE Policy goals of proactively identifying hazards, eliminating risks where possible and where this is not possible managing the risk to ALARP and to implement strategies which minimise pollution and effectively manage waste. |
| Legal Compliance with: | *Navigation Act 2012* (Part 3 – *Vessels Polluting or Damaging the Australian Marine Environment* & Part 4 – *Directions Relating to Foreign Vessels*)<br>*Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Section 26F - *Prohibition of discharge of garbage into the sea*)<br>• Marine Order 95 (Marine Pollution Prevention – Garbage) 2013 (Implements MARPOL 73/78 Annex V requirements) |
| EPBC Protected Matters Assessment: | Food-scrap discharges are not identified as a 'pressure' or potential concern within the SW Marine Bioregional Plan. Food-scrap discharges routinely occur in these regional waters as a result of commercial vessel transit with the discharge rapidly assimilated due to the dynamic nature of the marine environment in the region.<br>Food-scrap discharges with implemented control measures nominated above will not result in a significant impact to the Commonwealth Marine Environment (Significant Impact Guidelines, 2013) as it does not result in a substantial change in water quality or introduce persistent organic chemicals which adversely affect biodiversity, ecological function or integrity, social amenity or human health.<br>*With control measures implemented the action will not impact of items of National Environmental Significance (NES), it meets the requirements of the SW Marine Bioregional Plan and upholds IUCN Management Principles for Marine Reserves (Category VI) (ES, 2002) relevant to the West Eyre Marine Protected Area (MPA).* |
| Social Acceptability: | No issues have been raised by stakeholders regarding food-scrap discharges. On the basis the activity is considered acceptable from this stakeholder group. |
| Risk/Impact are demonstrated to be ALARP: | As per demonstration assessment below, both residual impact and risk has been assessed as ALARP. |

A demonstration of ALARP with respect to residual impacts and risks associated with food-scrap discharges is provided below. On the basis of this demonstration, both residual impact and risk are considered ALARP when measured against the criteria.

| *ALARP Demonstration* | |
|---|---|
| Hierarchy of Controls: | **Elimination:** *No elimination controls have been identified.*<br>**Prevention:** For vessels with maceration equipment – systems are capable of increasing surface area to enhance organic degradation. Equipment meets legislated discharge requirements and is routinely maintained to achieve performance. All crew members are inducted into the Garbage Management Plan requirements and placarding on-board the vessel reinforces these requirements.<br>**Reduction:** All discharges occur more than 12nm from coastline which, with the vessel proceeding en-route rapidly disperses the discharge.<br>**Mitigation:** Discharge occurs in an extremely dynamic and dispersive marine environment contributing to biodegradation.<br>*No additional practicable controls can be identified which reduce impacts or risks further (refer to options analysis).* |
| Compliance with Industry Standards and Codes: | Code of Environmental Practice (APPEA, 2008) objectives met for offshore geophysical operations.<br>National Standard for Domestic Commercial Vessels |

| *ALARP Demonstration* | |
|---|---|
| Comparative Assessment of Options: | Limited exploration techniques are available to the oil and gas industry to identify hydrocarbon reservoirs. Alternate technologies such as marine CSEM (still requires vessel) and satellite imaging technology provide insufficient resolution for defining drilling prospects and are not a viable alternative to seismic surveys. Marine vessels are required to undertake MSS activities.<br>A 'do-nothing' approach (i.e. no survey) does not align with obligations contained in work-plans approved as part of the permit release with the Australian Government.<br>The Lightning MSS program has been designed to cover the most prospective parts of EPP-41 and EPP-42 (i.e. survey area minimised) and use of a MSS vessel with multiple streamers (~8-10) minimises the acquisition period (refer **Section 2.2**).<br>Discharge standards adopted during the survey are consistent with third party commercial vessels which transit the area. Vessels may choose to retain food-scraps on-board the vessel for onshore disposal however this may lead to additional containment requirements, possible hygiene issues and affect the endurance of the vessel leading to greater port calls and associated fuel use. *Food-scrap disposal in accordance with MARPOL Annex V is considered most practical in this instance.*<br>*No additional options/controls can be identified which can further reduce the residual impact and risk associated with food-scrap discharges.* |
| Hazard/Risk Criteria: | In accordance with the Bight Petroleum Qualitative Risk Matrix, the residual risk associated with this hazard is assessment as low. The Bight Risk tolerability criteria identified in **Section 5.1** identify that the residual risk is acceptable and the risk control strategy is considered to be ALARP. |
| Cost Benefit Analysis: | Not applicable to this assessment. |

## 5.6.4 Air Emissions (Combustion)

### *5.6.4.1 Activity & Background*

Gaseous greenhouse gas (GHG) emissions such as carbon dioxide ($CO_2$), methane ($CH_4$) and nitrous oxide ($N_2O$) together with non-GHG emissions such as $NO_x$, $SO_x$, smoke and particulates may be emitted from vessel engines, generators, incinerators (MSS vessel only) and helicopters. The fuel sources used for combustion purposes will be Marine Gas Oil (MGO) or Marine Diesel Oil (MDO) with anticipated consumption of the seismic vessel in the order of 45$m^3$ per day during MSS activities. These types of emissions can lead to a localised reduction in air quality and contribute to global warming by contributing to the national GHG loading.

Vessels may also use Ozone Depletion Substances (ODSs) in closed system rechargeable refrigeration systems. ODS loss from these systems can contribute to ozone layer depletion.

Controls to reduce impacts from combustion emissions include:

- MDO/MGO use is compliant with MARPOL Annex VI requirements for total sulphur and will be used to fuel MSS vessels;
- Vessels carry a current International Air Pollution Prevention Certificate (IAPP) (or equivalent equipment specification) to show compliance with MARPOL 73/78 Annex VI. This prescribes the sulphur content of fuel used on-board; operational exhaust treatment systems to prevent excessive $NO_x$ and $SO_x$ emissions for certain categories of engine; and the use of the approved incineration equipment (for oily residue and waste disposal);
- All combustion equipment (engines, plant, incinerator) will be maintained in accordance with Manufacturer's instructions via the vessel's Planned Maintenance System (PMS);
- Proactive management of fuel usage on-board the vessels ensures consumption is monitored and benchmarked and corrective action initiated in the event of abnormally high fuel usage;
- The MSS vessel incinerator will be MARPOL compliant (MEPC 40/21). If the incinerators are used, the volumes of waste incinerated will be recorded in the Garbage Record Book.

Controls adopted to prevent the accidental release of ODS include:

- Maintenance of closed system refrigeration systems on-board vessels is undertaken by suitably qualified personnel in accordance with approved procedures; and
- Any repair or maintenance of equipment containing ODS or incidents which involve the accidental release of ODS to the atmosphere is recorded in an ODS Record Book in accordance with MARPOL 73/78 Annex VI.

### 5.6.4.2 *Environmental Risk Assessment*

The discharge of combustion products to the marine environment may result in temporary, localised reduction of air quality in the marine environment immediately surrounding the discharge point for the MSS period (i.e. 'negligible' impact, Consequence: 1). This small waste stream as it enters the marine air environment will be compliant with MARPOL 73/78 Annex VI requirements and discharged at distances of more than 60km from the nearest coastline in the highly dispersive Southern Ocean environment. With the control measures adopted, the constant vessel motion and dispersive nature of the receiving environment, impacts associated with air quality reduction are considered unlikely. The residual environmental risk for this discharge is assessed as low.

The accidental discharge of ODS substances, given the expected volumes in refrigeration systems, will contribute on a minor basis (Consequence: 2) to ozone layer depletion. With maintenance controls implemented, the likelihood of an accidental release is considered very unlikely. The residual environmental risk for this discharge is assessed as low.

The EPOs for combustion and ODS discharges associated with the Lightning MSS; and a summary of performance standards relating to the control measures adopted and associated measurement criteria is shown in the table below:

| Environmental Hazard/ Aspect | *Air Emissions (Combustion and Ozone Depleting Substances)* | |
|---|---|---|
| Performance Outcome | *Combustion emissions are compliant to MARPOL VI requirements.*<br>*ODS releases from vessel's refrigeration systems are eliminated.* | |
| Measurement Criteria | *Records indicate air emissions meet MARPOL Annex VI requirements.*<br>*Records indicate no release of ODS during maintenance of refrigeration systems.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Combustion emissions will be compliant to MARPOL Annex VI requirements | The vessels shall uses fuel which meets MARPOL Annex VI requirements for sulphur emissions | Fuel use records indicate use of MDO/MGO. |
| | Vessel engines (as required) will meet $NO_x$ emission levels as required by MARPOL 73/78 Regulation 13. | Pre-mobilisation audit records verify vessel engine certification records (as required) meet these emission requirements. |
| | All combustion equipment (propulsion systems, generator and incinerator) will be maintained in accordance with Manufacturer's instructions via the vessel's Planned Maintenance System (PMS) to ensure optimum performance and discharge specifications. | PMS records for the combustion equipment verify that the equipment is operating to specification. |
| | The MSS Vessel incinerator will meet the requirements of MARPOL 73/78 Annex VI (Regulation 16) | The MSS vessel will carry incineration equipment approved under MARPOL 73/78 Annex VI |
| | During MSS activities, the incinerator is operated in accordance with the requirements of MARPOL 73/78 Annex VI (Regulation 16) | Incinerated waste details recorded in the vessel's Garbage Record Book verify operation in accordance with Regulation 16 requirements. |
| Proactive measures are adopted to identify combustion system inefficiencies | Fuel usage on-board the vessels is monitored for abnormal consumption and corrective action initiated in the event of high fuel usage. | Monitoring & reporting records are available which record and benchmark fuel usage. |

| | | |
|---|---|---|
| Environmental Hazard/ Aspect | *Air Emissions (Combustion and Ozone Depleting Substances)* | |
| Performance Outcome | *Combustion emissions are compliant to MARPOL VI requirements.*<br>*ODS releases from vessel's refrigeration systems are eliminated.* | |
| Measurement Criteria | *Records indicate air emissions meet MARPOL Annex VI requirements.*<br>*Records indicate no release of ODS during maintenance of refrigeration systems.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Maintenance of closed system refrigeration systems | Personnel undertaking maintenance activities on refrigeration systems have the appropriate training/ certification to undertake maintenance activities. | Competency/PMS records verify that personnel undertaking maintenance activities have the relevant training and competencies for the task. |
| Management of ODS systems | Vessels which utilise ODSs manage these systems in accordance with Regulation 12 of MARPOL 73/78 Annex VI to eliminate ODS emissions. | ODS record book verifies that systems are managed in accordance with MARPOL Regulation 12 requirements. |

#### 5.6.4.3 *Acceptability and ALARP Demonstration*

An evaluation of air emission impacts and risks, against acceptability criteria detailed in **Section 5.1.2,** is provided below. On the basis of this information, both residual impact and risk associated with the hazard is considered acceptable.

| *Acceptability Demonstration* | |
|---|---|
| Meeting Bight Petroleum HSE Policy Objectives: | The risk management strategy for air emissions reflects Bight's HSE Policy goals of proactively identifying hazards, eliminating risks where possible and where this is not possible managing the risk to ALARP and to implement strategies which minimise pollution and use energy sources efficiently. |
| Legal Compliance with: | *Navigation Act 2012* (Part 3 – *Vessels Polluting or Damaging the Australian Marine Environment* & Part 4 – *Directions Relating to Foreign Vessels*)<br>*Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Part IIID – Prevention of air pollution)<br>• Marine Order 97 (Marine Pollution Prevention – Air Pollution) 2013 (Implements MARPOL 73/78 Annex VI requirements) |
| EPBC Protected Matters Assessment: | Air emissions are not identified as a 'pressure' or potential concern within the SW Marine Bioregional Plan. Air emissions routinely occur in these regional waters as a result of commercial vessel transit with the emissions rapidly assimilated due to the dynamic nature of the marine environment in the region.<br>Air emissions with implemented control measures nominated above will not result in a significant impact to the Commonwealth Marine Environment (Significant Impact Guidelines, 2013) as it does not result in a substantial change in air quality which adversely affects biodiversity, ecological function or integrity, social amenity or human health.<br>*With control measures implemented the action will not impact of items of National Environmental Significance (NES), it meets the requirements of the SW Marine Bioregional Plan and upholds IUCN Management Principles for Marine Reserves (Category VI) (ES, 2002) relevant to the West Eyre Marine Protected Area (MPA).* |
| Social Acceptability: | No issues have been raised by stakeholders regarding vessel air emissions. On the basis the activity is considered acceptable from this stakeholder group. |
| Risk/Impact are demonstrated to be ALARP: | As per demonstration assessment below, both residual impact and risk has been assessed as ALARP. |

A demonstration of ALARP with respect to residual impacts and risks associated with air emissions is provided below. On the basis of this demonstration, both residual impact and risk are considered ALARP when measured against the criteria.

| *ALARP Demonstration* | |
|---|---|
| Hierarchy of Controls: | **Elimination:** Vessel HVAC systems which may contain ODS are closed-circuit hence emission *during normal operations* is eliminated.<br>**Prevention:** Combustion equipment selection meets legislated discharge requirements. Vessels use MDO/MGO, a fuel source which is compliant to fuel sulphur level requirements. Equipment is maintained in accordance with manufacturer's specifications to ensure optimum fuel efficiencies and reduce pollution.<br>Maintenance on ODS systems is undertaken by qualified personnel in accordance with approved maintenance procedures.<br>**Reduction:** Fuel usage is monitored to ensure no anomalies and optimum equipment efficiencies.<br>**Mitigation:** Air emissions occur more than 12nm from coastline which, with the vessel proceeding en-route and given the dynamic nature of the marine environment, the emission rapidly assimilates.<br>*No additional practicable controls can be identified which reduce impacts or risks further (refer to options analysis).* |
| Compliance with Industry Standards and Codes: | Code of Environmental Practice (APPEA, 2008) objectives met for offshore geophysical operations.<br>National Standard for Domestic Commercial Vessels |
| Comparative Assessment of Options: | Limited exploration techniques are available to the oil and gas industry to identify hydrocarbon reservoirs. Alternate technologies such as marine CSEM (still requires vessel) and satellite imaging technology provide insufficient resolution for defining drilling prospects and are not a viable alternative to seismic surveys. Marine vessels are required to undertake MSS activities and require hydrocarbons to fuel engines. ODS substances may/may not be present on the vessel to support HVAC services.<br>A 'do-nothing' approach (i.e. no survey) does not align with obligations contained in work-plans approved as part of the permit release with the Australian Government.<br>The Lightning MSS program has been designed to cover the most prospective parts of EPP-41 and EPP-42 (i.e. survey area minimised) and the use of a MSS vessel with multiple streamers (~8-10) minimises the acquisition period (refer **Section 2.2**).<br>Air emission standards adopted by survey vessels for combustion equipment during the survey are consistent with third party commercial vessels which transit the area. This conforms with industry standard marine practices and are permissible under the *Protection of the Sea (Prevention of Pollution by Ships) Act 1983* and MARPOL 73/78 Annex VI.<br>The MSS vessel may incinerate waste on-board. Alternatives to this include on-board waste storage for disposal at an onshore facility. This may lead to decreased endurance time at sea and a greater frequency of deployment from the survey area (i.e. more fuel use). Alternately increased 'at sea' waste transfer may be used which carries a higher risk. On this basis, incineration is deemed the most practical solution.<br>The use of ODS in closed loop refrigeration systems is deemed acceptable under MARPOL 73/78 Annex VI. Lack of refrigeration on-board the vessel would lead to unacceptable workplace conditions (i.e. air conditioning) and food hygiene standards, limiting the vessel's ability to undertake survey activities. This is not considered practicable.<br>*No additional options/controls can be identified which can further reduce the residual impact and residual risk associated with air emissions from survey vessels.* |
| Hazard/Risk Criteria: | In accordance with the Bight Petroleum Qualitative Risk Matrix, the residual risk associated with this hazard is assessment as low. The Bight Risk tolerability criteria identified in **Section 5.1** identify that the residual risk is acceptable and the risk control strategy is considered to be ALARP. |
| Cost Benefit Analysis: | Not applicable to this assessment. |

## 5.7 Non-Routine Activities (Incidents)

Bight has assessed oil spill scenarios which have to potential to occur during the Lightning MSS, in the context of the environmental setting of the MSS area (i.e. deep water and distant from landfall/emergent reefs). The following causal pathways for oil spill were considered as part of the risk assessment:

- Deck spill from vessel (refer **Section 5.7.2**);
- Loss of containment during refuelling (ship-to-ship transfer) (refer **Section 5.7.3**);

- Leak from streamers (refer **Section 5.7.5**);
- Fuel Tank rupture from the following causal pathways (Refer **Section 5.7.1**):
    - Vessel grounding (either drift [loss of propulsion] or powered [navigational error]);
    - Vessel hull damage (leak due to structural failure, damage to hull, loss of stability or flooding); and
    - Vessel collision (strike by another ship):
        - Intra-field vessel collision;
        - Survey vessel collision with third party vessels.

Additional incidents (non-spill related) were identified associated with:

- Loss of solid, non-biodegradable waste overboard (refer **Section 5.7.4**);
- Streamer loss/release to the marine environment (refer **Section 5.7.5**); and
- Cetacean collision (refer **Section 5.7.7**).

## 5.7.1 Oil Spill due to Collision / Grounding / Hull Damage

### *5.7.1.1 Activity & Background*

Assessment of possible causal pathways which might lead to a vessel fuel tank leak/rupture as outlined above identified the following:

- **Hull damage** [*Leak due to damage to hull, structural failure, loss of stability or flooding, fire*]: Bight's selection process for seismic contractors and their associated vessels will address appropriate standards and class requirements. Vessel contractors must provide appropriate certifications which are maintained and valid; personnel on board the vessel must be trained and certified to appropriate maritime standards (STCW95 or equivalent to class) and vessel maintenance systems must meet stringent performance requirements.

  If the survey vessel is entering Australian waters, a safety audit is undertaken prior to mobilisation. If the vessel has been operating in Australian waters a safety audit must have been undertaken within 3 years, else a new audit is initiated. Given this selection process, vessels with integrity issues which might be prone to hull damage (failure) are essentially eliminated for survey consideration and vessel integrity is not seen as contributing significantly to the risk of hull damage. Conservatively, it has been assumed that should an event occur which leads to hull damage, the largest fuel tank volume might escape to the marine environment (refer *vessel collision* below);

- **Vessel Grounding** [*drift or powered*][81]: The Lightning survey occurs in water depths exceeding 130m and the closest approach distance to the SA coastline of 68km. No emergent reef systems lie within, or in proximity to, the Lightning MSS operational area. Given the distance from shoreline, powered grounding is not considered credible.

  Additionally, it should be noted that the MSS and support vessels have multiple independent propulsion systems (hence redundancy). In the scenario of loss of power, the support vessel is equipped, capable and prepared to tow the MSS vessel. Given these multiple redundancies of systems, and the distance from shorelines, drift grounding is not considered credible.

[81] The probability of grounding from a location more than 4nm from the nearest coast or reef is negligible (DNV, 2011).

- **Vessel Collision (Intra-field Vessels):** Collision between two survey vessels with sufficient energy to result in a fuel tank rupture is also not considered a credible scenario. Where the MSS vessel and support vessels are working in close proximity to each other, these activities will be conducted a very low speed, only in safe sea-states and under strict control of the Vessel Masters.

  During normal seismic operations, the support/escort vessel will be scouting the seismic line well in front and to one side of the seismic vessel such that it is not in the direct path of the vessel or the towed equipment. While the support vessel is more manoeuvrable than the MSS vessel (due to streamer constraints), and can divert with increased speed if there is a third party vessel presence, this activity is controlled and it is not considered that the vessels would approach each other with sufficient speed to cause a collision resulting in an oil spill.

- **Vessel Collision (Large Third Party Commercial Vessel):** A MSS vessel collision with third party vessels travelling at speed (i.e. high energy) is considered the only collision scenario which would have sufficient energy to damage a vessel's hull with the potential for a resultant fuel spill.

  AMSA has identified that a major shipping lane lies in the northern section of the Lightning MSS area and commercial vessel traffic will be encountered in that area. It is noted in **Figure 3-17** that the vessel encounter rate is expected to be frequent.

  Marine seismic surveys utilise towed equipment, which due to its replacement cost (~$20M), requires specialised controls to prevent both MSS vessel and streamer interference. Additionally third party interference or proximity to trailing equipment defeats survey outcomes (i.e. reliable data acquisition). The presence of this trailing equipment limits the ability of the MSS vessel to manoeuvre and hence support vessel(s) are deployed to the MSS area to eliminate the potential for collisions/interference with seismic equipment and the MSS vessel itself.

**Prevention Controls:** Controls which are present on the MSS Vessel and Support Vessel to detect and alert third party vessels to MSS vessel presence include the following[82]:

- Radio communication (MSS and support vessel), AIS and navigation lights[83] on both vessels. The MSS vessel is also fitted with day shapes to identify MSS activity;
- ARPA with vessel plotting capability on the MSS and support vessels. Additional repeater screens are located in the instrument room of the MSS vessel providing secondary monitoring on a 24/7 basis by seismic personnel;
- Crew are trained (STCW95) and the vessels maintain 24hr watch-keeping from the bridge. The MMOs are an additional watch during daylight hours; and
- Noise detection in the hydrophone equipment (monitored by the seismic crew) allow for detection of third party vessels in proximity to the streamers.

Seismic operations will be undertaken in accordance with all marine navigation and vessel safety requirements under the *Navigation Act 2012* which will include the following preventative measures for vessel collision:

- AMSA RCC notifications to advise of vessel activity/location by marine broadcasts and a Notice to Mariners is issued via the AHO for the program;
- Support vessel acts to detect third party vessels and as another communication channel to third parties in addition to the MSS vessel;

[82] It should be noted that the controls listed have multiple levels of redundancy present
[83] Both vessels have navigation lights with power backup and alarms to identify lighting failure. Lighting is also checked on a nightly basis.

- Automatic Radar Plotting Aid (ARPA) systems identify, track and project the closest approach for any third party vessel (time and location) within the operational area and radar range (~50km) based on the expected planned seismic operations;
- Radio communication with any identified 'third party risk vessel' will be initiated to ensure they have awareness of the survey vessels and the towed equipment, and to confirm their planned course;
- The MSS vessel will look to modify the seismic acquisition plan (next seismic line to be acquired) if it can reduce the possibility of the third party vessel interfering (noise) with seismic recordings (15-20km);
- If the third party vessel is likely to come within approximately 20km of the survey, or if there are problems communicating with the vessel:
    - The escort vessel will be deployed to position itself between the third party vessel and the MSS vessel;
    - If the third party vessel does not communicate and is expected to pose any risk to seismic vessel or trailing equipment, the escort vessel shall deploy flares to gain the attention of the third party vessel and, if necessary and safe to do so, run alongside the risk vessel (at low speed);

If these measures are unsuccessful and a real threat to the MSS vessel exists:

- The MSS vessel shall steer off line and dive the cables; and
- If the third party vessel changes course to re-endanger the MSS vessel, or appears intent on ramming the vessel, the MSS vessel will prepare to sever the seismic cables, inform the Navy and relevant authorities and take whatever action the master deems necessary to reduce the risk to crew. The MSS vessel will sacrifice the protection of the trailing equipment in order to take evasive action (and become more manoeuvrable to avert collision).

Adoption of these controls makes the possibility of vessel collision resulting in an oil spill remote, to the extent that it is considered an incredible event.

**Fuel Types and Volumes**:

The largest volume fuel storage tanks on-board the seismic vessel under consideration for the Lightning MSS has been estimated at 300m$^3$ (conservative). The vessel will utilise MGO or MDO. Hydrocarbon properties of MGO/MDO are provided in **Table 5-8.**

In the event of hull damage or a third party, high speed collision it has been conservatively assumed that the vessel's largest fuel tank volume will be lost over 6 hours, however in reality this may occur over a considerable period of time (days). This estimate is also conservative as it does not take into consideration mitigative actions which would be implemented by the Vessel Master such as tank lightering which would limit the spill volume.

Table 5-8: Fuel Properties (ITOPF, 2011)

| Hydrocarbon | SG (@15°C) | Viscosity (cP@15°C) | Pour Point (°C) | Flash Point (°C) | API Gravity | Oil Persistence Category/ Classification |
|---|---|---|---|---|---|---|
| MGO/ MDO | 0.842 | 5.0 | -3 | 61.5 | 36.5 | Group II or III (Light Persistent Oil) |

**Marine Gas/Diesel Oil:** Diesel oil is a common marine fuel used in vessel engines. Marine diesel is a mixture of both low/semi-volatile compounds (95%) and also persistent hydrocarbons (5%) and is classified as Group II/III hydrocarbon (ITOPF, 2011). Although classified as persistent, diesels will undergo rapid spreading and evaporative loss in the high energy/dispersive GAB waters and slicks will quickly disperse/break up. APASA modelling

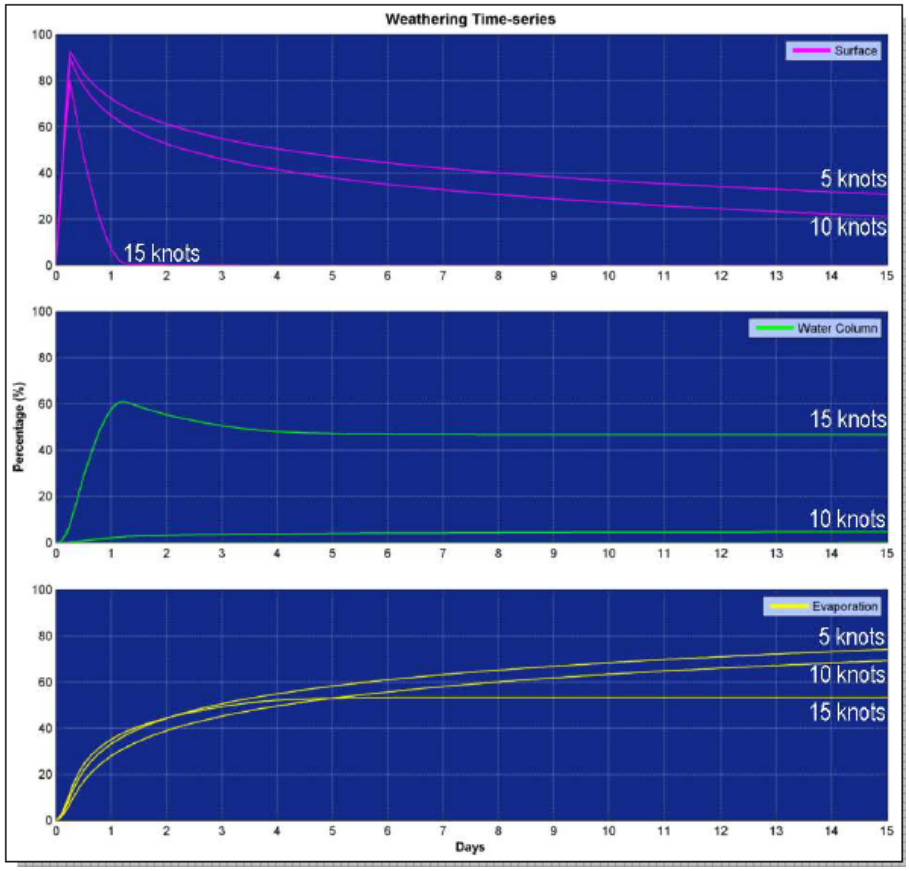
(2012) undertaken for an MGO oil spill identified that MGO has a strong tendency to physically entrain in the upper water column in the presence of moderate winds (i.e. >12knots) or breaking waves and can re-float if these energies abate. Within five days of simulation commencement approximately 50-60% of the total volume will be lost to the atmosphere. Weathering characteristics of MGO are provided in **Figure 5-5**.

MGO/MDO carries very low concentrations of aromatic components. ADIOS (NOAA, 2013) identifies the following aromatic content for MGO/MDO:

- Boiling Point Range <180°C: 1.9mol% (MGO), 1.7mol% (MDO);
- Boiling Point Range (180-264°C): 1.1mol% (MGO), 1.0mol% (MDO); and
- Boiling Point Range (265-380°C): 0.15mol% (MGO), 0.1mol% (MDO).

Generally for components with boiling points <180°C, most components will evaporate within a few hours and for components between 180-264°C evaporation/dissolution will occur within one day (APASA, 2013). Accordingly MGO/MDO after 24 hours has minimal toxicity associated with the weathered residue.

Figure 5-7: Predicted Weathering and Fate Graphs as a Percentage of a Single Spill under Three Wind Conditions (APASA, 2013)




**Spill Size (Zone of Potential Impact [ZPI]):** Oil Spill Trajectory Modelling (OSTM) (APASA, 2013) was performed for a 300m$^3$ MGO over a 6hour period at a point within the MSS area which was closest point to land (South Neptune Island and Kangaroo Island) over the period January to June. This modelling is therefore very conservative and represents the worst case which might be expected from the assumed conservative spill volume. Except for when the MSS vessel is acquiring data along the closest survey line to the coast, all spill trajectories will be seawards of the predicted trajectory used in this EP. *This simulation assumes no oil spill response intervention for the duration of the spill event.*

The following thresholds which have been adopted in this assessment of possible oil spill impacts:

- **Surface Oil Impacts**: Scholten et al (1996) identified that a 25µm thickness would be harmful for most birds which make contact with the surface slick. Additional literature on surface oil impacts to aquatic birds and marine mammals (Engelhart, 1983; Clark 1984; Geraci & St Aubin, 1988; Jenssen, 1994) has identified that the threshold thickness of oil harmful to intersecting wildlife is 10µm (10g/$m^2$). The predicted ZPI for the 10µm threshold is provided in **Figure 5-6** and time to exposure at these thresholds is provided in **Figure 5-7.** An additional threshold thickness of 0.5µm (0.5g/$m^2$) has also been modelled as a sensitivity. This represents the minimum 'visual' threshold thickness but does not represent a level which causes environmental harm. The full APASA study can be found in **Appendix D**.
- **Dissolved (toxic/aromatic) Phase**: $LC_{50}$ concentrations for species impact within the water column is based on global data (French-McCay 2002; French-McCay, 2003) that showed species (115 fish, 129 crustaceans, 34 invertebrate species inclusive of sensitive lifecycle stages such as eggs and larvae) sensitivity ranged from 6-400ppb. On the basis of this global dataset, $LC_{50}$ values of 6ppb (99%species protection), 50ppb (95% species protection) and 400ppb (50% species protection) are defined as threshold concentrations whereby exposure over a 96hr period may result in species impacts. However given the observed rapid weathering and reduction of aromatic content in MDO/MGO over 24hours; in addition to the dispersion present in the marine environment, concentrations of dissolved phase components will not remain in the marine environment for *sufficient* time (i.e. 96hrs) for any toxic impacts to be realised. *Dissolved phase impacts are therefore not considered further in this document*.
- **Dispersed (entrained) Phase:** Oil spill impact thresholds are derived from OSPAR Predicted No Effects Concentrations (PNEC) for dispersed oil based upon chronic hydrocarbon exposure values converted to acute exposure levels. These thresholds equate to:
    - $LC_{50}$ (99% species protection): 700µg/l (ppb) (low exposure);
    - $LC_{50}$ (95% species protection): 7,050ppb (medium exposure); and
    - $LC_{50}$ (50% species protection): 80,400ppb (high exposure).

  OSPAR (2012) has published accepted PNEC for 'dispersed oil' of 70.5ppb (95% species protection) and 804ppb (50% species protection) for Produced Formation Water which is representative of entrained oils which have been 'water-washed' (i.e. oils which have had significant portions of soluble toxics removed through evaporation/dispersion). These PNEC levels represent accepted long term 'chronic' exposure levels from continuous point source discharges in the North Sea, one of the most concentrated areas in the world for oil and gas production and have been based upon biomarker testing specifically looking at DNA damage and oxidative stress (Smit et al, 2009) for a variety of oils. Utilising methodologies contained in USEPA Guidelines (1986) to establish $LC_{50}$ data from these PNECs, $LC_{50}$ values have been derived by applying a factor of 100 to the PNEC values. This 'threshold' approach is considered representative of 'weathered' entrained MDO/MGO in the water column, given the low level of aromatics within the fuels, the rapid evaporation of lighter ends on release (surface) and water-washing of entrained hydrocarbons within the marine environment in the first 24hrs.

  Dispersed (entrained oil) phase effects will be present during high wind conditions and weathering data provided by APASA identifies at 96hrs (i.e. relevant $LC_{50}$ exposure period) identifies that at least 50-60% of the spilt MDO/MGO will have evaporated with the remainder possibly entrained within the water column. **Appendix E** provides the calculation basis for establishing the area affected by, and for assessing impacts associated with, dispersed (entrained oil) from such a spill.

  To achieve a concentration of 700ppb (µg/kg)(i.e. a 99% species protection trigger) after 96hrs within the upper 5m of the water column the spill footprint would occupy a footprint of approximately 3250Ha equivalent to a 6.6km x 6.6km area.

Currents within the region move parallel to the shoreline predominantly in a WNW-ESE direction. Calculations provided in **Appendix E** identify that the leading edge of the spill concentration may travel between 26-43km/day in a direction which is parallel to the shelf-break and adjacent shorelines. After 4 days the dispersed oil may travel up 160km, but given the Leeuwin current in the area is not expected to entre coastal waters. Factors which will decrease entrained oil concentration levels not considered in this assessment include the time period over which the original leak occurs, evaporation which occurs after 24hrs and dispersion along the spill corridor due to minor cross currents. Hence this assessment is very conservative.

Given the distance from shoreline environmental sensitivities (~70km and the additional dispersion expected by local currents over the 96hr period, dispersed (entrained oil) phase concentrations are expected to be significantly below 700ppb (99% species protection) within a short distance from the spill area running parallel to the shoreline.

- **Shoreline Accumulation of Hydrocarbons**: French-McCay (2009) in a review of literature associated with oiling of inter-tidal habitats (wetland, rocky shore, gravel and sand beach, and mudflat) identified the following threshold observations for shoreline impacts:
    - Marsh/Mangroves Species: Oil thicknesses of more than 1mm (1000g/m$^2$) during the growing season is expected to impact these species; and
    - Inter-tidal Invertebrates: Oil thicknesses of 0.1mm (100g/m$^2$) for benthic epifaunal invertebrates on hard substrates (rocky, artificial/man-made, etc.) and sediments (mud, silt, sand or gravel).

  These threshold levels have been nominated as trigger levels for possible impacts to these habitats/species.

Oil spill modelling, based on 200 scenarios, was undertaken from a nominated release site (35°35.71'S, 135°26.05'E) *conservatively* selected as it was the closest point within the survey area to the mainland and coastal islands. The modelling has predicted the following:

- Surface oils in thicknesses ~0.5g/m$^2$ (i.e. very low exposure) did not persist for more than 5.5days and for thicknesses of 10g/m$^2$ (i.e. moderate exposure) approximately 24hours. The ZPI defined by surface oiling at 10g/m$^2$ does not intersect identified marine sensitive areas where marine mammals and birds may concentrate (e.g. North and South Neptune Island). **Figure 5-6** shows the probability for sea-surface exposure for the minimum threshold thickness of 0.5g/m$^2$ and 10g/m$^2$ and **Figure 5-7** provides details of the predicted minimum time surface oiling at the designated thresholds remains on the sea-surface.
- Predicted Shoreline impacts are provided in **Table 5-9**. As provided in that table, there is a very low probability of hydrocarbon accumulation in excess of 0.5g/m$^2$ on Eyre Peninsula, North and South Neptune Islands (<1% probability) with no possibility of accumulation in excess of 1g/m$^2$. Based upon oil spill modelling predictions, no impacts to shoreline environments are expected based on the adopted shoreline environmental thresholds (>100g/m$^2$).

Table 5-9: Predicted Shoreline Contact (APASA, 2013)

| Location | Minimum Time (days) [Hours] before shoreline contact above 0.5g/m² | Probability (%) of shoreline contact above 0.5g/m² | Probability (%) of shoreline contact above 1.0g/m² |
|---|---|---|---|
| Eyre Peninsula – Lincoln National Park | 3.6 [85] | 1 | - |
| Northern Neptune Islands Conservation Park | 1.5 [37] | 1 | - |
| Southern Neptune Islands Conservation Park | 1.4 [33] | 1 | - |
| William Island | - | - | - |
| Thistle Island | - | - | - |
| Wedge Island | - | - | - |
| Yorke Peninsula | - | - | - |
| Kangaroo Island | - | - | - |

**Environmental Sensitivities within the ZPI & Assessment of Consequence:** Sensitivities which are present within the marine ZPI and the consequence assessment of MDO contact are provided in **Table 5-10**.

The potential effects of a hydrocarbon spill on the marine environment varies based upon factors such as the weather and sea state at the time of release, response measures and the sensitivities of the habitats and the species potentially affected. In the open ocean habitat, where most of the survey activities will occur any diesel spill would be subject to rapid dispersal, weathering, evaporative losses and dissipation through the water column. Potentially affected biota include seabirds, cetaceans, turtles, sea lions, fur seals or commercial fishing and fishing equipment which might come into contact with a surface diesel slick in the period prior to its disappearance. Contact with hydrocarbon slicks may have lethal or sub-lethal physical effects to seabirds, cetaceans, sea lions, seals and turtles due to internal and external exposure; or may damage commercial fishing equipment.

Elevated concentrations of entrained hydrocarbons associated with the surface diesel slick would only affect pelagic organisms (~upper 5m) present in the surface waters of the spill area if exposure concentrations are elevated for sufficient timespans (i.e. 96hrs). However, due to the characteristics of diesel and its rapid natural degradation and dispersion in the marine environment, the temporal and spatial effects are expected to be limited. Air breathing fauna, such as cetaceans and turtles, would also have an inhalation risk if they surfaced in a fresh slick, although the extent and duration of this potential exposure would be limited due to the rapid evaporation rates of volatile components of diesel.

Table 5-10: Marine ZPI Environmental Sensitivities and Assessment of Consequence

| Specific Sensitivity | Sensitivity to Oil Spills and Assessment of Consequence |
|---|---|
| Cetaceans | **Cetaceans** may be present in the marine waters of the Lightning survey area however at the time of the survey (March to May), the area is not expected to represent a significant feeding ground for the Blue Whale (i.e. feeding presence is generally November-December). It is expected that threatened cetacean presence in the area, will be migratory to breeding grounds located in Indonesia (Blue Whale) or southern coastline (Southern Right Whale from mid-May).<br>As cetaceans have smooth skins and limited pelage, there is limited opportunity for oil adhesion to the species skin, however they may be impacted by surface oil exposure during surfacing events which may lead to aspiration hazards which are present in fresh spills (GESAMP, 2002). Exposure could damage mucous membranes or damage airways during surfacing events (AMSA, 2011b). Dispersed (entrained) oil within the upper water column at low concentration levels is not expected to affect the species.<br>Also, it is possible that Baleen whales which skim the sea surface for food are more likely to ingest oil compared with the 'gulp feeders' or toothed cetaceans (AMSA, 2011b). Tar-like residue adhesion to the whale's baleen plates can adversely affect the feeding of the animal. As refined products, such as diesel, are not very sticky or viscous compared with black oils (some crude oils and heavy fuel oils) adhesion to baleen plates is not likely (AMSA, 2011b) and entrained oil within the water column is not expected to cause impacts. Additionally, between March and May, migrating Blue Whales are unlikely to be feeding within the Lightning MSS area.<br>French-McCay (2009) identifies a 10-25µm oil thickness threshold has the potential to impart a lethal does to intersecting wildlife, however also estimates a probability of 0.1% mortality to cetacean species if they encounter these thresholds based on the proportion of time spent at surface.<br>As cetacean presence is expected to be transitory in the survey area during March to May; and given the rapid weathering of the volatile (toxic) components within the diesel in the first 24hrs of the spill; the limited time (~24hours) and spatial area of the surface diesel slick at 10µm (~80% of all spill trajectories occur within 10km of the spill site); it is very unlikely that impacts at a population level (i.e. individuals only) will result.<br>*No oil spill environmental (scientific) monitoring to the species is justified on this basis.* |
| Turtles | Marine turtles may be present in the marine environment of the Bight Basin, however their precence will be transitory. No nesting beaches are found in South Australian waters hence hatchlings and juveniles are not expected in the area.<br>Marine turtles are vulnerable to the effects of hydrocarbon spills at all life stages (eggs, post hatchlings, juveniles and adults) while in the water or onshore (NOAA, 2010). Contact with hydrocarbons can have lethal or sub-lethal effects or may impair mobility. As for cetaceans, turtles through surfacing activities may contact a surface slick which may coat the species and allow for inhalation exposure. On contact with the slick, turtles may experience skin irritation and injury to airways or lungs, eyes and mucous membranes of the mouth and nasal cavities (AMSA, 2011b). Evidence from the Montara crude oil spill, identified that turtles also exhibit severe dermal pathologies (particularly in the softer skin of the neck) through surfacing behaviour (Gagnon, 2010). Adult sea turtles spend 1-10% of their time at the surface with each dive lasting between 30-70minutes (French-McCay, 2009). Dispersed (entrained) oil within the upper water column at low concentration levels is not expected to affect the species.<br>French-McCay (2009) identifies that a 10-25µm oil thickness has the potential to impart a lethal dose to intersecting wildlife and estimates a probability of 5% mortality to turtle species, if they encounter surface oil more than 10µm thick, based on the proportion of the time turtles spend at surface.<br>Given the rapid weathering of the volatile components with the diesel in the first 24hrs of the spill; the limited time (~24hrs) and spatial area of the surface diesel slick at 10µm ~80% of all spill trajectories occur within 10km of the spill site); and the low likelihood of encounter in the Lightning survey area, it is highly unlikely that significant numbers of turtles will be exposed to harmful thresholds (i.e. no population level impacts).<br>*No oil spill environmental (scientific) monitoring is justified on this basis.* |

| Specific Sensitivity | Sensitivity to Oil Spills and Assessment of Consequence |
|---|---|
| Pinnipeds | The Australian Sea Lion and New Zealand Fur Seal are present within the region. The closest breeding area for Sea Lions is located at Dangerous Reef (approx. 110km NE of the survey area) and for New Zealand Fur Seals at Liguania Island located 65km to the north. The ZPI defined by the 10µm surface oiling contour does not impact on these sensitive areas however adult male Sea Lions and fur seals (both sexes) may be present on a transitory basis in the Lightning survey area foraging.<br>Direct oiling of sea lion or fur seal pups can induce hypothermia by destroying their lanugo insulation. Adult fur seals have blubber and do not suffer from hypothermia if oiled. Particular types of oil residue (e.g. sticky oils such as heavy fuel oil not diesel) can 'stick' flippers to sea lion and seal bodies preventing escape from predators. Oil residues may also disguise scent that pups and mothers rely upon to identify each other leading to pup abandonment and starvation; and ingestion of oil may damage digestive tracts, suppress immune systems or damage mucous membranes (AMSA, 2011b).<br>French-McCay (2009) identifies that a 10-25µm surface oil thickness threshold has the potential to impart a lethal dose to intersecting wildlife and estimates a probability of 75% mortality to fur-bearing marine mammals, if they encounter surface oil more than 10µm thick, based on the proportion of the time the species spends on the sea surface.<br>Dispersed oil at low concentrations within the upper water column is unlikely to impact on the species during foraging activities (refer **Section 3.3.5**) as the species are air-breathing and benthic foragers which food sources unaffected by low level dispersed oil concentrations.<br>Given the rapid weathering of the diesel in the first 24hrs of the spill; and the limited time (~24hours) and spatial area of the surface diesel slick at 10µm; it is highly unlikely that significant numbers of pinnipeds will be exposed to harmful surface oil thresholds prior to the natural weathering of the slick. The location of the Lightning survey lies at distances greater than 65km from the nearest colonies and surface oil (~0.5µm or 0.5g/$m^2$) are not expected to affect pinniped pups. No impacts at a population level are expected.<br>*No oil spill environmental (scientific) monitoring to the species is justified on this basis.* |
| Migratory Seabirds | The marine environment supports migratory albatross and petrel species which may forage or over-fly the area, however low density presence is expected.<br>Marine seabirds are particularly vulnerable to hydrocarbon spills owing to the high potential for contact at the sea surface where they feed or rest. As most fish survive beneath floating slicks, they will continue to attract foraging seabirds. Oil-coated birds can suffer hypothermia, dehydration, drowning and starvation, and become easy prey. Ingestion of oil can be sub-lethal or acute depending on the type of oil, its weathering stage and inherent toxicity. Effects can include tissue and organ damage, altered metabolism, pneumonia and reduced reproduction capability (AMSA, 2011). The minimum threshold of oil which will result in harm in seabirds through ingestion from preening contaminated feathers, or the loss of thermal protection properties of their feathers has been estimated by different researchers to lie between 10µm and 25µm (French et al, 1999).<br>French-McCay (2009) identifies that a 10-25µm oil thickness threshold has the potential to impart a lethal dose to intersecting wildlife and estimates a probability of 5% mortality to aerial divers such as albatross and petrel species if they encounter surface oil more than 10µm thick, given they overfly habitat most of the time and dive occasionally.<br>Dispersed oil at low concentrations within the upper water column are not expected to impact on pelagic fish, a food source for migratory bird species, given fish mobility in the marine environment and the limited time of exposure to entrained hydrocarbons in the environment.<br>Given the rapid weathering of the diesel in the first 24hrs of the spill; and the limited time (~24hours) and spatial area of the surface diesel slick at 10µm; it is highly unlikely that significant numbers of marine seabirds will be impacted by the slick prior to its natural weathering to below environmentally significant thresholds (i.e. no population level impacts).<br>*No oil spill environmental (scientific) monitoring is justified on this basis.* |

| Specific Sensitivity | Sensitivity to Oil Spills and Assessment of Consequence |
|---|---|
| Fish/Sharks | Shark species inhabit all levels of the water column and feed on fish and seals. Sharks are mobile and have a transient presence in the survey area (i.e. limited exposure period). In assessing the impacts to fish by oil, the water soluble fraction (dissolved phase) of the hydrocarbon containing the aromatic fraction (benzene, toluene and xylenes) is the most important toxic component. Benzene, the most toxic of the compounds, has a $LC_{50}$ of approximately 10-200ppm[84] (CEDRE, 2000). It is noted that concentrations of dissolved phase oil which may cause harm (i.e. acute toxicity) to marine species in open water spills are unlikely to occur given the concentration of dissolved phase compounds below the slick ranges from a few parts per million to less than 0.1ppm (IPIECA, 2000). Additionally, MDO/MGO carries very low levels of aromatics which are rapidly lost from the spill (~24hrs), and fish species, if exposed, would need substantially longer exposure times (e.g. 96hrs) for species impacts to be realised. Adult free-swimming fish seldom suffer long-term damage from oil spill exposure because any dissolved phase concentrations of oil in the water will only rarely reach sufficient levels to cause harm[85]. Therefore impacts to adult fish/shark species from the MDO/MGO spill are considered very unlikely.<br><br>Low level dispersed phase oil concentrations predicted from this spill event (99% species protection levels) are not expected to have lethal impacts on adult fish/shark species. This is further supported by the mobility of these species within the area and the water column; and the limited exposure time of the MDO/MGO spill.<br><br>Eggs, larvae and young fish are comparatively sensitive to oil (particularly dispersed oil), as demonstrated in laboratory toxicity tests (AMSA, 2011), however there are no case histories to suggest that oil pollution has significant effects on fish populations in the open sea. This is partly because any oil-induced deaths of young fish are often of little significance compared with huge natural losses each year through natural predation and as fish spawn over large areas (AMSA, 2011). The region supports a significant finfish fishery (sardine and anchovy) with peak spawning periods for the species during January to March. Sardine and anchovy eggs and larvae are widely distributed in shelf waters during that time with higher densities in areas of high zooplankton mass (predominantly on shelf areas to the west of Kangaroo Island and Eyre Peninsula) (Dimmlich et al, 2004; cited in Pattiaratchi, 2007).<br><br>While an oil spill may lead to localised impacts on eggs and larvae which are entrained in the upper water column, fish population impacts are not considered significant given the short period dispersed oil components are present; the predominant movement of the plume parallel to the coastline with limited excursion onto shelf areas and the limited areal extent of the MDO/MGO spill. *No oil spill environmental (scientific) monitoring is justified on this basis*. |

[84] Species dependent
[85] Source: ITOPF Technical Information Paper No 3: Oil Spill Effects on Fisheries (2010)

| Specific Sensitivity | Sensitivity to Oil Spills and Assessment of Consequence |
|---|---|
| Commercial Fishing | Surface oil can foul vessels/equipment used to catch commercial fish and transfer contaminants to the catch. For fisheries operating in the Bight Basin, this would occur when demersal trawl/line and trap or pots are retrieved through surface slicks to the vessel OR if SBT pontoons are caught within the slick. Fisheries exclusion from the slick area would be expected for the duration of the oil spill. Notification of the incident to AMSA with resultant marine vessel and radio warning (Channel 16) to relevant stakeholders in the event of a spill will minimise the likelihood of impact to fisheries.<br><br>As per above, target species, which are primarily demersal species would not be expected to be affected by upper water column hydrocarbons presence from an MDO/MGO spill. Based on the 2013 season, SBT pontoons may be present in shelf waters to the north of the survey area up to the end of February and as a contingency the MSS program has allowed for the possibility of pontoons being present during March. Given survey activities will be undertaken off shelf waters (i.e. deep water racetrack) in March if SBT pontons are present, and given the prevailing current regime which runs parallel to the coastline, this fishing equipment is not expected to be affected by an oil spill should it occur during March (predominant current direction is WNW).<br><br>Studies have indicated that fish tainting may occur at low hydrocarbon concentration exposures (~250ppb) (Davis et al, 2002). Tainting is reversible but, whereas the uptake of oil taint is frequently rapid, the depuration process where contaminants are metabolised and eliminated is slower (weeks to months) (ITOPF, 2004) making commercial species unpalatable. As the MDO/MGO spill is surface based, dispersion of hydrocarbons within the upper 5m of the water column is expected. Commercial fishing known to be undertaken in the area involving pelagic species include Southern Bluefin Tuna. The Small Pelagic Fishery and Southern Squid Jig Fishery are not expected to be present in the MSS area (refer **Section 3.4.3** and **Section 5.4.1**). Other pelagic fisheries such as the Sardine Fishery and Marine Scale-fish Fishery operate inshore from the Lightning MSS area.<br><br>Based upon MDO/MGO weathering characteristics areas of entrained (dispersed) hydrocarbon concentrations which may cause fish tainting are considered very isolated spatially and if a spill occurs will move in a plume parallel to the coastline. In the March timeframe, if SBT pontoons are present and should a 300m³ oil spill occur, dispersed oil will remain in deeper waters parallel to the coastline. No impacts to commercial fish species (i.e. fish tainting) is expected. No oil spill environmental (scientific) monitoring is justified on this basis. |

Figure 5-8: Plot showing the **probability of sea surface exposure** (reported to **0.5 g/m²** (top) and **10 g/m²** (bottom)), in the event of a 300 m³ release of diesel over 6 hours following a vessel spill incident (APASA, 2013)

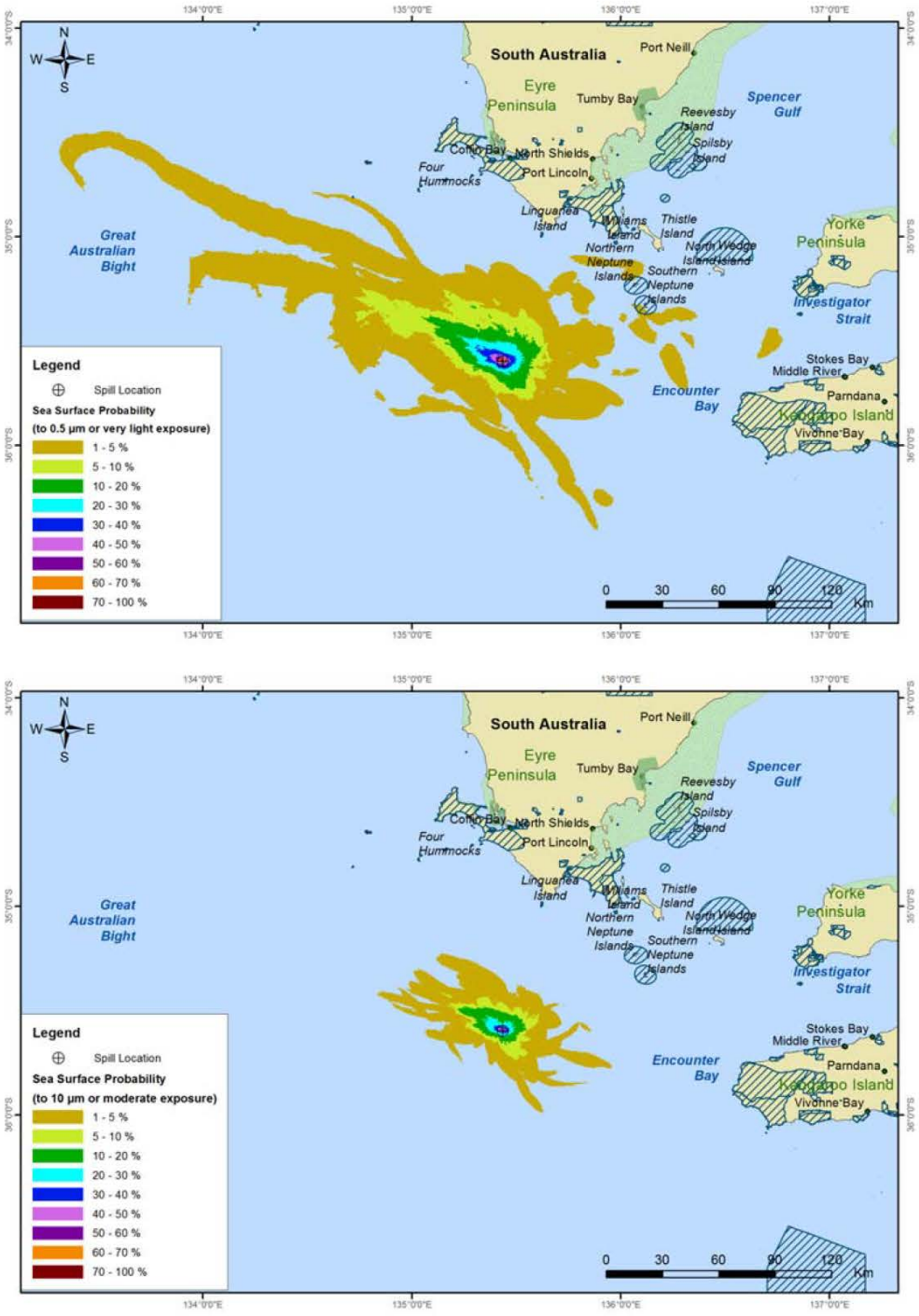
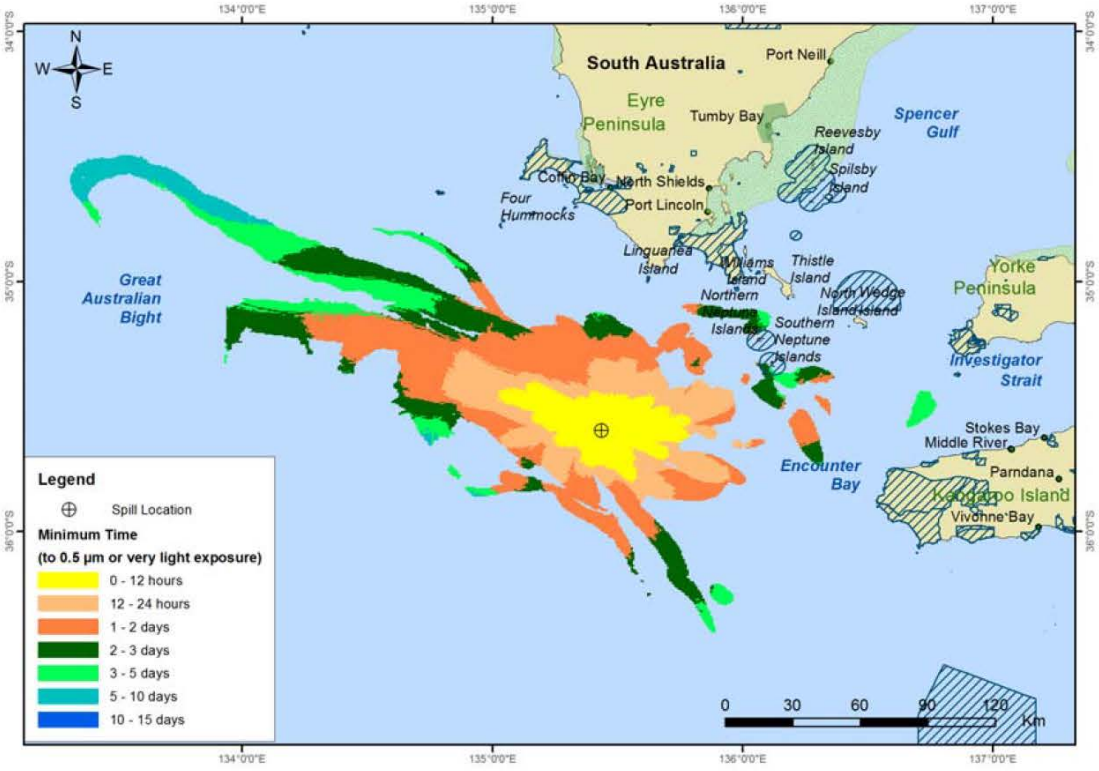
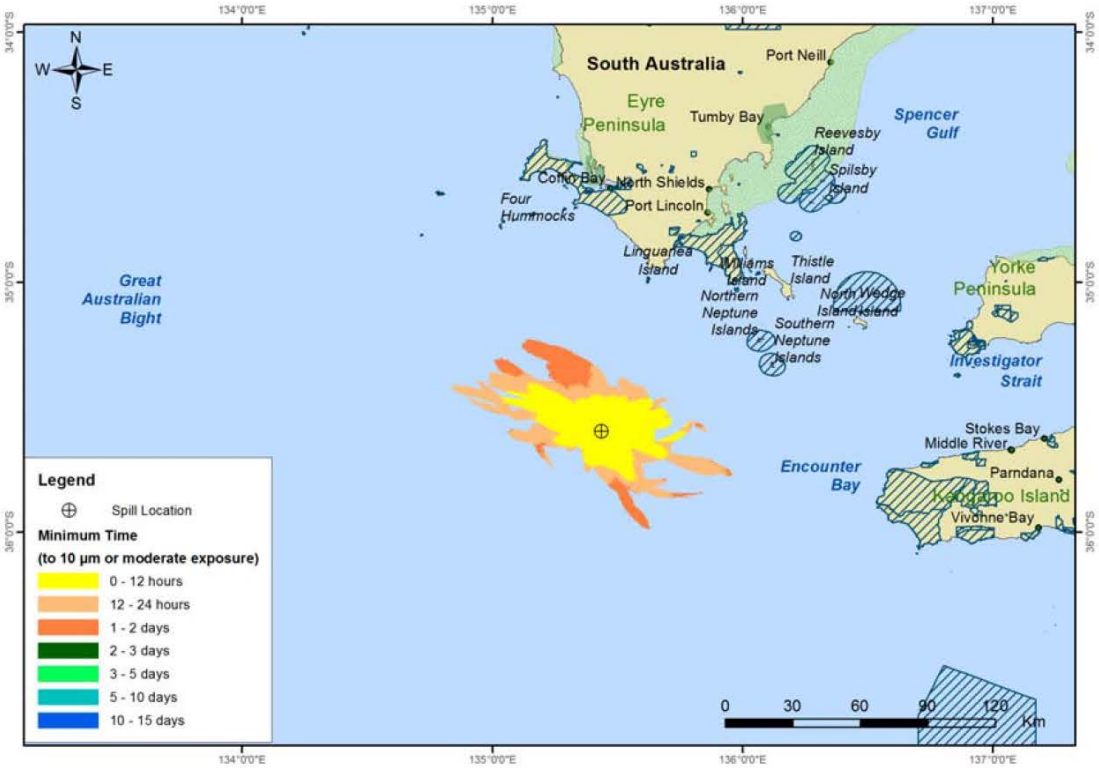


Figure 5-9: Plot showing the **minimum time to sea surface exposure** (reported to **0.5 g/m²** (top) and **10 g/m²** (bottom)), in the event of a 300 $m^3$ release of diesel over 6 hours following a vessel spill incident (APASA, 2013)



**Mitigation Measures:** The seismic and support vessels involved in the Lightning MSS operations operate under an approved Shipboard Oil Pollution Emergency Plan (SOPEP) (or equivalent for class) in accordance with MARPOL 73/78 Annex I requirements and as required by the *Protection of the Sea (Prevention of Pollution by Ships) Act 1983* Section 11A. Information contained in the SOPEP includes personnel responsibilities for the deployment and maintenance of response equipment; the emergency plan in case of pollution; communications/contacts required in the event of a spill (i.e. AMSA details); measures to control and limit the oil flow; and the required forms to be completed and transmitted.

For a collision incident involving a vessel resulting in a spill, actions taken by the vessel master would typically include:

- Make safe the vessel and crew;
- Immediate notification to AMSA (in Commonwealth waters) in the event of a vessel collision and/or possible oil spill[86] advising on location, oil spill volume, nearby sensitivities, etc.;
- Implementation of SOPEP remedial measures to limit volumes spilt (i.e. close water tight doors, check bulkheads; assess damage; determine whether vessel separation will increase spillage; isolation of penetrated tanks; possible tank lightering, etc.);
- AMSA, as vessel-based marine oil spill Combat Agency in Commonwealth waters (AMSA, 2012), activates the National Marine Oil Spill Contingency Plan (NATPLAN) (2011a) to respond to oil spill threats. AMSA will determine the appropriate response strategy for the spill type, location and protection priorities which are threatened via a Net Environmental Benefits Assessment (NEBA)[87].

Note that all vessels are required to undertake routine SOPEP testing/drills to ensure all crew are trained in the response requirements. The SOPEP is routinely reviewed and updated such that the document remains relevant and current.

Lightning MSS oil pollution emergency plan (OPEP) arrangements as described in **Section 8** will be implemented to ensure that all relevant parties are advised of the incident and sufficient and appropriate resources are deployed to combat and minimise all potential environmental impacts associated with the spill.

A campaign specific oil spill response drill will be undertaken prior to commencement of the Lightning MSS program. This will take the form of a desk top exercise involving all parties with an interest in the vessel operations including Bight Petroleum (refer to **Section 8.5** for details).

#### *5.7.1.2 Environmental Risk Assessment*

**Spill Event:**

The environmental consequences associated with a MGO/MDO from a collision incident (assumed to be a worst case spill of 300m$^3$ over six hours) is considered to have the potential consequences to the marine environment only at oil spill thresholds which are

[86] All spills in excess of 15litres must be reported to AMSA the statutory agency for vessel-based marine oil spills.
[87] Bight has undertaken a NEBA associated with an MGO/MDO/Isopar spill in the Lightning MSS area with results provided in **Appendix B**. At the time of any spill, AMSA as Combat Agency for vessel-based marine oil spills have verbally advised that they will undertake a NEBA to ensure that the environmental risk associated with the adopted oil spill response strategies is ALARP. AMSA have also verbally advised that all available response strategies under NATPLAN would be considered for any vessel-based Commonwealth marine oil spill event and will be dependent on the resources at risk, weather and the type of fuel spilt. Criteria for spill response termination will also be determined by AMSA (expected to be no visible sheen [Bonn Convention]). On the basis of the NEBA undertaken by Bight, given the fuel type and distance from landfall, a natural weathering/surveillance monitoring response strategy has the least environmental impact for the oil spill scenarios possible during the survey. It is expected that AMSA (under NATPLAN arrangements) will adopt this oil spill response strategy. Bight will consult with AMSA on oil spill response strategy and termination criteria during any oil spill event (refer **Section 8**).

considered significant (Commonwealth waters only). Under the Bight Qualitative Risk Matrix a Tier 2 spill (>10tonnes) is defined as a major impact (Consequence 4).

Analysis of oil spill frequency data for eastern GAB waters from vessel incidents (i.e. area coincident with the Lightning MSS area – 12 to 50nm from shoreline) indicates the following frequency of spills (from all causal pathways including collision) (DNV, 2011) over 1 and 100tonnes as low at 0.0001 to 0.001 (1 event every 1000-10,000years)[88]. While DNV (2011) compares the frequencies to Australian averages, the report identifies that in absolute terms, oil spill frequencies in all Australian sub-regions are considered low to very low.

Additionally, based upon a review of the Australian Transport Safety Bureau's (ATSB) marine safety database[89], there have been no instances of collision, grounding or sinking of a petroleum activity related survey vessel in Australian waters for the past 30 years.

On this basis, the likelihood of a collision event, resulting in a 300m$^3$ oil spill during the MSS is considered very unlikely with the preventative controls implemented. The residual environmental risk is therefore assessed as medium.

**Spill Response:**

Given the weathering and dispersion characteristics of MDO/MGO, and the limited effectiveness of other response strategies such as containment/recovery and dispersant application, a natural weathering/monitoring response strategy is the expected 'preferred' response strategy for the spill. An assessment of the consequences to environmental sensitivities present in the ZPI as a result of adopting this type of response strategy is provided in **Table 5-10**. All consequences are acceptable and the risk carried by the response strategy is low. In the event of a spill this would be confirmed though a spill-specific NEBA assessment by AMSA.

The EPO for vessel collision oil spills during the Lightning MSS; and a summary of performance standards relating to the adopted control measures is shown in the table below.

| Environmental Hazard/ Aspect | *Oil Spill due to Collision/Fuel Tank Leak/Rupture* | |
|---|---|---|
| Performance Outcome | *No collision incidents or serious near-misses[90] during the survey with third party vessels.* | |
| Measurement Criteria | *Incident records indicate no collision incidents for the survey activity.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Vessels selected to undertake Lightning MSS activity meet class and safety audit requirements. | Vessels selected for the MSS activity will provide:<br>• Valid and current class certification;<br>• Crew details which meet (STCW95) requirements;<br>• Records showing maintenance performance requirements are satisfied<br>• Safety Audit with evidence of corrective action completion (as appropriate). | Records of criteria are provided to Bight Project Manager as part of Contract Award. |
| Navigational safety equipment (AIS, navigation lighting, day shapes, ARPA and radio) is present on all vessels involved in the survey. | Vessels selected for the MSS conform to the hardware requirements of AMSA Marine Order 30: Prevention of Collisions – including AIS, navigation lighting, day shapes, ARPA and *Marine Order Part 27 – Radio Equipment* for radio equipment to ensure navigation safety equipment is present on vessels to prevent a collision. | Pre-mobilisation audit records identify that navigation lighting, AIS, ARPA and radio is present and functional in all vessels |

[88] Reference: DNV (2011) – Figure 3.2 (page 21)
[89] http://www.atsb.gov.au/publications/safety-investigation-reports.aspx?s=1&mode=Marine&sort=OccurrenceReleaseDate&sortAscending=descending&occurrenceClass=&typeOfOperation=&initialTab=
[90] Defined as an incident whereby the streamers are sacrificed to avoid collision.

| Environmental Hazard/ Aspect | *Oil Spill due to Collision/Fuel Tank Leak/Rupture* | |
|---|---|---|
| Performance Outcome | *No collision incidents or serious near-misses[90] during the survey with third party vessels.* | |
| Measurement Criteria | *Incident records indicate no collision incidents for the survey activity.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| | Navigation safety equipment (ARPA, AIS, radio, navigation lights is maintained in accordance with Manufacturer's specifications via the Vessel(s) Planned Maintenance System (PMS) to ensure functionality for the duration of the MSS | PMS records verify navigation safety equipment - ARPA, AIS, radio, and navigation lights - is operating to specification. |
| Notification to AMSA RCC of the Lightning MSS activity | AMSA RCC will be notified two weeks prior to the MSS activity commencing. The notification will describe the locations, activities and durations of the MSSs. | Records verify the AMSA RCC AusCoast warning for the duration of the Lightning MSS activity |
| Support/chase vessel available to prevent spatial conflicts with shipping | A support vessel will scout within the MSS area for the duration of the MSS activity to ensure that possible spatial conflicts between MSS and other vessels are avoided. | Vessel logs verify support vessel is present in the MSS area for the duration of MSS activities. |
| AHO issue of Notice to Mariners | AHO is advised 2-3 week prior to Lightning MSS commencement to allow for the issue of a Notice to Mariners.<br>The notification will describe the location, activity and duration of the survey. | Records verify that Notice to Mariners issued by AHO prior to Lightning MSS commencement |
| Marine crew undertaking watch activities are trained and competent | All marine crews are trained, experienced and competent to the *International Convention on Standards of Training, Certification and Watch-keeping for Sea-farers (or equivalent).* | Training and Competency Records indicate that all relevant marine crew are competent to STCW95 standards (or equivalent). |
| Vessels maintain a 24/7 watch for commercial vessels | All marine crews will maintain a 24/7 watch for third party vessels for the duration of the MSS activity. | Records of bridge watch activities show adherence to these requirements. |
| Vessel Interaction Procedures are implemented to prevent third party impacts to streamers | Induction program reinforces the Procedural Control Standards (Section 5.7.1) such that all personnel are familiar with requirements to prevent interference with streamers/vessels. | Records of induction program content contains vessel interaction procedural requirements |
| | | Induction records indicate that all field personnel have completed the Environmental Induction. |
| Current Vessel SOPEP is available to respond to vessel-based oil spills | The vessel has an approved current SOPEP consistent with the *IMO Guideline for the Development of Shipboard Marine Pollution Emergency Plans (or equivalent for class).* | As appropriate, records verify the SOPEP (or equivalent) is current and approved. |
| | Spill response equipment is located in accordance with SOPEP requirements | Pre-mobilisation audit records verify spill response equipment locations against SOPEP requirements |
| Personnel are trained to undertake spill response in accordance with the SOPEP | Routine drills involving spills are undertaken in accordance with the Vessel Drills Matrix contained in the Vessel(s) SOPEP (or equivalent) to ensure personnel are familiar with their role during an oil spill event. | Pre-mobilisation audit verifies that routine drills have been undertaken in accordance with SOPEP requirements. |
| Personnel are trained in the Oil Spill Response Arrangements for the Lightning MSS | A pre-mobilisation emergency response exercise is undertaken to test the Oil Spill Response Arrangements as detailed in Environment Plan (Section 8) and ensure all parties are familiar with them. | Records indicate that a pre-mobilisation emergency response exercise has been undertaken |

*Oil Spill Response EPOs, Standards and Measurement Criteria are provided in* ***Section 8.7.***

### *5.7.1.3 Acceptability and ALARP Demonstration*

An evaluation of vessel collision spill impacts and risks, against acceptability criteria detailed in **Section 5.1.2,** is provided below. On the basis of this information, both residual impact and risk associated with the hazard is considered acceptable.

| *Acceptability Demonstration* | |
|---|---|
| Meeting Bight Petroleum HSE Policy Objectives: | This risk management strategy for vessel collision spills reflects Bight's HSE Policy goals of proactively identifying hazards, eliminating risks where possible and where this is not possible managing the risk to ALARP; and to implement strategies which minimise pollution and promote the active well-being of personnel. |
| Legal Compliance with: | *Navigation Act 2012* (Com) & subordinate legislation (Marine Orders) (implements SOLAS requirements):<br>• Marine Order 21 (Safety of Navigation and Emergency Procedures) 2012<br>• Marine Order 30 (Prevention of Collisions) 2009<br>• Marine Order 58 (International Safety Management Code) 2002<br>*Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Section 11A – Shipboard Oil Pollution Emergency Plan)<br>• Marine Order 91 (Marine Pollution Prevention – Oil) 2006 (Implements MARPOL 73/78 Annex I requirements)<br>*Marine Safety (Domestic Commercial Vessel) National Law Act 2012* (Com) |
| EPBC Protected Matters Assessment: | Oil pollution is identified as a 'pressure' of *potential concern*[91] within the SW Bioregional Plan to the following conservation values: Blue Whale, Southern Right Whale, Humpback Whale, Sperm Whale, Australian Sea Lion, New Zealand Fur Seal, EPBC-listed bird species within the area (refer **Table 3-2**) and the Kangaroo Island KEF. The SW Bioregional Plan (SEWPC, 2012b) identifies the following:<br>• Introduction of a new source of *severe oil spill*[92] which has a reasonable potential of arising in the area of the Kangaroo Island KEF has the potential for 'significant impact' on the Commonwealth Marine environment. The Lightning MSS does not involve drilling only vessel-based activities which are common through the region, with industry-standard controls adopted. Fuel volumes on-board (MGO/MDO) are finite and small (limiting the areal extent of the spill); the fuel evaporates and weathers rapidly (short duration); and remains in the offshore marine environment due to prevailing currents. Given these factors, a Tier 2 oil spill from the MSS vessel does not result in a substantial change in water quality or introduce persistent organic chemicals which modify, destroy, fragment or disturb and important or substantial area of habitat (i.e. *does not trigger significant impact criteria* – EPBC Policy Guidelines 1.1). Additionally, as evidenced in ASTB statistics, the likelihood of a MSS vessel collision is extremely remote with the adopted controls.<br>• Similar issues relate to *pinniped populations* given their vulnerability to oiling & loss of thermo-regulation properties and to *Baleen whales* where oil residue may stick to baleen plates during filter-feeding. These issues are discussed in Table 5-10. The Lightning MSS area includes a portion of the foraging area for male Sea Lions; and the intermittent Kangaroo Island KEF is a foraging habitat for Blue Whales. Given the limited areal/temporal extent of the spill and the characteristics of MGO/MDO (i.e. not sticky) a spill event would not affect species at a population level and does not trigger significant impact criteria for threatened/migratory species (e.g. a reduction in the occupancy area, fragmentation of a population, disruption of breeding cycle or long-term population decrease) (EPBC Policy Guidelines 1.1). Again, as evidenced in ASTB statistics, the likelihood of a MSS vessel collision is extremely remote with the adopted controls<br>• Sea-birds foraging at sea are vulnerable to oiling. As above given the limited areal/temporal extent of the spill (as above), species at a population level will not be affected and s Tier 2 spill event from the MSS vessel would not trigger significant impact criteria for threatened/migratory species (e.g. a reduction in the occupancy area, fragmentation of a population, disruption of breeding cycle or long-term population decrease) (EPBC Policy Guidelines 1.1)<br>*With control measures implemented the action will not significantly impact of items of National Environmental Significance (NES), it meets the requirements of the SW Marine Bioregional Plan and upholds IUCN Management Principles for Marine Reserves (Category VI) (ES, 2002) relevant to the West Eyre Marine Protected Area (MPA).* |
| Social Acceptability: | Stakeholders have raised issues relating to significant oil spills associated with hydrocarbon exploration activities (i.e. drilling) however no issues with respect to vessel-based oil spills have been raised. As the proposed MSS activity presents a similar oil risk exposure as container ships/tankers which transit the region, the activity is considered acceptable from this stakeholder group. |

[91] 'Potential Concern' indicates the conservation value is vulnerable to the identified pressure but there is limited evidence of a substantial impact in the region; and the pressure is widespread or likely to increase in the region; and there are no management measures in place to mitigate potential or future impacts, or there is inadequate or inconclusive evidence of the effectiveness of management measures.
[92] Defined as drilling activities [oil and gas wells] and increased shipping from port construction/expansion (NOT applicable to the Lightning MSS)

| *Acceptability Demonstration* | |
|---|---|
| Risk/Impact are demonstrated to be ALARP: | As per demonstration assessment below, both residual impact and risk has been assessed as ALARP. |

A demonstration of ALARP with respect to residual impacts and risks associated with ship collision spills is provided below. On the basis of this demonstration, both residual impact and risk are considered ALARP when measured against the criteria.

| *ALARP Demonstration* | |
|---|---|
| Hierarchy of Controls: | **Elimination:** Vessels selected meet Class and safety audit requirements. Fuel source used on the survey vessels is MDO/MGO (low persistence in the marine environment).<br>**Prevention:** Marine warnings implemented for all vessels which may utilise the area (AHO, AMSA RCC AusCoast). MSS vessels also carry radar, AIS and ARPA to ensure that marine hazards can be identified in a timely manner and have navigation safety devices (Navigation lights, Radio, Foghorns) to warn third party vessels of presence. Crews maintain 24/7 watch with STCW95 competencies. Survey utilises support/scout vessels to identify possible third party impacts and warn shipping of the hazard. Survey area reduced to smallest practicable area. Survey duration reduced as far as possible through use of a multiple streamer vessel.<br>**Reduction:** MSS vessel will take avoidance action to minimise serious spatial conflict (i.e. threat of collision) and divert from seismic line or sacrifice cables and divert to prevent collision.<br>**Mitigation:** Current vessel SOPEP available to respond to vessel-based oil spills with response equipment contained on-board. Crew are drilled in SOPEP response requirements. Personnel also trained in Lightning-specific OPEP requirements.<br>NEBA identified that preferred oil spill response strategy is a 'monitoring and surveillance' response (no active intervention) given the degradation and weathering characteristics of the MDO/MGO, the distance offshore and the predicted impacts to environmental sensitivities (refer **Appendix B**).<br>*No additional controls can be identified which reduce impacts or risks further (refer to options analysis).* |
| Compliance with Industry Standards and Codes: | Code of Environmental Practice (APPEA, 2008) objectives met for offshore geophysical operations.<br>National Standard for Domestic Commercial Vessels<br>Guidelines for the Development of Shipboard Oil Pollution Emergency Plans (IMO)<br>National Marine Oil Spill Contingency Plan 2011 (NATPLAN) |
| Comparative Assessment of Options: | Limited exploration techniques are available to the oil and gas industry to identify hydrocarbon reservoirs. Alternate technologies such as marine CSEM (still requires vessel) and satellite imaging technology provide insufficient resolution for defining drilling prospects and are not a viable alternative to seismic surveys. Marine vessels are required to undertake MSS activities. Technologies are not available to eliminate the use of hydrocarbons as fuel on vessels.<br>A 'do-nothing' approach (i.e. no survey) does not align with obligations contained in work-plans approved as part of the permit release with the Australian Government.<br>The Lightning MSS area has been designed to cover the most prospective parts of EPP-41 and EPP-42 and minimise the duration of the survey period through a multi-streamer vessel (hence exposure period has been minimised).<br>Similar to other vessels transiting the area, the MSS vessels adopts industry-standard navigation warning and safety measures. Additional oil industry-standard measures include the use of support/escort vessels to assist in identifying collision hazards and emergency procedures which will allow the MSS vessel to severe cables and divert to avert collision threats.<br>The MSS vessel could consider carrying less fuel, however this would result in less endurance capability (hence potentially more port calls, associated fuel consumption in transit activities and increases to survey duration) or increased vessel-to-vessel refuelling which carries a higher spill risk. *Both options are considered unsuitable from an "additional" risk/impact perspective given the likelihood of vessel collision is remote based upon ASTB marine safety statistics.*<br>Standard marine industry SOPEPs (or equivalent documents appropriate to Class) will be available on all vessels to mitigate any vessel-based oil spills. SOPEP requirements are integrated with Lightning OPEP requirements consistent with the Australian NATPLAN. All spill response plans will be tested prior to mobilisation. |

| *ALARP Demonstration* | |
|---|---|
| Comparative Assessment of Options: | Spill response strategies for hydrocarbon liquids spills were assessed via a NEBA to determine the least impact response strategy whilst still meeting spill response objectives (refer **Section 8** and **Appendix B**). The Lightning MSS is located in oceanic waters where MDO/MGO[93] spills rapidly weather and disperse. OSTM has determined that environmental impacts associated with the spill, without oil spill response intervention remains within marine waters without landfall impact above environmental impact thresholds. Given the limited spill size and temporary nature of a MDO/MGO spill in the survey area, a natural weathering/dispersion strategy was considered to be the most effective/least environmental impact response strategy, providing a low risk to protection priorities identified in the ZPI.<br>*No additional options/controls can be identified which can further reduce the residual impact and residual risk associated with oil spills from MSS vessels.* |
| Hazard/Risk Criteria: | In accordance with the Bight Petroleum Qualitative Risk Matrix, the residual risk associated with this hazard is assessment as medium. On this basis, additional risk measures should be identified and assessed for practicability (refer *Comparative Assessment of Options Section*).<br>On the basis that no additional practicable controls can be identified to further reduce IMS impact and risk, and, in accordance with the Bight Risk Tolerability Criteria provided in **Section 5.1**, the residual impact and risk control strategy is considered ALARP. |
| Cost Benefit Analysis: | Not applicable to this assessment. |

## 5.7.2 Chemical/Oil Spill through Deck Drain System

### *5.7.2.1 Activity & Background*

Chemical inventories on-board the survey vessels are minimised to the extent practicable. Packaged chemicals/oils used on-board during seismic operations are limited to small quantities of cleaning products, solvents, cable fluid, hydraulic oils, paints and primers, and lithium batteries. These chemicals/oils could potentially leak during handling and enter the marine environment through the deck drainage system. The volume of liquid which could be released is likely to be small and limited to the volumes of individual containers stored on deck. Spills to the marine environment may lead to toxic impacts to marine fauna through contact with contaminated water.

Control measures implemented on the seismic vessel to minimise chemical handling risk include:

- Chemical/oil hazards are isolated from the deck drainage system (i.e. stored in suitable containers in appropriately bunded areas); and
- Information is available to all personnel on chemical/oil handing (i.e. Material Safety Data Sheets are available for all chemicals and hydrocarbons).

On-board deck drainage consists of two distinct areas; drainage from bunded areas (containing chemicals/oils and areas at high risk of spills); and open deck areas which handle 'uncontaminated' water runoff (wash down water, rainwater and sea-spray). To minimise the marine contamination risk from deck drainage the following controls are implemented:

- Deck bunding (e.g. tubs, scupper placement, etc.) provided for temporary activities where there is an increased risk of oil/chemical spill;
- Spill kits are strategically placed near high risk spill locations on all vessels;
- Routine inspection of bunded areas and spill kits undertaken on all vessels to ensure they are adequately stocked and clearly labelled;
- All personnel are aware of appropriate hydrocarbon/chemical spill response requirements through vessel induction;
- Spills are cleaned up immediately, reported through the vessels incident reporting system and contaminated material contained on-board for on-shore disposal;
- Marine impacts from deck wash-down waters minimised by utilising biodegradable detergents; and

[93] MGO is a low environmental impact (persistence) hydrocarbon compared with other marine fuels such as Heavy Fuel Oil which may be carried by other third party vessels transiting the area.

- High standards of house-keeping are maintained on decks.

Vessels will utilise their SOPEP (or equivalent) to respond to vessel-sourced oil spills. Vessel spill exercises are conducted on a routine basis. Further information on the oil spill response arrangements for the Lightning MSS is contained in **Section 8.**

#### *5.7.2.2 Environmental Risk Assessment*

**Spill:**

Given the packaged chemical/oil volumes used and stored during seismic operations are small in volume, the consequence of any chemical spills on deck which entered the marine environment are assessed as minor (i.e. Consequence 2). With the safeguards adopted, the likelihood of chemical spills entering the environment is considered unlikely and the residual environmental risk is assessed as low.

**Spill Response Strategy:**

The spill response strategy identified for this spill event is a natural weathering/surveillance monitoring strategy.

Given the small size of the spill volumes involved in a packaged chemical/oil leak, the limited areal ZPIs (~113m refer to **Table 8.4**) and the rapid evaporation/dispersion of the spill volume expected in the Southern Ocean, impacts to protection priorities if present within the ZPI (whales, turtles, seabirds, sharks) are expected to be negligible (Consequence 1). Given the rapid dispersion and dilution of these releases, species exposure is very unlikely and the residual risk associated with the natural weathering/monitoring response to these protection priorities is expected to be low.

The EPO for chemical/oil spills through the vessel deck drain systems during the Lightning MSS; and a summary of performance standards relating to the control measures adopted and associated measurement criteria is shown in the table below:

| Environmental Hazard/ Aspect | *Chemical/oil spill through deck drain system* | |
|---|---|---|
| Performance Outcome | *No release of packaged chemicals/oils through the deck system to the marine environment.* | |
| Measurement Criteria | *Incident records indicate no release of packaged chemicals/oils through the deck drain system to the marine environment.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Chemical/oil hazards are isolated from the deck drainage system. | Chemicals and oils are stored in suitable containers in bunded areas. | Pre-mobilisation audit records verify chemicals/oils are stored in bunded areas isolated from the deck drain system. |
| Information is available to all personnel on chemical/oil handling protocols | Material Safety Data Sheets are available for all chemicals and hydrocarbons on-board the survey vessels.<br>Content is in accordance with the *Code of Practice on the Preparation of Safety Data Sheets for Hazardous Chemicals* | Pre-mobilisation audit records verify all chemicals/ oils have MSDSs and this information is accessible to all crew members |
| Spill kits are strategically placed (i.e. near high risk spill locations) on all vessels | Vessels have assessed high-risk spill locations and spill kits have been located adjacent to those areas as nominated in the SOPEP. | Pre-mobilisation audit records verify spill kits are located in accordance with SOPEP |
| Marine impacts from deck wash-down waters are minimised by using biodegradable detergents | Detergents used for deck wash-down activities are verified to be non-hazardous and biodegradable | MSDS for detergents used verifies the non-hazardous and biodegradable nature of the product |
| Routine inspections are undertaken to ensure that minimum standards | An inspection regime is implemented on-board the vessel which monitors for, and verifies that: | Pre-mobilisation audit records verify an inspection program is implemented to this standard on survey vessels. |

| Environmental Hazard/ Aspect | *Chemical/oil spill through deck drain system* | |
|---|---|---|
| Performance Outcome | *No release of packaged chemicals/oils through the deck system to the marine environment.* | |
| Measurement Criteria | *Incident records indicate no release of packaged chemicals/oils through the deck drain system to the marine environment.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| are implemented to control deck spill risk. | • Spill kits adequately stocked and clearly labelled;<br>• Bunded areas clear of residues; and<br>• House-keeping is maintained at high levels. | Environment Plan compliance audit records verify implementation of the inspection regime. |
| All personnel are aware of appropriate hydrocarbon/chemical spill response procedures | All field personnel have completed the vessel induction and are familiar with chemical/oil spill response arrangements associated with deck spills. | Induction records indicate that all field personnel have attended. |
| | All deck spills are cleaned up immediately in accordance with MSDS requirements. | Incident records indicate the immediate action taken on discovery of a spill event (i.e. clean-up) |
| Current Vessel SOPEP (or equivalent) is available to respond to vessel-based oil spills | The vessel has an approved current SOPEP (or equivalent) consistent with the *IMO Guideline for the Development of Shipboard Marine Pollution Emergency Plans.* | Pre-mobilisation audit records verify a current SOPEP (or equivalent) is available on-board the vessel. |
| Personnel are trained in spill response | Routine drills involving spills are undertaken in accordance with the Vessel Drills Matrix contained in the Vessel(s) SOPEP (or equivalent) to ensure personnel are familiar with their role during an oil/chemical spill event. | Pre-mobilisation audit verifies that routine drills have been undertaken in accordance with SOPEP (or equivalent) matrix requirements. |

*Oil Spill Response EPOs, Standards and Measurement Criteria are provided in* ***Section 8.7.***

### *5.7.2.3 Acceptability and ALARP Demonstration*

An evaluation of deck spill impacts and risks, against acceptability criteria detailed in **Section 5.1.2,** is provided below. On the basis of this information, both residual impact and risk associated with the hazard is considered acceptable.

| *Acceptability Demonstration* | |
|---|---|
| Meeting Bight Petroleum HSE Policy Objectives: | This risk management strategy for chemical/oil spills through the deck drainage system reflects Bight's HSE Policy goals of proactively identifying hazards, eliminating risks where possible and where this is not possible managing the risk to ALARP; to implement strategies which minimise pollution and promote the active well-being of personnel. |
| Legal Compliance with: | *Navigation Act 2012* (Part 3 – *Vessels Polluting or Damaging the Australian Marine Environment* & Part 4 – *Directions Relating to Foreign Vessels*)<br>*Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Section 26AB – Prohibition of discharge by jettisoning of harmful substances into the sea)<br>• Marine Order 94 (Marine Pollution Prevention – Packaged Harmful Substances) 2014 (Implements MARPOL 73/78 Annex III requirements) |
| EPBC Protected Matters Assessment: | Package oil/chemical spills are not identified as a 'pressure' or potential concern within the SW Marine Bioregional Plan. Similar spill exposures occur in these regional waters as a result of commercial vessel transit.<br>Deck (chemical/oil) spills from survey activities (i.e. from discrete small packages) with implemented control measures nominated above will not result in a significant impact to the Commonwealth Marine Environment (Significant Impact Guidelines, 2013) as it does not result in a substantial change in water quality or introduce persistent organic chemicals which adversely affect biodiversity, ecological function or integrity, social amenity or human health.<br>*With control measures implemented the action will not impact of items of National Environmental Significance (NES), it meets the requirements of the SW Marine Bioregional Plan and upholds IUCN Management Principles for Marine Reserves (Category VI) (ES, 2002) relevant to the West Eyre Marine Protected Area (MPA).* |

| *Acceptability Demonstration* | |
|---|---|
| Social Acceptability: | No issues have been raised by stakeholders regarding packaged oil/chemical spills from vessels. On the basis the activity is considered acceptable from this stakeholder group. |
| Risk/Impact are demonstrated to be ALARP: | As per demonstration assessment below, both residual impact and risk has been assessed as ALARP. |

A demonstration of ALARP with respect to residual impacts and risks associated with potential decks spills from packages chemicals/oils is provided below. On the basis of this demonstration, both residual impact and risk are considered ALARP when measured against the criteria.

| *ALARP Demonstration* | |
|---|---|
| Hierarchy of Controls: | **Elimination:** Packaged chemical/oil inventories on-board the survey vessels are minimised.<br>**Prevention:** Packaged chemicals on board are considered 'minor storages' and are small in package size (i.e. limited release volumes). Storage areas are segregated (isolated) from the deck drainage system. For activities which are temporary (e.g. refuelling) temporary bunding measures for the activity duration may be adopted. MSDSs are available to all personnel to ensure correct chemical handling and storage. Storage areas are routinely inspected to ensure high levels of housekeeping.<br>**Reduction:** Spill kits are strategically placed near high spill risk locations on the survey vessels. These kits are routinely inspected and maintained. Personnel are aware of appropriate chemical/oil spill response requirements reinforced through vessel induction. Spills are cleaned up immediately and contaminated material contained on-board for onshore disposal. Detergents used are biodegradable to minimise impacts from deck wash-down activities subsequent to spill events.<br>**Mitigation:** Package volumes are small which are rapidly dispersed in the dynamic marine environment. Adoption of a natural weathering/surveillance strategy is adopted for spill response.<br>*No additional practicable controls can be identified which reduce impacts or risks further (refer to options analysis).* |
| Compliance with Industry Standards and Codes: | Code of Environmental Practice (APPEA, 2008) objectives met for offshore geophysical operations.<br>National Standard for Domestic Commercial Vessels<br>International Dangerous Goods Maritime (IMDG) Code |
| Comparative Assessment of Options: | Limited exploration techniques are available to the oil and gas industry to identify hydrocarbon reservoirs. Alternate technologies such as marine CSEM (still requires vessel) and satellite imaging technology provide insufficient resolution for defining drilling prospects and are not a viable alternative to seismic surveys. Marine vessels are required to undertake MSS activities. Industry-standard technologies are not available to eliminate the use of chemicals on-board (e.g. cable fluid, hydraulic oils, etc.) although chemical inventories are minimised to the extent practicable.<br>A 'do-nothing' approach (i.e. no survey) does not align with obligations contained in work-plans approved as part of the permit release with the Australian Government.<br>The Lightning MSS area has been designed to cover only the most prospective parts of EPP-41 and EPP-42 and minimise the duration of the survey period through a multi-streamer vessel (hence exposure period has been minimised).<br>Similar to other vessels transiting the area, the requirements of the IMDG Code is adopted to prevent the release of such materials. This includes designated chemical storage and handling areas; correct stowage requirements; labelling, packing marking and MSDS information on the chemicals; availability of spill clean-up equipment and containment (bunds) surrounding high-risk spill areas. Through the adoption of the IMDG Code it is considered that all practicable preventative measures have been implemented.<br>Spill response strategies for hydrocarbon liquids spills have been assessed via a NEBA in **Appendix B**. A surveillance monitoring strategy, to be adopted in this event, has been assessed as having the lowest environmental impact/risk to marine species.<br>*No additional options/controls can be identified which can further reduce the residual impact and residual risk associated with deck spills from survey vessels.* |
| Hazard/Risk Criteria: | In accordance with the Bight Petroleum Qualitative Risk Matrix, the residual risk associated with this hazard is assessment as low. The Bight Risk tolerability criteria identified in **Section 5.1** identify that the residual risk is acceptable and the risk control strategy is considered to be ALARP. |
| Cost Benefit Analysis: | Not applicable to this assessment. |

### 5.7.3 Oil Spill due to Refuelling

#### *5.7.3.1 Activity & Background*

A common source of oil spill in offshore marine operations is associated with refuelling (bunkering) activities. Causal pathways include hose breaks, coupling failures and tank over-fill. Spill volumes (MGO/MDO) associated with offshore refuelling activities, which utilise equipment such as dry-break couplings are estimated at the volume of the transfer hose (i.e. typically a volume less than $1m^3$) (EPA, 1997). Note for the Lightning MSS refuelling will preferentially occur in port facilities rather than at sea (i.e. at sea refuelling will be the exception).

However, if refuelling activities are undertaken offshore the following controls will be applied:

- Activity will be fully supervised, in accordance with documented bunkering procedures, Job Hazard Analysis or Permit-to-Work Permit by trained personnel;
- A Toolbox meeting in undertaken before bunkering operations commence;
- Refuelling will only occur during suitable weather conditions, good visibility, during daylight hours and will be fully supervised;
- Refuelling equipment (e.g. dry-break couplings) will be routinely inspected, tested and maintained;
- Tank levels are monitored so they are not over-filled (i.e. not above 90% capacity);
- The transfer area will be bunded with spill kits in the event of a spill or leak; and
- SOPEP/SOPEP equipment (or equivalent) is available, and tested, to respond to spill by appropriately trained personnel.

Based upon OSTM undertaken for tank failure scenarios and screening calculations provided in **Table 8-4**, a refuelling spill will be marine-based in close proximity to the vessel and given the small volume spilt, will rapidly disperse/evaporate.

Additional mitigation measures to be implemented to combat a hydrocarbon release from tank overfill or refuelling is outlined in the SOPEP response arrangements contained in **Section 8.3.**

#### *5.7.3.2 Environmental Risk Assessment*

**Spill**:

The consequence associated with a refuelling spill/leak has been conservatively assessed as having minor consequences (i.e. marine impacts only with rapid dispersion in the high energy Southern Ocean and no impact to shorelines – Consequence 2). Given the implementation of the nominated control measures and also that refuelling at sea will be on an exception basis, spills to the marine environment are considered unlikely and the residual environmental risk is considered low.

**Spill Response Strategy:**

The spill response strategy identified for this spill event is a natural weathering/surveillance monitoring strategy.

Given the small size of the spill volumes involved in a refuelling spill, the limited areal ZPIs (~180m refer to **Table 8.4**) and the rapid evaporation/dispersion of the spill volume expected in the Southern Ocean, impacts to protection priorities if present within the ZPI (whales, turtles, seabirds, sharks, pinnipeds) are expected to be negligible (Consequence 1). Given the rapid dispersion and dilution of these releases, species exposure is very

unlikely and the residual risk associated with the natural weathering/monitoring response to these protection priorities is expected to be low.

The EPO for spills resulting from refuelling activities during the Lightning MSS; and a summary of performance standards relating to the adopted control measures is shown in the table below.

| Environmental Hazard/Aspect | *Oil Spill due to Refuelling* | |
|---|---|---|
| Performance Outcome | *No release of petroleum products from refuelling to the marine environment during MSS activities.* | |
| Measurement Criteria | *Incident records verify no release of petroleum products from refuelling to the marine environment.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Vessel Bunkering Procedures (at sea)/ Vessel Permit-to–Work Procedure | Refuelling activities will be fully supervised, in accordance with documented procedures, Job Hazard Analysis or Permit to Work by trained personnel. | Activity records (JHA, Permit to Work, Procedures) indicate that offshore fuel transfers are conducted in accordance with documented controls |
| Toolbox Meetings | A Toolbox meeting is undertaken before bunkering operations commence to ensure all personnel are aware of the safety and environmental controls | Records indicate a toolbox meeting was held prior to refuelling activity |
| Dry-break couplings are available on refuelling equipment | Dry-break couplings on hoses are used for bulk transfer of petroleum products (refuelling). | Pre-mobilisation audit records verify that dry-break couplings are present on vessel bunkering hoses. |
| Refuelling equipment is fit-for-purpose | All transfer equipment (hoses, pumps) are maintained in accordance with Manufacturer's instructions via the vessel's Planned Maintenance System (PMS) and inspected prior to use to eliminate leaks during transfer. | PMS and task inspection records verify refuelling equipment is fit for purpose. |
| Vessel Bunkering Procedures (at sea) | Tank levels will be monitored so they are not over-filled (i.e. not filled above 90% capacity). | Pre-mobilisation audit records verify these requirements are included in bunkering procedures. |
| | The transfer area is bunded with spill kits in the event of a spill or leak | Pre-mobilisation audit records verify these requirements are included in bunkering procedures. |
| Vessel SOPEP (or equivalent) is available on-board | The vessel has an approved current SOPEP (or equivalent) consistent with the *IMO Guideline for the Development of Shipboard Marine Pollution Emergency Plans*. | Pre-mobilisation audit records verify the Vessel SOPEP (or equivalent) is current and available on-board the vessel. |
| Personnel are trained to undertake spill response | Routine drills involving spills are undertaken in accordance with the Vessel Drills Matrix contained in the Vessel(s) SOPEP (or equivalent) to ensure personnel are familiar with their role during an oil/chemical spill event. | Pre-mobilisation audit records verify routine drills have been undertaken in accordance with SOPEP (or equivalent). |
| Oil Spill Response Training for Lightning MSS | A pre-mobilisation emergency response exercise is undertaken to test the Oil Spill Response Arrangements as detailed in Environment Plan (Section 8) and ensure all parties are familiar with them. | Records indicate that an oil spill response exercise has been undertaken prior to survey commencement. |

*Oil Spill Response EPOs, Standards and Measurement Criteria are provided in* ***Section 8.7.***

### *5.7.3.3 Acceptability and ALARP Demonstration*

An evaluation of refuelling spill impacts and risks, against acceptability criteria detailed in **Section 5.1.2,** is provided below. On the basis of this information, both residual impact and risk associated with the hazard is considered acceptable.

| *Acceptability Demonstration* | |
|---|---|
| Meeting Bight Petroleum HSE Policy Objectives: | This risk management strategy for preventing oil spills from refuelling activities reflects Bight's HSE Policy goals of proactively identifying hazards, eliminating risks where possible and where this is not possible managing the risk to ALARP; and to implement strategies which minimise pollution and promote the active well-being of personnel. |

| *Acceptability Demonstration* | |
|---|---|
| Legal Compliance with: | *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Section 9 – Prohibition of discharge of oil or oily mixtures into the Sea & Section 11A – Shipboard Oil Pollution Emergency Plan)<br>• Marine Order 91 (Marine Pollution Prevention – Oil) 2006 (Implements MARPOL 73/78 Annex I requirements)<br>*Marine Safety (Domestic Commercial Vessel) National Law Act 2012* (Com) |
| EPBC Protected Matters Assessment: | Oil pollution is identified as a 'pressure' of *potential concern* within the SW Bioregional Plan to the following conservation values within the ZPI: Blue Whale, Southern Right Whale, Humpback Whale, Sperm Whale, Australian Sea Lion, New Zealand Fur Seal, EPBC-listed bird species within the area (refer **Table 3-2**) and the Kangaroo Island KEF.<br>As identified in the acceptability demonstration associated with vessel collision oil spills (Tier 2), as the fuel used on the MSS vessels is MDO/MGO; the release volume is small (~1m$^3$); the impact areas small; and the limited duration of the spill (rapid weathering & dispersion) no significant impacts as defined by the Significant Impact Guidelines 1.1 (2013) are triggered with respect to the:<br>• Commonwealth marine environment - no substantial change in water quality or introduction of persistent organic chemicals which modify, destroy, fragment or disturb an important or substantial area of habitat; or<br>• Threatened/Migratory Species - no reduction in the occupancy area; fragmentation of a population; disruption of breeding cycles or long-term population decrease.<br>*With control measures implemented the action will not impact of items of National Environmental Significance (NES), it meets the requirements of the SW Marine Bioregional Plan and upholds IUCN Management Principles for Marine Reserves (Category VI) (ES, 2002) relevant to the West Eyre Marine Protected Area (MPA).* |
| Social Acceptability: | Stakeholders have not rained any issues with respect to minor spills associated with vessel-based activities. On this basis, the activity is considered acceptable from this stakeholder group. |
| Risk/Impact are demonstrated to be ALARP: | As per demonstration assessment below, both residual impact and risk has been assessed as ALARP. |

A demonstration of ALARP with respect to residual impacts and risks associated with prevention of refuelling spills is provided below. On the basis of this demonstration, both residual impact and risk are considered ALARP when measured against the criteria.

| *ALARP Demonstration* | |
|---|---|
| Hierarchy of Controls: | **Elimination:** Wherever possible refuelling will occur in port facilities rather than at sea. Fuel source used on the survey vessels is MDO/MGO (low persistence in the marine environment).<br>**Prevention:** Toolbox Meeting held prior to activity and Permit-to-Work raised for activity. Bunkering Procedures available and utilised for the transfer activity. Dry-break couplings are used on transfer hoses and transfer equipment is fit-for-purpose. Tank levels are monitored to prevent overfilling. Refuelling activity is undertaken only in suitable weather conditions, good visibility, daylight hours and is fully supervised.<br>**Reduction:** Transfer area is bunded with spill kits available in the event of a spill or leak.<br>**Mitigation:** Current vessel SOPEP available to respond to vessel-based oil spills with response equipment contained on-board. Crew are drilled in SOPEP response requirements. Personnel also trained in Lightning-specific OPEP requirements.<br>NEBA identified that preferred oil spill response strategy for is a 'monitoring and surveillance' response (no active intervention) given the degradation and weathering characteristics of the MDO/MGO, the distance offshore and the predicted impacts to environmental sensitivities (refer **Appendix B**).<br>*No additional controls can be identified which reduce impacts or risks further (refer to options analysis).* |
| Compliance with Industry Standards and Codes: | Code of Environmental Practice (APPEA, 2008) objectives met for offshore geophysical operations.<br>National Standard for Domestic Commercial Vessels<br>Guidelines for the Development of Shipboard Oil Pollution Emergency Plans (IMO)<br>National Marine Oil Spill Contingency Plan 2011 (NATPLAN) |

| *ALARP Demonstration* | |
|---|---|
| Comparative Assessment of Options: | Limited exploration techniques are available to the oil and gas industry to identify hydrocarbon reservoirs. Alternate technologies such as marine CSEM (still requires vessel) and satellite imaging technology provide insufficient resolution for defining drilling prospects and are not a viable alternative to seismic surveys. Marine vessels are required to undertake MSS activities. Technologies are not available to eliminate the use of hydrocarbons as fuel on vessels.<br>A 'do-nothing' approach (i.e. no survey) does not align with obligations contained in work-plans approved as part of the permit release with the Australian Government.<br>Where possible, given the prevailing weather conditions in the survey area, refuelling will occur in port facilities. However, refuelling activities within the survey area has been added as a contingent activity. In these contingent activities, all appropriate industry-recommended controls are adopted to prevent spills. *No other preventative controls can be identified*.<br>Standard marine industry SOPEPs (or equivalent to Class), consistent with IMO Guidelines, will be available on all vessels to mitigate any vessel-based oil spills. SOPEP requirements are integrated with Lightning OPEP requirements consistent with the Australian NATPLAN. All spill response plans will be tested prior to mobilisation. *No alternatives to these standard procedures can be identified*.<br>Spill response strategies for hydrocarbon liquids spills have been assessed via a NEBA to determine the least impact response strategy whilst still meeting spill response objectives (refer **Section 8** and **Appendix B**). Oil residues will be localised remaining within marine waters without landfall impact. Given the limited spill size and temporary nature of a MDO/MGO spill, a monitoring & surveillance response strategy is considered to be the most effective/least environmental impact while maintaining a low risk to protection priorities identified in the ZPI.<br>*No additional options/controls can be identified which can further reduce the residual impact and residual risk associated with oil spills from MSS vessels.* |
| Hazard/Risk Criteria: | In accordance with the Bight Petroleum Qualitative Risk Matrix, the residual risk associated with this hazard is assessment as low. The Bight Risk tolerability criteria identified in **Section 5.1** identify that the residual risk is acceptable and the risk control strategy is considered to be ALARP. |
| Cost Benefit Analysis: | Not applicable to this assessment. |

## 5.7.4 Solid Non-biodegradable/Hazardous Waste Overboard Incident

### *5.7.4.1 Activity & Background*

During the Lightning MSS, small quantities of solid non-biodegradable wastes such as plastic packaging, and hazardous wastes, such as used chemical containers, batteries, waste oils, may be produced.

Solid, non-biodegradable wastes disposed overboard have the potential to damage benthic habitats or marine fauna may ingest (particularly turtles or marine seabirds with respect to plastics) or become entangled in the waste. Disposal of oils and chemical residues overboard reduce water quality and may expose marine fauna to toxic impacts.

Survey vessels engaged for the Lightning MSS will operate under Vessel Garbage Management Plans compliant with MARPOL 73/78 Annex V requirements. Guidelines for the development of Garbage Management Plans (MEPC/Circ.317 Annex) revolve around three complementary principles to manage garbage: source reduction, recycling, and disposal (i.e. waste minimisation hierarchy). Waste protocols adopted on the vessels will include:

- A 'No solid or hazardous waste overboard' policy;
- All wastes are appropriately containerised (i.e. with lids to prevent wind-blown material (plastics) or rain ingress), labelled and stored in dedicated areas which are routinely inspected and maintained with high levels of house-keeping;
- For the seismic vessel allowable wastes and oily residues may be combusted in the on-board incinerator (refer **Section 5.6.4**) approved under MARPOL 73/78 Annex VI requirements;
- Hazardous wastes (used oils, lithium batteries, chemical and metallic wastes) are segregated and stored on-board and either disposed onshore in accordance with SA waste disposal regulations; and
- Solid/hazardous waste disposal records are documented in the Garbage Record Book

### 5.7.4.2 Environmental Risk Assessment

Solid non-biodegradable/hazardous wastes will be handled in accordance with the vessel's Garbage Management Plans and will work to a 'no solid non-biodegradable/hazardous waste overboard' policy. Hence no impacts to the marine environment should occur. However, it is possible that accidental discharges of waste material (e.g. small amounts of wind-blown packaging) to the marine environment may occur. In this instance the material will be small in volume however for materials such as plastic, fauna impacts (i.e. mortality) may occur. On this basis the impact is considered moderate (Consequence: 3). With the on-board controls implemented with respect to inspection and waste containment standards, the likelihood of such an incident occurring during the survey is considered very unlikely and the residual risk assessed as low.

The EPO to be attained for solid non-biodegradable waste management during the Lightning MSS; and a summary of performance standards relating to the adopted control measures is shown in the table below.

| Environmental Hazard/ Aspect | *Solid Non-biodegradable/Hazardous Waste Overboard* | |
|---|---|---|
| Performance Outcome | *No release of solid or hazardous waste materials during MSS activities into the marine environment.* | |
| Measurement Criteria | *Incident records indicate no releases of solid or hazardous waste materials during MSS activities.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Survey vessels will operate under Vessel Garbage Management Plan(s) | All personnel are aware of, and familiar with, Vessel Garbage Management arrangements via the vessel and environmental induction including:<br>- No solid or hazardous waste overboard;<br>- Wastes are containerised, labelled in dedicated areas;<br>- Wastes which can be incinerated are identified;<br>- Hazardous/solid wastes are contained and disposed onshore | Induction records verify that all field personnel are aware of these requirements. |
| Solid/hazardous waste disposal documented | All vessel garbage disposal activities are compliant with the requirements of the Vessel's Garbage Management Plan. | Garbage Record Book entries verify that the garbage disposal activities are compliant with these requirements |
| Routine house-keeping inspections of waste storage areas | Routine inspections are undertaken to ensure that minimum housekeeping standards within waste storage areas with deficiencies corrected. | Pre-mobilisation audit records verify a routine inspection program is implemented on survey vessels.<br>EP Compliance Audit records verify routine inspections are occurring. |

### 5.7.4.3 Acceptability and ALARP Demonstration

An evaluation of the impacts and risks of a solid, non-hazardous/hazardous waste incident overboard, against acceptability criteria detailed in **Section 5.1.2,** is provided below. On the basis of this information, both residual impact and risk associated with the hazard is considered acceptable.

| *Acceptability Demonstration* | |
|---|---|
| Meeting Bight Petroleum HSE Policy Objectives: | The risk management strategy for eliminating solid, non-hazardous/hazardous wastes overboard during the Lightning MSS reflects Bight's HSE Policy goals of proactively identifying hazards, eliminating risks where possible and where this is not possible managing the risk to ALARP and to implement strategies which minimise pollution and effectively manage waste. |
| Legal Compliance with: | *Navigation Act 2012* (Part 3 – *Vessels Polluting or Damaging the Australian Marine Environment* & Part 4 – *Directions Relating to Foreign Vessels*)<br>*Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Section 26F - *Prohibition of discharge of garbage into the sea*)<br>• Marine Order 95 (Marine Pollution Prevention – Garbage) 2013 (Implements MARPOL 73/78 Annex V requirements) |

| *Acceptability Demonstration* | |
|---|---|
| EPBC Protected Matters Assessment: | Accidental releases of solid non-biodegradable/hazardous wastes from survey activities are not identified as a 'pressure' or potential concern within the SW Marine Bioregional Plan. Similar exposures occur in these regional waters as a result of commercial vessel transit.<br>Accidental release of solid non-biodegradable/hazardous wastes from survey activities with implemented control measures nominated above will not result in a significant impact to the Commonwealth Marine Environment as defined by the Significant Impact Guidelines 1.1 (2013) as it does not result in a substantial change in water quality or introduce persistent organic chemicals which adversely affect biodiversity, ecological function or integrity, social amenity or human health; reduce areas of occupancy or increase mortality to an extent that it hinders species recovery.<br>*With control measures implemented the action will not significantly impact items of National Environmental Significance (NES), it meets the requirements of the SW Marine Bioregional Plan and upholds IUCN Management Principles for Marine Reserves (Category VI) (ES, 2002) relevant to the West Eyre Marine Protected Area (MPA).* |
| Social Acceptability: | No issues have been raised by stakeholders regarding accidental solid non-biodegradable, hazardous waste releases. On the basis the activity is considered acceptable from this stakeholder group. |
| Risk/Impact are demonstrated to be ALARP: | As per demonstration assessment below, both residual impact and risk has been assessed as ALARP. |

A demonstration of ALARP with respect to residual impacts and risks associated with an accidental release of solid non-hazardous/hazardous waste is provided below. On the basis of this demonstration, both residual impact and risk are considered ALARP when measured against the criteria.

| *ALARP Demonstration* | |
|---|---|
| Hierarchy of Controls: | **Elimination:** Vessels adopt the waste minimisation hierarchy which looks at waste elimination, followed by reduction, recycling and treatment/disposal. Vessels adopt a "No Solid or Hazardous Waste Overboard" Policy during survey activities.<br>**Prevention:** All wastes are containerised (with lids), labelled and stored in dedicated areas which are routinely checked for housekeeping standards. On-board the MSS vessel nominated wastes, as identified in the Garbage Management Plan, are incinerated. Other wastes are transported to shore for treatment/disposal. All personnel are inducted into these requirements during vessel induction.<br>**Reduction:** Wastes generated on-board the vessels are small in volume.<br>**Mitigation:** *No mitigation controls have been identified.*<br>*No additional practicable controls can be identified which reduce impacts or risks further (refer to options analysis).* |
| Compliance with Industry Standards and Codes: | Code of Environmental Practice (APPEA, 2008) objectives met for offshore geophysical operations.<br>2012 Guidelines for the Development of Garbage Management Plans (IMO, 2012) MEPC.220(63)<br>International Dangerous Goods Maritime (IMDG) Code |
| Comparative Assessment of Options: | Limited exploration techniques are available to the oil and gas industry to identify hydrocarbon reservoirs. Alternate technologies such as marine CSEM (still requires vessel) and satellite imaging technology provide insufficient resolution for defining drilling prospects and are not a viable alternative to seismic surveys. Marine vessels are required to undertake MSS activities.<br>A 'do-nothing' approach (i.e. no survey) does not align with obligations contained in work-plans approved as part of the permit release with the Australian Government.<br>The Lightning MSS program duration has been minimised through survey design and vessel selection (multiple streamers (~8-10)) (refer **Section 2.2**).<br>Vessel practices adopted to prevent waste incidents overboard include the adoption of the waste minimisation hierarchy (prevents waste generation at source) & open deck unpacking of materials. Any wastes generated are stored on-board in fully enclosed containers in accordance with IMDG requirements (as relevant) for further onshore treatment/disposal with relevant state legislative requirements.<br>Further options which could be considered for vessel waste management include the immediate removal of waste from the vessel to shore-based facilities resulting in additional fuel usage (emissions increase); or the transfer of wastes between vessels (considered higher risk). These are not considered practicable solutions.<br>*No additional options/controls can be identified which can further reduce the residual impact and risk associated with accidental releases of solid non-biodegradable/hazardous waste overboard.* |

| *ALARP Demonstration* | |
|---|---|
| Hazard/Risk Criteria: | In accordance with the Bight Petroleum Qualitative Risk Matrix, the residual risk associated with this hazard is assessment as low. The Bight Risk tolerability criteria identified in **Section 5.1** identify that the residual risk is acceptable and the risk control strategy is considered to be ALARP. |
| Cost Benefit Analysis: | Not applicable to this assessment. |

## 5.7.5 Seismic Streamer Release

### *5.7.5.1 Activity & Background*

Seismic streamer loss can create marine debris hazards leading to impacts to fisheries (equipment) or leading to benthic habitat impacts through physical contact.

Controls which are adopted to prevent the loss of streamers in the marine environment include the following:

- Seismic streamers undergo regular inspection and maintenance system checks on bridles and harnesses for wear and damaged components. These components are replaced on an 'as required' basis;
- During operation a secondary retaining/attachment device is utilised to prevent streamer loss (i.e. system redundancy); and
- The solid-state seismic streamer contains buoyancy devices which allows for support vessel surface retrieval if lost and are fitted with marker buoys and radar reflectors which allows for rapid location and identification of the lost equipment.

The seismic vessel will operate using approved procedures for streamer retrieval. All relevant personnel will be trained in these procedural requirements.

Should a seismic streamer release occur during the survey, other marine stakeholders (primarily fisheries) will be notified of the incident and its' location.

### *5.7.5.2 Environmental Risk Assessment*

As the streamer is fitted with buoyancy, the potential for disturbance to benthic communities is considered extremely unlikely.

Given the rigidity and diameter of the streamers entanglement, hazards with marine fauna are not considered credible.

Temporary loss of a seismic streamer to the marine environment may create minor impacts (interference with fishing equipment, etc.) (Consequence 2) to other marine users, if present, however with the controls adopted to prevent loss from occurring, the recovery procedures available and notification to relevant stakeholders, the likelihood of disturbance occurring is considered very unlikely. The residual environmental risk associated with this temporary impact is assessed as low.

The EPO to be attained for seismic streamer management during the Lightning MSS; and a summary of performance standards relating to the adopted control measures is shown in the table below.

| Environmental Hazard/ Aspect | *Seismic Streamer Loss in the Marine Environment* | |
|---|---|---|
| Performance Outcome | *No unrecovered streamer loss to the marine environment.* | |
| Measurement Criteria | *Incident records indicate there has been no unrecovered streamers lost to the marine environment* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Vessel Streamer Deployment and Retrieval Procedures | Survey vessels will operate under approved procedures for streamer deployment and retrieval and these procedures are adhered to at all times. | Pre-mobilisation audit records verify approved procedures are available on-board the vessel. |

| Environmental Hazard/ Aspect | *Seismic Streamer Loss in the Marine Environment* | |
|---|---|---|
| Performance Outcome | *No unrecovered streamer loss to the marine environment.* | |
| Measurement Criteria | *Incident records indicate there has been no unrecovered streamers lost to the marine environment* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Streamer equipment is fit-for-purpose | Streamer equipment (bridles and harnesses) are routinely maintained and inspected for wear and tear in accordance with the Vessel's Planned Maintenance System (PMS) to ensure the equipment is fit-for purpose and will not detach during MSS activities. | PMS and inspection records verify streamer equipment is fit-for-purpose. |
| Minimum equipment standards are adopted on streamers to allow for retrieval | Streamers will be fitted with the following equipment while they are deployed from the MSS vessel to allow for easy retrieval:<br>- Buoyancy devices;<br>- Surface Marker Buoys<br>- Secondary retaining devices<br>- Radar Reflectors | MSS Environment Plan Audit records indicate that equipment is utilised during the Lightning MSS. |
| Marine stakeholders notification | Marine stakeholder notifications (VHF Channel 16) are made in the event of a streamer loss | Notifications recorded in the Vessel Log verify this action has been completed in the event of a streamer loss |

### 5.7.5.3 *Acceptability and ALARP Demonstration*

An evaluation of the impacts and risks of a seismic streamer release incidents against acceptability criteria detailed in **Section 5.1.2** is provided below. On the basis of this information, both residual impact and risk associated with the hazard is considered acceptable.

| *Acceptability Demonstration* | |
|---|---|
| Meeting Bight Petroleum HSE Policy Objectives: | The risk management strategy for eliminating seismic streamer releases during the Lightning MSS reflects Bight's HSE Policy goals of proactively identifying hazards, eliminating risks where possible and where this is not possible managing the risk to ALARP. |
| Legal Compliance with: | *Offshore Petroleum & Greenhouse Gas Storage Act 2006* (Com) (S350) – *Interference with Other Rights.* |
| EPBC Protected Matters Assessment: | Accidental releases of seismic streamers are not identified as a 'pressure' or potential concern within the SW Marine Bioregional Plan. It is noted that 'marine debris' (fishing nets, plastics, packing material, food packaging, plastic bags, rope, gloves, etc.) is listed as a pressure however hydrophone streamers are not considered to fall into this definition.<br>Accidental release of seismic streamers with implemented control measures nominated above will not result in a significant impact to the Commonwealth Marine Environment as defined by the Significant Impact Guidelines 1.1 (2013) as it does not result in the introduction of persistent organic chemicals which adversely affect biodiversity, ecological function or integrity, social amenity or human health; reduce areas of occupancy or increase mortality to an extent that it hinders species recovery.<br>*With control measures implemented the action will not significantly impact items of National Environmental Significance (NES), it meets the requirements of the SW Marine Bioregional Plan and upholds IUCN Management Principles for Marine Reserves (Category VI) (ES, 2002) relevant to the West Eyre Marine Protected Area (MPA).* |
| Social Acceptability: | No issues have been raised by stakeholders regarding accidental release of seismic streamers. On the basis the activity is considered acceptable from this stakeholder group. |
| Risk/Impact are demonstrated to be ALARP: | As per demonstration assessment below, both residual impact and risk has been assessed as ALARP. |

A demonstration of ALARP with respect to residual impacts and risks associated with an accidental release of seismic streamers into the marine environment is provided below. On the basis of this demonstration, both residual impact and risk are considered ALARP when measured against the criteria.

| *ALARP Demonstration* | |
|---|---|
| Hierarchy of Controls: | **Elimination:** *No elimination controls identified.*<br>**Prevention:** All streamers are routinely inspected and maintained for worn and damaged components. A secondary retaining/attachment device is fitted to prevent loss.<br>**Reduction:** Streamer contains buoyancy devices to assist in recovery. Also fitted with marker buoys and radar reflectors for rapid location of lost equipment.<br>**Mitigation:** Vessel operates under approved procedures for streamer retrieval. Marine stakeholders are notified in the event of streamer loss and location.<br>*No additional practicable controls can be identified which reduce impacts or risks further (refer to options analysis).* |
| Compliance with Industry Standards and Codes: | Code of Environmental Practice (APPEA, 2008) objectives met for offshore geophysical operations. |
| Comparative Assessment of Options: | Limited exploration techniques are available to the oil and gas industry to identify hydrocarbon reservoirs. Alternate technologies such as marine CSEM (still requires vessel) and satellite imaging technology provide insufficient resolution for defining drilling prospects and are not a viable alternative to seismic surveys. Hydrophone streamers are required to undertake MSS activities.<br>A 'do-nothing' approach (i.e. no survey) does not align with obligations contained in work-plans approved as part of the permit release with the Australian Government.<br>Streamer release from vessels is a known occurrence and accordingly controls consistent with good oil field practice are implemented during seismic campaigns. This includes streamer equipment being routinely maintained for integrity; system redundancy to prevent loss events; equipment installation to ensure that surface identification and retrieval is possible; and approved vessel procedures to recover the equipment.<br>*No additional options/controls can be identified which can further reduce the impact and risk associated with accidental release of a seismic streamer.* |
| Hazard/Risk Criteria: | In accordance with the Bight Petroleum Qualitative Risk Matrix, the residual risk associated with this hazard is assessment as low. The Bight Risk tolerability criteria identified in **Section 5.1** identify that the residual risk is acceptable and the risk control strategy is considered to be ALARP. |
| Cost Benefit Analysis: | Not applicable to this assessment. |

## 5.7.6 Seismic Streamer Liquid Release

### *5.7.6.1 Activity & Background*

Solid seismic streamer will be utilised within the Lightning MSS. While the streamer primarily contains solid material which cannot leak, there are certain sections within the streamer which contain 'Isopar' liquid (or equivalent). Liquid is contained in the following:

- 1 x HESA (Header Elastic Streamer Adapter) contains 15litres of Isopar;
- 2 x SHS (Streamer Header Section) each have 20litres Isopar (40litres total); and
- 1 x TES (Tail Elastic Section) with 60litres of Isopar.

Isopar is a low-odour, low aromatic hydrocarbon solvent recognised to have low acute and chronic toxicity. Isopar biodegrades at a moderate rate and does not persist in the environment. It has low water solubility and is a volatile organic compound which rapidly volatilises and degrades in air (Exxonmobil Chemicals, 2011).

As part of deployment, streamers are checked for integrity to prevent liquid leaks to the environment.

Perforation of these streamer sections due shark-bite or third party vessel impact may lead to small amounts of liquid (Isopar) release. The maximum release volume to the environment is estimated to be 720litres (max) – i.e. 12 streamers x 60litres resulting from a third party vessel impact across all streamer tail sections (refer to **Section 5.7.1.1** for vessel collision preventative measures).

Liquid release from shark bites to streamers is much lower in volume (~60litres (max)).

### 5.7.6.2 *Environmental Risk Assessment*

**Spill:**

The release of liquid from a streamer perforation is considered to have temporary, localised impacts[94] (i.e. Consequence: 2) given the type of liquid, and limited quantity released. Also as only small sections of the streamer which contain liquid, and with preventative (refer vessel collision controls) controls implemented, the incident is considered very unlikely during the MSS campaign. The residual environmental risk, associated with streamer perforation is assessed as low.

**Spill Response Strategies:**

The spill response strategy identified for this spill event is a natural weathering/surveillance monitoring strategy.

Given the small size of the spill volumes involved in a streamer perforation (ship collision event), the limited areal ZPIs (~151m refer to **Table 8.4**) and the rapid evaporation/dispersion of the spill volume expected in the Southern Ocean, impacts to protection priorities if present within the ZPI[95] (whales, turtles, seabirds, pinnipeds, sharks) are expected to be negligible (Consequence 1). Given the rapid dispersion and dilution of these releases, species exposure is very unlikely and the residual risk associated with the natural weathering/monitoring response to these protection priorities is expected to be low.

The EPO for seismic streamer liquid release during the Lightning MSS; and a summary of performance standards relating to the adopted control measures is shown in the table below.

| Environmental Hazard/Aspect | *Seismic Streamer Liquid Leak* | |
|---|---|---|
| Performance Outcome | *No liquid is released to the marine environment as a result of streamer perforation during the MSS.* | |
| Measurement Criteria | *No incidents of streamer perforation during the Lightning MSS activity.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Solid streamers are used for the Lightning MSS | The MSS will utilise solid streamers containing 'low environmental' hazard chemicals (e.g. ISOPAR) during survey activities. | Pre-mobilisation audit records verifies this streamer type will be used for the survey |
| Streamers deployed are fit-for-purpose | Streamers are routinely maintained and inspected for wear and tear in accordance with the MSS Vessel's PMS to ensure the equipment is fit-for purpose and will not leak during MSS activities. | PMS and inspection records verify streamer equipment is fit-for-purpose. |
| Vessel Interaction Procedures are implemented to prevent third party impacts to streamers | Induction program reinforces the Procedural Control Standards listed in EP Section 5.7.1 (Tank Rupture) such that all personnel are familiar with the requirements to prevent interference with streamers and vessels. | Records of induction program content contains vessel interaction procedural requirements |
| | | Induction records indicate that all field personnel have completed the Environmental Induction. |

*Note the controls listed below are in addition to the controls listed for vessel collision in **Section 5.7.1.4**. Oil Spill Response Performance Outcomes, Standards and Measurement Criteria are provided in **Section 8.7***

[94] This has been assessed on largest spill volume (i.e. third party vessel collision with streamers).
[95] Petroleum activity is seismic data acquisition and during acquisition sound sensitive species will not be present in the survey area. During non-acquisition periods, vessel noise will also act as a determent to species in the immediate proximity of the vessel.

### 5.7.6.3 *Acceptability and ALARP Demonstration*

An evaluation of streamer fluid release impacts and risks, against acceptability criteria detailed in **Section 5.1.2,** is provided below. On the basis of this information, both residual impact and risk associated with the hazard is considered acceptable.

| *Acceptability Demonstration* | |
|---|---|
| Meeting Bight Petroleum HSE Policy Objectives: | This risk management strategy for preventing seismic streamer fluid leaks reflects Bight's HSE Policy goals of proactively identifying hazards, eliminating risks where possible and where this is not possible managing the risk to ALARP. |
| Legal Compliance with: | *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Section 9 – Prohibition of discharge of oil or oily mixtures into the Sea & Section 11A – Shipboard Oil Pollution Emergency Plan)<br>• Marine Order 91 (Marine Pollution Prevention – Oil) 2006 (Implements MARPOL 73/78 Annex I requirements)<br>*Marine Safety (Domestic Commercial Vessel) National Law Act 2012* (Com) |
| EPBC Protected Matters Assessment: | Oil pollution is identified as a 'pressure' of *potential concern* within the SW Bioregional Plan to the following conservation values within the ZPI: Blue Whale, Southern Right Whale, Humpback Whale, Sperm Whale, Australian Sea Lion, New Zealand Fur Seal, EPBC-listed bird species within the area (refer **Table 3-2**) and the Kangaroo Island KEF.<br>As the streamer liquid used has low toxicity, volatile and biodegrades and the maximum release volume is small (~720litres); the impact area will be small and have a limited duration. No significant impacts as defined by the Significant Impact Guidelines 1.1 (2013) are triggered with respect to the:<br>• Commonwealth marine environment - no substantial change in water quality or introduction of persistent organic chemicals which modify, destroy, fragment or disturb an important or substantial area of habitat; or<br>• Threatened/Migratory Species - no reduction in the occupancy area; fragmentation of a population; disruption of breeding cycles or long-term population decrease.<br>*With control measures implemented the action will not impact of items of National Environmental Significance (NES), it meets the requirements of the SW Marine Bioregional Plan and upholds IUCN Management Principles for Marine Reserves (Category VI) (ES, 2002) relevant to the West Eyre Marine Protected Area (MPA).* |
| Social Acceptability: | Stakeholders have not rained any issues with respect to minor spills associated with vessel-based activities. On this basis, the activity is considered acceptable from this stakeholder group. |
| Risk/Impact are demonstrated to be ALARP: | As per demonstration assessment below, both residual impact and risk has been assessed as ALARP. |

A demonstration of ALARP with respect to residual impacts and risks associated with prevention of seismic streamer liquid releases is provided below. On the basis of this demonstration, both residual impact and risk are considered ALARP when measured against the criteria.

| *ALARP Demonstration* | |
|---|---|
| Hierarchy of Controls: | **Elimination:** Streamer liquid has a low environmental impact.<br>**Prevention:** Solid streamers utilised to prevent large volumes of streamer liquid entering the marine environment should perforation occur. Streamer checked for integrity during deployment activities.<br>**Reduction:** ISOPAR is a low toxicity, low persistence chemical in the marine environment.<br>**Mitigation:** *No mitigation controls identified.*<br>NEBA identified that preferred oil spill response strategy for is a 'monitoring and surveillance' response (no active intervention) given the degradation and weathering characteristics of ISOPAR and the small area affected (refer **Appendix B**).<br>*No additional controls can be identified which reduce impacts or risks further (refer to options analysis).* |
| Compliance with Industry Standards and Codes: | Code of Environmental Practice (APPEA, 2008) objectives met for offshore geophysical operations.<br>Industry Standard: Use of support and escort vessels to protect trailing equipment |

| *ALARP Demonstration* | |
|---|---|
| Comparative Assessment of Options: | Limited exploration techniques are available to the oil and gas industry to identify hydrocarbon reservoirs. Alternate technologies such as marine CSEM (still requires vessel) and satellite imaging technology provide insufficient resolution for defining drilling prospects and are not a viable alternative to seismic surveys. Hydrophone streamers historically adopted for MSS activities were completely liquid-filled (kerosene). Solid streamers now compartmentalise liquid sections to limit the amount of liquid which can be released on perforation and utilise a low toxicity liquid.<br>A 'do-nothing' approach (i.e. no survey) does not align with obligations contained in work-plans approved as part of the permit release with the Australian Government.<br>Industry standard techniques for maintaining equipment integrity and provision of support/escort vessels to prevent third party impacts to streamers have been adopted in this survey.<br>Spill response strategies for hydrocarbon liquids spills have been assessed via a NEBA to determine the least impact response strategy (refer **Section 8** and **Appendix B**). Given the limited spill size a monitoring & surveillance response strategy is considered to be the most effective/least environmental impact and is a low risk to any protection priorities within the ZPI.<br>*No additional options/controls can be identified which can further reduce the residual impact and residual risk associated with ISOPAR spills from seismic streamers.* |
| Hazard/Risk Criteria: | In accordance with the Bight Petroleum Qualitative Risk Matrix, the residual risk associated with this hazard is assessment as low. The Bight Risk tolerability criteria identified in **Section 5.1** identify that the residual risk is acceptable and the risk control strategy is considered to be ALARP. |
| Cost Benefit Analysis: | Not applicable to this assessment. |

## 5.7.7 Cetacean Collision

### *5.7.7.1 Activity & Background*

Vessels associated with the Lightning MSS will be operating on a 24/7 basis for the duration of the survey. All vessels pose a collision risk to cetacean species. The Lightning MSS area is recognised as having habitats which may support the presence of cetaceans and it is possible that these species may transit the survey area during the survey.

Laist et al (2001) identified that larger vessels moving in excess of 10knots may cause fatal or severe injuries to cetaceans, with the most severe injuries caused by vessels travelling faster than 14knots. The MSS vessel operating in the area will transit at low speeds (typically less than 5knots) during seismic acquisition. Operational acoustic sources together with vessel noise create conditions such that cetaceans avoid the immediate vessel area and MMOs during acquisition periods will identify whale presence.

Support/escort vessels generally travel at higher speeds to effectively patrol the requested clearance zone around the MSS vessel and towed array and possibly have a higher level of encounter potential compared with the MSS vessel.

As a precaution against collision, support vessels engaged in the survey will observe the requirements of the *EPBC Regulations 2000* Part 8 which detail interaction protocols between whales and vessels including proximity distances, and vessel speed/management when cetaceans are sighted within caution zones.

The survey environmental induction will contain and reinforce these requirements to vessel crew members.

All cetacean sighting reports during the survey period will be completed and submitted to DOE and NOPSEMA.

### *5.7.7.2 Environmental Risk Assessment*

Cetaceans are known to transit through the Lightning MSS area and may have a presence in the area during the MSS period. As referenced in **Section 5.5.2**, cetaceans will tend to practice avoidance around vessels with high sound signatures and avoid acoustic sound generated from seismic sources. A vessel strike to a cetacean has been assessed as a significant consequence (Consequence 3), however with the control measures implemented

(low speed, proximity distances and vessel sound deterrents) the likelihood of collision is assessed as very unlikely. On this basis the residual environmental risk is assessed as low.

The EPO to be attained to prevent cetacean collisions during the Lightning MSS; and a summary of performance standards relating to the adopted control measures is shown in the table below.

| Environmental Hazard/Aspect | *Cetacean Collision* | |
|---|---|---|
| Performance Outcome | *No cetacean injuries resulting from vessel collision.* | |
| Measurement Criteria | *Incident records indicate there have been no cetacean injuries resulting from vessel collision.* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Vessel Operations | Vessel operations to conform with proximity distances, speeds and management measures contained in the EPBC Regulations 2000 (Chapter 8) when in the operational survey area. | MMO Master Data Sheet verifies interaction between the MSS vessel and cetaceans comply with these requirements. |
| | | Support/Chase Vessel Log verifies interactions between the vessel and cetaceans comply with these requirements. |
| Environmental Induction | All crew have completed an environmental induction covering the requirements for cetacean/vessel interaction consistent with EPBC Regulations 2000 (Chapter 8) and are familiar with the requirements. | Induction records verify that all crews have completed an environmental induction. |

### 5.7.7.3 *Acceptability and ALARP Demonstration*

An evaluation of impacts and risks of cetacean collision, against acceptability criteria detailed in **Section 5.1.2,** is provided below. On the basis of this information, both residual impact and risk associated with the hazard is considered acceptable.

| *Acceptability Demonstration* | |
|---|---|
| Meeting Bight Petroleum HSE Policy Objectives: | This risk management strategy for preventing cetacean collision reflects Bight's HSE Policy goals of proactively identifying hazards, eliminating risks where possible and where this is not possible managing the risk to ALARP and address biodiversity issues. |
| Legal Compliance with: | *Environment Protection & Biodiversity Conservation Act 1999*<br>*Environment Protection and Biodiversity Conservation Regulations 2000 (Part 8)* |
| EPBC Protected Matters Assessment: | Collisions with vessels are identified as a 'pressure' of *potential concern*[96] within the SW Bioregional Plan for Blue and Southern Right Whales (i.e. species within the ZPI). *This is also identified as a pressure for marine turtles (which are expected to have a low presence in the Lightning MSS area due to water temperatures) particularly within waters adjacent to large populations where there is significant boats/pleasure craft and near marine construction projects (harbour development and dredging programs which include a large number of vessels).*<br>As provided in the SW Bioregional Plan, vessel strikes to cetacean species are not likely to impact at a population level however with shipping traffic increases, particularly with large vessels, ship strikes are expected to increase. The Plan also identifies that there is a high risk of significant impact on the identified whale species associated with the construction/expansion of ports which may lead to greater shipping traffic (not applicable to Lightning MSS activities).<br>While vessel collisions are possible with cetaceans during the Lightning MSS, survey activities adopt measures which are actively observing for whales in accordance with *EPBC Policy Statement 2.1: Industry – Interaction between offshore seismic surveys and whales* to minimise potential impacts. Support/escort vessels also act to identify possible cetacean presence. With the adoption of these control measures to protect against collision with whales, no significant impact criteria for threatened/migratory species, as defined by the Significant Impact Guidelines 1.1 (2013) will be triggered (i.e. no reduction in the occupancy area; fragmentation of a population; disruption of breeding cycles or long-term population decrease). |

[96] 'Potential Concern' indicates the conservation value is vulnerable to the identified pressure but there is limited evidence of a substantial impact in the region; and the pressure is widespread or likely to increase in the region; and

| *Acceptability Demonstration* | |
|---|---|
| EPBC Protected Matters Assessment (Con't): | *With control measures implemented the action will not impact of items of National Environmental Significance (NES), it meets the requirements of the SW Marine Bioregional Plan and upholds IUCN Management Principles for Marine Reserves (Category VI) (ES, 2002) relevant to the West Eyre Marine Protected Area (MPA).* |
| Social Acceptability: | Stakeholders have not rained any issues with respect to vessel collision with cetaceans for the Lightning MSS. On this basis, the activity is considered acceptable from this stakeholder group. |
| Risk/Impact are demonstrated to be ALARP: | As per demonstration assessment below, both residual impact and risk has been assessed as ALARP. |

A demonstration of ALARP with respect to residual impacts and risks associated with preventing vessel collisions with cetaceans is provided below. On the basis of this demonstration, both residual impact and risk are considered ALARP when measured against the criteria.

| *ALARP Demonstration* | |
|---|---|
| Hierarchy of Controls: | **Elimination:** Survey area is not located in proximity to Southern Right Whale breeding areas and there is only minor overlap of the MSS activity in seasonal timeframe with species presence in the area (i.e. late May when low numbers of species are observed).<br>**Prevention:** MSS activity avoids 'peak' seasonal timeframes for Blue Whale presence (i.e. December). Active watch on all vessels for the presence of cetaceans to minimise possible impacts. Adoption of EPBC Regulation 2000 (Part 8) requirements for proximity distances and vessel management if cetaceans are identified within certain buffer zones to the vessels. All crews are inducted into these requirements.<br>**Reduction:** Adoption of EPBC Regulation 2000 (Part 8) requirements for provides for vessel management actions (i.e. low speed) which would reduce the consequence to the cetacean should an impact occur.<br>**Mitigation:** *No mitigation controls identified.*<br>*No additional controls can be identified which reduce impacts or risks further (refer to options analysis).* |
| Compliance with Industry Standards and Codes: | Code of Environmental Practice (APPEA, 2008) objectives met for offshore geophysical operations.<br>*EPBC Policy Statement 2.1: Industry – Interaction between offshore seismic surveys and whales* |
| Comparative Assessment of Options: | As before, limited exploration techniques are available to the oil and gas industry to identify hydrocarbon reservoirs. Alternate technologies provide insufficient resolution for defining drilling prospects and are not a viable alternative to seismic surveys. Marine vessels are required to undertake survey activities.<br>A 'do-nothing' approach (i.e. no survey) does not align with obligations contained in work-plans approved as part of the permit release with the Australian Government.<br>Adoption of *EPBC Policy Statement 2.1: Industry – Interaction between offshore seismic surveys and whales* for the activities ensures that an active watch for cetaceans is maintained to avoid impact (including support/escort vessels) and MSS vessel speed is low. Adoption of EPBC Regulation 2000 (Part 8) requirements ensures that all survey vessels minimise the potential for collision with species and reduces impacts to animals (i.e. low speed) should contact be made.<br>*No additional options/controls can be identified which can further reduce the residual impact and residual risk associated with vessel strikes to cetaceans.* |
| Hazard/Risk Criteria: | In accordance with the Bight Petroleum Qualitative Risk Matrix, the residual risk associated with this hazard is assessment as low. The Bight Risk tolerability criteria identified in **Section 5.1** identify that the residual risk is acceptable and the risk control strategy is considered to be ALARP. |
| Cost Benefit Analysis: | Not applicable to this assessment. |

there are no management measures in place to mitigate potential or future impacts, or there is inadequate or inconclusive evidence of the effectiveness of management measures.

## 5.8 Oil Spill Response

The following spill scenarios, resulting in hydrocarbons entering the environment have been identified for the Lightning MSS activities:

- Tank rupture leading to an oil spill (refer **Section 5.7.1**);
- Oil/Chemical Spill through deck system (refer **Section 5.7.2**);
- Oil Spill due to refuelling (refer **Section 5.7.3**); and
- Seismic Streamer Liquid Leak (refer **Section 5.7.6**).

As detailed in **Section 8**, AMSA is the Combat Agency for all vessel-based marine spills in Commonwealth Waters and will implement oil spill response strategies in accordance with NATPLAN after a NEBA analysis to ensure environmental impacts arising from the response strategy are minimised.

For a Tier 2 spill (tank rupture) at the Lightning MSS location, the oil volume exposure ($300m^3$ (max)), and the ZPI for the spill area (i.e. retained in marine areas), it is expected that the following oil spill response strategy will be implemented by AMSA (refer **Section 8**) (refer also to **Appendix B**):

- Source Control (e.g. tank lightering during vessel collision); and
- Monitoring, surveillance and natural weathering (e.g. vessel and possible aerial surveillance, modelling, etc.).

A surveillance response strategy may incrementally increase the following environmental impacts should *additional resources* be required:

- Disruption to commercial fishing (**Section 5.4.1**) and commercial shipping (**Section 5.4.2**);
- Artificial lighting (**Section 5.4.3**);
- Acoustic disturbance from vessel activity (**Section 5.5.2**);
- Acoustic disturbance from aerial surveillance activities[97] (refer **Section 5.5.3**);
- Vessel discharges (oily water, sewage, food-scraps and air emissions) (**Section 5.6**);
- A risk of chemical/oil spill on-board vessels (**Section 5.7.2**);
- A risk of solid/hazardous waste over-board (**Section 5.7.4**); and
- A risk of cetacean collision (**Section 5.7.7**).

Control measures to manage impacts from these activities are detailed in the respective sections of this Environment Plan.

Bight will consult with AMSA ensuring these aspects are taken into consideration during the NEBA. AMSA, as the Combat Agency receives a copy of this Environment Plan.

Environmental Performance Outcomes, standards and measurement criteria for the implementation of the oil spill response arrangements are outlined in **Section 8.7.**

[97] Aerial surveillance is not expected to create impacts to marine fauna given the heights at which the surveillance aircraft will be working. Preferred altitude for monitoring of oil spills is 300-500m (AMSA, 2003). Impacts to fauna are generally not experienced at altitudes less than 230m (Leatherwood et al, 1982; Richardson & Malme, 1993).

## 5.9 Environmental Risk Summary

The results of the environmental risk evaluation for the proposed Lightning MSS activity are summarised in **Table 5-11** for both routine operations and accidental releases. This Table provides a summary of relevant environmental aspects associated with the survey, the potential environmental impacts, risk control measures and residual risk exposures in accordance with the risk methodology detailed in **Section 5-1** .

As can be seen from **Table 5-11** there have been no aspects or impacts assessed as having a high residual risk.

Table 5-11: Lightning MSS Environmental Risk Assessment Summary

| Aspect | Possible Impacts | Inherent Risk Assessment | | | Control/Mitigation Measures | Residual Risk Assessment | | |
|---|---|---|---|---|---|---|---|---|
| | | C | L | Risk | | C | L | Risk |
| Mobilisation | | | | | | | | |
| Vessel Entry to Australian Waters (Introduction of IMS) | Alteration of local ecosystem by IMS through Ballast Water Discharges | 4 | 2 | MEDIUM Risk | Prevention Controls:<br>Seismic Vessel during international mobilisation will adhere to *Guidelines on Ballast Water Management* (DAFF, 2011).<br>Mitigations:<br>Ballast water release unlikely during survey as there are no significant cargo transfers or exchanges (refuelling carried out on an exception basis).<br>Water depth of survey area is 130-2400m which is light-limited. This limits the success of IMS colonisation.<br>*Support/escort vessels, where possible, will be sourced locally from within Australian Waters however will adopt same protocols if source internationally.* | 4 | 1 | MEDIUM Risk |
| | Alteration of local ecosystem by IMS through Vessel Bio-fouling | 4 | 2 | MEDIUM Risk | Prevention Controls:<br>Seismic Vessel will be risk-assessed in accordance with the *National Biofouling Management Guidelines for the Petroleum Production & Exploration Industry* (2009) prior to entry into Australian waters. Corrective actions identified within that risk assessment have been completed and the vessel is considered low risk;<br>In-field equipment is cleaned between survey operations when operations do not occur in adjacent bioregion waters.<br>Mitigations:<br>Water depth of survey area is 130-2400m which is light-limited. This limits the success of IMS colonisation.<br>*Support/escort vessels, where possible, will be sourced locally from within Australian Waters however will adopt same protocols if source internationally.* | 4 | 1 | MEDIUM Risk |
| Physical Presence of Vessel In Permit | | | | | | | | |

| Aspect | Possible Impacts | Inherent Risk Assessment | | | Control/Mitigation Measures | Residual Risk Assessment | | |
|---|---|---|---|---|---|---|---|---|
| | | C | L | Risk | | C | L | Risk |
| Presence of Vessel Activities | Interference with Commercial Fishing Activities (Spatial Conflicts) | 2 | 3 | MEDIUM Risk | Prevention Controls:<br>Stakeholder consultation with fisheries to advise of activity, understand issues and identify practicable controls to reduce impacts;<br>Detailed notifications to marine users prior to survey commencement and on survey completion;<br>Equipment retrieval off the shelf edge to prevent spatial conflicts with fisheries;<br>Vessel activity reports issued to AMSA RCC who will issue shipping warnings to minimise potential for marine activity conflicts;<br>Notice to Mariners issued by AHO for activity<br>Frequent bulletins issued to fishermen on activity<br>Survey to be acquired in deeper water in March to avoid conflict with Tuna Fishermen, MSS vessel to give way to towed pontoons and no source activity within 3km of the towed pontoon;<br>Mitigation:<br>Escort vessel available to advise fishermen of seismic presence and avoid spatial conflict.<br>Potential impacts on catch experienced by individual members of the fishing industry, as shown by comparison between historical and actual catch statistics will be resolved to the satisfaction of those members affected. | 2 | 1 | LOW Risk |
| | Interference with Commercial Shipping (Diversion) | 2 | 3 | MEDIUM Risk | Prevention Controls:<br>Stakeholder consultation with commercial shipping to advise of activity and identify any issues to identify controls to minimise impacts;<br>Major east-west shipping lane through the MSS area;<br>Daily vessel activity reports issued to AMSA RCC who will issue shipping warnings to minimise potential for marine activity conflicts;<br>Notice to Mariners issued by AHO for activity.<br>Mitigation:<br>Escort vessels available to advise of seismic/third party presence;<br>Bridge manned 24/7 to identify third party vessel presence via vessel radar, radio and AIS to identify location;<br>Mobilisation route to avoid shipping lanes and cross at perpendicular when crossing is required;<br>Seismic program has limited duration (2 months). | 2 | 1 | LOW Risk |

| Aspect | Possible Impacts | Inherent Risk Assessment | | | Control/Mitigation Measures | Residual Risk Assessment | | |
|---|---|---|---|---|---|---|---|---|
| | | C | L | Risk | | C | L | Risk |
| Presence of Vessel Activities | Interference with Tourism | 2 | 2 | LOW Risk | Prevention Controls:<br>A Notice to Mariners will be issued via the AHO for the duration of the activity;<br>Vessel activity reports issued to AMSA RCC who will also be issuing Auscoast warnings;<br>Notify SARFAC of survey activity;<br>Support/chase vessel to identify spatial conflicts with Charter Vessels/Recreational Fishing;<br>Navigational safety equipment present on the vessels;<br>Survey vessels have trained personnel with 24/7 surveillance.<br>Mitigation Controls:<br>Limited recreational/tourism values are present in the Lightning MSS area (Charter Vessel/Recreational Fishing). Tourism values such as MMO tours, yacht racing, and recreational beach use are not present.<br>Survey duration has limited duration (approx. 2 months) and vessel is constantly moving. | 2 | 1 | LOW Risk |
| Vessel Lighting | Light-spill interfering with behaviour of marine fauna and birds | 1 | 3 | LOW Risk | Prevention Controls:<br>Vessel lighting is the minimum required for compliance with navigation safety and workplace safety requirements;<br>Workplace lighting directed inboard where possible to minimise direct light fall on water;<br>Pre-mobilisation inspection to determine opportunities for minimising light spill.<br>Mitigation:<br>Survey area not located within, or in proximity to, any known light-sensitive fauna aggregation areas (e.g. turtle breeding beaches). No expected change to marine species behaviour;<br>Survey duration has limited duration (approx. 2 months) and vessel is constantly moving. | 1 | 1 | LOW Risk |
| Standard Vessel Operations | | | | | | | | |

| Aspect | Possible Impacts | Inherent Risk Assessment | | | Control/Mitigation Measures | Residual Risk Assessment | | |
|---|---|---|---|---|---|---|---|---|
| | | C | L | Risk | | C | L | Risk |
| Operation of Seismic Sources | Damage to &/or behavioural changes to marine fauna (Cetaceans, Turtles) | 3 | 3 | MEDIUM Risk | Prevention Controls:<br>Smallest seismic source has been selected to acquire seismic data;<br>Prior to MSS commencement spotter aircraft will undertake an aerial survey to determine the presence of whale species (predominantly to confirm presence of Blue Whale, Sperm Whales and Southern Right Whales) in the MSS area three (3) days prior to survey commencement.<br>• ***All Cetaceans*:** Implement & comply with requirements of the DEWHA Industry Guidelines *Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales (2008) (includes 30minute prestart watch, 35min soft-start, 3km precautionary zone, 2km low power zone & power-down procedures, 500m shutdown zone & shut-down procedures; controls for start-up during periods of low visibility);*<br>• ***Specific Species:*** Additional adaptive management controls will be adopted during the MSS, for periods where an increased presence of Blue Whale, Sperm (& similar) Whale and Southern Right Whale could be expected.<br>The Vessel Master and Party Manager will be responsible for ensuring that the requirements of the guidelines are followed. Detailed reports of all cetacean sightings will be recorded using the DOE Cetacean Sightings Application (database) (http://data.aad.gov.au/aadc/ammc/index.cfm). A copy of the sighting forms are to be submitted to the Bight Project Manager after completion of the survey<br>Mitigation Controls:<br>Cetacean/reptiles species will avoid area if sound disturbance is too high;<br>Lightning MSS period (March-May) minimises the chance of encounter with cetaceans<br>Limited survey duration (2 months) | 3 | 1 | LOW Risk |
| | Damage/behavioural changes to Pinnipeds | 3 | 3 | MEDIUM Risk | Prevention Controls:<br>Implement & comply with requirements of the DEWHA Industry Guidelines *Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales (2008) (provides for soft-start procedures which will alert and deter pinnipeds if present).*<br>Mitigation Controls:<br>Seismic frequencies are below the 'normal' hearing range of the species (>1000Hz).<br>Behavioural impacts (i.e. foraging for adult male Sea Lions and Fur Seals) limited to small areas around acoustic source. | 3 | 1 | LOW Risk |

| Aspect | Possible Impacts | Inherent Risk Assessment | | | Control/Mitigation Measures | Residual Risk Assessment | | |
|---|---|---|---|---|---|---|---|---|
| | | C | L | Risk | | C | L | Risk |
| | Damage/ behavioural changes to shark species | 1 | 3 | LOW Risk | Mitigation Controls:<br>Shark species are observed to be tolerant of MSS activity (shark-bites to streamers);<br>Studies have also observed that sharks can withdraw immediately if sound intensity suddenly increases by 20dB re 1µPa (10 times) or more above the previous transmission.<br>Vessel is constantly moving (i.e. not situated in one area);<br>Species wide-ranging and migration pathways not expected to be impeded by MSS activity. | 1 | 3 | LOW Risk |
| | Damage/ permanent behavioural changes to fish species | 1 | 3 | LOW Risk | Mitigation Controls:<br>No lethal effects have been observed for adult fish, crustaceans or shellfish exposed to seismic arrays (McCauley, 1994);<br>Effects of seismic transitory except for fish eggs/larvae at very close range.<br>Fish species sensitive to sound will temporarily flee areas where sound impacts are too great;<br>Vessel is constantly moving (i.e. not situated in one area);<br>Implement & comply with requirements of the DEWHA Industry Guidelines *Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales (2008) (provides for soft-start procedures which will alert and disperse fish).*<br>*Note – no impacts to crustaceans are expected.* | 1 | 3 | LOW Risk |
| Propulsion of all Vessels | Sound Pollution & Behavioural Disturbance to Marine fauna | 1 | 3 | LOW Risk | Prevention Controls:<br>Sound levels emitted from vessels are below sound levels which are thought to cause damage to marine fauna;<br>Vessel propulsion systems undergo regular preventative maintenance and routine inspection against manufacturers requirements;<br>All crew have an environmental induction;<br>Comply with proximity distances and vessel speeds as required for cetaceans in Part 8 of the EPBC Regulations 2000.<br>Mitigations:<br>Small area of impact given the rapid dissipation of sound in the marine environment;<br>Fauna species will avoid area if sound disturbance is too high; and<br>Limited survey duration (2 months). | 1 | 3 | LOW Risk |

| Aspect | Possible Impacts | Inherent Risk Assessment | | | Control/Mitigation Measures | Residual Risk Assessment | | |
|---|---|---|---|---|---|---|---|---|
| | | C | L | Risk | | C | L | Risk |
| Helicopter Use (Supply/Crew Change) | Sound Pollution & Disturbance to Cetaceans | 1 | 3 | LOW Risk | Prevention Controls:<br>Comply with proximity distances as required for cetaceans in Part 8 of the EPBC Regulations 2000.<br>Crew changes to preferentially occur at port call;<br>All helicopter propulsions systems undergo regular preventative maintenance and are routinely inspected.<br>Mitigations:<br>Small area of impact given the rapid dissipation of sound in the marine environment;<br>Fauna species will avoid area if sound disturbance is too high;<br>Helicopter flights minimised (Medevac);<br>Very short duration of disturbance (helicopters at low altitude for small period of time). | 1 | 1 | LOW Risk |
| Standard Vessel Discharges | | | | | | | | |
| Oily water discharges from equipment spaces (All Vessels) | Reduction in water quality (organics & toxics) | 2 | 3 | MEDIUM Risk | Prevention Controls:<br>Vessels to have treatment systems which comply to MARPOL Annex I requirements and meet an oil-in-water content <15ppm prior to discharge (MARPOL 73/78 Annex 1);<br>Oily water discharged is monitored by a calibrated Oil-in-water (OIW) meter and is shut-in on excursion above 15ppm (recorded in oil record book);<br>Oil Detection Monitoring Equipment (ODME) is regularly calibrated;<br>Equipment routinely maintained (Preventative/Planned Maintenance System);<br>Separated oil store in dedicated tank for onshore disposal.<br>Mitigation:<br>Low volumes discharged and rapid dilution/dispersion in Southern Ocean marine waters.<br>Seismic survey is for a limited duration only (2 months). | 1 | 1 | LOW Risk |

| Aspect | Possible Impacts | Inherent Risk Assessment | | | Control/Mitigation Measures | Residual Risk Assessment | | |
|---|---|---|---|---|---|---|---|---|
| | | C | L | Risk | | C | L | Risk |
| Grey water/sewage disposal (All vessels) | Reduction in water quality (organics & visual amenity) | 2 | 3 | MEDIUM Risk | Prevention Controls:<br>Sewage is treated in accordance with MARPOL 73/78 Annex IV requirements prior to discharge in accordance with legislated distances from the shoreline.<br>Equipment routinely maintained and inspected (Vessel's Preventative/Planned Maintenance System);<br>POB strictly controlled on vessel.<br>Mitigation:<br>Low volume of sewage generated with typical numbers of personnel on board;<br>High dispersal/dilution in Southern Ocean marine environment;<br>Seismic survey is for a limited duration only (2 months); and<br>Survey areas not in proximity to landmass (i.e. >3nm). | 1 | 1 | LOW Risk |
| Putrescible waste (food-scraps) Discharges | Reduction in water quality (organics & visual amenity) | 2 | 3 | MEDIUM Risk | Prevention Controls:<br>Vessels operate in accordance with the Vessel's Waste Management Plan;<br>Food-scrap disposal in accordance with MARPOL Annex V discharge requirements;<br>Equipment routinely maintained and inspected (Preventative Maintenance System);<br>Personnel trained in the requirements of the Vessel's Waste Management Plan with placards available;<br>Breakdown of maceration equipment results in food-scraps collected in bins on-board for storage and disposal onshore until equipment operational.<br>Mitigation:<br>Low volumes discharged and rapid dilution/dispersion in marine waters;<br>Seismic survey is for a limited duration only (2 months). | 1 | 1 | LOW Risk |

| Aspect | Possible Impacts | Inherent Risk Assessment | | | Control/Mitigation Measures | Residual Risk Assessment | | |
|---|---|---|---|---|---|---|---|---|
| | | C | L | Risk | | C | L | Risk |
| Incineration of solid non-Biodegradable wastes & Equipment Combustion | Reduction in air quality ($NO_x$, $SO_x$, $CO_2$) & aesthetic impacts of smoke | 1 | 4 | LOW Risk | Prevention Controls:<br>On-board incinerator and vessel engines operate in accordance with MARPOL 73/78 Annex VI requirements;<br>MGO/MDO used as a fuel source;<br>Waste segregation/disposal requirements detailed in Vessel Garbage Management Plan;<br>Regular equipment monitoring and maintenance undertaken on incinerator and combustion equipment to ensure maximum efficiencies are obtained; and<br>Fuel monitoring undertaken to identify equipment inefficiencies.<br>Mitigation:<br>Low volumes generated and rapid dilution/dispersion in atmosphere;<br>Seismic survey is for a limited duration only (2 months). | 1 | 2 | LOW Risk |
| Air Emission: Release of ODS | Reduction in the Ozone Protection layer | 2 | 2 | LOW Risk | Prevention Controls:<br>ODS systems are managed in accordance with MARPOL 73/78 Annex VI (R12) requirements;<br>Maintenance of closed refrigeration systems on-board the vessel undertaken by suitably qualified personnel in accordance with approved procedures;<br>Any repair or maintenance of equipment containing ODS is recorded in the ODS Record Book<br>Mitigation:<br>Accidental Releases are recorded in the ODS Record Book;<br>Seismic survey is for a limited duration only (2 months). | 2 | 1 | LOW Risk |
| Non-Routine Activities (Incidents) | | | | | | | | |

| Aspect | Possible Impacts | Inherent Risk Assessment | | | Control/Mitigation Measures | Residual Risk Assessment | | |
|---|---|---|---|---|---|---|---|---|
| | | C | L | Risk | | C | L | Risk |
| Oil spill (MGO/MDO) due to vessel collision (Spill volume – largest fuel tank is 300m$^3$) | Toxic & Physiological impacts to marine biota (including marine fauna) | 4 | 2 | MEDIUM Risk | Preventative Controls:<br>MSS vessels are class certified and carry appropriate safety audit documentation.<br>Consultation with and notification to, marine stakeholders of activity;<br>Notification to AMSA RCC who will issue Auscoast warnings;<br>Notification to AHO who will issue a Notice to Mariners;<br>Radio communication (MSS & support vessel), AIS and Navigation lights on vessels;<br>Vessel operated by experienced and competent crew (STWC95) with 24/7 bridge watch;<br>Availability of a support vessel to detect third party vessels and avoid interference;<br>ARPA tracking of vessels on MSS and support vessel;<br>MSS Vessel can manoeuvre (change lines) to avoid collisions;<br>MSS vessel can steer offline and dive the cables;<br>MSS vessel sacrifices cables to avoid collision.<br>Mitigation:<br>Use of MGO/MDO as fuel for vessel;<br>Availability of approved, implemented and tested SOPEP and OPEP.<br>Oil Spill Response arrangements identified and tested for MSS.<br>AMSA and SA DPTI response to oil spill as Combat Agency<br>No landfall impacts identified with largest spill volume.<br>*Note MSS is located in an area of high vessel traffic (main shipping channel between Cape Leeuwin and Investigator Strait) which has been identified and is being managed with AMSA & AHO.* | 4[98] | 1 | MEDIUM Risk |

[98] Consequence defined by the largest possible spill size in accordance with the Bight Risk Matrix (Table 5-1 and Table 5-3)

| Aspect | Possible Impacts | Inherent Risk Assessment | | | Control/Mitigation Measures | Residual Risk Assessment | | |
|---|---|---|---|---|---|---|---|---|
| | | C | L | Risk | | C | L | Risk |
| Packaged Oil/Chemical spill through deck system | Localised Reduction of Water Quality | 2 | 3 | MEDIUM Risk | Prevention Controls:<br>Small volumes of chemicals/oils held on-board (usually in packages of limited volume);<br>Chemicals are isolated from the deck drainage system (bunding/containers);<br>Information available to crew members (including training) on the handling and PPE requirements of specific chemicals and spill clean-up procedures;<br>Spill clean-up kits are strategically placed in high risk spill locations;<br>Deck spills are cleaned up immediately and prior to any deck washing;<br>Biodegradable detergents used on vessels;<br>Chemicals/oils are appropriately labelled, packaged, marked and tethered in accordance with IMDG Code;<br>High levels of housekeeping maintained on the vessel and areas are routinely inspected.<br>Mitigation:<br>Availability of implemented and tested SOPEP.<br>Low volumes generated and rapid dilution/dispersion in marine environment;<br>Seismic survey is for a limited duration only (2 months). | 2 | 1 | LOW Risk |
| Refuelling at Sea Fuel (MDO/MGO) transfer spill (Spill 1m$^3$) | Water quality and marine life impacts (estimate 1m$^3$) | 2 | 3 | MEDIUM Risk | Prevention Controls:<br>Refuelling at sea will occur on an 'exception basins' only. Not a routine activity.<br>Refuelling activity is a fully supervised operation during daylight hours, good visibility and in appropriate sea-states, undertaken in accordance with approved Bunkering Procedures, JHA or Permit-to Work by trained personnel with all associated equipment routinely maintained and inspected prior to use (e.g. dry-break couplings);<br>Transfer area is bunded with spill kits available;<br>Tank levels are monitored so not to overfill;<br>Toolbox meetings undertaken and tanks levels monitored to prevent overfill;<br>Suitable absorbent material is held on the vessel to clean-up small diesel spills.<br>Mitigation:<br>Vessel has an approved, implemented and tested SOPEP; and<br>Spills will be rapidly dispersed in the high energy Southern Ocean – no impact to shoreline expected. | 2 | 2 | LOW Risk |

| Aspect | Possible Impacts | Inherent Risk Assessment | | | Control/Mitigation Measures | Residual Risk Assessment | | |
|---|---|---|---|---|---|---|---|---|
| | | C | L | Risk | | C | L | Risk |
| Solid/Hazardous Waste overboard incident | Toxicity impacts to marine flora & fauna<br>Alteration to Seafloor<br>Harm to Marine Fauna by Ingestion | 3 | 3 | MEDIUM Risk | Prevention Controls:<br>Vessel to operate in accordance with an approved Garbage Management Plan which includes identification of waste reduction measures (at source) to prevent waste generation;<br>Clear waste identification, segregation, containment (in skips or sealed drums) and labelling;<br>'No Waste Overboard Policy';<br>Waste storage areas are routinely inspected;<br>All hazardous waste disposed or recycled onshore;<br>Training and reinforcement to all crew (& other) personnel of waste management requirements. | 3 | 1 | LOW Risk |
| Streamer Loss | Hazard to Vessels (Shipping & Fishing Hazard) | 2 | 3 | MEDIUM Risk | Prevention Controls:<br>Streamer deployment and retrieval via approved Procedures;<br>For streamer operations a secondary retaining device is used to prevent loss;<br>Equipment is fit for purpose;<br>An inspection and maintenance system checks bridles and harnesses for wear with damaged components replaced as necessary.<br>Mitigation:<br>Navigation buoy is attached to each streamer (locator) with radar reflectors;<br>In the event of a streamer loss, marine stakeholders are notified | 2 | 1 | LOW Risk |
| Fluid Loss from Streamers (impact from vessels, etc.) | Toxicity impacts to marine flora & fauna | 2 | 2 | LOW Risk | Prevention Controls:<br>Vessel collision preventative controls (*as above*);<br>Low environmental hazard chemical contained in liquid sections of streamer;<br>Streamer is solid with only small sections of the streamer containing liquid;<br>Streamers maintained and inspected for integrity.<br>Mitigation Controls:<br>Rapid dispersion in the marine environment | 2 | 1 | LOW Risk |
| Collision with Marine Cetaceans | Damage/Death to Individual Cetacean | 3 | 3 | MEDIUM Risk | Prevention Controls:<br>Comply with proximity distances as required for cetaceans in Part 8 of the EPBC Regulations 2000 during non-seismic/transit periods (avoids cetacean strikes);<br>All crew given an environmental induction requirements<br>Mitigation:<br>Cetaceans deterred from high sound areas. | 3 | 1 | LOW Risk |

Note: C = Consequence
L = Likelihood

# 6 Environment Plan Implementation

## 6.1 Overview

### 6.1.1 Management System Arrangements

As part of contract award, Bight Petroleum will review the Management System of the Seismic/Vessel Contractor against ISO14001 requirements as it relates to the implementation of EP commitments for the Lightning MSS (i.e. a gap assessment). Key components of the system which will be assessed will include:

- Planning:
  - Contractor HSE Policy;
  - Contractor organisation including roles, responsibilities and resourcing levels (particularly with respect to EP control measure implementation);
  - Environmental Hazard & Risk Assessment process;
  - Emergency Response (including oil spill) preparedness and response arrangements;
- Implementation:
  - Operational procedures available to support environmental management of hazards (including equipment specifications and preventative maintenance system);
  - Management of change procedures;
  - Crew training needs analysis requirements and training records[99];
  - Vessel induction requirements;
  - Work activity assessment (e.g. JSEA) and management (e.g. Permit-to-Work, Toolbox Meeting, standard operating procedures);
- Monitoring & Measuring:
  - Incident reporting, investigation and corrective action management process;
  - HSE Inspection and corrective action management process;
  - Emission/discharge monitoring process;
- Review:
  - Audit procedures/schedule and corrective action management;
  - HSE Review and continuous improvement action items.

Both marine and seismic crews operate under a vessel-specific HSE plan which details the relevant procedures which address environmental management elements detailed above. Bight recognises that due to the short duration of this survey activity and the crew familiarity with the ship-based systems, contractor processes should be utilised wherever possible.

However, to ensure that the specific requirements of the Lightning MSS EP are integrated and implemented into contractor systems, gaps identified during the assessment of the contractor's management system, will be documented and implemented via a bridging document, the Lightning Project Specific HSE Plan, which will define the agreed procedures

[99] Particular emphasis will be placed on those positions responsible for implementing critical control measures to manage environmental impact/risk (e.g. MMOs).

and additional/supplemental requirements to be adopted within the contractor system during Lightning survey activities. This document is agreed and endorsed by Bight Petroleum and the seismic/vessel Contractor. Particular attention will be paid in the bridging document to:

- The utilisation of the Bight Petroleum Risk Management Framework as provided in **Section 5.1** for the assessment of environmental risk[100] and the use of this EP's Environmental Risk Register for the Lightning MSS;
- Identification of crew positions responsible/accountable for the implementation of control measures identified within this EP (i.e. control measure 'custodians'). Information provided to these position will include the required control measure performance standard, notification requirements if standards are not maintained/met[101] and delivery of records to verify performance (and effectiveness);
- Identification of 'reportable incidents' to be observed for the Lightning MSS. This will include the required internal notification/reporting requirements to meet regulatory notification and reporting timeframes and incident investigation requirements;
- Identification of vessel inspection programs included as a 'control measure' in this EP, ensuring the scope of the inspection addresses the relevant performance standard requirement;
- Identification of EPOs for the Lightning MSS and the required reporting, via the vessel's incident management process, where EPOs are not achieved;
- Identification of crew positions who maintain records (e.g. oil record book, incident records) to quantify emissions and discharges (during normal and incident/emergency events) during the Lightning MSS and the requirement to provide these records to the Offshore Bight Representative;
- Ensuring all corrective actions/opportunities for improvement arising from incidents, audits, inspections, monitoring events are documented in the Vessel's on-board Vessel Action Tracking System and monitored for closure by the Party Chief and Bight Offshore Representative in accordance with the vessel's corrective action close-out procedure;
- Events associated with the survey which may result in a *change in the activity scope (e.g. geographical or timing change); an observed significant new environmental impact/risk or significant increase in existing environmental impact/risk not provided in this EP; or a series of new environmental impacts/risk which when taken together results in a significant new, or increase in existing, environmental impact/risk* may trigger a revision to the NOPSEMA-accepted EP. Any change to the Lightning MSS program shall be directed to the Offshore Bight Representative for initial assessment. The change shall be assessed for environmental impact/risk in accordance with the Bight risk methodology and any implications determined for the environment and associated regulatory document revisions. Any confirmed change event shall be managed and documented via the Contractor's change management procedure, utilising the Bight risk methodology; and
- Oil spill response arrangement for the Lightning MSS which must be observed (refer **Section 8**) and the pre-survey exercise activities to be conducted.

[100] Safety and health aspects of the project will be assessed in accordance with the Contractor's risk framework.
[101] Crew position will be advised that this is a 'recordable incident' with required notification to the Offshore Bight Representative.

### 6.1.2 Implementation Strategy Methodology

Bight shall adopt the following methodology to ensure compliance with this EP:

- Pre-survey audits and information provision from the seismic contractor will determine 'hardware' and procedural compliance of the contractor and vessels engaged to the EP requirements (refer **Section 6.6.2**) prior to survey;
- The existing Contractor management systems will be bridged with specific Lightning EP requirements. Control measure 'custodians' will be identified for relevant control measure implementation and a daily report provided to the Bight Offshore Representative on compliance and effectiveness (as relevant);
- An environmental induction program will advise all survey personnel of relevant environmental sensitivities; identified environmental hazards, their EPOs and relevant incident reporting requirements if not achieved; and 'reportable incidents' (refer **Section 6.4.1**);
- The Offshore Bight Representative shall collate daily environmental parameters (e.g. waste streams, maritime compliance, cetacean mitigation and incident reporting outcomes) to determine EPO attainment and control measure implementation;
- The Offshore Bight Representative will undertake an EP Compliance Audit and an EP implementation review against the Lightning Project Specific HSE Plan to determine the effectiveness of the 'bridged' Bight requirements into the Contractor's management system; and
- The Offshore Bight Representative will obtain all relevant records to provide verification of discharges, incidents, etc. at the completion of the survey.

**Appendix F** provides a preliminary *Master Listing* of commitments contained within this EP. The listing identifies the responsible person for implementing the requirement; when the requirement shall be implemented or information obtained; and whether the requirement requires ongoing monitoring by the Bight Offshore Representative during the survey. Ongoing monitoring tasks will form the basis of a daily checklist for collation by the Bight Offshore Representative.

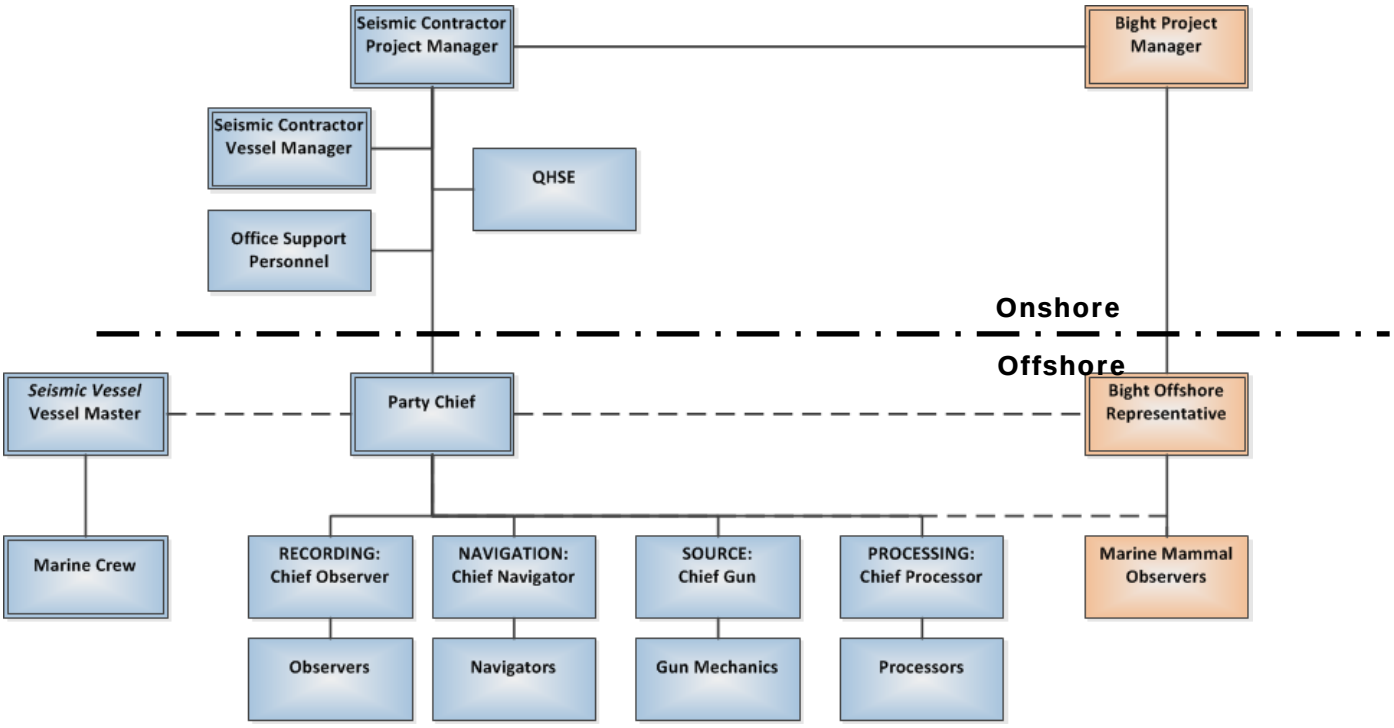
*Note that this detailed listing is preliminary and further refinement is expected on review of the selected Contractor's management system.*

## 6.2 Organisation Structure

Bight is responsible for ensuring that the proposed Lightning MSS is managed in accordance with this Environment Plan (EP). The selected Seismic Contractor will undertake MSS operations under contractual arrangement with Bight and is required to implement and comply with all environmental commitments contained within this EP.

The organisation structure for the program is provided in **Figure 6-1**.

Figure 6-1: Organisation Structure




The Master and Officer of the Watch on-board the MSS vessel are responsible for maintaining control of all vessel operations (including support, scout/escort vessels) associated with the MSS and for establishing/maintaining communication with other vessels and marine traffic during the survey. The support and scout/escort vessel shall abide by all instruction from the MSS vessel and communicate with other marine traffic during the MSS.

All vessels will be capable of communicating and operating on both dedicated UHF working channels and maritime VHF working channels.

The crew on-board the MSS vessel consists of the following crews:

- The **Maritime crew** operate the vessel performing duties in the engine room, galley and accommodation services, internal/external decks, small boats and bridge. The bridge watch offices and crew are responsible for safe navigation; 360 degree watch/lookout; radar monitoring; Automatic Identification System (AIS) monitoring; electronic chart, radio and telephone communication. In addition to navigation safety, the bridge are also responsible for the monitoring of all vessel internal communications, integrated safety and emergency alarm systems and indicators;
- The **Seismic crew** operate and run the survey equipment; are responsible for the deployment and recovery of all equipment and data acquisition throughout the survey. This crew is responsible for the planned and continued maintenance of all towed equipment to ensure there is minimum risk of electrical/mechanical failure which might result in the loss of equipment during deployment, acquisition and recovery. The seismic crew also form the small workboat crew to conduct the in-water maintenance on the streamer spread and the streamer depth control, steering, position and emergency recovery units, also clearing any debris entanglements with the streamers. All workboat operations are conducted during appropriate weather conditions; have appropriate lighting; and the boat complies with all international requirements for small boat operations for safety, navigation and lighting. The small workboat, when not utilised for these operations is located on-board the seismic vessel.

The seismic crew consists of four departments:

- **Navigation**: Responsible for the surface and sub-surface positioning of equipment, survey planning and execution. They are the communication hub during all operations for acquisition, deployment, recovery, in water maintenance or emergency. The department minimises the amount of time in acquiring survey data;
- **Recording:** Responsible for the safe deployment and recovery of the streamer spread and all streamer units controlling depth, steering, positioning and emergency recovery. This department is also responsible for the streamer and towing harness integrity and the planned maintenance of these items;
- **Source:** Responsible for the safe deployment, recovery, planned maintenance and operation of the acoustic source. This department maintains, deploys and recovers the barovane doors used to separate the streamers and assists with the operation during the deployment and recovery of streamers; and
- **Processing:** Responsible for the quality control of the seismic data acquired and are able to quantify in near real-time whether the data is achieving the objective negating the need for additional work in the same area.

## 6.3 Roles & Responsibilities

*Roles and responsibilities as they relate to Oil Spill Response are detailed in **Section 8**.*

*General accountabilities are provided in the section below. During contract award and on evaluation of the Contractor's management system, specific on-board positions will be identified who are responsible for specific control measure implementation.*

### 6.3.1 Bight Petroleum

The **Bight Petroleum Chief Executive Officer** (CEO) has overall accountability for the implementation of this MSS EP and the delivery of environmental performance outcomes for the MSS. This person is accountable for the:

- Seismic contractor and vessel selection meet the requirements of this EP;
- All statutory approvals have been obtained for the activity; and
- All relevant reporting and notification activities are undertaken for the Lightning MSS.

The **Bight Petroleum Project Manager** oversees the routine operation of the vessel, including the operations of the contractors and has overall responsibility for ensuring that the in-force EP is implemented consistently and effectively; all policies/procedures are implemented and the scope of the seismic survey is completed. This position ensures that:

- Regulatory approvals obtained for this activity are distributed to appropriate project personnel and relevant authorities (as identified in this EP);
- The petroleum activity is monitored for change which may trigger an Environment Plan revision;
- Appropriately qualified and experienced MMOs are engaged for the activity;
- All seismic activity incident notification(s) and associated reports to NOPSEMA, NOPTA and SA Department for Manufacturing, Innovation, Trade Resources and Energy (DMITRE) (including reportable environmental incidents and environmental performance close-out report) are fulfilled;
- Provision of weekly seismic activity reports to NOPTA;

- A full briefing and induction of project personnel is undertaken to ensure an understanding of the environmental sensitivities of the survey area, the environmental management procedures and commitments detailed in the EP and individual responsibilities;
- Consultation activities associated with the seismic program to relevant government agencies and marine stakeholders in advance of operations commencing, during and after the completion of the MSS;
- All necessary program-specific procedures are developed and implemented prior to the commencement of the MSS;
- Ensures a pre-mobilisation vessel inspection, oil spill response exercise and oil spill response capability audit is undertaken prior to MSS commencement; and
- Undertakes HSE review at the completion of the program and develops a 'lessons-learnt' listing.

The **Bight Offshore Representative** will be located on the vessel and is responsible for the oversight and reporting on the day-to-day conduct of the program by the seismic contractor. The Bight Offshore Representative verifies that the seismic contractor undertakes operations in a manner consistent with the Performance Outcomes and environmental management procedures detailed in this EP. This position ensures that:

- Day-to-day activities are monitored for compliance against this EP and the outcomes reported to the Bight Project Manager;
- The Bight Project Manager is immediately alerted to any changes in operations which could impact negatively on environmental performance or for changes in operation which alter the environmental risk profile of the activity;
- Maintains full awareness of ongoing operations, including status of EPO and control measure performance providing the necessary reports to the Bight Project Manager;
- Data and records are collected for the Environmental Performance Close-out Report;
- Monitors for control measure implementation and associated 'performance standard' compliance;
- Collates information for monthly recordable incident report and provides information to the Bight Project Manager;
- All on-board personnel have had a program environmental induction;
- All reportable incidents are reported to the Bight Project Manager;
- An environmental audit is conducted during the MSS;
- A review of the effectiveness of the 'bridged' Contractor management system with Lightning MSS Environment Plan requirements (i.e. delivering EPOs and environmental performance standards) identifying opportunities for improvement.

The **Marine Mammal Observer**(s) (MMO) act as Bight's environmental representative on-board the vessel with respect to marine fauna interactions. This includes:

- Ensuring approval requirements with regard to minimising disturbance to fauna are adhered to on-board the vessel;
- Reporting on fauna sightings; and
- Submitting daily reports to the Bight Project Manager.

### 6.3.2 Seismic Contractor

The Seismic Vessel's **Vessel Master** has ultimate responsibility for the safe execution of all vessel operations including:

- Compliance of the vessel with all regulatory (international and local) requirements;
- Notification of vessel movements to AMSA RCC;
- AMSA notifications associated with vessel or streamer (loss) incidents;
- Notifications to other marine users associated with incidents;
- All emergency drills and training are undertaken;
- Auditing is undertaken as required by vessel procedures;
- Equipment is maintained to statutory requirements or better;
- All statutory records (oil record book, garbage record book, ODS Book, etc.) are maintained;
- All HSE related procedures and work instructions are known, understood and followed;
- All new employees are provided with induction, job familiarisation and specific obligations with respect to HSE participation;
- All marine crew have minimum HSE training and are competent in marine activities; and
- Safe working codes and practices are implemented for all vessel operations in accordance with recognised standards and policies.

The **Party Chief** is responsible to the Vessel Manager for strict observance of the Health, Safety and Environmental Management System (HSEMS) on-board the vessel and supports the Master in the following aspects of the operation:

- Implements the vessel HSEMS on-board;
- Reports all incidents and near-misses, recording the details and taking initial actions to render the situation safe;
- Ensures the procedures and work instructions required for seismic operations are known, understood and followed;
- Ensures tool-box meetings area carried out;
- Ensures new employees receive inductions, training and are appropriately supervised;
- Ensures HSE inspections are undertaken;
- Ensures that all working codes and practices are implemented for all survey operations in accordance with recognised standards;
- Ensures that prompt action is taken in order to rectify any deficiencies in working practices or conditions;
- Ensures active participation in HSE meetings by survey crew;
- Communicates all deficiencies of operation with the Bight Offshore Representative; and
- Investigates all incidents along with the Safety Officer, Master and Bight Offshore Representative.

## 6.4 Training & Awareness

The seismic contractor will be highly experienced with regard to the proposed seismic activity and their suitability to undertake the proposed works will be evaluated as part of the project planning phase (contract award).

### 6.4.1 Induction

In addition to the vessel induction, all personnel on-board the survey vessels will be made aware of relevant environmental matters to achieve the required Lightning EPOs by a Lightning MSS environmental induction prior to their commencement on the MSS. Induction material will include, but not be limited to:

- Importance of conforming with the EP and associated regulatory requirements;
- The location of environmentally sensitive areas (e.g. Kangaroo Island Canyons, cetacean feeding areas, cetacean behaviours within the area) in proximity to the MSS area;
- Potential MSS environmental hazards and required controls to minimise impacts associated with MSS activities in the area;
- EPOs, management measures and requirements contained within this EP;
- Reportable and recordable incidents associated with the Lightning MSS;
- Personnel roles and responsibilities with respect to implementation of nominated controls in this EP; and
- The emergency and oil spill response arrangements for the Lightning MSS.

A record of induction will be maintained with endorsement of personnel who attended. These records shall be made available to Bight Offshore Representative as soon as possible after induction activities.

*Note all scout/escort and support vessel crews will be provided with awareness training particularly with respect to their role, and requirements for, marine mammal observation as outlined in this EP.*

### 6.4.2 Competency & Ongoing Awareness

Bight Petroleum will ensure that all MMOs engaged for the survey have appropriate qualifications and experience to undertake reliable marine mammal observation activities.

The seismic contractor will provide offshore personnel who are trained and competent to undertake their respective activities on-board the seismic vessel. All marine personnel are qualified in accordance with the International Convention on Standards of Training Certification and Watch Keeping for Seafarers (STCW95).

All contractor employees are inducted into the Vessel's HSEMS and specific responsibilities are detailed in position job descriptions. Appropriate training, in accordance with the Vessel training matrix is provided to individuals with specific environmental responsibilities.

The following ongoing activities serve to reinforce environmental awareness during the seismic program:

- *Project Kick-off Meeting* which is held at the start of each project and reviews the contractual and HSE specifications for the activity, scope of work, Lightning Specific HSE Plan, Survey Hazards and Risk Assessment[102]. This meeting is attended by the Bight Project Manager, Bight Offshore Representative, contractors and sub-contractors representatives, Vessel Master, Party Chief and marine/survey crews.

[102] Environmental risk as defined in this EP.

- *On-board Daily Meeting* which reviews all survey operations and incidents of the previous day. This meeting is attended by the Bight Offshore Representative, Party Chief, Vessel Master and relevant marine/survey crews.
- *On-board HSE Committee Meetings* attended by all on-board management positions and held on a regular basis. In addition crew safety meetings and departmental meetings are held. These meetings review all HSE issues against plan requirements, review the Vessel Action Tracking System list arising from incidents and inspections and prepare, in close liaison with all relevant parties, an action plan to facilitate continuous improvement in performance.
- *Toolbox Meetings* are attended by all personnel involved in specific operations (before mobilisation, operations involving major hazards and operations involving more than one person). This meeting reviews the activity and reinforces appropriate measures to be adopted to prevent environmental and safety impacts.

Records are produced for each of these meetings.

## 6.5 Communication & Consultation

### 6.5.1 Employee Communication and Participation

The seismic contractor will be responsible for keeping its workforce informed about environmental issues. The Party Chief acts as a focal point for personnel to raise environmental issues, and consults/involves all personnel in the following:

- Issues associated with the implementation of the Environment Plan;
- Any proposed changes to equipment, systems, or methods of operation of plant, where these may have environmental implications; and
- Any proposals for the continuous improvement of environmental protection, including the setting of environmental objectives and training schemes.

Regular HSE meetings will be held on the seismic vessel. The issues will be discussed and actions taken will be recorded. The minutes of each meeting, including action items from the meetings, will be made available to all personnel.

Other forms of internal communication include toolbox meetings which are undertaken before every critical or unfamiliar job. This meeting includes all personnel involved in the task and will include aspects such as spill prevention requirements, etc.

### 6.5.2 Marine Stakeholder Consultation

#### *6.5.2.1 General*

Stakeholder identification was initiated early in 2012 with key relevant stakeholders identified through the following mechanisms:

- Review of relevant legislation applicable to Commonwealth Water petroleum and marine activities;
- Identification of marine user groups in the area (possible recreational/commercial fisheries, fishing industry groups, merchant shipping, eco-tourism providers);
- Identification of marine 'interest' groups (i.e. technical and scientific entities); and
- Industry/company support groups (e.g. APPEA, etc.).

Communication with these differing groups identified 'relevant' persons that might be reasonably impacted by the activity; or additional persons to be contacted to determine possible impacts.

Communications/briefings with these parties and information obtained during this process has allowed for the collation of an Offshore Stakeholder listing; including their relevance to the Lightning MSS area; and the activity triggers as relevant to the seismic activity which may initiate consultation/ communication events or require on-going updates. **Table 6-1** provides details of the key Lightning MSS stakeholders identified in this process, their relevance or interaction trigger, the usual engagement methodology adopted and the timing of interaction. Records of interaction are maintained as far as possible (and as relevant).

Table 6-1: Key Stakeholder Engagement Methodologies & Triggers

| Stakeholder | Relevance/ Interaction Trigger | Engagement Methodology | Timing | Responsibility |
|---|---|---|---|---|
| Australian Fisheries Management Authority (AFMA) | Activity which may impact on Commonwealth Fisheries | Email: petroleum@afma.gov.au | Planning phase of activity | Bight Project Manager |
| | Activity Mobilisation/ Demobilisation Advice | Email: petroleum@afma.gov.au | Approx.5 days prior to activity and 3 days after demobilisation | Bight Project Manager |
| Australian Hydrographic Office (AHO) | Notice to Mariners of additional vessels in the Field | Telephone: [redacted]<br>Email: [redacted]@defence.gov.au | 6 weeks prior to activity commencement | Bight Project Manager |
| Australian Maritime Safety Authority (AMSA) | Notification of Seismic Activity to RCC | Telephone: (02) 6230 6811<br>Email: rccaus@amsa.gov.au | Two weeks prior to start of activity | Bight Project Manager |
| | Daily Vessel Position Report to Sea Safety Canberra | GDMSS | Daily | Vessel Master |
| | Oil Pollution Emergency Planning Consultation | Email: [redacted]@amsa.gov.au | Prior to EP/OPEP Submission | Bight Project Manager |
| | Copy of Final accepted EP | Email: [redacted]@amsa.gov.au | EP Acceptance | Bight Project Manager |
| | Marine Pollution Incident Report (POLREP) (Vessel-based spill incident) | Telephone: (02) 6230 6811<br>Email: rccaus@amsa.gov.au | As soon as possible (notify) | Vessel Master |
| Australian Petroleum Producer & Exploration Association (APPEA) | Industry-wide related issues | Telephone: 08 9321 9775<br>Email: [redacted]<br>Committee Meetings, Face-to-Face Meetings Address:<br>Level 1, 190 St Georges Terrace<br>PERTH, WA, 6000 | As required by the trigger | Bight Project Manager |
| Department of Agriculture (DOA) | Quarantine Issues associated with Equipment or vessels entering Australian Waters (QPAR Form) | Maritime National Coordination Centre<br>Fax: +61 8 8201 6176<br>Email: Maritimencc@daff.gov.au | 12-96hrs prior to arriving at a first Australian Port | Vessel Master |
| Border Protection Command (BPC) | Security and Vessel Activity in the Field | Email: bpliaison@customs.gov.au | As early as possible but at least 14days prior to activity commencement | Bight Project Manager |

| Stakeholder | Relevance/ Interaction Trigger | Engagement Methodology | Timing | Responsibility |
|---|---|---|---|---|
| Fishing Industry Groups (CFA, GABIA, ASBTIA, SASIA, NZRLF, SARLAC) | Activity which may impact on Commercial Fisheries | Email:<br>CFA: ceo@comfish.com.au<br>GABIA: [redacted]<br>ASBTIA: austuna@bigpond.com<br>SASIA: [redacted]<br>NZRLF: [redacted]<br>SARLAC: [redacted] | Planning phase of activity | Bight Project Manager |
| | Activity Mobilisation/ Demobilisation Advice | Email:<br>CFA: ceo@comfish.com.au<br>GABIA: [redacted]<br>ASBTIA: austuna@bigpond.com<br>SASIA: [redacted]<br>NZRLF: [redacted]<br>SARLAC [redacted] | Approx.5 days prior to activity and 3 days after demobilisation | Bight Project Manager |
| Recreational Fishing (SARFAC) | Activity Mobilisation/ Demobilisation Advice | Email: eo@sarfac.com ([redacted]) | Approx.5 days prior to activity and 3 days after demobilisation | Bight Project Manager |
| NOPSEMA | EP/OPEP Submissions | Face-to-Face Meetings (Address):<br>Level 8 Alluvion Building,<br>58 Mounts Bay Road, Perth, WA, 6001<br>Postal: GPO Box 2568, Perth, WA 6001<br>Email: submissions@nopsema.gov.au | Planning Phase of activity | Bight Project Manager |
| | Altered Risk, Activity or Change in Titleholder | Telephone: (08) 6461 7090<br>Email: submissions@nopsema.gov.au<br>Face-to-Face Meeting (Depending on severity):<br>Level 8 Alluvion Building,<br>58 Mounts Bay Road, Perth, WA, 6001 | ASAP on change trigger | Bight Project Manager |
| | Notification of Activity Commencement & Completion | | Within a period of 10 Day prior to commencement and 10 Days post completion | Bight Project Manager |
| | Reportable Incident | | Within 2hrs (oral notification)<br>Written notification (ASAP after verbal)<br>Within 3 days (written report) | Bight Project Manager |
| | Recordable Environmental Incident Monthly Report (Written Report) | Email: submissions@nopsema.gov.au | 15th Day of following Month | Bight Project Manager |
| | Environmental Performance Monitoring (against EP Criteria) | Email: submissions@nopsema.gov.au | Within three months of activity completion | Bight Project Manager |
| | EP Completion Notification | Email: submissions@nopsema.gov.au | After completion of activity and all obligations completed | Bight Project Manager |
| National Offshore Petroleum Titles Administrator | Annual Title Assessment Report | Email: reporting@nopta.gov.au | Within 30days on which the year of the term ends | Bight Project Manager |

| Stakeholder | Relevance/ Interaction Trigger | Engagement Methodology | Timing | Responsibility |
|---|---|---|---|---|
| (NOPTA) | Weekly Survey Report | Email: reporting@nopta.gov.au | As soon as practicable after the end of each week of the survey | Bight Project Manager |
| | Survey Acquisition Report and Data<br>Survey Processing Report & Data<br>Survey Interpretation Report and Data | Email: data@nopta.gov.au | **18months** after the day that acquisition of data is completed (or other agreed period) | Bight Project Manager |
| | Geological or Geophysical Survey Notification | Email: Reporting@nopta.gov.au | At least **48hrs** before proposed MSS start | Bight Project Manager |
| | Access Authority | Email: titles@nopta.gov.au<br>Address: Titles Manager – NOPTA<br>Level 8 Alluvion House<br>58 Mounts Bay Rd, PERTH WA 6000<br>GPO Box 7871, PERTH, WA 6850 | Applications should be lodged **at least 30 days** prior to activity start (recommended **90 days** prior to activity start). | Bight Project Manager |
| | Reportable Incident | Email: Reporting@nopta.gov.au<br>Address: Titles Manager – NOPTA<br>Level 8 Alluvion House<br>58 Mounts Bay Rd, PERTH WA 6000<br>GPO Box 7871, PERTH, WA 6850 | Written notification ASAP after NOPSEMA notification (i.e. 2hrs)<br>Written Report (within 7days of giving NOPSEMA written report) | Bight Project Manager |
| Department Environment (DOE) | Activity which could have significant impact on an item of National Environmental Significance | Email: epbc.referrals@environment.gov.au | Planning Phase of Activity | Bight Project Manager |
| | Compliance & Sighting Report | Email: offshore.petroleum@environment.gov.au | Within two (2) months of activity completion | Bight Project Manager |
| Department for Manufacturing, Innovation, Trade, Resources and Energy (DMITRE) (part of Joint Authority) | Initial Consultation Information (as appropriate) | [redacted]<br>Director Geophysical Operations<br>Petroleum and Geothermal Group<br>Phone: [redacted]<br>Fax: (08) 8463 3229<br>Mobile: [redacted]<br>Email: [redacted]@sa.gov.au | As early as possible | Bight Project Manager |
| | Reportable Incident | | Written Notification ASAP after NOPSEMA notification (i.e. 2hrs)<br>Written Report (within 7days of giving NOPSEMA written report) | Bight Project Manager |
| | Notification on commencement of activity | | One week prior to commencement date of MSS | Bight Project Manager |
| | Cessation Notification | | Within one week of ceasing the MSS | Bight Project Manager |
| Shipping Australia | Initial & Ongoing Consultation Material | [redacted]<br>Email: [redacted] | Planning Phase pf Activity | Bight Project Manager |
| CSIRO | Coordination and Cooperation with respect to seismic and scientific surveys. | Email: [redacted]@csiro.au | On EP acceptance | Bight Project Manager |

| Stakeholder | Relevance/ Interaction Trigger | Engagement Methodology | Timing | Responsibility |
|---|---|---|---|---|
| SARDI | Coordination and Cooperation with respect to seismic and scientific surveys. | Email: [redacted]@sa.gov.au | On EP acceptance | Bight Project Manager |
| DOD/DSTO | Coordination and Cooperation with respect to seismic and on water activities. | [redacted]<br>T: [redacted] | On EP acceptance | Bight Project Manager |
| Blue Whale Study | Notification on commencement of survey | Email: [redacted] | 2 weeks prior to survey | Bight Project Manager |
| SA Department of Planning, Transport and Infrastructure (DPTI) | Oil Pollution Emergency Planning Consultation | Email: [redacted]@sa.gov.au | Prior to EP/OPEP Submission | Bight Project Manager |
| | Copy of Final accepted EP | Email: [redacted]@sa.gov.au | EP Acceptance | Bight Project Manager |
| | Change in Activity which affects DPTI's functions, interests and activities | Email: [redacted]@sa.gov.au | Any time (as relevant) | Bight Project Manager |
| | Notification of Spill Incidents (potential to intersect State Waters) | Phone: (08) 8248 3505 | ASAP after spill | Vessel Master |
| Department of Environment Water & Natural Resources (DEWNR) | Interests lie in the protection of marine environment/fauna. Consultation trigger – any change in scope or control adoption which affects marine fauna or environment. | Email: [redacted]@sa.gov.au<br>[redacted]@sa.gov.au | | |
| SA Department of Fisheries (PIRSA) | Activity which may impact on State Fisheries | [redacted]<br>Email: [redacted]@sa.gov.au<br>Phone: (08) 8226 2214 | Planning phase of activity | Bight Project Manager |
| | Activity Mobilisation/ Demobilisation Advice | | Approx.5 days prior to activity and 3 days after demobilisation | Bight Project Manager |
| NGOs/ KI Council | Interests lie in the protection of marine environment/fauna. Consultation trigger – any change in scope or control adoption which affects marine fauna or environment. | AMCS: amcs@amcs.org.au<br>CCSA: [redacted]<br>Greenpeace: [redacted]<br>IFAW: mcollis@ifaw.org<br>KI Council: [redacted]<br>KI Dolphin Watch: [redacted]<br>KI Eco-action: [redacted]<br>KIMAG: [redacted]<br>MWN: [redacted]<br>Pew: [redacted]<br>WDCS: info.au@whales.org<br>Wilderness Society: [redacted] | Ongoing through the survey | Bight Project Manager |

Bight will continue to consult/communicate in accordance with these triggers during the Lightning MSS.

#### 6.5.2.2 *Activity-Specific Consultation*

The specific detail of the consultation activities undertaken for the Lightning MSS and the response of possible stakeholders is contained in **Appendix C.** Feedback received from initial consultation activities has identified the following comments and principal issues:

- **AMSA** identified that the main shipping channel from Investigator Strait to Cape Leeuwin passes through the Lightning MSS area. On this basis they advised that the AMSA RCC is advised of the MSS activities such that radio warnings to shipping (Auscoast warnings) are in place;
- The **Australian Hydrographic Office** (AHO) advised that a Notice to Mariners would be required. Submission of this application should occur 6 week prior to the activity commencement.
- **AFMA** provided advice on Commonwealth fisheries to be contacted for consultation purposes associated with the Lightning MSS were:
    - Commonwealth Fisheries Association (subsequently contacted but no response provided);
    - Australian Southern Bluefin Tuna Industry Association (ASBTIA) (refer to separate entry);
    - South-east Trawl Fishing Industry Association (subsequently contacted but advised that the appropriate industry association is the Great Australian Bight Trawl Industry Association – refer separate entry);
    - Sustainable Shark Fishing Association (subsequently contacted but no response received. This is thought to be a result of the Gulper Shark closure and the relocation a number of fishermen to Victoria);
    - Small Pelagic Concession Holders (subsequently contacted but not likely to be present in the area);
    - Southern Squid Jig Fishery (subsequently met with Peter Barwick (Barwick Fishing on 23rd November 2012) the sole SSJF Licence holder based in Port Lincoln however he fishes in SW Victoria);
- **ASBTIA** provided advice on preferred timing of survey activities to avoid conflict with tuna fisheries and tuna aerial surveys which determine tuna quotas. ASBTIA also provided conditions to Bight Petroleum to allow for survey activities to occur in March. These constraints have been included in **Section 5.4.1** (Impacts to Commercial Fishing)
- **Blue Whale Study** provided Blue Whale sighting data and aerial survey records which have been undertaken in the region. This information has been utilised within this EP for the assessment of Blue Whale impacts.
- **Conservation Council of SA** identified that it was not supportive of seismic surveys in the GAB and recommended the PAM is used to prevent impacts. PAM has been included as a control measure in **Section 5.5.1** to minimise the impacts on certain cetaceans;
- Department of Environment and Natural Resources **(DENR)** identified that timing of the survey should consider marine mammals which might be present along the coastline; the timing of the upwelling; sea lions and timing of the pilchard spawning season which occurs in late summer. These issues have been considered and addressed in this EP;
- Department of Defence /Defence Science and Technology Organisation **(DSTO)** advised that the DSTO may be undertaking work in the area during 2012, however did not envisage significant issues (now not relevant to survey timing). Further consultation will be carried out with DSTO when survey approvals are confirmed and on-water cooperation is required;

- Department of Resources Energy and Tourism **(DRET)** advised that they had no activities which would conflict with the proposed MSS activity;
- Department of Sustainability, Environment, Water, Population and Communities **(SEWPC)** was in engaged as part of the EPBC Referral process;
- Federal Member for Grey did not have any issues with the survey activity but requested a meeting;
- **GABIA** advised that their primary fishing grounds are located between 126-132°E and hence activity should not pose a problem, however there is sporadic access into these waters. Also advised that there was general uncertainty around impacts of seismic to marine species and fish larvae/juvenile fish; concerned about long term impacts of spills and the survey area in in an area of closure for the gulper shark. These items have been addressed in **Section 5.5.1** and **Section 3.4.3** of this document. GABIA would appreciate good communication with fisheries during the survey (nominated in **Table 6-1** for future notifications).
- International Fund for Animal Welfare **(IFAW)** provided advice that given the marine species present in the area they would prefer the survey not to proceed, however if it was to proceed the survey should avoid certain times of year (November and December); Cetacean surveys should be undertaken before, during and after the survey; and PAM should be included to enhance mitigation measures. These items have been included in **Section 5.5.1**.
- Kangaroo Island Council advised that they were concerned with the survey with respect to lack of consultation, impacts on tourism, fishing industries and a list of eNGO concerns (impacts to marine species. Relevant aspects of these concerns have been includes in **Section 3.4.2, Section 5.5.1** and **Section 5.4.4** of this EP. The Stakeholder consultation log provides evidence of consultation effort.
- **Kangaroo Island Dolphin Watch** had concerns with marine noise and impacts to marine species. Group suggested key mitigation measures of source reduction, geographical and seasonal restrictions, exclusion zones, visual surveillance and soft start/ramp-up techniques be incorporated into the survey; together with continuous acoustic monitoring of critical habitats; independent monitoring of critical habitats (survey vessel and independent platforms) to evaluate displacement and increased monitoring effort for standings which may coincide with the activity. Relevant mitigation controls have been adopted in **Section 5.5.1.**
- **Kangaroo Island Eco-Action** also had similar concerns as the Kangaroo Island Dolphin Watch - associated with marine noise and impacts to marine species. Group suggested key mitigation measures of source reduction, geographical and seasonal restrictions, exclusion zones, visual surveillance and soft start/ramp-up techniques be incorporated into the survey; together with continuous acoustic monitoring of critical habitats; independent monitoring of critical habitats (survey vessel and independent platforms) to evaluate displacement and increased monitoring effort for standings which may coincide with the activity. Relevant mitigation controls have been adopted in **Section 5.5.1**.
- **Kangaroo Island Marine Action Group** had concerns regarding the impacts of the activity to the marine environment from the whole lifecycle of the potential development and the possible impacts to Kangaroo Island particularly in the event of a serious oil spill; and to tourism and fishing industries. Issues relating to tourism have been addressed in **Section 3.4.2** and **Section 5.4.4** of this EP. Future petroleum activities (i.e. drilling), should they arise, will be subject to future approvals and separate consultation. Ongoing consultation will occur with potential users of the area will occur if survey is approved;
- **Migratory Wildlife Network** had concerns associated with the adequacy of environmental information submitted to SEWPC and NOPSEMA and requested copies prior to submission (not considered); concerns of impacts to other species and not

just the Blue Whale. Biological information provided on other species present in the region (captured in Section 3 of this EP). Requests made for public review of drilling approval documents (not relevant to this activity), acoustic modelling reports, details on ramp-up procedures; plans for 24hr visual monitoring of whales, great white sharks southern Bluefin tuna, sea lions (not practicable on a 24hr basis, nor practical on some fish species); and basis of the 'safe zone' for seismic operations. These areas have been addressed (where practicable) in **Section 3.3** and **Section 5.1.1**.

- **Pew Environmental Group** raised concerns aligned the Migratory Wildlife Network. Issues have been addressed in **Section 3.3** and **Section 5.1.1.**
- **PIRSA** (Fisheries) advised that there was a small amount of rock lobster and crab caught in the permit area however the impact is likely to be minimal. Advised that consultation with the Tuna fishery needed to be through AFMA and ASBTIA and a partial list of commercial fishermen were included for consultation purposes. These fishermen were individually contacted by letter in May 2012 however no individual responses received;
- SA Research and Development Institute **(SARDI)** suggested areas for possible scientific collaboration such as tagging Sea Lions/Seals, gulper closure areas etc. SARDI had available research capabilities (noted).
- SA Recreational Fishing Advisory Council (**SARFAC**) advised contact details had been changed (noted);
- Sardine Fishing Industry Association (**SASIA**) had concerns regarding inshore fisheries dispersion and bi-annual sardine egg production survey if undertaken in 1Q 2013. Information has been included in **Section 3.4.3** and impacts assessed generally in **Section 5.4.1** and **Section 5.5.1**.
- **Shipping Australia** had concerns around maritime notifications, adequate notice of the activity, ensuring advice provided to the AHO such that a notice to Mariners is issued, updates on a daily basis and all appropriate navigation safety equipment is provided and functional; compliance with requirements of all maritime authorities (i.e. AMSA). These requirements have been included in **Section 5.4.2**.
- State Member for Finness requested a briefing meeting and is supportive of the proposal. Requested further contact as necessary.
- State Member for Flinders requested a briefing meeting and further contact as necessary.
- State Member for Goyder requested a briefing meeting and further contact as necessary.
- SA State Minister for Manufacturing, Innovation, Trade, Resources and Energy requested to maintain contact as necessary.
- SA State Minister for Agriculture, Food and Fisheries, Regional Development advised that the permits were closer to the coast than other permits and commended the current consultation listing;
- SA State Minister for Sustainability, Environment and Conservation acknowledged the information sent by Bight Petroleum;
- South Australian Rock Lobster Advisory Council **(SARLAC)** advised that the area is relevant to the SA Northern Rock Lobster Fishery and had concerns on possible seismic impacts to the fishery's current level of production. Fishermen fish in water depths of 220-240m on the shelf with the season running from 1 November to 30 May. Item has been discussed in **Section 5.4.1, Section 5.5.1** and **Section 3.4.3;**
- Commonwealth Scientific and Industrial Research Organisation **(CSIRO)** required a commitment to ongoing coordination and cooperation once the activity is approved and operations can be planned.

- Dean Lukin was supportive of the survey and interested in any possible business opportunities.

Consultation guidance with respect to oil spill response by AMSA (Marine Environmental Pollution) was provided by the Advisory Note for Offshore Petroleum Industry Consultation with Respect of Oil Pollution Emergency Plans (AMSA, 2012b).No feedback was provided from the following stakeholders:

- Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF);
- Aboriginal Legal Rights Movement (not a relevant person);
- Australia Conservation Foundation;
- Australian Marine Conservation Society;
- Boating Industry Association of SA;
- Council District of Lower Eyre;
- Department of Transport, Energy & Infrastructure (SA);
- Eyre Region Development Board
- Federal Member for Mayo;
- Flinders Ports
- Geoscience Australia;
- Greenpeace;
- NOPSEMA;
- PIRSA Petroleum;
- Port Lincoln Aboriginal Community Council;
- Port Lincoln Council;
- Ports SA;
- SA Aquaculture Council;
- SA Museum;
- SA Chamber of Mines and Energy;
- The Nature Conservancy;
- Whale and Dolphin Conservation Society;
- Wildcatch SA;
- Wilderness Society;
- Worldwide Wildlife Fund;
- SA Greens Senator – Penny Wright[103];
- Marine Fishers Association of SA;
- CEBEL – Flinders University;
- Individual Fishing Companies (Small Pelagic Concession Holders, SA Marine Fisheries).

A copy of the consultation log/report of the specific stakeholder engagement activities undertaken for the Lightning MSS is provided in **Appendix C.**

[103] Preference to undertake consultation via the media and Senate.

## 6.6 Monitoring, Audit, Management of Non-conformance & Review

The objective of the monitoring, audit and review program for the Lightning MSS is to ensure that the MSS EPOs are observed, verified and measured; EP controls are implemented and performance standard verified; environmental emissions/discharges are recorded and overall performance assessed; and the EP implementation strategy is assessed for effectiveness. These activities assist Bight in reviewing their environmental performance with a view to continuous improvement of environmental management and implementation strategies.

Collation of information provided by control measure 'custodians', EPO incident records and emissions/discharge records allows the Bight Offshore Representative to assess environmental performance against nominated EPOs and standards as outlined in **Section 5.**

### 6.6.1 Emission/Discharge Monitoring, Quantification and Reporting

Parameters provided in **Table 6-2** provide the emission, discharge and interaction parameters which will be monitored and reported for the Lightning MSS program.

Table 6-2: Lightning MSS Emissions, Discharges & Interaction Monitoring Program

| Discharge/Incident | Parameters | Record | Responsibility |
|---|---|---|---|
| **Atmospheric Emissions** | | | |
| Machinery exhaust | Quantity of Marine diesel used by the vessel(s) | Daily Fuel Use Log | Vessel Master(s) |
| Incinerated waste | Volume of waste incinerated. | Garbage Record Book | Vessel Master(s) |
| Ozone Depleting Substances | Volume Released | ODS Record Book | Vessel Master(s) |
| **Discharges to Sea** | | | |
| Oily water discharges | The volume of oily water discharge from vessel(s). | Oil Record Book (by whole Tank Volume) | Vessel Master(s) |
| Food-scraps | The volume of food-scraps discharged from vessel(s) | Garbage Record Book | Vessel Master(s) |
| Sewage/Grey water discharge | The volume of potable water consumed | Water Use Records | Vessel Master(s) |
| **Disposal of Wastes** | | | |
| Hazardous wastes | Volume of hazardous wastes transferred onshore. | Garbage Record Book/Oil Record Book | Vessel Master(s) |
| Solid Non-biodegradable wastes | Volume of non-hazardous wastes transferred onshore | Garbage Record Book | Vessel Master(s) |
| Food-scraps | The volume of food-scraps discharged to shore based facilities | Garbage Record Book | Vessel Master(s) |
| **Marine Fauna Interaction** | | | |
| Cetacean sightings | Details required on the Whale and Dolphin Sighting Reports (DOE) | MMO Records | MMO |
| | Record of soft start commencements, shutdowns and visual checks undertaken before the commencement of arrays and actions taken if whale sightings within 2km of vessel during seismic acquisition<br>Daily log of seismic acquisition by Party Manager | MMO Records<br>Daily Seismic Report | MMO |
| **Marine User Interaction** | | | |
| Vessel Interaction/Complaints | Communications with other vessels. | Incident Records | Vessel Master(s) |
| **Spill/Release Incidents** | | | |
| Spill/release incidents from Vessel(s) | Location, volume, duration and type of spill/waste<br>Response actions taken | POLREP & SITREP Reports<br>Incident Records | Vessel Master(s) |
| Equipment release incidents | Location, equipment type and duration of incident<br>Response actions taken | Incident Records | Vessel Master(s) |
| Whale Collision Incidents | Location, time, type of whale, expected injury<br>Any response actions taken | Incident Records | MMOs/ Vessel Master(s) |

### 6.6.2 Pre-mobilisation Inspection and Audit

Prior to mobilisation, the Bight Project Manager (or delegate) will undertake:

- A vessel inspection to confirm that the vessel hardware and seismic contractor management systems meet with the environmental constraints detailed in this EP. The inspection will be documented and any corrective actions rectified prior to mobilisation;
- An audit of the on-board spill response capability of the vessels against SOPEPs will be made prior to survey mobilisation to verify spill preparedness for the Lightning MSS.

Additionally, the Bight Offshore Representative will also:

- Conduct an EP compliance audit against EP requirements during the Lightning MSS. This will target the following:
    - Compliance with regulatory requirements detailed in this EP;
    - Independent verification that all EPOs and control measure performance standards have been monitored, measured and correctly evaluated;
    - Emissions and discharges are being correctly monitored, measured and documented; and
    - Management strategies and procedures to achieve the EPOs are in place and being implemented effectively.

  Any required remedial actions will be followed up immediately. A copy of the environmental audit will be forwarded to NOPSEMA upon request.
- Conduct an EP implementation review against the Lightning Project Specific HSE Plan to determine the effectiveness of the 'bridged' Bight requirements into the Contractor's management system.

Non-conformances and opportunities for improvement will be identified and corrective actions will be tracked to completion via the seismic vessel's on-board action tracking system. Bight will carry forward any areas of non-conformance identified during the Lightning MSS campaign for consideration in future MSS campaigns to assist with continuous improvement in environmental management controls and performance outcomes.

### 6.6.3 Review

An end of survey HSE Review will be jointly conducted by Bight and seismic contractor during the Post Survey Meeting.

This activity will enable the review of management and mitigation strategies implemented during the MSS and, including reviews of environmental performance, incident investigations, audits and field activity identify actions for future MSSs which can be implemented on a continuous improvement basis. The MSS close out report will include a 'Lessons Learnt' section to facilitate incorporation of any recommended improvement actions in future MSS activities.

# 7 Reporting Requirements

## 7.1 Internal Reports

### 7.1.1 Activity Reports & Key Performance Indicators

The Daily Seismic Survey Report is distributed to Bight by the Seismic Contractor.

The Weekly Seismic Survey Report will be submitted to NOPTA at reporting@nopta.gov.au by the Bight Project Manager.

The Bight Offshore Representative and the MMOs will be responsible for recording compliance against this EP and for sending daily HSE reports to Bight outlining the status of the survey as well as information against environmental performance as covered in this EP.

### 7.1.2 Incident Reporting

All environmental incidents (including any environmental incident and near miss) on-board the seismic or support vessels are reported and investigated in accordance with the Vessel's Incident Reporting and Investigation Procedure. The Party Chief is responsible for forwarding any incident to the Bight Offshore Representative on-board. All corrective actions arising from incidents, audits and inspections are recorded in the on-board Vessel Action Tracking System and monitored for closure by the Party Chief and Bight Offshore Representative. Corrective and preventative actions taken to eliminate the cause of potential incidents will be commensurate with the magnitude of the environmental risks and will be monitored until close-out.

Bight will carry forward the identified corrective/preventative actions from incidents for consideration in future MSS campaigns to ensure 'lessons learnt' are captured and assist with continuous improvement in environmental management or to provide frequency data (i.e. likelihood determination) associated with MSS operations.

## 7.2 External Reports

### 7.2.1 Recordable Incidents

In accordance with Regulation 26 of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009*, the Bight Offshore Representative will record and report all incidents which breach the EPOs or control performance standards as detailed in **Section 5** nominating the incident as a 'recordable incident'. A monthly report shall include recordable incident 'data' including:

- A record of all recordable incidents that occurred during the calendar month[104];
- All material facts and circumstances concerning the incident which Bight knows or able to determine through reasonable enquiry;
- Actions taken to avoid or mitigate any adverse environmental impacts; and
- Corrective actions taken, or proposed to be taken to stop, control or remedy the incident and the action taken to prevent a similar incident from occurring in the future.

The Bight Project Manager shall submit this report to NOPSEMA as soon as practicable after the end of the calendar month but no later than 15 days after the end of the calendar month.

[104] A 'nil report' shall be submitted if no recordable incidents occurred during the month.

### 7.2.2 Reportable Incidents

#### *7.2.2.1 NOPSEMA Reporting*

Reporting Requirements

The Bight Project Manager will notify all activities that have caused, or have the potential to result in moderate to significant environmental consequences[105], to NOPSEMA as soon as possible but not later within two (2) hours after the first occurrence of the incident; or the time Bight becomes aware of the incident. This verbal notification will contain:

- All material facts and circumstances concerning the incident that the titleholder knows or is able, by reasonable enquiry to find out;
- Any action taken to avoid or mitigate any adverse environmental impacts associated with the incident; and
- The corrective action that has been taken or proposed to be taken to stop, control or remedy the incident.

Bight shall provide a written record of the notification to NOPSEMA, NOPTA and DMITRE as soon as possible after verbal notification of the incident to NOPSEMA.

Bight shall submit a written report of the incident to NOPSEMA within three (3) days of the incident or within a timeframe nominated by NOPSEMA. The written report will contain:

- All material facts and circumstances concerning the reportable incident that Bight knows or is able, by reasonable search or enquiry, to find out;
- Any action taken to avoid or mitigate any adverse environmental impacts of the incident;
- Corrective action taken, or proposed to be taken to stop, control or remedy the incident; and
- Action that has been taken, or proposed to be taken to prevent a similar incident occurring in the future.

Within seven (7) days of the written report submission to NOPSEMA, Bight will provide a copy of the report to NOPTA and DMITRE.

In accordance with OPGGSER Regulation 26AA, Bight will provide additional written reports in accordance with requests made by NOPSEMA.

Defined Reportable Incidents

Environmental aspects which have been identified in **Section 5** as having the potential to cause moderate to significant consequences (Consequence 3 to 5) during the Lightning MSS include the following:

- Biofouling hazards (ballast water/biofouling) have not been demonstrated to be low risk prior to Lightning MSS survey commencement;
- Whales[106] present in the shut-down zone (500m) when the array is operating on full power;
- Vessel incidents or near-misses with third party vessels which have the potential to, or result in, an oil spill;
- Solid/hazardous waste overboard incident;
- Vessel strike causing damage to whales; and

[105] This is defined as 'significant' to 'critical' on the Bight Qualitative Risk Matrix.
[106] This definition does not include dolphins.

- Any incident which has the potential to cause or has caused moderate to significant environmental consequences (Consequence 3 to 5) on the Bight Qualitative Risk Matrix.

A spill of 80litres or more of a chemical/hydrocarbon from the vessel is also nominated as a reportable incident for the proposed Lightning MSS.

All reportable incidents will be reported and investigated according to legislative requirements utilising the seismic contractor's Incident Reporting and Investigation Procedure and corrective actions tracked to completion by the Party Chief and On-board Bight Representative via the Vessel Action Tracking System.

#### *7.2.2.2 AMSA Reporting*

In accordance with the *Navigation Act 1912*, AMSA will be notified by the Vessel Master if any of the following incidents occur:

- An oil pollution incident has occurred in commonwealth waters (Marine Notice 1/1996);
- The seismic vessel has sustained or caused an accident occasioning loss of life or serious injury;
- The vessel has received damage or is defective affecting its seaworthiness; or
- There is a serious danger to navigation (e.g. a sizable piece of equipment overboard likely to float creating shipping hazard).

### 7.2.3 Seismic Closeout Reporting (NOPSEMA)

An end-of-survey closeout report will be prepared for Bight by the Bight Offshore Representative which details the performance of the Lightning MSS against the EPOs and performance standards in this EP within three (3) months of the MSS completion. The Bight Project Manager is accountable for the submission of this report to NOPSEMA.

Contained within that report will be the following:

- Reportable incidents, relevant incident investigation details, the corrective actions determined and actioned;
- Recordable incidents (i.e. those incidents which breach EPOs or control measure performance standards) including the incident details, actions taken to a avoid or mitigate adverse environmental impacts and corrective actions;
- Emission/discharge quantification (Refer **Section 6.6.1**); and
- Audit & review outcomes and corrective action status (Refer **Section 6.6.2** and **6.5.3**).

### 7.2.4 Compliance & Sighting Reports (DOE)

In accordance with the DEWHA Industry Guidelines DEWHA *Industry Guidelines Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales (2008)*, the interaction of seismic activities on whales in the area will be monitored via visual sighting records. The survey will utilise DOE's 'Cetaceans Sightings Application' software to record survey activities, observer effort and to report sighting information.

A report on the conduct of the MSS and whale interactions will be provided to DOE by the Bight Project Manager within two (2) months of completion in accordance with the above Industry Guidelines. The report will be collated by the on-board MMOs.

## 7.3 Records Management

The following list summarises the record retention requirements for the proposed MSS program:

- Lightning Project Specific HSE Plan;
- Contractor Management System Gap Assessment;
- Environmental Induction Register (refer **Section 6.4.1**);
- Measurement and recording of criteria that form the Environmental Outcomes and Performance Standards (Refer **Section 5**);
- Cetacean Surveillance and Sighting Forms and Seismic Activity Log[107];
- Cetacean Interaction Procedures;
- Garbage Management Register;
- Oil Record Book;
- Ballast Water Records;
- Marine User Consultation Logs (pre-mobilisation and during survey);
- Incident Register (including Marine User Complaints), incident investigation reports and corrective actions register;
- Notice to Mariners (AHO);
- AMSA RCC AusCoast notification;
- Other stakeholder communications/notifications;
- Qualifications and experience of MMOs;
- Emergency/Oil Pollution Emergency Plan Exercise Records;
- Oil Pollution Reports (POLREP), Situation Reports (SITREPS) and other incident documentation resulting from vessel oil spills (refer **Section 8);**
- External Reporting Records; and
- End of Survey Closeout Report.

The seismic contractor shall forward copies of all environmental reports and records to Bight during the survey for reference within the Lightning MSS Closeout Report to be issued to NOPSEMA. Bight will store and maintain these records, on their server, for a period of 5 years. These records shall be made available to regulatory authorities on request.

[107] Requirements are detailed in the EPBC Industry Guideline 2.1 (DEWHA, 2008) and include:
- The location, date and start time of the survey;
- The name, qualifications and experience of any Marine Mammal Observers (or research scientists) involved in the survey;
- The location, times and reasons where observations were hampered by poor visibility or high winds
- The location and time of any start-up delays, power-down or stop work procedures instigated as a result of whale sightings;
- The location, time and distance of any whale sightings including species where possible;
- The date and time of survey commencement and completion.

# 8 Oil Pollution Emergency Plan (OPEP) Arrangements

## 8.1 Introduction

### 8.1.1 General

This section details Bight's Oil Spill Response arrangements for marine spill incidents associated with the Lightning MSS and supports the vessel's SOPEP (as detailed in **Section 5.7.1**).

As required under MARPOL 73/78 Annex I (Regulation 37), all ships greater than 400 gross tonnes must carry an oil spill prevention plan, a SOPEP, as required by the International Maritime Organisation (IMO). For all ships in Australian waters, the Australian Marine Oil Spill Contingency Plan (NATPLAN) applies. The SOPEP recognises the divisions of responsibility as defined under NATPLAN to provide effective response to marine pollution incidents (refer **Section 8.1.3.2**).

SOPEP's, the principal working document for vessel and crew in the event of a marine oil spill, provides for the following specific management response provisions to mitigate and combat oil spills originating from vessels:

- The procedure to be followed by the Vessel Master to report an oil spill incident, the list of authorities to be contacted (i.e. AMSA RCC) and the oil spill details to be provided (i.e. Forms);
- A detailed description of action to be taken by the personnel on board to reduce or control the discharge (actual or probable) following the incident (i.e. operational spill prevention); and
- Roles and responsibilities of all personnel (Master, Radio Officer, Chief Officer, Chief Engineer, etc.,) with respect to the particular oil spill incident experienced;
- Procedures and point of contact on the ship for coordinating shipboard activities with National and Local Authorities;
- Details of SOPEP equipment held on board the vessel;
- Vessel drawings (drainage and layout); and
- SOPEP testing and drill requirements.

The SOPEP also includes specific emergency procedures including steps to control discharges for bunkering spills, hull damage, grounding and stranding, fire and explosions, collisions, tank failure, sinking and vapour release. The typical structure and content of a SOPEP is provided in **Table 8-1**.

*Bight, as part of seismic contractor selection, will confirm the vessel has an IMO certified SOPEP (or equivalent according to class); equipment and resources as described in the SOPEP are available; and that all scheduled drills and exercises have been undertaken against the documented testing program in the SOPEP.*

Updates to this OPEP may be required (as necessary) by the Bight Project Manager to accommodate changes in contact details for the seismic contractor, survey vessel details and Bight representative contacts; and possibly other minor procedural changes which do not materially change the response arrangements described in this section[108]. All OPEP updates will be undertaken in accordance with the Management of Change Process described in **Section 6.1** to ensure that all inter-related documents (e.g. Emergency

[108] These changes are not considered material changes which require EP/OPEP revision with NOPSEMA.

Response Procedures) are consistent; the integrity of the OPEP is maintained and whether regulator assessment of the revision is required.

Table 8-1: Contents of a Typical SOPEP

| Section | Section Title | Content |
|---|---|---|
| 1 | General Introduction & Purpose | Details the custodian of the Manual and its purpose |
| 2 | Reporting Requirements | Details:<br>Reporting procedures, when and what to report<br>Information requirements, actual/probable discharges<br>Lists of people to contact including coastal ports; coastal state and vessel interested contacts |
| 3 | Steps to Control/prevent discharges | Details:<br>Types of operational spills (pipes, tank leakage, spills from equipment) and types of spills from accidents and groundings (prevention of fire/explosion, extent of damage containment, reduction of spill volumes, securing the vessel)<br>Priority actions followed by mitigation actions, transfer of bunker/lightering, hull stress assessment<br>Responsibilities of the Master and designated Officers<br>General Responsibilities of crew |
| 4 | National & Local Coordination | Master to coordinate all activities with the coastal stet<br>Communication procedures for assistance/liaison with the coastal state |
| 5 | Other Information (as relevant) | Local Requirements<br>Insurance Policy Details<br>Owner/Operator Policies<br>Reference Material |
| Appendices | | Appendix 1: Initial Notification<br>Appendix 2: Coastal State Contacts (Focal Points)<br>Appendix 3: Port Contacts<br>Appendix 4: Ship Interest Contacts<br>Appendix 5: Ship Plans and Drawings<br>Appendix 6: On-board Spill Equipment<br>Appendix 7: Records of Oil Pollution Drills |

### 8.1.2 Scope, Objectives and Protection Priorities

**Purpose:** Oil spill response arrangements detailed in this section are relevant for the Lightning MSS activities in Exploration Permits EPP-41 and EPP-42 and surrounding non-permit areas, which will take approximately 70days between 1 March 2015 (or 2016) and 30 May 2015 (or 2016). This information should be read in conjunction with the vessel's SOPEP and emergency response arrangements (refer **Section 8.1.3**).

This OPEP has been structured such that it is consistent with, and aligned to, NATPLAN requirements.

**Oil Spill Response Objectives:** The overall objectives in any oil pollution event are to:

- Reduce risk to people, property and the environment;
- Effectively respond to minimise the oil impact area and impacts to protection priorities within that area; and

- Remove spill and remediate area to agreed spill termination criteria.

**Oil Spill Protection Priorities:** The hierarchy of protection priorities adopted within this OPEP, reflecting NATPLAN criteria, is as follows:

- Protection of human health and safety;
- Protection of habitat and cultural resources;
- Protection of rare and/or endangered flora and fauna;
- Protection of commercial resources; and
- Protection of amenities.

### 8.1.3 Interface with Other Emergency/Contingency Plans

Relevant legislation, international conventions and authority guidelines as they relate to oil spill in Commonwealth and South Australian waters are provided in **Section 4**.

#### *8.1.3.1 Project-Specific Plans*

Oil spill response arrangements detailed in this section integrate with the following plans which support the Lightning MSS activities:

- Vessel-specific Crew HSE Plan which includes Emergency Response Procedures;
- Lightning Project Specific HSE Plan[109]; and
- Vessels SOPEP.

Support and escort vessels will have SOPEPs or SOPEP-equivalent documents according to the size and classification of the vessel. These plans ensure timely response to emergencies and effective management of oil spills.

#### *8.1.3.2 NATPLAN*

NATPLAN integrates Commonwealth and State Government response frameworks to facilitate effective response to marine pollution incidents. AMSA manages NATPLAN, working with State Governments (*who have equivalent state plans which integrate into NATPLAN*); the shipping, oil, exploration, chemical industries; and emergency services to maximise Australia's marine pollution response capability to incidents.

NATPLAN applies in Commonwealth waters 200nm seaward of the territorial sea baseline (3nm). The South Australian Marine Spill Contingency Action Plan (SAMSCAP) applies in SA territorial waters from the shoreline to 3nm.

Response equipment and resources (under the management and control of AMSA's Marine Environment Protection (MEP)) which support NATPLAN include:

- Oil spill response equipment managed via the Marine Oil Spill Equipment System (MOSES);
- Oil Spill Response Atlas (OSRA) which identifies sensitive marine and foreshore ecosystems and biological resources present in a region (also available through the SA Department of Planning, Transport and Infrastructure (DPTI)); and
- Oil Spill Trajectory Modelling (OSTM).

[109] A project-specific bridging document including relevant Bight and Seismic Contractor contacts for any emergency (including oil spills). This also includes the relevant government/regulator contact numbers (e.g. AMSA, NOPSEMA, SA DPTI, SA DMITRE). These contact details will be verified as part of the pre-MSS oil spill response exercise planned for the Lightning MSS (refer **Section 8.5**).

#### 8.1.3.3 SAMSCAP

The SA DPTI is the Combat Agency for marine oil pollution in SA Territorial waters and will appoint an Incident Controller for oil spills in these areas except in Port Authority waters[110] under the SA Marine Spill Contingency Action Plan (SAMSCAP). The aim of SAMSCAP is to detail the roles, responsibilities strategies and actions to be carried out in the event of a spill occurring in SA waters.

Activation of the SAMSCAP, and hence mobilisation of associated resource, will be initiated by the State Marine Pollution Controller (SMPC). Where SAMSCAP is activated, a number of government agencies may be involved in the spill response at an operational level including DMITRE and Environmental Protection Agency.

AMSA may request that the SA DPTI assume the Lead Combat Agency role, even though the spill occurred in Commonwealth waters in situations where oil is likely to impact on the SA shoreline; where AMSA personnel are in transit to the site or committed to another incident (NATPLAN, 2011). Deployment of SA resources outside State Waters is usually coordinated and requested through AMSA (NATPLAN, 2011).

*Note that OSTM results indicate a very low likelihood of oil spill intersection at thresholds of 0.5g/m$^2$ or 0.5µm with South Australian coastal waters. The South Australian DPTI will be contacted as courtesy in the event of a Tier 2 oil spill during the Lightning MSS.*

### 8.1.4 NATPLAN Framework

#### 8.1.4.1 Authorities & Responsibilities

NATPLAN defines two levels of responsibility:

- Statutory Agency (SA) having the statutory responsibility to ensure an adequate spill response plan is prepared and, in the event of an incident, that a satisfactory response can be implemented by the Combat Agency; and
- Combat Agency (CA) having the responsibility to take operational control and respond to an oil spill in the marine environment.

**Table 8-2** provides details of the SA and CA with respect to a marine oil spill from a vessel.

*Bight Petroleum under the OPGGSA is responsible for oil spill incidents from petroleum activities (CA). Recognising the legislated responsibility of AMSA as CA for vessel-based marine oil spills in Commonwealth waters, AMSA will operate as CA for vessel-based spills associated with the Lightning MSS. However, Bight will monitor and liaise with AMSA, the Vessel Master and Seismic Contractor and provide assistance as required.*

Table 8-2: Statutory and Combat Agencies (NATPLAN, 2011)

| Spill Location | Spill Source | Statutory Agency | Combat Agency | |
|---|---|---|---|---|
| | | | Tier 1 | Tier 2/3 |
| Commonwealth Waters | Vessel-based Incident | AMSA | AMSA | AMSA |
| | Petroleum Activity[111] | NOPSEMA | | |

[110] This is the responsibility of the Port Authorities for a Tier 1 spill in port waters. For Tier 2+ spills this then becomes the responsibility of SA DPTI.

[111] Under NATPLAN provision is made for the integration into NATPLAN of 'Facility Contingency Plans' (Figure 1) and Petroleum Operations (Page 9). AMSA, the responsible authority for NATPLAN interprets 'Petroleum Operations' to be associated with Petroleum Facilities and not vessel-based activities. As such, AMSA is the CA for all Tiers of oil spill from vessels.

### 8.1.4.2 *'Tiered Response' Strategy*

Marine oil spills are classified under international classifications according to size or 'Tiers'. This assists with identifying the level/nature of assistance required to combat spills. The spill response tiers are defined according to the following parameters:

- The type and quantity of oil or other substance spilled;
- The potential impact on the marine environment;
- The potential social, economic and political impact;
- Potential media and public interest in the incident;
- The amount and source of resources deployed; and
- The levels of support and higher level management activated.

The classification system is outlined in **Table 8-3**.

*It should be noted that given the finite volumes contained within the Lightning MSS vessels, the maximum Tier size possible for the MSS is Tier 2 (i.e. causal pathway is high speed vessel collisions).*

Table 8-3: Summary of Response Tiers for Marine Vessels

| | Tier 1 | Tier 2 | Tier 3 |
|---|---|---|---|
| Level of Control | | | |
| Vessels (Commonwealth Waters with potential to make landfall in SA) | CA: AMSA | CA: AMSA (Commonwealth Waters) and SA Department of Planning, Transport & Infrastructure (SA State Waters) | |
| Possible Triggers for Determining Response Tier[(1)] | | | |
| Indicative Spill Size | Small (0-10tonnes) | Medium (10-1000 tonnes) | Large (>1000tonnes) |
| Typical Incident | Ship transfer, bunkering on vessel | Shipping incidents in ports/sea | Major incidents involving tankers/ vessels with large bunker oil volumes, |
| Potential for Environmental/Economic Damage | Low (Not Significant) | Moderate (Local or short term significance) | High (Regional or long-term significance) |
| Agency (Resources Mobilised) | | | |
| Vessel | | | |
| State CA (SA DPTI) | | | |
| National (AMSA) | | | |
| International | | | |

Mobilised or likely to be mobilised

Possibility or partially mobilised

### 8.1.4.3 *Tier 1 Response*

A Tier 1 response to small spills (<10tonnes), a spill where the ZPI occurs in proximity to the vessel, can be managed by the Vessel Master with on-board equipment and trained vessel crew members. These are small spills which will not impact shorelines or other sensitive resources.

The Vessel Master is also responsible for notifying the SA (AMSA). The Vessel Master (or delegate) shall monitor the spill and notify AMSA of the situation status. AMSA, as CA for

Tier 1 spills in Commonwealth Waters will monitor continue to assess this level of spill. *Note that the SA can reassess the response at any time and escalate the Tier as required*.

Refer to **Section 8.3.1** for regulatory notification responsibilities.

#### *8.1.4.4 Tier 2/3 Response*

A Tier 2 spill cannot be managed by onsite resources and/or could have serious impacts on the environment. The Vessel Master again will notify the SA (AMSA) as soon as possible. The CA (AMSA) will assume control of the Tier 2/3 spill incident and response in Commonwealth waters. The Vessel Master shall, as courtesy, also advise the South Australian DPTI of the spill.

It is the responsibility AMSA to liaise with SA DPTI as CA for SA territorial waters.

The responsibilities of the CA under a Tier 2/3 spill scenario include:

- Continued monitoring and surveillance of the spill, its weathering and proximity to environmentally sensitive locations;
- Undertaking oil spill trajectory modelling (as necessary) to predict slick movement; and
- As required, and after a NEBA assessment, deploy appropriate resources or equipment to protect identified sensitive environmental resources (i.e. primarily marine fauna).

Onsite resources (e.g. support vessels as requested) will continue to provide status updates (SITREPs), at the direction of AMSA, throughout the response activity.

AMSA will maintain control of the response until relevant termination criteria are achieved[112].

*A Tier 3 response (>1000tonnes) is not considered credible for the Lightning MSS.*

## 8.2 Spill Preparedness

*The Master must ensure that all relevant Vessel personnel are inducted and familiar with the contents of this OPEP and accompanying SOPEP; and trained to carry out their individual responsibilities. The Master shall also ensure that all port and emergency agency contact lists are complete, listed and posted in key locations on the vessel and that all relevant notifications can been provided to these agencies prior to the survey commencement.*

### 8.2.1 Spill Scenarios

Credible spill scenarios identified for the Lightning MSS activity are broadly divided into two categories:

- Small spill quantities from uncontained deck spills/leaks or refuelling to the marine environment; and
- Larger spills resulting from vessel failure[113] (e.g. vessel collision).

**Table 8-4** provides details on the potential Lightning spill scenarios, spill volumes and with controls implemented the residual risk associated with an oil spill occurring.

[112] For Tier 2 MDO/MGO spill in marine waters it is expected that a criteria of 'no visible sheen' will be applied.
[113] Note failure associated with grounding is not considered a credible scenario given the distance of the vessel from the SA coastline and any emergent reef systems (>4nm) (DNV, 2011).

Table 8-4: Potential Spill Scenarios & Volumes

| Spill Scenario | Cause | Potential Volume (Tier) | C | L | R | Spill Type, Zone of Potential Impact (ZPI) & Environmental Impacts |
|---|---|---|---|---|---|---|
| Spill from Deck (accidental loss of stored substances) | Poor Containment<br>Operator Error | <400litres (Tier 1) (Maximum likely Spill) | 2 | 2 | L | Possible release of solvent, hydraulic fluid or packaged hydrocarbons.<br>ZPI: Limited to immediate area around vessel (estimated ZPI of approximately 113m[114] around release point).<br>Environmental Impact: Minor localised water quality impacts rapidly diluted in Southern Ocean waters. No impacts to marine species anticipated. |
| Refuelling Spill | Equipment Integrity<br>Operator Error<br>Poor Weather Conditions | 1000litres (Tier 1) | 2 | 2 | L | Marine Gas Oil (MGO) or Marine Diesel Oil (MDO)<br>Rapid spread of oil on the sea surface with evaporation and dispersion according to weather conditions at the time of the spill.<br>ZPI: Limited to immediate area around vessel (estimated ZPI of approximatley 180m[115] around release point).<br>Environmental Impact: Localised water quality impacts rapidly evaporated/dispersed in Southern Ocean waters. No impacts to marine species anticipated. |
| Streamer Leak | Shark Bite | 60litres (Isopar) (Tier 1) | 1 | 3 | L | Isopar release.<br>Rapid spread of hydrocarbon the sea surface with rapid evaporation and dispersion according to weather conditions at the time of the spill.<br>ZPI: Limited to immediate area around vessel (estimated ZPI of approximatley 151m[116] around release point).<br>Environmental Impact: Localised water quality impacts rapidly evaporated/dispersed in Southern Ocean waters. No impacts to marine species anticipated. |
| | Third Party Vessel Collision | 300litres (Isopar) (Tier 1) | 2 | 1 | L | |
| Vessel Tank Failure | Vessel Collision | ~300m$^3$ (largest fuel tank) (Tier 2)[117]<br>(Maximum Credible Spill) | 4 | 1 | M | Marine Gas Oil (MGO) or Marine Diesel Oil (MDO)<br>Rapid spread of oil on the sea surface with evaporation and dispersion according to weather conditions at the time of the spill. No oil residue at 10µm predicted after 24hrs and 0.5µm prdicted after 5.5days.<br>ZPI: Refer **Figure 5-4** and **Figure 5-5**. Spill remains in marine waters with no shoreline contact at thresholds of environmental concern.<br>Environmental Impact: Water quality impacts dispersed/evaporated over an estimated period of 5.5 days. Possible impacts to air-breathing fauna present in the ZPI (i.e. whales, turtles, pinnipeds, seabirds). Refer to **Section 5.7.1** for potential impacts). |

[114] Radius is considered a maximum based on a 10µm oil thickness, no dispersion in the water column and no evaporation of spilt hydrocarbon
[115] Radius is considered a maximum based on a 10µm oil thickness, no dispersion in the water column and no evaporation of spilt hydrocarbon
[116] Radius is considered a maximum based on a 10µm oil thickness, no dispersion in the water column and no evaporation of spilt hydrocarbon
[117] Fuel on-board vessel is contained in multiple fuel tanks. The release of the largest fuel tank is considered a conservative estimate of the potential release volumes.

### 8.2.2 Spill Types

**MGO/MDO** (Group II/III oil): Is a common marine fuel used in vessel engines and is a mixture of both volatile and persistent hydrocarbons (ITOPF, 2011) (refer **Table 8-5**). On release, MGO/MDO is expected to undergo a rapid spreading and evaporative loss with the remainder becoming dispersed in the water column. Although classed as 'persistent oil', a slick tends to break up quickly. During evaporative weathering, low molecular weight aliphatic and aromatic hydrocarbons and phenols are lost from the oil, leaving higher concentrations of less volatile, higher molecular weight hydrocarbons. The heavier components have a strong tendency to entrain in the upper water column as oil droplets in the presence of wind/waves but can re-float to the surface if these energies abate.

Table 8-5: MGO/MDO Fuel Properties (ITOPF, 2011)

| Hydrocarbon | SG (@15°C) | Viscosity (cP@15°C) | Pour Point (°C) | Flash Point (°C) | API Gravity | Oil Persistence Category/ Classification |
|---|---|---|---|---|---|---|
| MGO/ MDO | 0.842 | 5.0 | -3 | 61.5 | 36.5 | Group II or III (Light Persistent Oil) |

Response options for MGO/MDO spills are as follows:

- Due to the rapid evaporation and dispersion MGO/MDO spills are normally monitored and allowed to naturally weather, if no protection priorities are at risk;
- MGO/MDO is dispersible, although not recommended because of the high proportion of toxic materials and their persistence and toxicity in the marine environment may increase with dispersant use. Additionally dispersant use on light products which form very thin films of oil or sheens on the water surface, tend to 'punch-through' the thin film into the underlying water causing herding of the oil (not to be confused with dispersion) (ITOPF, 2011). Dispersant may be used in instances where there is an immediate safety hazard, however the rapid spread of this material makes this strategy ineffective (NTDLP, 2012).
- Physical agitation by using propeller wash may assist in the evaporation and break up of spilled MGO/MDO however the potential exists to emulsify the oil which leads to decreased degradation rates. This response strategy is not recommended for these types of spills.
- The rapid spreading rate of these oils presents problems for containment strategies at sea but if contained diesel is easily recovered with sorbent or oleophilic disc skimmers (NTDLP, 2012).

**Isopar-M:** Isopar-M is a low-odour, low aromatic hydrocarbon solvent recognised to have low acute and chronic toxicity. Isopar biodegrades at a moderate rate and does not persist in the environment. It has low water solubility and is a volatile organic compound which rapidly volatilises and degrades in air (Exxonmobil Chemicals, 2011).

Response options for Isopar, due to the small volumes released, is a natural weathering/surveillance strategy

**Packaged Chemicals:** Small volumes of hydrocarbon-based chemicals such as hydraulic oils and solvents may also enter the environment. Physical properties and fate/weathering of these products varies, however given the small quantities held on-board the vessel, dispersion within the marine environment in close proximity to the vessel is expected.

*MSDSs for packaged chemicals should be consulted for appropriate clean-up strategies for these spill types.*

Should these materials be released to the marine environment, a natural weathering/surveillance monitoring response strategy should be adopted.

### 8.2.3 Zones of Potential Impact

Oil spill trajectory modelling has been undertaken for a 300m$^3$ MDO/MGO spill over six hours at a location within the survey area which has closest proximity to shore for the period January to June. This report is provided in **Appendix D**. ZPIs for this worst case credible spill are provided in **Figure 5-4** and **Figure 5-5**.

No coastline impacts at environmental 'harm' thresholds are expected for the period for this worst-case release volume. The spill ZPI (i.e. 10µm surface oil threshold) will be limited to marine waters (Commonwealth). *Environmental impacts will therefore be limited to the marine environment*.

### 8.2.4 Protection Priorities within ZPI

Protection priorities and response objectives within the ZPI, in accordance with NATPLAN's protection priority hierarchy are:

- **Priority 1:** Human Health and Safety Protection:
  - MSS Vessel & Support Vessel personnel;
  - Other marine users (merchant shipping and fishing vessels);
- **Priority 3:** Rare and/or Endangered Fauna Protection:
  - Whales (Blue, Humpback and Southern Right Whales)
  - Pinnipeds (Australia Sea Lion) (Marine);
  - Marine Turtles (Loggerhead, Green & Leatherback);
  - Marine Birds (Albatross, Petrels); and
- **Priority 4:** Commercial Resources:
  - Commercial Fisheries.

Accordingly, the following oil spill response priorities (objectives) have been identified for the Lightning MSS:

- Remove marine users from areas which present a safety hazard;
- Prevent exposure to oil of threatened species which may transit area (Whales, Turtles, Seabirds); and
- Prevent commercial fisheries (i.e. lobster) exposure (equipment & catch) in proximity to the MSS area.

### 8.2.5 Spill Response Strategies

#### *8.2.5.1 Tier 1*

A Tier 1 (up to 10tonnes) response to a small spill can be handled by on-site or local resources.

If a spill occurs from a vessel, the Master must mount the first response to the incident under the Vessel's SOPEP using the resources immediately available to the vessel (i.e. ship-board equipment). It is also the responsibility of the Master to immediately notify all spills over 15litres to the Rescue Coordination Centre (AMSA).

As identified in **Table 8-4**, the identified Tier 1 spills for the Lightning MSS (<1000litres [discrete volume]) will have a ZPI which is close to the vessel and will be managed by the Vessel Master with on-board equipment or until the spill is effectively dispersed or evaporated, with oversight by, and in close cooperation with, AMSA. The Vessel Master is responsible for providing updated reports to AMSA to inform the spill response strategy (at frequencies determined by AMSA).

#### *8.2.5.2 Tier 2*

A Tier 2 (10-1000tonnes) response is a medium/significant spill which could have serious impacts on the environment and/or cannot be managed by onsite resources. The Vessel Master will notify the SA (AMSA) who shall also become CA for a Tier 2 spill response. The Offshore Bight Representative will notify the Bight Project Manager who will provide notification to NOPSEMA.

The Vessel Master, after ensuring safety of crew and fire prevention and notification to AMSA, will implement the SOPEP and consider actions such as tank lightering[118] to reduce the oil volume released to the environment (refer Section **8.3.2.2** for SOPEP responses to vessel spill scenarios).

AMSA (CA) will determine the appropriate response strategies depending upon the protection priorities at risk within the ZPI. AMSA, depending on the location, prevailing weather conditions, available vessel responses (e.g. tank lightering) and volume spilt, will determine the need for OSTM to confirm protection priorities within the ZPI; and possible sea/aerial surveillance to confirm/inform trajectory predictions. All selected response strategies will be in accordance with NATPLAN and a NEBA[119] undertaken for the specific spill. This will include an assessment of all available response strategies and their associated risk to protection priorities in the ZPI. Bight will consult with AMSA during this assessment.

The Vessel Master is responsible for providing SITREPs to AMSA to inform the spill response strategy.

*Note a Tier 3 spill is not credible for the Lightning MSS activity.*

## 8.3 Spill Response Management

### 8.3.1 Notification Structure & Team Responsibilities

#### *8.3.1.1 Notification Structure*

**Figure 8-1** shows the Lightning Emergency Reporting structure adopted for marine emergencies/oil spills.

The Vessel Master is responsible for notification and reporting (via POLREP Form contained in SOPEP) all spills to the marine environment to the AMSA RCC. In the event of a Tier 2 spill during the activity, the Vessel Master will also contact the SA DPTI as a courtesy. Once the vessel has transmitted an initial report, further reports will be sent at regular intervals to keep relevant parties (AMSA, Seismic Contractor, Bight Petroleum, NOPSEMA, etc.) informed.

The On-board Bight Representative is responsible for advising the Bight Project Manager of the spill incident. The Bight Project Manager is then responsible for notifying NOPSEMA.

[118] Activity is undertaken in conjunction with maritime experts to ensure the ship's stability.
[119] A preliminary NEBA for a MGO/MDO/Isopar spills is provided in **Appendix B**.

#### *8.3.1.2 Response Team Responsibilities*

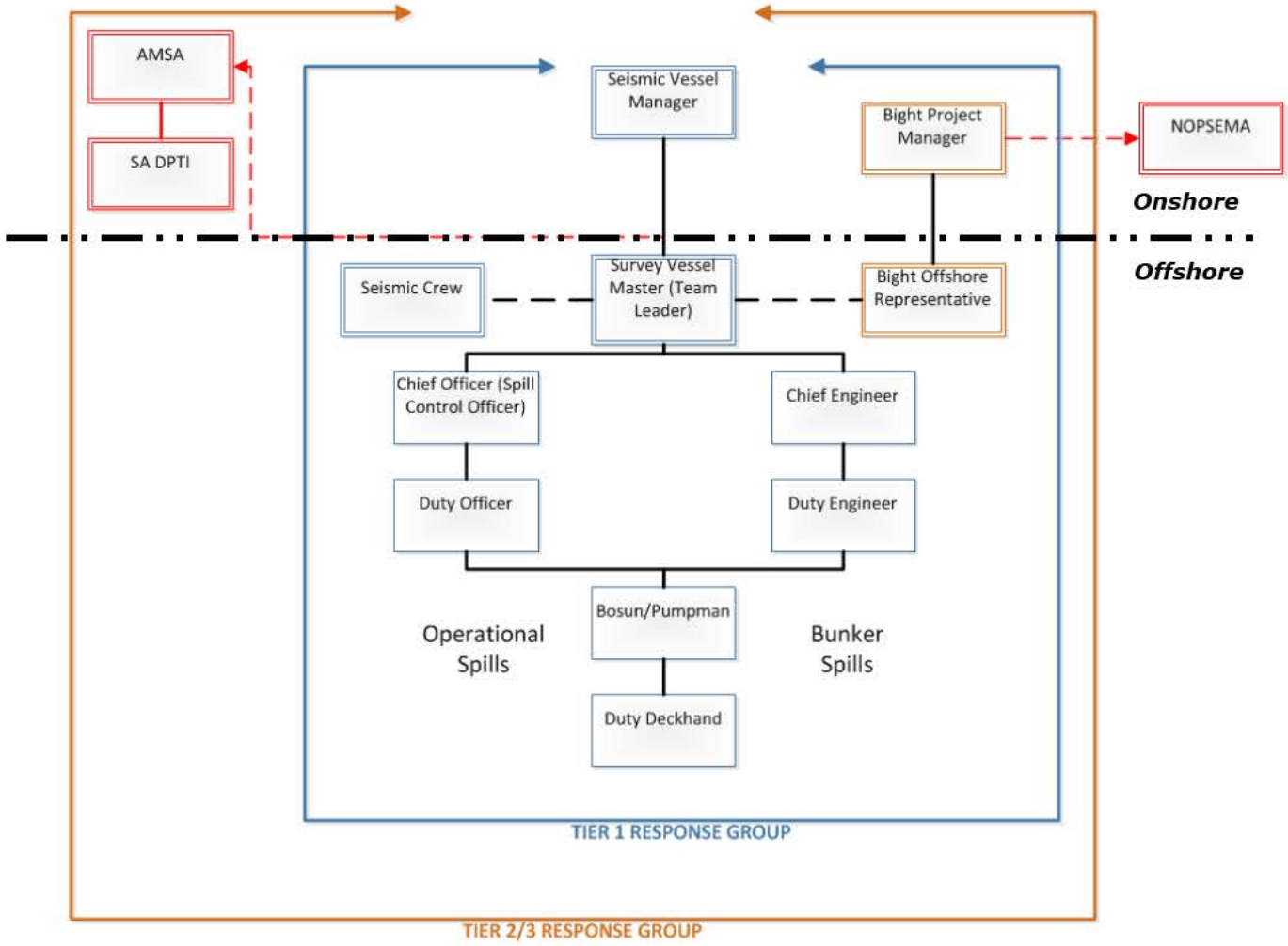
**MSS Vessel Pollution Prevention Team (VPPT):** The VPPT is responsible for initiating the Incident Action Plan (refer Immediate Actions – **Section 8.3.2**) and emergency procedures as detailed in the Vessel's SOPEP. The major roles within the VPPT are as follows:

- The Vessel Master has overall control of the on-board operations and has the responsibility of reporting the incident, without delay, to AMSA. The Master oversees any stability computations/evaluations, direct damage controls; initiates incident investigations and coordinates response activities with AMSA & SA DPTI (as appropriate);
- The Chief Engineer, in charge of the engine room and bunkering activities, coordinates spill response activities within the engine room and ensures that all available engine room staff are mobilised for containment and clean-up activities;
- The Duty Engineer assists the Chief Engineer and ensures engine room services are available to deck personnel engaged in clean-up operations (e.g., air, water, power etc.);
- The Chief Officer is responsible deck operations including containment and clean-up activities, checking stability criteria and keeping the Master informed and updated;
- The Duty Officer assists the Chief Officer as required, and alerts and mobilises all off-duty personnel.
- The Duty Deckhand alerts all personnel as soon as possible and will attempt to contain any oil spill on deck, and prevent oil from going over the side by using available sorbents or sawdust, rags, scuppers etc.
- Duty Rating(s) alerts Officer(s) on Duty immediately of an oil leakage. Positions sorbent materials/clean-up material to prevent any oil from escaping over-board and commences clean-up by using the available equipment on-board the vessel.
- Other crew responsibilities follow the instructions of the Chief Officer, and carry out containment and clean-up operations as directed.

**Seismic Contractor Company Contingency Team (CCT):** Primary duty is to ensure that the Master is fully supported and to engage with regulatory authorities and relevant resources as detailed in the SOPEP. This may include logistics support and telecommunications; safety; planning; finance; insurance and legal support. The Seismic Vessel Manager normally represents the CCT.

**Bight Emergency Management Team (EMT):** The Bight Project Manager normally represents the Bight EMT and notifies NOPSEMA of the initial incident (& provides regular interval updates). The EMT monitors the incident and provides support (as required) to the CCT and Vessel Master. The EMT also provides updates to affected stakeholders and media (as necessary).

Figure 8-1: Lightning MSS Emergency Reporting Structure




## 8.3.2 Immediate Actions

### *8.3.2.1 Immediate Action Checklist*

**Table 8-6** provides a checklist which specifies the immediate tasks to be undertaken in the event of a marine spill. All response personnel should maintain logs to record significant events, actions, decisions, expenses, etc.

Table 8-6: Immediate Action Listing

| Action | Responsibility |
|---|---|
| **Initial Emergency Actions** | |
| 1. Sound relevant alarm. Report spill event to the Vessel Master and/or Chief Officer on Duty | Crew Member discovering leak/spill |
| 2. Implement the relevant emergency response procedures to protect human life and equipment and in particular, those procedures focused at reducing the risk of fire or explosion (i.e. (SOPEP/ERP)) or equivalent. | Vessel Master |
| 3. Attempt to isolate the supply of oil to the spill area if safe to do so. Minimise loss overboard utilising available spill prevention/clean-up equipment on-board. | Vessel Master (or delegate) |

| Action | Responsibility |
|---|---|
| 4. After safety measures have been implemented, identify the damage, location of incident, proximity to land, other navigational hazards, other traffic in the area, extent of spill (rate/volume) and the weather/current conditions in the area. | Vessel Master |
| 5. Notify AMSA immediately if spill>15litres and confirm response actions (**AMSA RCC Phone: +61 2 6230 6811**).<br>If the spill is large and may enter SA state waters contact the OSRC **(24Hr Reporting Number: +61 8 8248 3505)** | Vessel Master |
| 6. As appropriate, issue emergency call-out on marine radio **VHF Channel 16** to warn other vessels in the immediate path of the spill. *Warning should include the type of accident, such as collision or leak; where the accident has occurred; possible hazards such as risk of fire or explosion; where the slick is moving and recommended actions, for example leaving the area, staying 500m up-current, up-wind from the spill site and no naked flames.* | Vessel Master |
| 7. Notify Bight Project Manager of incident | Bight On-board Representative |
| 8. Notify NOPSEMA verbally WITHIN 2 HOURS if there is a spill of 80litres or more (**Phone: (08) 6461 7090**) (written incident report required within 3days) and DMITRE (**Phone: (08) 8463 6666**) | Bight Project Manager |
| 9. Issue POLREP to AMSA RCC (cc. Bight Project Manager) | Vessel Master |
| 10. Issue POLREP to NOPSEMA | Bight Project Manager |
| 11. On advice from AMSA, initiate response strategy | Vessel Master |
| 12. As directed, monitor leak size, changes to the physical/chemical character of the slick, direction, weather and sea-state conditions providing this information to AMSA, SA DPTI (as necessary) & Bight. Formally log and record this data on a time basis. | Vessel Master/On-board Bight Representative |
| 13. As required, forward regular SITREPs details to AMSA, SA DPTI (cc. Bight) | Vessel Master |
| 14. Forward SITREPs to NOPSEMA | Bight Project Manager |
| 15. Continue to implement SOPEP (or equivalent) procedures (refer **Section 8.3.2.2)** | Vessel Master |
| 16. As directed by AMSA, undertake spill surveillance by support vessel (as appropriate). Continue to monitor the spill providing information on spill amount, trajectory, weather, area of coverage and spill appearance. Information to be provided back to AMSA & Bight | Vessel Master/On-board Bight Representative |
| 17. Confirm trajectory and ZPI; and any protection priorities at risk | Vessel Master/ Bight Project Manager (EMT) |
| 18. As directed by AMSA, continue routine surveillance to monitor the effectiveness of **natural weathering strategy** (i.e. monitoring and surveillance strategy) utilising the following effectiveness criteria:<br>**a.** Trajectory is in line with manual estimates & predicted weathering;<br>**b.** No new environmental sensitivities are being threatened. | Vessel Master/Support Vessel Master |
| 19. If natural weathering strategy is determined as not effective, confirm with AMSA the revised response strategy based on environmental resources at risk (as appropriate). Provide support where directed | Vessel Master/Bight On-board Representative |
| 20. Coordinate oil spill response activities (response equipment deployment, aerial surveillance, oil spill trajectory modelling (as necessary)). | AMSA |

| Action | Responsibility |
|---|---|
| 21. Continue to advise marine stake-holders on the progress of the spill response | Vessel Master/ Bight Project Manager (EMT)/AMSA |
| 22. Advise AMSA of any changes or increased threats to environmental sensitivities (as relevant) | Vessel Master |
| *Response Termination* | |
| 23. The oil spill response termination criteria will be determined and advised by AMSA. Water monitoring (oil-in-water sheen) will continue until termination criteria in accordance with the Bonn Convention are achieved. AMSA will advise Vessel Master and Bight Petroleum when the response termination criteria have been achieved | AMSA |
| 24. Bight Petroleum to advise NOPSEMA of spill response termination. | Bight Project Manager (EMT) |

#### 8.3.2.2 *Spill Scenarios: Specific Vessel Actions*

The Vessel SOPEP contains vessel-specific actions to contain and mitigate oil spills for identified credible oil spill threats. This includes the following typical actions which are assigned to vessel positions:

- Bunkering Overflow/Transfer System Leak: Immediately stop the transfer; report the discharge; contain the spill; evaluate the cause and corrective actions to be undertaken; undertake on-board clean-up; and obtain permission to resume operations;
- Hull Failure/Leak: Where possible stop/reduce outflow; take appropriate safety action; contain the spill (as practical); report the spill/threat; evaluate the cause and corrective actions to be undertaken; initiate on-board clean-up; identify leaking tank (consider internal transfer if leak can be identified, else consider reducing level in all tanks in the vicinity giving careful consideration to hull stress and stability);
- Collision: Immediate notification; determine tanks penetrated (above & below water line) and any other oil spilled by vessel; assess consequences of separating two interlocked vessels causing ignition; reducing buoyancy/sinking; awareness that action may have a larger spill; assess the potential danger to other vessel traffic and manoeuvrability after separation; consider bringing vessel upwind of the oil slick; isolating penetrated tanks; and making ready for towing or lightering;
- Fire and Explosion: Fight fire; notify incident; bring vessel upwind of oil slick; isolate damaged tanks; undertake damage assessment and repair; initiate on-board clean-up; carryout hull leak prevention; make ready to tow or bunker transfer;
- Equipment Failure (propulsion, steering): Notify incident; determine cause of failure; determine possibility, methods and duration of repairs; determine proximity of navigational hazards (i.e. shoreline, reefs); determine likely drift due to wind, tide and currents; determine availability of tugs, salvage equipment; asses future weather conditions; consider the potential for pollution; consider the timeframe for assistance to arrive or the possibility of assistance from other nearby vessels.

## 8.4 Oil Spill Resources

### 8.4.1 Vessel Resources

The response equipment for the prevention / minimisation of loss of oil to sea during the proposed Lightning MSS will include the vessel's on-board spill response kit equipment. Typical contents of the SOPEP kit include:

- Absorbent materials and kits.
- Scupper and drain plugs.
- Hand shovels and scoops.
- Protective clothing.
- Portable pumps.
- Portable containers.
- Portable radios.

This equipment will be stored in dedicated lockers located on the vessel, identified as spill equipment (as outlined in the Vessel's SOPEP or equivalent for class) and routinely checked to ensure kit contents are suitable.

All relevant crew will be trained in the use of the vessel equipment listed above and the PPE required to appropriately respond to the spill (as contained in MSDSs).

*Equipment and training will be checked as part of the pre-mobilisation audit* (refer **Section 8.6**).

### 8.4.2 NATPLAN Resources

AMSA as CA in Commonwealth waters will mobilise resources (as necessary) from stockpiles located around Australia, however primarily drawing upon equipment located at the Port of Adelaide. AMSA/SA DPTI (as necessary) are responsible for the mobilisation of this equipment if required to respond to a vessel-based oil spill.

## 8.5 SOPEP / OPEP Training Requirements

Regular drills are carried out on all vessels in line with IMO / SOPEP (or equivalent) requirements to maintain the crew's currency in response equipment and incident response procedures. This verifies emergency response efficiency, effectiveness of procedures and detects any failure in equipment. These drills include, but are not limited to, spill response, collision and grounding, fire and explosion and helicopter emergency. All drills are documented, debriefings held and corrective actions identified (including revisions to SOPEP) and included in the Vessel's action listing and tracked to completion.

Oil spill response arrangements as detailed in this section and it's interaction with the MSS vessel's SOPEP will be tested prior to the commencement of the Lightning MSS as indicated in **Section 5.7.1.** This will be a campaign specific oil pollution emergency drill with the objective of testing the following:

- Availability of response procedures/documentation on-board the vessels;
- Access to, and testing of, notification contact numbers for the Bight EMT, Seismic Contractor CCT;
- Confirmation of relevant external (regulator) and responder (AMSA) contact details; and

- Testing of Vessel SOPEP response actions[120] (including crew and equipment response) to the identified spill scenario.

The effectiveness of response arrangements will be assessed against the performance standards detailed in **Section 8.7**. The exercise will include all parties with an interest in the vessel operations including Bight Petroleum, the Seismic Contractor and engaged vessels.

This exercise will be documented with opportunities for improvement and corrective actions documented in the Vessel Action Tracking System. The actions will be monitored by the Party Manager and Offshore Bight representative to closure. All corrective actions will be implemented in a timely manner.

## 8.6 Oil Spill Response Audit

An audit of the on-board spill response capability of the vessel against its SOPEP will be made prior to survey mobilisation to ensure appropriate preparedness for the Lightning MSS. The audit will check that equipment is stored appropriately for rapid deployment where spills could occur, and sufficient containers are available for used equipment/waste containment for disposal onshore. It will also include a check that relevant documents (SOPEP, EP & OPEP), contact listings, statutory reporting forms (POLREP and SITREP) are available on-board the vessel; and all crew have been trained in SOPEP response requirements.

[120] Note actions required in any SOPEP response scenario which might affect the safety and integrity of the vessel *when it is not under emergency conditions* will not be tested.

## 8.7 Environmental Performance outcomes, Standards and Measurement Criteria

| | | |
|---|---|---|
| Environmental Hazard/ Aspect | *Oil Spill Response* | |
| Performance Objective (Prevention): | *Procedures for minimising spills volumes to the marine environment are followed at all times in the event of a marine oil spill.* | |
| Measurement Criteria (Prevention): | 1. *SOPEP available on-board vessel and vessel SOPEP Drill records are complete.*<br>2. *Lightning MSS EP/OPEP available on-board vessel and records indicate that oil spill response exercise has been completed and corrective actions implemented.* | |
| Performance Outcome (Response): | 1. *AMSA and Bight Petroleum are notified immediately of the incident*<br>2. *Marine environmental surveillance/monitoring continue until oil spill termination criteria, measured in accordance with the Bonn Convention, are achieved.* | |
| Measurement Criteria (Response): | 1. *AMSA is notified and Oil Spill Contingency Arrangements are activated within 1hr of the incident occurring.*<br>2. *Spill monitoring and surveillance, at frequencies determined by the Incident Controller (AMSA), continue to inform the spill response until the termination criteria is achieved (SITREP Records).* | |
| Control Measure | Performance Standard | Measurement Criteria |
| Oil Spill Response Capability Audit undertaken | An oil spill capability audit will be undertaken prior to mobilisation to confirm the following:<br>- Vessels have access to current SOPEPs (or equivalent appropriate to class);<br>- Port and Emergency Contact details in the event of an oil spill are complete and correct;<br>- Response equipment is available and located at locations designated in the SOPEP (or equivalent appropriate to class);<br>- Crews are competent and familiar with SOPEP implementation verified through SOPEP drill exercises;<br>- All personnel are familiar with OPEP requirements for the MSS.<br>Corrective actions arising from this audit shall be close-out prior to MSS activity commencement. | Records indicate audit has been undertaken and corrective actions completed prior to mobilisation. |
| Third Party Vessels are advised of spill | Radio notification of the spill occurs on Channel 16 to alert third parties such that they avoid the impacted area and are not within 500m of the vessel releasing hydrocarbon. | Incident log verifies that no third party vessels are present within a 500m radius for the duration of the response. |
| AMSA is notified of all spill incidents | AMSA is notified as soon as possible but within 30minutes of the spill occurring. | Incident log verifies AMSA notification within this timeframe |
| SA DPTI is notified of the spill incident | DPTI (as courtesy) is notified as soon as possible but within 30minutes of the spill occurring. | Incident log verifies DPTI notification within this timeframe |
| NOPSEMA is notified of the incident | NOPSEMA is notified as soon as possible but within 2hrs of the spill incident | Notification record verities this notification is provided within the nominated timeframe. |
| SOPEP Implemented to minimise hydrocarbon release to the marine environment | Spill mitigation measures as detailed in the vessel's SOPEP (or equivalent appropriate to class) are implemented to minimise hydrocarbon release to the marine environment. | Incident log verifies that mitigation measures adopted align to the requirements of the SOPEP |

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# 10 Abbreviations

| | |
|---|---|
| 2D | 2-Dimensional |
| 3D | 3-Dimensional |
| µPa | Micro-pascal |
| AFMA | Australian Fisheries Management Authority |
| AFZ | Australian Fishing Zone |
| AHO | Australian Hydrographic Office |
| AIS | Automatic Identification System |
| ALARP | As Low as Reasonably Practicable |
| AMSA | Australian Maritime Safety Authority |
| AOASSG | Albany Ocean Adventures/Silver Star Cruises |
| APPEA | Australian Petroleum Production & Exploration Association |
| AQIS | Australian Quarantine Inspection Service |
| AS | Australian Standard |
| BOD | Biological Oxygen Demand |
| BOM | Bureau of Meteorology |
| BPC | Border protection Command |
| BRS | Bureau of Rural Sciences |
| Bsl | Below sea level |
| $^{o}$C | Degrees Celcius |
| CAMBA | China/Australia Migratory Birds Agreement |
| CFA | Commonwealth Fisheries Association |
| CITES | Convention in International Trade in Endangered Species of Wildlife and Flora |
| Com | Commonwealth |
| CSIRO | Commonwealth Scientific and Industrial Research Organisation |
| dB | Decibels |
| DAFF | Department of Agriculture Fisheries and Forestry |
| DEC | Department of Environment & Conservation (DEC) |
| DEH | Department of Environment & Heritage (now SEWPC) |
| DEWHA | Department of Environment, Water, Heritage and the Arts (now SEWPC) |
| DGLF | Demersal Gillnet and Longline Fishery |
| DoF | Department of Fisheries (SA) |
| DOT | Department of Transport |

| | |
|---|---|
| DoIR | Department of Infrastructure and Resources (WA) now Department of Mines and Petroleum |
| DRET | Commonwealth Department of Resources, Energy & Tourism |
| E | East |
| EA | Environment Australia (now SEWPC) |
| EP | Environment Plan |
| ENE | East-North-East |
| ENSO | El Niño Southern Oscillation |
| EPBC | Environment Protection Biodiversity Conservation |
| ERA | Environmental Risk Assessment |
| GABTS | Great Australian Bight Trawl Sector |
| HFO | Heavy Fuel Oil |
| HSEQ | Health, Safety, Environment, Quality |
| HSEMS | Health, Safety, Environmental Management System |
| Hz | Hertz |
| IAFS | International Anti-fouling Systems |
| IAPP | International Air Pollution Prevention (Certificate) |
| IGAE | Intergovernmental Agreement on the Environment |
| IMCRA | Integrated Marine and Coastal Regionalisation of Australia |
| IMDG | International Maritime Dangerous Goods Code |
| IMO | International Maritime Organisation |
| IMS | Invasive Marine Species |
| IOPP | International Oil Pollution Prevention (Certificate) |
| $in^3$ | Cubic inches |
| ISO | International Standards Organisation |
| ISPP | International Swage Pollution Prevention (Certificate) |
| ITOPF | International Tanker Owners Pollution Federation |
| IUCN | International Union for Conservation Value |
| JAMBA | Japan/Australia Migratory Birds Agreement |
| km | Kilometre |
| km/hr | Kilometres per hour |
| $km^2$ | Square kilometres |
| LTI | Lost Time Injury |
| m | Metres |
| mm | Millimetres |
| $m^3$ | Cubic metres |

| | |
|---|---|
| m/s | Metres per second |
| MARPOL | International Convention for the Prevention of Pollution from Ships |
| MDO | Marine Diesel Oil |
| MMO | Marine Mammal Observer |
| MPA | Marine Protected Area |
| MSDS | Material Safety Data Sheet |
| MSS | Marine Seismic Survey |
| MV | Marine Vessel |
| N | North |
| NATPLAN | National Marine Oil Spill Contingency Plan (Australia) |
| NDSF | Northern Demersal Scalefish Fishery |
| NE | North East |
| NEPM | National Environmental Pollution Measure |
| NES | National Environmental Significance |
| Nm | Nautical Miles |
| NOO | National Oceans Office |
| NOPSEMA | National Offshore Petroleum Safety & Environmental Management Authority |
| NOPTA | National Offshore Petroleum Titles Administrator |
| NT | Northern Territory |
| NTSC | Northern Territory Seafood Council |
| NW | North-west |
| ODME | Oil Detection Monitoring Equipment |
| ODP | Ozone Depleting Potential |
| OIW | Oil in Water |
| OPGGSA | Offshore Petroleum & Greenhouse Gas Storage Act 2006 |
| OPGGS(RMA)R | Offshore Petroleum & Greenhouse Gas Storage (Resource Management & Administration) Regulations 2011 |
| OPGGSER | Offshore Petroleum & Greenhouse Gas Storage (Environment) Regulations 2009 |
| OPRC | International Convention on Oil Pollution (Preparedness, Response and Cooperation) 1990 |
| OPEP | Oil Pollution Emergency Plan |
| µPa | Micropascals |
| POB | Persons on Board |
| PM | Party Manager |
| PMS | Planned Maintenance System |

| | |
|---|---|
| PPE | Personal Protective Equipment |
| ppm | Parts per million |
| psi | Pounds per square inch |
| PTS | Permanent Threshold Shift |
| PTW | Permit to Work |
| RAMSAR | The Convention on Wetlands of International Importance |
| RCC | Rescue Coordination Centre |
| rms | Root mean square |
| ROKAMBA | Republic of Korea/ Australia Migratory Birds Agreement |
| RWDC | Restricted Work Day Case |
| S | South |
| SA | South Australia |
| SBTF | Southern Bluefin Tuna Fishery |
| SCDSF | South Coast Demersal Scalefish Fishery |
| SE | South East |
| SEL | Sound Exposure Levels |
| SEWPC | Department of Environment, Water, Population and Communities |
| SOPEP | Shipboard Oil Pollution Emergency Plan |
| SPF | Small Pelagics Fishery |
| STF | Skipjack Tuna Fishery |
| STP | Sewerage Treatment Plant |
| SSW | South-South-West |
| SW | South West |
| TTS | Temporary Threshold Shift |
| UN | United Nations |
| W | West |
| WA | Western Australia |
| WAFIC | Western Australian Fishing Industry Council |
| WNW | West-North-West |
| WSW | West-South-West |
| WTBF | Western Tuna & Billfish Fishery |

# Appendix A: Lightning 3D MSS Acoustic Modelling

Sound Exposure Modelling for the Bight 3D seismic survey in the eastern Great Australian Bight, South Australia. Prepared by CMST (Centre for Marine Science and Technology). Report C2012-36, 23 July 2012

This document can downloaded from www.bightpetroleum.com

http://www.bightpetroleum.com/cmst

# Appendix B: Net Environmental Benefits Assessment

## Net Environmental Benefits Assessment: Response Options for Protection Priorities in the Spill ZPI

| Response Priority | Response Option | Availability of Equipment to achieve Objective | Practicality in Achieving Objective | Net Environmental Benefit compared with Natural Degradation |
|---|---|---|---|---|
| Vessel Spill (MGO, Package Hydrocarbon, Isopar Spill) | | | | |
| 1. Protect human health & safety within ZPI: *Marine Users* | Remove vessels from ZPI | Yes – Radio | Local presence of vessels together with marine warnings considered practical.<br>*Objective is achieved by this method.* | NA |
| 2. Protect Rare/ Endangered Marine species: *Prevent exposure to oil* | Natural Weathering (Monitor & Surveillance) | Availability of:<br>• Marine resources (support vessel) to monitor and inform oil spill response<br>• Aerial Surveillance Capabilities (AMSA)<br>• OSTM (AMSA) | Objective (no oil on surface) should be achieved within 24hrs (10µm – threshold for causing environmental harm to marine species based APASA modelling). Shorter period for smaller spills. | NA |
| | Prop Washing | Support vessel available for prop washing. | The physical break-up of surface slicks may disperse surface oil however can also lead to the oil emulsification leading to a slower rate of degradation & increased environmental impact. | **Positive Benefits:**<br>• Reduction in surface oiling benefitting species.<br>**Negative Benefits**:<br>• Increased water column toxicity which may impact fish species and sharks;<br>• Risk of emulsification may increase degradation time<br>• Increased vessel movement utilises more diesel and increases the potential for a cetacean/turtle strike (& other marine incidents).<br>*Option may achieve objective, however has some drawbacks compared with Natural Degradation.* |

| Response Priority | Response Option | Availability of Equipment to achieve Objective | Practicality in Achieving Objective | Net Environmental Benefit compared with Natural Degradation |
|---|---|---|---|---|
| Protect Rare/ Endangered Marine species: *Prevent exposure to oil* | Containment & Recovery | Booming and skimmer equipment available **in Adelaide (AMSA)** (approx. 290km and steaming time of 18hrs to MSS area) to protect species. | Option is usually not successful with light hydrocarbons given oils ability to spread into thin layers very quickly. Success of this option is also dependent on favourable weather conditions in the waters of the MSS area (oceanic waters). | **Positive Benefits:**<br>• Reduces surface oiling benefitting species.<br>**Negative Benefit**:<br>• Equipment deployment utilises fuel & produces wastes.<br>• Weather conditions in Southern Ocean waters may preclude equipment operation and be unsafe for personnel.<br>• Increased vessel movement utilises more diesel and increases the potential for a cetacean/turtle strike (& other marine incidents).<br>*Option will not achieve objective as equipment cannot be deployed quickly and may not be practical given the possible conditions in the Lightning MSS area (i.e. personal safety).* |
| | Dispersant Application | Dispersant aircraft available **in Adelaide (SA)** (290km from MSS area) (4hrs notice, 2hr flying time + dispersant relocation time ~1hr) to Ballarat) to protect species. | MGO/MDO/Isopar rapidly spreads into thin layers and dispersant application is not effective. | **Positive Benefits:**<br>• Reduce surface oiling benefitting species.<br>**Negative Benefit**:<br>• Higher proportion of toxic materials and their persistence/toxicity in the marine environment may increase with dispersant application. Potential to impact commercial fisheries/sharks to a greater extent.<br>• Additional aircraft/transport fuel utilisation.<br>• Weather conditions in Lightning area may preclude equipment operation.<br>*Option is not considered to achieve objective. Not preferred above Natural Degradation.* |
| | Shoreline Response | *Not applicable to response priority – no shoreline impacts above thresholds of environmental concern.* | NA | NA |

| Response Priority | Response Option | Availability of Equipment to achieve Objective | Practicality in Achieving Objective | Net Environmental Benefit compared with Natural Degradation |
|---|---|---|---|---|
| 3. Protect Commercial Fisheries: *Prevent commercial fisheries exposure (equipment and catch)* | Natural Weathering (Monitor & Surveillance) | Availability of:<br>• Radio to advise fishermen of hydrocarbon presence<br>• Aerial Surveillance Capabilities (AMSA)<br>• Support Vessel | Protection of response priority is achieved by this approach (i.e. impacts to fisheries minimised) as the MGO/MDO remains at the sea surface *as far as possible* and not within the water column benefitting fish species.<br>Period of time MGO/MGO is present on the surface over the affected area will precludes fishing activities. | NA |
| | Prop Washing | Support vessel available for prop washing. | The physical break-up of slicks disperses surface oil however can also lead to:<br>• Increased oil emulsification (leading to a slower rate of degradation and longer impact time); and<br>• Increased toxicity and dispersed (entrained) phase within the water column which may lead to increased fish exposure/tainting. | **Negative Benefit**:<br>*Response option increases the impacts to commercial fisheries, utilises more fuel and creates more opportunities for marine incidents. Not recommended.* |
| | Containment & Recovery | Booming and skimmer equipment available **in Adelaide (AMSA)** (approx. 285km and steaming time of 18hrs to MSS area) to protect species | Option is usually not successful with light hydrocarbons given oils ability to spread into thin layers very quickly. Success of this option is also dependent on favourable weather conditions in the waters of the MSS area (oceanic waters). | **Positive Benefits:**<br>• Reduces surface oiling benefitting species.<br>**Negative Benefit**:<br>• Equipment deployment utilises fuel & produces wastes.<br>• Weather conditions in Southern Ocean waters may preclude equipment operation and be unsafe for personnel.<br>• Increased vessel movement utilises more diesel and increases the potential for a cetacean/turtle strike (& other marine incidents).<br>*Option will not achieve objective as equipment cannot be deployed quickly and may not be practical given the possible conditions in the Lightning MSS area (i.e. personal safety).* |

| Response Priority | Response Option | Availability of Equipment to achieve Objective | Practicality in Achieving Objective | Net Environmental Benefit compared with Natural Degradation |
|---|---|---|---|---|
| | Dispersant Application | Dispersant aircraft available **in Adelaide (SA)** (290km from MSS area) (4hrs notice, 2hr flying time + dispersant loading ~1hr) to protect species. | MDO/MGO rapidly spreads into thin layers and dispersant application is not effective. | **Negative Benefit:**<br>*Response option, if suitable, would increase environmental impacts to commercial fisheries and utilises more fuel. Not recommended.* |
| | Shoreline Response | *Not applicable to response priority – no shoreline impacts.* | NA | NA |